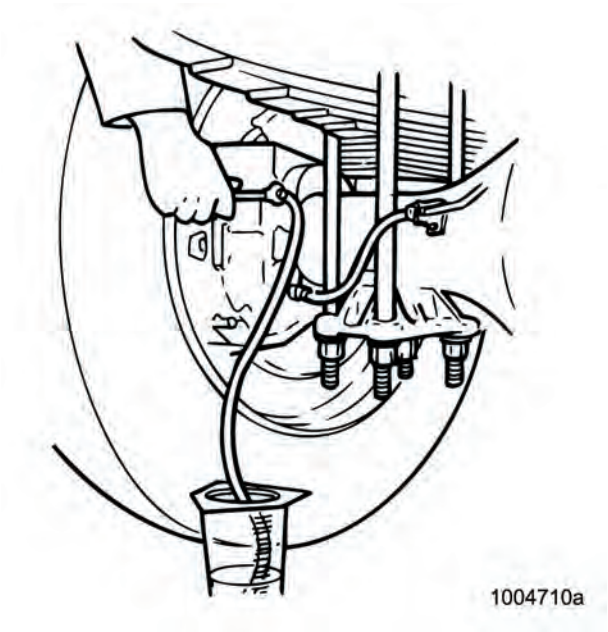

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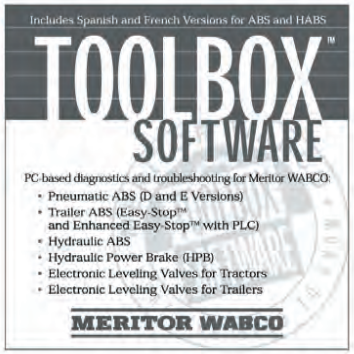

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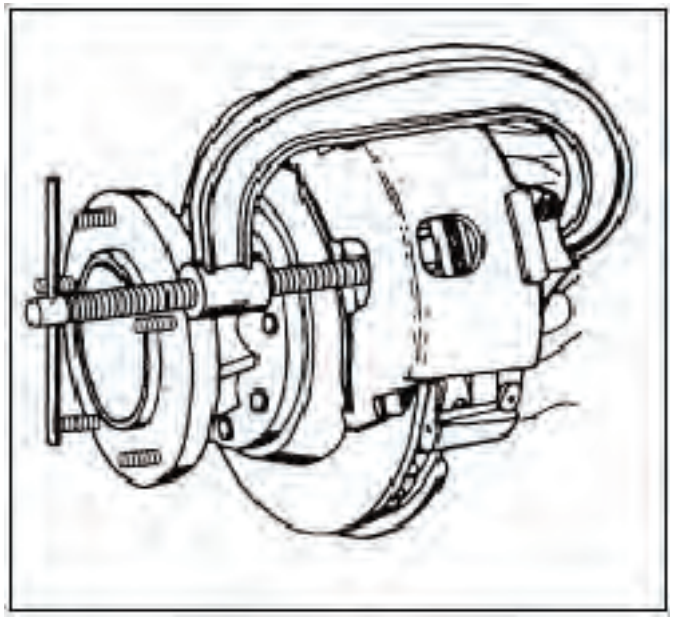
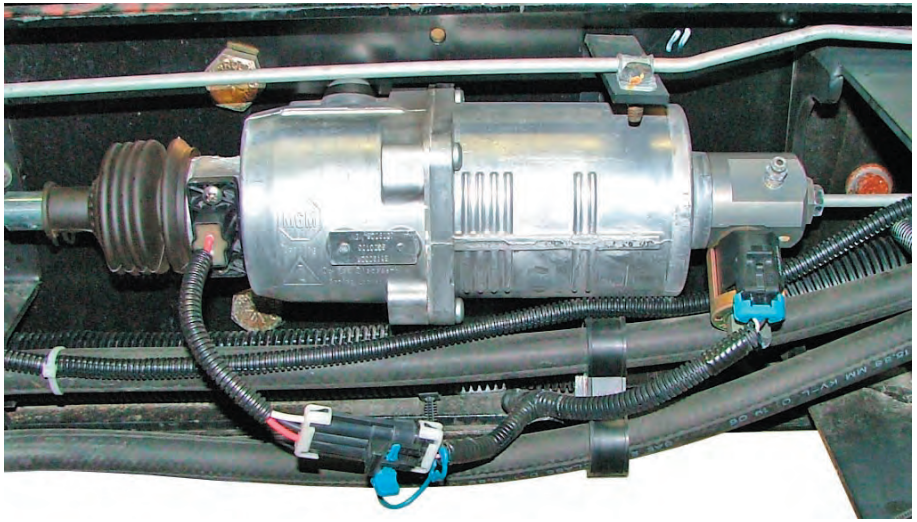
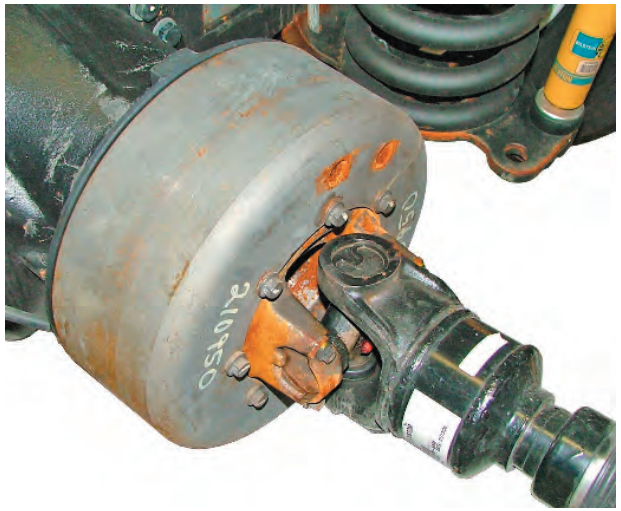


BRAKE SYSTEM





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FASTENER TIGHTENING SPECIFICATIONS

Description	English	Metric
ABS sensor bolt	124 lb in	14 N·m
Banjo bolt	35 lb ft	47 N·m
Bleed screw	97 lb in	11 N·m
Brake hose fitting	350 lb ft	475 N·m
Brake hose hold down clamp bolt	124 lb in	14 N·m
Brake pad retainer spring bolt	30 lb ft	41 N·m
Brake shield bolts	12-16 lb ft	16-21 N·m
Caliper to caliper mounting bracket bolts	225 lb ft	305 N·m
Caliper mounting bracket to steering knuckle bolts – 5/8-inch, 18 bolt	225 lb ft	305 N·m
Caliper mounting bracket to steering knuckle bolts – 9/16-inch, 18 bolt	150 lb ft	203 N·m
Cross over tube nuts	124 lb in	14 N·m
Lining rail Covers	195 lb in	22 N·m
Rotor to hub bolts	110 lb ft	149 N·m
Rotor to hub bolts – 9/16-inch, 18 bolt, with lock nuts)	90 lb ft	122 N·m
Rotor to hub bolts – 9/16-inch, 18 bolt, with plain nuts)	150 lb ft	203 N·m

BRAKE SYSTEM SPECIFICATIONS

Description	English	Metric
Brake Pad minimum thickness above metal – discard	.125 in	3.175mm
Brake fluid	DOT 3	
Rotor diameter	15.38 in	390.7mm
Rotor thickness – discard	Refer to Marking on Rotor	

BRAKE LATHE SPECIFICATIONS (AMMCO)

Data	Rough Cut	Finish Cut
Spindle Speed	150 RPM	150 RPM
Depth of Cut (per side)	0.127 mm (0.005 in)	0.051 mm (0.002 in)
Total Cross Feed (per revolution)	0.152 – 0.254 mm (0.006 – 0.01 in)	0.051 mm max. (0.002 in)
Vibration Dampener	Yes	Yes
Swirl Pattern 120 Grit	No	Yes

BRAKE LATHE SPECIFICATIONS (ACCU-TURN)

Data	Cut Information
Spindle Speed	150 RPM
Tool Cross Feed (per revolution)	0.076 mm (0.003 in)
Tool Bit Nose Radius	0.396 mm (0.003 in)
Vibration Dampener	Yes
Swirl Pattern 120 Grit	Yes

INTRODUCTION

OBJECTIVES OF THIS SECTION

This section is intended to provide information regarding the hydraulic brake system components. This is specific to the UFO-Series Workhorse Chassis.

Explanations for most components will include purpose, function, operation, and location. Guidance for proper and safe disassembly, inspection, repair, and assembly are provided.

DESCRIPTION AND OPERATION

The brake systems on a Workhorse motor home chassis can be broken down into three basic functions:

- Service Brake System
- Antilock Brake System (ABS)
- Park Brake System

DESCRIPTION AND OPERATION

SERVICE BRAKE SYSTEM DESCRIPTION

The service brakes are the primary brake system for the chassis. The system uses hydraulic pressure from a foot-pedal operated master cylinder to actuate cylinders that apply the brake pads to the braking surfaces on the brake rotors. The amount of hydraulic pressure in the system (applied by the driver) determines how much pressure is applied to the brake pads on the brake rotors.

Hydraulic pressure created by the master cylinder operation is transmitted through brake 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. Brake power is generated when the friction material that has been displaced on the rotor bonds itself to the friction material on the pads. After bonding has occurred, the rotation of the wheel will cause the bond to break apart or shear. This cycle of bonding and shearing is how the brakes stop the vehicle.

Service Brake System Components

The service brake system is made up of the following components:

- Hydraulic Power Brake (HPB) System
- Brake rotors
- Brake calipers and pads
- Brake lines and hoses

Hydraulic Power Brake (HPB) Overview

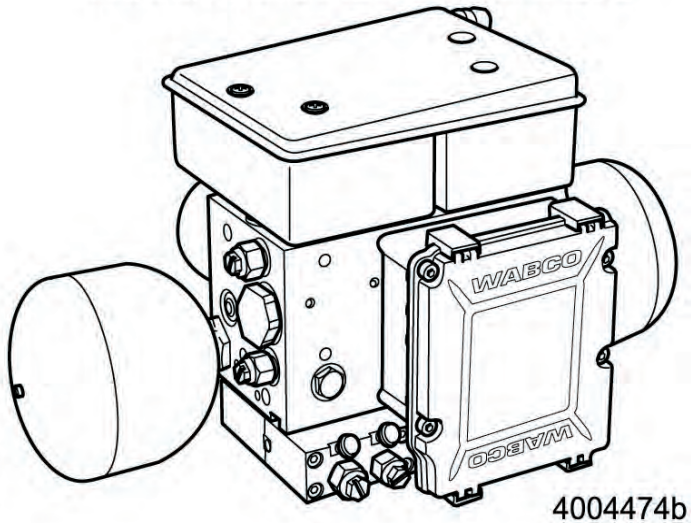
Meritor WABCO's Hydraulic Power Brake (HPB) is a braking and vehicle control system that provides the following functions. Full power brake performance, Brake control functions including Anti-Lock Braking System (ABS), Automatic Traction Control (ATC), and parking brake control.

HPB Components

The HPB system used on this chassis consists of the following main components:

- Hydraulic Compact Unit (HCU)
- Dual circuit master cylinder

HCU WITHOUT OPTIONAL POWER PARKING BRAKE SUPPLY VALVE



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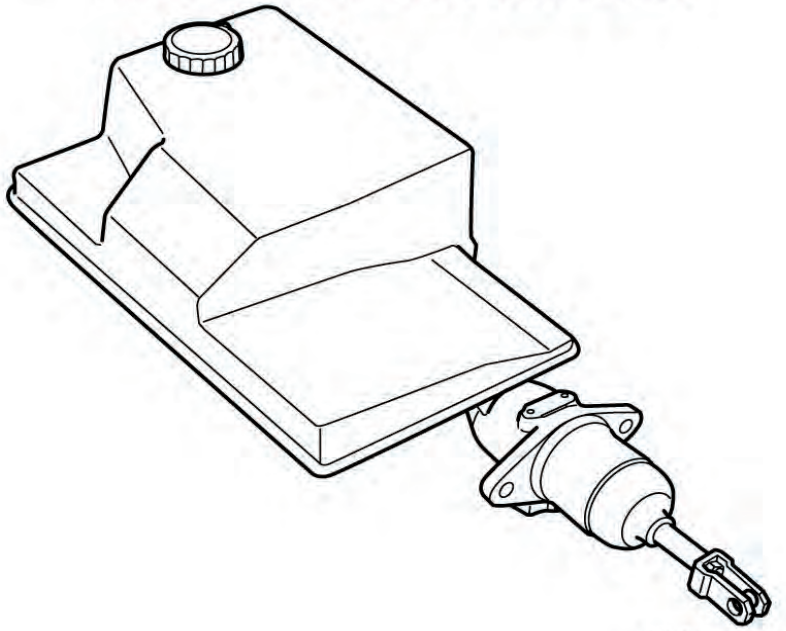
MASTER CYLINDER ASSEMBLY



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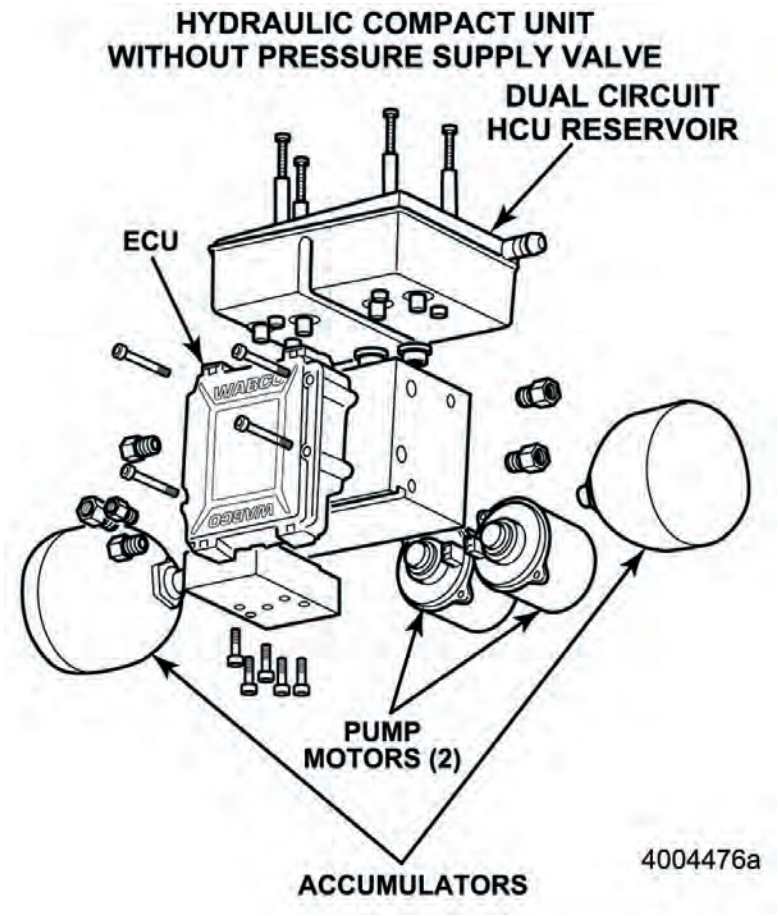
Hydraulic Compact Unit (HCU)

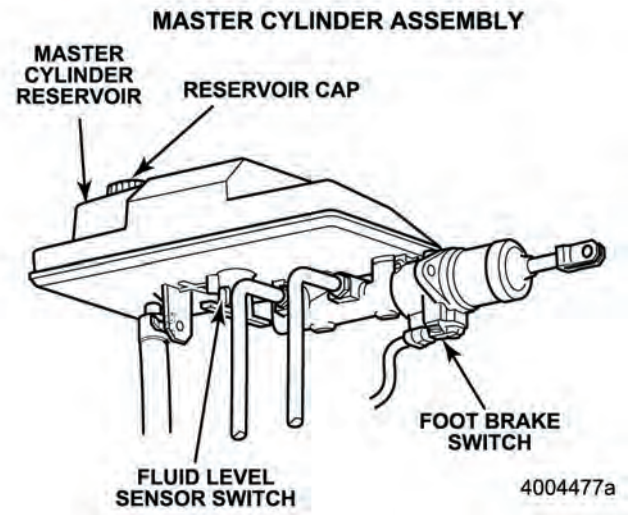
The HCU consists of an electronic control unit, two independent electric motors driving two pump systems, two accumulators, a dual circuit fluid reservoir with integrated filters, pressure relief valves, solenoid valves and a dual circuit relay valve. The HCU is mounted to the vehicle frame rail with two brackets.

- Two pump motors draw brake fluid from the reservoir to pressurize the accumulators. The motors are not serviceable.
- Two gas-filled hydraulic accumulators store energy supplied by the pumps. Accumulators are sealed at the factory and are non-refillable. Accumulators may be replaced without replacing the entire HCU.
- The ECU processes sensor signals and generates solenoid valve commands to reduce, maintain or increase brake pressure for control function. The ECU constantly monitors the pressure in the accumulators, using one pressure sensor per brake circuit. The ECU may be replaced without replacing the complete HCU.
- The pressure supply valve controls the Spring-Applied/ Hydraulic Released (SAHR) parking brake. The pressure supply valve is mounted on the HCU behind the accumulator. The pressure supply valve may be replaced without replacing the entire HCU. This option is not used on the WCC UFO™ chassis.
- The dual circuit HCU reservoir holds the hydraulic brake fluid. The reservoir may be replaced without replacing the entire HCU.



Master Cylinder Assembly

The dual circuit master cylinder with an integrated relay valve provides the translation of brake pedal force into hydraulic braking pressure, and sends the driver's demand signal to the HCU.



- The foot brake switch provides brake status to the ECU and eliminates the need for a brake light switch.
- The master cylinder reservoir holds the hydraulic brake fluid.
- The fluid sensor switch monitors fluid level in the master cylinder reservoir.
- The master cylinder reservoir and both switches may be replaced without replacing the entire master cylinder.
- The master cylinder cap provided by Meritor WABCO contains a special gore material that allows the reservoir to breathe, and serves as a filter to help prevent contaminants from getting into the reservoir. This is the only cap approved for use with Meritor WABCO HPB. Replacement caps may be obtained from Meritor WABCO.

Hub and Rotor Assemblies

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

For ABS operation, speed sensor reluctor rings are used.

BRAKE CALIPERS AND PADS

The brake caliper and pad information is shown below:

Chassis Model	GVWR (lbs)	Brake System	Caliper Size	Option Code
R26	25,500	Meritor Quadraulic	4X70	JM8

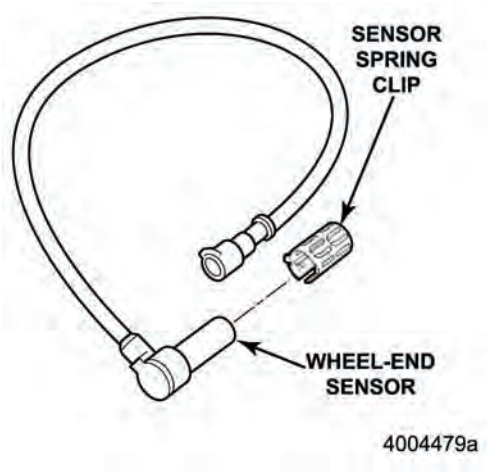
Anti-Lock Brake System (ABS)

The Anti-lock Brake System is a standard feature on the Workhorse UFO-Series chassis. The components that make up the ABS system are:

- Hydraulic Compact Unit (HCU)
- Wheel-End Sensors
- Tone rings

Wheel-End Sensors

A Meritor WABCO wheel-end sensor is installed at all wheels. These sensors generate electronic signals which are sent to the ECU. A sensor spring clip holds the wheel speed sensor in place. The sensor and sensor clip must be lubricated before installation and whenever wheel-end maintenance is performed.



HOW THE HPB SYSTEM WORKS

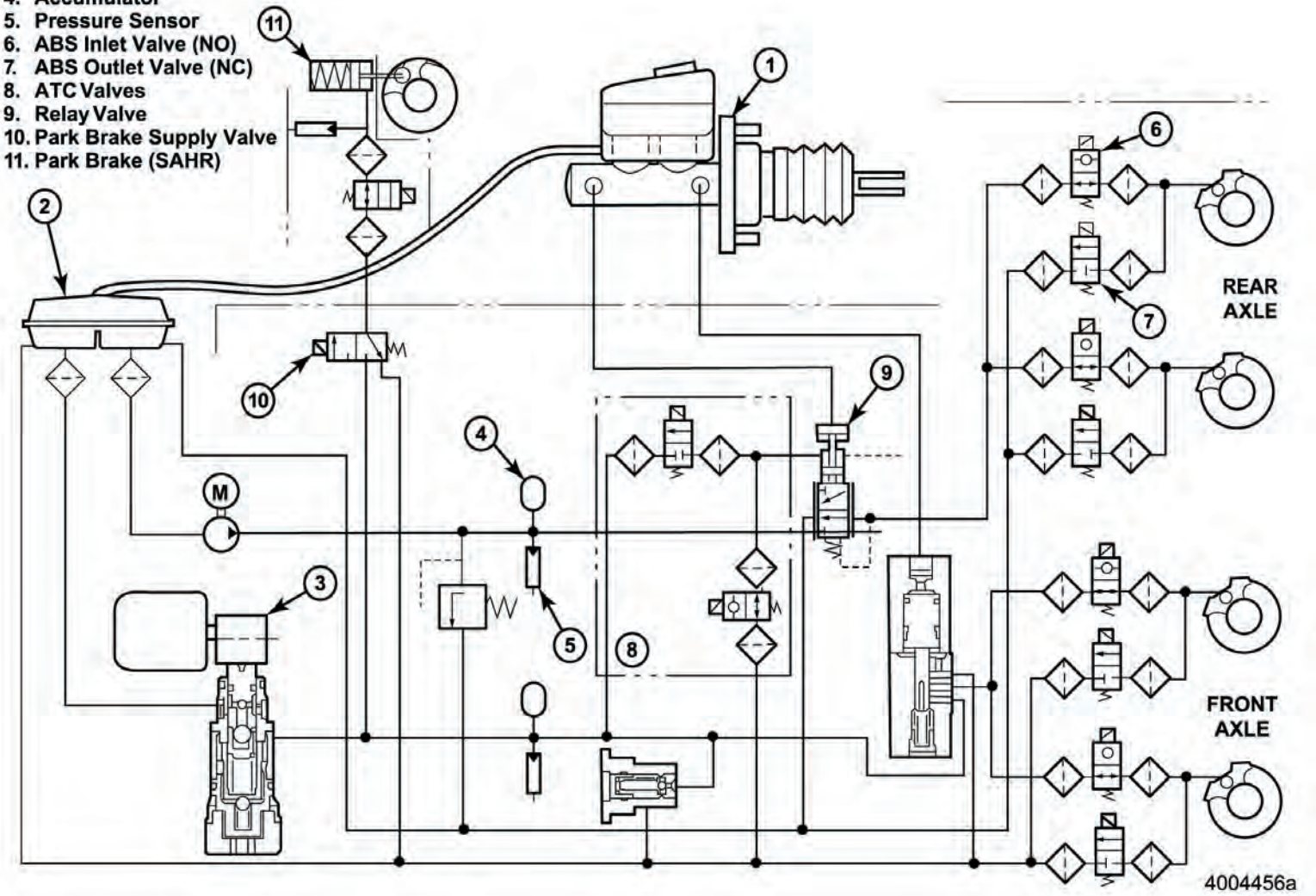
Meritor WABCO's hydraulic power braking system provides the energy required to actuate the brakes and control the ABS and ATC functions. The HCU is activated each time the ignition is turned on or whenever the driver steps on the brake pedal. If the system is equipped with the power park brake, the HCU also supplies the energy to release and control the service and park brakes.

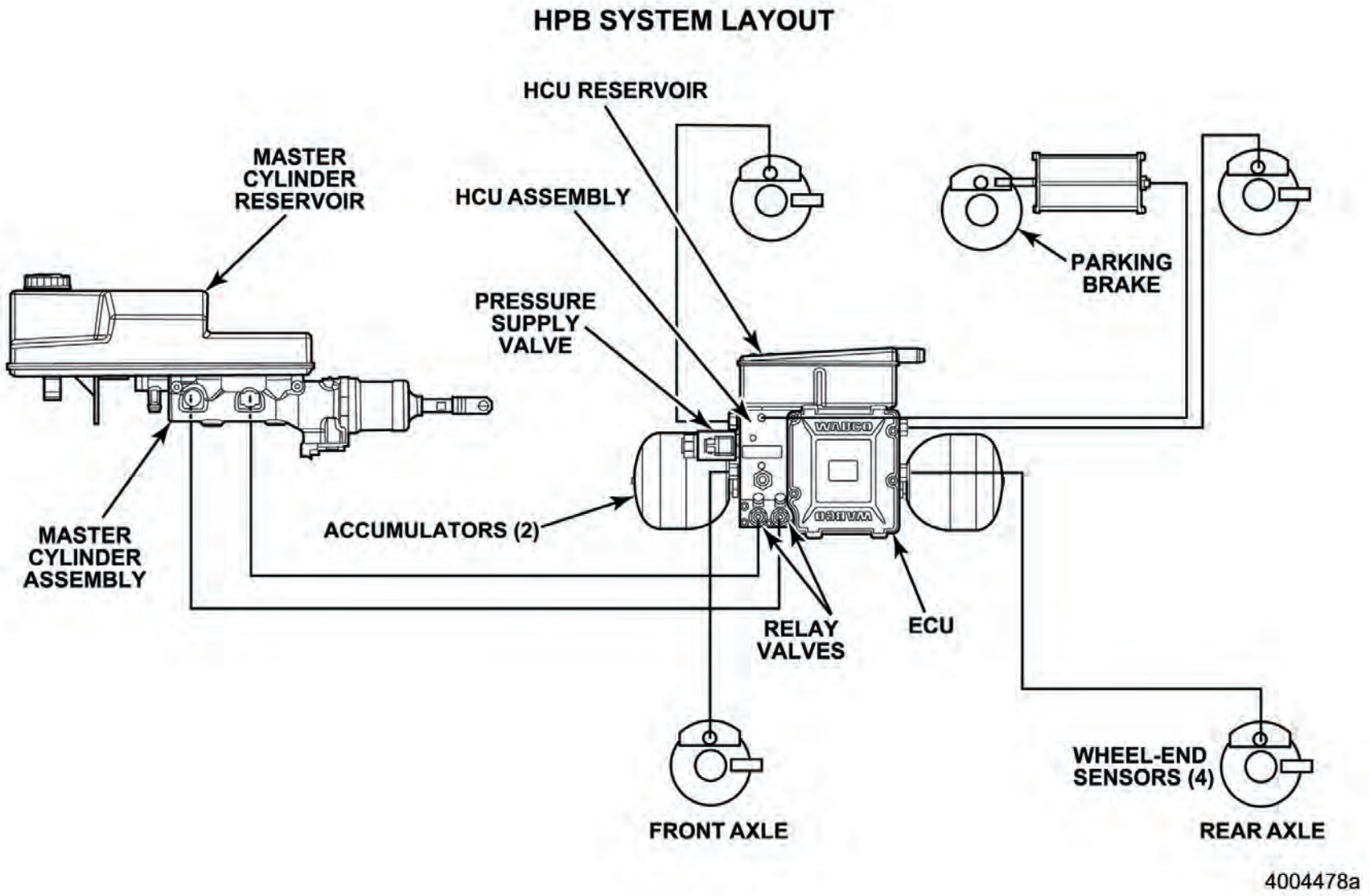
The following pages contain Meritor WABCO HPB system overview graphics. The graphics are:

- Complete HPB system layout, with hydraulic brake lines
- HPB System for Trucks – Overview

HYDRAULIC SYSTEM FOR HPB

1. Master Cylinder
2. Reservoir
3. Pump with Motor
4. Accumulator
5. Pressure Sensor
6. ABS Inlet Valve (NO)
7. ABS Outlet Valve (NC)
8. ATC Valves
9. Relay Valve
10. Park Brake Supply Valve
11. Park Brake (SAHR)





FUNCTIONAL DESCRIPTION

Hydraulic energy is stored in the gas-filled hydraulic accumulators, one for each circuit. When the vehicle's ignition is turned on, internal pumps are activated and fill both accumulators with hydraulic brake fluid. Two internal sensors, one in each accumulator, measure pressure and the ECU continuously monitors and controls pressure.

During normal operation, the ECU actuates two separate power drivers for the electric motors, keeping the pressure level within the desired limits. Two pressure relief valves provide safety against overpressure.

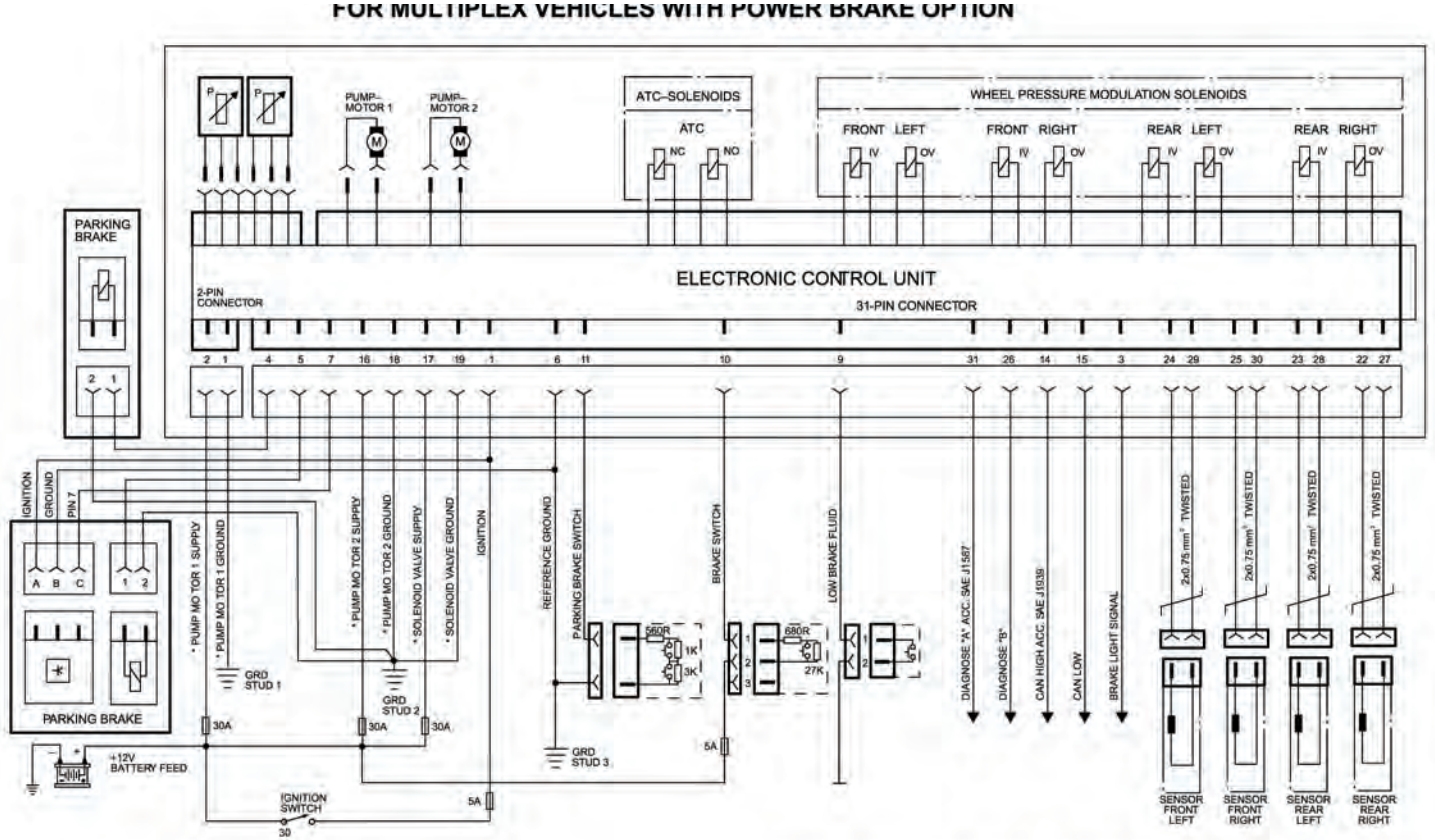
When the brake pedal is applied, the master cylinder provides a hydraulic signal to the relay valve. Proportional to that signal, the accumulators release pressure to the brake calipers. When the pedal is released, brake fluid returns from the brake calipers to the reservoir, and line pressure is reduced to zero.

