Overview

The optional air brakes system on the Blue Bird Vision utilizes Meritor cam-operated drum brakes, with captive spring brake chambers on the rear axle providing parking brake and safety backup functions. A gear driven Wabco air compressor mounted on the engine operates whenever the engine is running. A governor mounted directly to the rear of the compressor monitors system air pressure and switches the compressor between load and unload modes to maintain a normal operating pressure range within the storage tanks.

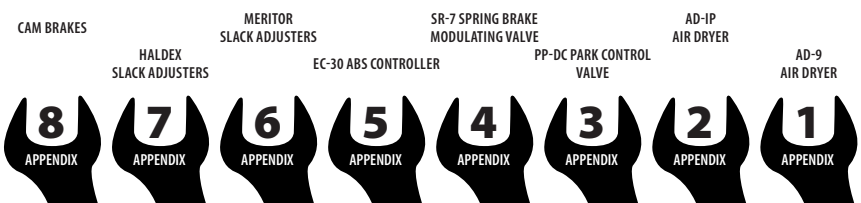
As air is compressed, moisture vapor tends to condense inside the storage tanks. The tanks are equipped with bleeder valves to allow removal of this built-up moisture. Some buses are equipped with an air dryer to assist collection and expulsion of the excess moisture. Air from the compressor passes through the air dryer before passing into the storage tank. The storage tank is mounted under the bus, outboard the frame rail on the driver's side, and on buses equipped with an air dryer, the dryer is mounted inboard of the frame rails just forward of the storage tank.

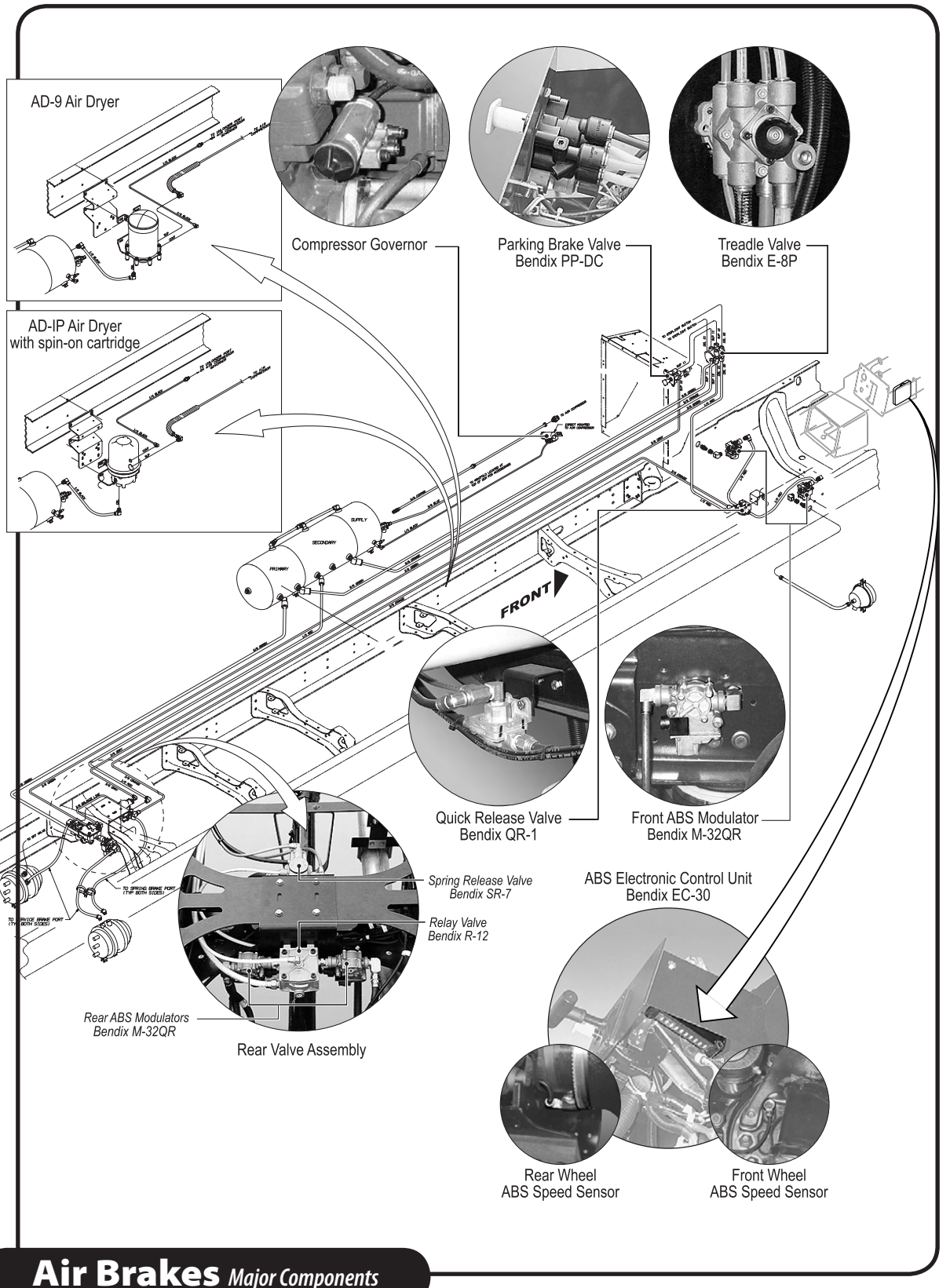
The system is divided into two separate circuits; one for rear brakes (primary) and one for front (secondary). The brake treadle valve mounted on the front side of the driver's fire wall is connected to the brake pedal, and receives pressure from both the primary and secondary tanks. The treadle valve directly controls the pressure and volume of air delivered to the front brakes. However, for the rear brakes, the treadle valve provides a signal only, which actuates a relay valve mounted to the frame crossmember just forward of the rear axle. The relay valve receives the pressure and volume of air needed to operate the rear brakes directly from the primary tank, and controls that supply in response to the signals it receives from the treadle valve.

At each wheel, air pressure is delivered to a closed brake chamber, which encases a diaphragm. The increased pressure area behind the diaphragm results in an increased mechanical advantage to move a pushrod, which rotates the shaft of an S-cam situated between the ends of two brake shoes. As the S-cam rotates, it spreads the brake shoes, pushing their friction linings against the inner wall of the drum to slow or stop the wheel.

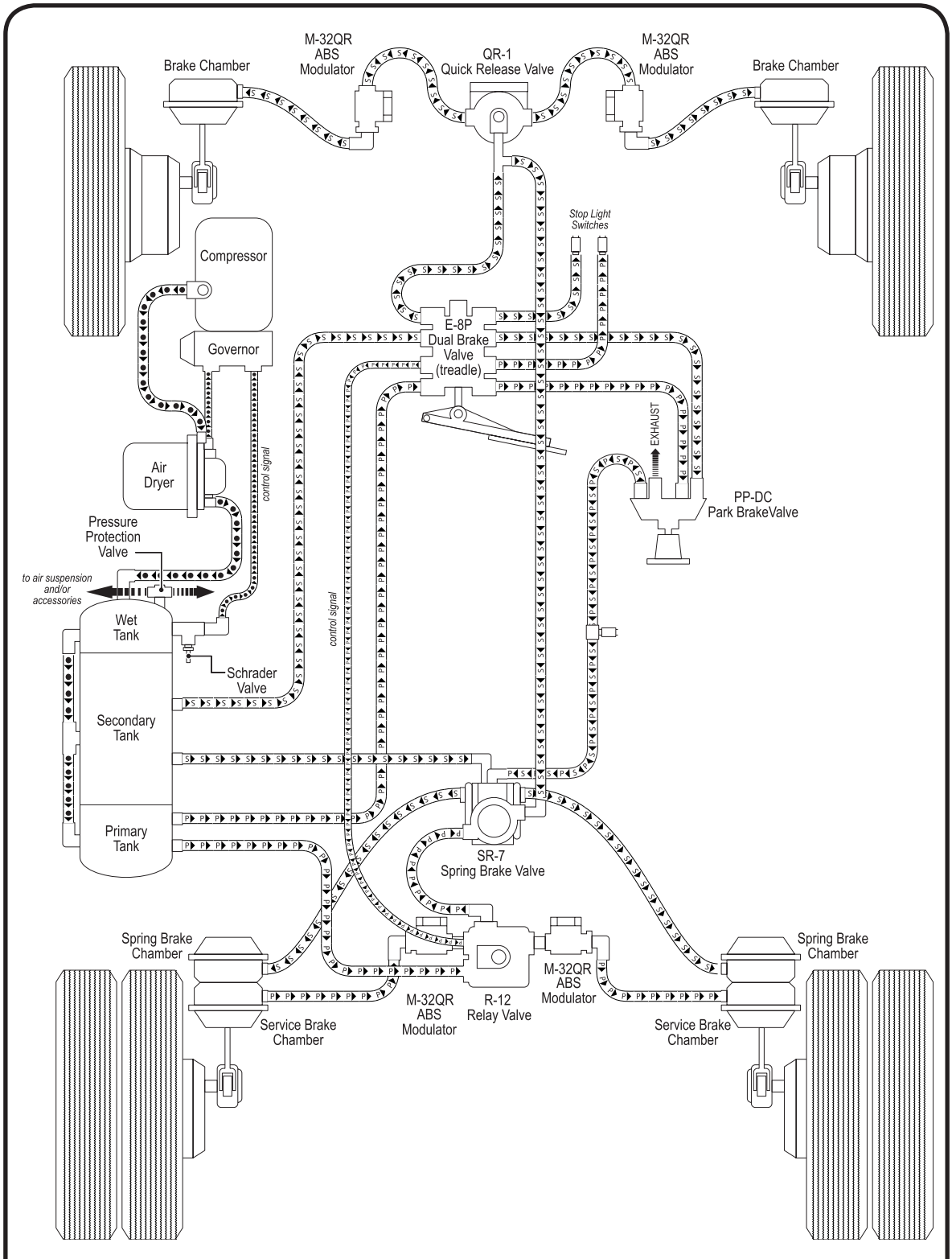
Over time, as the friction linings of the brake shoes wear, the push rods of the brake chambers must travel farther in order to actuate the brakes. To compensate for this normal wear of the brake shoes, the push rod of each brake chamber is connected to the S-cam by way of a slack adjuster; a ratcheting mechanism which incrementally and automatically takes up the linkage slack as the brake shoes wear.

An important concept in air brake systems is the matter of releasing air pressure in order to release the brake. Generally speaking, when brakes are applied, a valve is opened to allow air pressure to activate a brake chamber. However, simply closing the valve thereafter does not release the brakes, because the air pressure that activated them is still present in the chambers. A means must be provided to quickly release the captive pressure when the driver releases the brake pedal. On the secondary (front brake) circuit of the Blue Bird Vision, this is accomplished by a quick release valve, mounted on the rear-facing side of the engine crossmember. Air goes to the quick release valve, which serves to tee the air pressure toward the left and right front wheels. On the rear, the relay valve performs the quick release function.





Air Brakes *Major Components*



Air Brakes *Flow Diagram*

Before reaching the brake chambers at the front wheels, each of the two output lines from the QR-1 connect to an ABS modulator valve mounted on the inboard side of the frame rails near the wheel. For the rear brakes, left and right modulator valves are also mounted directly to the two output ports of the relay valve. Thus, there are four ABS modulator units, one for each wheel. Lines from the modulators then proceed to the chambers.

The modulator valves incorporate quick release valves of their own, which aid in exhausting pressure from the brake chambers. But their primary function is to independently modulate braking force to each wheel in order to minimize wheel lock during braking.

The modulators receive electric signals from the ABS Electronic Control Unit (ECU) mounted on the support bracket of the Driver's transmission control housing. The ECU is a computer which monitors electric signals it receives from wheel speed sensors mounted at each wheel, and uses this information to determine when wheel lock up (and, therefore, loss of traction) is about to occur. When the ECU makes such a determination, it signals the ABS modulator(s) for the affected wheel(s) to adjust the air pressure being applied to the wheel(s), using high frequency pulses. This helps maintain maximum traction by preventing the wheels from locking.

Parking brake and emergency brake function is provided by the rear axle brake chambers (MGM Type 30). Unlike the front chambers (MGM Type 20L), each rear chamber incorporates two mechanisms by which to extend their pushrods; one powered by air pressure during normal driving as described above (service brakes) and the other powered by a heavy duty spring enclosed in the brake chamber (spring brakes). The spring brakes provide rear braking in the case of primary brake system failure, and also perform as normal parking brakes. Whenever system air pressure is within normal operating range and the parking brake control is pushed in, a spring release valve, mounted on the front side of the same cross member as the relay valve, allows air pressure it receives directly from the secondary tank to compress the rear brake chamber springs, preventing them from actuating the rear brakes (the springs are "caged"). Whenever primary operating pressure is absent, the SR7 valve dumps the pressure which cages the springs in proportion to the amount of pressure the driver applies to the brake pedal. Thus, in the case of primary failure, the spring brakes take over braking function for the rear wheels. This condition is referred to as "spring brake modulation." A warning buzzer and light are activated in the driver's area.

When the driver pulls the dash-mounted Parking Brake control valve (Bendix PP-DC), it signals the SR7 valve to fully dump the air caging the spring brakes, thereby causing them to serve as parking brakes. This signal pressure from the PP-DC must be present in order to cause the SR7 to cage (release) the spring brakes. This prevents the parking brakes from being released until system pressure is adequate for normal service brake operation.

Appendixes In This Chapter

Appendix 1. AD-9 Air Dryer. This Bendix Service Data Sheet describes in detail the function of the AD-9 Air Dryer, covers inspection and maintenance, and includes a troubleshooting chart.

Appendix 2. AD-IP Air Dryer. This Bendix Service Data Sheet describes in detail the function of the AD-IP (Integral Purge) Air Dryer, covers inspection and maintenance, and includes a troubleshooting chart.

Appendix 3. PP-DC Park Brake Valve. This Bendix Service Data Sheet describes in detail the function of the PP-DC , and includes inspection and testing procedures. Blue Bird does not recommend rebuilding of damaged air brake system valves.

Appendix 4. SR-7 Spring Release Valve. This Bendix Service Data Sheet describes in detail the function of the SR-7, and includes inspection and testing procedures. Blue Bird does not recommend rebuilding of damaged air brake system valves.

Appendix 5. EC-30 ABS Controller Module. This Bendix Service Data Sheet describes in detail the EC-30, including blink code diagnostics and troubleshooting charts.

Appendix 6. Meritor Slack Adjusters. Meritor Manintenance Manual 4B describes function, inspection, maintenance and adjustment of Meritor Automatic Slack Adjusters.

Appendix 7. Haldex Slack Adjusters. This Haldex Service Manual describes function, inspection, and maintenance of Haldex Automatic Brake Adjusters.

Appendix 8. Meritor Cam Brakes. Meritor Manintenance Manual 4 describes function, inspection, and maintenance of the cam brake assemblies.

On TechReference CD

The TechReference CD includes Bendix Service Data Sheets on the valves listed below. These documents provide detailed descriptions of the functioning of the valves, inspection proceedures, and troubleshooting. Note that Blue Bird does not recommend rebuilding of damaged air brake system valves.

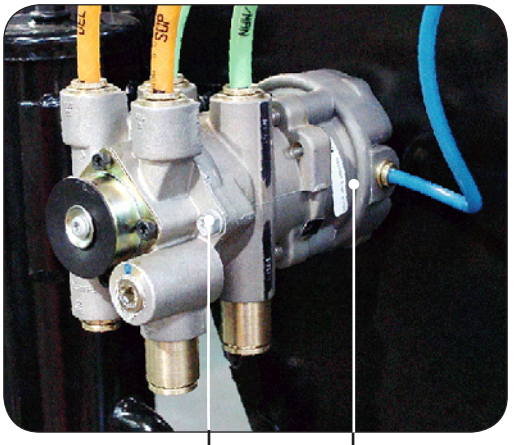
- **E-8P Dual Brake Valve.**
- **R-12 Relay Valve.**
- **QR-1 Quick Release Valve**
- **M-32QR Antilock Modulator Valve**
- **WS-20 Wheel Speed Sensor**

Also See…

The Hydraulc Brakes chapter of this manual includes a detailed procedure for removing the rear disc rotor/hub assembly.

Brake Interlock

As a safety feature, Blue Bird Visions equipped with wheelchair lift doors incorporate an interlock system designed to automatically apply the service brakes when the lift door is open and the park brake valve is not set. The main components of the interlock system include a brake valve actuator (BVA), a pressure switch, an air-operated solenoid valve, and a pressure regulator valve. The BVA is mounted onto the brake treadle valve between it and the firewall. The other components are mounted on the driver side (bus interior) of the firewall to the left of the steering column just below the air accessory manifold.

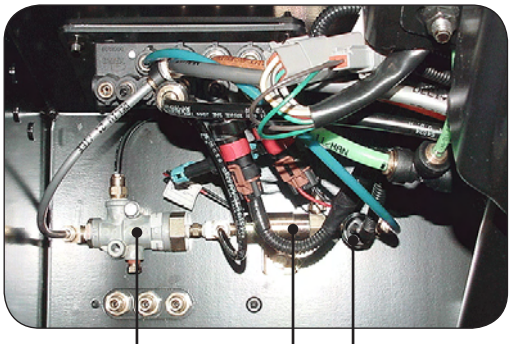


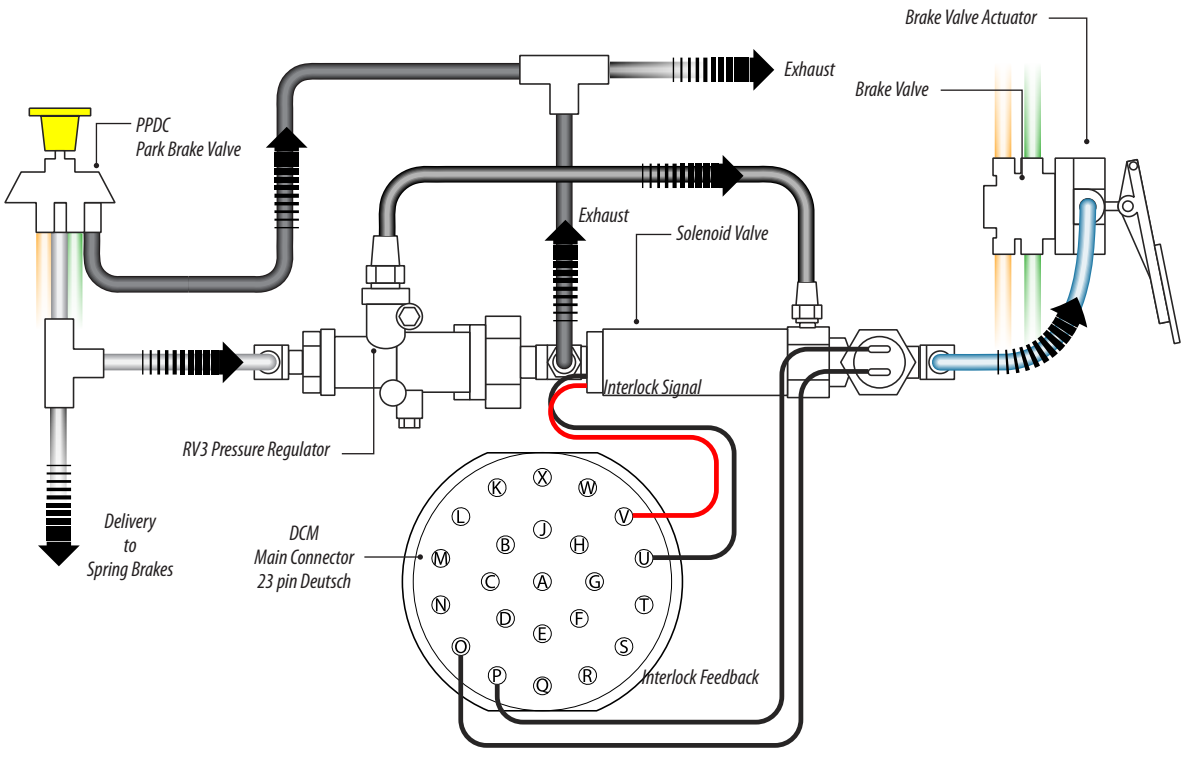
The input port of the RV-3 pressure regulator valve is teed into the line from the delivery side of the PP-DC park brake valve. This is the line which delivers pressure to cage the spring brakes. When pressure is present in this line, the RV-3 feeds a reduced pressure (approximately 70 psi) to the normally-closed solenoid valve.

The solenoid valve's coil is wired to one of the MPX module's Outputs through the V and U connectors of the 23 pin Deutsch main harness connector located at the upper right of the steering column. Thus, the interlock function is one of the circuits controlled by the Vision's Multiplex system.

Whenever conditions required for interlock exist (see MPX Ladder Logic line # 21), the MPX Module supplies a path to ground for the air solenoid valve, energizing it and causing it to open. The open solenoid valve allows pressure to pass to the pressure switch and the BVA. The BVA in turn applies it as braking pressure to the treadle valve exactly as if the driver had pressed the brake pedal.

The purpose of the pressure switch is to provide an active Interlock Feedback Input to the MPX module. (See Ladder Logic Line # 9.)





