

SECTION 5

BRAKES

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FASTENER TIGHTENING SPECIFICATIONS

Description English		Metric
ABS Sensor Bolts — 5/16-18	9-12 lb-ft	12.2-16.3 N•m
Brake Hose Hold Down Clamp Bolt — 5/16-18	9-12 lb-ft	12.2-16.3 N•m
Banjo Bolt	30-40 lb-ft	40.8-54.4 N•m
Pad Retainer Spring Bolt — M10x1.5x16	28-32 lb-ft	38.1-43.5 N•m
Caliper-to-Support Bolts — M20	320-360 lb-ft	435.2-489.6 N•m
Cross Over Tube Nuts — 7/16-24	9-12 lb-ft	12.2-16.3 N•m
Bleed Screw — 7/16-24	9-12 lb-ft	12.2-16.3 N•m
Lining Rail Covers — M8x1.25x14	12-18 lb-ft	16.3-24.5 N•m
Rotor to Hub Bolt (9/16-12 bolt)	100-125 lb-ft	136.0-170.0 N•m
Rotor to Hub Bolt (9/16-18) with Lock Nuts	70-95 lb-ft	95.2-129.2 N•m
Rotor to Hub Bolt (9/16-18) with Plain Nuts	130-165 lb-ft	176.8-224.4 N•m
Support to Axle	————	————
(5/8-18 bolt)	190-250 lb-ft	258.4-340.0 N•m
(9/16-18 bolt)	130-165 lb-ft	176.8-224.4 N•m

BRAKE SYSTEM SPECIFICATIONS

Description	English	Metric
Brake Pad —	————	————
Thickness Above Metal (New)	0.73"	18.5 mm
Minimum Thickness Above Metal (Discard)	0.125"	3.2 mm
Brake Fluid	DOT 3	
Rotor Diameter	15.38"	390.7 mm
Thickness (New)	1.54"	39.1 mm
Thickness (Discard)	1.42"	36.1 mm

BRAKING SYSTEMS

There are two brake systems on a Workhorse motor home chassis, the service brakes and the parking brakes. The service brakes use hydraulic pressure from a foot-pedal-operated master cylinder to actuate cylinders that apply brakes at each wheel. Fluid lines and hoses connect the master cylinder with each of the wheel cylinders and calipers.

Hydraulic pressure created by the master cylinder operation is transmitted through lines and hoses to the wheel cylinders and calipers. The hydraulic pressure forces the pistons in the wheel cylinders and/or calipers outward, causing the brakes to be applied.

Braking action occurs as a result of friction between the brake lining and the metal surface of the rotor disc or the drum.

Parking brake system is mechanically operated by a lever and strut or a pedal, which will active the rear brakes only or the transmission mounted propshaft drum brake on chassis with 12,300 lb., 14,800 lb., 15,000 lb., 20,700 lb. and 22,000 lb. GVWR. The parking brake on chassis with 16,500 lb., 17,000 lb., 18,000 lb. and 24,000 lb. GVWR is referred to as automatic apply parking brake. This style of parking brake is spring applied and hydraulically released via an electro-hydraulic pump; refer to the Automatic Apply Parking Brake section for detailed operation.

BRAKE SYSTEM SERVICE

The Workhorse 12,300 lb. GVWR chassis has front disc and rear drum brakes, JB8 system.

The 14,800 lb. thru 18,000 lb. GVWR chassis have four-wheel disc brakes, JF9 system.

The 20,700 lb. and 22,000 lb. chassis has four-wheel disc brakes, JLP system.

The 24,000 lb. chassis also has four-wheel disc brakes, JL9 system.

All P Series chassis have a 3-channel Four-Wheel Anti-Lock braking systems standard.

The W Series chassis have a 4-channel Four-Wheel Anti-Lock braking system standard.

HYDRO-BOOST

Hydro-Boost system receives hydraulic pressure from the power steering pump to assist with the effort required to operate braking system. Hydro-Boost unit is located between the brake pedal linkage and the master cylinder. When the brake pedal is depressed, linkage moves the pushrod into the master cylinder to create hydraulic brake pressure.

The hydraulic brake booster is supplied hydraulic pressure from the power steering pump assisting with the movement of the pushrod into the master cylinder. This in turn lowers the amount of effort required by the operator.

HYDRO-MAX BY BOSCH

The Hydro-Max system is utilized on all W Series chassis, figure 5-1. It works on the same principle as a Hydro-Boost system but also incorporates a safety feature to retain power brake assistance with the engine on or off. With the Hydro-Boost type system, the engine must be operating to provide hydraulic pressure from the power steering pump to assist with the movement of the pushrod into the master cylinder. The Hydro-Max system also relies on hydraulic pressure for operation of the hydraulic power brake booster but has two sources.

The primary source is from the power steering pump, as in the hydro-boost system. The secondary source is an electric-hydraulic pump mounted on the hydraulic brake booster. It monitors the hydraulic pressure when the brake is depressed and activates the electric hydraulic pump if hydraulic pressure is not available from the power steering pump.

For example, if the engine dies or is turned off a sensor detects no hydraulic pressure in the system and activates the electrical/hydraulic motor to provide hydraulic power brake assistance for normal brake operation.

BRAKE SYSTEM MAINTENANCE

At periodic intervals the vehicle brake system should be inspected for "pedal travel." Brake pedal travel is the distance the brake pedal moves toward the floor from the fully released position (foot not applied to the brake).

Brake pedal inspection should be made with the brakes "cold" and with the engine turned off. Depress the brake pedal a minimum of four (4) times to exhaust all vacuum and/or accumulator pressure. Disable the electric pump on Hydro-Max systems before proceeding.

Applying approximately 90 pounds of pedal pressure, the approximate distance the brake pedal should travel is as follows:

- Chassis with disc front and drum rear brakes (JB8) 3.5 inches
- Chassis with disc front and rear brakes (JF9) 6.0 inches
- Chassis with disc front and rear brakes (JLP & JL9) 2.5 inches

Note: Total pedal stroke that would be achievable during the bleeding process for the JB8 and JF9, P Series, is 9.66 inches. Total pedal stroke for the JLP and JL9 systems, W Series chassis, is 8.3 inches.

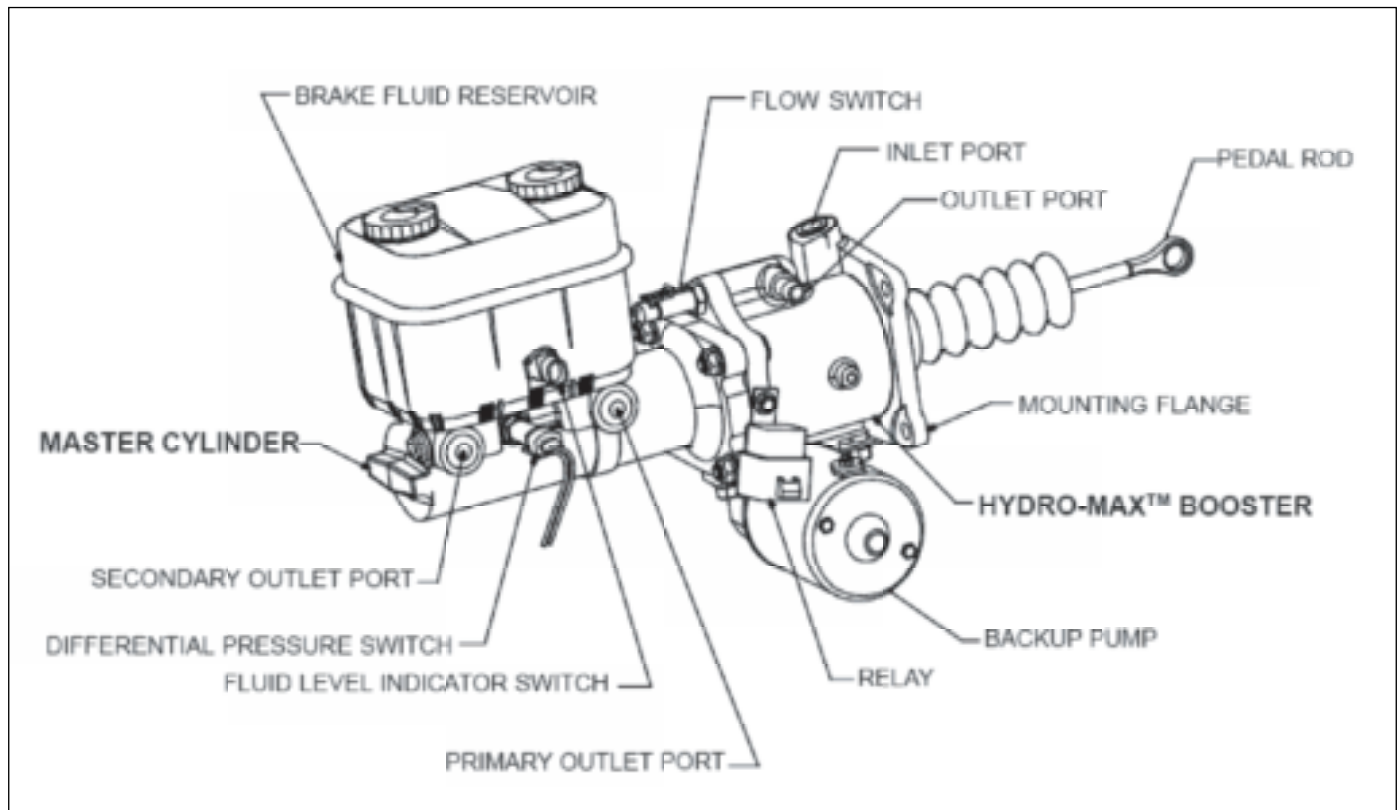


Fig. 5-1. Hydro-Max booster and master cylinder assembly.

Brake Fluid Change

Although there is not a recommended service interval to change the brake fluid listed in the owners manual, the recommendation by a number of the brake manufacturers is every two to three years. If the fluid becomes contaminated, change immediately. Use Delco Supreme No. II Hydraulic Brake Fluid (Dot No. 3) or equivalent.

Filling the Master Cylinder

The master cylinder must be kept properly filled to ensure adequate reserve and to prevent air from entering the hydraulic system. However, because of expansion due to heat absorbed from the brakes and from the engine, the master cylinder must not be overfilled.

The master cylinder is located on the P Series chassis under the floor on the drivers side of the engine. The position of the master cylinder on the chassis may require the use of a flashlight and mirror to check the fluid level.

Access to the master cylinder is normally through the drivers side wheel well. On the W Series chassis the master cylinder is located just above and forward of the radiator on the drivers side of the chassis.

Thoroughly clean the reservoir cover before removal to avoid getting dirt into the reservoir.

Remove the cover and diaphragm. Add fluid as required to bring the level to $\frac{1}{4}$ inch (plus or minus $\frac{1}{8}$ inch) from

the lowest portion of the top of each reservoir. Use Delco Supreme No. II Hydraulic Brake Fluid (Dot No. 3) or equivalent.

Do not use shock absorber fluid or any other fluid that contains mineral oil. Do not use a container that has been used for mineral oil or a container that is wet from water. Mineral oil will cause swelling and distortion of rubber parts in the hydraulic brake system and water will mix with brake fluid, lowering the fluid boiling point. Keep all fluid containers capped to prevent water contamination.

CAUTION: Check for leaks if a large quantity of fluid is required.

Disc Brake Squeal or Squeak

A persistent amount of "squeal or squeak" is often associated with heavy-duty disc brake usage. These noises are common for both foreign and domestic disc brake systems. Heat, humidity and severity of usage are contributing factors to brake noise. Changing the brake pads or rotor refinishing as a repair is often considered a temporary repair or by some technicians as useless. The recommended approach is to have an inspection to assure free and proper operation of all caliper parts. At this point, the owner should realize that the brake noise exists, but is not detrimental to overall brake life.

Bleeding the Hydraulic System

A bleeding operation is necessary to remove air whenever air is introduced into the hydraulic brake system. It is recommended for a trained service technician to perform this procedure.

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

Note: The following procedure is for manual bleeding of the brakes only. If possible, obtain approved commercial pressure-bleeding equipment.

1. Fill the master cylinder reservoir with brake fluid and keep at least half full during the bleeding procedure. Ensure reservoir cap is secured.
2. If the master cylinder is known or suspected to having air in the bore, bleed the master cylinder using the following procedure. Master cylinder must be completely bled of air before bleeding wheel cylinders or calipers.
 - a. Disconnect the forward brake pipe connector at the master cylinder.
 - b. Allow the brake fluid to flow from the connector port.
 - c. Connect the brake pipe connector. Do not tighten the brake pipe connector.
 - d. Slowly apply the brake pedal. Allow air to bleed from loose connector.
 - e. Tighten the connector before releasing the brake pedal.
 - f. Release the break pedal.
 - g. Wait 15 seconds.
 - h. Repeat this sequence; include the 15 second wait, until you purge all the air from the master cylinder bore.
 - i. Repeat this procedure for the rear pipe after you purge all the air from the forward pipe.
3. Bleed each wheel in the following sequence:
 - a. Right rear wheel cylinder or caliper.
 - b. Left rear wheel cylinder or caliper.
 - c. Right front wheel caliper.
 - d. Left front wheel caliper.
4. Attach a hose to the wheel cylinder/caliper bleed valve.
5. Immerse the opposite end of the hose into a container partially filled with clean brake fluid.
6. Slowly apply the brake pedal one time and hold.
7. Loosen the bleeder valve in order to purge the air from the wheel cylinder/caliper.
8. Tighten the bleeder valve.
9. Slowly release the brake pedal.
10. Wait 15 seconds
11. Repeat this sequence, including the 15 seconds wait, until you purge all the air from the wheel cylinder or caliper.
12. Repeat steps 4-11 at each wheel until you purge all the air from the brake system.
13. This procedure may use up to a pint of fluid per wheel. Check the master cylinder level every four to six strokes of the brake pedal in order to avoid running the system dry.
14. Check the pedal for sponginess. Check the brake warning lamp for an indication of unbalanced pressure. Repeat the bleeding procedure in order to correct either of these conditions.

ABS BLEEDING PROCEDURE

Important:

- Use the two-person bleed procedure under the following conditions.
- Installed a new Electro-Hydraulic Control Unit (EHCU) or Brake Pressure Modulator Valve (BPMV).
- Air is trapped in the valve body.
- Use the vacuum, the pressure and the gravity bleeding procedures only for base brake bleeding.
- Do not drive vehicle until the brake pedal feels firm.

1. Complete steps 3-13 in above manual/two-person bleeding procedure.
2. Press the brake pedal firmly and run the Scan Tool Function Test four times. Release the brake pedal between each test.
3. Bleed all four wheels again using the above manual bleeding procedure steps 3-13. This will remove the remaining air from the brake system.
4. Evaluate the feel for the brake pedal before attempting to drive the vehicle.
5. Bleed the system as many times as necessary in order to obtain the appropriate feel of the pedal.

HYDRO-BOOST & HYDRO-MAX BLEEDING PROCEDURE

Whenever the booster is removed and reinstalled, the steering system should be bled as outlined.

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

1. Make sure that the ignition switch is in the UNLOCK position.
2. Turn the steering full left.
3. Fill the power steering fluid to the FULL COLD level. Leave cap off.
4. Raise the front wheels off the ground and support vehicle using suitable safety stands.

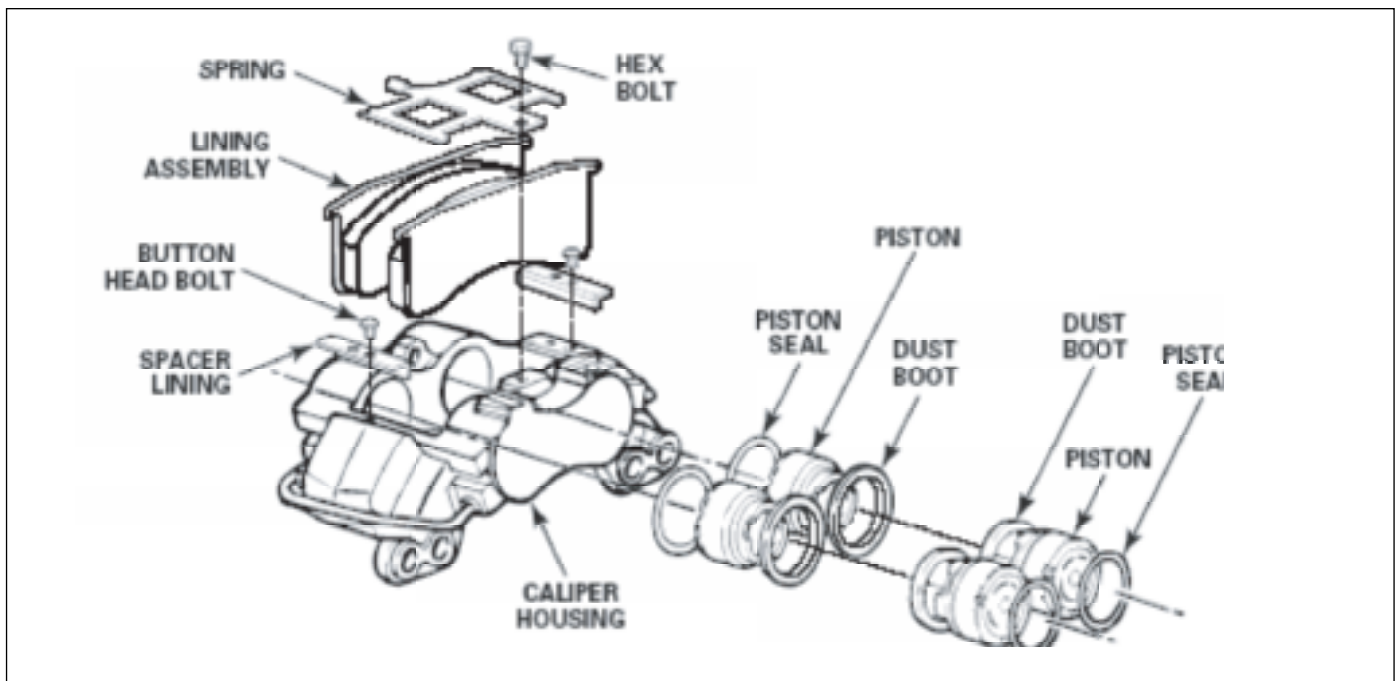


Fig. 5-2. Exploded view of Quadraulic caliper assembly.

5. Place a drain pan under the vehicle to catch any power steering fluid that may overflow.
6. With an assistant checking fluid level and condition, turn the steering wheel lock-to-lock at least 40 times.
 - Trapped air may cause fluid to overflow. Any fluid that spills out will need to be cleaned for a proper leak check.
 - Maintain the fluid level at FULL COLD.
 - Fluid should be free of any air bubbles. If any air bubbles are present, check all of the power steering hose fittings for leaks. Repair any leaks and repeat step 6.
7. Start engine and allow it to idle. Maintain the power steering fluid level at FULL COLD.
8. Install the power steering reservoir cap.
9. Return the front wheels to the straight ahead position.
10. Return the front wheels to the ground.
11. After allowing the engine to idle for two minutes, fully turn the steering wheel in both directions and depress the brake pedal several times.

FOUR PISTON QUADRAULIC DISC BRAKE CALIPER

Meritor's Quadraulic disc brakes have a four-piston, fixed-mount caliper design for use on both front and rear drive axles. An installation includes four major components — the caliper assembly, support assembly, hub/rotor assembly and the attaching hardware.

The inboard pistons apply the inboard pads and the outboard pistons apply the outboard pads.

CALIPER

The caliper assembly consists of two halves assembled with four bolts and washers, figure 5-2.

It includes four hydraulic piston bores, two brake pads, two stainless steel lining rail covers installed with button head bolts, a pad retainer spring and bolt, bleeder screw and crossover tube.

The piston bores contain the pistons, piston seals and piston boots.

The crossover tubes connect the two halves of the caliper piston to supply brake fluid to the outboard pistons.

SUPPORT

The support assembly includes the ABS sensor bracket attached with two screws. It also has provisions to mount an optional splash shield to protect the rotor and brake assembly from road contamination.

HUB/ROTOR

The hub and rotor assemblies consist of a hub and rotor, fitted with bearing cups and wheel attachment studs.

Some rotors are equipped with a cast-in ABS speed sensor tooth wheel, typically with 100 slots. Some rotors have separate ABS speed sensor tooth wheels attached to the rotor with bolts.

Front hub/rotor assemblies can have various ABS speed sensor tooth wheels such as: a separate ring mounted to the inboard end of the hub, ABS teeth integral to the rotor, or a separate ABS ring attached to the rotor by bolts.

There are various hub configurations offered to accept the 19.5-inch (495.3 mm) eight-hole wheels, as well as 22.5-inch (571.5 mm) 10-hole wheels with the hub piloted or stud piloted system.

BRAKE PAD SERVICE

WARNING

To prevent serious personal injury, always wear safe eye protection when you perform vehicle maintenance or service.

Remove Brake Pads

1. Visually inspect all brake pads. Replace pads when the remaining lining reaches 1/8-inch (3.175 mm) thickness.
- If you replace pads: Replace all disc brake pads at the same time to maintain original brake balance.
- If a complete vehicle pad replacement is not necessary or desirable: Replace the pads on both wheel ends on the same axle.

Replace Brake Pads

1. Raise and support the vehicle.

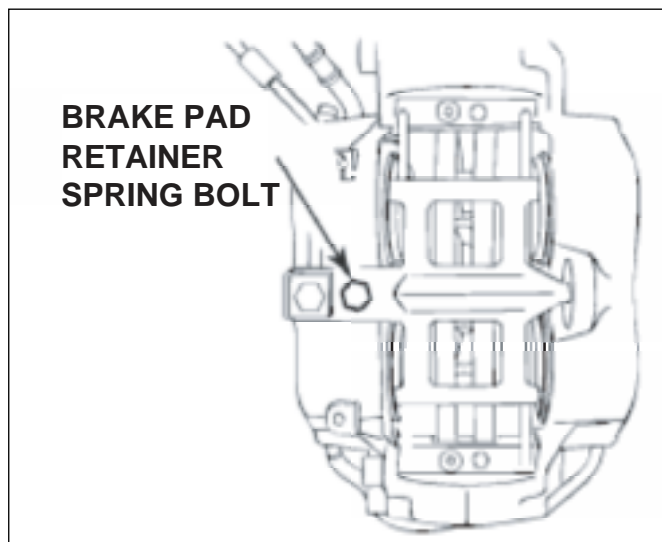


Fig. 5-3. Pad retainer spring bolt

2. Remove the wheel and tire assembly according to manufacturer's recommendation.
3. Remove the master cylinder reservoir filler cap. Check the brake fluid level in the reservoir. If necessary, remove fluid to keep the reservoir from overflowing when compressing pistons into the caliper.
4. Remove the pad retainer spring bolt, figure 5-3.
5. Compress the caliper pistons, figure 5-4.
6. Remove the brake pads.

BRAKE CALIPER SERVICE

WARNING

Park the vehicle on a level surface. Block the wheels to prevent the vehicle from moving. Support the vehicle with safety stands. Do not work

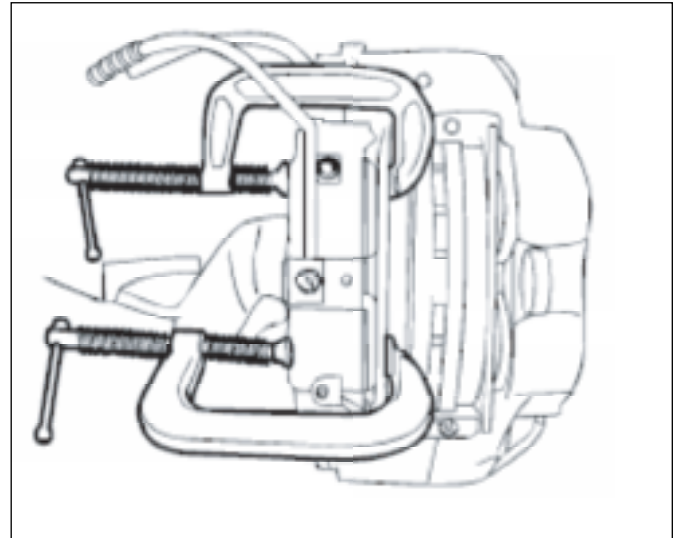


Fig. 5-4. Compress caliper pistons.

3. Push all four pistons to the bottom of their bores.
4. Remove the piston boots by prying the metal ring portion of the boot out of the bore with a screwdriver. Use care to avoid damage to the piston or bore. Discard the boots.

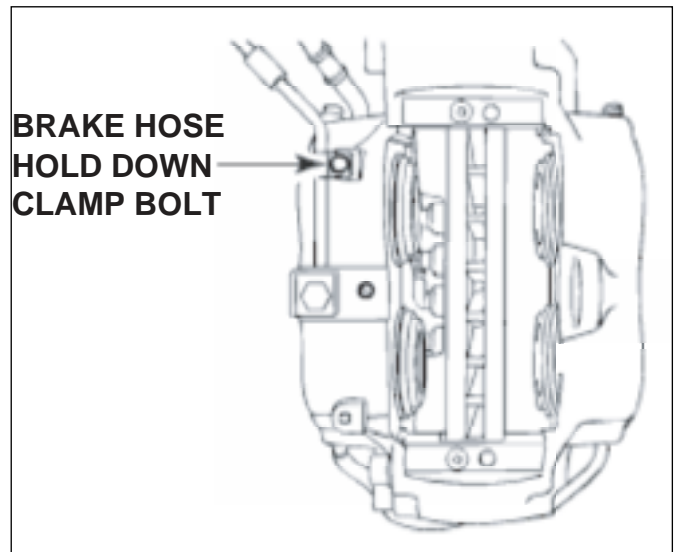


Fig. 5-5. Brake hose hold down bolt.

under a vehicle supported only by jacks. Jacks can slip and fall over. Serious personal injury can result.

1. Raise and support the vehicle.
2. Remove the tire and wheel assembly according to manufacturer's instructions.
3. Remove the brake hose hold down clamp bolt, if equipped, figure 5-5.
4. Remove the brake hose/tube from the caliper.
5. Remove four caliper-to-support assembly bolts.

Do not disassemble the four bolts joining the two halves of the caliper.

Disassemble and Overhaul the Brake Caliper

1. Remove the brake caliper. Refer to Brake Caliper in this section.
2. Drain all fluid from the caliper.

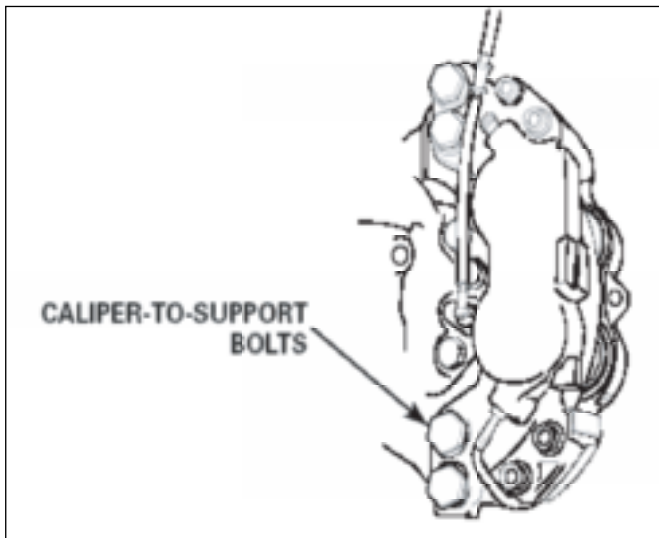


Fig. 5-6. Remove caliper mounting bolts.

Note: The C-clamp must be between the pistons on the opposite side so they may move to the wood block without striking the C-clamp. Cover pistons with shop rag to prevent brake fluid spray.

- Place a block of wood, figure 5-7 (7-5/8 x 3-1/2 x 2-9/16-inches thick) between the caliper pistons, figure 5-7. Use a C-clamp to hold the block of wood against the pistons on one side of the caliper.

WARNING

When you use compressed air to remove the pistons from the caliper bore, do not place your hands or fingers near the bore to catch or protect the pistons. Serious personal injury can result.

CAUTION

When you remove the pistons from the caliper bore, only direct enough compressed air into the caliper brake fluid inlet to ease the pistons out of the bore. Do not exceed 25 psi (172 kPa). Damage to components will result.

- Apply low air pressure (no more than 25 psi [172 kPa]) to the fluid port in the caliper to move the caliper pistons out to the wood block.
- With the pistons in contact with the wood block, there will be a small amount of seal engagement remaining. Remove the C-clamp and the wood block. The pistons may now be removed by hand.
- To remove the pistons from the other side of the caliper, place the block of wood now over the empty bores (from where the pistons have been removed) with a thick sheet of rubber (3/8-inch) between the wood and the caliper bores.

Note: Use the C-clamp to hold the block of wood in position against the empty bores. The C-clamp must be between the pistons on the opposite side so they may move out to the wood block without striking the C-clamp. Cover pistons with a shop rag to prevent brake fluid spray.

- Apply low air pressure (no more than 25 psi [172 kPa]) to the fluid port in the caliper to move the caliper pistons out to the wood block.
- With the pistons in contact with the wood block, there will be a small amount of seal engagement remaining. Remove the C-clamp and the wood block. The pistons may now be removed by hand.
- Remove the piston seals with a non-metallic device and discard them. Do not nick, scratch or otherwise scar piston bores or seal grooves.

Note: Do not hone the caliper bores. Pistons are not available for honed caliper bores. If the caliper bores are excessively scored or corroded, install a new caliper.

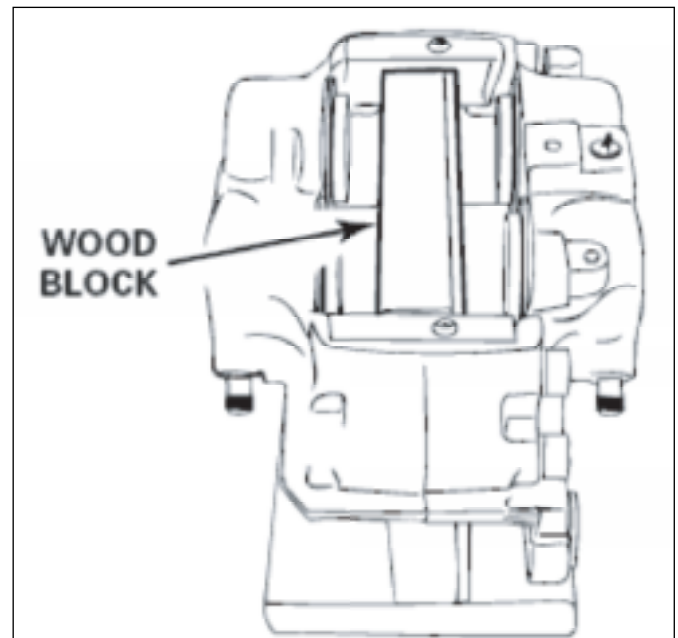


Fig. 5-7. Remove caliper mounting bolts.

Prepare Parts for Assembly

WARNING

To prevent serious eye injury, always wear safe eye protection when you perform vehicle maintenance or service. Solvent cleaners can be flammable, poisonous and cause burns. Examples of solvent cleaners are carbon tetrachloride, emulsion-type cleaners and petroleum-based cleaners.

ROTOR SERVICE

Note: The thickness of the resurfaced rotor must exceed the minimum thickness dimension stamped or cast into the rotor. Replace if necessary.

- Check the rotor while assembled to the hub or spoke wheel and mounted on the axle spindle. The lateral runout of the rotor friction surfaces should not exceed 0.015-inches (0.381 mm) total indicator reading

(TIR). The thickness variation of the rotor should not exceed 0.0012-inches (0.0300 mm).

If the lateral runout and/or the thickness variation exceed the above values: Resurface or replace the rotor.

2. Remove the caliper. Refer to Brake Caliper in this section.
3. Remove the hub/spoke wheel and rotor assembly from the axle according to vehicle manufacturer's recommendation.
4. Remove the hub-to-rotor attachment fasteners (hat-shaped rotor). For the U-shaped rotor, remove the studs holding the hub and rotor.

CLEAN, DRY AND INSPECT PARTS

Clean Parts

For Ground or Polished Metal Parts

CAUTION

Do not use hot solution tanks or water and alkaline solutions to clean ground or polished parts. Damage to parts will result.

Use a cleaning solvent or kerosene or diesel fuel to clean ground or polished metal parts or surfaces.

For Rough Metal Parts

Use a cleaning solvent or a weak alkaline solution in a hot solution tank to clean rough metal parts. If you use a hot

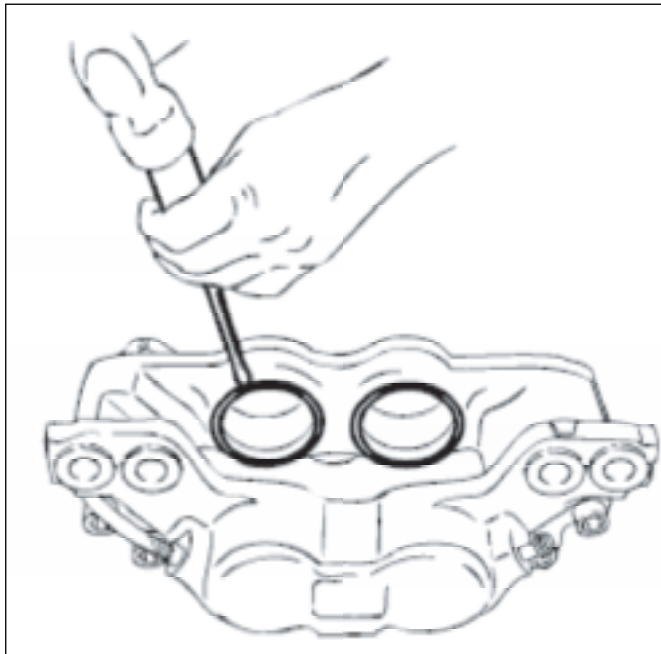


Fig. 5-8. Remove piston seals.

solution tank, follow the instructions below.

1. Leave the rough parts in the tank until they are completely cleaned and heated.
2. Remove the rough parts from the tank.
3. Wash the parts with water until you remove the alkaline solution.

Dry and Inspect Parts

1. Use soft, clean paper or cloth rags or compressed air to completely dry parts immediately after you clean them.
2. Carefully inspect all parts for wear or damage before you assemble them.
3. Repair or replace worn or damaged parts.

Apply Corrosion Protection

1. Apply a thin layer of brake grease to cleaned, dried parts. Be careful that you do not apply the grease to the linings or rotor.
2. If you will store the parts, apply a special material, which prevents corrosion and rust, to all surfaces. Store parts inside special paper or other material that prevents rust and corrosion.

ASSEMBLY AND INSTALLATION

WARNING

To prevent serious eye injury, always wear safe eye protection when you perform vehicle maintenance or service.

Brake Caliper Assembly

Note: When using compressed air, use air lines that are completely free of oil and moisture. All brake parts must be clean and completely dried of cleaning fluid. Use ONLY Workhorse replacement parts to ensure proper caliper performance.

1. Clean caliper, caliper piston bores and fluid ports with solvent. Use compressed air to clean out and dry grooves and passages.
2. Dip new piston seals in new, clean DOT 3 hydraulic brake fluid and install in piston seal groove in caliper piston bores. Make sure that they are properly seated. Apply a thin film of silicon grease or brake fluid to the caliper bore seal land between the piston boot and seal groove. Apply the grease or brake fluid around the entire circumference of the caliper bore.
3. Apply DOT 3 hydraulic brake fluid to the outside of the caliper pistons and install them in caliper bores, making sure that they are square to the bore.
4. Be careful not to cock the caliper pistons and press them into the bores.
5. Install the piston boots over the projecting ends of the pistons and press the ring side of the boots into the boot bore. An old bearing cup equal to the boot ring size helps install the boots. Make sure the piston boot bead is seated back against the shoulder of the projecting end of the piston. Boots for the 64 mm and 70 mm pistons are color-coded.
6. If required, replace the two stainless steel wear rails by removing the button head bolts.

Note: Inspect the caliper prior to reinstalling it onto the support. Pistons must be fully retracted into the caliper. Piston boots must be fully seated in the caliper boot grooves.

Rotor Installation

NOTE: Do not resurface a new replacement rotor.

1. To install, reverse the removal processes, making sure that the mating surfaces of the hub or spoke wheel and rotor are clean and free of rust build-up.
2. Check the rotor for lateral runout. If the lateral runout exceeds 0.015-inches (0.381 mm), the rotor may be rotated to a different mounting hole position on the hub or spoke wheel to reduce the value.

Caliper Installation

1. Inspect the caliper for leakage, damage or defects to piston seals or pistons. If leakage, damage or defect is found, caliper disassembly may be required.
2. To install, reverse the removal process.
3. Bleed the brake system and road test the vehicle.

Brake Pad Installation

1. Inspect the rotor for scoring, warping, cracks, bluing, heat spots or other damage or defects and minimum thickness. Repair or replace if necessary.
2. Inspect the disc brake calipers for leakage, damage or defects to piston boots, seals or pistons. Replace or repair the parts as required.
3. Clean and inspect the lining rail covers. If they are worn, they must be replaced.

Note: The inboard and outboard brake pads are identical, except when they are equipped with a mechanical wear sensor.

4. Install the brake pads. Ensure that the friction surface is against the rotor. Install the pad retainer spring and tighten the bolt to 30 lb-ft (40 N•m) of torque.

Note: Brake pad clearance adjustment is automatic.

5. Fill the master cylinder reservoir with new, clean, high-performance DOT 3 brake fluid or equivalent. Make several brake applications to move the brake pistons and linings out into contact with the brake rotors.
6. Recheck master cylinder reservoir and top off as necessary to manufacturer's recommended level.
7. Bleed the brake system.
8. Install the tire and wheel assembly.
9. Lower the vehicle and road test for correct operation.