For ABS, wheel pressure is individually modulated by eight integrated ABS solenoid valves in the ECU.

For ATC , the normally closed ATC solenoid valve in the ECU is actuated and hydraulic energy is supplied to the sensed wheel. At the same time, the normally open ATC valve is actuated to prevent fluid flow back into the reservoir. The brake pressure is then modulated by the corresponding ABS solenoid valves.

HPB FOR MULTIPLEX VEHICLES

The graphic below shows the Meritor WABCO HPB electronic control unit interface wiring diagram for multiplex vehicles.



NOTES:

ELECTRIC CABLES WITHOUT MARKS:
AWG 18 (SAE J 1128 TYP: TXL–CABLE) RESPECTIVELY 1MM^2:

BLADE TYPE FUSES CORRESPONDING TO ISO/DIS 8820
ABBREVIATIONS: IV — INLET VALVE
OV — OUTLET VALVE
NC — NORMAL CLOSED
NO — NORMAL OPEN

*** WIRE SIZE AWG 12 (SAE J 1128 TYP: GXL–CABLE) RESPECTIVELY MIN. 3 MM^2:**

TOTAL RESISTANCE INCLUDING CRIMP = 0.04 OHMS. CORRESPONDS TO AN OVERALL LENGTH OF 6 METERS.

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FOUNDATION BRAKE SYSTEM

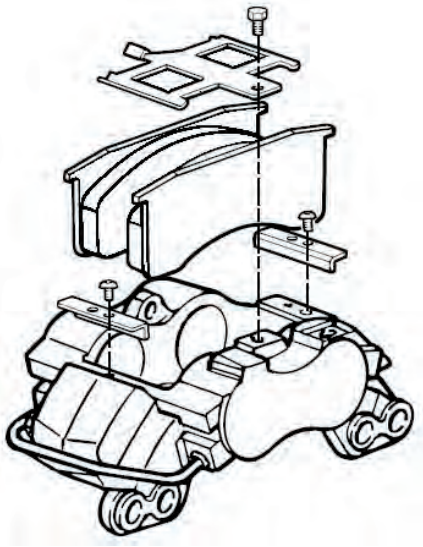
Meritor's quadraulic disc brakes have a four-piston, fixed-mount caliper design for use on both front and rear drive axles. An installation includes four major components — the caliper assembly, support assembly, hub/rotor assembly and the attaching hardware.

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

Features of the caliper include:

- Designed for hydraulic brake systems.
- Hard-mounted to the anchor plate to eliminate caliper and anchor plate replacement.
- Designed with hardened stainless steel mounting surfaces, high temperature piston boot compound, sealed bleeder screws and full-coverage zinc plating.
- Compatible with anti-lock braking systems (ABS) and existing hydraulic systems.
- Helps to increase lining life.

Caliper



- The caliper assembly consists of two halves assembled with four bolts and washers.
- 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.

How to Identify the Caliper

Check for an assembly number on the side of the caliper.

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. When the ABS system is not used or the sensor is mounted through the axle flange, the supports are not equipped with the sensor bracket.

Hub/Rotor

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

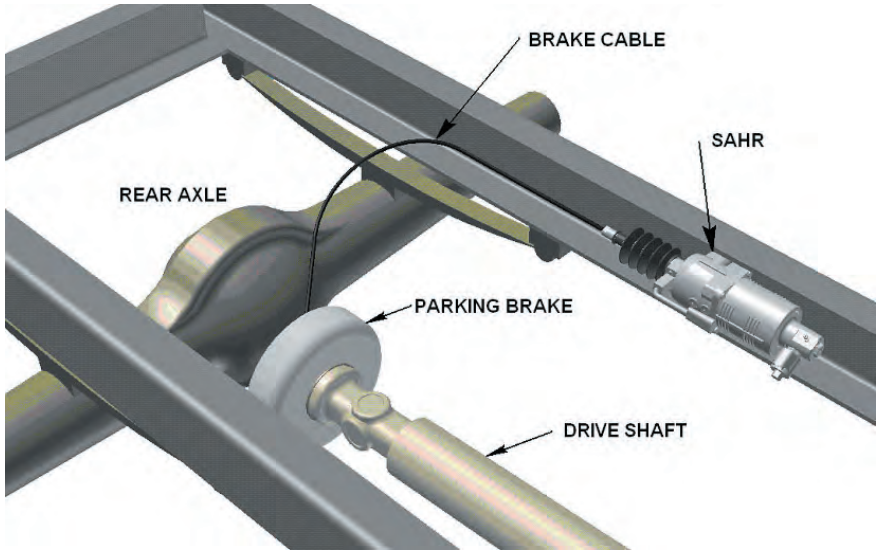
PARK BRAKE SYSTEM DESCRIPTION

The automatic apply parking brake system used on the UFO-Series chassis is an electro-hydraulic system. This style of parking brake is spring applied and hydraulically released via an electro-hydraulic pump. The park brake system consists of the following components:

- SAHR
- Manual control button
- Cables
- Differential mounted drum style park brake

The purpose of the automatic apply park brake system is to prevent the vehicle from moving while the vehicle is in park or neutral. The park brake system is controlled by the ECU on the Hydraulic Power Brake (HPB). The ECU has one input from the dash mounted park brake switch, an input from the park brake cut off sensor, one output for the park brake supply valve solenoid, and one output for the park brake cut off valve solenoid.

The park brake system utilizes a Spring Applied, Hydraulic Release (SAHR) brake actuator to apply the force to apply the cable actuated, drum-style, driveline parking brake. When tension is applied to the brake cable, brake shoes are expanded inside of the drum, effectively locking the drive wheels. When tension is removed from the brake cable, springs retract the brake shoes, releasing the drum and unlocking the drive wheels.

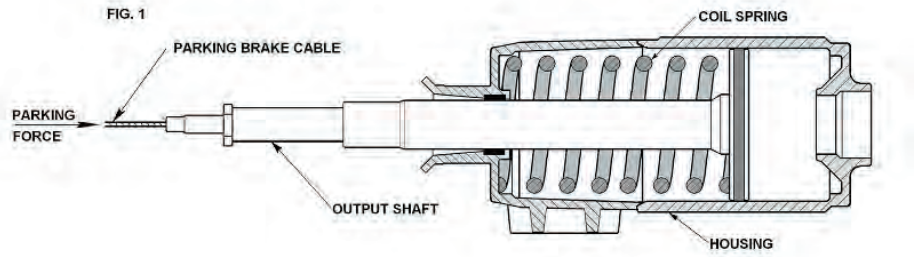


The other components of the powered parking brake system are:

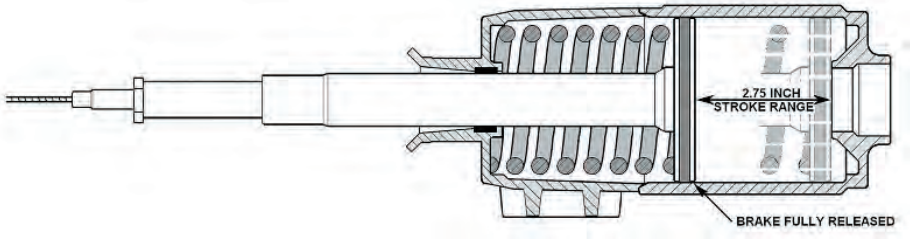
- Dash mounted switch
- Pressure Supply Valve (PSV)
- Cut-off valve
- Travel switch.

Spring Apply

The amount of movement (stroke) of the output shaft required to apply the brake depends on several factors such as initial adjustment of the cable tension, brake lining to drum clearance, etc.

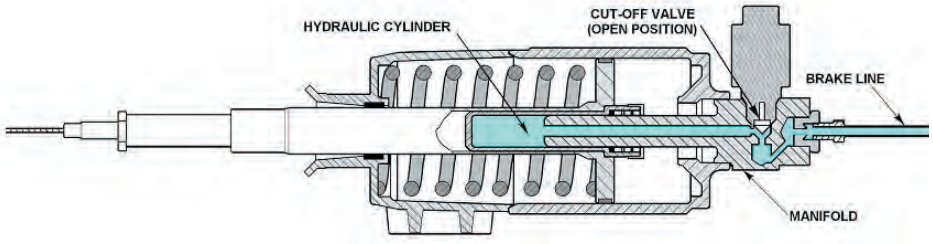


The stroke of the unit is typically around 1.25 inch with a total range of 2.75 inches from the fully released position. The force which the SAHR Actuator provides is between 400 and 500 pounds at 1.25 inches of stroke. Because the force is provided by a spring, the parking force will become lower as the unit travels (strokes) further. At 2.75 inches of stroke, the force is typically between 300 and 400 pounds.

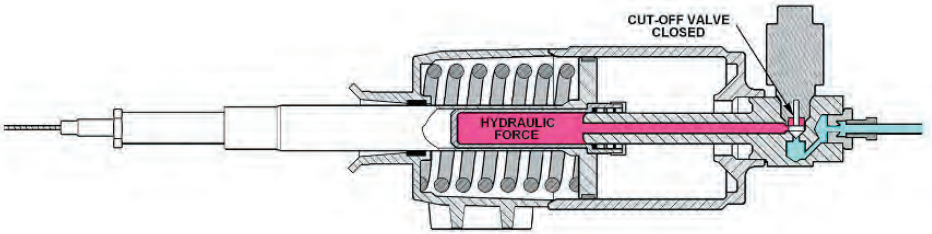


Hydraulic Release

A hydraulic cartridge is installed in the end of the SAHR Actuator to release the brake. This cartridge consists of a hydraulic cylinder, a manifold, and an electric solenoid valve (called the cut-off valve). The hydraulic brake line attaches to the manifold. Fig 3 below shows the SAHR unit in the “BRAKE APPLIED” position with the cartridge installed. There is no pressure in the brake line or hydraulic cylinder when the SAHR is in the brake applied condition.



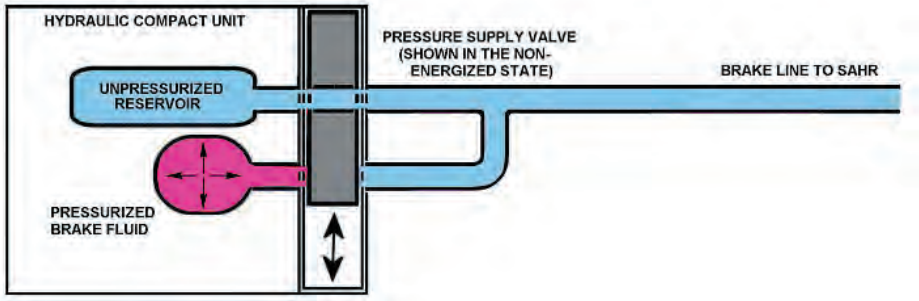
To release the parking brake, hydraulic pressure supplied thru the brake line will cause the hydraulic cylinder to push away from the manifold, thus compressing the power spring. The coil on the cut-off valve is then energized and the valve will be held close, thus trapping hydraulic pressure inside the cylinder keeping the actuator in the brake released position.



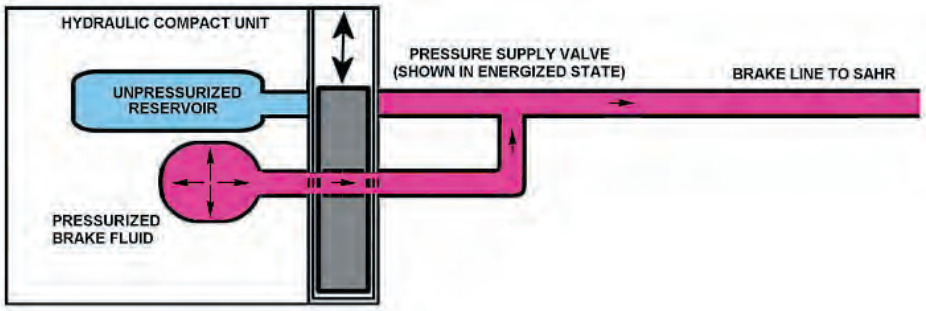
Interface with HCU (Hydraulic Compact Unit)

The HCU is the heart of the Full Power Brake System. It provides hydraulic brake pressure to the entire vehicle which includes the SAHR Actuator. A port on the HCU provides a route for brake fluid to and from the SAHR Actuator. This port is activated by the Pressure Supply Valve (PSV), which is controlled by the Electronic Control Unit (ECU).

The PSV is a 3-way valve. When the coil on the PSV is not energized, the brake line is open to the un-pressurized reservoir, thus there is no pressure in the brake line.



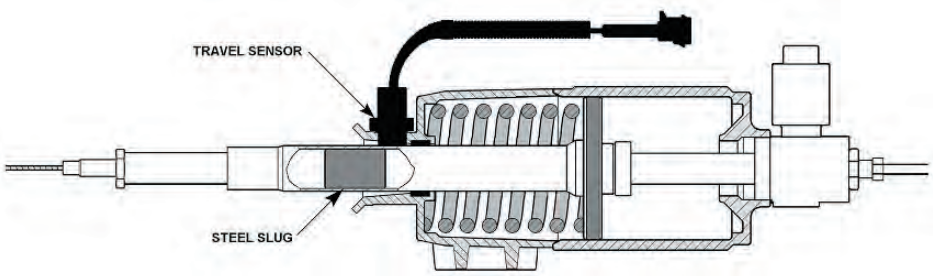
When the coil on the PSV is energized, pressurized brake fluid flows through the brake line to the SAHR Actuator. The valve also closes off the brake line so that pressure does not flow back to the un-pressurized reservoir.



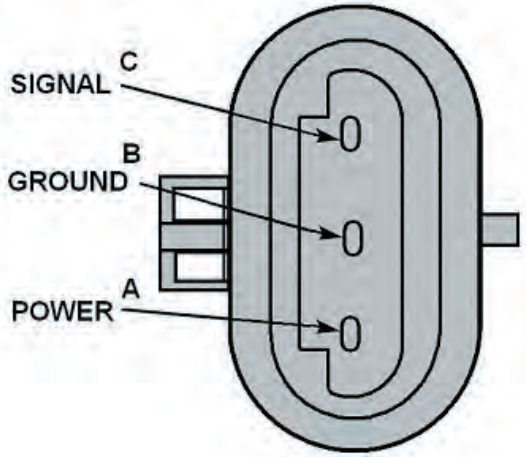
Travel Sensor

The SAHR Actuator assembly also includes a stroke travel sensor which tells the position of the output shaft to the ECU. This is the only sensor that communicates the operational status (released or applied) of the SAHR Actuator.

The following graphic shows a steel slug inside the aluminum tube which makes up the main component of the output shaft. The travel sensor contains a magnet and a Hall effect switch. When the steel slug passes close to the sensor, it conducts the magnetic field of the magnet inside the sensor and thus changes the state of the Hall effect switch.



Looking at the end of the travel sensor connector there are 3 pins

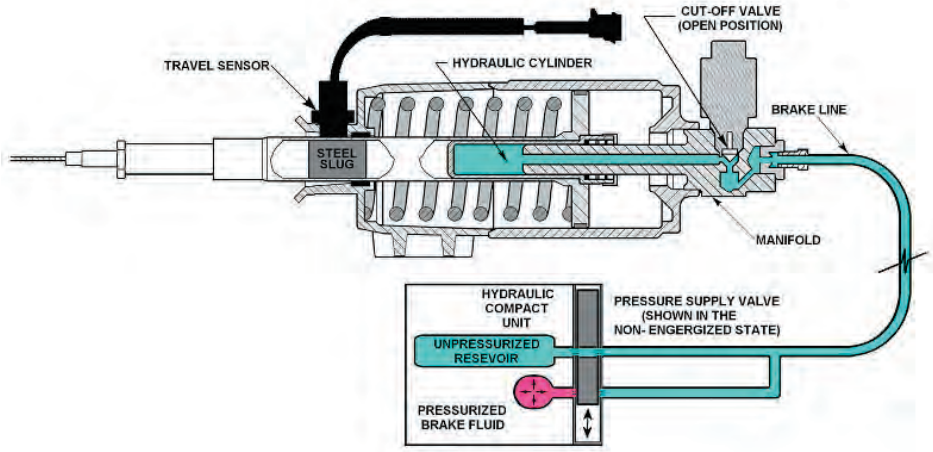


- The system ECU supplies power between 9 -18 volts to the Travel Sensor.
- When the steel slug is not under the Travel Sensor, the output signal should be the same voltage as the sensor input voltage.
- When the steel slug is under the sensor, the output signal should be less than 1 volt.

SAHR Operation

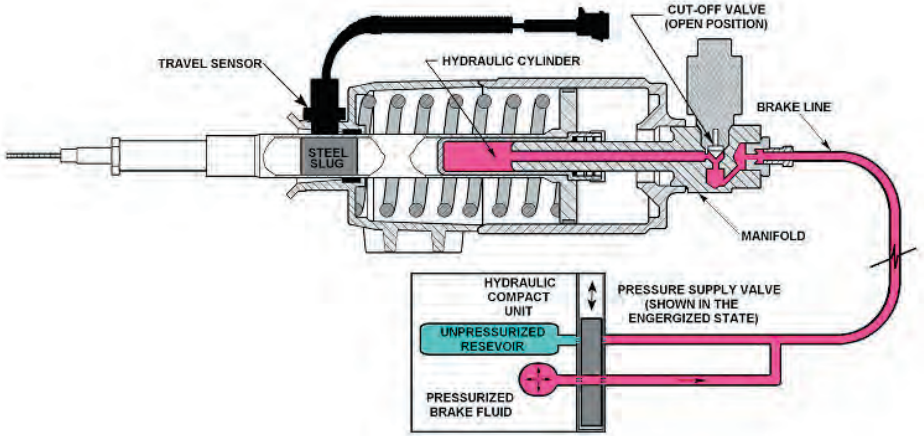
Starting with the parking brake in the APPLIED position, the components would appear as follows:

- The coil spring is applying tension to the parking brake cable.
- The cut-off valve on the SAHR Actuator is open (non-energized),
- The PSV is open (non-energized) to the unpressurized reservoir, so that there is no pressure in the hydraulic cylinder or the brake line.
- The steel slug is under the travel sensor which will indicate to the ECU that the brake is applied. The signal voltage from the sensor is less than 1 volt.



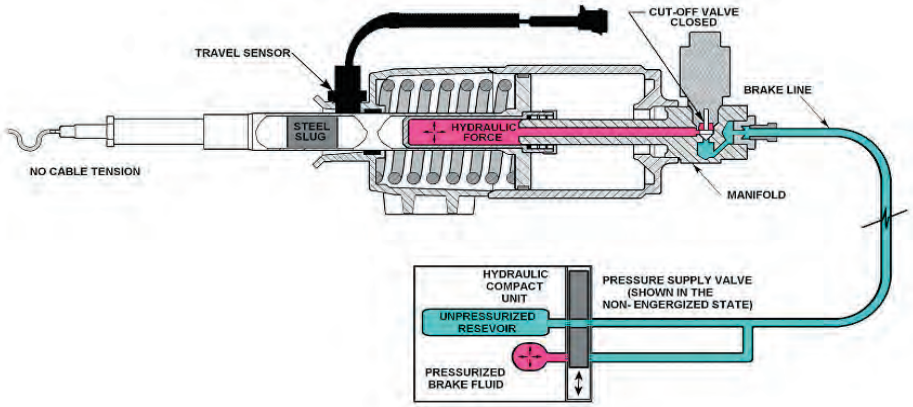
From the “Brake Applied” position, to begin to RELEASE the brake:

- Key is turned to the ignition position; this provides power to the brake system.
- The brake pedal is pressed down to apply the service brakes.
- The dash switch is pushed to release the parking brake.
- The PSV is energized.
- Pressurized brake fluid begins to flow from the HCU.
- The hydraulic cylinder begins to compress the spring inside the SAHR Acutator.



Brake Released

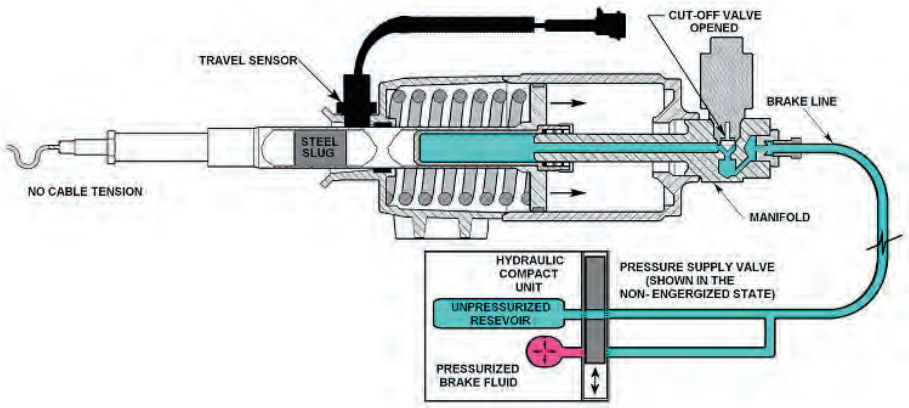
- When the steel slug moves past the travel sensor, the hall-effect switch changes state signaling the ECU that the brake is released.
- The ECU then energizes the cut-off valve on the SAHR, closing the valve and thus holding the SAHR Actuator in the RELEASED position by trapping the hydraulic pressure inside the hydraulic cylinder.
- The PSV is then de-energized and the brake line pressure dumps back into the unpressurized reservoir.
- This is the condition of the SAHR Actuator when the parking brake is released and the vehicle may be driven.



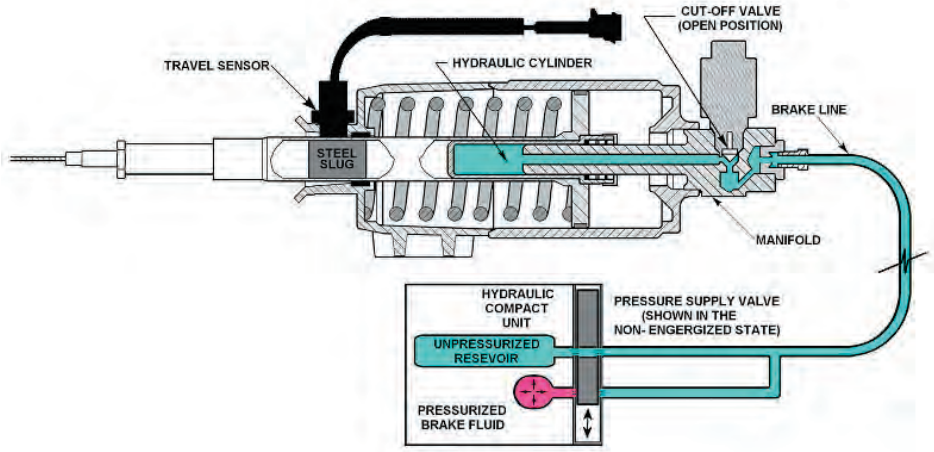
- As the SAHR Actuator is being released the steel slug will travel approximately 0.37 inch past the point where the travel sensor indicates that the brake is released. The full released position is determined by internal mechanical stops. As stated in section 5, the change of state of the travel sensor is related to the position of the steel slug inside the output shaft. The slug position in the shaft is controlled by the manufacturing plant.
- This 0.37 inch travel allows for small amounts of internal hydraulic pressere bleed back through the cut-off valve and into the brake line. When the actuator is released a small internal leak, if not replenished, could eventually lead to a dragging brake when the vehicle is being driven. However, the travel sensor will detect the movement at 0.37 inch of stroke and signal the ECU, which will then replenish the pressure and maintain the SAHR Actuator in the fully released position.

SAHR Operation starting with brake released and moving to brake applied. After the vehicle has been driven, to apply the parking brake:

- The service brake is used to bring the vehicle to a complete stop.
- The parking brake dash switch is pulled signaling the ECU to:
- De-energize the coil on the cut-off valve allowing the pressure trapped inside the hydraulic cartridge to return to the un-pressurized reservoir in the HCU.
- The initial .037 inch of shaft movement from the released position will take up slack and will allow the actuator to tension the park brake cable.



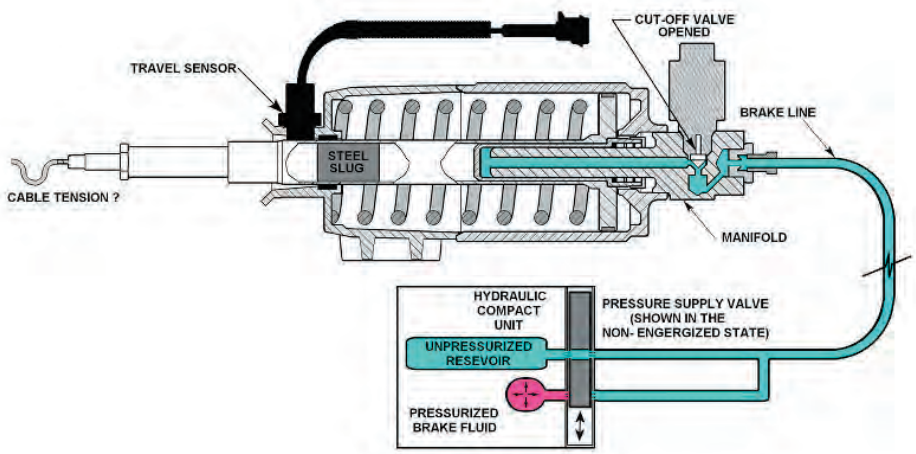
- The SAHR will stroke until it pulls tension on the parking brake cable and the brake shoes make contact with the brake drum.
- The steel slug will be under the travel sensor which will change state signaling the ECU that the brake is in the “BRAKE APPLIED” position and the ECU will turn on the parking brake light on the dash.



Brake Overstroked

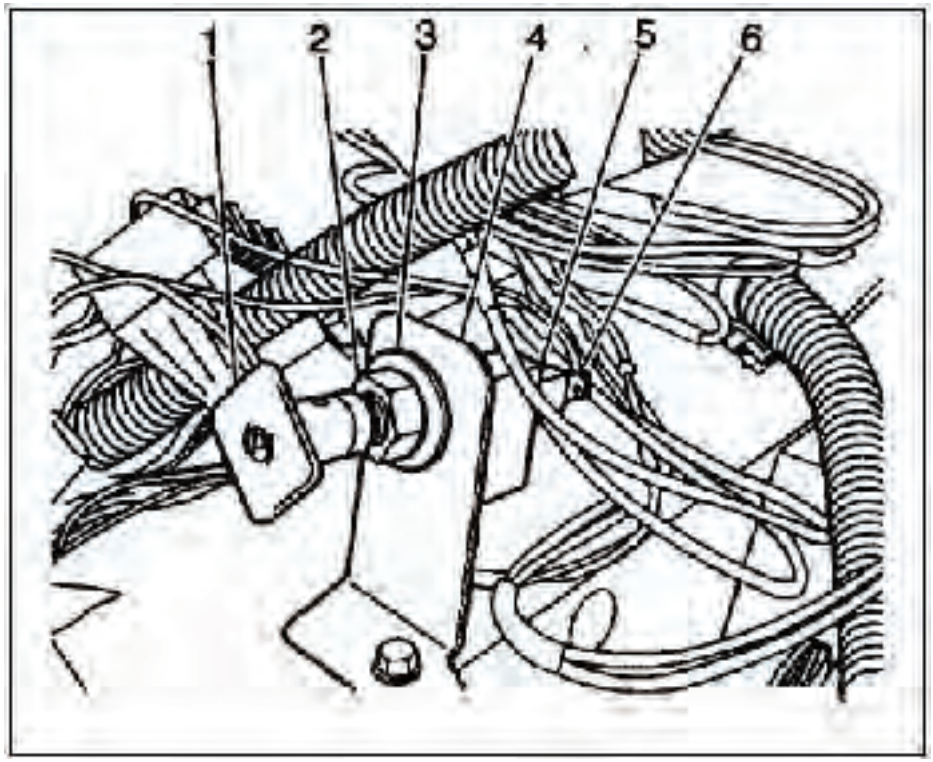
Occurs when the brake is applied but the stroke travels beyond 2.5 inches. Cause of Over-stroke include wear of brake components, and broken or disconnected parking brake cable. Overstroke of the SAHR Actuator is an indication that some other component in the parking brake system needs to be adjusted, repaired or replaced. Over-stroke is a warning that the SAHR Actuator is close to the end of its maximum stroke at which point, internal mechanical contact will reduce the parking force output of the SAHR Actuator to 0 and the parking brake will not be able to prevent the vehicle from rolling.

- The cut-off valve is open (non-energized). (as it should be for “Brake Applied” condition)
- The PSV is open (non-energized). (as it should be for “Brake Applied” condition)
- There is no pressure in the hydraulic cylinder or brake line. (as it should be for “Brake Applied” condition)
- The steel slug has traveled past and out from under the travel sensor so that the hall-effect switch changes state.
- There may or may not be any tension on the parking brake cable, thus the parking brake might not be able to hold the vehicle from rolling.
- The length of the steel slug has been engineered so that the SAHR Actuator has a brake applied range from 0.37 to 2.50 inches. If the SAHR strokes beyond 2.50 inches, it will still provide parking force up to 2.75 inches however the sensor will indicate “BRAKE OVERSTROKE” and the parking brake system should be serviced.



Dash Mounted Park Brake Switch

The dash mounted parking brake switch has three switch states (positions): apply (out), neutral (center), and release (in). The switch is spring-loaded to return to the neutral (center) position after either of the other positions is selected. A resistor network in the switch assembly allows the ECU to detect the position of the switch by sensing a change in the resistance value of the switch circuit. The resistor network also allows the ECU to detect malfunctions in the switch circuit. When the ECU detects the switch 'apply' actuation, it sets both the PSV and the cut-off valves to their non-energized states (normally open). This condition provides an open brake fluid connection between the SAHR canister and the HCU reservoir. With no pressurized fluid at the SAHR canister, the internal springs are used to retract the SAHR shaft, applying tension to the brake cable; which, in turn, applies the parking brake. The travel switch on the SAHR canister is used to indicate the shaft position to the ECU. If the shaft position does not indicate a properly applied parking brake, the ECU will generate a fault code and turn on the SERVICE PARK BRAKE indicator.



1. Pull Button
2. Nut
3. Washer
4. Mounting Bracket
5. Switch Connector
6. Harness Connector

When the parking brake is released using the dash switch, the ECU electronically controls the PSV and the cut-off valves as follows. First, the PSV is energized to route brake fluid from the pressurized primary accumulator circuit to the SAHR canister. The cut-off valve remains non-energized (open) long enough for the pressurized brake fluid to overcome the force of the internal springs and extend the SAHR shaft. Once the travel switch indicates that the shaft has extended, the ECU energizes (closes) the cut-off valve, preventing the pressurized brake fluid from leaving the SAHR canister. After a short delay the ECU returns the PSV to its non-energized state so that the parking brake line is again open to the HCU reservoir. This allows the parking brake line to be unpressurized even though the SAHR canister is pressurized (park brake released). With the SAHR shaft extended, the brake cable is no longer under tension and the parking brake is released. The travel switch on the SAHR canister is used to indicate the shaft position to the ECU. If the shaft position does not indicate a properly released parking brake, the ECU will generate a fault code and turn on the SERVICE PARK BRAKE indicator.