Brake Interlock (units with air brakes)

Maintenance Overview

Wear and service life of brake system components varies according to the operating conditions of the vehicle. Regular inspections and attentiveness to any unusual pedal feel (abruptness or sponginess), or sounds (for example, unusual air releases) is especially important. Air brake system maintenance includes items in all these categories:

- Daily tasks such as purging the air tanks to remove moisture and in cold climates, inspecting the system purge valves for freezing.
- Regularly scheduled inspection of brake chamber push rod travel and automatic slack adjuster operation according to intervals in the Scheduled Maintenance section.
- Routine maintenance of consumables such as replacement of Air Dryer desiccant and/or filters. Service life will vary according to operating conditions.
- Replacement or renewal of normal wear parts such as brake shoes and rotors.
- Careful inspection of all air lines and fittings, checking for cracked, abraded, kinked, loose, or otherwise damaged lines.
- Inspection of components for proper operation. Blue Bird does not recommend disassembly or rebuilding of air brake valves and other components. When a component is found defective, replace it with a new or remanufactured unit.

Never attempt to disassemble a brake cylinder, even when it contains no compressed air. The spring brake cylinders enclose very powerful coil springs held under high mechanical compression. Any attempt to disassemble the brake chamber can result in injury or death.

When working on the air brake system, always follow these precautions in addition to those in the Warnings and Cautions section:

- Park the vehicle on a level surface, stop the engine, and chock the wheels securely. Remember, during servicing, the brakes will not be available to prevent the bus from rolling.
- If wheel end components are to be serviced which require wheel removal, support the bus by proper jack stands under the frame rails. Do not rely upon a jack to support the bus during servicing.
- Fully drain all air tanks .before removing any air lines, fittings, or components. Never remove an air line which is under pressure. Never remove a component or plug unless you are certain all system pressure has been depleted.
- Disconnect the negative battery terminal. Some air brake system components have electrical connections.
- Never exceed recommended pressures and always wear safety glasses.
- Never re-use air lines, fittings, or connections which appear to be marginal, faulty, insecure, or leaking. When in doubt, replace the line and fitting.

Air Compressor

The Blue Bird Vision's air compressor is a gear driven single cylinder Wabco unit with turbocharged intake, and is mounted to the left side of the Caterpillar engine.

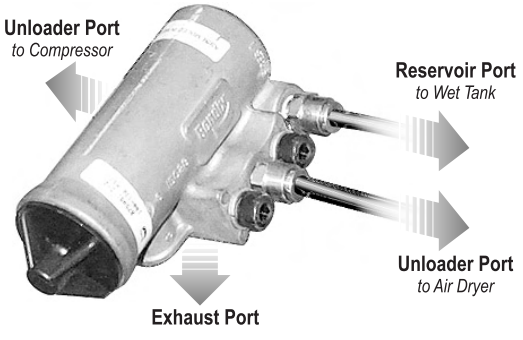
Being directly gear driven by the engine, the air compressor turns continually while the engine is running. But the actual compression of air is cycled on (load mode) or off (unload mode) by an unloading mechanism in the compressor. This maintains a normal operating range of pressure within the system. The pressures at which the compressor switches between load and unlode modes are set by the governor, mounted on the rear side of the compressor.

Servicing

As an integral part of the engine package, the compressor is installed by Caterpillar. For additional general information on the air compressor, refer to the Caterpillar engine manual supplied with your vehicle. For more detailed service and maintenance information, contact your local Caterpillar dealer and ask for Service Manual RENR2314.

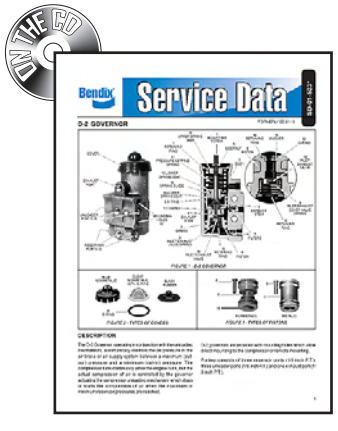
Air Compressor Governor (D-2)

The Bendix D-2 air compressor governor operates in conjunction with the unloading mechanism of the compressor to automatically keep the air pressure in the system between 100 and 120 psi.



The governor's porting includes a reservoir port, which connects to the wet tank; unloader ports which connect to the compressor's unloader mechanism and to the air dryer's control port; and an exhaust port which opens to the atmosphere.

Air pressure from the Blue Bird Vision's wet tank enters the D-2's reservoir ports and acts upon a piston in opposition to a pressure setting spring. When the pressure from the tanks is sufficient to overcome the tension of the spring, an inlet/exhaust valve integrated in the piston closes the exhaust and opens the inlet passage. Air pressure can then pass around the inlet valve, through the piston and out the unloader port to activate the unloader mechanism of the compressor. This unload pressure also travels to the air dryer to open the purge valve, allowing the air dryer to expel accumulated moisture and contaminates.



Bendix D-2 Governor

Bendix Publication SD-01-503

When the system reservoir pressure drops to the level insufficient to overcome the pressure setting spring, the spring moves the piston to close the inlet valve and open the exhaust. This allows air in the unloader line to escape back through the piston and out the exhaust port. The compressor goes into load mode and begins compressing air to raise the system pressure in the wet tank.

On the Blue Bird Vision, the governor is set to maintain system pressure between 100 and 120 psi. When the system pressure drops to 100 psi, the governor de-activates the compressor's unloader mechanism. When system pressure rises to 120 psi, the governor activates the compressor's unloader mechanism. **Appendix 1** contains additional information on the inner workings of the D-2 governor.

Servicing

Bendix recommends performing operating and leakage tests on the D-2 governor every 6 months, 50,000 miles, or 1800 hours; whichever comes first. Instructions for leak and operating tests are provided in Air Brakes Appendix 1.

Troubleshooting

Conditions that may indicate problems with the D-2 governor include:

- Over pressure of the system. The compressor fails to go into unload mode when system pressure reaches 120 psi.
- Under pressure of the system. The compressor fails to go into load mode when system pressure drops to 100 psi.

Adjustment

The activation pressure of the D-2 governor is adjustable by means of an adjustment screw under the plastic cap in the end of the governor body. Note that adjustment affects both the cut-in and cut-out pressures. The pressure difference or range between cut-in and cut-out will remain constant and is not adjustable. Before deciding to adjust the governor pressure setting, be sure to check the system cut-in and cut-out pressures with an accurate test gauge. To adjust the D-2 governor:

1. Unscrew the top cover from the governor, exposing the adjusting screw. The adjusting screw is slotted on its outer end.

2. Loosen the adjusting screw locknut.

3. To raise the pressure setting, turn the adjusting screw counter-clockwise. To lower the pressure setting, turn the adjusting screw clockwise. Be careful not to overadjust. Each quarter turn of the adjusting screw raises or lowers the pressure setting approximately 4 psi.

4. When proper adjustment is obtained, tighten the adjusting screw locknut and replace the cover.

Removal

The D-2 governor is fastened to the compressor body by two Allen-head bolts, one on each side of the rear side unloader port. To remove:

1. Block and securely hold vehicle by means other than air brakes.

2. Drain the air brake system by opening the purge valve at the bottom of the air tank.

3. Disconnect the air tank line from the reservoir port.

4. Disconnect from the unloader port the line which leads to the air dryer.

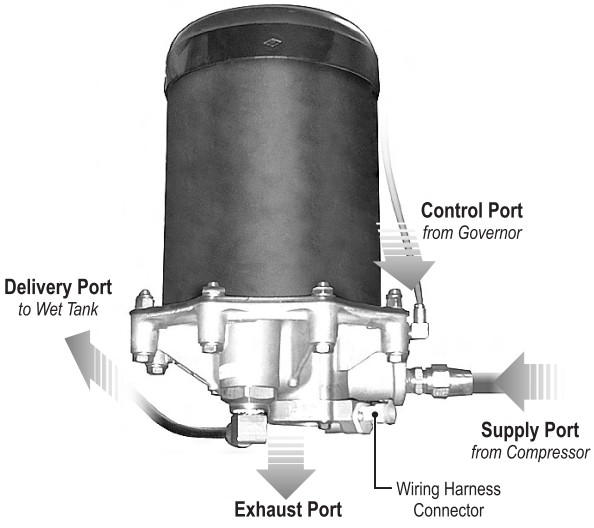
5. Remove the two Allen head bolts and carefully remove the governor, taking care not to damage the rubber gasket.

Installation

Reverse the removal steps. If the gasket was damaged during removal, replace it with a new gasket. Torque the mounting bolts to 18–20 ft. lbs. (24.4–27.1 Nm).

Air Dryer (Optional)

Your Blue Bird Vision may be equipped with one of two Bendix air dryer models; the AD-IP integral purge dryer or the AD-9. The two dryers are similar in function. The main difference is that the AD-IP contains a desiccant cartridge which can be changed without removing the dryer assembly.



The air dryer operates in two modes, depending on whether the compressor is in load mode (compressing air) or unload mode (not compressing).

When the compressor is in load mode, the air dryer operates in its charge cycle. Air from the compressor enters the supply port of the air dryer. In the body of the air dryer, the air changes direction several times, reducing its temperature and causing contaminates to collect in the dryer's internal sump. The air continues its flow into a cartridge containing two filtering stages. The first stage is an oil separator, which removes water in liquid form as well as oil and solid contaminates. The second stage is a desiccant drying bed. Water vapor contained in the air flowing through the desiccant column is attracted to and condenses upon the surfaces of the desiccant particles.

Dry air exits the air dryer through a check valve and proceeds to the wet tank reservoir, ready for use by the system.

When system pressure reaches the cutout setting of the governor, the governor pressurizes its unloader ports, which signals the compressor to switch to unload mode (stop compressing) and signals the air dryer to switch to its purge cycle. Control pressure from the governor enters the air dryer's control port, causing a purge valve to open the air dryer's exhaust port and an initial audible burst of air is heard as moisture, oil, and contaminates are expelled. The purge valve remains open (after the audible burst) as long as the control pressure from the governor is present. A check valve in the delivery port prevents pressurized air from the storage tank from backing up into the dryer, but the air still inside the dryer reverses direction, flows back through the desiccant column, serving to remove most of the water adhering to the desiccant. Thus, the purge process effectively reactivates the desiccant. Generally 15–30 seconds are required for the entire purge volume to pass back through the desiccant drying bed. The purge valve assembly of the air dryer incorporates an electric heating element and thermostat to prevent freezing in cold climates.

Servicing & Inspection

Over time, the desiccant cartridge becomes less effective and eventually must be replaced. Bendix lists three years as typical cartridge life and recommends replacement at intervals of 10,800 hours, 300,000 miles, or 36 months. Actual service life is highly dependent upon operation conditions and climate. Blue Bird recommends inspecting the air dryer every 3 months or 24,000 miles, whichever occurs first.

- Whenever purging the air tanks (see Scheduled Maintenance section), watch for unusual amounts of moisture accumulation. In climates and seasons in which ambient temperatures vary more than 30 degrees in a day, small amounts of moisture due to condensation inside the tanks should not be considered an indication that the dryer is not performing properly. Similarly, trace amounts of oil in the system may be normal and should not, in itself, be considered a reason to replace the desiccant; oil stained desiccant can function adequately.
- In cold months, visually inspect the air dryer's exhaust port for signs of freezing, which may indicate improperly functioning heating of the purge valve.

Air Brakes appendixes 2 and 3 (Bendix publications SD-08-2412 for AD-9; and SD-08-2424 for AD-IP) contain additional helpful information on testing, cleaning, and inspection.

Removal (AD-9)

The AD-9 dryer must be removed to replace its internal desiccant cartridge.

1. Park the bus on a level surface and apply the parking brake. Stop the engine. Chock wheels to prevent movement. Disconnect the negative terminal of the battery.

2. Open the wet tank purge valve to drain the air brake system to 0 psi.

3. Disconnect the heater/thermostat electric connector from the air dryer's purge valve assembly.

4. Identify and disconnect the air lines connected to the air dryer at the delivery port (leads to wet tank), control port (leads to governor), and supply port (leads to compressor).

5. Loosen the 5/16 horizontal bolt and nut securing the upper mounting strap to the upper mounting bracket. It is not necessary to completely remove the nut and bolt. The nut is a special nut with an extended threaded shank which inserts into the mounting hole, allowing the clamp to be loosened sufficiently.

6. Remove the two 3/8" bolts mounting the air dryer body to the lower mounting bracket. Mark the locations of these two bolts on the body of the air dryer to aid in orienting the dryer correctly on re-installation.

7. Remove the air dryer by pulling the bottom flange clear of the lower mounting bracket tabs and slipping the dryer downward from inside the upper mounting clamp.

Installation

1. Slide the upper body of the dryer up into the upper mounting clamp. Position the bottom flange on top of the tabs of the lower mounting bracket. The dryer should rest on top of the bracket's mounting tabs, not fasten below them.

2. Install the two lower mounting bolts, four special washers, and two lock nuts. Tighten to 270–385 in. lbs. (30.5–43.5 Nm).

3. Tighten the upper clamp's bolt and nut to 80–120 in. lbs. (9–13.5 Nm).

4. Connect the air lines connected to the air dryer at the delivery port (leads to wet tank), control port (leads to governor), and supply port (leads to compressor).

5. Connect the heater/thermostat electric connector to the air dryer's purge valve assembly.

6. Before returning the Blue Bird Vision to service, perform the operation and leakage tests in Appendix 2.

Removal (AD-IP)

Note that it is not necessary to remove the AD-IP air dryer in order to change its desiccant cartridge.

1. Park the bus on a level surface and apply the parking brake. Stop the engine. Chock wheels to prevent movement. Disconnect the negative terminal of the battery.

2. Open all three tank bleed valves to drain the air brake system to 0 psi.

3. Disconnect the heater/thermostat electric connector from the air dryer's purge valve assembly.

4. Identify and disconnect the air lines connected to the air dryer at the delivery port (leads to wet tank), control port (leads to governor), and supply port (leads to compressor).

5. Remove the four bolts, which secure both the upper and lower mounting brackets to the Blue Bird Vision's frame, and remove the dryer.

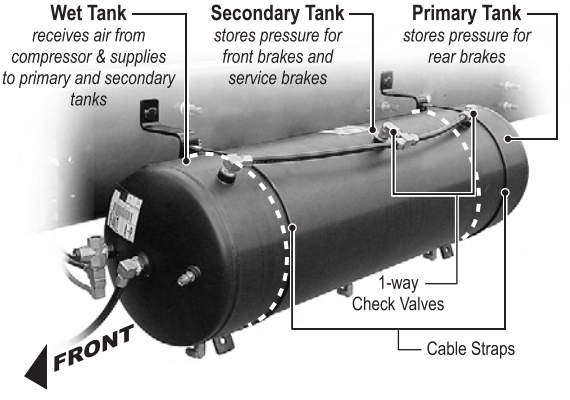
Installation

1. Reverse the removal steps, described above.

2. Before returning the Blue Bird Vision to service, perform the operation and leakage tests in Appendix 3.

Air Tanks

The supply (wet tank), primary (rear brake reservoir), and secondary (front brake reservoir) air tanks are separate chambers integrated into one air tank assembly mounted under the bus, outboard the frame rail on the driver's side.

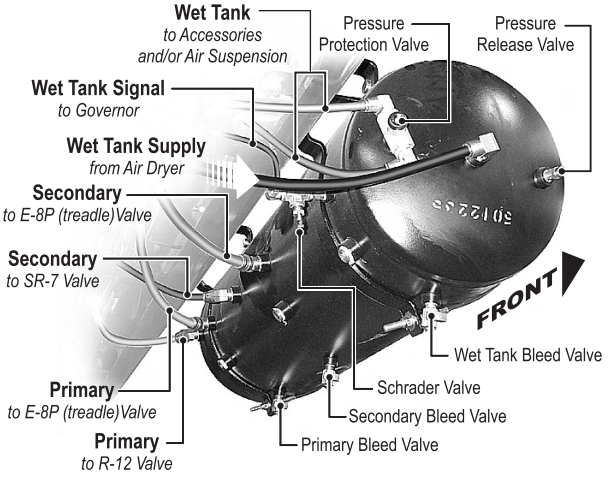


The supply tank (front-most chamber) receives dry air from the delivery port of the air dryer (or from the compressor, if not equipped with an air dryer) through a fitting at the front end of the tank assembly. The secondary (middle chamber) and primary (rear most chamber) tanks receive air from the supply tank through one-way check valves located on the top side of the tank assembly.

Each chamber (supply, primary, and secondary) has its own drain valve on the bottom side of the tank assembly for the purpose of manually expelling any moisture condensation that may have collected in the tanks.

The supply tank chamber has these fittings:

- A drain valve.
- A Schrader valve allows manual pressurization of the system for service or testing purposes by using a common air hose, without having to charge the system by running the engine and compressor.
- A pressure protection valve. This valve attaches to a line which leads to a pressure connection box under the left side of the driver's dash for powering air-operated accessories. On units equipped with air suspensions, the supply line for the suspension is also connected at this fitting. The pressure protection valve closes when system pressure drops to 60 psi in



order to preserve air pressure to the brakes in an abnormally low pressure situation.

The secondary tank chamber has these fittings:

- A drain valve.
- A 5/8" line leading to the supply side of the E-8P treadle valve, providing service pressure for the front brakes.
- A ½" line leading to the SR-7 spring brake release valve, providing pressure to cage the spring brakes, and/or to control the spring brakes when spring brake modulation is operative due to low primary system pressure.

The primary tank chamber has these fittings:

- A drain valve.
- A 5/8" line leading to the supply side of the E-8P treadle valve, providing signal pressure which the treadle valves uses to activate the rear service brakes.
- A 5/8" line leading to the R-12 relay valve, providing service brake pressure for the rear brakes.

Removal

The air tank assembly is mounted to a bracket on the chassis frame by means of two cable straps. To remove the tank assembly:

1. Park the bus on a level surface. Stop the engine. Chock all wheels securely to prevent movement in either direction. Means other than air brakes must be used to prevent vehicle movement. Disconnect the negative terminal of the battery.

2. Open all three tank bleed valves to drain the air brake system to 0 psi.

3. Disconnect all air lines leading to chassis mounted components.

4. Support the air tank assembly from the bottom to prevent its dropping when the cable straps are removed.

5. Remove the nuts from the threaded fittings on the bottom ends of the two cable straps. Carefully lower the air tank assembly.

Installation

Reverse the removal procedure to install the air tank assembly.

Treadle Valve (E-8P)

The E-8P dual brake valve is the unit directly acted upon when the driver presses the brake pedal, and which provides the driver a variable, graduated control for applying and releasing the brakes. The E-8P is mounted on the fire wall in the engine compartment, directly in front of the driver's area.

The E-8P is internally divided into two separate supply and delivery circuits. As mounted in the Blue Bird Vision, ports on the front half of the E-8P affect the front (secondary) brake circuit; those on the rear half affect the rear (primary) brake circuit.

In both primary and secondary circuits, ports on the left (as viewed when facing the front of the vehicle) of the valve body are supply ports. Ports on the right are delivery ports, sending controlled air to power (front) or control (rear) the brakes; and to actuate brake light switches. The brake light switches are located at the air distribution manifold under the left side of the driver's instrument panel.

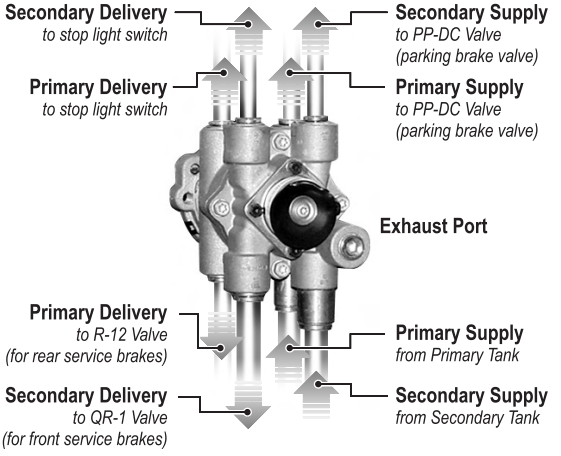
An exhaust port, protected by a rubber diaphragm, is on the front-facing end of the E-8P and opens to the atmosphere to exhaust air from the delivery lines when the driver releases the pedal.

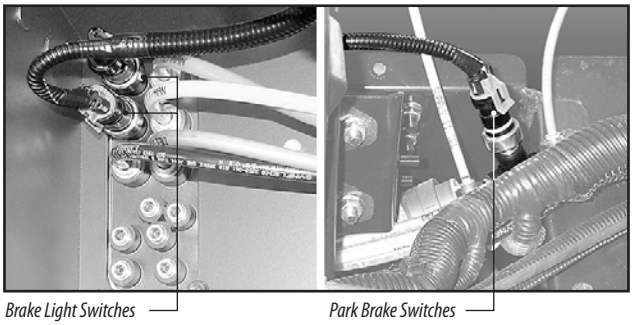
The port on the lower left (supply) rear (primary) receives air pressure directly from the primary chamber of the air tank assembly. When the brake pedal is applied, this air pressure is allowed to flow out the lower right (delivery) rear (primary) port in proportion the distance the brake pedal is moved, to serve as a signal pressure to control the R-12H relay valve which in turn controls the delivery of pressure from the primary tank through the rear ABS modulators, and on to the rear brake chambers.

