SECTION 5A

HYDRAULIC BRAKES

CAUTION: This vehicle has a Supplemental Inflatable Restraint (SIR) System. Refer to the SIR Component and Wiring Location view in order to determine whether you are performing service on or near the SIR components or the SIR wiring. When you are performing service on or near the SIR components or the SIR wiring, refer to the SIR On-Vehicle Service information. Failure to follow the CAUTIONS could cause air bag deployment, personal injury, or unnecessary SIR system repairs.

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

NOTICE: ***Always use the correct fastener in the proper location. When you replace a fastener, use ONLY the exact part number for that application. General Motors will call out those fasteners that require a replacement after removal. General Motors will also call out the fasteners that require thread lockers or thread sealant. UNLESS OTHERWISE SPECIFIED, do not use supplemental coatings (paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.***

CONTENTS

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 reseal and wipe off brake fluid containers to prevent spills.***

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

Brake fluid should always be stored in a closed, sealed container. Never use previously opened containers of stored brake fluid. Always use new fluid from a sealed container. Reseal 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.

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).

"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:

J 28662 Brake Pedal Effort Gage

At frequent intervals, brake pedal travel should be checked (Figure 1). Travel is the distance the pedal moves toward the floor from a full released position. This check should be made with the brakes cold and about 445 N (100 lb) of force on the pedal using a brake pedal effort gage, such as J 28662.

1. Apply the brake 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" in this section.

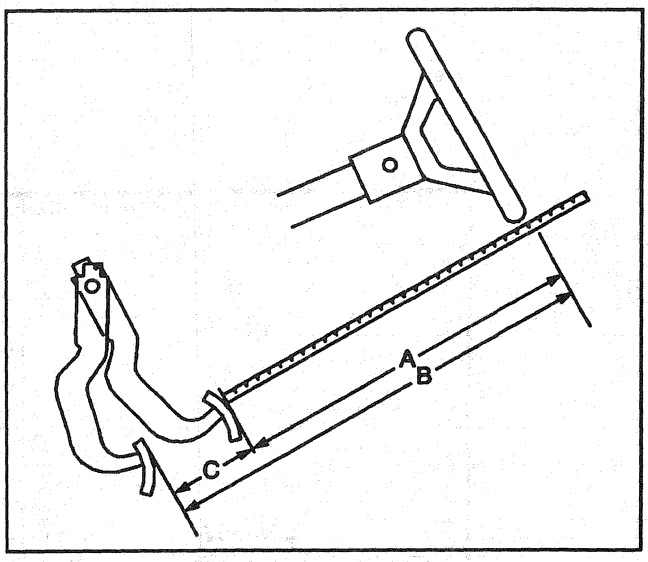

Figure 1—Checking Brake Pedal Travel

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 5A1.

If no external leaks are found, an internal leakage condition may be the cause. This relates to an internal master cylinder condition. To diagnose internal leakage, the master cylinder will require disassembly. Refer to SECTION 5A1A.

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.

BRAKE SYSTEM DIAGNOSIS

For diagnosis of the brake system, refer to Figure 2.

CAUSES / SYMPTOM	Excessive Brake Pedal Travel	Brake Pedal Travel Gradually Increases	Excessive Brake Pedal Effort	Excessive Braking Action	Brakes Slow to Respond	Brakes Slow to Release	Brakes Drag	Uneven Braking Action (Side to Side)	Uneven Braking Action (Front to Rear)	Scraping Noise from Brakes	Brakes Squeak Without Application	Brakes Squeak During Stop	Brakes Chatter (Roughness)	Brakes Groan at End of Stop	"Brake" Warning Lamp Glows
Leaking Brake Line or Connection	X	XX							X						XX
Leaking Piston Seal	X	XX							X						X
Leaking Master Cylinder	X	XX							X						X
Air in Brake System	XX								X						XX
Contaminated or Improper Brake Fluid	X				X	X	X	X	X						X
Leaking Vacuum System			XX		X										
Restricted Passage in Vacuum Booster		X	X		XX	X									
Damaged Vacuum Booster Sys.		X	X	X	X	XX									
Worn Out Brake Lining – Replace			X	X				X	X	X	X	X			
Uneven Brake Lining Wear – Replace or Correct	X			X				X	X	X	X	XX			X
Glazed Brake Lining			XX		X			X	X		X	X			
Incorrect Lining Material – Replace			X	X				X	X		X	X			
Contaminated Brake Lining – Replace			X					XX	XX	X	X	X			
Lining Damaged by Abusive Use – Replace			X	XX				X	X	X	X	X		X	
Improper Rotor Surface Finish				X											
Heat Spotted or Scored Discs				X				X	X		X	X	XX		
Improper Thickness Variation	X												XX		
Excessive Lateral Run-out	X												X		
Brake Asm. Attachments – Missing or Loose	X			X			X	X	X	X		X	X		
Restricted Brake Fluid Passage		X	X		X	X	X	X	X						
Improperly Adj. Stoplamp Switch or Cruise Control Vacuum Dump							X								
Brake Pedal Linkage Interference or Binding			X		X	XX	XX								
Improperly Adjusted Parking Brake							X		X						
Incorrect Front Wheel Alignment								XX							
Incorrect Tire Pressure								X							
Loose Front Suspension Attachments							X	X		XX			X		
Out-of-balance Wheel Assemblies													XX		
Operator Riding Brake Pedal			X				X								
Sticking Caliper or Caliper Pistons					X	X	XX	X	X						
Park Brake Switch Circuit Grounded															XX
Park Brake Not Releasing						X		X							XX
Low Brake Fluid															X

XX – INDICATES MORE PROBABLE CAUSES(S) X – INDICATES OTHER CAUSE(S)

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Figure 2—Brake System Diagnosis

ON-VEHICLE SERVICE

FILLING MASTER CYLINDER RESERVOIR

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

BRAKE PEDAL

Remove or Disconnect (Figures 3 and 4)

1. Negative battery cable. Refer to SECTION 6D1.
2. Disable SIR. Refer to SECTION 9J.
3. Electrical connector from stoplamp switch.
4. Retainer.
5. Switch.
6. Pushrod.
7. Nut.
8. Bolt.
9. Bushings and spacer.
10. Brake pedal.

Install or Connect (Figures 3 and 4)

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

1. Brake pedal.
2. Bushings and spacer.
3. Bolt and nut.

Tighten

- Bolt to 47 N·m (35 lb ft).

4. Pushrod.
5. Switch.
6. Retainer.
7. Electrical connector to stoplamp switch.
8. Enable SIR. Refer to SECTION 9J.
9. Negative battery cable.

STOPLAMP SWITCH

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

Remove or Disconnect (Figure 4)

1. Negative battery cable. Refer to SECTION 6D1.
2. Disable SIR. Refer to SECTION 9J.
3. Retainer from brake pedal pin. Use snap ring pliers.
4. Switch by unsnapping from pushrod.
5. Electrical connector from switch.

Install or Connect (Figure 4)

1. Electrical connector into switch.

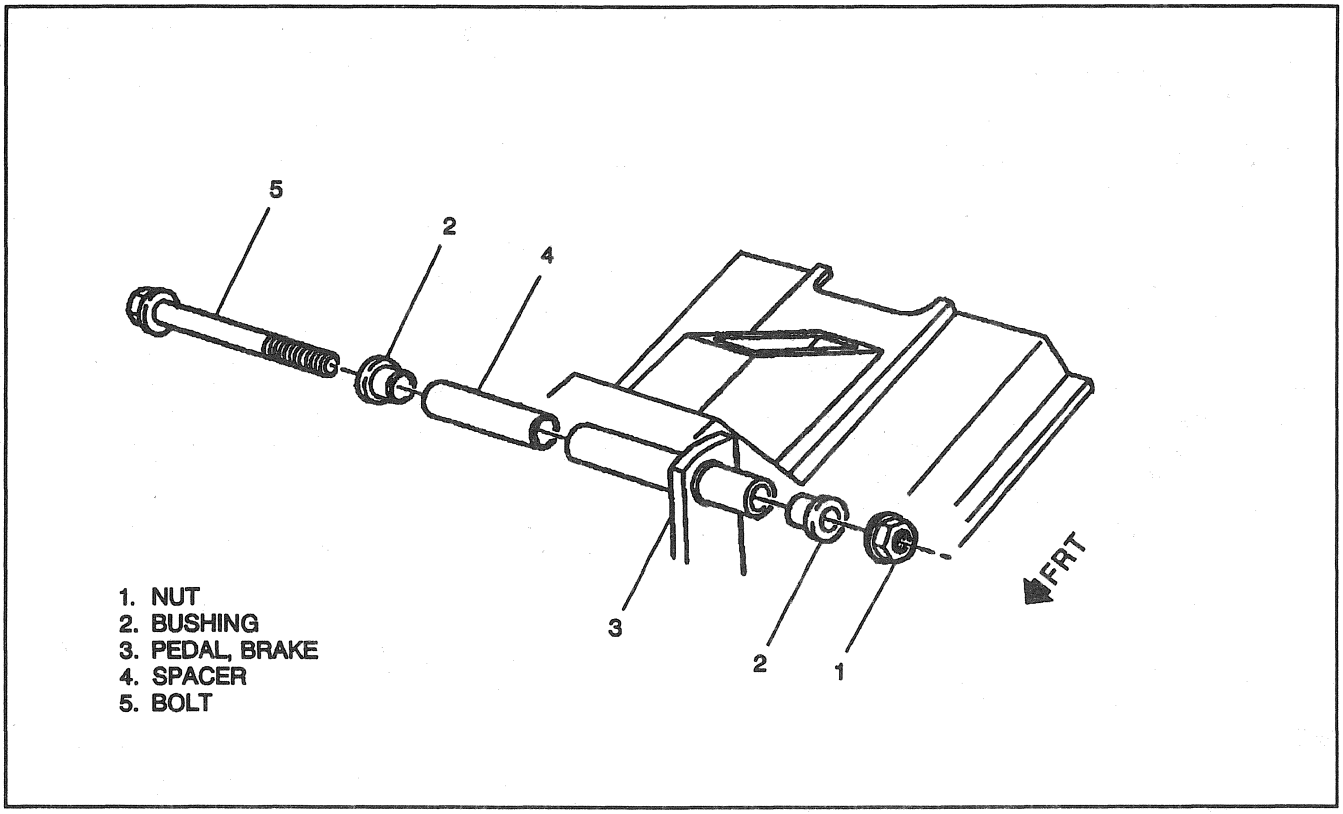


Figure 3—Brake Pedal

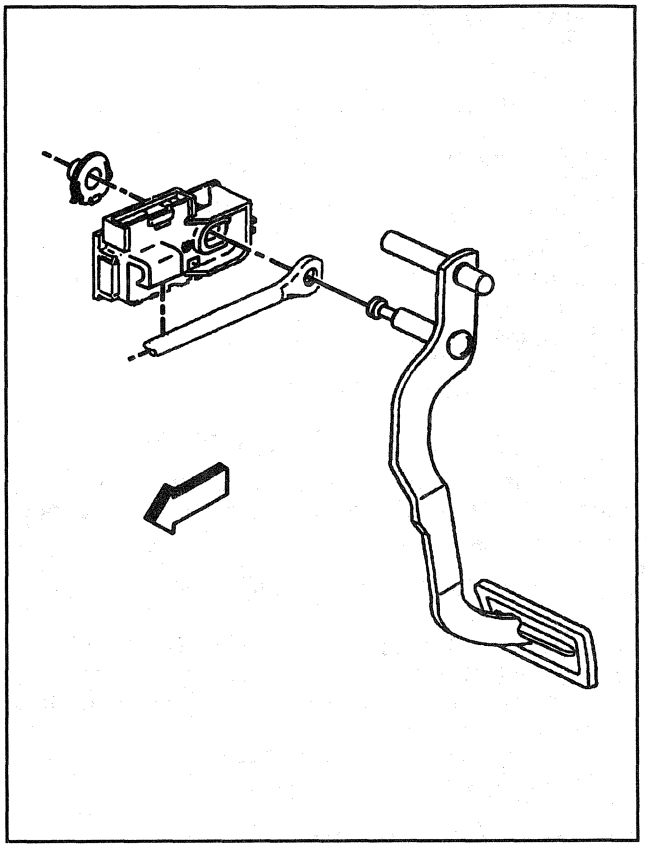


Figure 4—Stoplamp Switch

2. Switch by snapping it onto pushrod.
3. Retainer onto brake pedal pin. Use 11 mm (7/16 inch) socket to push new clip on pin.
4. Negative battery cable.
5. Enable SIR. Refer to SECTION 9J.

PIPES, HOSES, AND FITTINGS

Pipe Replacement

CAUTION: Always use double-flared 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 lead to 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 5)

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

Install or Connect (Figure 5)

- 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 Hydraulic Brake System" in this section.

BLEEDING BRAKE HYDRAULIC SYSTEM

Tools Required:
J 28434 Wheel Cylinder Bleeder Wrench

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 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. Refer to SECTION 5A1.
   B. Allow the brake fluid to flow from the connector port.
   C. Connect the brake pipe but do not tighten.

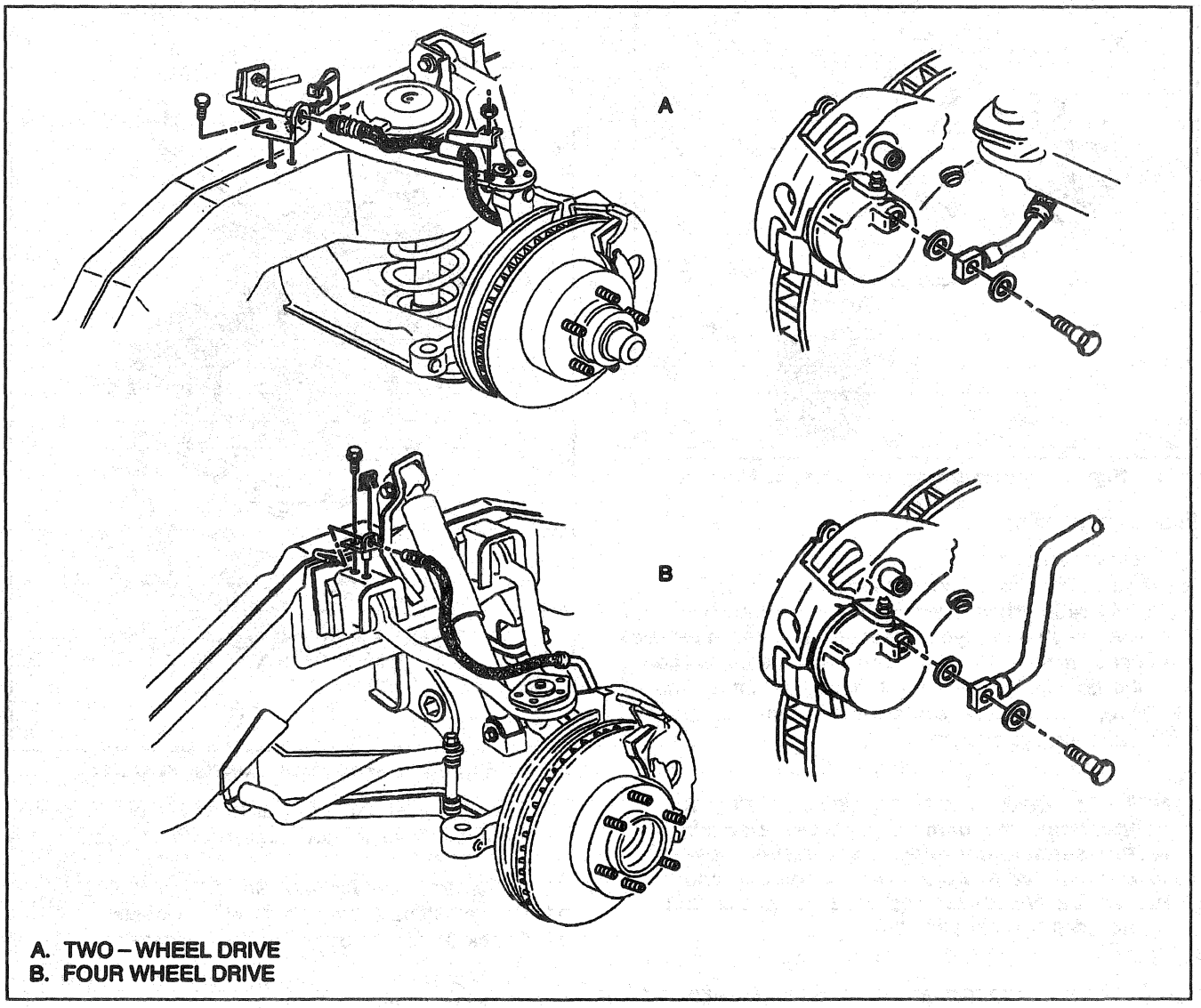


Figure 5—Flexible Hose

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 6).
6. Slowly apply the brake pedal one time and hold.
7. Loosen the bleeder valve to purge the air from the wheel cylinder/caliper.
8. Tighten the bleeder valve to 13 N·m (110 lb 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.

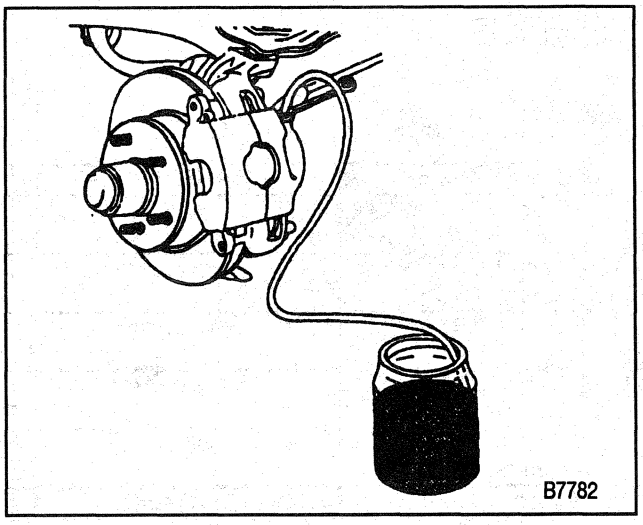


Figure 6—Immersing the Bleeder Hose

Pressure Bleeding

Tools Required:
J 29567 Brake Bleeder Adapter
J 28434 Wheel Cylinder Bleeder Wrench

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

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

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. Install the bleeder adapter (Figure 7).
4. 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.
5. Bleed each wheel in the following sequence:
   A. Right rear.
   B. Left rear.
   C. Right front.
   D. Left front.
6. Connect the hose from the bleeder to the adapter at the master cylinder.
7. Open the tank valve.
8. Attach a hose to the bleeder valve.
   - Immerse the opposite end of the hose into a container partially filled with clean brake fluid.

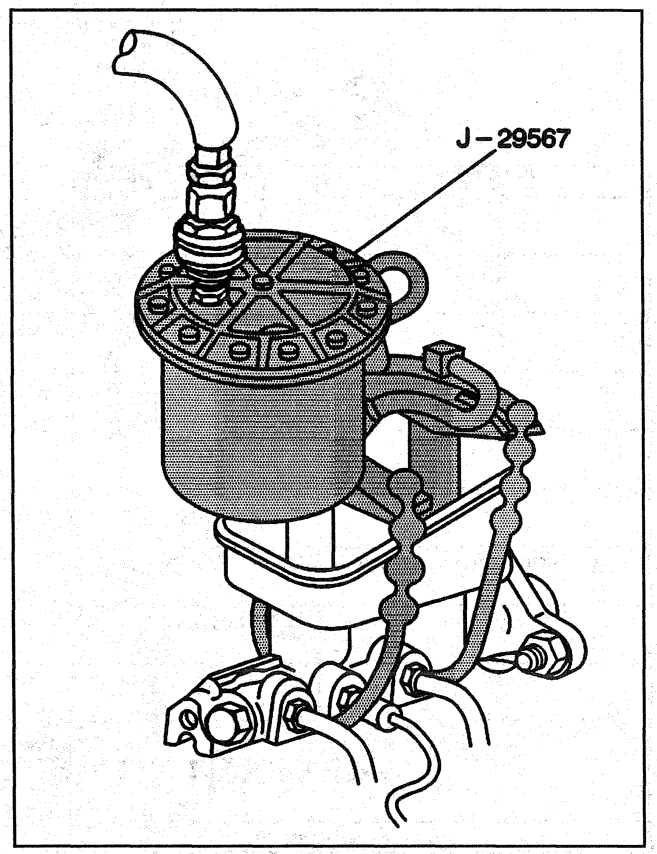


Figure 7—Reservoir Bleeder Adapter

9. 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.
10. Tighten the bleeder valve to 13 N·m (110 lb in).
11. Repeat Steps 9 through 11 at all wheels.
12. Check the brake pedal for "sponginess."
    - Repeat the entire bleeding procedure if this condition is found.
13. Disconnect the hose from the bleeder adapter.
14. Remove the bleeder adapter.
15. Fill the master cylinder to the proper level.

FLUSHING HYDRAULIC BRAKE 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 Hydraulic Brake System" in this section.

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

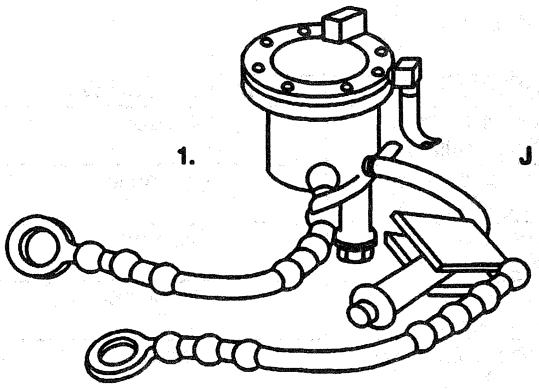
BRAKE SYSTEMS

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	Disc 11.57 inch x 1.25 inch	254 mm x 57 mm (Leading/Trailing)	Hydraulic
JB6	Disc 11.57 inch x 1.25 inch	11.15 inch x 2.75 inch (Duo-Servo)	Vacuum
JD6	Disc 11.57 inch x 1.25 inch	11.15 inch x 2.75 inch (Duo-Servo)	Hydraulic
JB7	Disc 12.5 inch x 1.26 inch	13.00 inch x 2.5 inch (Duo-Servo)	Vacuum
JD7	Disc 12.5 inch x 1.26 inch	13.00 inch x 2.5 inch (Duo-Servo)	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 13.86 inch x 1.435 inch	Disc 13.58 inch x 1.435 inch	Hydraulic

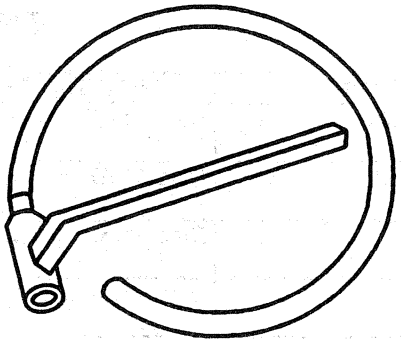
FASTENER TIGHTENING SPECIFICATIONS

Application	N·m	Lb ft	Lb in
Bleeder Valves	13	—	110
Brake Pedal Through Bolt	47	35	—
Brake Pipe Clip Bolts	17	13	—
Brake Pipe Fittings	24	18	—
Front Brake Hose to Caliper Bolt	44	32	—

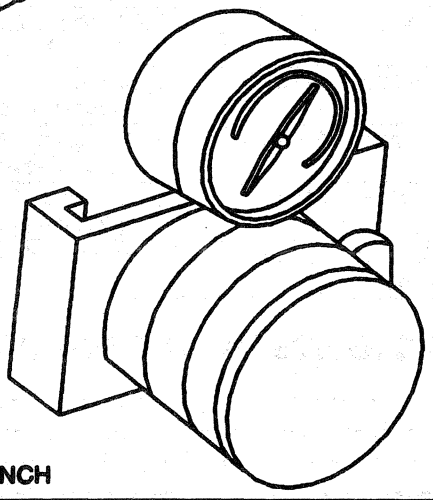
SPECIAL TOOLS



1. J 29567



3. J 28434



2. J 28662

1. BRAKE BLEEDER ADAPTER
2. BRAKE PEDAL EFFORT GAGE
3. WHEEL CYLINDER BLEEDER WRENCH

SECTION 5A1

MASTER CYLINDER

CAUTION: This vehicle has a Supplemental Inflatable Restraint (SIR) System. Refer to the SIR Component and Wiring Location view in order to determine whether you are performing service on or near the SIR components or the SIR wiring. When you are performing service on or near the SIR components or the SIR wiring, refer to the SIR On-Vehicle Service information. Failure to follow the CAUTIONS could cause air bag deployment, personal injury, or unnecessary SIR system repairs.

NOTICE: ***Always use the correct fastener in the proper location. When you replace a fastener, use ONLY the exact part number for that application. General Motors will call out those fasteners that require a replacement after removal. General Motors will also call out the fasteners that require thread lockers or thread sealant. UNLESS OTHERWISE SPECIFIED, do not use supplemental coatings (paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.***

CONTENTS

GENERAL DESCRIPTION

MASTER CYLINDER

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

Reservoir and Cover

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

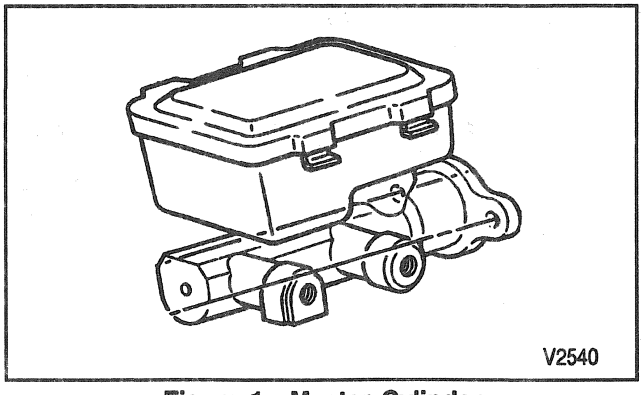


Figure 1—Master Cylinder

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.**

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

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

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

Substandard or Contaminated Fluid

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

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

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

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

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

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

DIAGNOSIS

MASTER CYLINDER

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

Visual Inspection

1. Check for a cracked casting or brake fluid leaks around the master cylinder.
   - Leaks are indicated only if there is at least a drop of fluid. A damp condition is not abnormal.
2. Check for binding pedal linkage and incorrect pushrod length.
   - Disassemble the master cylinder if there is no brake pedal binding or improper brake pedal travel. Refer to SECTION 5A1A for the procedure.
3. Check the master cylinder for swollen or elongated primary piston seal(s).
   - If swollen seals are found, refer to "Substandard or Contaminated Fluid" in this section.

Low Pressure Check

This procedure checks for internal seal damage, porosity, and component bore integrity by the following procedure:

1. With the ignition switch in the "OFF" position, pump the brake pedal until all brake booster assist has been depleted (5 times for vacuum assisted brakes and 25 times for hydraulic assisted brakes).
2. Apply the brake pedal at a slow rate (approximately 1/8 inch per second) to generate pressure in the master cylinder and gradually increase pedal force, and observe for gradually increasing brake pedal travel or the "FALLING AWAY" feel.
3. If the brake pedal tends to fall away, refer to "High Pressure Check" in this section. If the "High Pressure" test is good, the master cylinder has an internal leak, refer to SECTION 5A1A.

High Pressure Check

This procedure checks for internal and external fluid leaks such as connections, hoses, casting, and gross internal leaks will be evident by the following procedure:

1. With the engine running, apply the brake at a slow rate (approximately 1/8 inch per second) to generate pressure in the master cylinder. Gradually increase pedal force and observe for gradually increasing brake pedal travel or the "FALLING AWAY" feel.
2. Observe for external fluid leakage on the ground, pipe connections, and tires.
3. If fluid is evident around any component, replace the failed component. If the fluid leak is at a connection, tighten connection to specified tightening specification at the end of this section and recheck.

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 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 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)

- Apply parking brake.

1. Brake pipes.
   - Cover the ends of the pipes to prevent dirt from entering the system.
2. Nuts.
3. Master cylinder and bracket.

Install or Connect (Figure 2)

NOTICE: ***Refer to "Notice" on page 5A1-1.***

- Prior to installation, refer to "Bench Bleeding" in this section.

1. Master cylinder and bracket.
2. Nuts.

Tighten

- Nuts to 27 N·m (20 lb ft).

3. Brake pipes.

Tighten

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

4. Bleed brakes. Refer to SECTION 5A.
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" in this section.

BRAKE SYSTEM BLEEDING

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

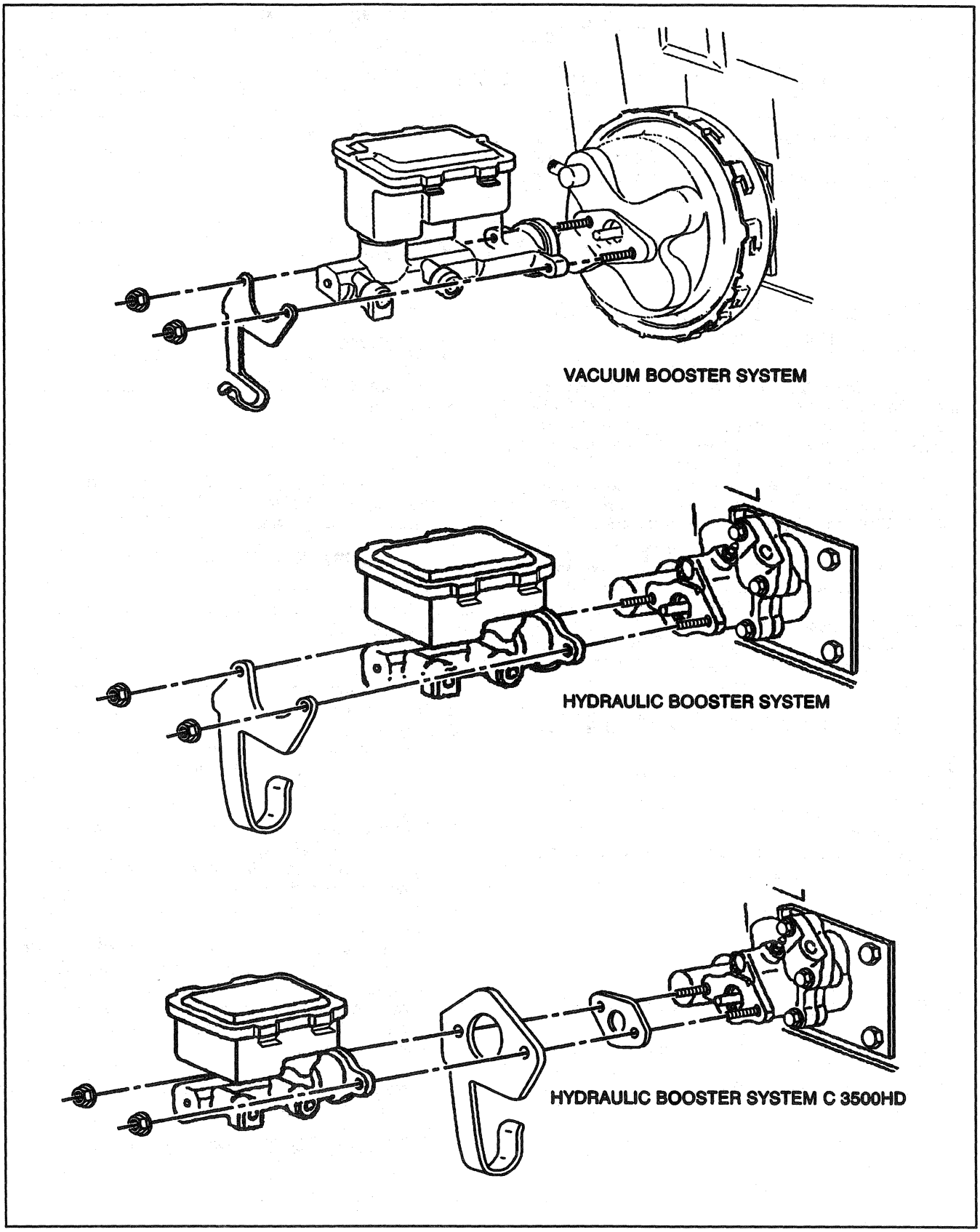


Figure 2—Master Cylinder

SPECIFICATIONS

BRAKE SYSTEMS

SYSTEM	FRONT BRAKES	REAR BRAKES	BRAKE ASSIST
JB5	Disc 11.57 inch x 1.25 inch	254 mm x 57 mm (Leading/Trailing)	Vacuum
JD5	Disc 11.57 inch x 1.25 inch	254 mm x 57 mm (Leading/Trailing)	Hydraulic
JB6	Disc 11.57 inch x 1.25 inch	11.15 inch x 2.75 inch (Duo-Servo)	Vacuum
JD6	Disc 11.57 inch x 1.25 inch	11.15 inch x 2.75 inch (Duo-Servo)	Hydraulic
JB7	Disc 12.5 inch x 1.26 inch	13.00 inch x 2.5 inch (Duo-Servo)	Vacuum
JD7	Disc 12.5 inch x 1.26 inch	13.00 inch x 2.5 inch (Duo-Servo)	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 13.86 inch x 1.435 inch	Disc 13.58 inch x 1.435 inch	Hydraulic

FASTENER TIGHTENING SPECIFICATIONS

Application	N.m	Lb ft	Lb in
Brake Pipe Fittings	24	18	—
Master Cylinder Mounting Nuts	27	20	—

SECTION 5A1A

MASTER CYLINDER UNIT REPAIR

CAUTION: This vehicle has a Supplemental Inflatable Restraint (SIR) System. Refer to the SIR Component and Wiring Location view in order to determine whether you are performing service on or near the SIR components or the SIR wiring. When you are performing service on or near the SIR components or the SIR wiring, refer to the SIR On-Vehicle Service information. Failure to follow the CAUTIONS could cause air bag deployment, personal injury, or unnecessary SIR system repairs.

NOTICE: ***Always use the correct fastener in the proper location. When you replace a fastener, use ONLY the exact part number for that application. General Motors will call out those fasteners that require a replacement after removal. General Motors will also call out the fasteners that require thread lockers or thread sealant. UNLESS OTHERWISE SPECIFIED, do not use supplemental coatings (paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.***

NOTICE: ***Do not hone the master cylinder bore. When the brake master cylinder is overhauled, it is recommended that the cylinder body be replaced rather than "cleaned up" by honing the bore. The master cylinder has a hard, highly polished "bearingized" surface, which is produced by diamond boring followed by ball or roller burnishing under heavy pressure. Honing will destroy this hard smooth surface and cause rapid wear of the rubber cups.***

NOTICE: ***Use approved solvents only when cleaning or flushing the master cylinder and related components. The use of these liquids as cleaning solvent will damage the rubber parts in the system if they have any trace of mineral oil or other contaminants.***

CONTENTS

GENERAL DESCRIPTION

Master cylinders have identifying information stamped into the unit.

Delphi master cylinders have identification information on the front surface of the body. The first and second digits are the build code. The third digit shows the year it was built (5 means 1995, 6 means 1996, etc.). The last digits show the day it was built (Example: 271 means it was the 271st day of the production year).

MASTER CYLINDERS

COMPOSITE MASTER CYLINDER

Remove or Disconnect (Figures 1 through 4)

1. Cover.
2. Diaphragm.
3. Brake fluid from reservoir.
4. Reservoir and grommets (Figure 3).
   - Clamp the mounting flange in a vise and pry the reservoir off with a bar.
5. Snap ring.
6. Primary piston assembly.

CAUTION: If air pressure is used to remove the secondary piston, place the open end of the cylinder bore approximately 25 mm (1 inch) from a padded workbench or other surface to catch the piston when it comes out of the bore. Apply low air pressure very carefully to ease the piston out of the bore. Never point the open end of the bore at anyone when applying air pressure. The piston may come out of the bore with considerable force and cause personal injury.

7. Secondary piston.
   - With the rear port plugged, apply a small amount of air pressure to the front port.
8. Seals.
9. Spring retainer and spring.

Clean

- All metal parts in denatured alcohol.
- All rubber parts in clean brake fluid.

Inspect

- Diaphragm for cuts, cracks, or a swollen condition.
- Cylinder bore for scoring or corrosion. If corrosion is present, replace the cylinder. Do not attempt to hone the bore.
- Reservoir for cracks.

Install or Connect (Figures 1 through 4)

- Lubricate the grommets, seals, and cylinder bore with clean brake fluid.
- Use new seals when assembling the master cylinder.

1. Spring and spring retainer.
2. Seals on the secondary piston.
3. Secondary piston.
4. Primary piston assembly.
5. Snap ring.
   - The primary piston must be compressed when installing the snap ring.
6. Grommets.
   - Use new grommets when assembling the master cylinder.
7. Reservoir (Figure 4).
   - Press on the body while using a rocking motion.
8. Diaphragm in cover.
9. Cover.

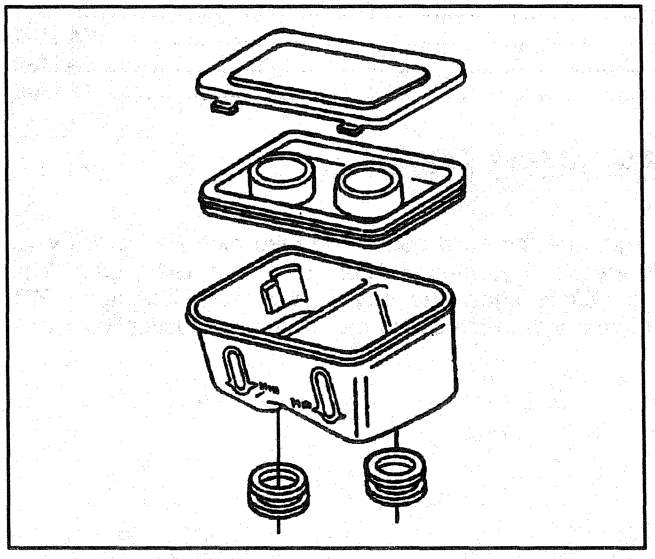


Figure 1—Composite Master Cylinder Reservoir

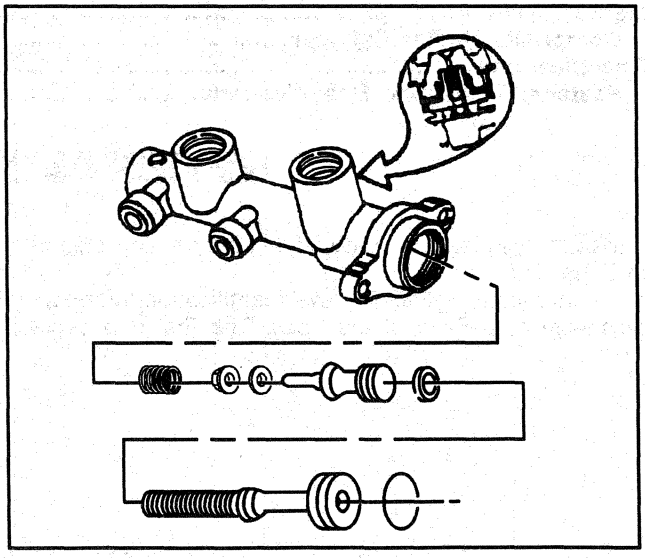


Figure 2—Composite Master Cylinder Body

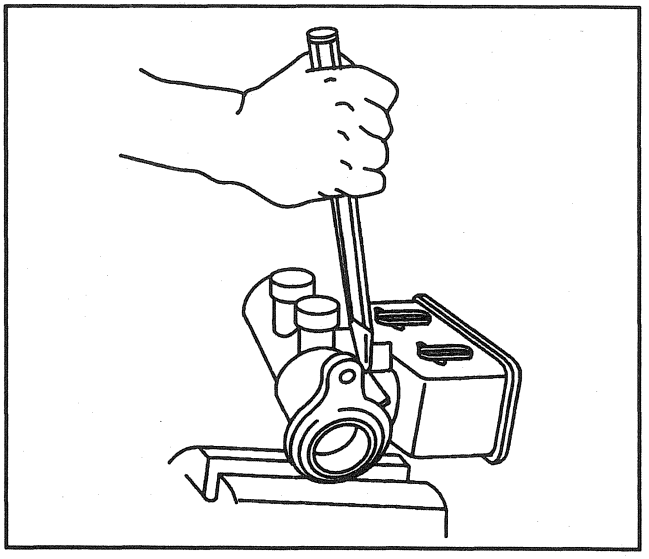


Figure 3—Removing Reservoir

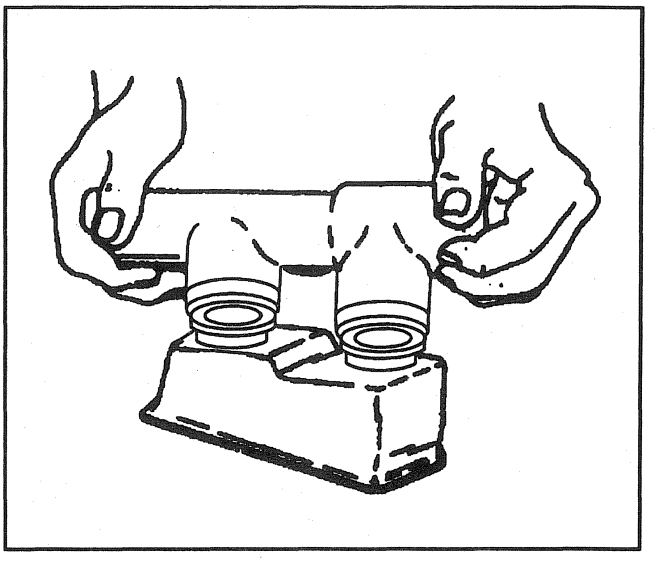


Figure 4—Installing the Reservoir

SPECIFICATIONS

Fastener Tightening Specifications

Application	N·m	Lb ft	Lb in
Brake Pipe Fittings	24	18	—
Master Cylinder Mounting Nuts	27	20	—

SECTION 5B1

FRONT DISC BRAKES

CAUTION: This vehicle has a Supplemental Inflatable Restraint (SIR) System. Refer to the SIR Component and Wiring Location view in order to determine whether you are performing service on or near the SIR components or the SIR wiring. When you are performing service on or near the SIR components or the SIR wiring, refer to the SIR On-Vehicle Service information. Failure to follow the CAUTIONS could cause air bag deployment, personal injury, or unnecessary SIR system repairs.

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

NOTICE: ***Always use the correct fastener in the proper location. When you replace a fastener, use ONLY the exact part number for that application. General Motors will call out those fasteners that require a replacement after removal. General Motors will also call out the fasteners that require thread lockers or thread sealant. UNLESS OTHERWISE SPECIFIED, do not use supplemental coatings (paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.***

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

CONTENTS

CONTENTS (cont'd)

GENERAL DESCRIPTION

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

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

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

Servicing Information

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

ROTOR

The front disc brakes use one of four different styles of rotors. The smaller two wheel drive models (C1, C2, and C3) use standard 1.250 inch rotors. The heavy duty two wheel drive model (C 3500HD) has four wheel disc brakes with 1.435 inch rotors. The smaller four wheel drive models (K1 and K2) use a composite rotor. 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 C 3500HD 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 inch) of the shoe. Replace riveted shoe and lining assemblies when the lining is worn to within 0.76 mm (0.030 inch) of any rivet head. Always replace disc brake shoe and lining assemblies as a complete axle set.

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

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

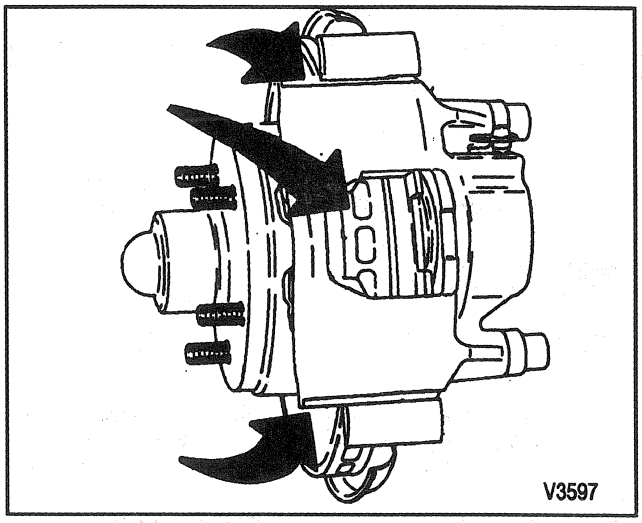


Figure 1—Lining Inspection Points

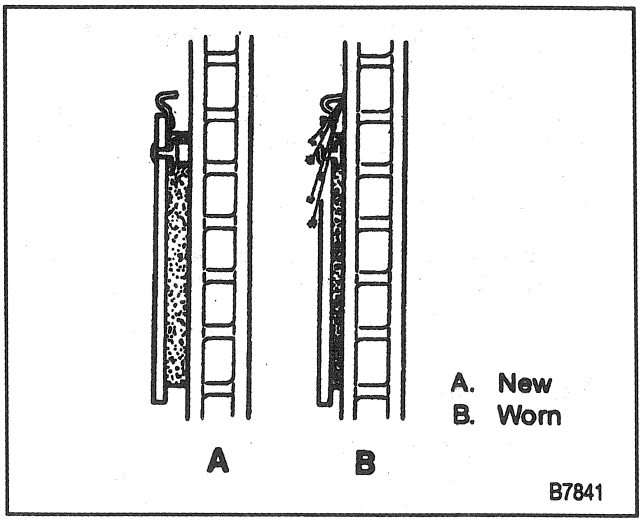


Figure 2—Wear Indicator

ROTOR INSPECTION

Rotor Tolerance and Surface Finish

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

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

Light scoring of the rotor surfaces not exceeding 1.5 mm (0.06 inch) 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 inch) 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. C 3500HD Models must not exceed.025 mm (.001 inch) thickness variation.

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. Failure to properly tighten wheel nuts can cause pedal pulsation and/or front end vibration during brake applications.

2. Fasten a dial indicator to the steering knuckle so the indicator button contacts the rotor surface about 13 mm (0.5 inch) 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 inch). C 3500HD Models must not exceed 0.25 mm (0.010 inch).
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 inch), repair or replace the hub and bearing assembly.

NOTICE: ***When the brake rotor has been separated from the wheel bearing flange, remove all 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" in this section.

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

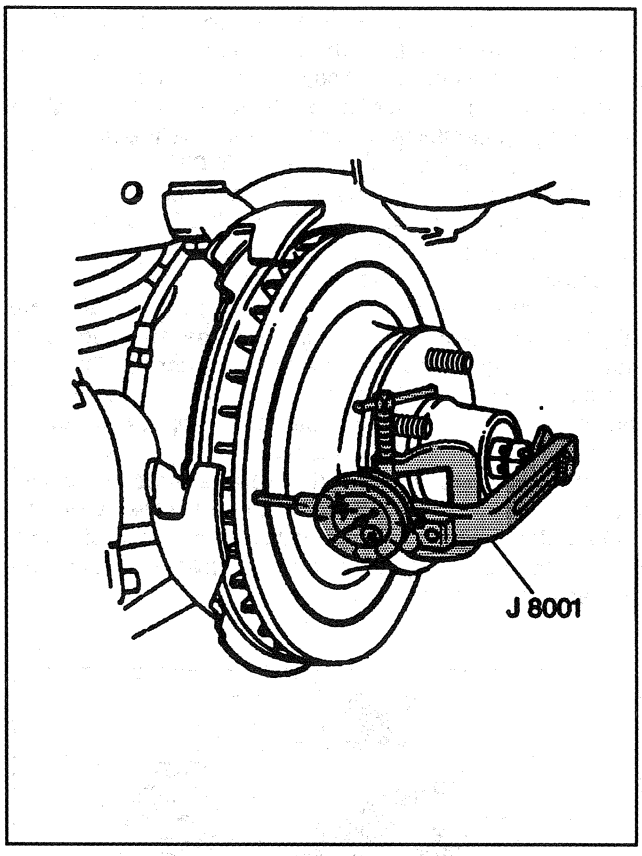


Figure 3—Inspecting for Lateral Runout

ON-VEHICLE SERVICE

CALIPER

Delco

Remove or Disconnect (Figures 4 through 9)

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

Inspect

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

Important

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

Install or Connect (Figures 5 through 14)

NOTICE: ***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 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 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 lb ft).
  - — The bolt boots (1) must remain secure after tightening bolts.
6. Brake hose to caliper.

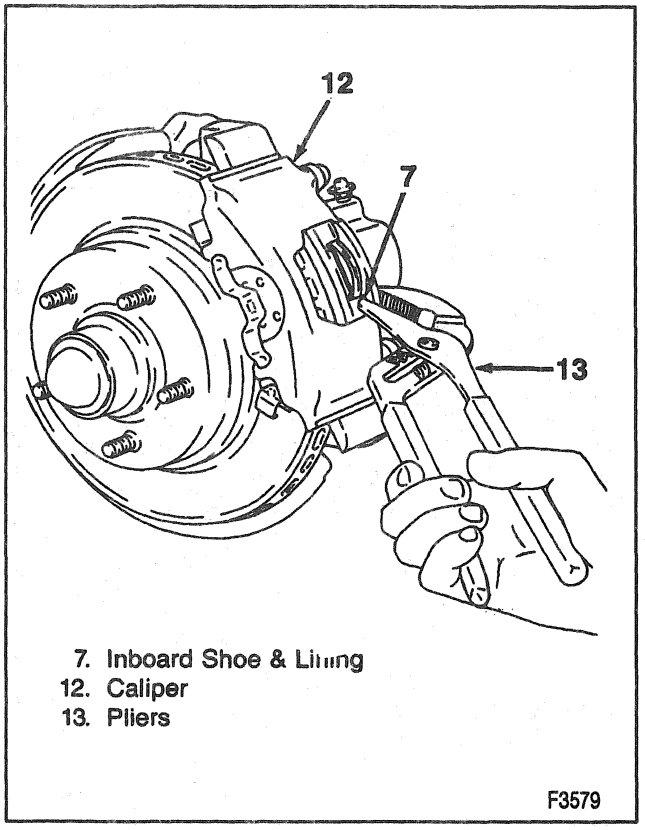


Figure 4—Compressing the Piston

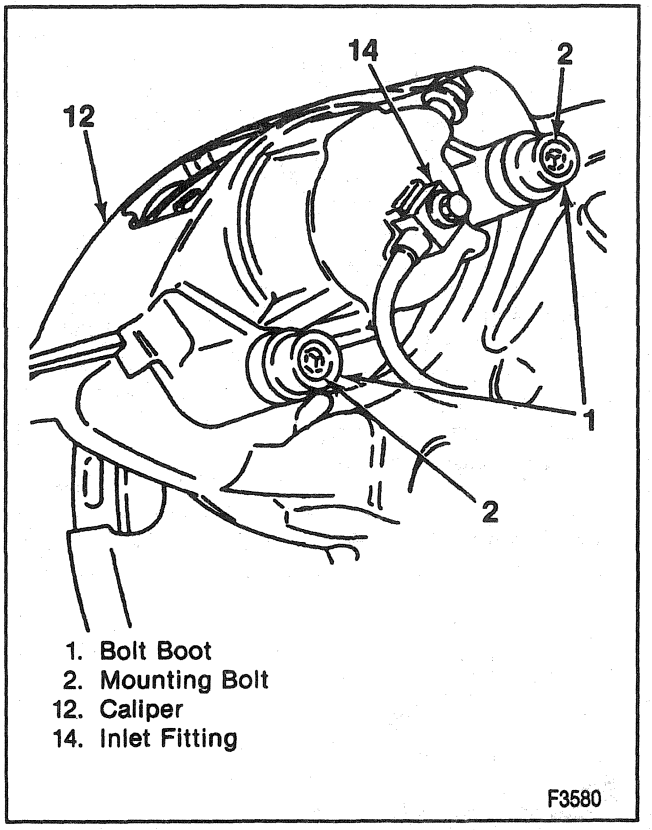


Figure 5—Caliper Attachment (Delco)

Tighten

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

Measure (Figure 14)

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

7. Tire and wheel.

Important

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

Bendix®

Remove or Disconnect (Figures 15 through 19)

1. Two-thirds of the brake fluid from master cylinder.
2. Raise vehicle and support with safety stands.
3. Mark relationship of wheel to hub.
4. Tire and wheel. Refer to SECTION 3E.
5. Position a C-clamp and tighten until piston bottoms in bore (Figure 16).
6. C-clamp.

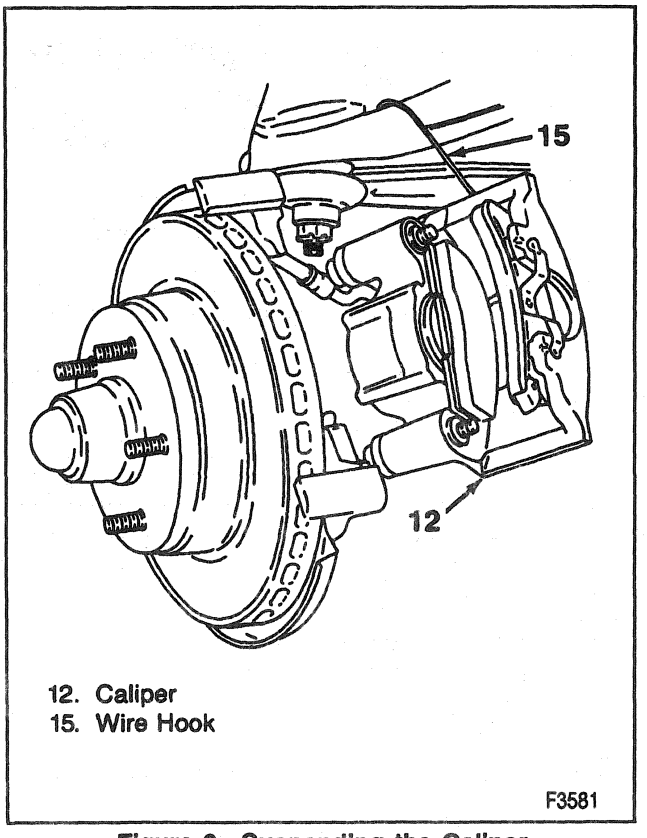


Figure 6—Suspending the Caliper

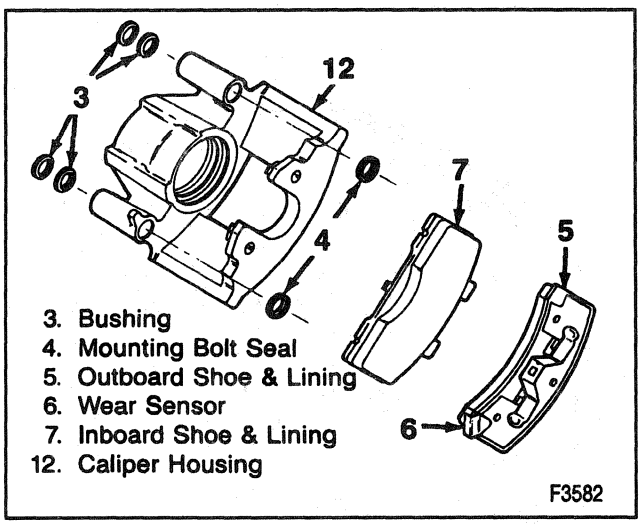


Figure 7—Delco Shoe and Lining Assembly (3400)

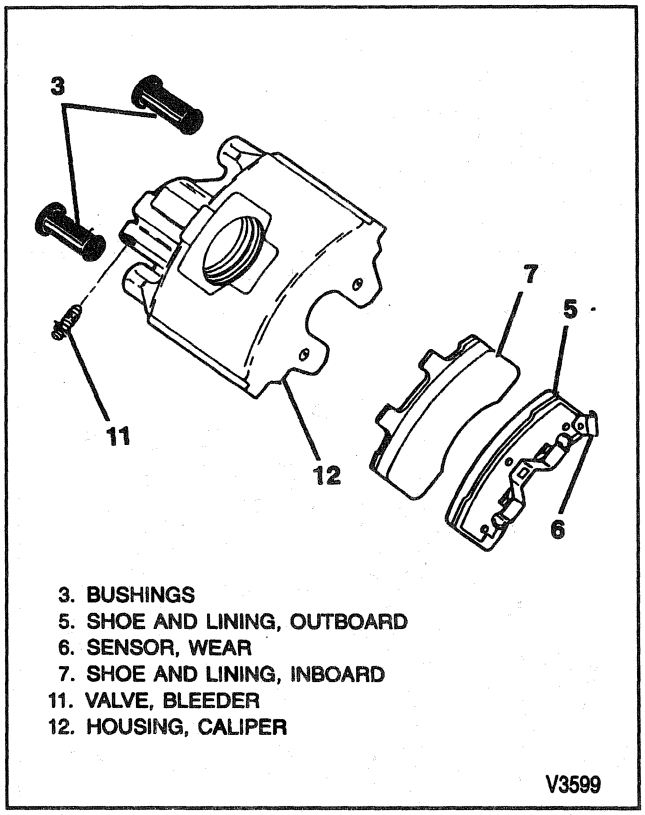


Figure 8—Delco Shoe and Lining Assembly (3486)

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" in this section.

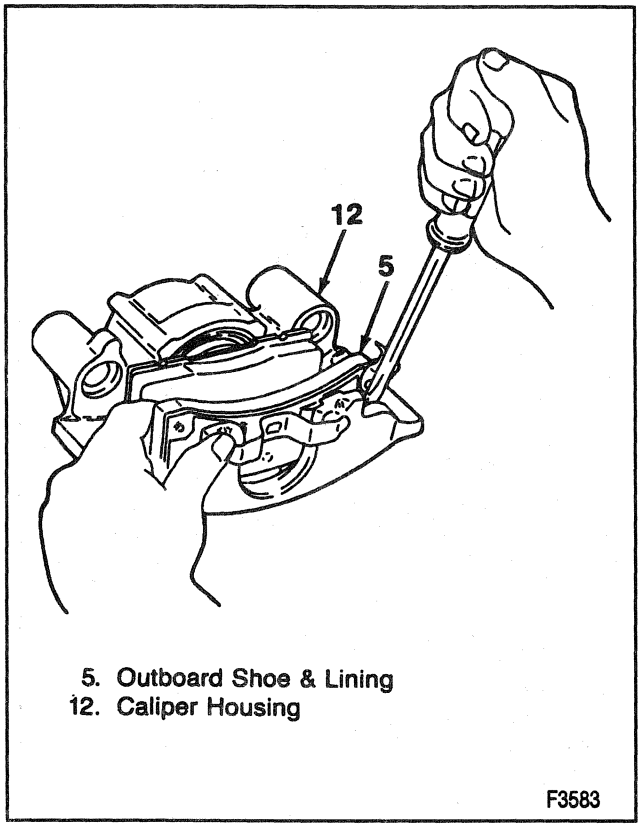


Figure 9—Removing the Outboard Shoe and Lining

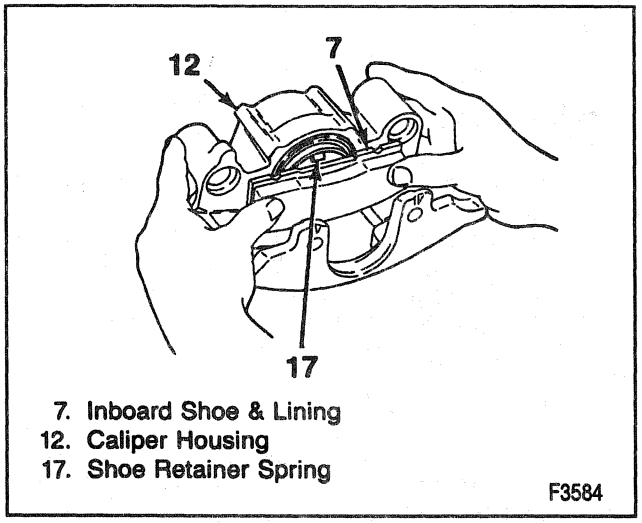


Figure 10—Installing the Inboard Lining

Clean

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

Install or Connect (Figures 15 through 20)

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

1. Lubricate caliper and anchor plate sliding surfaces with Shell Aeroshell® #5 or equivalent.

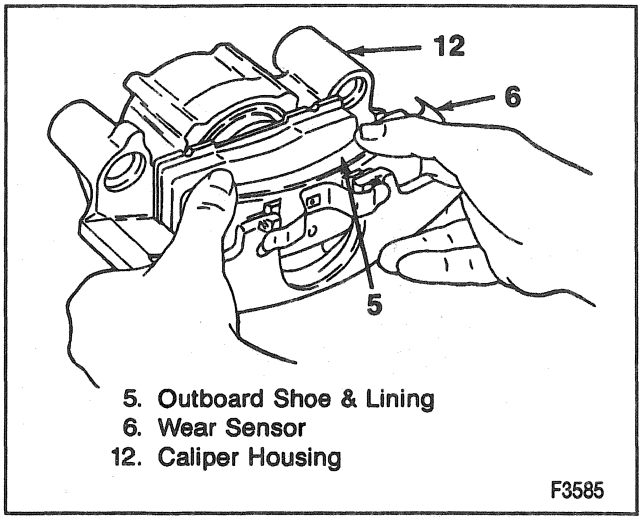


Figure 11—Installing the Outboard Lining

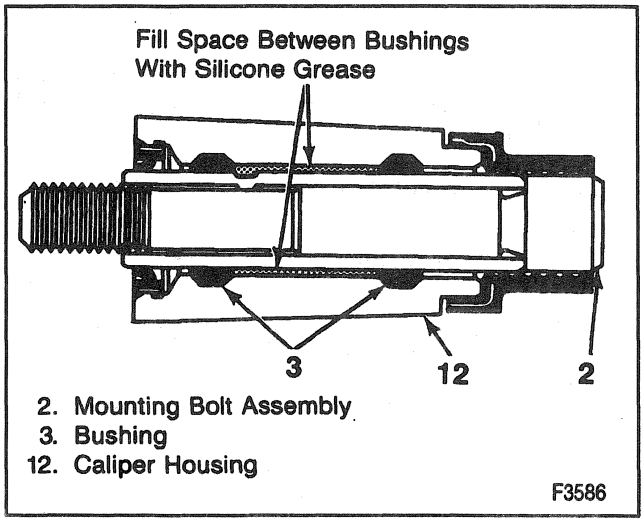


Figure 12—Mounting Bolt Lubrication (Delco 3400)

2. Caliper assembly (1).

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

NOTICE: ***Do not use "never sieze" type products on the caliper V-ways and anchor plate guide way surfaces. These products are not lubricants and result in high caliper slide forces which can cause increased wear of the brake pads.***

3. Spring (4) and support key (3).
   - Use a brass punch and hammer to drive the support key in place (Figure 20).
4. Caliper lock mounting bolts.
   - The boss on the bolt must fit into the circular cutout in the key.

Tighten

- Bolts to 20 N·m (15 lb ft).

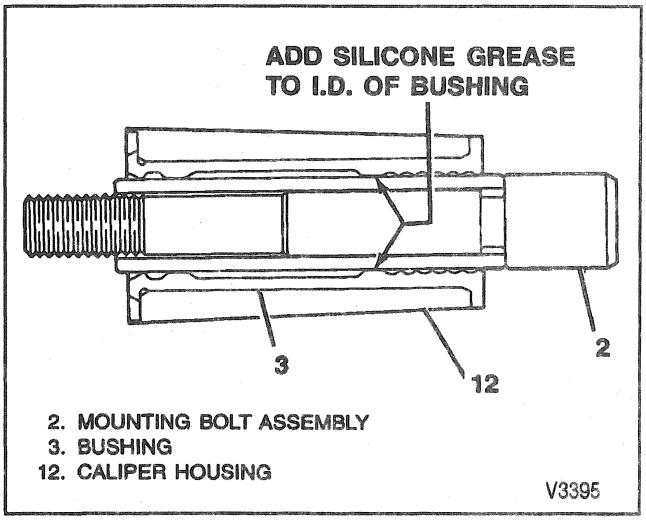


Figure 13—Mounting Bolt Lubrication (Delco 3486)

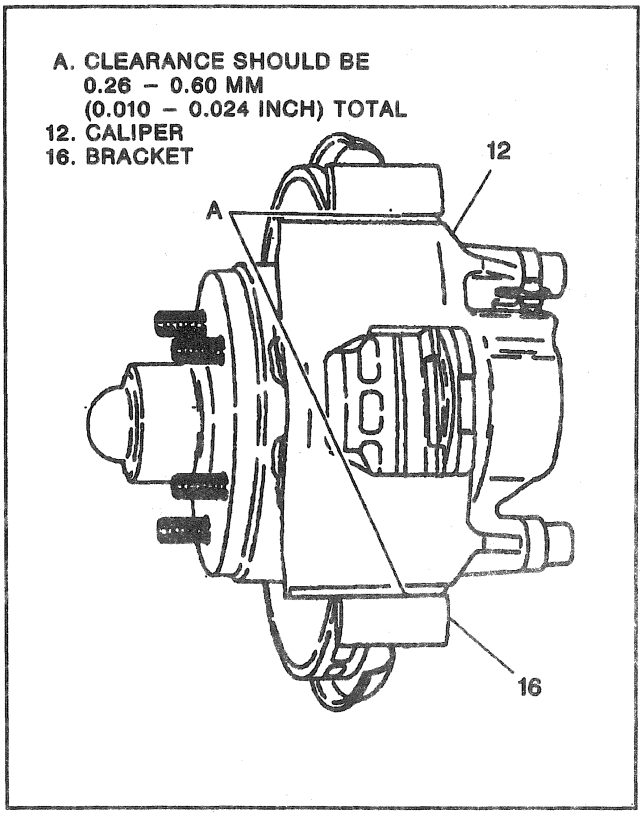


Figure 14—Caliper to Bracket Clearance

5. Brake hose.

Tighten

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

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

Important

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

LININGS

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

Delco

Remove or Disconnect (Figures 6 through 14)

1. Caliper. Refer to "Caliper" in this section.
   - Suspend the caliper (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. Do not attempt to polish away corrosion. Replace if any is found.
- Bolt boots for nicks, cuts, or corrosion. Replace if any are found.

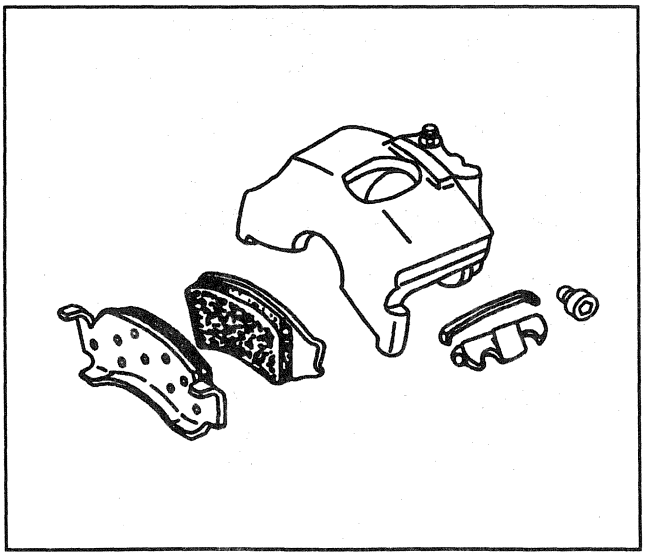


Figure 15—Bendix® Shoe and Lining Assembly

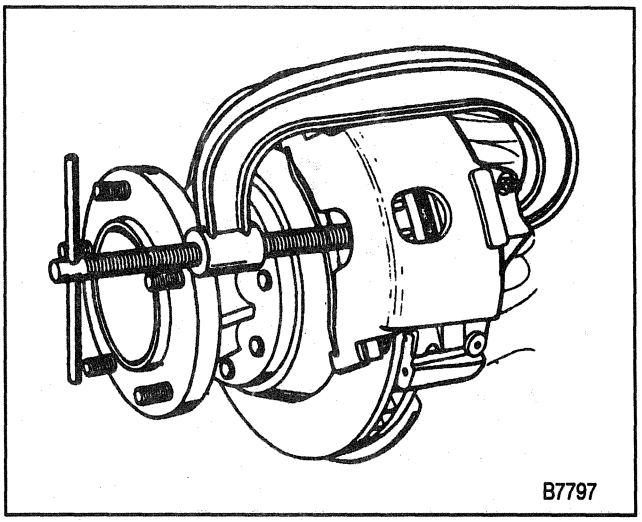


Figure 16—Compressing the Caliper Piston

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)

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

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" in this section.

Important

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

Bendix®

Remove or Disconnect (Figures 15 and 19)

1. Caliper. Refer to "Caliper" in this section.
   - Suspend the caliper (Figure 19).

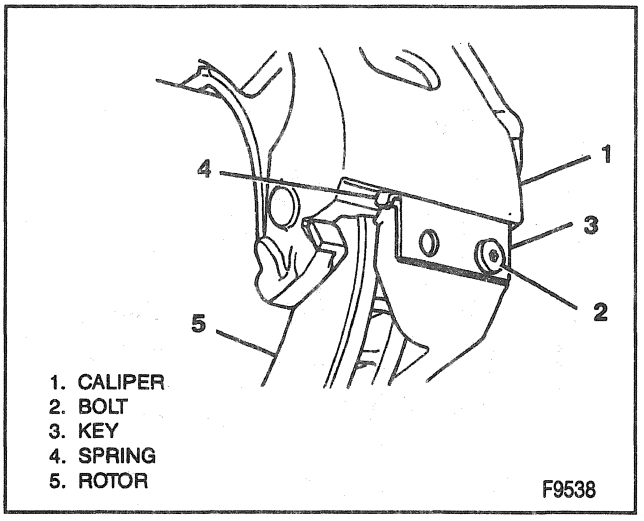


Figure 17—Caliper Mounting

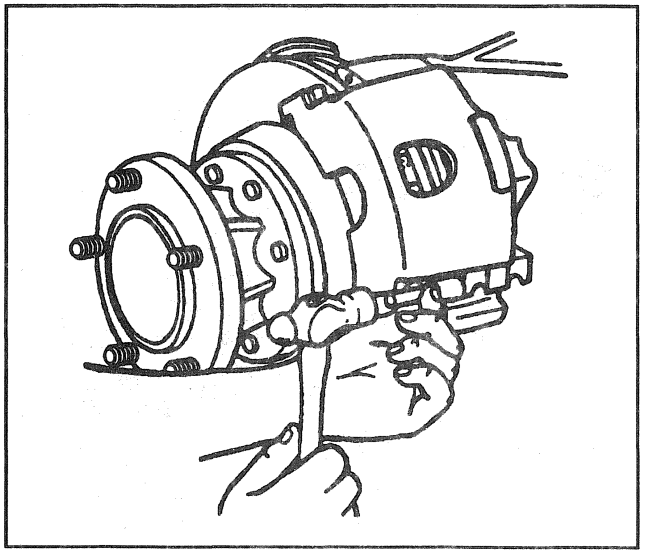


Figure 18—Removing the Caliper Support Key

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

2. Inboard lining.
3. Outboard lining.

Inspect

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

Clean

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

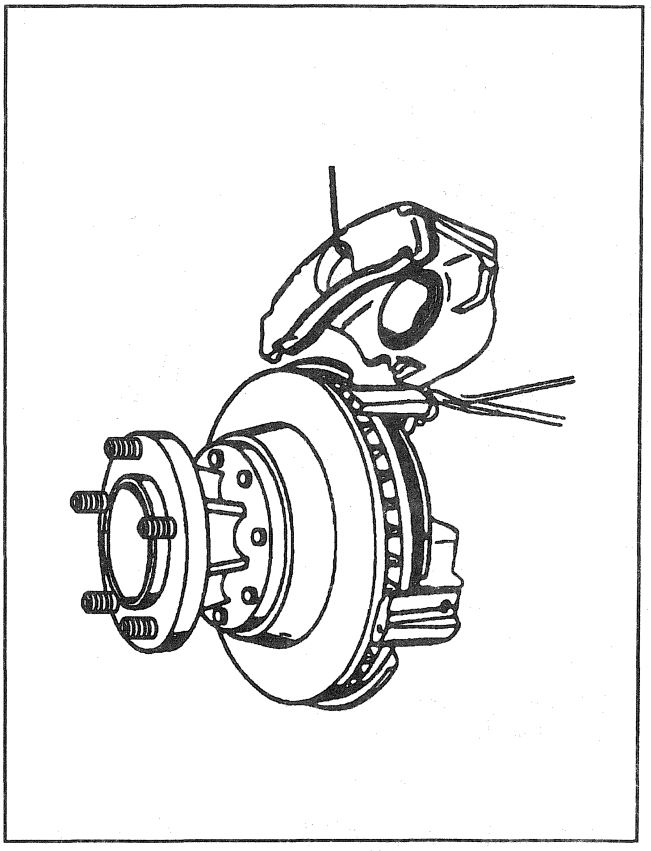


Figure 19—Suspending the Caliper

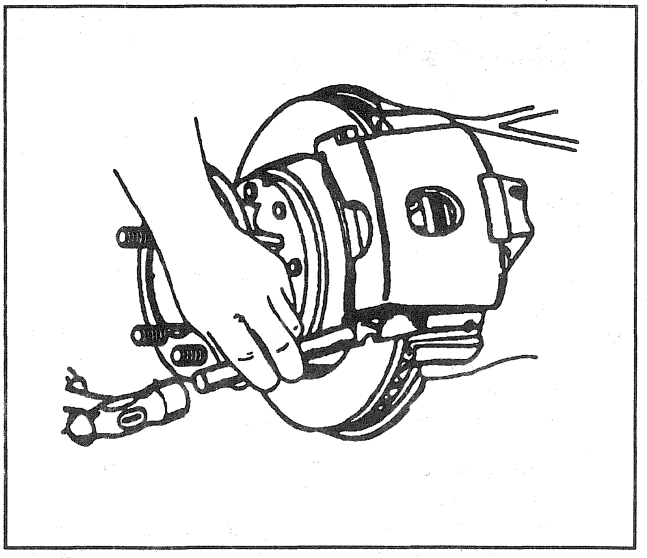


Figure 20—Installing the Caliper Support Key

Install or Connect (Figures 15, 21 through 24)

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

1. Lubricate the caliper and steering knuckle (or support) sliding surfaces and spring with Shell Aeroshell® #5 or equivalent.
2. Place new pad in a vise (Figure 21).