When the parking brake is in its released state (SAHR canister pressurized), small reductions of pressure may occur over a period of time. To prevent the pressure from dropping far enough to allow a partial parking brake application; the ECU commands the PSV and cut-off valve to repressurize the SAHR canister whenever the travel switch indicates that the SAHR shaft has moved beyond a preset limit. If system leakage requires the SAHR canister to be replenished too frequently, the HCU/ECU will enter the 'backup mode' and generate a fault code. The 'backup mode' is described in the following paragraph. In this condition the HCU/ECU will also turn on the SERVICE PARK BRAKE indicator.

The system has a safety function (backup mode) to ensure that the parking brake will not apply unexpectedly if the cut-off valve fails. When the cut-off valve fails it assumes its 'normally open' state. When the ECU detects a cut-off valve failure, it uses the PSV as a backup. To provide pressurization of the SAHR canister (to keep the park brake released), the ECU energizes the PSV. The energized PSV routes pressurized brake fluid from the primary accumulator circuit to the SAHR canister continuously to keep the parking brake in its 'applied' state. The parking brake line is pressurized continuously during the backup mode. When the ECU detects the cut-off valve malfunction, it will generate a fault code and turn on the SERVICE PARK BRAKE indicator. The parking brake circuit is placed in the backup mode any time SERVICE PARK BRAKE indicator is turned on.

A travel switch mounted on the SAHR canister monitors the action of the park brake shaft and cable. The state of this switch is read by the ECU to determine:

- if the parking brake is applied (ECU will send a signal to the ESC requesting it to turn on the PARK BRAKE indicator.)
- if overtravel of the brake cable is occurring (possible worn brake shoes or stretched/broken cable)
- if undertravel of the brake cable is occurring (possible frozen park brake or cable).

The ECU also monitors the status of the park brake switch, and the current flow to the cut-off and pressure supply solenoid valves used to route brake fluid between the HCU and the SAHR canister. If any fault condition is detected, the ECU will send a signal to the ESC requesting it to turn on the SERVICE PARK BRAKE indicator, and place the park brake circuit in the backup mode. In addition, a diagnostic code will be generated by the ECU and stored in memory. Retrieval of the diagnostic codes is explained later in this section.

DYNAMIC PARKING BRAKE FUNCTION

This function is controlled by the ECU. The ECU is constantly monitoring vehicle speed. If it detects a parking brake apply signal while vehicle speed is above 2 mph, it uses the ATC and ABS valves to apply the rear service brakes. After the vehicle has come to a safe stop, the driveline parking brake is applied as described above.

PARKING BRAKE SAFETY INTERLOCKS

The parking brake apply/release input signal to the ECU is normally provided by the dash mounted park brake switch as described above. However, because the HCU/ECU is electronically controlled, various interlocks can be used to control the parking brake and even override the park brake switch. The following interlock functions are used to verify that safe conditions exist before allowing the parking brake to be applied or released.

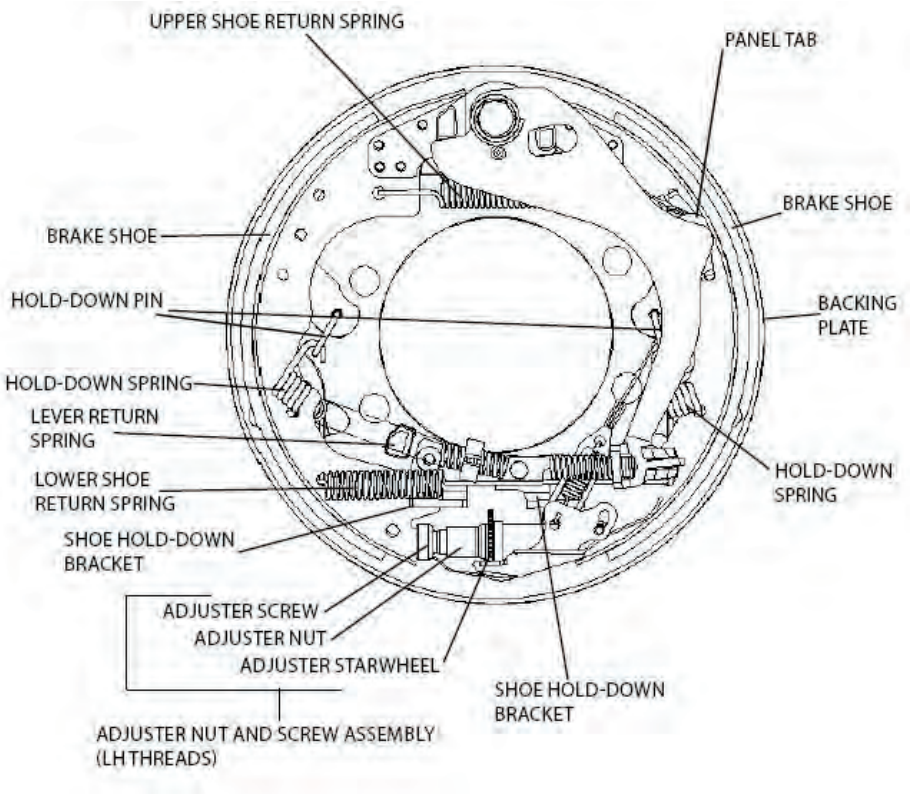
- When the park brake is applied, driver cannot “drive” against the park brake. When the parking brake is applied the ECU sends a J1939 message to the engine control module to reduce engine torque.
- The parking brake applies automatically when the key is turned off and the vehicle is stopped. If the key is turned off while the vehicle is moving (more than 2 mph), the park brake is prevented from coming on.

The ECU electronically monitors the vehicle speed and the position of the ignition key; and will apply the parking brake only when the correct conditions exist.

- Pressing the dash switch will ONLY release the park brake if all of the following conditions are met. The ECU detects these conditions electronically and responds to the dash switch only when the correct conditions exist.
  - — The foot brake must be applied.
  - — The ignition key must be in the “On” position.
  - — There must be no major brake system faults.
  - — If the vehicle is equipped with the optional “Auto Apply” feature, the shifter must be in a position other than PB.

Parking Brake Shoes and Related Components

Brake shoes are attached to the backing plate by hold-down springs and pins. Both shoes seat against the backing plate anchor post at the top and are connected by the adjuster nut and screw assembly at the bottom. Shoe hold-down brackets are permanently mounted to the backing plate to assist in guiding the shoes. The shoes are pulled toward each other by two low-tension shoe return springs. Proper orientation of the various springs, including their hook ends, must be maintained for proper function. The starwheel used for adjusting the shoe clearance to the drum is on the adjuster nut.



Shoe Cage Adjusting Components

The clearance between the shoe linings and the inside drum surface is adjusted in response to excessive movement of a given shoe when the brake is actuated. This excessive movement is typically due to normal wear of the lining during use. The adjuster cable is anchored on top of the anchor post, under the cam, by the anchor screw, routed along the side of the shoe by a cable guide, and attached to the auto adjuster lever via a spring (assembled on the cable end-fitting) at the bottom of the brake. A push in panel tab retains the cable in the cable guide. The adjuster lever seats against the starwheel on the adjuster nut. The adjuster screw and adjuster nut/starwheel assembly use left hand threads to expand the shoes to compensate for lining wear.

DIAGNOSTIC INFORMATION AND PROCEDURES

Indicator Lamps

If the indicator lamps do 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. After checking the indicator lamps, make repairs as necessary.

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.

IMPORTANT:
No gap is allowed at installation. During normal operation, a gap not to exceed 0.04-inch (1.02 mm) is allowed.

Vehicle Test Drive

After replacing an HPB component, test drive the vehicle as follows:

1. Turn ignition ON.

IMPORTANT:
Depending on the vehicle, the ATC lamp may be labeled differently and some vehicles may not have an ATC lamp. Refer to the vehicle specification sheet for label designation.

2. Check the vehicle dash lamps:
   - All of the dash lamps for HPB come on briefly (approximately three seconds) for a bulb check, then go off. This indicates the system is O.K.
   - ABS and ATC lamps do not go off. The system is looking for wheel speed. Drive the vehicle at speeds of 10-15 mph (16-24 km/h). The ABS and ATC lamps will go off. This indicates the system is OK.
   - ABS and ATC lamps do not go off after the vehicle reaches a speed of 10-15 mph (16-24 km/h). This indicates there is a system fault. Perform vehicle diagnostics and make all of the necessary repairs, including appropriate bleed procedures, before returning the vehicle to service.
3. Drive the vehicle for a short distance. Make gentle brake applications to verify brake performance.

TROUBLESHOOTING USING MERITOR WABCO TOOLBOX™ SOFTWARE

This section contains information for testing the HPB system with TOOLBOX™ Software, and for performing standard component and electrical tests.

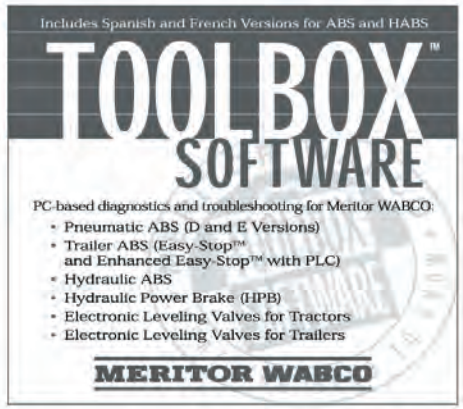
WARNING:

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.



1004690c

TOOLBOX™ Software is a PC-based diagnostics program required to diagnose HPB system faults. For HPB, version 5.0 or higher is required. The program runs in Windows® 98 or higher. TOOLBOX™ is available via the WOW message board under the Service tab. Use TOOLBOX™ Software to verify the activation of various system components.

- Turn valves, pump and retarder relay on and off (Valve Activation Menu)
- Turn indicator lamps on and off (Miscellaneous Output Activation Menu)

IMPORTANT:

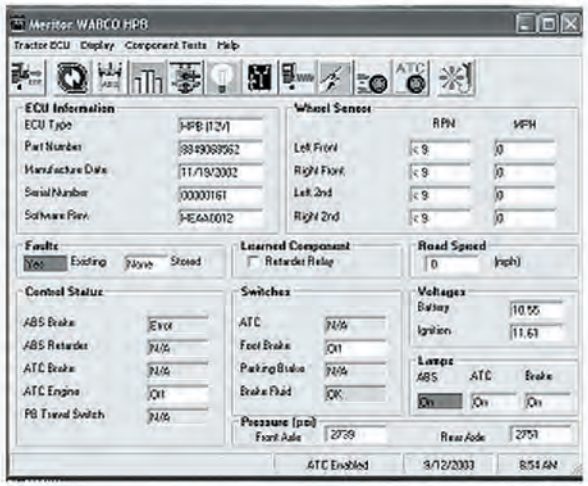
TOOLBOX™ Software must be connected to the vehicle and the vehicle ignition must be ON in order to display information. For complete instructions for using this program, refer to the User's Manual, TP-99102. Contact Workhorse Custom Chassis Technical Assistance Center (TAC) at 877-246-7731 for information about TOOLBOX™ Software.

Hydraulic Power Brake Menus and Toolbars

Select Hydraulic ABS from the TOOLBOX™ Main Menu. TOOLBOX™ senses the type of ECU being used and displays 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.

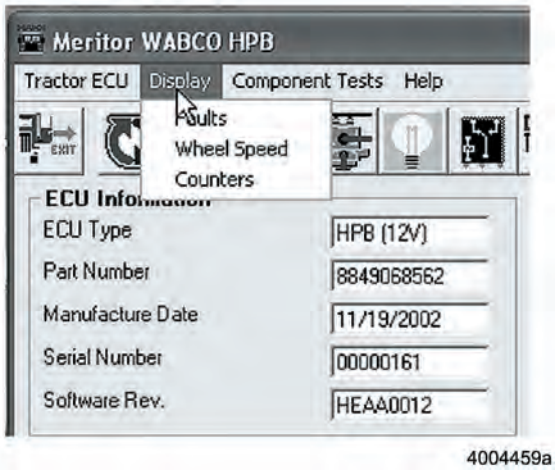


4004458a

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.

Display

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



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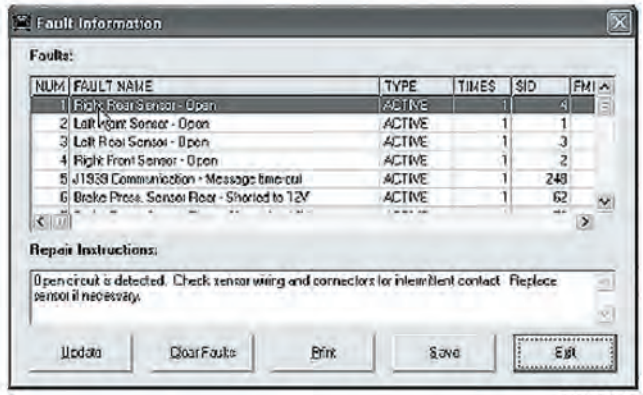
Faults

Select Faults to display the Fault Information screen.

IMPORTANT:

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



4004460a

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.

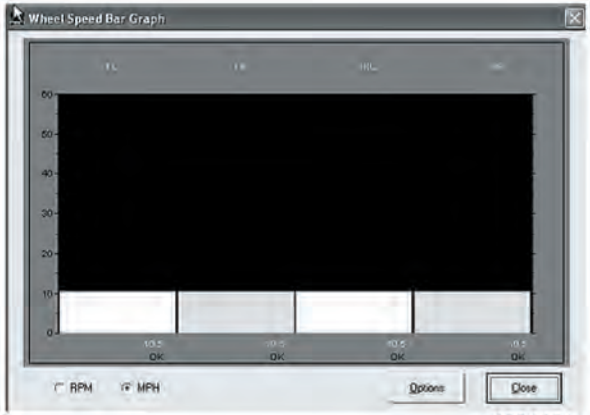
Faults that occur after the screen is displayed will not appear until a screen update is requested. Use the Update button at the bottom of the screen to refresh the fault information table and display a new list of faults.

After making any required repairs, use the Clear Faults button to clear the fault. Clear each fault as it is repaired. Cycle the ignition after clearing the faults.

Use the Save or Print button to save or print the fault information data. Select Exit to close this section.

Wheel Speed

Select Wheel Speed to display the Wheel Speed screen.



4004461a

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

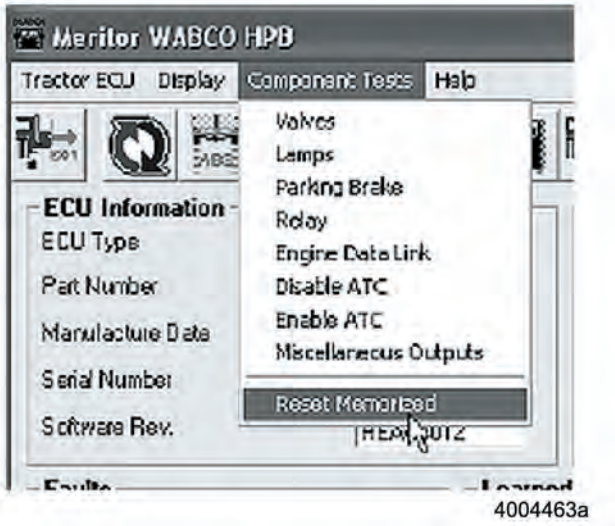
Select Counters to display the Counters screen.

4004462a

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

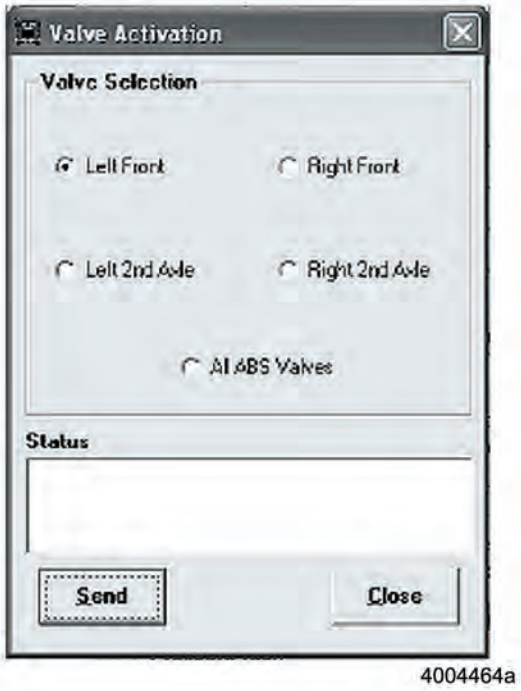
Select Component Tests from the HPB Main Screen. A pull-down menu will appear.



4004463a

Valves

Select Valves to display the Valve Activation test screen.



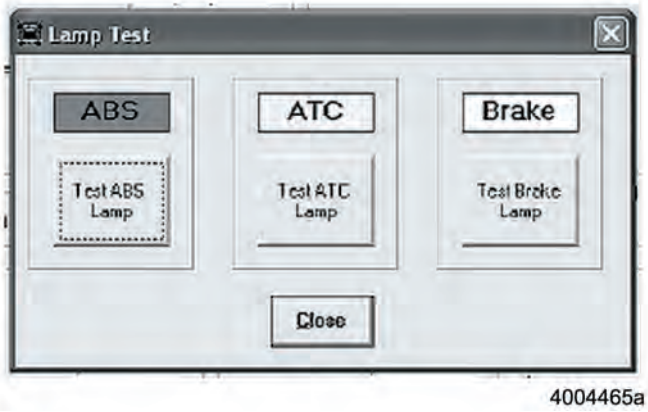
4004464a

The Valve Activation test screen lets you activate the HPB valves to check for correct activation and to 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.



4004465a

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

Parking Brake

The parking brake option is not used on the UFO™ chassis. This option in the software will not function.

Relay

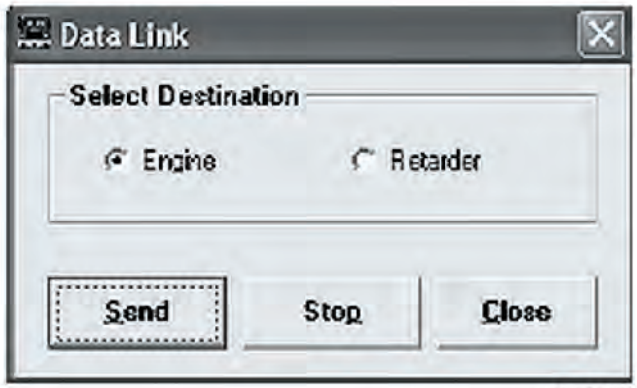
Select Relay to display the Activate Relay test screen.

4004467a

This screen is not used on the UFO™ Chassis. Select Close to exit this screen.

Engine Data Link

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



4004468a

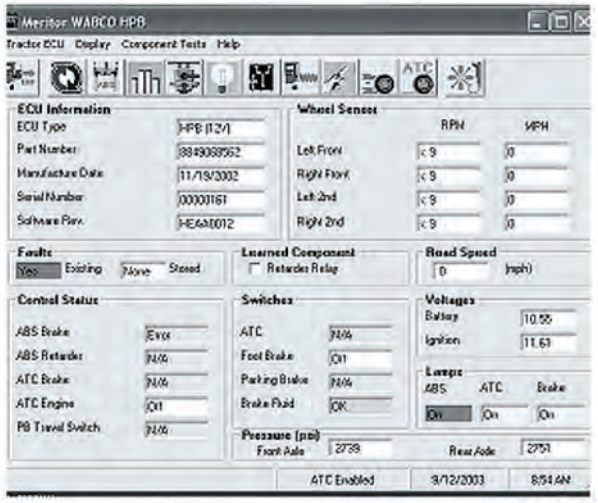
This screen is not used on the UFO™ Chassis. Select Close to exit this screen.

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.



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IMPORTANT:

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

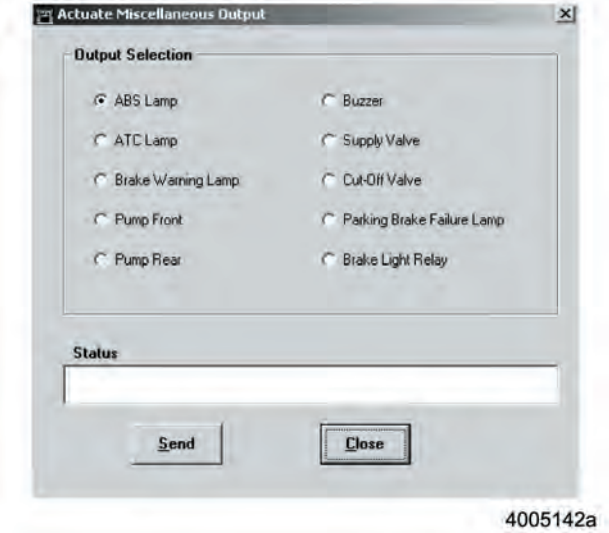
Miscellaneous Outputs

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

IMPORTANT:

Use TOOLBOX™ Software 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.



4005142a

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

Select Reset Memorized to display the Learned Component screen.

4004471a

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.

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.

WHEEL SPEED SENSOR LUBRICATION

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).
- Lubricants approved for use on Meritor WABCO sensors and spring clips are:
  - — Mobilith SHC-220 (Mobil)
  - — TEK 662 (Roy Dean Products)
  - — Staburags NBU 30 PTM (Kluber Lubrication)
  - — Valvoline EP 633
- When replacing the wheel speed sensor on the HPB system, It is not necessary to bleed the system.
- When replacing the wheel speed sensor, the sensor spring clip must also be replaced.

SYSTEM REQUIREMENTS AND COMPONENT TESTS

Tire Size Range

For correct hydraulic ABS operation, front and rear tire sizes must be within 16% of each other. Do not use a tire size range that exceeds 16%.

Calculate the tire size with the following equation:

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

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 10 and 16 volts for the 12-volt hydraulic ABS to function correctly. Check the voltage as follows.

1. Turn the ignition ON.
2. Check for correct voltage:

31-Pin Harness:

- Pins 1 and 6 for ignition and ground
- Pins 16 and 18 for pump motor 2
- Pins 17 and 19 for the solenoid valve

2-Pin Power Connector:

- Pins 2 and 1 for pump motor 1

If voltage is not between 10 and 16 volts, verify the wiring connections. Make corrections as required.

Park Brake System Diagnosis

WARNING:

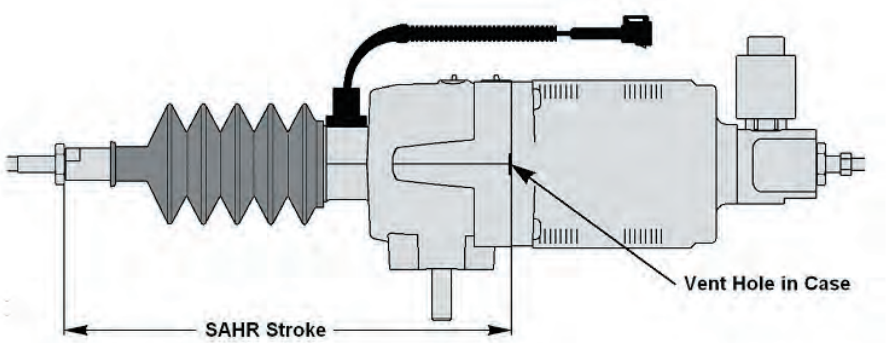
For the following steps, be sure to use wheel chocks so that the vehicle will not roll.

Check The SAHR Actuator For Proper Operation

After placing wheel chocks to prevent the vehicle from rolling, release the parking brake by:

- Turn key to the ignition position; this provides power to the brake system.
- Press down on the brake pedal to apply the service brakes.
- Push dash switch to release the parking brake.

When the brake is released, the output shaft extends out of the SAHR Actuator housing and stops at a set distance. This set distance is controlled by internal mechanical stops. With the brake released, a tape measure can be used to measure from the jam nut on the end of the output shaft to the seam in the SAHR Actuator housing.



SAHR Actuator Position	Stroke (in)	Sensor Signal	Cut-off Valve Status	PSV Status
Brake Fully Released	10.6	12 volts	12 volts	No Voltage
Preferred Operating Range of Brake Applied	9.8 – 8.7	Low Voltage	No Voltage	No Voltage
Over-stroke Signal	8.1 – 7.8	12 volts	No Voltage	No Voltage

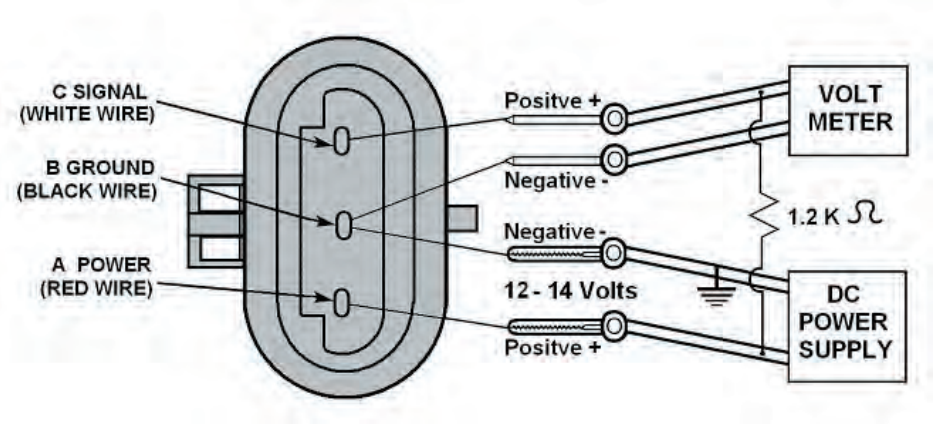
1. When the brake is released, the parking brake cable should be slack.
2. When the brake is applied, the parking brake cable will be under tension. If the stroke is outside of the preferred operating range per Fig 13, inspect and adjust the appropriate mechanical parts of the brake system to bring the stroke back within that range.
3. If the SAHR Actuator reaches the over-stroked position, it is an indication that one of the other system components may be damaged or misadjusted. Over-stroke is not a failure of the SAHR, but an indication that something else is not correct.

Travel Sensor Diagnosis

IMPORTANT:
Only move on to travel sensor diagnosis after verifying that the SAHR unit strokes within the correct range, refer to Check The Sahr Actuator For Proper Operation.

IMPORTANT:
This proceedure requires the use of a DC power supply or battery capable of supplying 12 -14 volts DC to power the Travel Sensor.

1. Refer to the following graphic to connect the power supply as follows:
   - Power Supply Positve (+) connects to Travel Sensor Power Terminal A
   - Power Supply Negative(-) connects to Travel Sensor Ground Terminal B
2. Use a standard voltmeter, capable of measuring 0-14 volts DC, to measure the travel sensor output. Connect the voltmeter as follows:
   - Volt Meter Positive (+) connects to Travel Sensor Signal Output Terminal C
   - Volt Meter Negative (-) connects to Travel Sensor Ground Terminal B
3. Connect a 1.2k ohm resistor between the Travel Sensor power terminal A and Travel Senor Output terminal C.



4. When the SAHR Actuator is fully released, the metal slug will not be under the Travel Sensor. Thus, the reading on the volt meter should be the same as the power supply, approximately 12-14V DC.
5. When the SAHR Actuator is applied, the steel slug will be under the Travel Sensor. This will change the state of the switch. The output voltage should drop to less than 1 volt.
6. When the SAHR Actuator is released again, the reading on the volt meter should return to the higher level: that is, it should be the same as the power supply, approximately 12-14V DC.

Cut-off Valve

The cut-off valve is a normally open solenoid valve. When the brake is applied, the valve is open. When the brake is released, electrical voltage is applied across the coil actuating the valve closed. The normal resistance of the coil is 9.3 ohms +/- 10%. This can be checked by unplugging the connector from the wiring harness and checking the resistance between coil pins with a multi-meter. Resistance outside of this range may indicate that

the coil is developing or has a short. Simple functional tests of cut-off valve include:

Release parking brake using dash switch. Observe stroke of SAHR Actuator shaft. If system is functioning correctly, the shaft should remain extended. If the shaft does not remain extended, the cut-off valve is not trapping fluid pressure inside the SAHR Actuator. There may be 4 possible problems:

1. Defective Coil – check resistance per section 7.3 and replace coil if resistance is out of specification (9.3 ohms +/- 10%).

CAUTION:

When replacing coil, do not exceed 5 lb ft of torque on the coil nut. Excessive torque can damage the valve stem, causing the valve to become non-functional.

2. No voltage from ECU.
3. Defective Valve – If steps 1 and 2 above do not indicate a problem, the valve may be defective. Replace valve or hydraulic cartridge??
4. Leaking brake fluid out of hydraulic cylinder. This would be indicated by brake fluid dripping from the vent slot in the bottom of the SAHR Actuator housing.

Leave SAHR in released position (shaft extended) for 90 minutes; this will allow time for the coil to come up to full stabilized temperature. Coil may function correctly when cold (ie: ambient temp. when first activated) but could fail after temperature rises due to sustained release condition.

Unplug the connection to the cut-off valve. SAHR Actuator shaft should immediately begin to retract, thus applying the brake.

MAINTENANCE AND ADJUSTMENT PROCEDURES

WARNING:

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

Release all air from the air systems before you remove any components. Pressurized air can cause serious personal injury.

The full power brake system is a pressurized system that achieves pressures of up to 2320 psi. This pressure is not reduced by switching the ignition off or removing battery power. Prior to servicing this system, the depressurization procedures must be performed exactly as presented. Failure to depressurize the system may result in personal injury or death.

CAUTION:

The HPB hydraulic power brake system is a complex device that provides optimum efficiency and operation. If the system sustains damage, or a component malfunctions and requires replacement, the replacement procedures provided by Meritor WABCO must be followed exactly with the associated steps performed in the order presented.

CAUTION:

Hydraulic brake fluid is a caustic substance. Contact with the 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 contact brake pads, shoes, rotors or discs.

Before disposing of used HPB components, verify the warranty status. Contact Workhorse Custom Chassis Technical Assistance Center (TAC) at 1-877-246-7731.

PARK BRAKE SYSTEM MAINTENANCE

This section contains general maintenance information and procedures. There is no regularly scheduled maintenance required for the Full Power Brake system.

During bleeding, special tools may be required. Because the Master Cylinder (MC) system is isolated from the wheel caliper system, brake pedal feel does not indicate properly bled brakes. Air can still exists in the lines between the HCU and the calipers. Insure that ALL NECESSARY bleeding procedures have been properly performed after any repairs that require disconnecting brake lines. If lines are disconnected in both the MC circuit and the wheel caliper circuits; then, both bleeding procedures must be performed. If the SAHR (parking brake) circuit is opened, the SAHR bleed procedure must be performed. If the HCU is removed or replaced, all three bleed procedures must be performed.

WARNING:

The full power brake system is a pressurized system that achieves pressures of up to 2320 psi. This pressure IS NOT reduced by switching the ignition off or removing battery power. Prior to servicing this system, the depressurization procedures MUST BE PERFORMED EXACTLY AS PRESENTED. Failure to depressurize the system may result in property damage, personal injury or death.

PARK BRAKE SYSTEM INSPECTION

WARNING:

Whenever possible, work on brakes in a separate area away from other operations. Always wear a respirator approved by NIOSH or MSHA during all brake service procedures. Wear the respirator from removal of the wheels through assembly. NEVER use compressed air or dry brushing to clean brake parts or assemblies. OSHA recommends that you use cylinders that enclose the brake. These cylinders have vacuums with high efficiency (HEPA) filters and worker's arm sleeves. But, if such equipment is not available, carefully clean parts and assemblies in the open air.

Clean brake parts and assemblies in the open air. During disassembly, carefully place all parts on the floor to avoid getting dust into the air. Use an industrial vacuum cleaner with a HEPA filter system to clean dust from the brake drums, backing plates and other brake parts. After using the vacuum, remove any remaining dust with a rag soaked in water and wrung until nearly dry.