Support Installation

1. Install the support mounting bolts. Tighten the bolts to the specified torque.
2. Install the ABS sensor. Tighten the bolt to 8 lb-ft (11 N•m).
3. Install the hub and rotor assembly.
4. Install the splash shield, if equipped.
5. Install the caliper as described under Caliper in this section.

WARNING

To prevent serious eye injury, always wear safe eye protection when you perform vehicle maintenance or service.

COMPONENT INSPECTION

Caliper

1. Clean the area around the brake hose. Use brake parts cleaner.
2. Inspect the heat shields (previous style only) for wear and damage. Replace worn or damaged shields.
3. Inspect the caliper lining spacers for wear and damage. Replace worn or damaged spacers.
4. Inspect the housing for cracks or damage. Replace a cracked or damaged housing.

CAUTION

The OUTSIDE diameter of the piston is the caliper's primary sealing surface and is manufactured to very close tolerances. Replace a piston if the OUTSIDE diameter is damaged. Do not re-finish or use abrasives, including an emery cloth, on the piston. Damage to components can result.

5. Inspect the OUTSIDE diameter of the pistons for scoring, nicks, corrosion, wear and damage. If any of these conditions are evident, replace the pistons. Do not re-finish or use abrasives.
6. Inspect the caliper bore for scoring, nicks, corrosion, wear and damage. If any of these conditions are evident: Replace the caliper.

CAUTION

Use a crocus cloth to remove minor stains and corrosion from the caliper bore. Do not use abrasives, including an emery cloth. If you cannot remove minor stains and corrosion, replace the caliper bore to avoid damage to components.

7. Inspect the caliper bore for minor stains and corrosion. If these conditions are evident: Use a crocus cloth to remove stains or corrosion. Clean the caliper bore after using a crocus cloth. Do not use abrasives, including an emery cloth. If you cannot remove stains and corrosion from the caliper bore: Replace the caliper.

Caliper Mounting Plate

1. Inspect caliper mounting plate area for rust, corrosion. Replace a damaged or worn mounting plate.
2. Use a wire brush to clean the caliper mounting area.
3. Inspect the mounting plate for cracks or elongated bolt holes. If these conditions are evident: Replace the mounting plate.

BRAKE SYSTEM BLEEDING PROCEDURE

Refer to ABS section for information on ABS bleeding instructions.

1. Check the master cylinder reservoir and fill, if necessary, with DOT 3 or DOT 4 brake fluid.
2. Bleed brakes in the following order: right rear, left rear, right front and left front.
3. Each four-piston caliper is equipped with two bleeder screws. Loosen the inner bleeder screw (which is always on the top) and purge the air. Tighten it loosely.
4. Open the outer bleeder screw and purge the air and tighten the bleeder screw to 9-12 lb-ft (12.2-16.3 N•m).
5. Now again open the inner bleeder screw and purge the air and tighten the bleeder screw to 9-12 lb-ft (12.2-16.3 N•m).
6. Repeat this procedure for all other brakes in the sequence specified in Step 2.
7. Test brakes prior to returning vehicle to service. A firm pedal should be felt during brake application.

TROUBLESHOOTING

BRAKES

Conditions Possible Causes Correction

Excessive Pedal Effort

Pads worn below minimum thickness Install new pads.
Faded, overheated condition, glazed pads, "blued" or heat-checked rotors Replace the rotor and/or reface pads if sufficient lining remains Grease, oil and/or brake fluid on linings Install new pads in axle sets. Seized or frozen pistons Disassemble calipers and free pistons, or replace caliper.

Pedal Pulsation (Brake Roughness or Chatter)

- Excessive lateral runout of brake rotor Check with dial indicator. Install new rotor if runout exceeds the maximum specified.
- Excessive out-of-parallelism of brake rotor Check the parallelism (rotor thickness variation) with micrometer and resurface the rotor, or install new rotor if the parallelism exceeds the maximum allowed.
- Loose or worn steering or suspension parts Replace parts and realign. Excessive front bearing clearance Readjust the bearing to specifications.

Vehicle Pulls to One Side

- Brake fluid, oil and/or grease on linings Install new pads in axle sets.
- Unmatched linings, uneven lining wear, distorted pads Install new pads in axle sets.
- Rough rotor surfaces on one rotor Resurface or replace rotor in axle sets. Seized or frozen pistons Disassemble caliper and repair or replace.
- Loose caliper mounting bolts Tighten to specifications. Uneven tire pressure, tread wear or size, right to left

- Equalize to recommended pressures. Install correct size tires with good tread.
- Excessive rotor parallelism or runout Resurface or replace rotor.
- Restricted hose or line. Examine the hoses and lines, and replace as necessary.
- Front end out of alignment Reset alignment.

Leaky Caliper

- Cylinder bore surface scored or corroded Disassemble calipers, clean bore and replace seals and boots.
- Caliper piston seal damaged or worn Disassemble calipers and install new seals and boots.
- Caliper piston damaged Replace piston.

No Braking Effect or Excessive Pedal Travel

Reservoir fluid level low Check for causes of fluid leak, repair as required and refill the reservoir. Bleed system as needed.

- Air in the hydraulic system Bleed the system.
- Bleeder screw loose or open Bleed the system and tighten the bleeder screw.
- Caliper piston seal damaged Disassemble the caliper and replace the piston seals. Replace piston if damaged.
- Excessive rotor runout or bent rotor Check rotor with dial indicator. Install new rotor if runout exceeds maximum specified.
- Bad or excessively loose wheel bearings Adjust or replace bearings as needed.
- Poor quality brake fluid Drain and clean system. Replace with recommended brake fluid.
- Weak brake hose that expands under pressure Replace defective hoses.

Brake Noise — Chatter

- Excessive lateral runout of rotor Check the runout with a dial indicator. Install new rotor if the runout exceeds the maximum specified.
- Lack of rotor parallelism Check the parallelism with a micrometer. Resurface or install new rotor as required.
- Loose wheel bearing Readjust the bearing to specified torque.

Brake Noise — Scraping

- Rust or mud build-up on edges of rotor and on caliper housing
- Clean or replace as necessary.
- Worn pad or pad installed backward Replace pads in axle sets only with friction surface against the rotor.
- Faulty caliper alignment permitting rotor to scrape on housing
- Correct the alignment.

Brake Noise — Groan

- Pressure on the brake pedal too light Slightly increase

the pedal effort to eliminate noise.

Brake Noise — Rattle

- Excessive clearance between the shoe and caliper. Install new pads.
- Pad retainer spring missing or not properly positioned. Install new pad retainer spring or position correctly.

Brake Noise — Squeal

- Glazed pads Resurface or replace pads in axle sets only.
- Weak pad retainer spring Install new pad retainer spring.
- Pad wear indicator contacting rotor Install new pads in axle sets only.
- Foreign material embedded in linings Replace pads in axle sets only.

DIAGNOSTIC INFORMATION AND PROCEDURES

Brake Rotor Thickness Variation Check

Check thickness variation by measuring the brake rotor thickness at four or more points around the circumference of the brake rotor. Use a micrometer calibrated in ten-thousandths of an inch. Make all measurements about 25.4 mm (1 in) in from the edge of the brake rotor.

A brake rotor that varies in thickness by more than 0.05 mm (0.002 in) can cause brake pedal pulsation and/or front end vibration during brake applications. Refinish or replace a brake rotor that does not meet these specifications.

Brake Rotor 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 (TIR) 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 with the brake caliper still installed.

In some cases, excessive lateral runout can be improved by indexing the brake rotor on the hub that is one or two bolt positions from the original position. If the lateral runout cannot be corrected by indexing the brake 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 (0.0016 in), replace the hub and/or bearing assembly if necessary. If the lateral runout is not within specifications, refinish or replace the brake rotor as necessary.

1. Set the parking brake.
2. Block the vehicle wheels.
3. Raise the vehicle.
4. Support the vehicle with safety stands.
5. Remove the tires and wheels.
6. Clean the brake rotor surface.
7. Tighten the wheel bearings to zero end play.

8. Fasten a dial indicator to the steering knuckle so that the indicator button contacts the brake rotor surface about 25.4 mm (1 in) from the outer edge.
9. Set the dial indicator to zero.
10. Turn the wheel one complete revolution.
11. Observe the runout indicated on the dial.
12. The (TIR) must not exceed 0.13 mm (0.005 in).
13. Adjust the wheel bearings. Refer to Wheel Bearing Adjustment (Independent) or Wheel Bearing Adjustment (I-Beam).

Brake Rotor Tolerance

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 in order to prevent brake roughness or brake pedal pulsation.

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

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

BRAKE ACTUATION LINKAGE

Bell Crank Service

A lubrication fitting has been added to the bell crank connecting the brake pedal to the master cylinder. This fitting

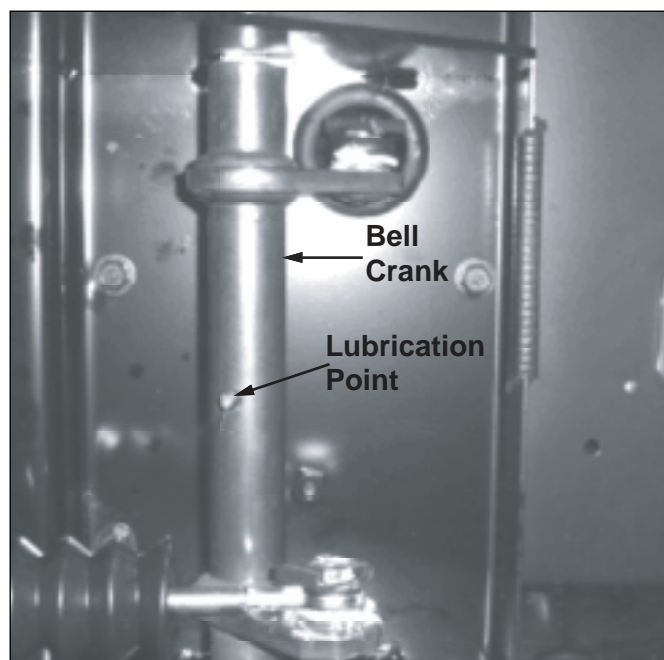


Fig. 5-9. Bell crank lubrication point.

requires lubrication at each chassis service.

Vehicles without the lubrication fitting require the following steps to lubricate the bell crank shaft:

1. Disconnect the linkage from the bell crank assembly.
2. Remove the bolt retaining the bell crank shaft in the housing.
3. Remove the shaft from the housing and inspect for damage or scoring. If the shaft is damaged, replace the bell crank assembly.
4. Apply a liberal coat of chassis lube to the shaft and into the housing bore.
5. Reinstall the shaft and replace the retaining bolt.
6. Lubricate the linkage pivot points before reconnecting.
7. Check proper operation of the brake linkage to ensure free operation.

Note: If the shaft cannot be completely removed due to interference with the body panels, pull the shaft out as far as possible and complete steps 4 through 7.

BOSCH HYDRAULIC BRAKE DIAGNOSIS

IMPORTANT REMINDER: The first step in diagnosing any customer complaint is to confirm the customer's complaint and determine which category applies.

The flow charts show which diagnostic steps need to be taken. The brake technician must have the necessary skills needed to perform each step. The flow charts are structured to guide the brake technician to take the quickest and easiest steps first. Often, these first, simple steps will be enough to determine what repair needs to be made.

In all cases, the vehicle manufacturer's service manual must be used for any repair instructions.

Brake system warning lights and buzzers are unique to the vehicle manufacturer. The Brake Warning Light and Buzzer Do Not Shut Off flow chart offered in this guide is generic and may not apply to all vehicles. The vehicle manufacturer's service manual must be consulted in order to determine the proper function of these warning devices.

Exclusions

The ABS portion of the hydraulic brake system is not addressed in detail in this guide since the ABS hardware and software are unique to the specific vehicle manufacturer. Any diagnosis or repair needs to be done in accordance with the vehicle manufacturer's ABS service manual.

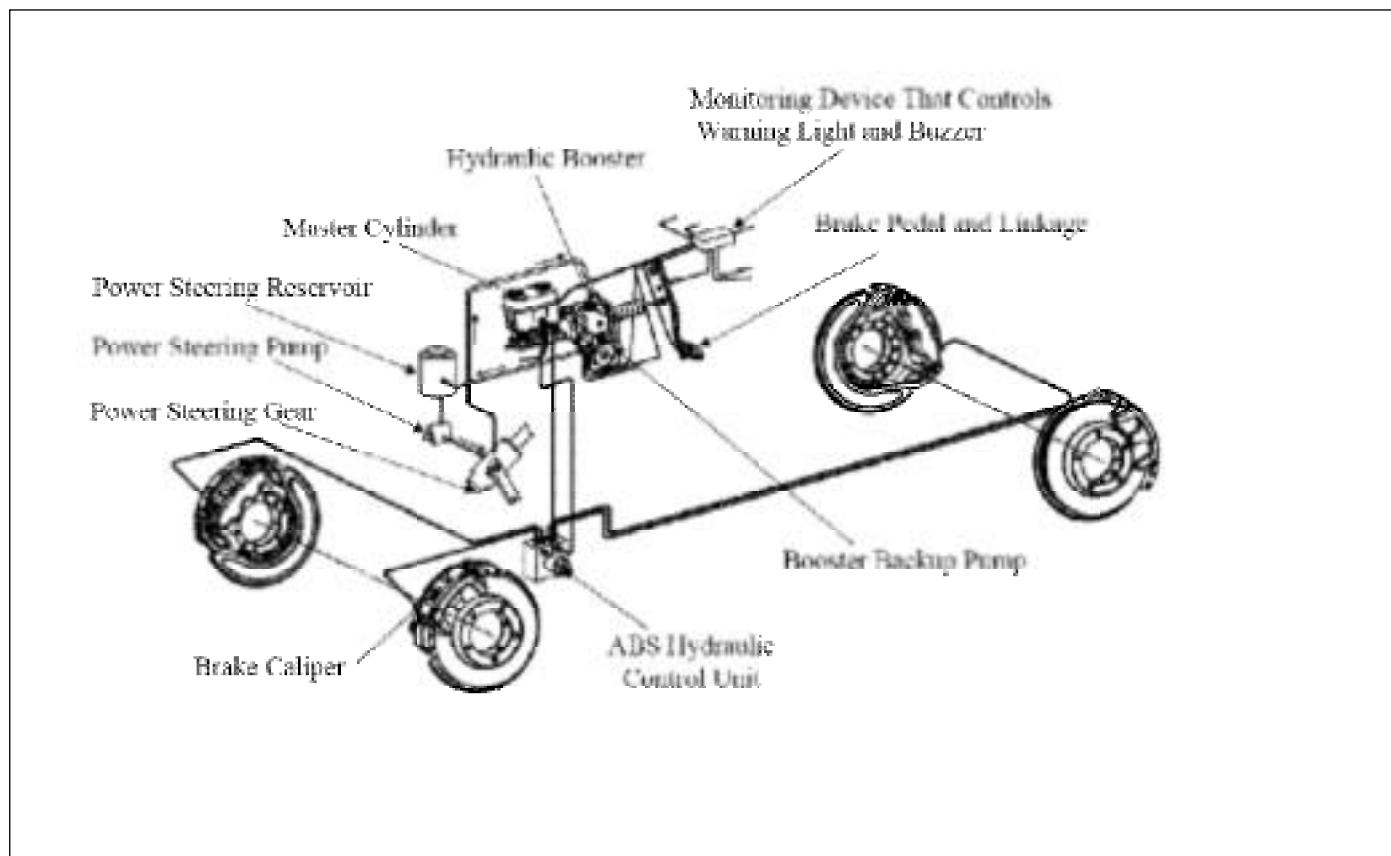


Fig. 5-10. Typical brake system components

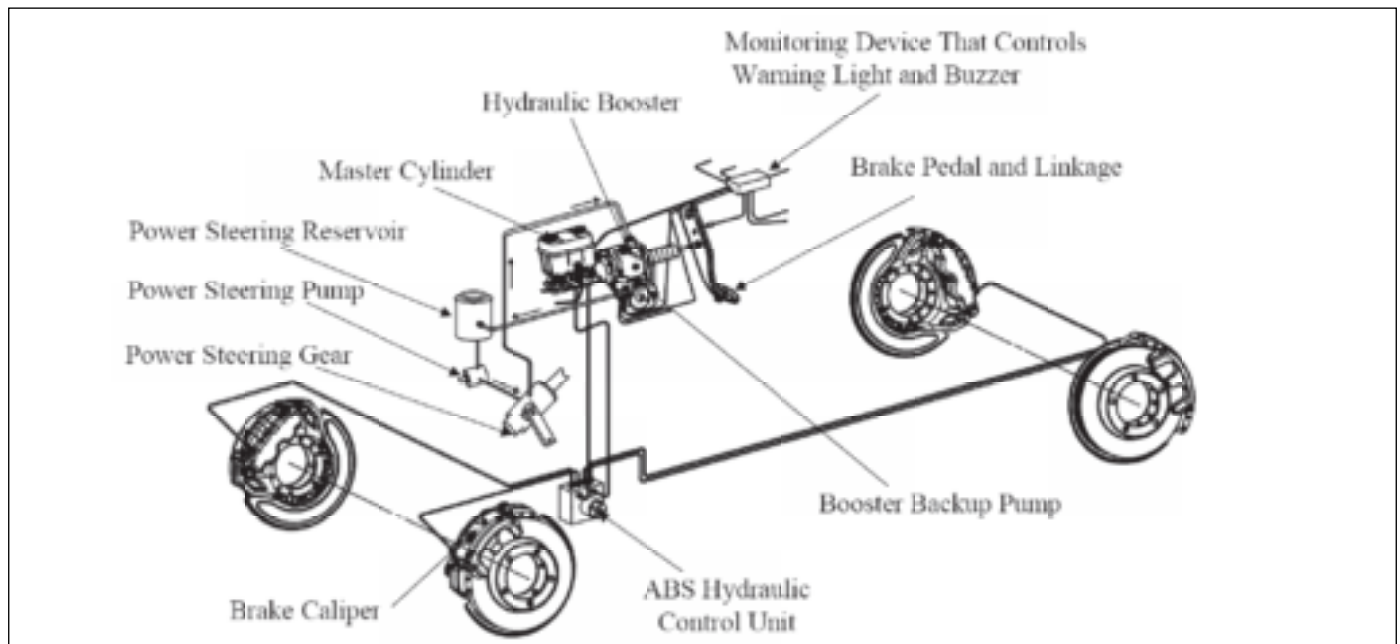


Fig. 5-11. Typical electrical system components.

Warning Light and Buzzer Do Not Shut Off

The light and buzzer come on together, typically in re-

sponse to signals from the parking brake switch, booster flow switch, master cylinder fluid level indicator switch, the master cylinder differential pressure switch or booster

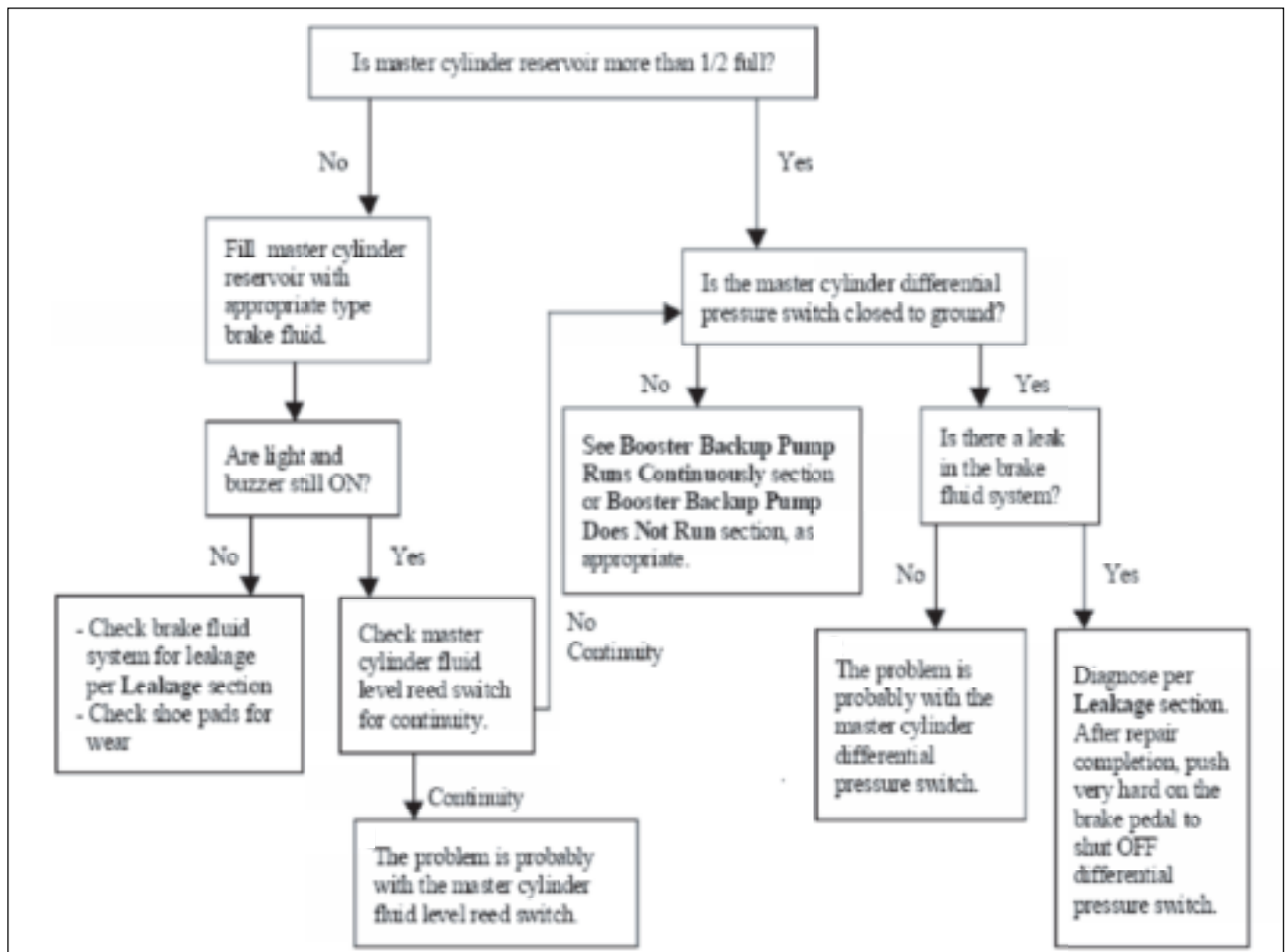


Fig. 5-12. Warning light and buzzer do not shut off.

backup pump (See Figure 2).

Booster Backup Pump Runs Continuously

The booster backup pump can run only if the relay is closed. The relay will be closed only if:

1. The flow switch is closed and there is power to the coil

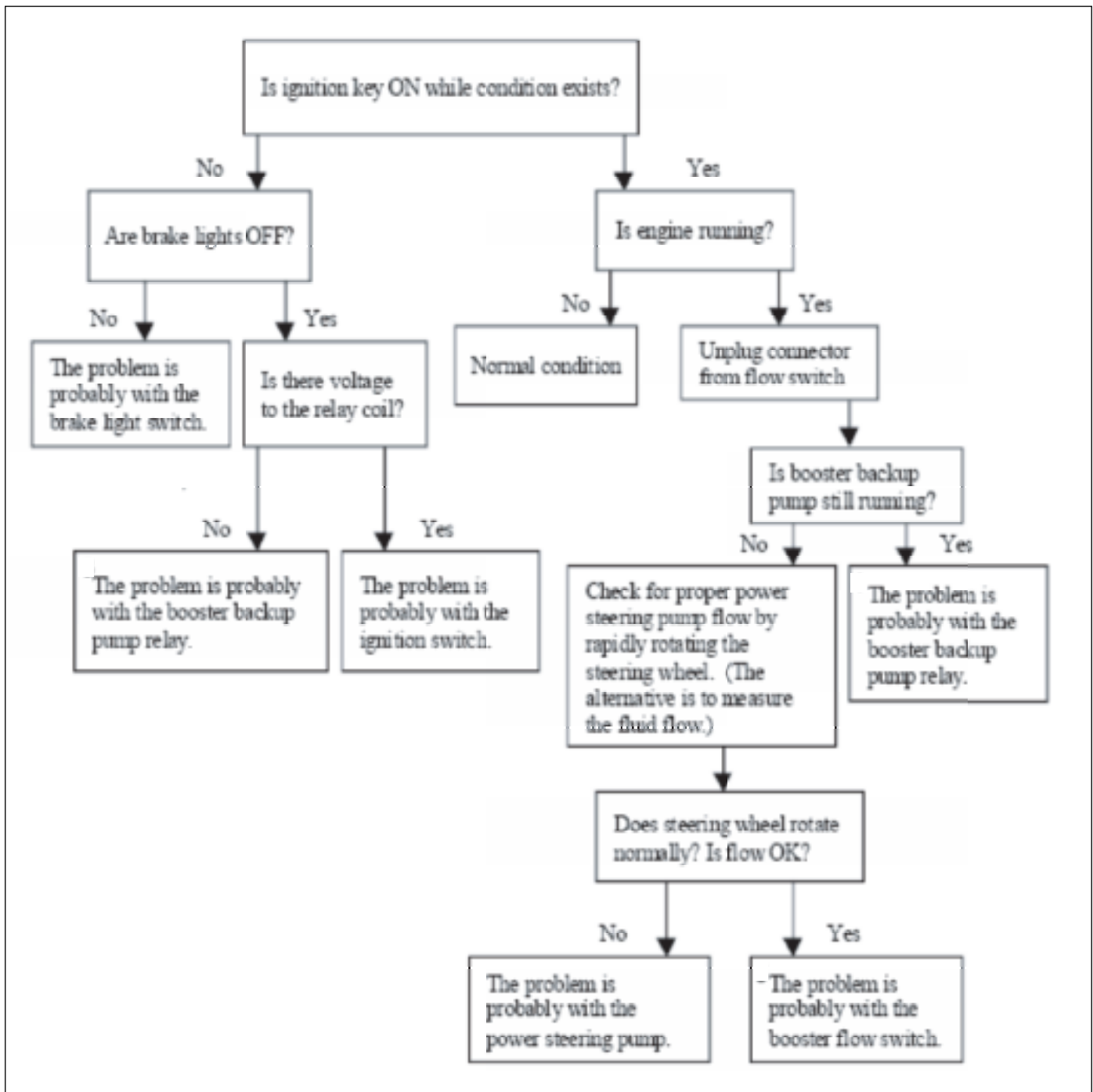


Fig. 5-13. Booster backup pump runs continuously diagnostic tree.

2. The relay is stuck closed

Booster Backup Pump Does Not Run

The booster backup pump will not run if there is no voltage to the motor or if the motor is damaged(e.g., burned out or jammed).

A no-voltage condition can occur because:

1. Battery is dead
2. Relay is stuck
3. Wires are broken (battery to motor circuit or ignition switch / brake light switch to booster flow switch circuit)
4. Booster flow switch is not closed to ground

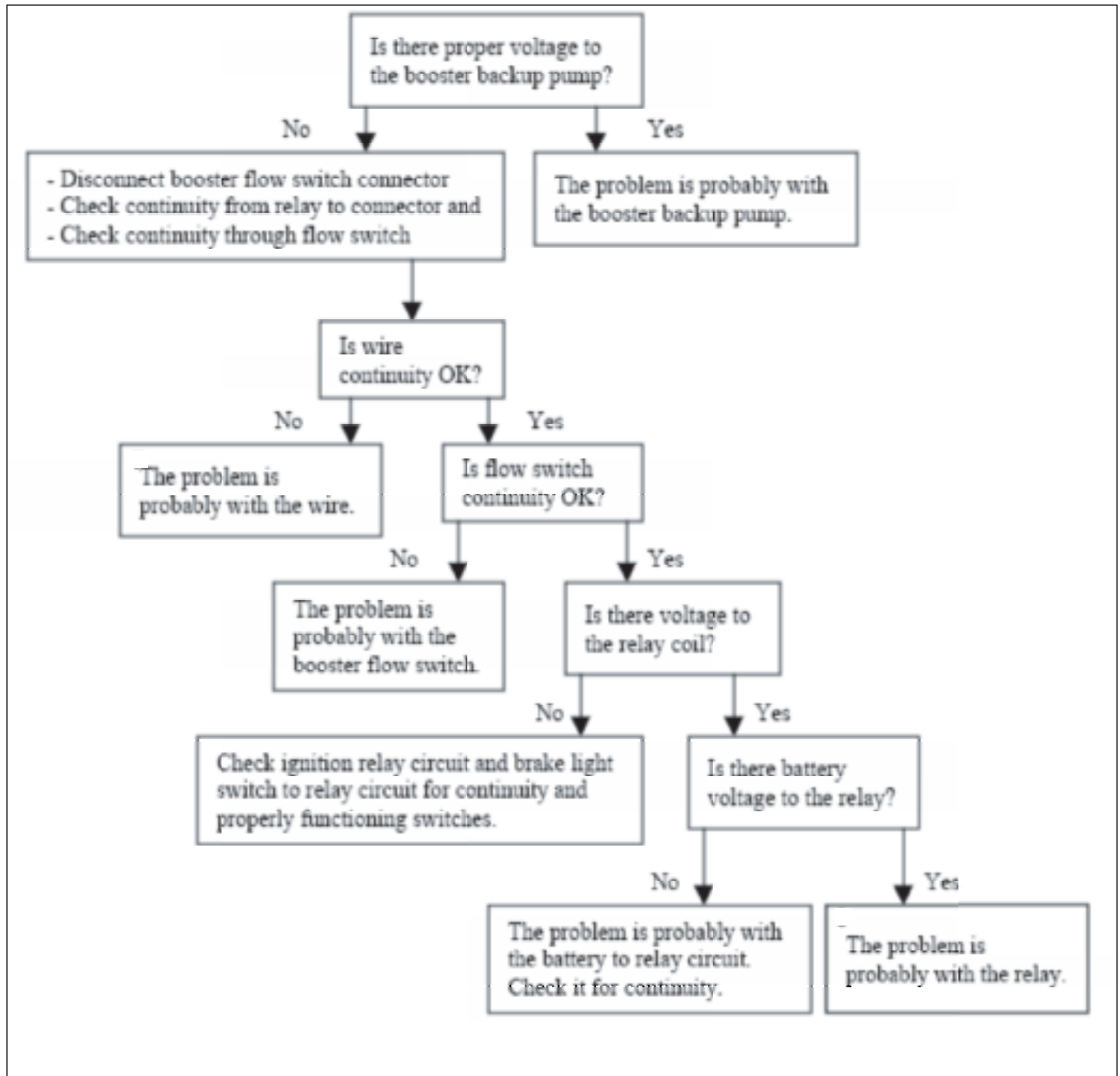


Fig. 5-14. Booster backup pump does not run diagnostic tree.

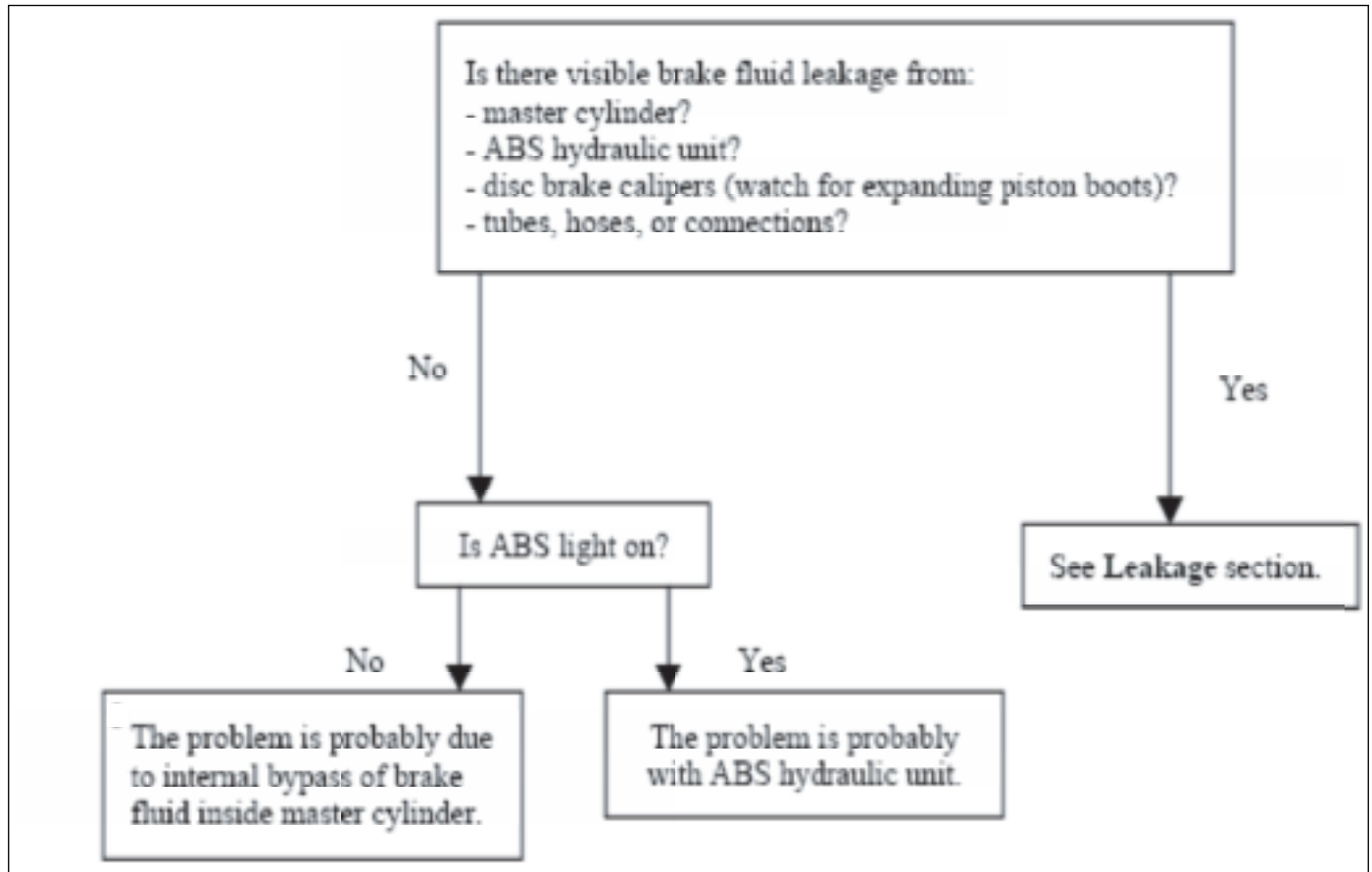
Brake Pedal Continues to Fall With Steady Foot Force

Fig. 5-15. Brake pedal falls under steady pressure diagnostic tree.

Brake Pedal Feels Spongy, Soft or Springy

If the brake pedal does NOT fall with steady foot pressure

but feels spongy, soft or springy, the problem is probably caused by air trapped in the brake fluid system. Start by bleeding the brake system at the caliper furthest from the master cylinder and work from the back to the front of the vehicle.

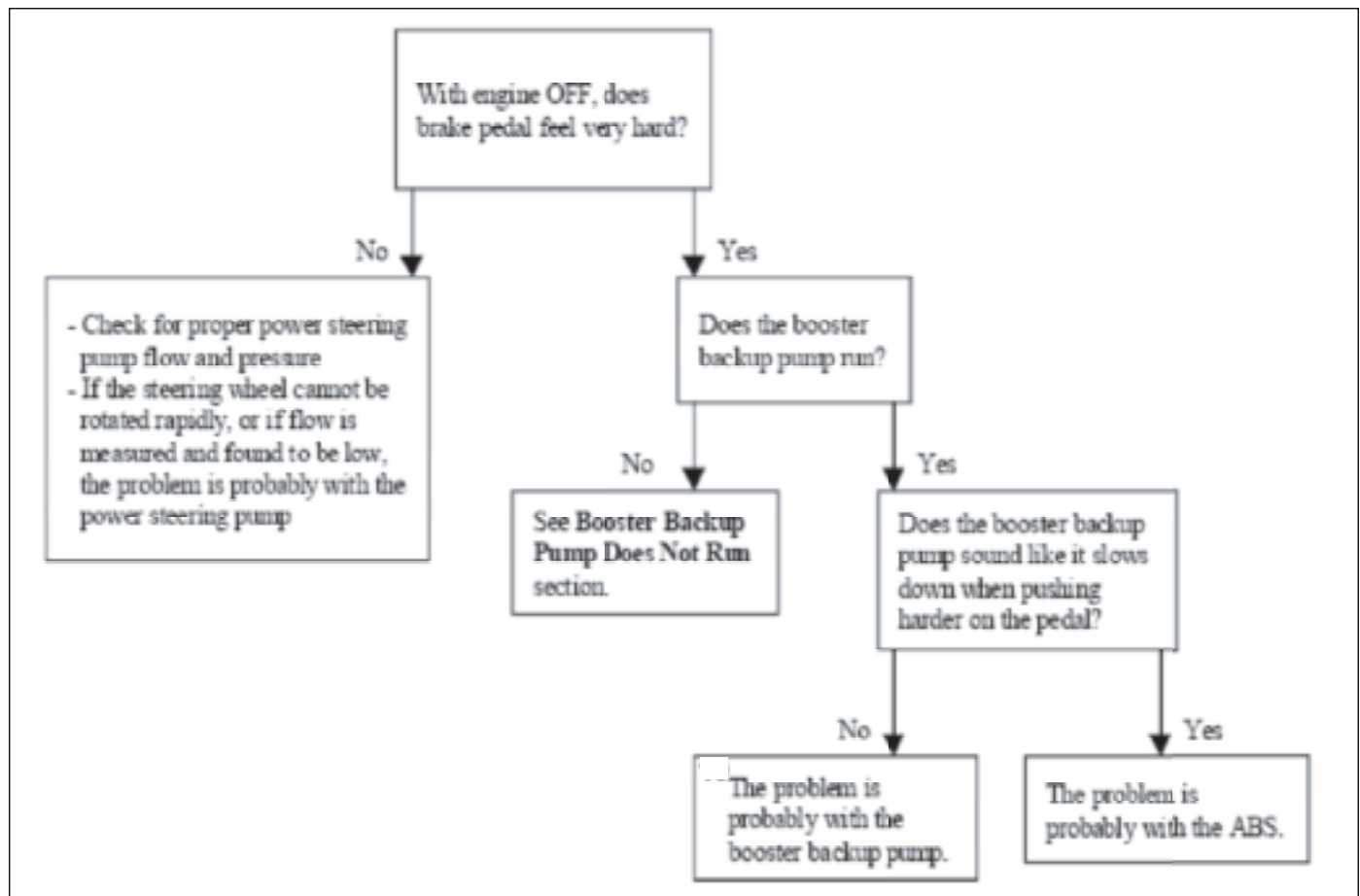


Fig. 5-16. Brake pedal feels very hard diagnostic tree.