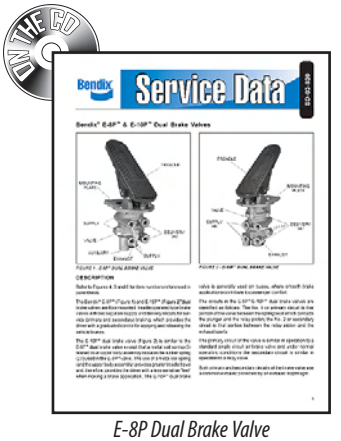
The port on the lower left (supply) front (secondary) receives air pressure directly from the secondary chamber of the air tank assembly. When the brake pedal is applied, this air pressure is allowed to flow out the lower right (delivery) front (secondary) port in proportion the distance the brake pedal is moved, delivering full actuating pressure to the front brakes, through the QR-1 quick release valve, modulators, and on to the front brake chambers.

On the upper left side of the E-8P, two delivery ports provide both primary and secondary supply pressure to the PP-DC parking brake control valve, which in turns signals the SR-7 valve to control the rear spring brakes.

On the upper right side of the E-8P, two delivery ports provide pressure to activate stop light switches.







E-8P Dual Brake Valve

Bendix Publication SD-03-830

Inspection & Maintenance

Appendix 4 contains more information on the inner workings of the E-8P, as well as operational and leakage testing. Blue Bird does not recommend disassembling or re-building the E-8P. If testing determines the valve to be operating incorrectly, contact your Blue Bird Parts Distributor for a replacement.

Removal

The E-8P is fastened to the firewall by three studs which pass through the firewall and the pushrod assembly's forward support flange and are secured with self-locking nuts inside the driver's foot area. To remove the E-8P valve:

1. Park the bus on a level surface. Stop the engine. Chock all wheels securely to prevent movement in either direction. Means other than air brakes must be used to prevent vehicle movement. Disconnect the negative terminal of the battery.

2. Open all three tank bleed valves to drain the air brake system to 0 psi.

3. Disconnect all 8 air lines connected to the E-8P valve.

4. Have someone support the E-8P valve so it does not fall when the mounting nuts are removed. Inside the bus, remove the three mounting nuts. Remove the E-8P valve.

Installation

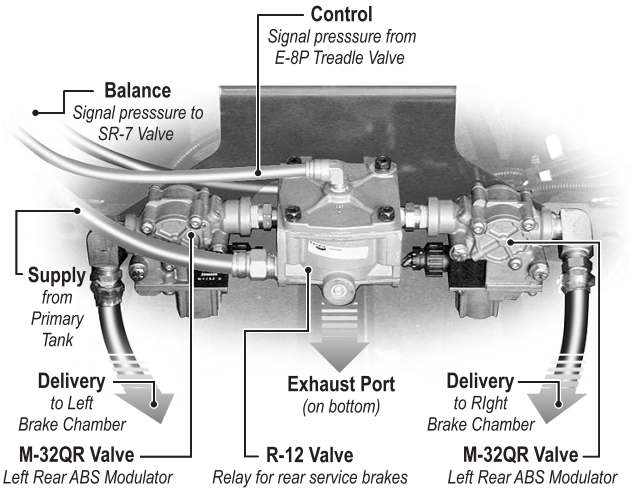
Reverse the removal procedure to install the E-8P valve.

Relay Valve (R-12H)

The Bendix R-12H relay valve is mounted to the rear-facing side of the frame cross member just forward of the rear axle. The R-12 is mounted between the two ABS modulator valves for the rear wheels.

The valve operates as a remote controlled brake valve, which delivers or releases air to the rear brake chambers in response to the control air signal it receives from the E-8P treadle valve.

A port on the top of the R-12H receives the controlling signal air pressure from the E-8P treadle valve. A port on the side of the R-12 receives air directly from the primary air tank. Ports on each side of the R-12 connect to the ABS modulators to deliver service brake pressure to the left and right rear brakes. A balance line connects to a port on the front side of the R-12 and leads to the SR-7 spring brake modulating valve.



As the R-12's internal piston moves in response to control pressure from the E-8P treadle valve, it allows air from the primary tank to proportionally flow to the rear brake chambers through the ABS modulators.

When the driver releases the brakes, air in the lines to the brake chambers is allowed to exhaust through the exhaust valve on the bottom of the R-12.

The balance line leading to the SR-7 is pressurized as long as pressure is present in the incoming line from the primary tank. This "tells" the SR-7 that primary pressure is present for normal service brake operation. This is to enable the SR-7 to perform its anti-compounding function. (See SR-7 section, below.)

R-12 Relay Valve

Bendix Publication SD-03-1064

Inspection & Maintenance

Appendix 5 contains more information on the inner workings of the R-12, as well as operational and leakage testing. Blue Bird does not recommend disassembling or rebuilding the R-12. If testing determines the valve to be operating incorrectly, contact your Blue Bird Parts Distributor for a replacement.

Removal

Because the two rear ABS modulator valves are mounted directly to the R-12 valve by ¾" x ½" male threaded nipples, it is necessary to remove the three units as an assembly to remove the R-12.

1. Park the bus on a level surface. Stop the engine. Chock all wheels securely to prevent movement in either direction. Means other than air brakes must be used to prevent vehicle movement. Disconnect the negative terminal of the battery.

2. Open all three tank bleed valves to drain the air brake system to 0 psi.

3. Disconnect all 3 air lines connected to the R-12 valve, and the outgoing air line connected to each of the rear ABS modulators.

4. Remove the four 5/16" bolts which mount the ABS modulators to the frame mounting bracket Self locking nuts are on the inboard side of the bracket.

5. Two threaded studs mount the R-12 to the bracket. Remove the two 3/8" self locking nuts on the inboard side of the bracket. The R-12 and two rear modulators can now be removed as a unit.

6. Disassemble the modulators from the R-12.

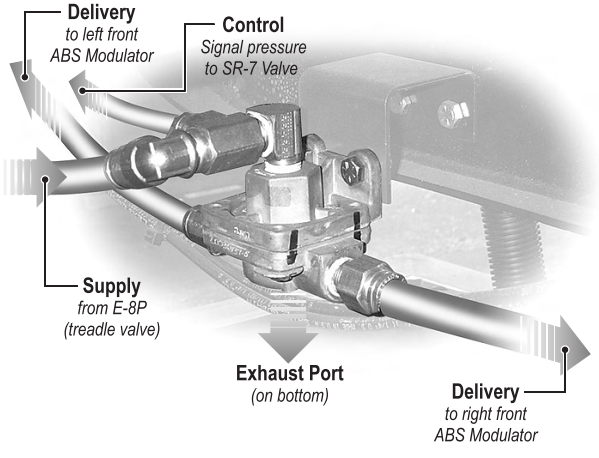
Installation

Reverse the removal procedure to reassemble the R-12 valve to the two ABS modulators. Use nylon pipe thread tape on all four threaded parts of the male nipples between the valve units.

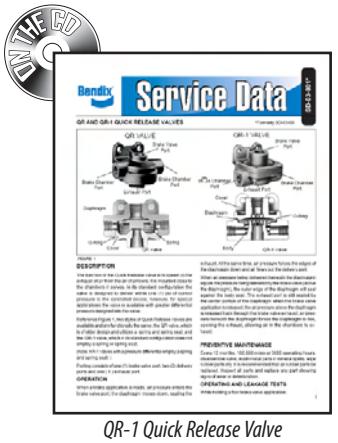
Quick Release Valve (QR-1H)

The Bendix QR-1H valve is mounted under the engine on the engine frame crossmember. When the driver presses on the brake, this valve receives air pressure from the delivery side of the E-8P treadle valve. The QR-1 serves as a tee, splitting the air pressure flow to the left and right front brakes.

When the brake pedal is eased or fully released, pressure is correspondingly released from the outgoing ports of the E-8P treadle valve and exhausted through its exhaust port. However, because of the volume of air contained in the brake chambers and the tubing distances involved, requiring release pressure to travel all the way back to the treadle valve for release would result in sluggish response when releasing brakes.



The QR-1 addresses this situation. Air pressure between the E-8P and the QR-1 is allowed to escape through the E-8P's exhaust port. This drop of pressure in the QR-1's incoming line causes it to open its exhaust port which allows the much larger volume of compressed air captive in the front brake chambers to exhaust through the QR-1H's exhaust port. The function is called "quick release" not in reference to the suddenness with which the brake pedal is released, but in reference to the quick response which results from the release valve's greater exhaust capacity and from its nearness to the brake chambers. The quick release valve performs the function of releasing pressure from the brake cylinders whether the brake pedal is release slowly or quickly.



QR-1 Quick Release Valve

Bendix Publication SD-03-901

Inspection & Maintenance

Appendix 6 contains more information on the inner workings of the QR-1 valve, as well as operational and leakage testing. Blue Bird does not recommend disassem-

bling or rebuilding the QR-1. If testing determines the valve to be operating incorrectly, contact your Blue Bird Parts Distributor for a replacement.

Removal

The QR-1 valve is mounted by two ¼" bolts, lock washers, and nuts to a bracket on the rear facing side of the lower engine crossmember.

1. Park the bus on a level surface. Stop the engine. Chock all wheels securely to prevent movement in either direction. Means other than air brakes must be used to prevent vehicle movement. Disconnect the negative terminal of the battery.

2. Open all three tank bleed valves to drain the air brake system to 0 psi.

3. Disconnect all 4 air lines connected to the QR-1 valve: the two outgoing air line connected to the front ABS modulators, the supply line coming from the treadle valve, and the supply-side signal line leading to the SR-7 valve.

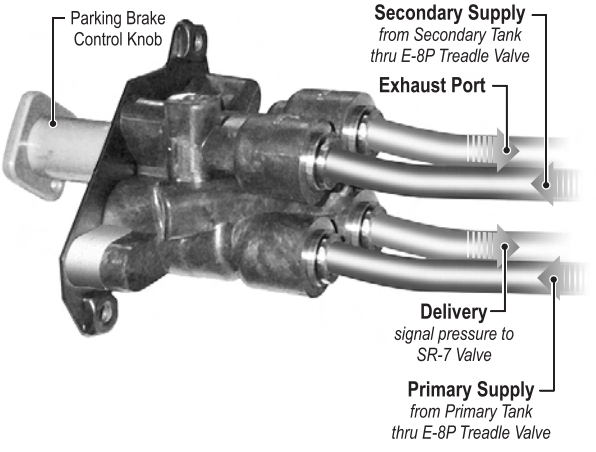
4. Remove the two 1/4" bolts that mount the flange of the QR-1 to its mounting bracket. The QR-1 can now be removed.

Installation

Reverse the removal procedure to install the QR-1 valve.

Park Control Valve (PP-DC)

The PP-DC is the control panel mounted valve that the driver operates when applying the parking brake.



Two separate supply ports receive air from primary and secondary lines leading from the supply side of the E-8P treadle valve. When the PP-DC valve is pushed in to release the parking brake, these two intakes "compete" with each other to deliver pressure to the delivery port. Whichever of the two supply lines contains the higher pressure at any moment delivers pressure to the delivery port. From the delivery port, pressure signals the SR-7 spring brake modulating valve to cage the rear spring brakes, allowing normal service brake operation.

When the driver pulls outward on the PP-DC knob, the intake ports closes, and the exhaust port opens, releasing the signal pressure going to the SR-7, causing the SR-7 to release the pressure which is caging the spring brakes, thereby activate the spring brakes as parking brakes.

The PP-DC valve is designed to automatically "pop out" if supply pressure drops below 20–30 psi. Thus, the parking spring brakes are automatically active whenever total system pressure is insufficient for normal service brake operation.

Inspection & Maintenance

Appendix 7 contains more information on the inner workings of the PP-DC valve, as well as operational and leakage testing. Blue Bird does not recommend disassembling or rebuilding the PP-DC. If testing determines the valve to be operating incorrectly, contact your Blue Bird Parts Distributor for a replacement.

Removal

The PP-DC has an integral mounting plate with mounting nuts welded to its back side. Three Phillips head screws surrounding the valve's control knob thread into these nuts, securing the PP-DC to the metal face of the driver's control panel. A thermoplastic housing surrounds the mounting, and is easily removed to access the PP-DC and other components.

1. Park the bus on a level surface. Stop the engine. Chock all wheels securely. Disconnect the negative terminal of the battery.

2. Open all three tank bleed valves to drain the air brake system to 0 psi.

3. Inside the bus, remove the four screws on the face of the driver's control housing and remove the housing. The PP-DC will now be accessible from the top of the control panel.

4. Disconnect the four air lines which connect to the PP-DC.

5. Remove the three Phillips head screws on the front panel which thread into the PP-DC's integral bracket. The PP-DC can now be removed.

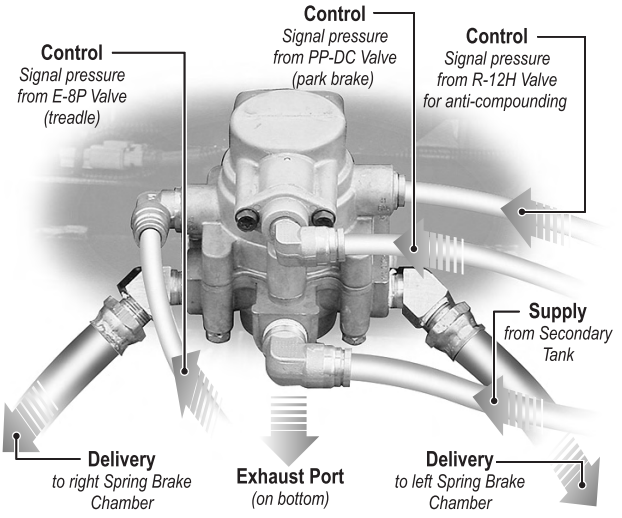
Installation

Reverse the removal procedure to install the E-8P valve.

Spring Brake Modulating Valve (SR-7)

The SR-7 spring brake modulating valve controls the operation of the spring brakes integrated into the rear brake chambers.

In normal driving, with normal operating pressure present in both primary and secondary circuits, the SR-7's park control port receives pressure from the delivery side of the PP-DC parking brake valve, signaling the SR-7 that system pressure is operative and to therefore cage (disengage) the spring brakes. In response to the signal pressure, air entering the SR-7's supply port directly from the secondary tank is allowed to pass out the left and right delivery ports to cage the springs.



If secondary circuit air pressure is absent, a single check valve closes the supply port. Control line pressure then becomes the SR-7's supply air, and serves to cage the springs.

When the parking brake is applied by the driver, the pressure at the SR-7's control port is released. The SR-7 responds by closing the supply port pressure coming from the secondary air tank and opening the exhaust port to release air from the spring brake chambers. This provides a quick release of air and a quick and full actuation of the spring brakes.

The balance port on the SR-7 receives signal pressure from a short line leading from the R-12 relay valve. When pressure from this line is absent, indicating a loss of pressure in the primary circuit, the SR-7 goes into its spring brake modulation mode. Variable pressure at the secondary control port is received from a line connected to a tee on the supply side of the front QR-1 valve. As described above in the QR-1 section, this is the front brake actuating pressure which is adjusted by the E-8P treadle valve. In spring brake modulation mode, the SR-7 valve responds to this variable pressure by proportionally releasing spring brake chamber pressure through the exhaust port. Thus, the spring brakes serve as redundant backup rear brakes in the case of primary circuit pressure being lost. A warning light and buzzer notify the driver of the pressure loss condition. The bus can be safely operated in this mode to drive to a service facility.

The SR-7 also performs an anti-compounding function. That is, it prevents the simultaneous application of full spring brake pressure and service brake pressure to the brake actuating mechanism. When the parking brakes are set, pressure is released from the control port. This causes the SR-7 to release pressure from the spring brake chambers, allowing the springs to actuate the brakes. However, if service brakes are also then applied, pressure from the balance port signals the SR-7 to allow secondary pressure to cage the spring brakes. Thus, when the system is charged, and both parking brake and service brakes are applied, it is actually the service brakes, which are in effect.

Inspection & Maintenance

Appendix 8 contains more information on the inner workings of the SR-7 valve, as well as operational and leakage testing. Blue Bird does not recommend disassembling or rebuilding the SR-7. If testing determines the valve to be operating incorrectly, contact your Blue Bird Parts Distributor for a replacement.

Removal

The SR-7 is fastened to its bracket by two mounting studs at the top of the body.

1. Park the bus on a level surface. Stop the engine. Chock all wheels securely to prevent movement in either direction. Means other than air brakes must be used to prevent vehicle movement. Disconnect the negative terminal of the battery.

2. Open all three tank bleed valves to drain the air brake system to 0 psi.

3. Disconnect the four air lines connected by push-in connectors, at the park control port, the balance port, the secondary control port, and the supply port.

4. The left and right spring brake hoses are fitted with swivel fittings at their lower ends, where they connect to the brake chambers. Disconnect the hoses at the brake chamber, then at the SR-7.

5. Remove the two self-locking nuts and flat washers from the mounting studs. The SR-7 can now be removed.

Installation

Reverse the removal procedure to install the SR-7 valve.

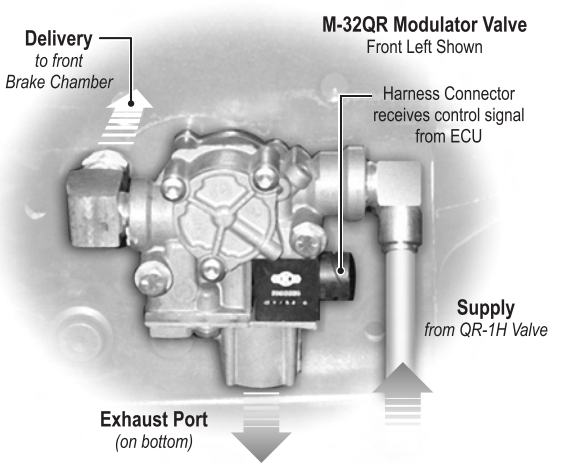
ABS Modulator Valves (M-32QR)

In air systems, a modulator valve is more effective when located a short distance from the brake chamber it controls. A Blue Bird Vision equipped with air brakes uses four Bendix M-32QR modulator valves; one located near each wheel.

The front modulators are mounted on the inboard side of the frame rails, just over the front axle. The rear modulators are mounted on either side of the R-12 relay.

The modulators are the final valve assemblies though which air passes on its way to actuate the brake chambers.

Each M-32QR modulator has three ports: a supply port receiving air from the R-12 relay valve (rear) or QR-1 quick release valve (front); a delivery port which sends air to the brake chamber; and an exhaust port on the bottom of the modulator body. The modulator incorporates two electric solenoids, which control supply and exhaust diaphragms inside the modulator, in response to signals received from the EC-30 control unit during anti-skid braking situations.



Under most normal braking conditions, the modulators are passive, simply through-passing air pressure to the chambers. Similarly, when the brake pedal is released, air moves back through the modulator as it flowed during brake application, and is exhausted at the R-12 relay or QR-1 quick release valve.

If a service brake application is made by the driver, and the ABS system detects an impending wheel lockup, the coils of the two solenoid valve in the affected wheel's modulator are independently energized or de-energized in a pre-programmed sequence by the E-30. This is similar in principle to the practice of "pumping the brakes" to prevent wheel skid; however, the ABS system is able to affect the brake application of each wheel independently, with much more accuracy and with a series of high-frequency pulses. The effect is better traction in a wide variety of braking conditions, and more controlled stops.

M-32 Antilock Modulator

Bendix Publication SD-13-4870

Inspection & Maintenance

Appendix 9 contains more information on the inner workings of the modulator valves. Blue Bird does not recommend disassembling or rebuilding the M-32QR modulators. If testing determines the valve(s) to be operating incorrectly, contact your Blue Bird Parts Distributor for a replacement.

Removal, Front

Each front modulator is mounted directly to the frame rail by two 5/16" bolts which pass through the body of the modulator and through the frame rail, and are fastened with lock washers and flange nuts on the outboard side of the frame rails.

1. Park the bus on a level surface. Stop the engine. Chock all wheels securely to prevent movement in either direction. Means other than air brakes must be

used to prevent vehicle movement. Disconnect the negative terminal of the battery.

2. Open all three tank bleed valves to drain the air brake system to 0 psi.

3. The brake hose, which leads from the modulator to the brake chamber, is fitted with a swivel fitting at the end connected to the modulator. Disconnect the brake hose at this fitting on the outboard side of the frame rail.

4. Remove the two nuts on the outboard side of the frame rail which secure the modulator.

5. Pull the modulator away from the frame rail to more easily access the air lines and electrical connector.

6. Remove the supply line connected to the push-in fitting. Remove the electrical connector. The modulator can now be removed.

Installation

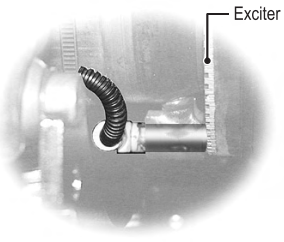
Reverse the removal procedure to install the front M-32QR modulator. Tighten the mounting bolts to 80–100 in. lbs. (9–13.5 Nm).