1. Remove the park brake drum. Clean the individual brake components, removing dust to the extent reasonable.
2. Visually inspect the brake shoes. Linings should be replaced if there is uneven lining wear or when the remaining lining reaches 0.76mm (0.030" or approximately 1/32") thickness or less above the shoe. If grease, automotive fluids or other foreign matter that would compromise friction performance is found on, soaked into, or embedded in the linings, the shoes should be replaced. If cracks, excessive deformation, or wear of either end is found, the shoes should be replaced.
3. Visually inspect the brake lever and cam. If cracks, excessive wear, or abnormal deformation is found in either part, they should be replaced.
4. Inspect all springs and hold down pins for excessive corrosion, heat discoloration, wear, or other damage. Replace as needed.
5. Inspect for damage or wear of the adjuster cable assembly. Replace as needed.
6. Inspect adjuster nut and screw for any damage to the threads, burr, chip or other damage to the teeth on the adjuster nut star wheel. Damaged teeth or threads may prevent proper function of the brake self-adjusting function. Replace as needed.

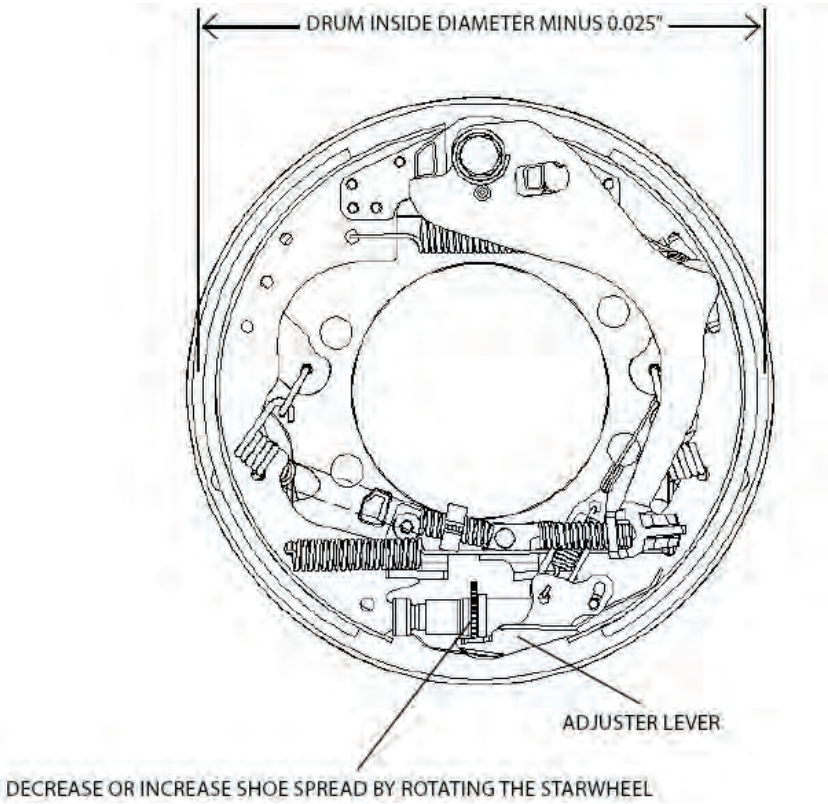
7. Clean any dust or grease present on the inside of drum. Use a 12 inch caliper or an inside diameter micrometer to measure the inside diameter of the drum.The inside diameter is stamped on the inside of the drum near the mounting holes. Replace the drum if it exceeds the maximum inside diameter, is worn unevenly, has deep grooves, or excessive runout.

Shoe Cage Adjustment Procedures

Adjustment with Drum Off - Primary Procedure.

1. Use a 12-inch caliper, or inside micrometer, to measure the inside diameter of the drum. Subtract 0.02 5 inches from the drum inside diameter measurement. Set the measurement caliper to this value, and lock the set screw.
2. Rotate the axle input flange yoke as necessary to provide clearance for the measurement caliper.
3. Place the pre-adjusted caliper over the shoes at the center of the shoes.
4. To adjust brake, rotate the starwheel until the shoes touch the measurement caliper jaws. It is necessary to disengage the adjuster lever away from the starwheel.

IMPORTANT:
During adjustment the calipers should be moved up and down around the shoe center points to ensure adjustment at the highest points across the width of the shoes.



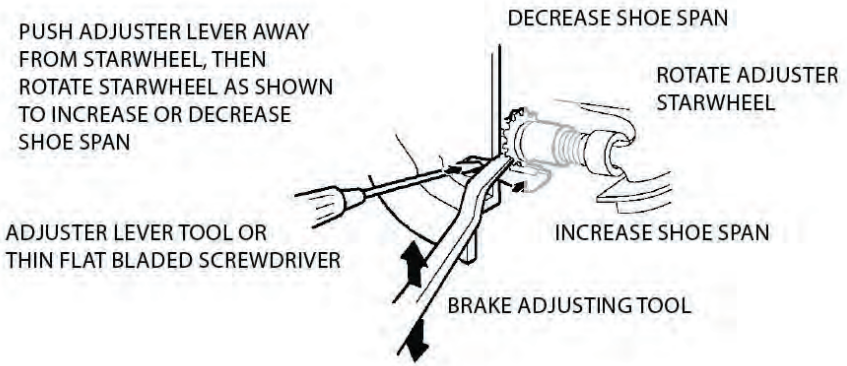
Adjustment with Drum Installed - Alternate Procedure

1. With the engine off, the battery disconnected, and the tires blocked to prevent vehicle movement, place transmission in neutral and fully release the parking brake. Check to see if the drum can be rotated back and forth by hand. If the drum cannot rotate, it will be necessary to raise the rear wheels off the ground, in order to allow rotation of the drum. Support the vehicle with suitable floor stands.

IMPORTANT:

Some vehicles may not have enough clearance behind the park brake to have direct access through the access slot to the adjuster lever. In these cases, an adjuster lever tool can be made from 3/32" diameter welding filler rod.

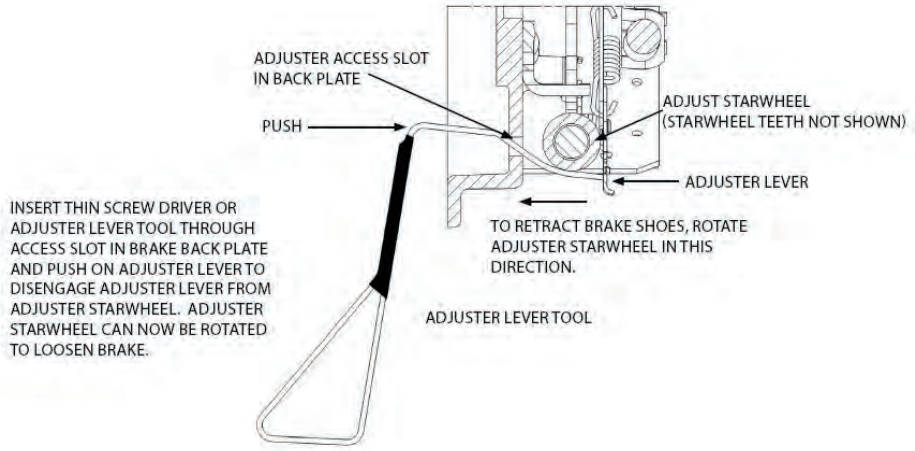
2. Insert the adjuster lever tool or a thin flat bladed screw driver through the adjusting slot in the backplate and push on the adjuster lever to disengage it from the adjuster starwheel. Insert a brake adjusting tool (or flathead screwdriver) through the adjusting slot and move the starwheel teeth downward to expand the brake shoes outward.Continue expanding the shoes until the drum can not be rotated by hand.
3. Now adjust the starwheel teeth upward to retract the shoes until the drum just begins to rotate freely by hand (without drag from the shoes).

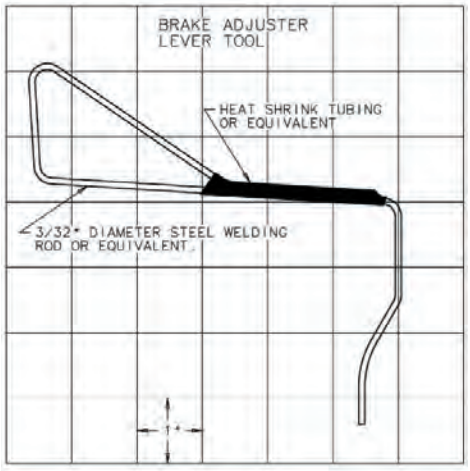


Disengaging Adjuster Lever from Adjuster Starwheel to Allow Retracting the Brake Shoes (Loosen Brake)

IMPORTANT:

Some vehicles may not have enough clearance behind the park brake to have direct access through the access slot to the adjuster lever. In these cases, an adjuster lever tool can be made from 3/32" diameter welding filler rod.





REPAIR PROCEDURES

Hydraulic Compact Unit Replacement

Removal Procedure

CAUTION:

Thoroughly clean the area around the HCU fittings before beginning the removal procedure to avoid contaminating the system. As hoses and brake lines are removed, plug all open ports and lines. Contamination may prevent the HPB system from operating correctly.

IMPORTANT:

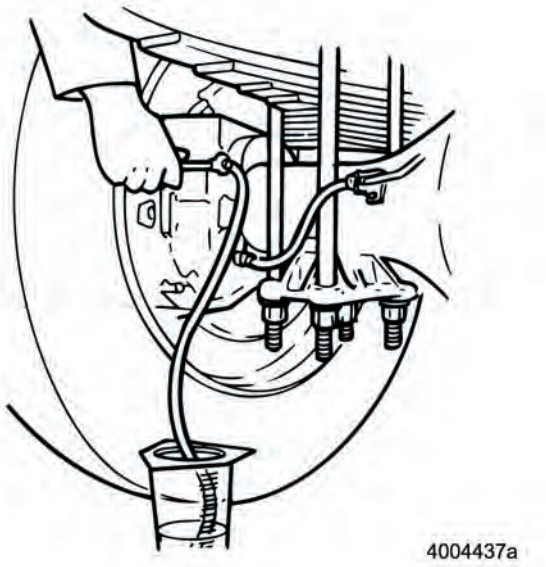
The following general guidelines are provided to facilitate the safe removal of the HCU from the vehicle.

- *Two people are needed to perform this procedure.*
- *For the HCU drain procedure in Step 11, TOOLBOX™ Software version 5.4 or higher is required. If you do not have this version of TOOLBOX™ Software, please contact the ArvinMeritor Customer Service Center for additional information.*
- *In some vehicles it may be necessary to move non-HPB system components, such as the air tank, in order to access the HPB part. If this is necessary, refer to the vehicle manufacturer's manual for information before moving the component.*

IMPORTANT, CONTINUED

- *Bleed the brake and master cylinder circuits. Bleed procedures appear in Section 5 of this manual.*
- *After installing HPB components or making system repairs, use TOOLBOX™ Software to remove the error code from the ECU memory. Instructions for using TOOLBOX™ Software appear in earlier in this Section.*

1. Park the vehicle on a level surface. For vehicles equipped with manual parking brakes, apply the parking brakes. Ensure that the ignition is turned off.
2. Block the front and rear tires to prevent the vehicle from moving.
3. Disconnect the battery.
4. Use a clean rag to carefully clean the surface of the HCU and the surrounding area.
5. Apply the brake pedal a minimum of 30 times to decrease pressure in the system. To ensure the system is depressurized, perform the following check on both the front and rear axles.
   A. Remove the protective cover from the end of the bleeder fitting on one brake caliper.
   B. Attach a bleeder bottle hose to the bleeder fitting at the wheel end. Submerge the free end of the bleeder hose into the bleeder bottle. Both the tubing and container must be able to withstand the effects of hydraulic brake fluid.
   C. Use a wrench to open the bleeder fitting screw.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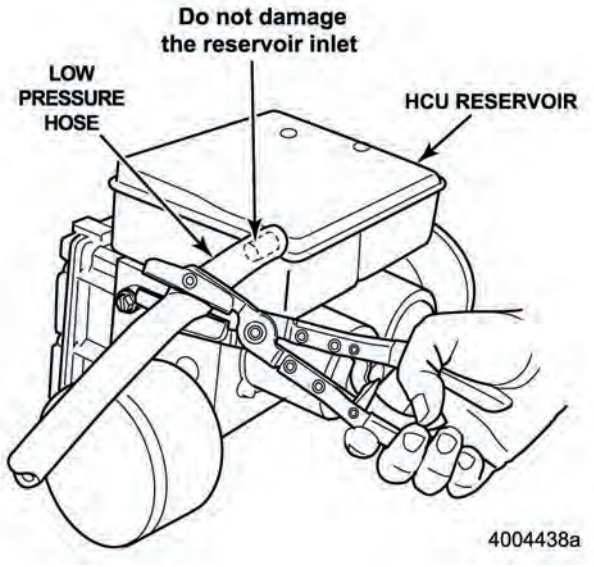
D. Apply and hold the brake pedal down until no more brake fluid runs out. Do not release the brake pedal.

E. With the brake pedal still applied, use a torque wrench to tighten the bleeder fitting screw.

6. Repeat Steps A-E for the second axle.

IMPORTANT:
Do not damage the HCU reservoir inlet when attaching the pinch clamp.

7. Attach a pinch clamp to the low pressure hose at the HCU reservoir inlet.



8. Loosen the two support brackets and any retaining hardware that holds the middle section of the low pressure hose to the chassis. The bolts must be loose enough to allow movement of the hose during the HCU removal.

9. To help prevent brake fluid from damaging the vehicle or floor paint, or from seeping into the ground, position a container beneath the work area to collect any drained or spilled brake fluid.

10. Disconnect the low pressure hose from the HCU reservoir. Plug both the low pressure hose and the HCU reservoir inlet to prevent system contamination.

11. Before removing the HCU assembly from the vehicle, drain the fluid from the HCU reservoir. To do this:
    A. Reconnect the battery.
    B. Attach a bleeder bottle to one wheel end at the front axle.
    C. Connect the vehicle to a computer that has TOOLBOX™ Software, version 5.4 or higher, installed.
    D. From the HPB Main Menu, select EOL to enable the End of Line test. The pull-down option, Drain Reservoir, will appear. Click on Drain Reservoir to start the drain procedure.

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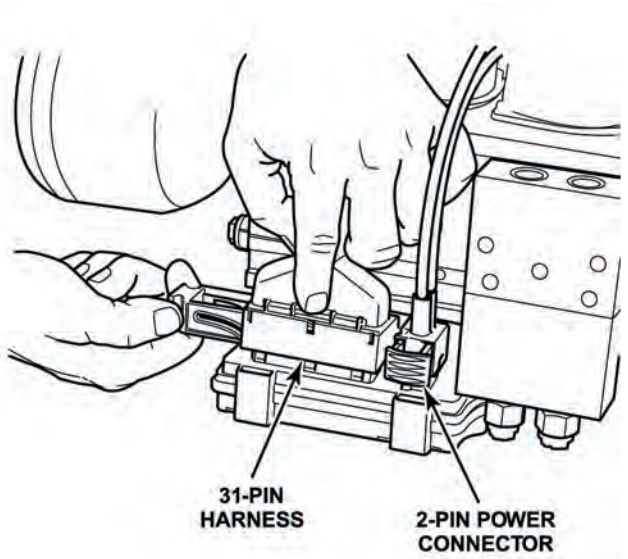
    E. Open the bleeder screw.
    F. Apply and hold the brake pedal down until no more fluid runs out.
    G. Tighten the bleeder screw. Attach a bleeder bottle to one wheel end at the rear axle. Repeat Steps D-G for the rear axle.
12. Disconnect the battery.
13. Disconnect the brake lines from the HCU. There are at least six brake lines. Plug the brake lines and ports on the HCU. Mark the brake lines to ensure correct positioning during reassembly.
14. Open the latches on the two-pin power connector and the 31-pin harness attached to the ECU. After the latch is released, remove the connectors from the ECU.



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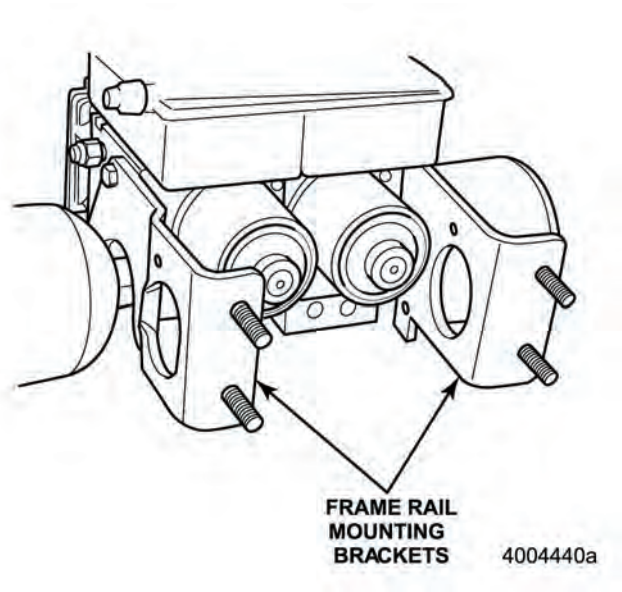
IMPORTANT:
If space does not permit removing the HCU with the mounting brackets attached, skip Step 15 and proceed to Step 16.

15. While supporting the HCU, loosen and remove the four nuts (two per side) that hold the HCU mounting brackets to the frame rail of the vehicle. Remove the HCU, with mounting brackets attached, from the vehicle.



16. Loosen and remove the two bolts that hold the HCU to the front mounting bracket. Then, loosen and remove the two bolts that hold the HCU to the rear mounting bracket.
17. Remove the mounting brackets from the HCU.
18. Examine the four bushings inside the brackets. Replace if necessary.
19. Verify the warranty status. If the HCU is under warranty, return it to Meritor WABCO.

Installation Procedure

CAUTION:

The replacement HCU is pre-charged with brake fluid to ensure successful bleeding. To prevent fluid loss, do not remove the protective caps until you are ready to connect the brake lines. Damage to components can result.

IMPORTANT:

Meritor WABCO recommends that you install the replacement HCU in the same location as the old one.

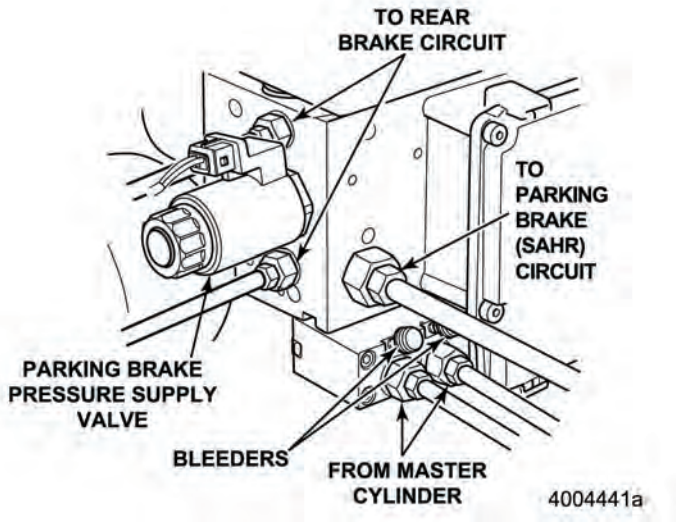
Bleeding the master cylinder, brake caliper and spring-applied/hydraulic release (SAHR) circuits is required during installation of the HCU.

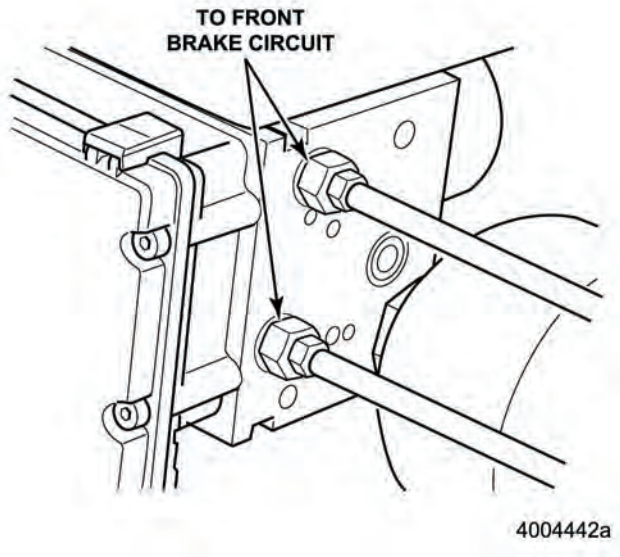
Examine the four bushings inside the brackets before attaching the HCU to the brackets. Replace if necessary.

If space does not permit installing the HCU with the mounting brackets attached, perform Step 2 first, then perform Step 1.

1. Position the HCU between the mounting brackets. While supporting the HCU, install the four replacement bolts that attach the HCU to the mounting brackets. Tighten the bolts to 32-34 lb-ft (43-46 N•m).

2. Attach the two mounting brackets to the frame rail of the vehicle. Tighten the nuts to 79.7-99.6 lb-ft (108-135 N•m).
3. Connect the brake lines. Remove the protective cover before attaching the line. Check the line markers to ensure correct installation on the HCU.
   - Four lines leading to the wheel ends
   - Two lines leading to the master cylinder
   - One line leading to the parking brake (this port is not used on the UFO™ chassis)



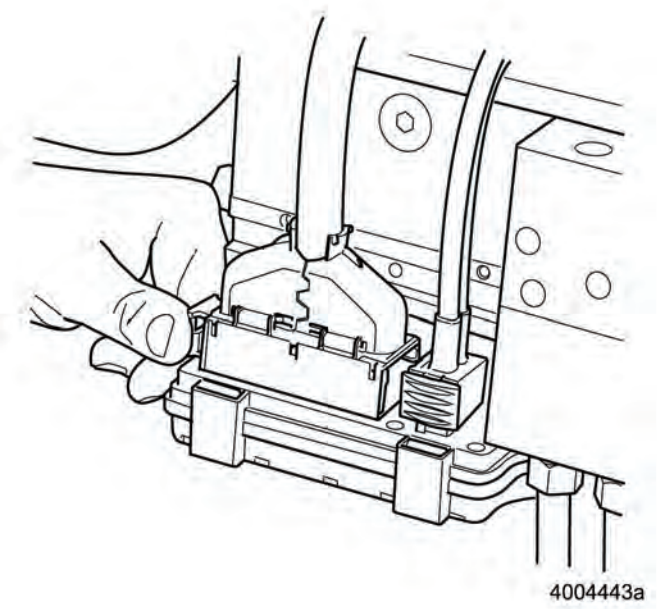


4. Connect the low pressure hose from the master cylinder reservoir to the HCU reservoir and secure the connection with a hose clamp. Once the connection is secure, remove the pinch clamp installed during the removal of the old HCU.
5. Tighten the two support brackets (hose clamps) that secure the low pressure hose to the vehicle chassis.
6. Fill the master cylinder reservoir to the MAX mark with new brake fluid from a sealed container. Use DOT 3 or DOT 4 hydraulic brake fluid. Refer to the vehicle specification sheet to determine which fluid to use.

WARNING:

Electrical connectors must be correctly installed with the latch pushed in to lock the connection to prevent them from coming loose or disconnecting. Failure to securely connect and correctly latch the connectors could result in loss of braking functions during vehicle operation.

7. Attach the 31-pin harness and then the two-pin power connector to the ECU. Push the latch into position to lock the connection.

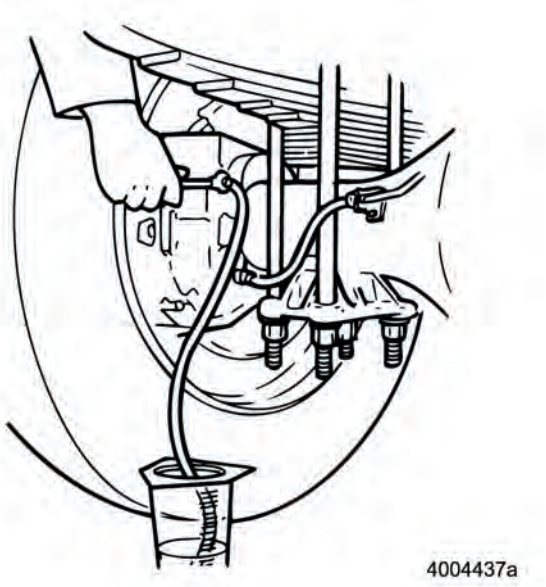


8. Attach a bleeder bottle hose to the bleeder fitting at the wheel end. Submerge the free end of the bleeder hose into the bleeder bottle. Both the tubing and container must be able to withstand the effects of hydraulic brake fluid.
9. Open the bleeder screw until fluid begins to flow out of the opening.
10. Bleed the master cylinder circuit. Refer to Brake System Bleeding.
11. Turn the ignition switch OFF.
12. Disconnect the battery.
13. Apply the brake pedal a MINIMUM of 30 times to decrease pressure in the system. This will purge trapped air from the hose.
14. Connect the battery.
15. Turn the ignition switch ON. The HCU pump motors will start up and fill the accumulators. Approximate running time is 45 seconds.
16. When the pumps stop running, check the system for leaks. If there are no leaks, go to Step 17. If there are leaks, depressurize the system before making the necessary repairs.
    - Disconnect the battery.
    - Apply the brake pedal a minimum of 30 times to decrease pressure in the system. To ensure that the system is depressurized, perform the following check on both the front and rear axles:

    A. Remove the protective cover from the end of the bleeder fitting on one brake caliper.

    B. Attach a bleeder bottle hose to the bleeder fitting at the wheel end. Both the tubing and container must be able to withstand the effects of hydraulic brake fluid.

    C. Use a wrench to open the bleeder fitting screw.



D. Apply and hold the brake pedal down until no more brake fluid runs out. Do not release the brake pedal.

E. With the brake pedal still applied, tighten the bleeder fitting screw.

- Repeat Steps A-E for the second axle.
- When all leaks have been repaired, connect the battery.

17. Check the fluid level in the master cylinder reservoir to make sure it is at the MAX mark. Refill as necessary, using only the recommended DOT 3 or DOT 4 hydraulic brake fluid.
18. Use TOOLBOX™ Software to cancel the diagnostic code for the HCU.
19. Remove the wheel blocks.
20. Test drive the vehicle. Refer to the Vehicle Test Drive.

HCU Reservoir Replacement

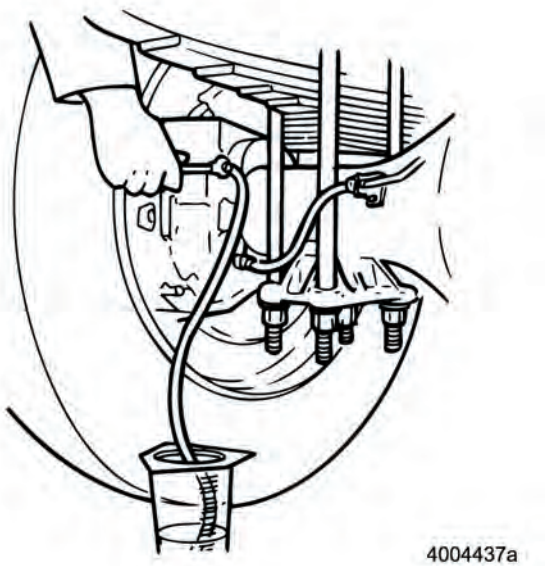
IMPORTANT:

The following general guidelines are provided to facilitate the safe removal of the HCU from the vehicle.

- *Two people are needed to perform this procedure.*
- *For the HCU drain procedure in Step 11, TOOLBOX™ Software version 5.4 or higher is required. If you do not have this version of TOOLBOX™ Software, please contact the ArvinMeritor Customer Service Center for additional information. Meritor WABCO recommends removal of the entire HCU prior to removal and replacement of the HCU reservoir.*
- *Bleeding the brake caliper circuit is required during installation of the HCU. Bleed procedures appear in Section 5 of this manual.*
- *After installing HPB components or making system repairs, use TOOLBOX™ Software to remove the error code from the ECU memory. Instructions for using TOOLBOX™ Software appear in Section 3 of this manual.*
- *Do not remove the reservoir from the HCU before draining the brake fluid into a suitable container. Follow shop procedures to correctly dispose of used brake fluid.*

1. Park the vehicle on a level surface. For vehicles equipped with manual parking brakes, apply the parking brakes. Ensure that the ignition is turned off.

2. Block the front and rear tires to prevent the vehicle from moving.
3. Disconnect the battery.
4. Use a clean rag to carefully clean the surface of the HCU and the surrounding area.
5. Apply the brake pedal a minimum of 30 times to decrease pressure in the system. To ensure the system is depressurized, perform the following check on both the front and rear axles.
   A. Remove the protective cover from the end of the bleeder fitting on one brake caliper.
   B. Attach a bleeder bottle hose to the bleeder fitting at the wheel end. Submerge the free end of the bleeder hose into the bleeder bottle. Both the tubing and container must be able to withstand the effects of hydraulic brake fluid.
   C. Use a wrench to open the bleeder fitting screw.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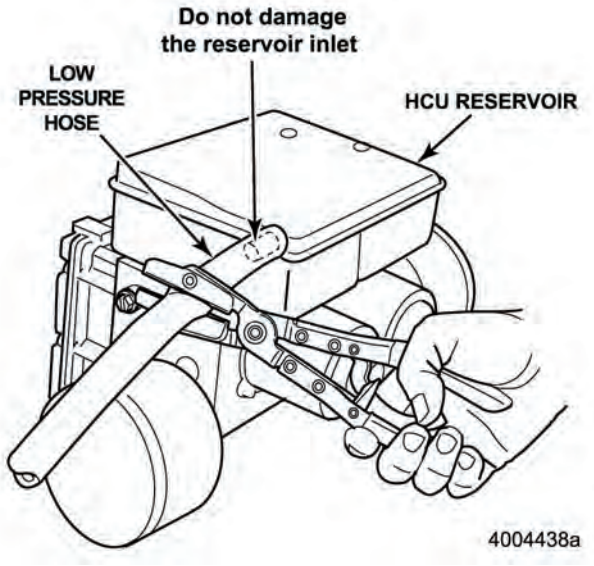
   D. Apply and hold the brake pedal down until no more brake fluid runs out. Do not release the brake pedal.
   E. With the brake pedal still applied, use a torque wrench to tighten the bleeder fitting screw.
6. Repeat Steps A-E for the second axle.

IMPORTANT:
Do not damage the HCU reservoir inlet when attaching the pinch clamp.

7. Attach a pinch clamp to the low pressure hose at the HCU reservoir inlet.



8. Loosen the two support brackets and any retaining hardware that holds the middle section of the low pressure hose to the chassis. The bolts must be loose enough to allow movement of the hose during the HCU removal.

9. To help prevent brake fluid from damaging the vehicle or floor paint, or from seeping into the ground, position a container beneath the work area to collect any drained or spilled brake fluid.
10. Disconnect the low pressure hose from the HCU reservoir. Plug both the low pressure hose and the HCU reservoir inlet to prevent system contamination.
11. Before removing the HCU assembly from the vehicle, drain the fluid from the HCU reservoir. To do this:
    A. Reconnect the battery.
    B. Attach a bleeder bottle to one wheel end at the front axle.
    C. Connect the vehicle to a computer that has TOOLBOX™ Software, version 5.4 or higher, installed.
    D. From the HPB Main Menu, select EOL to enable the End of Line test. The pull-down option, Drain Reservoir, will appear. Click on Drain Reservoir to start the drain procedure.

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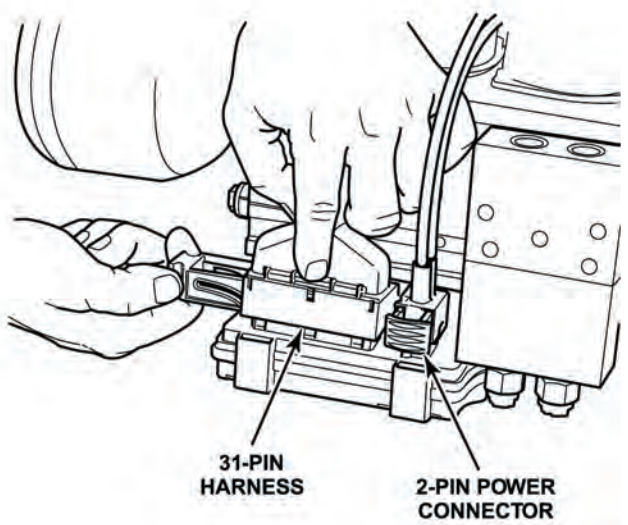
    E. Open the bleeder screw.
    F. Apply and hold the brake pedal down until no more fluid runs out.
    G. Tighten the bleeder screw. Attach a bleeder bottle to one wheel end at the rear axle. Repeat Steps D-G for the rear axle.
12. Disconnect the battery.
13. Disconnect the brake lines from the HCU. There are at least six brake lines. Plug the brake lines and ports on the HCU. Plug the low pressure hose to prevent contamination to the system. Mark the brake lines to ensure correct positioning during reassembly.
14. Open the latches on the two-pin power connector and the 31-pin harness attached to the ECU. After the latch is released, remove the connectors from the ECU.