Brake Pedal Feels Very Hard

The most common reasons for a very hard brake pedal

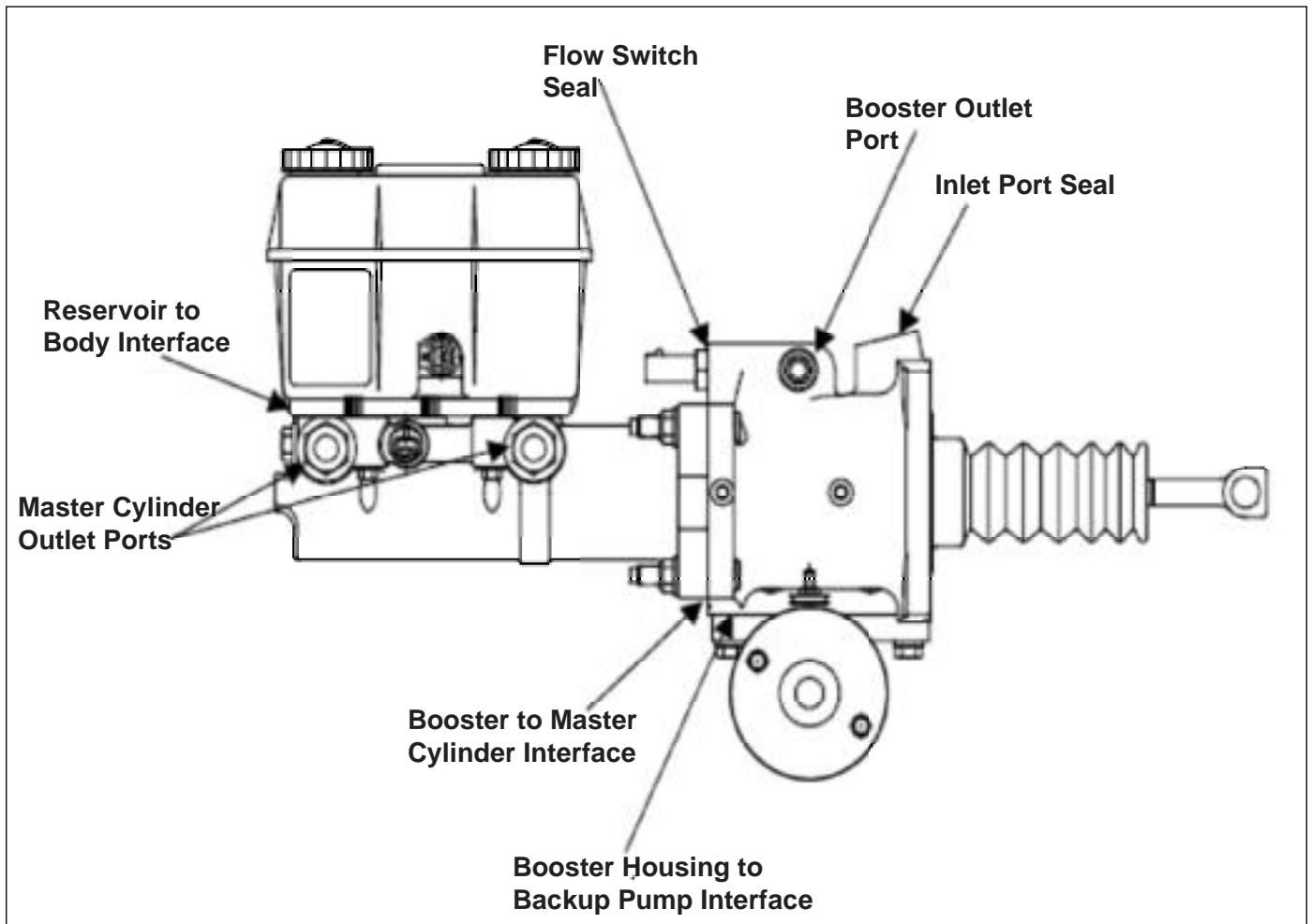


Fig. 5-17. Potential master cylinder and booster leak points.

are:

1. Insufficient flow or pressure from the power steering pump
2. The ABS hydraulic unit is blocking the flow of brake

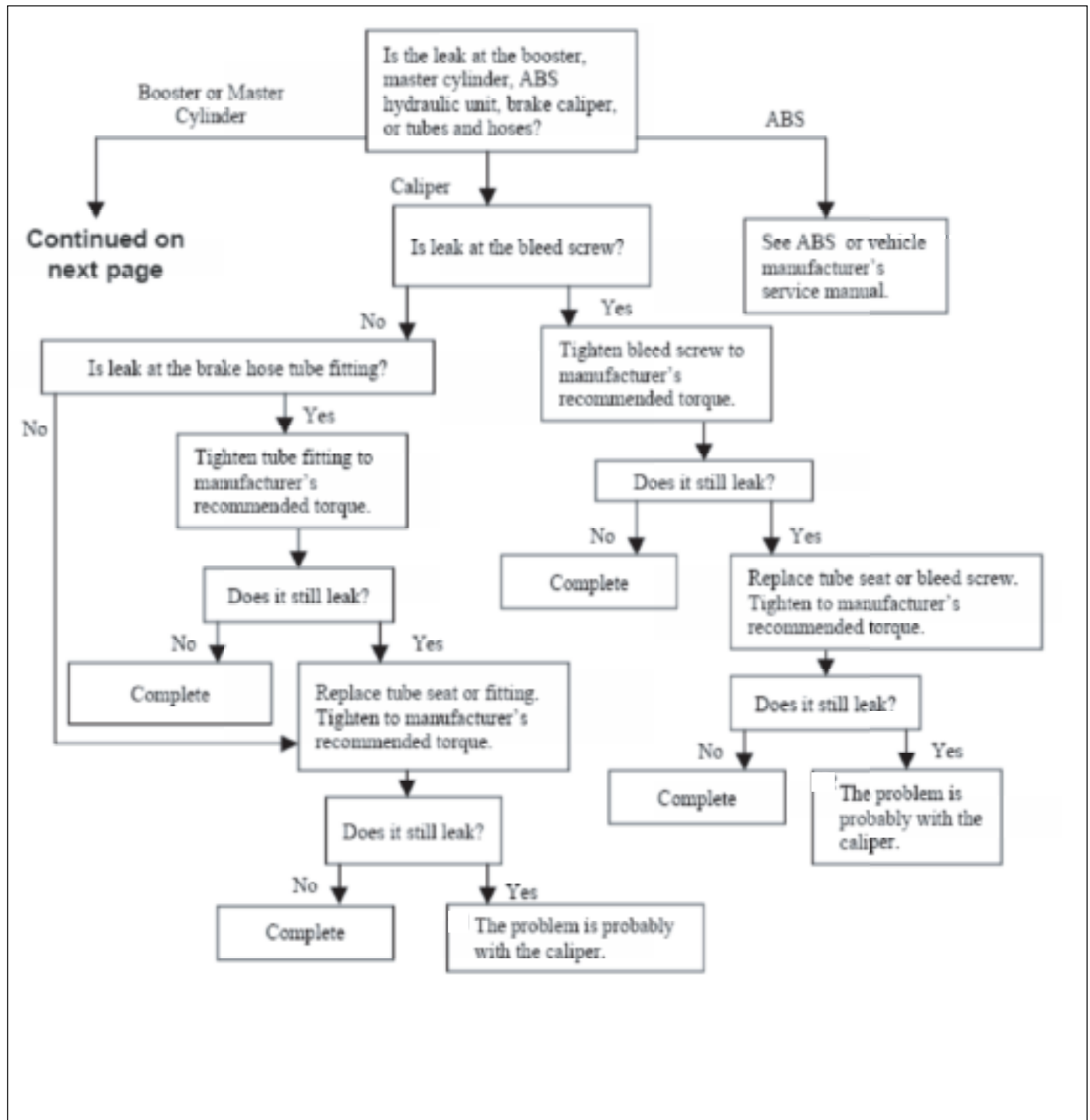


Fig. 5-18. Leakage diagnostic tree. (1 of 3)

fluid to the calipers

Potential Master Cylinder and Booster Leak Points

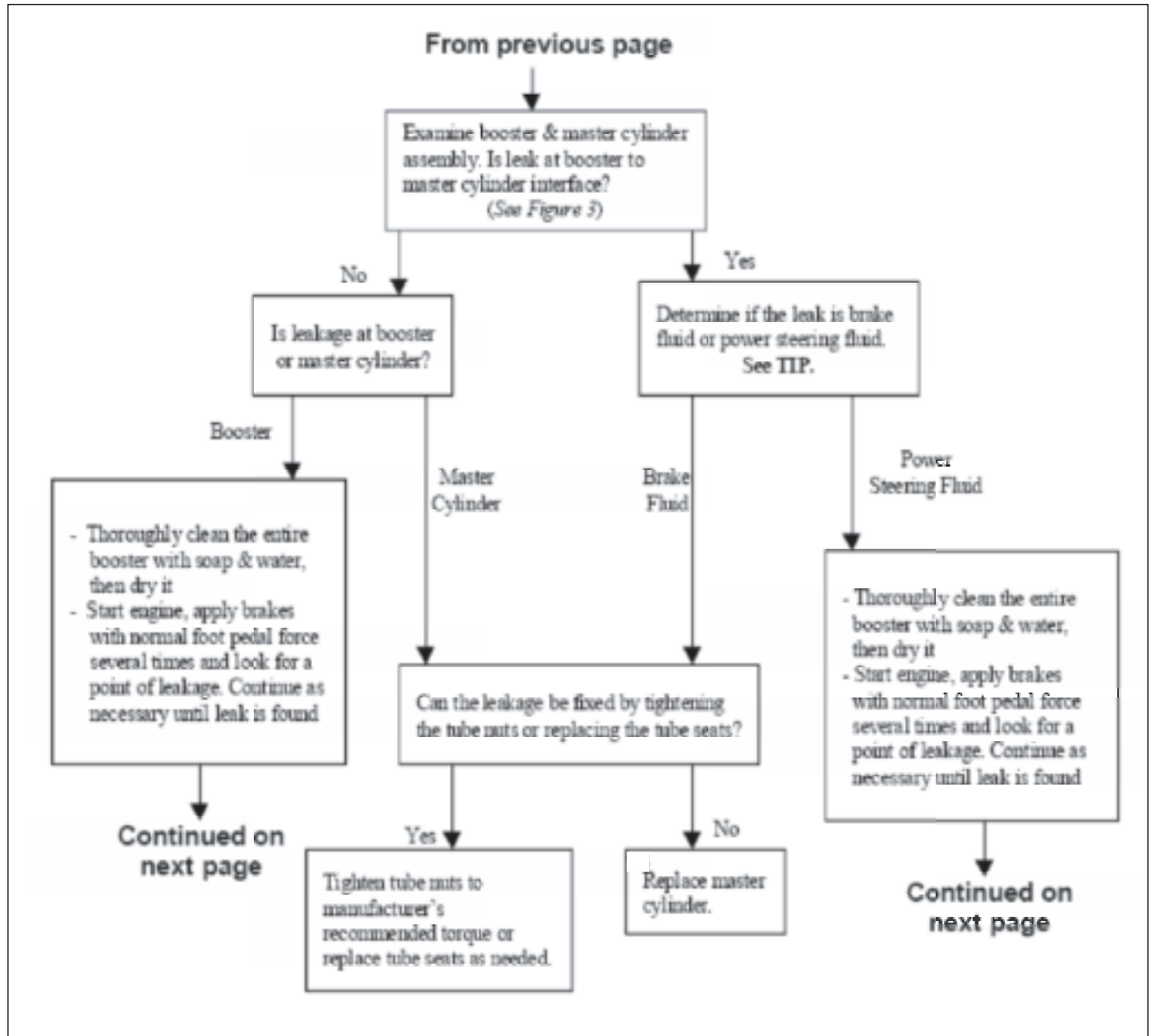


Fig. 5-19. Leakage diagnostic tree. (2 of 3)

Leakage

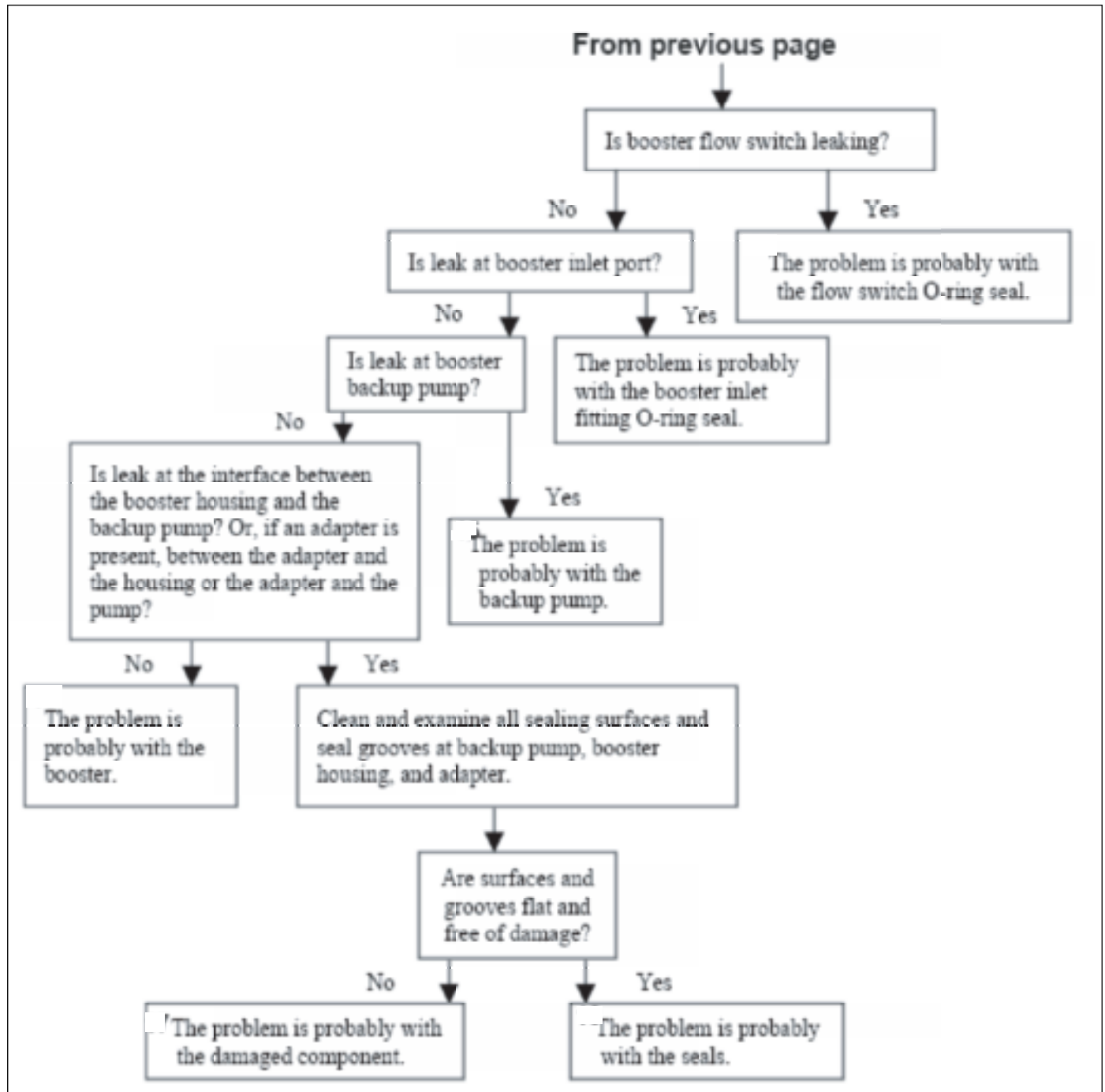


Fig. 5-20. Leakage diagnostic tree. (3 of 3)

Most external leakage is easy to detect by wetness and/or appearance of fluid drops. However, slight dampness (no drops or wetness) may not indicate a leak.

Leakage (continued)

Brake fluid mixes with water
Power steering fluid floats on water.

Leakage (continued)

Brake Drag

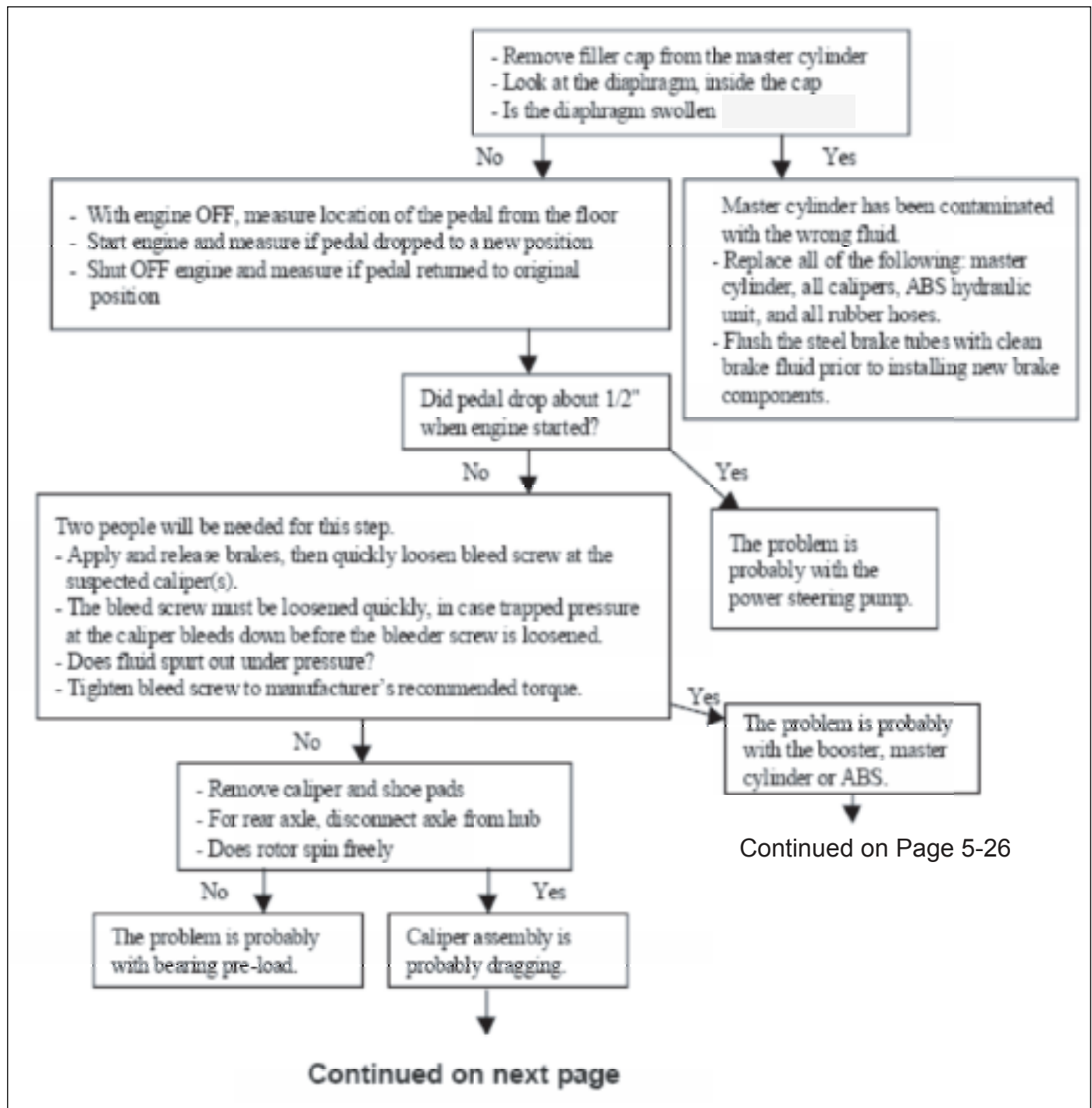


Fig. 5-21. Brake drag diagnostic tree. (1 of 4)

Possible Causes of Brake Drag:

1. Booster does not return
2. Master cylinder does not return
3. Brake pedal does not return
4. ABS traps pressure
5. Brake hoses and tubes collapsed or kinked

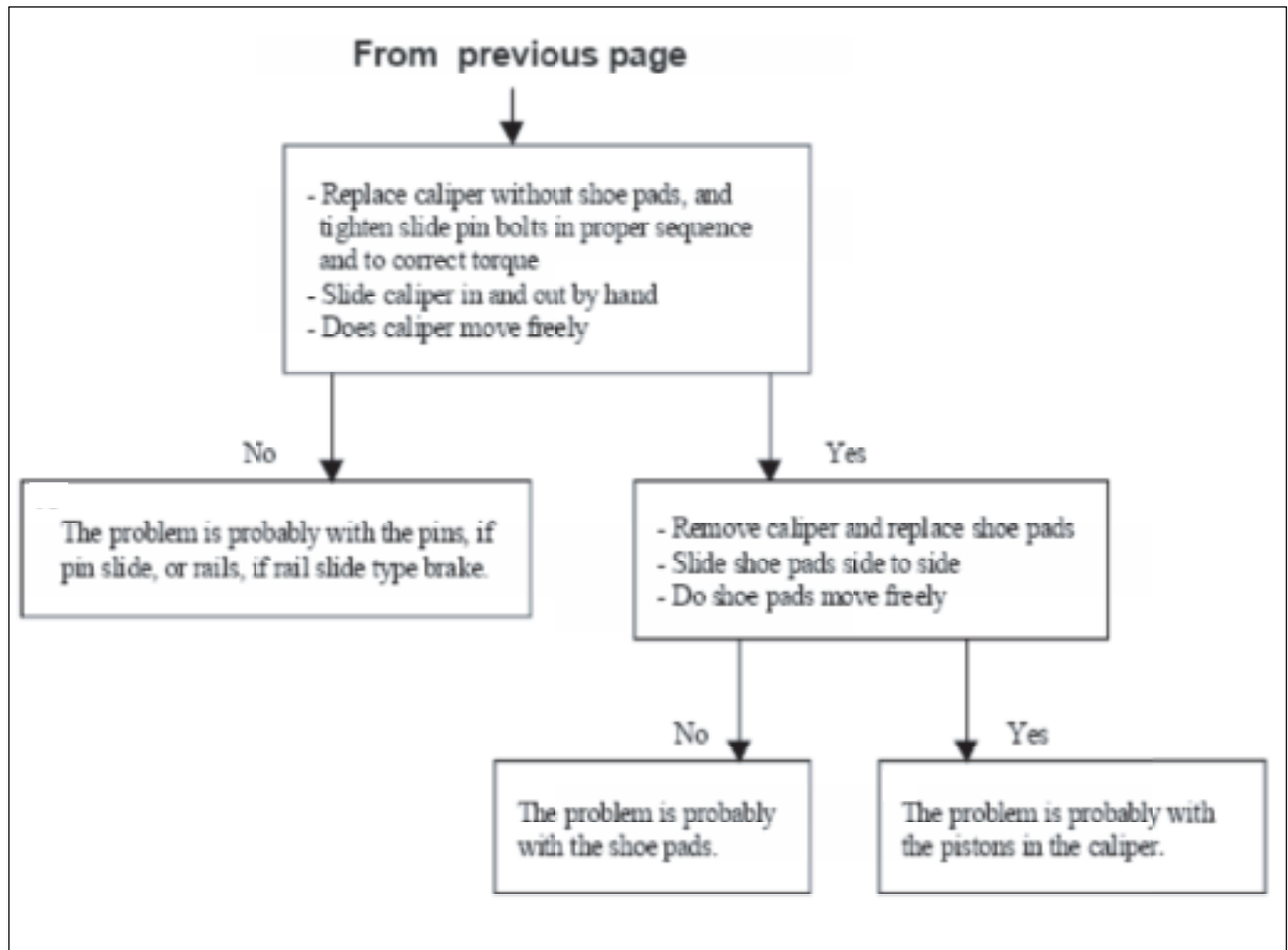


Fig. 5-22 Brake drag diagnostic tree. (2 of 4)

6. Brake caliper does not release

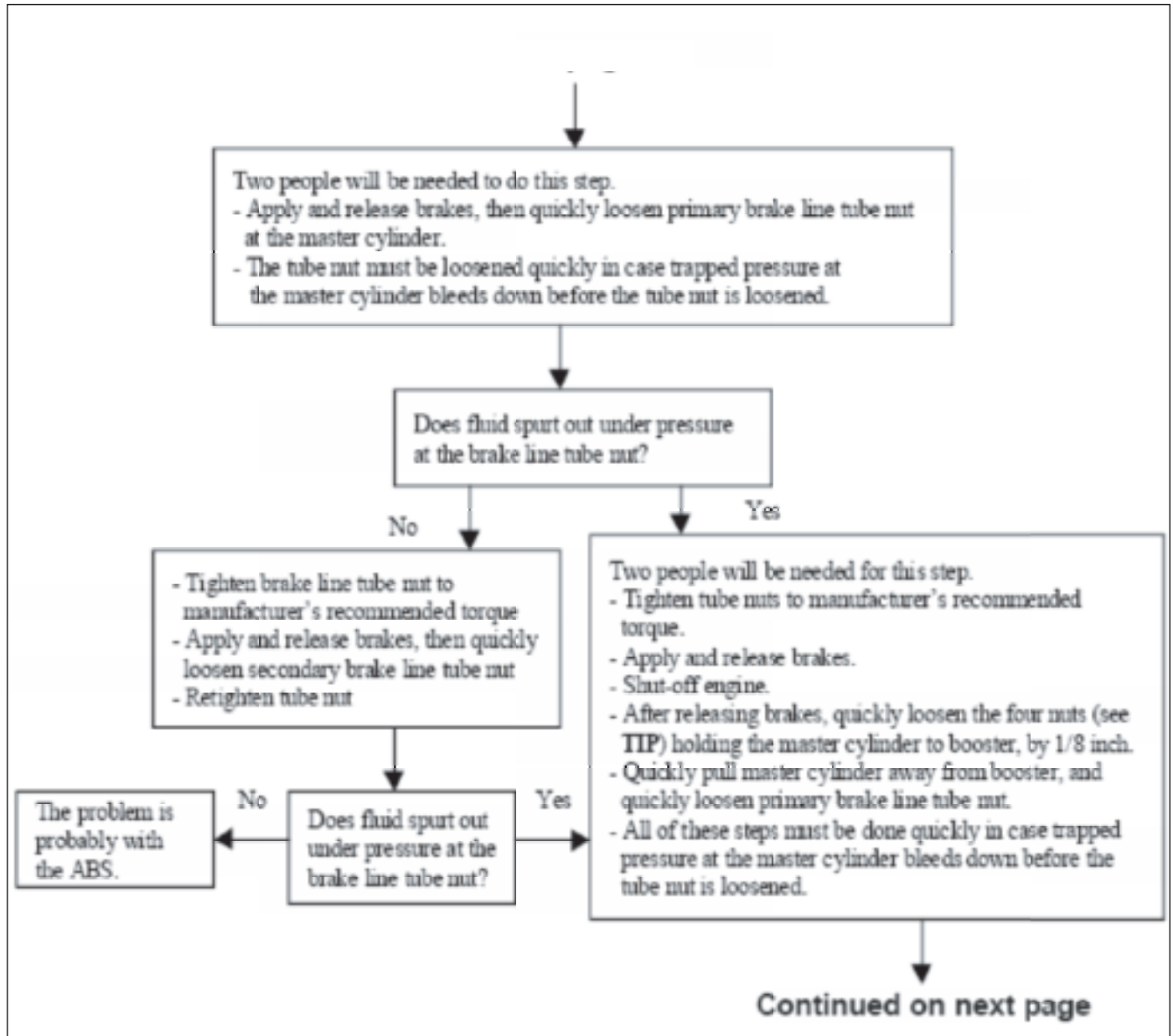


Fig. 5-23. Brake drag diagnostic tree. (3 of 4)

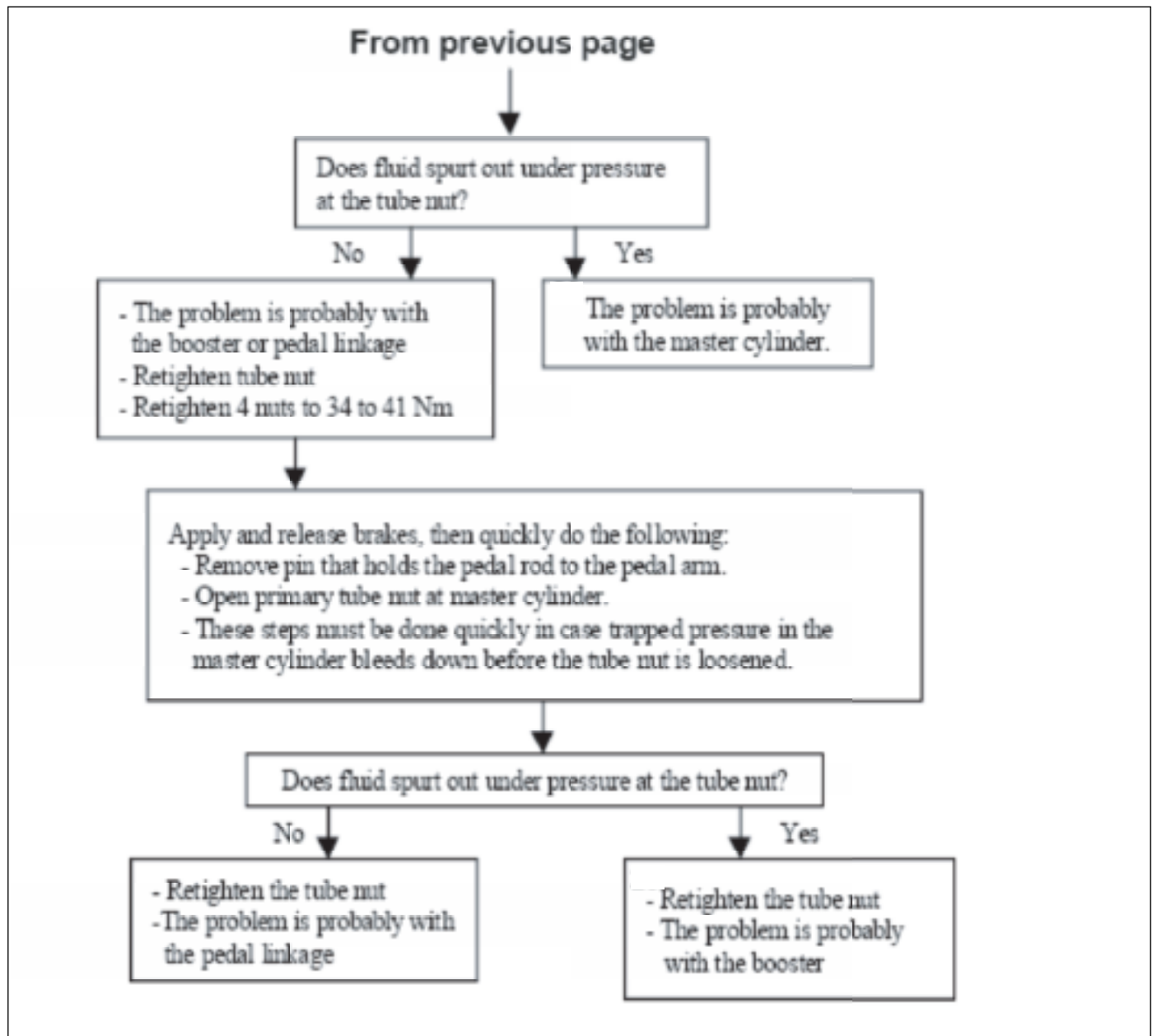


Fig. 5-24. Brake drag diagnostic tree. (4 of 4)

Brake Drag

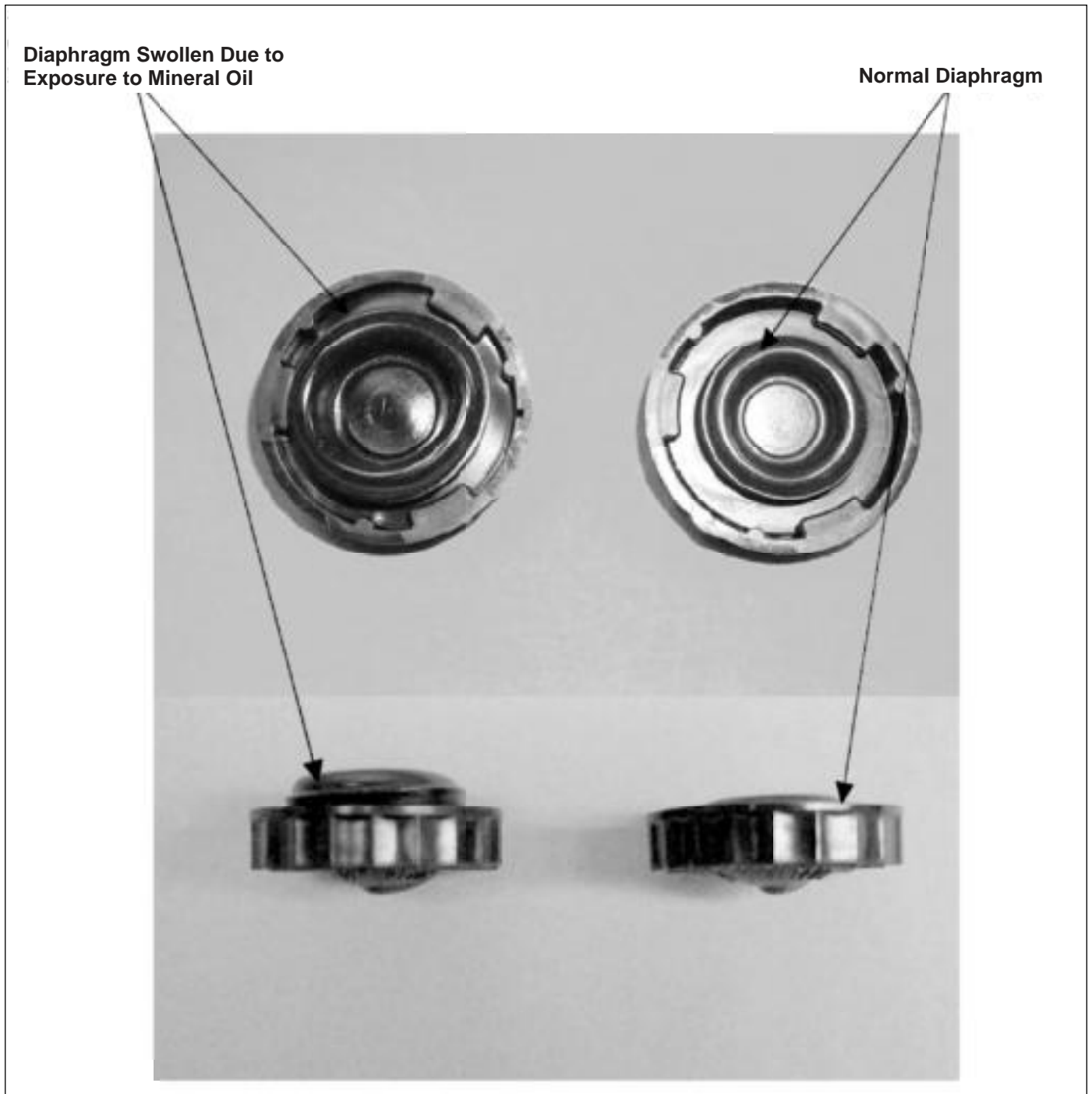


Fig. 5-25. Master cylinder cap diaphragms.

Prior to moving master cylinder 1/8 inch away from booster, loosen two diagonally opposed nuts that hold the master cylinder to the booster, by 1/8 inch. Have a power tool ready to loosen the remaining two nuts after the brakes have been applied and released.