Removal & Installation, Rear

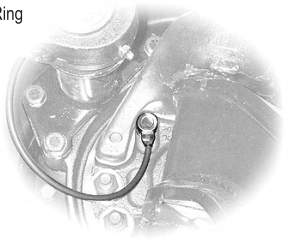
The rear M-32QR modulators are assembled directly to the R-12 valve and mounted as an assembly. See the section above on the R-12 valve for removal & installation procedure.

ABS Wheel Speed Sensors (WS-20)

The Bendix WS-20 Antilock wheel speed sensors are electro magnetic devices slip-fitted into mounting sockets on the in-board side of each wheel hub. A notched exciter ring formed with regularly spaced flats rotates with the wheel drum in very close proximity to the sensor. As the flats pass through the sensor's magnetic field, they AC voltage is generated, the frequency of which is proportional to the speed of the turning wheel. This signal is conveyed electrically through the wiring harness to the ABS Electronic Control Unit.



ABS Wheel Speed Sensor, Rear
remove brake drum for access



ABS Wheel Speed Sensor, Front
accessible without wheel removal

Inspection

Inspect for any visible damage to the sensor, cable, connector, mounting block, and bushing. Replace any damaged components. Appendix 10 contains more information on the WS-20 wheel speed sensors. Contact your Blue Bird Parts Distributor for a replacement.

WS-20 Wheel Speed Sensors
Bendix Publication SD-13-4754

Removal, Front

A front wheel speed sensor can be removed without removing the wheel.

1. Park the bus on a level surface. Turn the steering wheel in the direction of the side of the bus on which you want to remove the sensor. Stop the engine. Apply the parking brake. Disconnect the negative terminal of the battery.

2. Unlatch and raise the hood. Locate the wheel speed sensor by following its electrical lead

3. Disconnect the sensor lead from the wire harness. Remove the cable ties securing the lead. . Take note of the locations of the ties in order to replace with new ones.

4. Gently pry the sensor out of its socket using needle nose pliers and/or bladed screwdriver. The sensor location is tight, but it can be removed with care. The sensor is not threaded, but friction fitted, so twisting slightly can help removal. Be careful not to damage the wire leads, and do not pull on the leads.

5. The spring clip may remain in the socket, or may pull out with the sensor. Remove the spring clip.

Removal, Rear

Removing a rear wheel speed sensor requires removal of the wheel and brake drum.

1. Park the bus on a level surface with parking brake off. Block the other wheels to prevent the vehicle from moving in either direction.

2. Raise the wheel to be serviced and support the vehicle with safety stands under the frame rails.

3. Remove the tire and wheel assembly.

4. Remove the brake drum.

5. Locate the ABS sensor. Disconnect its electrical leads from the chassis wiring harness and remove the cable ties securing the leads. Take note of the locations of the ties in order to replace with new ones.

6. Gently pull the sensor straight back from its mounting bore. Remove the spring clip.

Installation

Reverse the removal procedures above to install the wheel speed sensors. When inserting the sensors:

1. Install a new spring bushing into the mounting block bore, with the retaining tabs toward the inside.

2. Gently push the sensor all the way into its mounting bore until it contacts the exciter ring. Do not strike the sensor to insert it.

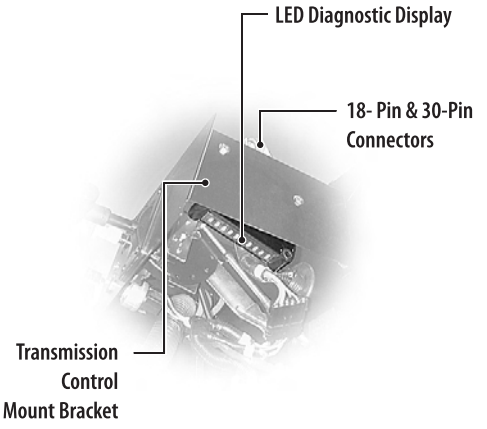
3. Secure the cable leads with cable ties in the locations noted during removal. Inspect to assure that cable leads will not be abraded by contact with other components.

The friction fit of the WS-20 sensors allow them to slide back and forth under force, but retain their position when force is removed. Thus, the sensors self-adjust after being installed. When the sensor is inserted all the way into the mounting block, the hub exciter contacts the sensor, which pushes it back. Normal bearing play will "bump" the sensor away from the exciter. The combination of these two actions will establish a running clearance between the sensor and exciter.

It is important that the wheel bearings be adjusted correctly to ensure that the antilock function does not shut down as a result of excessive wheel endplay.

ABS Controller (EC-30)

The ABS Controller is mounted inside the right wall of the bracket supporting the transmission shift control, and is connected to the chassis wiring harness by an 18-pin and a 30-pin connector on its bottom side (as mounted on the Blue Bird Vision). The Controller is the "black box" encasing the computer circuitry, which controls the Antilock Braking System. The model used on a Blue Bird Vision equipped with air brakes is the basic configuration Bendix EC-30.



The EC-30 continuously receives and monitors signals from the wheel speed sensors. It analyzes this information during braking to determine when a particular wheel is about to lock up, and thereby loose braking traction. When the EC-30 anticipates an impending wheel lock condition, it energizes the supply and/or exhaust diaphragm solenoids in the appropriate M-32QR modulator to "pulse" the brake pressure at that wheel. This maximizes traction and, in most cases, reduces braking distance. When performing ABS braking functions, the ECU also communicates via SAE J1939 serial communications link with the transmission to over-ride torque converter lock; necessary for wheel-independent ABS modulation to occur.

The EC-30 controls an ABS warning lamp on the driver's indicator light panel. On power-up, the light turns on for 2.5 seconds and then turns off. Also at start up, the EC-30 performs a modulator chuff test. With brake pressure applied, the EC-30 activates a chuff at each modulator in the following sequence: right front; left front; right rear; left rear. The chuff sequence is then repeated for a total of 8 chuffs.

Being a sealed electronic unit, the EC-30 is not repairable or rebuildable, but is re-settable; and the EC-30 is itself a diagnostic tool. The EC-30 has a row of LED indicators on its top surface, which reflect the results of simple self-contained diagnostics. When the EC-30 senses an erroneous system condition, it stores the fault code in memory, activates the appropriate warning lamp and disables all or part of the affected ABS function(s). The faulted component is identified on the EC-30's diagnostic display.

In most cases, the EC-30 will automatically reset the active fault code when the fault is corrected. However, repeated occurrences of a given fault will cause the fault code to latch. Once the fault code is latched, a manual reset is required. After repair, latched fault codes can be reset by briefly holding a magnet on the reset location of the EC-30 diagnostic display.

For more detailed diagnostics, the EC-30 provides a J1708/J1587 link to communicate with the vehicle and various diagnostic tools via the Blue Bird Vision's diagnostic link port located in the driver's area under the dash, to the left of the steering column.

More detailed information on troubleshooting and diagnosis of the EC-30 and the ABS system is contained in Appendix 11.

Removal

The EC-30 is through-bolted to the wall of the bracket supporting the Driver's transmission shifter control. To remove:

1. Park the bus on a level surface. Stop the engine. Apply the parking brake. Disconnect the negative terminal of the battery.

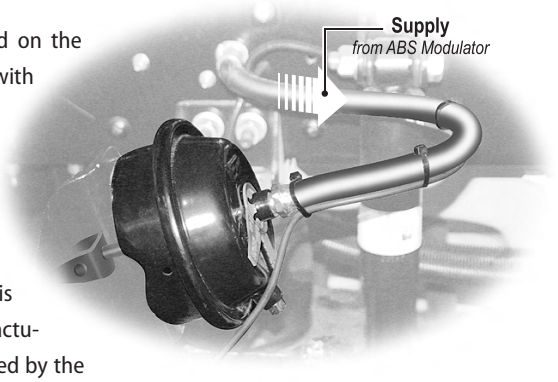
2. Remove the four screws which attach the shifter housing, and remove the housing. Disconnect the 18-pin and 30-pin connectors from the EC-30.

3. Remove the two mounting bolts. The EC-30 can now be removed.

Installation

Reverse the removal procedure.

Brake Chambers, Front



MGM Type 20L (2.5" stroke) service brake chambers are used on the front wheels of the Blue Bird Vision. These are non-adjustable, with welded-on clevis ends. Each front brake chamber has one port on the top end of the pressure chamber housing. The hose connected to this fitting leads from the delivery port of the M32QR modulator mounted a short distance away inside the frame rail.

Air entering the chamber acts upon a diaphragm which is connected to a push rod, which extends from the chamber to actuate the brakes. The pressure delivered to the chamber, multiplied by the area of the diaphragm results in a significant mechanical advantage gain. Thus, for example, a supply line pressure of 30 psi results in a force of approximately 600 lbs. at the pushrod end.

Inspection

The brake chambers should be visually inspected whenever brake maintenance is scheduled, or at a minimum of every 50.000 miles (80,000 km):

- The brake rod shaft is marked by a bright orange band at its inboard end. With brakes applied, if this band is seen protruding from the brake chamber, it is an indication of excessive push rod extension. The automatic slack adjusters should be inspected for proper operation and/or the brake pads should be inspected for excessive wear.
- Check for any visible signs of cracks in the non-pressure chamber housing around mounting studs.
- Check actuator for leaks around the joint seam between the chamber halves. With brakes applied, spray leak detector solution around the seam.
- The chamber should be replaced if there are any signs of the diaphragm leaking or of compressor oil contamination reaching the diaphragm.

Blue Bird does not recommend disassembly or rebuilding of the brake chambers. If a chamber is found to be damaged or suspect, replace it with an identical OEM component.

Removal

The front brake chambers are attached to the chamber bracket of the axle by two self-locking nuts with flat washers. The push rod attaches to the slack adjuster arm by two clevis pins. To remove:

1. Park the bus on a level surface. Stop the engine. Apply Parking Brake. Chock all wheels securely to prevent movement in either direction.

2. Open all three tank bleed valves to drain the air brake system to 0 psi.

3. Disconnect the supply hose at the end connected to the modulator. (This end has a swivel connector). Then disconnect the hose at the brake chamber end.

4. Remove the two cotter pins and clevis pins, which connect the pushrod to the actuator rod and body of the slack adjuster.

Do not re-use clevis pin retaining clips after removing them. Always replace used clevis pin retainer clips with new ones.

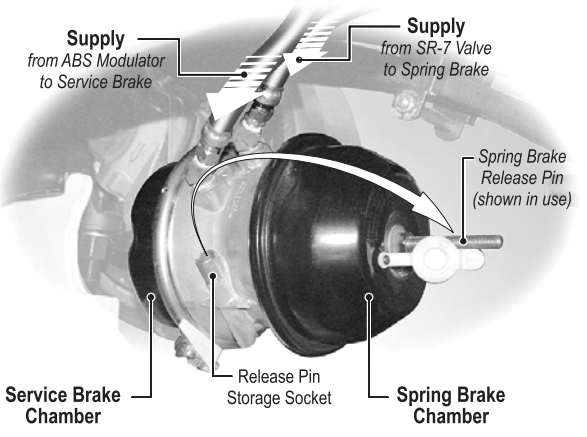
5. Remove the two self-locking nuts and flat washers which mount the brake chamber assembly to the axle bracket. The chamber can now be removed.

Installation

To reinstall the brake chamber when no other changes have been made (such as brake shoe replacement) reverse the removal procedure. Tighten the chamber mounting stud nuts to 100–115 ft. lbs. (135.5–156 Nm). Use new clevis pin retaining clips. Then check slack adjuster adjustment. (See Slack Adjusters section, below.)

Brake Chambers, Rear

MGM Type 30 brake chambers are used on the rear wheels of the Blue Bird Vision. These are non-adjustable, with welded-on clevis ends. The Type 30 chamber assembly is a combination of two different kinds of brake chambers sharing a common center housing. The lower chamber, from which the pushrod protrudes, is the service brake chamber and operates similarly to the front brake chambers described above. The upper chamber is the spring brake chamber, and contains a powerful coil spring which actuates the brakes when parking brakes are applied, or while driving when primary circuit pressure is absent. Thus, the spring brakes serve



two purposes: as normal parking brakes and as a mechanically actuated backup system for rear air brakes.

The service brake and spring brake chambers have separate supply ports. The service brake chamber receives air from the primary tank, as controlled by the R-12 valve and the M-32QR modulator valve. Air entering the service brake chamber acts upon a diaphragm connected to the push rod, which extends from the chamber to actuate the brakes. The pressure delivered to the chamber, multiplied by the area of the diaphragm results in a significant mechanical advantage gain.

The spring brake chamber also contains a diaphragm. However, its supply port receives pressure from the secondary air tank, as controlled by the SR-7 valve. Air entering the spring brake chamber is used not to extend the push rod; but to work against the tension of the coil spring. Whenever air pressure is absent (or released) from the spring brake chamber, the powerful spring tension is applied to the push-rod, actuating the brakes.

It is important to note that the spring brake does not gain mechanical advantage as does the air-powered service brake. Therefore, the captive coil spring is actually strong enough to apply the full force necessary to stop the bus. Even when expanded the full length of its chamber, the spring is still under tremendous compression.

Never attempt to disassemble a spring brake cylinder, even when it contains no compressed air. The spring brake cylinders enclose very powerful coil springs held under high mechanical compression. Any attempt to disassemble the brake chamber can result in injury or death.

Under normal driving conditions, with the parking brake released and the air system fully charged, the system delivers air to the spring brake chambers, fully compressing (caging) the springs. The spring brakes are held in this disengaged position, and the service brakes perform braking functions.

Whenever the vehicle is stopped and the parking brake is applied, air is released from the spring brake chamber through the SR-7 valve, allowing the spring brakes to fully apply the rear brakes.

If primary circuit pressure is abnormally low or absent, the SR-7 valve varies the air being delivered to the spring brake chamber in response to the driver's operation of the brake pedal. This condition, called "spring brake modulation," allows the spring brakes to function as rear brakes while driving the bus.

If both primary and secondary system pressure fail (or if system pressure is not yet charged, as at the beginning of service), no pressure is available to cage the spring brakes. The spring brakes fully apply, preventing the vehicle from being driven until proper air brake operation is restored.

Manual Spring Brake Disengagement

Means are provided on the spring brake chambers by which to manually disengage the spring brakes so as to allow the bus to be towed for repair in an emergency situation; or to allow the rear brake components to be serviced without the air system being charged.

On each of the rear combination brake chambers, a special tool is carried in a storage socket cast into the body of the chamber. The tool consists of a release bolt with a specially formed end, a washer, and hex nut. To manually disengage the spring brakes for service:

1. Stop the engine. Chock all wheels to prevent movement in either direction. Use whatever means necessary to make absolutely certain the bus cannot roll when the spring brakes are released.

Do not manually disengage spring brakes if the vehicle is in an unstable roadside situation, or if the vehicle can roll when the spring brakes are released. Movement of the bus must be prevented by means other than brakes.

2. Open all three tank bleed valves to drain the air brake system to 0 psi.

3. Remove the nut and washer from the end of the release bolt, and remove the tool from its storage socket.

4. Remove the rubber dust cap from the access hole in the upper end of the spring brake chamber.

5. Insert the toggle end of the release bolt into the access hole. Be sure that the formed end of the release bolt has entered the hole in the piston inside the chamber. Continue to insert the bolt until it bottoms out.

6. Turn the release bolt ¼ turn clockwise and pull outward on the bolt to lock the formed end into the piston.

7. Holding the bolt locked into the piston, install the flat washer and the release nut onto the end of the release bolt, and turn down the nut against the flat washer until finger tight.

8. Using a ¾" hand wrench (do not use an impact-type wrench), turn the release nut clockwise until the internal spring is fully caged.

9. Repeat this procedure for the spring brake chamber on the opposite side of the bus. The spring brakes are now released, having their springs compressed by the release bolts.

Inspection

The brake chambers should be visually inspected whenever brake maintenance is scheduled, or at a minimum of every 50.000 miles (80,000 km):

- The brake rod shaft is marked by a bright orange band at its inboard end. With brakes applied, if this band is seen protruding from the brake chamber, it is

an indication of excessive push rod extension. The automatic slack adjusters should be inspected for proper operation and/or the brake pads should be inspected for excessive wear.

- Check for any visible signs of cracks in the non-pressure chamber housing around mounting studs.
- Check actuator for leaks around the joint seam between the chamber halves. With brakes applied, spray leak detector solution around the seam.
- The chamber should be replaced if there are any signs of the diaphragm leaking or of compressor oil contamination reaching the diaphragm.

Never attempt to disassemble or rebuild the rear brake chambers. If a chamber is found to be damaged or suspect, replace it with an identical OEM component.

Removal

The rear combination brake chambers are attached to the chamber bracket of the axle by two self-locking nuts with flat washers. The push rod attaches to the slack adjuster arm by two clevis pins. To remove:

1. Park the bus on a level surface. Stop the engine. Chock all wheels securely to prevent movement in either direction. Means other than brakes must be used to prevent vehicle movement.

2. Open all three tank bleed valves to drain the air brake system to 0 psi.

3. Manually disengage the spring brake being removed as described above in Manual Spring Brake Disengagement.

4. Disconnect both supply hoses from the brake chamber supply ports.

5. Remove the two cotter pins and clevis pins which connect the pushrod to the actuator rod and body of the slack adjuster.

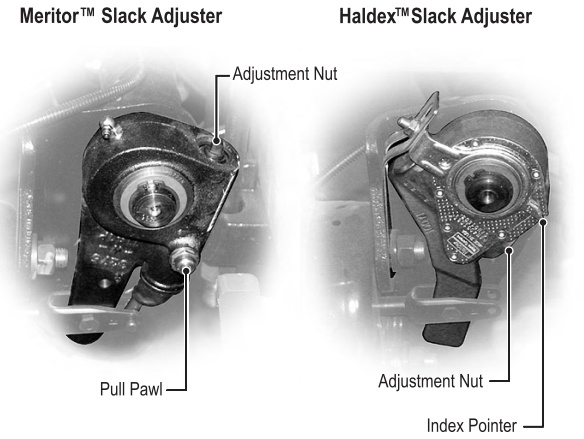
Do not re-use clevis pin retaining clips after removing them. Always replace used clevis pin retainer clips with new ones.

6. Remove the two self-locking nuts and flat washers which mount the brake chamber assembly to the axle bracket. The chamber can now be removed.

Installation

To reinstall the brake chamber when no other changes have been made (such as brake shoe replacement) reverse the removal procedure. Tighten the chamber mounting stud nuts to 100–115 ft. lbs. (135.5–156 Nm). Use new clevis pin retaining clips. Then check slack adjuster adjustment. (See Slack Adjusters section, below.)

Slack Adjusters



At each wheel, the brake actuating push rod of the air brake chamber connects to an automatic slack adjuster mechanism, which acts as a lever to turn the brake assembly's S-cam shaft.

As the friction surfaces of the brake shoes wear, they grow thinner, and the clearance between the brake shoes and drum increases. If this situation were left uncorrected, the brake chamber push rod would have to travel an ever-increasing distance in order to actuate the brakes and frequent manual adjustment would be necessary to remove this excess travel. The role of the automatic slack adjuster is to compensate for the brake shoe wear by acting as a ratcheting mechanism, much like a ratchet wrench, keeping the linkage travel within normal tolerance.

Meritor slack adjusters are standard on the Blue Bird Vision. Haldex adjusters are on some units as an option. The two types perform the same function, but by somewhat different internal mechanisms.

In Meritor slack adjustors, the ratcheting function is performed by a pawl which engages the notches of a toothed adjusting sleeve which rotates as brake lining wear occurs. The spring-loaded pawl can be manually released by pulling a button on the outside of the slack adjuster body.

On Haldex adjusters, the internal ratcheting action is performed by a one-way clutch on the shaft of a worm drive gear which rotates as brake lining wear occurs.

Appendix 12 contains more detailed information on the Meritor automatic slack adjusters. Appendix 13 contains more detailed information on the Haldex automatic slack adjusters.

Adjustment

The slack adjusters on the Blue Bird Vision are designed to be self-adjusting. The only times at which manual adjustment should be necessary is when initially setting the adjusters after reassembling the brakes following service procedures such as shoe replacement. If brake travel is found to be out of range, always be sure to find the root cause. Making manual adjustments of the slack adjusters is probably only affecting a symptom, and not correcting the actual cause of a problem.

Thorough instructions for making the initial slack adjuster settings after servicing the brakes are contained in the two appendixes mentioned above.

Removal of Meritor Slack Adjusters

Meritor slack adjusters are mounted on the splined shaft of the S-cam, and secured by an outer diameter circlip. The end of the actuating arm is connected to the brake chamber push rod clevis by two clevis pins and clevis pin retainer clips. To remove:

1. Park the bus on a level surface. Stop the engine. Chock all wheels securely to prevent movement in either direction. Means other than brakes must be used to prevent vehicle movement.

2. If the bus is equipped with air suspension, support the frame rail securely with safety stands.

3. Open all three tank bleed valves to drain the air brake system to 0 psi.

4. Manually disengage the spring brake as described above in Manual Spring Brake Disengagement.

5. Remove the two cotter pins and clevis pins that connect the pushrod to the slack adjuster.

Do not re-use clevis pin retaining clips after removing them. Always replace used clevis pin retainer clips with new ones.