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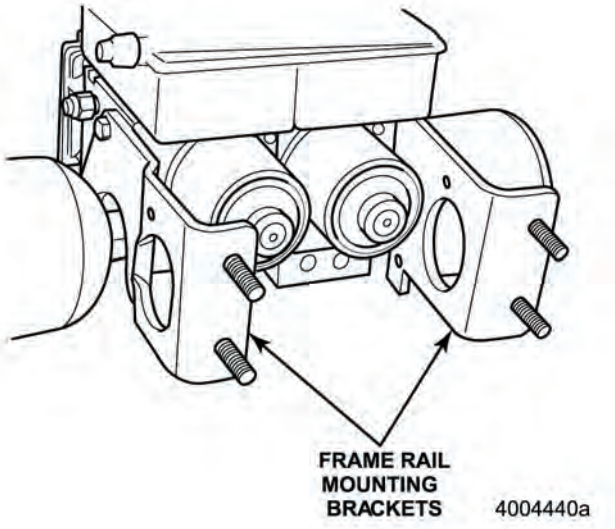
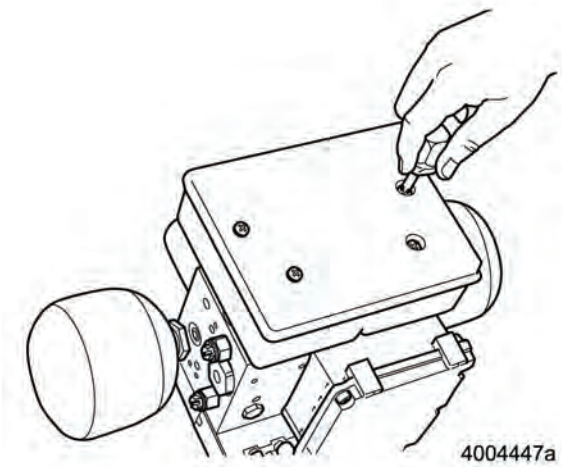
IMPORTANT:
If space does not permit removing the HCU with the mounting brackets attached, skip Step 15 and proceed to Step 16.

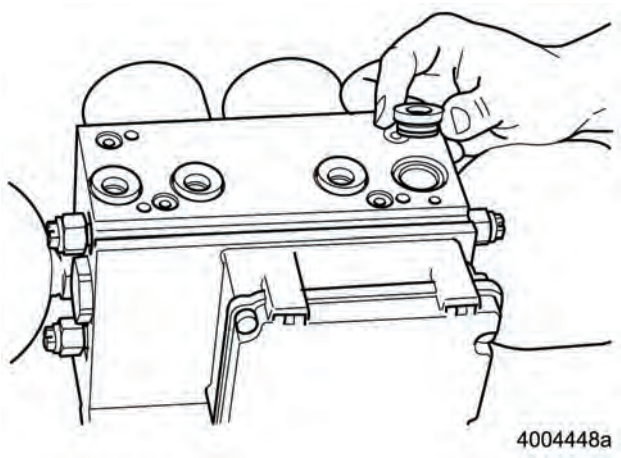
15. While supporting the HCU, loosen and remove the four nuts (two per side) that hold the HCU mounting brackets to the frame rail of the vehicle. Remove the HCU, with mounting brackets attached, from the vehicle.



16. Loosen and remove the two bolts that hold the HCU to the front mounting bracket. Then, loosen and remove the two bolts that hold the HCU to the rear mounting bracket.
17. Remove the mounting brackets from the HCU.
18. Drain all brake fluid from the old reservoir. Pour the old brake fluid into a suitable container.
19. Inspect the area between the body of the HCU and the HCU reservoir to ensure the area is free from any dirt or other contaminants. Clean if necessary. Do not allow any contaminants to enter the HCU ports.
20. Use a number 4 Phillips-head screwdriver to remove the four HCU reservoir mounting screws. Then, remove the reservoir from the HCU.



21. Verify the warranty status. If the reservoir is under warranty, return it to Meritor WABCO.
22. Remove the old rubber grommets from the four ports. Do not allow any dirt or other contaminants from these grommets to enter the HCU ports.
23. Seal the HCU reservoir ports.



24. With the ports plugged, clean the top of the HCU.

Installation Procedure

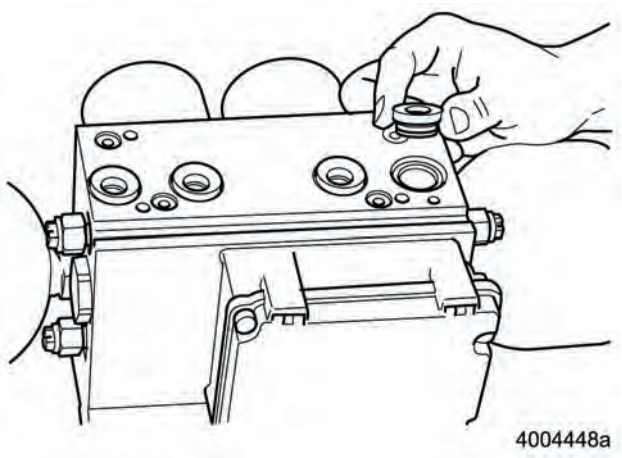
CAUTION:

To ensure correct assembly, use only the four seals and four screws included in the HCU reservoir replacement kit. Do not reuse the seals or screws from the old reservoir.

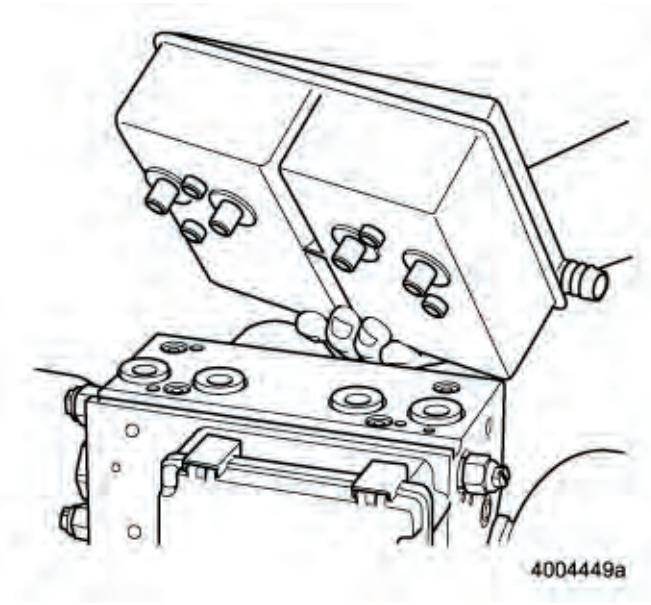
IMPORTANT:

Bleeding the master cylinder, brake caliper and spring-applied/hydraulic release (SAHR) circuits is required during installation of the HCU.

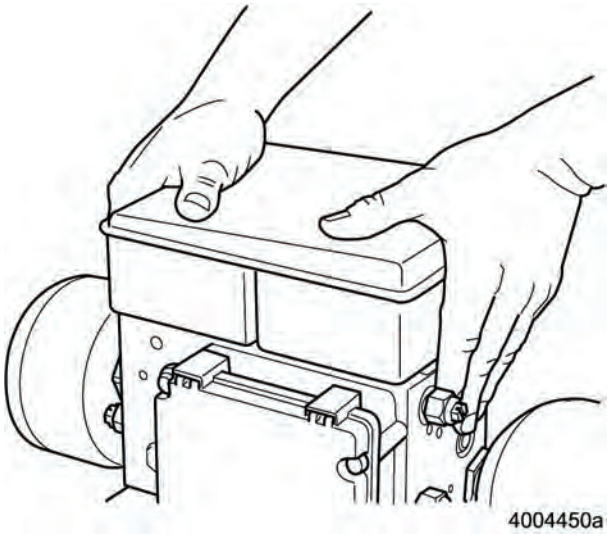
1. Inspect the top of the HCU to ensure it is clean and free from debris or other contaminants.
2. Remove the plugs from the reservoir ports on the HCU.
3. Install the four new black rubber grommets from the replacement kit into the ports on the top of the HCU.



4. Use new, clean brake fluid to lubricate the reservoir grommets. Use DOT 3 or DOT 4 hydraulic brake fluid. Refer to the vehicle specification sheet to determine which fluid to use.
5. Position the reservoir on the HCU and verify orientation: The mounting screw holes must line up and the inlet port for the low pressure hose must face the front of the HCU.



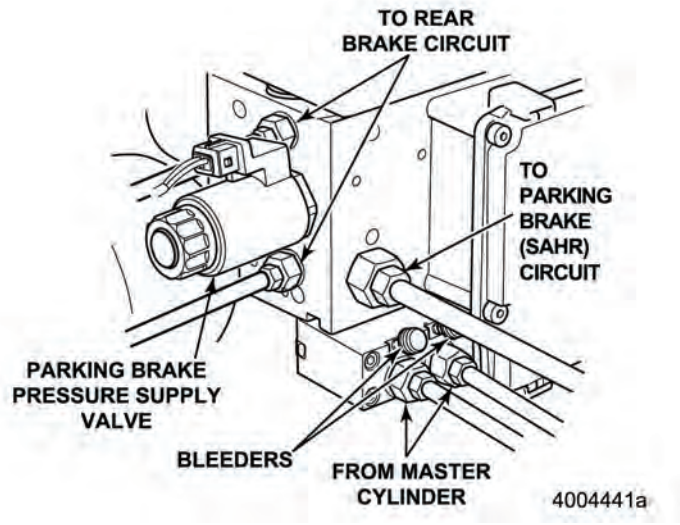
6. Install the new reservoir by pressing it carefully and completely into the grommets in the ports.

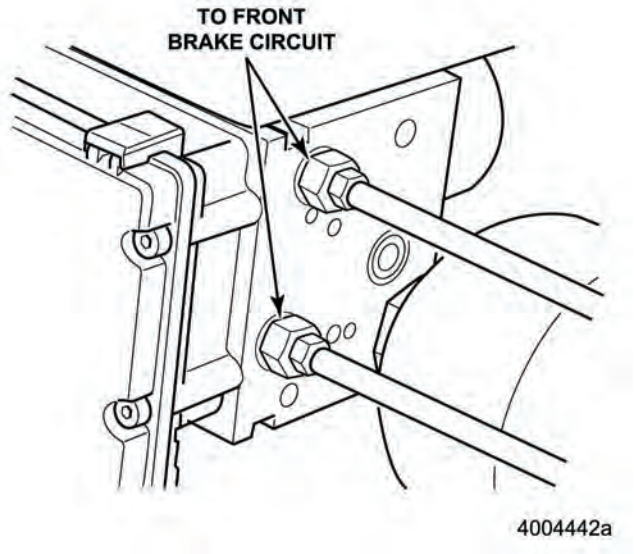


7. Use the four new mounting screws to attach the reservoir to the HCU. Using a number 4 Phillips-head screwdriver, tighten the screws to 43-60 lb in (5-7 N•m).

IMPORTANT:
If space does not permit installing the HCU with the mounting brackets attached, perform Step 9 first, then perform Step 8.

8. Reinstall the HCU assembly. Position the HCU between the mounting brackets. While supporting the HCU, install the four bolts that attach the HCU to the mounting brackets. Tighten the bolts to 32-34 lb-ft (43-46 N•m).
9. Attach the two mounting brackets to the frame rail of the vehicle. Tighten the nuts to 79.7-99.6 lb-ft (108-135 N•m).
10. Connect the brake lines. Remove the protective cover before attaching the line. Check the line markers to ensure correct installation on the HCU.
    - Four lines leading to the wheel ends
    - Two lines leading to the master cylinder
    - One line leading to the parking brake (not used on UFO™ chassis)



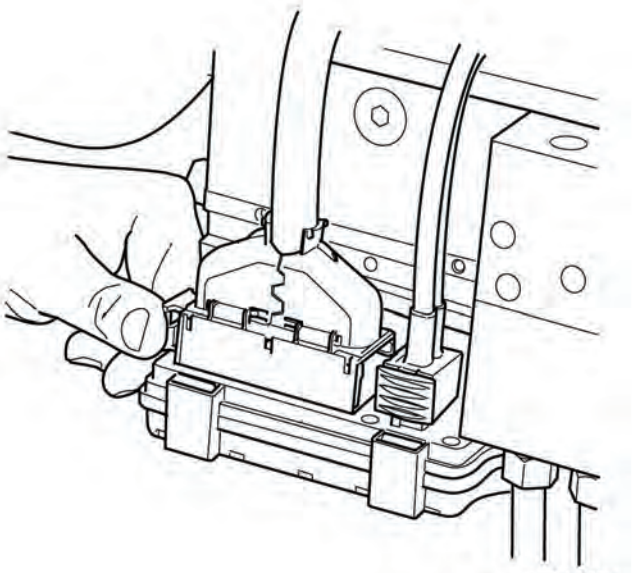


11. Connect the low pressure hose from the master cylinder reservoir to the HCU reservoir and secure the connection with a hose clamp. Once the connection is secure, remove the pinch clamp installed during the removal of the old HCU.
12. Tighten the two support brackets (hose clamps) that secure the low pressure hose to the vehicle chassis.
13. Fill the master cylinder reservoir to the MAX mark with new brake fluid from a sealed container. Use DOT 3 or DOT 4 hydraulic brake fluid. Refer to the vehicle specification sheet to determine which fluid to use.

WARNING:

Electrical connectors must be correctly installed with the latch pushed in to lock the connection in order to prevent them from coming loose or disconnecting. Failure to securely connect and correctly latch the connectors could result in loss of braking functions during vehicle operation. Damage to components can result.

14. Attach the 31-pin harness and then the two-pin power connector to the ECU. Push the latch into position to lock the connection.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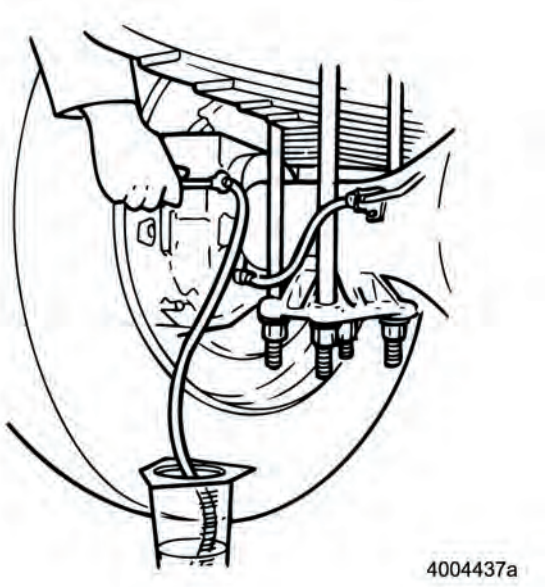
15. Attach a bleeder bottle hose to the bleeder fitting at the wheel end. Submerge the free end of the bleeder hose into the bleeder bottle. Both the tubing and container must be able to withstand the effects of hydraulic brake fluid.
16. Open the bleeder screw until fluid begins to flow out of the opening. Then close the bleeder screw and fill the master cylinder reservoir.
17. Bleed the master cylinder circuit. Refer to Brake System Bleeding.
18. Turn the ignition switch OFF.
19. Disconnect the battery.
20. Apply the brake pedal a minimum of 30 times to decrease pressure in the system. This will purge trapped air from the hose.
21. Connect the battery.
22. Turn the ignition switch ON. The HCU pump motors will start up and fill the accumulators. Approximate running time is 45 seconds.
23. When the pumps stop running, check the system for leaks. If there are no leaks, go to Step 24. If there are leaks, depressurize the system before making the necessary repairs. Use the following procedure to depressurize the system.
    - Disconnect the battry.
    - Apply the brake pedal a minimum of 30 times to decrease pressure in the system. To ensure that the system is depressurized, perform the following check on both the front and rear axles:

    A. Remove the protective cover from the end of the bleeder fitting on one brake caliper.

    B. Attach a bleeder bottle hose to the bleeder fitting at the wheel end. Submerge the free end of the bleeder hose into the bleeder bottle. Both the tubing and container must be able to withstand the effects of hydraulic brake fluid.

    C. Use a wrench to open the bleeder fitting screw.



D. Apply and hold the brake pedal down until no more brake fluid runs out. Do not release the brake pedal.

E. With the brake pedal still applied, use a torque wrench to tighten the bleeder fitting screw to 34.7-39 lb-in (4-4.5 N•m)

- Repeat Steps A-E for the second axle.
- When all leaks have been repaired, connect the battery.

24. Check the fluid level in the master cylinder reservoir to make sure it is at the MAX mark. Refill as necessary, using only the recommended DOT 3 or DOT 4 hydraulic brake fluid.
25. Use TOOLBOX™ Software to cancel the diagnostic code for the HCU reservoir. Refer to TOOLBOX™ instructions.
26. Remove the wheel blocks.
27. Test drive the vehicle. Refer to the Vehicle Test Drive.

HCU Accumulators Replacement

Removal Procedure

WARNING:

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

Release all air from the air systems before you remove any components. Pressurized air can cause serious personal injury.

It is possible for the removed accumulator to retain an internal pressure of up to 1087 psi. To eliminate any removed accumulator from posing a safety hazard, depressurize the accumulator and disable its pressure chamber.

The full power brake system is a pressurized system that achieves pressures of up to 2320 psi. This pressure is not reduced by switching the ignition off or removing battery power. Prior to servicing this system, the depressurization procedures must be performed exactly as presented. Failure to depressurize the system may result in personal injury or death.

CAUTION:

The HPB hydraulic power brake system is a complex device that provides optimum efficiency and operation. If the system sustains damage, or a component malfunctions and requires replacement, the vehicle owner is strongly advised to contact the nearest dealer for professional assistance and repair. If location and circumstances prevent consulting the dealer, and components must be replaced, the replacement procedures provided by Meritor WABCO must be followed exactly with the associated steps performed in the order presented.

Hydraulic brake fluid is a caustic substance. Contact with the 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 contact brake pads, shoes, rotors or discs.

Thoroughly clean the area around the HCU fittings before beginning the removal procedure to avoid contaminating the system. As hoses and brake lines are removed, plug all open ports and lines. Contamination may prevent the HPB system from operating correctly.

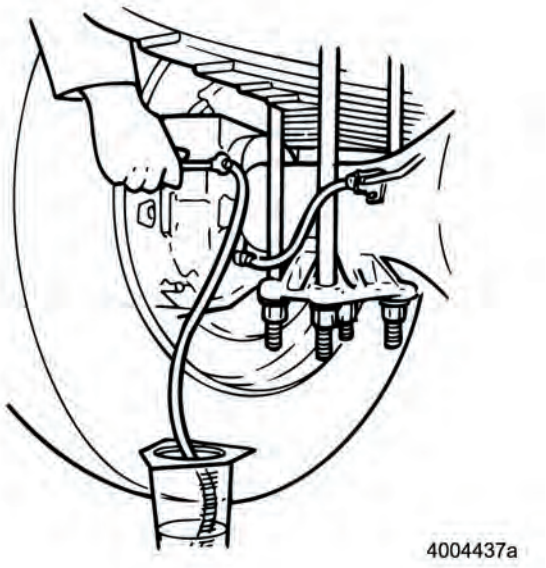
IMPORTANT:

The following general guidelines are provided to facilitate the safe removal of the accumulators from the HPB.

- *Accumulators are precharged with gas pressure to 1087 psi and have a limited shelf life. When replacing an accumulator, note and record the expiration date of the replacement accumulator.*
- *Used accumulators must be depressurized before disposal. Follow Steps 10A-10D to perform this procedure.*
- *Meritor WABCO recommends replacing both accumulators at the same time.*
- *It is not necessary to remove the entire HCU to replace the accumulators.*
- *Replacing the accumulators does not require any brake bleed procedures.*
- *Accumulators still under warranty must be returned without depressurizing. Drilling accumulators will void the warranty.*
- *Two people are needed to perform this procedure.*
- *After installing HBP components or making system repairs, use TOOLBOX™ Software to remove the error code from the ECU memory. Instructions for using TOOLBOX™ Software appear in Section 3 of this manual.*

1. Park the vehicle on a level surface. For vehicles with manual parking brakes, apply the parking brakes.
2. Block the front and rear tires to prevent vehicle movement.

3. Disconnect the battery.
4. Use a clean rag to carefully wipe the surface of the HCU and the surrounding area.
5. Apply the brake pedal a minimum of 30 times to decrease pressure in the system. To ensure the system is depressurized, perform the following check on both the front and rear axles.
   A. Remove the protective cover from the end of the bleeder fitting on one brake caliper.
   B. Attach a bleeder bottle hose to the bleeder fitting at the wheel end. Submerge the free end of the bleeder hose into the bleeder bottle. Both the tubing and container must be able to withstand the effects of hydraulic brake fluid.
   C. Use a wrench to open the bleeder fitting screw.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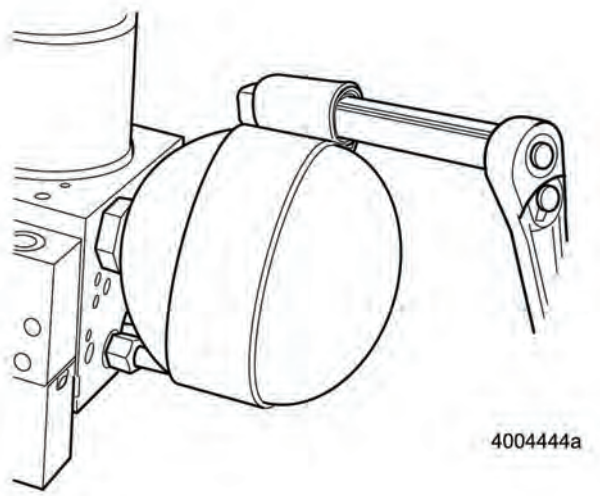
   D. Apply and hold the brake pedal down until no more brake fluid runs out. Do not release the brake pedal.
   E. With the brake pedal still applied, use a torque wrench to tighten the bleeder fitting screw.
6. Repeat Steps A-E for the second axle.
7. To help prevent brake fluid from damaging the vehicle or floor paint, or from seeping into the ground, position a container beneath the work area to collect any drained or spilled brake fluid.
8. Use a strap wrench to remove the accumulator. The accumulator has a right-hand thread.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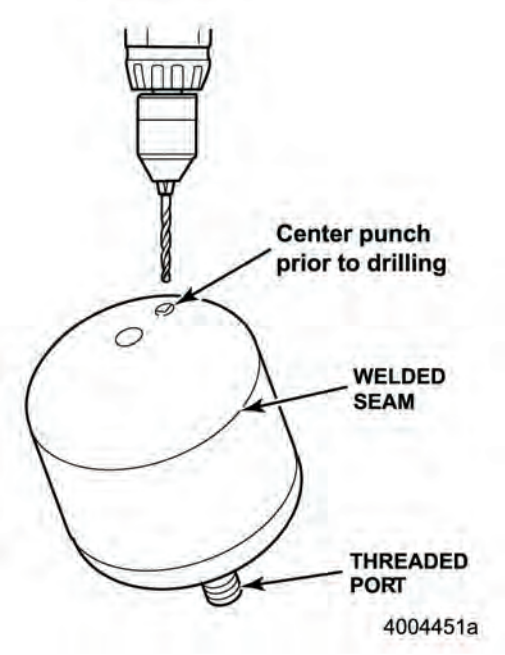
9. Use a clean rag to clean the counterbore on the HCU. Inspect the counterbore to ensure that the O-ring seal was removed. Plug the counterbore to prevent contamination from entering the HCU.
10. Determine the warranty status of the accumulators. If the accumulators are under warranty, do not perform Step 11 (depressurizing the accumulators). Return the accumulators to Meritor WABCO. If the accumulators are not under warranty, the accumulators MUST be depressurized before disposal (Step 11).

WARNING:

A slight hissing sound may be heard when the wall of the accumulator is pierced. Metal shavings may be blown away from the hole during this procedure. Wear protective goggles, not glasses, to protect the eyes.

11. Use the following steps to depressurize the accumulator and disable the internal pressure chamber before disposing of the accumulators.
    A. Securely position the accumulator on a drill press table. Use a vise or clamp that will allow the accumulator to be correctly positioned. The drilling point will be on the opposite side of the welded seam from the threaded port.
    B. Center punch the accumulator.
    C. Use a 3 mm or 1/8-inch drill bit to slowly and carefully drill approximately 1/2-inch (12.7 mm) into the accumulator.



    D. After releasing the internal pressure, correctly dispose of the accumulator. Repeat Steps A-D to depressurize the second accumulator.

Installation Procedure

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.

WARNING:

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 incorrect hydraulic brake fluid will damage the rubber parts of the brake caliper and can cause damage, loss of braking and serious personal injury.

A new accumulator is precharged to a pressure of 1087 psi. Do not puncture or pierce the accumulator. Puncturing or piercing the accumulator may result in personal injury or death.

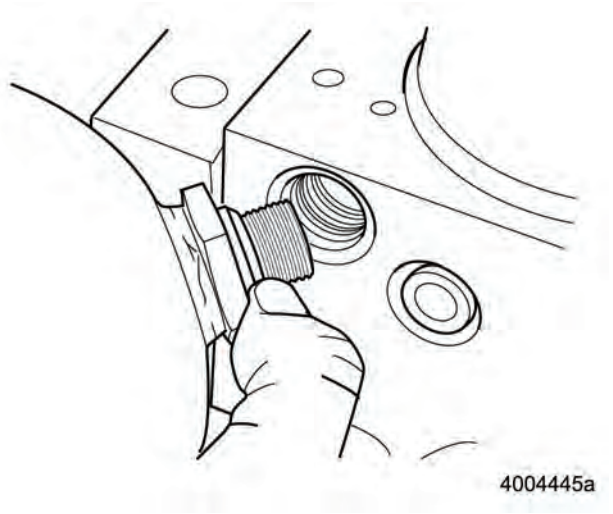
IMPORTANT:

Use DOT 3 or DOT 4 hydraulic brake fluid. Refer to the vehicle specification sheet to determine which fluid to use.

CAUTION:

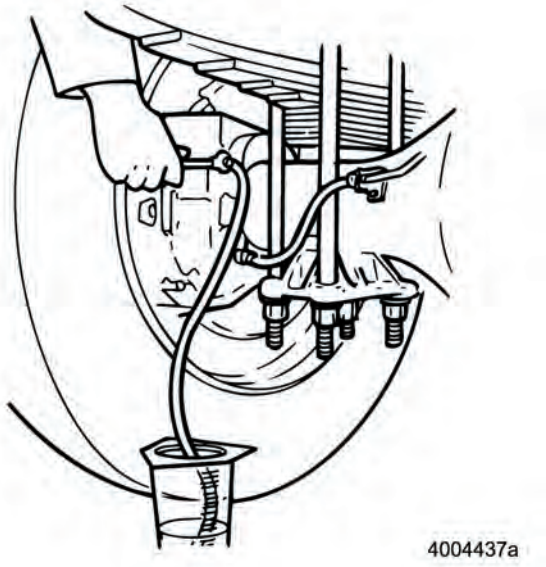
Hydraulic brake fluid is a caustic substance. Contact with hydraulic brake fluid can cause skin irritation. Do not let hydraulic brake fluid touch any painted surfaces, as it will remove the paint. Hydraulic brake fluid may also damage certain non-metal surfaces. Do not let fluid get on brake pads, shoes,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

1. Remove the plug from the accumulator counterbore on the HCU. Clean the counterbore and the surrounding area. The old accumulator O-rings should have been removed from the counterbore during removal of the accumulators. Verify that the O-ring was removed.
2. Use clean brake fluid to lubricate the O-ring on the new accumulator. Use DOT 3 or DOT 4 hydraulic brake fluid. Refer to the vehicle specification sheet to determine which fluid to use.
3. Place the new accumulator and O-ring into the counterbore. After positioning, use a torque wrench with a strap wrench attachment to tighten to 43.4-50 lb-ft (60-70 N•m). Do not overtighten.



4. Repeat Steps 1-3 to replace the second accumulator.
5. Check the fluid level in the master cylinder reservoir. Fluid level should be above the MAX mark. If not, fill the reservoir to the MAX mark with new brake fluid from a sealed container. Use only DOT 3 or DOT 4 brake fluid. Refer to the vehicle specification sheet to determine which fluid to use.

6. Connect the battery.
7. Turn the ignition to ON. The HCU pump motors will start up and fill the accumulators. Approximate running time is 45 seconds.
8. When the pumps stop running, fill the master cylinder reservoir to the MAX mark with new, brake fluid from a sealed container. Use only DOT 3 or DOT 4 brake fluid. Refer to the vehicle specification sheet to determine which fluid to use.
9. Check the accumulator connections for leaks. If there are no leaks, go to Step 11. If there are leaks, depressurize the system before making the necessary repairs. Use the following procedure to depressurize the system: Apply the brake pedal a minimum of 30 times to decrease pressure in the system. To ensure that the system is depressurized, perform the following check on both the front and rear axles:
   A. Remove the protective cover from the end of the bleeder fitting on one brake caliper.
   B. Attach a bleeder bottle hose to the bleeder fitting at the wheel end. Submerge the free end of the bleeder hose into the bleeder bottle. Both the tubing and container must be able to withstand the effects of hydraulic brake fluid.
   C. Use a wrench to open the bleeder fitting screw.



   D. Apply and hold the brake pedal down until no more brake fluid runs out. Do not release the brake pedal.
   E. With the brake pedal still applied, use a torque wrench to tighten the bleeder fitting screw. Repeat Steps A-E for the second axle.
10. After making the repairs, check the fluid level in the master cylinder reservoir to make sure it is at the MAX mark. Refill as necessary, using only the recommended DOT 3 or DOT 4 hydraulic brake fluid, as described above.
11. Use TOOLBOX™ Software to cancel the diagnostic code for the accumulator.
12. Remove the wheel blocks.
13. Test drive the vehicle. Refer to the Vehicle Test Drive.

Electronic Control Unit (ECU) Replacement

Removal Procedure

WARNING:

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

Release all air from the air systems before you remove any components. Pressurized air can cause serious personal injury.

The full power brake system is a pressurized system that achieves pressures of up to 2320 psi. This pressure is not reduced by switching the ignition off or removing battery power.

Prior to servicing this system, the depressurization procedures must be performed exactly as presented. Failure to depressurize the system may result in personal injury or death.

CAUTION:

The HPB hydraulic power brake system is a complex device that provides optimum efficiency and operation. If the system sustains damage, or a component malfunctions and requires replacement, the replacement procedures provided by Meritor WABCO must be followed exactly with the associated steps performed in the order presented.