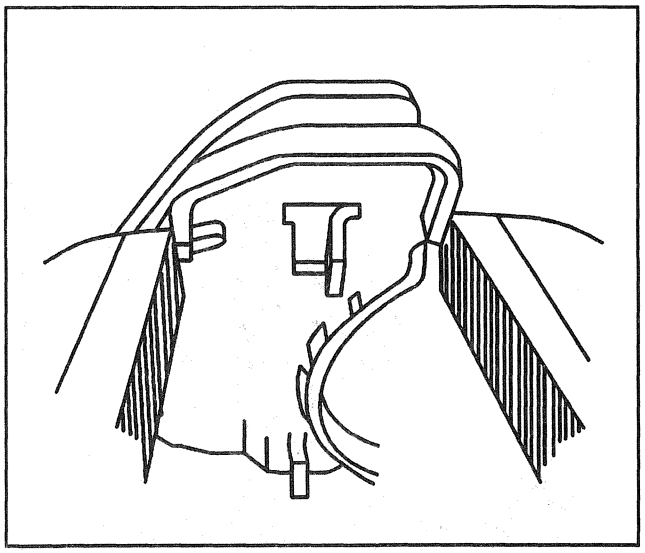


Figure 21—Crimping Outer Brake Pad

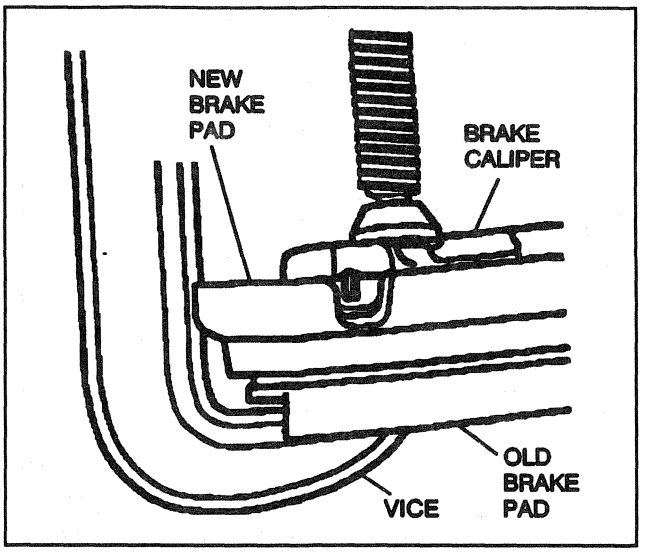


Figure 23—Installing Outer Pad

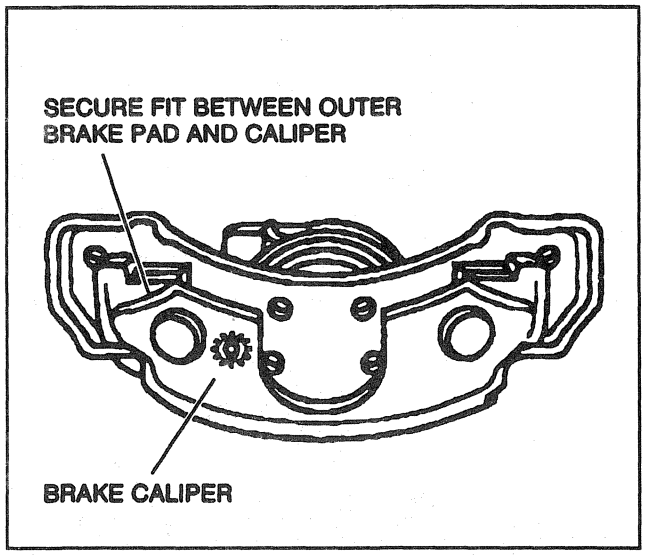


Figure 22—Outer Brake Pad Secured To Caliper

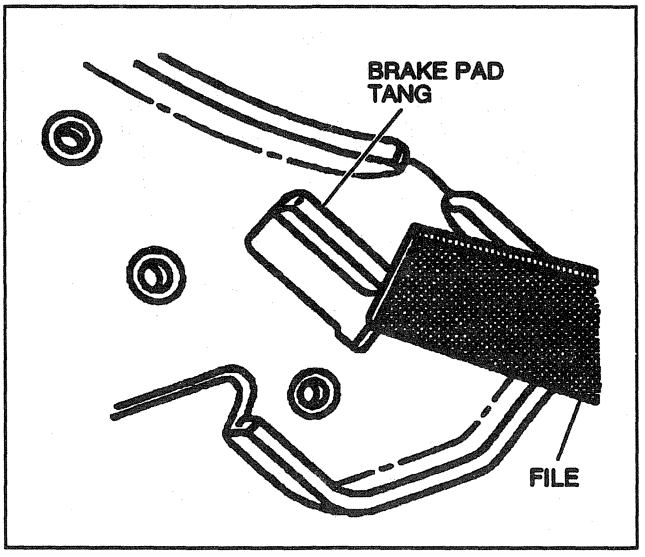


Figure 24—Filing Outer Brake Pad Tang

3. Compress the vise as necessary to obtain a secure fit between the outer brake pad and the caliper (Figure 22).
4. Install the outer brake pad onto the caliper (Figure 23).
   - If necessary use a C-clamp to install the pad onto the caliper.
   - Do not allow the C-clamp to come in contact with the lining, insert a used brake pad between C-clamp and the new brake lining.
5. File the leading edge of the brake pad tang to aid in installing brake pad to caliper (Figure 24).
6. Caliper. Refer to "Caliper" in this section.

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 wear shims available to compensate for wear at the caliper to anchor plate contact points. 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 25.

1. Remove caliper. Refer to "Caliper" in this section.
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 1.25mm (0.050 inch) or more.
5. Measure caliper to anchor plate wear.
   A. Install caliper.
   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 on either side of the screw driver.
   G. Based on the bumper gap measurement, select a shim according to the table in "Specifications" at the end of this section.
6. Replacing the caliper after a shim has been selected.
   A. Remove caliper from anchor plate.
   B. Install shim on the anchor plate V-way opposite the key and spring V-way.
   C. With the shim installed on the anchor plate V-way, install the caliper using a new key and spring.
7. Remeasure the bumper gap, if the gap exceeds 1.50 mm (0.058 inch) install a thicker shim or replace components according to table in "Specifications" at the end of this section.

ANCHOR PLATE

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

ROTOR

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

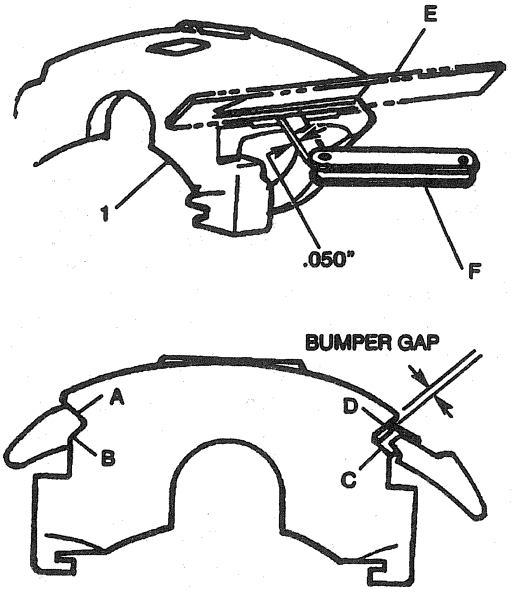


Figure 25—Bendix® Caliper Wear Adjustment

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. Refinishing composite rotors requires using a rotor adapter tool as a holding fixture for the brake lathe (Figure 26).

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.

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 inch) 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.

Ammco Brake Lathe

—	ROUGH CUT	FINISH CUT
Spindle Speed	150 RPM	150 RPM
Depth Of Cut (Per Side)	0.127 mm (0.005 inch)	0.051 mm (0.002 inch)
Total Cross Feed (Per Revolution)	0.152-0.254 mm (0.006-0.010 inch)	0.051 mm (0.002 inch) Max.
Vibration Damp.	Yes	Yes
Swirl Pattern—120 Grit	No	Yes

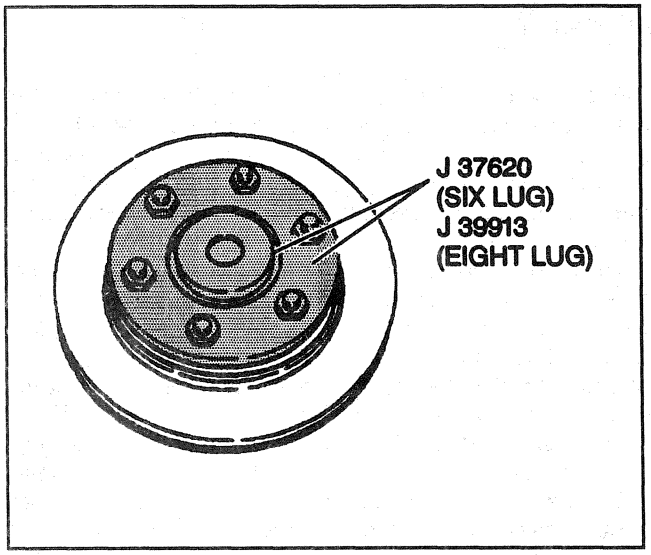


Figure 26—Rotor Adaptor Installed on the Rotor

Accu-Turn Brake Lathe, GM Dealer Equipment (One Cut Refinish Procedure)

Spindle Speed	150 RPM
Tool Cross Feed (Per Revolution)	0.076 mm (0.003 inch)
Tool Bit Nose Radius	1/64
Vibration Damper	Yes
Swirl Pattern—120 Grit	Yes

CALIPER

Delco

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

Remove or Disconnect (Figures 29 through 32)

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 29).
   - Use just enough air pressure to ease piston out of bore.
4. Boot (8) (Figure 30).
   - 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.

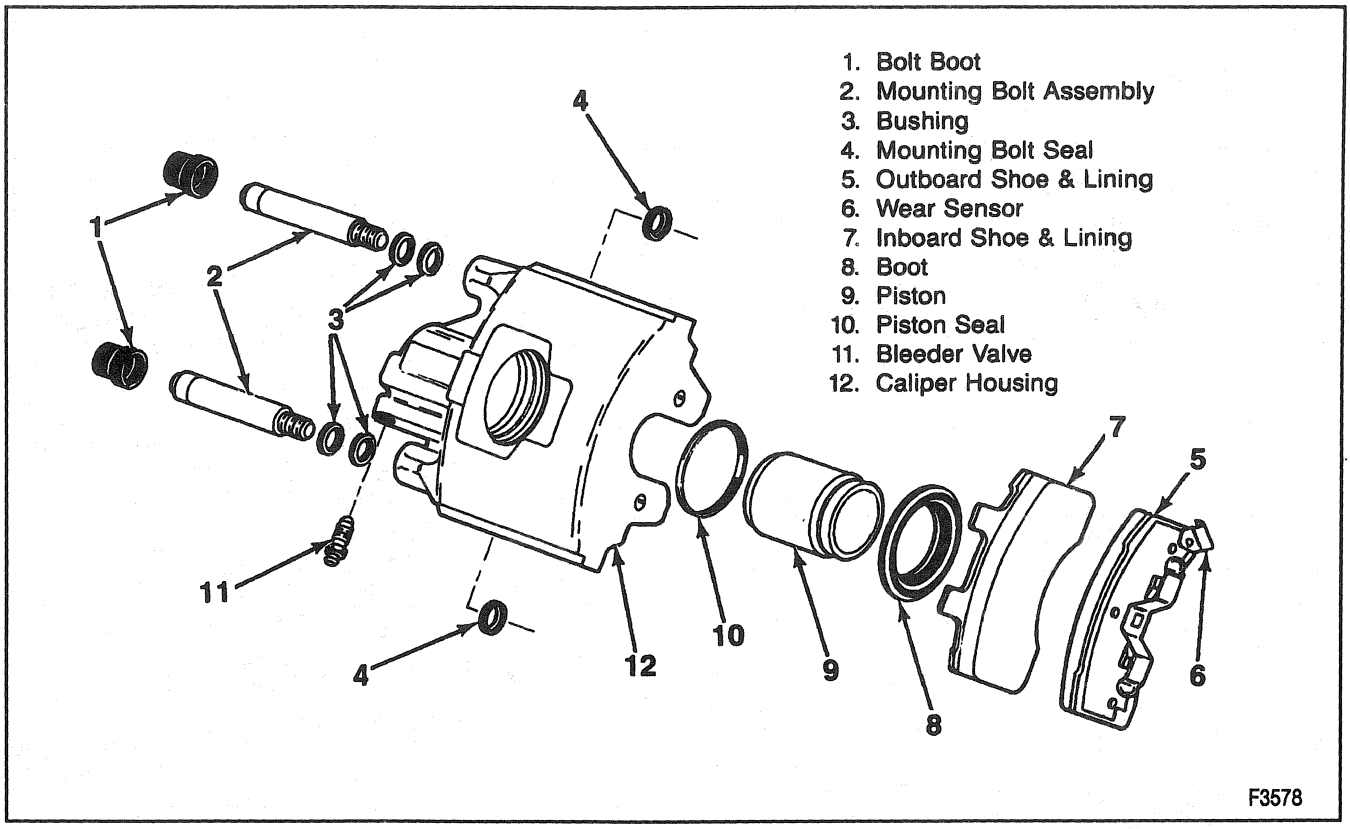


Figure 27—Caliper Components (Delco 3400)

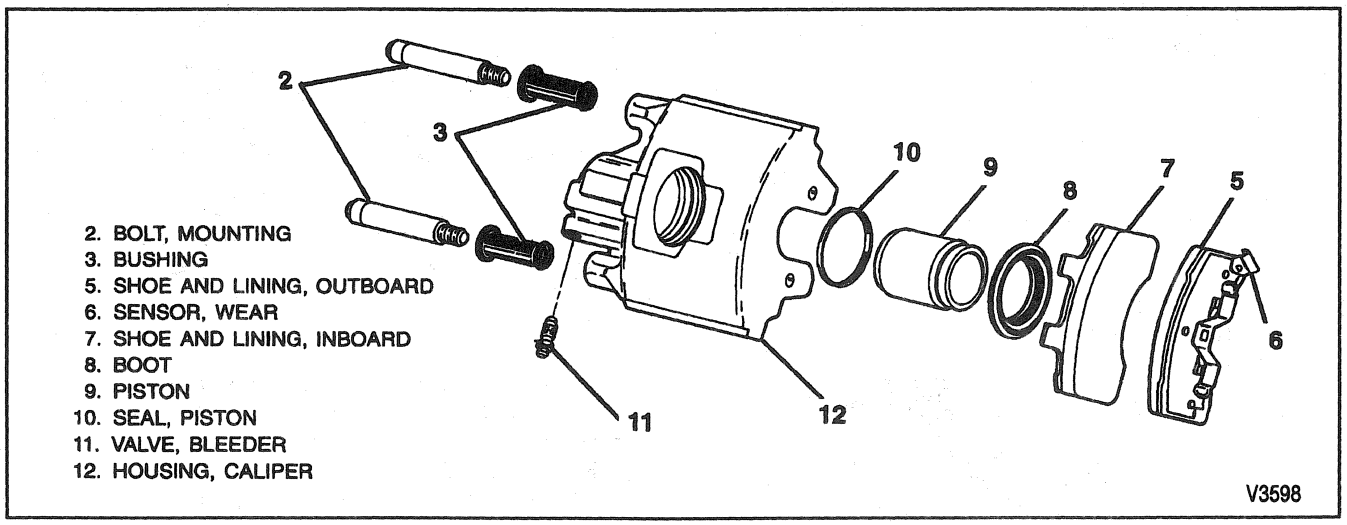


Figure 28—Caliper Components (Delco 3486)

Install or Connect (Figures 27 through 32)

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 31).
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 31).
5. Bleeder valve (11).

Tighten

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

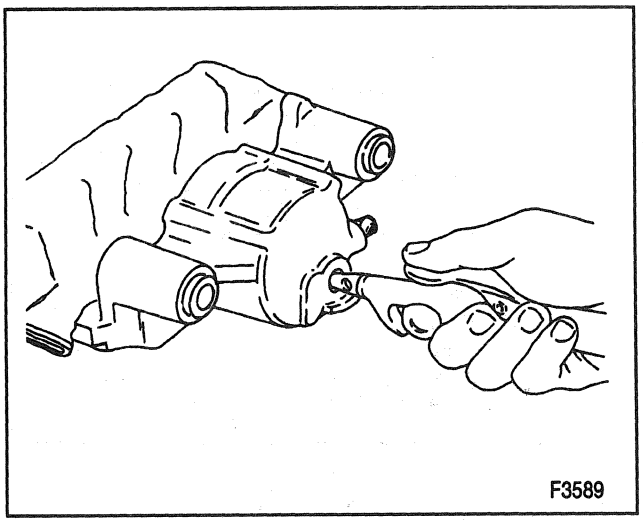


Figure 29-Removing the Piston

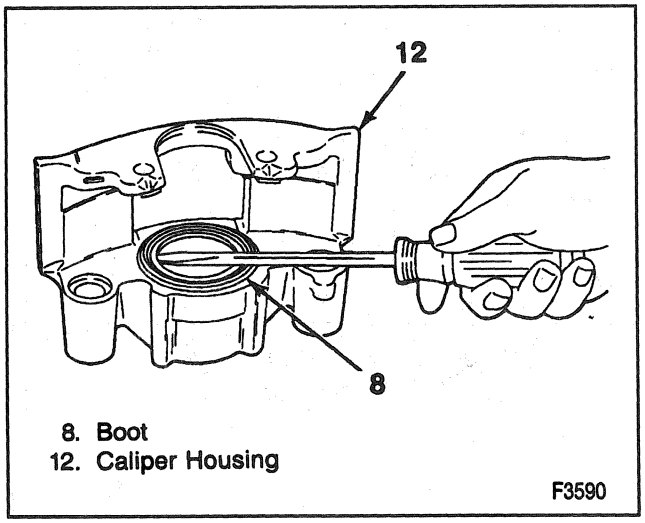


Figure 30—Removing the Boot

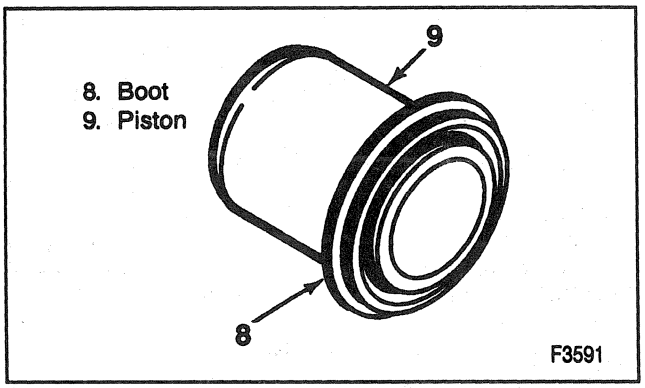


Figure 31—Installing the Boot on the Piston

Bendix®

Tool Required:
J 24548 Piston Seal Installer

Remove or Disconnect (Figures 33 through 35)

1. Fluid from caliper.

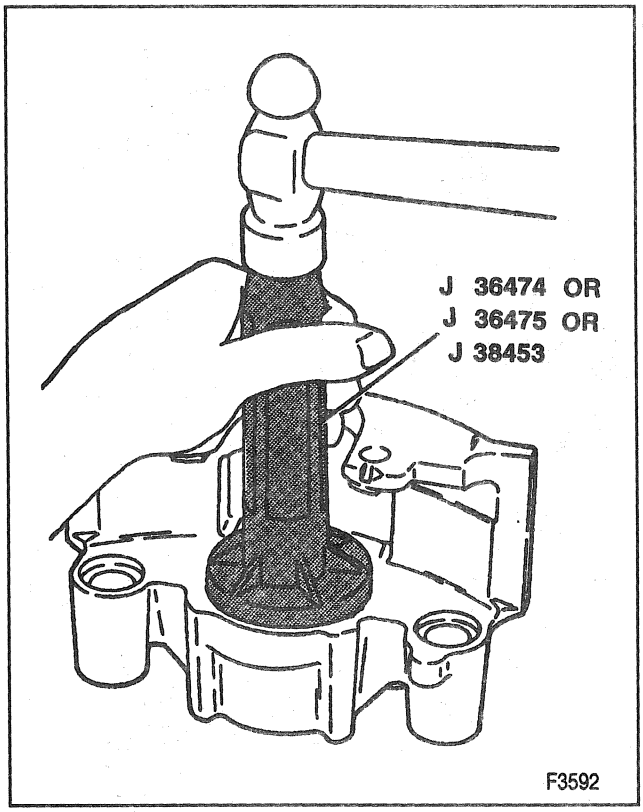


Figure 32—Seating the Boot in the Housing

2. Pad interior of caliper with clean shop towels.

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

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

3. Piston (22).
   - Direct compressed air into caliper fluid inlet (Figure 34).
4. Boot (23) (Figure 35).
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.

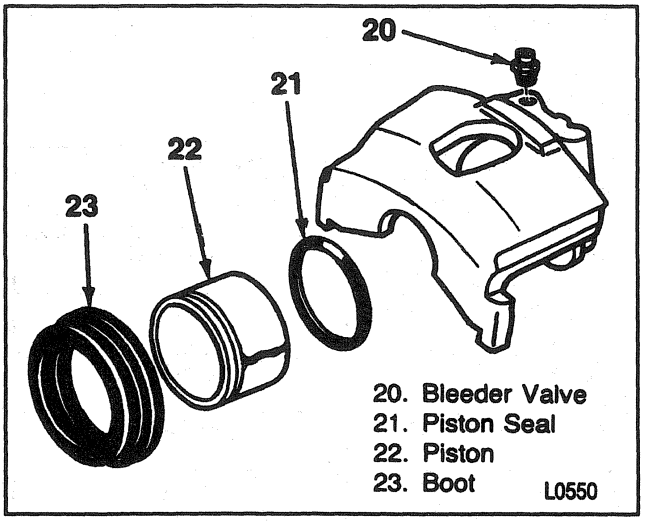


Figure 33—Caliper Components (Bendix®)

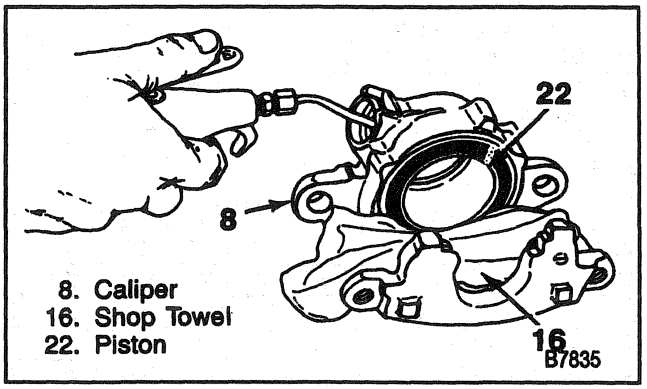


Figure 34—Removing the Piston

- 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 33 and 36)

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

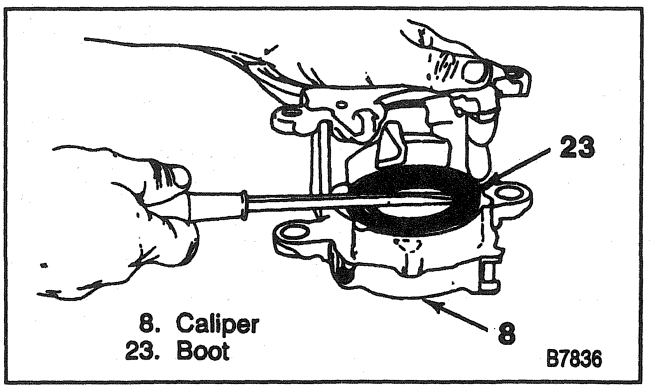


Figure 35—Removing the Boot

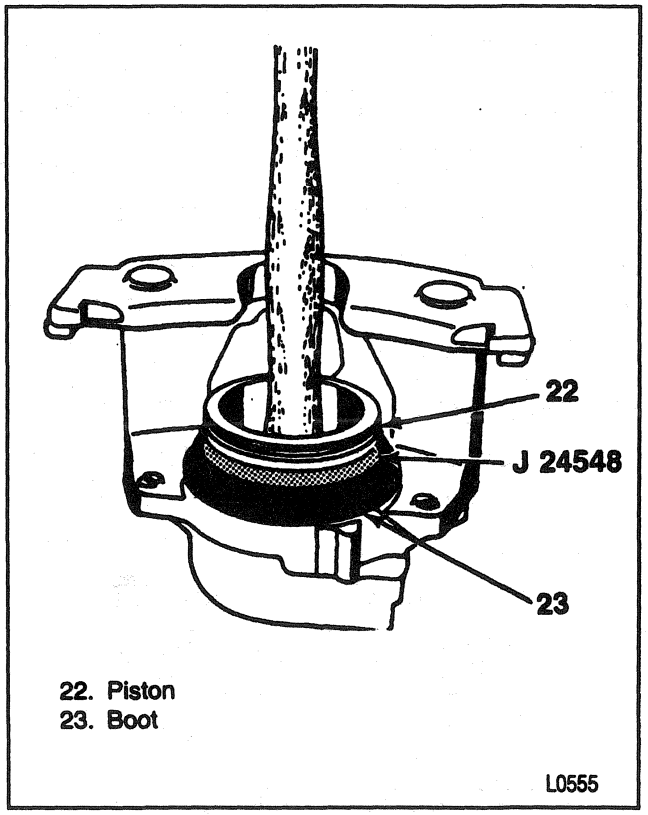


Figure 36—Installing the Piston

5. Piston (22) inside J 24548 (Figure 36).
6. Piston halfway into bore.
   A. Remove J 24548.
   B. Make sure boot is firmly seated.
7. Bleeder valve (20).

Tighten

- Bleeder valve to 13 N·m (110 lb in).

SPECIFICATIONS

BRAKE SYSTEMS

SYSTEM	FRONT BRAKES	REAR BRAKES	BRAKE ASSIST
JB5	Disc 11.57 inch x 1.25 inch	254 mm x 57 mm (Leading/Trailing)	Vacuum
JD5	Disc 11.57 inch x 1.25 inch	254 mm x 57 mm (Leading/Trailing)	Hydraulic
JB6	Disc 11.57 inch x 1.25 inch	11.15 inch x 2.75 inch (Duo-Servo)	Vacuum
JD6	Disc 11.57 inch x 1.25 inch	11.15 inch x 2.75 inch (Duo-Servo)	Hydraulic
JB7	Disc 12.5 inch x 1.26 inch	13.00 inch x 2.5 inch (Duo-Servo)	Vacuum
JD7	Disc 12.5 inch x 1.26 inch	13.00 inch x 2.5 inch (Duo-Servo)	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 13.86 inch x 1.435 inch	Disc 13.58 inch x 1.435 inch	Hydraulic

ROTOR THICKNESS

SYSTEM	ORIGINAL	THINNEST (REFINISHING)	REPLACEMENT (DISCARD)
JB5/JD5/JB6	31.75 mm (1.25 inch)	31.25 mm (1.23 inch)	30.86 mm (1.215 inch)
JB7/JD7/JB8	32 mm (1.26 inch)	31.25 mm (1.23 inch)	30.86 mm (1.215 inch)
JB8 Dual	38.10 mm (1.50 inch)	37.59 mm (1.480 inch)	37.21 mm (1.465 inch)
JF9	36.26-36.64 mm (1.428-1.443 inch)	35.1 mm (1.382 inch)	34.7 mm (1.366 inch)

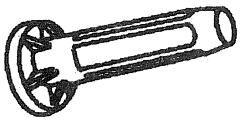
BENDIX CALIPER WEAR SHIM SPECIFICATIONS

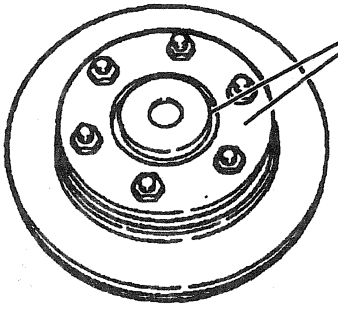
MORE THAN	BUT NOT EXCEEDING	SHIM THICKNESS	SHIM P/N
0	.058 inch	None Required	None Required
.058 inch	.101 inch	.025 inch	15625734
.101 inch	.145 inch	.045 inch	15625735
.145 inch	—	See Note 1	See Note 1
Note 1: If bumper gap exceeds.145 inch, remove old caliper and replace with a new caliper and remeasure bumper gap. If the bumper gap with the new caliper is between.058 inch and.145 inch, select a shim from table. If the bumper gap with the new caliper exceeds.145 inch, replace the anchor plate also. Use a new key and spring when assembling the new components.			

FASTENER TIGHTENING SPECIFICATIONS

Application	N·m	Lb ft	Lb in
Bleeder Valve (Bendix)	13	—	110
Bleeder Valve (Delco)	13	—	115
Brake Hose to Caliper Bolt	45	33	—
Caliper Lock Mounting Bolt (C 3500HD)	20	15	—
Caliper Mounting Bolt (Delco)	51	38	—
Front Anchor Plate to Knuckle Nut (C 3500HD)	285	210	—
Front Rotor to Hub Bolt (C 3500HD)	237	175	—
Front Splash Shield Bolt (C 3500HD)	16	12	—
Rear Anchor Plate to Axle Flange Nut (C 3500HD)	105	78	—
Splash Shield to Knuckle Bolt	26	19	—

SPECIAL TOOLS

1. 
J 36474 OR
J 36475 OR
J 38453

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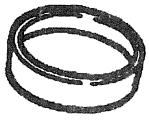
(SIX LUG)
J 39913
(EIGHT LUG)

3. 
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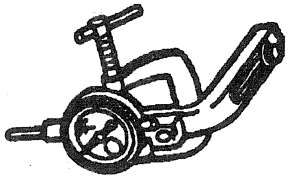
4. 
J 8001

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

SECTION 5B2

REAR DISC BRAKES

CAUTION: This vehicle has a Supplemental Inflatable Restraint (SIR) System. Refer to the SIR Component and Wiring Location view in order to determine whether you are performing service on or near the SIR components or the SIR wiring. When you are performing service on or near the SIR components or the SIR wiring, refer to the SIR On-Vehicle Service information. Failure to follow the CAUTIONS could cause air bag deployment, personal injury, or unnecessary SIR system repairs.

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

NOTICE: ***Always use the correct fastener in the proper location. When you replace a fastener, use ONLY the exact part number for that application. General Motors will call out those fasteners that require a replacement after removal. General Motors will also call out the fasteners that require thread lockers or thread sealant. UNLESS OTHERWISE SPECIFIED, do not use supplemental coatings (paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.***

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

CONTENTS

CONTENTS (cont'd)

GENERAL DESCRIPTION

The disc brake assembly consists of a caliper assembly, rotor, linings, and anchor plate. Applying the brake pedal causes hydraulic pressure to move the caliper 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 in the caliper bore 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 9,650 km (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 inch) of the shoe. Replace riveted shoe and lining assemblies when the lining is worn to within 0.76 mm (0.030 inch) of any rivet head. Always replace disc brake shoe and lining assemblies as a complete axle set.

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

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

ROTOR INSPECTION

Rotor Tolerance and Surface Finish

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

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

Light scoring of the rotor surfaces not exceeding 1.5 mm (0.06 inch) 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 0.025 mm (0.001 inch) 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.

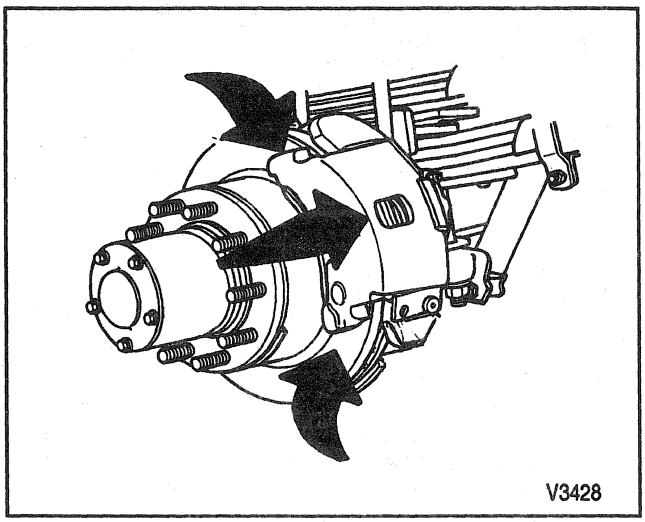


Figure 1—Lining Inspection Points

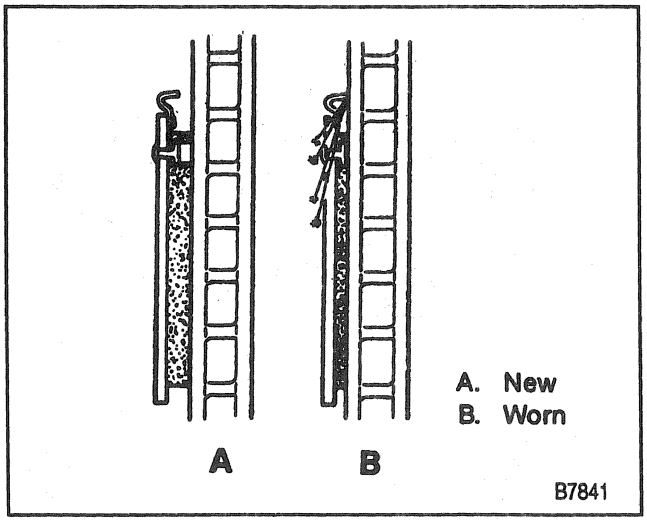


Figure 2—Wear Indicator

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 inch) 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 0.25 mm (0.010 inch).
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 inch), 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" in this section.

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

ON-VEHICLE SERVICE

CALIPER

Remove or Disconnect (Figures 3 through 6)

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

Inspect

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

Clean

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

Install or Connect (Figures 4 and 6)

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

1. Lubricate caliper and anchor plate sliding surfaces with Shell Aeroshell® Grade 5 lubricant or equivalent.

NOTICE: ***Do not use "never sieze" type products on the caliper V-ways and anchor plate guide way surfaces. These products are not lubricants and result in high caliper slide forces which can cause increased wear of the brake pads.***

2. Caliper assembly (1) (Figure 4).
3. Spring (4) and support key (3) (Figure 4).
   - Use a brass punch and hammer to drive the support key in place (Figure 6).
4. Bolt (2) (Figure 4).
   - The boss on the bolt must fit into the circular cutout in the key.

Tighten

- Bolt (2) to 20 N·m (15 lb ft).

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

5. Brake hose.

Tighten

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

6. Bleed system. Refer to SECTION 5A.
7. Tire and wheel assembly.
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.

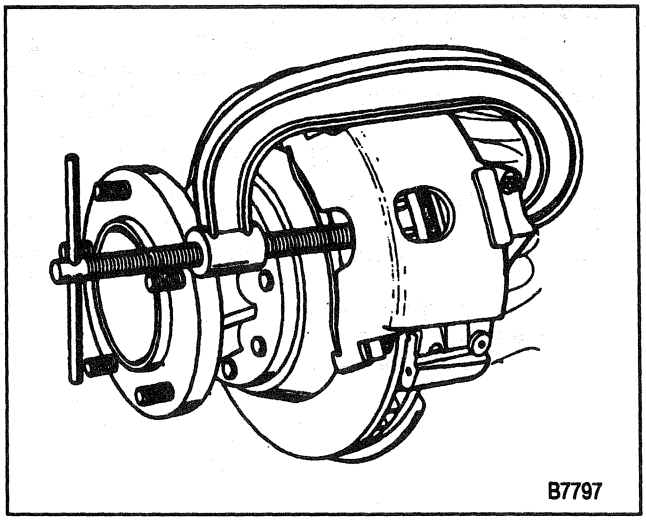


Figure 3—Compressing the Caliper Piston

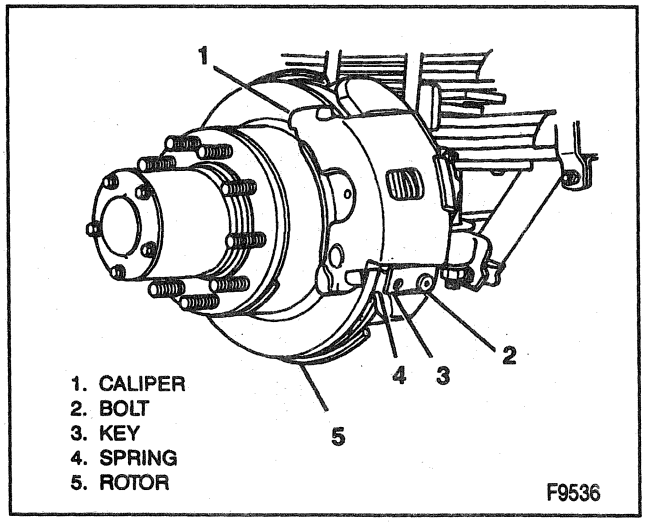


Figure 4—Disc Brake Assembly

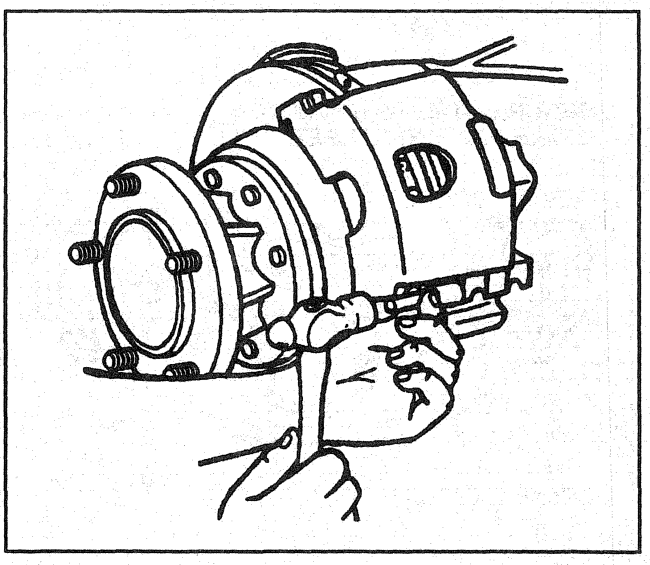


Figure 5—Removing the Caliper Support Key

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 7 and 8)

1. Caliper. Refer to "Caliper" in this section. Do not disconnect the brake hose as in "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 and outboard lining (Figure 8).

Clean

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

Install or Connect (Figures 9 through 12)

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

1. Lubricate the caliper and steering knuckle (or support) sliding surfaces and spring with Shell Aeroshell® #5 or equivalent.
2. Place new pad in a vise (Figure 9).
3. Compress the brake pad tangs as necessary to obtain a secure fit between the outer brake pad and the caliper (Figure 10).

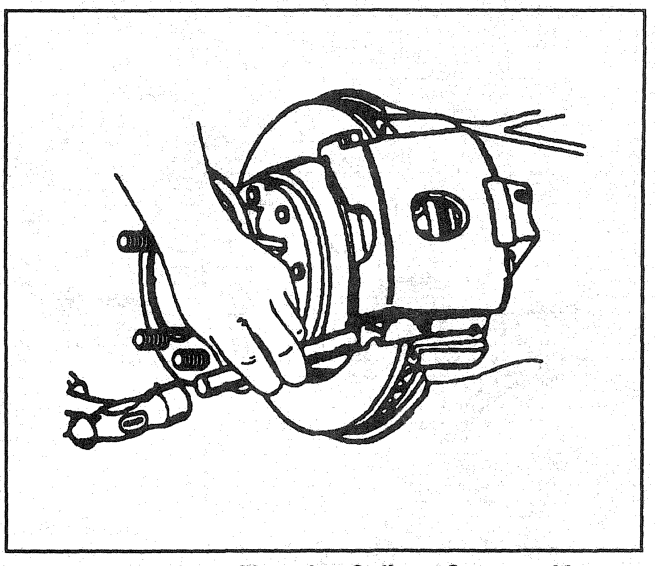


Figure 6—Installing the Caliper Support Key

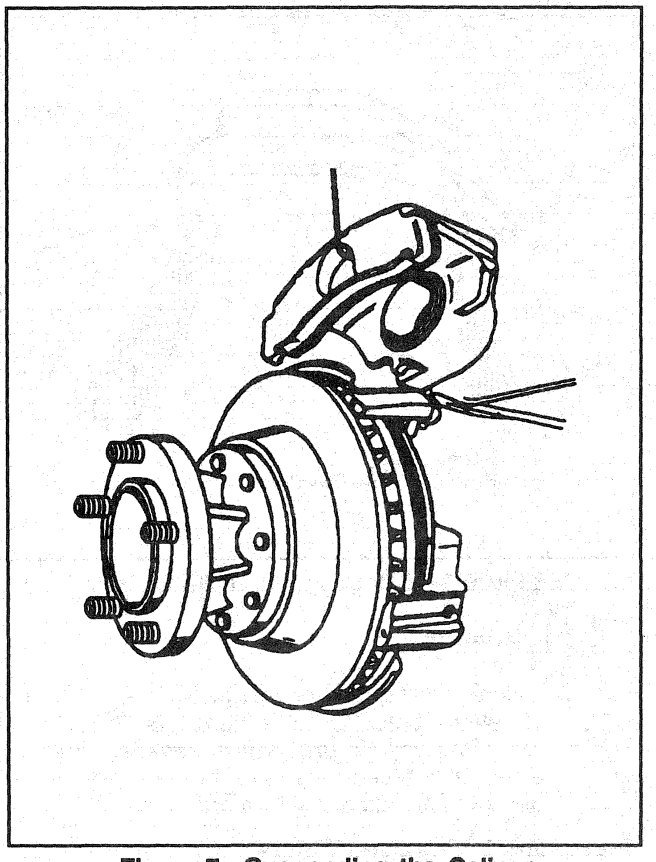


Figure 7—Suspending the Caliper

4. Install the outer brake pad onto the caliper (Figure 11).
   - If necessary use a C-clamp to install the pad onto the caliper.
   - Do not allow the C-clamp to come in contact with the lining. Insert a used brake pad between C-clamp and the new brake lining.
5. File the leading edge of the brake pad tang to aid in installing brake pad to caliper (Figure 12).
6. Caliper.

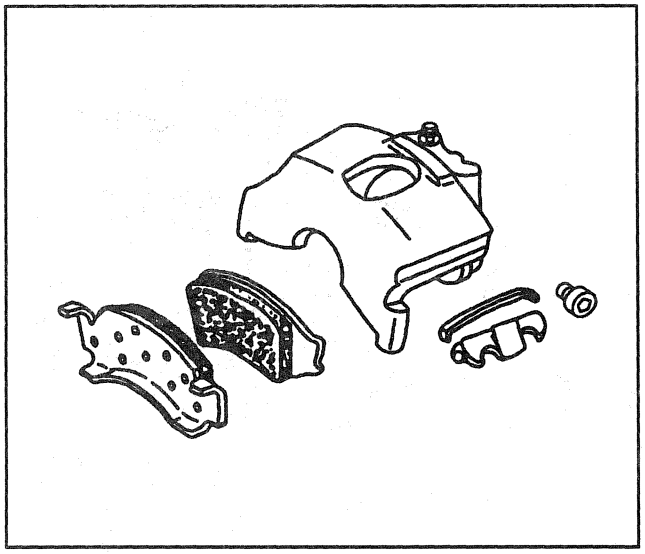


Figure 8—Replacing the Disc Brake Pads

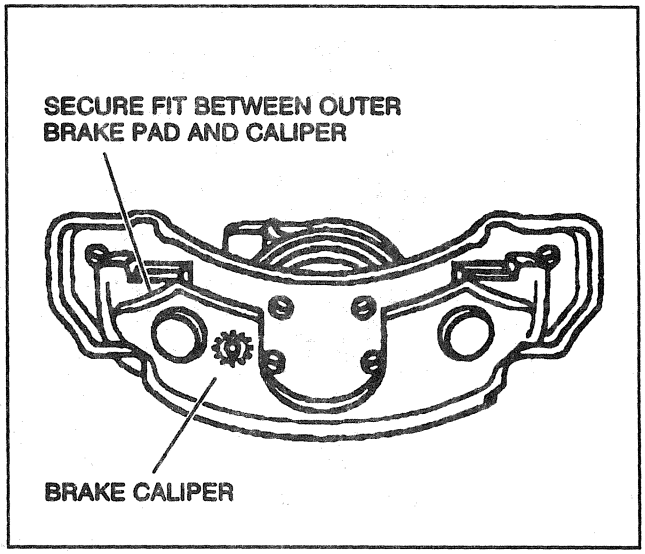


Figure 10—Outer Brake Pad Secured to Caliper

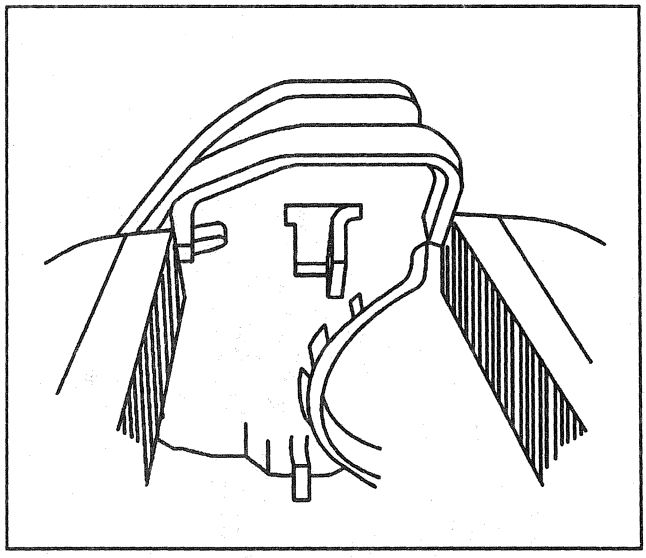


Figure 9—Crimping Outer Brake Pad

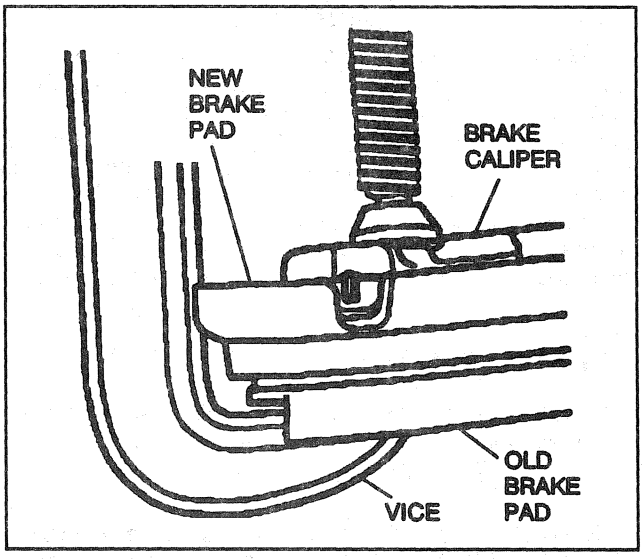


Figure 11—Installing Outer Pad

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 13. 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 13.

1. Remove caliper. Refer to "Caliper" in this section.
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 1.25 mm (0.050 inch) or more.
5. Measure caliper to anchor plate wear.
   A. Install caliper.
   B. Install a new standard size key without the spring.
   C. Install the key retention bolt.

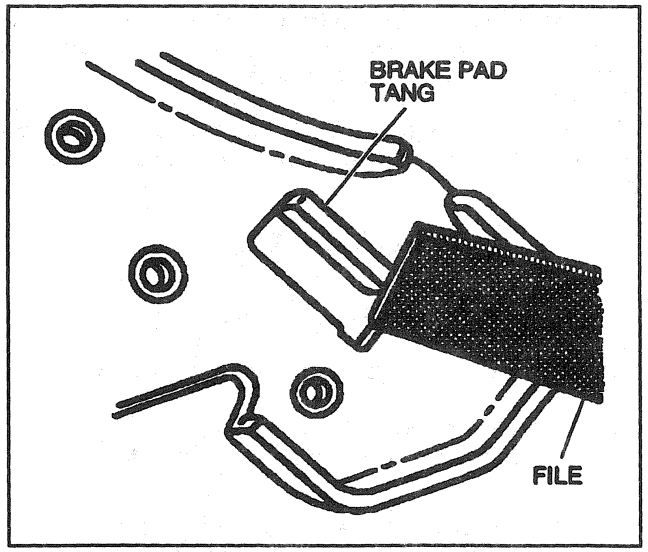


Figure 12—Filing Outer Brake Pad Tang

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 gage that will fit into the gap on either side of the screw driver.
G. Based on the bumper gap measurement, select a shim according to the table in "Specifications" at the end of this section.

6. Replacing the caliper after a shim has been selected.
   A. Remove caliper from anchor plate.
   B. Install shim on the anchor plate V-way opposite the key and spring V-way.
   C. With the shim installed on the anchor plate V-way, install the caliper using a new key and spring.
7. Remeasure the bumper gap, if the gap exceeds 1.50 mm (0.058 inch) install a thicker shim or replace components according to table in "Specifications" at the end of this section.

ANCHOR PLATE

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

ROTOR

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

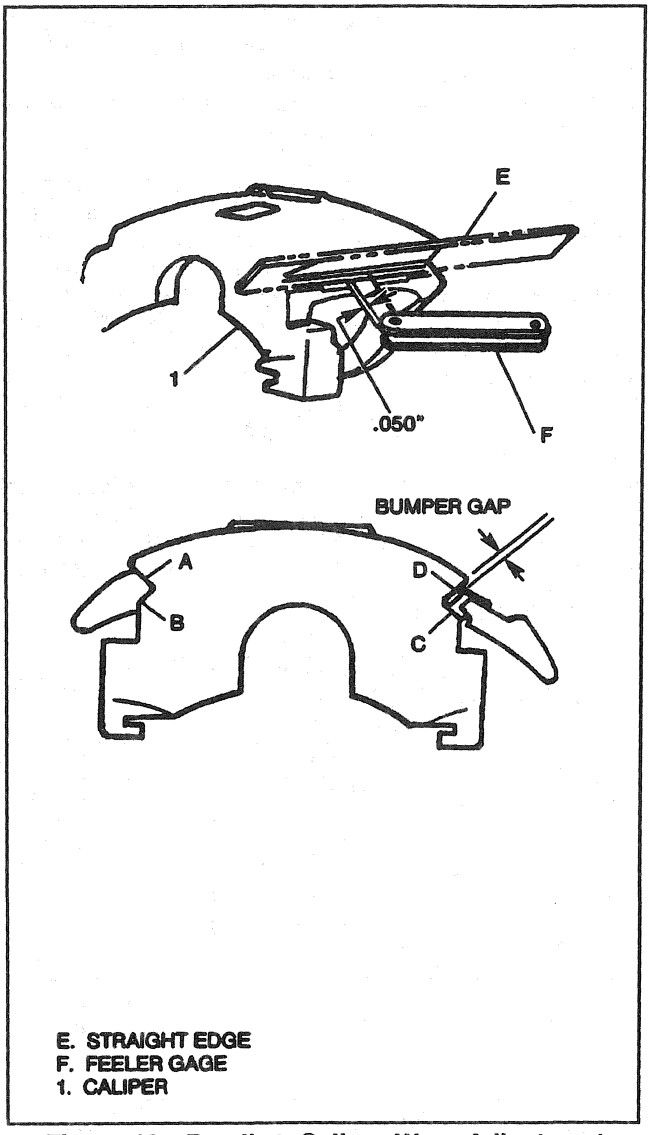


Figure 13—Bendix® Caliper Wear Adjustment

PARKING BRAKE ADJUSTMENT

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

UNIT REPAIR

REFINISHING BRAKE ROTORS

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

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

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

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

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

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

Ammco Brake Lathe

—	ROUGH CUT	FINISH CUT
Spindle Speed	150 RPM	150 RPM
Depth Of Cut (Per Side)	0.127 mm (0.005 inch)	0.051 mm (0.002 inch)
Total Cross Feed (Per Revolution)	0.152-0.254 mm (0.006-0.010 inch)	0.051 mm (0.002 inch) Max.
Vibration Damp.	Yes	Yes
Swirl Pattern—120 Grit	No	Yes

Accu Turn Brake Lathe, GM Dealer Equipment (One Cut Refinish Procedure)

Spindle Speed	150 RPM
Tool Cross Feed (Per Revolution)	0.076 mm (0.003 inch)
Tool Bit Nose Radius	1/64
Vibration Damper	Yes
Swirl Pattern—120 Grit	Yes

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 inch) 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

Tool Required:
J 24548 Piston Seal Installer

Remove or Disconnect (Figures 14 through 16)

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***

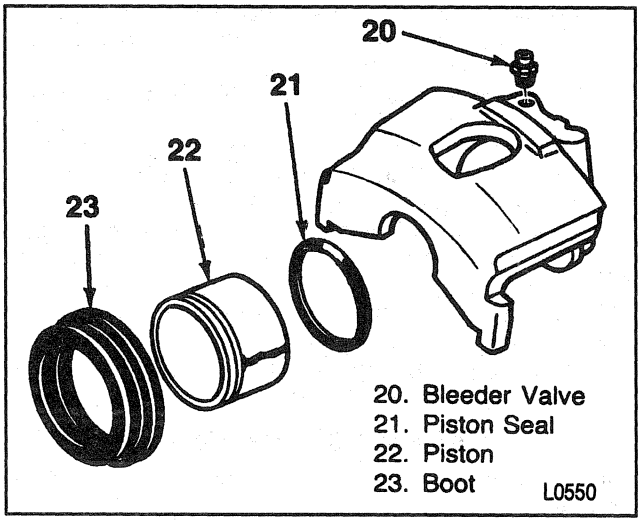


Figure 14—Caliper Components

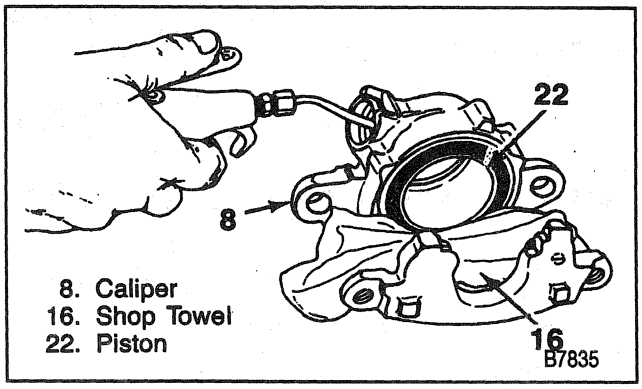


Figure 15—Removing the Piston

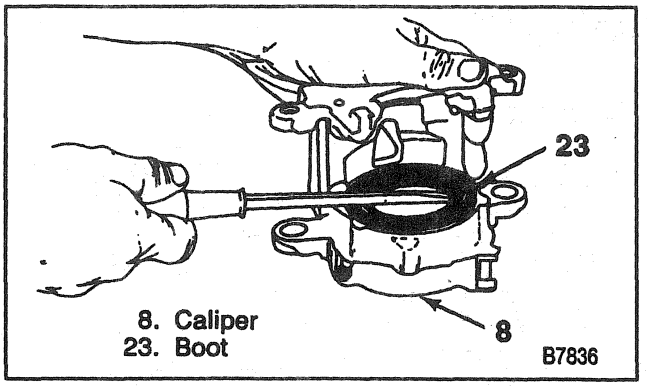


Figure 16—Removing the Boot

3. Piston (22) (Figure 14).
   - Direct compressed air into caliper fluid inlet (Figure 15).
4. Boot (23) (Figure 16).
5. Piston seal (21) (Figure 14).
   - Do not use any type of metal tool.
6. Bleeder valve (20) (Figure 14).

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 (Figures 14 and 17)

1. Lubricate new piston seal, caliper bore, piston, and seal lips on boot with clean brake fluid.
2. Piston seal (21) (Figure 14).
   - Make sure seal is not twisted in caliper bore groove.

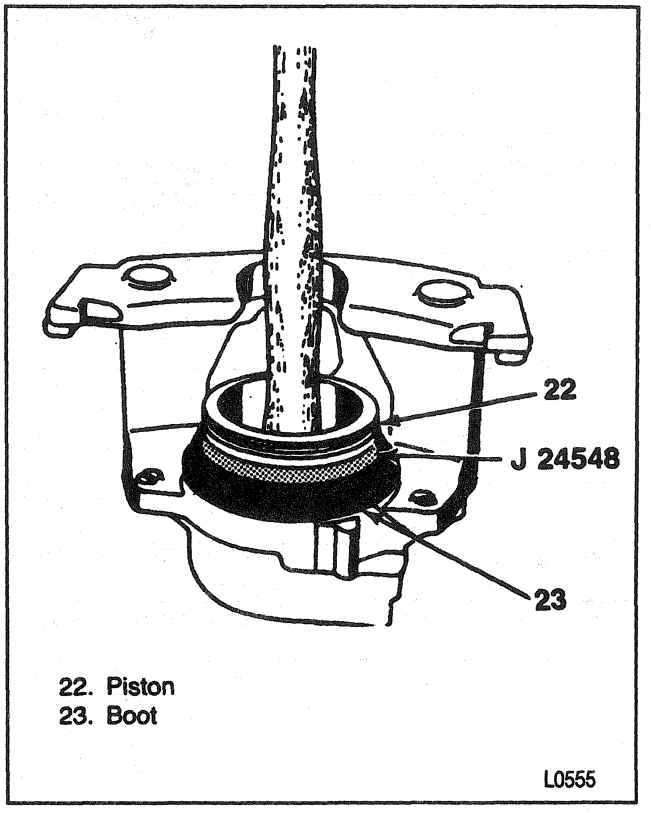


Figure 17—Installing the Piston

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 17).
6. Piston halfway into bore.
   A. Remove J 24548.
   B. Make sure boot is firmly seated.
7. Bleeder valve (20) (Figure 14).

Tighten

- Bleeder valve to 13 N·m (110 lb in).

SPECIFICATIONS

BRAKE SYSTEMS

SYSTEM	FRONT BRAKES	REAR BRAKES	BRAKE ASSIST
JB5	Disc 11.57 inch x 1.25 inch	254 mm x 57 mm (Leading/Trailing)	Vacuum
JD5	Disc 11.57 inch x 1.25 inch	254 mm x 57 mm (Leading/Trailing)	Hydraulic
JB6	Disc 11.57 inch x 1.25 inch	11.15 inch x 2.75 inch (Duo-Servo)	Vacuum
JD6	Disc 11.57 inch x 1.25 inch	11.15 inch x 2.75 inch (Duo-Servo)	Hydraulic
JB7	Disc 12.5 inch x 1.26 inch	13.00 inch x 2.5 inch (Duo-Servo)	Vacuum
JD7	Disc 12.5 inch x 1.26 inch	13.00 inch x 2.5 inch (Duo-Servo)	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 13.86 inch x 1.435 inch	Disc 13.58 inch x 1.435 inch	Hydraulic

ROTOR THICKNESS

SYSTEM	ORIGINAL	THINNEST (REFINISHING)	REPLACEMENT (DISCARD)
JB5/JD5/JB6	31.75 mm (1.25 inch)	31.25 mm (1.23 inch)	30.86 mm (1.215 inch)
JB7/JD7/JB8	32 mm (1.26 inch)	31.25 mm (1.23 inch)	30.86 mm (1.215 inch)
JB8 Dual	38.10 mm (1.50 inch)	37.59 mm (1.480 inch)	37.21 mm (1.465 inch)
JF9	36.26-36.64 mm (1.428-1.443 inch)	35.1 mm (1.382 inch)	34.7 mm (1.366 inch)

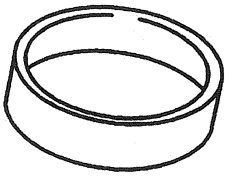
BENDIX CALIPER WEAR SHIM SPECIFICATIONS

MORE THAN	BUT NOT EXCEEDING	SHIM THICKNESS	SHIM P/N
0	.058 inch	None Required	None Required
.058 inch	.101 inch	.025 inch	15625734
.101 inch	.145 inch	.045 inch	15625735
.145 inch	—	See Note 1	See Note 1
Note 1: If bumper gap exceeds.145, remove old caliper and replace with a new caliper and remeasure bumper gap. If the bumper gap with the new caliper is between.058 and.145, select a shim from table. If the bumper gap with the new caliper exceeds.145, replace the anchor plate also. Use a new key and spring when assembling the new components.			

FASTENER TIGHTENING SPECIFICATIONS

Application	N·m	Lb ft	Lb in
Anchor Plate Mounting Nut	105	78	—
Bleeder Valve	13	—	110
Brake Hose to Caliper Bolt	45	33	—
Caliper Support Key Bolt	20	15	—

SPECIAL TOOLS



J 24548

SECTION 5C1

LEADING/TRAILING DRUM BRAKES

CAUTION: This vehicle has a Supplemental Inflatable Restraint (SIR) System. Refer to the SIR Component and Wiring Location view in order to determine whether you are performing service on or near the SIR components or the SIR wiring. When you are performing service on or near the SIR components or the SIR wiring, refer to the SIR On-Vehicle Service information. Failure to follow the CAUTIONS could cause air bag deployment, personal injury, or unnecessary SIR system repairs.

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

NOTICE: ***Always use the correct fastener in the proper location. When you replace a fastener, use ONLY the exact part number for that application. General Motors will call out those fasteners that require a replacement after removal. General Motors will also call out the fasteners that require thread lockers or thread sealant. UNLESS OTHERWISE SPECIFIED, do not use supplemental coatings (paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.***

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 which may leave an oily residue. This residue is damaging to brake linings and flammable.***

CONTENTS

CONTENTS (cont'd)

GENERAL DESCRIPTION

Leading/trailing drum brakes are used on vehicles with a 6450 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 9,650 km (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 inch) of the shoe. Replace riveted shoe and lining assemblies when the lining is worn to within 0.76 mm (0.030 inch) 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 in "Unit Repair" at the end of this section.

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 through 3)

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

Inspect

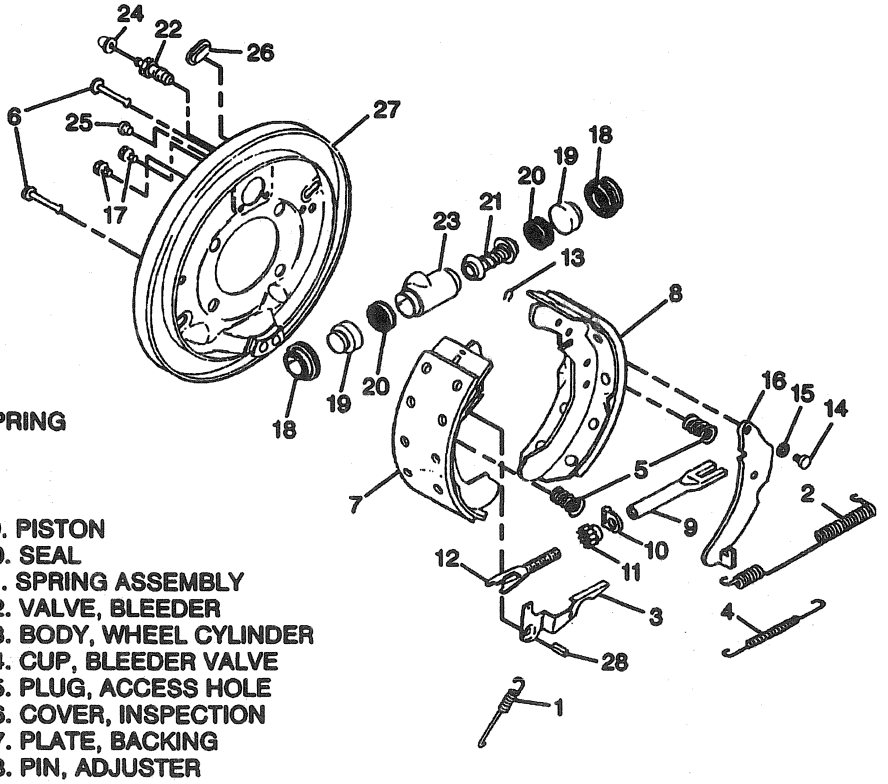
- If any parts show signs of discoloration from heat, over-stress, or wear, replace them.
- Threads of the adjuster screw (12) for smooth rotation over the full length.

Clean

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

Install or Connect (Figure 1)

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.



1. SPRING, ACTUATOR
2. SPRING, UPPER RETURN
3. ACTUATOR, ADJUSTER
4. SPRING, LOWER RETURN
5. ASSEMBLY, HOLD – DOWN SPRING
6. PIN, HOLD – DOWN
7. SHOE & LINING
8. SHOE & LINING
9. SOCKET, ADJUSTER
10. CLIP, SPRING
11. NUT,ADJUSTER
12. SCREW, ADJUSTER
13. RING, RETAINING
14. PIN
15. WASHER, SPRING
16. LEVER, PARK BRAKE
17. BOLT
18. BOOT
19. PISTON
20. SEAL
21. SPRING ASSEMBLY
22. VALVE, BLEEDER
23. BODY, WHEEL CYLINDER
24. CUP, BLEEDER VALVE
25. PLUG, ACCESS HOLE
26. COVER, INSPECTION
27. PLATE, BACKING
28. PIN, ADJUSTER

Figure 1—Leading/Trailing Drum Brake

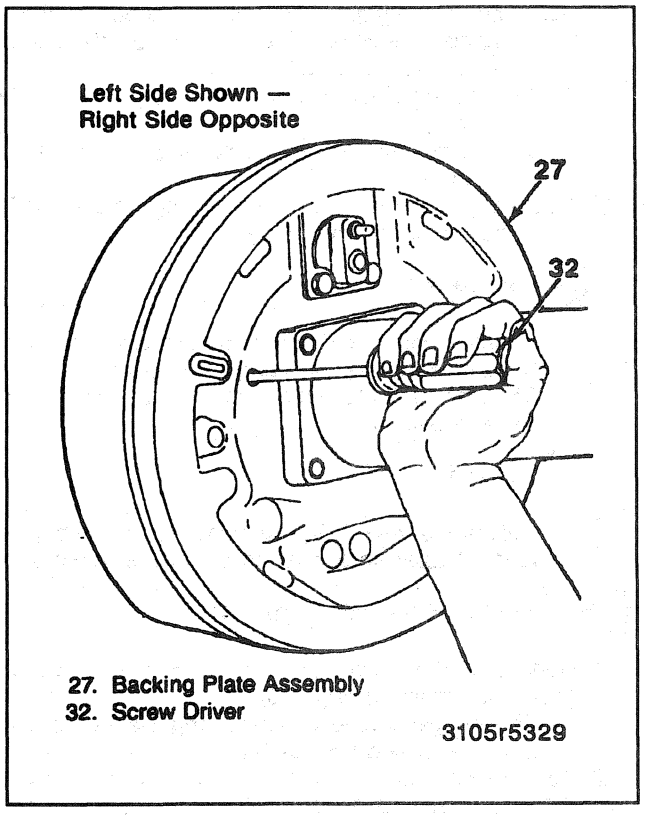


Figure 2—Pushing the Parking Brake Lever Off It's Stop

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 (8) 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.

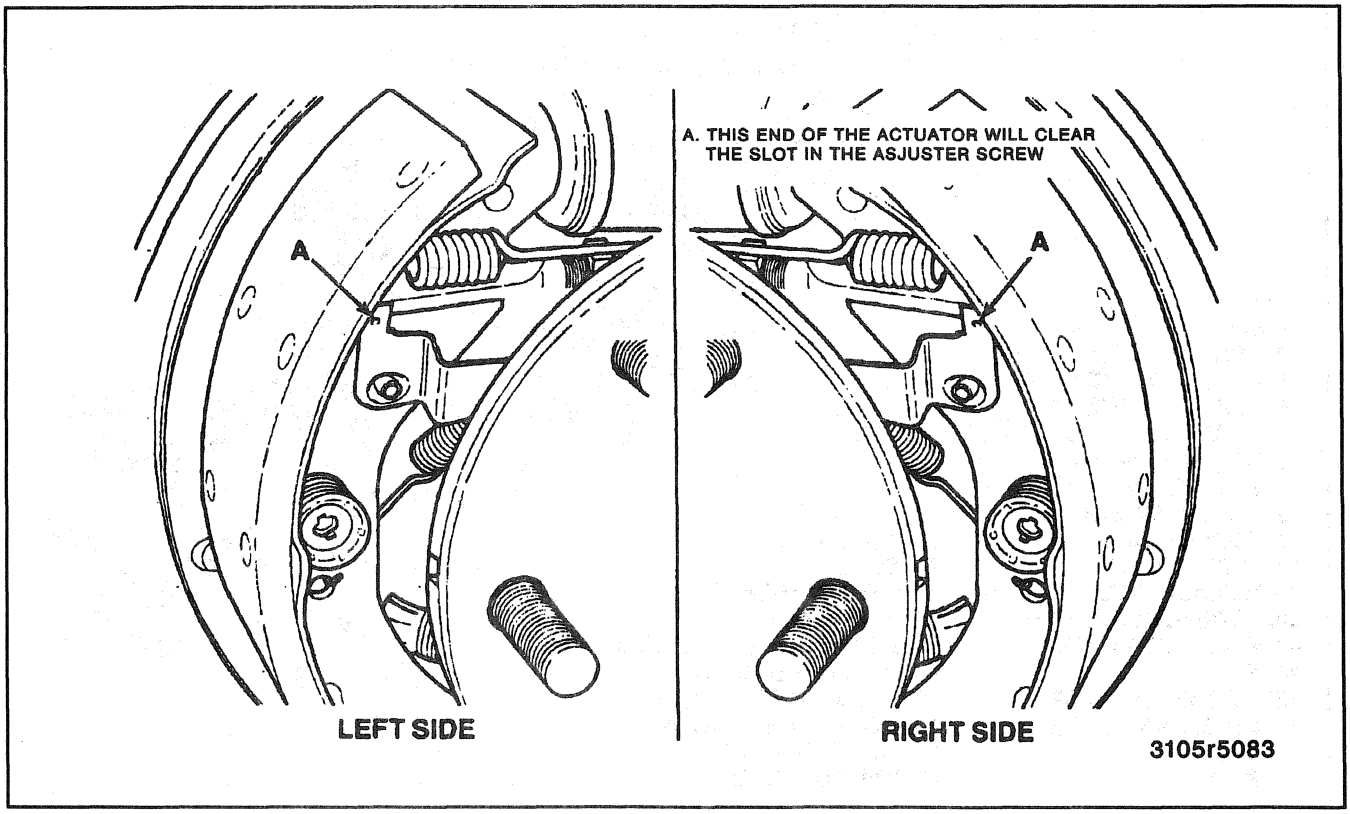


Figure 3—Removing the Adjuster Actuator

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).
13. Drum.
    - Align the marks made during disassembly.