6. Pry the spring-loaded pawl button outward to release the ratchet mechanism of the slack adjuster. While holding the pawl outward, use a wrench to turn the adjusting hex head on the bottom of the adjuster clockwise. This will cause the slack adjuster to rotate. Turn the nut until the slack adjuster arm is clear of the pushrod clevis.

7. Use outer circlip pliers to remove the circlip securing the adjuster assembly to the S-cam shaft. Note the number and assembly order of spacing washers on either side of the adjuster as you remove the adjuster from the shaft.

Installation

Reinstall the Meritor slack adjuster by reversing the removal procedure. After installing, make the initial setting of the slack adjuster by following the instructions in Appendix 13.

Removal of Haldex Slack Adjusters

Haldex slack adjusters are mounted on the splined shaft of the S-cam, and secured by an outer diameter circlip. The end of the actuating arm is connected to the brake chamber push rod clevis by one clevis pin and a clevis pin retainer clip. The adjuster's control arm is fastened to a slotted hole in the anchor bracket. To remove:

1. Park the bus on a level surface. Stop the engine. Chock all wheels securely to prevent movement in either direction. Means other than brakes must be used to prevent vehicle movement.

2. If the bus is equipped with air suspension, support the frame rail securely with safety stands.

3. Open all three tank bleed valves to drain the air brake system to 0 psi.

4. Manually disengage the spring brake as described above in Manual Spring Brake Disengagement.

5. Remove the clevis pin retainer clip and clevis pin which connect the pushrod to the slack adjuster.

Do not re-use clevis pin retaining clips after removing them. Always replace used clevis pin retainer clips with new ones.

6. Use a wrench to turn the adjusting hex head on the bottom of the adjuster clockwise. This will cause the slack adjuster to rotate. Turn the nut until the slack adjuster arm is clear of the pushrod clevis.

7. Use outer circlip pliers to remove the circlip securing the adjuster assembly to the S-cam shaft. Note the number and assembly order of spacing washers on either side of the adjuster as you remove the adjuster from the shaft.

Installation

Reinstall the Haldex slack adjuster by reversing the removal procedure. After installing, make the initial setting of the slack adjuster by following the instructions in Appendix 13.

Brake Shoes & Drums

The Blue Bird Vision uses Meritor Q-Plus model S-cam brakes and drums. The front brakes are 16.5" diameter, 5" wide models with cast spiders. Rear brakes are 16.5" diameter, 7" wide with cast spiders.

The brake shoes are mounted on individual pivots at their rear-most end, as mounted on the Blue Bird Vision. Half-round notches on the pivot ends of the shoes engage the shouldered ends of individual anchor pins that pass through the casting of the spider plate. The pivoting ends of the shoes and are held in place by a heavy-duty spring connecting to both shoes.

The opposite ends of the brake shoes are supported by cam rollers, which ride in the round notches of an S-shaped cam situated between the two shoes. Wire retaining clips hold the cam rollers in the ends of the shoes, and heavy-duty springs again provide pressure to retain the shoes in their position.

When brakes are applied, the slack adjuster rotates the shaft of the S-cam. The S-shape of the cam forces the forward ends of the brake shoes to spread, pressing the shoe linings against the walls of the brake drum.

Maintenance

Brake shoe service life will vary according to operating conditions. The thickness of the brake shoe friction linings can be viewed from the inboard side of the wheel, and should be measured regularly. The brake shoes should be replaced when lining

thickness is .25 in. (6.3mm) at the thinnest point. Springs, rollers, cam bushings, and anchor pins should be replaced when replacing brake shoes.

Do not re-bore brake drums. Doing so decreases the strength and heat capacity of the drum.

Appendix 14 contains detailed information on inspection, disassembly and reassembly of the Q Plus brakes used on the Blue Bird Vision.

Removal, Front Drums

The same mounting stud nuts that retain the front wheel also retain the front brake drum.

1. Park the bus on a level surface. Stop the engine. Chock all wheels securely to prevent movement in either direction. Means other than brakes must be used to prevent vehicle movement.

2. Open all three tank bleed valves to drain the air brake system to 0 psi.

3. Raise the bus with an appropriate jack and support it with safety stands under the frame rails.

4. Disconnect the automatic slack adjuster to allow the brake shoes to fully retract from the drum. The extra clearance will be required when reassembling with new brake shoes. Refer to the instructions above for kind of slack adjuster (Meritor or Haldex) installed.

4. Remove the wheel nuts. Remove the front wheel. The brake drum can now be removed for access to the brake shoes and other components.

Refer to Appendix 14 for instructions on disassembling, inspecting and reassembling the brake shoes and related components.

Installation, Front Drums

After reinstalling the brake components according to instructions in Air Brakes Appendix 15:

1. Install the brake drum, wheel, and wheel mounting nuts. Draw up the wheel nuts evenly, rotating the wheel a few turns to be sure to remove all free play in the mounting nuts. Then use a calibrated torque wrench to gradually tighten the wheel nuts to 450–500 ft. lbs. (610–678 Nm), working back and forth across the center of the wheel as in the pattern shown:

2. Reconnect the automatic slack adjuster using new clevis pin retainer clips. Adjust the slack adjuster according to instructions in Air Brakes Appendix 13 (for Meritor slack adjusters) or Air Brakes Appendix 14 (for Haldex slack adjusters).

Removal, Rear Drums

The same mounting stud nuts which retain the rear wheel also retain the rear brake drum.

1. Park the bus on a level surface. Stop the engine. Chock all wheels securely to prevent movement in either direction. Means other than brakes must be used to prevent vehicle movement.

2. Open all three tank bleed valves to drain the air brake system to 0 psi.

3. Raise the bus with an appropriate jack and support it with safety stands under the frame rails.

4. Manually disengage the spring brake as described above in Manual Spring Brake Disengagement.

5. Disconnect the automatic slack adjuster to allow the brake shoes to fully retract from the drum. The extra clearance will be required when reassembling with new brake shoes. Refer to the instructions above for kind of slack adjuster (Meritor or Haldex) installed.

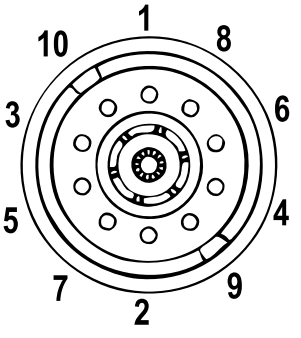
6. Remove the wheel nuts. Remove the rear wheels. The brake drum can now be removed for access to the brake shoes and other components.

Refer to Appendix 14 for instructions on disassembling, inspecting and reassembling the brake shoes and related components.

Installation, Rear Drums

After reinstalling the brake components according to instructions in Appendix 15:

1. Install the brake drum, wheel, and wheel mounting nuts. Draw up the wheel nuts evenly, rotating the wheel a few turns to be sure to remove all free play in the mounting nuts. Then use a calibrated torque wrench to gradually tighten the wheel nuts to 450–500 ft. lbs. (610–678 Nm), working back and forth across the center of the wheel as in the pattern shown:



2. Reconnect the automatic slack adjuster using new clevis pin retainer clips. Adjust the slack adjuster according to instructions in Air Brakes Appendix 13 (for Meritor slack adjusters) or Air Brakes Appendix 14 (for Haldex slack adjusters).

3. Remove the manual release tool from the spring brake chamber to engage the air spring. Reinstall the tool in its storage socket.

Bendix

Service Data

SD-08-2412

AD-9 AIR DRYER

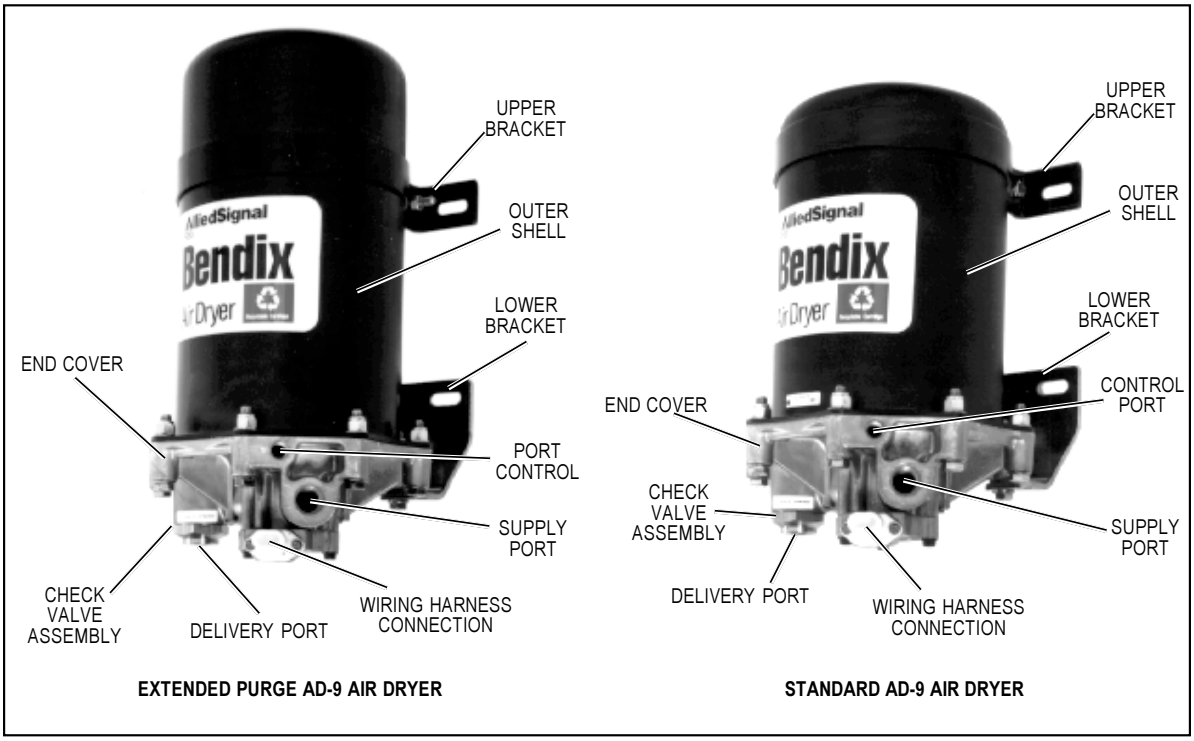


*FIGURE 1 - **AD-9 AIR DRYER MODELS***

DESCRIPTION

The function of the AD-9 **A**ir **D**ryer is to collect and remove air system contaminants in solid, liquid and vapor form before they enter the brake system. It provides clean, dry air to the components of the brake system which increases the life of the system and reduces maintenance costs. Daily manual draining of the reservoirs is eliminated.

The AD-9 Air Dryer consists of a desiccant cartridge and a die cast aluminum end cover secured to a cylindrical steel outer shell with eight cap screws and nuts. The end cover contains a check valve assembly, a safety valve, three threaded air connections and the purge valve housing assembly. The removable purge valve housing assembly incorporates a purge valve mechanism and a turbo charger cut-off feature that is designed to prevent loss of engine "turbo" boost pressure during the purge cycle of the AD-9 air dryer. For ease of serviceability, the desiccant cartridge and discharge check valve assembly are screw in type. The purge valve housing assembly, which includes the heater and thermostat assembly, and the discharge check valve assembly, is serviceable from the exterior of the air dryer, while servicing the screw-in desiccant cartridge requires removal of the air dryer assembly from the vehicle.

The AD-9 has three female pipe thread air connections and each is identified as follows:

Port I.D.	Function/Connection
CON 4	Control Port (purge valve control and turbo cut-off).
SUP 11	Supply Port (air in).
DEL 2	Delivery Port (air out).

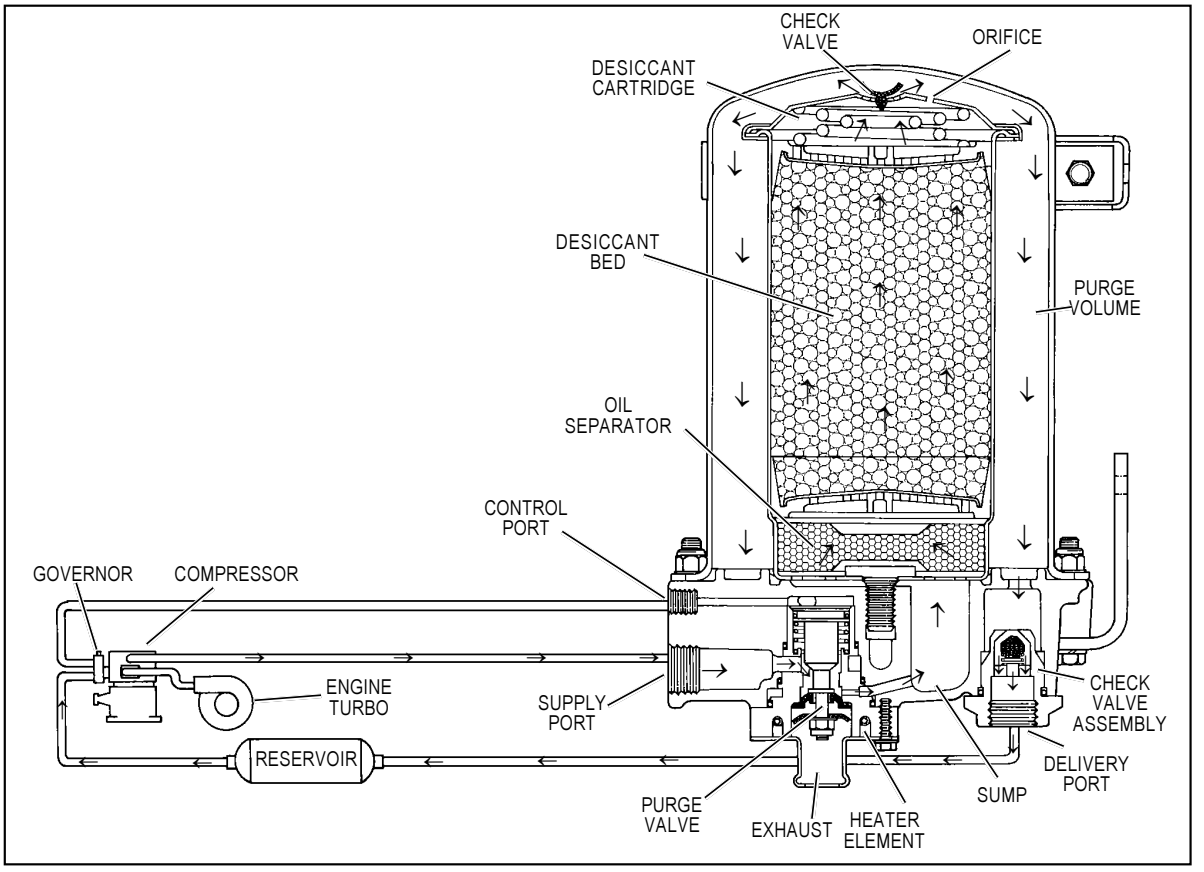


FIGURE 2 - ***AD-9 CHARGE CYCLE***

OPERATION OF THE AD-9 AIR DRYER

The AD-9 air dryer alternates between two operational modes or "cycles" during operation: the *charge cycle* and the *purge cycle*. The following description of operation is separated into these "cycles" of operation.

CHARGE CYCLE (refer to Figure 2)

When the compressor is loaded (compressing air) compressed air, along with oil, oil vapor, water and water vapor flows through the compressor discharge line to the supply port of the air dryer end cover. As air travels through the end cover assembly, its direction of flow changes several times, reducing the temperature, causing contaminants to condense and drop to the bottom or sump of the air dryer end cover.

After exiting the end cover, the air flows into the desiccant cartridge. Once in the desiccant cartridge air first flows through an oil separator which removes water in liquid form as well as oil, oil vapor and solid contaminants.

Air exits the oil separator and enters the desiccant drying bed. Air flowing through the column of desiccant becomes progressively dryer as water vapor adheres to the desiccant material in a process known as *"adsorption"*. The desiccant cartridge using the adsorption process typically removes 95% of the water vapor from the pressurized air.

The majority of dry air exits the desiccant cartridge through its integral single check valve to fill the purge volume between the desiccant cartridge and outer shell. Some air will also exit the desiccant cartridge through the purge orifice adjacent to the check valve.

Dry air flows out of the purge volume through the single check valve assembly and out the delivery port to the first (supply) reservoir of the air system.

The air dryer will remain in the charge cycle until air brake system pressure builds to the governor cutout setting.

PURGE CYCLE (refer to Figure 3)

When air brake system pressure reaches the cutout setting of the governor, the compressor unloads (air compression stopped) and the purge cycle of the air dryer begins. When the governor unloads the compressor, it pressurizes the compressor unloader mechanism and line connecting the

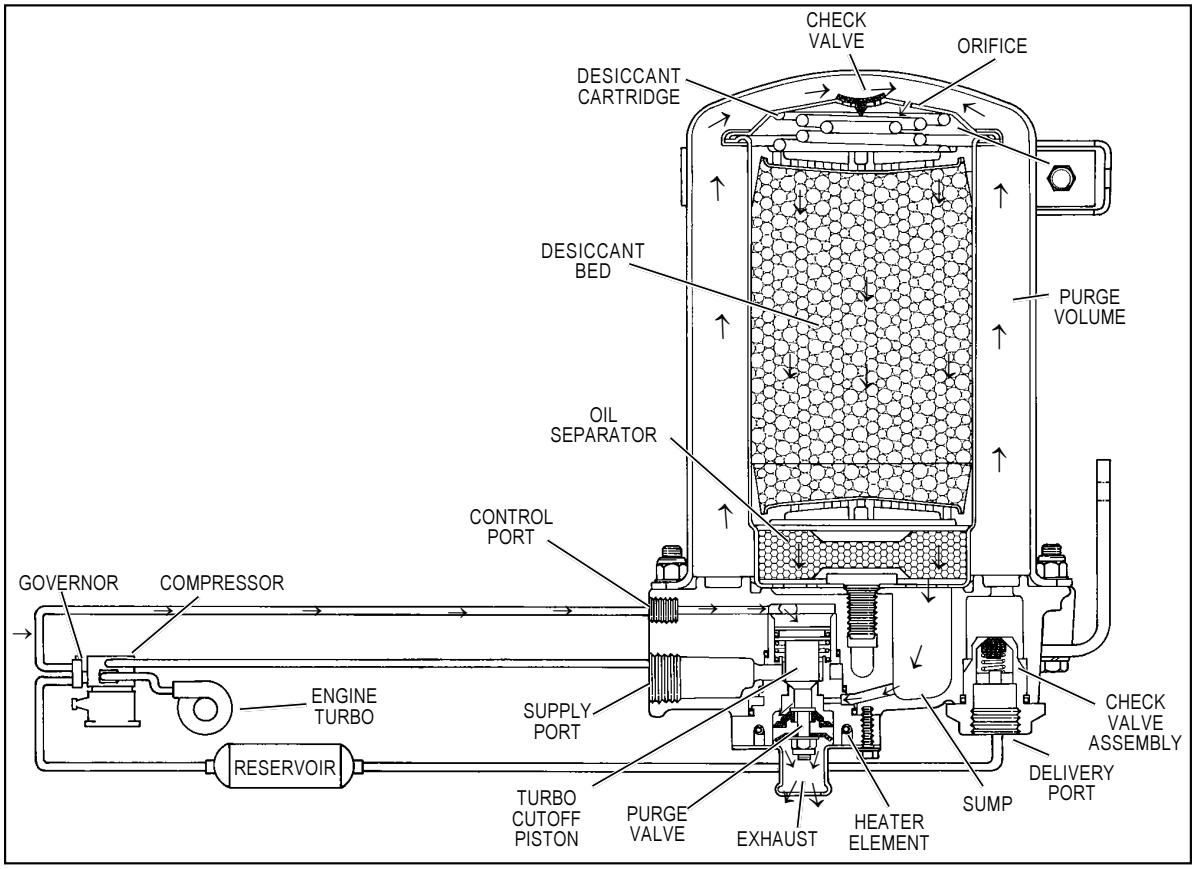


FIGURE 3 - ***AD-9 PURGE CYCLE***

governor unloader port to the AD-9 end cover control port. The purge piston moves in response to air pressure causing the purge valve to open to atmosphere and (partially) closing off the supply of air from the compressor, this will be further discussed in the section covering the turbo cut-off feature. Contaminants in the end cover sump are expelled immediately when the purge valve opens. Also, air which was flowing through the desiccant cartridge changes direction and begins to flow toward the open purge valve. Oil and solid contaminants collected by the oil separator are removed by air flowing from the desiccant drying bed to the open purge valve.

The initial purge and desiccant cartridge decompression lasts only a few seconds and is evidenced by an audible burst of air at the AD-9 exhaust.

The actual reactivation of the desiccant drying bed begins as dry air flows from the purge volume through the desiccant cartridge purge orifice and into the desiccant drying bed. Pressurized air from the purge volume expands after passing through the purge orifice; its pressure is lowered and its volume increased. The flow of dry air through the drying bed reactivates the desiccant material by removing the water vapor adhering to it. Generally 15-30 seconds are required for the entire purge volume of a standard AD-9 to flow through the desiccant drying bed.

The end cover single check valve assembly prevents air pressure in the brake system from returning to the air dryer during the purge cycle. After the 30 second purge cycle is complete, the air dryer is ready for the next charge cycle to begin.