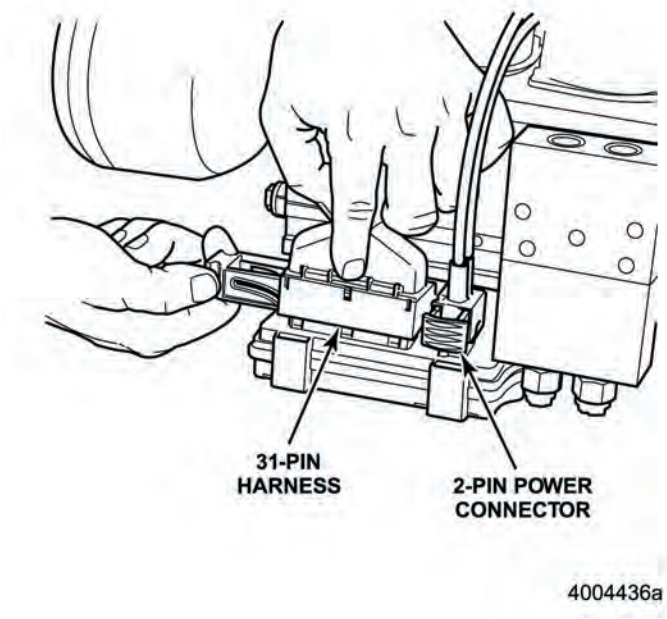
Hydraulic brake fluid is a caustic substance. Contact with the hydraulic brake fluid can cause skin irritation. Do not let hydraulic brake fluid touch any painted surfaces, as it will remove the paint. Hydraulic brake fluid may also damage certain non-metal surfaces. Do not let fluid contact brake pads,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

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

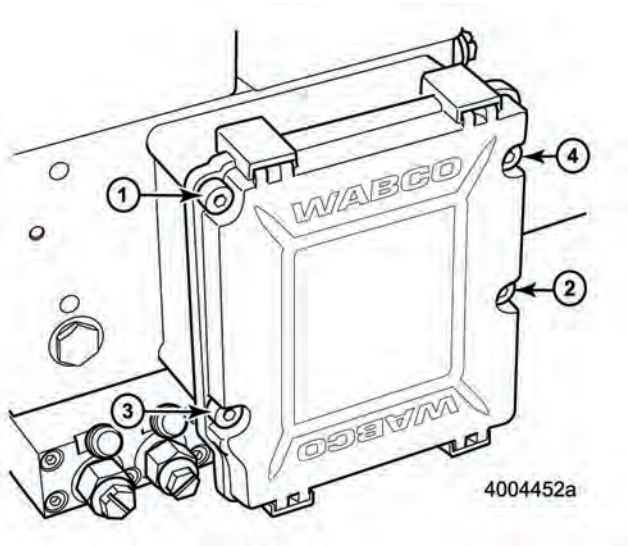
IMPORTANT:
The following general guidelines are provided to facilitate the safe removal of the ECU module from the HCU assembly.

- *It is not necessary to remove the entire HCU to replace the Electronic Control Unit (ECU).*
- *After replacing the ECU, new system parameters must be entered.*
- *When only the ECU is replaced, bleeding the system is not necessary.*

1. Park the vehicle on a level surface. For vehicles with manual parking brakes, apply the parking brakes.
2. Block the front and rear tires to prevent vehicle movement.
3. Disconnect the battery.
4. Use a clean rag to carefully wipe the surface of the HCU and the surrounding area.
5. Open the latches on the two-pin power connector and the 31-pin harness attached to the ECU. After the latch is released, remove the connectors from the ECU.



6. Use a 4 mm Allen wrench to loosen and remove the four mounting screws that attach the ECU module to the HCU. Remove the screws in the sequence shown.

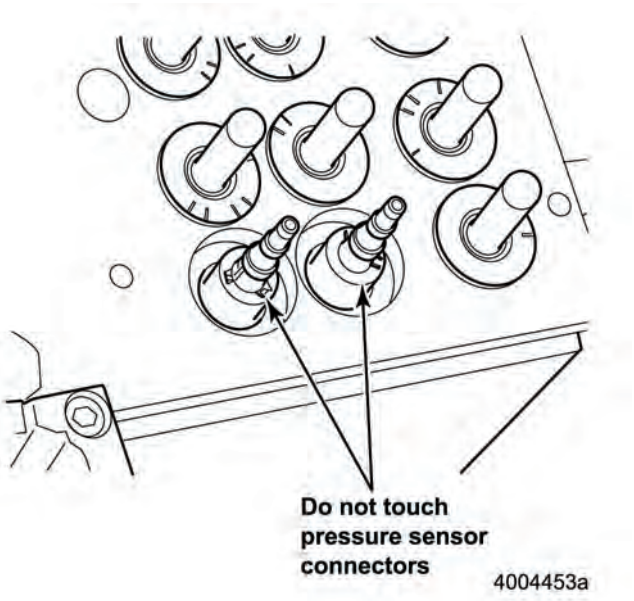


7. Carefully remove the ECU by lifting straight out. To avoid damaging the HCU, do not twist the ECU during removal. Determine the warranty status of the ECU. If the ECU is under warranty, return it to Meritor WABCO. If it is not under warranty, discard the used ECU.

CAUTION:

Do not touch the pressure sensor connectors. The connectors are sensitive and can be damaged by static electrical shock.

8. Use a clean rag to carefully clean the area around the valves formerly covered by the ECU. Do not touch the two pressure sensor connectors.



9. Remove and discard the orange seals from the two pressure sensors. Do not touch the two pressure sensor connectors.

Installation Procedure

CAUTION:

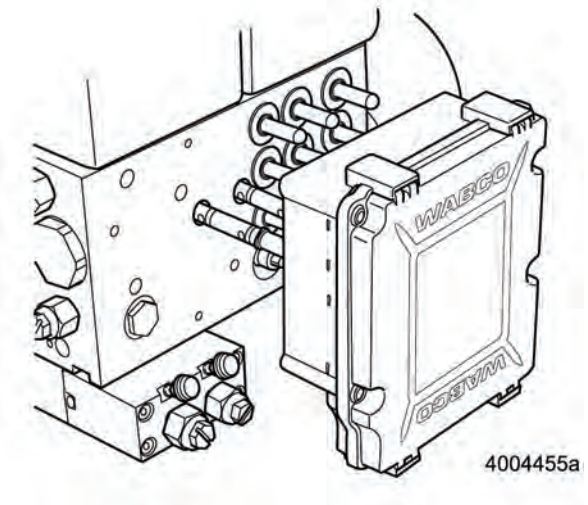
Do not touch the pressure sensor connectors.

1. Remove the replacement orange seals from the ECU replacement kit. Install the seals onto the replacement ECU.

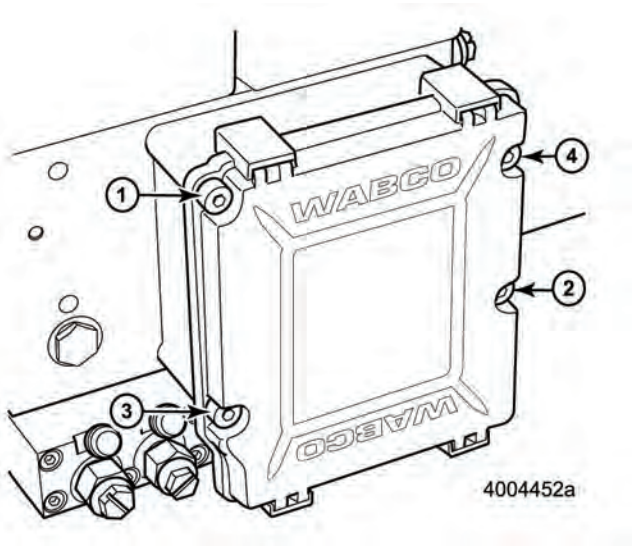
CAUTION:

Excessive force in positioning the ECU onto the HCU will damage the ECU housing. Do not force the ECU into position. Use a gentle, even pressure when positioning the ECU.

2. Position the ECU onto the HCU valves. Apply gentle pressure to seat the ECU. Motor connectors must achieve full depth into the housing. The gap between the HCU and ECU must not exceed 0.08-inch (2 mm).



3. Use a 4 mm Allen wrench to tighten the four mounting screws that attach the ECU to the HCU. Tighten to 14 lb-in (1.5 N•m). Do not exceed this torque. The metal sleeves on the ECU housing must rest flat on the body of the HCU. Tighten the screws using the correct sequence.

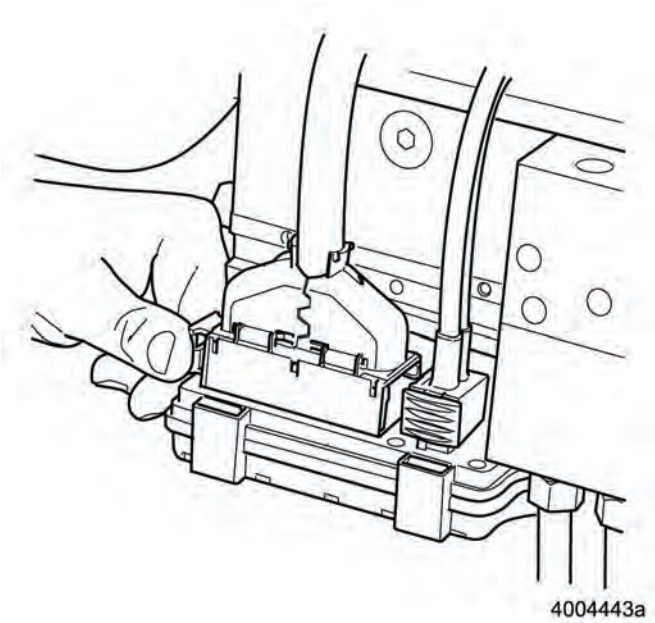


4. When the ECU is correctly installed with the metal sleeves flat on the HCU, tighten the bolts to 21-30 lb-in (2.5-3.5 N•m).

WARNING:

Electrical connectors must be correctly installed with the latch pushed in to lock the connection to prevent them from coming loose or disconnecting. Failure to securely connect and correctly latch the connectors could result in loss of braking functions during vehicle operation.

5. Attach the 31-pin harness and then the two-pin power connector to the ECU. Push the latch into position to lock the connection.



6. Connect the battery.

IMPORTANT:

Refer to the vehicle specification sheet for HPB system parameter values and parameter entry information.

7. Use TOOLBOX™ Software to enter the HPB system parameters.
8. Test drive the vehicle. Refer to the Vehicle Test Drive.

Master Cylinder Replacement

Removal Procedure

Before removing the master cylinder assembly or the master cylinder reservoir, verify the components to be replaced:

- Master cylinder and reservoir
- Master cylinder only, reusing reservoir
- Master cylinder reservoir only, reusing master cylinder

Replacement kits specific to each of these three replacements are available from WCC Parts. Make sure the replacement kit is available before you begin the removal.

If the current reservoir is to be reused, you will need to be careful when removing the master cylinder and reservoir assembly from the vehicle, and when you separate the components. If the reservoir is damaged in any way, it is not reusable.

- The master cylinder replacement kit contains a master cylinder travel switch, grommets and roll pins. It does not include the master cylinder reservoir.
- The master cylinder reservoir replacement kit contains a master cylinder reservoir with a fluid level switch and four rubber grommets.

CAUTION:

To avoid damage to the system while working on the brake system, do not apply the foot pedal unless instructed to do so.

- Two people are needed to perform this procedure.
- In some vehicles it may be necessary to move non-HPB system components, such as the air tank, in order to access the HPB part. If this is necessary, refer to the vehicle manufacturer's manual for information before moving the component.
- Bleeding the master cylinder circuit is required during installation of the master cylinder.
- After installing HPB components or making system repairs, use TOOLBOX™ Software to remove the error code from the ECU memory. Instructions for using TOOLBOX™ Software appear in this section 3.

IMPORTANT:

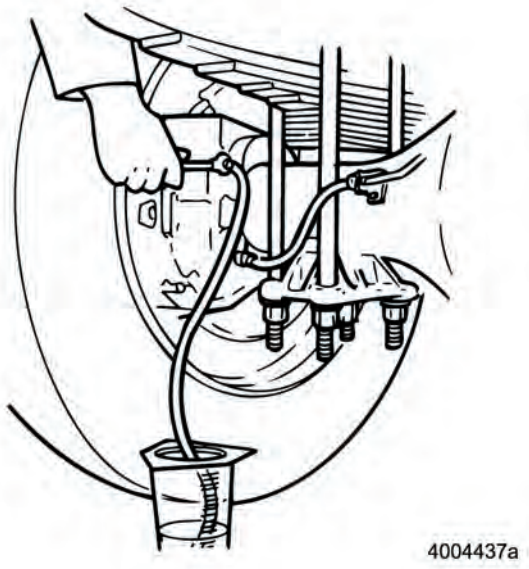
Removing the master cylinder involves removing the master cylinder reservoir. If the old reservoir is going to be installed onto the new master cylinder, care must be taken during the removal process. Do not install a damaged reservoir.

1. Park the vehicle on a level surface. For vehicles with manual parking brakes, apply the parking brakes.
2. Block the front and rear tires to prevent vehicle movement.
3. Disconnect the battery.
4. Use a clean rag to carefully clean the outside of the master cylinder and master cylinder reservoir.

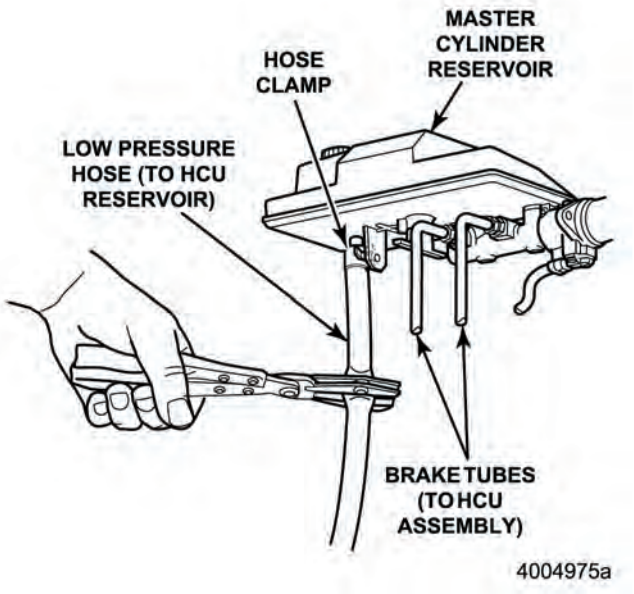
IMPORTANT:

Both the foot brake switch and the fluid level sensor switch can be replaced without draining the brake fluid. If you are replacing either of these switches, follow the procedures given in this manual.

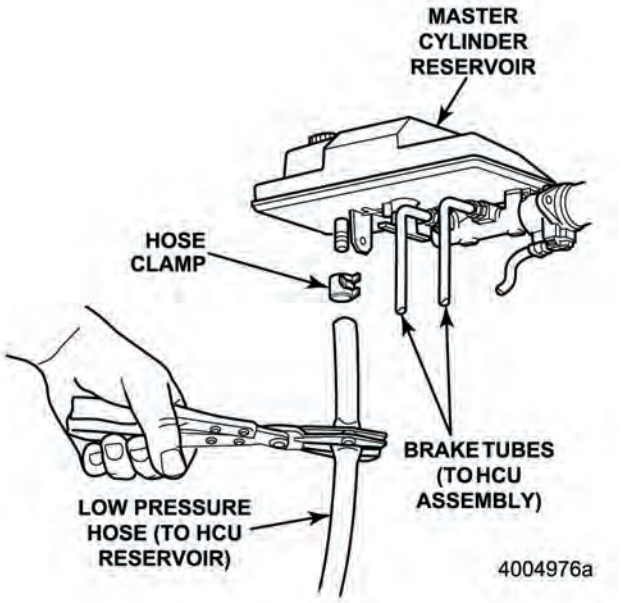
5. Disconnect the foot brake switch on the master cylinder and the fluid level switch on the master cylinder reservoir.
6. Apply the brake pedal a minimum of 30 times to decrease pressure in the system. To ensure the system is depressurized, perform the following check on both the front and rear axles.
   A. Remove the protective cover from the end of the bleeder fitting on one brake caliper.
   B. Attach a bleeder bottle hose to the bleeder fitting at the wheel end. Submerge the free end of the bleeder hose into the bleeder bottle. Both the tubing and container must be able to withstand the effects of hydraulic brake fluid.
   C. Use a wrench to open the bleeder fitting screw.
   D. Apply and hold the brake pedal down until no more brake fluid runs out. Do not release the brake pedal.
   E. With the brake pedal still applied, use a torque wrench to tighten the bleeder fitting screw. Repeat Steps A-E for the second axle.



7. Attach a pinch clamp to the low pressure hose near the outlet of the master cylinder reservoir. Do not damage the reservoir outlet.

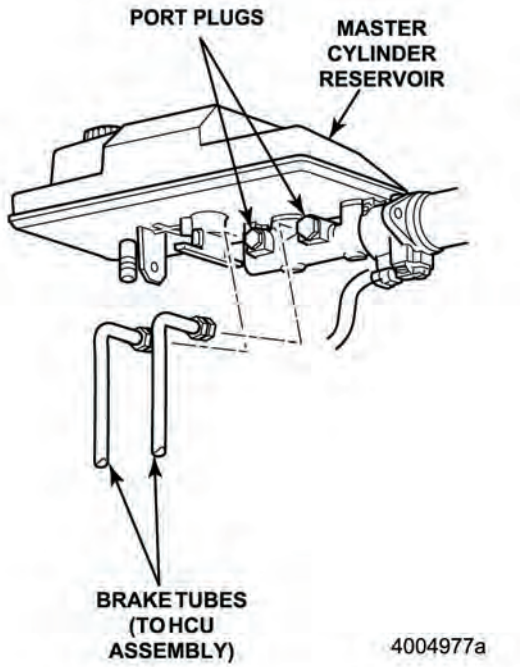


8. To help prevent brake fluid from damaging the vehicle or floor paint, or from seeping into the ground, position a container beneath the work area to collect any drained or spilled brake fluid.
9. Remove the hose clamp.
10. Disconnect the low pressure hose from the master cylinder reservoir. All of the fluid coming out of the master cylinder reservoir, approximately one gallon (3.4 liters), should drain into the container. Remove the cap from the master cylinder reservoir to improve the draining process. Plug the low pressure hose to prevent system contamination.

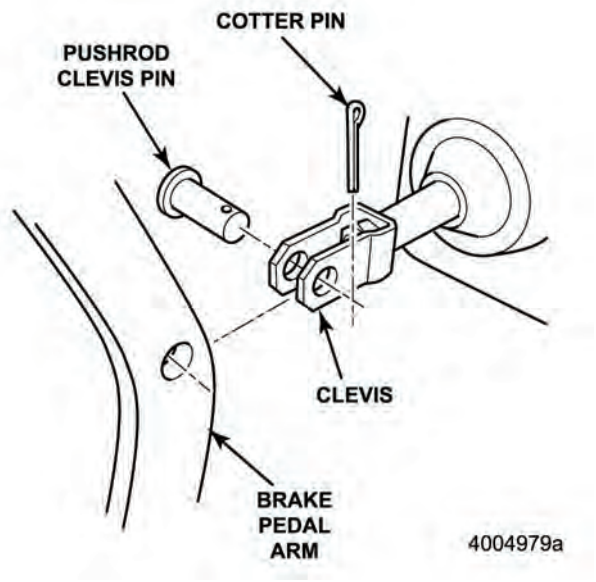


IMPORTANT:
Some brake fluid may remain in protected areas of the master cylinder reservoir.

11. When the reservoir is empty, replace the cap on the master cylinder reservoir and plug the reservoir outlet to prevent any excess fluid from spilling during removal.
12. Disconnect the two brake tubes from the master cylinder. Plug the brake tubes and the master cylinder ports to protect them from contamination.



13. Disconnect the master cylinder pushrod clevis pin from the brake pedal.



14. Loosen and remove the two bolts that hold the master cylinder assembly to the bracket on the fire wall. Remove the master cylinder and master cylinder reservoir assembly from the vehicle.
15. If the master cylinder reservoir is undamaged and is going to be reused, follow these steps to remove the undamaged reservoir from the old master cylinder.
    A. Remove the nut from the front bolt. Use a punch to drive out the two roll pins.
    B. Lift the reservoir off the master cylinder.
    C. Pour any fluid remaining in the reservoir into a suitable container.
    D. Plug the reservoir outlet ports to prevent contamination to the system.
16. Verify the warranty status. If the master cylinder is under warranty, return it to Meritor WABCO.

Installation Procedure

WARNING:

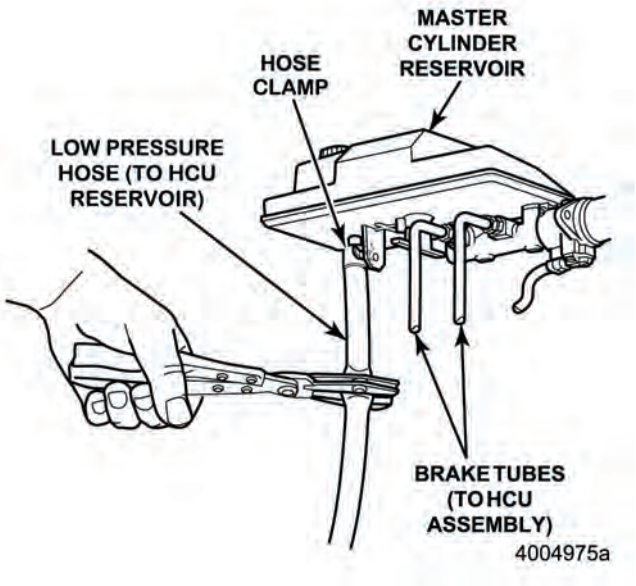
To prevent serious eye injury, always wear safe eye protection when you perform vehicle maintenance or service.

- ***Two people are needed to perform this procedure.***
- ***In some vehicles it may be necessary to move non-HPB system components, such as the air tank, in order to access the HPB part. If this is necessary, refer to the vehicle manufacturer's manual for information before moving the component.***
- ***Bleeding the master cylinder circuit is required during installation of the master cylinder. Bleed procedures appear in this section.***
- ***After installing HPB components or making system repairs, use TOOLBOX™ Software to remove the error code from the ECU memory. Instructions for using TOOLBOX™ Software appear in this section.***

1. Attach the original or replacement reservoir to the new master cylinder, as follows.
    A. Install two new rubber grommet seals into the inlet ports of the master cylinder. Use new brake fluid from a sealed container to lubricate the seals. Use DOT 3 or DOT 4 brake fluid. Refer to the vehicle specification sheet to determine which fluid to use.
    B. Install the original or replacement reservoir by carefully pressing it fully into the grommets.

C. Install two new roll pins from the replacement kit. Drive the pins through the holes in the master cylinder boss and the reservoir mounting tab holes. Support the back of the tabs as you install each pin.

D. Install the nut on the front bolt.

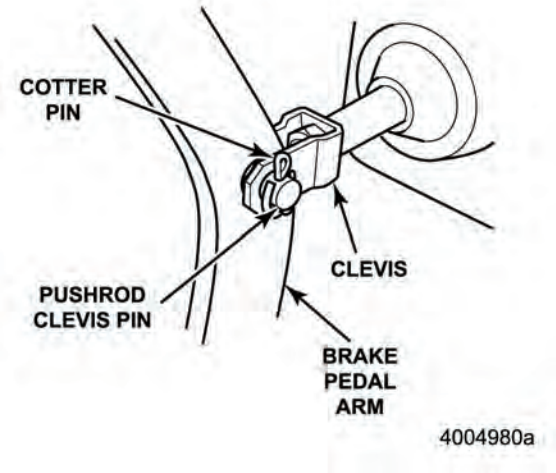


2. Use the two mounting nuts included in the replacement kit to attach the master cylinder assembly to the bracket on the fire wall. Tighten the bolts to 50 lb-ft (70 N•m).

WARNING:

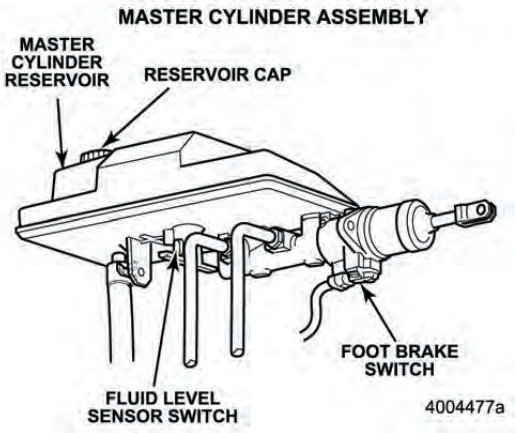
Failure to correctly install the clevis pin as described may result in damage to the push-rod, abnormal brake pedal feel and/or loss of brakes during vehicle operation.

3. Connect the master cylinder pushrod clevis pin to the pedal assembly. The clevis pin must be installed into the same hole on the brake pedal as it was before the old master cylinder was removed. Secure the cotter pin.



4. Connect the brake tubes to the master cylinder. Tighten the fittings to 10.8-14.4 lb-ft (15-20 N•m).
5. Connect the low pressure hose to the master cylinder reservoir and secure the connection with a hose clamp.
6. Remove the pinch clamp from the low pressure hose.
7. Connect the foot brake switch on the master cylinder and the fluid level sensor switch under the reservoir.
8. Fill the master cylinder reservoir to the MAX mark with new brake fluid from a sealed container. Use DOT 3 or DOT 4 hydraulic brake fluid. Refer to the vehicle specification sheet to determine which fluid to use.
9. Bleed the master cylinder circuit. Refer to Brake System Bleeding.

10. Connect the battery.
11. Turn the ignition ON. The HCU pump motors will start up and fill the accumulators. Approximate running time is 45 seconds.
12. Depress the brake pedal rapidly four times to activate both HCU pump motors.

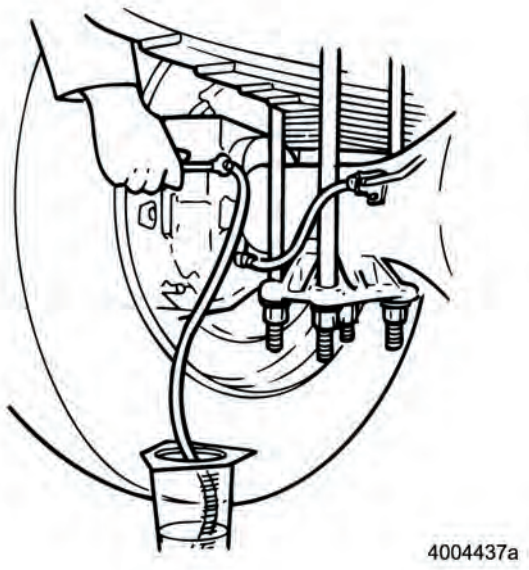


13. After the pumps stop running, fill the master cylinder reservoir to the MAX mark with new brake fluid from a sealed container. Use DOT 3 or DOT 4 hydraulic brake fluid. Refer to the vehicle specification sheet to determine which fluid to use.
14. Check the system for leaks. If there are no leaks, go to Step 16. If there are leaks, depressurize the system before making the necessary repairs. Use the following procedure to depressurize the system.
    - Apply the brake pedal a minimum of 30 times to decrease pressure in the system. To ensure that the system is depressurized, perform the following check on both the front and rear axles:

    A. Remove the protective cover from the end of the bleeder fitting on one brake caliper.

    B. Attach a bleeder bottle hose to the bleeder fitting at the wheel end. Submerge the open end of the bleeder hose into the bleeder bottle. Both the tubing and container must be able to withstand the effects of hydraulic brake fluid.

    C. Use a wrench to open the bleeder fitting screw.



    D. Apply and hold the brake pedal down until no more brake fluid runs out. Do not release the brake pedal.

    E. With the brake pedal still applied, use a torque wrench to tighten the bleeder fitting screw to 34.7-39 lb-in (4-4.5 N•m). Repeat Steps A-E for the second axle.

15. After making the repairs, check the fluid level in the master cylinder reservoir to make sure it is at the MAX mark. Refill as necessary, using only the recommended DOT 3 or DOT 4 hydraulic brake fluid, as described above.

16. Use TOOLBOX™ Software to cancel the diagnostic code for the master cylinder. Refer to TOOLBOX™ instructions.
17. Remove the wheel blocks.
18. Test drive the vehicle. Refer to the Vehicle Test Drive.

Master Cylinder Reservoir Replacement

Removal Procedure

WARNING:

The full power brake system is a pressurized system that achieves pressures of up to 2320 psi. This pressure is not reduced by switching the ignition off or removing battery power.

Prior to servicing this system, the depressurization procedures must be performed exactly as presented. Failure to depressurize the system may result in personal injury or death.

CAUTION:

To avoid damage to the system while working on the brake system, do not apply the foot pedal unless instructed to do so.

IMPORTANT:

It is not necessary to remove the complete master cylinder assembly when replacing the reservoir.

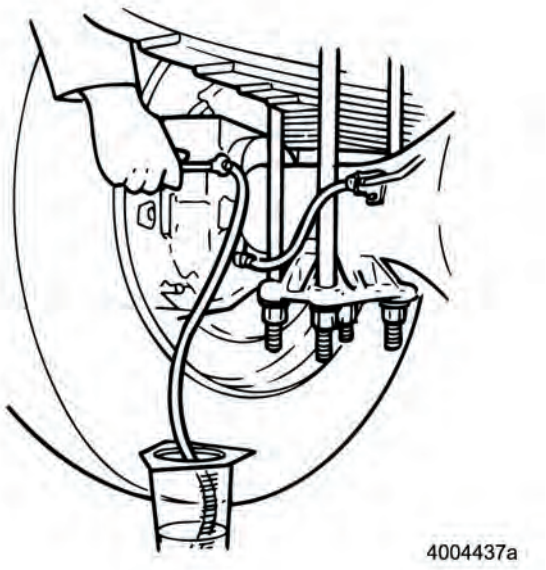
- *Two people are needed to perform this procedure.*
- *In some vehicles it may be necessary to move non-HPB system components, such as the air tank, in order to access the HPB part. If this is necessary, refer to the vehicle manufacturer's manual for information before moving the component.*
- *Bleeding the master cylinder circuit is required during installation of the master cylinder reservoir. Bleed procedures appear in this section.*
- *After installing HPB components or making system repairs, use TOOLBOX™ Software to remove the error code from the ECU memory. Instructions for using TOOLBOX™ Software appear in this section.*

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.

1. Park the vehicle on a level surface. For vehicles with manual parking brakes, apply the parking brakes.
2. Block the front and rear tires to prevent vehicle movement.
3. Disconnect the battery.

4. Use a clean rag to carefully clean the outside of the master cylinder and master cylinder reservoir.
5. Apply the brake pedal a minimum of 30 times to decrease pressure in the system. To ensure the system is depressurized, perform the following check on both the front and rear axles.
   A. Remove the protective cover from the end of the bleeder fitting on one brake caliper.
   B. Attach a bleeder bottle hose to the bleeder fitting at the wheel end. Submerge the free end of the bleeder hose into the bleeder bottle. Both the tubing and container must be able to withstand the effects of hydraulic brake fluid.
   C. Use a wrench to open the bleeder fitting screw.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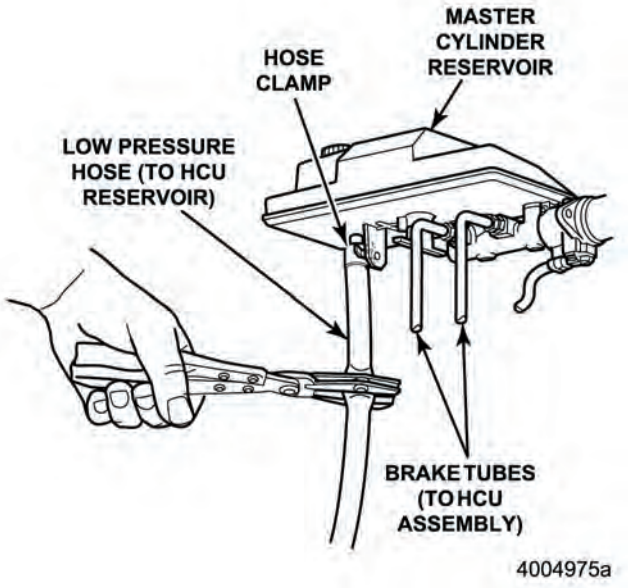
   D. Apply and hold the brake pedal down until no more brake fluid runs out. Do not release the brake pedal.
   E. With the brake pedal still applied, use a torque wrench to tighten the bleeder fitting screw. Repeat Steps A-E for the second axle.
6. Attach a pinch clamp to the low pressure hose near the outlet to the master cylinder reservoir. Do not damage the reservoir outlet.