Adjust

- Rear brakes. Refer to "Adjustment" in this section.

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

WHEEL CYLINDER

Remove or Disconnect (Figure 4)

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 4)

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

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

Tighten

- Bolts (22) to 20 N·m (15 lb ft).

3. Inlet pipe.

Tighten

- Fitting to 17 N·m (13 lb ft).

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

BACKING PLATE

Remove or Disconnect (Figure 5)

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).

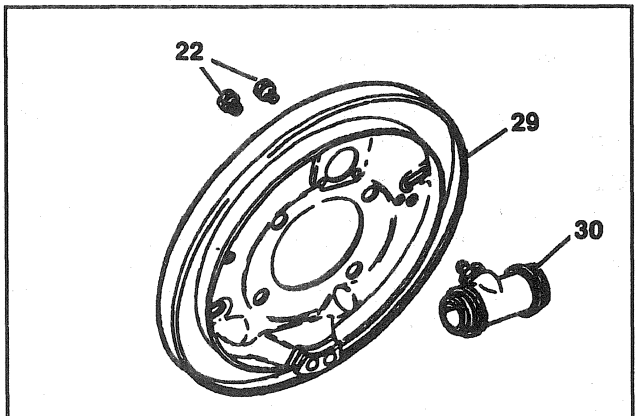
Install or Connect (Figure 5)

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

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

Tighten

- Bolts (31) to 70 N·m (52 lb ft)



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

F3598

Figure 4—Wheel Cylinder Replacement

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 5A.

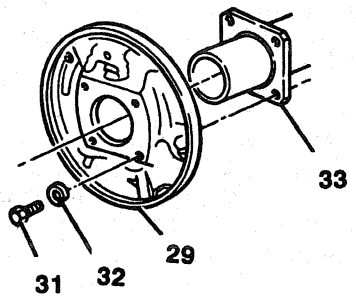
ADJUSTMENT

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

1. Remove the lanced area in the backing plate.
2. Turn the adjusting screw until the wheel can just be turned by hand.
3. The brake drag should be equal at both wheels.
4. Back off the adjusting screw 20 notches.
   - Brakes should have no drag after the adjusting screw is backed off about 10 notches. If a heavy drag is still present, refer to SECTION 5F.
5. Install an adjusting hole cover in the backing plate.
6. Check the parking brake adjustment. Refer to SECTION 5F.

PARKING BRAKE ADJUSTMENT

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



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

V3341

Figure 5—Backing Plate Replacement

UNIT REPAIR

DRUMS

Cracked, Scored, or Grooved

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

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

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

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

Out-of-Round or Tapered

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

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

Refinishing

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

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

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

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

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

New Replacement Drum Refinishing

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

Balance

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

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

WHEEL CYLINDER

Remove or Disconnect (Figure 6)

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 6)

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

1. Spring assembly (5).

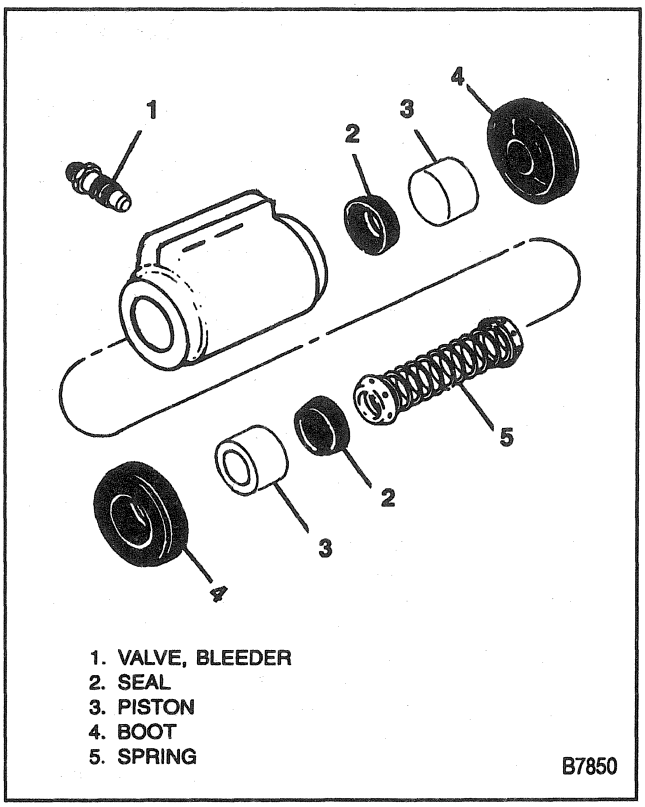


Figure 6—Wheel Cylinder Components

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

Tighten

- Bleeder valve to 13 N·m (110 lb in).

SPECIFICATIONS

BRAKE SYSTEMS

SYSTEM	FRONT BRAKES	REAR BRAKES	BRAKE ASSIST
JB5	Disc 11.57 inch x 1.25 inch	254 mm x 57 mm (Leading/Trailing)	Vacuum
JD5	Disc 11.57 inch x 1.25 inch	254 mm x 57 mm (Leading/Trailing)	Hydraulic
JB6	Disc 11.57 inch x 1.25 inch	11.15 inch x 2.75 inch (Duo-Servo)	Vacuum
JD6	Disc 11.57 inch x 1.25 inch	11.15 inch x 2.75 inch (Duo-Servo)	Hydraulic
JB7	Disc 12.5 inch x 1.26 inch	13.00 inch x 2.5 inch (Duo-Servo)	Vacuum
JD7	Disc 12.5 inch x 1.26 inch	13.00 inch x 2.5 inch (Duo-Servo)	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 13.86 inch x 1.435 inch	Disc 13.58 inch x 1.435 inch	Hydraulic

DRUM DIAMETERS

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

FASTENER TIGHTENING SPECIFICATIONS

Application	N·m	Lb ft	Lb in
Backing Plate Mounting Bolt	70	52	—
Bleeder Valve	13	—	110
Pipe Fitting	17	13	—
Wheel Cylinder Mounting Bolts	20	15	—

SECTION 5C2

DUO-SERVO DRUM BRAKES

CAUTION: This vehicle has a Supplemental Inflatable Restraint (SIR) System. Refer to the SIR Component and Wiring Location view in order to determine whether you are performing service on or near the SIR components or the SIR wiring. When you are performing service on or near the SIR components or the SIR wiring, refer to the SIR On-Vehicle Service information. Failure to follow the CAUTIONS could cause air bag deployment, personal injury, or unnecessary SIR system repairs.

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

NOTICE: ***Always use the correct fastener in the proper location. When you replace a fastener, use ONLY the exact part number for that application. General Motors will call out those fasteners that require a replacement after removal. General Motors will also call out the fasteners that require thread lockers or thread sealant. UNLESS OTHERWISE SPECIFIED, do not use supplemental coatings (paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.***

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

CONTENTS

CONTENTS (cont'd)

GENERAL DESCRIPTION

This section covers service procedures for duo-servo drum brakes. Applying the brakes causes 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 9,650 km (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 inch) of the shoe. Replace riveted shoe and lining assemblies when the lining is worn to within 0.76 mm (0.030 inch) 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.

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

Inspect

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

Install or Connect (Figure 1)

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

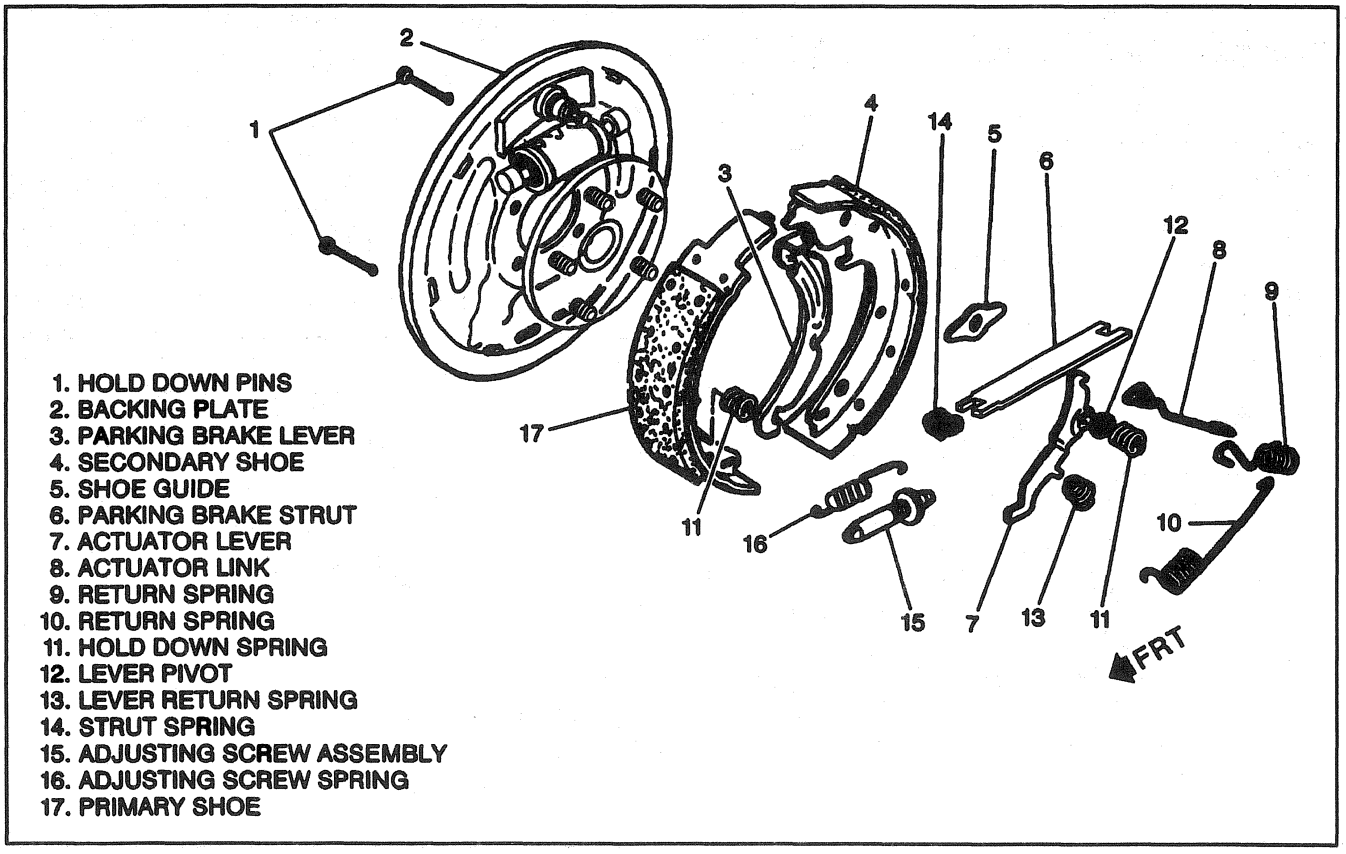


Figure 1—Duo-Servo Drum Brake Components

Important

- Do not interchange right and left adjusting screws.

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

WHEEL CYLINDER

Remove or Disconnect (Figure 2)

1. Linings. Refer to "Linings" in this section.
2. Brake pipe from rear of master cylinder.
3. Bolts.
4. Wheel cylinder.

Install or Connect (Figure 2)

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

1. Wheel cylinder.
2. Bolts.

Tighten

- Bolts to 25 N·m (18 lb ft).

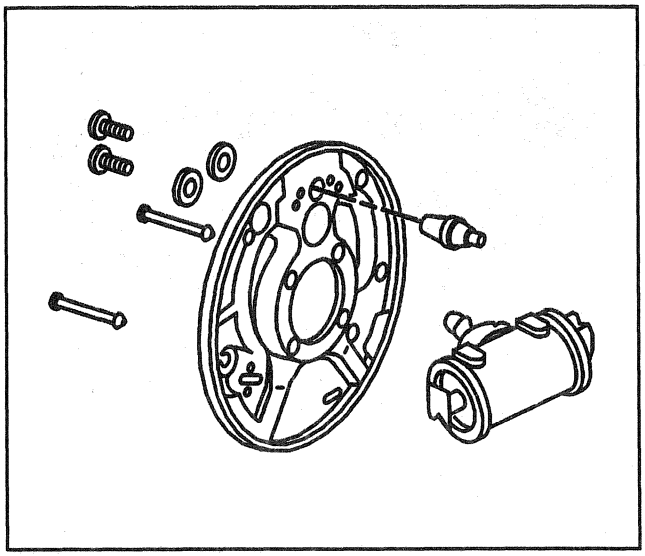


Figure 2—Wheel Cylinder Replacement

3. Brake pipe.

Tighten

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

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

BACKING PLATE

Remove or Disconnect (Figure 3)

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)

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

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

Tighten

- Bolts (31) to 160 N·m (118 lb ft)

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

ADJUSTMENT

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.

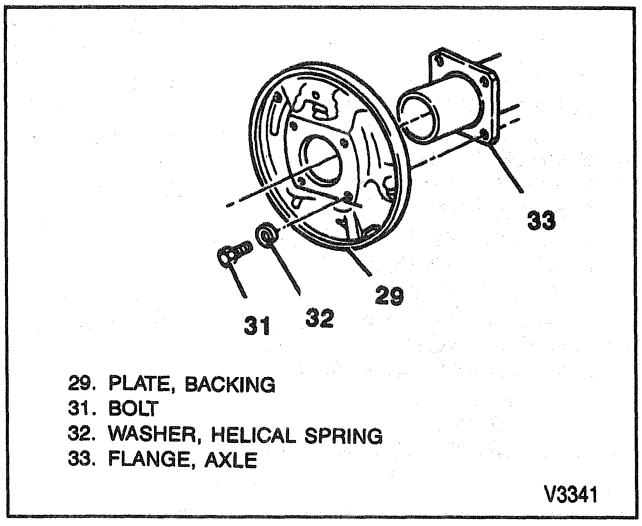


Figure 3—Backing Plate Replacement

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 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 not more than 0.76 mm (0.030 inch) less than the discard diameter. The refinish diameter is the maximum diameter the drum can be refinished to and still allow safe braking action. If you exceed this diameter, the brake drum will wear beyond the discard diameter during normal brake use.

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

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

New Replacement Drum Refinishing

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

Balance

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

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

WHEEL CYLINDER

Remove or Disconnect (Figure 4)

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

Inspect

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

Clean

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

Install or Connect (Figure 4)

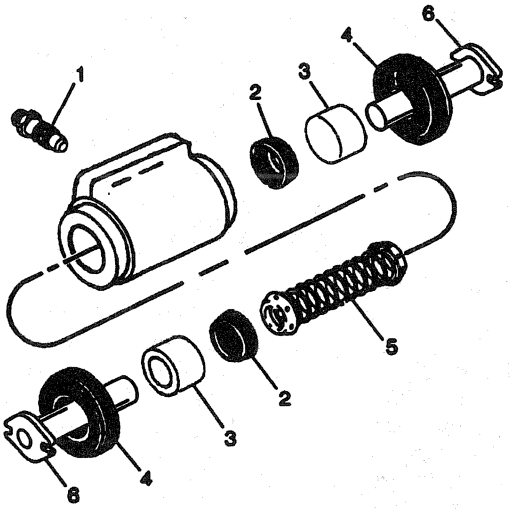
1. Lubricate the seals and cylinder bore with clean brake fluid.

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

Tighten

- Bleeder valve (1) to 13 N.m (110 lb in).

7. Links (6).



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

Figure 4—Wheel Cylinder Components

SPECIFICATIONS

BRAKE SYSTEMS

SYSTEM	FRONT BRAKES	REAR BRAKES	BRAKE ASSIST
JB5	Disc 11.57 inch x 1.25 inch	254 mm x 57 mm (Leading/Trailing)	Vacuum
JD5	Disc 11.57 inch x 1.25 inch	254 mm x 57 mm (Leading/Trailing)	Hydraulic
JB6	Disc 11.57 inch x 1.25 inch	11.15 inch x 2.75 inch (Duo-Servo)	Vacuum
JD6	Disc 11.57 inch x 1.25 inch	11.15 inch x 2.75 inch (Duo-Servo)	Hydraulic
JB7	Disc 12.5 inch x 1.26 inch	13.00 inch x 2.5 inch (Duo-Servo)	Vacuum
JD7	Disc 12.5 inch x 1.26 inch	13.00 inch x 2.5 inch (Duo-Servo)	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 13.86 inch x 1.435 inch	Disc 13.58 inch x 1.435 inch	Hydraulic

DRUM DIAMETERS

Original	Maximum (Refinish)	Replacement (Discard)
254 mm (10 inch)	255.30 mm (10.05 inch)	356.30 mm (10.09 inch)
283.21 mm (11.15 inch)	284.73 mm (11.21 inch)	285.50 mm (11.24 inch)
330.20 mm (13 inch)	331.72 mm (13.06 inch)	332.49 mm (13.09 inch)

FASTENER TIGHTENING SPECIFICATIONS

Application	N.m	Lb ft	Lb in
Backing Plate Mounting Bolt (JB6)	160	118	—
Backing Plate Mounting Bolt (JB7, JB8)	160	118	—
Bleeder Valve	13	—	110
Pipe Fitting	17	13	—
Wheel Cylinder Mounting Bolt	25	18	—

SECTION 5D1

VACUUM BOOSTER SYSTEM

CAUTION: This vehicle has a Supplemental Inflatable Restraint (SIR) System. Refer to the SIR Component and Wiring Location view in order to determine whether you are performing service on or near the SIR components or the SIR wiring. When you are performing service on or near the SIR components or the SIR wiring, refer to the SIR On-Vehicle Service information. Failure to follow the CAUTIONS could cause air bag deployment, personal injury, or unnecessary SIR system repairs.

NOTICE: ***Always use the correct fastener in the proper location. When you replace a fastener, use ONLY the exact part number for that application. General Motors will call out those fasteners that require a replacement after removal. General Motors will also call out the fasteners that require thread lockers or thread sealant. UNLESS OTHERWISE SPECIFIED, do not use supplemental coatings (paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.***

CONTENTS

GENERAL DESCRIPTION

BOOSTER ASSEMBLY

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

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

CHECK VALVE HOSE AND ROUTING

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

DIAGNOSIS OF THE VACUUM BOOSTER

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

BOOSTER ASSEMBLY

Remove or Disconnect (Figures 1 and 2)

1. Negative battery cable. Refer to SECTION 6D1.
2. Apply parking brake.
3. Nuts.
4. Wiring harness bracket and master cylinder.
5. Vacuum hose.
6. Retainer and stoplamp switch.
7. Pushrod.
8. Nuts.
9. Booster assembly.
10. Gasket.

Install or Connect (Figures 1 and 2)

NOTICE: *Refer to "Notice" on page 5D1-1.*

1. Gasket.
2. Booster assembly.
3. Nuts.

Tighten

- Nuts to 36 N·m (26 lb ft).

4. Pushrod.
5. Stoplamp switch and retainer.
6. Vacuum hose.

Measure

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

7. Master cylinder and wiring harness bracket.
8. Nuts.

Tighten

- Nuts (1) to 30 N·m (22 lb ft).

9. Release parking brake.
10. Negative battery cable.

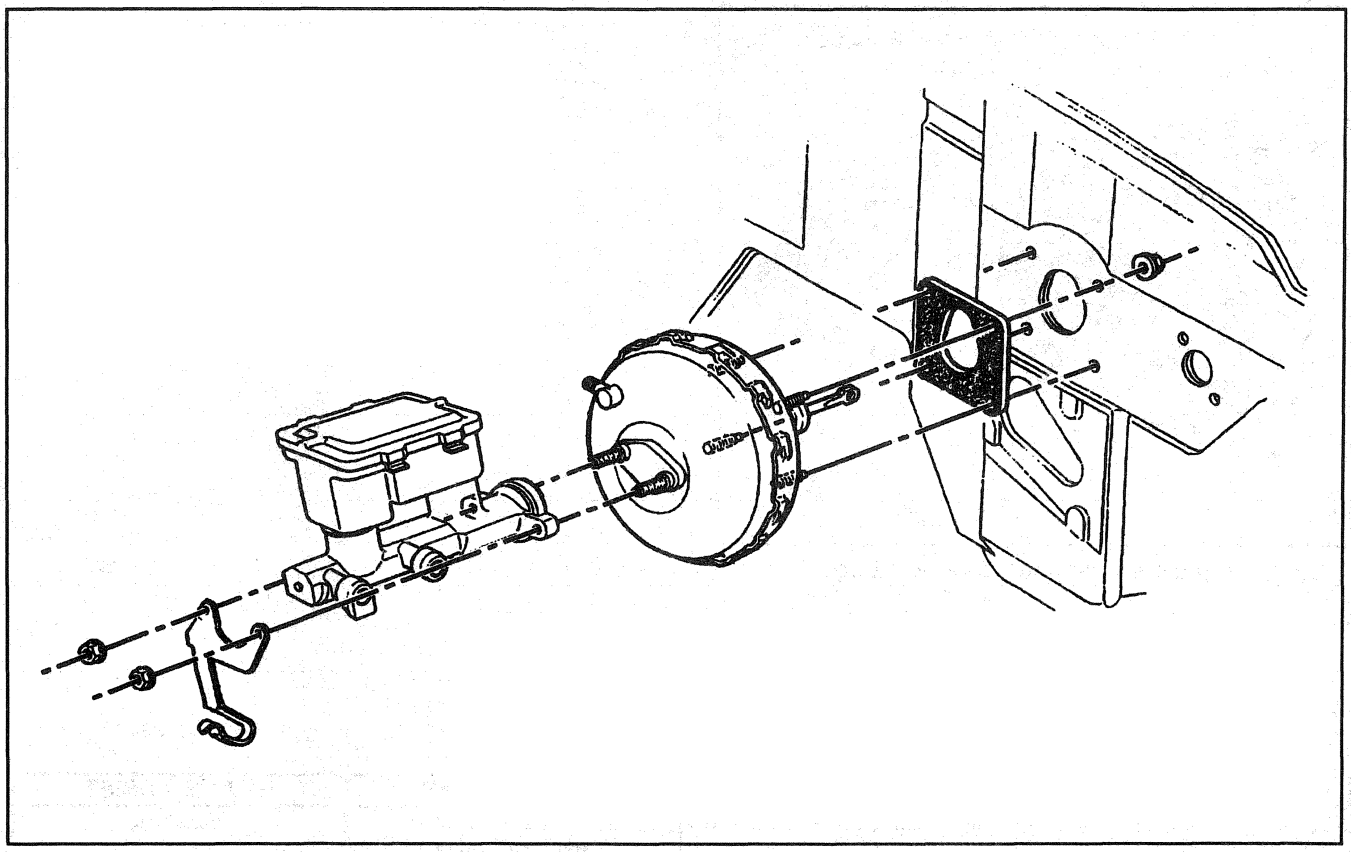

Figure 1—Vacuum Booster

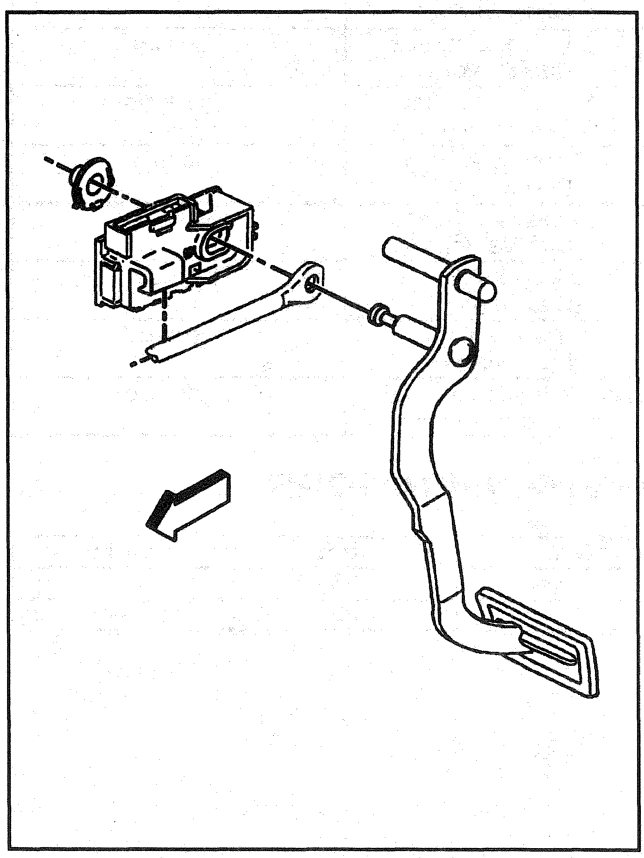

Figure 2—Booster Pushrod

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 kPa (20 inches 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.

CHECK VALVE HOSE AND ROUTING

Vacuum hose routing is shown in Figure 4.

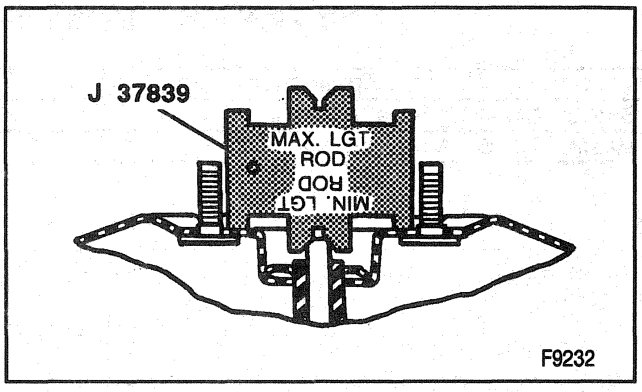

Figure 3—Gaging the Piston Rod

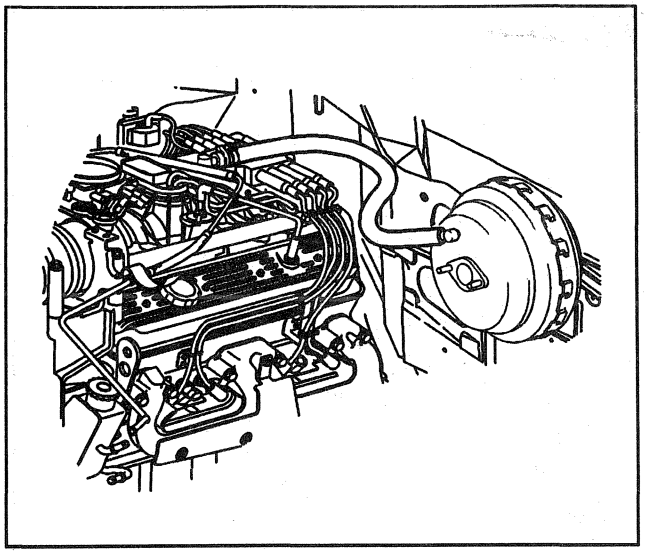

Figure 4—Vacuum Hose Routing

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
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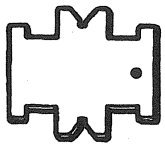
JF9	Disc 13.86 inch x 1.435 inch	Disc 13.58 inch x 1.435 inch	Hydraulic

FASTENER TIGHTENING SPECIFICATIONS

Application	N·m	Lb ft	Lb in
Booster Mounting Nuts	36	26	—
Master Cylinder Mounting Nuts	30	22	—

SPECIAL TOOLS

1.  J 37839

1. Power Brake Push Rod Height Gage

V1377

SECTION 5D2

HYDRAULIC BOOSTER SYSTEM

CAUTION: This vehicle has a Supplemental Inflatable Restraint (SIR) System. Refer to the SIR Component and Wiring Location view in order to determine whether you are performing service on or near the SIR components or the SIR wiring. When you are performing service on or near the SIR components or the SIR wiring, refer to the SIR On-Vehicle Service Information. Failure to follow the CAUTIONS could cause air bag deployment, personal injury, or unnecessary SIR system repairs.

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CONTENTS

GENERAL DESCRIPTION

BOOSTER ASSEMBLY

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

POWER STEERING PUMP

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

PIPES, HOSES, AND FITTINGS

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

FLUID AND FLUID HANDLING

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. Flushing the system involves draining the old fluid and replacing it with clean fluid. For the procedure to flush the system, refer to SECTION 3B.

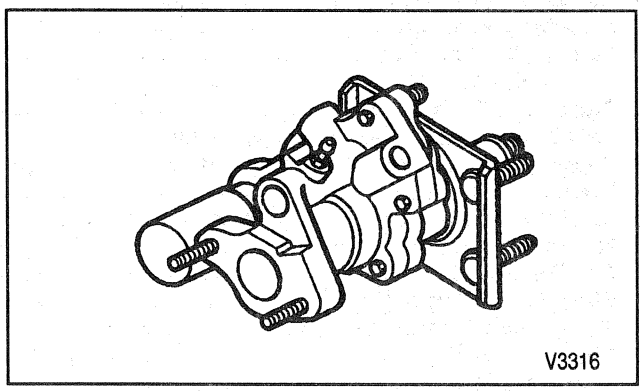

Figure 1—Hydraulic Booster Assembly

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 266 N (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 266 N (60 LBS.) AND SYSTEM OPERATING TEMPERATURE INCREASES. LOUD HISSING SOUNDS AT OR BELOW NORMAL 111 N (25 LBS.) PEDAL EFFORT WARRANTS INVESTIGATION.

CLUNK, CLATTER, OR CLICKING NOISES WILL BE HEARD WHEN THE BRAKE PEDAL IS QUICKLY RELEASED FROM HARD 222-444 N (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 44 N (10 LBS.) OF FORCE. RELEASE THE PEDAL AND MEASURE THE DISTANCE TO THE FLOOR BOARD.

MAKE A 444 N (100 LB.) BRAKE APPLICATION. RELEASE THE BRAKE PEDAL AND AGAIN MEASURE THE PEDAL TO FLOOR BOARD DISTANCE. THE PEDAL SHOULD RETURN TO ITS ORIGINAL POSITION.

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

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

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

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

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

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

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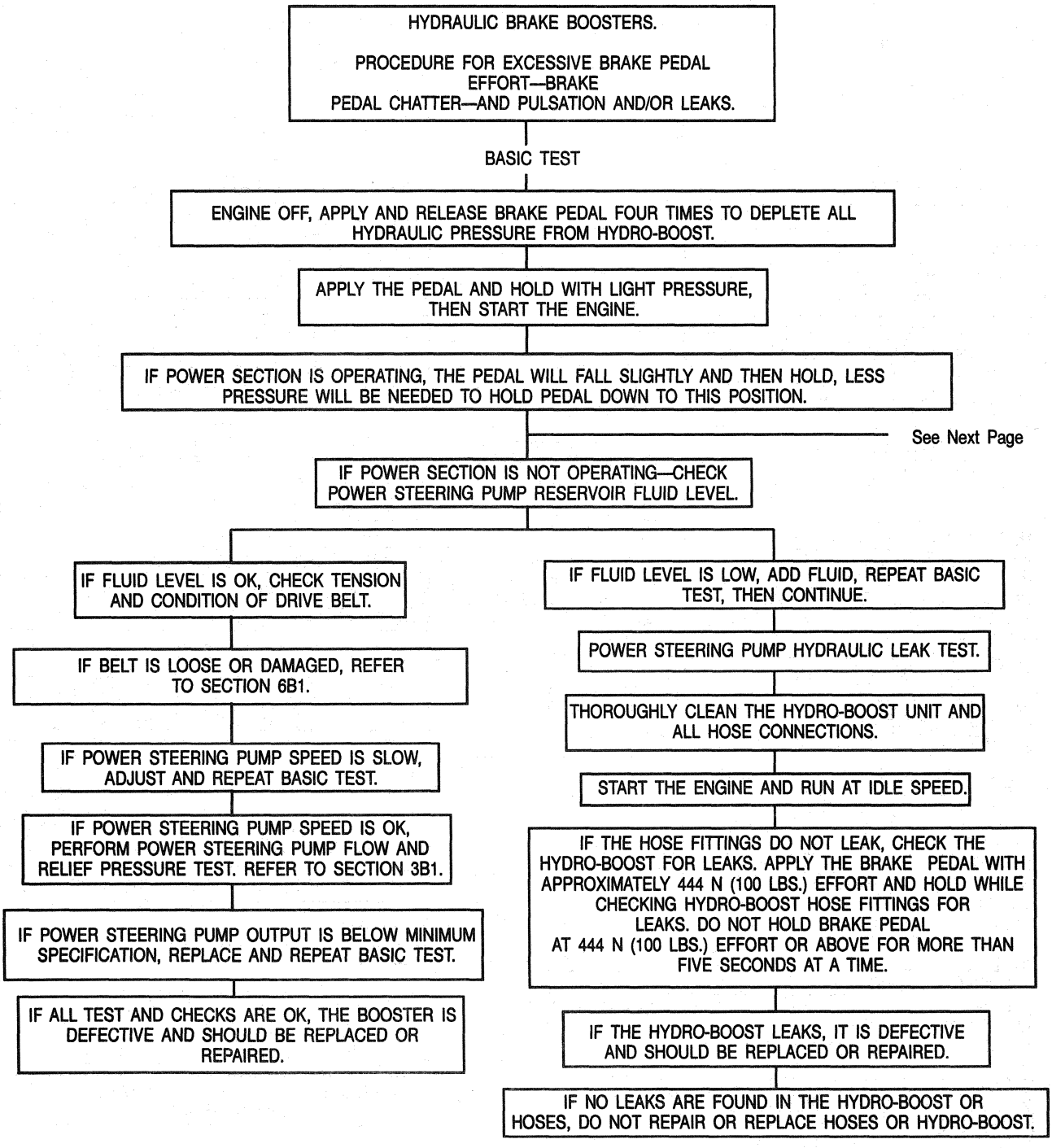
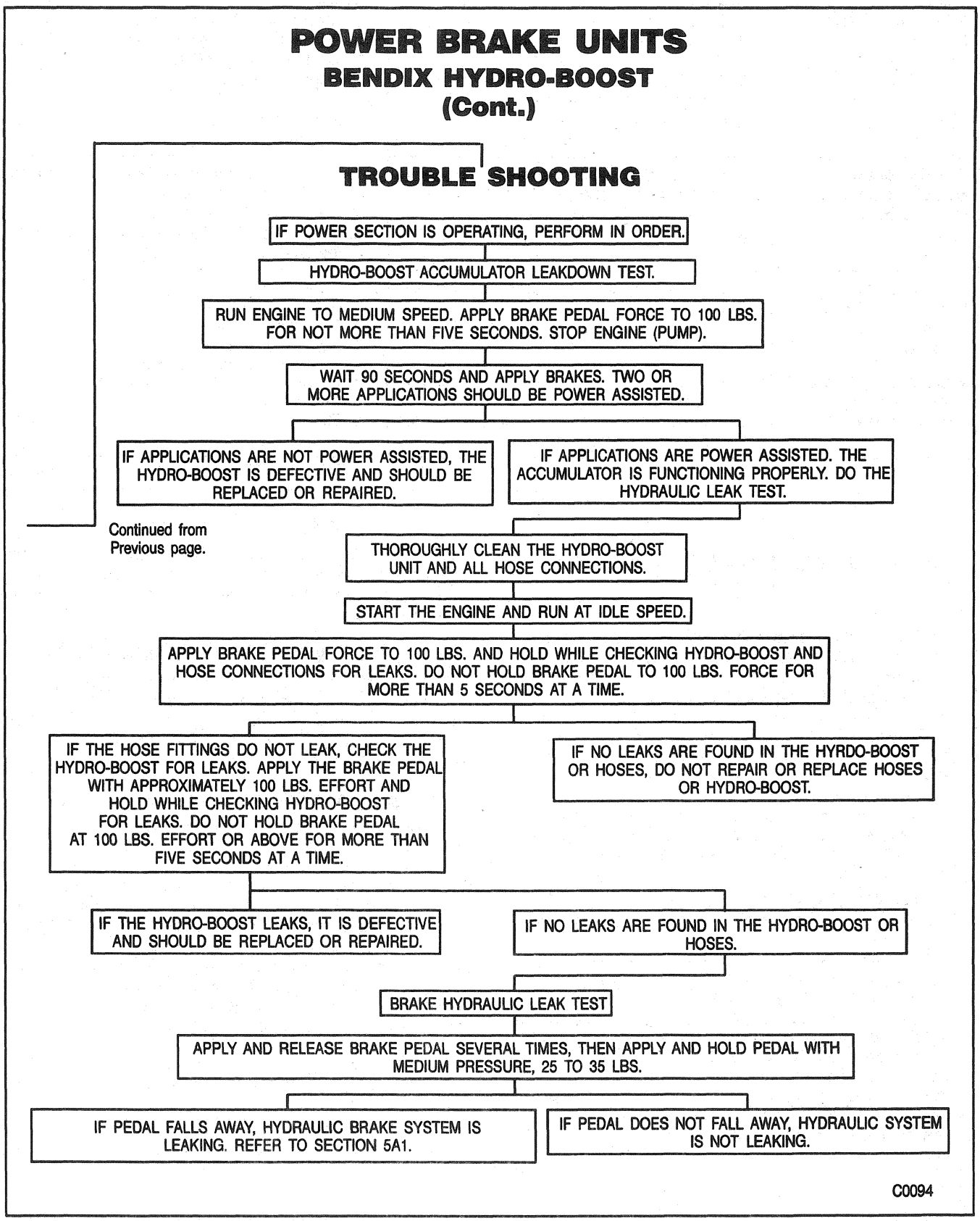
POWER BRAKE UNITS
BENDIX HYDRO-BOOST (CONT.)
TROUBLE SHOOTING



POWER BRAKE UNITS
BENDIX HYDRO-BOOST (Cont.)



DIAGNOSIS OF THE HYDRAULIC BOOSTER SYSTEM

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

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.

Metal shavings from a worn power steering pump often contaminate the system. The hydraulic booster system should be cleaned and flushed when the power steering pump is replaced. Refer to "Flushing the Hydraulic Booster System" in this section. Pipes and hoses should be removed and blown clean of all metal shavings.

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 6B.

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 "Checking and Adding Fluid" in this section.

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 6B.
5. Check power steering pump pressure. Refer to SECTION 3B.

Noise Diagnosis

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

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

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

Functional Test

With the ignition switch in the "OFF" position, apply the brake pedal several times to empty the accumulator. Apply the brake pedal using 180 N (40 lb) 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 faulty.
   - To repair this condition, the booster must be disassembled and the accumulator valves replaced. Refer to SECTION 5D2A.
5. If the accumulator can be heard charging and discharging, but it does not hold a charge, the accumulator valves are faulty.
   - To repair this condition, the booster must be disassembled and the accumulator valves replaced. Refer to SECTION 5D2A.
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.

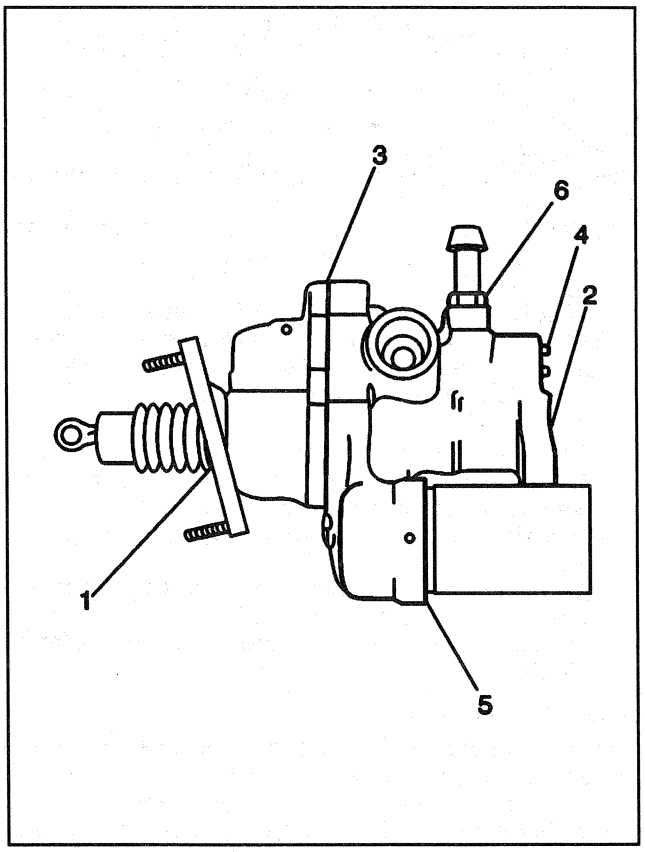
Seal Leak Diagnosis

Refer to Figure 2.

1. **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.
2. **POWER PISTON SEAL:** Power piston seal damage is noticed by fluid leaking at the common master cylinder brake booster vent and a possible reduction in power assist. The booster must be removed and disassembled. Check the piston for any scratches that may be the cause of the leak. If no scratches are present, replace all seals using the booster seal kit.
3. **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.
4. **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.
5. **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.
6. **RETURN PORT FITTING:** If the leak continues, replace the seal ring under the fitting.

Tighten

- Fitting to 10 N·m (88 lb in).



Legend

(1) Input Rod Seal
(2) Power Piston Seal
(3) Housing Seal
(4) Spool Valve Plug Seal
(5) Accumulator Seal
(6) Return Port Fitting

Figure 2—Seal Leak Diagnosis

ON-VEHICLE SERVICE

SERVICE PRECAUTION

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. Negative battery cable. Refer to SECTION 6D1.
2. Apply parking brake. Refer to SECTION 5F.
3. Inlet hose, steering gear, and return hoses from booster assembly.
4. Nuts.
5. Wiring harness bracket and master cylinder (Figure 3).
6. Retainer.

7. Pushrod and stoplamp switch (Figure 5).
8. Nuts.
9. Booster assembly.
10. Gasket.

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

NOTICE: *Refer to "Notice" on page 5D2-1.*

1. Gasket.
2. Booster assembly.
3. Nuts.

Tighten

- Nuts (8) to 36 N·m (26 lb ft).

4. Pushrod and stoplamp switch.
5. Retainer.
6. Master cylinder and wiring harness bracket.
7. Nuts.

Tighten

- Nuts to 30 N·m (22 lb ft).

8. Return hose, steering gear, and inlet hoses.

Tighten

- Hose fittings to 30 N·m (22 lb ft).

9. Negative battery cable.
10. Bleed booster. Refer to SECTION 3B.

POWER STEERING PUMP

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

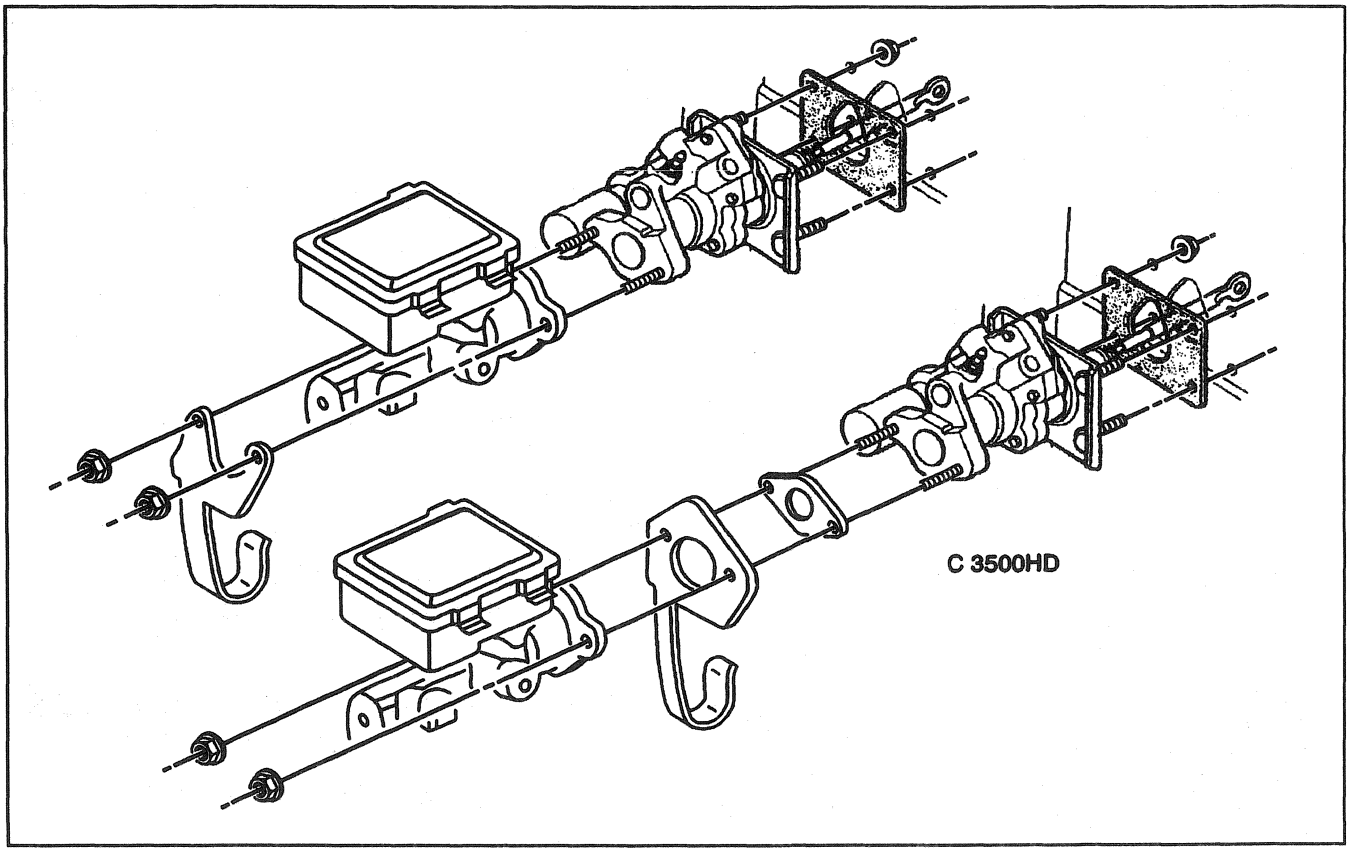


Figure 3—Booster Replacement

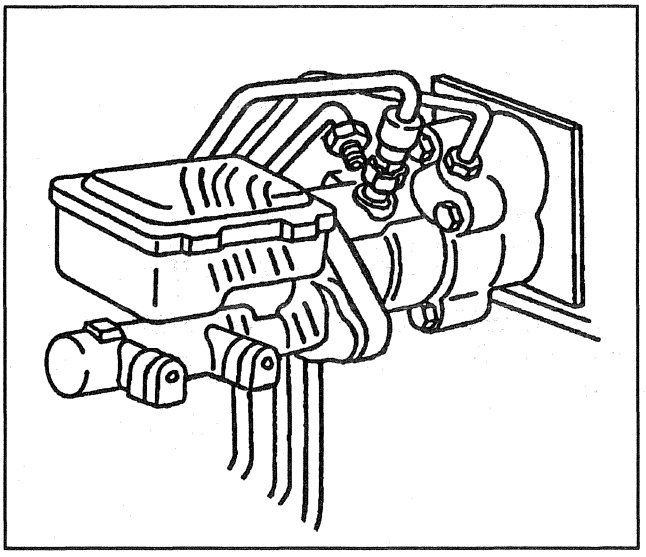


Figure 4—Booster Hoses

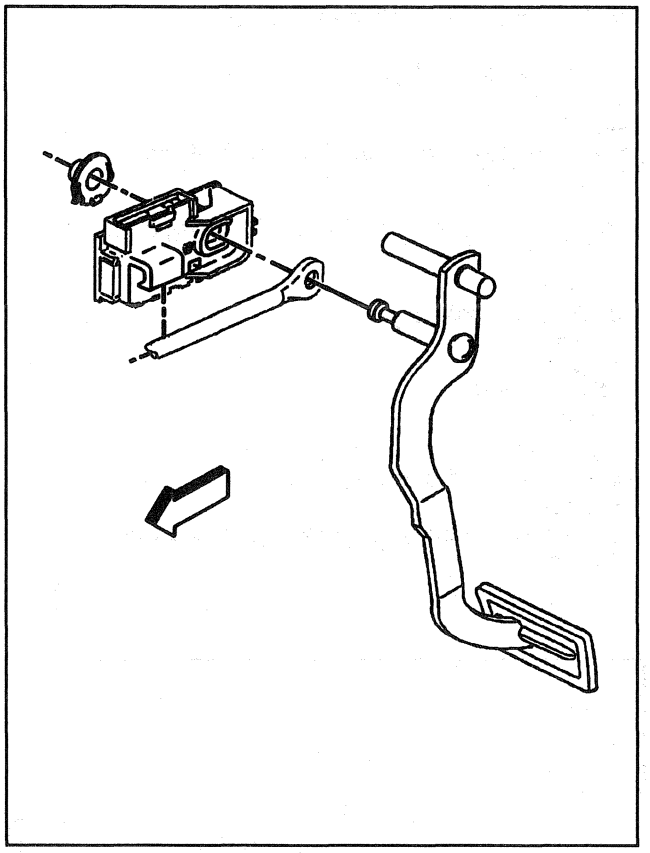


Figure 5—Pushrod Mounting

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	Disc 11.57 inch x 1.25 inch	254 mm x 57 mm (Leading/Trailing)	Hydraulic
JB6	Disc 11.57 inch x 1.25 inch	11.15 inch x 2.75 inch (Duo-Servo)	Vacuum
JD6	Disc 11.57 inch x 1.25 inch	11.15 inch x 2.75 inch (Duo-Servo)	Hydraulic
JB7	Disc 12.5 inch x 1.26 inch	13.00 inch x 2.5 inch (Duo-Servo)	Vacuum
JD7	Disc 12.5 inch x 1.26 inch	13.00 inch x 2.5 inch (Duo-Servo)	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 13.86 inch x 1.435 inch	Disc 13.58 inch x 1.435 inch	Hydraulic

FASTENER TIGHTENING SPECIFICATIONS

Application	N·m	Lb ft	Lb in
Booster Mounting Nuts	36	26	—
Hose Fitting	30	22	—
Master Cylinder Mounting Nuts	30	22	—
Return Port Fitting	10	—	88

SECTION 5D2A

HYDRAULIC BOOSTER UNIT REPAIR

NOTICE: ***Always use the correct fastener in the proper location. When you replace a fastener, use ONLY the exact part number for that application. General Motors will call out those fasteners that require a replacement after removal. General Motors will also call out the fasteners that require thread lockers or thread sealant. UNLESS OTHERWISE SPECIFIED, do not use supplemental coatings (paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.***

CONTENTS

GENERAL DESCRIPTION

The Bendix 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.

Identifying information is stamped into the housing near the inlet valve.

UNIT REPAIR

CAUTION: The accumulator contains compressed gas. Always use the proper tools and follow the recommended procedures or personal injury may result. Do not apply heat to accumulator. Do not attempt to repair an inoperative accumulator. Always replace an inoperative accumulator with a new one. Dispose of an inoperative accumulator by drilling a 1/16 inch diameter hole through the end of the accumulator can, opposite the O-ring.

CAUTION: Push rod removal is not recommended. Improper staking of the push rod to the Hydroboost reaction piston can result in a loss of brakes. If the rod or seals require service, the entire unit must be replaced.

ACCUMULATOR

Tool Required:
J 26889 Accumulator Piston Compressor

Remove or Disconnect (Figures 1 through 3)

1. Place J 26889 over end of accumulator and install nuts on stud (Figure 3).
2. Depress accumulator with a C-clamp (Figure 3).
3. Accumulator retainer ring (43).
4. Release C-clamp.
5. Nut from stud (Figure 3).
6. J 26889 (Figure 3).
7. Accumulator (44) and O-ring seal.

Install or Connect (Figures 1 through 3)

- Lubricate all seals and metal friction points with power steering fluid.
  1. Accumulator (44) and O-ring seal.
  2. Place J 26889 over end of accumulator and install nuts on stud (Figure 3).
  3. Depress accumulator with a C-clamp (Figure 3).
  4. Accumulator retainer ring (43).
  5. Release C-clamp.
  6. Nut from stud.
  7. J 26889.

CHECK VALVE

Remove or Disconnect (Figures 1 and 2)

1. Bolts (50) retaining the booster cover (33) to the booster housing (51).
2. Separate booster cover (33) from the booster housing (51).
3. Check valve.
   - Make a wire hook, using dimensions as illustrated in Figure 3 to aid in the removal.
   - Dimension 2 = 3.0 mm (0.125 inch)
   - Dimension 3 = 57 mm (2.25 inches)

Install or Connect (Figures 1 and 2)

1. Check valve.
2. Assemble booster cover (33) to booster housing (51).
3. Bolts (50) retaining the booster cover (33) to the booster housing (51).

Tighten

- Bolts to 30 N·m (22 lb ft).

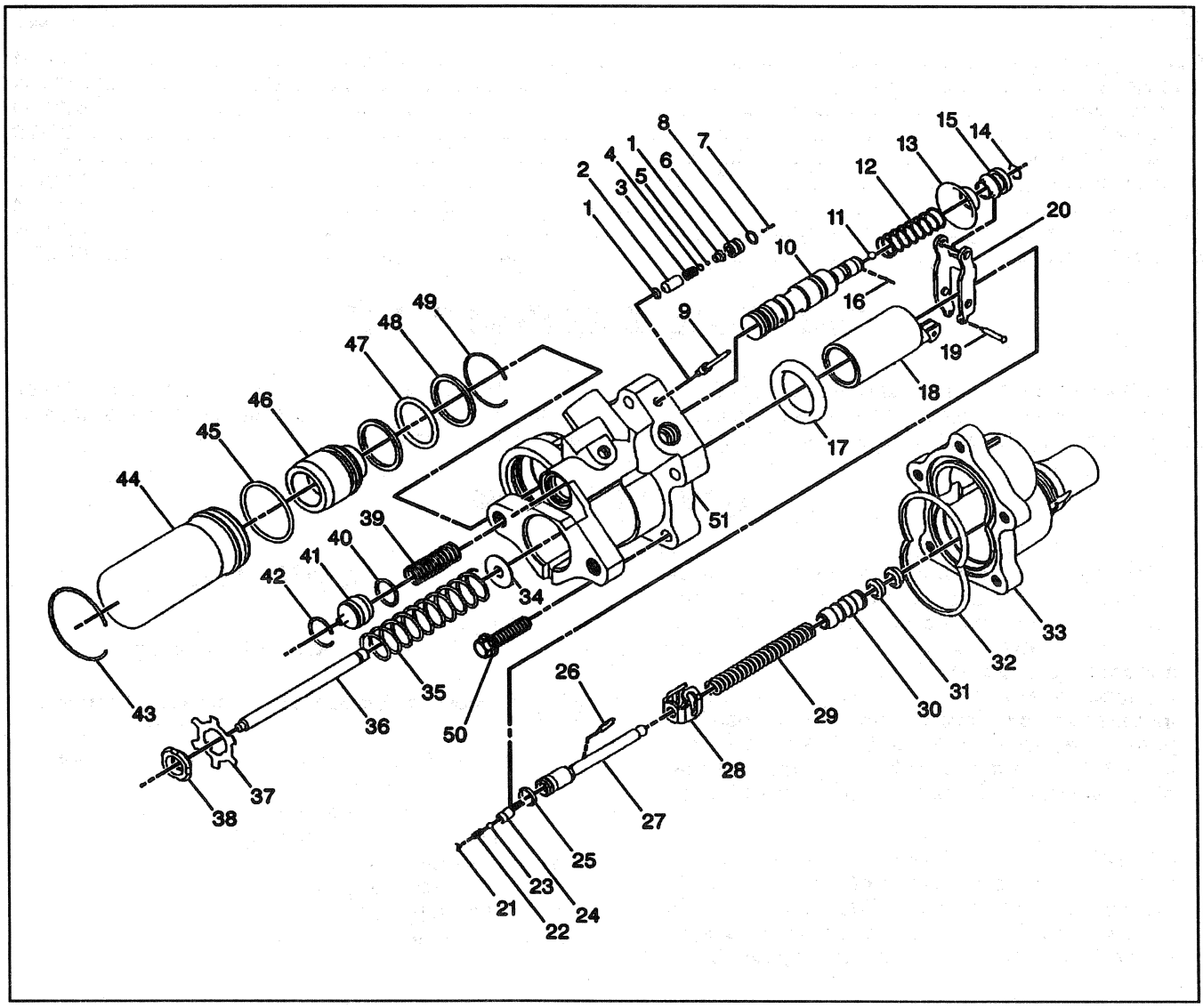


Figure 1—Hydraulic Booster Assembly

1.Seat, Check Valve
2.Body, Check Valve
3.Spring, Check Valve Relief
4.Washer, Check Valve
5.Ball, Check
6.Insert, Body
7.Plunger
8.O-ring
9.Plug, Housing
10.Valve, Spool
11.Ball, Spool Valve Check
12.Spring, Sleeve
13.Actuator
14.Ring, External Retainer
15.Sleeve, Spool
16.Pin, Spool Valve
17.Seal, Piston
18.Piston
19.Pin, Input Lever
20.Lever, Input
21.Spring, Retainer
22.Spring, Relief Valve
23.Ball, Relief Valve Check
24.Seat, Relief Valve
25.Ring, Input Rod
26.Rod and Plunger
27.Rod, Input
28.Bracket, Input Rod
29.Spring, Input Rod
30.End, Input Rod
31.Seals, Input Rod
32.Seal, Hpusing/Cover
33.Cover, Booster
34.Retainer, Output Push Rod
35.Spring, Piston Return
36.Push Rod, Output
37.Spring, Piston Retainer
38.Spring, Baffle Retainer
39.Spring, Spool
40.O-ring, Spool Plug
41.Plug, Spool
42.Ring, Spool Plug Retaining
43.Ring, Accumulator Retainer
44.Accumulator
45.Ring, Accumulator
46.Piston, Accumulator
47.O-ring, Accumulator Piston
48.Rings, Accumulator Piston
49.Ring, Retainer
50.Bolts, Housing/Cover
51.Housing, Booster

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Figure 2—Hydraulic Booster Assembly Chart

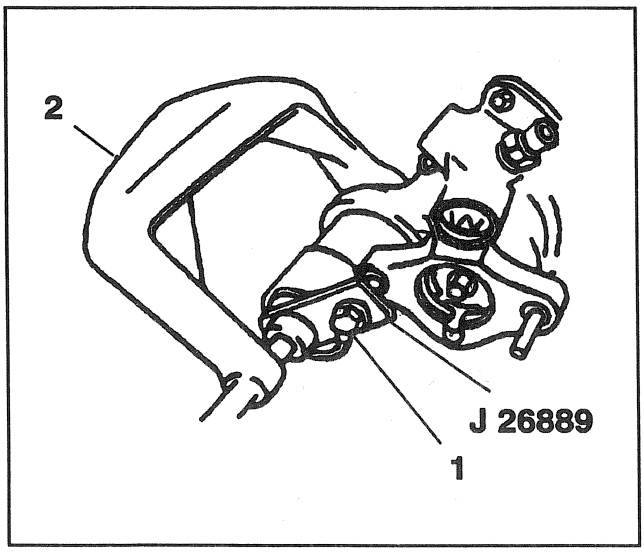


Figure 3—Removing the Accumulator

GAGING PROCEDURE

Tool Required:
J 37839 Push Rod Height Gage

1. Gage the piston rod using J 37839 (Figure 4).
   - Check the maximum and minimum rod length.
2. If the piston rod is not within limits, obtain a service adjustable piston rod and adjust the rod to the correct measurement.

POWER STEERING PUMP

For power steering pump unit repair, refer to SECTION 3B1B.

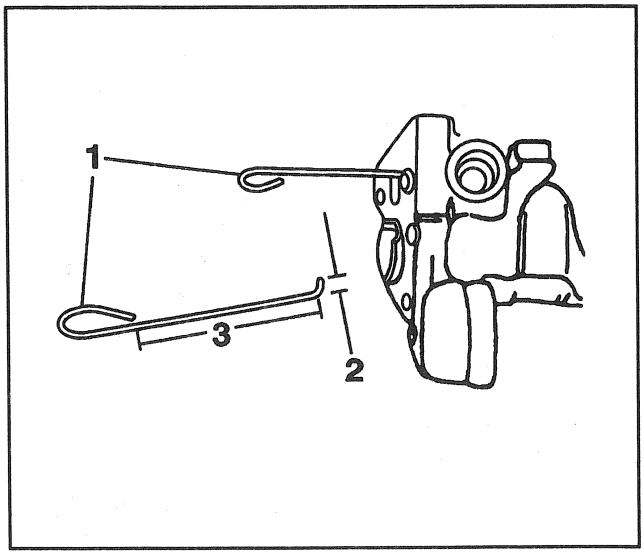


Figure 4—Removing the Check Valve

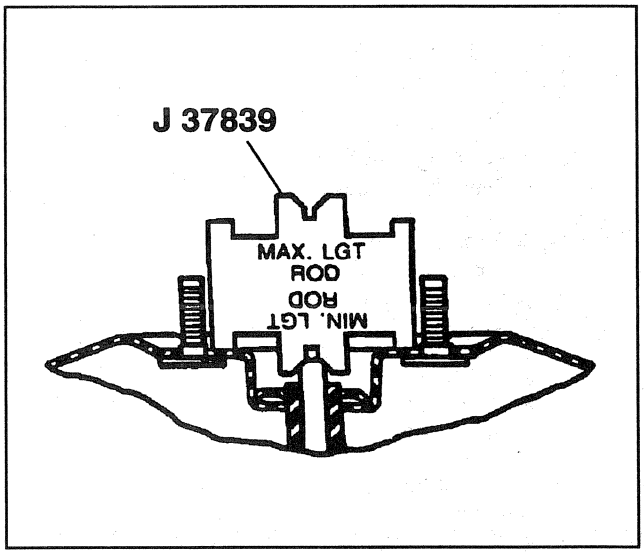


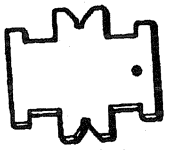
Figure 5—Gaging the Piston Rod

SPECIFICATIONS

Fastener Tightening Specifications

Application	N·m	Lb ft	Lb in
Booster Cover Bolts	30	20	—

SPECIAL TOOLS

1.  J 37839

2.  J 26889

1. PUSH ROD HEIGHT GAGE
2. ACCUMULATOR PISTON COMPRESSOR

SECTION 5E1

FOUR WHEEL ANTILOCK BRAKE SYSTEM

CAUTION: This vehicle has a Supplemental Inflatable Restraint (SIR) System. Refer to the SIR Component and Wiring Location view in order to determine whether you are performing service on or near the SIR components or the SIR wiring. When you are performing service on or near the SIR components or the SIR wiring, refer to the SIR On-Vehicle Service information. Failure to follow the CAUTIONS could cause air bag deployment, personal injury, or unnecessary SIR system repairs.

CAUTION: Certain components in the Antilock Brake System are not intended to be serviced individually. Attempting to remove or disconnect certain system components may result in personal injury and/or improper system operation. Only those components with approved removal and installation procedures should be serviced.

NOTICE: ***Always use the correct fastener in the proper location. When you replace a fastener, use ONLY the exact part number for that application. General Motors will call out those fasteners that require a replacement after removal. General Motors will also call out the fasteners that require thread lockers or thread sealant. UNLESS OTHERWISE SPECIFIED, do not use supplemental coatings (paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.***

CONTENTS

CONTENTS (cont'd)

GENERAL DESCRIPTION

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

ABBREVIATIONS/DEFINITIONS

BPMV	Brake Pressure Modulator Valve
CKT	Circuit
DLC	Data Link Connector
DTC	Diagnostic Trouble Code
DUMP	Dump Valve (Cartridge)
DMM	Digital Volt Meter
EBCM	Electronic Brake Control Module
EHCU	Electro-Hydraulic Control Unit
4WAL	Four Wheel Antilock
ISO	Isolation Valve (Cartridge)
LPA	Low Pressure Accumulator
2WD	Two Wheel Drive
4WD	Four Wheel Drive
VSS	Vehicle Speed Sensor
WSS	Wheel Speed Sensor

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

The EHCU is the entire unit, including the BPMV, EBCM and combination valve. The EBCM is the electronic control portion of the antilock assembly. It mounts to the top of the BPMV and is housed in aluminum with a black plastic top.

ANTILOCK BRAKE SYSTEM INTRODUCTION

ABS is designed to provide the average driver with:

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

Wheel Slip

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

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

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

Steering Control

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

BASIC KNOWLEDGE REQUIRED

Before using this section, it is important that you have a basic knowledge of the following items. Without this basic knowledge, it will be difficult to use the diagnostic procedures contained in this section.

If you need a review of basic electrical troubleshooting knowledge, SECTION 8A contains helpful information in the introduction. Basic use of circuit testing tools is also covered in SECTION 8A. Additionally, electrical/electronic courses are offered through General Motors Service Training.

- BASIC ELECTRICAL CIRCUITS.
  - — You should understand the basic theory of electricity and know the meaning of voltage (volts), current (amperes) and resistance (ohms).
  - — You should understand what happens in a circuit with an open or shorted wire.
  - — You should be able to read and understand a wiring diagram.
- .USE OF CIRCUIT TESTING TOOLS.
  - — You should be familiar with the high impedance Digital Multimeter (DMM) J 39200 and be familiar with the meter controls and how to use them correctly.
  - — You should be able to measure voltage, resistance and current.
  - — You should also know how to use jumper wires to bypass components to test circuits.

TIRES AND ANTILOCK BRAKES

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

Spare Tire

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

Replacement Tires

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

ANTILOCK BRAKE SYSTEM OPERATION

Warning/Indicator Lamp Operation

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

Normal Lamp Operation

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

Self-Tests

The Antilock Brake System performs two system self-tests automatically:

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

Normal Braking Mode (Figure 1)

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

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

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

Antilock Braking Mode (Figure 2)

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

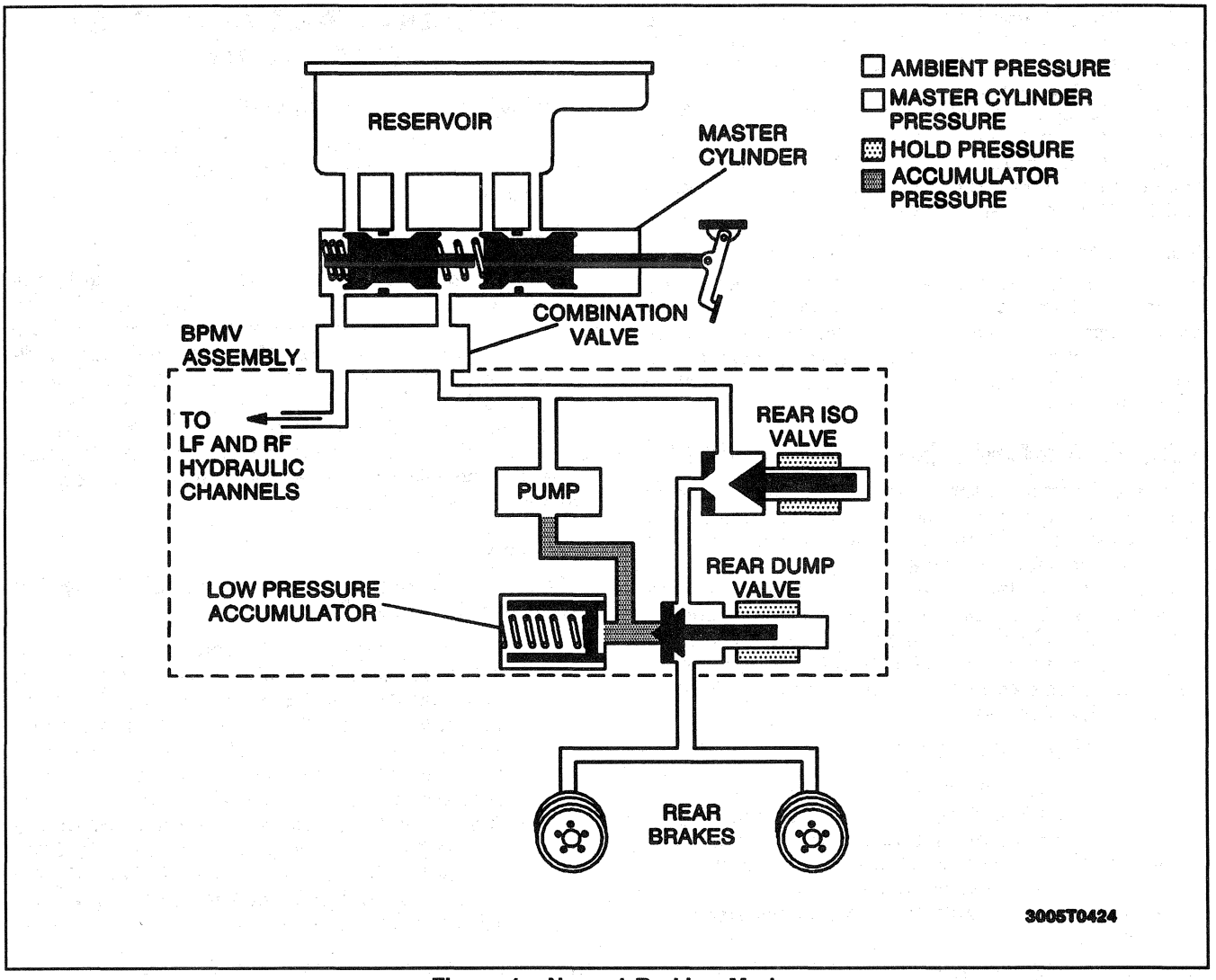


Figure 1 - Normal Braking Mode

The 4WAL system operates through a four step process:

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

Sequence Of Events

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

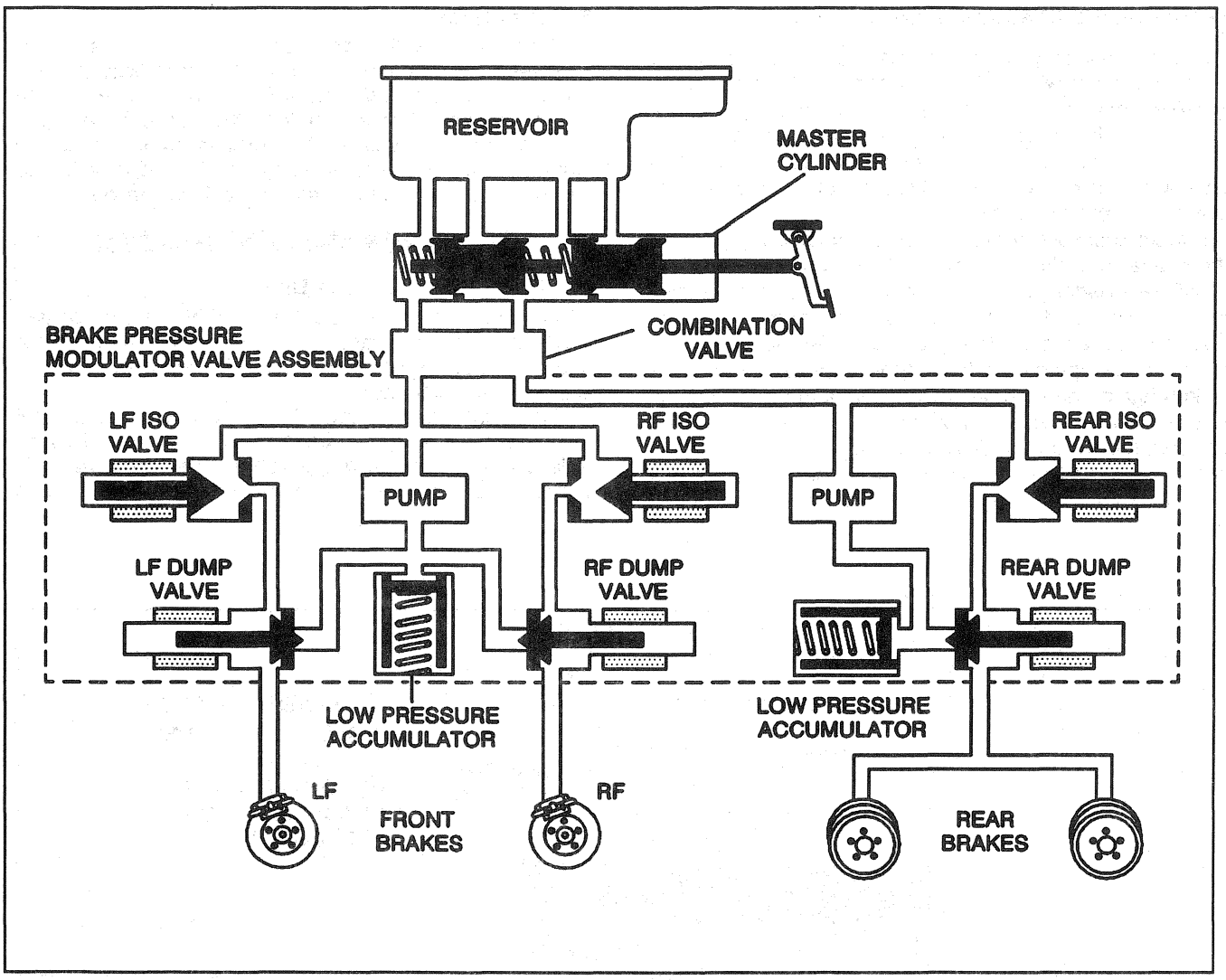


Figure 2 - 4WAL Hydraulic System

Isolation Mode (Pressure Maintain) (Figure 3)

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

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

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

Dump Mode (Pressure Decrease) (Figure 4)

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

The EBCM energizes the dump cartridge coil(s) to open the dump cartridge, allowing fluid from the wheels to be dumped into the LPA. This is done with very short activation pulses opening and closing the dump cartridge passageway. Brake pressure is lowered at the wheel and allows the affected wheel to begin rolling again.