Brake Drag Continued

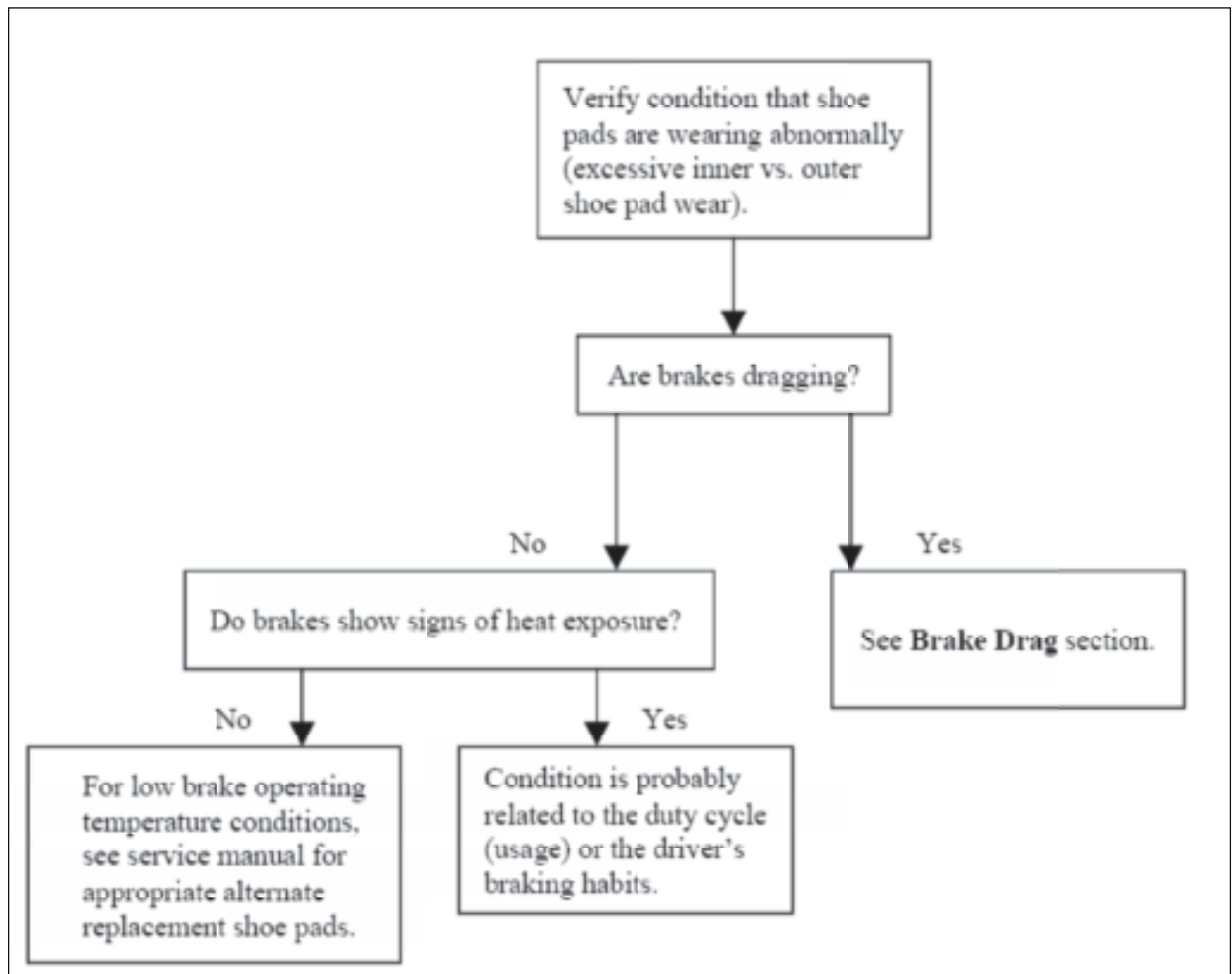


Fig. 5-26. Brake pad/shoe lining wear diagnostic tree.

Section 5

J72 Auto/Apply Park Brake System Service

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J72 PARK BRAKE SYSTEM SERVICE

The J72 park brake system is made up of two major separate components or systems, the actuator and the brake assembly. Each of the components is serviced as an assembly.

SYSTEM OVERVIEW

The J72 system incorporates a unique full-circle parking brake. The automatic electric/hydraulic parking system controls the transmission/propeller shaft mounted parking brake. This system consists of a pump motor relay, vehicle ignition relay, electric/hydraulic pump, reservoir, proportional relief solenoid valve, pressure transducer, and an electronic control module (ECM). The ECM monitors seven inputs from the vehicle and controls the pump motor relay, auto-park light, park brake warning light, buzzer, proportional valve, and pressure transducer.

The park brake is released by pushing the park brake switch pull-button in and moving the shift lever on the steering column from the park position or select “D”, “N” or “R” on the push button shift control.

Notice: Both situations must occur for the brake to release.

Once the ECM receives the signals from the transmission and button contacts, the ECM closes the solenoid valve and closes the pump/motor relay allowing current to flow to the motor. The pump/motor then supplies fluid to the brake assembly. The brake assembly includes a friction disc clamped by a piston through force of an internal spring. The fluid pressure acts on the piston overcoming the spring tension that clamps the friction disc, releasing the brake. The pump motor will shut off when the transducer reads the fluid pressure of approximately 1400 psi. The solenoid valve holds pressure in the system while the brake is in a released state. The ECM monitors system pressure from the pressure transducer and energizes the pump motor when system pressure drops below approximately 1200 psi.

Putting the shift lever back to park, selecting “P” on the push button shift control, turning off the ignition, or pulling the push/pull switch prompts the ECM to de-energize the solenoid valve dumping fluid back into the reservoir. As the pressure decreases, the spring force clamps the piston back against the friction disc and applies the park brake.

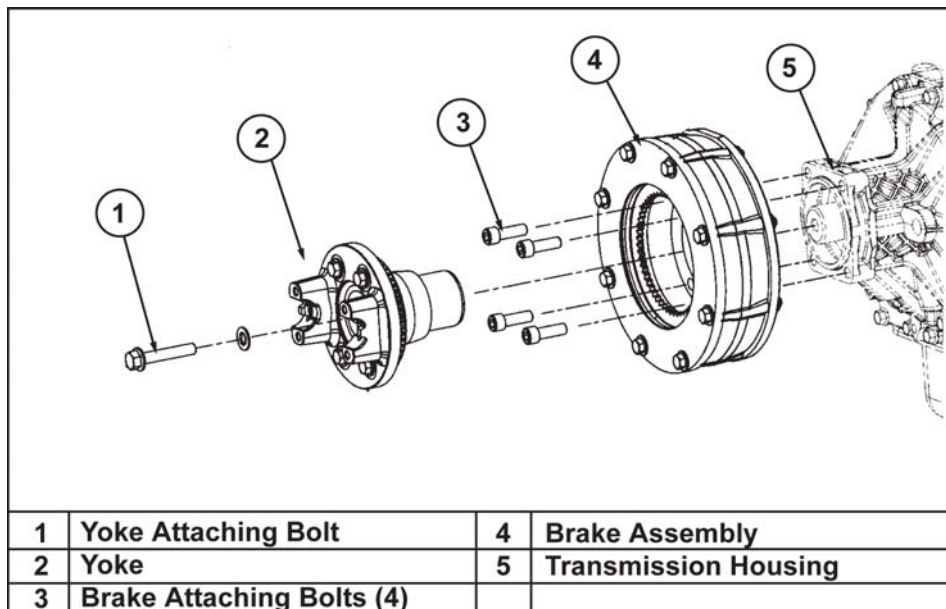


Figure 5-1. J72 Auto Apply Park Brake – Transmission Mounted Brake Assembly

Auto-Apply Warning Lamp

The auto-apply warning lamp turns on when the system pressure falls below than 900 psi and the ECM receives the signal from the transmission.

Park Brake Warning Lamp

The park brake warning lamp illuminates when system pressure falls below 900 PSI or when the parking brake pull-button is pulled out.

Park Brake Pull Switch

The park brake pull switch is mounted on the instrument panel. This is a manual activation switch for the park brake. This switch is normally closed, pushed in. The body manufacturer determines final location of this switch.

Park Brake Pump Motor Relay

The park brake pump motor relay is located in the underhood fuse box on the front driver's side of the radiator core support. It receives ground from the ECM and acts as the automatic control circuit for the high voltage current required to run the pump motor. When the ECM supplies ground to the relay switch, the contacts close to complete the feed circuit to the pump motor.

Ignition Relay

The ignition relay is also located in the underhood fuse box on the front driver's side of the radiator core support. It monitors the vehicle's ignition switch to turn on/off the supply of the fifteen and forty-five amp fused-lines that the ECM and electric motor use. If the relay was not present, the ECM would be continually powered since it would be directly connected to the batteries.

ACTUATOR ASSEMBLY

The actuator assembly controls the pressure in the park brake system to either set or release the park brake. The actuator consists of a mounting bracket and the following components:

Electronic Control Module

The electronic control module (ECM) is an analog logic device that monitors the various vehicle conditions then controls the actuator accordingly. It is the "black box" mounted underneath the actuator mounting bracket. It connects to the vehicle via a fourteen pin connector, to the proportional solenoid valve via a two pin connector, and a pressure transducer via a three pin connector. The ECM is powered by two different sources.

First, it receives power primarily through a fifteen amp fuse. Secondly, the ECM receives power off of the forty-five amp fused-line that the pump motor relay also uses.

Pump/Motor Assembly

The pump/motor assembly consists of an electric motor, geared pump, aluminum port block, and a semi-transparent fluid reservoir. The port block holds the proportional solenoid valve and pressure transducer. The pump provides fluid pressure for the system. A pressure relief valve in the port block limits system pressure to around 1700 psi.

Proportional Solenoid Valve

The proportional solenoid valve controls when fluid can return to the pump reservoir. When the parking brake is released, the valve is closed to hold pressure in the system. When the parking brake is applied, the valve opens to allow fluid to return to the pump reservoir. If the vehicle is at a speed greater than five miles per hour (5mph) and the pull button is pulled, the valve will remain open for a few moments and then release the pressure slowly for a gradual apply of the brake.

CAUTION: *The park brake is NOT designed for dynamic stops; if a dynamic stop occurs the park brake assembly must be inspected immediately for any internal damage.*

Pressure Transducer

The pressure transducer monitors the pressure of the system and relays that information back to the ECM. The critical pressure values are the cut-in and out for the motor which are 1200 psi and 1400 psi, respectively.

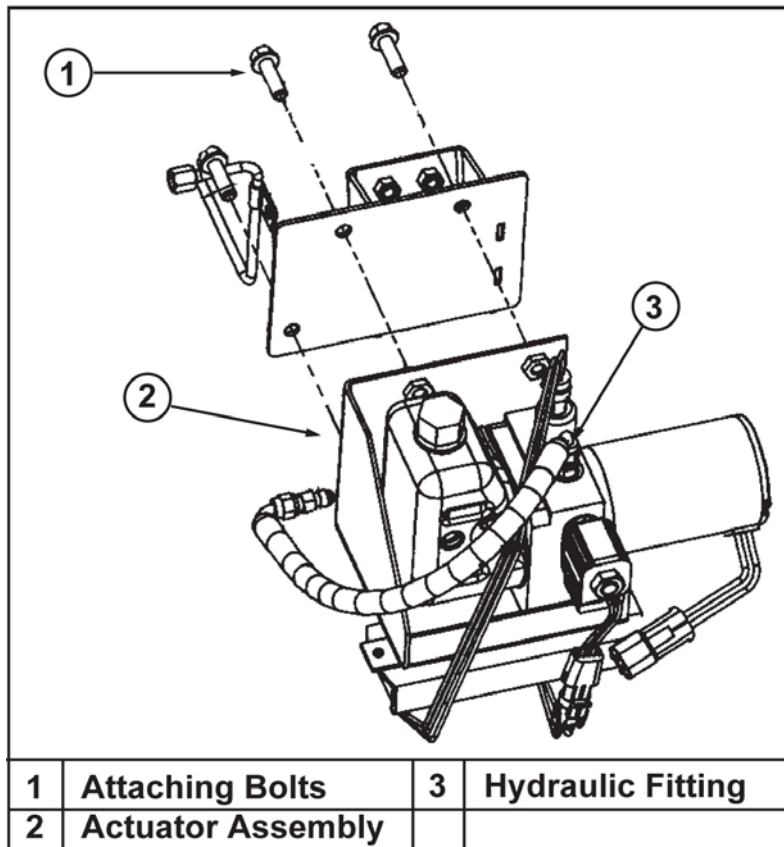


Figure 5-2. J72 Auto Apply Park Brake Actuator Assembly

DIAGNOSIS

PARK BRAKE SYSTEM DIAGNOSIS

Park brake operational concerns fall into two different areas.

- Brake Does Not Hold
- Brake Will Not Release

Park Brake Does Not Hold

To test the park brake function, conduct the following steps.

1. Choose a LEVEL location away from people, pets, and buildings.
2. Ensure the vehicle is in PARK.
3. Apply the service brake (foot brake) and start the engine.
4. Place the transmission in DRIVE.
5. Apply the park brake by pulling the park brake button out to the applied position.
6. Slowly release the service brake (foot brake).

CAUTION: *If the vehicle moves, reapply the foot brake and place the transmission back in PARK. Service the park brake before repeating the test.*

7. If the vehicle does not move, GRADUALLY increase the throttle opening to approximately 1,500 RPM for five seconds, then release the throttle and apply the service brake (foot brake).
 - a. Test results:
 - i. If the brake holds, no further action is required. Note the results of the test on the Repair Order for future reference.
 - ii. If the brake does not hold, the park brake assembly must be replaced.
8. Apply the service brake (foot brake), then release the park brake.
9. Release and reapply the service brake (foot brake) to relieve any strain in the drivetrain.
10. Place the transmission in PARK. The auto-apply park brake should set.
11. Turn the ignition OFF and remove the key.
12. If the brake did not hold in step 7, chock the wheels and proceed to the repair instructions.

Park Brake Will Not Release

If the J72 park brake will not release, chock the wheels and check the following items.

1. Check the fluid level in the reservoir. Add fluid if the level is below the MIN line.
2. Check the ALT/START fuse.
3. Check the function of the Auto Park Brake Motor Relay by substituting a known good relay of the same type.
4. Check the function of the Auto Park IGN relay by substituting a known good relay of the same type.
5. Check the function of the Park Brake Pull Button relay by substituting a known good relay of the same type.
6. Check for leaks in the hydraulic lines. Correct any leaks found.
7. Check for power to the motor. If power is not present, check for continuity on the power feed circuit. If power is present, check for continuity on the ground circuit.

8. Check for motor function by providing battery voltage to pin A of the motor connector and ground to pin B of the motor connector. If the motor does not function, replace it.
9. Perform Park Brake ECM Connector Pin Out Diagnostic Tests:
 - Pin 1 – Check for battery voltage on ECM Pin 1. If no voltage is present check the fuse and the circuit.
 - Pin 2 – Disconnect the harness from the ECM. Connect a test lead from Cavity 2 and ground. The pump motor should operate. If not check the relay and motor circuit.
 - Pin 3 – Backprobe cavity 3 and apply the park brake. Power should be present when the brake is applied and the ignition is in the ON position.
 - Pin 4 – Backprobe cavity 4 with the brake applied. Ground should be present when the brake is applied.
 - Pin 5 – Backprobe Cavity 5 with the brake applied. Ground should be present.
 - Pin 6 through Pin 8 – Not used.
 - Pin 9 – Backprobe Cavity 9 with the brake applied. Ground should be present.
 - Pin 10 – Check for battery voltage on ECM Pin 10. If no voltage is present check the fuse and the circuit.
 - Pin 11 – Pin 11 provides the speed signal from the ABS module.
 - Pin 12 – Check for battery voltage on ECM Pin 10 with the vehicle in PARK. If no voltage is present check the fuse and the circuit to the PNP switch.
 - Pin 13 – Backprobe Cavity 9 with the brake applied. Ground should be present.
 - Pin 14 – Pin 14 supplies the ECM with chassis ground. Backprobe Cavity 14 and check for ground.

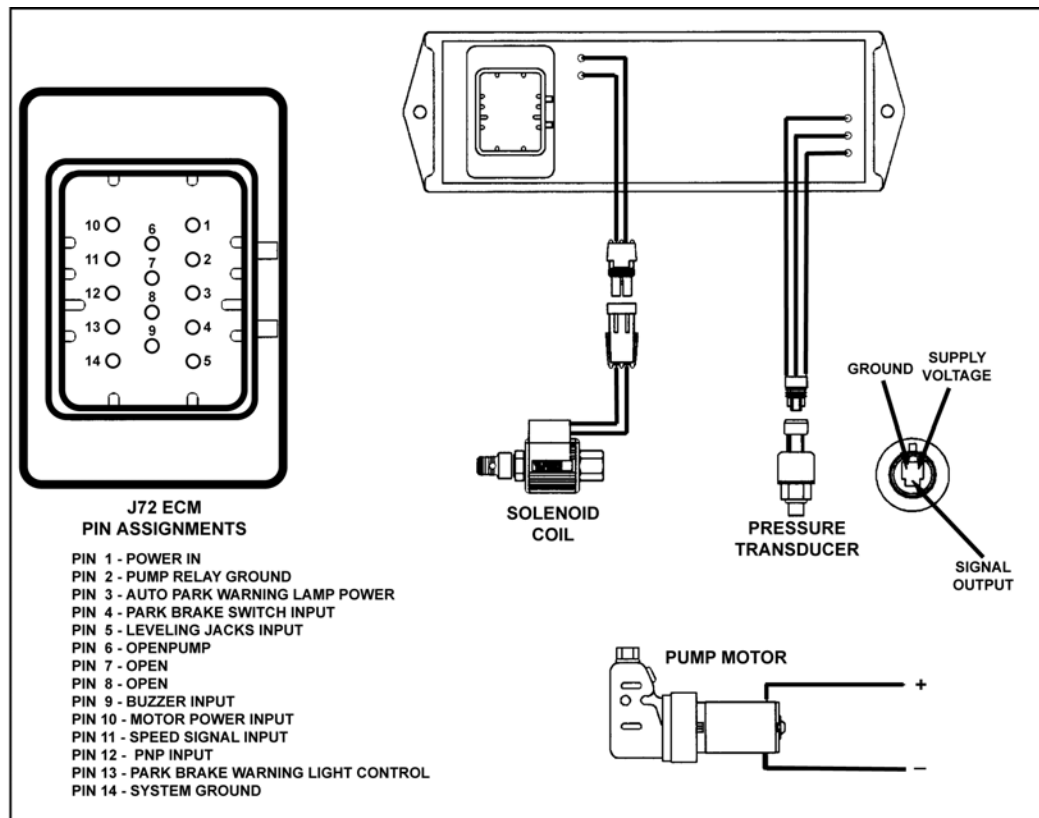


Figure 5-3. J72 Park Brake ECU Pinout Guide

COMPONENT REPLACEMENT

PARK BRAKE ASSEMBLY REPLACEMENT

CAUTION: Block the vehicle wheels to prevent movement before servicing the park brake assembly.

Removal Procedure

1. Raise the vehicle and support the vehicle with safety stands. Refer to Lifting and Jacking the Vehicle in General Information.

Important: Ensure the park brake is applied.

2. Remove the propeller shaft. Refer to Two-Piece Propeller Shaft Replacement or Three-Piece Propeller Shaft Replacement.
3. Disconnect the hydraulic line from the brake assembly. Install a suitable plug in the hydraulic line and cap the brake assembly fitting to minimize fluid loss.
4. Remove the center bolt retaining the yoke to the transmission output shaft. Remove the yoke.

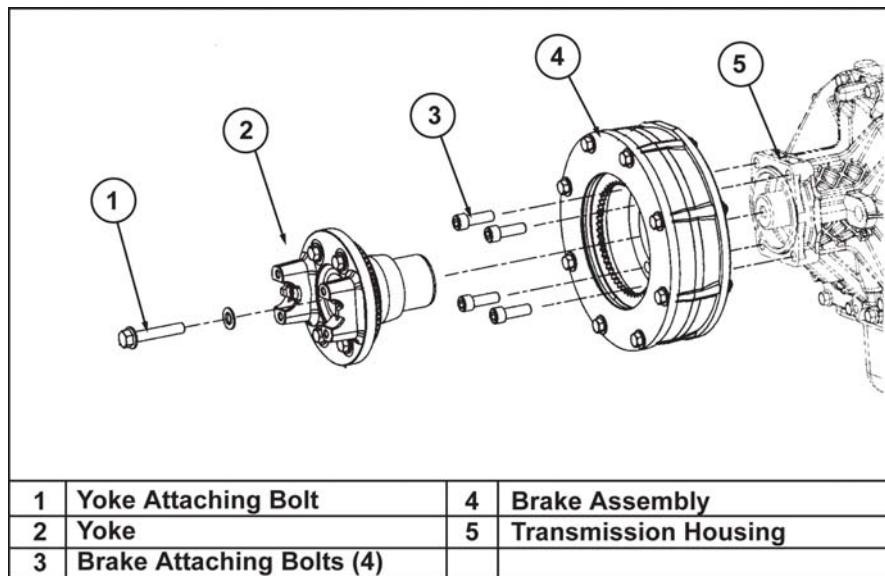


Figure 5-4. Removing the Park Brake Assembly

Important: Cap the end of the transmission in order to minimize fluid loss.

5. Inspect the yoke ears for damage and the splines for the following damage:
 - Wear
 - Burrs
 - Twisting

CAUTION: The park brake assembly weighs approximately 45lbs (20 kg). Use a suitable jack to support the brake before removing the attaching bolts. Failure to do so may result in personal injury.

6. Remove the four bolts attaching the brake assembly to the transmission housing.
7. Remove the brake assembly.

Installation Procedure

Notice: Refer to *Fastener Notice* in **Cautions and Notices**.

1. Raise the brake assembly into position and align with the mounting holes in the transmission housing.
2. Install the bolts and washers attaching the brake assembly to the transmission housing. Tighten the bolts and washers to 89 lb ft (121 Nm).
3. Install the yoke and attaching bolt. Tighten the bolt to 89 lb ft (121 Nm).
4. Connect the hydraulic line to the brake assembly.
5. Fill the brake actuator reservoir with the specified fluid.

Notice: 2004-2005 models use Dexron III in the park brake system. 2006 models are filled with Dexron VI.

6. Install the propeller shaft. Refer to Two-Piece Propeller Shaft Replacement or Three-Piece Propeller Shaft Replacement.
7. Bleed the park brake hydraulic system. See bleeding the park brake in this section.
8. Lower the vehicle.
9. Test the operation of the park brake.

CAUTION: Always test the park brake before proper operation before returning the vehicle to the customer.

PARK BRAKE ACTUATOR ASSEMBLY REPLACEMENT

Removal Procedure

CAUTION: Ensure the park brake is applied before removing the actuator. The park brake hydraulic system operates at high pressure. Always relieve pressure by applying the park brake before disconnecting any hydraulic fittings.

1. Disconnect the electrical connectors from the actuator assembly.
2. Disconnect the Hydraulic line from the actuator assembly. Cap the actuator fitting and plug the line to prevent fluid loss.
3. Remove the bolts attaching the actuator assembly to the bulkhead.

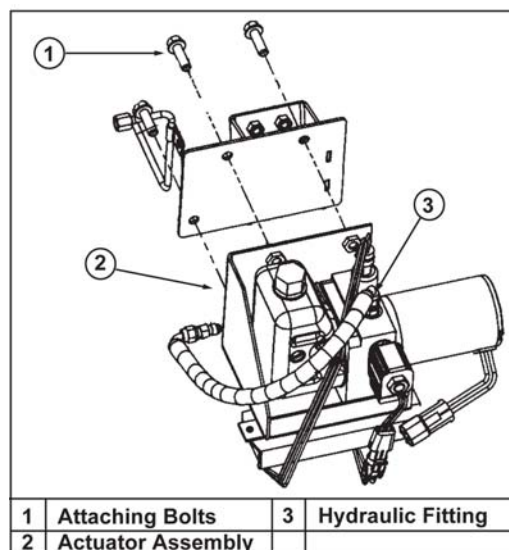


Figure 5-5. Replacing the Actuator Assembly

Installation Procedure

Notice: Refer to *Fastener Notice* in **Cautions and Notices**.

1. Ensure that the hydraulic fitting is properly tightened in the actuator housing before installing the hydraulic line. Tighten the fitting to 108 lb in (12 Nm).
2. Install the new actuator assembly and tighten the bolts. Tighten the bolts to 28 lb ft (38 Nm).
3. Connect the hydraulic line to the actuator assembly. Tighten the fitting to 108 lb in (12 Nm).
4. Connect the electrical connection to the actuator assembly.
5. Fill the fluid reservoir with the appropriate fluid.

Notice: 2004-2005 models use Dexron III in the park brake hydraulic system. 2006+ models use Dexron VI in the hydraulic system.

6. Bleed the park brake system. See bleeding the park brake in this section.

CAUTION: *Always test the park brake before proper operation before returning the vehicle to the customer.*

MERITOR WABCO

Hydraulic ABS for Medium-Duty Trucks, Buses and Motor Home Chassis

**Maintenance Manual No. 39
Revised 09-00**

For D Version Hydraulic ABS

Before You Begin

This manual provides maintenance and service instructions for Meritor WABCO's hydraulic ABS for medium-duty trucks, buses and motor home chassis. Before you begin procedures:




1. Read and understand all instructions and procedures before you begin to service components.
2. Read and observe all Caution and Warning safety alerts that precede instructions or procedures you will perform. These alerts help to avoid damage to components, serious personal injury, or both.
3. Follow your company's maintenance and service, installation, and diagnostics guidelines.
4. Use special tools when required to help avoid serious personal injury and damage to components.


Access Information on ArvinMeritor's Web Site

Additional maintenance and service information for ArvinMeritor's commercial vehicle systems component lineup is also available at www.arvinmeritor.com.

To access information, click on Products & Services/Tech Library Icon/HVS Publications. The screen will display an index of publications by type.

Safety Alerts, Torque Symbol and Notes

 WARNING	A Warning alerts you to an instruction or procedure that you must follow exactly to avoid serious personal injury and damage to components.
 CAUTION	A Caution alerts you to an instruction or procedure that you must follow exactly to avoid damage to components and possible serious injury.
	A torque symbol alerts you to tighten fasteners to a specified torque value.
NOTE	A Note provides information or suggestions that help you correctly service a component.

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ASBESTOS FIBERS WARNING

The following procedures for servicing brakes are recommended to reduce exposure to asbestos fiber dust, a cancer and lung disease hazard. Material Safety Data Sheets are available from ArvinMeritor.

Hazard Summary

Because some brake linings contain asbestos, workers who service brakes must understand the potential hazards of asbestos and precautions for reducing risks. Exposure to airborne asbestos dust can cause serious and possibly fatal diseases, including asbestosis (a chronic lung disease) and cancer, principally lung cancer and mesothelioma (a cancer of the lining of the chest or abdominal cavities). Some studies show that the risk of lung cancer among persons who smoke and who are exposed to asbestos is much greater than the risk for non-smokers. Symptoms of these diseases may not become apparent for 15, 20 or more years after the first exposure to asbestos.

Accordingly, workers must use caution to avoid creating and breathing dust when servicing brakes. Specific recommended work practices for reducing exposure to asbestos dust follow. Consult your employer for more details.

Recommended Work Practices

1. **Separate Work Areas.** Whenever feasible, service brakes in a separate area away from other operations to reduce risks to unprotected persons. OSHA has set a maximum allowable level of exposure for asbestos of 0.1 f/cc as an 8-hour time-weighted average and 1.0 f/cc averaged over a 30-minute period. Scientists disagree, however, to what extent adherence to the maximum allowable exposure levels will eliminate the risk of disease that can result from inhaling asbestos dust. OSHA requires that the following sign be posted at the entrance to areas where exposures exceed either of the maximum allowable levels:

**DANGER: ASBESTOS
CANCER AND LUNG DISEASE HAZARD
AUTHORIZED PERSONNEL ONLY
RESPIRATORS AND PROTECTIVE CLOTHING
ARE REQUIRED IN THIS AREA.**

2. **Respiratory Protection.** Wear a respirator equipped with a high-efficiency (HEPA) filter approved by NIOSH or MSHA for use with asbestos at all times when servicing brakes, beginning with the removal of the wheels.

3. **Procedures for Servicing Brakes.**

- a. Enclose the brake assembly within a negative pressure enclosure. The enclosure should be equipped with a HEPA vacuum and worker arm sleeves. With the enclosure in place, use the HEPA vacuum to loosen and vacuum residue from the brake parts.
- b. As an alternative procedure, use a catch basin with water and a biodegradable, non-phosphate, water-based detergent to wash the brake drum or rotor and other brake parts. The solution should be applied with low pressure to prevent dust from becoming airborne. Allow the solution to flow between the brake drum and the brake support or the brake rotor and caliper. The wheel hub and brake assembly components should be thoroughly wetted to suppress dust before the brake shoes or brake pads are removed. Wipe the brake parts clean with a cloth.
- c. If an enclosed vacuum system or brake washing equipment is not available, employers may adopt their own written procedures for servicing brakes, provided that the exposure levels associated with the employer's procedures do not exceed the levels associated with the enclosed vacuum system or brake washing equipment. Consult OSHA regulations for more details.
- d. Wear a respirator equipped with a HEPA filter approved by NIOSH or MSHA for use with asbestos when grinding or machining brake linings. In addition, do such work in an area with a local exhaust ventilation system equipped with a HEPA filter.
- e. **NEVER** use compressed air by itself, dry brushing, or a vacuum not equipped with a HEPA filter when cleaning brake parts or assemblies. **NEVER** use carcinogenic solvents, flammable solvents, or solvents that can damage brake components as wetting agents.

4. **Cleaning Work Areas.** Clean work areas with a vacuum equipped with a HEPA filter or by wet wiping. **NEVER** use compressed air or dry sweeping to clean work areas. When you empty vacuum cleaners and handle used rags, wear a respirator equipped with a HEPA filter approved by NIOSH or MSHA for use with asbestos. When you replace a HEPA filter, wet the filter with a fine mist of water and dispose of the used filter with care.

5. **Worker Clean-Up.** After servicing brakes, wash your hands before you eat, drink or smoke. Shower after work. Do not wear work clothes home. Use a vacuum equipped with a HEPA filter to vacuum work clothes after they are worn. Launder them separately. Do not shake or use compressed air to remove dust from work clothes.

6. **Waste Disposal.** Dispose of discarded linings, used rags, cloths and HEPA filters with care, such as in sealed plastic bags. Consult applicable EPA, state and local regulations on waste disposal.

Regulatory Guidance

References to OSHA, NIOSH, MSHA, and EPA, which are regulatory agencies in the United States, are made to provide further guidance to employers and workers employed within the United States. Employers and workers employed outside of the United States should consult the regulations that apply to them for further guidance.



NON-ASBESTOS FIBERS WARNING

The following procedures for servicing brakes are recommended to reduce exposure to non-asbestos fiber dust, a cancer and lung disease hazard. Material Safety Data Sheets are available from ArvinMeritor.

Hazard Summary

Most recently manufactured brake linings do not contain asbestos fibers. These brake linings may contain one or more of a variety of ingredients, including glass fibers, mineral wool, aramid fibers, ceramic fibers and silica that can present health risks if inhaled. Scientists disagree on the extent of the risks from exposure to these substances. Nonetheless, exposure to silica dust can cause silicosis, a non-cancerous lung disease. Silicosis gradually reduces lung capacity and efficiency and can result in serious breathing difficulty. Some scientists believe other types of non-asbestos fibers, when inhaled, can cause similar diseases of the lung. In addition, silica dust and ceramic fiber dust are known to the State of California to cause lung cancer. U.S. and international agencies have also determined that dust from mineral wool, ceramic fibers and silica are potential causes of cancer.

Accordingly, workers must use caution to avoid creating and breathing dust when servicing brakes. Specific recommended work practices for reducing exposure to non-asbestos dust follow. Consult your employer for more details.

Recommended Work Practices

1. **Separate Work Areas.** Whenever feasible, service brakes in a separate area away from other operations to reduce risks to unprotected persons.

2. **Respiratory Protection.** OSHA has set a maximum allowable level of exposure for silica of 0.1 mg/m³ as an 8-hour time-weighted average. Some manufacturers of non-asbestos brake linings recommend that exposures to other ingredients found in non-asbestos brake linings be kept below 1.0 f/cc as an 8-hour time-weighted average. Scientists disagree, however, to what extent adherence to these maximum allowable exposure levels will eliminate the risk of disease that can result from inhaling non-asbestos dust.

Therefore, wear respiratory protection at all times during brake servicing, beginning with the removal of the wheels. Wear a respirator equipped with a high-efficiency (HEPA) filter approved by NIOSH or MSHA, if the exposure levels may exceed OSHA or manufacturers' recommended maximum levels. Even when exposures are expected to be within the maximum allowable levels, wearing such a respirator at all times during brake servicing will help minimize exposure.

3. **Procedures for Servicing Brakes.**

- a. Enclose the brake assembly within a negative pressure enclosure. The enclosure should be equipped with a HEPA vacuum and worker arm sleeves. With the enclosure in place, use the HEPA vacuum to loosen and vacuum residue from the brake parts.
- b. As an alternative procedure, use a catch basin with water and a biodegradable, non-phosphate, water-based detergent to wash the brake drum or rotor and other brake parts. The solution should be applied with low pressure to prevent dust from becoming airborne. Allow the solution to flow between the brake drum and the brake support or the brake rotor and caliper. The wheel hub and brake assembly components should be thoroughly wetted to suppress dust before the brake shoes or brake pads are removed. Wipe the brake parts clean with a cloth.
- c. If an enclosed vacuum system or brake washing equipment is not available, carefully clean the brake parts in the open air. Wet the parts with a solution applied with a pump-spray bottle that creates a fine mist. Use a solution containing water, and, if available, a biodegradable, non-phosphate, water-based detergent. The wheel hub and brake assembly components should be thoroughly wetted to suppress dust before the brake shoes or brake pads are removed. Wipe the brake parts clean with a cloth.
- d. Wear a respirator equipped with a HEPA filter approved by NIOSH or MSHA when grinding or machining brake linings. In addition, do such work in an area with a local exhaust ventilation system equipped with a HEPA filter.
- e. **NEVER** use compressed air by itself, dry brushing, or a vacuum not equipped with a HEPA filter when cleaning brake parts or assemblies. **NEVER** use carcinogenic solvents, flammable solvents, or solvents that can damage brake components as wetting agents.

4. **Cleaning Work Areas.** Clean work areas with a vacuum equipped with a HEPA filter or by wet wiping. **NEVER** use compressed air or dry sweeping to clean work areas. When you empty vacuum cleaners and handle used rags, wear a respirator equipped with a HEPA filter approved by NIOSH or MSHA, to minimize exposure. When you replace a HEPA filter, wet the filter with a fine mist of water and dispose of the used filter with care.

5. **Worker Clean-Up.** After servicing brakes, wash your hands before you eat, drink or smoke. Shower after work. Do not wear work clothes home. Use a vacuum equipped with a HEPA filter to vacuum work clothes after they are worn. Launder them separately. Do not shake or use compressed air to remove dust from work clothes.

6. **Waste Disposal.** Dispose of discarded linings, used rags, cloths and HEPA filters with care, such as in sealed plastic bags. Consult applicable EPA, state and local regulations on waste disposal.

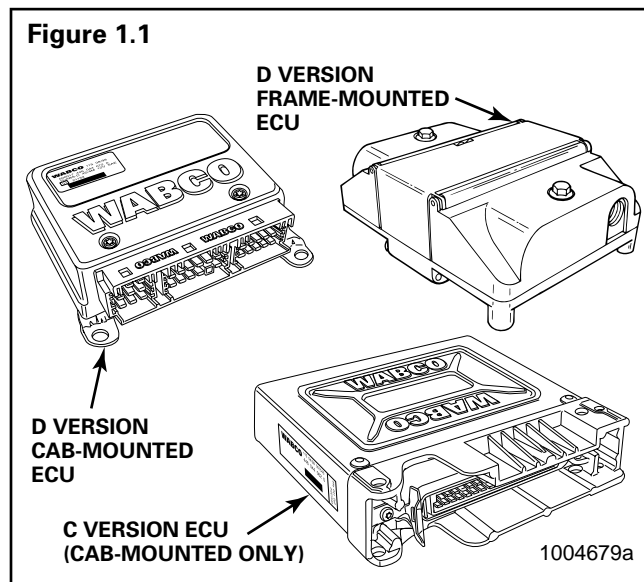
Regulatory Guidance

References to OSHA, NIOSH, MSHA, and EPA, which are regulatory agencies in the United States, are made to provide further guidance to employers and workers employed within the United States. Employers and workers employed outside of the United States should consult the regulations that apply to them for further guidance.

Overview

Meritor WABCO Hydraulic Anti-lock Braking System (ABS) is an electronic wheel speed monitoring and control system used on medium-duty trucks, buses and motor home chassis equipped with a hydraulic brake system.

There are two systems available, C and D version hydraulic ABS. D version ECUs are available in both cab- and frame-mounted versions. **Figure 1.1.**



Maintenance Manual Information

This manual contains service information for the Meritor WABCO **D version** cab- and frame-mounted hydraulic ABS. If you are servicing a **C version** hydraulic ABS, you will need Maintenance Manual 38.

To determine which version hydraulic ABS is installed on the vehicle you are servicing, please refer to the ECU Identification portion of this manual. If you are not able to identify the version, or to request service literature, please contact the Meritor Customer Service Support Center at 800-535-5560.

How Hydraulic ABS Works

ABS wheel sensors detect wheel speeds. The sensors generate signals that are transmitted to an Electronic Control Unit (ECU). If the wheels start to lock, the ECU signals the modulator assembly to regulate the brake pressure of each locking wheel.

During an ABS stop, a solenoid valve in the modulator assembly is rapidly pulsed; that is, it opens and closes several times per second to control the brake pressure. When this occurs, drivers may notice a pulsation of the brake pedal.

An ABS indicator lamp on the vehicle dash alerts the driver to a possible system fault and provides blink code information to diagnose the system.

If the ABS indicator lamp comes on during normal vehicle operation, drivers may complete their trip, but are instructed to have their vehicles serviced as soon as possible.