7. To help prevent brake fluid from damaging the vehicle or floor paint, or from seeping into the ground, position a container beneath the work area to collect any drained or spilled brake fluid.
8. Remove the hose clamp from the low pressure hose.

9. Disconnect the low pressure hose from the master cylinder reservoir. All of the fluid coming out of the master cylinder reservoir, approximately one gallon (3.4 liters), should drain into the container. Remove the cap from the master cylinder reservoir to improve the draining process. Plug the low pressure hose to prevent system contamination.
10. Remove the reservoir from the master cylinder assembly, as follows.
    A. Disconnect the fluid level switch.
    B. Remove the nut from the front bolt. Use a punch to drive out the two roll pins.
    C. Lift the reservoir off the master cylinder.
    D. Plug the reservoir outlet ports to prevent contamination to the system.
    E. Pour any remaining fluid into a suitable container.
    F. Close the reservoir outlet ports to prevent spillage.
11. Verify the warranty status. If the master cylinder reservoir is under warranty, return it to Meritor WABCO.

Installation Procedure

WARNING:

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

CAUTION:

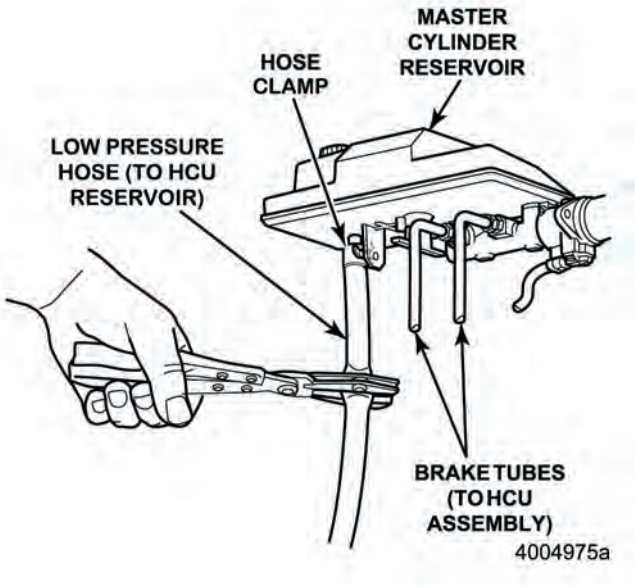
Do not install a damaged reservoir. A damaged reservoir will result in loss of hydraulic brake fluid which can lead to loss of HPB function.

- ***Two people are needed to perform this procedure.***
- ***In some vehicles it may be necessary to move non-HPB system components, such as the air tank, in order to access the HPB part. If this is necessary, refer to the vehicle manufacturer's manual for information before moving the component.***
- ***Bleeding the master cylinder circuit is required during installation of the master cylinder reservoir. Bleed procedures appear in Section 5 of this manual.***
- ***After installing HPB components or making system repairs, use TOOLBOX™ Software to remove the error code from the ECU memory. Instructions for using TOOLBOX™ Software appear in Section 3 of this manual.***

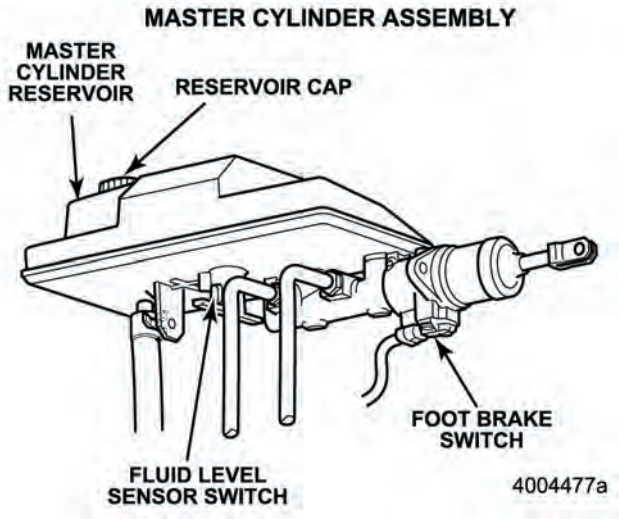
1. Attach the replacement reservoir to the new master cylinder, as follows.
    A. Install the new rubber grommets in the two inlet ports of the master cylinder. Use new brake fluid from a sealed container to lubricate the seals. Use DOT 3 or DOT 4 brake fluid. Refer to the vehicle specification sheet to determine which fluid to use.
    B. Install the replacement reservoir by carefully pressing it fully into the grommets.

C. Install the two new roll pins from the replacement kit. Drive the pins through the holes in the master cylinder boss and the reservoir mounting tab holes. Support the back of the tabs as you install each pin.

D. Install the nut on the front bolt.

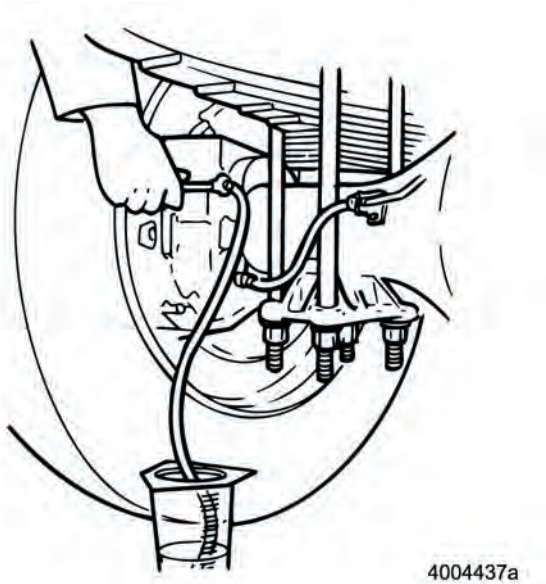


2. Connect the low pressure hose to the reservoir.
3. Remove the pinch clamp from the low pressure hose.
4. Connect the fluid level switch on the master cylinder reservoir.



5. Fill the master cylinder reservoir to the MAX mark with new brake fluid from a sealed container. Use DOT 3 or DOT 4 hydraulic brake fluid. Refer to the vehicle specification sheet to determine which fluid to use.
6. Bleed the master cylinder circuit. Follow the instructions for bleeding the master cylinder circuit that appear in Section 5 of this manual.
7. Connect the battery.
8. Turn the ignition ON. The HCU pump motors will start up and fill the accumulators. Approximate running time is 45 seconds.
9. Verify the fluid level is above the MIN mark. If not, add new brake fluid. Use only DOT 3 or DOT 4 hydraulic brake fluid. Refer to the vehicle specification sheet to determine which fluid to use.
10. Depress the brake pedal rapidly four times to activate both HCU pump motors.

11. When the pumps stop running, fill the master cylinder reservoir to the MAX mark with new brake fluid from a sealed container. Use only DOT 3 or DOT 4 brake fluid. Refer to the vehicle specification sheet to determine which fluid to use.
12. Check the system for leaks. If there are no leaks, go to Step 15. If there are leaks, depressurize the system before making the necessary repairs. Use the following procedure to depressurize the system. Apply the brake pedal a minimum of 30 times to decrease pressure in the system. To ensure that the system is depressurized, perform the following check on both the front and rear axles:
    A. Remove the protective cover from the end of the bleeder fitting on one brake caliper.
    B. Attach a bleeder bottle hose to the bleeder fitting at the wheel end. Submerge the free end of the bleeder hose into the bleeder bottle. Both the tubing and container must be able to withstand the effects of hydraulic brake fluid.
    C. Use a wrench to open the bleeder fitting screw.
    D. Apply and hold the brake pedal down until no more brake fluid runs out. Do not release the brake pedal.
    E. With the brake pedal still applied, use a torque wrench to tighten the bleeder fitting screw. Repeat Steps A-E for the second axle.



13. After making the repairs, check the fluid level in the master cylinder reservoir to make sure it is at the MAX mark. Refill as necessary, using only the recommended DOT 3 or DOT 4 hydraulic brake fluid.
14. Use TOOLBOX™ Software to cancel the diagnostic code for the master cylinder reservoir. Refer to TOOLBOX™ instructions.
15. Remove the wheel blocks.
16. Test drive the vehicle. Refer to the Vehicle Test Drive.

Low Pressure Hose Replacement

Removal Procedure

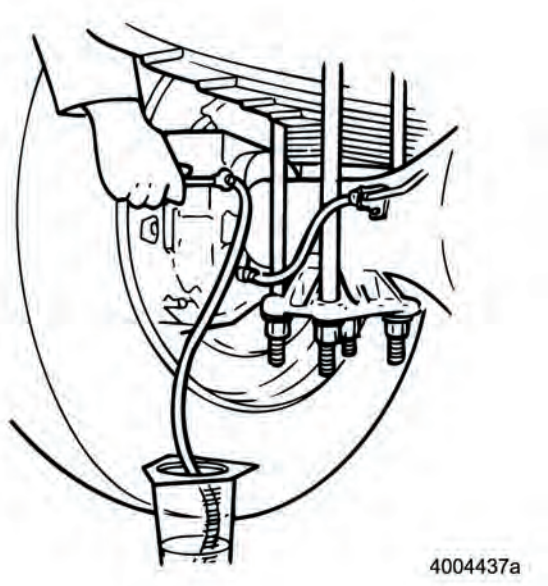
WARNING:

The full power brake system is a pressurized system that achieves pressures of up to 2320 psi. This pressure is not reduced by switching the ignition off or removing battery power. Prior to servicing this system, the depressurization procedures must be performed exactly as presented. Failure to depressurize the system may result in personal injury or death.

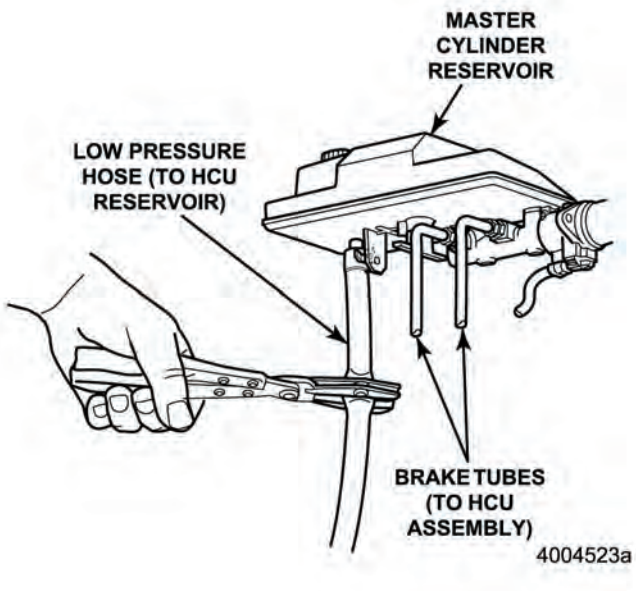
IMPORTANT:

Meritor WABCO does not manufacture low pressure hoses. Refer to the vehicle manufacturer for specific installation and service information. The following removal and installation procedures are included to assist you in servicing Meritor WABCO's HPB system.

1. Park the vehicle on a level surface.
2. Block the front and rear tires to prevent vehicle movement.
3. Disconnect the battery.
4. Use a clean rag to carefully wipe the surface of the HCU and the master cylinder reservoir.
5. Apply the brake pedal a minimum of 30 times to decrease pressure in the system. To ensure the system is depressurized, perform the following check on both the front and rear axles.
   A. Remove the protective cover from the end of the bleeder fitting on one brake caliper.
   B. Attach a bleeder bottle hose to the bleeder fitting at the wheel end. Submerge the free end of the bleeder hose into the bleeder bottle. Both the tubing and container must be able to withstand the effects of hydraulic brake fluid.
   C. Use a wrench to open the bleeder fitting screw.
   D. Apply and hold the brake pedal down until no more brake fluid runs out. Do not release the brake pedal.
   E. With the brake pedal still applied, use a torque wrench to tighten the bleeder fitting screw. Repeat Steps A-E for the second axle.



6. Attach a pinch clamp to the low pressure hose near the outlet of the master cylinder reservoir. Do not damage the reservoir outlet.



7. Remove the clamps that hold the middle section of the low pressure hose to the chassis. Note the position of the clamps for installation of the new hose.
8. To help prevent brake fluid from damaging the vehicle or floor paint, or from seeping into the ground, position a container beneath the work area to collect any drained or spilled brake fluid.
9. Remove the hose clamp and remove the hose from the master cylinder reservoir.

IMPORTANT:
Some brake fluid may remain in protected areas of the master cylinder reservoir.

10. Remove the cap from the master cylinder reservoir to assist draining. When the reservoir is empty, replace the cap on the master cylinder reservoir and plug the reservoir outlet to prevent any excess fluid from spilling during removal. Approximately one gallon (3.4 liters) should drain into the container.
11. Remove the hose clamp and remove the hose from the HCU.
12. Remove the “P” clamps and remove the hose from the vehicle.

Installation Procedure

- When replacing the low pressure hose, bleeding the system is not necessary.
- To help prevent contamination of the system, keep the hose ends sealed until you are ready to connect them.

1. Remove the plug from the HCU reservoir.

IMPORTANT:
When installing the hose clamps that hold the middle portion of the low pressure hose to the vehicle, use the same location as was used for the original installation.

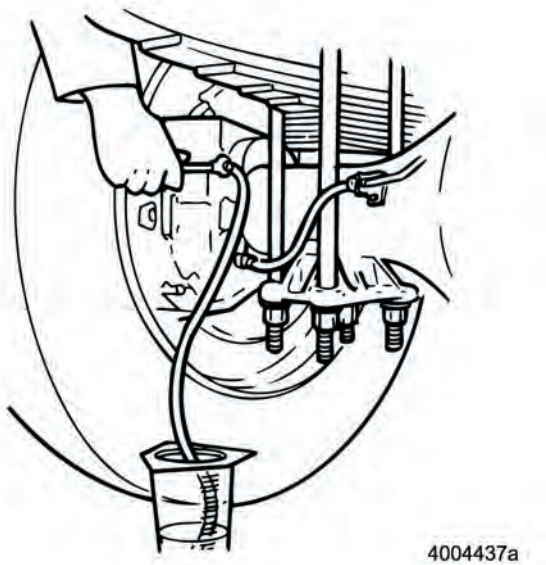
2. Attach the new hose to the HCU reservoir and master cylinder reservoir. Reuse the “P” clamps to attach the middle portion of the hose to the vehicle frame. Make sure the new hose does not contact any sharp edges or hot components.
3. Remove the plugs from the ends of the new hose.

4. Fill the master cylinder reservoir with new brake fluid from a sealed container. The fluid level must be above the MIN mark, approximately one gallon (four liters). Use DOT 3 or DOT 4 hydraulic brake fluid. Refer to the vehicle specification sheet to determine which fluid to use.
5. Connect the battery.
6. Turn the ignition ON. The HCU pump motors will start up and fill the accumulators. Approximate running time is 45 seconds.
7. Turn the ignition OFF and disconnect the battery.
8. Apply the brake pedal a minimum of 30 times to decrease pressure in the system. This will purge any trapped air from the hose.
9. Connect the battery.
10. Turn the ignition ON. The HCU pump motors will start up and fill the accumulators. Approximate running time is 45 seconds.
11. Pump the brakes rapidly four times to activate both HCU pump motors. After the pumps stop, fill the master reservoir up to the MAX mark with new hydraulic brake fluid from a sealed container. Use only DOT 3 or DOT 4 hydraulic brake fluid. Refer to the vehicle specification sheet to determine which fluid to use.
12. Check the system for leaks. If there are no leaks, go to Step 14. If there are leaks, depressurize the system before making the necessary repairs. Use the following procedure to depressurize the system.
    - Apply the brake pedal a minimum of 30 times to decrease pressure in the system. To ensure that the system is depressurized, perform the following check on both the front and rear axles:

A. Remove the protective cover from the end of the bleeder fitting on one brake caliper.

B. Attach a bleeder bottle hose to the bleeder fitting at the wheel end. Submerge the free end of the bleeder hose into the bleeder bottle. Both the tubing and container must be able to withstand the effects of hydraulic brake fluid.

C. Use a wrench to open the bleeder fitting screw.



D. Apply and hold the brake pedal down until no more brake fluid runs out. Do not release the brake pedal.

E. With the brake pedal still applied, use a torque wrench to tighten the bleeder fitting screw. Repeat Steps A-E for the second axle.

13. After making the repairs check the fluid level in the master cylinder reservoir to make sure it is at the MAX mark. Refill as necessary, using only the recommended DOT 3 or DOT 4 hydraulic brake fluid, as described above.
14. Remove the wheel blocks.
15. Test drive the vehicle. Refer to the Vehicle Test Drive.

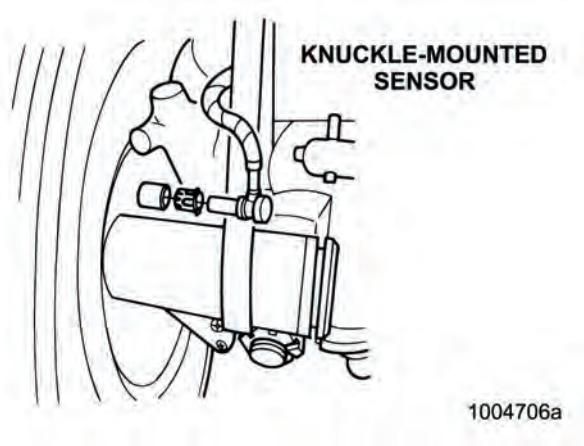
Front Axle Wheel Speed Sensor Replacement

Removal Procedure

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.

1. Park the vehicle on a level surface. Apply the parking brakes. Block the rear tires to prevent the vehicle from moving. If necessary, raise the front tires off the ground. Place safety stands under the axle.
2. Disconnect the fasteners that hold the sensor cable to the 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.
5. Remove and inspect the spring clip. Replace if necessary.



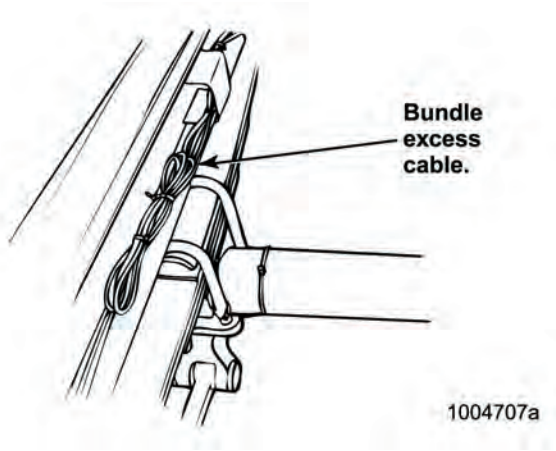
Installation Procedure

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. Verify that 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.

CAUTION:

Overtightening the tie wraps may damage the cables.

7. Fasten the sensor cable with tie wraps every 12 inches. Do not overtighten the tie wraps. Correctly bundle and store any excess cable in the sub-frame.



8. Remove the blocks and safety stands.
9. Test drive the vehicle. Refer to the Vehicle Test Drive.

Rear Axle Wheel Speed Sensor Replacement

Removal Procedure

1. Apply the parking brake. Block the front tires to prevent vehicle movement.
2. Raise the rear tires off the ground. Place 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 Procedure

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. Verify that 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. Re-attach the sensor cable to the cable clamps or clips.

CAUTION:

Overtightening the tie wraps may damage the cables.

6. Fasten the sensor cable with tie wraps every 12 inches. Do not overtighten the tie wraps. Correctly bundle and store excess cable in the sub-frame.

7. Use TOOLBOX™ Software to remove the error code from the ECU memory.
8. Replace the tire and remove the safety stands. Lower the vehicle and remove the blocks from the front tires.
9. Test drive the vehicle. Refer to the Vehicle Test Drive procedure in this section.

Master Cylinder Foot Brake Switch Replacement

Removal Procedure

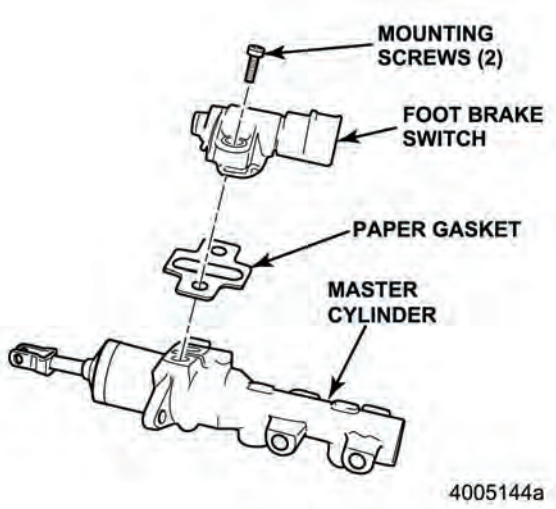
WARNING:

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.

1. Park the vehicle on a level surface.
2. Apply the parking brake and block the wheels.
3. Disconnect the foot brake switch.
4. Remove the two machine screws securing the foot brake switch to the base of the master cylinder.
5. Remove the foot brake switch.
6. Remove and discard the paper gasket from the master cylinder.
7. Verify the warranty status. If the switch is under warranty, return it to Meritor WABCO.

Installation Procedure

1. Clean the surface of the master cylinder base and install the paper gasket.
2. Install the foot brake switch to the base of the master cylinder. Tighten the two screws to 26.5-35.4 lb-in (3-4 N•m).



3. Connect the foot brake switch.
4. Remove the safety stands and wheel blocks.
5. Test drive the vehicle. Refer to the Vehicle Test Drive.

Master Cylinder Fluid Level Sensor Switch Replacement

Removal Procedure

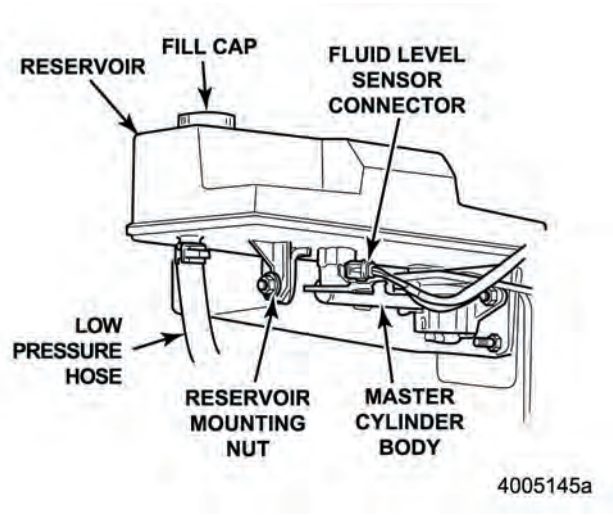
WARNING:

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.

1. Park the vehicle on a level surface.
2. Apply the parking brake and block the wheels.
3. Remove the electrical connector from the fluid level sensor.
4. Squeeze the tabs together to remove the fluid level sensor from its mounting location on the master cylinder reservoir.
5. Verify the warranty status. If the switch is under warranty, return it to Meritor WABCO.

Installation Procedure

1. Install the fluid level sensor in the same direction as the switch you removed.



2. Connect the fluid level sensor connector.
3. Remove the safety stands and wheel blocks.
4. Test drive the vehicle. Refer to the Vehicle Test Drive.

BRAKE SYSTEM BLEEDING

The following brake bleeding methods explain how to bleed the hydraulic power brake system during installation, or in the event of air in the brake system.

When performing bleed procedures, read and observe all Warning and Caution hazard alert messages in this publication. They provide information that can help prevent serious personal injury, damage to components, or both.

WARNING:

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

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 incorrect 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.

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.

IMPORTANT:

Prior to working on the braking system, all bleeder screws and the master cylinder cap must be cleaned thoroughly; cleanliness of fluid and areas around the service points have to be maintained.

- *Do not use mineral oil-based fluid for this cleaning. Using mineral oil-based fluid can contaminate brake fluid and could damage the interior of the components and cause a system malfunction.*
- *Cover all electrical connectors near the bleeder screws carefully to make absolutely certain that no brake fluid enters the terminals or plugs.*
- *After removing a component or disconnecting a brake tube connection, block off ports and brake tubes with appropriate plugs to prevent the ingress of dirt and unnecessary loss of fluid.*
- *Use only new specified brake fluid from a sealed container to refill the system. Refer to the specification on the Maste Cylinder (MC) reservoir or in the vehicle service manual.*

IMPORTANT:

Continued from the previous page

- *If a lubricant is required to aid assembly, use only the specified brake fluid from a sealed container. Do not use any other assembly lubricant.*
- *During bleeding procedures, brake fluid level must not be allowed to fall below the MIN mark on the master cylinder reservoir. The master cylinder reservoir should be regularly checked and filled to the MAX mark.*
- *Perform the bleeding procedure exactly as described in the instructions. Perform the reservoir top-off procedure, when bleeding is complete.*
- *After completing all desired brake service operations, test the braking system for function and check for leakage.*
- *Use DOT 3 or DOT 4 hydraulic brake fluid. Refer to the vehicle specification sheet to determine which fluid to use.*

The pressure-assisted brake bleeding procedures described here may be used with any fill and bleed equipment capable of filling the system and creating pressure in the reservoir.

- Meritor WABCO does not recommend using manual bleeding procedures.

Before bleeding brakes, perform the following procedure.

1. Park the vehicle on a level surface. Apply the parking brake and block the wheels to prevent the vehicle from moving.
2. Turn the ignition OFF and disconnect the battery terminals.

CAUTION:

Disconnect the battery for the entire bleed procedure; energizing the unit during bleeding must be impossible.

Pressure Fill and Bleed

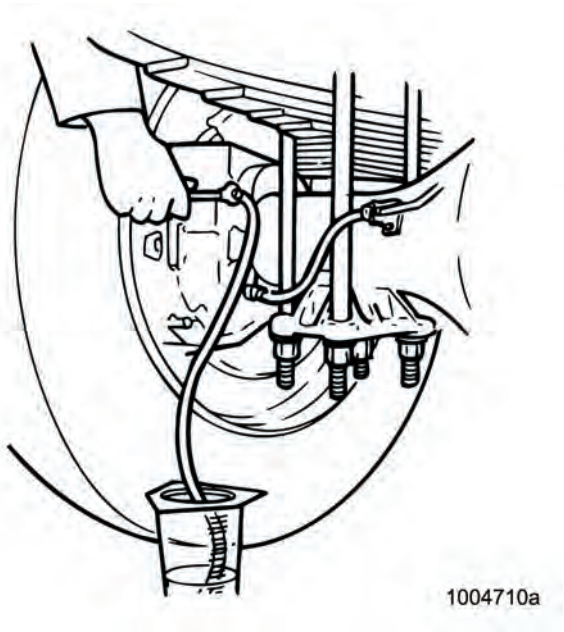
Master Cylinder Circuit

1. Install a suitable adapter from the fill and bleed equipment to the master cylinder reservoir filler neck. Verify that the adapter and bleed equipment are securely tightened onto the master cylinder reservoir filler neck.
2. Fit the bleeder hose onto one relay valve bleeder screw located on the hydraulic compact unit.
3. Submerge the free end of the bleeder hose into the bleed bottle.
4. Apply 14.5-22 psi (1-1.5 bar) pressure from the fill and bleed equipment to the master cylinder.
5. Use a 7 mm wrench to open one bleeder screw. Allow the fluid to run until four ounces (100 cc) has been collected.
6. If no further air bubbles enter the bleed bottle, close the bleeder screw. Remove the bleeder hose and tighten the bleeder screw to 34.7-39 lb-in (4-4.5 N•m).
7. Repeat Steps 5 and 6 with the second bleeder screw.
8. Release the pressure from the master cylinder reservoir.

9. If brake caliper circuit bleeding is not required, remove the bleed equipment. Fill the master cylinder reservoir up to the MAX mark with new specified brake fluid from a sealed container.
10. Install the master cylinder reservoir cap.

Brake Caliper Circuit

1. Install a suitable adapter from the fill and bleed equipment to the master cylinder reservoir filler neck. Verify that the adapter and bleed equipment are securely tightened onto the master cylinder reservoir filler neck.
2. Fit the bleeder hose onto the caliper bleeder screw at one wheel end.
3. Submerge the free end of the bleeder hose into the bleed bottle.
4. Apply 14.5-22 psi (1-1.5 bar) pressure from the fill and bleed equipment to the master cylinder.
5. Open one bleeder screw. Allow the fluid to run until four ounces (100 cc) has been collected.



6. If no further air bubbles enter the bleed bottle, close the bleeder screw. Remove the bleeder hose and tighten the bleeder screw to 8.6-11.5 lb-in (12-16 N•m).
7. Repeat Steps 2-6 with the three other calipers.
8. Release the pressure from the reservoir.
9. Disconnect the fill and bleed equipment from the master cylinder reservoir filler neck.
10. Connect the battery.
11. Turn the ignition ON. The hydraulic compact unit pump motors will start up automatically and fill the accumulators. Approximate running time is 45 seconds. The brake light and buzzer will turn OFF.

IMPORTANT:

If the hydraulic compact unit pump motors fail to deliver a sufficient amount of fluid, the ECU module will control the hydraulic compact unit pump motors in a self-priming procedure. The hydraulic control unit pump motors should stop in less than three minutes, with the brake indicator light and buzzer OFF. If that does not occur, apply pressure to assist pump priming.

12. Fill the master cylinder reservoir up to the MAX mark with new specified brake fluid from a sealed container.
13. Install the master cylinder reservoir cap.

Spring-Applied/Hydraulic Release Parking Brake Circuit

Before bleeding the circuit, the parking brake cable has to be disconnected from the spring-applied/hydraulic release (SAHR) canister. This is to ensure that the SAHR piston achieves the full stroke and forces most of the fluid volume out of the SAHR canister, thus moving potential entrapped air into the bleeder screw area.

1. Install a suitable adapter from the fill and bleed equipment to the master cylinder reservoir filler neck. Verify that the adapter and bleed equipment are securely tightened onto the master cylinder reservoir filler neck.
2. Fit the bleeder hose onto the bleeder screw on the SAHR chamber.
3. Submerge the free end of the bleeder hose into the bleed bottle.
4. Apply 14.5-22 psi (1-1.5 bar) pressure from the fill and bleed equipment to the master cylinder.
5. Open the bleeder screw. Allow the fluid to run until four ounces (100 cc) has been collected.
6. If no further air bubbles enter the bleed bottle, close the bleeder screw. Remove the bleeder hose and tighten the bleeder screw to 8.6-11.5 lb-in (12-16 N•m).
7. Release the pressure from the master cylinder reservoir.
8. If brake caliper or master cylinder circuit bleeding is not required, remove the bleed equipment. Fill the master cylinder reservoir up to the MAX mark with new specified brake fluid from a sealed container.
9. Install the master cylinder reservoir cap.
10. Connect the parking brake cable to the SAHR canister.

Changing Hydraulic Brake Fluid

1. Disconnect the battery.
2. Decrease pressure in the system by fully applying the brake pedal a minimum of 30 times.
3. Connect a bleeder bottle to two wheel ends, one per axle. This may be performed one axle at a time.
4. Open the corresponding bleeder screws. Press the brake pedal until no more fluid runs out. Close the screws again. This will ensure that the system is depressurized.
5. Use a clamp to pinch the hose from the HCU reservoir.