The purge valve will remain open after the purge cycle is complete and will not close until air brake system pressure is reduced and the governor signals the compressor to charge.

TURBO CUT-OFF FEATURE (Refer to Figure 4)

The primary function of the turbo cut-off valve is to prevent loss of engine turbocharger air pressure through the AD-9 in systems where the compressor intake is connected to the engine turbocharger. The turbo cut-off valve also reduces the “puffing” of air out the open exhaust when a naturally aspirated, single cylinder compressor equipped with an inlet check valve is in use.

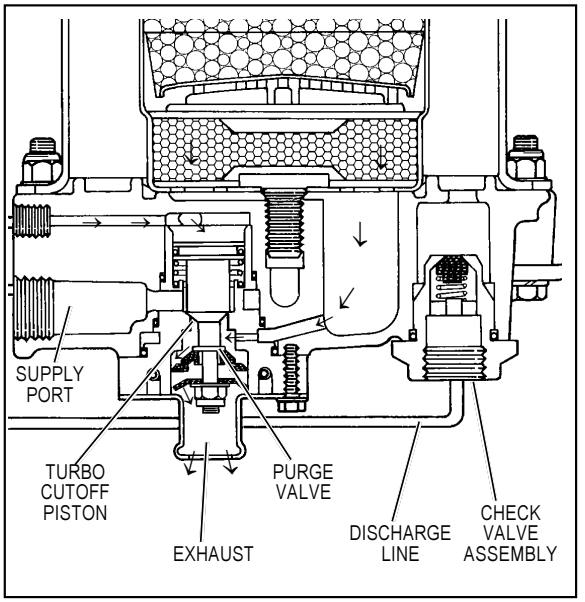


FIGURE 4 - ***AD-9 TURBO CUTOFF***

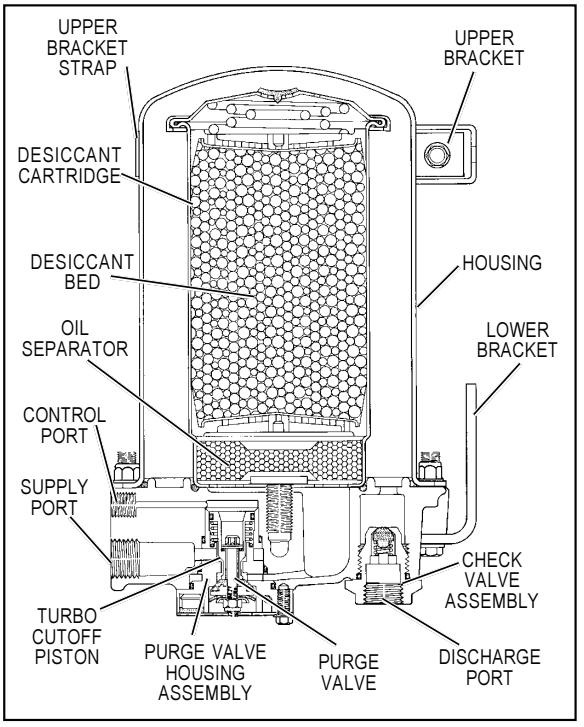


FIGURE 5 - ***AD-9 AIR DRYER SECTIONAL VIEW***

At the onset of the purge cycle, the downward travel of the purge piston is stopped when the turbo cut-off valve (tapered portion of purge piston) contacts its mating metal seat in the purge valve housing. With the turbo cut-off valve seated (closed position), air in the discharge line and AD-9 inlet port is restricted from entering the air dryer. While the turbo cut-off effectively prevents loss of turbo charger boost pressure to the engine, some "seepage" of air may be detected under certain conditions of compressor engine and turbo charger operation, even so there will always be low pressure trapped in the discharge line.

PREVENTIVE MAINTENANCE

Important: Review the warranty policy before performing any intrusive maintenance procedures. An extended warranty may be voided if intrusive maintenance is performed during this period.

Because no two vehicles operate under identical conditions, maintenance and maintenance intervals will vary. Experience is a valuable guide in determining the best maintenance interval for any one particular operation.

Every 900 operating hours or 25,000 miles or every three (3) months:

1. Check for moisture in the air brake system by opening reservoirs, drain cocks, or valves and checking for presence of water. If moisture is present, the desiccant may require replacement; however, the following conditions can also cause water accumulation and should be considered before replacing the desiccant:
   A. An outside air source has been used to charge the system. This air did not pass through the drying bed.
   B. Air usage is exceptionally high and not normal for a highway vehicle. This may be due to accessory air demands or some unusual air requirement that does not allow the compressor to load and unload (compressing and non-compressing cycle) in a normal fashion. Check for high air system leakage.
   C. The air dryer has been installed in a system that has been previously used without an air dryer. This type system will be saturated with moisture and several weeks of operation may be required to dry it out.
   D. Location of the air dryer is too close to the air compressor. Refer to *Locating AD-9 On Vehicle* section.
   E. In areas where more than a 30 degree range of temperature occurs in one day, small amounts of water can accumulate in the air brake system due to condensation. Under these conditions, the presence of small amounts of moisture is normal and should not be considered as an indication that the dryer is not performing properly.

   Note: A small amount of oil in the system may be normal and should not, in itself, be considered a reason to replace the desiccant; oil stained desiccant can function adequately.
2. Check mounting bolts for tightness. Retorque to 270-385 inch pounds.

3. Perform the *Operation & Leakage Tests* listed in this publication.

Every 10,800 hours; 300,000 miles or 36 months:

1. Rebuild the air dryer including the desiccant cartridge.

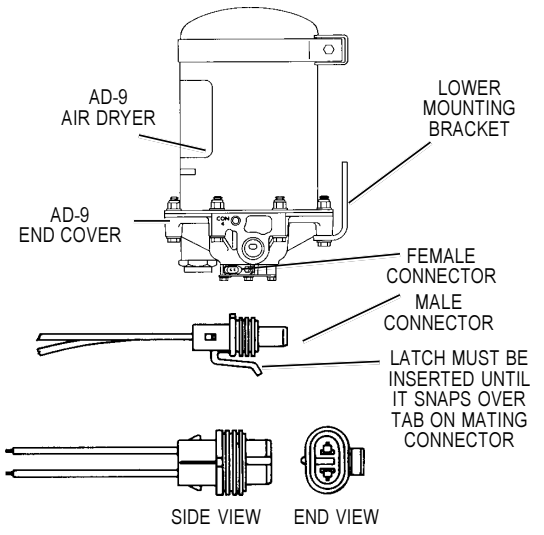
Note: The desiccant change interval may vary from vehicle to vehicle. Although typical desiccant cartridge life is three years, many will perform adequately for a longer period of time. In order to take maximum advantage of desiccant life and assure that replacement occurs only when necessary, it is important that *Operation & Leakage Tests* be performed.

WARNING!

This air dryer is intended to remove moisture and other contaminants normally found in the air brake system. Do not inject alcohol, anti-freeze, or other de-icing substances into or upstream of the air dryer. Alcohol is removed by the dryer, but reduces the effectiveness of the device to dry air. Use of other substances can damage the air dryer and may void the warranty.

OPERATION & LEAKAGE TESTS

1. Test the outlet port check valve assembly by building the air system to governor cut-out and observing a test air gauge installed in the #1 reservoir. A rapid loss of pressure could indicate a failed outlet port check valve. This can be confirmed by bleeding the system down, removing the check valve assembly from the end cover, subject air pressure to the unit and apply a soap solution to the check valve side. Leakage should not exceed a 1 inch bubble in 1 second.
2. Check for excessive leakage around the purge valve. With the compressor in loaded mode (compressing air), apply a soap solution to the purge valve housing assembly exhaust port and observe that leakage does not exceed a 1 inch bubble in 1 second. If the leakage exceeds the maximum specified, service the purge valve housing assembly.
3. Close all reservoir drain cocks. Build up system pressure to governor cut-out and note that AD-9 purges with an audible escape of air. “Fan” the service brakes to reduce system air pressure to governor cut-in. Note that the system once again builds to full pressure and is followed by an AD-9 purge.
4. Check the operation of the safety valve by pulling the exposed stem while the compressor is loaded (compressing air). There must be an exhaust of air while the stem is held and the valve should reseat when the stem is released.
5. Check all lines and fittings leading to and from the air dryer for leakage and integrity.



A two lead, 12 inch, wire harness with attached weather resistant connector is supplied with all retrofit and replacement AD-9 Air Dryers. Connect one of the two leads of the wire harness to the engine kill or ignition switch. The remaining lead of the wire harness must be connected to a good vehicle ground. A fuse should be installed in the power carrying wire; install a 10 amp fuse for 12 volt heaters and a 5 amp fuse for a 24 volt heater.
Use 14 AWG wire if it is necessary to lengthen the wire harness provided.
Make certain all wire splices are waterproofed.
Tie wrap or support all electrical wire leading to the AD-9.

*FIGURE 6 - **HEATER AND THERMOSTAT CONNECTOR***

6. Check the operation of the end cover heater and thermostat assembly during cold weather operation as follows:

   A. Electric Power to the Dryer

      With the ignition or engine kill switch in the ON position, check for voltage to the heater and thermostat assembly using a voltmeter or test light. Unplug the electrical connector at the air dryer and place the test leads on each of the pins of the male connector. If there is no voltage, look for a blown fuse, broken wires, or corrosion in the vehicle wiring harness. Check to see if a good ground path exists.

   B. Thermostat and Heater Operation

      Turn off the ignition switch and cool the end cover assembly to below 40 degrees Fahrenheit. Using an ohmmeter, check the resistance between the electrical pins in the female connector. The resistance should be 1.5 to 3.0 ohms for the 12 volt heater assembly and 6.8 to 9.0 ohms for the 24 volt heater

assembly. **Note**: *Some early models of the AD-9 will have resistance readings of 1.0 to 2.5 ohms for the 12 volt heater assembly and 4.8 to 7.2 ohms for the 24 volt heater assembly. If the resistance is higher than the maximum stated, replace the purge valve housing assembly, which includes the heater and thermostat assembly.*

Warm the end cover assembly to over 90 degrees Fahrenheit and again check the resistance. The resistance should exceed 1000 ohms. If the resistance values obtained are within the stated limits, the thermostat and heater assembly is operating properly. If the resistance values obtained are outside the stated limits, replace the purge valve housing assembly, which includes the heater and thermostat assembly.

REBUILDING THE AD-9 AIR DRYER

GENERAL

If, after completing the routine operation and leakage tests, it has been determined that one or more components of the air dryer requires replacement or maintenance, refer to the following list to find the appropriate kit(s).

When rebuilding or replacing components of the air dryer use only genuine Bendix parts. For ease in servicing the AD-9 desiccant cartridge assembly, it is recommended that the air dryer be removed from the vehicle.

MAINTENANCE KITS AVAILABLE:

5005037 Hard Seat Purge Valve Housing Maintenance Kit
5005893 Soft Seat Purge Valve Housing Maintenance Kit

These kits contain the parts necessary to rebuild the air portion of the purge valve housing and do not include the heater and thermostat.

107794 Desiccant Cartridge Replacement Kit

This kit contains the parts necessary to change the desiccant cartridge only.

107796 Remanufactured Desiccant Cartridge Replacement Kit

This kit contains the parts necessary to change the desiccant cartridge only.

107799 End Cover Check Valve Assembly Replacement

3/4 inch thread size.

107800 End Cover Check Valve Assembly Replacement

1/2 inch thread size.

800405 Service New or Remanufactured Exchange Purge Valve Housing Assembly - Soft Seat (w/heater and thermo.) 12 volt system.

5004479 Service New or Remanufactured Exchange Purge Valve Housing Assembly - Hard Seat (w/heater and thermo.) 12 volt system.

5004339 Service New or Remanufactured Exchange Purge Valve Housing Assembly - DLU (w/heater and thermo.) 12 volt system.

5004338 Service New or Remanufactured Exchange Purge Valve Housing Assembly - Soft Seat (w/heater and thermo.) 24 volt system.

5004480 Service New or Remanufactured Exchange Purge Valve Housing Assembly - Hard Seat (w/heater and thermo.) 24 volt system.

5004340 Service New or Remanufactured Exchange Purge Valve Housing Assembly - DLU (w/heater and thermo.) 24 volt system.

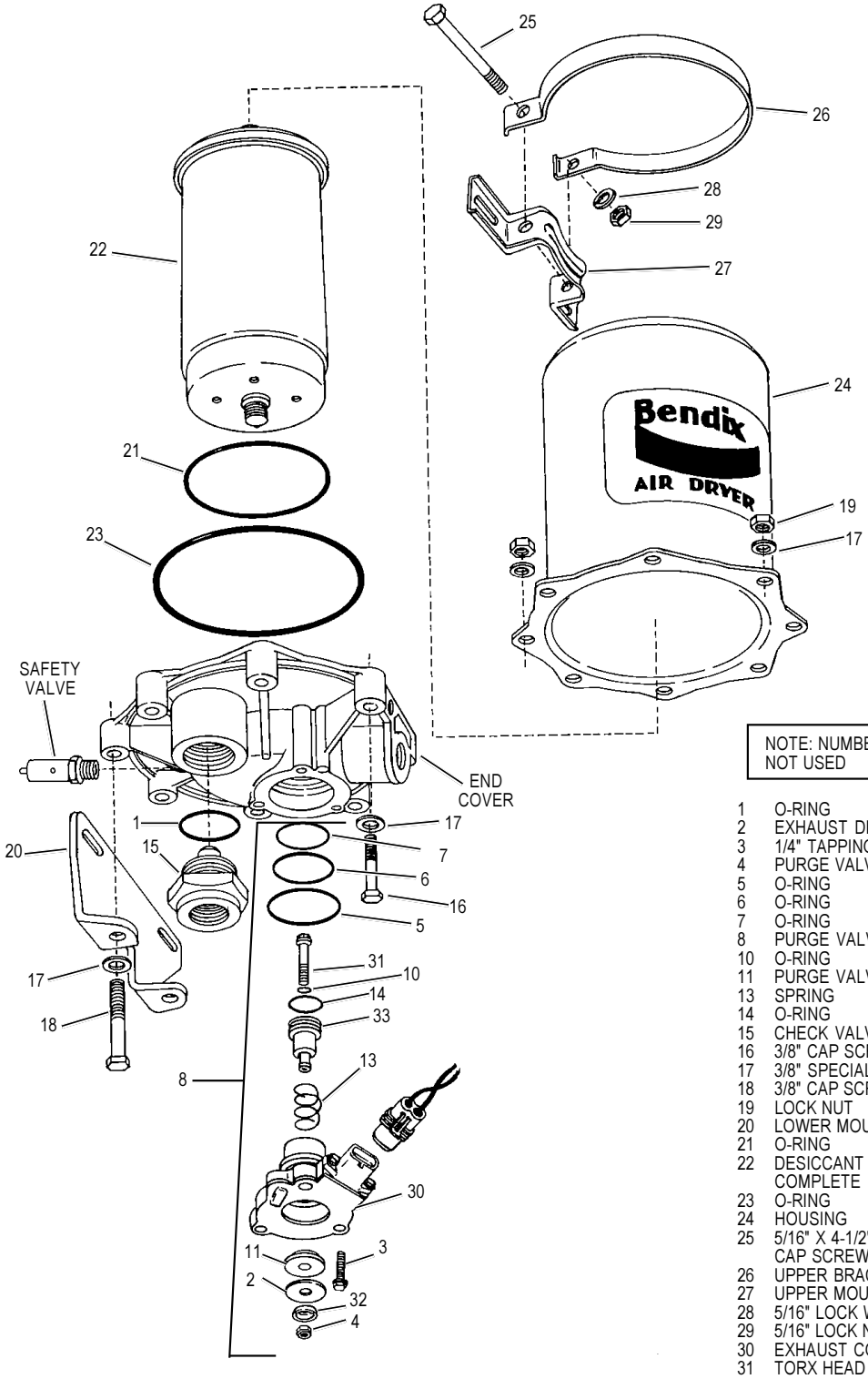
107695 Complete Mounting Bracket Kit

This kit contains the upper and lower brackets as well as the necessary hardware items to mount them.

IMPORTANT! PLEASE READ AND FOLLOW THESE INSTRUCTIONS TO AVOID PERSONAL INJURY OR DEATH:

When working on or around a vehicle, the following general precautions should be observed at all times:

1. **Park the vehicle on a level surface, apply the parking brakes, and always block the wheels.**
2. **Stop the engine when working around the vehicle.**
3. **If the vehicle is equipped with air brakes, make certain to drain the air pressure from all reservoirs before beginning ANY work on the vehicle.**
4. **Following the vehicle manufacturer's recommended procedures, deactivate the electrical system in a manner that removes all electrical power from the vehicle.**
5. **When working in the engine compartment the engine should be shut off. Where circumstances require that the engine be in operation, EXTREME CAUTION should be used to prevent personal injury resulting from contact with moving, rotating, leaking, heated, or electrically charged components.**
6. **Never connect or disconnect a hose or line containing pressure; it may whip. Never remove a component or plug unless you are certain all system pressure has been depleted.**
7. **Never exceed recommended pressures and always wear safety glasses.**
8. **Do not attempt to install, remove, disassemble or assemble a component until you have read and thoroughly understand the recommended procedures. Use only the proper tools and observe all precautions pertaining to use of those tools.**



NOTE: NUMBERS 9 AND 12 NOT USED

1	O-RING
2	EXHAUST DIAPHRAGM
3	1/4" TAPPING SCREW
4	PURGE VALVE LOCK NUT
5	O-RING
6	O-RING
7	O-RING
8	PURGE VALVE ASSEMBLY
10	O-RING
11	PURGE VALVE
13	SPRING
14	O-RING
15	CHECK VALVE ASSEMBLY
16	3/8" CAP SCREW
17	3/8" SPECIAL WASHER
18	3/8" CAP SCREW (LONG)
19	LOCK NUT
20	LOWER MOUNTING BRACKET
21	O-RING
22	DESICCANT CARTRIDGE COMPLETE
23	O-RING
24	HOUSING
25	5/16" X 4-1/2" UPPER BRACKET CAP SCREW
26	UPPER BRACKET STRAP
27	UPPER MOUNTING BRACKET
28	5/16" LOCK WASHER
29	5/16" LOCK NUT
30	EXHAUST COVER
31	TORX HEAD BOLT
32	EXHAUST DIAPHRAGM WASHER
33	PURGE PISTON

FIGURE 7 - ***AD-9 AIR DRYER ASSEMBLY***

9. **Use only genuine Bendix replacement parts, components, and kits. Replacement hardware, tubing, hose, fittings, etc. should be of equivalent size, type, and strength as original equipment and be designed specifically for such applications and systems.**
10. **Components with stripped threads or damaged parts should be replaced rather than repaired. Repairs requiring machining or welding should not be at tempted unless specifically approved and stated by the vehicle or component manufacturer.**
11. **Prior to returning the vehicle to service, make certain all components and systems are restored to their proper operating condition.**

AD-9 REMOVAL

1. Park the vehicle on a level surface and prevent movement by means other than the brakes.
2. Drain all reservoirs to 0 p.s.i. (0 kPa).— Caution: Compressor discharge line may still contain residual pressure.
3. Identify and disconnect the three air lines from the end cover and note the position of end cover ports relative to the vehicle.
4. Unplug the vehicle wiring harness from the heater and thermostat assembly connector on the purge valve housing assembly.
5. Loosen the 5/16" X 4-1/2" hex bolt securing the upper mounting strap.
6. Remove, retain and mark the two 3/8" end cover cap screws, lock nuts and four special washers that retain the lower mounting bracket to the end cover, also mark these two holes of the end cover. (These bolts are longer than the other 6 bolts.)
7. Remove the AD-9 air dryer from its mounting brackets on the vehicle.

DISASSEMBLY

The following disassembly and assembly procedure is presented for reference purposes and presupposes that a major rebuild of the AD-9 is being undertaken. Several replacement parts and maintenance kits are available which do not require full disassembly. The instructions provided with these parts and kits should be followed in lieu of the instructions presented here. Refer to Figure 7 during disassembly.

Caution: While performing service on the AD-9 air dryer, it is not recommended that a clamping device (vise, C-clamp, etc.) be used to hold any die cast aluminum component as damage may result. To hold the end cover, install a pipe nipple in the supply port and clamp the nipple into a vise.

1. Using an adjustable wrench or an 1-3/4" socket, remove the delivery, check valve assembly (15) and o-ring. Remove the o-ring from the check valve assembly.
2. Remove the three 1/4" self tapping screws (3) that secure the purge valve housing assembly to the end cover assembly. Pull the purge valve housing assembly out of the end cover assembly. Remove the three o-rings (5,6 & 7) from the exterior of the purge valve housing assembly. **Note:** O-rings 5 and 6 may be lodged in the end cover bores, if so, they must be removed
3. Purge Valve Disassembly:

   Note: In most cases a flat (non-extended) exhaust cover (30) is used. This cover should be left intact while servicing the purge valve housing assembly. However, if an extended type exhaust cover is in use to accommodate the attachment of an exhaust hose, the exhaust cover must be carefully peeled off the purge valve housing. **Use a thin flat blade to pry the exhaust cover off, taking care not to damage the potting material (RTV sealant) under the cover.** To remove the piston from the purge valve housing assembly requires a special Torx head socket or a twelve point 1/4" socket to hold the head of the purge valve bolt (31).