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

Reapply Mode (Pressure Increase) (Figure 5)

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

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

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

Brake Release

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

SYSTEM COMPONENTS

Electro-hydraulic Control Unit

The Electro-hydraulic Control Unit (EHCU) is located inside the engine compartment on the left inner fender and regulates hydraulic pressure in the brake system during an antilock stop.

The BPMV is split into 3 hydraulic channels; right front, left front and rear brakes. Each channel has an isolation valve and a dump valve. The front channels share a low pressure accumulator, attenuator and

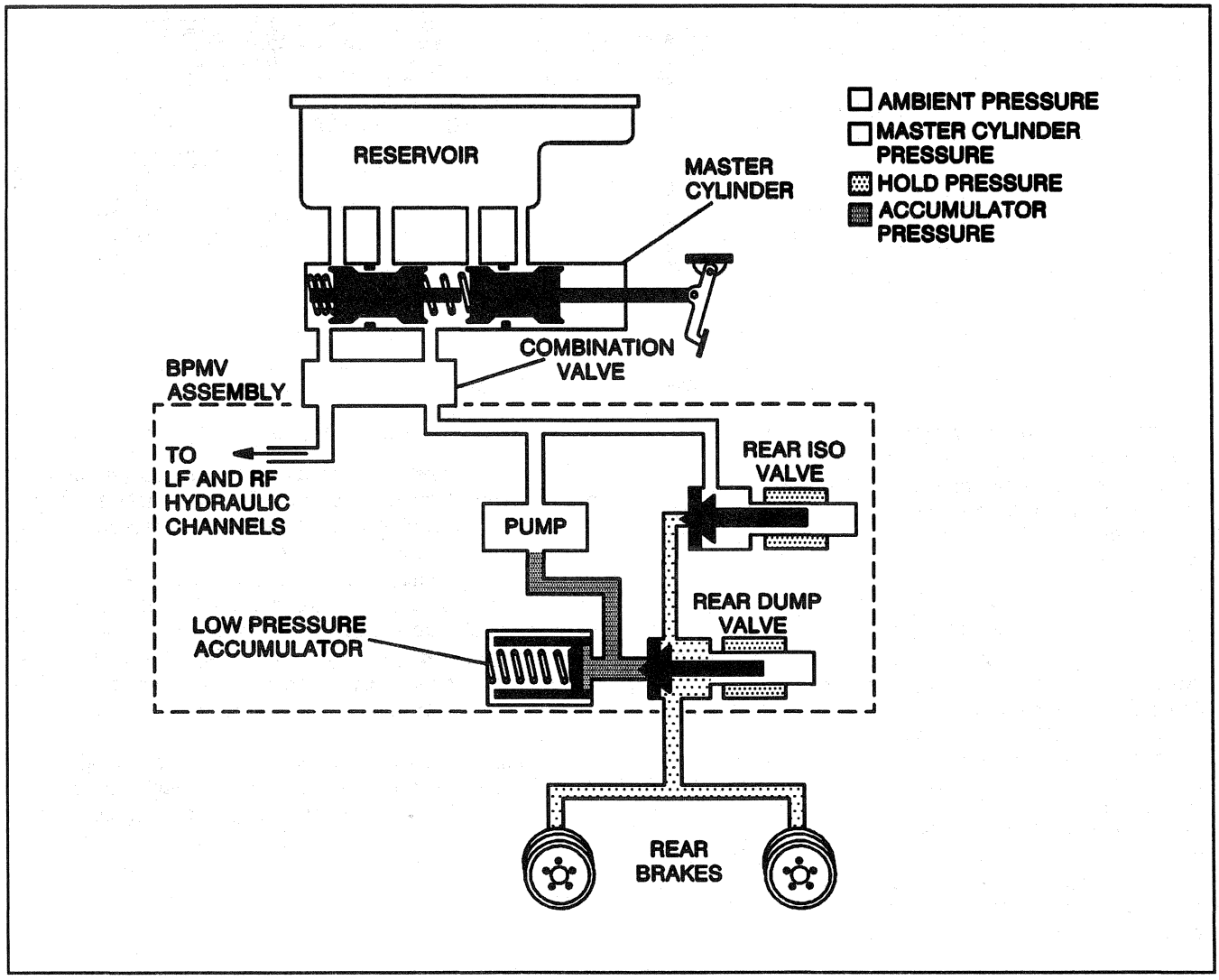


Figure 3 - Isolation Mode (Pressure Maintain)

pump. The rear channel also has a low pressure accumulator, attenuator and a pump. The rear brake channel of the BPMV controls both rear wheels simultaneously.

Front Wheel Speed Sensors

The front wheel speed sensor (WSS) is a magnetic coil/pickup that mounts to the front steering knuckle. It produces an AC voltage signal to tell the EBCM how fast the wheel is turning. The speed of the wheel is directly proportionate to the frequency of pulses the sensor produces. The WSSs connect to the EBCM through the 5-pin connector. On 2WD models, the WSSs mount to the dust shields (except C 3500HD). On 4WD models, the WSSs are integrated into the front wheel bearing along with the tone wheels.

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 pole piece. The tone wheels are attached to the rotor on 2WD models and are integral with the wheel bearing on 4WD models. Any imperfections in the tone wheels, such as a broken or missing tooth, can cause an inaccurate wheel speed reading on the affected wheel.

The front wheel speed sensor tone wheels on the C 3500HD models are not serviceable separately. If the tone wheel becomes damaged the complete front wheel hub assembly must be replaced. DO NOT attempt to remove and replace a tone wheel. The tone wheels are pressed on the hub to a precise location. Attempting to do so will cause damage to the tone wheel and wheel speed sensor.

Wheel Speed Sensor Calibration

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

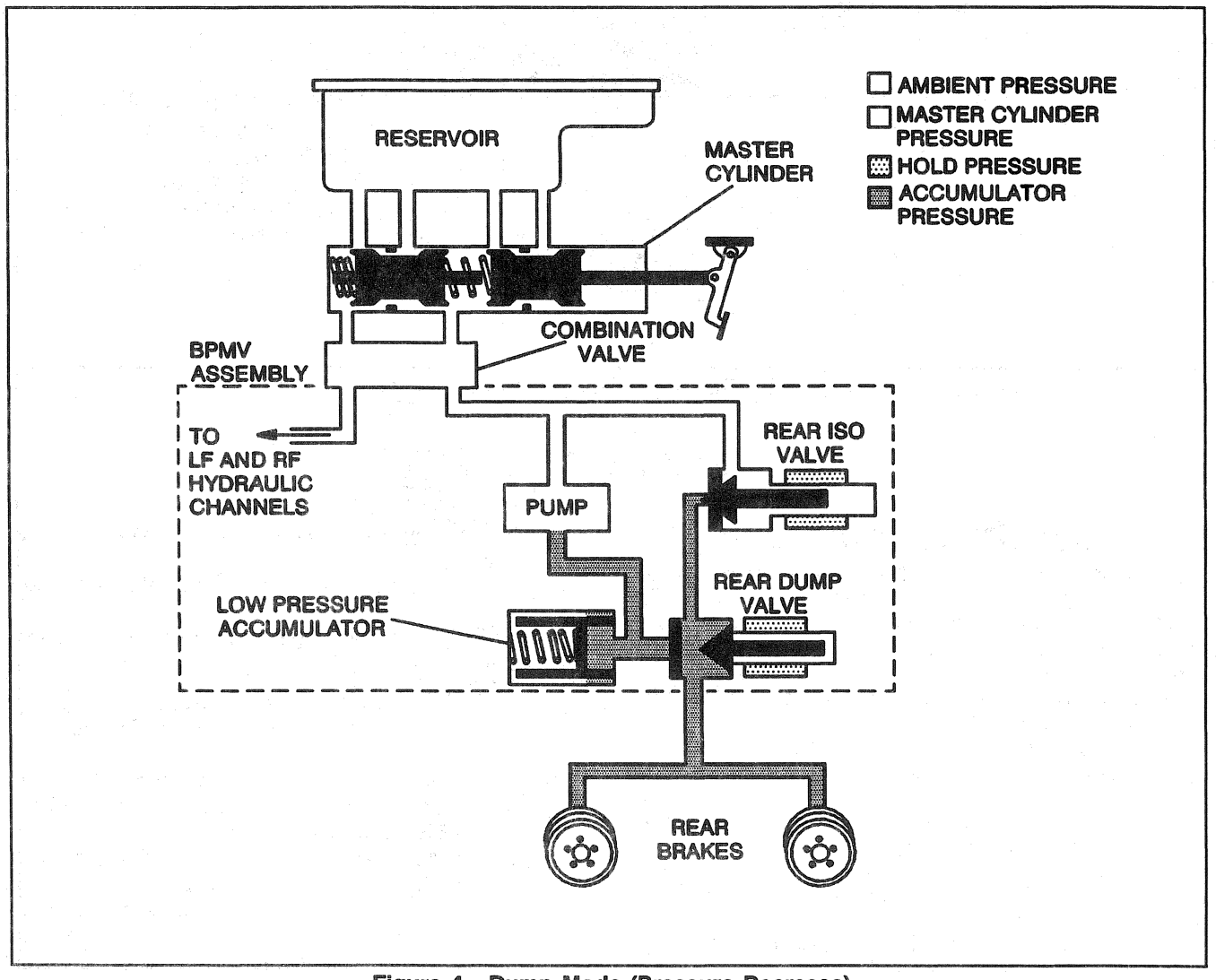


Figure 4 - Dump Mode (Pressure Decrease)

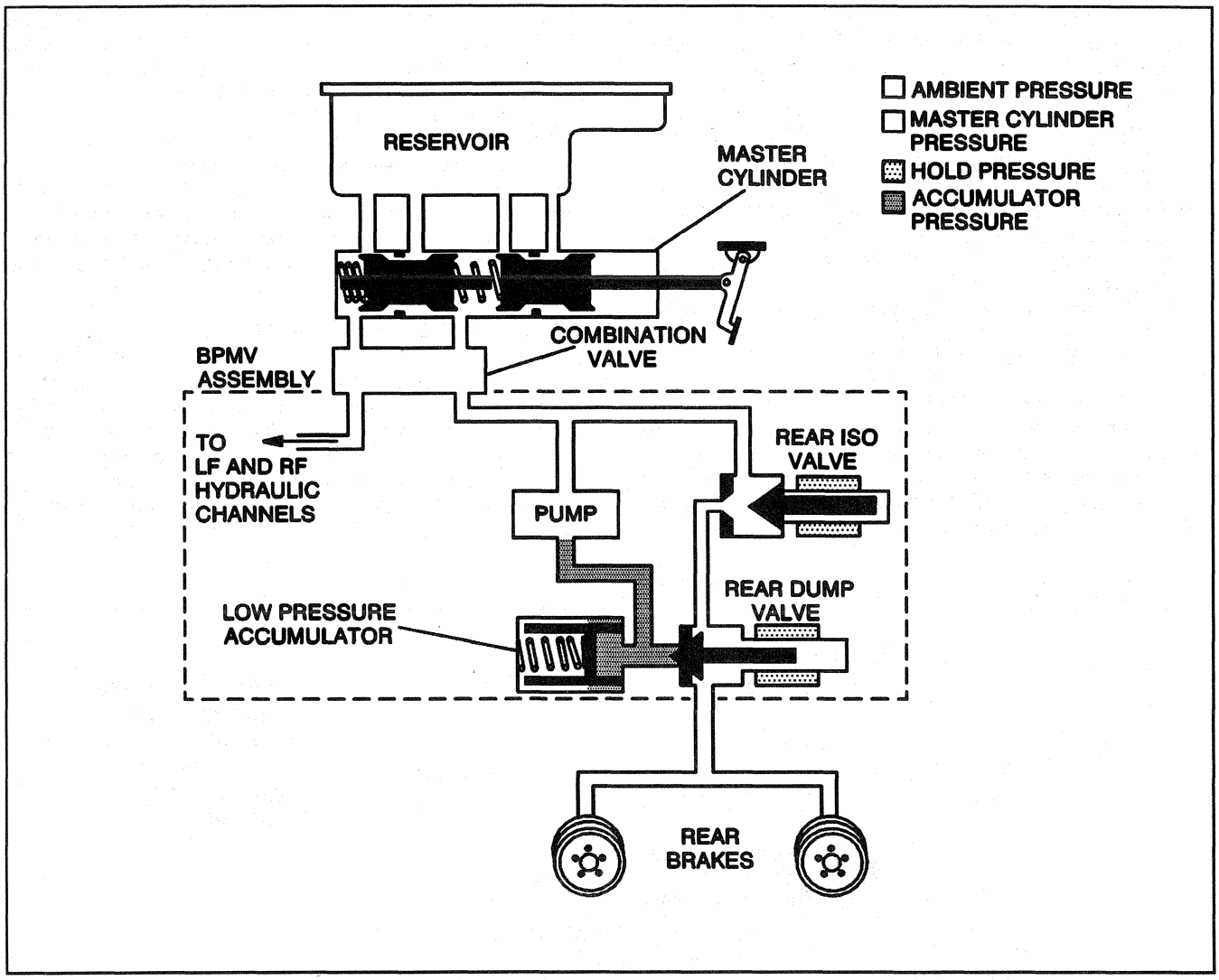


Figure 5 - Reapply Mode (Pressure Increase)

DIAGNOSIS

DIAGNOSTIC PROCESS

When servicing the ABS, the following steps should be followed in order. Failure to follow these steps may result in the loss of important diagnostic data and will lead to difficult and time-consuming diagnostic procedures:

1. Perform a vehicle preliminary diagnosis inspection. This should include:
   - Inspection of the master cylinder fluid reservoir for proper brake fluid level and signs of contamination.
   - Inspection of the electro-hydraulic control unit for any leaks or wiring damage.
   - Inspection of brake components at all four wheels. Verify no drag exists. Also, verify proper brake apply operation.
   - Inspection for worn or damaged wheel bearings that may allow a wheel to wobble.
   - Inspection of the wheel speed sensors and their wiring.
   - Verify proper outer CV joint alignment and operation.
   - Verify tires meet legal tread depth requirements.
2. Perform Diagnostic System Check found in this section. If any DTCs are displayed, note the last malfunction that occurred. Diagnose and repair this malfunction first.
3. If no DTCs or mechanical component malfunctions are present, or if the malfunction is intermittent and not reproducible, test drive the vehicle while using the automatic snapshot feature of the scan tool. Perform normal acceleration, stopping, and turning maneuvers. If this does not reproduce the malfunction, perform an ABS stop, on a low coefficient surface such as gravel, from approximately

48-80 km/h (30-50 mph) while triggering the snapshot mode on any ABS DTC. If the malfunction is still not reproducible, use the enhanced diagnostic information found in DTC HISTORY to determine whether or not this malfunction should be diagnosed further based on frequency of the malfunction. Refer to Enhanced Diagnostics found in this section.

4. Once all system malfunctions have been corrected, clear the ABS DTCs.

SELF-DIAGNOSTICS

The EBCM performs self-diagnostics and can detect and often isolate system malfunctions. When a malfunction is detected, the EBCM 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 EBCM performs an automatic self-test the first time the vehicle reaches approximately 13 km/h (8 mph) after an ignition cycle. The EBCM 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) must be read with a scan tool. The scan tool is connected to the DLC (Data Link Connector) located under the steering column.

CLEARING DIAGNOSTIC TROUBLE CODES

The DTCs in the EBCM memory can be erased using a scan tool.

Be sure to verify proper system operation and absence of DTCs when the clearing procedure is completed.

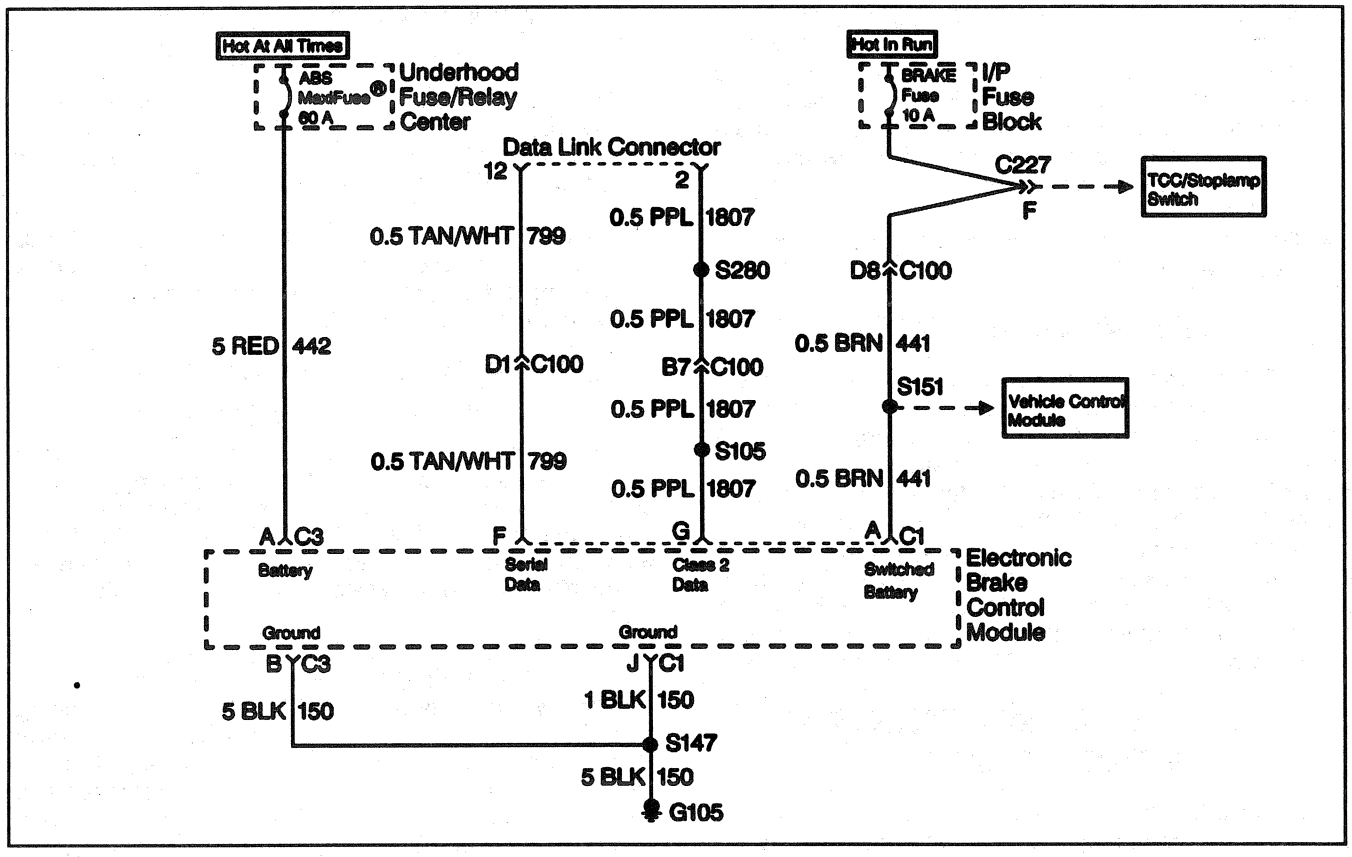
The EBCM will not permit DTC clearing until all DTCs have been displayed. Also, DTCs cannot be cleared by unplugging the EBCM, disconnecting the battery cables, or turning the ignition to OFF.

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.

DIAGNOSTIC CHARTS

Refer to the Diagnostic System Check as a starting point for all diagnosis. Failure to perform the Diagnostic System Check will result in extended diagnostic time, incorrect diagnosis, and incorrect parts replacement. Refer to Figures 6 through 10 for the wiring diagram and connector face views. Charts for symptom diagnosis follow.



DIAGNOSTIC SYSTEM CHECK

SYSTEM DESCRIPTION:

The diagnostic system check is an organized approach to identifying a problem created by an Antilock Brake System (ABS) malfunction. It must be the starting point for any ABS complaint diagnosis because it directs the service technician to the next logical step in diagnosing the complaint.

Serial data is exchanged by the EBCM through connector C1, terminal F. The EBCM is supplied switched ignition voltage through connector C1, terminal A, and ground is provided through connector C1, terminal J.

CHART TEST DESCRIPTION:

Number(s) below refer to number(s) on the diagnostic chart.

1. Indicates if the EBCM is transmitting data.
2. Checks for a serial data line malfunction.
3. Checks for proper scan tool connection to DLC.
4. Checks for open BRAKE fuse.
6. Checks for high resistance in the EBCM ground circuit.
7. Checks for current DTCs.
8. Checks for proper ANTILOCK indicator lamp operation.
9. Checks for history DTCs.
12. Checks for possible short to ground in the battery feed circuitry.
13. Checks for possible short to ground in the EBCM.
14. Ensures short to ground is not due to physical damage of the circuitry.
15. Checks for an open in CKT 441.
16. Ensures malfunction is not due to poor terminal contact.

DIAGNOSTIC AIDS:

Excessive resistance in the ground or power supply circuits will not allow communication with the EBCM. If communication with the EBCM is not possible, ensure the ABS ground connection is good and that there is no excessive resistance in any of the power supply circuits.

DIAGNOSTIC SYSTEM CHECK

Step	Action	Value(s)	Yes	No
1	1. Verify all EBCM connectors are connected properly. 2. Install scan tool. 3. Turn the ignition to RUN. 4. Within the ABS portion of the Mass Storage Cartridge Chassis Application, select F0: DATA LIST. Is data being received from the EBCM?	—	Go to Step 7	Go to Step 2
2	Observe scan tool. Does scan tool display WAITING FOR DATA?	—	Go to Step 3	—
3	Ensure scan tool DLC connector is connected properly to DLC. Is connection good?	—	Go to Step 4	Go to Step 5
4	1. Turn the ignition to OFF. 2. Remove and inspect 10 amp BRAKE fuse. Is fuse open?	—	Go to Step 11	Go to Step 6
5	Reconnect the scan tool DLC connector. Is the scan tool DLC connector reconnected?	—	Go to Step 1	—
6	1. Turn the ignition to OFF. 2. Install 10 amp BRAKE fuse. 3. Disconnect negative battery cable. 4. Disconnect 10-way EBCM connector C1. 5. Using the J 39200, measure the resistance between the negative battery terminal and the 10-way EBCM harness connector C1 terminal J. Is the resistance within the range specified in the Value(s) column?	0-2 Ω	Go to Step 14	Go to Step 17
7	Select DTC(s). Are any current DTCs displayed?	—	Go to Symptom and DTC table	Go to Step 8
8	1. Turn the ignition to OFF for 10 seconds. 2. Turn the ignition to RUN and observe the ANTILOCK indicator lamp. Did the lamp illuminate for 3 seconds and then go off?	—	Go to Step 9	Go to Step 10
9	Select DTC History. Are any history DTCs present?	—	Go to Enhanced Diagnostics in this section	System OK
10	Observe the ANTILOCK indicator lamp. Does the ANTILOCK indicator lamp stay on?	—	Go to Table B	Go to Table A
11	1. Replace the 10 amp BRAKE fuse. 2. Turn the ignition to RUN, wait 10 seconds. 3. Turn the ignition to OFF. 4. Remove and inspect the fuse. Is the fuse open?	—	Go to Step 12	Go to Step 19
12	1. Disconnect the 10- way EBCM connector C1. 2. Replace the 10 amp BRAKE fuse. 3. Turn the ignition to RUN, wait 10 seconds. 4. Turn the ignition to OFF. 5. Remove and inspect the fuse. Is the fuse open?	—	Go to Step 20	Go to Step 13

Step	Action	Value(s)	Yes	No
13	1. Inspect CKT 441, 420 and 10-way EBCM harness connector C1 for physical damage which may result in a short to ground with the 10-way EBCM harness connector C1 connected to the EBCM. Correct damage if evident. 2. Reconnect all connectors. 3. Turn the ignition to RUN, wait 10 seconds. 4. Turn the ignition to OFF. 5. Remove and inspect the 10 amp BRAKE fuse. Is the fuse open?	—	Go to Step 21	Go to Intermittents and Poor Connections in this section
14	1. Reconnect the negative battery cable. 2. Turn the ignition to RUN. 3. Using the J 39200, measure voltage between the 10-way EBCM harness connector C1 terminal A and ground. Is the voltage within the range specified in the Value(s) column?	10-15V	Go to Step 15	Go to Step 22
15	1. Turn the ignition to OFF. 2. Disconnect the positive battery cable to perform next measurement, then reconnect. 3. Turn the ignition to RUN. (This is done to provide circuit continuity). 4. Using the J 39200, measure resistance between the positive battery cable and the 10-way EBCM connector C1, terminal A. Is the resistance within the range specified in the Value(s) column?	0-2 Ω	Go to Step 16	Go to Step 23
16	1. Inspect the EBCM and EBCM connector terminals for poor terminal contact. 2. Inspect the battery terminals and battery cable terminals for poor connection. Refer to SECTION 8A, Checking Terminal Contact. Is poor terminal contact or a poor connection evident?	—	Go to Step 24	Go to Step 25
17	Repair open or high resistance in CKT 150. Is repair complete?	—	Go to Step 1	—
18	Repair short to ground in CKT 867. Is repair complete?	—	Go to Step 1	—
19	1. Install fuse 2. Refer to SECTION 8A to diagnose for a possible short to ground in the battery feed circuitry. Is repair complete?	—	Go to Step 1	—
20	Refer to SECTION 8A to diagnose for a short to ground in CKT 440 or 441. Is repair complete?	—	Go to Step 1	—
21	1. Replace EBCM 2. Replace 10 amp BRAKE fuse. Is repair complete?	—	Go to Step 1	—
22	Repair open in CKT 441. Is repair complete?	—	Go to Step 1	—
23	Repair open or high resistance in CKT 441. Is repair complete?	—	Go to Step 1	—
24	Replace terminals or repair poor connection. Is repair complete?	—	Go to Step 1	
25	Reconnect EBCM connectors and battery cables. Are EBCM connectors and battery cables reconnected?	—	Go to SECTION 8A-50	—

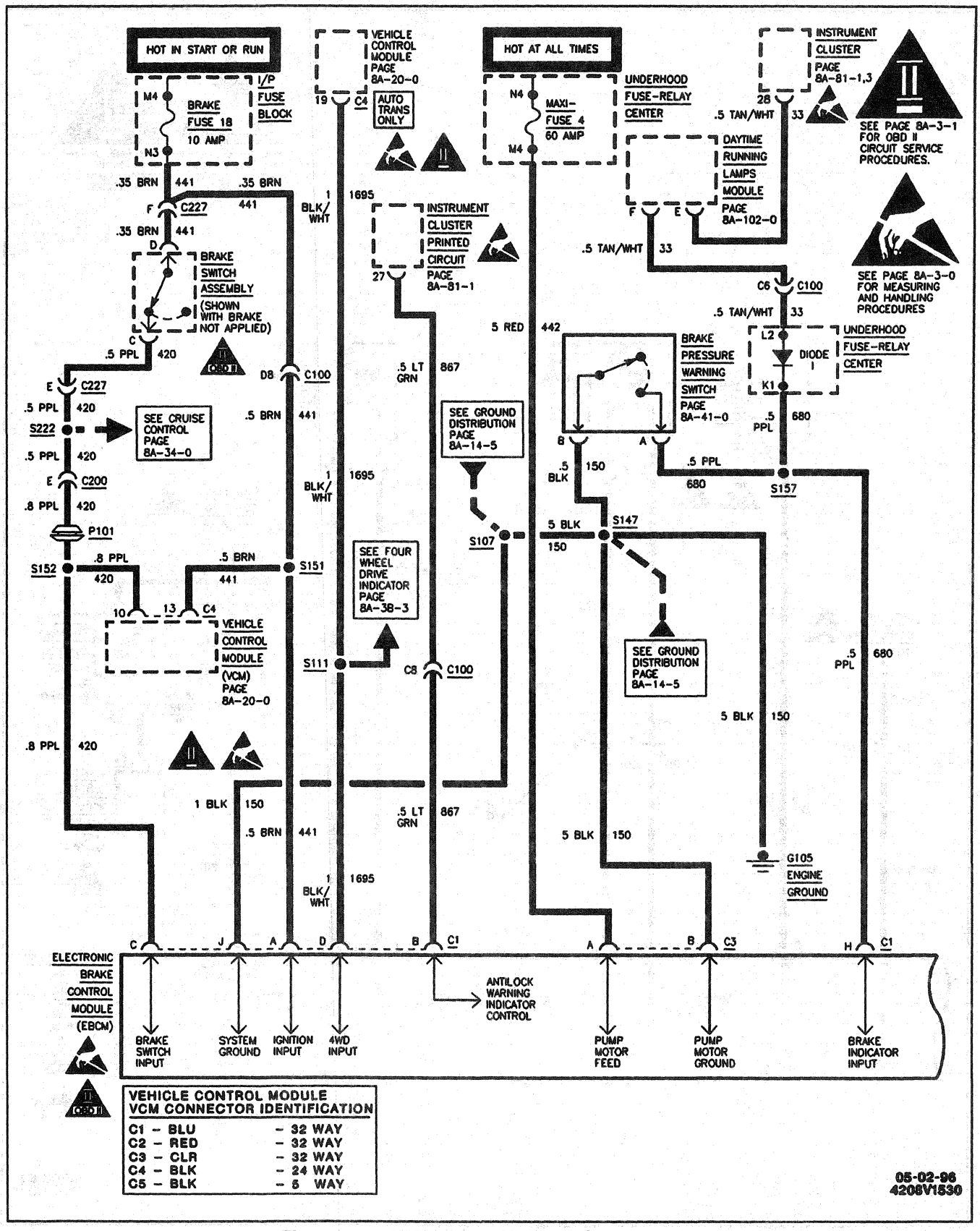


Figure 6 - 4WAL Wiring Diagram (Gas Engines)

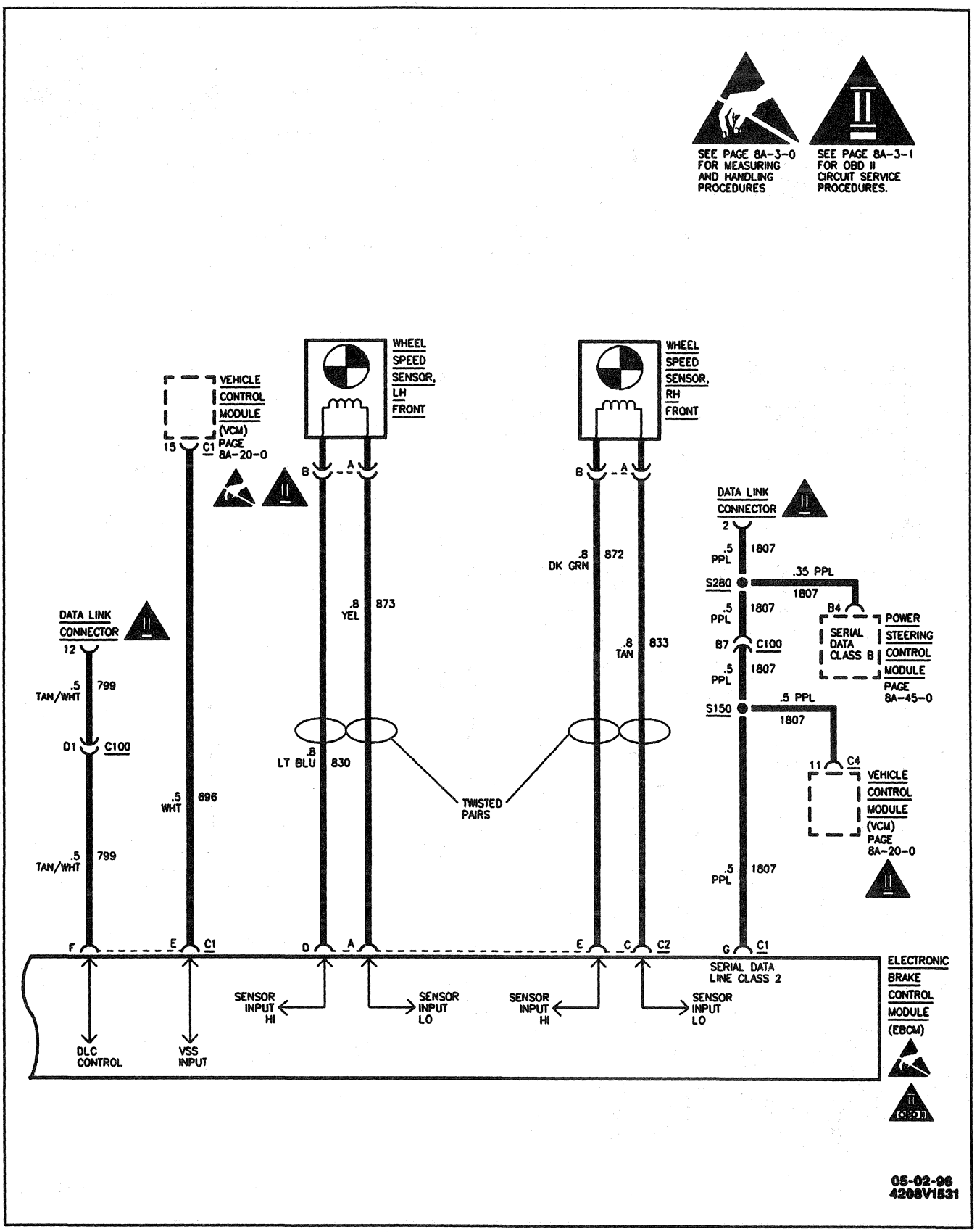


Figure 7 - 4WAL Wiring Diagram (Gas Engines)

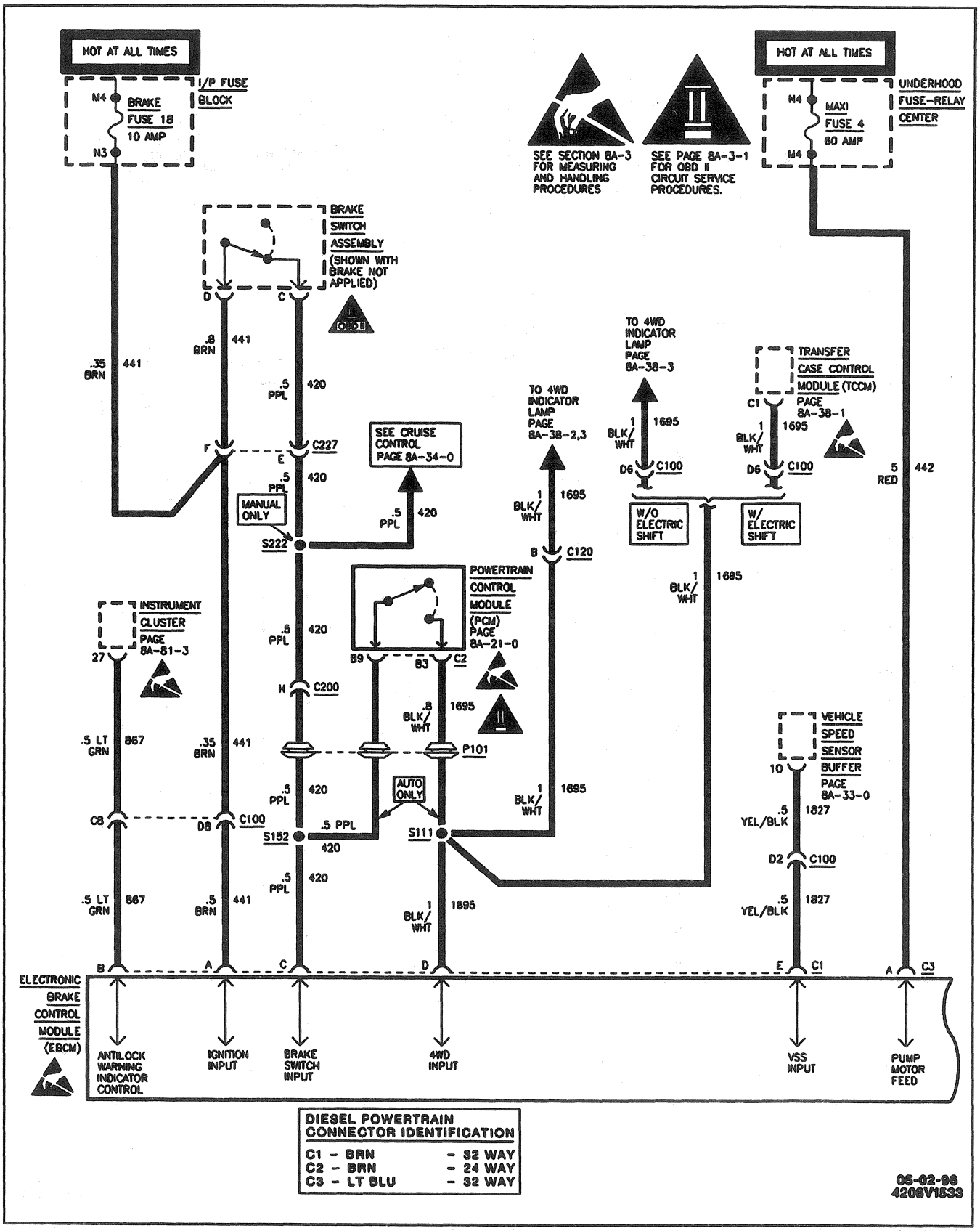


Figure 8 - 4WAL Wiring Diagram (Diesel Engines)

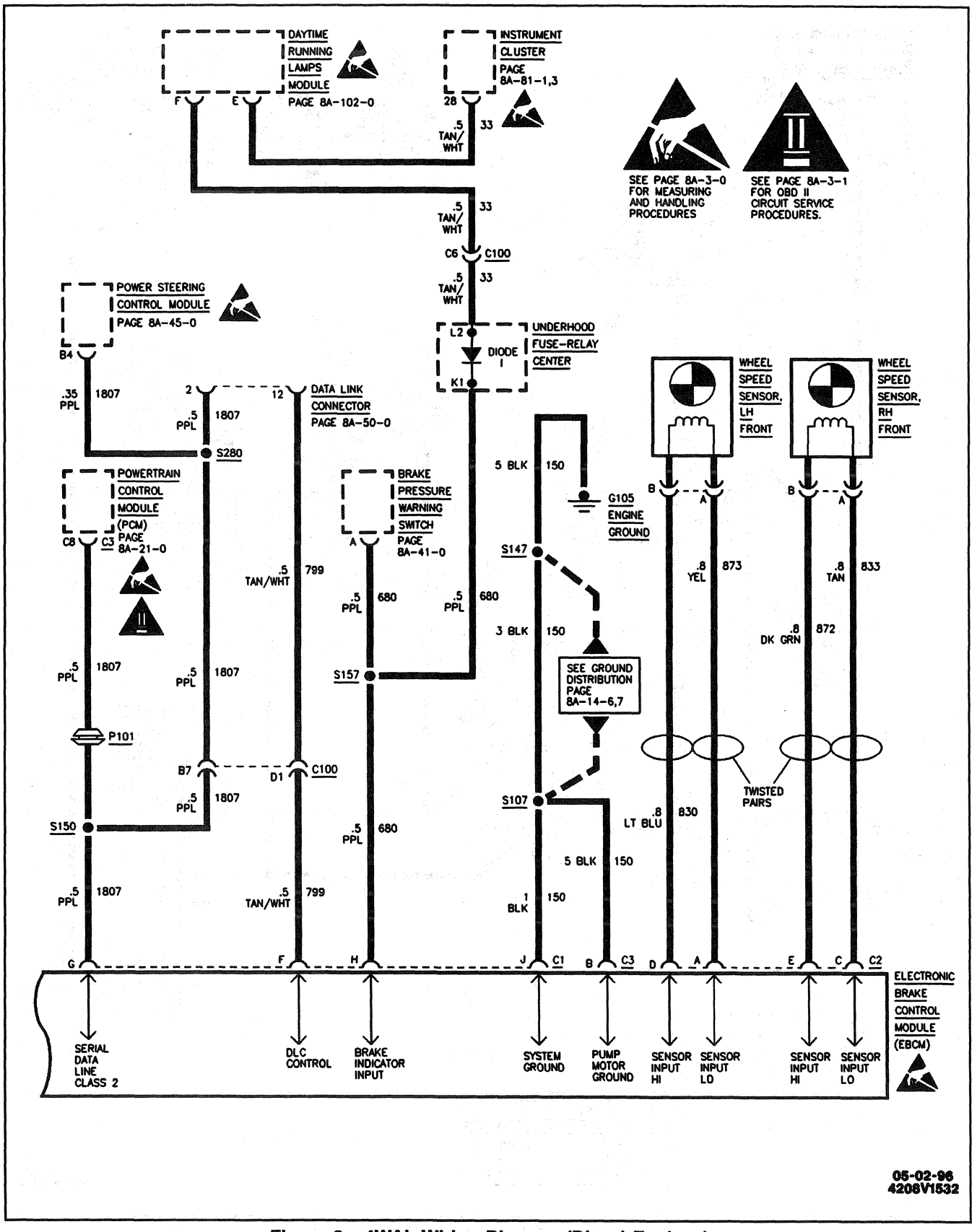


Figure 9 - 4WAL Wiring Diagram (Diesel Engines)

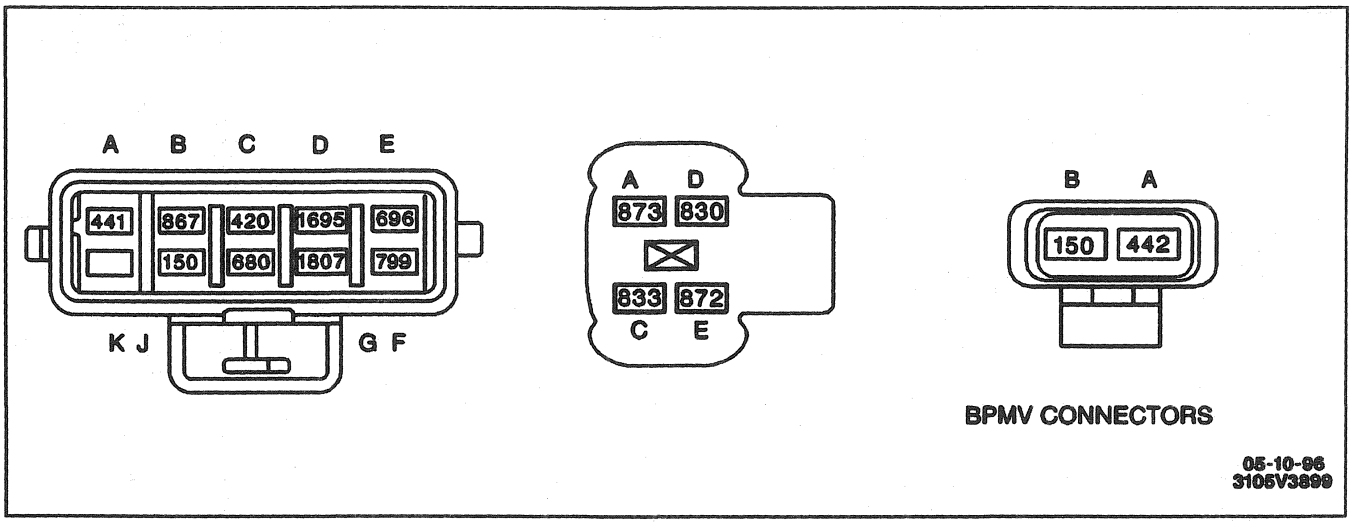


Figure 10 - 4WAL Connector Face Views

TERMINAL	CIRCUIT NO.	COLOR	CIRCUIT DESCRIPTION
A	441	BRN	SWITCHED IGNITION POWER
B	867	LT GRN	ABS WARNING LAMP CONTROL
C	420	PPL	STOPLAMP SWITCH INPUT
D	1695	BLK/WHT	4WD SWITCH INPUT
E	696	WHT	VEHICLE SPEED SIGNAL INPUT
F	799	TAN/WHT	SERIAL DATA LINE
G	1807	PPL	CLASS 2 DATA
H	680	PPL	BRAKE WARNING LAMP CONTROL
J	150	BLK	EBCM GROUND
K	PLUGGED		NOT USED

EBCM 10-WAY CONNECTOR

TERMINAL	CIRCUIT NO.	COLOR	CIRCUIT DESCRIPTION
A	873	YEL	LT FRONT SENSOR HIGH
C	833	TAN	RT FRONT SENSOR HIGH
D	830	LT BLU	LT FRONT SENSOR LOW
E	872	DK GRN	RT FRONT SENSOR LOW

EBCM 4-WAY CONNECTOR

TERMINAL	CIRCUIT NO.	COLOR	CIRCUIT DESCRIPTION
A	442	RED	PUMP MOTOR POWER
B	150	BLK	GROUND

EBCM 2-WAY CONNECTOR

SYMPTOM AND DIAGNOSTIC TROUBLE CODES TABLE

CHART	SYMPTOM	PAGE #
A	ABS (Amber) Indicator lamp OFF Always, No DTCs Stored	5E1-20
B	ABS (Amber) Indicator lamp ON Always, No DTCs Stored	5E1-22

DIAGNOSTIC TROUBLE CODE	DESCRIPTION	PAGE #
C0021	Right Front Wheel Speed Sensor Circuit Open or Shorted to Battery	5E1-24
C0022	Right Front Wheel Speed Signal Missing	5E1-26
C0023	Right Front Wheel Speed Sensor Signal Erratic	5E1-28
C0025	Left Front Wheel Speed Sensor Circuit Open or Shorted to Battery	5E1-30
C0026	Left Front Wheel Speed Signal Missing	5E1-32
C0027	Left Front Wheel Speed Sensor Signal Erratic	5E1-34
C0029	Simultaneous Drop-Out of Front Wheel Speed Signals	5E1-36
C0035	Rear Speed Sensor Circuit Open or Grounded	5E1-38
C0036	Rear Speed Signal Missing	5E1-42
C0037	Rear Speed Signal Erratic	5E1-46
C0038	Wheel Speed Signal Malfunction	5E1-50
C0041	Right Front Isolation Solenoid Circuit Open	5E1-52
C0042	Right Front Dump Solenoid Circuit Open	5E1-54
C0043	Right Front Isolation Solenoid Circuit Shorted	5E1-56
C0044	Right Front Dump Solenoid Circuit Shorted	5E1-58
C0045	Left Front Isolation Solenoid Circuit Open	5E1-60
C0046	Left Front Dump Solenoid Circuit Open	5E1-62
C0047	Left Front Isolation Solenoid Circuit Shorted	5E1-64
C0048	Left Front Dump Solenoid Circuit Shorted	5E1-66
C0051	Rear Isolation Solenoid Circuit Open	5E1-68
C0052	Rear Dump Solenoid Circuit Open	5E1-70
C0053	Rear Isolation Solenoid Circuit Shorted	5E1-72
C0054	Rear Dump Solenoid Circuit Shorted	5E1-74
C0065	Pump Motor Relay Circuit Open	5E1-76
C0066	Pump Motor Relay Circuit Shorted	5E1-78
C0067	Pump Motor Circuit Open	5E1-80
C0068	Pump Motor Locked or Pump Motor Circuit Shorted	5E1-82
C0071-74	EBCM Internal Fault	5E1-84
C0081	Stoplamp Switch Always Closed or Shorted	5E1-86
C0086	Antilock Indicator Lamp Circuit Shorted to Battery	5E1-88
C0088	Brake Warning Lamp Circuit Shorted to Battery	5E1-90

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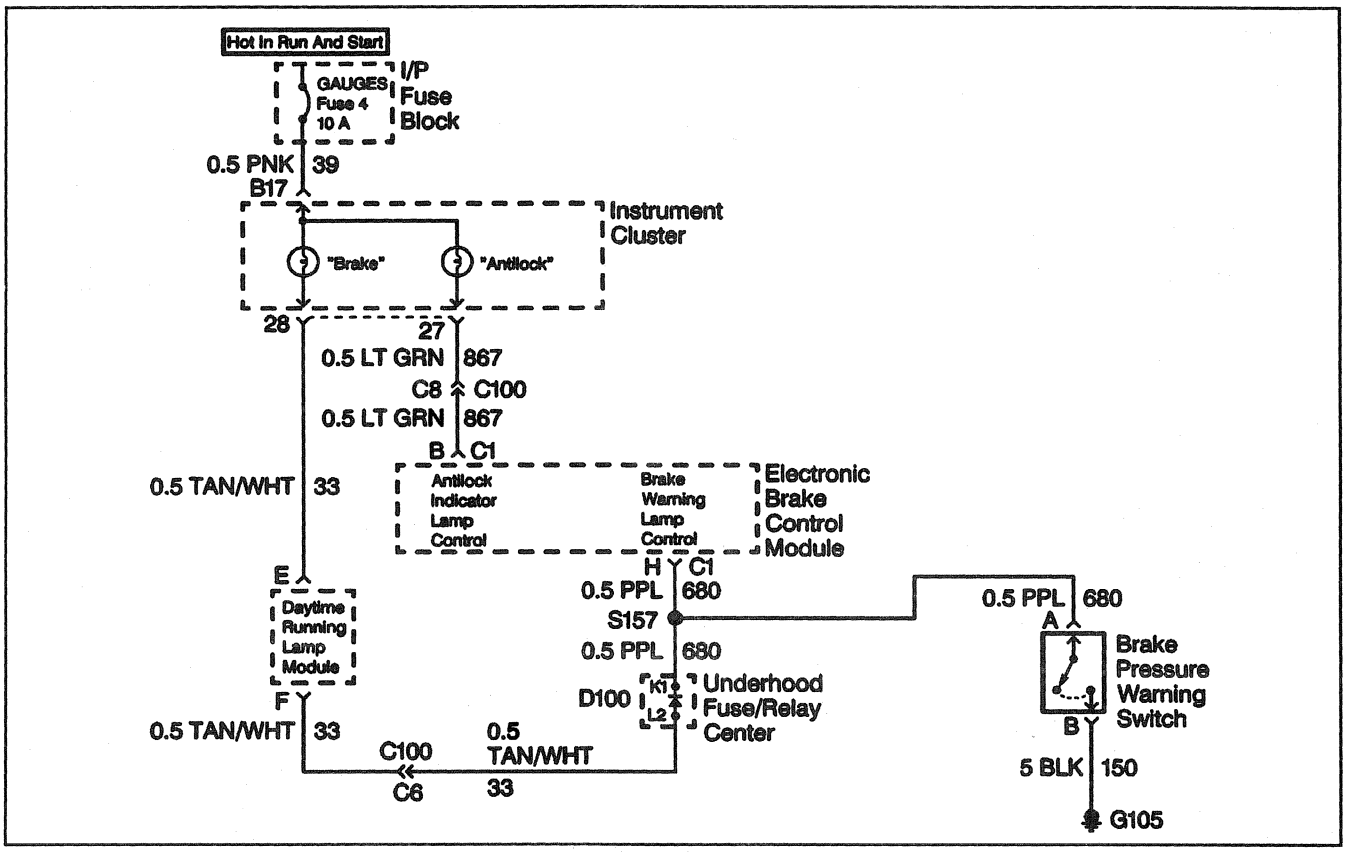


TABLE A
ABS INDICATOR LAMP OFF ALWAYS, NO DTCs

Circuit Description

The EBCM controls the ANTILOCK indicator lamp by supplying ground to turn the lamp on or 12 volts to turn the lamp off.

Diagnostic Aids

If the ANTILOCK indicator lamp is off constantly, there is an open or short to voltage in the lamp circuit between the indicator lamp and the EBCM. Also check for an open GAUGES fuse or an open bulb.

Test Description

Number(s) below refer to number(s) on the diagnostic chart.

2. Check for normal operation of the indicator lamp.
3. Manually (with fused jumper) turn off the indicator lamp.

TABLE A - ANTILOCK LAMP OFF ALWAYS - NO DTCs

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	Go to Step 2	Go to Diagnostic System Check
2	1. Turn the ignition to OFF. 2. Disconnect the 10-way ABS wiring harness connector from the EBCM. 3. Using a 3 amp fused jumper wire, jumper terminal B of the 10-way ABS wiring harness connector to ground. 4. Turn the ignition to RUN. Does the ANTILOCK indicator lamp turn on?	—	Go to Step 3	Go to Step 4
3	Inspect the 10-way ABS harness connector for signs of damage or corrosion. Is the connector OK?	—	Go to Step 9	Go to Step 8
4	Inspect the jumper wire fuse. Is fuse open?	—	Go to Step 10	Go to Step 5
5	Inspect the 10 amp GAUGE fuse. Is fuse open?	—	Go to Step 6	Go to Step 7
6	1. Turn the ignition to OFF. 2. Replace the 10 amp GAUGE fuse. 3. Turn the ignition to RUN. 4. Remove and inspect the 10 amp GAUGE fuse. Is the fuse open?	—	Go to Step 13	Go to Step 14
7	Remove and inspect the ANTILOCK indicator bulb. Is bulb OK?	—	Go to Step 12	Go to Step 11
8	repair ABS 10-way wiring harness connector. Is repair complete?	—	Go to Diagnostic System Check	—
9	Replace EBCM. Is repair complete?	—	Go to Diagnostic System Check	—
10	Repair a short to voltage in CKT 867. Is repair complete?	—	Go to Diagnostic System Check	—
11	Replace ANTILOCK indicator bulb. Is repair complete?	—	Go to Diagnostic System Check	—
12	Repair an open in CKT 867 or CKT 39 Is repair complete?	—	Go to Diagnostic System Check	—
13	Repair a short to ground in CKT 39. Is repair complete?	—	Go to Diagnostic System Check	—
14	Problem is an intermittent short to ground in CKT 39. Refer to Intermittents and Poor Connections.	—	Go to Diagnostic System Check	—

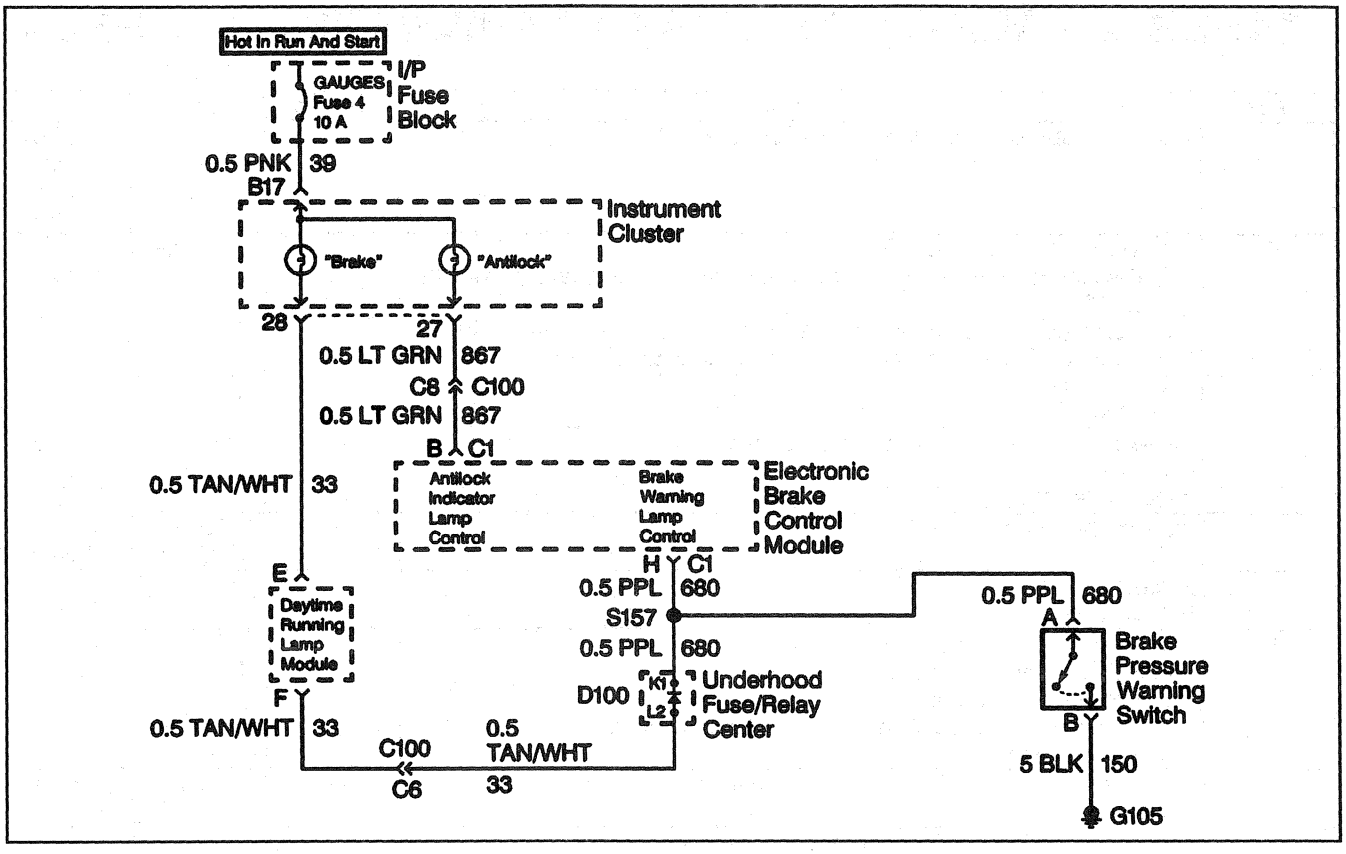


TABLE B
ABS INDICATOR LAMP ON ALWAYS, NO DTCs

Circuit Description

The EBCM controls the ANTILOCK indicator lamp by supplying ground to turn the lamp on or 12 volts to turn the lamp off.

Diagnostic Aids

If the ANTILOCK indicator lamp is on constantly, the EBCM is not capable of turning the lamp off or there is a short to ground in the circuit.

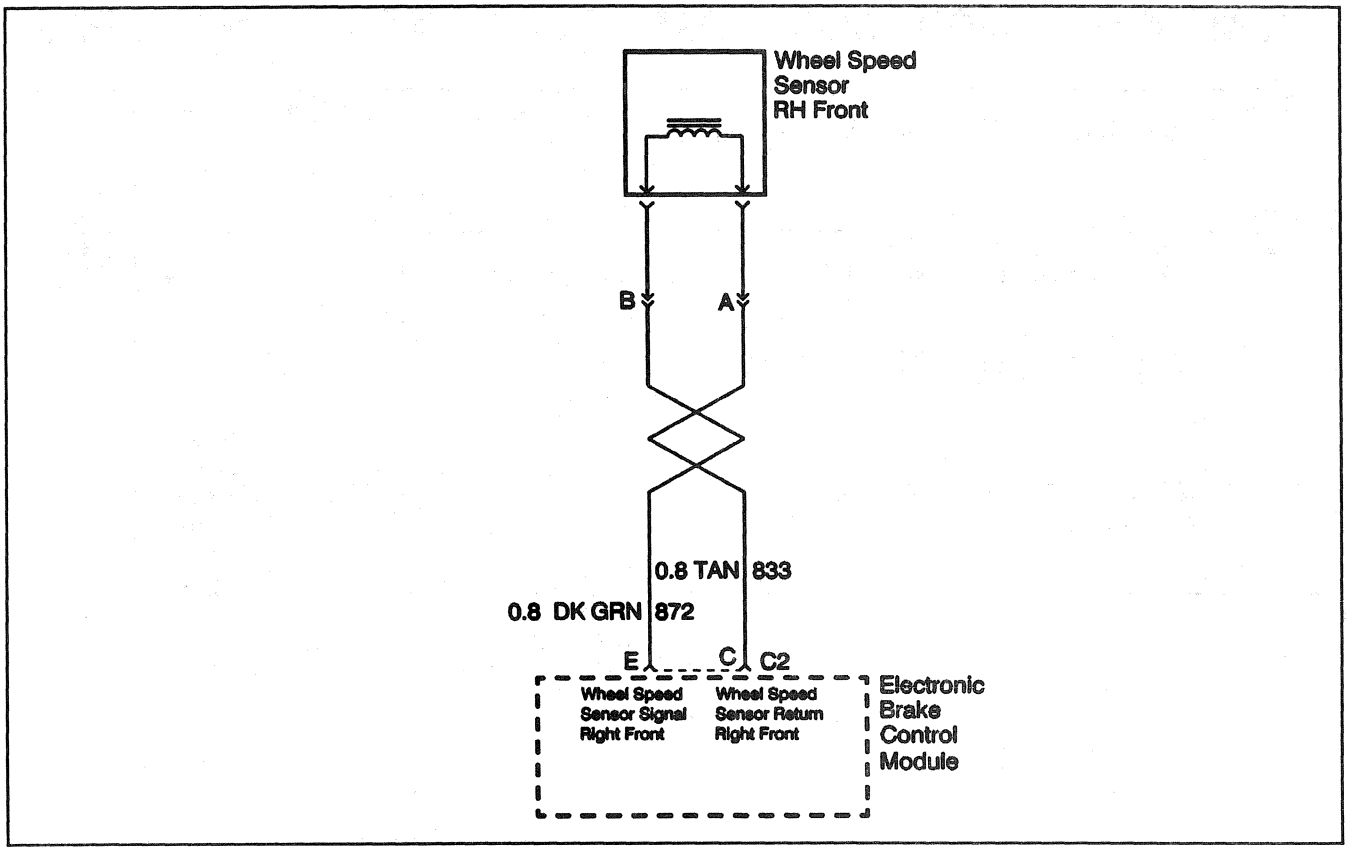
Test Description

Number(s) below refer to number(s) on the diagnostic chart.

2. Check for normal operation of the ANTILOCK indicator lamp.
3. Manually (with fused jumper) turn off ANTILOCK indicator lamp.

TABLE B - ANTILOCK LAMP ON ALWAYS - NO DTCs

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	Go to Step 2	Go to Diagnostic System Check
2	1. Turn the ignition to OFF 2. Disconnect the 10-way ABS wiring harness connector from the EBCM. 3. Turn the ignition to RUN. Does the ANTILOCK indicator lamp turn on and stay on?	—	Go to Step 4	Go to Step 3
3	Replace the EBCM. Is the repair complete?	—	Go to the Diagnostic System Check	—
4	Repair a short to ground in CKT 867. Is repair complete?	—	Go to the Diagnostic System Check	—



DTC C0021
RIGHT FRONT WHEEL SPEED SENSOR CIRCUIT OPEN OR SHORTED TO BATTERY

Circuit Description

As a toothed ring passes by the wheel speed sensor, changes in the electromagnetic field cause the wheel speed sensor to produce a sinusoidal (AC) voltage signal whose frequency and amplitude is proportional to wheel speed. The magnitude of this signal is directly related to wheel speed and the proximity of the wheel speed sensor to the toothed ring, often referred to as the air gap.

Conditions For Setting DTC

- No output signal from right front wheel speed sensor for 1.0 second.
- Excessive right front wheel speed sensor resistance for 1.0 second.

Action Taken When the DTC Sets

- ANTILOCK indicator lamp is illuminated
- ABS is disabled

This DTC is a Condition Latched DTC which indicates the above is true only as long as the condition persists.

Conditions For Clearing the DTC

- Conditions for the setting the DTC are repaired and the scan tool clear DTCs function is used.

Diagnostic Aids

An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

When inspecting a wheel speed sensor, inspect the sensor terminals and harness connector for corrosion. If evidence of corrosion exists, replace the wheel speed sensor. Refer to On-Vehicle Service in this section.

Resistance of the wheel speed sensor will increase with an increase in sensor temperature. Refer to the following table for temperature/resistance values.

TEMP (°C)	TEMP (°F)	RESISTANCE (OHMS)
-40 to 4	-40 to 40	1575 to 2950
5 to 43	41 to 110	1980 to 3450
44 to 93	111 to 200	2250 to 4100
94 to 150	201 to 302	2750 to 4760

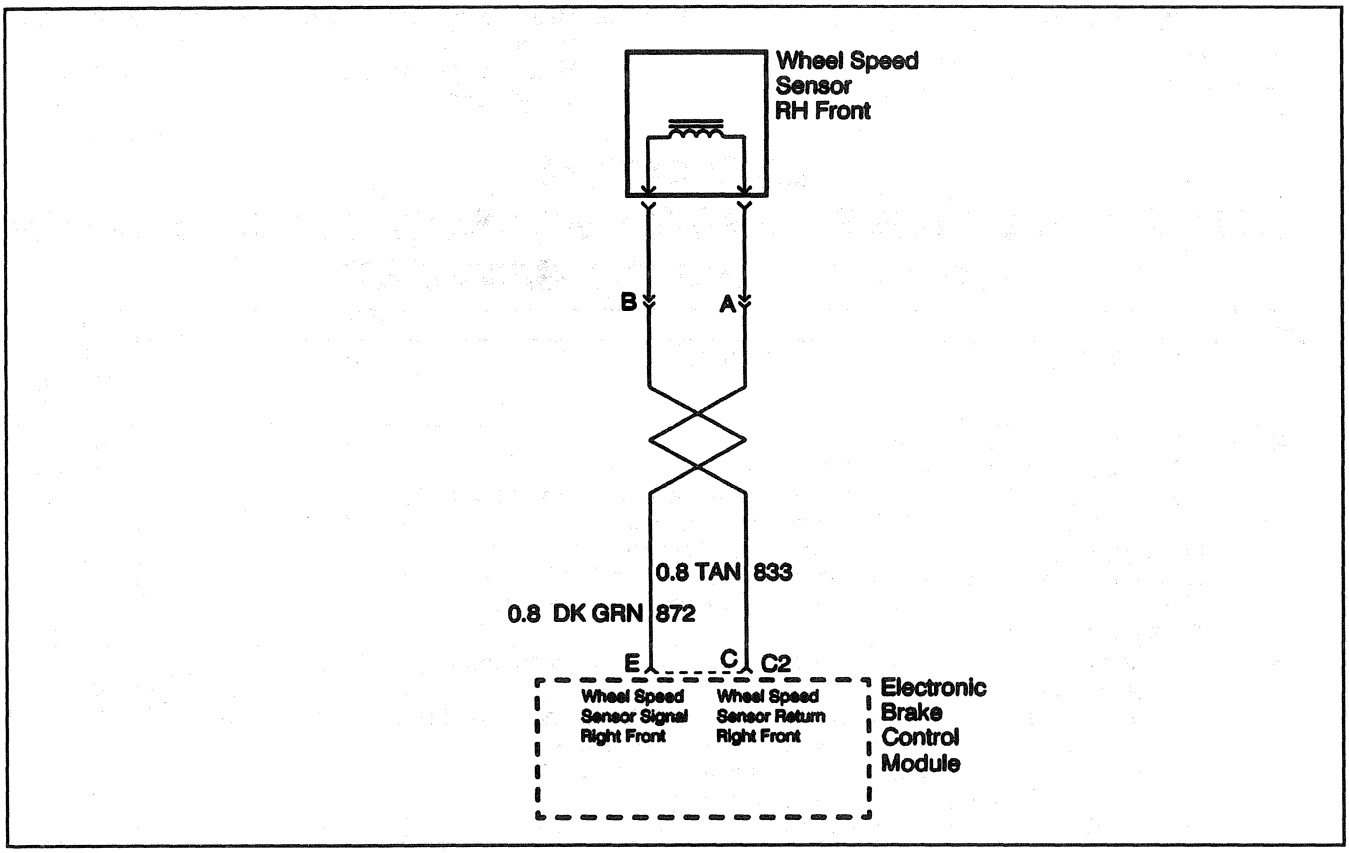
WSS Temperature vs. Sensor Resistance

Test Description:

2. Measure the resistance of the 4-way EBCM harness connector terminals C and E.
3. Measure the resistance of the right front sensor harness.
4. Measure the resistance of the right front wheel speed sensor.