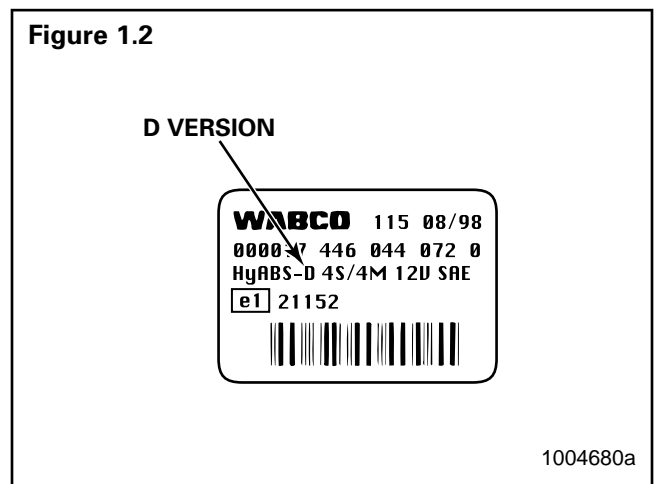
In the unlikely event of an ABS system malfunction, the ABS in the affected wheel will be disabled and will return to normal braking. The other sensed wheels will retain their ABS function.

ECU Identification

NOTE: Do not open the ECU. Opening the ECU to gain access to the internal components will void the warranty.

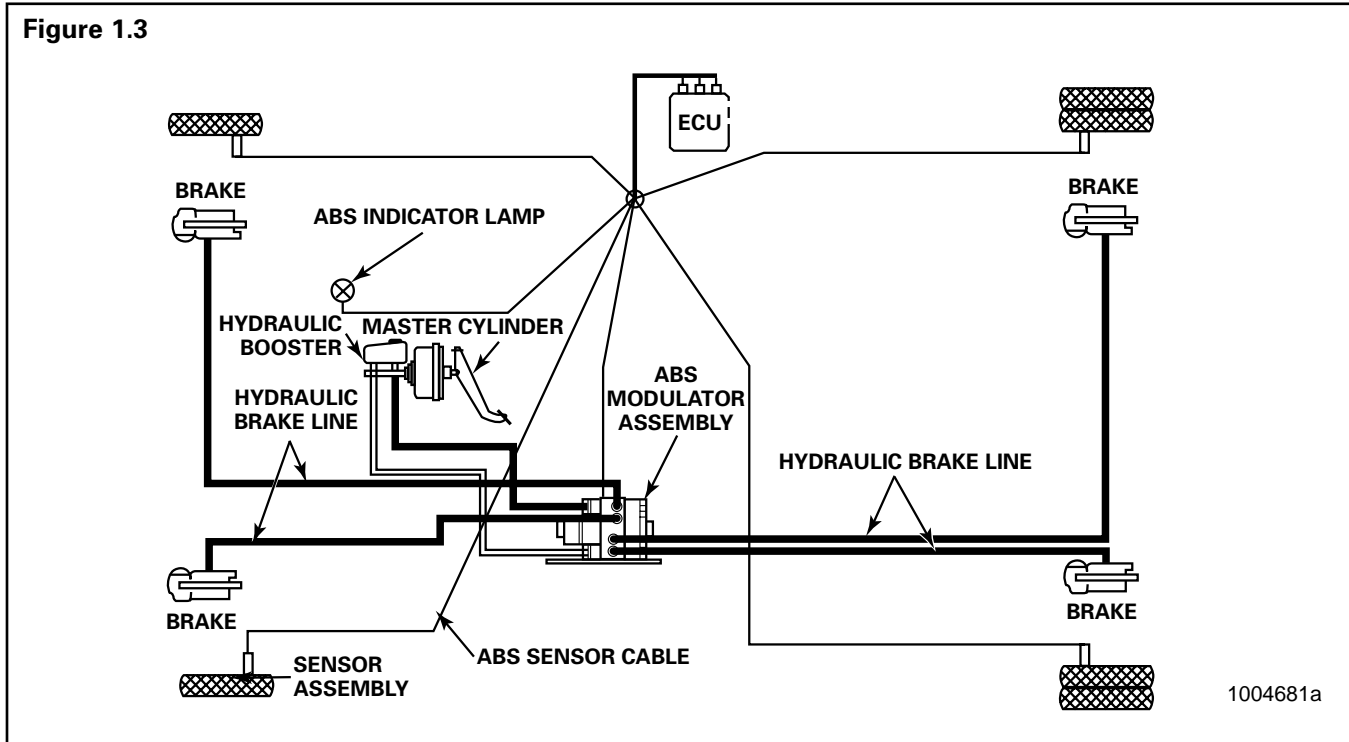
It's easy to determine the hydraulic ABS version installed on the vehicle by looking at the ECU. C version system ECUs are larger than D version ECUs. (Refer to **Figure 1.1.**)

If the ECU is easily visible, look at the part number identification tag. D version ECUs will have a D designation printed on the tag. There is no letter designation on C version ECUs. **Figure 1.2.**

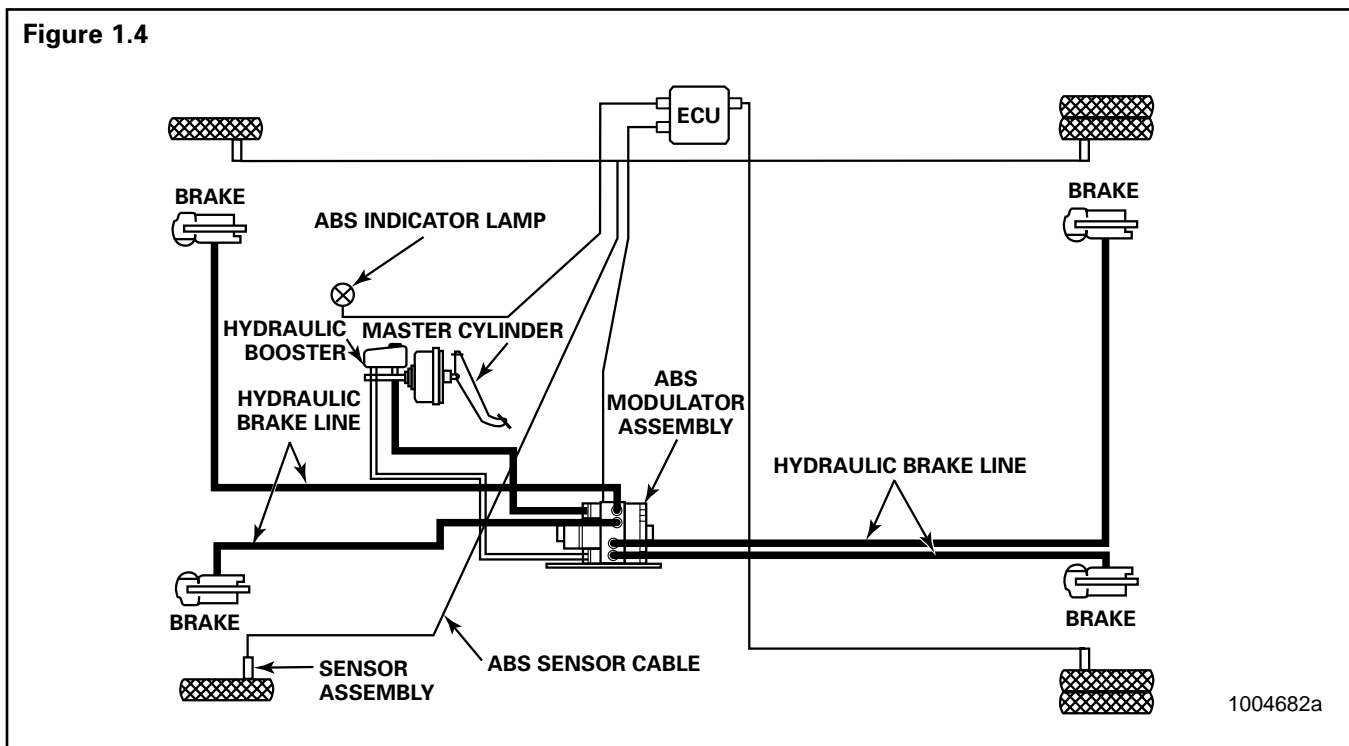


System Layout

A typical Meritor WABCO Hydraulic ABS with cab-mounted ECU is illustrated below. **Figure 1.3.**



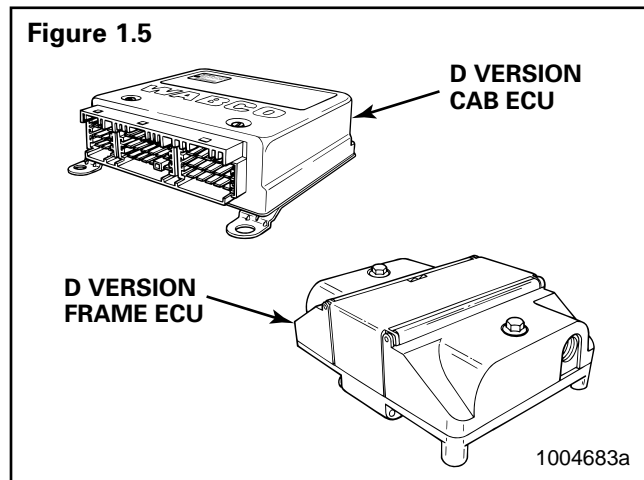
A typical Meritor WABCO Hydraulic ABS with frame-mounted ECU is illustrated below. **Figure 1.4.**



System Components

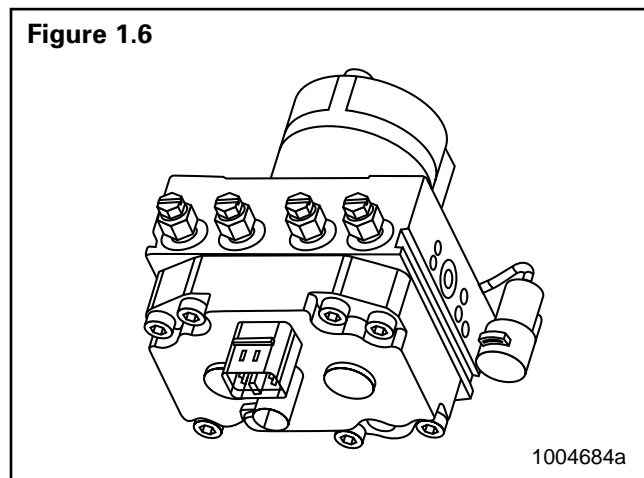
The following components make up the Meritor WABCO Hydraulic ABS.

Electronic Control Unit (ECU)



- Processes sensor signals and generates solenoid valve commands to reduce, maintain or reapply brake pressure.
- Mounting locations vary, depending upon the vehicle. Refer to the vehicle specifications for the exact location. Cab- and frame-mounted versions available.

Modulator Assembly

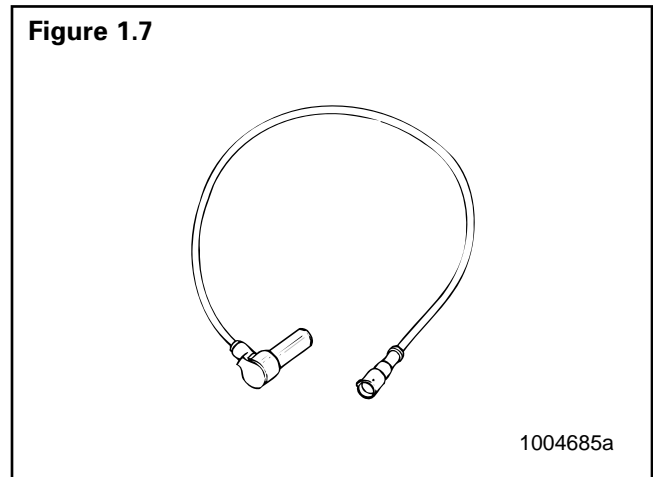


- Houses the ABS solenoid control valves (one inlet valve and one outlet valve per wheel), a pump motor and two accumulators.

- Contains brake fluid and must be handled with appropriate care. It should not be exposed to impact loads, excessive vibrations or compressed air blown into the hydraulic ports.

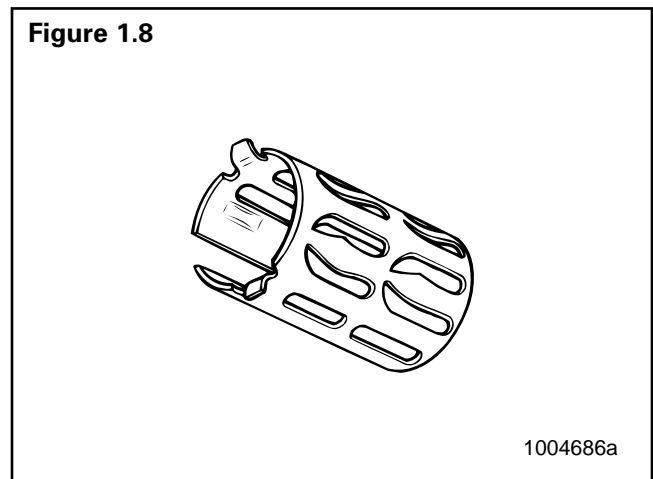
Sensors

Sensor with Molded Socket



- Measures the speed of a tooth wheel rotating with the vehicle wheel.
- Produces an output voltage proportional to wheel speed.

Sensor Spring Clip

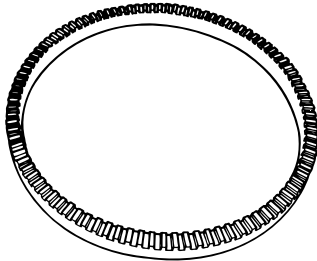


- Holds the wheel speed sensor in close proximity to the tooth wheel.

Section 1 Introduction

Tooth Wheel

Figure 1.9

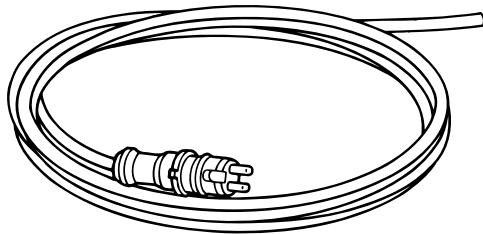


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- A machined or stamped ring mounted to a machined surface on the hub of each ABS-monitored wheel.

Sensor Extension Cables

Figure 1.10

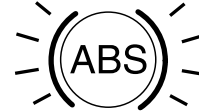


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- Two-wire cable with molded-on connector.
- Connects the wheel speed sensor to the ECU.

ABS Indicator Lamp

Figure 1.11



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- Located on vehicle dash.
- Alerts drivers to a possible system fault.
- Used by service personnel to display blink codes.
- ABS indicator lamp is not provided by Meritor WABCO.

Figure 1.12



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- A PC-based diagnostics program.
- Displays system faults and wheel speed data, tests individual components, verifies installation wiring and more.
- Runs in Windows® 95, 98 or NT.
- To order, call 800-535-5560.

NOTE: An RS232 to J1708 converter box is required.

General Maintenance Information

There is no regularly scheduled maintenance required for Meritor WABCO D Version Hydraulic ABS. However, ABS does not change current vehicle maintenance requirements. For example, it is important that the vehicle brake fluid level be properly maintained.

System Wiring Information

NOTE: Refer to **Table A** for ECU pin identification.

Wiring may vary, according to the vehicle. Refer to the vehicle specifications for specific wiring diagrams. A typical Meritor WABCO 4S/4M Hydraulic ABS wiring diagram appears in **Figure 2.1**.

Table A: Wiring Refer to Appendix A for Modulator Assembly Connector Pin Assignments

CAB

Pin Numbers and Locations (Cab-Mounted ECU)

9-Pin ECU Connector

Pin Number	Circuit Description
1	Left Front Sensor
2	Left Front Sensor
3	Right Rear Sensor
4	Right Front Sensor
5	Right Front Sensor
6	Right Rear Sensor
7	Left Rear Sensor
8	Left Rear Sensor
9	Not Used

18-Pin ECU Connector

Pin Number	Circuit Description
1	+12 Battery
2	+12 Ignition
3	Not Used
4	Not Used
5	SAE J1587 (-)
6	SAE J1587 (+)
7	Not Used
8	Motor Monitor
9	Not Used
10	Not Used
11	Not Used
12	Ground
13	Not Used
14	Not Used
15	Jumper
16	Not Used
17	Not Used
18	ABS Indicator Lamp and Blink Code Switch

15-Pin ECU Connector

Pin Number	Circuit Description
1	Left Front Outlet Valve
2	Left Front Inlet Valve
3	Ground
4	Right Front Outlet Valve
5	Right Front Inlet Valve
6	Not Used
7	Left Rear Outlet Valve
8	Left Rear Inlet Valve
9	Not Used
10	Right Rear Outlet Valve
11	Right Rear Inlet Valve
12	Retarder Relay
13	Not Used
14	Not Used
15	Pump Relay

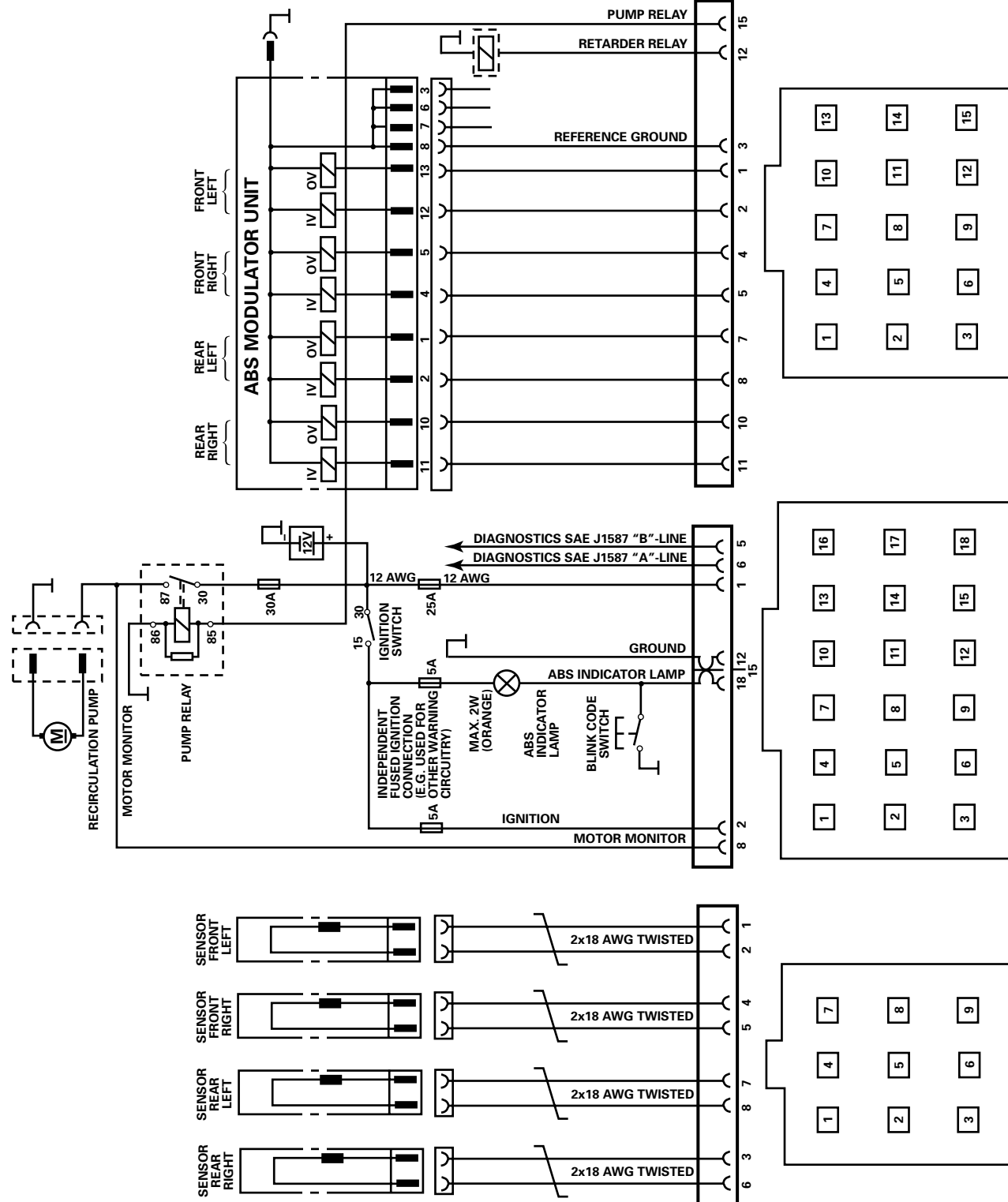
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Section 2 Troubleshooting and Testing

Figure 2.1

CAB

**4S/4M D Version Hydraulic ABS Wiring Diagram
(Cab-Mounted ECU)**



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Table B: Wiring Refer to Appendix A for Modulator Assembly Connector Pin Assignments

FRAME

Pin Numbers and Locations (Frame-Mounted ECU)

Black X-2 Connector

Pin Number	Circuit Description
1	SAE J1587 (-)
2	+12 Ignition
3	+12 Battery
4	Warning Lamp Relay
5	X
6	Pump Relay
7	Retarder Relay
8	ABS Indicator Lamp and Blink Code Switch
9	Ground
10	Motor Monitor
11	+12 Battery
12	SAE J1587 (+)

Gray X-1 Connector

Pin Number	Circuit Description
1	X
2	Ground
3	Left Front Inlet Valve
4	Right Front Inlet Valve
5	Left Rear Inlet Valve
6	Right Rear Inlet Valve
7	Right Rear Outlet Valve
8	Left Rear Outlet Valve
9	Right Front Outlet Valve
10	Left Front Outlet Valve
11	X
12	X

Green X-3 Connector

Pin Number	Circuit Description
1	X
2	X
3	Left Rear Sensor
4	Right Front Sensor
5	Left Front Sensor
6	Right Rear Sensor
7	Right Rear Sensor
8	Left Front Sensor
9	Right Front Sensor
10	Left Rear Sensor
11	X
12	X

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System Diagnostics

Use Meritor WABCO’s PC-based diagnostic program, TOOLBOX Software, or standard blink codes to diagnose hydraulic ABS faults. Information for using standard blink codes appears on page 11 of this manual.

**Meritor WABCO
TOOLBOX Software**

NOTE: For complete instructions for using this program, refer to the User’s Manual, TP-99102. Contact Meritor WABCO at 800-535-5560 for information about TOOLBOX Software.

If you have TOOLBOX Software installed on your computer, use it to identify system faults. Then, follow the on-screen repair information to make the necessary repairs or replacements.

To display D version Hydraulic ABS faults, use the pull-down menu or the HABS icon **Figure 2.3** to select HABS (Hydraulic ABS) from the **Main Menu**. The **Hydraulic ABS Main Menu** will appear. **Figure 2.4.**

Select the View ECU Faults icon or select Display Faults to use the pull-down menu. **Figure 2.5.** This will display the **Fault Information** screen. **Figure 2.6.**

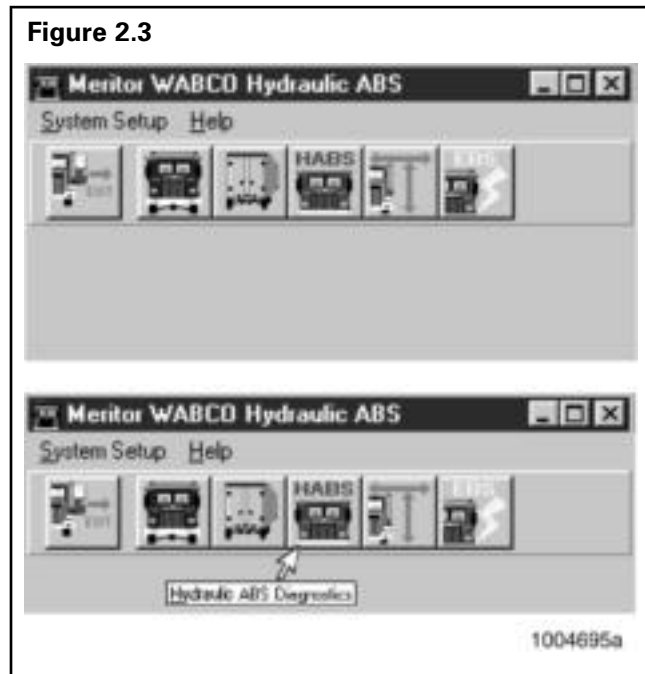


Figure 2.4

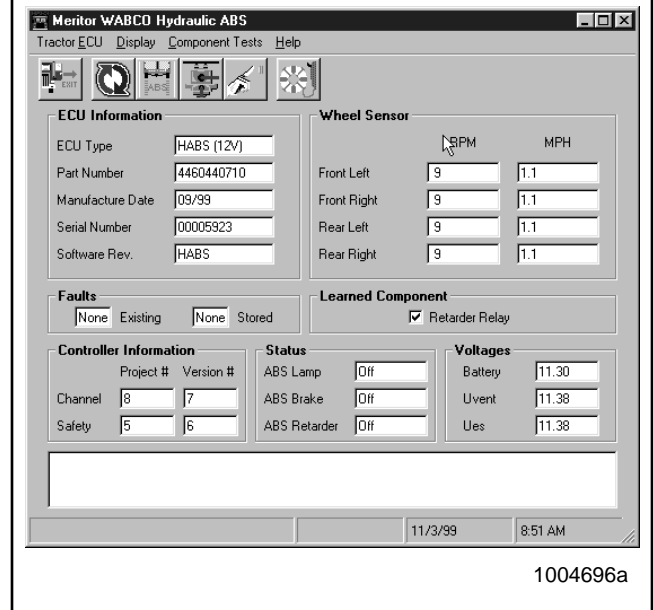


Figure 2.5

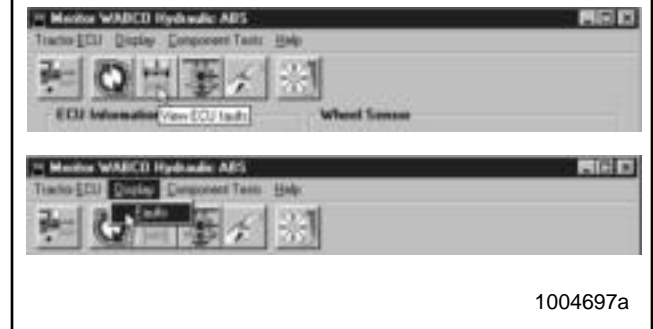
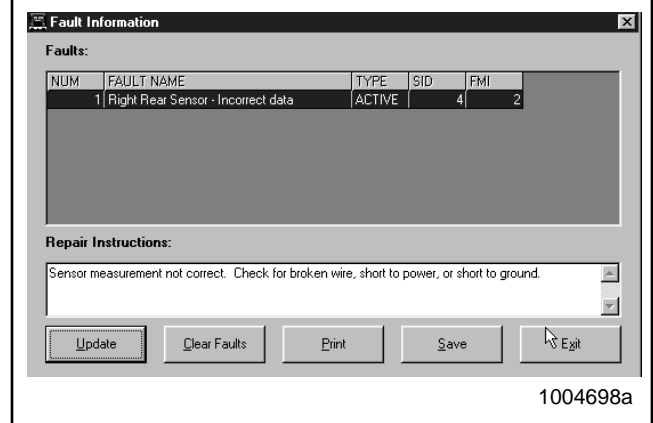


Figure 2.6



Section 2

Troubleshooting and Testing

The **Fault Information Screen** contains a description of the fault. Repair instructions for each fault appear at the bottom of the screen.

Faults that occur after the screen is displayed will not appear until a screen update is requested. Use the UPDATE button to refresh the fault information table.

After making the necessary repairs, use the CLEAR FAULTS button to clear the fault. Use the update button to refresh the fault information table and display the new list of faults.

Blink Code Diagnostics

Definitions

ABS Indicator Lamp: This lamp, located on the vehicle dash, serves two purposes:

1. Alerts drivers or service personnel to a possible fault in the hydraulic ABS, as follows:

IF . . .the ABS indicator lamp comes on briefly then goes OFF when the ignition is turned ON there are no active or stored faults in the hydraulic ABS

IF . . .the ABS indicator lamp comes on and **stays on** AFTER the ignition is turned ON
and

The vehicle is driven in excess of 4 mph (6 km/h) . . .5 **There may be an active fault in the hydraulic ABS**

IF . . .ABS indicator lamp comes on and stays on
and

Goes OFF after the vehicle is driven in excess of 4 mph (6 km/h) . . .5 **There may be a stored fault in the hydraulic ABS**

2. Displays diagnostic blink codes for easy servicing.

Blink Code: A series of blinks or flashes that describe a particular ABS system condition. (Refer to **Table D** [cab-mounted] or **Table E** [frame-mounted] for blink code identification.)

****Blink Code Diagnostics:** The ability of the Meritor WABCO ECU to sense faults in the ABS system and to depne these faults via blink codes.

Blink Code Switch: A momentary switch that activates blink code diagnostic capabilities. Usually, it is mounted under the dash or on the steering column. Refer to the vehicle specifications for type and location.

Clearing Fault Codes: The process of erasing faults from the ECU memory bank. (Refer to **Table C.**)

Fault Code: An ABS condition (fault) detected and stored in memory by the Meritor WABCO ECU and displayed by blink code. System faults may be **Active** or **Stored**.

Active Fault: A condition that currently exists in the ABS system; for example, a sensor circuit malfunction on the left front steering axle. An active fault **must be repaired before you can display additional faults**. Once an active fault has been repaired, it becomes a stored fault.

Stored Fault: A condition that caused the system to register a fault, but **is not currently active**. For example, a loose wire that corrected itself. A stored fault can also be an active fault that has been corrected (refer to Active Fault).

Table C describes the method of distinguishing between active and stored faults and explains how to clear them.

** NOTE:

The Tech 2 cannot access the Meritor Wabco® ABS module. Diagnosis can be accomplished using the Toolbox® software connected to a PC using the appropriate adapters and cables.

Diagnostic “blink codes” can be retrieved using the procedure described on the following pages of this section. Workhorse chassis are not equipped with a Blink Code switch. To access the fault codes perform the following steps:

- Locate Pin 8 of the Black X-2 Connector at the ABS ECU
- Backprobe the circuit at the connector with a jumper wire
- Ground the other end of the jumper wire for 1 second and then remove
- The ABS should begin to flash the stored code(s) in memory

Using Blink Code Diagnostics

Follow the steps listed in **Table C** to use blink code diagnostics. Refer to **Figure 2.7** for blink code illustrations.

Table C: Identifying D-Version Hydraulic ABS Blink Codes

Troubleshooting with Blink Code Diagnostics			
Mode	Procedure	System Response	Action
DIAGNOSTIC	Step I. Turn Ignition ON.	Possible responses: 1. ABS indicator lamp comes on momentarily then goes out, indicating System O.K. 2. ABS indicator lamp does not light, indicating possible wiring fault or burned-out bulb. 3. ABS indicator lamp stays on, indicating: <ul style="list-style-type: none"> • Fault, or faults, in the system. • Sensor fault during last operation. • Faults cleared from ECU, but vehicle not driven. • ECU disconnected. 	No recognizable active faults in the ABS. No action required. Inspect wiring. Inspect bulb. Make necessary repairs. Continue with blink code diagnostics. (Go to Step II.) Continue with blink code diagnostics. (Go to Step II.) Drive vehicle — lamp will go out when vehicle reaches 4 mph (6 km/h). Connect ECU.
	Step II. Press and hold Blink Code Switch for one second, then release.	ABS indicator lamp begins flashing two-digit blink code(s).	Determine if fault is active or stored: Active Fault: Lamp will repeatedly display one code. Stored Fault: Lamp will display code for each stored fault then stop blinking. Faults will be displayed one time only .
	Step III. Count the flashes to determine the blink code.	First Digit: 1 - 8 flashes, Pause (1-1/2 seconds). Second Digit: 1 - 8 flashes, Pause (4 seconds).	Find definition for blink code on blink code chart.
	Step IV. Turn Ignition OFF. Repair and Record faults.	Active Fault. Stored Faults.	Make the necessary repairs. Record for future reference.
	Step V. Turn Ignition ON. Clear Faults from memory: Press and hold blink code switch for at least three seconds, then release.	ABS Indicator Lamp flashes eight times. Eight flashes not received.	All stored faults successfully cleared. Turn ignition OFF. Turn ignition ON. The indicator lamp will stay on. This is because the ECU is looking for wheel speed. Drive the vehicle at a speed of 4 mph (6 km/h). Once the ECU senses wheel speed, the lamp will go off. Active faults still exist, repeat Steps I through V.
CLEAR			

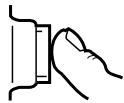
* If you receive a blink code that is not identified in **Table D** or **Table E**, contact the Customer Support Center at 800-535-5560.

Section 2 Troubleshooting and Testing

Using Blink Code Diagnostics, Continued

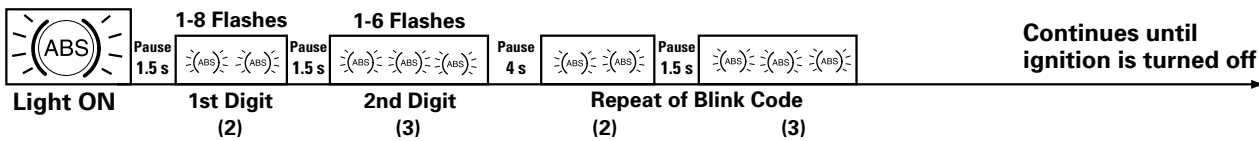
Blink Codes Illustrated

Figure 2.7

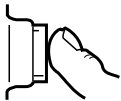


1 Second Hold

Active Fault

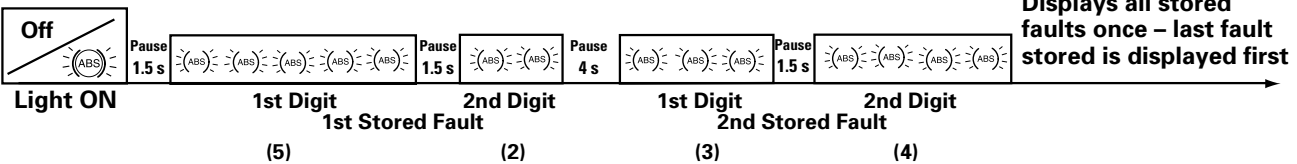


Blink Code 2-3: Fault in ABS modulator valve, right rear drive axle.



1 Second Hold

Stored Faults



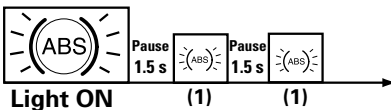
Blink Code 5-2: Sensor signal erratic, left front steer axle.

3-4: Too much sensor gap, left rear drive axle.



1 Second Hold

System O.K.

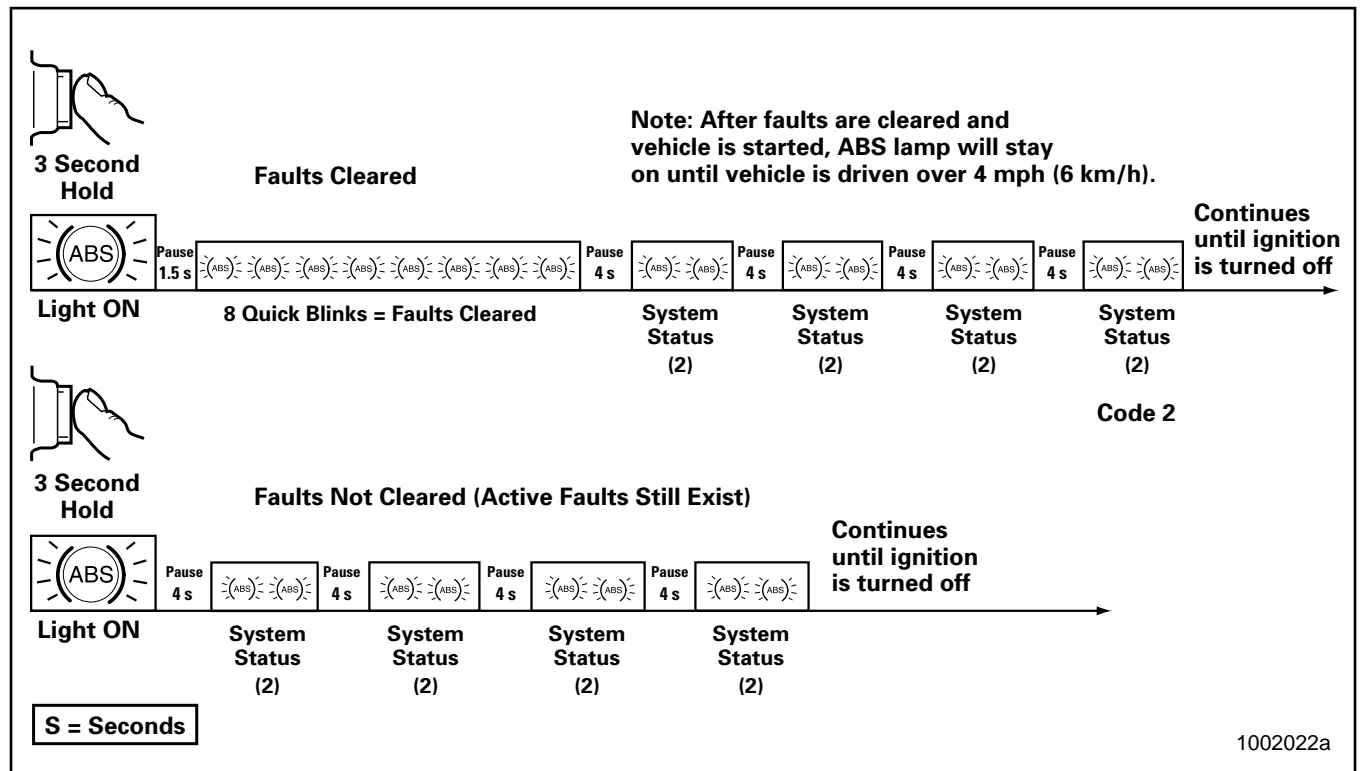


Blink Code 1-1: System OK

S = Seconds

1002021b

Using Blink Code Diagnostics, Continued



1002022a

Section 2

Troubleshooting and Testing

Using Blink Code Diagnostics, Continued

Use the information in **Table D, D Version Hydraulic ABS Blink Codes (Cab-Mounted ECU)** or **Table E, D Version Hydraulic ABS Blink Codes (Frame-Mounted ECU)**, to identify a fault, check for proper volt or ohm measurements and repair the fault.