   A. Remove the 1/4" nut (4) from the bottom of the purge valve housing assembly using a 9/16" socket wrench and a Torx head socket to hold the head of the bolt (31). Remove the diaphragm washer (32) (if present), and the diaphragm (2) (if present), and the purge valve (11) from the purge valve housing.

   B. Remove the 1/4" Torx head bolt (31) from the opposite end, then the purge piston (33), the return spring (13) and two o-rings (10 & 14); one on the O.D. and the other in the inside of the purge piston.

   C. Heater and Thermostat Assembly Replacement.

      Caution: Do not attempt to remove this assembly, as it will be damaged during the removal process and is **not available as a service part**. If the heater and thermostat are defective, replace the entire purge valve housing assembly which includes these items.
4. Remove the remaining six 3/8" cap screws (16), lock nuts (19) and twelve special washers (17) that secure the end cover to the housing (24). Separate the end cover and desiccant cartridge (22) from the housing (24).
5. Remove the end cover to outer housing o-ring (23).
6. Do not remove the safety valve from the end cover unless it has been proven defective. If replacement is required, apply thread sealant or teflon tape on the threads of the replacement valve and torque to 120-400 in. lbs.
7. Place a strap or chain wrench around the desiccant cartridge (22) so that it is approximately 2-3 inches away from the end cover. Rotate the cartridge counterclockwise until it completely separates from the end cover. **Note:** *A substantial torque (up to 50 lb. ft.) may be required to perform this disassembly.*

8. Remove the desiccant cartridge o-ring (21) from the end cover.

CLEANING & INSPECTION

1. Using mineral spirits or an equivalent solvent, clean and thoroughly dry all metal parts.
2. Inspect the interior and exterior of all metal parts that will be reused for severe corrosion, pitting and cracks. Superficial corrosion and or pitting on the exterior portion of the upper and lower body halves is acceptable.
3. Inspect the bores of both the end cover and the purge valve housing for deep scuffing or gouges.
4. Make certain that all purge valve housing and end cover passages are open and free of obstructions.
5. Inspect the pipe threads in the end cover. Make certain they are clean and free of thread sealant.
6. Inspect the purge valve housing bore and seats for excessive wear and scuffing.
7. Inspect the purge valve piston seat for excessive wear.
8. Inspect all air line fittings for corrosion. Clean all old thread sealant from the pipe threads.
9. All o-rings removed should be discarded and replaced with new o-rings provided in appropriate kit(s).

Any component exhibiting a condition described in step 1 to 8 should be replaced.

ASSEMBLY

Prior to assembly, coat all o-rings, o-ring grooves, and bores with a generous amount of barium base lubricant. Refer to Figure 7 during assembly unless otherwise advised.

1. Purge Valve Housing Assembly
   A. Install the o-ring (14) in its groove on the O.D. of the purge piston. Place the return spring (13) in the bore of the purge valve housing. Place the o-ring (10) into its recess in the bore of the purge piston. Install the 1/4" Torx head bolt (31) into the I.D. of the purge piston. Insert the purge piston (33) into the I.D. of the spring (13). Using a Torx head wrench, push the purge piston into the piston housing until it bottoms.
   B. While depressing the purge piston with the Torx head wrench, install the following parts over the purge valve bolt (31) from the opposite end of the purge valve housing; the purge valve (11) with its rubber side first, followed by the diaphragm (2) (if present), the diaphragm washer (32) (if present) or the flat washer and finally the 1/4" hex nut (4). Torque the purge valve nut and bolt (4 & 31) to between 60-80 in. lbs.
   C. Install the three o-rings (5, 6 & 7) on the purge valve housing placing each in its appropriate location. If the exhaust cover (30) was removed during disassembly, install it on the purge valve housing assembly making certain the "bubble" portion is positioned over the thermostat. Install the assembled purge valve housing in the end cover making certain to orient both parts such that the connector is approximately 10 degrees clockwise from the supply port, while making certain the purge valve housing is fully seated against the end cover. Secure the purge valve housing to the end cover using the three 1/4" self-tapping screws (3). Start all three screws by hand then torque to 50-80 in. lbs.
2. Install the o-ring on the check valve assembly (15), then install the assembly in the end cover.
3. Install the desiccant cartridge o-ring (21) in its groove in the end cover. Using a light coat of barium grease, lubricate the bottom of the desiccant cartridge in the area that will contact the o-ring (21) and end cover. Screw the desiccant cartridge into the end cover until contact is made between it and the o-ring. Using a strap or chain wrench positioned 2-3" from the bottom of the cartridge, turn the desiccant cartridge clockwise 180-225 degrees beyond the position where initial contact was made between the cartridge and end cover o-ring. Torque should not exceed 50 ft. lbs.

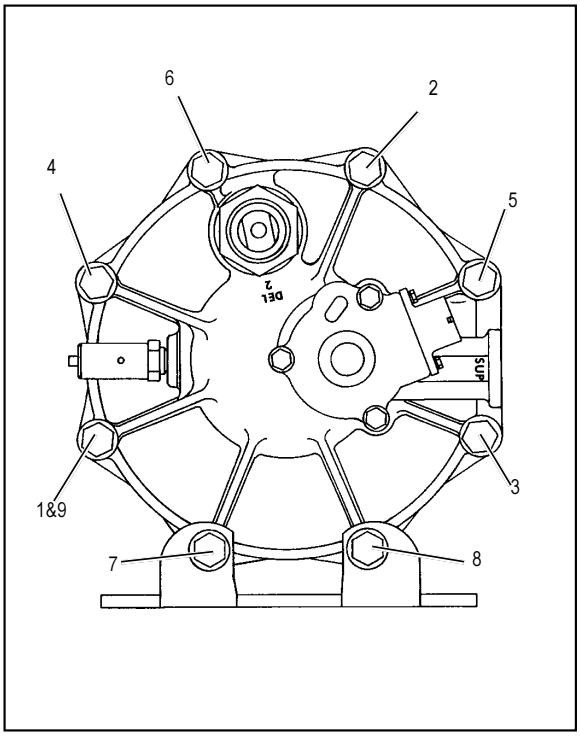


FIGURE 8 - ***END COVER TO HOUSING TORQUE PATTERN***

4. Install the end cover outer housing o-ring (23) on the shoulder in the end cover. Place the housing (24) over the desiccant cartridge and align the holes. Install the six 3/8" cap screws (16), lock nuts (19) and twelve special washers (17) making certain they are in the proper position as marked during disassembly. The two longer 3/8" cap screws (18) will be used to secure the AD-9 to its mounting bracket. Tighten the six cap screws and nuts in a star pattern in a fashion similar to Figure 8; depending on lower bracket location. Torque to 270-385 in. lbs. (Refer to Fig. 8.) **Note:** The two remaining bolt holes in the end cover and two 3/8" cap screws must be the ones marked during disassembly to assure proper orientation of the ports and adequate length of the cap screws.

INSTALLATION

1. Install the assembled AD-9 air dryer back onto the vehicle by slipping it into the upper mounting bracket. Align the two unused holes in the end cover with the bottom mounting bracket such that the bottom bracket supports air dryer. The AD-9 end cover should rest on the bracket. Using the remaining two 3/8" cap screws (18), four special washers (17), and two lock nuts (19), secure the air dryer to the lower bracket. Tighten, then torque the two remaining cap screws to 270-385 in. lbs.
2. Tighten the 5/16" X 4-1/2" bolt and nut on the upper mounting bracket. Torque to 80-120 in lbs.
3. Reconnect the three airlines to the proper ports on the end cover (identified during disassembly).
4. Reconnect the vehicle wiring harness to the AD-9 heater and thermostat assembly connector by plugging it into the air dryer connector until its lock tab snaps in place.
5. Before placing vehicle back into service, perform the *Operation and Leakage Tests* stated elsewhere in this manual.

RETROFITTING THE AD-9 AIR DRYER

GENERAL

The following retrofit instructions are presented for reference purposes only since Bendix aftermarket retrofit and replacement air dryers are packaged with the most up-to-date installation instructions. The instructions packaged with the AD-9 should be followed in lieu of those presented here.

The preceding portion of this manual deals with "in-service" repair and or replacement of the AD-9 air dryer. The portion of the manual that follows is concerned with installing an AD-9 on a vehicle not previously equipped with one.

VEHICLE APPLICATION REQUIREMENTS

The basic application requirements presented here apply to a standard air dryer installation. The majority of highway vehicles in use today will meet these basic requirements however, some may not. Examples of vehicles that may not meet the requirements include, bulk trailer unloading operations and other high air consumption/continuous flow systems. While the AD-9 air dryer can be used on these vehicles the standard installation procedure presented in this manual may require modification to assure proper operation and service life. Consult your local authorized Bendix parts outlet or sales representative for additional information.

1. Charge Cycle Time - The AD-9 air dryer is designed to provide clean, dry air for the brake system. When a vehicle's air system is used to operate non-brake air accessories it is necessary to determine that during normal, daily operation the compressor should recover from governor "cut-in" to governor "cut-out" (usually 100 psi to 120 psi) in 90 seconds or less at engine RPMs commensurate with the vehicle vocation. If the recovery time consistently exceeds this limit, it may be necessary to "bypass" the air accessory responsible for the high air usage. Consult your local authorized Bendix parts outlet or sales representative for additional information.
2. Purge Cycle Time - During normal vehicle operation, the air compressor **must remain unloaded for a minimum of 20 seconds for the standard AD-9 Air Dryer or 30 seconds for the Extended Purge model.** These minimum purge times are required to ensure complete regeneration of the desiccant material. If the purge time is occasionally shorter than the times specified, no permanent ill effect should be expected, however, if the purge time is consistently less than the minimum, an accessory by-pass system must be installed.
3. European Air Brake Systems - Brake systems that incorporate compressors without integral unloading mechanisms and/or utilize a compressor discharge line unloader valve have special AD-9 air dryer installation requirements. Consult your local authorized Bendix parts outlet or sales representative for additional information.
4. Air Compressor Size - Although the AD-9 air dryer can be used in conjunction with larger compressors, it was designed primarily for units rated for up to 17 CFM. It is recommended that when using the AD-9 air dryer with a compressor which has a rated displacement exceeding 17 CFM that an authorized Bendix parts outlet or Bendix marketing representative be contacted for assistance.
5. Holset "E or QE" Type Air Compressors - In order for the AD-9 to function properly when installed with the Holset Type "E or QE" compressor, several specialized Holset components are required. Consult your local authorized Holset parts outlet or sales representative for additional information.
6. Use of Standard or Extended Purge AD-9 - Use the following guidelines:

Total Vehicle Reservoir Volume	Requirement
Less than 9,000 cu. in.	Standard AD-9
9,000 - 12,500 cu. in.	Extended Purge AD-9
Greater than 12,500 cu. in.	Contact Bendix Rep. or Bendix Engineering

VEHICLE PREPARATION

1. Park the vehicle on a level surface and prevent movement by means other than the brakes.
2. Drain all reservoirs to 0 p.s.i. (0 kPa).

LOCATING AD-9 ON VEHICLE

1. The AD-9 air dryer must be mounted vertically (purge exhaust toward road surface) outside the engine compartment in an area of air flow while the vehicle is in motion. The AD-9 must not be exposed to direct wheel splash (located behind axle mud flap is acceptable).
2. Locate the AD-9 air dryer as close to the first (supply) reservoir as possible.
3. Do not locate the AD-9 air dryer near heat producing components such as the vehicle exhaust and make certain adequate clearance from moving components (e.g. drive shaft, suspension, pitman arm, etc.) is provided.

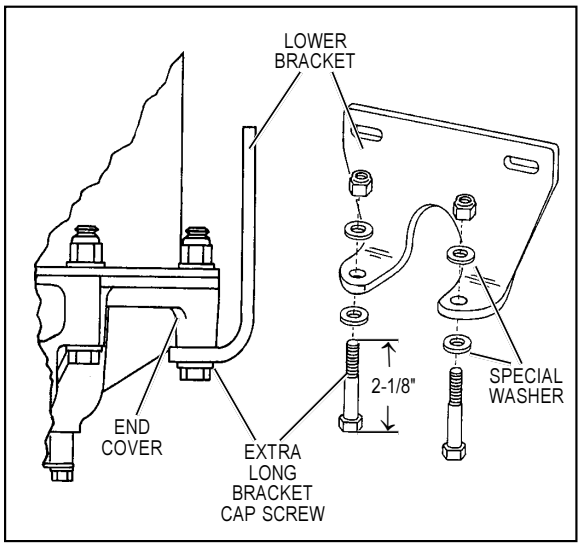


FIGURE 9 - ***LOWER BRACKET INSTALLATION***

4. Locate the AD-9 air dryer on vehicle so that a minimum of 11 inches (28 CM) clearance below the end cover is available to allow servicing. Alternatively, provide access to the bracket bolts so the unit may be removed for servicing.
5. When choosing the mounting location for the AD-9, note the discharge line length requirements stated under the heading *Connecting the Air Lines*, elsewhere in this instruction sheet.

   Important Note: Under normal operating conditions, the maximum inlet air temperature for the AD-9 air dryer is 150 degrees Fahrenheit.

MOUNTING THE AD-9

1. To install the lower mounting bracket on the AD-9 air dryer, it will be necessary to remove and discard two of the end cover bolts and lock nuts. To determine which end cover bolts to utilize to attach the lower bracket, take into consideration the piping connections required to install the AD-9 air dryer and use those that will best position the unit for ease of installation. Locate the bracket such that it cradles the end cover as shown in Figure 2. Utilizing the two 2-3/8" long cap screws, lock nuts and special washers provided with the AD-9 air dryer retrofit unit, attach the lower mounting bracket and torque to 270-385 in. lbs.
2. Assemble the mounting strap and upper mounting bracket as illustrated in Figure 4, by utilizing the 5/16" cap screw, 5/16" lockwasher and 5/16" nut provided.
3. Place the upper bracket assembly onto the shell of the AD-9 air dryer and orient it so that it bears entirely on the cylindrical surface and does not extend onto the domed top. The slot spacing between the upper and lower bracket should be a minimum of 5.5 inches apart. Do not tighten strap onto the shell at this time.

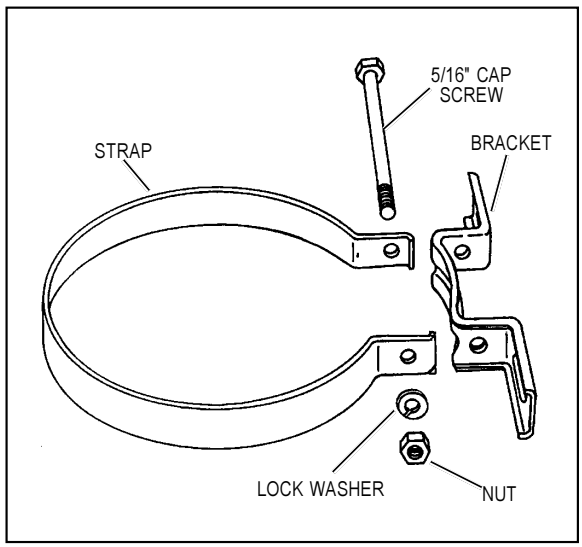


FIGURE 10 - ***UPPER MOUNTING BRACKET AND STRAP***

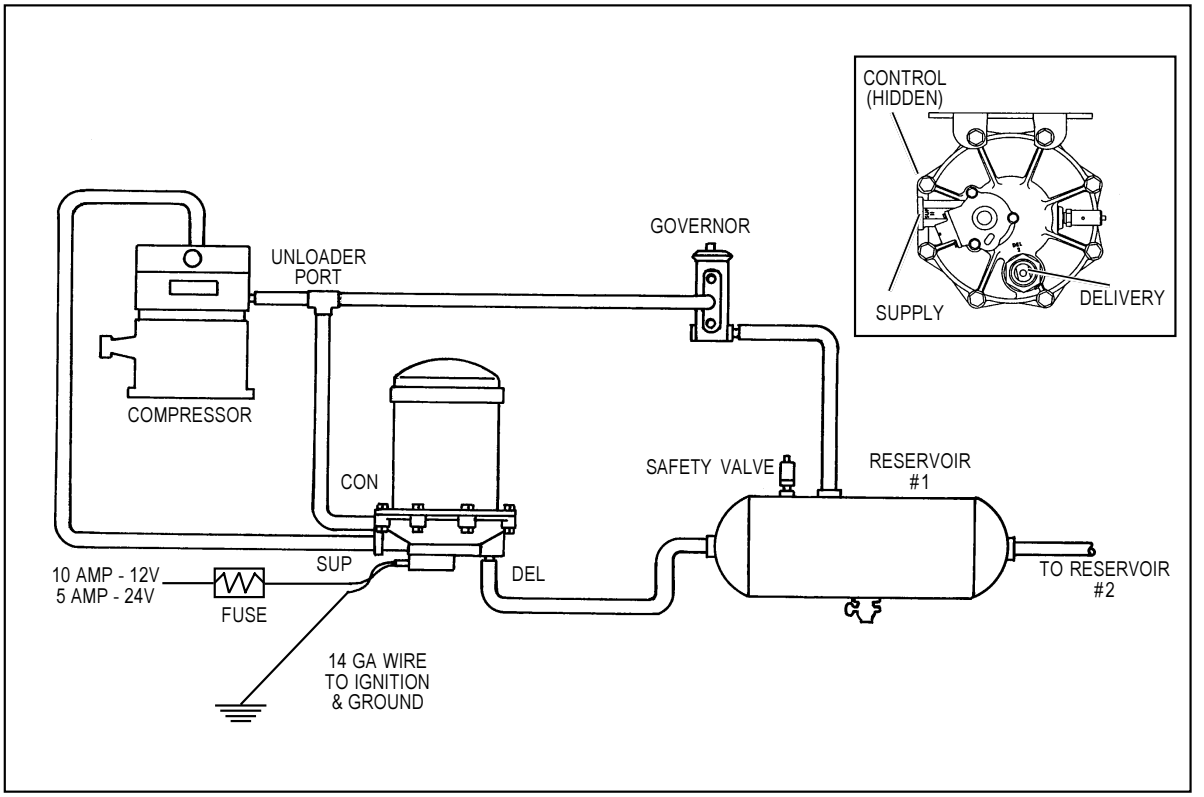


FIGURE 2 - ***AD-9 CHARGE CYCLE***

4. A universal mounting plate (Pc. No. 248478) is available to facilitate the mounting of the AD-9 air dryer to the vehicle. It can be obtained through an authorized Bendix parts outlet.
5. Mount the AD-9 air dryer on the vehicle using 3/8" bolts (grade 5 min.) and washers. Torque to 25 ft. lbs. (300 inch pounds.) After positioning and mounting the upper bracket assembly according to the installation requirements, torque the 5/16" nut to 80120 in. lbs. to tighten strap onto the shell.

CONNECTING THE AIR LINES

PURGE CONTROL LINE

1. Install a Purge Control air line having a minimum inside diameter of 3/16 inches between the AD-9 end cover control port and an unused unloader port on the governor. The control line must be plumbed direct to the governor and not in series with automatic drain valves, lubrication systems, etc.
2. The control line should slope downward to the end cover without forming potential water traps.

DISCHARGE LINE

General:

Where minimum diameter are specified, larger line diameters generally improve performance and life and reduce temperatures, particularly in severe applications.

1. The discharge line material should be wire braided "Teflon" hose, copper tubing or a combination of both.
2. The discharge line should slope downward from the compressor discharge port to the AD-9 air dryer supply port without forming water traps, kinks or restrictions. Cross-overs from one side of the frame rail to the other, if required, should occur as close as possible to the compressor.
3. Fitting extensions must not be installed at the AD-9 supply port.
4. Discharge line lengths and inside diameter requirements are dependent on the vehicle application and are as follows:

Typical P&D, School Bus and Line Haul

The minimum discharge line length is 6 feet and the maximum is 16 feet.

LENGTH	I.D. MIN.	OTHER REQUIREMENTS
6.0 - 9.5 ft.	1/2 in.	None
9.5 - 12 ft.	1/2 in.	Last 3 feet including Supply Port fitting must be insulated with 1/2 inch thick closed cell polyethylene pipe insulation.
12 - 16 ft.	5/8 in.	Last 3 feet including Supply Port fitting must be insulated with 1/2 inch thick closed cell polyethylene pipe insulation.

If the discharge line length must be less than 6 feet or greater than 16 feet, contact your local Bendix representative or authorized parts outlet for further information.

High Duty Cycle Vehicles (City Transit Coaches, Refuse Haulers, etc.)

The minimum discharge line length is 10 feet and the maximum is 16 feet.

LENGTH	I.D. MIN.	OTHER REQUIREMENTS
10-16 ft.	1/2 in.	None

If the discharge line length must be less than 10 feet or greater than 16 feet, contact your local Bendix representative or authorized parts outlet for further information.

DELIVERY LINE

1. Install an air line of the same approximate I.D. as the discharge line between the AD-9 air dryer delivery port and the first (supply) reservoir. This line should also slope downward to the reservoir, if possible.