DTC C0021
RIGHT FRONT WHEEL SPEED SENSOR CIRCUIT OPEN OR SHORTED TO BATTERY

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	Go to Step 2	Go to System Check
2	1. Turn the ignition to OFF. 2. Disconnect the 4-way EBCM harness connector. 3. Using a J 39200, measure the resistance between terminals C and E of the 4-way EBCM harness connector. Is the resistance of the sensor within specifications? (Refer to the table on the previous page for applicable sensor resistance values. The values in this table are for the temperature of the sensor, not the air temperature.)	—	Go to Step 5	Go to Step 3
3	1. Disconnect the right front wheel speed sensor harness connector from the wheel speed sensor. 2. Using a fused jumper wire, jumper terminals A and B of the 2-way EBCM to wheel speed sensor harness connector. 3. Using a J 39200, measure the resistance between terminals C and E of the 4-way EBCM harness connector. Is the resistance within range specified in the Value(s) column?	0-2 Ω	Go to Step 4	Go to Step 10
4	Using a J 39200, measure the resistance between terminal A and terminal B of the right front wheel speed sensor connector. Is the resistance of the sensor within specifications? (Refer to the table on the previous page for applicable sensor resistance values. The values in this table are for the temperature of the sensor, not the air temperature.)	—	Go to Step 7	Go to Step 11
5	Inspect the 4-way EBCM harness connector for signs of damage or corrosion. Does damage or corrosion exist?	—	Go to Step 8	Go to Step 6
6	1. Reconnect all connectors. 2. Test drive vehicle above 24 km/h (15 mph). Did DTC C0021 set?	—	Go to Step 9	Go to Step 7
7	Malfunction is intermittent. Inspect all connectors and harnesses for damage which may result in high resistance when all components are connected. Refer to Diagnostic Aids on the facing page for more information. Perform all necessary repairs. Is repair complete?	—	Go to Diagnostic System Check	—
8	Make necessary repairs to the 4-way EBCM harness connector. Is repair complete?	—	Go to Diagnostic System Check	—
9	Replace the EBCM Is repair complete?	—	Go to Diagnostic System Check	—
10	Repair open or high resistance in CKT 833 or 872. Is repair complete?	—	Go to Diagnostic System Check	—
11	Replace wheel speed sensor. Is repair complete?	—	Go to Diagnostic System Check	—



DTC C0022
RIGHT FRONT WHEEL SPEED SIGNAL MISSING

Circuit Description

As a toothed ring passes by the wheel speed sensor, changes in the electromagnetic field cause the wheel speed sensor to produce a sinusoidal (AC) voltage signal whose frequency and amplitude is proportional to wheel speed. The magnitude of this signal is directly related to wheel speed and the proximity of the wheel speed sensor to the toothed ring, often referred to as the air gap.

Conditions For Setting DTC

- Right front wheel speed is less than 4mph.
- All other wheel speeds are greater than 8mph.
- No unexpected wheel acceleration/deceleration. Anything that keeps the right front wheel speed sensor low while the vehicle is moving above 8mph.

Action Taken When the DTC Sets

- ANTILOCK indicator lamp is illuminated
- ABS is disabled

This DTC is a Ignition Latched DTC which indicates the above is true until the ignition is turned to OFF (even if the cause of the DTC is intermittent).

Conditions For Clearing the DTC

- Conditions for setting the DTC are repaired and the scan tool clear DTCs function is used.

Diagnostic Aids

An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

When inspecting a wheel speed sensor, inspect the sensor terminals and harness connector for corrosion. If evidence of corrosion exists, replace the wheel speed sensor. Refer to On-Vehicle Service in this section.

Resistance of the wheel speed sensor will increase with an increase in sensor temperature. Refer to the following table for temperature/resistance values.

TEMP (°C)	TEMP (°F)	RESISTANCE (OHMS)
-40 to 4	-40 to 40	1575 to 2950
5 to 43	41 to 110	1980 to 3450
44 to 93	111 to 200	2250 to 4100
94 to 150	201 to 302	2750 to 4760

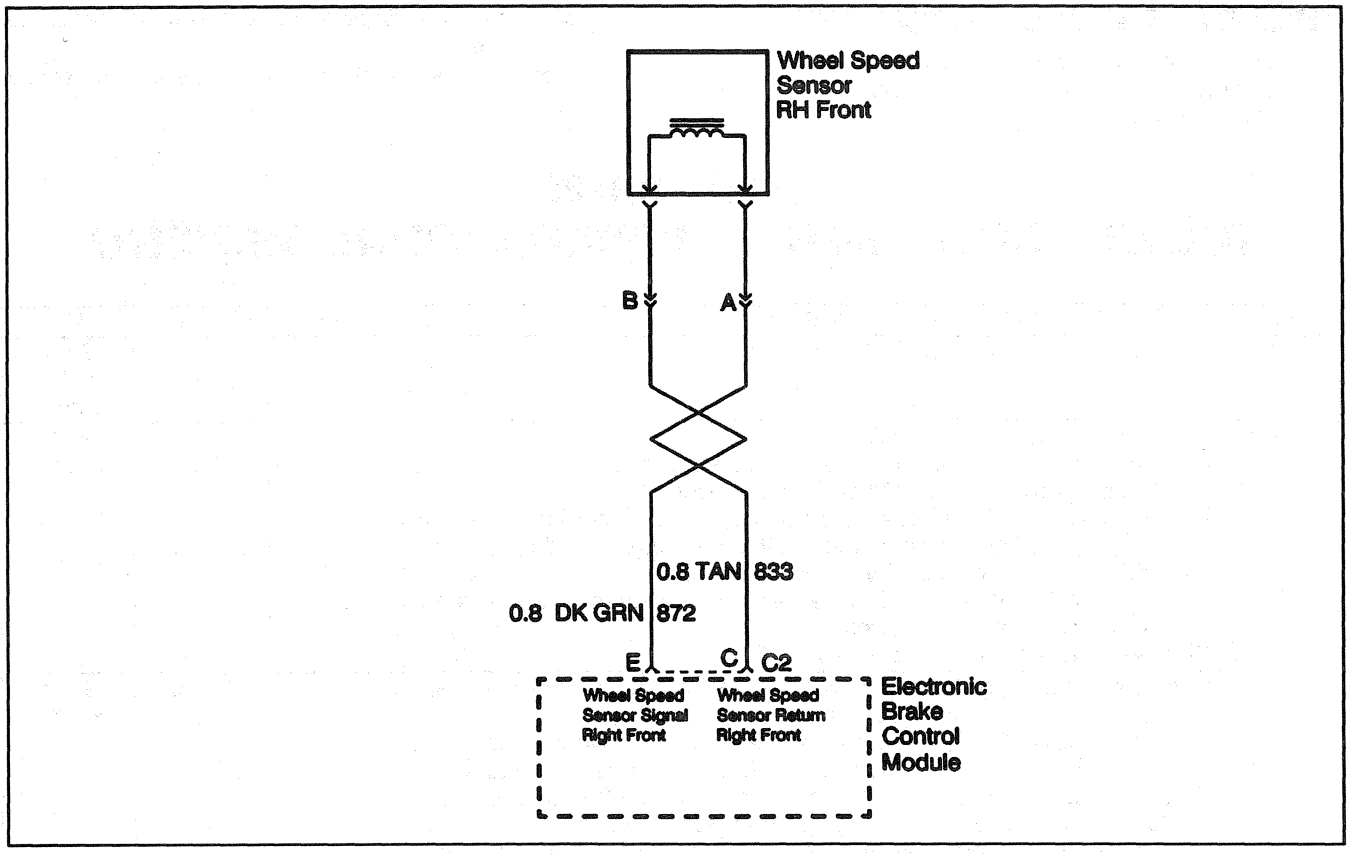
WSS Temperature vs. Sensor Resistance

DTC CHART TEST DESCRIPTION:

2. Visually inspect harness for damage.
3. Measure the resistance of the right front wheel speed sensor.
4. Measure the voltage output of the right front wheel speed sensor.
5. Measure the resistance of the right front sensor harness.

DTC C0022
RIGHT FRONT WHEEL SPEED SIGNAL MISSING

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	Go to Step 2	Go to System Check
2	1. Turn the ignition to OFF. 2. Inspect the right front wheel speed sensor, sensor cable, and connectors for signs of damage or corrosion. 3. Inspect the wheel speed sensor and toothed ring for looseness paying particular attention to the toothed ring. Any deviation will affect the wheel speed sensor output signal. 4. Inspect the 4-way EBCM harness connector and harness for signs of damage or corrosion. Is there evidence of physical damage?	—	Go to Step 7	Go to Step 3
3	1. Disconnect the right front wheel speed sensor harness connector from the wheel speed sensor. 2. Using a J 39200, measure the resistance between terminal A and terminal B of the right front wheel speed sensor connector. Is the resistance of the sensor within specifications? (Refer to the table on the previous page for applicable sensor resistance values. The values in this table are for the temperature of the sensor, not the air temperature.)	—	Go to Step 4	Go to Step 8
4	1. With the J 39200 still connected, select A/C voltage scale. 2. Spin the wheel by hand while observing the voltage reading. Is the voltage within the range specified in the Value(s) column?	Greater than 100 mV	Go to Step 5	Go to Step 8
5	1. Disconnect the 4-way EBCM harness connector from the EBCM. 2. Using a J 39200, measure the resistance between terminal C and E of the 4-way EBCM harness connector. Does the J 39200 display OL (infinite)?	—	Go to Step 6	Go to Step 10
6	1. Reconnect all connectors. 2. Test drive vehicle above 24 km/h (15 mph). Did DTC C0022 set?	—	Go to Step 9	Go to Step 11
7	Make necessary repairs. Is repair complete?	—	Go to Diagnostic System Check	—
8	Replace the right front wheel speed sensor. Is repair complete?	—	Go to Diagnostic System Check	—
9	Replace the EBCM Is repair complete?	—	Go to Diagnostic System Check	—
10	Repair short between CKTs 833 or 872. Is repair complete?	—	Go to Diagnostic System Check	—
11	Malfunction is intermittent. Inspect all connectors and harnesses for damage which may result in high resistance when all components are connected. Refer to Diagnostic Aids on the facing page for more information. Repair all damage found. Is repair complete?	—	Go to Diagnostic System Check	—



DTC C0023
RIGHT FRONT WHEEL SPEED SIGNAL ERRATIC

Circuit Description

As a toothed ring passes by the wheel speed sensor, changes in the electromagnetic field cause the wheel speed sensor to produce a sinusoidal (AC) voltage signal whose frequency and amplitude is proportional to wheel speed. The magnitude of this signal is directly related to wheel speed and the proximity of the wheel speed sensor to the toothed ring, often referred to as the air gap.

Conditions For Setting DTC

- Average wheel speed for all wheel speed signals is greater than 25mph.
- Average right front wheel speed is greater than 25mph.
- No output from right front wheel speed signal for 15ms. Anything which suddenly prevents (intermittant) the right front wheel speed signal to drop to 0 while the vehicle is moving greater than 25mph.

Action Taken When the DTC Sets

- ANTILOCK indicator lamp is illuminated
- ABS is disabled

DTC C0023 is an Ignition Latched DTC which indicates the above is true until the ignition is turned to OFF (even if the cause of the DTC is intermittent).

Conditions For Clearing the DTC

- Conditions for setting the DTC are repaired and the scan tool clear DTCs function is used.

Diagnostic Aids

An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

When inspecting a wheel speed sensor, inspect the sensor terminals and harness connector for corrosion. If evidence of corrosion exists, replace the wheel speed sensor. Refer to On-Vehicle Service in this section.

Resistance of the wheel speed sensor will increase with an increase in sensor temperature. Refer to the following table for temperature/resistance values.

TEMP (°C)	TEMP (°F)	RESISTANCE (OHMS)
-40 to 4	-40 to 40	1575 to 2950
5 to 43	41 to 110	1980 to 3450
44 to 93	111 to 200	2250 to 4100
94 to 150	201 to 302	2750 to 4760

WSS Temperature vs. Sensor Resistance

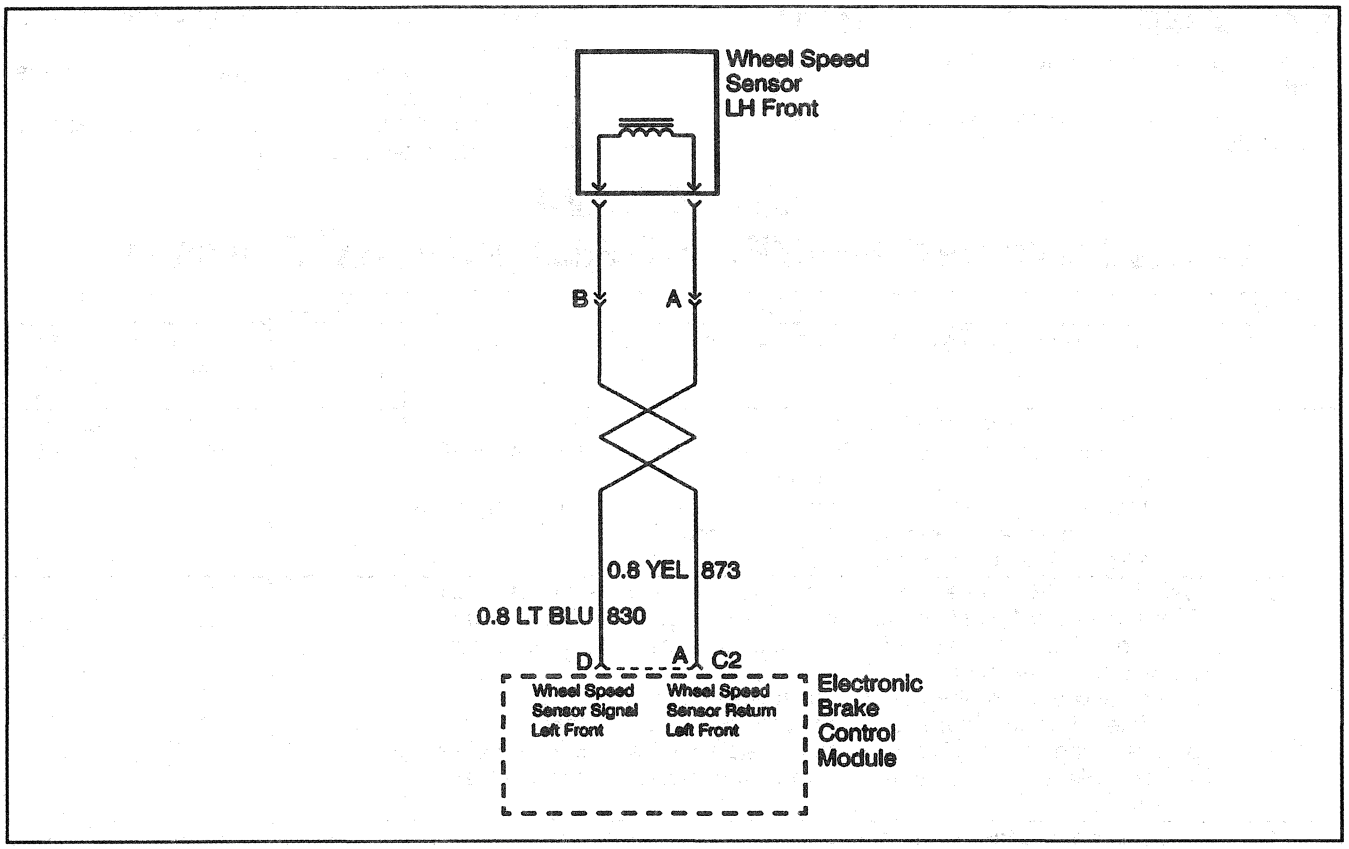
DTC CHART TEST DESCRIPTION:

Number(s) below refer to number(s) on the diagnostic chart.

2. Check EBCM 4-way connector for looseness, corrosion, etc.
3. Measure the resistance of EBCM 4-way connector pins C and E.
4. Measure resistance at the right front wheel speed sensor connector.
5. Inspect the right front WSS and tone wheel for physical damage or excessive clearance.

DTC C0023
RIGHT FRONT WHEEL SPEED SIGNAL ERRATIC

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	Go to Step 2	Go to System Check
2	1. Turn the ignition to OFF. 2. Disconnect the 4-way EBCM harness connector from the EBCM and inspect for signs of damage or corrosion. 3. Inspect the wheel speed sensor harness and sensor harness connector for signs of damage or corrosion. Are all connection clean and tight?	—	Go to Step 3	Go to Step 6
3	Using a J 39200, measure the resistance between terminals C and E of the 4-way EBCM harness connector. Wiggle the WSS harness in various locations between the sensor and the EBCM while performing this measurement. Is the resistance of the sensor within specifications and does not fluctuate when the harness is wiggled? (Refer to the table on the previous page for applicable sensor resistance values. The values in this table are for the temperature of the sensor, not the air temperature.)	—	Go to Step 5	Go to Step 4
4	1. Disconnect the wheel speed sensor from the wheel speed sensor harness connector. 2. Using a J 39200, measure the resistance between terminal A and terminal B of the right front wheel speed sensor. Is the resistance of the sensor within specifications? (Refer to the table on the previous page for applicable sensor resistance values. The values in this table are for the temperature of the sensor, not the air temperature.)	—	Go to Step 7	Go to Step 8
5	1. Reconnect all connectors. 2. Remove right front tire, hub and rotor. 3. Verify that the right front wheel speed sensor is securely mounted and that the tone wheel is in good condition. Is the Wheel speed sensor and tone wheel in good condition?	—	Go to Step 9	Go to Step 10
6	Make necessary repairs to the 4-way EBCM harness connector. Is repair complete?	—	Go to Diagnostic System Check	—
7	Repair open, high resistance or short in CKTs 833 or 872. Is repair complete?	—	Go to Diagnostic System Check	—
8	Replace wheel speed sensor. Is repair complete?	—	Go to Diagnostic System Check	—
9	Malfunction is intermittent. Inspect all connectors and harnesses for damage which may result in high resistance when all components are connected. Refer to Diagnostic Aids on the facing page for more information. Repair all damage found. Is repair complete?	—	Go to Diagnostic System Check	—
10	Make necessary repairs. Is repair complete?	—	Go to Diagnostic System Check	—



DTC C0025
LEFT FRONT WHEEL SPEED SENSOR CIRCUIT OPEN OR SHORTED TO BATTERY

Circuit Description

As a toothed ring passes by the wheel speed sensor, changes in the electromagnetic field cause the wheel speed sensor to produce a sinusoidal (AC) voltage signal whose frequency and amplitude is proportional to wheel speed. The magnitude of this signal is directly related to wheel speed and the proximity of the wheel speed sensor to the toothed ring, often referred to as the air gap.

Conditions For Setting DTC

- No output signal from left front wheel speed sensor for 1.0 second.
- Excessive left front wheel speed sensor resistance for 1.0 second.

Action Taken When the DTC Sets

- ANTILOCK indicator lamp is illuminated
- ABS is disabled

This DTC is a Condition Latched DTC which indicates the above is true only as long as the condition persists.

Conditions For Clearing the DTC

- Conditions for the setting the DTC are repaired and the scan tool clear DTCs function is used.

Diagnostic Aids

An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

When inspecting a wheel speed sensor, inspect the sensor terminals and harness connector for corrosion. If evidence of corrosion exists, replace the wheel speed sensor. Refer to On-Vehicle Service in this section.

Resistance of the wheel speed sensor will increase with an increase in sensor temperature. Refer to the following table for temperature/resistance values.

TEMP (°C)	TEMP (°F)	RESISTANCE (OHMS)
-40 to 4	-40 to 40	1575 to 2950
5 to 43	41 to 110	1980 to 3450
44 to 93	111 to 200	2250 to 4100
94 to 150	201 to 302	2750 to 4760

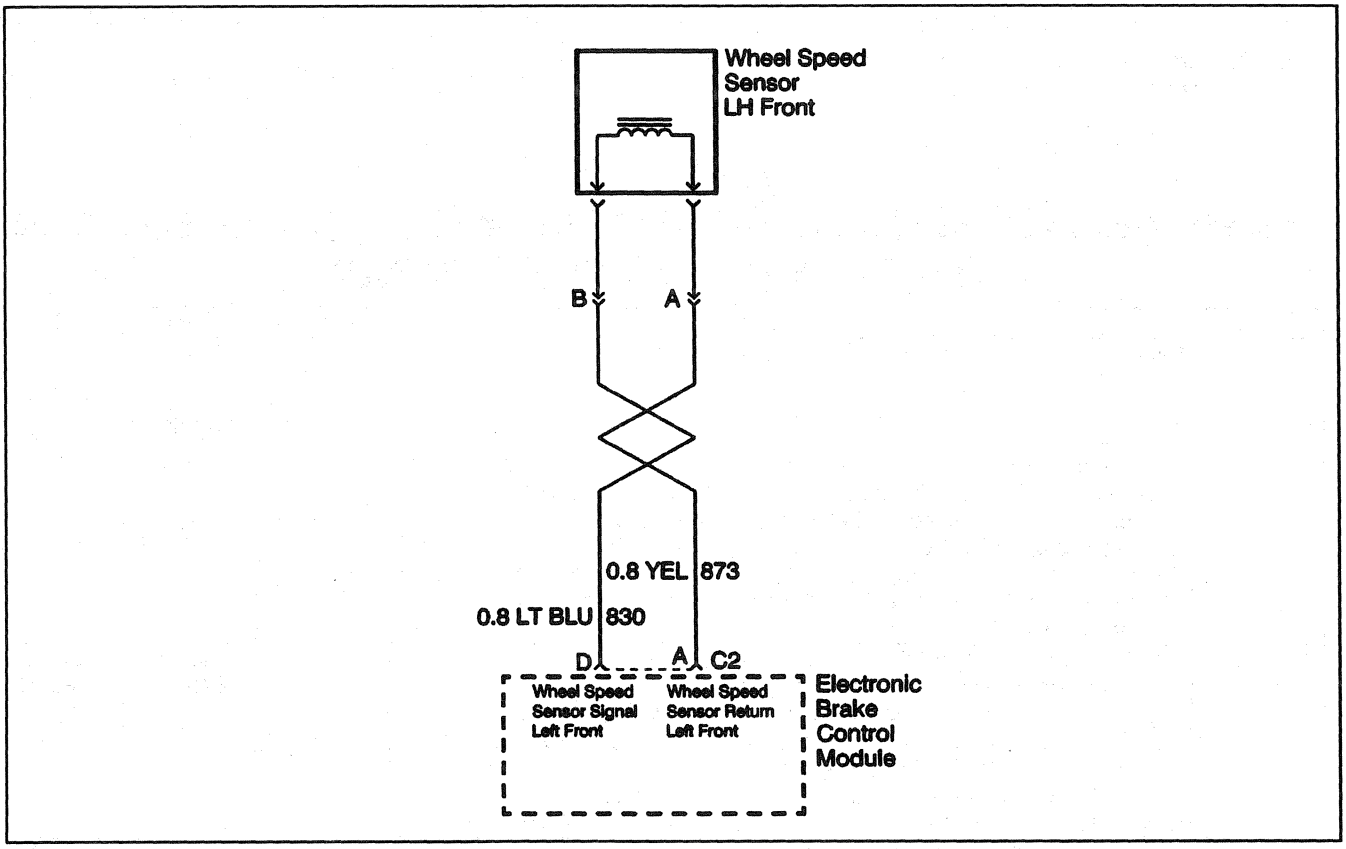
WSS Temperature vs. Sensor Resistance

Test Description:

2. Measure the resistance of the 4-way EBCM harness connector terminals C and E.
3. Measure the resistance of the left front sensor harness.
4. Measure the resistance of the left front wheel speed sensor.

DTC C0025
LEFT FRONT WHEEL SPEED SENSOR CIRCUIT OPEN OR SHORTED TO BATTERY

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	Go to Step 2	Go to System Check
2	1. Turn the ignition to OFF. 2. Disconnect the 4-way EBCM harness connector. 3. Using a J 39200, measure the resistance between terminals D and A of the 4-way EBCM harness connector. Is the resistance of the sensor within specifications? (Refer to the table on the previous page for applicable sensor resistance values. The values in this table are for the temperature of the sensor, not the air temperature.)	—	Go to Step 5	Go to Step 3
3	1. Disconnect the left front wheel speed sensor harness connector from the wheel speed sensor. 2. Using a fused jumper wire, jumper terminals A and B of the 2-way EBCM to wheel speed sensor harness connector. 3. Using a J 39200, measure the resistance between terminals D and A of the 4-way EBCM harness connector. Is the resistance within range specified in the Value(s) column?	0-2 Ω	Go to Step 4	Go to Step 10
4	Using a J 39200, measure the resistance between terminal A and terminal B of the left front wheel speed sensor connector. Is the resistance of the sensor within specifications? (Refer to the table on the previous page for applicable sensor resistance values. The values in this table are for the temperature of the sensor, not the air temperature.)	—	Go to Step 7	Go to Step 11
5	Inspect the 4-way EBCM harness connector for signs of damage or corrosion. Does damage or corrosion exist?	—	Go to Step 8	Go to Step 6
6	1. Reconnect all connectors. 2. Test drive vehicle above 24 km/h (15 mph). Did DTC C0025 set?	—	Go to Step 9	Go to Step 7
7	Malfunction is intermittent. Inspect all connectors and harnesses for damage which may result in high resistance when all components are connected. Refer to Diagnostic Aids on the facing page for more information. Perform all necessary repairs. Is repair complete?	—	Go to Diagnostic System Check	—
8	Make necessary repairs to the 4-way EBCM harness connector. Is repair complete?	—	Go to Diagnostic System Check	—
9	Replace the EBCM Is repair complete?	—	Go to Diagnostic System Check	—
10	Repair open or high resistance in CKT 830 or 873. Is repair complete?	—	Go to Diagnostic System Check	—
11	Replace wheel speed sensor. Is repair complete?	—	Go to Diagnostic System Check	—



DTC C0026
LEFT FRONT WHEEL SPEED SIGNAL MISSING

Circuit Description

As a toothed ring passes by the wheel speed sensor, changes in the electromagnetic field cause the wheel speed sensor to produce a sinusoidal (AC) voltage signal whose frequency and amplitude is proportional to wheel speed. The magnitude of this signal is directly related to wheel speed and the proximity of the wheel speed sensor to the toothed ring, often referred to as the air gap.

Conditions For Setting DTC

- Left front wheel speed is less than 4mph.
- All other wheel speeds are greater than 8mph.
- No unexpected wheel acceleration/deceleration. Anything that keeps the left front wheel speed sensor low while the vehicle is moving above 8mph.

Action Taken When the DTC Sets

- ANTILOCK indicator lamp is illuminated
- ABS is disabled

This DTC is a Ignition Latched DTC which indicates the above is true until the ignition is turned to OFF (even if the cause of the DTC is intermittent).

Conditions For Clearing the DTC

- Conditions for setting the DTC are repaired and the scan tool clear DTCs function is used.

Diagnostic Aids

An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

When inspecting a wheel speed sensor, inspect the sensor terminals and harness connector for corrosion. If evidence of corrosion exists, replace the wheel speed sensor. Refer to On-Vehicle Service in this section.

Resistance of the wheel speed sensor will increase with an increase in sensor temperature. Refer to the following table for temperature/resistance values.

TEMP (°C)	TEMP (°F)	RESISTANCE (OHMS)
-40 to 4	-40 to 40	1575 to 2950
5 to 43	41 to 110	1980 to 3450
44 to 93	111 to 200	2250 to 4100
94 to 150	201 to 302	2750 to 4760

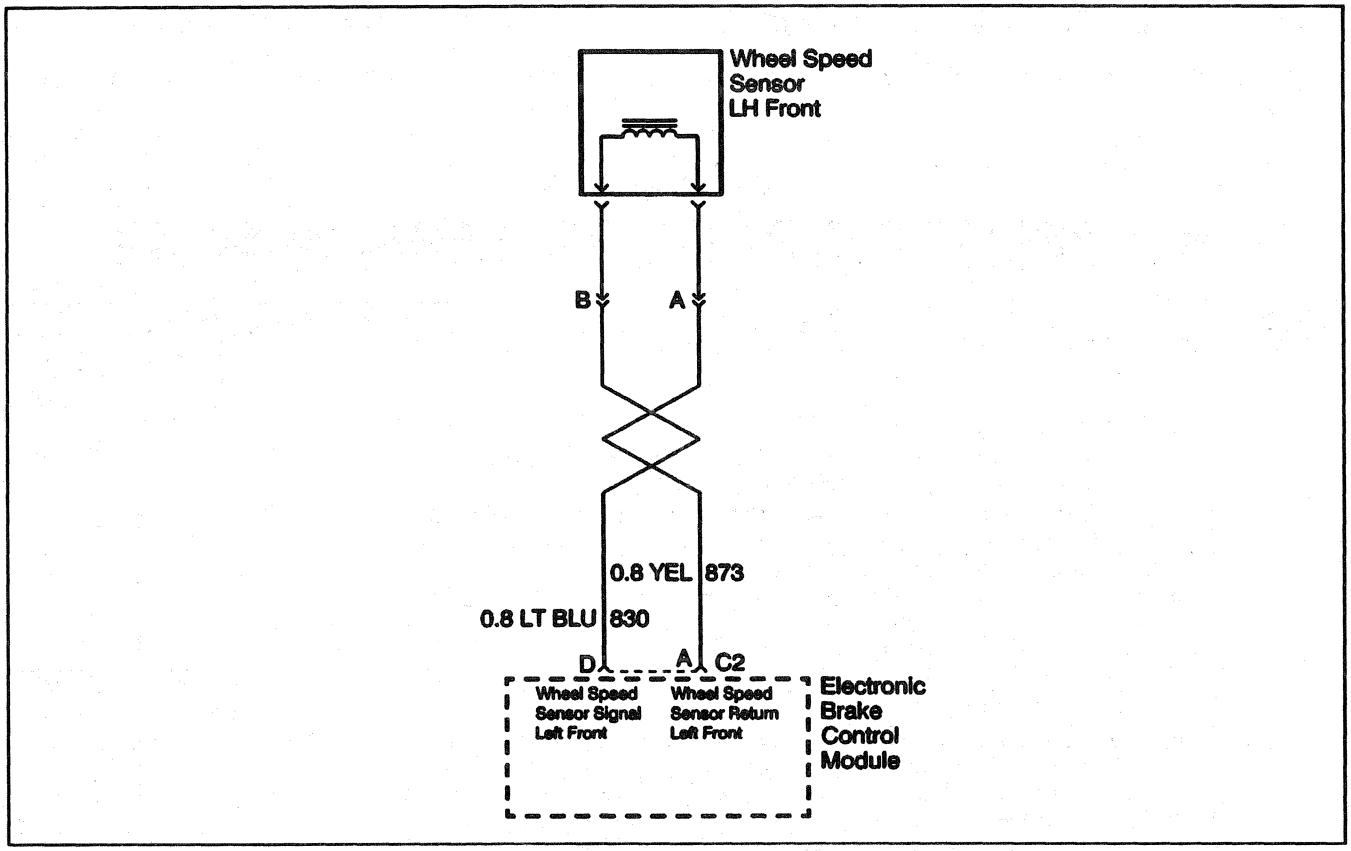
WSS Temperature vs. Sensor Resistance

DTC CHART TEST DESCRIPTION:

2. Visually inspect harness for damage.
3. Measure the resistance of the left front wheel speed sensor.
4. Measure the voltage output of the left front wheel speed sensor.
5. Measure the resistance of the left front sensor harness.

DTC C0026
LEFT FRONT WHEEL SPEED SIGNAL MISSING

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	Go to Step 2	Go to System Check
2	1. Turn the ignition to OFF. 2. Inspect the left front wheel speed sensor, sensor cable, and connectors for signs of damage or corrosion. 3. Inspect the wheel speed sensor and toothed ring for looseness paying particular attention to the toothed ring. Any deviation will affect the wheel speed sensor output signal. 4. Inspect the 4-way EBCM harness connector and harness for signs of damage or corrosion. Is there evidence of physical damage?	—	Go to Step 7	Go to Step 3
3	1. Disconnect the left front wheel speed sensor harness connector from the wheel speed sensor. 2. Using a J 39200, measure the resistance between terminal A and terminal B of the left front wheel speed sensor connector. Is the resistance of the sensor within specifications? (Refer to the table on the previous page for applicable sensor resistance values. The values in this table are for the temperature of the sensor, not the air temperature.)	—	Go to Step 4	Go to Step 8
4	1. With the J 39200 still connected, select A/C voltage scale. 2. Spin the wheel by hand while observing the voltage reading. Is the voltage within the range specified in the Value(s) column?	Greater than 100 mV	Go to Step 5	Go to Step 8
5	1. Disconnect the 4-way EBCM harness connector from the EBCM. 2. Using a J 39200, measure the resistance between terminal D and A of the 4-way EBCM harness connector. Does the J 39200 display OL (infinite)?	—	Go to Step 6	Go to Step 10
6	1. Reconnect all connectors. 2. Test drive vehicle above 24 km/h (15 mph). Did DTC C0026 set?	—	Go to Step 9	Go to Step 11
7	Make necessary repairs. Is repair complete?	—	Go to Diagnostic System Check	—
8	Replace the left front wheel speed sensor. Is repair complete?	—	Go to Diagnostic System Check	—
9	Replace the EBCM Is repair complete?	—	Go to Diagnostic System Check	—
10	Repair short between CKTs 830 or 873. Is repair complete?	—	Go to Diagnostic System Check	—
11	Malfunction is intermittent. Inspect all connectors and harnesses for damage which may result in high resistance when all components are connected. Refer to Diagnostic aids on the facing page for more information. Repair all damage found. Is repair complete?	—	Go to Diagnostic System Check	—



DTC C0027
LEFT FRONT WHEEL SPEED SIGNAL ERRATIC

Circuit Description

As a toothed ring passes by the wheel speed sensor, changes in the electromagnetic field cause the wheel speed sensor to produce a sinusoidal (AC) voltage signal whose frequency and amplitude is proportional to wheel speed. The magnitude of this signal is directly related to wheel speed and the proximity of the wheel speed sensor to the toothed ring, often referred to as the air gap.

Conditions For Setting DTC

- Average wheel speed for all wheel speed signals is greater than 25mph.
- Average left front wheel speed is greater than 25mph.
- No output from left front wheel speed signal for 15ms. Anything which suddenly prevents (intermittant) the left front wheel speed signal to drop to 0 while the vehicle is moving greater than 25mph.

Action Taken When the DTC Sets

- ANTILOCK indicator lamp is illuminated
- ABS is disabled

DTC C0027 is an Ignition Latched DTC which indicates the above is true until the ignition is turned to OFF (even if the cause of the DTC is intermittent).

Conditions For Clearing the DTC

- Conditions for setting the DTC are repaired and the scan tool clear DTCs function is used.

Diagnostic Aids

An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

When inspecting a wheel speed sensor, inspect the sensor terminals and harness connector for corrosion. If evidence of corrosion exists, replace the wheel speed sensor. Refer to On-Vehicle Service in this section.

Resistance of the wheel speed sensor will increase with an increase in sensor temperature. Refer to the following table for temperature/resistance values.

TEMP (°C)	TEMP (°F)	RESISTANCE (OHMS)
-40 to 4	-40 to 40	1575 to 2950
5 to 43	41 to 110	1980 to 3450
44 to 93	111 to 200	2250 to 4100
94 to 150	201 to 302	2750 to 4760

WSS Temperature vs. Sensor Resistance

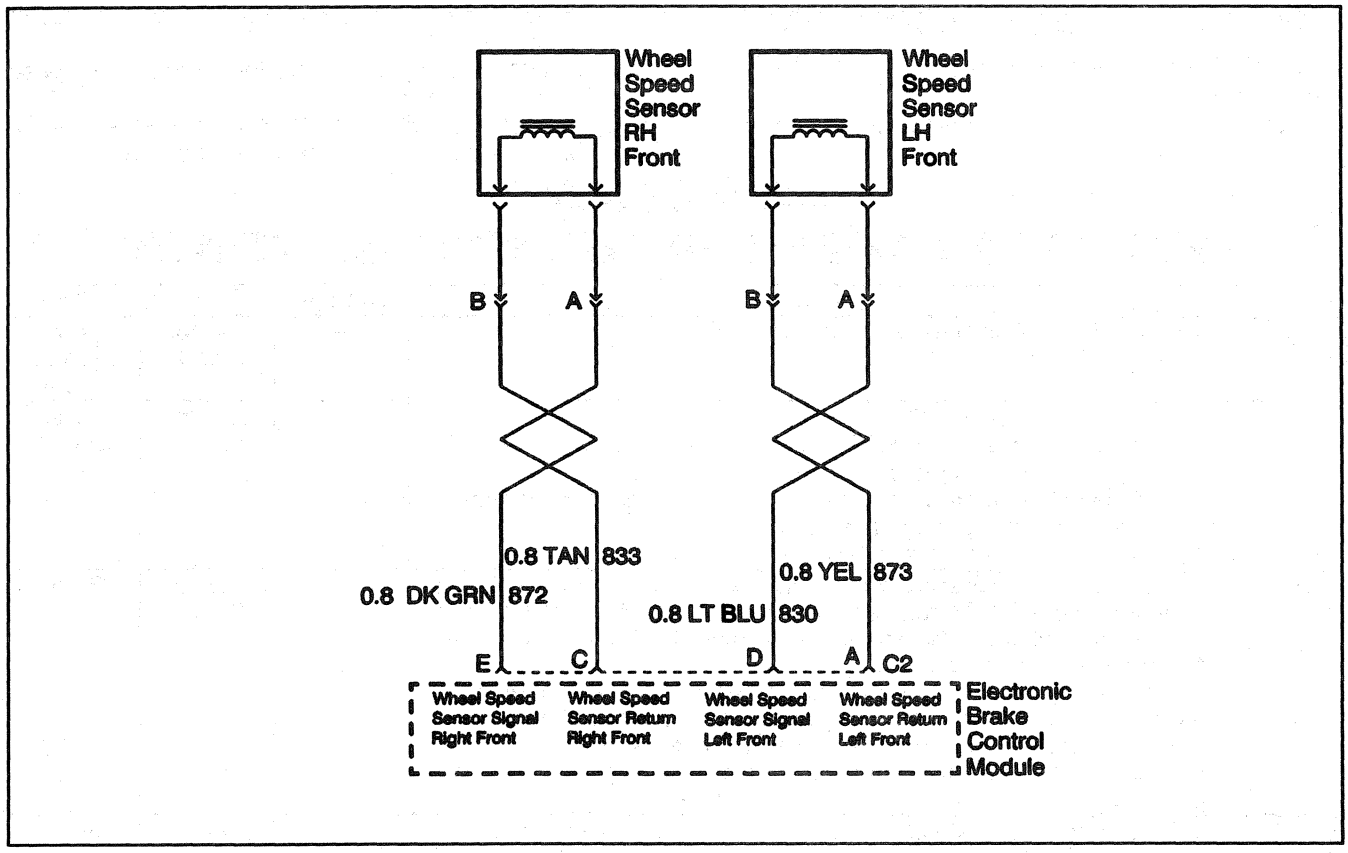
DTC CHART TEST DESCRIPTION:

Number(s) below refer to number(s) on the diagnostic chart.

2. Check EBCM 4-way connector for looseness, corrosion, etc.
3. Measure the resistance of EBCM 4-way connector pins C and E.
4. Measure resistance at the left front wheel speed sensor connector.
5. Inspect the left front WSS and tone wheel for physical damage or excessive clearance.

DTC C0027
LEFT FRONT WHEEL SPEED SIGNAL ERRATIC

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	Go to Step 2	Go to System Check
2	1. Turn the ignition to OFF. 2. Disconnect the 4-way EBCM harness connector from the EBCM and inspect for signs of damage or corrosion. 3. Inspect the wheel speed sensor harness and sensor harness connector for signs of damage or corrosion. Are all connection clean and tight?	—	Go to Step 3	Go to Step 6
3	Using a J 39200, measure the resistance between terminals D and A of the 4-way EBCM harness connector. Wiggle the WSS harness in various locations between the sensor and the EBCM while performing this measurement. Is the resistance of the sensor within specifications and does not fluctuate when the harness is wiggled? (Refer to the table on the previous page for applicable sensor resistance values. The values in this table are for the temperature of the sensor, not the air temperature.)	—	Go to Step 5	Go to Step 4
4	1. Disconnect the wheel speed sensor from the wheel speed sensor harness connector. 2. Using a J 39200, measure the resistance between terminal A and terminal B of the left front wheel speed sensor. Is the resistance of the sensor within specifications? (Refer to the table on the previous page for applicable sensor resistance values. The values in this table are for the temperature of the sensor, not the air temperature.)	—	Go to Step 7	Go to Step 8
5	1. Reconnect all connectors. 2. Remove left front tire, hub and rotor. 3. Verify that the left front wheel speed sensor is securely mounted and that the tone wheel is in good condition. Is the Wheel speed sensor and tone wheel in good condition?	—	Go to Step 9	Go to Step 10
6	Make necessary repairs to the 4-way EBCM harness connector. Is repair complete?	—	Go to Diagnostic System Check	—
7	Repair open, high resistance or short in CKTs 830 or 873. Is repair complete?	—	Go to Diagnostic System Check	—
8	Replace wheel speed sensor. Is repair complete?	—	Go to Diagnostic System Check	—
9	Malfunction is intermittent. Inspect all connectors and harnesses for damage which may result in high resistance when all components are connected. Refer to Diagnostic Aids on the facing page for more information. Repair all damage found. Is repair complete?	—	Go to Diagnostic System Check	—
10	Make necessary repairs. Is repair complete?	—	Go to Diagnostic System Check	—



DTC C0029
SIMULTANEOUS DROP-OUT OF FRONT WHEEL SPEED SIGNALS

Circuit Description

As a toothed ring passes by the wheel speed sensor, changes in the electromagnetic field cause the wheel speed sensor to produce a sinusoidal (AC) voltage signal whose frequency and amplitude is proportional to wheel speed. The magnitude of this signal is directly related to wheel speed and the proximity of the wheel speed sensor to the toothed ring, often referred to as the air gap.

Conditions For Setting DTC

- EBCM losing both front wheel speed signals when the vehicle is at speeds over 19 km/h (12 mph) (brake released) or 32 km/h (20 mph) (brake applied).

Action Taken When the DTC Sets

- ANTILOCK indicator lamp is illuminated
- ABS is disabled

DTC C0029 is an Ignition Latched DTC which indicates the above is true until the ignition is turned to OFF (even if the cause of the DTC is intermittent).

Conditions For Clearing the DTC

- Conditions for setting the DTC are repaired and the scan tool clear DTCs function is used.

Diagnostic Aids

The 4-way harness connector or the EBCM are the most probable causes for this DTC.

An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

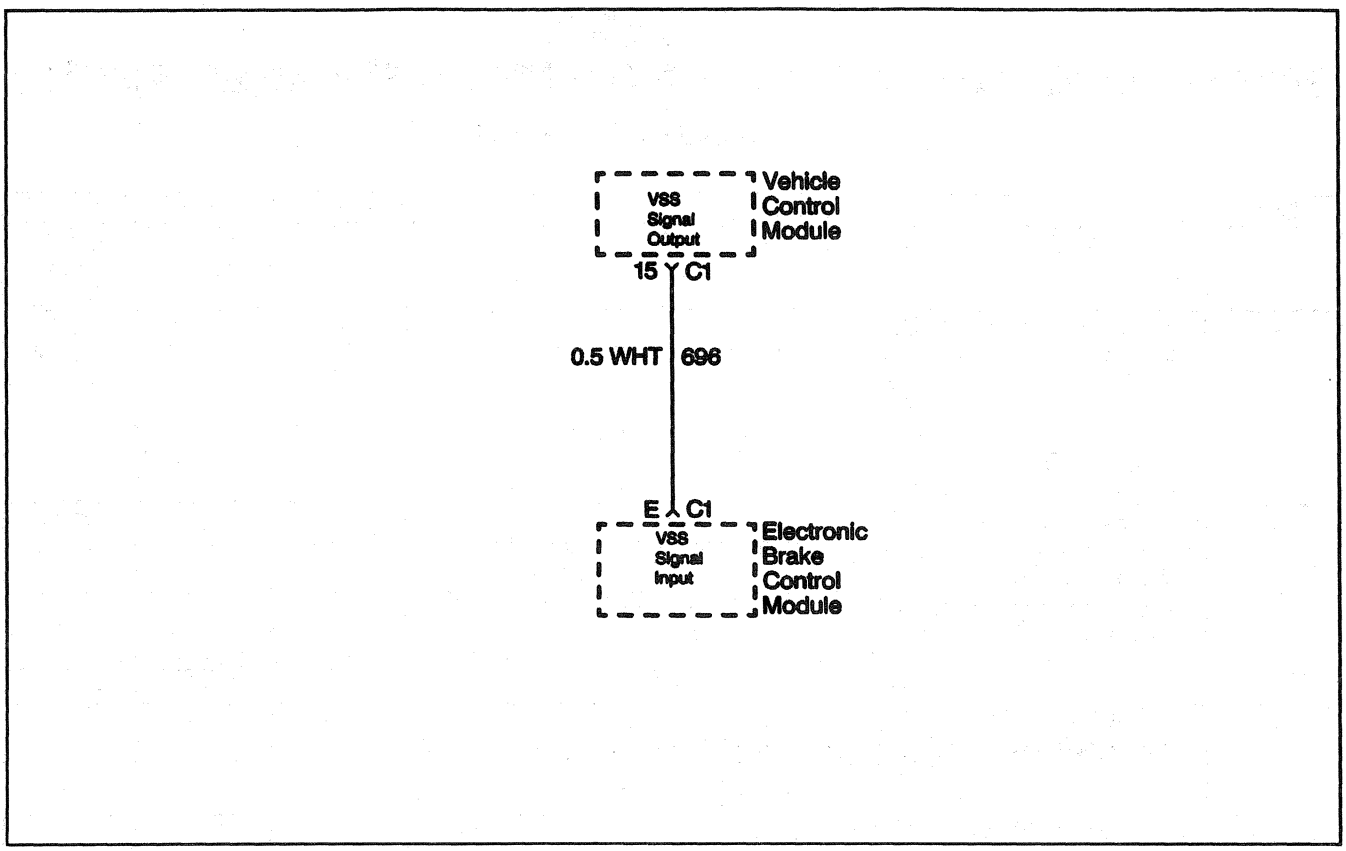
DTC Chart Test Description

Number(s) below refer to number(s) on the diagnostic chart.

2. Check the condition of the EBCM 4-way connector and harness.
3. Road test.

DTC C0029
SIMULTANEOUS DROP-OUT OF FRONT WHEEL SPEED SIGNALS

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	Go to Step 2	Go to System Check
2	1. Turn the ignition to OFF. 2. Disconnect the 4-way EBCM harness connector from the EBCM. 3. Inspect the 4-way EBCM harness connector and harness for signs of damage or corrosion. Is the harness OK and are all connection clean and tight?	—	Go to Step 3	Go to Step 4
3	1. Reconnect all connectors. 2. Clear DTC. 3. Road test vehicle at speeds above 24 km/h (15 mph). 4. Use the scan tool to read the DTCs. Did the DTC C0029 set?	—	Go to Step 5	Go to Step 6
4	Make necessary repairs to the 4-way EBCM harness connector. Is repair complete?	—	Go to Diagnostic System Check	—
5	Replace the EBCM. Is repair complete?	—	Go to Diagnostic System Check	—
6	Malfunction is intermittent. Inspect all connectors and harnesses for damage which may result in high resistance when all components are connected. Refer to Diagnostic Aids on the facing page for more information. Perform all necessary repairs. Is repair complete?	—	Go to Diagnostic System Check	—



DTC C0035
REAR SPEED SIGNAL CIRCUIT OPEN OR GROUNDED (GAS ENGINES ONLY)

Circuit Description

The rear wheel speed signal originates from the Vehicle Speed Sensor (VSS) which is connected to the Vehicle Control Module (VCM). The EBCM receives the rear wheel speed signal from the VCM.

Conditions For Setting DTC

- EBCM not seeing the correct voltage level from the VCM at startup.

Action Taken When the DTC Sets

- ANTILOCK indicator lamp is illuminated
- ABS is disabled

Conditions For Clearing the DTC

- Conditions for setting the DTC are repaired and the scan tool clear DTCs function is used.

Diagnostic Aids

A fault in CKT 696 can 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.

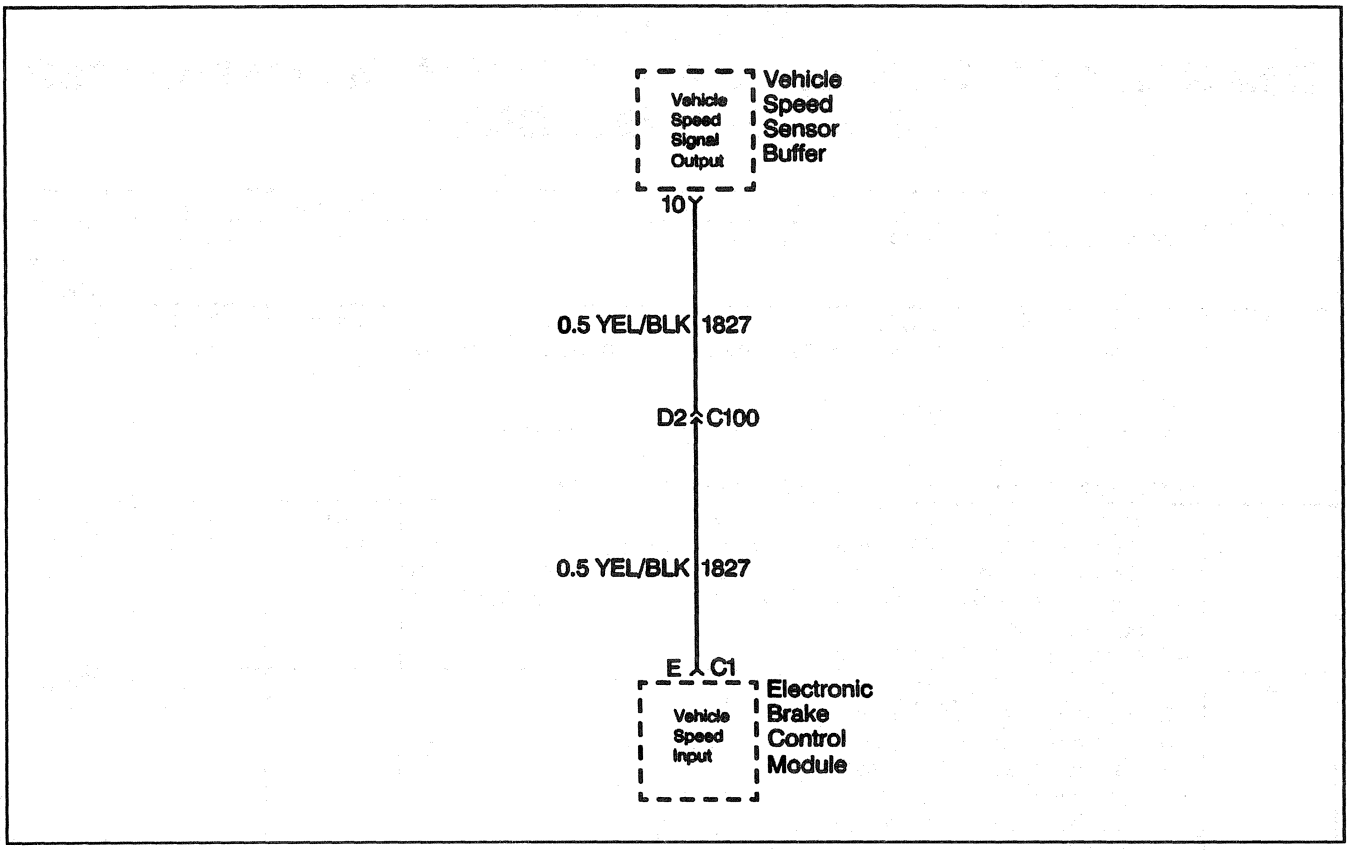
DTC Chart Test Description

Number(s) below refer to number(s) on the diagnostic chart.

1. Measure the voltage at terminal E of the EBCM.
3. Check for an open in CKT 696.
5. Check for a short to ground in CKT 696.

DTC C0035
REAR SPEED SIGNAL CIRCUIT OPEN OR GROUNDED
(GAS ENGINES ONLY)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	Go to Step 2	Go to System Check
2	1. Turn the ignition to OFF. 2. Disconnect the 10 way EBCM harness connector from the EBCM. 3. Turn the ignition to RUN. 4. Using the J 39200, measure the voltage at terminal E of the 10-way EBCM harness connector. Is the voltage within range specified in the value(s) column?	Greater than 10 volts	Go to Step 4	Go to Step 3
3	1. Turn the ignition to OFF. 2. Disconnect the VCM harness connector C1 from the VCM. 3. Using the J 39200, measure the resistance from terminal E of the 10-way EBCM harness connector to terminal 5 of the VCM harness connector C1. Is the resistance within range specified in the Value(s) column?	OL (Infinite)	Go to Step 5	Go to Step 8
4	1. Turn the ignition to OFF. 2. Reconnect all connectors. 3. Turn the ignition to RUN. 4. Use the scan tool to clear DTCs. 5. Test drive vehicle above 24 k/mh (15 mph). 6. Use the scan tool to read DTCs. Did DTC C0035 set?	—	Go to Step 6	Go to Step 7
5	Using the J 39200, measure the resistance from terminal E of the 10-way EBCM harness connector to ground. Is the resistance within range specified in the Value(s) column?	OL (Infinite)	Refer to SECTION 6E for VSS diagnostics.	Go to Step 9
6	Replace EBCM. Is repair complete?	—	Go to Diagnostic System Check	—
7	Malfunction is intermittent. Inspect all connectors and harnesses for damage which may result in high resistance when all components are connected. Refer to Diagnostic Aids on the facing page for more information. Perform all necessary repairs. Is repair complete?	—	Go to Diagnostic System Check	—
8	Repair open in CKT 696. Is repair complete?	—	Go to Diagnostic System Check	—
9	Repair short to ground in CKT 696. Is repair complete?	—	Go to Diagnostic System Check	—



DTC C0035
REAR SPEED SIGNAL CIRCUIT OPEN OR GROUNDED (DIESEL ENGINES ONLY)

Circuit Description

The rear wheel speed signal originates from the Vehicle Speed Sensor (VSS) which is connected to the VSS buffer. The EBCM receives the rear wheel speed signal from the VSS buffer.

Conditions For Setting DTC

- EBCM not seeing the correct voltage level from the PCM

Action Taken When the DTC Sets

- ANTILOCK indicator lamp is illuminated
- ABS is disabled

Conditions For Clearing the DTC

- Conditions for setting the DTC are repaired and the scan tool clear DTCs function is used.

Diagnostic Aids

A fault in CKT 696 can 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.

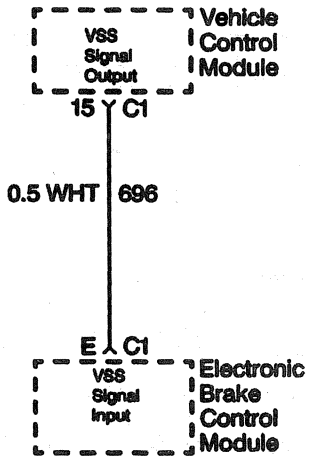
DTC Chart Test Description

Number(s) below refer to number(s) on the diagnostic chart.

1. Measure the voltage at terminal E of the EBCM.
3. Check for an open in CKT 696.
5. Check for a short to ground in CKT 696.

DTC C0035
REAR SPEED SIGNAL CIRCUIT OPEN OR GROUNDED (DIESEL ENGINES ONLY)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	Go to Step 2	Go to System Check
2	1. Turn the ignition to OFF. 2. Disconnect the 10 way EBCM harness connector from the EBCM. 3. Turn the ignition to RUN. 4. Using the J 39200, measure the voltage at terminal E of the 10-way EBCM harness connector. Is the voltage within range specified in the value(s) column?	Greater than 10 volts	Go to Step 4	Go to Step 3
3	1. Turn the ignition to OFF. 2. Disconnect the VSS buffer harness connector from the VSS buffer. 3. Using the J 39200, measure the resistance from terminal E of the 10-way EBCM harness connector to terminal 10 of the VSS buffer harness connector. Is the resistance within range specified in the Value(s) column?	OL (Infinite)	Go to Step 5	Go to Step 8
4	1. Turn the ignition to OFF. 2. Reconnect all connectors. 3. Turn the ignition to RUN. 4. Use the scan tool to clear DTCs. 5. Test drive vehicle above 24 k/mh (15 mph). 6. Use the scan tool to read DTCs. Did DTC C0035 set?	—	Go to Step 6	Go to Step 7
5	Using the J 39200, measure the resistance from terminal E of the 10-way EBCM harness connector to ground. Is the resistance within range specified in the Value(s) column?	OL (Infinite)	Refer to SECTION 6E for VSS diagnostics.	Go to Step 9
6	Replace EBCM. Is repair complete?	—	Go to Diagnostic System Check	—
7	Malfunction is intermittent. Inspect all connectors and harnesses for damage which may result in high resistance when all components are connected. Refer to Diagnostic Aids on the facing page for more information. Perform all necessary repairs. Is repair complete?	—	Go to Diagnostic System Check	—
8	Repair open in CKT 696. Is repair complete?	—	Go to Diagnostic System Check	—
9	Repair short to ground in CKT 696. Is repair complete?	—	Go to Diagnostic System Check	—



DTC C0036
REAR SPEED SIGNAL MISSING
(GAS ENGINES ONLY)

Circuit Description

The rear wheel speed signal originates from the Vehicle Speed Sensor (VSS) which is connected to the Vehicle Control Module (VCM). The EBCM receives the rear wheel speed signal from the VCM.

Conditions For Setting DTC

- EBCM losing the rear wheel speed signal for at least 5 seconds at speeds over 13 km/h (8 mph) with the brake pedal released. If a DTC C0035 is also stored, use that diagnostic chart.

Action Taken When the DTC Sets

- ANTILOCK indicator lamp is illuminated
- ABS is disabled

Conditions For Clearing the DTC

- Conditions for setting the DTC are repaired and the scan tool clear DTCs function is used.

Diagnostic Aids

This DTC can be set by a faulty VSS, or a fault in CKT 821, 822, or 696.

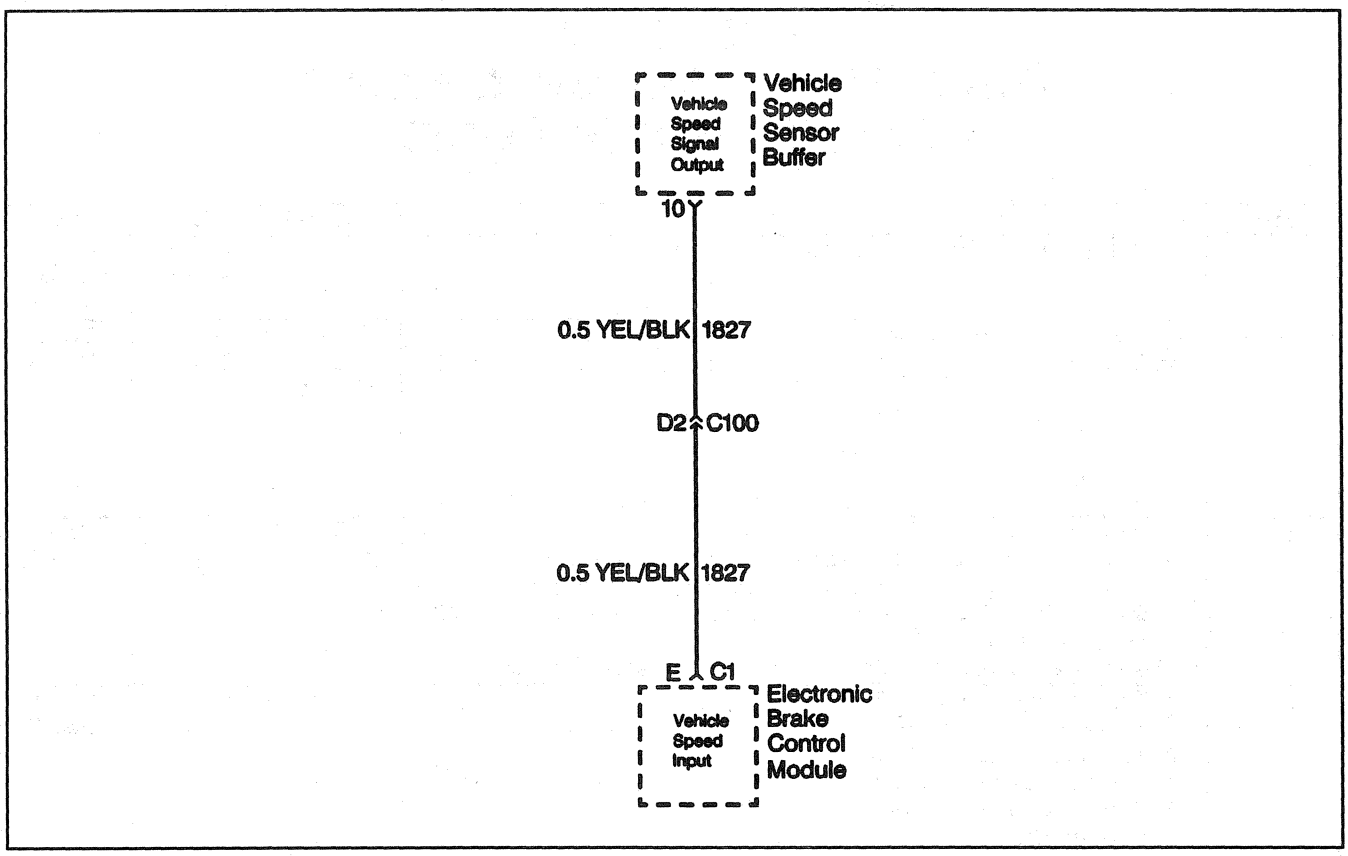
DTC Chart Test Description

Number(s) below refer to number(s) on the diagnostic chart.

1. Measure the voltage at terminal E of the EBCM.
3. Check for an open in CKT 696.
5. Check for a short to ground in CKT 696.

DTC C0036
REAR SPEED SIGNAL MISSING
(GAS ENGINES ONLY)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	Go to Step 2	Go to System Check
2	1. Turn the ignition to OFF. 2. Disconnect the 10 way EBCM harness connector from the EBCM. 3. Turn the ignition to RUN. 4. Using the J 39200, measure the voltage at terminal E of the 10-way EBCM harness connector. Is the voltage within range specified in the value(s) column?	Greater than 10 volts	Go to Step 4	Go to Step 3
3	1. Turn the ignition to OFF. 2. Disconnect the VCM harness connector C1 from the VCM. 3. Using the J 39200, measure the resistance from terminal E of the 10-way EBCM harness connector to terminal 5 of the VCM harness connector C1. Is the resistance within range specified in the Value(s) column?	OL (Infinite)	Go to Step 5	Go to Step 8
4	1. Turn the ignition to OFF. 2. Reconnect all connectors. 3. Turn the ignition to RUN. 4. Use the scan tool to clear DTCs. 5. Test drive vehicle above 24 k/mh (15 mph). 6. Use the scan tool to read DTCs. Did DTC C0036 set?	—	Go to Step 6	Go to Step 7
5	Using the J 39200, measure the resistance from terminal E of the 10-way EBCM harness connector to ground. Is the resistance within range specified in the Value(s) column?	OL (Infinite)	Refer to SECTION 6E for VSS diagnostics.	Go to Step 9
6	Replace EBCM. Is repair complete?	—	Go to Diagnostic System Check	—
7	Malfunction is intermittent. Inspect all connectors and harnesses for damage which may result in high resistance when all components are connected. Refer to Diagnostic Aids on the facing page for more information. Perform all necessary repairs. Is repair complete?	—	Go to Diagnostic System Check	—
8	Repair open in CKT 696. Is repair complete?	—	Go to Diagnostic System Check	—
9	Repair short to ground in CKT 696. Is repair complete?	—	Go to Diagnostic System Check	—



DTC C0036
REAR SPEED SIGNAL MISSING (DIESEL ENGINES ONLY)

Circuit Description

The rear wheel speed signal originates from the Vehicle Speed Sensor (VSS) which is connected to the VSS buffer. The EBCM receives the rear wheel speed signal from the VSS buffer.

Conditions For Setting DTC

- EBCM losing the rear wheel speed signal for at least 5 seconds at speeds over 13 km/h (8 mph) with the brake pedal released. If a DTC C0035 is also stored, use that diagnostic chart.

Action Taken When the DTC Sets

- ANTILOCK indicator lamp is illuminated
- ABS is disabled

Conditions For Clearing the DTC

- Conditions for setting the DTC are repaired and the scan tool clear DTCs function is used.

Diagnostic Aids

This DTC can be set by a faulty VSS, or a fault in CKT 821, 822, or 696.

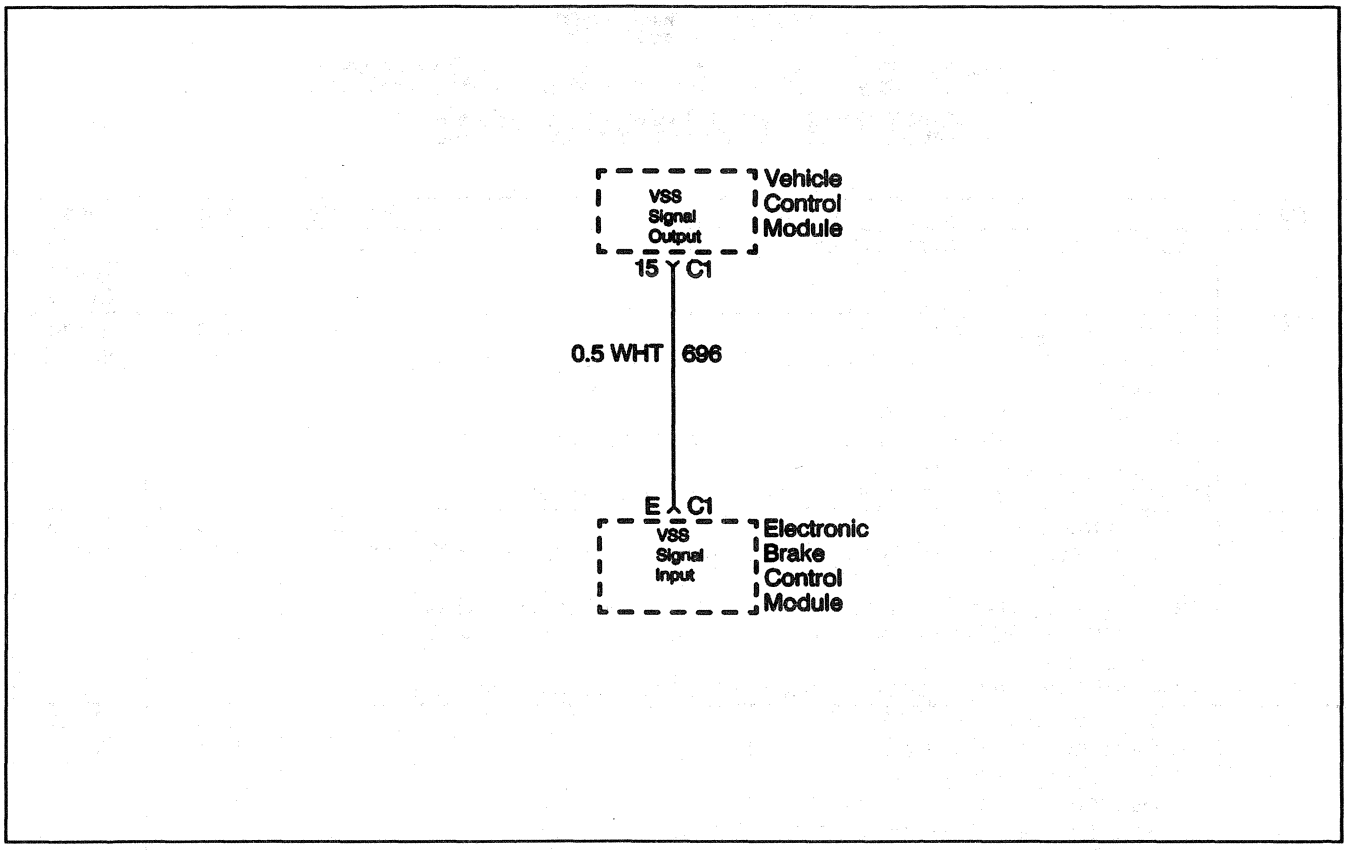
DTC Chart Test Description

Number(s) below refer to number(s) on the diagnostic chart.

1. Measure the voltage at terminal E of the EBCM.
3. Check for an open in CKT 696.
5. Check for a short to ground in CKT 696.

DTC C0036
REAR SPEED SIGNAL MISSING
(DIESEL ENGINES ONLY)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	Go to Step 2	Go to System Check
2	1. Turn the ignition to OFF. 2. Disconnect the 10 way EBCM harness connector from the EBCM. 3. Turn the ignition to RUN. 4. Using the J 39200, measure the voltage at terminal E of the 10-way EBCM harness connector. Is the voltage within range specified in the value(s) column?	Greater than 10 volts	Go to Step 4	Go to Step 3
3	1. Turn the ignition to OFF. 2. Disconnect the VSS buffer harness connector from the VSS buffer. 3. Using the J 39200, measure the resistance from terminal E of the 10-way EBCM harness connector to terminal 10 of the VSS buffer harness connector. Is the resistance within range specified in the Value(s) column?	OL (Infinite)	Go to Step 5	Go to Step 8
4	1. Turn the ignition to OFF. 2. Reconnect all connectors. 3. Turn the ignition to RUN. 4. Use the scan tool to clear DTCs. 5. Test drive vehicle above 24 k/mh (15 mph). 6. Use the scan tool to read DTCs. Did DTC C0036 set?	—	Go to Step 6	Go to Step 7
5	Using the J 39200, measure the resistance from terminal E of the 10-way EBCM harness connector to ground. Is the resistance within range specified in the Value(s) column?	OL (Infinite)	Refer to SECTION 6E for VSS diagnostics.	Go to Step 9
6	Replace EBCM. Is repair complete?	—	Go to Diagnostic System Check	—
7	Malfunction is intermittent. Inspect all connectors and harnesses for damage which may result in high resistance when all components are connected. Refer to Diagnostic Aids on the facing page for more information. Perform all necessary repairs. Is repair complete?	—	Go to Diagnostic System Check	—
8	Repair open in CKT 696. Is repair complete?	—	Go to Diagnostic System Check	—
9	Repair short to ground in CKT 696. Is repair complete?	—	Go to Diagnostic System Check	—



DTC C0037
REAR SPEED SIGNAL ERRATIC
(GAS ENGINES ONLY)

Circuit Description

The rear wheel speed signal originates from the Vehicle Speed Sensor (VSS) which is connected to the Vehicle Control Module (VCM). The EBCM receives the rear wheel speed signal from the VCM.

Conditions For Setting DTC

- EBCM seeing the rear speed signal line drop out and return. This DTC can be caused by a malfunction in the VSS, or a fault in CKT 821, 822, or 696.

Action Taken When the DTC Sets

- ANTILOCK indicator lamp is illuminated
- ABS is disabled

Conditions For Clearing the DTC

- Conditions for setting the DTC are repaired and the scan tool clear DTCs function is used.

Diagnostic Aids

This DTC can be caused by a malfunction in the VSS, or a fault in CKT 821, 822, or 696.