1. Identify and record the blink code. Blink codes are identified in Columns 1 and 2.
2. Test the pins indicated. Pin locations to be tested are listed in Column 3.
3. Compare the measurement received against the correct volt or ohm measurement listed in Column 4.
4. Follow the instructions listed in Column 5.

Table D: D Version Hydraulic ABS Blink Codes (Cab-Mounted ECU)

Ignition Key ON to determine ABS blink code fault		Ignition Key OFF to test system (except where noted)			
1	2	3	4	5	
Fault Code	Problem Area	Connector	Pins to be Tested	Correct Volt Ohm Meter Readings	Action
1-1	System OK				None required
2-1	Right Front Solenoid valve (inlet or outlet valve) failure in modulator, wiring harness or inside ECU	15-pin	IV 5 and 3 OV 4 and 3	Inlet valve: 6.5 ± 0.5 ohms Outlet valve: 3.5 ± 0.5 ohms	Check electrical resistance of affected valve wiring to ground at ECU vehicle connector and at modulator plug. Check voltages at wiring harness and connectors. Voltage of ground connector should be approximately 0 volts. Make necessary repairs.
2-2	Left Front Solenoid valve (inlet or outlet valve) failure in modulator, wiring harness or inside ECU	15-pin	IV 2 and 3 OV 1 and 3		
2-3	Right Rear Solenoid valve (inlet or outlet valve) failure in modulator, wiring harness or inside ECU	15-pin	IV 11 and 3 OV 10 and 3		
2-4	Left Rear Solenoid valve (inlet or outlet valve) failure in modulator, wiring harness or inside ECU	15-pin	IV 8 and 3 OV 7 and 3		
2-7	Reference to ground interrupted	15-pin	3 to chassis ground	0 ohms	Check ABS ground connections. Make necessary repairs.

IV = Inlet Valve
OV = Outlet Valve

Using Blink Code Diagnostics, Continued

Table D: D Version Hydraulic ABS Blink Codes (Cab-Mounted ECU), Continued

Ignition Key ON to determine ABS blink code fault		Ignition Key OFF to test system (except where noted)			CAB
1	2	3	4	5	
Fault Code	Problem Area	Connector	Pins to be Tested	Correct Volt Ohm Meter Readings	Action
3-1	Right Front sensor — Air gap	9-pin	4 and 5	Greater than .2 volts AC at 30 RPM <i>(Rotate wheel 1/2 revolution per second)</i>	Check for sensor adjustment. Check for excessive wheel bearing endplay. Repair or replace as needed.
3-2	Left Front sensor — Air gap	9-pin	1 and 2		
3-3	Right Rear sensor — Air gap	9-pin	3 and 6		
3-4	Left Rear sensor — Air gap	9-pin	7 and 8		
4-1	Right Front sensor — Electrical fault	9-pin	4 and 5	900-2000 ohms	Check electrical resistance of affected sensor and wiring at ECU connector and at harness plugs. Repair or replace as needed.
4-2	Left Front sensor — Electrical fault	9-pin	1 and 2		
4-3	Right Rear sensor — Electrical fault	9-pin	3 and 6		
4-4	Left Rear sensor — Electrical fault	9-pin	7 and 8		
5-1	Right Front wheel — Erratic wheel speed				Check for tire size mismatch or tooth wheel difference. Check sensor, sensor cable and connector for intermittent contact. Repair or replace as needed.
5-2	Left Front wheel — Erratic wheel speed				
5-3	Right Rear wheel — Erratic wheel speed				
5-4	Left Rear wheel — Erratic wheel speed				
7-3	Retarder Relay	15-pin	12 to chassis ground	50-200 ohms	Verify proper connections to relay. (Refer to wiring diagram.)
7-4	ABS warning lamp	18-pin	18 and 2	10-200 ohms	Check bulb. Repair or replace as needed.

Section 2

Troubleshooting and Testing

Using Blink Code Diagnostics, Continued

Table D: D Version Hydraulic ABS Blink Codes (Cab-Mounted ECU), Continued

Ignition Key ON to determine ABS blink code fault		Ignition Key OFF to test system (except where noted)			
1	2	3	4	5	
Fault Code	Problem Area	Connector	Pins to be Tested	Correct Volt Ohm Meter Readings	Action
7-7	Recirculation pump does not switch off. OR Recirculation pump does not switch on (low level with act). OR Recirculation pump motor locked.	15- and 18-pin	Link pin 15 on 15-pin connector and pin 1 on the 18-pin connector. Measure between pin 8 on the 18-pin connector and chassis ground. Do not hold for more than one minute.	12 volts if linked 0 volts if not linked	Check the recirculation pump wiring, the pump relay and fuse and pump connections. Repair or replace as needed. If pump does not run when pins are linked, replace modulator assembly.
7-8	Recirculation pump relay sticks.				
8-1	No voltage to ABS solenoid valves.	18-pin	1 and 12	12 volts DC	Check the valve relay, fuse and wiring. Repair or replace as needed.
8-2	Continuous supply to ECU with ignition off.				Check for proper wiring connections. Make necessary repairs. If problem persists, replace ECU.
8-3	Internal ECU Fault				Replace ECU.

Using Blink Code Diagnostics, Continued

Table E: D Version Hydraulic ABS Blink Codes (Frame-Mounted ECU)

Ignition Key ON to determine ABS blink code fault		Ignition Key OFF to test system (except where noted)			
1	2	3	4	5	
Fault Code	Problem Area	Connector	Pins to be Tested	Correct Volt Ohm Meter Readings	Action
1-1	System OK				None required
2-1	Right Front Solenoid valve (inlet or outlet valve) failure in modulator, wiring harness or inside ECU	Gray X-1	IV 4 and 2 OV 9 and 2	Inlet valve: 6.5 ± 0.5 ohms Outlet valve: 3.5 ± 0.5 ohms	Check electrical resistance of affected valve wiring to ground at ECU vehicle connector and at modulator plug. Check voltages at wiring harness and connectors. Voltage of ground connector should be approximately 0 volts. Make necessary repairs.
2-2	Left Front Solenoid valve (inlet or outlet valve) failure in modulator, wiring harness or inside ECU	Gray X-1	IV 3 and 2 OV 10 and 2		
2-3	Right Rear Solenoid valve (inlet or outlet valve) failure in modulator, wiring harness or inside ECU	Gray X-1	IV 6 and 2 OV 7 and 2		
2-4	Left Rear Solenoid valve (inlet or outlet valve) failure in modulator, wiring harness or inside ECU	Gray X-1	IV 5 and 2 OV 8 and 2		
2-7	Reference to ground interrupted	Gray X-1	2 to chassis ground		

IV = Inlet Valve
OV = Outlet Valve

Section 2

Troubleshooting and Testing

Using Blink Code Diagnostics, Continued

Table E: D Version Hydraulic ABS Blink Codes (Frame-Mounted ECU), Continued

Ignition Key ON to determine ABS blink code fault		Ignition Key OFF to test system (except where noted)			
1	2	3	4	5	
Fault Code	Problem Area	Connector	Pins to be Tested	Correct Volt Ohm Meter Readings	Action
3-1	Right Front sensor — Air gap	Green X-3	4 and 9	Greater than .2 volts AC at 30 RPM <i>(Rotate wheel 1/2 revolution per second)</i>	Check for sensor adjustment. Check for excessive wheel bearing endplay. Repair or replace as needed.
3-2	Left Front sensor — Air gap	Green X-3	5 and 8		
3-3	Right Rear sensor — Air gap	Green X-3	7 and 6		
3-4	Left Rear sensor — Air gap	Green X-3	3 and 10		
4-1	Right Front sensor — Electrical fault	Green X-3	4 and 9	900-2000 ohms	Check electrical resistance of affected sensor and wiring at ECU connector and at harness plugs. Repair or replace as needed.
4-2	Left Front sensor — Electrical fault	Green X-3	5 and 8		
4-3	Right Rear sensor — Electrical fault	Green X-3	7 and 6		
4-4	Left Rear sensor — Electrical fault	Green X-3	3 and 10		
5-1	Right Front wheel — Erratic wheel speed				Check for tire size mismatch or tooth wheel difference. Check sensor, sensor cable and connector for intermittent contact. Repair or replace as needed.
5-2	Left Front wheel — Erratic wheel speed				
5-3	Right Rear wheel — Erratic wheel speed				
5-4	Left Rear wheel — Erratic wheel speed				
7-3	Retarder Relay	Black X-2	7 to chassis ground	50-200 ohms	Verify proper connections to relay. (Refer to wiring diagram.)
7-4	ABS warning lamp	Black X-2	8 and 2	10-200 ohms	Check bulb. Repair or replace as needed.

Using Blink Code Diagnostics, Continued

Table E: D Version Hydraulic ABS Blink Codes (Frame-Mounted ECU), Continued

Ignition Key ON to determine ABS blink code fault		Ignition Key OFF to test system (except where noted)			
1	2	3	4	5	
Fault Code	Problem Area	Connector	Pins to be Tested	Correct Volt Ohm Meter Readings	Action
7-7	Recirculation pump does not switch off. OR Recirculation pump does not switch on (low level with act). OR Recirculation pump motor locked.	Black X-2	Link pins 6 and 3. Measure between pin 10 and chassis ground. Do not hold for more than one minute.	12 volts if linked 0 volts if not linked 12 volts DC Turn Ignition ON	Check the recirculation pump wiring, the pump relay and fuse and pump connections. Repair or replace as needed. If pump does not run when pins are linked, replace modulator assembly.
7-8	Recirculation pump relay sticks.				
8-1	No voltage to ABS solenoid valves.	Black X-2	3 and 9	12 volts DC	Check the valve relay, fuse and wiring. Repair or replace as needed.
8-2	Continuous supply to ECU with ignition off.				Check for proper wiring connections. Make necessary repairs. If problem persists, replace ECU.
8-3	Internal ECU Fault				Replace ECU.

Section 2 Troubleshooting and Testing

Testing the System

This section of the manual contains information for testing the hydraulic ABS with TOOLBOX Software, as well as procedures for conducting standard air and electrical tests.



WARNING

To prevent serious eye injury, always wear safe eye protection when you perform vehicle maintenance or service.

Exhaust gas contains poison. When testing a vehicle with the engine running, test in a well-ventilated area or route the exhaust hose outside.

To avoid serious personal injury, keep away, and keep test equipment away, from all moving or hot engine parts.

Refer to, and follow, the vehicle manufacturer's Warnings, Cautions and Service Procedures.

When testing, set the parking brake and place the gear selector in NEUTRAL (manual transmission) or PARK (automatic transmission) unless otherwise directed.

Meritor WABCO TOOLBOX Software

Use TOOLBOX Software to verify the activation of various system components:

Turn valves, pump and retarder relay on and off (Valve Activation Menu). Turn ABS indicator lamp on and off (Miscellaneous Output Activation Menu). Reset components in ECU memory.

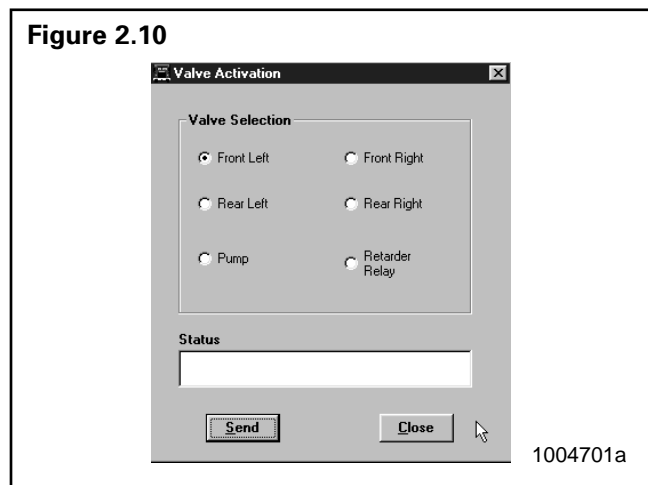
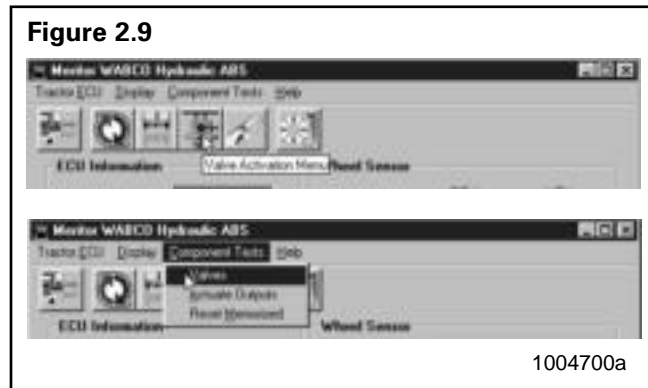
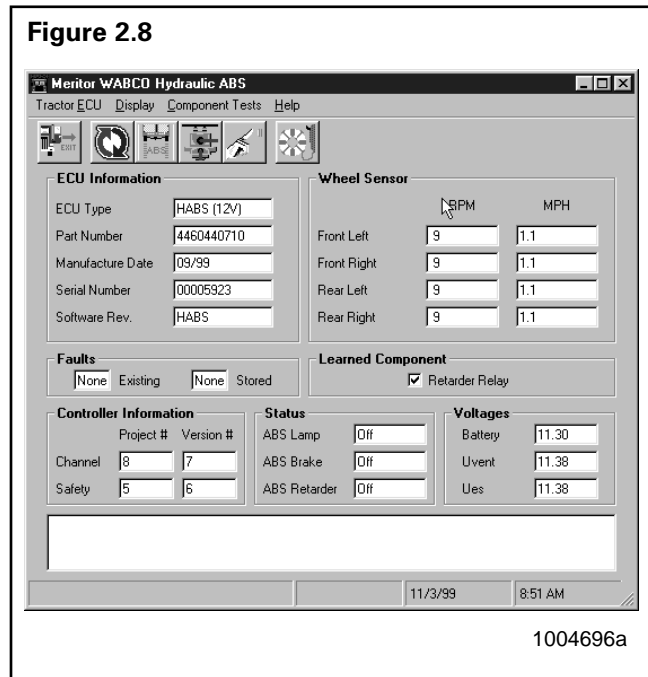
NOTE: For complete instructions for using this program, refer to the User's Manual, TP-99102. Contact Meritor WABCO at 800-535-5560 for information about TOOLBOX Software.

Valve, Pump and Retarder Relay Activation

To activate the ABS valves, pump or retarder relay, select HABS (Hydraulic ABS) from the **Main Menu**. The **Hydraulic ABS Main Menu** will appear.

Figure 2.8.

Select the Valve Activation icon or select Component Tests, then Valves to use the pull-down menu. **Figure 2.9.** This displays the **Valve Activation** screen. **Figure 2.10.**

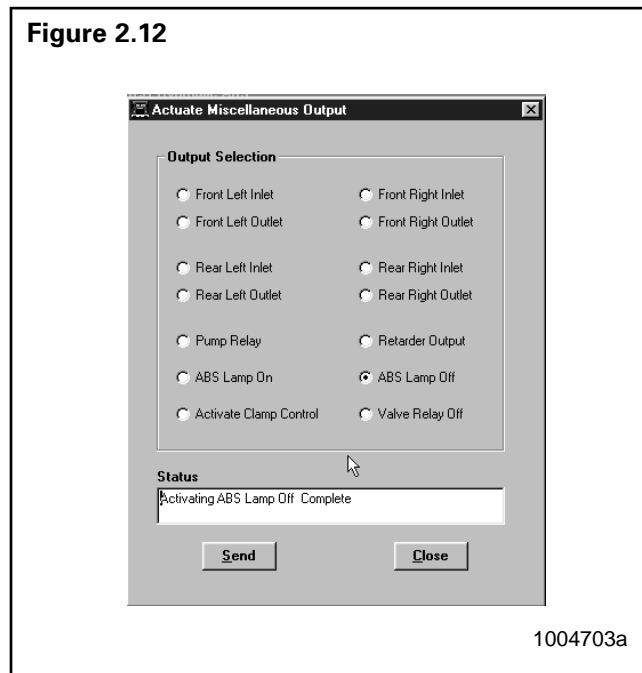
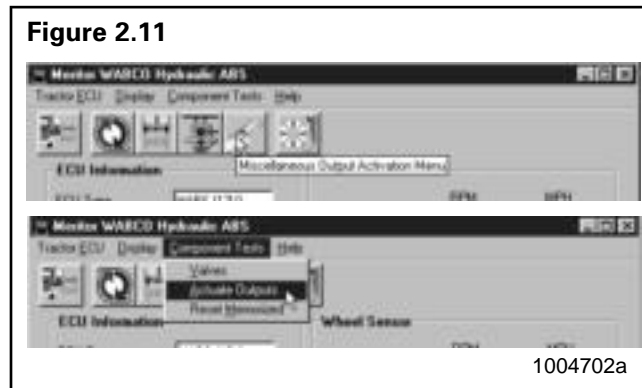


The **Valve Activation** screen lets you activate the four valves, the pump and the retarder relay. In addition to checking for proper activation, this screen provides an easy way to make sure the valves are wired properly — and that wiring is not reversed. Component activation status appears in the status box of this screen.

ABS Indicator Lamp Activation

To activate the ABS indicator lamp, select HABS (Hydraulic ABS) from the **Main Menu**. The **Hydraulic ABS Main Menu** will appear. **Figure 2.8**.

Select the Miscellaneous Output Activation icon or select Component Tests to use the pull-down menu **Figure 2.11** to display the **Actuate Miscellaneous Output** screen. **Figure 2.12**.



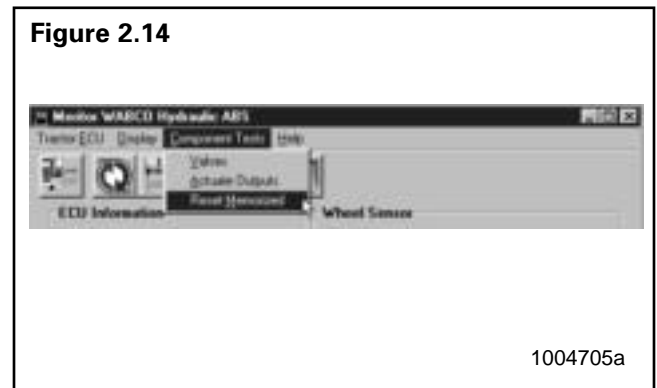
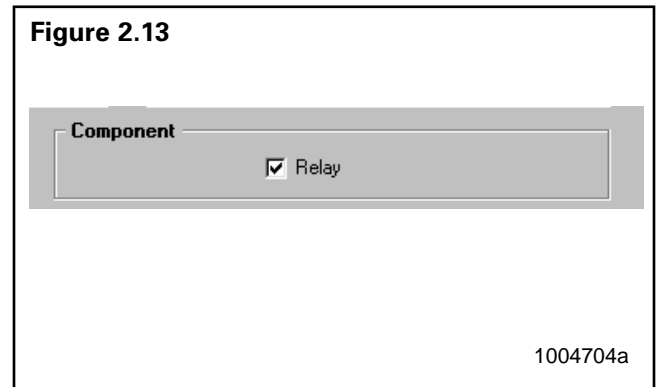
This screen provides a check of the ABS indicator lamp. In addition, it provides a way to check either inlet or outlet activity of the valves, pump or retarder relay. Component activation status appears in the status box of this screen.

Reset Memorized

This is an automatic default and cannot be de-selected. It indicates the ECU has memorized the installed retarder relay. Once the ECU has seen a retarder, it expects to see it every time the vehicle is powered up. **Figure 2.13**.

Because there are times when an ECU is moved to another vehicle — or during diagnostic testing — you may want the ECU to disregard this learned component. Use the **Reset Memorized** command for this purpose.

Select **Component Tests** from the **Hydraulic ABS Main Menu**. Then, select **Reset Memorized** from the pull-down menu to reset the **Learned Component** screen. **Figure 2.14**.



Standard Testing

Test Equipment: Volt-Ohm Meter (VOM)

Use of a VOM with automatic polarity sensing is recommended. This eliminates the concern of the polarity of the meter leads during voltage measurements.

System Requirements and Component Tests

Tire Size Range

For proper hydraulic ABS operation, front and rear tire sizes must be within 16% of each other.

Contact the Meritor WABCO Customer Support Center at 800-535-5560 if you plan a tire size difference greater than $\pm 8\%$.

Calculate the tire size with the following equation:

$$\% \text{ Difference} = \left\{ \frac{\text{RPM Steer}}{\text{RPM Drive}} \right\} - 1 \times 100$$

RPM = tire revolutions per mile

CAUTION

When troubleshooting or testing the ABS system, do not damage the connector terminals.

Voltage Check

Voltage must be between 9.5 and 14 volts for the 12-volt hydraulic ABS to function properly.

Check voltage as follows:

1. Turn ignition ON.
2. Check for proper voltage:

Cab-mounted ECU: Pins 12 and 1 and 12 and 2 on the 18-pin connector.

Frame-mounted ECU: Pins 9 and 3 and 9 and 2 on the black connector.

If voltage is not between 9.5 and 14 volts, verify proper wiring connections. Make corrections as required.

Standard Component Testing

ABS Indicator Lamp

If the ABS indicator lamp does not come on after the ignition is turned on, or it comes on but does not go out after three seconds, check all ABS fuses or circuit breakers and replace if necessary. Check the wiring to the ABS diagnostic switch and the indicator lamp and repair or replace the wiring as required. When checking the indicator lamp, follow these steps:

1. Check voltage potential at the lamp socket.
2. Check continuity of the wires to the socket.
3. Replace the bulb.

NOTE: A complete wiring diagram for 4S/4M D-version hydraulic ABS appears in **Figure 2.1**.

ABS Blink Code Switch

When testing the ABS Diagnostic switch:

1. Check the resistance between the terminals while cycling the switch. A lack of resistance is an indication of a faulty switch.
2. Check the continuity of the wires to the switch:

Cab-mounted ECU: Pins 18 and 12 on the 18-pin connector.

Frame-mounted ECU: Pins 8 and 9 on the black connector.

Sensor Adjustment

On steering axles, the sensor is typically accessible on the in-board side of the steering knuckle.

On drive axles, the sensor is typically accessible on the in-board side of the rear axle spindle.

To adjust the sensor, push the sensor in until it contacts the tooth wheel:

- Do not pry or push sensors with sharp objects
- Sensors will self-adjust during wheel rotation.

NOTE: No gap is allowable at installation. During normal operation a gap not to exceed 0.04-inch is allowable.

Sensor Output Voltage Test

Sensor output voltage must be at least 0.2 volts AC at 30 rpm. Test the sensor output voltage as follows:

1. Turn ignition OFF.
2. Disconnect the ECU. To measure voltage at the pins on the ECU connector, disconnect the sensor from the sensor extension cable.

**WARNING**

Block the wheels to prevent the vehicle from moving. Support the vehicle with safety stands. Do not work under a vehicle supported only by jacks. Jacks can slip and fall over. Serious personal injury can result.

3. Put blocks under the front and rear tires to stop the vehicle from moving.
4. Raise the vehicle off the ground. Put safety stands under the axle.
5. Rotate wheel by hand at 30 rpm (1/2 revolution per second).
6. Measure the voltage at the pins indicated in **Table F**.

To measure resistance at the sensor connector, disconnect the sensor from the sensor extension cable.

3. Measure output at the pins indicated in **Table F**, Sensor Check Pins.

If measurement is not between 900 and 2000 ohms, replace the sensor.

Table F: Sensor Check Pins

Sensor	Cab-Mounted	Frame-Mounted
	Pins (9-Pin Connector)	Green Connector
Left Front	1 and 2	5 and 8
Right Front	4 and 5	4 and 9
Left Rear	7 and 8	3 and 10
Right Rear	3 and 6	7 and 6

Sensor Resistance

The sensor circuit resistance must be between 900 and 2000 ohms. Measure resistance at the sensor connector, or at the pins on the ECU connector, as follows:

1. Turn ignition OFF.
2. To measure resistance at the pins on ECU connector, disconnect the ECU connector from the ECU.

Component Removal and Installation

Sensors

Sensor Lube Specification

Meritor WABCO specifications call for a sensor lubricant with the following characteristics:

Lube must be mineral oil-based and contain molydisulfide. It should have excellent anti-corrosion and adhesion characteristics and be capable of continuous function in a temperature range of -40° to 300°F (-40° to 150°C).

Wheel Speed Sensor Replacement — Front Axle

Removal



WARNING

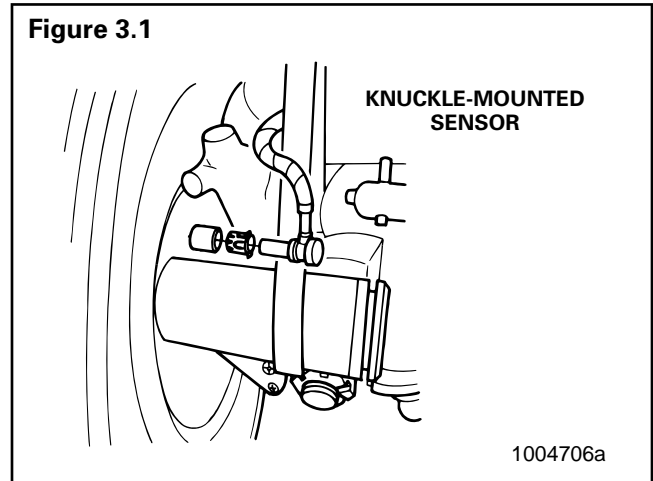
To prevent serious eye injury, always wear safe eye protection when you perform vehicle maintenance or service.

Block the wheels to prevent the vehicle from moving. Support the vehicle with safety stands. Do not work under a vehicle supported only by jacks. Jacks can slip and fall over. Serious personal injury can result.

To avoid damage to the electrical system or ABS components, when welding on an ABS-equipped vehicle disconnect the power connector from the ECU.

1. Apply the parking brakes. Chock the rear tires to prevent vehicle movement.
If necessary, raise the front tires off the ground. Put safety stands under the axle.
2. Disconnect the fasteners that hold the sensor cable to other components.
3. Disconnect the sensor cable from the chassis harness.

4. Remove the sensor from the sensor holder. Twist and pull the sensor to remove it from the sensor bracket. **Do not pull on the cable.**
Figure 3.1.



Installation

1. Connect the sensor cable to the chassis harness.
2. Install the fasteners used to hold the sensor cable in place.
3. Apply a Meritor WABCO-recommended lubricant to the sensor spring clip and sensor.
4. Install the sensor spring clip. Make sure the spring clip tabs are on the inboard side of the vehicle.
5. With the tabs on the inboard side, push the sensor spring clip into the bushing in the steering knuckle until the clip stops.
6. Push the sensor completely into the sensor spring clip until it contacts the tooth wheel.
7. Fasten the sensor cable with tie wraps every 12 inches. Properly bundle and store excess cable in the sub frame. **Figure 3.2.**
8. Remove the blocks and safety stands.
9. Perform a voltage output check to ensure proper installation. Refer to "Sensor Output Voltage Test" in Section 2.

Section 3

Component Replacement

Wheel Speed Sensor Replacement — Rear Axle

Removal

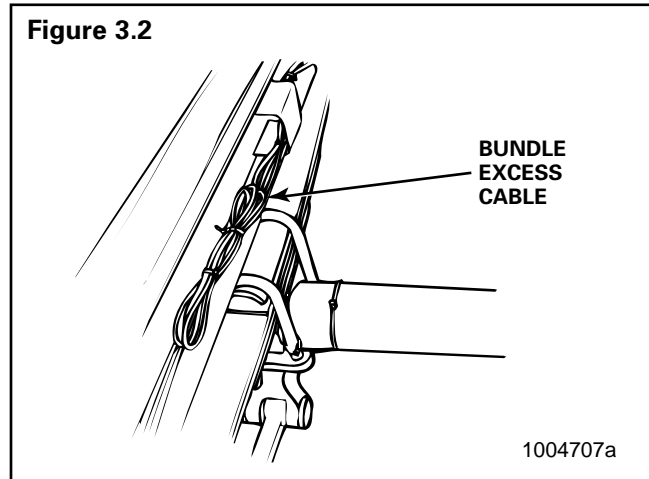
1. Apply the parking brake. Chock the front tires to prevent vehicle movement.
2. Raise the rear tires off of the ground. Put safety stands under the axle.
3. If the rear tire must be removed to gain access to the sensor, release the parking brake to release the brake shoe.

Remove the wheel and tire assembly from the axle.

4. Remove the sensor from the mounting block in the axle housing. Use a twisting motion if necessary. **Do not pull on the cable.**
5. Disconnect the sensor cable from the chassis harness.
6. Remove the sensor cable from any cable clamps or clips.
7. Remove the sensor spring clip from the sensor bracket.

Installation

1. Connect the new sensor cable to the chassis harness.
2. Press the sensor spring clip into the sensor bracket, located on the rear axle, until it stops. Make sure the tabs are on the inboard side.
3. Apply a Meritor WABCO-recommended lubricant to the sensor.
4. Push the sensor completely into the spring clip until it contacts the tooth wheel.
5. Reattach the sensor cable to the cable clamps or clips.
6. Fasten the sensor cable with tie wraps every 12 inches. Properly bundle and store excess cable in the sub frame. **Figure 3.2.**



7. Replace the tire, remove the safety stands, lower the vehicle and remove the chocks from the front tires.
8. Perform a voltage output check to ensure proper installation. Refer to "Sensor Output Voltage Test" in Section 2.

Modulator Assembly

Modulator Assembly Removal

⚠ CAUTION

The modulator assembly contains hydraulic brake fluid, a caustic substance. Remove the valve carefully so that fluid does not leak and cause skin irritation or damage to components.

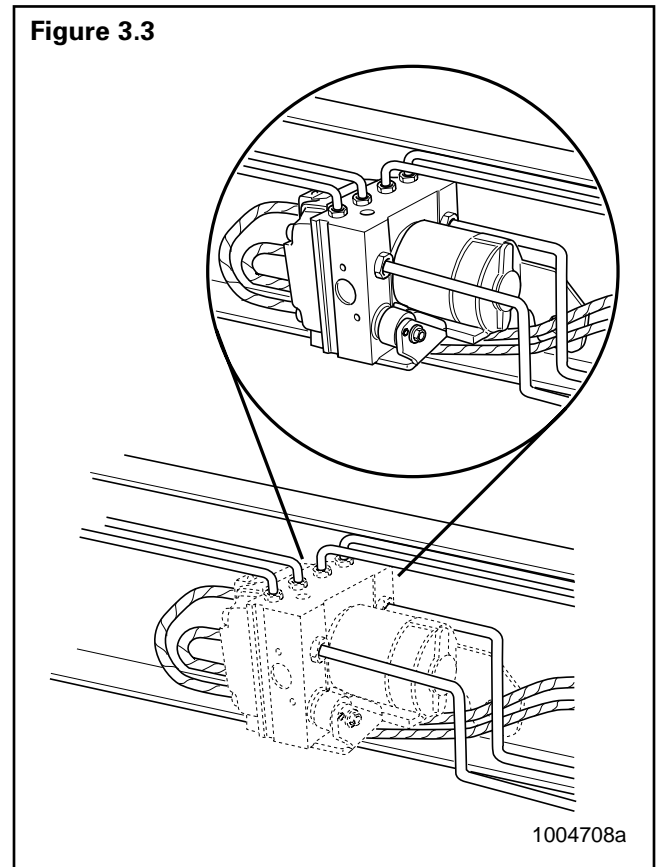
1. Apply the parking brakes. Chock the front and rear tires to prevent vehicle movement.
2. Place a container under the modulator assembly to catch leaking brake fluid.
3. Disconnect the electrical harness connectors from the modulator assembly.
4. Mark the six brake lines for ease of installation. Disconnect the lines from the modulator assembly.
5. Remove the three mounting capscrews, washers and nuts that attach the modulator assembly and bracket assembly to vehicle.

NOTE: Whenever any hydraulic system fitting is loosened or disconnected, the entire system must be bled to remove any air that may have entered.

6. Remove the modulator assembly and bracket.

Modulator Assembly Installation

1. Position the modulator assembly and bracket in place on the vehicle. **Figure 3.3.**



2. Tighten the three mounting nuts to 132 lb-in (15 N•m). **T**
3. Connect and tighten brake line connections as follows:
 - Two small (M10X1) adapters: 108 lb-in (12 N•m). **T**
 - Four large (M12X1) adapters: 132 lb-in (15 N•m). **T**
4. Bleed the brake system, per the following instructions.
5. Connect the electrical harnesses to the modulator assembly.

Section 3

Component Replacement

Brake Bleeding Procedures

General

The following brake bleeding methods explain how to bleed the hydraulic ABS modulator assembly during installation, or in the event of air in the brake system. There are instructions for both pressure and manual bleeding procedures.

These instructions include the procedure for bleeding both the master cylinder and the brake system. In some cases, for example, if you are replacing only the modulator assembly, it may not be necessary to bleed the master cylinder. If you have any questions, please contact the Meritor Service Center at 800-535-5560.

NOTE: The modulator assembly must be handled with appropriate care and should not be exposed to excessive impact or compressed air at the hydraulic ports prior to assembly.

WARNING

Failure to bleed the system whenever any hydraulic system fitting is loosened or disconnected will allow air to remain in the system. This will prevent the hydraulic pressure in the brake system from rising enough to apply the brakes properly. This will cause the stopping distance to increase and can result in serious personal injury.

Properly discard hydraulic brake fluid that is removed from the brake system. Hydraulic brake fluid that is removed can be contaminated and can cause damage, loss of braking and serious personal injury.

Use only the type of hydraulic brake fluid specified by the equipment manufacturer. Do not use or mix different types of hydraulic brake fluid. The wrong hydraulic brake fluid will damage the rubber parts of the brake caliper and can cause damage, loss of braking and serious personal injury.

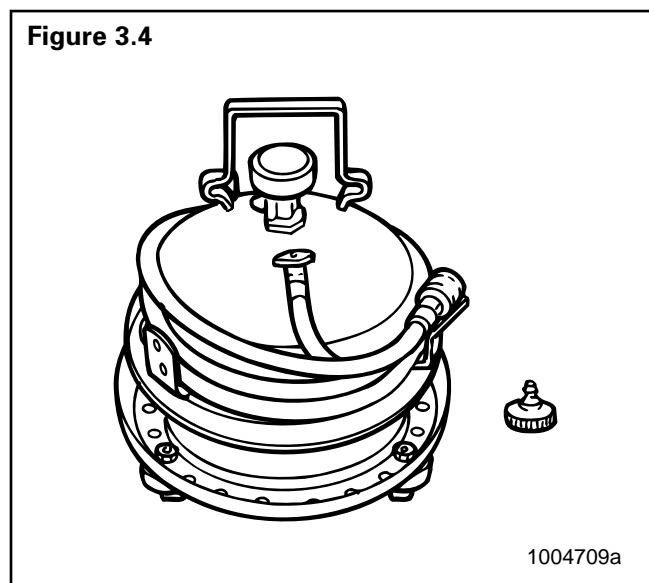
NOTE: Use DOT 3 or DOT 4 hydraulic brake fluid. Refer to the vehicle specifications to determine which fluid to use.

CAUTION

Hydraulic brake fluid is a caustic substance. Contact with hydraulic brake fluid can cause skin irritation. Do not let hydraulic brake fluid touch any painted surfaces, as it will remove the paint. Hydraulic brake fluid may also damage certain non-metal surfaces. Do not let fluid get on brake pads, shoes, rotors or disks.

Pressure Fill and Bleed

Pressure fill and bleed is the preferred method for bleeding the service brake system. It requires the use of a special pressure bleeder kit, consisting of a tank, pressure pump and valve, gauge, tubing and adapter. These kits are available from a number of manufacturers and include instructions for use. **Figure 3.4.**



Pressure Fill and Bleed Procedure:

1. Apply the parking brake and chock the tires. Turn the ignition OFF and disconnect the battery terminals.

NOTE: The ignition must remain off for the entire bleed procedure; energizing the unit during bleeding must be impossible.

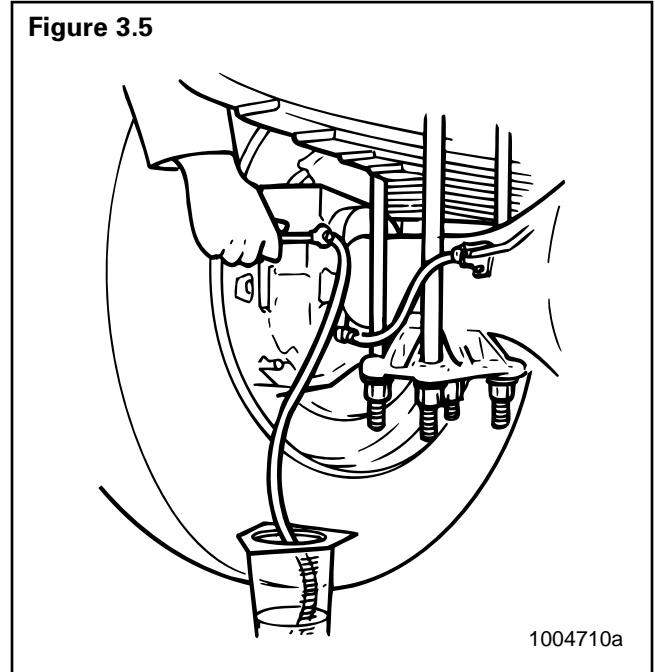
2. Fill the pressure bleeder with new DOT 3 or DOT 4 hydraulic brake fluid. Refer to the vehicle specifications to determine which fluid to use.
3. Follow the manufacturer's instructions to connect the pressure bleeder to the brake master cylinder reservoir.
4. Set filling pressure to 20 to 30 psi (1.5 to 2.0 bar).
5. Turn on bleed equipment until fluid level in reservoir reaches approximately 0.875-inches (20 mm).
6. Release pressure for 3 to 5 seconds. Apply pressure for 5 to 10 seconds.
7. Repeat Steps 5 and 6 approximately 10 times. After releasing the pressure, air bubbles should rise up into the reservoir.