6. Disconnect the hose from the HCU reservoir. Use a container to collect the drained brake fluid. To help prevent brake fluid from damaging the vehicle or floor paint, or from seeping into the ground, position a container beneath the work area to collect any drained or spilled brake fluid.
7. Remove the cap on the master cylinder reservoir. Open the pinch clamp. All the fluid in the master cylinder reservoir and the hose should drain into the container.
8. Reconnect the hose to the HCU reservoir.
9. Fill the master cylinder reservoir with new brake fluid from a sealed container. The fluid level must be above the MIN mark, approximately 0.9 gallon (3.2 liters). Use DOT 3 or DOT 4 hydraulic brake fluid. Refer to the vehicle specification sheet to determine which fluid to use.
10. Bleed the master cylinder circuit by following the service bleeding instructions.
11. Pump the brake pedal, fully and slowly, a minimum of 25 times. Approximately 2.75 cu-in (45 ccm) of brake fluid will flow through each bleeder screw. Close the bleeder screws.
12. Fill the master cylinder reservoir to the MAX mark with new specified brake fluid from a sealed container.
13. Connect the battery.
14. Connect the bleeder bottles on one wheel on each axle. Open the bleeder screws.
15. Press the brake pedal. The HCU pump motors will start and brake fluid will run out of the bleeder screws into the bleeder bottles.
16. Release the brake pedal when the fluid level in the master cylinder reservoir reaches the MIN mark. The HCU pump motors will automatically fill the accumulators.
17. Close the bleeder screws on the wheel ends.
18. Fill the master cylinder reservoir up to the MAX mark with new specified brake fluid from a sealed container.
19. Bleed the SAHR circuit. Refer to the Brake System Bleeding.
20. Bleed the brake caliper circuits. Refer to the Brake System Bleeding.
21. Pump the brakes rapidly four times to activate both HCU pump motors. After the pumps stop, fill the master cylinder reservoir to the MAX mark with new specified brake fluid from a sealed container.
22. Check the system for leaks.
23. Test drive the vehicle. Refer to the Vehicle Test Drive.

Brake Caliper Replacement

Removal Procedure

1. Remove the brake hose hold down clamp bolt, if equipped.
2. Remove the brake hose/tube from the caliper.
3. Remove four caliper-to-support assembly bolts.

CAUTION

Do not disassemble the four bolts joining the two halves of the caliper. Disassemble and Overhaul the Brake Caliper.

4. Remove the brake caliper.

Clean, Dry, and Inspect

CLEAN PARTS

1. Thoroughly clean the exterior caliper surfaces using a damp cloth.

DRY AND INSPECT PARTS

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

Installation Procedure

1. Position the caliper on the support.
2. Install the four caliper-to-support assembly bolts.
3. Tighten the bolts to 435.2-489.6 N•m (320-360 lb-ft).

Brake Pad Replacement

Removal Procedure

1. 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.
2. Remove the pad retainer spring bolt
3. Compress the caliper pistons
4. Remove the brake pads.

Installation Procedure

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.

NOTICE
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.

NOTICE
Brake pad clearance adjustment is automatic.

5. Fill the master cylinder reservoir with new, clean, high-performance DOT 3 brake fluid. 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. Refer to Brake System Bleeding.

Seal and Dust Boot Replacement

Removal Procedure

1. Remove the caliper. Refer to Caliper Replacement.
2. Remove the caliper pistons. Refer to Caliper Piston Replacement.
3. Remove the dust boots.
4. Remove the seals.

Clean, Dry, and Inspect

CLEAN PARTS

For ground or polished 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 safety solvent or equivalent to clean the surfaces of ground or polished parts.

For rough metal parts

Use a cleaning solvent or weak alkaline solution in a hot solution tank to clean rough metal parts. If a hot solution tank is used, follow the instructions below:

1. Place the rough parts in the hot solution tank.
2. Leave the rough parts in the tank until they are completely cleaned and heated.
3. Remove the rough parts from the tank.
4. Thoroughly wash the rough parts with water until the alkaline solution is completely washed off of the parts.

DRY AND INSPECT PARTS

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

Installation Procedure

1. Lubricate the new seals with brake grease.
2. Install the new seals in the seats inside the caliper body. Make sure the seals are properly seated before continuing.
3. Lubricate the pistons around their outer diameter with brake grease.
4. Install dust boot on the caliper.
5. Install the pistons. Refer to Caliper Piston Replacement.
6. Install the caliper. Refer to Caliper Replacement.

Caliper Piston Replacement

Removal Procedure

1. Remove the caliper. Refer to Caliper Replacement.
2. Loosen the bleed screw, but do not remove it.
3. Place one end of a hose on the tip of the bleed screw and the other end in a container to catch the brake fluid as it drains.
4. Use disc brake pad spreader tool to press both pistons back into their bores, which will force the brake fluid out of the caliper.

CAUTION

While pressing the pistons back into their bores, be careful to not damage the insulating ring and the dust covers. The dust covers must not be twisted or allowed to trap air. If air becomes trapped in the dust cover, use a flat blade to gently lift the edge of the seal to release the air.

CAUTION

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

CAUTION

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

5. Tighten the bleed screw to 14 N•m (124 lb in).
6. Install a block of wood into the caliper in front of the caliper pistons.

CAUTION

When removing 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.

7. 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.
8. Remove the pistons.
9. Remove the dust boots and the piston seals. Refer to Seal and Dust Boot Replacement.

Clean, Dry, and Inspect

CLEAN PARTS

For ground or polished 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 safety solvent or equivalent to clean the surfaces of ground or polished parts.

For rough metal parts

Use a cleaning solvent or weak alkaline solution in a hot solution tank to clean rough metal parts. If a hot solution tank is used, follow the instructions below:

1. Place the rough parts in the hot solution tank.
2. Leave the rough parts in the tank until they are completely cleaned and heated.
3. Remove the rough parts from the tank.
4. Thoroughly wash the rough parts with water until the alkaline solution is completely washed off of the parts.

DRY AND INSPECT PARTS

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

Installation Procedure

1. Install the seals and dust boots. Refer to Seal and Dust Boot Replacement.
2. Install the pistons in their bores. Make sure the lip of the dust boot is seated in the groove in the piston.
3. Check the dust boot to determine if there is any air trapped in the dust boot. If there is air trapped, use a flat blade tool to gently lift the edge of the dust boot to release the air.
4. Pump the brake pedal repeatedly to move the pistons out until the pads are pressed against the rotor. Continue pumping the brake pedal until pedal force returns to normal and the normal stroke is restored.
5. Have an assistant press and hold the brake pedal. While the system is under pressure, check all of the brake fittings, lines, and hoses for possible fluid leaks.
6. Check the brake fluid level in the reservoir. Add fluid if necessary.

Bleed Screw Replacement

Removal Procedure

1. Remove the cap from the bleed screw.
2. Loosen the bleed screw.
3. Inside the vehicle, position a spacer between the front edge of the driver seat and brake pedal so that the pedal is pressed throughout the repair. This is done to avoid any leakage of brake fluid from the brake hose.
4. Remove the bleed screw.

Inspection Procedure

1. Carefully inspect threads in the caliper bleed port for damage.
2. Repair or replace worn or damaged parts.

Installation Procedure

1. Thread the bleed screw into the port on the caliper.
2. Tighten the bleed screw to 97 lb in (11 N·m).
3. Bleed the brakes. Refer to Brake System Bleeding.
4. Install the cap on the bleed screw.

Caliper Mounting Bolt Replacement

CAUTION

When the caliper mounting bolts are removed, they MUST be replaced with new bolts.

Removal Procedure

1. Loosen and remove the caliper mounting bolts.

Installation Procedure

1. Install the new caliper mounting bolts.
2. Tighten the caliper mounting bolt to 115 N•m (85 lb ft).

Brake Rotor Replacement

Removal Procedure

1. Remove the brake caliper. Refer to Brake Caliper Replacement.
2. Remove the hub and brake rotor assembly.
3. Remove the brake rotor to humb mounting bolts.
4. Remove the brake rotor.

Installation Procedure

NOTICE

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

1. Install the brake rotor.

IMPORTANT

Threads must be clean and free of grease. Apply 272 Threadlocker P/N 12345493 or the equivalent to the threads of each brake rotor mounting bolt.

2. Insert the bolts that mount the brake rotor to the hub.
3. Tighten the brake rotor to hub bolts:
   - For units with the 9/16-inch OD bolts, tighten the bolts to 152 N•m (112 lb ft).
   - For units with the 5/8-inch OD bolts, tighten the bolts to 256 N•m (189 lb ft).
4. Install the hub and brake rotor assembly.
5. Inspect the brake rotor for runout. Refer to Brake Rotor Lateral Runout Check.
6. Clean both sides of the rotor with brake cleaner.
7. Grease the cap or cover (if equipped). Coat the inside of the cap with wheel grease, but do not fill the cap.
8. Install the brake caliper. Refer to Brake Caliper Replacement.

NOTICE:

Workhorse does not recommend wheel stud replacement every time a rotor is replaced (unless the wheel stud is damaged or out of round when verified with a dial indicator.) If it is determined that any stud(s) need replacing, they can be pressed out (if access to a press is available) to minimize any potential for stud/rotor damage. If a press is unavailable, the studs can be carefully driven out by using a brass mallet. Be sure to wear proper eye/hand protection and administer all safety precautions when performing either procedure.

Refinishing Brake Rotors

It is not always necessary to refinish brake rotors during routine brake maintenance (i.e. replacing brake pads). Refinish only under the following circumstances:

- There is a complaint of brake pulsation.
- There is scoring greater than 1.5 mm (0.060 in).

Brake rotor minimum thickness dimension is cast into the rotor. This is the minimum wear dimension, not a refinish dimension. A rotor that will not meet this specification after refinishing should not be used.

Always replace the rotor with a new rotor. It may be necessary to replace the brake rotors in pairs in order to assure an even braking balance on both wheels.

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

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

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

Accu-turn Brake Lathe

1. Mount the brake rotor to the brake lathe. Refer to the brake lathe manufacturer's recommended procedure.
2. Locate the deepest score and turn the micrometer knobs until the tool bit bottoms out at the deepest point of the score.
3. Zero the scale.
4. Back out the tool bits.
5. Advance the cutter hand-wheel until the bits have cleared the inner edge of the brake rotor face.
6. Adjust the micrometer knobs for approximately 0.0127 mm (0.005 in) more than the first reading. This will ensure clearing the brake rotor in one cut.
7. Perform one cut procedure. For refinishing information, refer to the Brake Lathe Specifications (ACCU-TURN).
8. Perform swirl refinishing to the brake rotor. Refer to Non Directional Refinishing below.
9. Remove the brake rotor from the brake lathe.
10. Clean the brake rotor using brake cleaner.

Ammco Brake Lathe Method

1. Mount the brake rotor to the brake lathe. Refer to the brake lathe manufacturer's recommended procedure.
2. Locate the deepest score.
3. Turn the brake rotor micrometer knobs until the tool bit bottoms out at the deepest point of the score.
4. Zero the scale.
5. Back out the tool bits.
6. Advance the cutter hand-wheel until the bits have cleared the inner edge of the brake rotor face.
7. Perform rough and finish cuts. For refinishing information, refer to the *Brake Lathe Specifications (AMMCO).*
8. Perform swirl refinishing to the brake rotor. Refer to Non-Directional Refinishing below.
9. Remove the brake rotor from the brake lathe.
10. Clean the brake rotor using brake cleaner.

Non-directional Refinishing

It is very important that you make the brake rotor surface non-directional. Dress the brake surfaces with a sanding disc tool such as the Ammco 8750 Safe Swirl Disc Rotor Grinder, Accu-turn 4331 79 Non-directional Swirl Finisher, or the equivalent. Use 120 grit aluminum oxide sandpaper.

STANDARD METHOD

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

Sand each brake rotor surface using moderate pressure for a minimum of 60 seconds.

ALTERNATE METHOD

If the brake lathe is not equipped with an adequate non-directional finishing tool, use a sanding block with 150 grit aluminum oxide sandpaper.

1. Run the brake rotor at the equipment manufacturer's highest recommended cutting speed.

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

2. Sand each brake rotor surface using moderate pressure for a minimum of 60 seconds.

Burnishing the Rotors and Pads

For maximum braking efficiency, the rotors must be prepared for operation. This preparation is referred to as burnishing. Burnishing is the process of displacing brake pad friction material onto the rotor.

Brake power is generated when the friction material that has been displaced on the rotor bonds itself to the friction material on the pads. After bonding has occurred, the rotation of the wheel will cause the bond to break apart or shear. This cycle of bonding and shearing is how the brakes stop the vehicle.

If the rotors and pads are not burnished properly, the efficiency of the braking system will be compromised.

Typically, burnishing occurs during the first 10 – 50 stops. Anytime a rotor is cleaned, it will need to be burnished again to deposit the friction material from the brake pads onto the friction surface of the rotors.

1. Make 10 stops from 45 mph at an average deceleration rate of approximately 15 ft./sec^2 with brake applications at two-mile intervals.
2. Make six stops from 60 mph at an average deceleration rate of 27 ft./sec^2, with brake applications at 15-second intervals.

NOTICE
DO NOT make light pedal applications or ride the brakes before the burnishing process is complete.

Park Brake Shoe Replacement

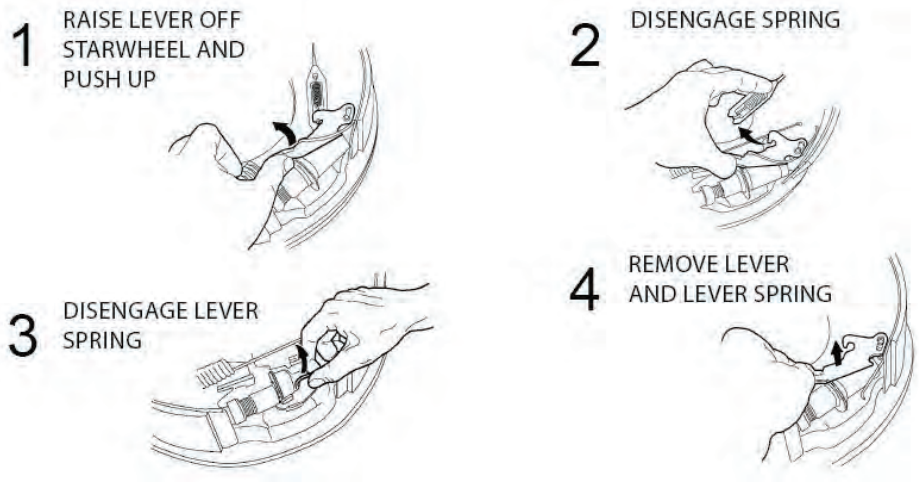
Removal Procedure

1. Block the front wheels to keep the vehicle from moving.
2. With the engine off and battery disconnected, place the transmission in gear and release the parking brake.
3. If recommended in vehicle manufacturer's service manual, raise the rear of the vehicle so the wheels clear the floor and install safety stands to support.
4. Remove the drum. See vehicle manufacturer's service manual for details, if necessary.

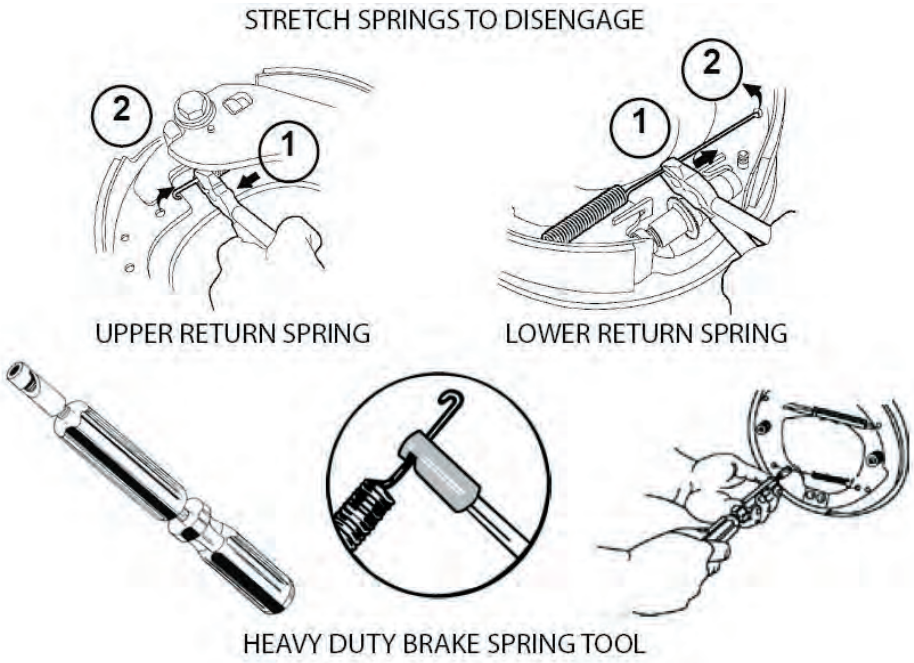
IMPORTANT:

If the drum proves difficult to remove, insert a thin flat bladed screwdriver through the brake adjusting hole in the backing plate and disengage the adjuster lever from the adjuster nut teeth. With the adjuster lever disengaged, insert a brake adjusting tool (or flat bladed screw driver) through the adjusting hole to engage the adjusting nut teeth. Move the teeth upward enough times to retract the brake shoes to clear the drum. If the drum is rusted to the axle input flange yoke pilot, tap the center of the brake drum with a nonmetallic mallet to loosen.

5. Inspect the brake per the INSPECTION PROCEDURE in this service manual.



6. Detach adjuster cable from adjuster lever, slide cable off of adjuster cable guide, and remove the cable retaining tab if so equipped.
7. Remove the adjuster lever and the adjuster spring. (These parts will need to be placed on the new replacement shoe, along with the adjuster lever mounting pin, in the opposite order removed.)
8. Remove both shoe-return springs. Use pliers, vice-grips, or a heavy duty brake spring tool.



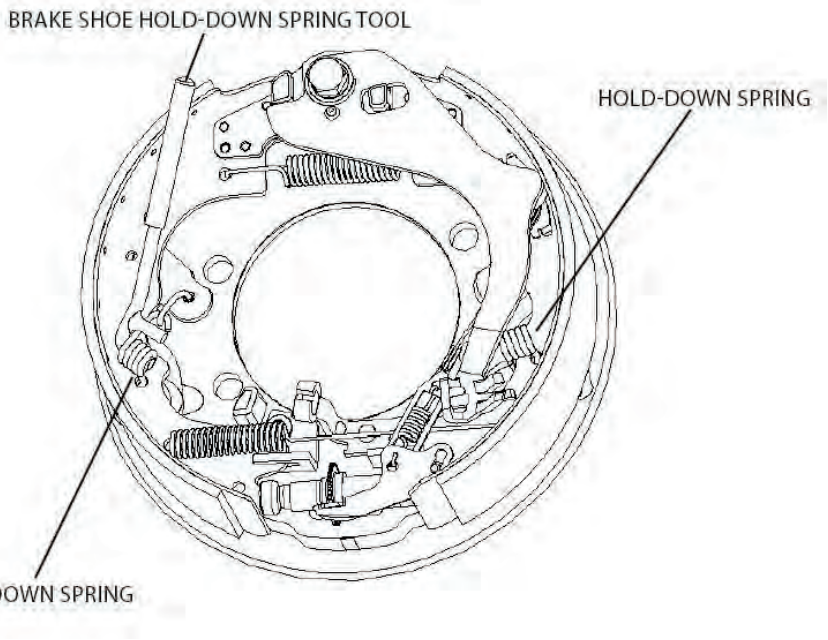
9. Remove both shoe hold-down springs. Use a brake shoe spring tool.

IMPORTANT:
Detach the parking brake apply cable and lever return spring from the end of the lever to allow easier access to the spring on the lever side.

IMPORTANT:
If the brake is a Release 2 level design with a lever guide present, it will need to be removed to provide access to the spring underneath with the tool shown in Figure 9. Upon removal of the hold down springs, the shoes, and the adjuster nut screw assembly will fall if not secured by hand.

10. Remove brake shoes from backing plate.

11. Disassemble the adjuster nut and screw assembly for cleaning and inspection of the threads.



Installation Procedure

WARNING:
Failure to correctly assemble the Adjuster Cable may result in reduced brake performance that could cause personal injury or property damage.

WARNING:
Torque all fasteners to the manufacturer's recommended torque using a torque wrench. Failure to do so could possibly result in personal injury or property damage.

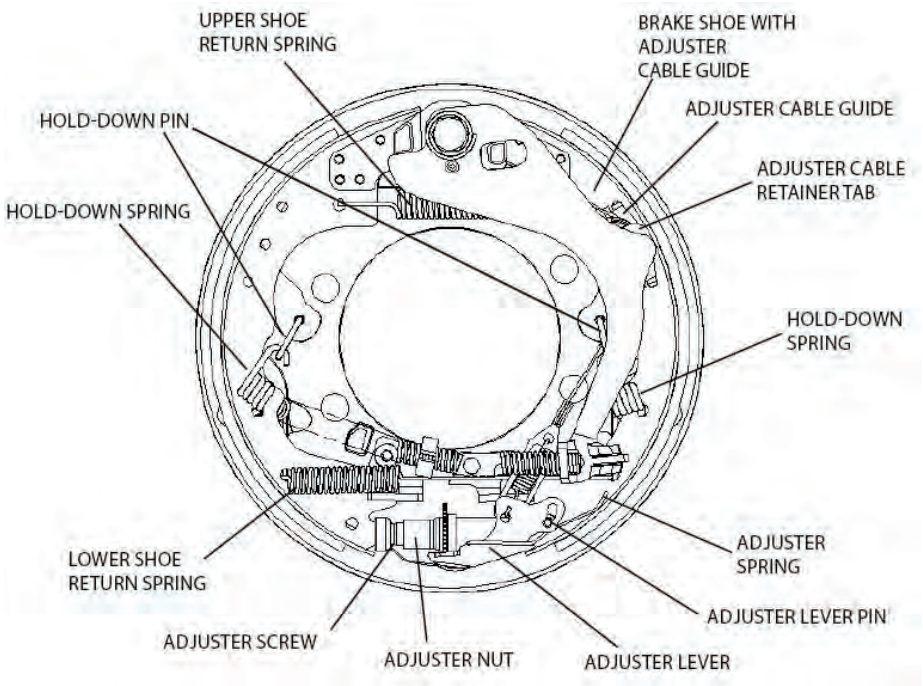
1. Clean backing plate and adjuster screw assembly. Remove old grease from shoe contact points and adjuster threads as well as debris and corrosion that could contaminate linings or interfere with proper brake operation.
2. Apply a light film of Wolfrakote paste ledge grease to the six (6) backing plate shoe ledges and one (1) anchor post.
3. Apply Chevron RPM heavy duty, lithium complex, molybdenum disulfide, extreme pressure grease, or equivalent, to the cam plate lugs where they contact the shoe ends, the end of the shoes that contact the cam lugs, and the brake lever.
4. Apply Chevron RPM heavy duty, lithium complex, molybdenum disulfide, extreme pressure grease to the threads of the adjuster screw, adjuster nut, and the socket ends of the adjuster nut and install the screw fully into the adjuster nut. Insure the screw moves in and out freely. If any damage to the threads prohibits free movement, or if the starwheel is damaged, replace adjuster assembly.

IMPORANT:
Only use the approved lubricants as specified. Do not substitute.

IMPORTANT:
When installing new shoes, make sure the shoe with the adjuster cable guide and adjuster lever pin is installed on the correct side of the shoe.

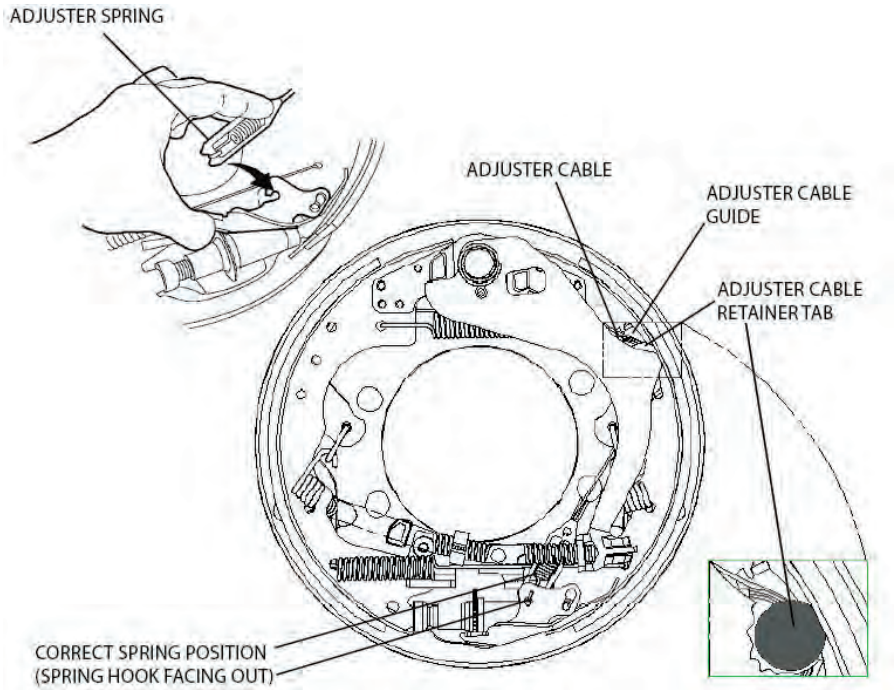
5. Place one shoe into the installed position. Reattach shoe hold-down spring and pin.

CAUTION:
For Steps 5 through 10, proper orientation of the various springs, including their hook-ends must be maintained, for proper brake function.



6. Position the second shoe and the adjuster nut and screw assembly. The adjuster nut (internally threaded) should be seated against the shoe with the adjuster cable guide and pin. Reattach shoe hold-down spring to shoe hold-down pin using the brake spring tool.
7. Install both shoe-return springs.
8. Install the adjuster spring and the adjuster lever. Ensure that the adjuster lever is properly seated against the starwheel.

9. If the lever has been removed, reinstall lever and associated components per the ANCHOR SCREW, LEVER, AND CAM REPLACEMENT section in the manual.



10. Route the adjuster cable around the adjuster cable guide, under the shoe hold down spring, and attach to the adjuster lever. Install adjuster cable retaining tab if so equipped.

IMPORTANT:
Correctly assembled, the adjuster cable end-fitting is behind the adjuster lever, with the spring hook facing out.

11. The shoe cage should be adjusted now per the SHOE CAGE ADJUSTMENT PRIMARY procedure or after the drum has been reinstalled per the SHOE CAGE ADJUSTMENT ALTERNATE procedure in this service manual.
12. Make a final inspection of the shoe linings and the inside of the drum to ensure that no grease or other contamination was accidentally applied.
13. Inspect, service and reinstall drum per the vehicle manufacturer's service manual.
14. Lower the vehicle and test the brake for proper function before returning the vehicle for service use. If necessary, make adjustments per the vehicle manufacturer's service manual.

Park Brake Anchor Screw, Lever, and Cam Replacement

Removal Procedure

Note: The anchor screw, lever, and cam should all be replaced at the same time. Do not replace just one or two of the three parts at any time. Inspection of these parts is recommended at 250,000 miles or 5 years for typical use, or more often under severe operating conditions.

1. Block the front wheels to keep the vehicle from moving.
2. With the engine off and battery disconnected, place the transmission in gear and fully release the parking brake.
3. If recommended in vehicle manufacturer's service manual, raise the rear of the vehicle so the wheels clear the floor and install safety stands to support.

4. Remove the drum. See vehicle manufacturer's service manual for details, if necessary.

CAUTION:

Do not use a drum puller or a torch to remove a brake drum. Drum distortion may result.

IMPORTANT:

If the drum proves difficult to remove, insert a narrow screwdriver through the brake adjusting hole in the backing plate and disengage the adjuster lever from the adjuster nut starwheel teeth. With adjuster lever disengaged, insert a brake adjusting tool (or screw driver) through the adjusting hole to engage the adjusting nut teeth. Move the teeth upward enough times to retract the brake shoes to clear the drum. If the drum is rusted to the axle input flange yoke pilot, tap the center of the brake drum with a non-metallic mallet to loosen.

5. Inspect the brake per the INSPECTION procedure in this service manual.
6. Detach the parking brake apply cable and lever return spring from end of brake lever. Remove the apply lever guide (on Release brakes).
7. Detach adjuster cable from the adjuster lever and slide adjuster cable off the adjuster cable guide, remove retaining tab if so equipped.
8. Remove the anchor screw.

IMPORTANT:

On Release 1 brakes with a hex socket anchor screw, the use of a thread-locking compound may prevent removal of the anchor screw with a hex key and torque in excess of 55 Nm (40 ft.-lbs.) May break or deform a 6mm hex key. If necessary, use a pipe wrench, vice grips, or similar tool on the knurling of the head to loosen the anchor screw. Replace screw if removed, regardless of condition.

9. Remove the flat washers (if installed on your application for Release 1 level brake), anti-rattle spring, lever, cam, and adjuster cable.

Installion Procedure

IMPORTANT:

If for any reason the cam, lever, and anchor screw is removed, a complete new set is recommended for service.

1. Remove the cured thread-locking compound from the anchor post hole threads. Run the appropriate size tap completely into the anchor post and back out to clean the threads. Remove loose debris from anchor post hole.

IMPORTANT:

For brakes with a hex socket head anchor screw, use an M10 x 1.5 tap (brakes manufactured prior to April 2002). For brakes with an external hex head anchor screw, use and M12 x 1.75 tap (brakes manufactured after April 2002).

2. Apply Chevron heavy duty lithium complex extreme pressure grease, or equivalent, to the cam plate lugs where they contact the shoes and the apply lever, to the cam plate slotted hole and top and bottom faces. Apply grease to the brake lever pivot hole and the contact surfaces with the cam plate lugs. Apply grease to the non-threaded portion of the anchor screw. Do not get grease on anchor screw threads or in anchor post threaded hole.
3. Reinstall the adjuster cable, new cam plate, new lever, anti-rattle spring (small coil end toward screw head for Release), flat washers (if previously installed on your application), and new anchor screw. Make sure the adjuster cable end fitting is installed to allow the cam plate to sit flat on the fitting and anchor post.
   - Stepped type end fitting - the step faces towards the backplate.
   - Alternate “eyelet” type fitting - cable crimp portion faces towards the backplate.

CAUTION:

Only thread anchor screw into the anchor post 1 to 2 turns to temporarily hold assembly together. Do not thread in completely until ready to tighten to specification (step 4).

A faulty installation will result if the thread-locking compound is activated and begins to cure prior to tightening the screw.

CAUTION:

When installing the hex socket head anchor screw, careful attention should be taken during reassembly to ensure that the adjuster cable-end fitting is not clamped underneath the shoulder of the anchor screw during reassembly.

Clamping the adjuster cable may prevent proper functioning of the brake self-adjust feature.

4. Tighten the anchor screw per the appropriate specification:
   - For the internal hex socket anchor screw tighten to 50 ± 3 Nm (37 ± 2 ft-lbs.)
   - For the external hex head anchor screw tighten to 1 00 ± 0 Nm (74 ± 7 ft-lbs.)

CAUTION:

To tighten the anchor screw, only use a recently calibrated, known good, “clicker” type torque wrench set to the correct torque specification. Do not use add on devices such as universal joints, swivels, crows feet or other devices as these can cause inaccurate tightening results. Do not attempt this repair if a recently calibrated, known good “clicker” type torque wrench is not available. Failure to do so could result in personal injury or property damage.

IMPORTANT:

Remove excess grease that could contaminate brake drum or linings while the brake is in service.

5. Reinstall the lever return spring and parking brake cable to the end of the brake lever.
6. Route the adjuster cable around the adjuster cable guide, under the shoe hold-down spring, and attach to the adjuster lever. Install adjuster cable retainer tab if equipped.

IMPORTANT:

When correctly assembled, the adjuster cable end-fitting is behind the adjuster lever with the spring hook facing out. Failure to do so may result in reduced brake operation.

7. The shoe cage should now be adjusted per the SHOE CAGE ADJUSTMENT PRIMARY procedure or after the drum has been reinstalled, per the SHOE CAGE ADJUSTMENT ALTERNATE procedure in this service manual.
8. Make a final inspection of the shoe linings and the inside of the drum to ensure that no grease or other contamination is present.

CAUTION:

Keep grease and other foreign materials away from the shoe lining and drum surfaces. Contamination of shoe linings or drum surface may result in degradation of brake holding capability, possibly resulting in personal injury or property damage.