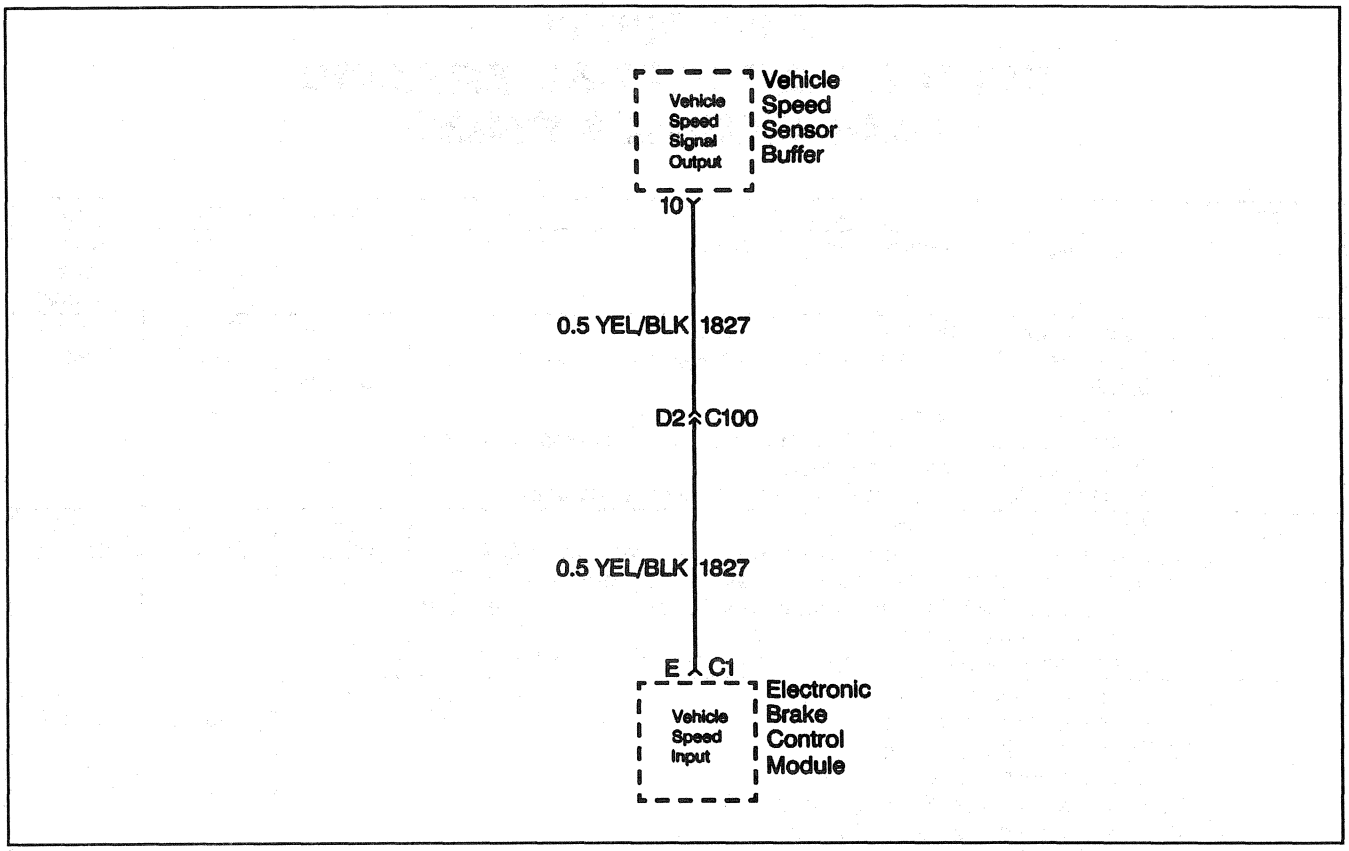
DTC Chart Test Description

Number(s) below refer to number(s) on the diagnostic chart.

1. Measure the voltage at terminal E of the EBCM.
3. Check for an open in CKT 696.
5. Check for a short to ground in CKT 696.

DTC C0037
REAR SPEED SIGNAL ERRATIC
(GAS ENGINES ONLY)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	Go to Step 2	Go to System Check
2	1. Turn the ignition to OFF. 2. Disconnect the 10 way EBCM harness connector from the EBCM. 3. Turn the ignition to RUN. 4. Using the J 39200, measure the voltage at terminal E of the 10-way EBCM harness connector. Is the voltage within range specified in the value(s) column?	Greater than 10 volts	Go to Step 4	Go to Step 3
3	1. Turn the ignition to OFF. 2. Disconnect the VCM harness connector C1 from the VCM. 3. Using the J 39200, measure the resistance from terminal E of the 10-way EBCM harness connector to terminal 5 of the VCM harness connector C1. Is the resistance within range specified in the Value(s) column?	OL (Infinite)	Go to Step 5	Go to Step 8
4	1. Turn the ignition to OFF. 2. Reconnect all connectors. 3. Turn the ignition to RUN. 4. Use the scan tool to clear DTCs. 5. Test drive vehicle above 24 k/mh (15 mph). 6. Use the scan tool to read DTCs. Did DTC C0037 set?	—	Go to Step 6	Go to Step 7
5	Using the J 39200, measure the resistance from terminal E of the 10-way EBCM harness connector to ground. Is the resistance within range specified in the Value(s) column?	OL (Infinite)	Refer to SECTION 6E for VSS diagnostics.	Go to Step 9
6	Replace EBCM. Is repair complete?	—	Go to Diagnostic System Check	—
7	Malfunction is intermittent. Inspect all connectors and harnesses for damage which may result in high resistance when all components are connected. Refer to Diagnostic Aids on the facing page for more information. Perform all necessary repairs. Is repair complete?	—	Go to Diagnostic System Check	—
8	Repair open in CKT 696. Is repair complete?	—	Go to Diagnostic System Check	—
9	Repair short to ground in CKT 696. Is repair complete?	—	Go to Diagnostic System Check	—



DTC C0037
REAR SPEED SIGNAL ERRATIC (DIESEL ENGINES ONLY)

Circuit Description

The rear wheel speed signal originates from the Vehicle Speed Sensor (VSS) which is connected to the VSS buffer. The EBCM receives the rear wheel speed signal from the VSS buffer.

Conditions For Setting DTC

- EBCM seeing the rear speed signal line drop out and return. This DTC can be caused by a malfunction in the VSS, or a fault in CKT 821, 822, or 696.

Action Taken When the DTC Sets

- ANTILOCK indicator lamp is illuminated
- ABS is disabled

Conditions For Clearing the DTC

- Conditions for setting the DTC are repaired and the scan tool clear DTCs function is used.

Diagnostic Aids

This DTC can be caused by a malfunction in the VSS, or a fault in CKT 821, 822, or 696.

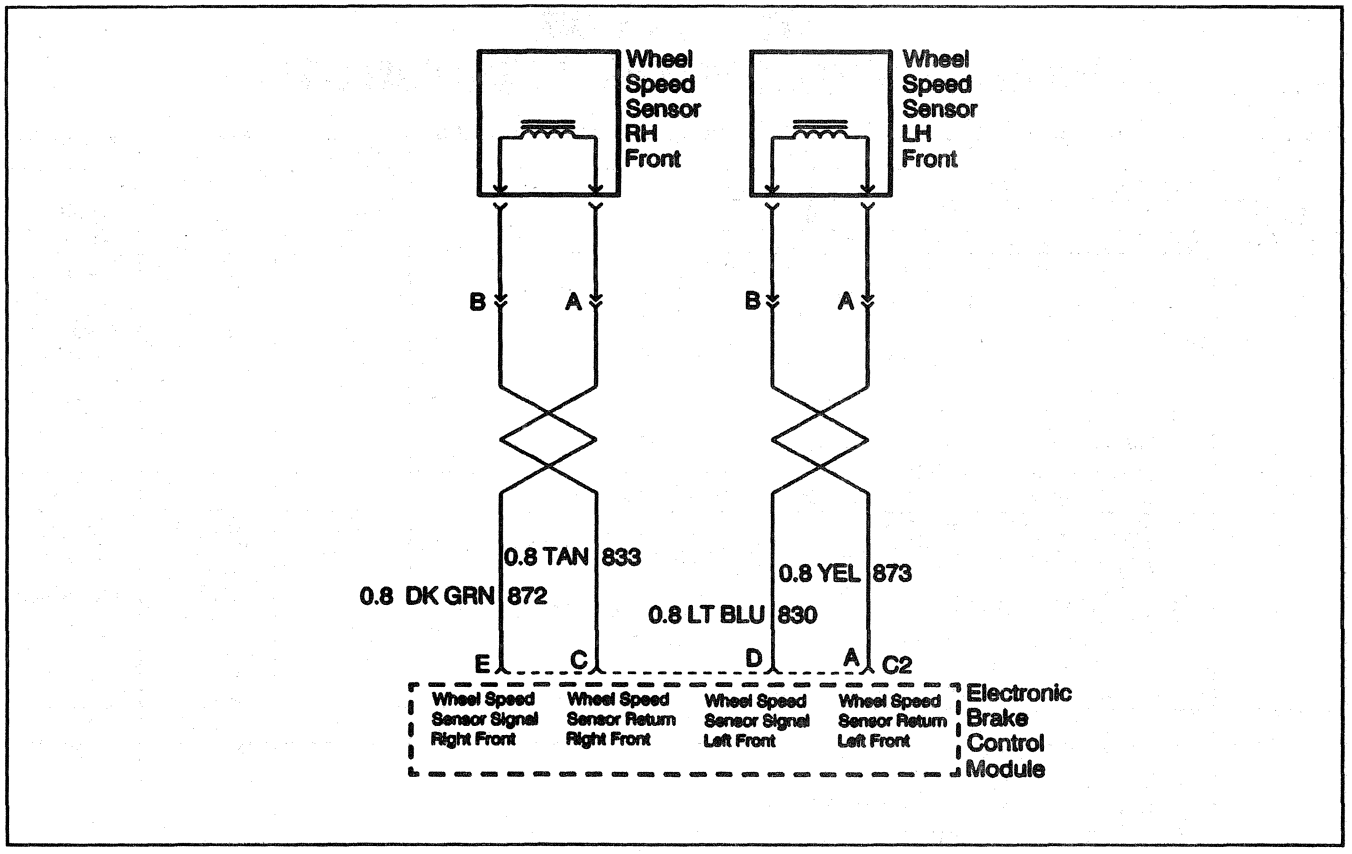
DTC Chart Test Description

Number(s) below refer to number(s) on the diagnostic chart.

1. Measure the voltage at terminal E of the EBCM.
3. Check for an open in CKT 696.
5. Check for a short to ground in CKT 696.

DTC C0037
REAR SPEED SIGNAL ERRATIC
(DIESEL ENGINES ONLY)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	Go to Step 2	Go to System Check
2	1. Turn the ignition to OFF. 2. Disconnect the 10 way EBCM harness connector from the EBCM. 3. Turn the ignition to RUN. 4. Using the J 39200, measure the voltage at terminal E of the 10-way EBCM harness connector. Is the voltage within range specified in the value(s) column?	Greater than 10 volts	Go to Step 4	Go to Step 3
3	1. Turn the ignition to OFF. 2. Disconnect the VSS buffer harness connector from the VSS buffer. 3. Using the J 39200, measure the resistance from terminal E of the 10-way EBCM harness connector to terminal 10 of the VSS buffer harness connector. Is the resistance within range specified in the Value(s) column?	OL (Infinite)	Go to Step 5	Go to Step 8
4	1. Turn the ignition to OFF. 2. Reconnect all connectors. 3. Turn the ignition to RUN. 4. Use the scan tool to clear DTCs. 5. Test drive vehicle above 24 k/mh (15 mph). 6. Use the scan tool to read DTCs. Did DTC C0037 set?	—	Go to Step 6	Go to Step 7
5	Using the J 39200, measure the resistance from terminal E of the 10-way EBCM harness connector to ground. Is the resistance within range specified in the Value(s) column?	OL (Infinite)	Refer to SECTION 6E for VSS diagnostics.	Go to Step 9
6	Replace EBCM. Is repair complete?	—	Go to Diagnostic System Check	—
7	Malfunction is intermittent. Inspect all connectors and harnesses for damage which may result in high resistance when all components are connected. Refer to Diagnostic Aids on the facing page for more information. Perform all necessary repairs. Is repair complete?	—	Go to Diagnostic System Check	—
8	Repair open in CKT 696. Is repair complete?	—	Go to Diagnostic System Check	—
9	Repair short to ground in CKT 696. Is repair complete?	—	Go to Diagnostic System Check	—



DTC C0038
WHEEL SPEED SIGNAL MALFUNCTION

Circuit Description

As a toothed ring passes by the wheel speed sensor, changes in the electromagnetic field cause the wheel speed sensor to produce a sinusoidal (AC) voltage signal whose frequency and amplitude is proportional to wheel speed. The magnitude of this signal is directly related to wheel speed and the proximity of the wheel speed sensor to the toothed ring, often referred to as the air gap.

Conditions For Setting DTC

- Any wheel speed differing from the vehicle speed for any of the following:
  - One mismatched wheel speed more than double or less than half the other 3 wheel speeds.
  - All four wheel speeds differing from each other by 8 percent.
- Vehicle speed greater than 12mph.
- No unexpected wheel acceleration. Anything that generates consistant differences between wheel speed signals.

Action Taken When the DTC Sets

- ANTILOCK indicator lamp is illuminated
- ABS is disabled

This DTC is a Ignition Latched DTC which indicates the above is true until the ignition is turned to OFF (even if the cause of the DTC is intermittent).

Conditions For Clearing the DTC

- Conditions for setting the DTC are repaired and the scan tool clear DTCs function is used.

Diagnostic Aids

A DTC C0038 is usually set by significantly different tires installed on the vehicle.

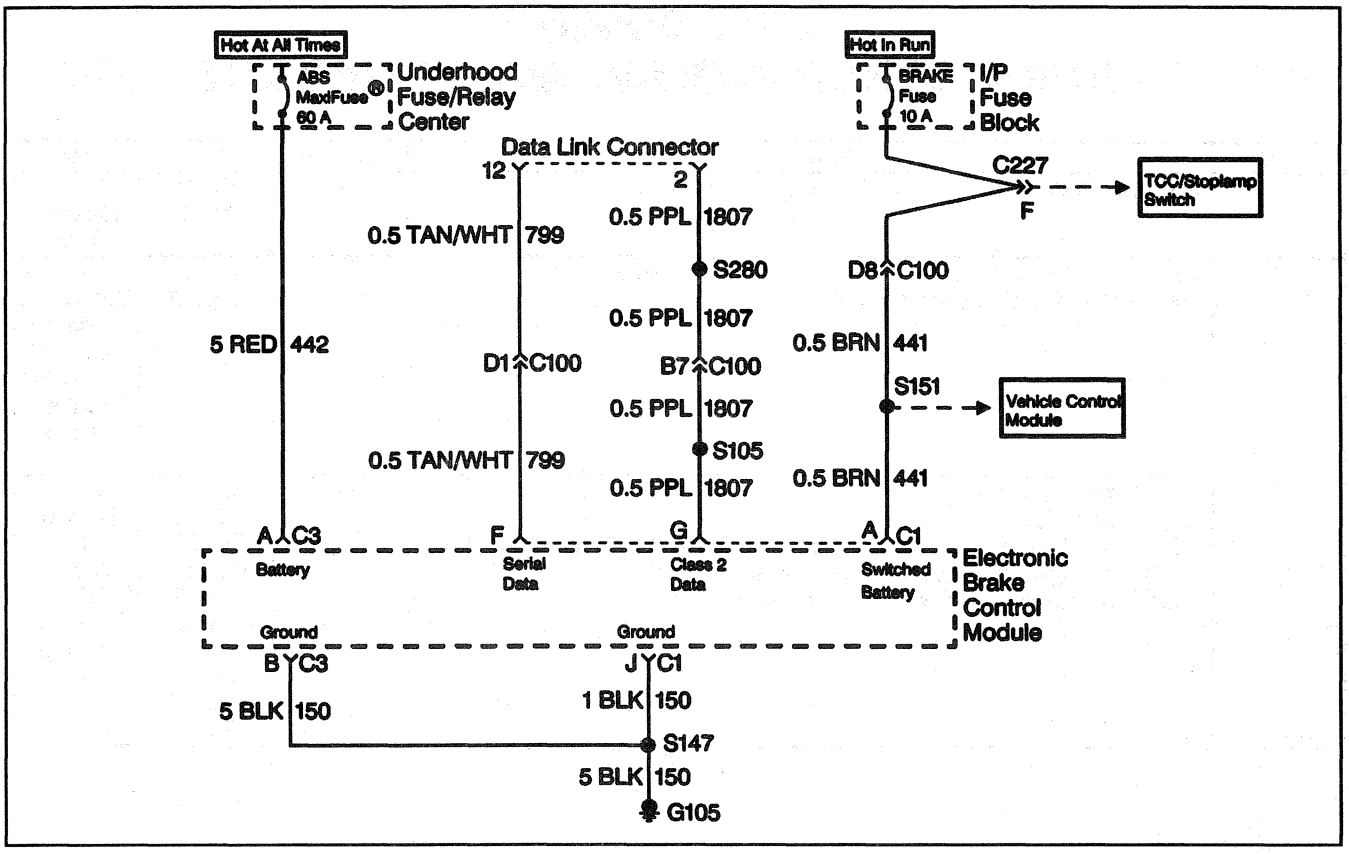
Test Description

Number(s) below refer to number(s) on the diagnostic chart.

2. Check all speed sensor outputs using the scan tool.

DTC C0038
WHEEL SPEED SIGNAL MALFUNCTION

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	Go to Step 2	Go to System Check
2	Inspect the vehicles tires for a variation in tire size. Are all four tire sizes the same?	—	Go to Step 3	Refer to Diagnostic Aids on facing page for further information.
3	1. Install scan tool. 2. Clear DTCs. 3. While driving the vehicle, use the DATA LIST function of the scan tool to monitor the wheel speeds. Does the scan tool indicate a faulty sensor?	—	Go to DTC C0023, C0027, C0037 depending upon which sensor is effected	Problem is intermittent. Go to Diagnostic Aids on facing page



DTC C0041
RIGHT FRONT ISOLATION SOLENOID CIRCUIT OPEN

Circuit Description:

When the RF isolation solenoid is needed (see ABS Braking Mode in this Section), the EBCM will ground the solenoid circuit to energize the coil within the solenoid. This will close the isolation valve by the magnetic force created by the solenoid coil.

Conditions For Setting the DTC

- ABS bulb check complete
- Low voltage on EBCM solenoid driver circuit when expected to be high (solenoid not energized)

Action Taken When the DTC Sets

- ANTILOCK indicator lamp is illuminated
- ABS is disabled

DTC C0041 is an Ignition Latched DTC which indicates the above is true until the ignition is turned to OFF (even if the cause of the DTC is intermittent).

Conditions For Clearing the DTC

- Conditions for setting the DTC are repaired and the scan tool clear DTCs function is used.

Diagnostic Aids

DTC C0041 is usually set by an open solenoid coil within the EBCM. The RF isolation solenoid is located within the BPMV and is not serviceable. If the test does not repair the DTC, the EBCM must be replaced.

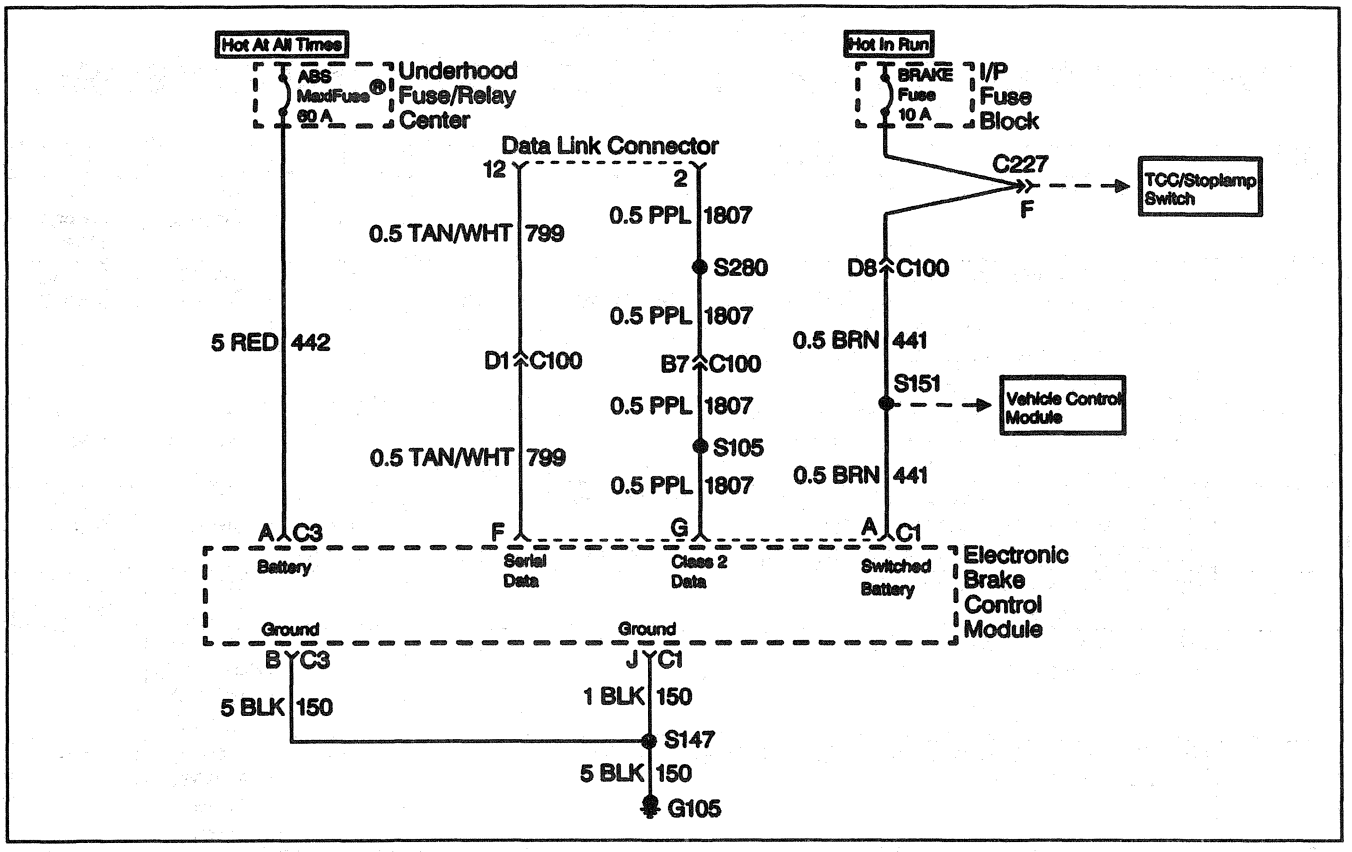
If DTC C0041 is set with other DTCs, check for a poor EBCM ground or poor EBCM power feed.

Test Description

2. Inspect EBCM 2-way harness connector for damage.
3. Check EBCM power and ground circuits.

DTC C0041
RIGHT FRONT ISOLATION SOLENOID CIRCUIT OPEN

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	Go to Step 2	Go to System Check
2	1. Turn the ignition to OFF. 2. Disconnect the 2-way EBCM harness connector from the EBCM. 3. Inspect the connector for damage or corrosion which could cause a loss of power to the EBCM. Is the connector in good condition?	—	Go to Step 3	Go to Step 6
3	Using a J 39200, measure the resistance from terminal B of the 2-way EBCM harness connector and ground. Is the resistance within the range specified in the Value(s) column?	0-2 Ω	Go to Step 4	Go to Step 7
4	Using a J 39200, measure the voltage from terminal A of the 2-way EBCM harness connector to ground. Is the voltage within the range specified in the Value(s) column?	Greater than 10 volts	Go to Step 8	Go to Step 5
5	Inspect the ABS 60 amp fuse. Is the fuse open?	—	Go to Step 9	Go to Step 10
6	Make necessary repairs to the 2 way EBCM harness connector. Is repair complete?	—	Go to Diagnostic System Check	—
7	Repair open or high resistance in the ground CKT 150. Is repair complete?	—	Go to Diagnostic System check	—
8	Replace the EBCM. Is repair complete?	—	Go to Diagnostic System Check	—
9	Repair short to ground in CKT 442. Is repair complete?	—	Go to Diagnostic System Check	—
10	Repair open or high resistance in CKT 442. Is repair complete?	—	Go to Diagnostic System Check	—



DTC C0042
RIGHT FRONT DUMP SOLENOID CIRCUIT OPEN

Circuit Description:

When the RF dump solenoid is needed (see ABS Braking Mode in this Section), the EBCM will ground the solenoid circuit to energize the coil within the solenoid. This will open the dump valve by the magnetic force created by the solenoid coil.

Conditions For Setting the DTC

- ABS bulb check complete
- Low voltage on EBCM solenoid driver circuit when expected to be high (solenoid not energized)

Action Taken When the DTC Sets

- ANTILOCK indicator lamp is illuminated
- ABS is disabled

DTC C0042 is an Ignition Latched DTC which indicates the above is true until the ignition is turned to OFF (even if the cause of the DTC is intermittent).

Conditions For Clearing the DTC

- Conditions for setting the DTC are repaired and the scan tool clear DTCs function is used.

Diagnostic Aids

DTC C0042 is usually set by an open solenoid coil within the EBCM. The RF dump solenoid is located within the BPMV and is not serviceable. If the test does not repair the DTC, the EBCM must be replaced.

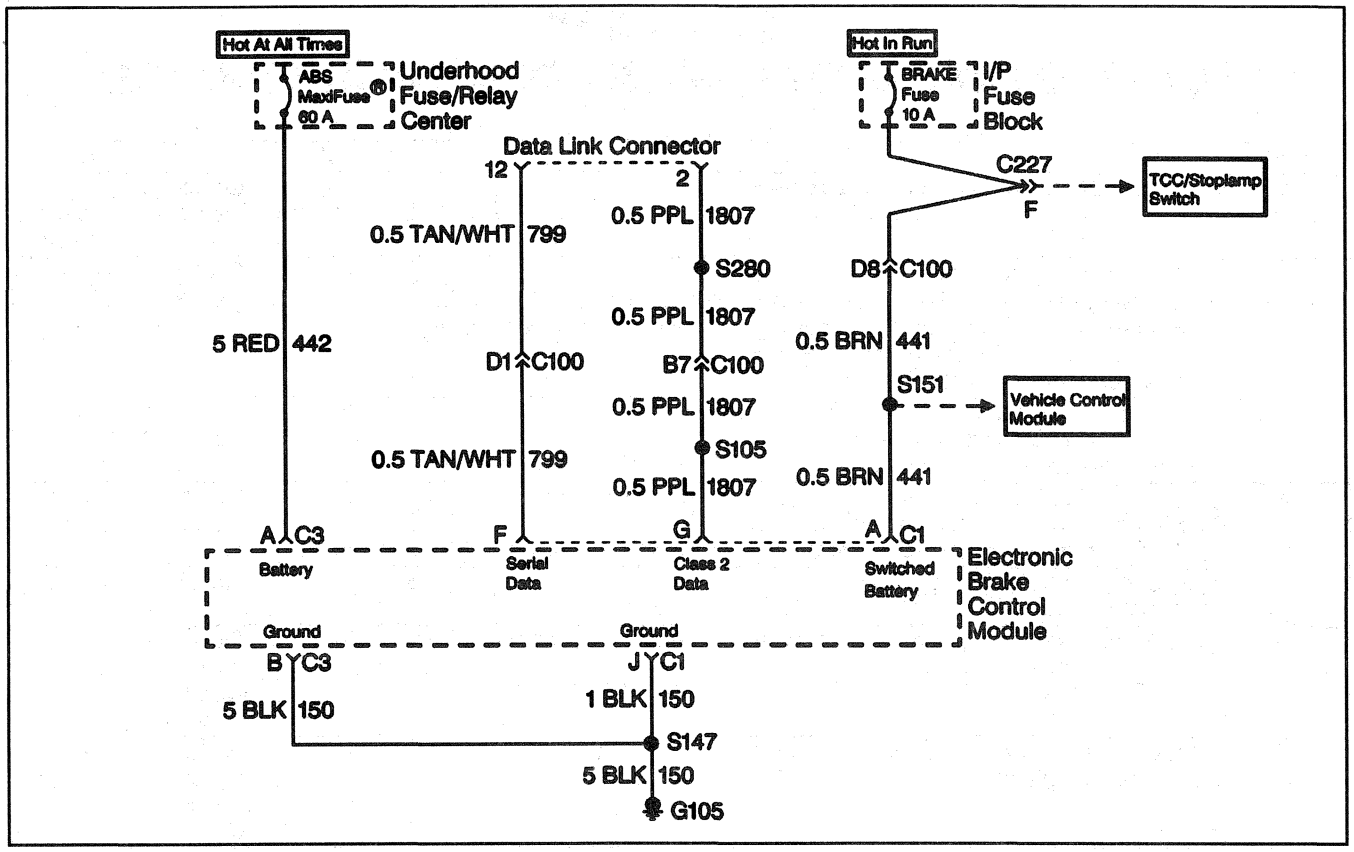
If DTC C0042 is set with other DTCs, check for a poor EBCM ground or poor EBCM power feed.

Test Description

2. Inspect EBCM 2-way harness connector for damage.
3. Check EBCM power and ground circuits.

DTC C0042
RIGHT FRONT DUMP SOLENOID CIRCUIT OPEN

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	Go to Step 2	Go to System Check
2	1. Turn the ignition to OFF. 2. Disconnect the 2-way EBCM harness connector from the EBCM. 3. Inspect the connector for damage or corrosion which could cause a loss of power to the EBCM. Is the connector in good condition?	—	Go to Step 3	Go to Step 6
3	Using a J 39200, measure the resistance from terminal B of the 2-way EBCM harness connector and ground. Is the resistance within the range specified in the Value(s) column?	0-2 Ω	Go to Step 4	Go to Step 7
4	Using a J 39200, measure the voltage from terminal A of the 2-way EBCM harness connector to ground. Is the voltage within the range specified in the Value(s) column?	Greater than 10 volts	Go to Step 8	Go to Step 5
5	Inspect the ABS 60 amp fuse. Is the fuse open?	—	Go to Step 9	Go to Step 10
6	Make necessary repairs to the 2 way EBCM harness connector. Is repair complete?	—	Go to Diagnostic System Check	—
7	Repair open or high resistance in the ground CKT 150. Is repair complete?	—	Go to Diagnostic System check	—
8	Replace the EBCM. Is repair complete?	—	Go to Diagnostic System Check	—
9	Repair short to ground in CKT 442. Is repair complete?	—	Go to Diagnostic System Check	—
10	Repair open or high resistance in CKT 442. Is repair complete?	—	Go to Diagnostic System Check	—



DTC C0043
RIGHT FRONT ISOLATION SOLENOID CIRCUIT SHORTED

Circuit Description:

When the RF isolation solenoid is needed (see ABS Braking Mode in this Section), the EBCM will ground the solenoid circuit to energize the coil within the solenoid. This will close the isolation valve by the magnetic force created by the solenoid coil.

Conditions For Setting the DTC

- High voltage on EBCM solenoid driver circuit when expected to be low (solenoid energized)

Action Taken When the DTC Sets

- ANTILOCK indicator lamp is illuminated
- ABS is disabled

DTC C0043 is an Ignition Latched DTC which indicates the above is true until the ignition is turned to OFF (even if the cause of the DTC is intermittent).

Conditions For Clearing the DTC

- Conditions for setting the DTC are repaired and the scan tool clear DTCs function is used.

Diagnostic Aids

DTC C0043 is usually set by a shorted solenoid within the EBCM. The isolation solenoid coils are located within the EBCM and are not serviceable. If the test does not repair the DTC, the EBCM must be replaced.

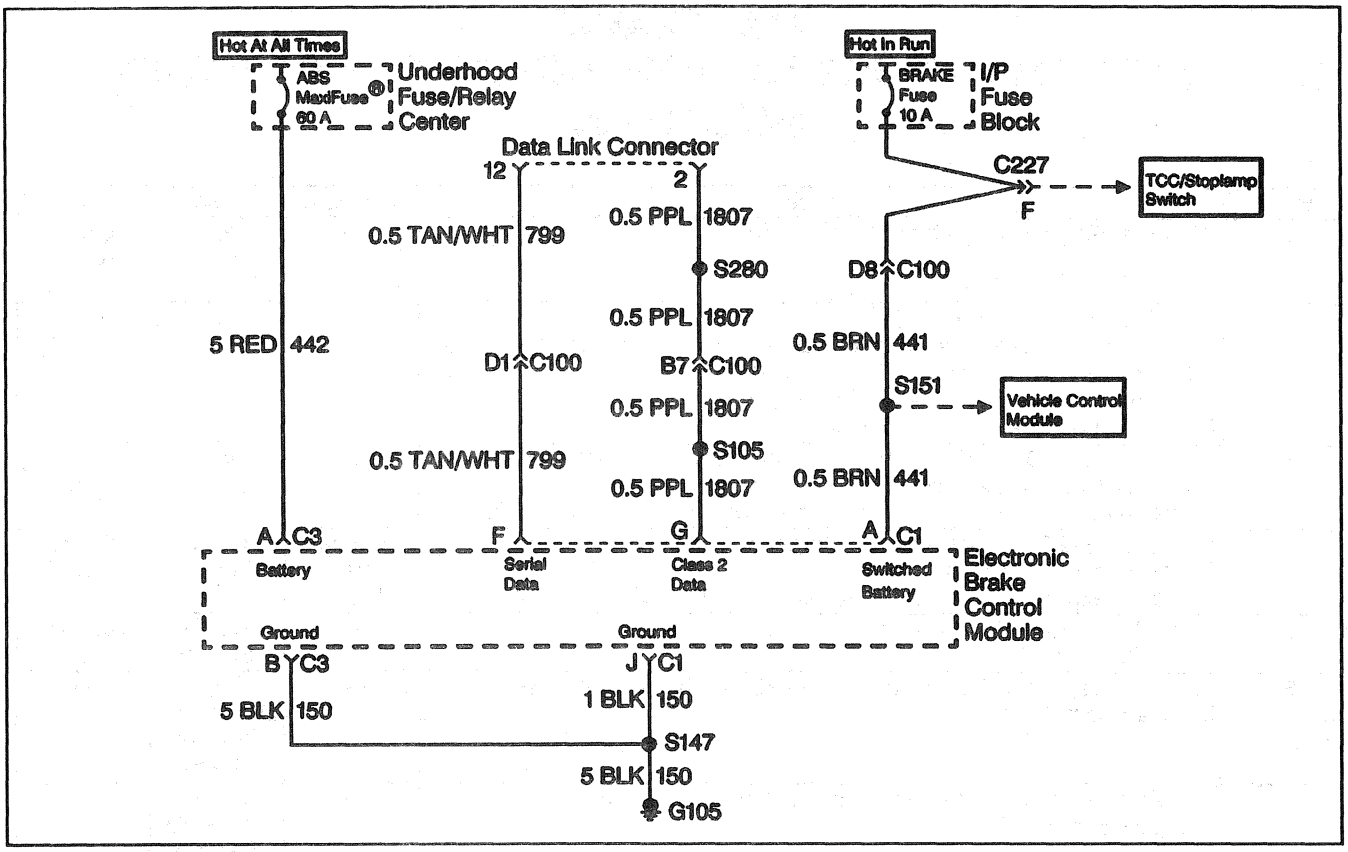
If DTC C0043 is set with other DTCs, check for a poor EBCM ground or poor EBCM power feed.

Test Description

2. Inspect EBCM 2-way harness connector for damage.
3. Check EBCM power and ground circuits.

DTC C0043
RIGHT FRONT ISOLATION SOLENOID CIRCUIT SHORTED

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	Go to Step 2	Go to System Check
2	1. Turn the ignition to OFF. 2. Disconnect the 2-way EBCM harness connector from the EBCM. 3. Inspect the connector for damage or corrosion which could cause a loss of power to the EBCM. Is the connector in good condition?	—	Go to Step 3	Go to Step 6
3	Using a J 39200, measure the resistance from terminal B of the 2-way EBCM harness connector and ground. Is the resistance within the range specified in the Value(s) column?	0-2 Ω	Go to Step 4	Go to Step 7
4	Using a J 39200, measure the voltage from terminal A of the 2-way EBCM harness connector to ground. Is the voltage within the range specified in the Value(s) column?	Greater than 10 volts	Go to Step 8	Go to Step 5
5	Inspect the ABS 60 amp fuse. Is the fuse open?	—	Go to Step 9	Go to Step 10
6	Make necessary repairs to the 2 way EBCM harness connector. Is repair complete?	—	Go to Diagnostic System Check	—
7	Repair open or high resistance in the ground CKT 150. Is repair complete?	—	Go to Diagnostic System check	—
8	Replace the EBCM. Is repair complete?	—	Go to Diagnostic System Check	—
9	Repair short to ground in CKT 442. Is repair complete?	—	Go to Diagnostic System Check	—
10	Repair open or high resistance in CKT 442. Is repair complete?	—	Go to Diagnostic System Check	—



DTC C0044
RIGHT FRONT DUMP SOLENOID CIRCUIT SHORTED

Circuit Description:

When the RF dump solenoid is needed (see ABS Braking Mode in this Section), the EBCM will ground the solenoid circuit to energize the coil within the solenoid. This will open the dump valve by the magnetic force created by the solenoid coil.

Conditions For Setting the DTC

- High voltage on EBCM solenoid driver circuit when expected to be low (solenoid energized)

Action Taken When the DTC Sets

- ANTILOCK indicator lamp is illuminated
- ABS is disabled

DTC C0044 is an Ignition Latched DTC which indicates the above is true until the ignition is turned to OFF (even if the cause of the DTC is intermittent).

Conditions For Clearing the DTC

- Conditions for setting the DTC are repaired and the scan tool clear DTCs function is used.

Diagnostic Aids

DTC C0044 is usually set by a shorted solenoid within the EBCM. The dump solenoid coils are located within the EBCM and are not serviceable. If the test does not repair the DTC, the EBCM must be replaced.

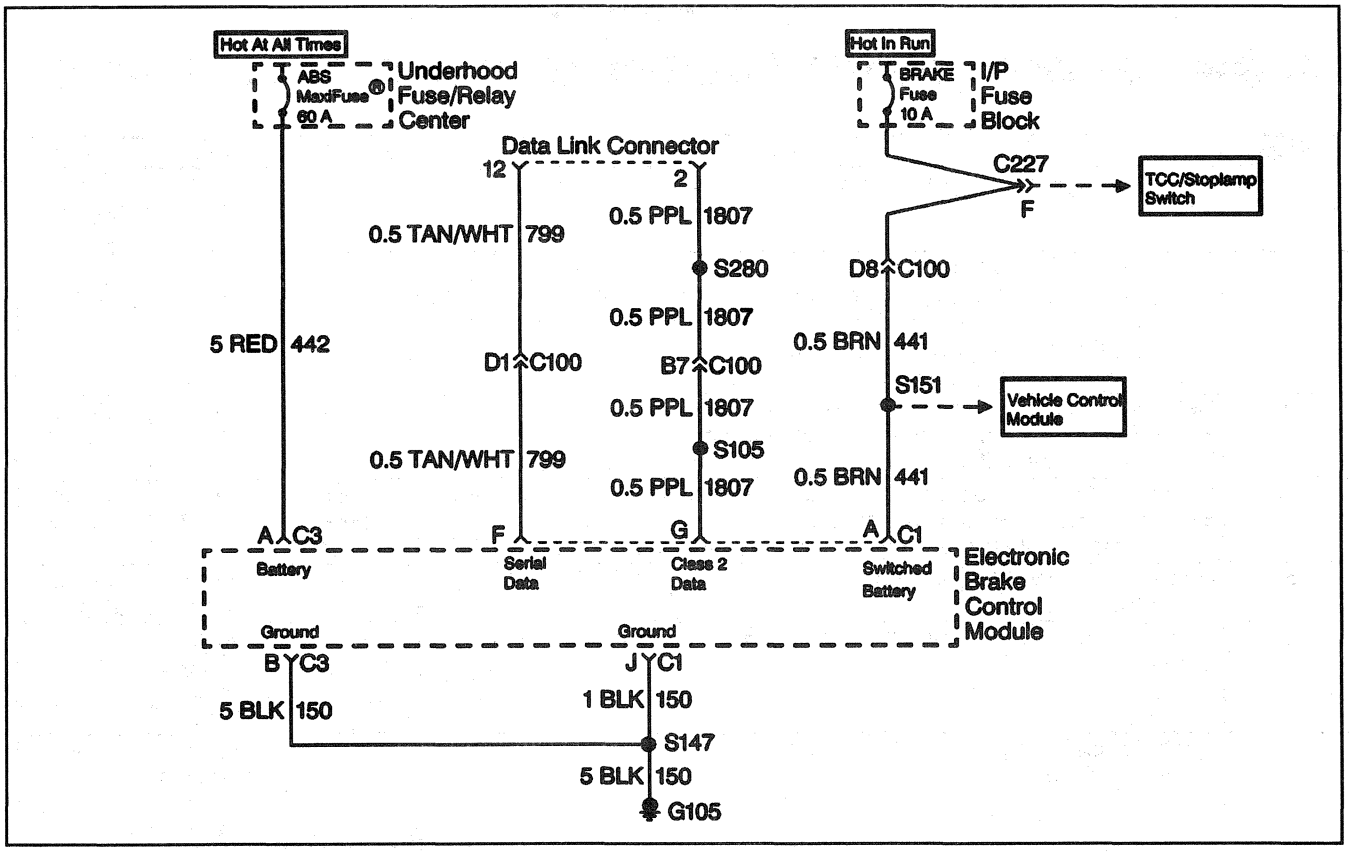
If DTC C0044 is set with other DTCs, check for a poor EBCM ground or poor EBCM power feed.

Test Description

2. Inspect EBCM 2-way harness connector for damage.
3. Check EBCM power and ground circuits.

DTC C0044
RIGHT FRONT DUMP SOLENOID CIRCUIT SHORTED

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	Go to Step 2	Go to System Check
2	1. Turn the ignition to OFF. 2. Disconnect the 2-way EBCM harness connector from the EBCM. 3. Inspect the connector for damage or corrosion which could cause a loss of power to the EBCM. Is the connector in good condition?	—	Go to Step 3	Go to Step 6
3	Using a J 39200, measure the resistance from terminal B of the 2-way EBCM harness connector and ground. Is the resistance within the range specified in the Value(s) column?	0-2 Ω	Go to Step 4	Go to Step 7
4	Using a J 39200, measure the voltage from terminal A of the 2-way EBCM harness connector to ground. Is the voltage within the range specified in the Value(s) column?	Greater than 10 volts	Go to Step 8	Go to Step 5
5	Inspect the ABS 60 amp fuse. Is the fuse open?	—	Go to Step 9	Go to Step 10
6	Make necessary repairs to the 2 way EBCM harness connector. Is repair complete?	—	Go to Diagnostic System Check	—
7	Repair open or high resistance in the ground CKT 150. Is repair complete?	—	Go to Diagnostic System check	—
8	Replace the EBCM. Is repair complete?	—	Go to Diagnostic System Check	—
9	Repair short to ground in CKT 442. Is repair complete?	—	Go to Diagnostic System Check	—
10	Repair open or high resistance in CKT 442. Is repair complete?	—	Go to Diagnostic System Check	—



DTC C0045
LEFT FRONT ISOLATION SOLENOID CIRCUIT OPEN

Circuit Description:

When the LF isolation solenoid is needed (see ABS Braking Mode in this Section), the EBCM will ground the solenoid circuit to energize the coil within the solenoid. This will close the isolation valve by the magnetic force created by the solenoid coil.

Conditions For Setting the DTC

- ABS bulb check complete
- Low voltage on EBCM solenoid driver circuit when expected to be high (solenoid not energized)

Action Taken When the DTC Sets

- ANTILOCK indicator lamp is illuminated
- ABS is disabled

DTC C0045 is an Ignition Latched DTC which indicates the above is true until the ignition is turned to OFF (even if the cause of the DTC is intermittent).

Conditions For Clearing the DTC

- Conditions for setting the DTC are repaired and the scan tool clear DTCs function is used.

Diagnostic Aids

DTC C0045 is usually set by an open solenoid coil within the EBCM. The LF isolation solenoid is located within the BPMV and is not serviceable. If the test does not repair the DTC, the EBCM must be replaced.

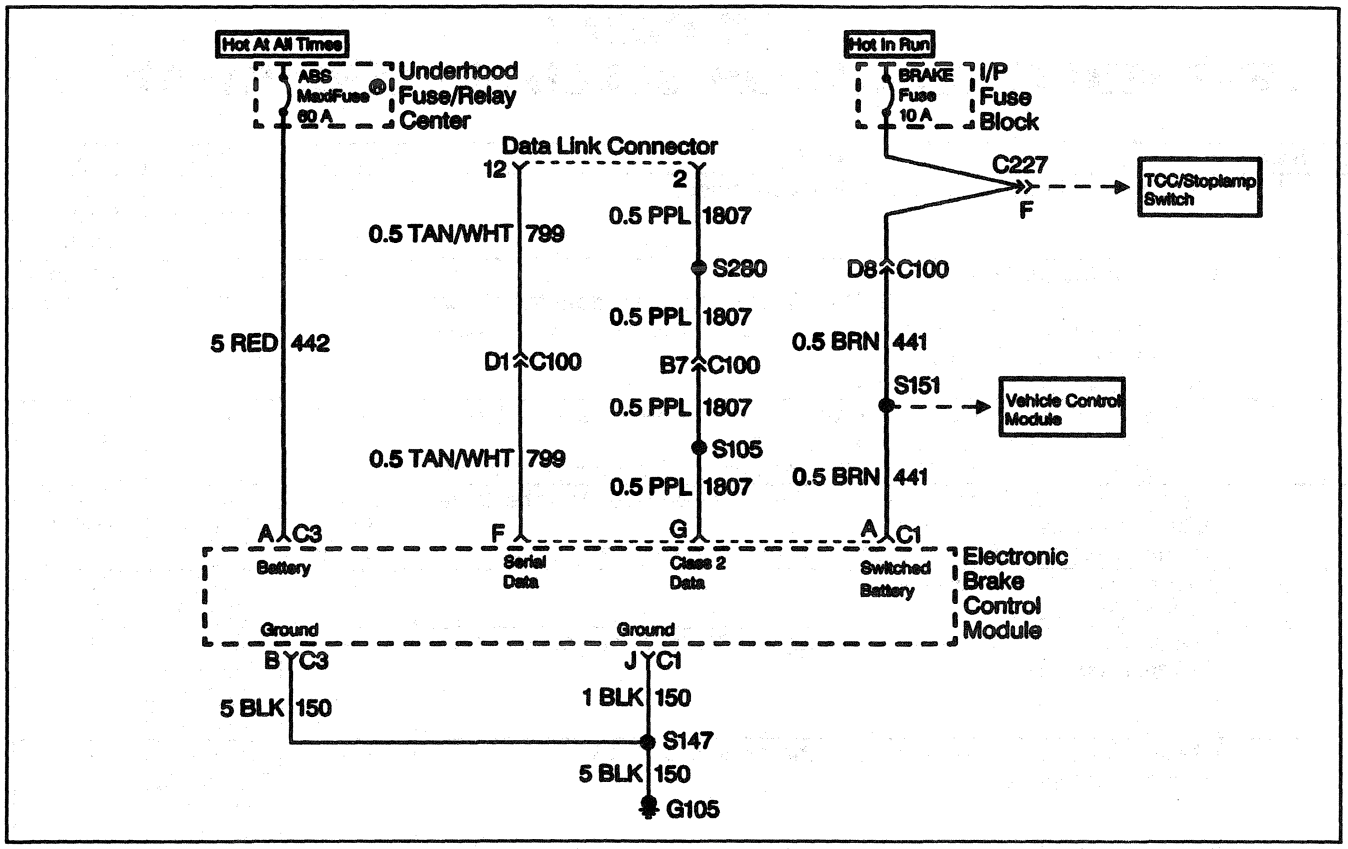
If DTC C0045 is set with other DTCs, check for a poor EBCM ground or poor EBCM power feed.

Test Description

2. Inspect EBCM 2-way harness connector for damage.
3. Check EBCM power and ground circuits.

DTC C0045
LEFT FRONT ISOLATION SOLENOID CIRCUIT OPEN

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	Go to Step 2	Go to System Check
2	1. Turn the ignition to OFF. 2. Disconnect the 2-way EBCM harness connector from the EBCM. 3. Inspect the connector for damage or corrosion which could cause a loss of power to the EBCM. Is the connector in good condition?	—	Go to Step 3	Go to Step 6
3	Using a J 39200, measure the resistance from terminal B of the 2-way EBCM harness connector and ground. Is the resistance within the range specified in the Value(s) column?	0-2 Ω	Go to Step 4	Go to Step 7
4	Using a J 39200, measure the voltage from terminal A of the 2-way EBCM harness connector to ground. Is the voltage within the range specified in the Value(s) column?	Greater than 10 volts	Go to Step 8	Go to Step 5
5	Inspect the ABS 60 amp fuse. Is the fuse open?	—	Go to Step 9	Go to Step 10
6	Make necessary repairs to the 2 way EBCM harness connector. Is repair complete?	—	Go to Diagnostic System Check	—
7	Repair open or high resistance in the ground CKT 150. Is repair complete?	—	Go to Diagnostic System check	—
8	Replace the EBCM. Is repair complete?	—	Go to Diagnostic System Check	—
9	Repair short to ground in CKT 442. Is repair complete?	—	Go to Diagnostic System Check	—
10	Repair open or high resistance in CKT 442. Is repair complete?	—	Go to Diagnostic System Check	—



DTC C0046
LEFT FRONT DUMP SOLENOID CIRCUIT OPEN

Circuit Description:

When the LF dump solenoid is needed (see ABS Braking Mode in this Section), the EBCM will ground the solenoid circuit to energize the coil within the solenoid. This will open the dump valve by the magnetic force created by the solenoid coil.

Conditions For Setting the DTC

- ABS bulb check complete
- Low voltage on EBCM solenoid driver circuit when expected to be high (solenoid not energized)

Action Taken When the DTC Sets

- ANTILOCK indicator lamp is illuminated
- ABS is disabled

DTC C0046 is an Ignition Latched DTC which indicates the above is true until the ignition is turned to OFF (even if the cause of the DTC is intermittent).

Conditions For Clearing the DTC

- Conditions for setting the DTC are repaired and the scan tool clear DTCs function is used.

Diagnostic Aids

DTC C0046 is usually set by an open solenoid coil within the EBCM. The LF dump solenoid is located within the BPMV and is not serviceable. If the test does not repair the DTC, the EBCM must be replaced.

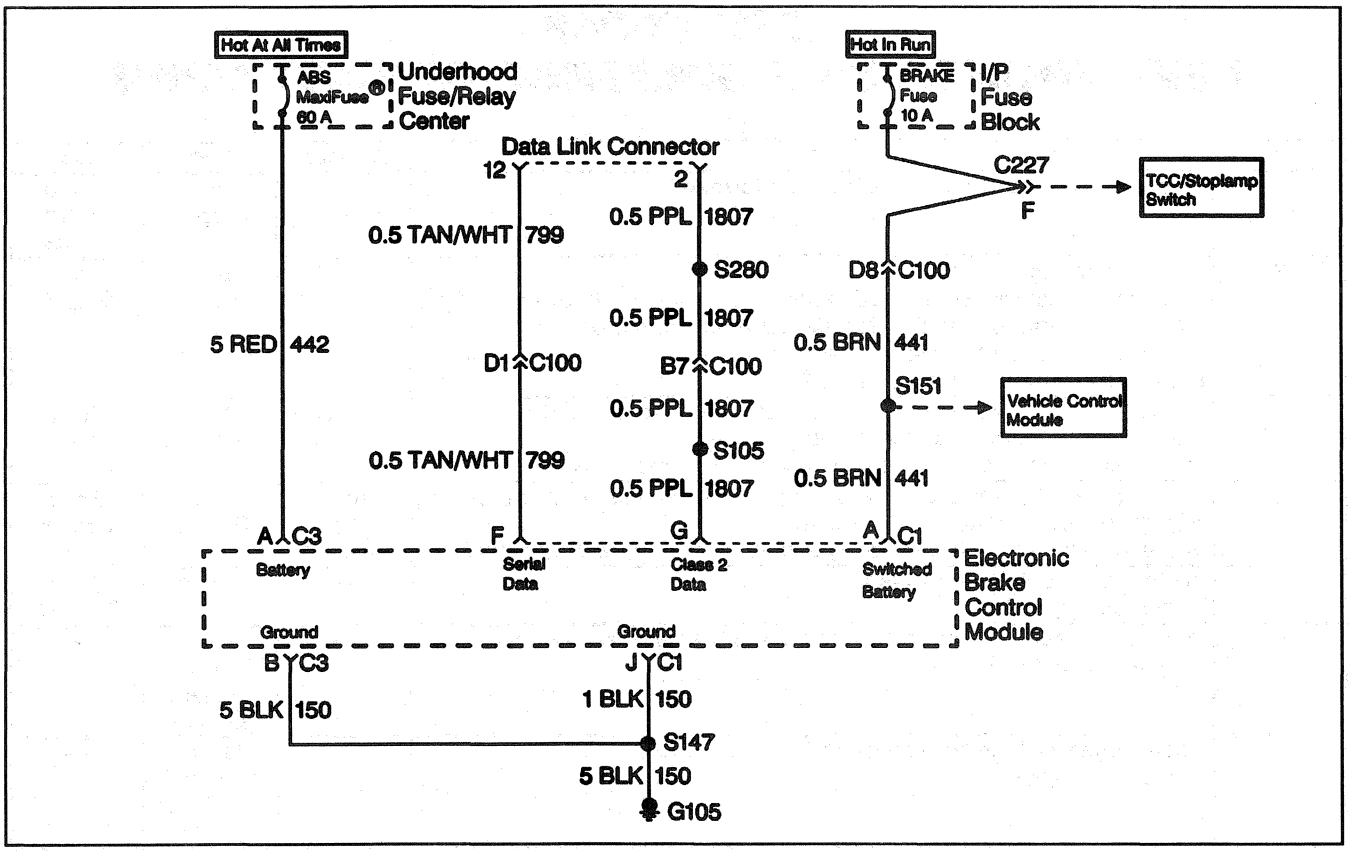
If DTC C0046 is set with other DTCs, check for a poor EBCM ground or poor EBCM power feed.

Test Description

2. Inspect EBCM 2-way harness connector for damage.
3. Check EBCM power and ground circuits.

DTC C0046
LEFT FRONT DUMP SOLENOID CIRCUIT OPEN

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	Go to Step 2	Go to System Check
2	1. Turn the ignition to OFF. 2. Disconnect the 2-way EBCM harness connector from the EBCM. 3. Inspect the connector for damage or corrosion which could cause a loss of power to the EBCM. Is the connector in good condition?	—	Go to Step 3	Go to Step 6
3	Using a J 39200, measure the resistance from terminal B of the 2-way EBCM harness connector and ground. Is the resistance within the range specified in the Value(s) column?	0-2 Ω	Go to Step 4	Go to Step 7
4	Using a J 39200, measure the voltage from terminal A of the 2-way EBCM harness connector to ground. Is the voltage within the range specified in the Value(s) column?	Greater than 10 volts	Go to Step 8	Go to Step 5
5	Inspect the ABS 60 amp fuse. Is the fuse open?	—	Go to Step 9	Go to Step 10
6	Make necessary repairs to the 2 way EBCM harness connector. Is repair complete?	—	Go to Diagnostic System Check	—
7	Repair open or high resistance in the ground CKT 150. Is repair complete?	—	Go to Diagnostic System check	—
8	Replace the EBCM. Is repair complete?	—	Go to Diagnostic System Check	—
9	Repair short to ground in CKT 442. Is repair complete?	—	Go to Diagnostic System Check	—
10	Repair open or high resistance in CKT 442. Is repair complete?	—	Go to Diagnostic System Check	—



DTC C0047
LEFT FRONT ISOLATION SOLENOID CIRCUIT SHORTED

Circuit Description:

When the LF isolation solenoid is needed (see ABS Braking Mode in this Section), the EBCM will ground the solenoid circuit to energize the coil within the solenoid. This will close the isolation valve by the magnetic force created by the solenoid coil.

Conditions For Setting the DTC

- High voltage on EBCM solenoid driver circuit when expected to be low (solenoid energized)

Action Taken When the DTC Sets

- ANTILOCK indicator lamp is illuminated
- ABS is disabled

DTC C0047 is an Ignition Latched DTC which indicates the above is true until the ignition is turned to OFF (even if the cause of the DTC is intermittent).

Conditions For Clearing the DTC

- Conditions for setting the DTC are repaired and the scan tool clear DTCs function is used.

Diagnostic Aids

DTC C0047 is usually set by a shorted solenoid within the EBCM. The isolation solenoid coils are located within the EBCM and are not serviceable. If the test does not repair the DTC, the EBCM must be replaced.

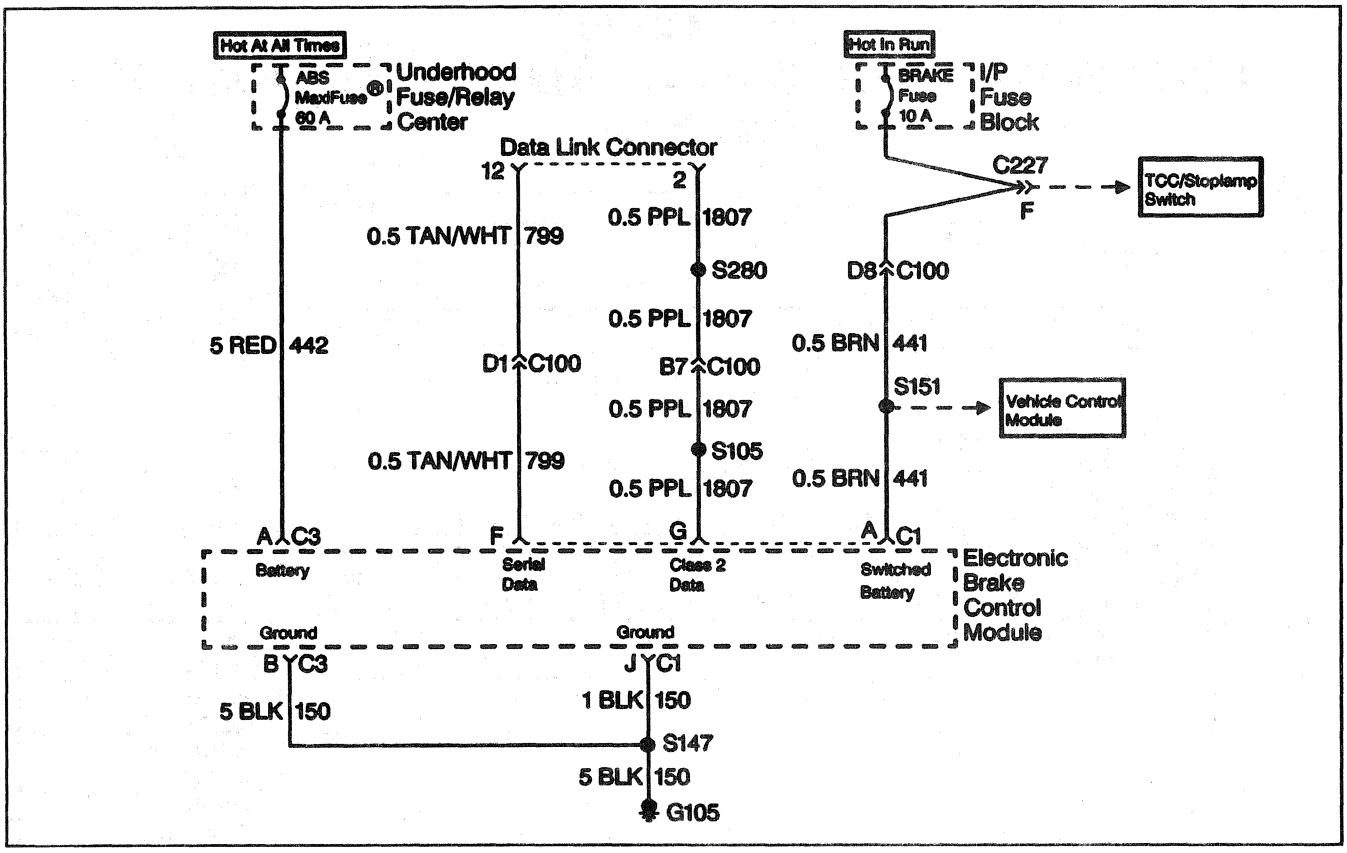
If DTC C0047 is set with other DTCs, check for a poor EBCM ground or poor EBCM power feed.

Test Description

2. Inspect EBCM 2-way harness connector for damage.
3. Check EBCM power and ground circuits.

DTC C0047
LEFT FRONT ISOLOATION SOLENOID CIRCUIT SHORTED

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	Go to Step 2	Go to System Check
2	1. Turn the ignition to OFF. 2. Disconnect the 2-way EBCM harness connector from the EBCM. 3. Inspect the connector for damage or corrosion which could cause a loss of power to the EBCM. Is the connector in good condition?	—	Go to Step 3	Go to Step 6
3	Using a J 39200, measure the resistance from terminal B of the 2-way EBCM harness connector and ground. Is the resistance within the range specified in the Value(s) column?	0-2 Ω	Go to Step 4	Go to Step 7
4	Using a J 39200, measure the voltage from terminal A of the 2-way EBCM harness connector to ground. Is the voltage within the range specified in the Value(s) column?	Greater than 10 volts	Go to Step 8	Go to Step 5
5	Inspect the ABS 60 amp fuse. Is the fuse open?	—	Go to Step 9	Go to Step 10
6	Make necessary repairs to the 2 way EBCM harness connector. Is repair complete?	—	Go to Diagnostic System Check	—
7	Repair open or high resistance in the ground CKT 150. Is repair complete?	—	Go to Diagnostic System check	—
8	Replace the EBCM. Is repair complete?	—	Go to Diagnostic System Check	—
9	Repair short to ground in CKT 442. Is repair complete?	—	Go to Diagnostic System Check	—
10	Repair open or high resistance in CKT 442. Is repair complete?	—	Go to Diagnostic System Check	—



DTC C0048
LEFT FRONT DUMP SOLENOID CIRCUIT SHORTED

Circuit Description:

When the LF dump solenoid is needed (see ABS Braking Mode in this Section), the EBCM will ground the solenoid circuit to energize the coil within the solenoid. This will open the dump valve by the magnetic force created by the solenoid coil.

Conditions For Setting the DTC

- High voltage on EBCM solenoid driver circuit when expected to be low (solenoid energized)

Action Taken When the DTC Sets

- ANTILOCK indicator lamp is illuminated
- ABS is disabled

DTC C0048 is an Ignition Latched DTC which indicates the above is true until the ignition is turned to OFF (even if the cause of the DTC is intermittent).

Conditions For Clearing the DTC

- Conditions for setting the DTC are repaired and the scan tool clear DTCs function is used.

Diagnostic Aids

DTC C0048 is usually set by a shorted solenoid within the EBCM. The dump solenoid coils are located within the EBCM and are not serviceable. If the test does not repair the DTC, the EBCM must be replaced.

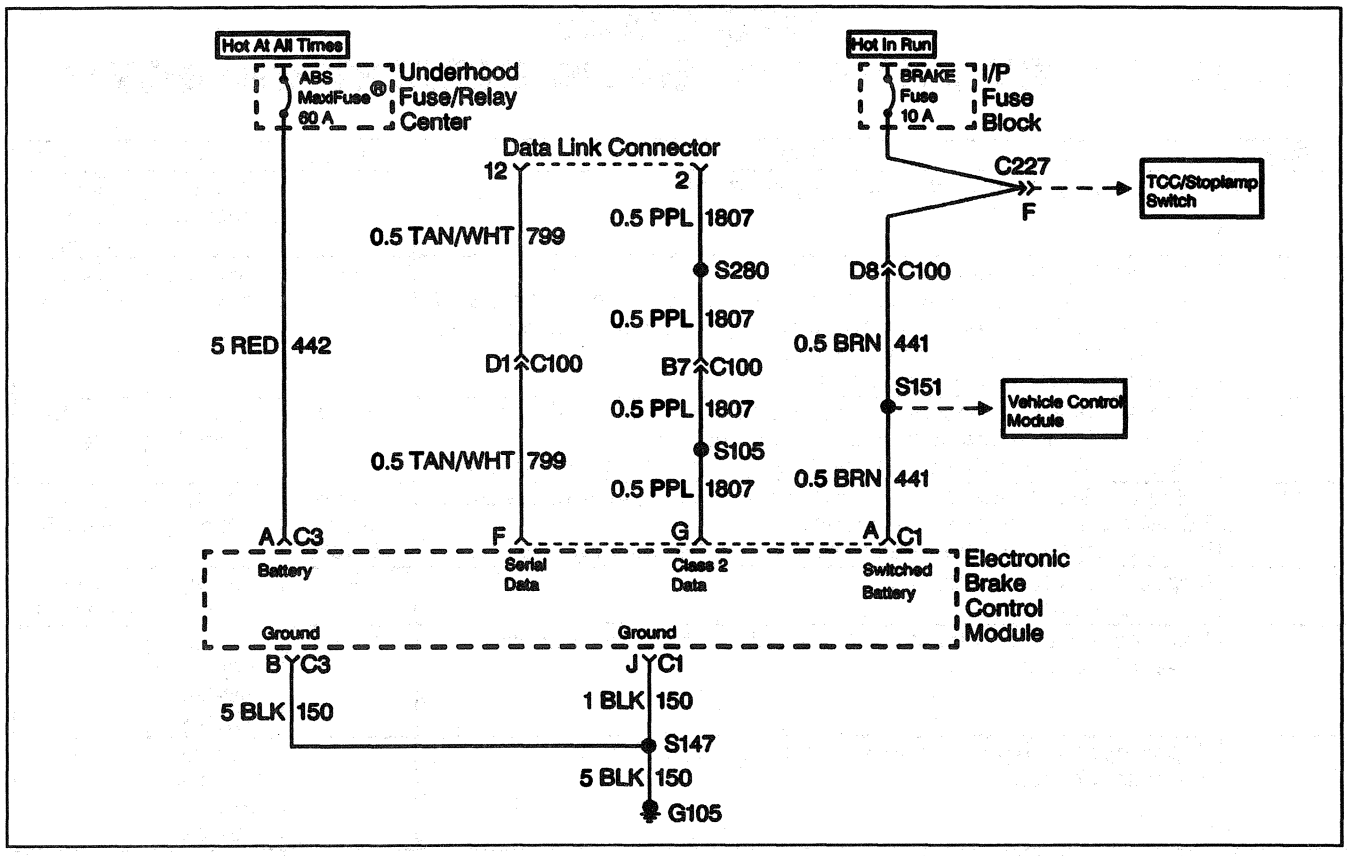
If DTC C0048 is set with other DTCs, check for a poor EBCM ground or poor EBCM power feed.

Test Description

2. Inspect EBCM 2-way harness connector for damage.
3. Check EBCM power and ground circuits.

DTC C0048
LEFT FRONT DUMP SOLENOID CIRCUIT SHORTED

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	Go to Step 2	Go to System Check
2	1. Turn the ignition to OFF. 2. Disconnect the 2-way EBCM harness connector from the EBCM. 3. Inspect the connector for damage or corrosion which could cause a loss of power to the EBCM. Is the connector in good condition?	—	Go to Step 3	Go to Step 6
3	Using a J 39200, measure the resistance from terminal B of the 2-way EBCM harness connector and ground. Is the resistance within the range specified in the Value(s) column?	0-2 Ω	Go to Step 4	Go to Step 7
4	Using a J 39200, measure the voltage from terminal A of the 2-way EBCM harness connector to ground. Is the voltage within the range specified in the Value(s) column?	Greater than 10 volts	Go to Step 8	Go to Step 5
5	Inspect the ABS 60 amp fuse. Is the fuse open?	—	Go to Step 9	Go to Step 10
6	Make necessary repairs to the 2 way EBCM harness connector. Is repair complete?	—	Go to Diagnostic System Check	—
7	Repair open or high resistance in the ground CKT 150. Is repair complete?	—	Go to Diagnostic System check	—
8	Replace the EBCM. Is repair complete?	—	Go to Diagnostic System Check	—
9	Repair short to ground in CKT 442. Is repair complete?	—	Go to Diagnostic System Check	—
10	Repair open or high resistance in CKT 442. Is repair complete?	—	Go to Diagnostic System Check	—



DTC C0051
REAR ISOLATION SOLENOID CIRCUIT OPEN

Circuit Description:

When the REAR isolation solenoid is needed (see ABS Braking Mode in this Section), the EBCM will ground the solenoid circuit to energize the coil within the solenoid. This will close the isolation valve by the magnetic force created by the solenoid coil.

Conditions For Setting the DTC

- ABS bulb check complete
- Low voltage on EBCM solenoid driver circuit when expected to be high (solenoid not energized)

Action Taken When the DTC Sets

- ANTILOCK indicator lamp is illuminated
- ABS is disabled

DTC C0051 is an Ignition Latched DTC which indicates the above is true until the ignition is turned to OFF (even if the cause of the DTC is intermittent).

Conditions For Clearing the DTC

- Conditions for setting the DTC are repaired and the scan tool clear DTCs function is used.

Diagnostic Aids

DTC C0051 is usually set by an open solenoid coil within the EBCM. The REAR isolation solenoid is located within the BPMV and is not serviceable. If the test does not repair the DTC, the EBCM must be replaced.

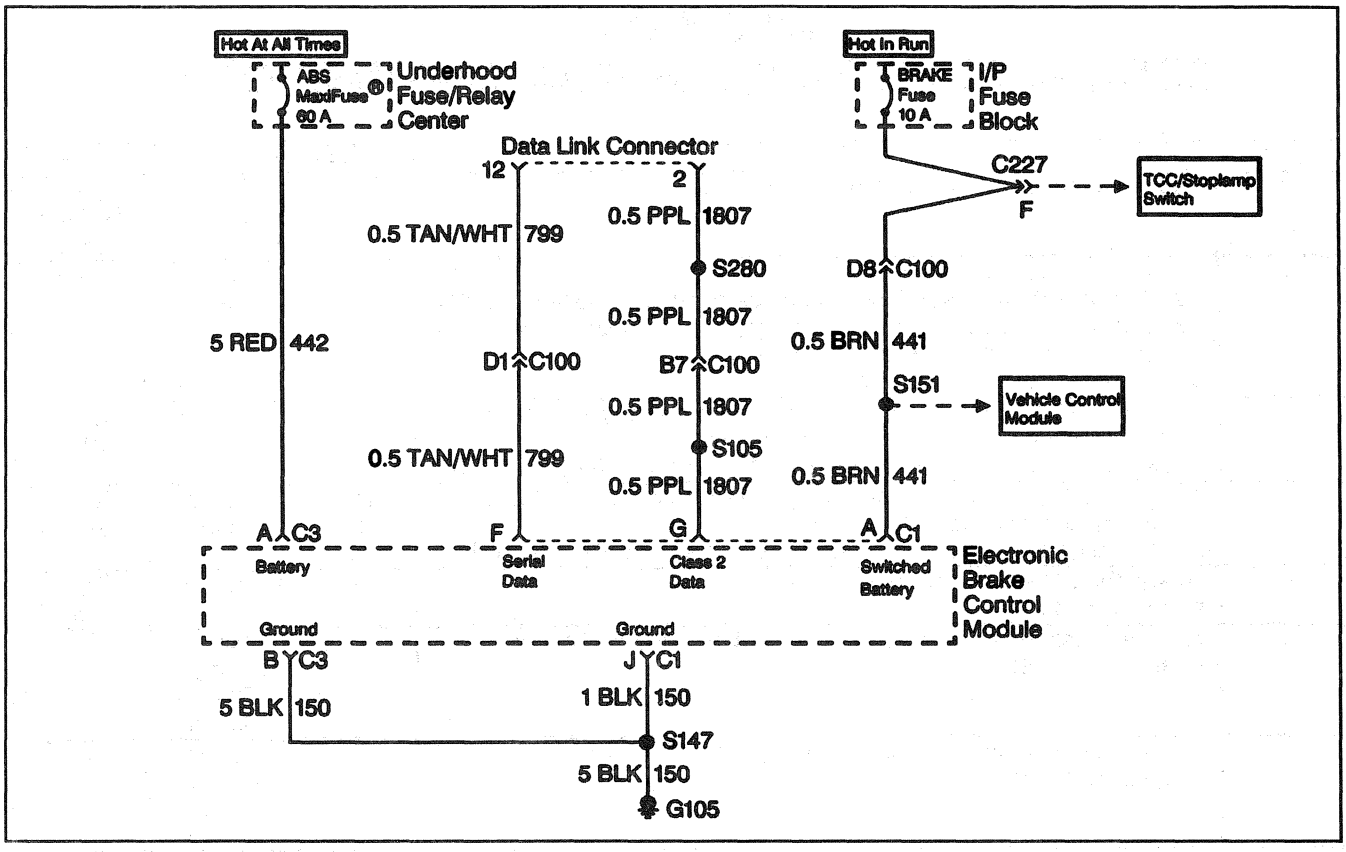
If DTC C0051 is set with other DTCs, check for a poor EBCM ground or poor EBCM power feed.