⚠ WARNING

Do not let the brake master cylinder fluid get below the minimum level during the bleeding operation. Keep the master cylinder reservoir filled with new DOT-approved brake fluid, as specified by the original equipment manufacturer. Failure to keep the brake reservoir level above minimum could result in more air entering system, making it impossible to effectively bleed the system.

8. Bleed the brake system:
 - Set filling pressure to 20 to 30 psi (1.5 to 2.0 bar).
 - Put a wrench on the brake actuator bleeder fitting. Start with the farthest from the modulator, (typically the right rear), then attach a length of clear plastic tubing to the bleeder fitting. Make sure the tube fits snugly.
9. Submerge the tubing in a container of clean hydraulic brake fluid. **Figure 3.5.**

NOTE: Both the tubing and container must be able to withstand the effects of hydraulic brake fluid.

Figure 3.5

Loosen the bleeder fitting until the fluid begins to flow (about 3/4 turn). Let the hydraulic fluid flow out of the fitting until it is free of air bubbles.

10. Tighten firmly to secure the fitting.
11. Repeat Steps 5 through 8 to bleed the remaining three brake actuators. Bleed in sequence of the longest to shortest circuit from the modulator assembly.
12. Turn off bleed equipment and remove pressure. Remove bleed device and check fluid level in reservoir. Fill if required. Replace reservoir cap and dispose of used brake fluid.
13. Remove wheel chocks.

Manual Bleed Procedure:

1. Apply the parking brake and chock the tires. Turn the ignition OFF and disconnect the battery terminals.

NOTE: The ignition must remain off for the entire bleed procedure; energizing the unit during bleeding must be impossible.

Section 3

Component Replacement

2. Fill the reservoir with DOT 3 or DOT 4 hydraulic brake fluid. Refer to the vehicle specifications to determine which fluid to use.
3. Depress the brake pedal five times using the stroke between 1/3 travel and maximum travel in 5 seconds.
4. Release the pedal for 5 to 10 seconds. Air bubbles will rise into the reservoir while depressing and releasing pedal.
5. Repeat Steps 3 and 4 another three times, or until sufficient pedal resistance is felt.
14. Check the fluid level in reservoir and fill if required. Replace reservoir cap and dispose of used brake fluid.
15. Remove wheel chocks.

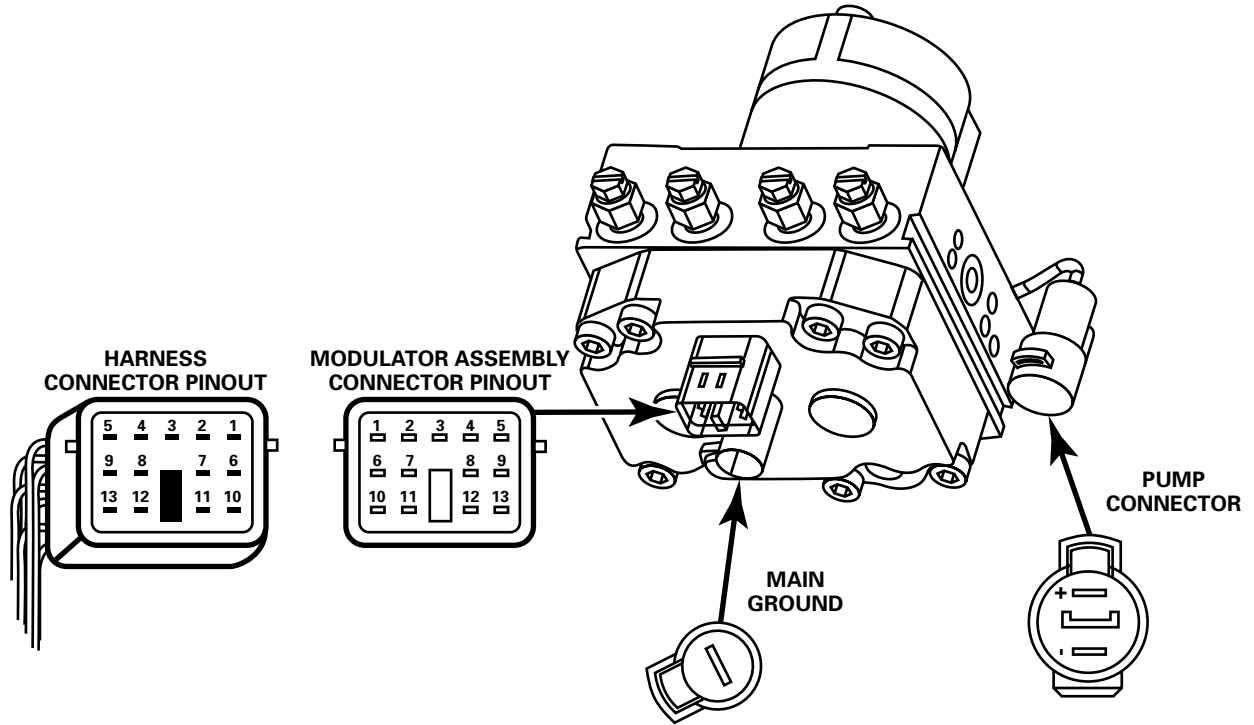
 **WARNING**

Do not let the brake master cylinder fluid get below the minimum level during the bleeding operation. Keep the master cylinder reservoir filled with new DOT-approved brake fluid as specified by the original equipment manufacturer. Failure to keep the brake reservoir level above minimum could result in more air entering system, making it impossible to effectively bleed the system.

6. Bleed the brake system. Put a wrench on the brake actuator bleeder fitting. Start with the farthest from the modulator, (typically the right rear), then attach a length of clear plastic tubing to the bleeder fitting. Make sure the tube fits snugly.
7. Submerge the tubing in a container of clean brake fluid. **Figure 3.5.**

NOTE: Both the tubing and container must be able to withstand the effects of brake fluid.
8. Depress the brake pedal 10 to 15 times, using the maximum available stroke.
9. Loosen the bleeder fitting until the fluid begins to flow, (about 3/4 turn), while depressing the brake pedal through its maximum available stroke.
10. Tighten the fitting firmly prior to releasing the brake pedal.
11. Repeat Steps 6 through 8 several times until the discharged fluid is free of air bubbles.
12. Repeat Steps 3 through 9 to bleed the remaining three brake actuators. Bleed in sequence of the longest to the shortest circuit from the modulator.
13. Check the travel of the brake pedal. If a firm resistance is felt the manual bleeding procedure is complete.

Modulator Assembly Connector Pin Assignment



1004711a

Pin Number	Circuit Description	Pin Number	Circuit Description
1	Outlet Valve RL	8	Reference Ground
2	Inlet Valve RL	9	-----
3	-----	10	Outlet Valve RR
4	Inlet Valve FR	11	Inlet Valve RR
5	Outlet Valve FR	12	Inlet Valve FL
6	-----	13	Outlet Valve FL
7	-----		

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Information contained in this publication was in effect at the time the publication was approved for printing and is subject to change without notice or liability. Meritor WABCO reserves the right to revise the information presented or discontinue the production of parts described at any time.

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Printed in the USA

Maintenance Manual 39
Revised 09-00
16579/24240



Proper Sensor Adjustment for Hydraulic ABS

For proper hydraulic ABS operation, all wheel-end sensors must be properly installed and maintained, as follows:

At installation, the sensor must be installed to initially contact the tooth wheel. The center of the sensor must contact the tooth wheel near the center of the tooth wheel, at least 0.12-inch (3 mm) from the edge of the tooth. No gap is allowable at installation.

When adjusting the sensor, push the sensor completely into the sensor spring clip until it contacts the tooth wheel. During normal operation a gap not to exceed 0.04-inch (1 mm) is allowable.

Meritor WABCO specifications call for a mineral oil-based lubricant for the sensor spring clip and sensor that contains molydisulfide. It should have excellent anti-corrosion and adhesion characteristics and be capable of continuous function in a temperature range of -40° to 300° F (-40° to 150° C).

For complete Hydraulic ABS troubleshooting and maintenance information, please refer to Maintenance Manual 38, *C-version Hydraulic ABS*, or Maintenance Manual 39, *D-version Hydraulic ABS*. To order a maintenance manual, call ArvinMeritor's Customer Service Center at 800-535-5560 or go on-line at www.arvinmeritor.com and download a copy from our technical library.

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Drivetrain Plus[™] by ArvinMeritor



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Printed in the USA

TP-20192
Issued 10-00
16579/ArvinMeritor

User's Manual

TOOLBOX™ SOFTWARE

Diagnostic and On-Screen Service Instructions For:

- ▶ Pneumatic ABS (D and E Versions)
- ▶ Trailer ABS (Easy-Stop™ and Enhanced Easy-Stop™ with PLC)
- ▶ Hydraulic ABS (HABS)
- ▶ Hydraulic Power Brake (HPB)
- ▶ Electronic Leveling Module (ELM) for Tractors
- ▶ Electronic Leveling Module (ELM) for Trailers

MERITOR WABCO

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Introduction

Meritor WABCO TOOLBOX™ Software is a PC-based diagnostics program that runs in Windows® 98, Me, NT, 2000 or XP①. TOOLBOX™ Software provides PC diagnostic capabilities for Meritor WABCO tractor and trailer pneumatic ABS, hydraulic ABS and the electronic leveling module (ELM) for both tractor and trailer. The program provides four basic functions:

- Displays both constant (e.g., ECU number) and changing (e.g., RPMs) information from the system under test.
- Displays both active and stored system faults, as well as the appropriate repair instructions.
- Provides a link to service information testing procedures, etc. (ABS and HABS only)
- Activates system components to verify system integrity, correct component operation and installation wiring.

NOTE: For complete Meritor WABCO maintenance information, refer to the appropriate maintenance manual which is listed in this manual at the beginning of each product section. For copies of Meritor WABCO service literature, contact the ArvinMeritor Customer Service Center at 800-535-5560 or visit our website: meritorwabco.com

① Early versions of TOOLBOX™ (Version 4.2 or lower) will run in Windows® 95.

System Requirements

- Pentium-based personal computer
- Microsoft Windows® 98, Me, 2000 or XP^①. Internet Explorer version 3.02 or higher must be installed.

NOTE: You must have Administrator Privileges to install and run TOOLBOX™ Software on Windows® NT.

- 64 MB RAM
- Approximately 10.0 MB hard disk space for each program. 60 MB hard disk space for full install
- CD-ROM drive
- RS232 to SAE J1708 or RS232 to PLC converter cable
- Serial Port. RS232-SAE J1708 interface adapter required
- Meritor WABCO recommends using a mouse with this program

Windows® is a registered trademark of the Microsoft Corporation.

① Windows® versions approved for use with TOOLBOX™ as of 01/04.

Installation

Follow the instructions included with TOOLBOX™ Software to install the program on your computer.

The installation screen offers three types of installations: Typical, Compact and Custom. Select **Typical** or **Compact** to install tractor, trailer and hydraulic ABS diagnostic programs. Select **Custom** to install only one or two of these programs.



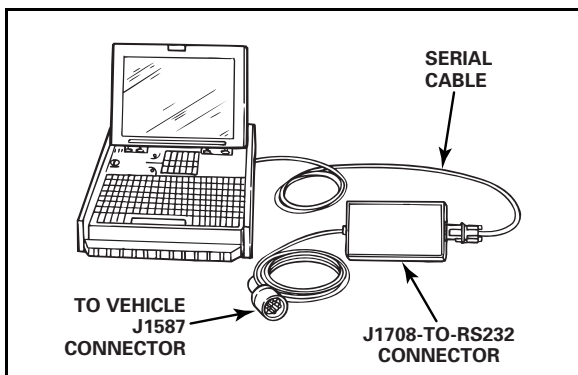
After installation, Meritor WABCO TOOLBOX™ Software will be available on your desktop as an icon and under the Windows® start menu.

Refer to “System Setup” on page 5 for first-time use instructions.

NOTE: An RS232 to J1708 or RS232 to PLC converter box attached to the communications port on your computer (COM1 or COM2) is required. Converter boxes that have been tested and proven satisfactory are Noregon, MPSI, B&B Devices, Kent-Moore and Dearborn Group.

**Starting
TOOLBOX™
Software**

1. Attach the RS232 to J1708 converter cable from your computer’s serial port to the converter box.
2. Attach the diagnostic cable (Deutsch) to the vehicle.



At start-up, select the **TOOLBOX™ Software** icon from Desktop or from the Windows® Start Menu to display the MAIN MENU.

Main Menu



ABS Menus and Toolbars are illustrated and explained in this manual, as follows:

Tractor ABS	pages 11-21
Trailer ABS	pages 23-36
Hydraulic ABS	pages 37-47
Hydraulic Power Brake (HPB)	pages 48-57
ELM for Tractors	pages 58-62
ELM for Trailers	pages 63-68

Most TOOLBOX™ features are accessible through pull down menus. Many of these features may also be accessed by a shortcut icon. When a shortcut is available, the appropriate icon is illustrated to the left of the copy.

At the **Main Menu** you may select a shortcut icon to:



Exit TOOLBOX™



Go to Tractor ABS diagnostics



Go to Trailer ABS diagnostics



Go to Hydraulic ABS (HABS) diagnostics
OR Go to Hydraulic Power Brake (HPB) diagnostics



Go to Electronic Leveling Module (ELM) for Tractors



Go to Electronic Leveling Module (ELM) for Trailers

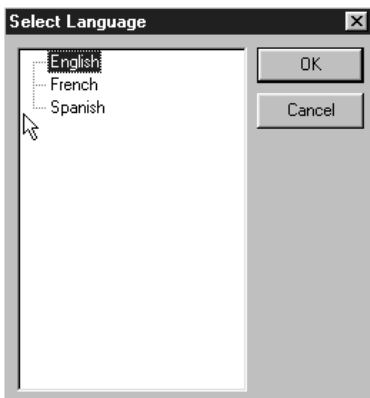
Main Menu

System Setup Select **System Setup** from the **Main Menu**.



Language Select **Language** from the **System Setup** menu. The default is English. To change the default to French or Spanish (ABS only):

1. Select the appropriate language.
2. Click OK to accept the selection.



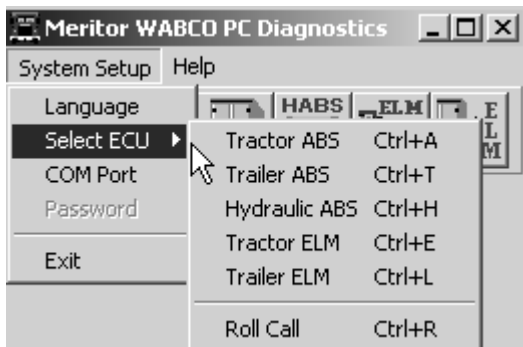
Select ECU

Tractor
ABSELM
TractorTrailer
ABSELM
TrailerHydraulic
ABS/HPB

Click on **Select ECU** from the **System Setup** menu, then select the type of ABS to be tested. Click on the appropriate Meritor WABCO product icon to display the **Main Menu** for that program.

Roll Call displays all actively broadcasting ECUs.

NOTE: TOOLBOX™ diagnostics cover only Meritor WABCO ECUs.



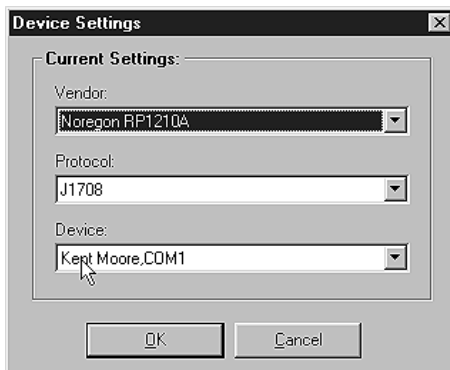
COM Port

Palm Pilot Setup:

- Go to Palm Pilot Setup Menu
- Change COM port to COM port 3
- Reboot PC

The correct **Vendor**, **Protocol** and **Device** selections are essential. TOOLBOX™ will not operate correctly if these selections are not accurate. For assistance, contact the ArvinMeritor Customer Service Center at 800-535-5560.

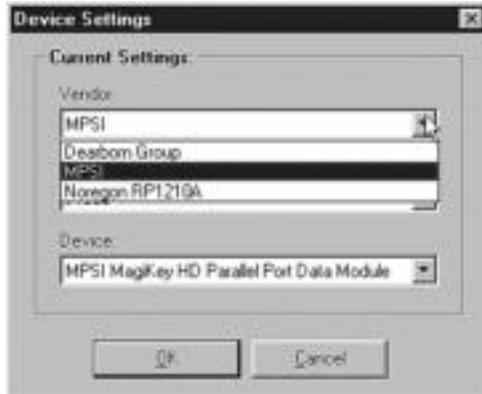
From the **System Setup** pull down menu, select **COM Port** to display the **Device Settings** menu. Current settings will be shown.



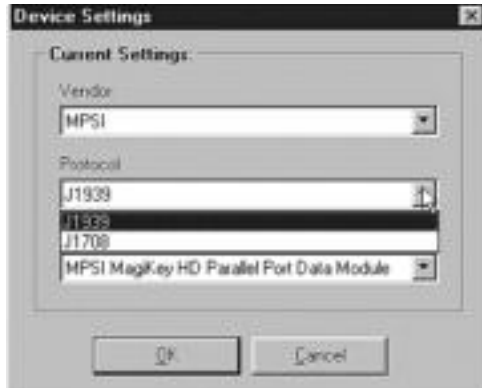
To change these selections:**Vendor**

(Vendor name should appear on the parts label on the connector box)

Click on the down arrow for a list of **vendor** choices. Select the appropriate vendor.

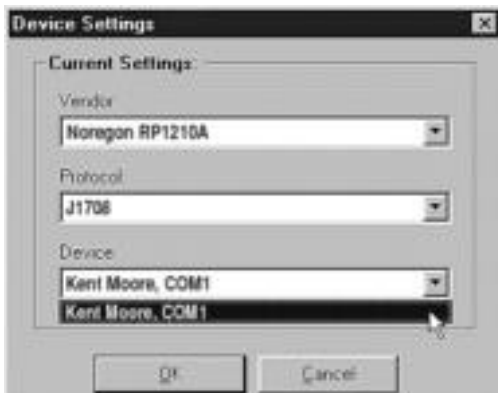
**Protocol**

Click on the down arrow for the **protocol** choices.



Device

Click on the down arrow for the **device** choices. Select the device and port to which the data cable is connected.



Click OK to accept the selections and close the **Device Settings** window.

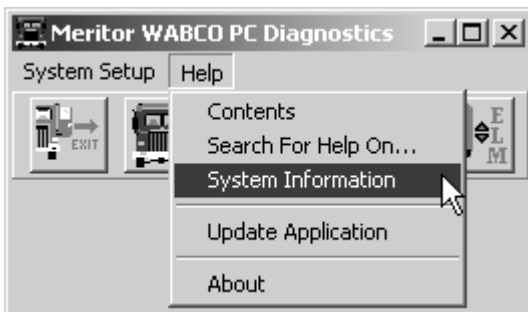
Help



Select the **Help** icon for help in using Meritor WABCO TOOLBOX™ Software. Help is accessible from all TOOLBOX™ pages. Search by title (**contents**) or type in a specific topic (**search for help on**).

System Information

Select **System Information** and follow the screen prompts to print a report of system hardware: operating system version, drivers, etc. Run this report whenever you contact the ArvinMeritor Customer Service Center.



Update Application

(Versions 5.0 and Higher)

Select **Update Application** to download future revisions to TOOLBOX™. This option is available for TOOLBOX™ version 5.0 and higher. Follow the screen prompts to complete the download.



About

Select **About** from the pull down menu for information about Meritor WABCO TOOLBOX™ Software, including the version number. You may need this information if you call the ArvinMeritor Customer Service Center.



Tractor ABS

Reference Material

For maintenance and repair information, refer to the appropriate Meritor WABCO Truck, Tractor and Bus ABS Maintenance Manual:

MM-30 D Version ABS
MM-0112 E Version ABS



NOTE: TOOLBOX™ Software must be connected to the vehicle and the vehicle ignition must be ON in order to display information.

TRACTOR ABS MENUS AND TOOLBARS

Select **Tractor ABS** from the TOOLBOX™ **Main Menu**. The Tractor ABS **Main Screen** will appear.

Main Screen



This screen provides icons and pull down menu task selections. It also provides information about the current state of Meritor WABCO ABS. ECU information is read once from the ECU and does not change. All other information (e.g., wheel sensors, control status, voltages, faults and road speed) is read and updated continuously.

The status of ABS switches and lamps as well as other data may be observed from this screen.

Restart Exit Help

From the **Main Screen** you can select **Restart**, **Exit** or **Help**.



Tractor ECU

Select **Tractor ECU** from the Tractor ABS **Main Screen**. A pull down menu will appear.

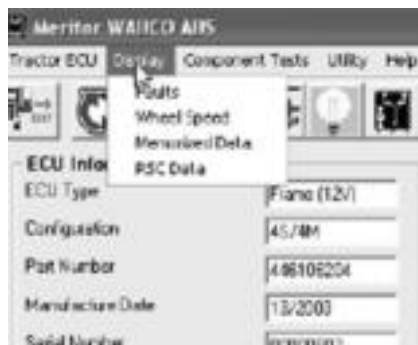


Refer to page 5 of this manual for information about using the **Language** selection.

Select **Restart** to refresh (update) ECU information.

Display

Select **Display** from the Tractor ABS **Main Screen**. A pull down menu will appear.



Faults



Select **Faults** from the pull down menu. The **Fault Information** screen will appear.



A description of the fault, the number of times the fault occurred, the system identifier (SID) and the failure mode (FMI) are all displayed in the fault information window. Basic repair instructions for each fault are also provided.

- Bookmarks — Complete listing of ABS fault codes by SID/FMI. Click to display.
- Thumbnails — Click individual pages to display.

For detailed repair instructions, click on the fault to display a troubleshooting information sheet. **Bookmark** and **Thumbnail** tabs at the side of the troubleshooting information sheet provide additional information. A sample troubleshooting information sheet appears in the Appendix. This screen also provides a link to the appropriate system schematic.

Faults that may occur after the screen is displayed will not appear until a screen update is requested. Use the **update** button to refresh the fault information table.

After making the necessary repairs, use the **clear faults** button to clear the fault. Use the update button to refresh the fault information table and display the new list of faults.

Use the **Save** or **Print** button to save or print the fault information data.

Wheel Speed

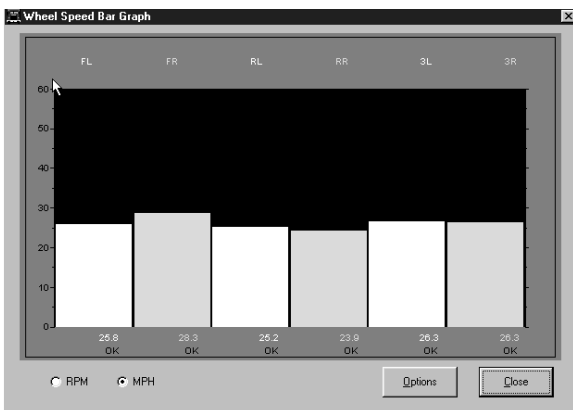
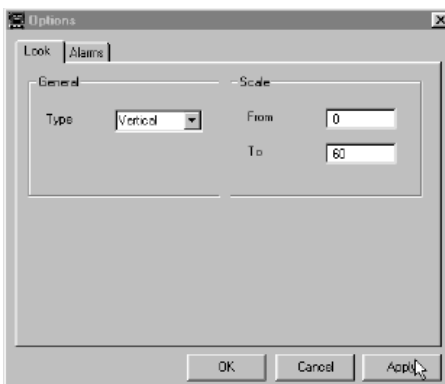


Select **wheel speed** from the pull down menu to display wheel speed data in both numeric and graph form.



Wheel speed information may be viewed in RPM (revolutions per minute) or MPH (miles per hour). Select the appearance and style from the **options** menu.

Display wheel speed data vertically or horizontally.





Memorized Data

*(E Version
ABS Only)*

Select **Memorized Components** from the pull down menu.

NOTE: Use Display/Memorized Components to view data. To clear a memorized component, use the Memorized Components function that appears on the Component Tests Menu.



RSC Data

*(E Version
ABS Only)*

Select **RSC Data** from the pull down menu for RSC status information:



For RSC Control Status:

NA — RSC is not an option

OFF — RSC is installed but is not currently active

For Accelerometer sensor:

Acceptable range is 2.21-2.78 volts

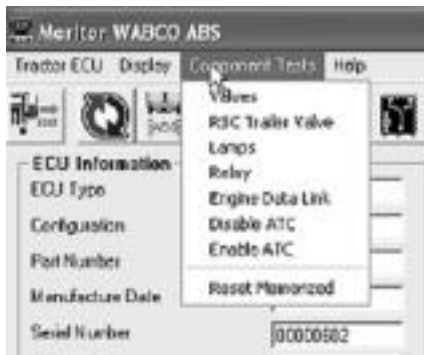
A **red** background in this field indicates voltage is outside of the acceptable range.

A **green** background in this field indicates voltage is within the acceptable range.

Component Tests

Select **Component Tests** from the Tractor **ABS Main Screen**. A pull down menu will appear.

NOTE: Components for test may also be selected from the icons on the Tractor ABS Main Screen.



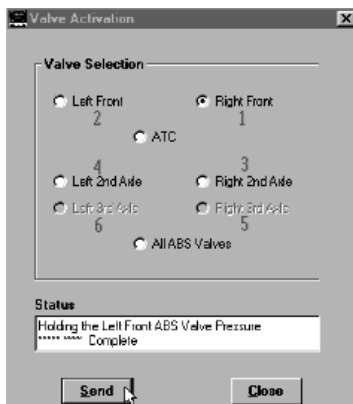
Valves



Select **Valves** from the pull down menu to select and cycle individual ABS modulator valves. Then, listen to ensure the correct valve is cycling. This is also helpful in verifying correct operation, installation and wiring.

Select **all valves** from the menu to cycle all available ABS valves in the order shown below.

NOTE: Verification of the ATC valve is also available from this menu.



RSC Trailer Valve

*(E Version
ABS Only)*

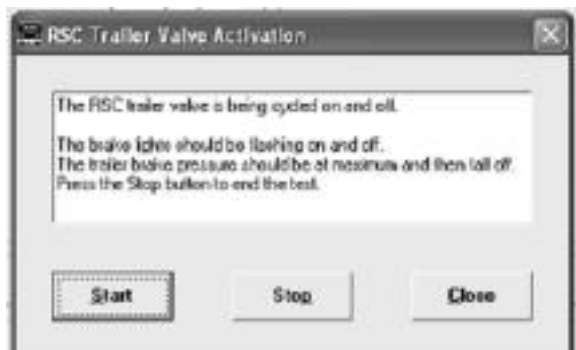
Select **RSC Trailer Valve** from the pull down menu to cycle the RSC trailer valve.



NOTE: Do not activate the service brake while testing the RSC trailer valve.



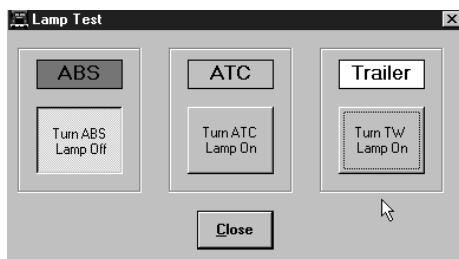
Press **Start** to begin the test.



Lamps



Select **Lamps** from the pull down menu to turn the tractor ABS, trailer ABS or ATC (wheel spin) indicator lamps on or off.



This is helpful in verifying correct operation, installation and wiring of the lamps to the ECU.

Relay



Select **Relay** from the pull down menu to turn the Retarder Relay on or off.

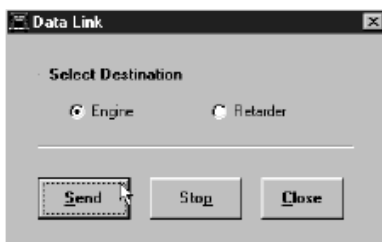
This is helpful in verifying correct operation, installation and wiring of the unit under test.



Engine Data Link



Select **Engine Data Link** from the pull down menu to send a “limit engine torque” command to the engine or a “disable retarder” command to the retarder.



Disable ATC



Select **Disable ATC** from the pull down menu to send a command to the ECU to disable automatic traction control. ATC will remain disabled until the enable command is sent or the vehicle ignition is cycled. The status bar on the Main Screen reflects the current state of the ATC function, either Enabled, Disabled or N/A (not available).

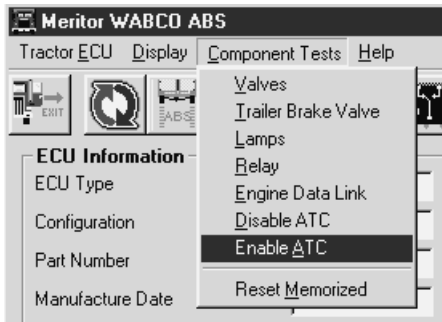
Using the **Disable ATC** command is useful and essential for dynamometer testing.



Enable ATC



Select **Enable ATC** from the pull down menu to send a command to the ECU to enable automatic traction control. This is the normal state of the ECU. The status bar on the Main Screen reflects the current state of the ATC function, either Enabled, Disabled or N/A (not available).



Reset Memorized

Select **Reset Memorized** from the pull down menu to tell the ECU to reset the memorized or “learned” components.

The ECU has the ability to learn the following components: ATC valve, engine data link and retarder relay. Once any of these have been detected, the ECU expects to see them each time the ECU is powered on. If they are not seen, the ECU records a fault.

Because there are times when an ECU is moved to another vehicle — or during diagnostic testing — you may want the ECU to disregard these learned components. Use the **Reset Memorized** command for this purpose.

Trailer ABS

Reference Material

For maintenance and repair information, refer to the appropriate Meritor WABCO Trailer ABS Maintenance Manual:

- MM-33 Easy-Stop™ Trailer ABS
- MM-0180 Enhanced Easy-Stop™ with PLC Trailer ABS



NOTE: TOOLBOX™ Software must be connected to the vehicle and the vehicle ignition must be ON in order to display information.

TRAILER ABS MENUS AND TOOLBARS

Select **Trailer ABS** from the TOOLBOX™ **Main Menu**. The Trailer ABS **Main Screen** will appear.

Main Screen

This screen provides icons and pull down menu task selections. It also provides information about the current status of Meritor WABCO ABS.

ECU information is read once from the ECU and does not change. All other information (e.g., wheel sensors, voltages and fault information) is read and updated continuously.

NOTE: Double click on Yes in the Existing or Stored Faults fields to bring up the Fault Information screen. This screen is illustrated on page 40.

Service Information may also be observed from the Trailer ABS main screen.

Restart Exit Help

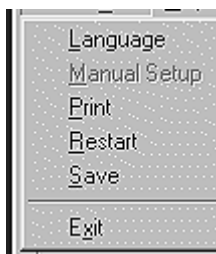
From the **Main Screen**, you can select **Restart**, **Exit** or **Help**.



Trailer ECU

Select **Trailer ECU** from the Trailer ABS **MAIN SCREEN**. A pull down menu will appear.

Language Restart



Refer to page 5 of this manual for information about using the **Language** selection.

Select **Restart** to refresh (update) ECU information.

Manual Setup

The **Manual Setup** menu selection is not available.

Print

To print vehicle data in a report format.

1. From the Trailer ECU pull down menu, select **Print**. The **Report Information Screen** will appear.
2. Enter the VIN and Employee number for the report you want to print.
3. Click OK to print and close the window.

NOTE: Selecting the **Print** function does not save report data. You must save all data according to the instructions given in Save, above.



The image shows a screenshot of a software dialog box titled "Report Information". The dialog box has a title bar with a close button (X) on the right. Below the title bar, the text "Enter Report Information" is displayed. There are four input fields, each with a label to its left: "Plant Location" with the value "Troy MI", "VIN" with the value "1111", "DEM" with the value "bh", and "Employee" with the value "Clouzeau". At the bottom right of the dialog box, there are two buttons: "OK" and "Cancel".

Save

To save vehicle data in a report format:

1. From the Trailer ECU pull down menu, select **Save**. The **Report Information Screen with path selections** will appear.
2. Enter the VIN and Employee number.
3. Select the file where vehicle reports are stored; e.g., Main.
4. Click OK to close the window.



NOTE: Trailer ABS reports are not displayed in TOOLBOX™. To view a report, use Windows Explorer to find and open the report file. The following is a sample report.

Meritor WABCO ABS Fault Report						
Date:	September 13, 2000					
Time:	5:25 PM					
Page:	1					
VIN:	12345678					
Employee Information:	KILEY					
ABS System Configuration:	4S/2M					
ECU Revision:	V 3 2 2xxxx					
Part Number:	446-108-000-1					
Serial Number:	5 9 3 0 3 9 4 8xxxxxxxx					
Date of Manufacture:	13/1999					
Current Miles:	0.0					
Service Miles:	0.0					
Tire Calibration:	495.0					
Fault#	Description	Status	SID	FMI	Count	
1	Ext. modulator BLUE open circuit detected	Active	9	5	1	
2	Ext. modulator BLUE open circuit detected	Stored	9	5	1	
Sensor Test Results:						
Sensor	Max RPM	Order				
YE1	40.0	1				
YE2	59.0	2				
BU1	50.0	3				
BU2	38.0	4				
Valve Tests Performed:						
Valve	Status (Tested / Not Tested / NA)					
Yellow	Tested					
Blue	Tested					
Red	N/A					

Display

Select **Display** from the Trailer ABS **Main Screen**. A pull down menu will appear.



Faults

Select **Faults** to display the Fault Information Screen.

NOTE: The Fault Information Screen is also accessible from the Trailer ABS **Main Screen**. Refer to page 23.

Fault Information



The **Fault Information Screen** contains a description of each fault, including the type of fault (Active or Stored), SID and FMI number. Repair instructions for the fault appear at the bottom of the screen.

- Bookmarks — Complete listing of ABS fault codes by SID/FMI. Click to display.
- Thumbnails — Click individual pages to display.

For detailed repair instructions, click on the fault to display a troubleshooting information sheet. **Bookmark** and **Thumbnail** tabs at the side of the troubleshooting information sheet provide additional information. A sample troubleshooting information sheet appears in the Appendix. This screen also provides a link to the appropriate system schematic.

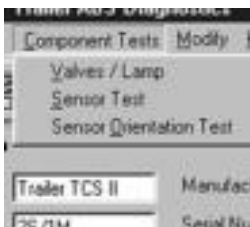
Faults that occur after the screen is displayed will not appear until a screen update is requested. Use the **Update** button at the bottom of the screen to refresh the fault information table and display a new list of faults.

After making any required repairs, use the **Clear Faults** button to clear the fault. Clear each fault as it is repaired.

Use the **Save** or **Print** button to save or print the fault information data. Please refer to page 25 for complete information about Save and Print functions.

Component Tests

Select **Component Tests** from the Trailer ABS **Main Screen**. A pull down menu will appear.



NOTE: Sensor Orientation Test option is only available with TCSII (Enhanced Easy-Stop™) ECUs. It will not appear as a menu choice for Easy-Stop™ ECUs.

Valve and Lamp Activation



Select **Valves/Lamp** to display the **Valve Activation** screen. From this screen you can check the status of the trailer ABS valves and the ABS indicator lamp mounted on the trailer.



Valves**2S/1M Systems**

S = Sensors

M = Modulator Valves

The **Red** valve indicator will be selected. Click on the **Activate** button and listen for the valve to click, indicating a good installation.

2S/2M, 4S/2M and 4S/3M Systems

The **Yellow** valve indicator will be selected. Click on the **Activate** button and listen for the valve to click, indicating a good installation. Repeat for the **Blue** valve.

NOTE: Selecting **All Valves** will sequence all of the valves, beginning with the Yellow valve.

As each valve is cycled, the **Test Status** box at the bottom of the screen will display the status of the test.

Lamp

Click on the **Warning Lamp Test** button on the bottom of the valve and lamp activation screen to activate the lamp that is mounted on the side of the trailer. The lamp will flash eight times, indicating the lamp is OK. The test status box at the bottom of the menu will display the status.

Message	Status
Complete	OK
Critical Error	Communication error (If this message occurs, check the cable connections, recycle power.)

Sensors



This test requires rotating the vehicle wheels. Refer to the maintenance manual to make sure the vehicle is correctly prepared for this test. Follow all of the warnings and cautions printed in the manual.

Select **Sensor Test** to display the **Sensor Test** screen.





WARNING

To prevent serious eye injury, always wear safe eye protection when you perform vehicle maintenance or service.

Park the vehicle on a level surface. Block the wheels to prevent the vehicle from moving. Support the vehicle with safety stands. Do not work under a vehicle supported only by jacks. Jacks can slip and fall over. Serious personal injury and damage to components can result.