Test Description

2. Inspect EBCM 2-way harness connector for damage.
3. Check EBCM power and ground circuits.

DTC C0051
REAR ISOLATION SOLENOID CIRCUIT OPEN

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	Go to Step 2	Go to System Check
2	1. Turn the ignition to OFF. 2. Disconnect the 2-way EBCM harness connector from the EBCM. 3. Inspect the connector for damage or corrosion which could cause a loss of power to the EBCM. Is the connector in good condition?	—	Go to Step 3	Go to Step 6
3	Using a J 39200, measure the resistance from terminal B of the 2-way EBCM harness connector and ground. Is the resistance within the range specified in the Value(s) column?	0-2 Ω	Go to Step 4	Go to Step 7
4	Using a J 39200, measure the voltage from terminal A of the 2-way EBCM harness connector to ground. Is the voltage within the range specified in the Value(s) column?	Greater than 10 volts	Go to Step 8	Go to Step 5
5	Inspect the ABS 60 amp fuse. Is the fuse open?	—	Go to Step 9	Go to Step 10
6	Make necessary repairs to the 2 way EBCM harness connector. Is repair complete?	—	Go to Diagnostic System Check	—
7	Repair open or high resistance in the ground CKT 150. Is repair complete?	—	Go to Diagnostic System check	—
8	Replace the EBCM. Is repair complete?	—	Go to Diagnostic System Check	—
9	Repair short to ground in CKT 442. Is repair complete?	—	Go to Diagnostic System Check	—
10	Repair open or high resistance in CKT 442. Is repair complete?	—	Go to Diagnostic System Check	—



DTC C0052
REAR DUMP SOLENOID CIRCUIT OPEN

Circuit Description:

When the REAR dump solenoid is needed (see ABS Braking Mode in this Section), the EBCM will ground the solenoid circuit to energize the coil within the solenoid. This will open the dump valve by the magnetic force created by the solenoid coil.

Conditions For Setting the DTC

- ABS bulb check complete
- Low voltage on EBCM solenoid driver circuit when expected to be high (solenoid not energized)

Action Taken When the DTC Sets

- ANTILOCK indicator lamp is illuminated
- ABS is disabled

DTC C0052 is an Ignition Latched DTC which indicates the above is true until the ignition is turned to OFF (even if the cause of the DTC is intermittent).

Conditions For Clearing the DTC

- Conditions for setting the DTC are repaired and the scan tool clear DTCs function is used.

Diagnostic Aids

DTC C0052 is usually set by an open solenoid coil within the EBCM. The REAR dump solenoid is located within the BPMV and is not serviceable. If the test does not repair the DTC, the EBCM must be replaced.

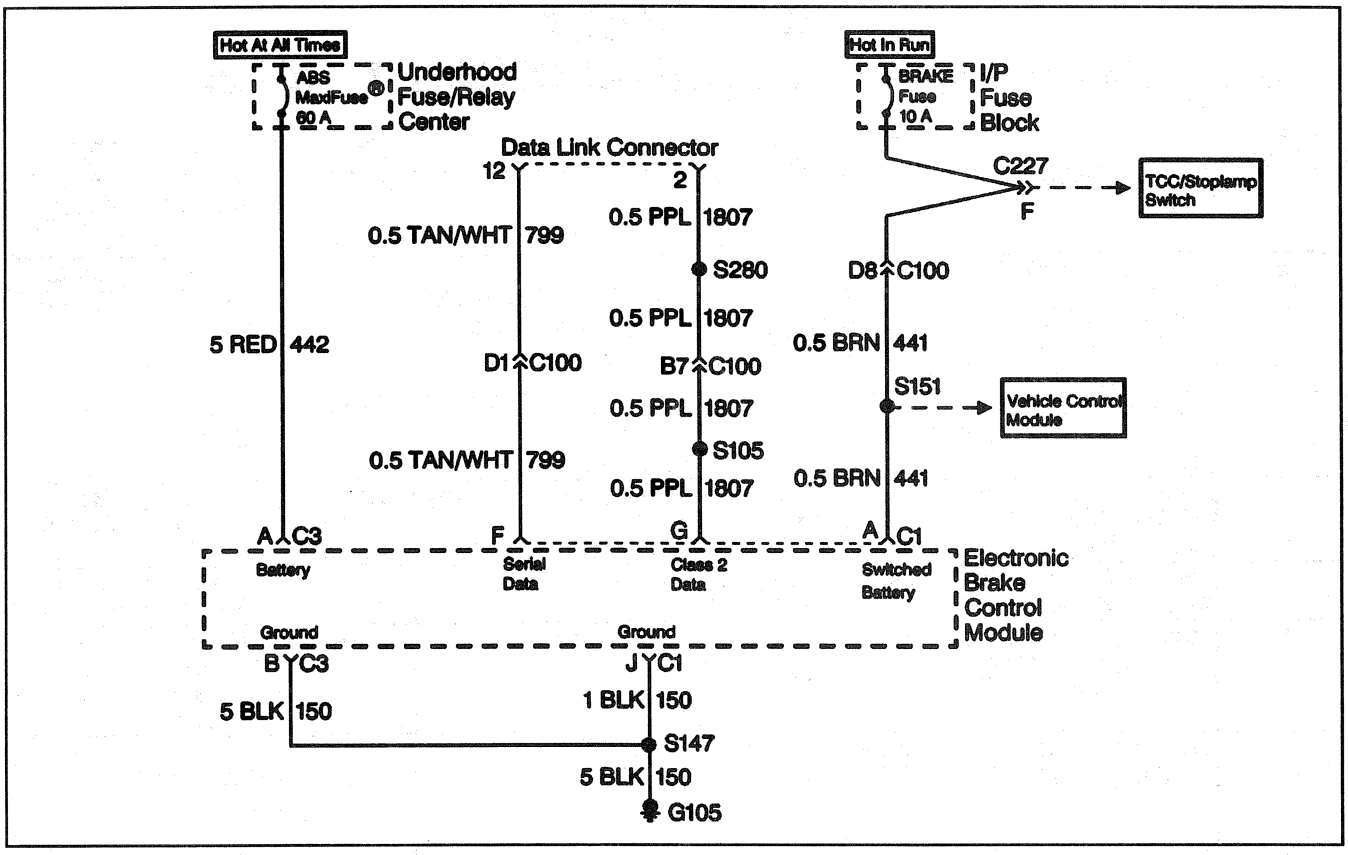
If DTC C0052 is set with other DTCs, check for a poor EBCM ground or poor EBCM power feed.

Test Description

2. Inspect EBCM 2-way harness connector for damage.
3. Check EBCM power and ground circuits.

DTC C0052
REAR DUMP SOLENOID CIRCUIT OPEN

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	Go to Step 2	Go to System Check
2	1. Turn the ignition to OFF. 2. Disconnect the 2-way EBCM harness connector from the EBCM. 3. Inspect the connector for damage or corrosion which could cause a loss of power to the EBCM. Is the connector in good condition?	—	Go to Step 3	Go to Step 6
3	Using a J 39200, measure the resistance from terminal B of the 2-way EBCM harness connector and ground. Is the resistance within the range specified in the Value(s) column?	0-2 Ω	Go to Step 4	Go to Step 7
4	Using a J 39200, measure the voltage from terminal A of the 2-way EBCM harness connector to ground. Is the voltage within the range specified in the Value(s) column?	Greater than 10 volts	Go to Step 8	Go to Step 5
5	Inspect the ABS 60 amp fuse. Is the fuse open?	—	Go to Step 9	Go to Step 10
6	Make necessary repairs to the 2 way EBCM harness connector. Is repair complete?	—	Go to Diagnostic System Check	—
7	Repair open or high resistance in the ground CKT 150. Is repair complete?	—	Go to Diagnostic System check	—
8	Replace the EBCM. Is repair complete?	—	Go to Diagnostic System Check	—
9	Repair short to ground in CKT 442. Is repair complete?	—	Go to Diagnostic System Check	—
10	Repair open or high resistance in CKT 442. Is repair complete?	—	Go to Diagnostic System Check	—



DTC C0053
REAR ISOLATION SOLENOID CIRCUIT SHORTED

Circuit Description:

When the REAR isolation solenoid is needed (see ABS Braking Mode in this section), the EBCM will ground the solenoid circuit to energize the coil within the solenoid. This will open the isolation valve by the magnetic force created by the solenoid coil.

Conditions For Setting the DTC

- ABS bulb check complete
- Low voltage on EBCM solenoid driver circuit when expected to be high (solenoid not energized)

Action Taken When the DTC Sets

- ANTILOCK indicator lamp is illuminated
- ABS is disabled

DTC C0053 is an Ignition Latched DTC which indicates the above is true until the ignition is turned to OFF (even if the cause of the DTC is intermittent).

Conditions For Clearing the DTC

- Conditions for setting the DTC are repaired and the scan tool clear DTCs function is used.

Diagnostic Aids

DTC C0053 is usually set by an open solenoid coil within the EBCM. The REAR isolation solenoid is located within the EBCM and is not serviceable. If the test does not repair the DTC, the EBCM must be replaced.

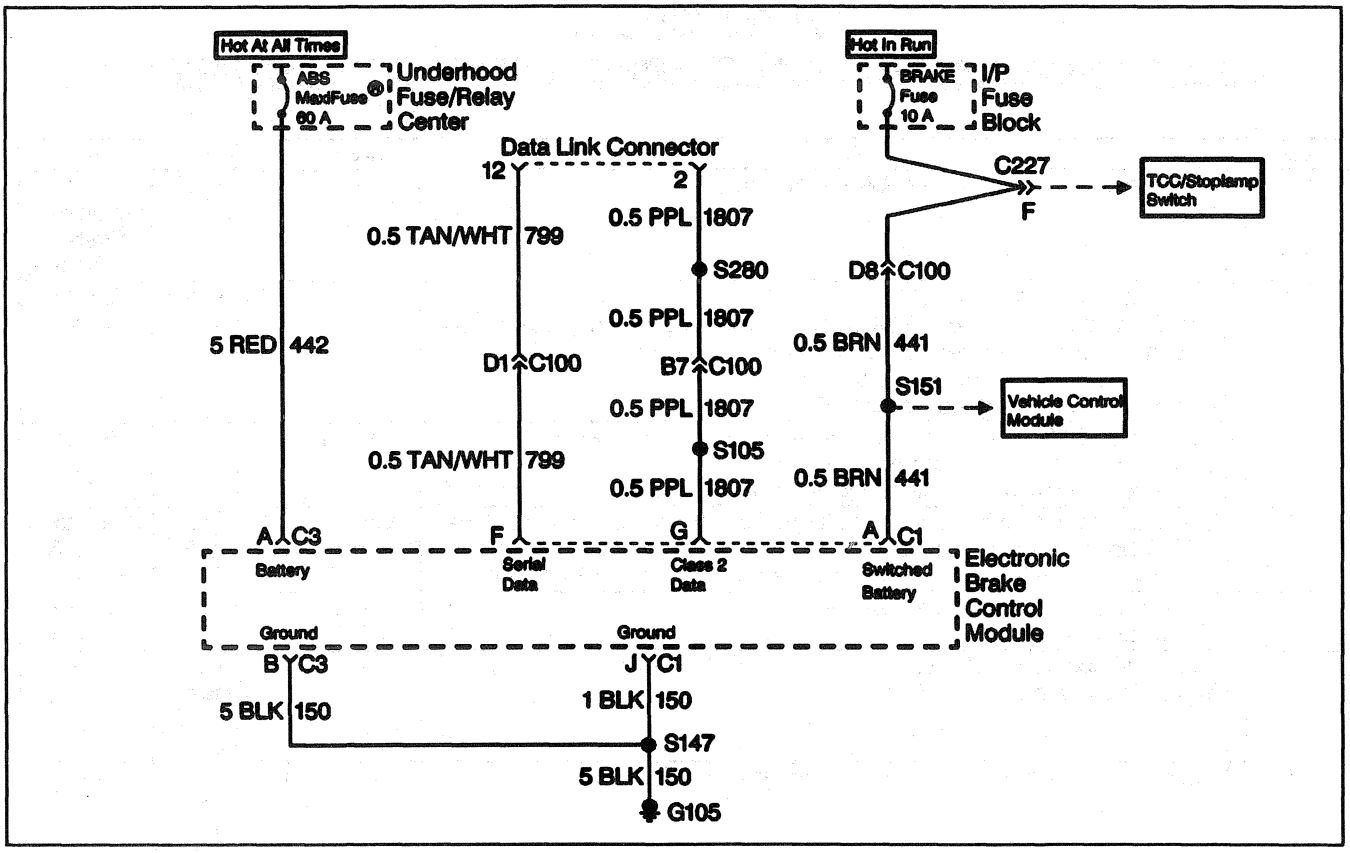
If DTC C0053 is set with other DTCs, check for a poor EBCM ground or poor EBCM power feed.

Test Description

2. Inspect EBCM 2-way harness connector for damage.
3. Check EBCM power and ground circuits.

DTC C0053
REAR ISOLATION SOLENOID CIRCUIT SHORTED

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	Go to Step 2	Go to Diagnostic System Check
2	1. Turn the ignition to OFF. 2. Disconnect the 2-way EBCM harness connector from the EBCM. 3. Inspect the connector for damage or corrosion which could cause a loss of power to the EBCM. Is the connector in good condition?	—	Go to Step 3	Go to Step 6
3	Using a J 39200, measure the resistance from terminal B of the 2-way EBCM harness connector and ground. Is the resistance within the range specified in the Value(s) column?	0-2 Ω	Go to Step 4	Go to Step 7
4	Using a J 39200, measure the voltage from terminal A of the 2-way EBCM harness connector to ground. Is the voltage within the range specified in the Value(s) column?	Greater than 10 volts	Go to Step 8	Go to Step 5
5	Inspect the 60 amp ABS maxi-fuse. Is the fuse open?	—	Go to Step 9	Go to Step 10
6	Make necessary repairs to the 2 way EBCM harness connector. Is repair complete?	—	Go to Diagnostic System Check	—
7	Repair open or high resistance in the ground CKT 650. Is repair complete?	—	Go to Diagnostic System check	—
8	Replace the EBCM. Is repair complete?	—	Go to Diagnostic System Check	—
9	Repair short to ground in CKT 442. Is repair complete?	—	Go to Diagnostic System Check	—
10	Repair open or high resistance in CKT 442. Is repair complete?	—	Go to Diagnostic System Check	—



DTC C0054
REAR DUMP SOLENOID CIRCUIT SHORTED

Circuit Description:

When the REAR dump solenoid is needed (see ABS Braking Mode in this Section), the EBCM will ground the solenoid circuit to energize the coil within the solenoid. This will open the dump valve by the magnetic force created by the solenoid coil.

Conditions For Setting the DTC

- High voltage on EBCM solenoid driver circuit when expected to be low (solenoid energized)

Action Taken When the DTC Sets

- ANTILOCK indicator lamp is illuminated
- ABS is disabled

DTC C0054 is an Ignition Latched DTC which indicates the above is true until the ignition is turned to OFF (even if the cause of the DTC is intermittent).

Conditions For Clearing the DTC

- Conditions for setting the DTC are repaired and the scan tool clear DTCs function is used.

Diagnostic Aids

DTC C0054 is usually set by a shorted solenoid within the EBCM. The dump solenoid coils are located within the EBCM and are not serviceable. If the test does not repair the DTC, the EBCM must be replaced.

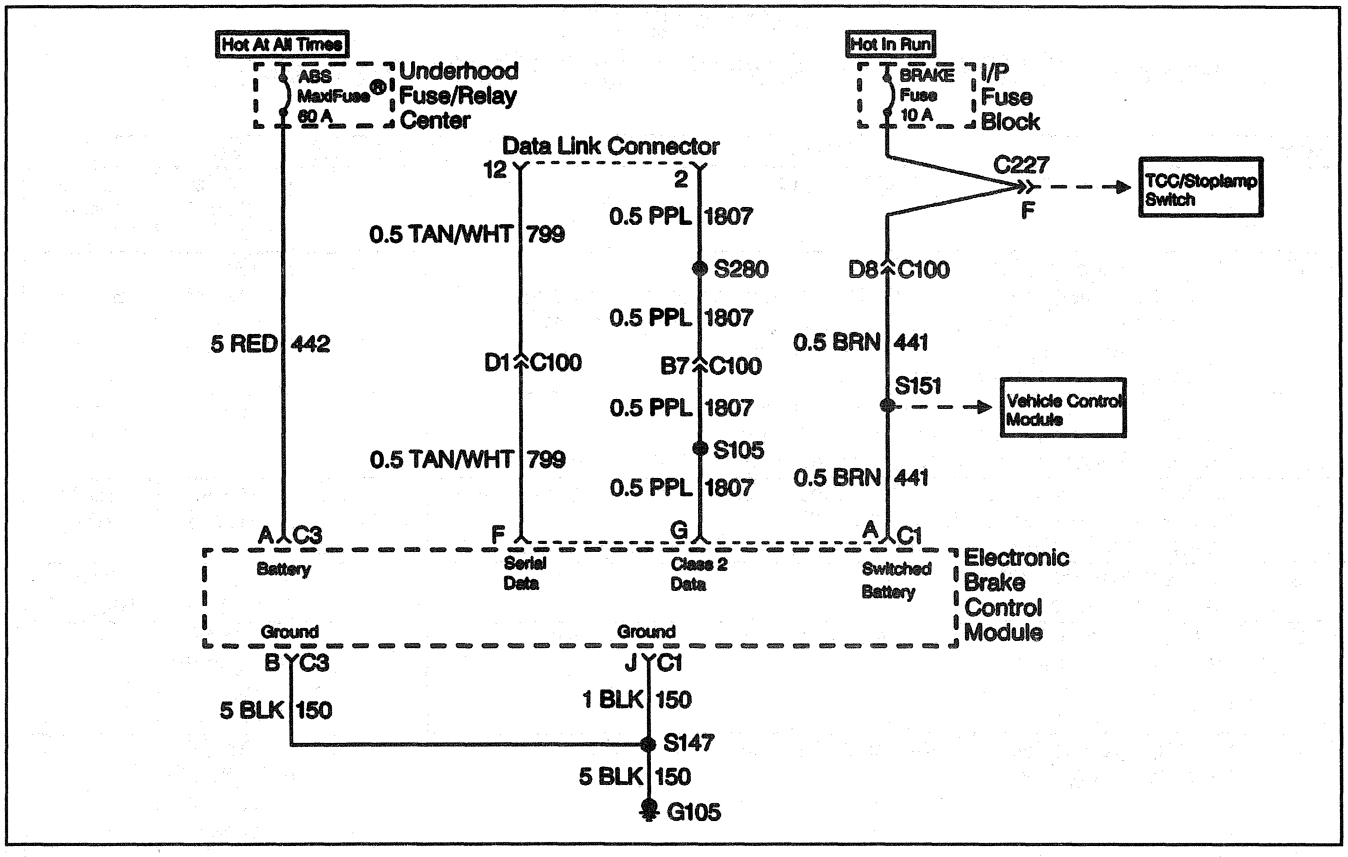
If DTC C0054 is set with other DTCs, check for a poor EBCM ground or poor EBCM power feed.

Test Description

2. Inspect EBCM 2-way harness connector for damage.
3. Check EBCM power and ground circuits.

DTC C0054
REAR DUMP SOLENOID CIRCUIT SHORTED

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	Go to Step 2	Go to System Check
2	1. Turn the ignition to OFF. 2. Disconnect the 2-way EBCM harness connector from the EBCM. 3. Inspect the connector for damage or corrosion which could cause a loss of power to the EBCM. Is the connector in good condition?	—	Go to Step 3	Go to Step 6
3	Using a J 39200, measure the resistance from terminal B of the 2-way EBCM harness connector and ground. Is the resistance within the range specified in the Value(s) column?	0-2 Ω	Go to Step 4	Go to Step 7
4	Using a J 39200, measure the voltage from terminal A of the 2-way EBCM harness connector to ground. Is the voltage within the range specified in the Value(s) column?	Greater than 10 volts	Go to Step 8	Go to Step 5
5	Inspect the ABS 60 amp fuse. Is the fuse open?	—	Go to Step 9	Go to Step 10
6	Make necessary repairs to the 2 way EBCM harness connector. Is repair complete?	—	Go to Diagnostic System Check	—
7	Repair open or high resistance in the ground CKT 150. Is repair complete?	—	Go to Diagnostic System check	—
8	Replace the EBCM. Is repair complete?	—	Go to Diagnostic System Check	—
9	Repair short to ground in CKT 442. Is repair complete?	—	Go to Diagnostic System Check	—
10	Repair open or high resistance in CKT 442. Is repair complete?	—	Go to Diagnostic System Check	—



DTC C0065
PUMP MOTOR RELAY CIRCUIT OPEN

Circuit Description

The relay supplies power to all eight solenoid coils (4 isolation solenoid coils and 4 dump solenoid coils) when ABS is required. The relay and the eight solenoid coils are located within the EBCM.

Conditions For Setting the DTC

- EBCM microprocessor commands the relay on
- Low voltage on all eight solenoid driver circuits when all are expected to be high (solenoid not energized)

Action Taken When the DTC Sets

- ANTILOCK indicator lamp is illuminated
- ABS is disabled

This DTC is an Ignition Latched DTC which indicates the above is true until the ignition is turned to OFF (even if the cause of the DTC is intermittent).

Conditions For Clearing the DTC

- Conditions for setting the DTC are repaired and the scan tool clear DTCs function is used.

Diagnostic Aids

DTC C0065 is usually set by an open relay coil or non-closeable relay contacts. The relay is located within the EBCM and is not serviceable. If the test does not repair the DTC, the EBCM must be replaced.

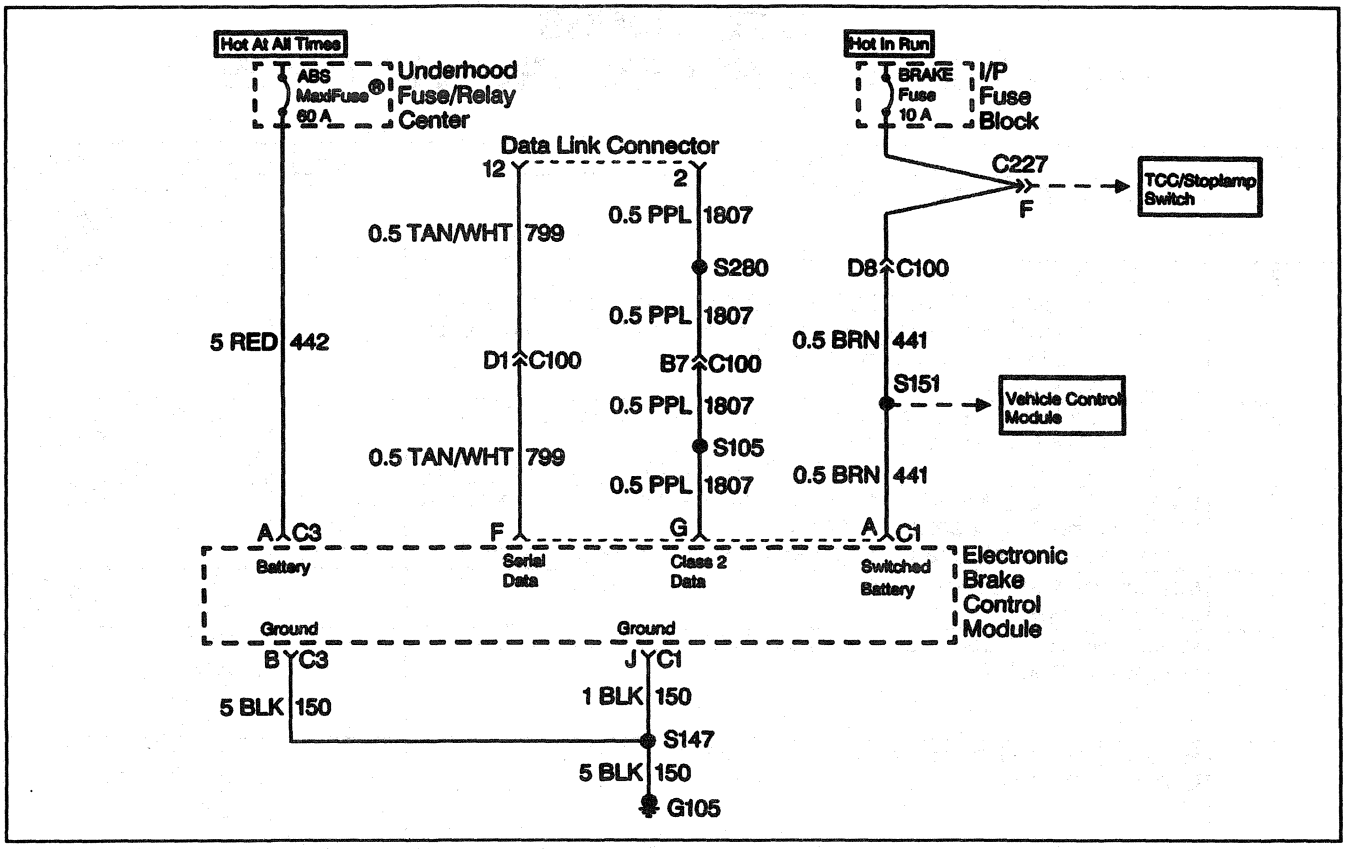
Test Description:

Number(s) below refer to number(s) on the diagnostic chart.

2. Inspect the EBCM 2-way harness connector for damage.
3. Check the ground circuits to the EBCM.
4. Check the power circuits to the EBCM.

DTC C0065
PUMP MOTOR RELAY CIRCUIT OPEN

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	Go to Step 2	Go to System Check
2	1. Turn the ignition to OFF. 2. Disconnect the 2-way EBCM harness connector from the EBCM. 3. Inspect the connector for damage or corrosion which could cause a loss of power to the EBCM. Is the connector in good condition?	—	Go to Step 3	Go to Step 6
3	Using a J 39200, measure the resistance from terminal B of the 2-way EBCM harness connector and ground. Is the resistance within the range specified in the Value(s) column?	0-2 Ω	Go to Step 4	Go to Step 7
4	Using a J 39200, measure the voltage from terminal A of the 2-way EBCM harness connector to ground. Is the voltage within the range specified in the Value(s) column?	Greater than 10 volts	Go to Step 8	Go to Step 5
5	Inspect the ABS 60 amp fuse. Is the fuse open?	—	Go to Step 9	Go to Step 10
6	Make necessary repairs to the 2 way EBCM harness connector. Is repair complete?	—	Go to Diagnostic System Check	—
7	Repair open or high resistance in the ground CKT 150. Is repair complete?	—	Go to Diagnostic System check	—
8	Replace the EBCM. Is repair complete?	—	Go to Diagnostic System Check	—
9	Repair short to ground in CKT 442. Is repair complete?	—	Go to Diagnostic System Check	—
10	Repair open or high resistance in CKT 442. Is repair complete?	—	Go to Diagnostic System Check	—



DTC C0066
PUMP MOTOR RELAY CIRCUIT SHORTED

Circuit Description:

The relay supplies power to the pump motor when ABS is required. The relay is located within the EBCM.

Conditions For Setting the DTC

- ABS bulb check complete
- High voltage on pump motor driver circuit when all are expected to be low (relay not commanded on)

Action Taken When the DTC Sets

- ANTILOCK indicator lamp is illuminated
- ABS is disabled

This DTC is an Ignition Latched DTC which indicates the above is true until the ignition is turned to OFF (even if the cause of the DTC is intermittent).

Conditions For Clearing the DTC

- Conditions for setting the DTC are repaired and the scan tool clear DTCs function is used.

Diagnostic Aids

DTC C0066 is usually set by the relay contacts stuck closed. The relay is located within the EBCM and is not serviceable. If the test does not repair the DTC, the EBCM must be replaced.

Diagnostic Aids:

If DTC C0066 appears with other DTCs, first repair the other DTCs, clear DTCs, and run three function tests with the scan tool. If DTC C0066 resets, refer to this diagnostic chart.

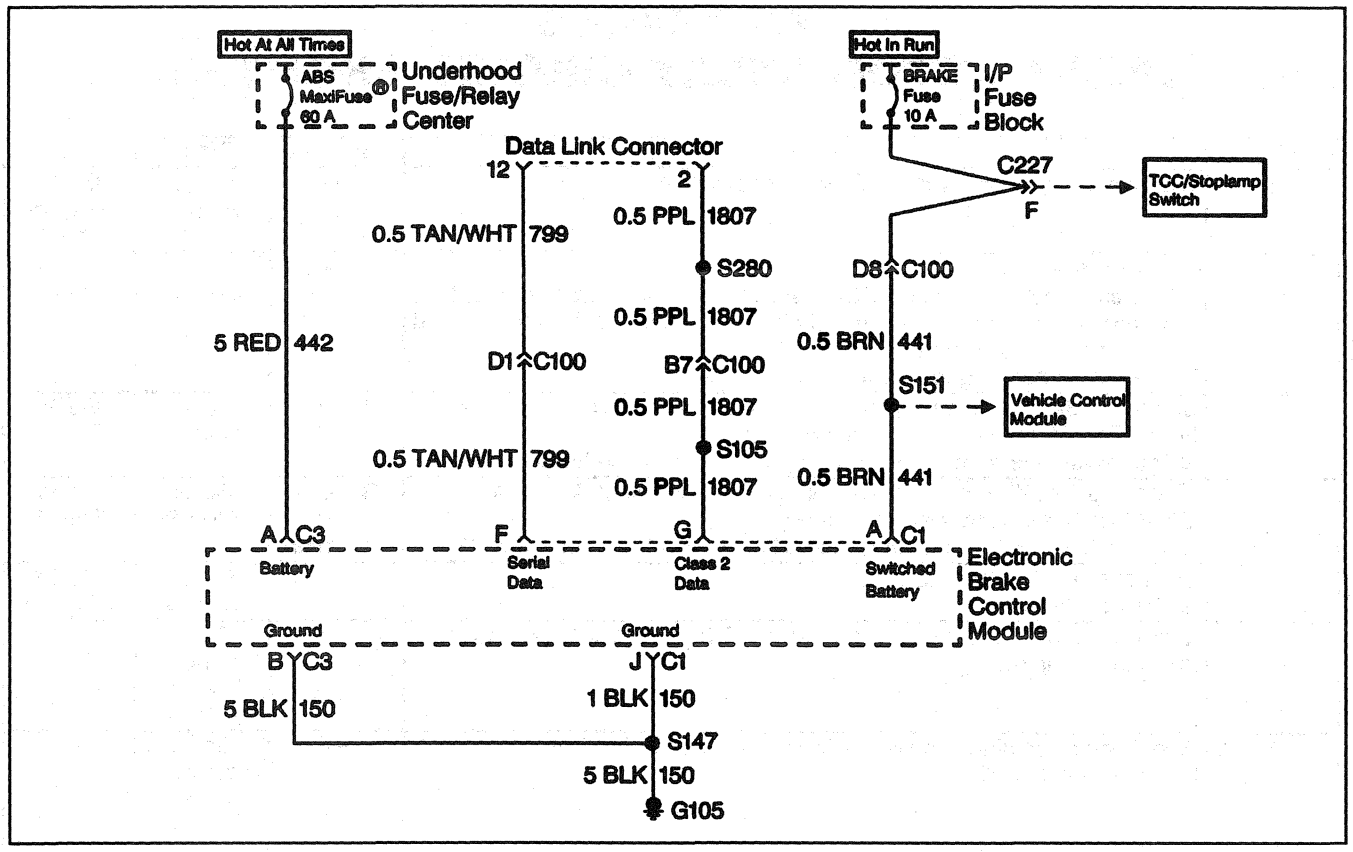
Test Description:

Number(s) below refer to number(s) on the diagnostic chart.

2. Inspect the EBCM 2-way harness connector for damage.
3. Check the ground circuits to the EBCM.
4. Check the power circuits to the EBCM.

DTC C0066
PUMP MOTOR RELAY CIRCUIT SHORTED

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	Go to Step 2	Go to System Check
2	1. Turn the ignition to OFF. 2. Disconnect the 2-way EBCM harness connector from the EBCM. 3. Inspect the connector for damage or corrosion which could cause a loss of power to the EBCM. Is the connector in good condition?	—	Go to Step 3	Go to Step 6
3	Using a J 39200, measure the resistance from terminal B of the 2-way EBCM harness connector and ground. Is the resistance within the range specified in the Value(s) column?	0-2 Ω	Go to Step 4	Go to Step 7
4	Using a J 39200, measure the voltage from terminal A of the 2-way EBCM harness connector to ground. Is the voltage within the range specified in the Value(s) column?	Greater than 10 volts	Go to Step 8	Go to Step 5
5	Inspect the ABS 60 amp fuse. Is the fuse open?	—	Go to Step 9	Go to Step 10
6	Make necessary repairs to the 2 way EBCM harness connector. Is repair complete?	—	Go to Diagnostic System Check	—
7	Repair open or high resistance in the ground CKT 150. Is repair complete?	—	Go to Diagnostic System check	—
8	Replace the EBCM. Is repair complete?	—	Go to Diagnostic System Check	—
9	Repair short to ground in CKT 442. Is repair complete?	—	Go to Diagnostic System Check	—
10	Repair open or high resistance in CKT 442. Is repair complete?	—	Go to Diagnostic System Check	—



DTC C0067
PUMP MOTOR CIRCUIT OPEN

Circuit Description:

The pump motor circuit is integral to the EBCM. The EBCM microprocessor energizes the relay within the EBCM to supply battery voltage to the high side of the pump motor. When pump motor activation is required, the EBCM microprocessor grounds the low side of the pump motor.

Conditions For Setting the DTC

- EBCM internal relay on
- Pump motor off
- Low voltage from low side of pump motor when expected to be high.

Action Taken When the DTC Sets

- ABS indicator lamp is turned ON
- ABS is disabled

This DTC is an Ignition Latched DTC which indicates the above is true until the ignition is turned to OFF (even if the cause of the DTC is intermittent).

Conditions For Clearing the DTC

- Conditions for setting the DTC are repaired and the Scan Tool Clear DTCs function is used.

Diagnostic Aids:

The pump motor is integral with the BPMV assembly and cannot be seperately serviced. DTC C0067 can be caused by poor power and ground at the 2-way EBCM connector or 2-way motor harness from the EBCM to the pump motor. The EBCM or BPMV must be replaced if these tests show the pump motor EBCM internal circuitry have failed.

Important

- The J 39200 test leads must be zeroed prior to making any resistance measurements. Refer to the J 39200 users manual.

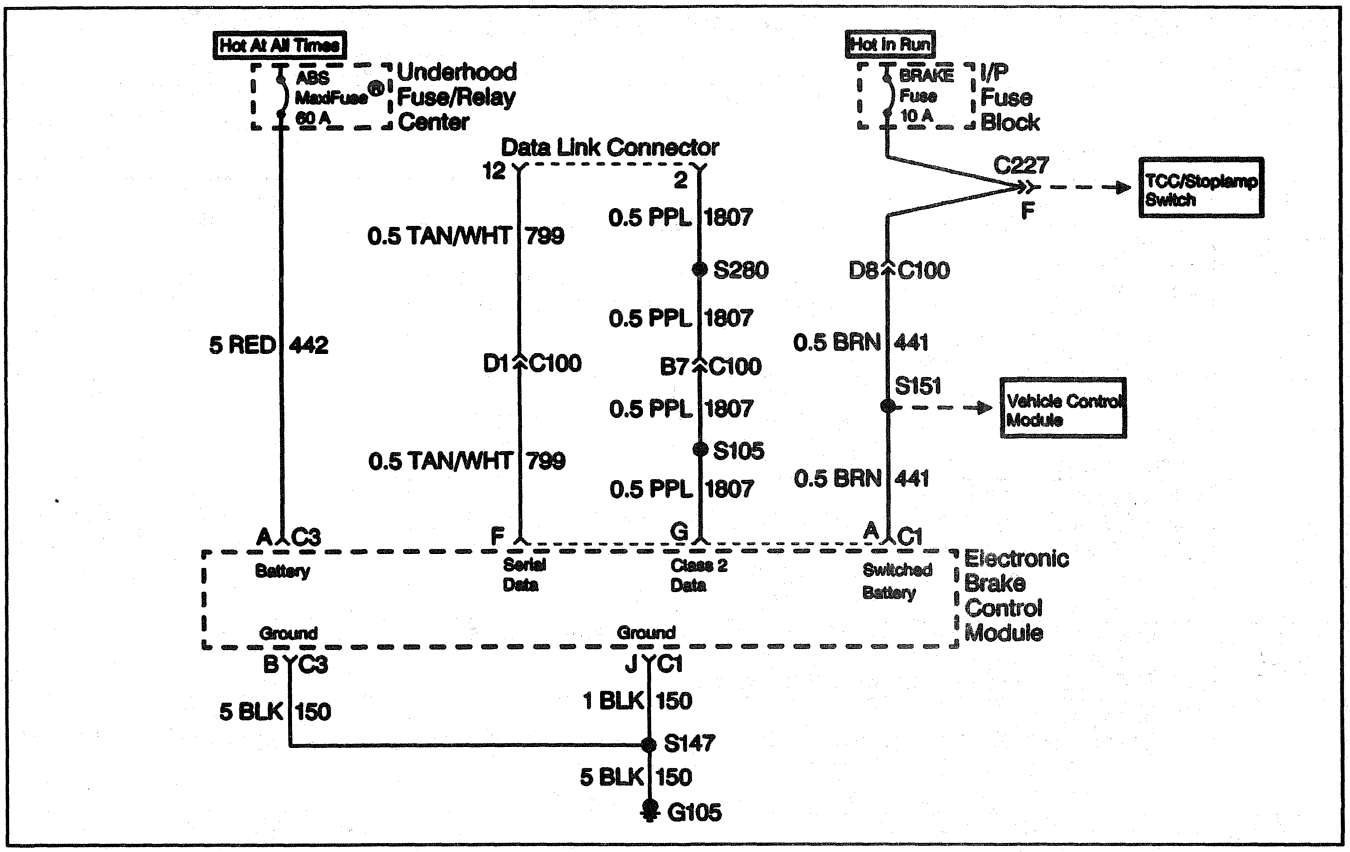
Test Description

Number(s) below refer to number(s) on the diagnostic chart.

3. Checks for an open pump motor circuit. The pump motor circuit resistance should not be above 0.3 ohms. The J 39200 test leads must be zeroed prior to making this low resistance measurement.
5. Checks the resistance of the EBCM ground circuit.
7. Checks the ignition voltage available to the EBCM.

DTC C0067 PUMP MOTOR CIRCUIT OPEN

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	Go to Step 2	Go to Diagnostic System Check
2	1. Turn the ignition to OFF. 2. Disconnect the 2-way pump motor pigtail connector from the EBCM. 3. Inspect the connector and wirng for damage or corrosion which could cause an open circuit between the pump motor and the EBCM. Is the connector and wiring in good condition?	—	Go to Step 3	Go to Step 10
3	Using a J 39200, measure the resistance between terminals 1 and 2 of the 2-way pump motor pigtail connector (J 39200 test leads must be zeroed prior to making this resistance measurement). Is the resistance within the specified range?	0.1 - 0.3 Ω	Go to Step 15	Go to Step 4
4	1. Turn the ignition to OFF. 2. Disconnect the 2-way EBCM harness connector from the EBCM. 3. Inspect the connector for damage or corrosion which could cause a loss of power to the EBCM. Is the connector in good condition?	—	Go to Step 5	Go to Step 9
5	Using a J 39200, measure the resistance between terminal 2 of the 2-way EBCM harness connector and ground. Is the resistance within the specified range?	0-2 Ω	Go to Step 6	Go to Step 11
6	1. Turn the ignition to RUN. 2. Using a J 39200, measure the voltage between terminal 1 of the 2-way EBCM harness connector and ground. Is the voltage equal to or greater than the specified range?	10 V	Go to Step 8	Go to Step 7
7	Inspect the 60 amp maxi fuse. Is the fuse open?	—	Go to Step 13	Go to Step 14
8	1. Inspect the 2-way EBCM harness connector for poor terminal contact or corrosion. Inspect CKT 442 and CKT 150 for damage which may result in an open circuit. Repair damage if evident. Replace terminals if poor contact or corrosion exists. 2. Reconnect all connectors. 3. Using the Scan Tool, clear all DTCs. 4. Test drive vehicle above 16 km/h (10 mph). Does DTC C0067 set as a current DTC?	—	Go to Step 12	Malfunction is intermittent. Refer to Diagnostic Aids on the facing page.
9	Make necessary repairs to the 2-way EBCM harness connector. Is repair complete?	—	Go to Diagnostic System Check	—
10	Make necessary repairs to the 2-way pump motor pigtail connector or wiring. Is repair complete?	—	Go to Diagnostic System Check	—
11	Repair open or high resistance in CKT 150. Is repair complete?	—	Go to Diagnostic System check	—
12	Replace the EBCM. Is repair complete?	—	Go to Diagnostic System Check	—
13	Repair short to ground in CKT 442. Is repair complete?	—	Go to Diagnostic System Check	—
14	Repair open or high resistance in CKT 442. Is repair complete?	—	Go to Diagnostic System Check	—
15	Replace the BPMV assembly. Is repair complete?	—	Go to Diagnostic System Check	—



DTC C0068
PUMP MOTOR LOCKED OR PUMP MOTOR CIRCUIT SHORTED

Circuit Description:

The pump motor circuit is integral to the EBCM. The EBCM microprocessor energizes the relay within the EBCM to supply battery voltage to the high side of the pump motor. When pump motor activation is required, the EBCM microprocessor grounds the low side of the pump motor.

Conditions For Setting the DTC

- Vehicle speed 8 mph or greater
- EBCM internal relay on
- Pump motor commanded on and then off
- High voltage from low side of pump motor for 100ms when expected to be low.

Action Taken When the DTC Sets

- ABS indicator lamp is turned ON
- ABS is disabled

This DTC is an Ignition Latched DTC which indicates the above is true until the ignition is turned to OFF (even if the cause of the DTC is intermittent).

Conditions For Clearing the DTC

- Conditions for setting the DTC are repaired and the Scan Tool Clear DTCs function is used.

Diagnostic Aids

DTC C0068 is usually caused by a seized pump motor, but also can be caused by shorted pump motor windings or by poor power/ground at the 2-way EBCM connector. The pump motor is integral with the BPMV assembly and cannot be seperately serviced. The EBCM or BPMV must be replaced if these tests show the pump motor EBCM internal circuitry have failed.

Important

- The J 39200 test leads must be zeroed prior to making any resistance measurements. Refer to the J 39200 users manual.

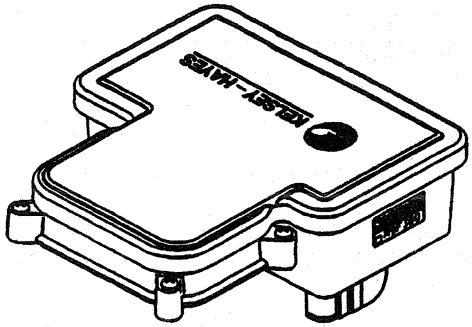
Test Description

Number(s) below refer to number(s) on the diagnostic chart.

3. Checks for a shorted pump motor circuit. The pump motor circuit resistance should not be below 0.1 ohm. The J 39200 test leads must be zeroed prior to making this low resistance measurement.
5. Checks the resistance of the EBCM ground circuit.
7. Checks the ignition voltage available to the EBCM.

DTC C0068 PUMP MOTOR LOCKED OR PUMP MOTOR CIRCUIT SHORTED

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	Go to Step 2	Go to Diagnostic System Check
2	1. Turn the ignition to OFF. 2. Disconnect the 2-way pump motor pigtail connector from the EBCM. 3. Inspect the connector and wirng for damage or corrosion which could cause an open circuit between the pump motor and the EBCM. Is the connector and wiring in good condition?	—	Go to Step 3	Go to Step 10
3	Using a J 39200, measure the resistance between terminals 1 and 2 of the 2-way pump motor pigtail connector (J 39200 test leads must be zeroed prior to making this resistance measurement). Is the resistance within the specified range?	0.1 - 0.3 Ω	Go to Step 15	Go to Step 4
4	1. Turn the ignition to OFF. 2. Disconnect the 2-way EBCM harness connector from the EBCM. 3. Inspect the connector for damage or corrosion which could cause a loss of power to the EBCM. Is the connector in good condition?	—	Go to Step 5	Go to Step 9
5	Using a J 39200, measure the resistance between terminal 2 of the 2-way EBCM harness connector and ground. Is the resistance within the specified range?	0-2 Ω	Go to Step 6	Go to Step 11
6	1. Turn the ignition to RUN. 2. Using a J 39200, measure the voltage between terminal 1 of the 2-way EBCM harness connector and ground. Is the voltage equal to or greater than the specified range?	10 V	Go to Step 8	Go to Step 7
7	Inspect the 60 amp maxi fuse. Is the fuse open?	—	Go to Step 13	Go to Step 14
8	1. Inspect the 2-way EBCM harness connector for poor terminal contact or corrosion. Inspect CKT 442 and CKT 150 for damage which may result in an open circuit. Repair damage if evident. Replace terminals if poor contact or corrosion exists. 2. Reconnect all connectors. 3. Using the Scan Tool, clear all DTCs. 4. Test drive vehicle above 16 km/h (10 mph). Does DTC C0068 set as a current DTC?	—	Go to Step 12	Malfunction is intermittent. Refer to Diagnostic Aids on the facing page.
9	Make necessary repairs to the 2-way EBCM harness connector. Is repair complete?	—	Go to Diagnostic System Check	—
10	Make necessary repairs to the 2-way pump motor pigtail connector or wiring. Is repair complete?	—	Go to Diagnostic System Check	—
11	Repair open or high resistance in CKT 150. Is repair complete?	—	Go to Diagnostic System check	—
12	Replace the EBCM. Is repair complete?	—	Go to Diagnostic System Check	—
13	Repair short to ground in CKT 442. Is repair complete?	—	Go to Diagnostic System Check	—
14	Repair open or high resistance in CKT 442. Is repair complete?	—	Go to Diagnostic System Check	—
15	Replace the BPMV assembly. Is repair complete?	—	Go to Diagnostic System Check	—



KELSEY – HAYES
ELECTRONIC BRAKE
CONTROL MODULE

DTC C0071, C0072, C0073, C0074 EBCM INTERNAL FAULT

Circuit Description

The EBCM initializes a self-test when the ignition is turned to the RUN position. The EBCM self-test verifies all internal circuitry within the EBCM is operating correctly.

Conditions For Setting DTC(S)

- Any condition within the EBCM which causes a memory error.

Action Taken When the DTC Sets

- ANTILOCK indicator lamp is illuminated
- ABS is disabled

This DTC is a Permanent Latched DTC which indicates the above is true until the DTC is cleared using a scan tool.

Conditions For Clearing the DTC

- Conditions for setting the DTC are repaired and the scan tool clear DTCs function is used.

Diagnostic Aids

DTCs C0071 through C0074 are EBCM internal diagnosis. The EBCM must be replaced if these tests show the EBCM circuitry has failed.

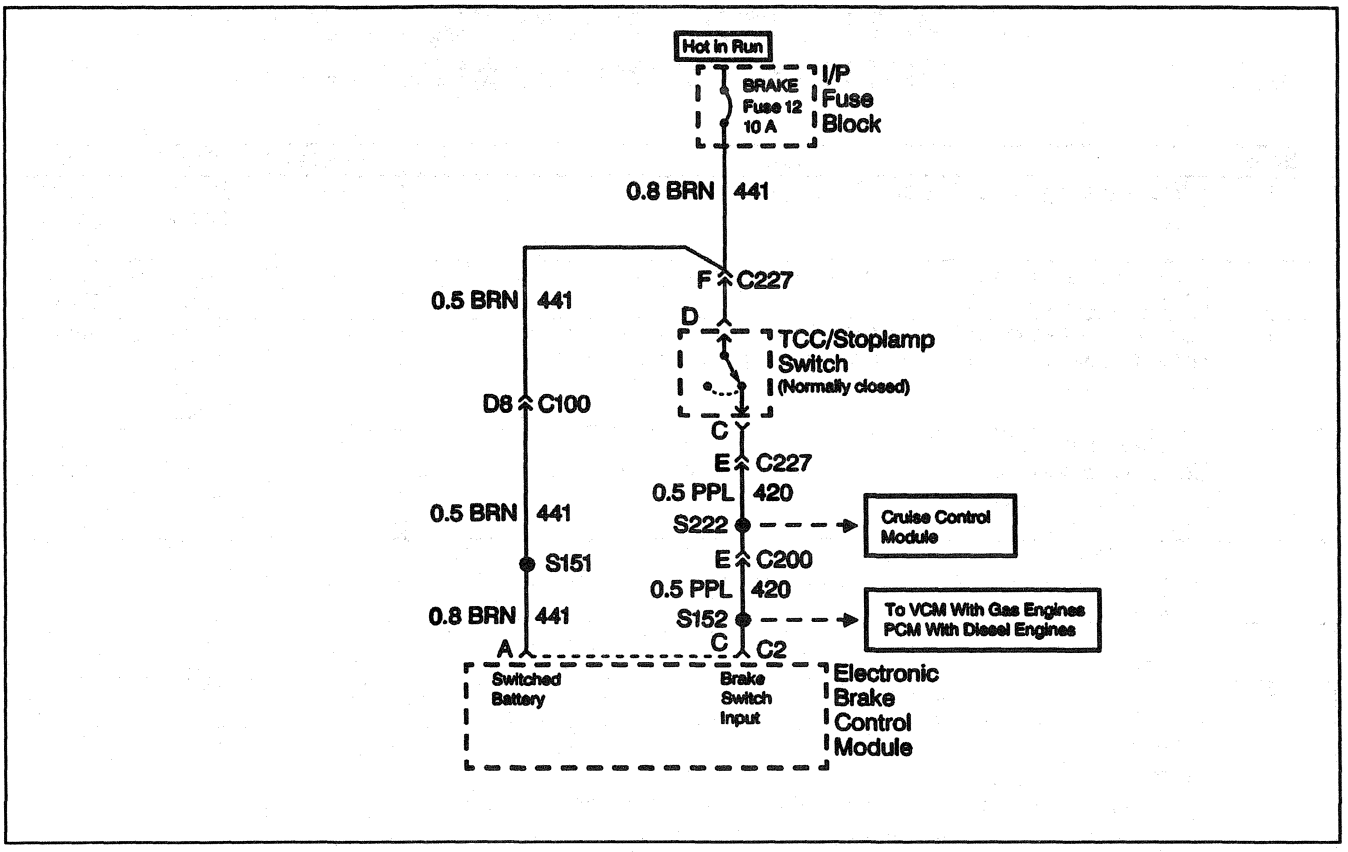
Test Description:

Number(s) below refer to number(s) on the diagnostic chart.

2. Check if EBCM will clear DTCs.
3. Check if DTC has been set previously.

DTC C0071, C0072, C0073, C0074
EBCM INTERNAL FAULT

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	Go to Step 2	Go to System Check
2	Install the scan tool and attempt to clear the DTCs. Did the DTCs clear?	—	Go to Step 3	Go to Step 4
3	Check the history DTCs and data. Was this the first time the DTC has set?	—	Go to Diagnostic System Check	Go to Step 4
4	Replace the EBCM. Is repair complete?	—	Go to Diagnostic System Check	—



DTC C0081
STOPLAMP SWITCH ALWAYS CLOSED OR SHORTED

Circuit Description

The stoplamp switch is a normally closed switch. With the ignition in the RUN position and the brake pedal not depressed, ignition voltage will be present at the EBCM. When the brakes are applied, the ignition voltage present at the EBCM will be zero.

Conditions For Setting DTC(S)

- Vehicle above 35 mph for 10 seconds followed by vehicle at rest for 1 second
- Stoplamp switch never switching during the above condition

Action Taken When the DTC Sets

- ANTILOCK indicator lamp is illuminated
- ABS is disabled

This DTC is a Ignition Latched DTC which indicates the above is true until the ignition is turned to OFF (even if the cause of the DTC is intermittent).

Conditions For Clearing the DTC

- Conditions for setting the DTC are repaired and the scan tool clear DTCs function is used.

Diagnostic Aids

A faulty stoplamp switch or circuit condition in CKT 420 can cause this DTC.

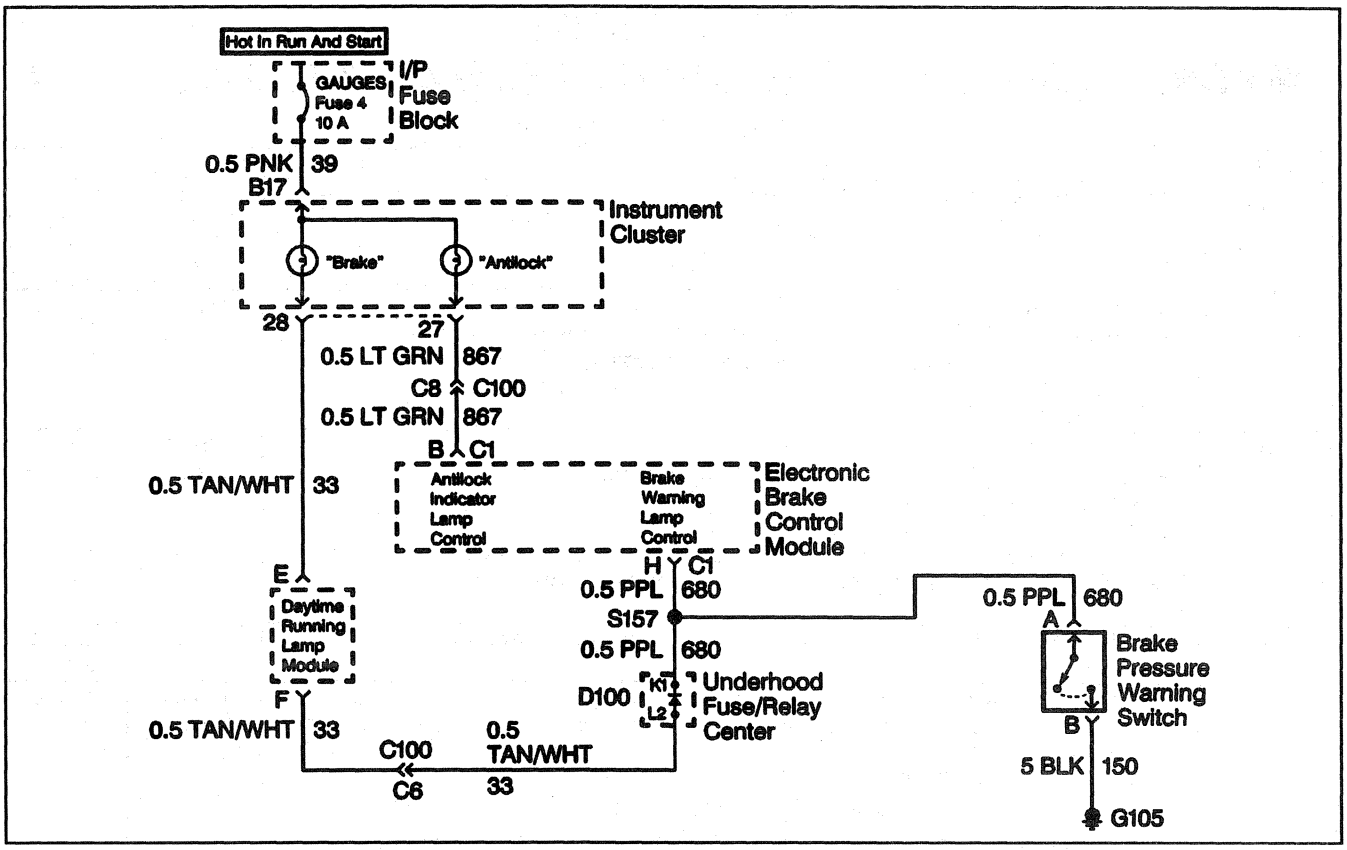
Test Description

Number(s) below refer to number(s) on the diagnostic chart.

2. Check stoplamp switch status using the scan tool.
3. Check for a short to battery or misadjusted stoplamp switch.
5. Check for an open in CKT 420 or faulty stoplamp switch.

DTC C0081
STOPLAMP SWITCH ALWAYS CLOSED OR SHORTED

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	Go to Step 2	Go to Diagnostic System Check
2	1. Install scan tool. 2. Using the Data List function of the scan tool, check the status of the stoplamp switch while applying and releasing the pedal. Does the scan tool indicate the switch to be closed (pedal not applied) constantly?	—	Go to Step 3	Go to Step 4
3	1. Turn the ignition to OFF. 2. Disconnect the stoplamp switch harness connector from the stoplamp switch. 3. Turn ignition to RUN. 4. Using the scan tool, check the status of the stoplamp switch. Does the scan tool indicate the switch to be closed (pedal not applied).	—	Go to Step 7	Go to Step 8
4	Does the scan tool indicate the switch to be open (pedal applied) constantly?	—	Go to Step 5	Go to Step 7
5	1. Turn the ignition to OFF. 2. Disconnect the 10-way EBCM harness connector form the EBCM. 3. Turn the ignition to RUN. 4. Using the J 39200, measure the voltage from terminal C of the 10-way EBCM harness connector to ground. Is the voltage within range specified in the Value(s) column?	Greater than 10 volts	Go to Step 6	Go to Step 8
6	1. Turn the ignition to OFF. 2. Reconnect all connectors. 3. Install scan tool. 4. Turn ignition to RUN. 5. Using the Data List function of the scan tool, check the status of the stoplamp switch while applying and releasing the pedal. Does the scan tool indicate the switch to be open (pedal applied) constantly?	—	Go to Step 9	Go to Step 7
7	Malfunction is intermittent. Refer to Diagnostic Aids on the facing page for more information. Repair all damage found. Is repair complete?	—	Go to Diagnostic System Check	—
8	Repair faulty stoplamp switch or open in CKT 420. Is repair complete?	—	Go to Diagnostic System Check	—
9	Replace the EBCM. Is repair complete?	—	Go to Diagnostic System Check	—



DTC C0086
ANTILOCK INDICATOR LAMP CIRCUIT SHORTED TO BATTERY

Circuit Description

The amber ANTILOCK indicator lamp is supplied ignition voltage through the GAUGE fuse. The output of the EBCM will be high (battery voltage) when the lamp is off, and will be low (ground) when the lamp is on. If a code C0086 sets, the EBCM will store the code in memory but will not disable the ABS. If a code C0086 is in memory and a different fault occurs, the EBCM will turn on the red BRAKE lamp to notify the driver of the problem.

Conditions For Setting DTC(S)

- High voltage on ABS indicator lamp circuit when expected to be low (lamp commanded on) Anything that keeps the ABS indicator lamp circuit high when the lamp is supposed to be illuminated such as a short to voltage on CKT 867.

Action Taken When the DTC Sets

- ABS is not disabled
- Code C0086 is stored in memory

Conditions For Clearing the DTC

- Conditions for setting the DTC are repaired and the scan tool clear DTCs function is used.

Diagnostic Aids

DTC C0086 is typically set by a shorted ANTILOCK indicator lamp, although it can be set from a short to voltage in the wiring between the lamp and the EBCM or a faulty EBCM.

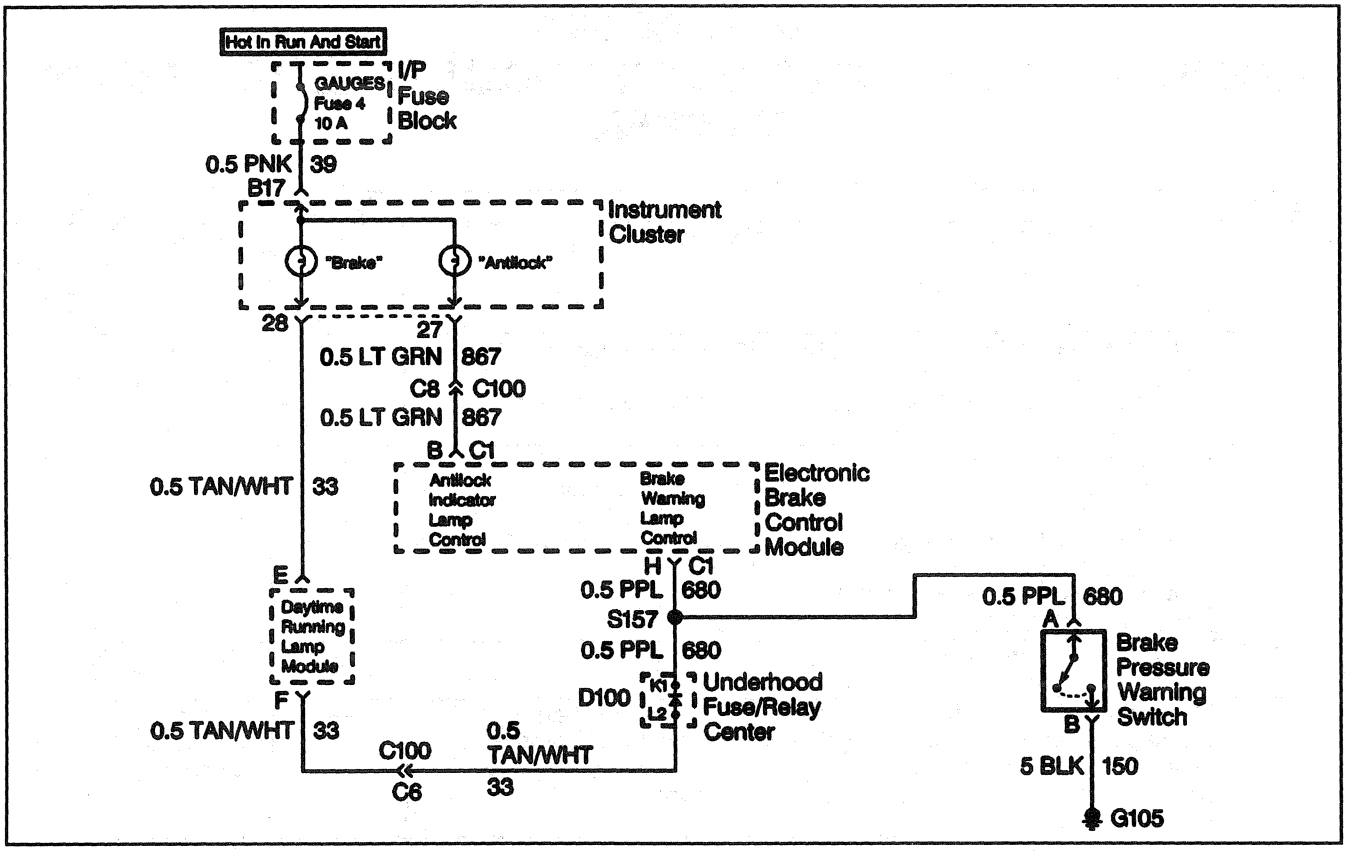
Test Description

Number(s) below refer to number(s) on the diagnostic chart.

2. Observe the ANTILOCK indicator lamp operation.
3. Check for a faulty EBCM or a short to voltage in CKT 867.

DTC C0086
ANTILOCK INDICATOR LAMP CIRCUIT SHORTED TO BATTERY

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	Go to Step 2	Go to the Diagnostic System Check
2	Turn the ignition to RUN and observe the amber antilock indicator lamp operation. Did the ANTILOCK indicator lamp turn on and then turn off after 3 seconds?	—	Go to Step 5	Go to Step 3
3	1. Turn the ignition to OFF. 2. Disconnect the 10-way EBCM harness connector from the EBCM. 3. Using a 3 amp fused jumper wire, connect terminal B of the 10-way EBCM harness connector to ground. 4. Turn the ignition to RUN. Does the ANTILOCK indicator lamp turn on?	—	Go to Step 6	Go to Step 4
4	Inspect the jumper wire fuse. Is the fuse open?	—	Go to Step 7	Go to Step 5
5	Malfunction is intermittent. Inspect all connectors and harnesses for damage which may result in high resistance when all components are connected. Refer to Diagnostic Aids on the facing page for more information. Perform all necessary repairs. Is repair complete?	—	Go to Diagnostic System Check	—
6	Replace the EBCM. Is repair complete?	—	Go to Diagnostic System Check	—
7	Replace the short to voltage in CKT 867. Is repair complete?	—	Go to Diagnostic System Check	—



DTC C0088
BRAKE WARNING LAMP CIRCUIT SHORTED TO BATTERY

Circuit Description

The red BRAKE warning lamp is supplied ignition voltage through the GAUGE fuse. The BRAKE warning lamp can be illuminated by the EBCM, Daytime Running Lamps Module (DRL), Brake Pressure Differential Switch or by the Park Stoplamp switch. If a code C0088 sets, the EBCM will store the code in memory but will not disable the ABS. If a code C0088 is in memory, the EBCM will not attempt to perform the bulb check at startup.

Conditions For Setting DTC(S)

- High voltage on the BRAKE warning lamp circuit when expected to be low (lamp commanded on).
- Anything that keeps the BRAKE warning lamp circuit high when the lamp is supposed to be illuminated such as a short to voltage on CKT 680.

Action Taken When the DTC Sets

- ABS is not disabled
- Code C0088 is stored in memory

Conditions For Clearing the DTC

- Conditions for setting the DTC are repaired and the scan tool clear DTCs function is used.

Diagnostic Aids

DTC C0088 is typically set by a shorted BRAKE warning lamp, although it can be set from a short to voltage in the wiring between the lamp and the EBCM or a faulty EBCM.

Test Description

Number(s) below refer to number(s) on the diagnostic chart.

2. Observe the BRAKE warning lamp operation.
3. Check for a faulty EBCM or a short to voltage in CKT 680.

DTC C0088
BRAKE WARNING LAMP CIRCUIT SHORTED TO BATTERY

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	Go to Step 2	Go to Diagnostic System Check
2	Turn the ignition to RUN and observe the BRAKE warning lamp operation. Did the lamp turn on and then turn off after 3 seconds?	—	Go to Step 5	Go to Step 3
3	1. Turn the ignition to OFF. 2. Disconnect the 10-way EBCM harness connector from the EBCM. 3. Using a 3 amp fused jumper wire, connect terminal H of the 10-way EBCM harness connector to ground. 4. Turn ignition to RUN. Does the BRAKE warning lamp turn on?	—	Go to Step 6	Go to Step 4
4	Inspect the jumper wire fuse. Is the fuse open?	—	Go to Step 7	Go to Step 5
5	Malfunction is intermittent. Inspect all connectors and harnesses for damage which may result in high resistance when all components are connected. Refer to Diagnostic Aids on the facing page for more information. Perform all necessary repairs. Is repair complete?	—	Go to Diagnostic System Check	—
6	Replace the EBCM. Is repair complete?	—	Go to Diagnostic System Check	—
7	Replace the short to voltage in CKT 680. Is repair complete?	—	Go to Diagnostic System Check	—

ON-VEHICLE SERVICE

SERVICE PRECAUTIONS

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

- Before welding on the vehicle with an electric welding unit, turn the ignition switch OFF and disconnect the 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 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.

ABS BLEEDING PROCEDURE

Important

- The two-person bleed procedure is required when installing a new electro-hydraulic control unit, or when air is suspected to be trapped in the valve body.
- Do not run the Function Test after combination valve or tube adapter replacement except on S/T trucks.
- Do not drive the vehicle until brake pedal feel is firm.
- Do not re-use brake fluid used during bleeding.
- Vacuum, pressure, or gravity bleeding may be used for base brake bleeding only.

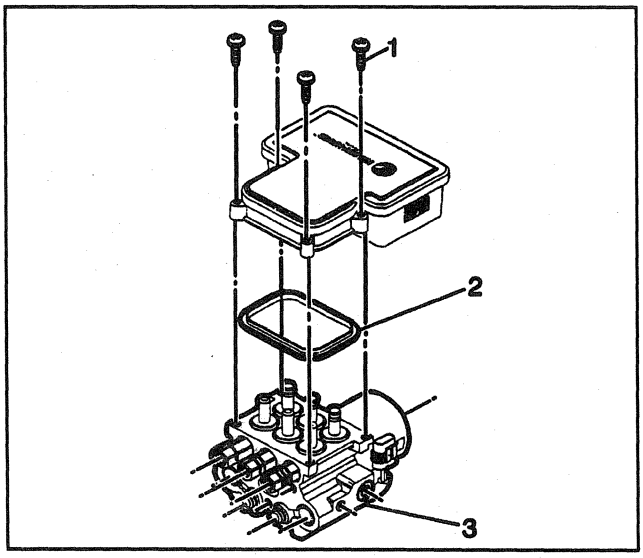
Two Person ABS Procedure

1. Raise the vehicle to gain access to the system bleed screws.
2. Begin by bleeding the system at the right rear wheel.
3. Install clear hose on the bleed screw. Immerse the opposite end of the hose into a container partially filled with clean DOT 3 brake fluid.
4. Open the bleed screw 1/2 to 1 full turn.
5. Slowly depress the brake pedal until it reaches its full travel and hold until the bleed screw has been tightened. Release the brake pedal and wait 10-15 seconds for the master cylinder pistons to return to the home position. Repeat until clean, air free brake fluid is present at the wheel bleed screw. This procedure may use more than a pint of fluid per wheel. Check the master cylinder fluid level every 4 to 6 strokes of the brake pedal to avoid running the system dry. Repeat steps 3 though 5 on the left rear, then right front, then left front.
6. Use the scan tool to run Function Test four times consecutively while applying the brake pedal firmly. Remove foot from the brake pedal between each test.
7. Rebleed all four wheels using steps 3 through 5 to remove the remaining air from the brake system.
8. Evaluate the brake pedal feel before attempting to drive the vehicle and re-bleed as many times as necessary to obtain appropriate pedal feel.

ELECTRONIC BRAKE CONTROL MODULE REPLACEMENT

Remove or Disconnect (Figure 11)

1. Negative battery cable. Refer to SECTION 0A.
2. Four electrical connectors.
3. Four T-25 Torx® bolts.



Legend

(1) Bolt/Screw 5 N.m
(2) Seal
(3) Module, Electronic Brake Control

Figure 11—Electronic Brake Control Module (EBCM)

4. EBCM from BPMV. A light amount of force may be necessary to remove the EBCM.

Important

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

Important

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

Clean

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

Install or Connect (Figure 11)

1. New EBCM gasket onto BPMV.

Important

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

2. EBCM to BPMV.

Inspect

- Gasket for correct alignment.