The ABS is an electrical system. When you work on the ABS, take the same precautions that you must take with any electrical system to avoid serious personal injury. As with any electrical system, the danger of electrical shock or sparks exists that can ignite flammable substances. You must always disconnect the battery ground cable before working on the electrical system.

1. Make sure sensed wheel ends are off of the ground.
2. Apply air to the emergency line to fill the air tanks and release the spring brakes so that the wheels can be rotated.
3. Apply 12 volts DC to the ABS.
4. Click on the **Start** button on the **Sensor Test** screen to start the test.
5. Rotate the sensed wheel ends at a rate of 1/2 revolution per second. This rate equals a wheel speed of approximately 4 mph (7 kph).
6. Check the screen for sensor output: If Sensor Output is displayed, the sensor test is complete. If there is no Sensor Output, verify tone ring installation and sensor placement (sensor must be pushed all the way in against the tone ring). Refer to the maintenance manual for complete information.

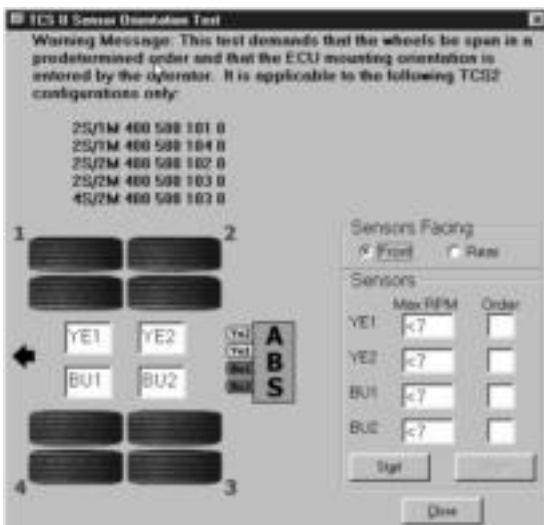
7. Check the **Order** fields to verify sensors were installed in the right location, based on the orientation of the valves.

Sensor Orientation Test

(For Enhanced Easy-Stop™ Only)

If you are using TOOLBOX™ to test an Enhanced Easy-Stop™ system, you can check sensor installation by performing a sensor orientation test.

Select **Sensor Orientation Test** from the pull down menu. The **Sensor Orientation Test** screen will appear.



This test requires that the sensed wheels be spun in a predetermined order and that you enter the ECU mounting orientation. The sensed wheels are rotated in turn, starting at the front curbside, moving to the rear, and ending at the front roadside.

- A correct sensor installation will be displayed in green (Pass).
- An incorrect installation will be displayed in red (Fail).

The results of the sensor orientation test will also appear on the test page printout.

Modify

Select **Modify** from the Trailer ABS **Main Menu**. A pull down menu will appear.



Service Information

Select **Service Information** to set, change or display the odometer reading for scheduled maintenance.



When the mileage setting selected for scheduled maintenance is reached, the ABS indicator lamp on the side of the trailer will flash eight times. The lamp will continue to flash eight times whenever the ignition switch is turned on, or until service is performed and this parameter is changed. To change the mileage for the next scheduled maintenance, type in the new odometer reading, then press the **Write** button. Maintenance settings may be entered in miles or kilometers.

Tire Calibration

Select **Tire Calibration** to set, change or display the revolutions per mile.



Tip: TOOLBOX™ will automatically change some numeric values; e.g., you may type in a number and see a number that is slightly higher or lower displayed. This does not affect calibration accuracy.

The RPM entry range is 150.0 to 634.0 RPM. The default value is 502.0. RPM figures are calculated based on a 100-tooth tone ring. To change a value, type in the RPM figure, then press the **Write** button.

- Trailers with 12-1/4-inch brakes use an 80-tooth tone ring. Use a value of 80 percent of the tire manufacturer's recommended RPM (revolutions x 0.80).

Reconfigure

This option is used to reconfigure an ECU that has been installed on a system with **fewer** sensors or modulator valves than the original system. It is not necessary to reconfigure an ECU installed on a system with **more** sensors or modulator valves than the original system. In these cases, reconfiguration is automatic.

Select **Reconfigure** to display the following screen, then mark the appropriate configuration.



Notebook



Select **Notebook** to enter or view information about a specific vehicle.

NOTE: The O.E.M. location and production date are automatically saved in Notebook and will appear on this screen once they have been saved to the registry. V.I.N. and inspector must be saved after entering.



Tip: The registry function of Notebook is especially useful to an OEM.

To enter information, type the data, then click on the **Write** button to send the information to the ECU. Use the **Print** button to print the displayed data.

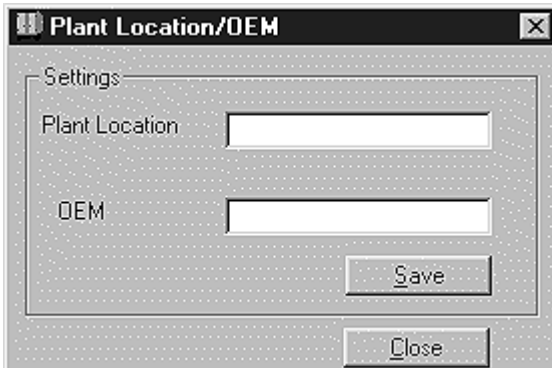
Lift Axle

Select **Lift Axle** to observe or change lift axle status.



Plant Location/ OEM

Select **Plant Location/OEM** to observe or enter plant and OEM information.



Hydraulic ABS

Reference Material

For maintenance and repair information, refer to the Meritor WABCO Trailer ABS Maintenance Manual:

- MM-39 Hydraulic ABS for Medium-Duty Trucks, Buses and Motor Home Chassis



NOTE: TOOLBOX™ Software must be connected to the vehicle and the vehicle ignition must be ON in order to display information.

HYDRAULIC ABS MENUS AND TOOLBARS

Select Hydraulic ABS from the TOOLBOX™ **Main Menu**. TOOLBOX™ will recognize the HABS or Hydraulic Power Brake (HPB) ECU and display the appropriate screen. If you are working with HPB, refer to the HPB section of this manual.

Main Screen



The **Main Screen** provides icons and pull down menu task selections. It also provides information about the current status of Meritor WABCO HABS.

ECU information is read once from the ECU and does not change. All other information (e.g., wheel sensors, voltages and fault information) is read and updated continuously.

NOTE: Double click on Yes in the Existing or Stored Faults fields of the HABS **Main Screen** to bring up the Fault Information screen. Service Information may also be observed from this screen.

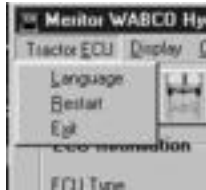
From the **Main Screen**, you can select **Restart**, **Exit** or **Help**.

Restart
Exit
Help



Tractor ECU

Select **Tractor ECU** from the HABS **Main Screen**. A pull down menu will appear.

**Language Restart**

Refer to page 5 of this manual for information about using the **Language** selection.

Select **Restart** to refresh (update) ECU information.

Exit

Select **Exit** to exit HABS and return to the TOOLBOX™ **Main Menu**.

Display

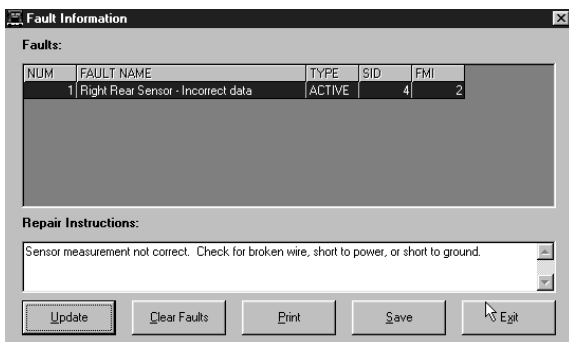
Select **Display** from the HABS **Main Screen**. A pull down menu will appear.



Faults

Select **Faults** to display the **Fault Information** screen.

NOTE: The **Fault Information** Screen is also accessible from the HABS **Main Menu**.



The **Fault Information** screen contains a description of each fault, including the type of fault (Active or Stored), SID and FMI number. Repair instructions for the fault appear at the bottom of the screen.

- Bookmarks — Complete listing of ABS fault codes by SID/FMI. Click to display.
- Thumbnails — Click individual pages to display.

For detailed repair instructions, click on the fault to display a troubleshooting information sheet. **Bookmark** and **Thumbnail** tabs at the side of the troubleshooting information sheet provide additional information. A sample troubleshooting information sheet appears in the Appendix. This screen also provides a link to the appropriate system schematic.

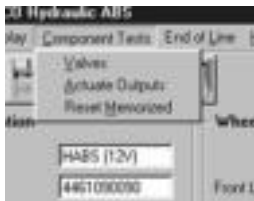
Faults that occur after the screen is displayed will not appear until a screen update is requested. Use the **Update** button at the bottom of the screen to refresh the fault information table and display a new list of faults.

After making any required repairs, use the **Clear Faults** button to clear the fault. Clear each fault as it is repaired.

Use the **Save** or **Print** button to save or print the fault information data. Please refer to page 25 for more information about Save and Print functions. Select **Exit** to close this screen.

Component Tests

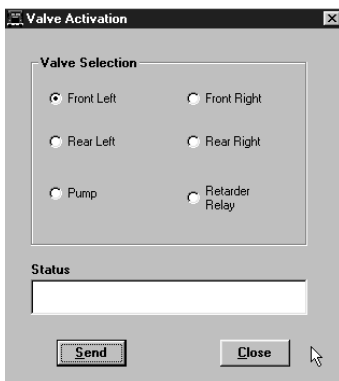
Select **Component Tests** from the HABS **Main Screen**. A pull down menu will appear.



Valves



Select **Valves** to display the **Valve Activation** screen.



The **Valve Activation** screen lets you activate the four valves, the pump and the retarder relay. In addition to checking for correct activation, this screen provides an easy way to make sure the valves are wired correctly – and that wiring is not reversed.

Click on the valve, pump or retarder relay you wish to test, then click on the **Send** button to actuate the component. Component activation status appears in the **status box** field. Use the **Close** button to close this screen.

Actuate Outputs

Select **Actuate Outputs** to display the **Actuate Miscellaneous Output** screen.

Actuate Miscellaneous Output

Output Selection

Front Left Inlet Front Right Inlet
 Front Left Outlet Front Right Outlet
 Rear Left Inlet Rear Right Inlet
 Rear Left Outlet Rear Right Outlet
 Pump Relay Retarder Output
 ABS Lamp On ABS Lamp Off
 Valve Relay Off

Status

Send **Close**

This screen provides a check of the ABS indicator lamp. In addition, it provides a way to check either inlet or outlet activity of the valves, pump or retarder relay.

Click on the component you wish to test, then click on the **Send** button to actuate the component. Component activation status appears in the **status box** field. Use the **Close** button to close this screen.

Reset Memorized

Select **Reset Memorized** to display the **Learned Component** screen.



Relay is an automatic default and cannot be de-selected. It indicates the ECU has memorized the installed retarder relay. Once the ECU has seen a retarder, it expects to see it every time the vehicle is powered up.

Because there are times when an ECU is moved to another vehicle — or during diagnostic testing — you may want the ECU to disregard this learned component. Use the **Reset Memorized** command for this purpose.

End of Line

Tip: Have a copy of MM 39 or Installation Guide TP-99124 available BEFORE you perform a brake bleed. For your convenience, these publications are posted on meritorwabco.com.

The End of Line Brake Bleed Procedure is accessed from the HABS main screen. Use the Brake Bleed feature to bleed the expansion chambers. (See page 45.)

NOTE: Before connecting the vehicle to the computer, bleed the circuit and master cylinder. Follow the standard bleed procedures used by your facility, or use the procedures listed in Meritor WABCO HABS Installation Guide TP-99124 or HABS Maintenance Manual 39.



WARNING

Failure to bleed the system whenever any hydraulic system fitting is loosened or disconnected will allow air to remain in the system. This will prevent the hydraulic pressure in the brake system from rising enough to apply the brakes correctly. This will cause the stopping distance to increase and can result in serious personal injury.

Correctly discard hydraulic brake fluid that is removed from the brake system. Hydraulic brake fluid that is removed can be contaminated and can cause damage, loss of braking and serious personal injury.

Use only the type of hydraulic brake fluid specified by the equipment manufacturer. Do not use or mix different types of hydraulic brake fluid. The wrong hydraulic brake fluid will damage the rubber parts of the brake caliper and can cause damage, loss of braking and serious personal injury.

Do not let the brake master cylinder fluid get below the minimum level during the bleeding operation. Keep the master cylinder reservoir filled with new DOT-approved brake fluid, as specified by the original equipment manufacturer. Failure to keep the brake reservoir level above minimum could result in more air entering system, making it impossible to effectively bleed the system.

NOTE: Use DOT 3 or DOT 4 hydraulic brake fluid. Refer to the vehicle specifications to determine which fluid to use.



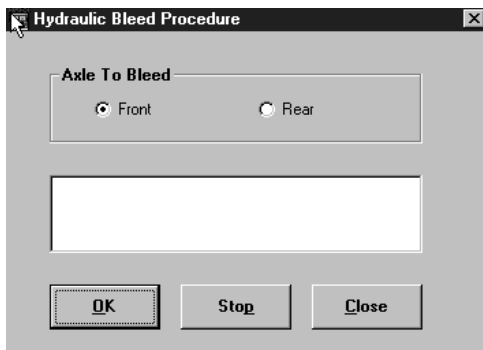
CAUTION

Hydraulic brake fluid is a caustic substance. Contact with hydraulic brake fluid can cause skin irritation. Do not let hydraulic brake fluid touch any painted surfaces, as it will remove the paint. Hydraulic brake fluid may also damage certain non-metal surfaces. Do not let fluid get on brake pads, shoes, rotors or disks.

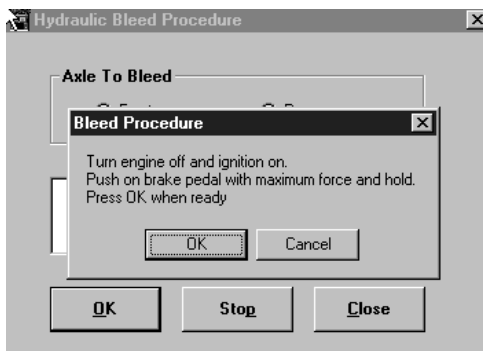
1. Apply the parking brake and block the tires. Turn the ignition off.
2. Perform brake bleed procedure for wet module, bleeding the circuit and master cylinder if required, prior to connecting laptop to truck.
3. Connect laptop to the vehicle using the J1587 diagnostic port in the cab of the truck.
4. Launch Meritor WABCO TOOLBOX™ Diagnostic Software.
5. From the **Main Menu** select the HABS icon.
6. Select **End of Line** from the **HABS Main Menu**.
7. Select **Bleed Procedure** from the **End of Line Menu**.



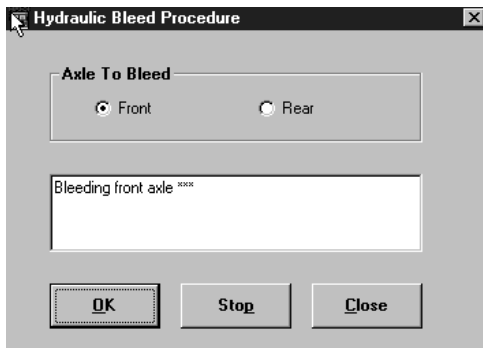
8. Choose axle to bleed from the select axle screen.



9. Follow on-screen prompts.



Click OK to continue.



Click OK to continue.



10. Repeat procedure two additional times on this axle. This should eliminate all of the air in the chamber.
11. Perform manual bleed on this axle.
12. Repeat Steps 8-11 for the other axle.
13. Test drive the vehicle after bleeding the brakes.
 - If a firm brake pedal resistance is felt and the brake pedal pushes back when you perform an ABS stop, the system bleed procedure is complete.
 - If there is no firm pedal resistance, check the brake system for defects (leaks, etc.) and make the necessary repairs, then repeat the bleed procedure.

Hydraulic Power Brake (HPB)

Technical Assistance



For technical assistance, please contact the ArvinMeritor Customer Service Center at 800-535-5560

NOTE: TOOLBOX™ Software must be connected to the vehicle and the vehicle ignition must be ON in order to display information.

HYDRAULIC POWER BRAKE MENUS AND TOOLBARS

Select Hydraulic ABS from the TOOLBOX™ **Main Menu**. TOOLBOX™ will sense the type of ECU being used and will display the **HPB Main Screen**.

Main Screen



This screen provides icons and pull down menu task selections. It also provides information about the current status of Meritor WABCO HPB.

ECU information is read once from the ECU and does not change. All other information (e.g., wheel sensors, voltages and fault information) is read and updated continuously.

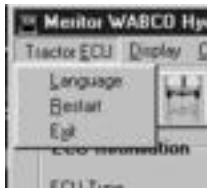
From the Main Screen you can select **Restart**, **Exit** or **Help**.

Restart
Exit
Help



Tractor ECU

Select **Tractor ECU** from the HPB **Main Screen**. A pull down menu will appear.



Language

Refer to page 5 of this manual for information about using the Language selection.

Restart

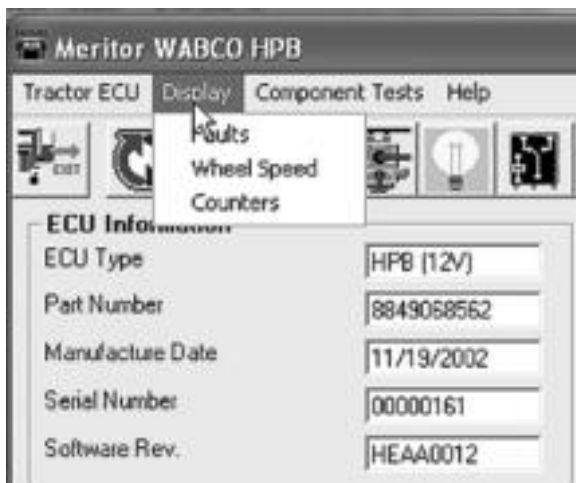
Select **Restart** to refresh (update) ECU information.

Exit

Select **Exit** to exit HPB and return to the TOOLBOX™ **Main Menu**.

Display

Select **Display** from the HPB **Main Screen**. A pull down menu will appear.



Faults

Select **Faults** to display the **Fault Information** screen.

NOTE: The **Fault Information** screen is also accessible from the **HPB Main Menu**.



The **Fault Information** screen contains a description of each fault, including the type of fault (Active or Stored), SID and FMI number. Repair instructions for the fault appear at the bottom of the screen.

Faults that occur after the screen is displayed will not appear until a screen update is requested. Use the **Update** button at the bottom of the screen to refresh the fault information table and display a new list of faults.

After making any required repairs, use the **Clear Faults** button to clear the fault. Clear each fault as it is repaired.

Use the **Save** or **Print** button to save or print the fault information data. Please refer to page 25 for more information about Save and Print functions. Select **Exit** to close this section.

Wheel Speed

Select **Wheel Speed** to display the **Wheel Speed** screen.



Use the **Wheel Speed** screen to verify that sensors are connected at each wheel. Speed at a sensed wheel (FL, FR, RL, RR) indicates sensors are installed, but does not verify correct sensor installation.

Counters

Select Counters to display the **Counters** screen.



The **Counters** screen provides an overview of HPB component performance (pump hours, brake events, etc.) as well as general vehicle activity such as ignition cycles. Occurrences displayed on this screen accumulate until the Clear button is selected.

Component Tests

Select **Component Tests** from the HPB **Main Screen**. A pull down menu will appear.



Valves

Select **Valves** to display the **Valve Activation** test screen.

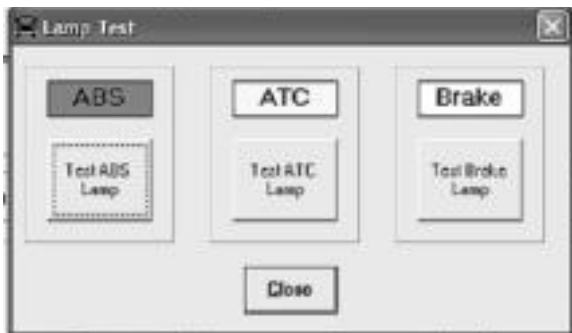


The Valve Activation test screen lets you activate the HPB valves and verify correct brake line installation.

Click on the valve you wish to test, then click the **send** button to actuate the component. Component activation status appears in the **Status** box field. Select **Close** to exit this screen.

Lamps

Select **Lamps** to display the **Lamp Test** screen.



As each lamp is tested, check the actual lamp to verify correct operation. Select **Close** to exit this screen.



WARNING

Park the vehicle on a level surface. Block the wheels to prevent the vehicle from moving. Support the vehicle with safety stands. Do not work under a vehicle supported only by jacks. Jacks can slip and fall over. Serious personal injury and damage to components can result.

Parking Brake

Select **Parking Brake** to display the **Parking Brake** test screen.



Select **Release** or **Apply**, then select **Send** to test the parking brake. Select **Close** to exit this screen.

Relay

Select **Relay** to display the **Activate Relay** test screen.



This screen allows you to turn the Retarder Relay on or off. This is helpful in verifying correct operation, installation and wiring of the unit under test. Select **Close** to exit this screen.

Engine Data Link

Select Engine Data Link to display the **Data Link** test screen.



This screen allows you to send a “limit engine torque” command to the engine or a “disable retarder” command to the retarder.

Select the data link destination (engine or retarder), then select **Send** to test. Use the **Stop** button to end testing. Select **Close** to exit this screen.

Disable ATC

Select Disable ATC to send a command to the ECU to disable automatic traction control. ATC will remain disabled until the enable command is sent, or until the vehicle ignition is cycled. ATC must be disabled for ATC testing.

Enable ATC

Select Enable ATC to send a command to the ECU to enable automatic traction control. This is the normal state of the ECU.

NOTE: The status bar on the HPB Main Menu reflects the current ATC status (enabled, disabled or not available).



Miscellaneous Outputs

Select Miscellaneous Outputs to display the Activate Miscellaneous Outputs test screen.

NOTE: Use TOOLBOX™ to test the following components: **Retarder Relay, Brake Light Relay, Supply Valve, Cut-Off Valve, ABS Lamp, Traction Lamp, Brake Warning, Pump Front, Pump Rear, Buzzer.**



This screen provides a check of several HPB components, as well as a way to check either inlet or outlet activity of the valves, pump or retarder relay.

Highlight the component you wish to test, then select the **Send** button to actuate the component. Component activation status appears in the **Status Box** field. Select **Close** to exit this screen.

**Reset
Memorized**

*(For Systems
Equipped with a
Retarder Relay)*

Select **Reset Memorized** to display the **Learned Component** screen.



The screenshot shows a rectangular window with a light gray background. At the top left, the word "Component" is displayed in a dark font. Below it, there is a single line item consisting of a small square checkbox with a checkmark inside, followed by the word "Relay".

Relay is an automatic default and cannot be de-selected. It indicates the ECU has memorized the installed retarder relay. Once the ECU has seen a retarder, it expects to see it every time the vehicle is powered up.

Electronic Leveling Module (ELM) for Tractors

Reference Material

For Maintenance and Repair information, refer to Meritor WABCO ELM Service Bulletin number TP0324. A copy of this bulletin is posted on our website, www.meritorwabco.com.

Computer to Vehicle



NOTE: TOOLBOX™ Software must be connected to the vehicle and the vehicle ignition must be on in order to display information.

ELM ABS MENUS AND TOOLBARS

Select **Tractor ELM** from the TOOLBOX™ **Main Menu**. The ELM **Main Screen** will appear.

Main Screen

This screen provides icons and pull down menu task selections. It also provides information about the current state of the Meritor WABCO ELM. ECU information (e.g., part number, serial number, etc.) is read once and does not change. All other information, such as wheel sensor speed and voltages, is read and updated continuously.

**Restart
Exit
Help**

From the **Main Screen** you can select **Restart**, **Exit** or **Help**.



ELM

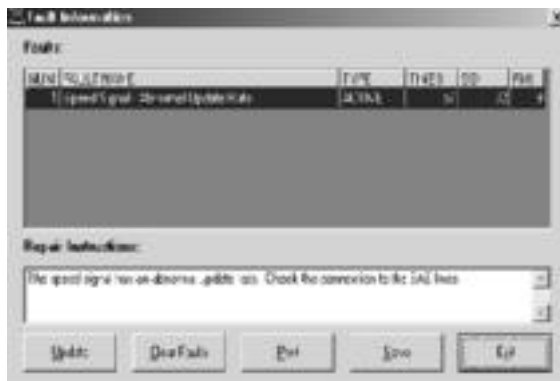
Select **ELM** from the ELM **Main Screen**. A pull down menu will appear with English listed. This program is available in English only.

Display

Select Display from the ELM **Main Screen**. A pull down menu will appear.

Faults

Select faults from the pull down menu. The **Fault Information** screen will appear.



A description of the fault, the number of times the fault occurred, the system identifier (SID) and the failure mode (FMI) are all displayed in the fault information window. Repair instructions for each fault are also provided.

Faults that may occur after the screen is displayed will not appear until a screen update is requested. Use the **Update** button to refresh the fault information table.

After making the necessary repairs, use the **Clear Faults** button to clear the fault. Use the update button to refresh the fault information table and display the new list of faults.

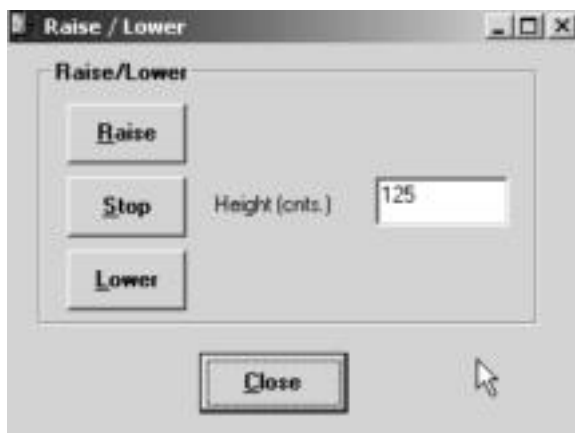
Use the **Save** or **Print** button to save or print the fault information data.

Components

Select **Component Tests** from the ELM **Main Screen**. A pull down menu will appear.



Select **Raise/Lower** to raise or lower the chassis. The **Raise/Lower** screen will appear.



Select **Raise** to raise the vehicle chassis to the ride height or **Lower** to lower the vehicle chassis to the ride height low level.

Select **Stop** to halt the raising or lowering. The height of the vehicle chassis during raising or lowering is displayed on the screen in the **Height** field. Note that the measurement is in centimeters.

Select **Close** to return to the **ELM Main Menu**.

Modify

CAUTION:
Do not modify ELM parameters unless instructed to do so by the fleet or terminal manager.

Select Modify from the ELM **Main Screen**. The **Edit ELM Parameters** screen will appear.



Calibrate

At the **ELM Main Menu** click on the **Calibration** icon.

CALIBRATION ICON



Select **Start Calibration**. The **Calibrate ELM** screen will appear.

The screenshot shows a software window titled "Calibrate ELM". It is divided into several sections:

- Raise/Lower:** Contains three buttons labeled "Raise", "Stop", and "Lower". To the right of these buttons is a text input field labeled "Height (cnts.)" with the value "127". A larger "Calibrate" button is positioned to the right of the "Lower" button.
- Calibration Values:** Contains three labels: "High Level:", "Normal Level:", and "Low Level:", each followed by an empty rectangular input field.
- Status:** A text area containing the message: "Calibrating NORMAL Level.. Adjust vehicle to the normal level and then select the Calibrate button".
- Cancel:** A button with a dashed border at the bottom center of the window.

- Follow the on-screen prompts to raise and lower the vehicle to the normal ride height selected by the vehicle manufacturer. Press **Calibrate** to set.
- After ride height is set, raise the vehicle to the upper level. Press **Calibrate** to set.
- After upper level is set, lower the vehicle to the low level. Press **Calibrate** to set.
- Check the screen to verify that the calibration was successful.

Electronic Leveling Module (ELM) for Trailers

Reference Material

For Maintenance and Repair information, refer to Meritor WABCO ELM Service Bulletin number TP0326. A copy of this bulletin is posted on our website, www.meritorwabco.com.

Computer to Vehicle

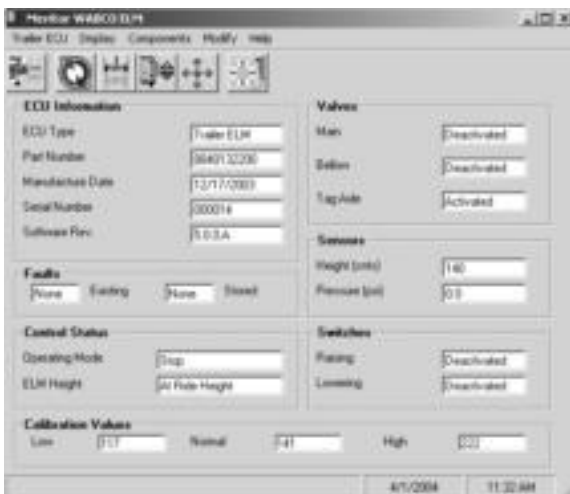


NOTE: TOOLBOX™ Software must be connected to the vehicle and the vehicle ignition must be ON in order to display information.

ELM ABS MENUS AND TOOLBARS

Select **Trailer ELM** from the TOOLBOX™ **Main Menu**. The ELM **Main Screen** will appear.

Main Screen



This screen provides icons and pull down menu task selections. It also provides information about the current state of the Meritor WABCO ELM. ECU information (e.g., part number, serial number, etc.) is read once and does not change. All other information, such as wheel sensor speed and voltages, is read and updated continuously.

**Restart
Exit
Help**

From the **Main Screen** you can select **Restart**, **Exit** or **Help**.



ELM

Select **ELM** from the ELM **Main Screen**. A pull down menu will appear with English listed. This program is available in English only.

Display

Select Display from the ELM **Main Screen**. A pull down menu will appear.

Faults

Select faults from the pull down menu. The **Fault Information** screen will appear.



A description of the fault, the number of times the fault occurred, the system identifier (SID) and the failure mode (FMI) are all displayed in the fault information window. Repair instructions for each fault are also provided.

Faults that may occur after the screen is displayed will not appear until a screen update is requested. Use the **Update** button to refresh the fault information table.

After making the necessary repairs, use the **Clear Faults** button to clear the fault. Use the update button to refresh the fault information table and display the new list of faults.

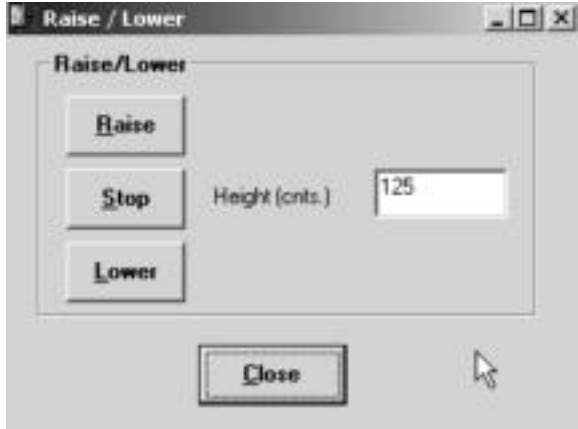
Use the **Save** or **Print** button to save or print the fault information data.

Components

Select Components from the ELM **Main Screen**. A pull down menu will appear.

Select **Raise/Lower** to raise or lower the chassis. The **Raise/Lower** screen will appear.





Select **Raise** to raise the vehicle chassis to the ride height or **Lower** to lower the vehicle chassis to the ride height low level.

Select **Stop** to halt the raising or lowering. The height of the vehicle chassis during raising or lowering is displayed on the screen in the **Height** field. Note that the measurement is in centimeters.

Select **Close** to return to the **ELM Main Menu**.

Modify

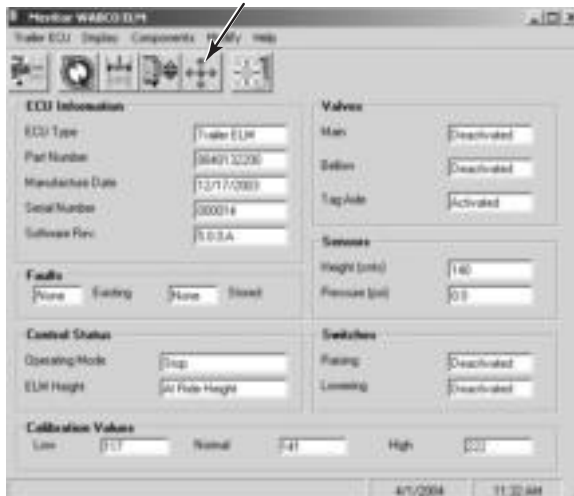
CAUTION:
Do not modify ELM parameters unless instructed to do so by the fleet or terminal manager.

Select Modify from the ELM **Main Screen**. The **Edit ELM Parameters** screen will appear.



Calibrate

At the **ELM Main Menu**, click on the **Calibration** icon.

CALIBRATION ICON

Select **Start Calibration**. The **Calibrate ELM screen** will appear.

Calibrate ELM

Raise/Lower

Raise Height (cnts.)

Stop

Lower **Calibrate**

Calibration Values

High Level :

Normal Level :

Low Level :

Status:

Calibrating NORMAL Level..
Adjust vehicle to the normal level and then select the
Calibrate button

Cancel

- Follow the on-screen prompts to raise and lower the vehicle to the normal ride height selected by the vehicle manufacturer. Press **Calibrate** to set.
- After ride height is set, raise the vehicle to the upper level. Press **Calibrate** to set.
- After upper level is set, lower the vehicle to the low level. Press **Calibrate** to set.
- Check the screen to verify that the calibration was successful.

Appendix

Device Select Information

Before using TOOLBOX™ Software for the first time, you must indicate which COM port and adapter box will be used. If you have questions about Com Ports, Adapter Boxes or Drivers, the following information will answer many of your questions. Please review this material before you select the COM port and device. If you need further clarification, please contact the ArvinMeritor Customer Service Center at 1-800-535-5560.

Communication Drivers

Communication drivers are software programs that control the passing of data between the PC and the vehicle. Messages are sent and received via the PC's Com port and an adapter box.

Noregon communication drivers are included with the TOOLBOX™ installation CD. These drivers are RP1210A compliant and work with most adapter boxes (refer to adapter boxes). Some adapter boxes (i.e., MPSI MagiKey and Dearborn) require communication drivers other than Noregon. These drivers must be procured from the manufacturer and installed separately.

Adapter Box

An adapter box is an electronic device that connects the PC's COM port to the vehicle's diagnostic connector. It converts the computer's voltages to the levels used in the truck.

Selecting an Adapter Box in TOOLBOX™

To communicate correctly with the vehicle, TOOLBOX™ needs to know which adapter box is being used. To select an adapter box, run TOOLBOX™. Go to the **System Setup** menu and select **COM Port** from the pull down menu. All of the installed communication drivers will be displayed on the **Vendor** listing.

Once a vendor has been selected, the **Protocol** and **Device** lists will be updated, and the adapter can then be selected under **Devices**.

Connecting the Adapter Box

Most adapter boxes require two cables, one that connects the PC to the adapter box and a second that connects the adapter box to the vehicle. The first cable is usually connected to the serial (COM) port on the PC, but in the case of the MPSI Parallel Data Module, the connection is made to the parallel (printer) port. The second cable goes to the diagnostic connector located in the vehicle.

Fault Information Sheet

This is an example of a Fault Information Sheet. These sheets are available in version 5.0 for Tractor ABS, Trailer ABS and Hydraulic ABS.

The image shows a thumbnail of a document page. On the left side, there are two vertical labels: 'Bookmarks' at the top and 'Thumbnails' below it. The document content includes the Meritor Wabco logo and 'Vehicle Control Systems' at the top right. The main text identifies the SAE Fault Code as SID 1 FMI 7 and provides a description: 'Left Front Wheel Sensor Incorrect Tooth Wheel'. It explains that the ABS ECU has detected a recurring pulse drop out condition and advises checking the tooth wheel for damage or missing teeth. A blue link for 'Sensor Resistance Check' is also present.

SID001FMI007

MERITOR WABCO
Vehicle Control Systems

SAE Fault Code: SID 1
FMI 7

Description: Left Front Wheel Sensor Incorrect Tooth Wheel

The ABS ECU has detected a recurring pulse drop out condition. Check the tooth wheel for damaged or missing teeth that could cause pulses to be missing on each rotation of the wheel. Replace tooth wheel if damaged.

[Sensor Resistance Check](#)

TOOLBOX™ Technical Support

For technical assistance, contact the ArvinMeritor Customer Service Center at 800-535-5560. Or, visit the Meritor WABCO website at www.meritorwabco.com and use the Contact Us feature to email your request to a customer service representative.

To expedite your request, you should be prepared to provide the following information.

- TOOLBOX™ Software Version Number.
To find the version number:

Open TOOLBOX™.

Click on Help, then on About PC Diagnostics.

The version number will appear on the screen.

- ECU Type
- ABS Tractor: Basic, Universal or Frame
- ABS Trailer:

Look at the ECU field on the ABS Tractor Main Screen. If ECU type is not listed, refer to the vehicle specification sheet for this information.

Electronic Leveling Module (ELM)

Select **System Information** and follow the screen prompts to print a report of system hardware: operating system version, drivers, etc. Run this report whenever you contact the ArvinMeritor Customer Service Center.

System Information

*(Versions 5.0 and
Higher)*



About

Select **About** from the pull down menu for information about Meritor WABCO TOOLBOX™ Software, including the version number. You may need this information if you call the ArvinMeritor Customer Service Center.