3. Four new EBCM bolts.

Tighten

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

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

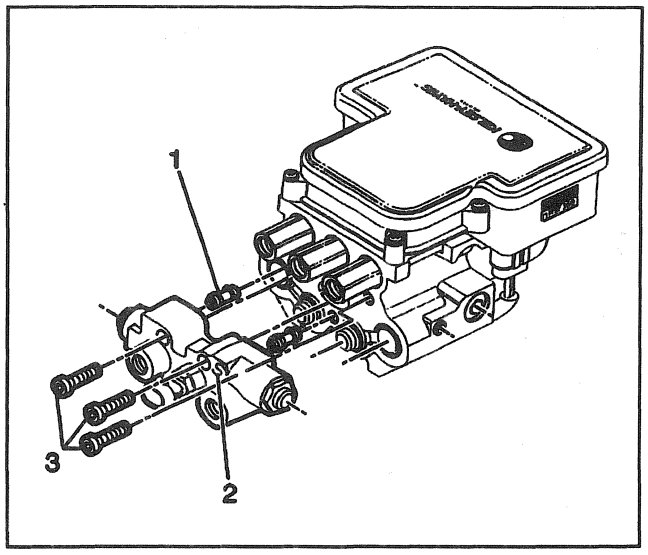
COMBINATION VALVE REPLACEMENT

Inspect

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

Remove or Disconnect (Figure 12)

1. Electrical connector.
2. Front and rear brake pipes.
3. Three Allen bolts.



Legend
(1) Transfer Tubes
(2) Identification Code
(3) Bolt/Screw 16 N·m

Figure 12—Combination Valve

4. Combination valve from BPMV.
5. Two transfer tubes.

Important

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

Inspect

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

Install or Connect (Figure 12)

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

Tighten

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

4. Front and rear brake pipes to combination valve.

Tighten

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

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

Important

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

TUBE ADAPTERS

Remove or Disconnect (Figure 13)

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

Install or Connect (Figure 13)

1. Tube adapter.

Tighten

- Tube adapter to 31 N·m (23 lb. ft.)

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

Important

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

BRAKE PRESSURE MODULATOR VALVE REPLACEMENT

Remove or Disconnect (Figures 14 and 15)

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

Important

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

Important

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

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

Important

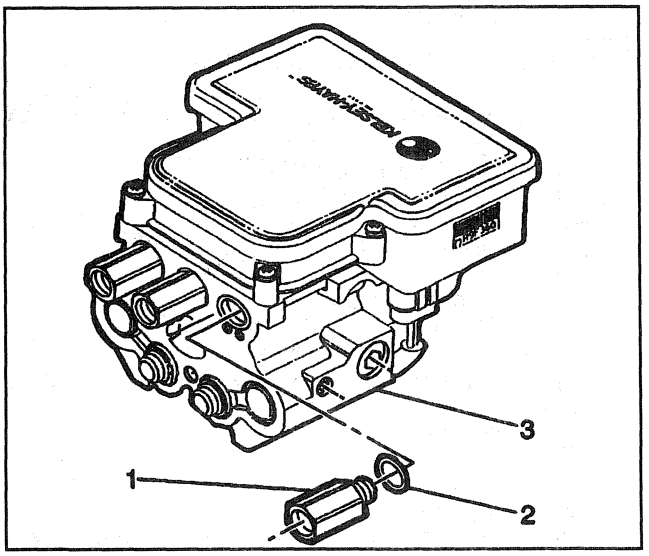
- Do not reuse the transfer tubes. Always install new transfer tubes.

Install or Connect (Figures 14 and 15)

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

Tighten

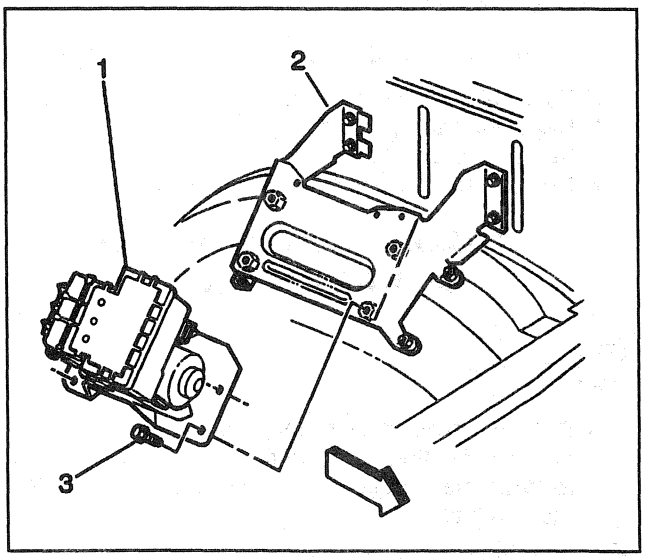
- Bolts in two steps.
  - — First to 8 N·m (6 lb. ft.)
  - — Second to 16 N·m (12 lb. ft.)



Legend

(1) Tube Adapter
(2) O Ring
(3) Valve, Brake Pressure Modulator

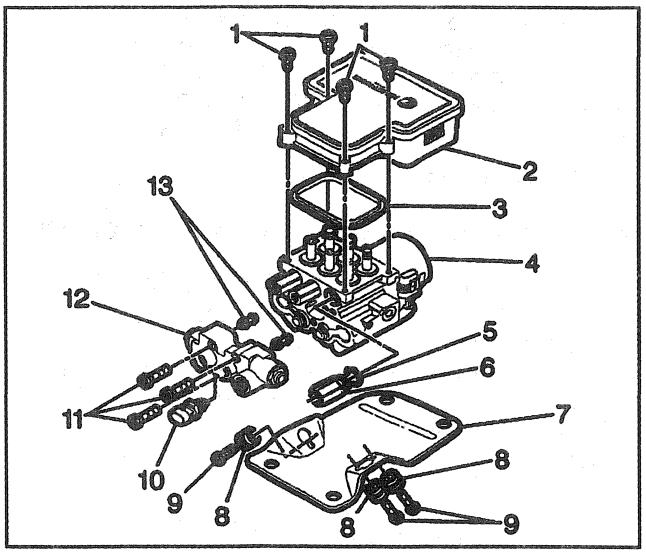
Figure 13—Tube Adapters



Legend

(1) Electro-hydraulic Control Unit
(2) Bracket
(3) Bolt/Screw 27 N·m

Figure 14—ABS Mounting Bracket



Legend

(1) Bolt/Screw
(2) Module, Electronic Brake Control
(3) Gasket
(4) Valve, Brake Pressure Modulator
(5) Seal, Rubber O Ring
(6) Tube Adapters
(7) Bracket
(8) Grommet
(9) Bolt/Screw
(10) Switch, Brake Pressure differential
(11) Bolt/Screw
(12) Valve, Combination
(13) Transfer Tubes

Figure 15—Electro-Hydraulic Control Unit (EHCU)

4. New EBCM gasket to EBCM.

Important

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

5. EBCM to BPMV.

Inspect

- Gasket to verify proper alignment.

6. Four new EBCM Torx® bolts.

Tighten

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

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

Tighten

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

9. Front and rear brake pipes to combination valve.

Tighten

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

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

FRONT WHEEL SPEED SENSOR REPLACEMENT

Two Wheel Drive (Except C 3500HD Models)

Remove or Disconnect (Figures 16 through 19)

1. Tire and wheel. Refer to SECTION 3C.
2. Brake caliper. Refer to SECTION 5B1.
3. Hub and rotor. Refer to SECTION 3C.
4. Wheel speed sensor electrical connector.
5. Wheel speed sensor harness clip rivets.

- Use a 3/16 inch drill.

6. Clips from wheel speed sensor wire.

- Save clips for new wheel speed sensor.

7. Wheel speed sensor mounting bolts and nut.
8. Splash shield mounting bolts.
9. Wheel speed sensor and splash shield.
10. Splash shield gasket.

Install or Connect (Figures 16 through 19)

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 bolts to 16 N.m (12 lb. ft.).

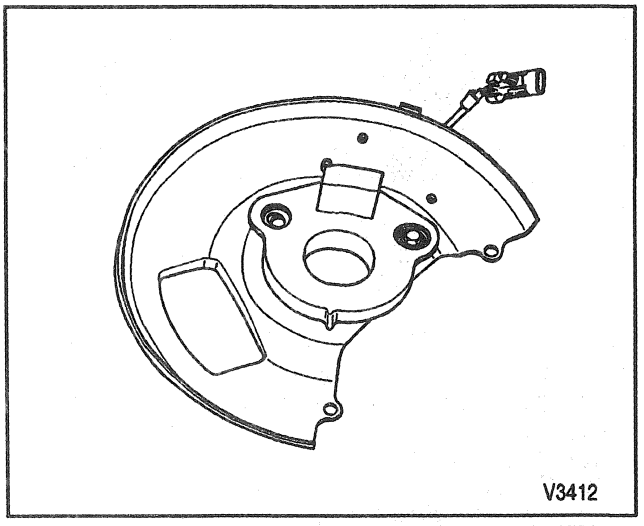
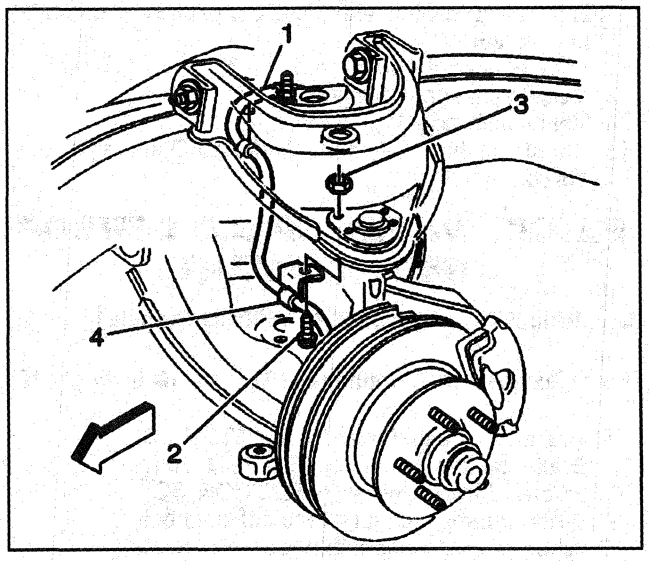


Figure 16—Front Wheel Speed Sensor (2WD)



Legend
(1) Cable, Wheel Speed Sensor
(2) Bolt/Screw
(3) Nut 20 N.m
(4) Clip, Wheel Speed Sensor Harness

Figure 17—WSS Harness Routing (2WD)

4. Wheel speed sensor mounting bolts and nut.

Tighten

- Wheel speed sensor mounting bolts to 26 N.m (19 lb. 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 (Figures 20, 21, 22)

1. Tire and wheel. Refer to SECTION 3E.
2. Brake Caliper. Refer to SECTION 5B1.
3. Rotor. Refer to SECTION 3C.
4. Sensor wire mounting clip on the control arm.
5. Sensor wire mounting clip on the frame.
6. Sensor electrical connector.

Clean

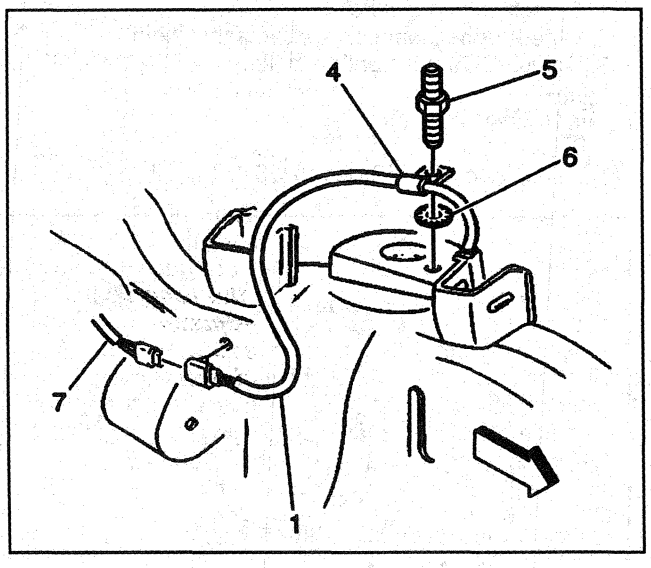
- The entire area thoroughly

Important

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

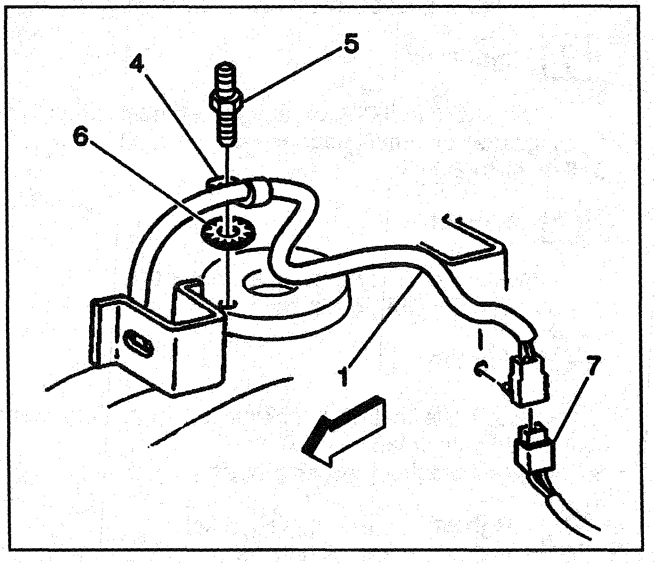
7. Sensor from hub and bearing assembly.

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



Legend
(1) Cable, Wheel Speed Sensor
(4) Clip, Wheel Speed Sensor Harness
(5) Stud 15 N.m
(6) Washer
(7) Harness, ABS Wiring

Figure 18—WSS Harness Routing (2WD)



Legend
(1) Cable, Wheel Speed Sensor
(4) Clip, Wheel Speed Sensor Harness
(5) Stud 15 N.m
(6) Washer
(7) Harness, ABS Wiring

Figure 19—WSS Harness Routing (2WD)

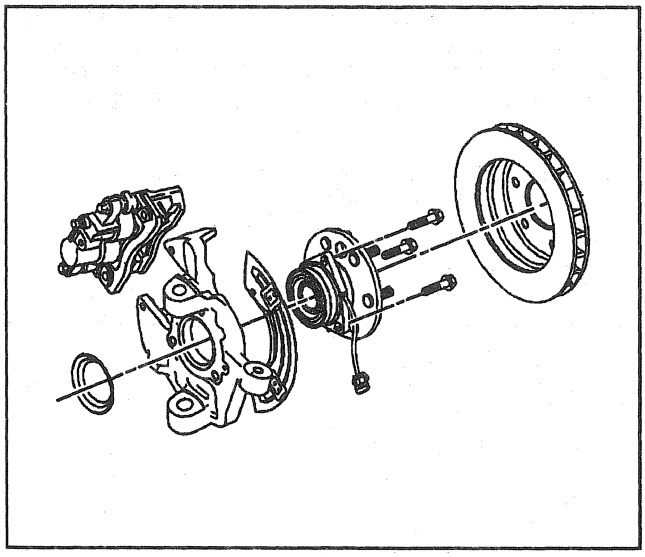


Figure 20—Front Wheel Speed Sensor (4WD)

Install or Connect (Figures 20, 21, 22)

Important

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

1. Sensor into hub and bearing assembly.

Tighten

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

Important

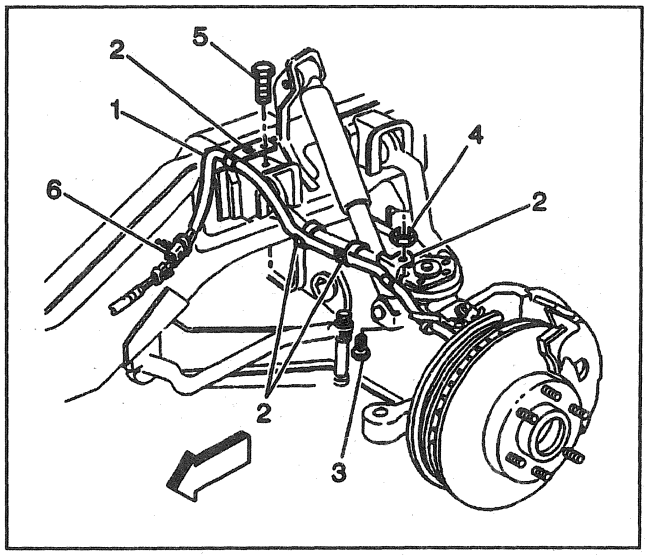
- The new speed sensor has new mounting clips already installed on the wire. **DO NOT** reuse the old clips.

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

C 3500HD Models

Remove or Disconnect (Figures 23 through 27)

1. Tire and wheel. Refer to SECTION 3C.
2. Brake Caliper. Refer to SECTION 5B1.
3. Hub and Rotor Assembly. Refer to SECTION 3C.
4. Splash shield. Refer to SECTION 3C.
5. Wheel speed sensor wire mounting clip attached to upper king pin cap.
6. Wheel speed sensor wire mounting clip attached to frame rail.
7. Wheel speed sensor electrical connector.



Legend

(1) Cable, Wheel Speed Sensor
(2) Clip, Wheel Speed Sensor Harness
(3) Bolt/Screw
(4) Nut 20 N·m
(5) Bolt/screw 15 N·m
(6) Connector, Wheel Speed Sensor Cable

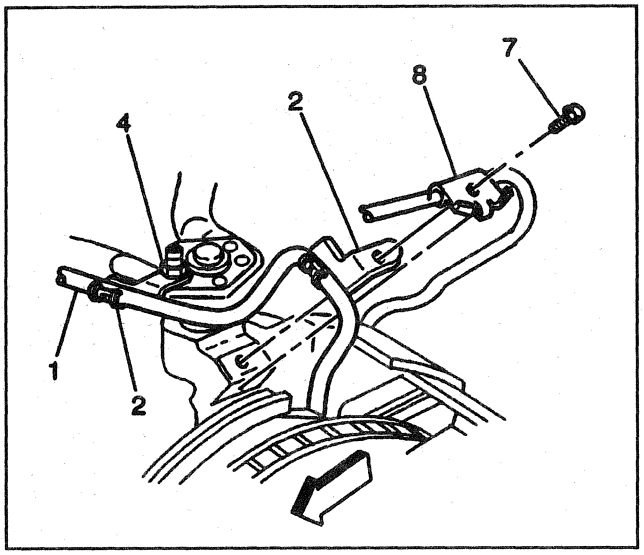
Figure 21—WSS Harness Routing (4WD)

8. Wheel speed sensor to bracket mounting nuts and bolts.
   - It is not necessary to remove the wheel speed sensor mounting bracket unless the bracket is damaged.
9. Wheel speed sensor from mounting bracket.
   - It is not necessary to replace the sensor mounting bracket unless there is visible damage or distortion to the mounting bracket.

NOTICE: ***The wheel speed sensor used on the C 3500HD models is adjustable by means of slots provided in the mounting bracket. The sensor must be properly adjusted in order to provide the correct air gap between the wheel speed sensor and the tone wheel. If the sensor is not properly adjusted the tone wheel may hit the wheel speed sensor or the output from the wheel speed sensor may be low, missing, or erratic. Follow the procedure outlined below to properly adjust the front wheel speed sensor.***

Install or Connect (Figures 23)

1. Wheel speed sensor to mounting bracket
2. Wheel speed sensor to bracket mounting nuts and bolts.
   - Run down nuts but do not torque. The wheel speed sensor must remain loose and move along the slots in the bracket.



Legend
(1) Cable, Wheel Speed Sensor
(2) Clip, Wheel Speed Sensor Harness
(4) Nut 20 N·m
(7) Bolt/Screw 20 N·m
(8) Bracket, Brake Hose

Figure 22—WSS Harness Routing (4WD)

3. Place the front hub and rotor assembly on a surface with the tone wheel facing up. Take care not to damage the wheel studs.
4. Mark the position of the rotor relative to the hub so the rotor can be reinstalled in the same position later.

Remove or Disconnect

1. Bolts attaching the rotor to the hub.
2. Rotor from the hub.

Install or Connect

1. Hub and tone wheel assembly on the knuckle spindle.
2. Outer bearing, washer and spindle nut.

Tighten

- Spindle nut to 12 lb. ft. while rotating the hub in either direction.
  - Do not back off the nut.

3. Insert flexible shim stock or equivalent between the tone wheel and the wheel speed sensor.
   - The thickness of the shim stock must be 1.25 mm (0.050 in.). The length and width of the shim stock must be sufficient enough to cover the face of the wheel speed sensor. If shim stock is not available, regular notebook or writing paper can be used provided the specified thickness is inserted between the tone wheel and the wheel sensor.

CAUTION: DO NOT use a rigid feeler gage or a wire spark plug gap gage to set the wheel speed sensor to tone wheel air gap as these tools will not result in the correct air gap.

4. Press wheel speed sensor firmly against the shim stock and the tone wheel.

Tighten

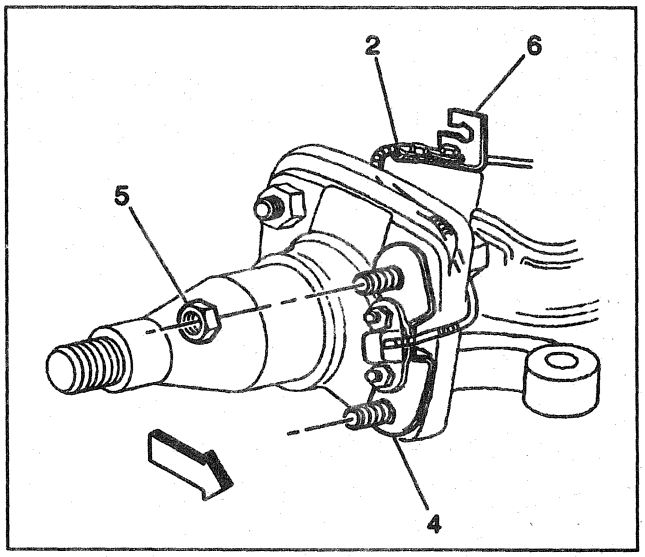
A. The left hand lower attaching nut to 13 N·m (10 lb. ft.).
B. The left hand upper attaching nut to 13 N·m (10 lb. ft.).
C. The right hand upper attaching nut to 13 N·m (10 lb. ft.).
D. The right hand lower attaching nut to 13 N·m (10 lb. ft.) while holding the wheel speed sensor against the shim stock.

Remove or Disconnect

1. The shim stock from between the tone wheel and the wheel speed sensor.

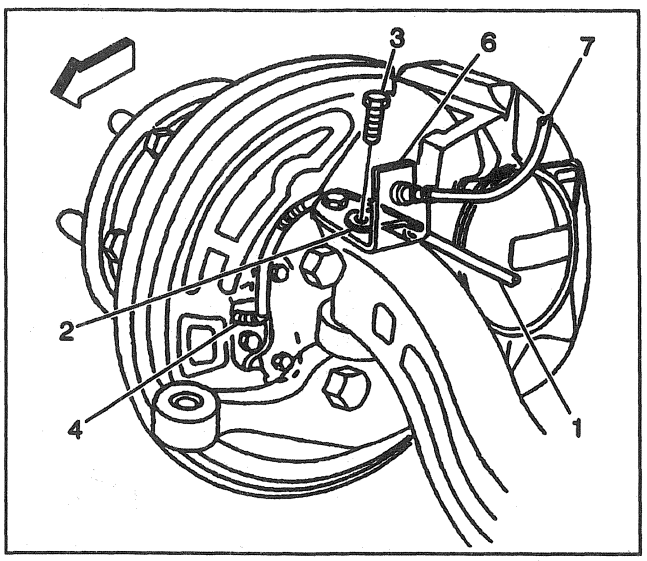
Inspect

- That the tone wheel does not contact the wheel speed sensor when the hub and tone wheel are rotated.



Legend
(2) Clip, Wheel Speed Sensor Harness
(4) Sensor, Wheel Speed
(5) Nut 285 N·m
(6) Bracket, Brake Hose

Figure 23—Wheel Speed Sensor (C 3500HD)



Legend

(1) Cable, Wheel Speed Sensor
(2) Clip, Wheel Speed Sensor Harness
(3) Bolt/Screw 16 N.m
(4) Sensor, Wheel Speed
(6) Bracket, Brake Hose
(7) Hose, Brake

Figure 24—WSS Harness Routing (C 3500HD)

Install or Connect (Figures 23 and 24)

1. The splash shield to the front anchor plate.
   - Take care to route the wheel speed sensor wire through the opening in the splash shield near the center mounting hole.

Tighten

   - Bolts to 17 N.m (13 lb. ft.).
2. Route the wheel speed sensor wire between the splash shield and the knuckle.
3. The wheel speed sensor mounting clip to the upper king pin cap.

Tighten

   - Bolt to 17 N.m (13 lb. ft.).
4. Electrical connectors.

Install or Connect (Figures 23)

1. Front wheel hub and tone wheel assembly to spindle.
2. Rotor to front wheel hub.
   - Take care to line up reference position marks.
3. Bolts

Tighten

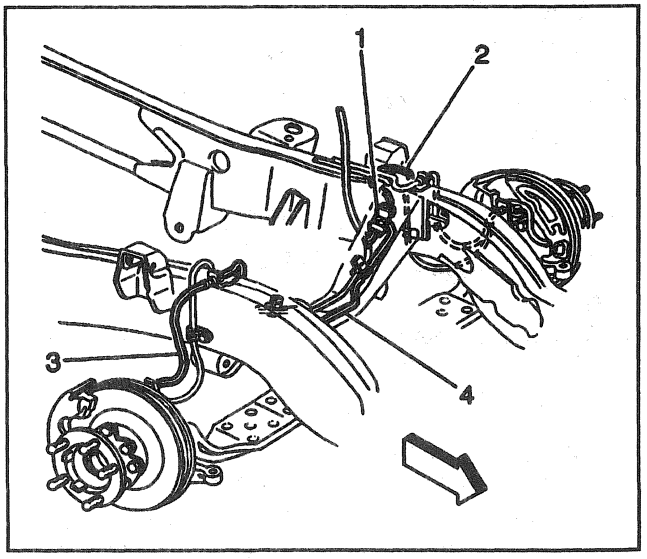
   - Bolts to 237 N.m (175 lb. ft.).
4. Front hub and rotor assembly. Refer to SECTION 3C.
5. Caliper assembly. Refer to SECTION 5B1.
6. Tire and wheel. Refer to SECTION 3C and 3E.

FRONT WHEEL SPEED SENSOR MOUNTING BRACKET (C 3500HD MODELS ONLY)

NOTICE: ***Whenever performing repairs to the wheel speed sensor, wheel speed sensor mounting bracket, steering arm, front caliper anchor plate, steering knuckle, inner bearing dust shield, or any attaching fasteners, the wheel speed sensor air gap may be moved out of adjustment. Always check and adjust the wheel speed sensor air gap as outlined in SECTION 5E1, FRONT WHEEL SPEED SENSOR REPLACEMENT to prevent damage to the wheel speed sensor and to insure proper operation of the four wheel antilock brake system.***

Remove or Disconnect (Figure 23 and 24)

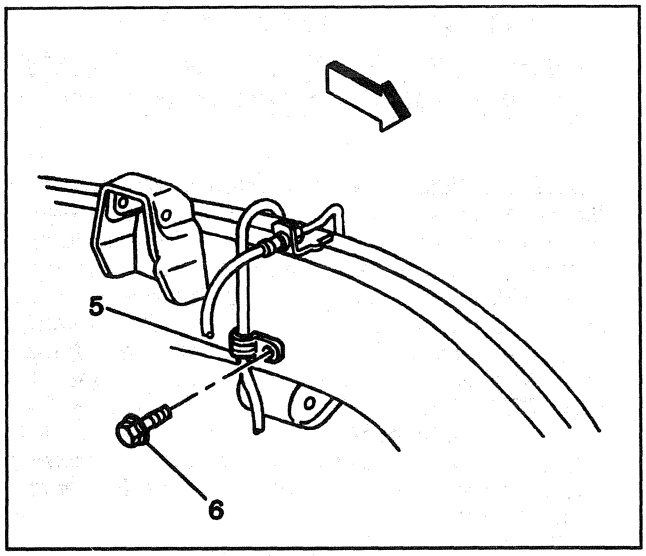
1. Tire and wheel. Refer to SECTION 3C.
2. Brake caliper. Refer to SECTION 5B1.
3. Hub and Rotor Assembly. Refer to SECTION 3C.
4. Splash shield. Refer to SECTION 3C.
5. Wheel speed sensor to bracket mounting nuts and bolts.
6. Wheel speed sensor from mounting bracket.
7. Wheel speed sensor mounting bracket attaching nuts.
8. Wheel speed sensor mounting bracket.



Legend

(1) Harness, ABS Wiring
(2) Cable, Wheel Speed Sensor
(3) Hose, Brake
(4) Pipe, Brake

Figure 25—WSS Harness Routing (C 3500HD)



Legend
(5) Clip, Wheel Speed Sensor Cable
(6) Bolt/Screw 8 N.m

Figure 26—WSS Harness Routing (C 3500HD)

Install or Connect (Figure 23 and 24)

1. Wheel speed sensor mounting bracket.
2. Wheel speed sensor mounting bracket attaching nuts.
   - Do not install washers between the attaching nuts and the wheel speed sensor mounting bracket or insufficient thread engagement of the nut may occur.

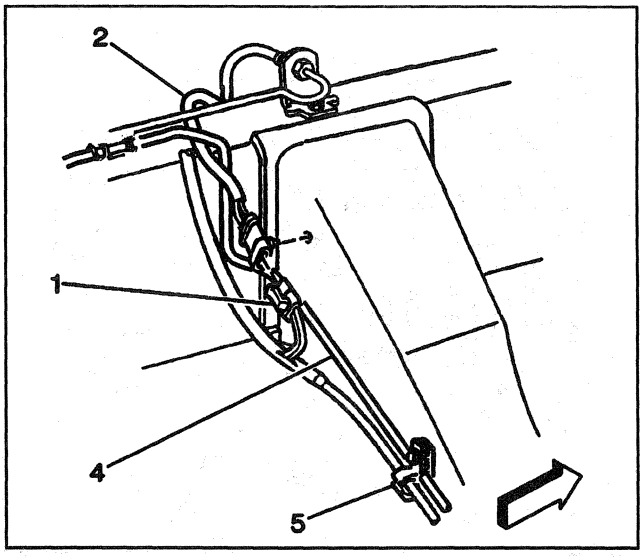
Tighten

   - Attaching nuts to 285 N.m (210 lb. ft.).

3. Wheel speed sensor to mounting bracket.
   - Refer to SECTION 5E1, FRONT WHEEL SPEED SENSOR REPLACEMENT.

FRONT WHEEL SPEED SENSOR TONE WHEELS

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



Legend
(1) Harness, ABS Wiring
(2) Cable, Wheel Speed Sensor
(4) Pipe, Brake
(5) Clip, Wheel Speed Sensor Cable

Figure 27—WSS Harness Routing (C 3500HD)

FRONT WHEEL SPEED SENSOR TONE WHEELS (C 3500HD ONLY)

The front wheel speed sensor tone wheels are not serviceable separately from the bearing (4WD models) or from the front wheel hub (2WD models). If the tone wheel becomes damaged or if a tooth is broken or missing, the complete front wheel hub assembly must be replaced (2WD models). DO NOT attempt to remove and replace a tone wheel. The tone wheels are pressed on the hub to a precise location and can cause damage to the wheel speed sensor if the tone wheel is not pressed to the proper location. Also, if the tone wheel is not pressed to the proper location, a low, missing, or erratic wheel speed sensor output can occur.

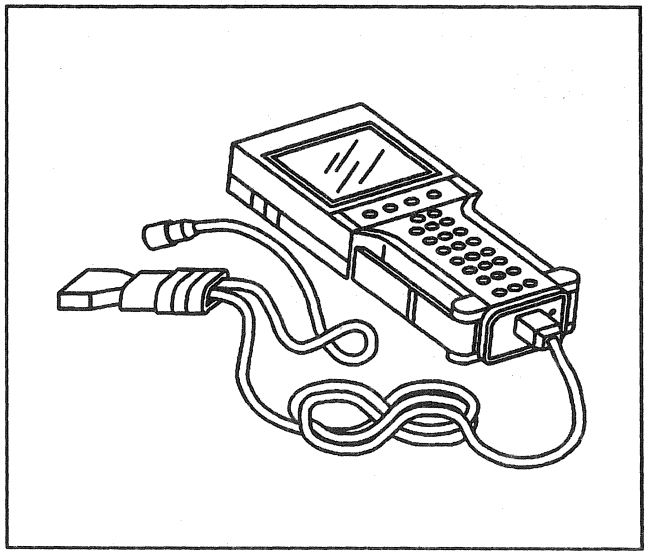
WARNING/INDICATOR LAMPS

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

SPECIFICATIONS

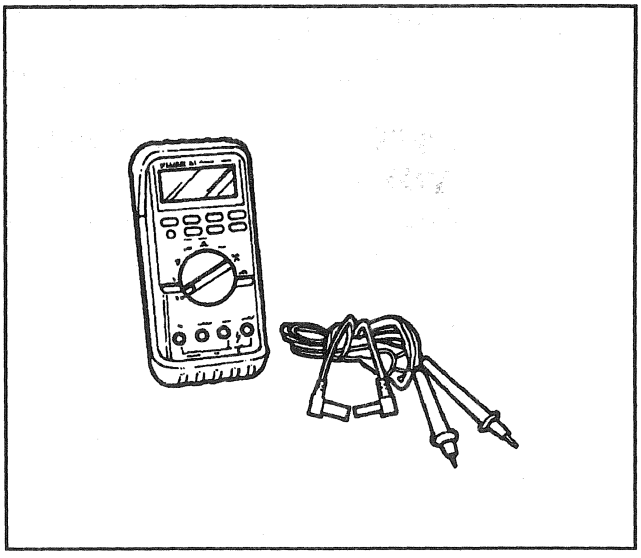
ITEM	Nm	Lb. Ft	Lb. In.
BPMV Bracket Mounting Bolts	24	18	-
Combination Valve to BPMV	16	12	-
EBCM to BPMV	5	-	39
EHCU to Bracket	9	7	-
Front Brake Line to Combination Valve	24	18	-
Front Wheel Speed Sensor Mounting Bolts (2WD)	26	19	-
Front Wheel Speed Sensor Mounting Bolts (4WD)	18	13	-
Front Wheel Speed Sensor Mounting Nuts (C 3500HD)	13	10	115
Front Wheel Speed Sensor Mounting Bracket Nut (C 3500HD)	285	210	-
King Pin Cap to Knuckle Bolt (C 3500HD)	17	13	-
Rear Brake Line to Combination Valve	24	18	-
Splash Shield Mounting Bolts (2WD)	16	12	-
Splash Shield Mounting Bolt (C 3500HD)	17	13	150
Tube Adapters to BPMV	31	23	-

SPECIAL TOOLS



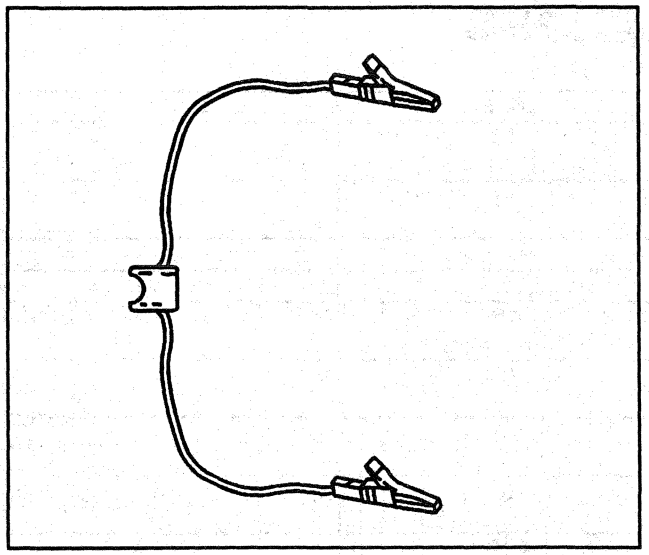
Legend
(1) Scan Tool

Figure 28



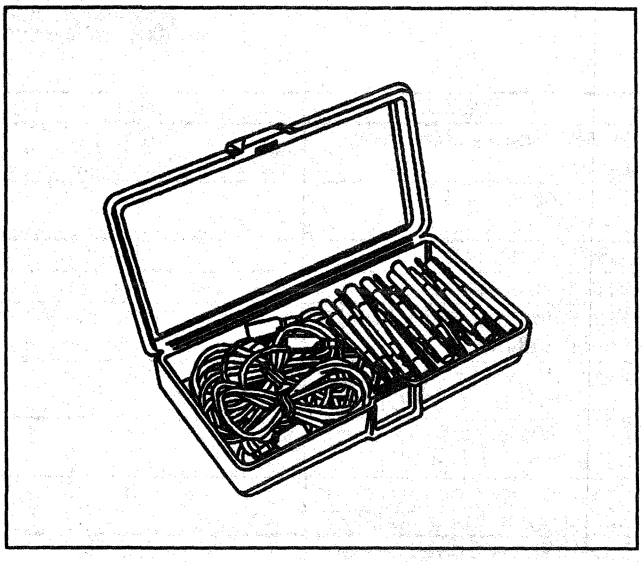
Legend
(1) Digital Multi-Meter

Figure 29



Legend
(1) Fused Jumper Wire

Figure 30



Legend
(1) Jumper Kit

Figure 31

SECTION 5F

PARKING BRAKE

CAUTION: This vehicle has a Supplemental Inflatable Restraint (SIR) System. Refer to the SIR Component and Wiring Location view in order to determine whether you are performing service on or near the SIR components or the SIR wiring. When you are performing service on or near the SIR components or the SIR wiring, refer to the SIR On-Vehicle Service information. Failure to follow the CAUTIONS could cause air bag deployment, personal injury, or unnecessary SIR system repairs.

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

NOTICE: ***Always use the correct fastener in the proper location. When you replace a fastener, use ONLY the exact part number for that application. General Motors will call out those fasteners that require a replacement after removal. General Motors will also call out the fasteners that require thread lockers or thread sealant. UNLESS OTHERWISE SPECIFIED, do not use supplemental coatings (paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.***

CONTENTS

GENERAL DESCRIPTION

There are three basic types of parking brakes used. The lower GVW models use leading/trailing rear drum brakes. The higher GVW models use duo-servo rear drum brakes. The highest GVW model C 3500HD 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 use 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 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

All vehicles are equipped with 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 inch) of the shoe. For riveted shoe and lining assemblies, replace when the lining is worn to within 0.76 mm (0.030 inch) 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 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.

PARKING BRAKE LEVER

Remove or Disconnect (Figure 1)

- The C 3500HD lever looks the same as the other models, but uses a different torque applying lever assembly.
- The parking brake must be fully released.

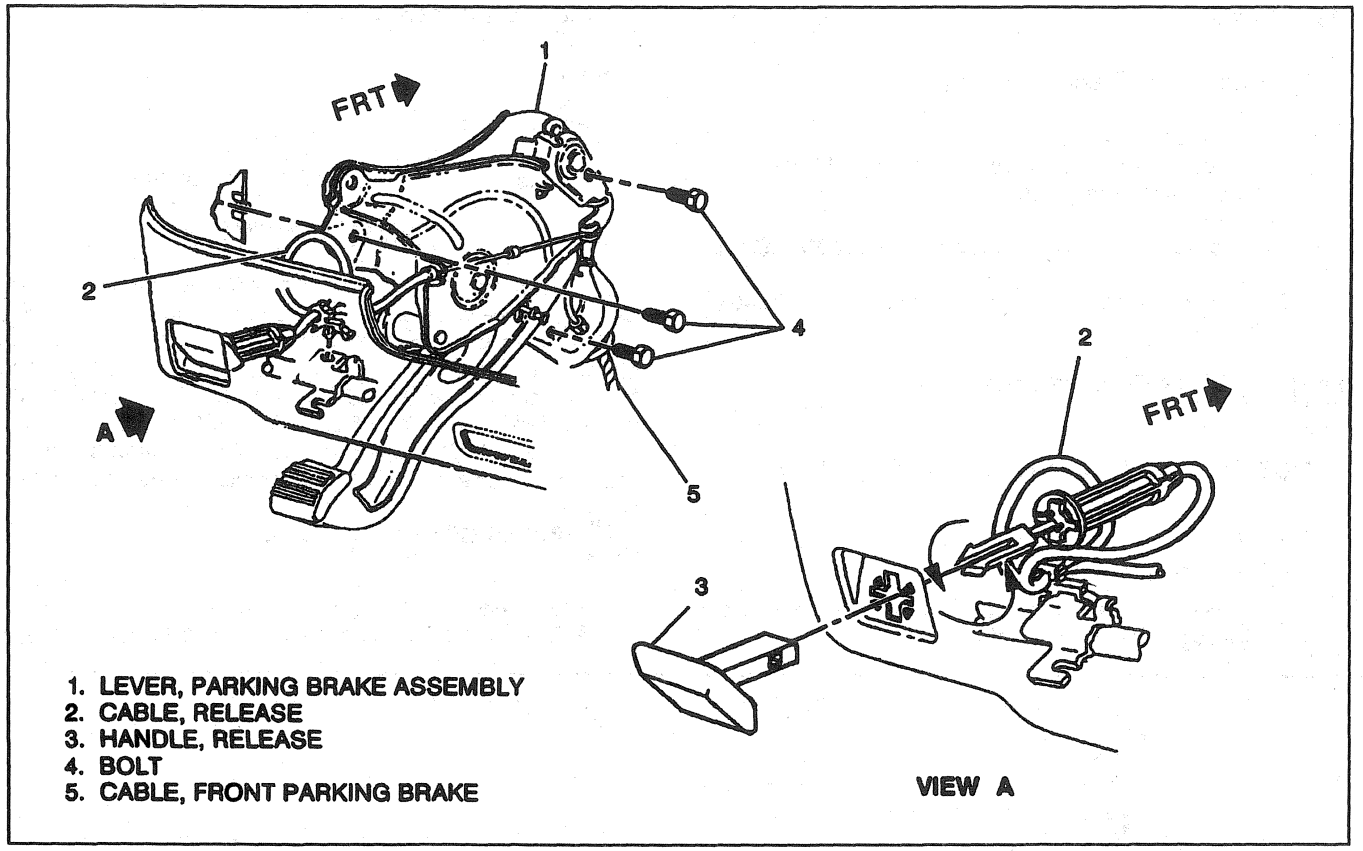


Figure 1—Parking Brake Lever

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)

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

1. Lever assembly (1).
2. Bolts (4).

Tighten

- Bolts (4) to 24 N·m (18 lb. 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)

- Make sure parking brake is released.

1. Raise vehicle and support with safety stands.
2. Loosen adjusting nut at equalizer (5) (Figure 2).
3. Connector (8).
4. Cable (5) from parking brake lever (1).
   - Bend in the retaining fingers (6) at the frame bracket.
5. Front cable (5).

Install or Connect (Figure 2)

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

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 at the equalizer.
4. Connector.
5. Rear brake assembly. Refer to SECTION 5C1 or 5C2.
6. Bend in the retaining fingers at the backing plate.
7. Cable.

Install or Connect (Figure 3)

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

1. Cable.
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.

Adjust

- Refer to "Adjustment" in this section.

ADJUSTMENT

The parking brake must be adjusted any time the parking brake cables are serviced, or the holding ability is not adequate. Before adjusting the parking brake, check the condition of the service brakes. The service brakes must be adjusted properly before adjusting the parking brake. Refer to SECTION 5C1 or 5C2.

The C 3500HD has a propeller shaft mounted parking brake and does not affect the service brakes.

Adjust (Figures 3 and 4)

1. Block the front wheels.
2. Raise the vehicle and support with safety stands.

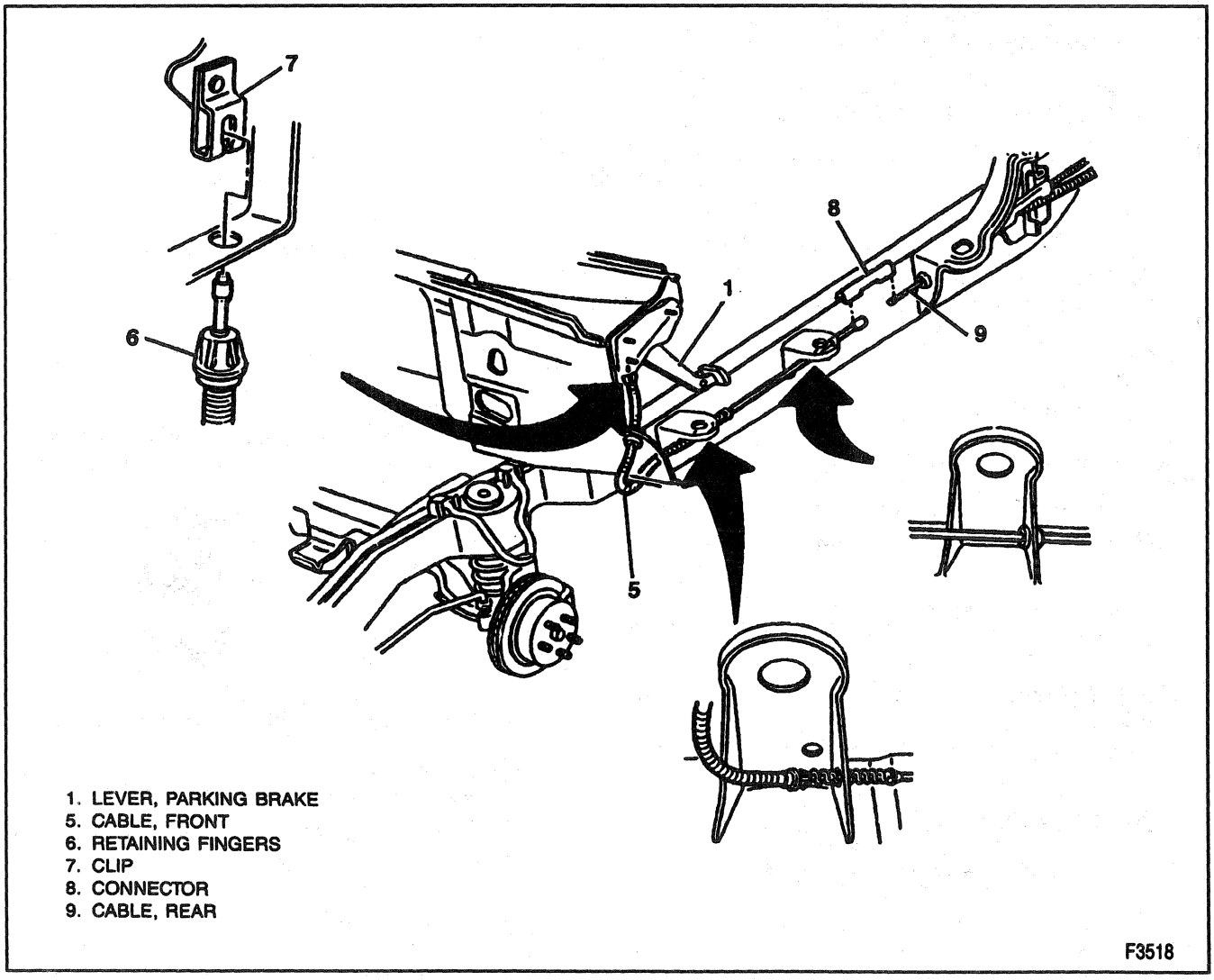


Figure 2—Front Parking Brake Cable

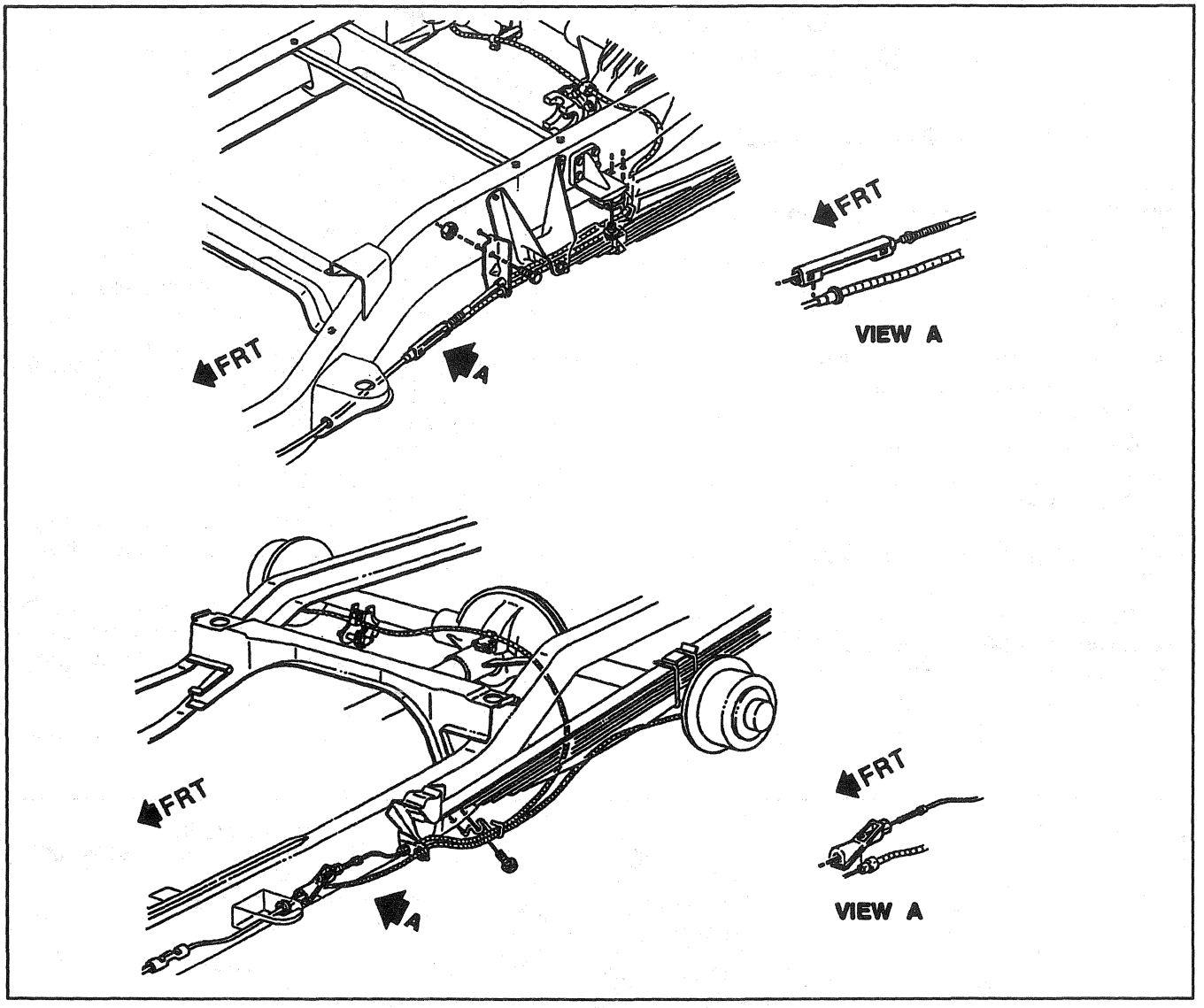


Figure 3—Rear Parking Brake Cable

3. Loosen the adjusting nut at the equalizer.
4. Set the parking brake by pushing the pedal down 18 degrees.
   - Insert a 3 mm (.125 inch) pin into locating hole (A) in the pedal assembly (Figure 4). Push the pedal downward until the pin contacts the parking brake outer flange.
5. Turn adjusting nut until wheels rotate forward with moderate drag.
6. Release parking brake and rotate rear wheels.
   - There should be no drag.
7. Lower the vehicle and unblock front wheels.

"BRAKE" LAMP

For "BRAKE" lamp on-vehicle service, refer to SECTION 8C.

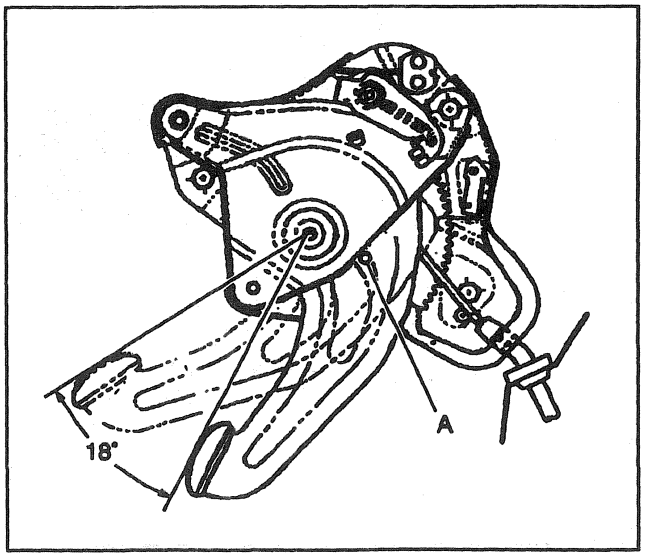


Figure 4—Parking Brake Adjustment Setting

ON-VEHICLE SERVICE: PROPELLER SHAFT PARKING BRAKE

PARKING BRAKE CABLE

Remove or Disconnect (Figure 5)

1. Release the parking brake.
2. Raise the vehicle and support with safety stands.
3. Cotter pin (4) and clevis pin (3).
4. Clevis (5) and nut (6) from cable.
5. Grommet (7) from bracket.
6. Bolt (8) and clip (9).
7. Cable end from lever (13).
8. Retaining fingers (12) from lever (13).
9. Cable assembly (10).

Install or Connect (Figure 5)

1. Cable assembly (10).
2. Retaining fingers (12) to lever (13).
3. Cable end to lever (13).
4. Grommet (7) to bracket.
5. Clip (9) and bolt (8).

Tighten

- Bolt (8) to 10 N·m (88 lb. in.).

6. Nut (6) and clevis (5) to cable, finger tight.
7. Adjust. Refer to "Adjustment" in this section.
8. Lower the vehicle.

PARKING BRAKE ADJUSTMENT

Tool Required:
J 35999 Tension Scale

Adjust (Figures 4, 5 and 6)

1. Remove clevis pin (3) from lever (2) (Figure 5).
2. Set parking brake by pushing the pedal down 18 degrees.
   - Insert a 3 mm (.125 inch) pin into locating hole (A) in the pedal assembly (Figure 4). Push the pedal down until the pin contacts the parking brake outer flange.

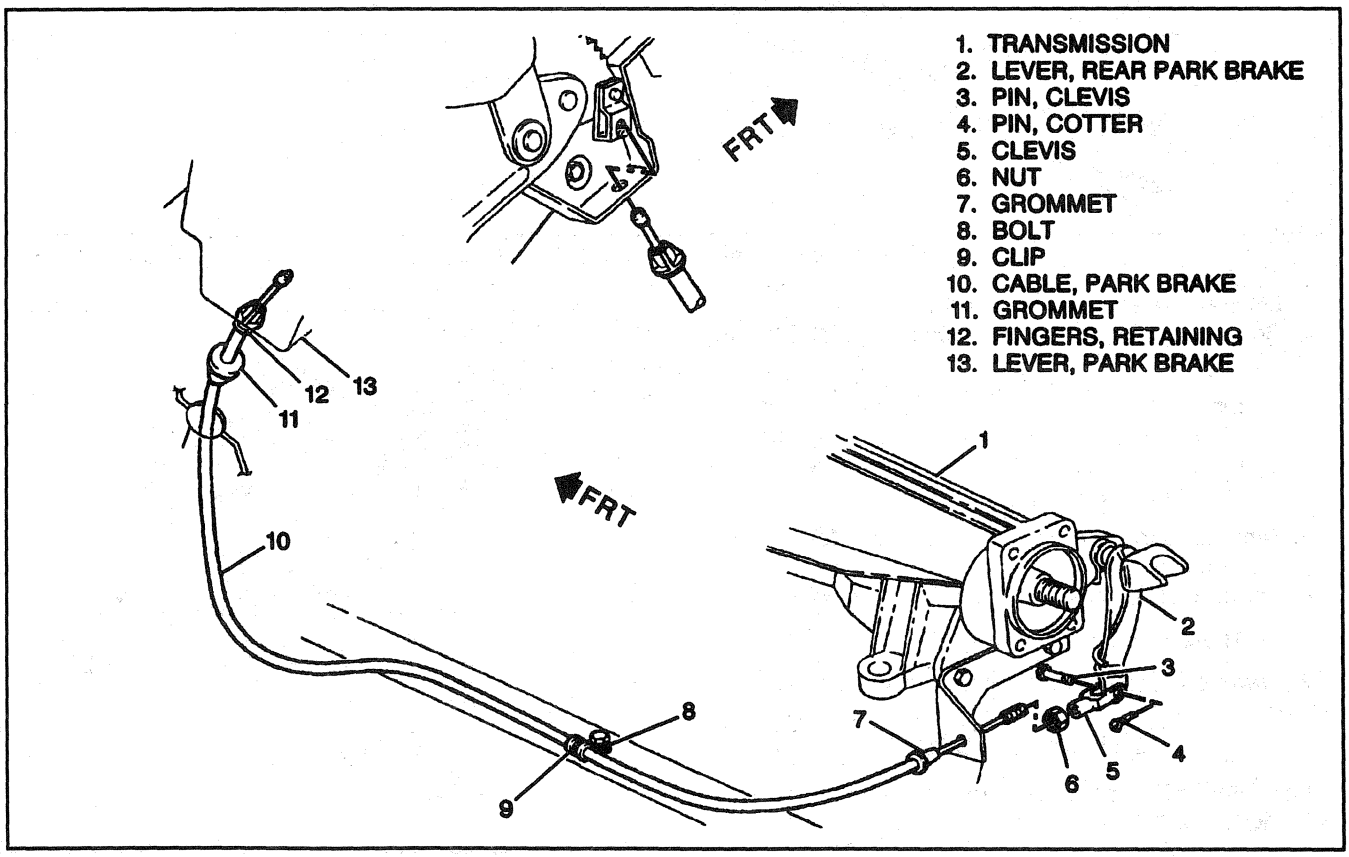
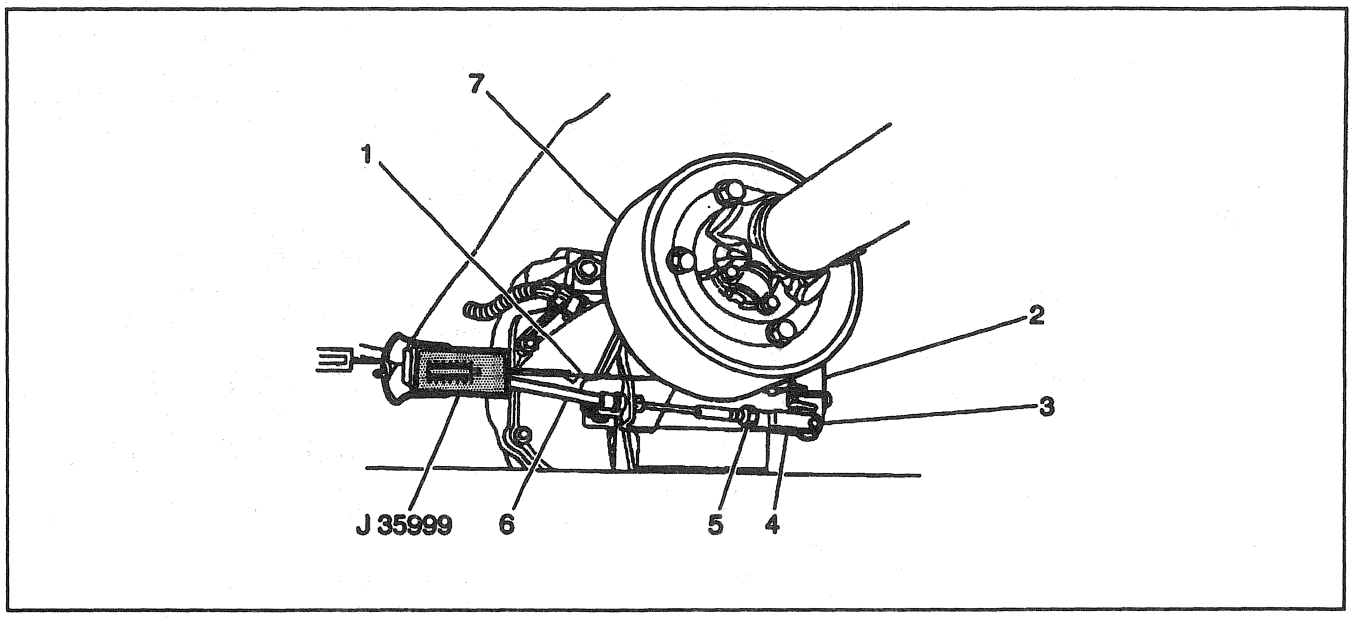


Figure 5—Parking Brake Cable



Legend

(1) Small Chain
(2) Parking Brake Lever
(3) Clevis Pin
(4) Clevis
(5) Nut
(6) Parking Brake Cable
(7) Parking Brake Drum

Figure 6—Parking Brake Adjustment

3. Install J 35999 with a small length of cable or chain, and a tightening device (like a turn buckle) on the frame (Figure 6).
4. Install a small chain (1) on the lever (2) near the spring on the bottom of the lever.
5. Tighten the tightening device until J 35999 is at 222 N·m (50 lb ft).
6. Loosen nut (5) and turn the clevis (4) 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.

Tighten

- Nut (5) to 37 N·m (27 lb. ft.)

8. Remove J 35999 and all extensions used.
9. Release the parking brake.
10. Rotate the drum to make sure that there is no drag.

DRUM REPLACEMENT

Remove or Disconnect (Figures 7 and 8)

1. Release the parking brake.
2. Raise the vehicle and support with stands.
3. Propeller shaft. Refer to SECTION 4A.
4. Nut and washer if equipped with manual transmission.
5. Bolt and washer if equipped with automatic transmission.
6. Drum and yoke assembly.
7. Bolts and washers.
8. Drum from yoke.

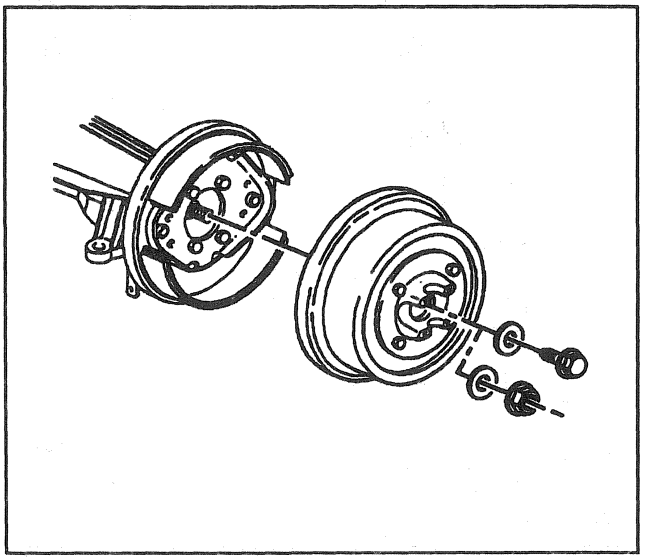


Figure 7—Drum Replacement

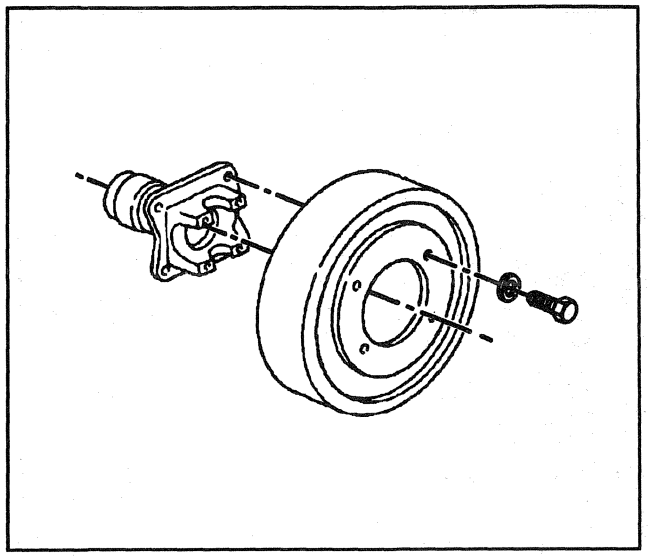


Figure 8—Drum and Yoke

Install or Connect (Figures 7 and 8)

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

1. Drum to yoke.
2. Bolts and washers.

Tighten

- Bolts to 37 N·m (27 lb. ft.)

3. Drum and yoke assembly.
4. Washer and nut if equipped with manual transmission.
5. Washer and bolt if equipped with automatic transmission.

Tighten

- Nut to 475 N·m (350 lb. ft.).
- Bolt to 122 N·m (90 lb. ft.).

6. Propeller shaft.
7. Lower the vehicle.

LINING REPLACEMENT

Remove or Disconnect (Figures 9 and 10)

1. Drum. Refer to "Drum Replacement" in this section.
2. Bolts (26) and washers (25).
3. Support plate (24) and shoe kits (19).
4. Springs (27, 28, and 29).
5. Shoe kits (19).

Inspect

- Springs for signs of wear or excessive heat. Replace as needed.
- Support plate friction points for wear. Replace if wear is excessive.

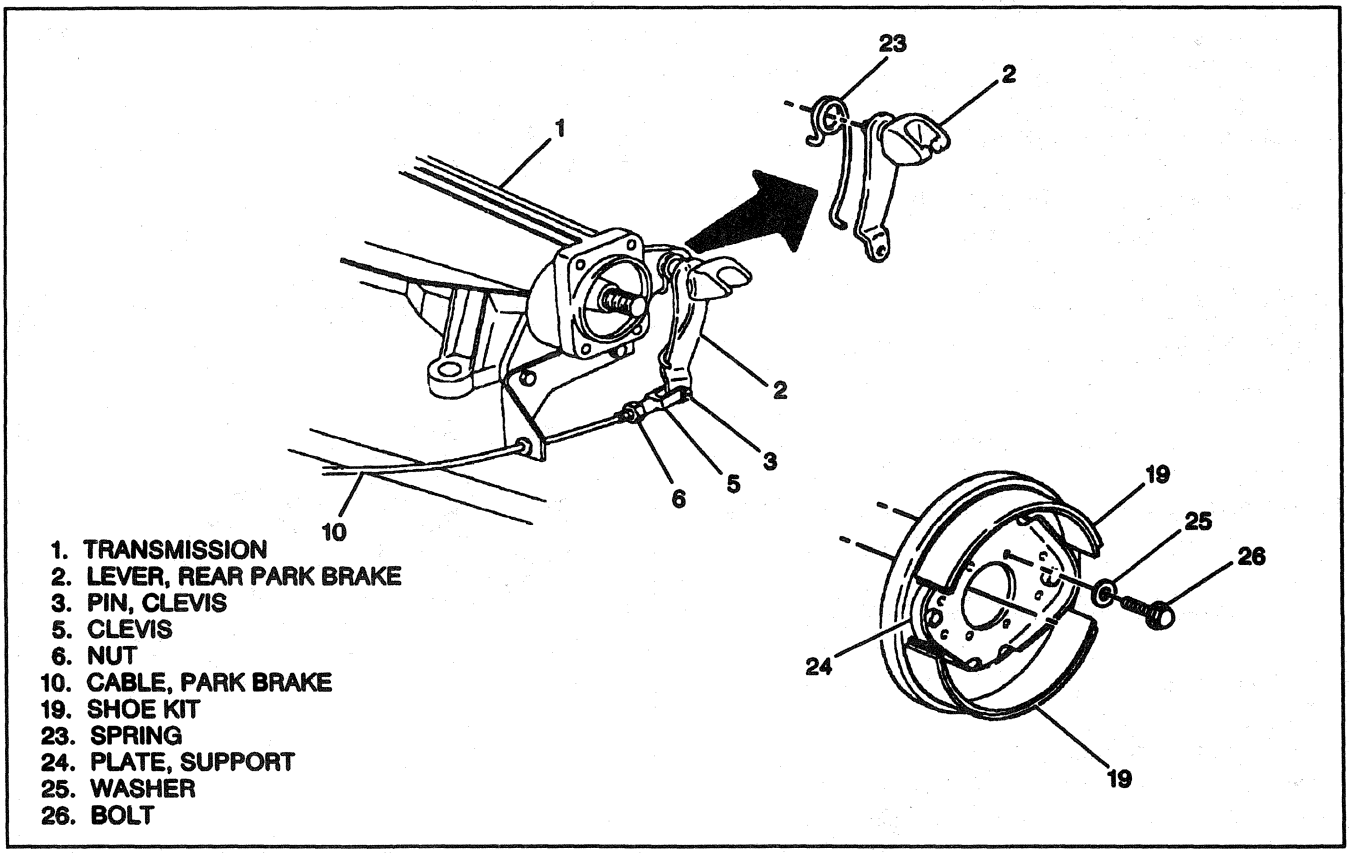


Figure 9—Parking Brake Components

Install or Connect (Figures 9 and 10)

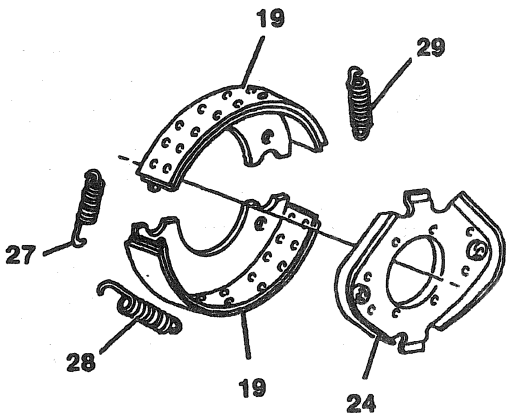
NOTICE: *Refer to "Notice" on page 5F-1.*

1. Shoe kits (19) to support plate (24).
2. Springs (27, 28, and 29).
3. Support plate (24) and shoe kits (19).
   - Index lever (2) between shoes.
4. Bolts (26) and washers (25).

Tighten

   - Bolts (26) to 105 N·m (77 lb. ft.).

5. Drum. Refer to "Drum Replacement" in this section.



19. SHOE KIT
24. PLATE SUPPORT
27. SPRING, RETURN
28. SPRING, RETURN
29. SPRING, ANCHOR

3105r5294

Figure 10—Lining Replacement

SPECIFICATIONS

BRAKE SYSTEMS

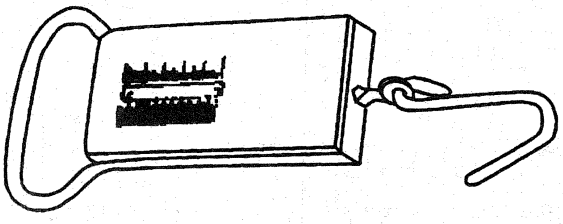
SYSTEM	FRONT BRAKES	REAR BRAKES	BRAKE ASSIST
JB5	Disc 11.57 inch x 1.25 inch	254 mm x 57 mm (Leading/Trailing)	Vacuum
JD5	Disc 11.57 inch x 1.25 inch	254 mm x 57 mm (Leading/Trailing)	Hydraulic
JB6	Disc 11.57 inch x 1.25 inch	11.15 inch x 2.75 inch (Duo-Servo)	Vacuum
JD6	Disc 11.57 inch x 1.25 inch	11.15 inch x 2.75 inch (Duo-Servo)	Hydraulic
JB7	Disc 12.5 inch x 1.26 inch	13.00 inch x 2.5 inch (Duo-Servo)	Vacuum
JD7	Disc 12.5 inch x 1.26 inch	13.00 inch x 2.5 inch (Duo-Servo)	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 13.86 inch x 1.435 inch	Disc 13.58 inch x 1.435 inch	Hydraulic

FASTENER TIGHTENING SPECIFICATIONS

Application	N·m	Lb. Ft.	Lb. In.
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	122	90	—
Yoke Shaft Nut	475	350	—

SPECIAL TOOLS

1.



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1. TENSION SCALE