EXHAUST LINE

1. If it is necessary to direct AD-9 air dryer discharge contaminants away from vehicle components it may be necessary to purchase a special exhaust cover for the AD-9 air dryer (Pc. No. 298924) to replace the standard exhaust cover furnished with the unit. A 1 inch (25.4 mm) I.D. hose can be clamped on the special AD-9 air dryer exhaust cover. **Note:** Use a thin flat blade to pry the standard exhaust cover off.

WIRING THE HEATER/THERMOSTAT

1. Determine the vehicle's electrical system voltage and make certain that the AD-9 air dryer that is to be installed contains the same voltage heater. Use the AD-9 air dryer part number to confirm the proper voltage. The AD-9 air dryer is available with either a 12 or 24 volt heater which uses 75 watts of power.
2. A two lead, 12 inch, wire harness with attached weather resistant connector is supplied with all retrofit and replacement AD-9 air dryers. Connect one of the two leads of the wire harness to the engine kill or ignition switch. The remaining lead of the wire harness must be connected to a good vehicle ground (not to the air dryer or its mounting bracket). A fuse should be installed in the power carrying wire; install a 10 amp fuse for 12 volt heaters and a 5 amp fuse for a 24 volt heater.
3. Use 14 GA wire if it is necessary to lengthen the wire harness provided with the AD-9 air dryer. Make certain all wire splices are waterproofed.
4. Tie wrap or support all electrical wire leading to the AD-9 air dryer at 6 - 8 inch intervals. **Note:** Wires should have sufficient slack and not completely taught.

TESTING THE AD-9

Before placing the vehicle in service, perform the following tests:

1. Close all reservoir drain cocks.
2. Build up system pressure to governor cut-out and note that the AD-9 air dryer purges with an audible escape of air.
3. "Fan" the service brakes to reduce system air pressure to governor cut-in. Note that the system once again builds to full pressure and is followed by a purge at the AD-9 air dryer exhaust.
4. It is recommended that the following items be tested for leakage to assure that the AD-9 air dryer will not cycle excessively.
   (A) Total air system leakage (See Bendix publication BW-5057 "Air Brake Handbook").
   (B) Compressor unloader mechanism.
   (C) Governor.
   (D) Drain cock and safety valve in first (supply) reservoir.
   (E) All air connections leading to and from the first (supply) reservoir.

AD-9 AIR DRYER TROUBLESHOOTING CHART

SYMPTOMS	CAUSE	REMEDY
1. Dryer is constantly "cycling" or purging.	A. Excessive system leakage.	A. Test for excessive system leakage. Allowable leakage: Pre-121 vehicles, single vehicles - 2 psi/minute. Tractor trailer - 3 psi/minute. 121 vehicles, single vehicle - 1 psi/minute per service reservoir. Tractor trailer - 3 psi/minute per service reservoir.
	B. Excessive leakage in fitting, hoses and tubing connected to the compressor, air dryer and first reservoir.	B. Using soap solution, test for leakage at fittings, drain valve (if any) and safety valve in first reservoir. Repair or replace as necessary.
	C. Defective check valve assembly in AD-9 air dryer end cover.	C. Remove check valve assembly from end cover. Subject air pressure to delivery side of valve. Apply soap solution at opposite end and check for leakage. (Permissible leakage - 1 inch bubble in five seconds) If excessive leakage, replace check valve assembly.
	D. Defective governor.	D. Test governor for proper cut-in and cut-out pressures and excessive leakage in both positions.
	E. Leaking purge valve housing assembly and/or o-rings in AD-9 air dryer end cover.	E. With the supply port open to atmosphere, apply 120 psi at the control port. Apply a soap solution to the supply port and exhaust port (purge valve seat area). Permissible leakage - 1 inch bubble in five seconds.
	F. Compressor unloader mechanism leaking excessively.	F. Remove air strainer or fitting from compressor inlet cavity. With compressor unloaded, check for unloader piston leakage. Slight leakage permissible.
	G. Holset "E" type compressor.	G. Test Air Dryer system using Bendix Product Bulletin PRO-08-19 entitled "Troubleshooting The Holset E compressor system With Bendix Air Dryer."
	H. Rapid cycling of the governor due to air starvation at the RES port of the governor.	H. With gauge installed at RES port of governor, pressure should not drop below "Cut-In" pressure at the onset of the compressor "Unloaded" cycle. If pressure drops, check for "kinks" or restrictions in line connected to RES port. Line connected to RES port on governor must be same diameter, or preferably larger than, lines connected to UNL port(s) on governor.

AD-9 AIR DRYER TROUBLESHOOTING CHART (Continued)

SYMPTOMS	CAUSE	REMEDY
2. Water in vehicle reservoir.	A. Desiccant requires replacement - excessive contaminants in desiccant cartridge assembly.	A. Replace desiccant cartridge.
	B. Improper discharge line length or improper line material. Maximum air dryer inlet temperature is exceeded.	B. Refer to section entitled “Connecting the Air Lines” and check “Discharge Line” size and length.
	C. Air system charged from outside air source (outside air not passing through air dryer).	C. If system must have outside air fill provision, outside air should pass through air dryer. This practice should be minimized.
	D. Air dryer not purging (see Symptom #5).	D. See cause and remedy for Symptom #5.
	E. Purge (air exhaust) time insufficient due to excessive system leakage (see causes for Symptom #1).	E. Check causes and remedies for Symptom #1.
	F. Excessive air usage - Air dryer/vehicle application requires additional purge volume. Air dryer not compatible with vehicle air system requirement (Improper air dryer/ vehicle application).	F. Charge Cycle Time - The AD-9 is designed to provide clean, dry air for the brake system. When a vehicle’s air system is used to operate non-brake air accessories it is necessary to determine that during normal, daily operation the compressor should recover from governor “cut-in” to governor “cut-out” (usually 100 psi to 120 psi) in 90 seconds or less at engine RPM’s commensurate with the vehicle vocation. If the recovery time consistently exceeds this limit, it may be necessary to “bypass” the air accessory responsible for the high air usage. An example of where a by-pass system would be required is when the compressor is used to pressurize a tank trailer for purposes of off-loading product. Consult your local authorized Bendix parts outlet or sales representative for additional information. Purge Cycle Time - During normal vehicle operation, the air compressor **must remain unloaded for a minimum of 20 seconds for the standard AD-9 or 30 seconds for the Extended Purge Model.** These minimum purge times are required to ensure complete regeneration of the desiccant material. If the purge time is consistently less than the minimum, an accessory by-pass system must

AD-9 AIR DRYER TROUBLESHOOTING CHART (Continued)

SYMPTOMS	CAUSE	REMEDY
2. Water in vehicle reservoir (continued).		be installed. Consult your local authorized Bendix parts outlet or sales representative for additional information. European Air Brake Systems - Brake systems that incorporate compressors without integral unloading mechanisms and/or utilize a compressor discharge line unloader valve have special air dryer installation requirements. Consult your local authorized Bendix parts outlet or sales representative for additional information. Air Compressor Size - Although the AD-9 can be used in conjunction with larger compressors, it was designed primarily for units rated for up to 17 CFM. It is recommended that when using the AD-9 with a compressor which has a rated displacement exceeding 17 CFM that an authorized Bendix parts outlet or Bendix marketing representative be contacted for assistance.
	G. Air by-passes desiccant cartridge assembly.	G. Replace desiccant cartridge/end cover/o-ring. Check to make sure desiccant cartridge assembly is properly installed.
	H. Purge time is significantly less than minimum allowable.	H. Replace desiccant cartridge/end cover o-ring. Check to make sure desiccant cartridge assembly is properly installed. Replace desiccant cartridge assembly.
3. Safety valve on air dryer "popping off" or exhausting air.	A. Desiccant cartridge plugged.	A. Check compressor for excessive oil passing and/or correct compressor installation. Repair or replace as necessary. Rebuild or replace cartridge.
	B. Defective discharge check valve in end cover of the AD-9.	B. Test to determine if air is passing through check valve. Repair or replace.
	C. Defective fittings, hose or tubing between air dryer and first reservoir.	C. Check to determine if air is reaching first reservoir. Inspect for kinked tubing or hose. Check for undrilled or restricted hose or tubing fittings.
	D. Excessive pressure pulsations from compressor. (Typical single cylinder type).	D. Increase volume in discharge line. Added length or size of line, or add a ping tank.
	E. Safety valve setting lower than the maximum system pressure.	E. Reduce system pressure or obtain a higher setting safety valve.

AD-9 AIR DRYER TROUBLESHOOTING CHART (Continued)

SYMPTOMS	CAUSE	REMEDY
4. Constant exhaust of air at air dryer purge valve exhaust or unable to build system pressure. (Charge mode.)	A. Air dryer purge valve leaking excessively.	A. With compressor loaded, apply soap solution on purge valve exhaust, to test for excessive leakage. Repair purge valve as necessary.
	B. Defective governor.	B. Check governor for proper “cut-in”, “cut-out” pressure and excessive leakage in both positions. Repair or replace as necessary.
	C. Purge control line connected to reservoir or exhaust port of governor.	C. Purge control line must be connected to unloader port of governor.
	D. Purge valve frozen open - faulty heater and thermostat, wiring, blown fuse.	D. Test heater and thermostat as described in Step 7 of *Preventative Maintenance* Section.
	E. Inlet and outlet air connections reversed.	E. Compressor discharge to inlet port. Reconnect lines properly.
	F. Kinked or blocked (plugged) discharge line.	F. Check to determine if air passes through discharge line. Check for kinks, bends, excessive carbon deposits.
	G. Excessive bends in discharge line (water collects and freezes).	G. Discharge line should be constantly sloping from compressor to air dryer with as few bends as possible.
	H. Excessive system leakage.	H. See Symptom #1’s Causes and Remedies.
	I. Purge valve stays open - supply air leaks to control side.	I. Replace purge valve housing assembly o-rings.
5. Air dryer does not purge or exhaust air.	A. Broken, kinked, frozen, plugged or disconnected purge control line.	A. Test to determine air flows through purge control line when compressor unloaded. Check for undrilled fittings. (See Symptom #4, Remedy C.)
	B. See Causes B, E, G for Symptom #4.	B. Refer to Remedies B, E, G for Symptom #4.
6. Desiccant material being expelled from air dryer purge valve exhaust (may look like whitish liquid or paste or small beads.) - OR - Unsatisfactory desiccant life.	A. This symptom is almost always accompanied by one or more of Symptoms 1, 2, 3, 4 and 5. See related causes for these Symptoms above.	A. See Causes and Remedies for Symptoms 1, 2, 3, 4 and 5.
	B. Air dryer not securely mounted. (Excessive vibration.)	B. Vibration should be held to minimum. Add bracket supports or change air dryer mounting location if necessary.
	C. Defective cloth covered perforated plate in air dryer.	C. Replace desiccant cartridge assembly.

AD-9 AIR DRYER TROUBLESHOOTING CHART (Continued)

SYMPTOMS	CAUSE	REMEDY
6. (Continued.)	D. Compressor passing excessive oil.	D. Check for proper compressor installation; if symptoms persist, replace compressor.
	E. Desiccant cartridge not assembled properly to end cover. (Loose attachment)	E. Check the torque on the desiccant cartridge to end cover attachment. Refer to assembly section of this data sheet.
7. "Pinging" noise excessive during compressor loaded cycle.	A. Single cylinder compressor with high pulse cycles.	A. A slight "pinging" sound may be heard during system build up when a single cylinder compressor is used. If this sound is deemed objectionable, it can be reduced substantially by increasing the discharge line volume. This can be accomplished by adding an additional four feet of discharge line or adding a 90 cubic inch reservoir between the compressor and the AD-9 air dryer.
8. Constant seepage of air at air dryer purge valve exhaust (non-charging mode.)	A. Inlet of air compressor pressurized by turbocharger from engine.	A. Some leakage of pressure past the metal seat of the turbo cutoff feature of the AD-9 is to be expected also may be audible. This slight loss of air will not effect the engine or turbo performance.
	B. Defective check valve assembly in AD-9 air dryer end cover.	B. Refer to Remedy C, Symptom #1.
9. The air dryer purge piston cycles rapidly in the compressor unloaded (noncompressing) mode.	A. Compressor fails to "unload".	A. Faulty governor installation; no air line from governor to compressor or line is "kinked" or restricted. Install or repair air line.

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Bendix

Service Data

SD-08-2414

AD-IP INTEGRAL PURGE AIR DRYER

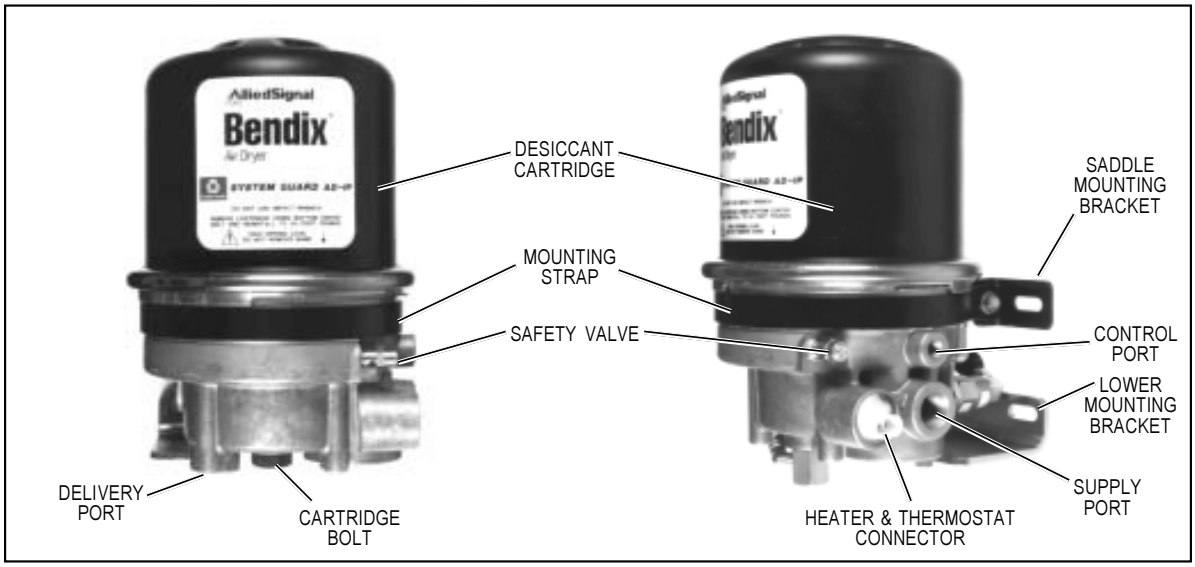

FIGURE 1 - ***AD-IP INTEGRAL PURGE AIR DRYER***

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DESCRIPTION

The function of the AD-IP **I**ntegral **P**urge **A**ir **D**ryer is to collect and remove air system contaminants in solid, liquid and vapor form before they enter the brake system. It provides clean, dry air to the components of the brake system which increases the life of the system and reduces maintenance costs. Daily manual draining of the reservoirs is eliminated.

The AD-IP Air Dryer consists of a desiccant cartridge secured to a die cast aluminum end cover with a single, central bolt. The end cover contains a check valve assembly, safety valve, heater and thermostat assembly, three pipe thread air connections and the purge valve assembly. The removable purge valve assembly incorporates the purge valve mechanism and a turbo charger cutoff feature that is designed to prevent loss of engine "turbo" boost pressure during the purge cycle of the AD-IP air dryer. For ease of serviceability, all replaceable assemblies can be replaced without removal of the air dryer from its mounting on the vehicle.

The AD-IP has three female pipe thread air connections identified as follows:

Air Connection Port ID	Function/Connection
CON 4	Control Port (purge valve control & turbo cutoff).
SUP 11	Supply Port (air in).
DEL 2	Delivery Port (air out).

AD-IP DI "DROP IN" MODEL

In addition to the standard AD-IP, the AD-IP DI (Drop In) is also offered. It is a specialized version designed especially for air systems that use either the Holset (Cummins) Type E or QE air compressor. These Holset compressors utilize an unusual unloading system that requires that air pressure remain in the discharge line during the entire unloaded cycle of the compressor. To accomplish this, Holset compressors rely on air "feedback" from the supply reservoir as shown in Figure 3B. When an air dryer is installed the direct "feedback" from the supply reservoir is interrupted and an alternate source for "feedback" pressure must be provided. A standard AD-IP air dryer can be installed however a separate "feedback" line with a single check must be installed as shown in Figure 3B.

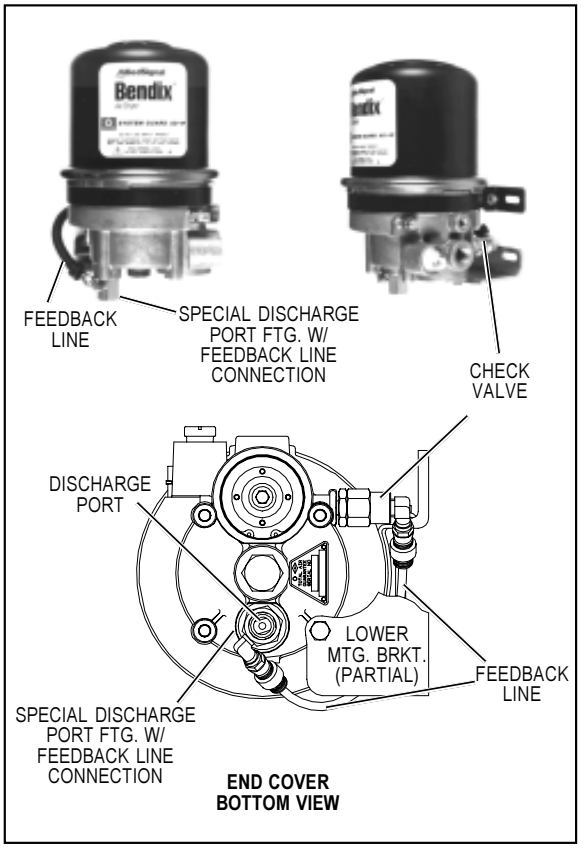

FIGURE 2 - ***AD-IP DROP IN AIR DRYER FOR HOLSET COMPRESSORS***

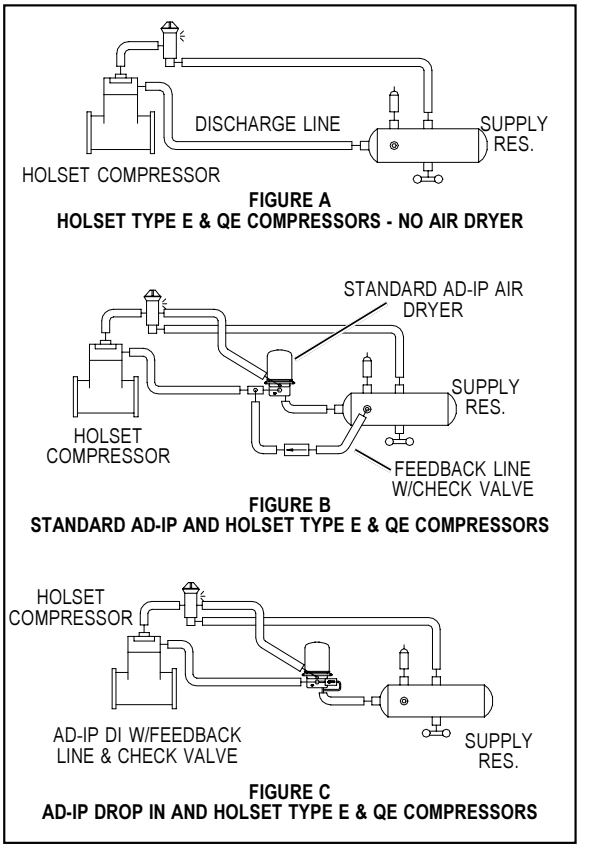

FIGURE 3 - ***AD-IP AND HOLSET TYPE E & QE COMPRESSORS***

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The AD-IP Drop In model incorporates the feedback line and single check as an integral part of the dryer and eliminates the need for these components as shown in Figures 2 & 3C.

OPERATION

GENERAL

The AD-IP air dryer alternates between two operational modes or "cycles" during operation: the *Charge Cycle* and the *Purge Cycle*. The following description of operation is separated into these "cycles" of operation.

CHARGE CYCLE (refer to Figure 4)

When the compressor is loaded (compressing air) compressed air, along with oil, oil vapor, water and water vapor flows through the compressor discharge line to the supply port of the air dryer body.

As air travels through the end cover assembly, its direction of flow changes several times, reducing the temperature, causing contaminants to condense and drop to the bottom or sump of the air dryer end cover.

After exiting the end cover, the air flows into the desiccant cartridge. Once in the desiccant cartridge air first flows through an oil separator located between the outer and inner shells of the cartridge. The separator removes water in liquid form as well as oil and solid contaminants.

Air, along with the remaining water vapor, is further cooled as it exits the oil separator and continues to flow upward between the outer and inner shells. Upon reaching the top of the cartridge the air reverses its direction of flow and enters the desiccant drying bed. Air flowing down through the column of desiccant becomes progressively dryer as water vapor adheres to the desiccant material in a process known as "ADSORPTION." The desiccant cartridge using the adsorption process typically removes most of the water vapor from the pressurized air.

Dry air exits the bottom of the desiccant cartridge and flows through the center of the bolt used to secure the cartridge to the end cover. Air flows down the center of the desiccant cartridge bolt, through a cross drilled passage and exits the air dryer delivery port through the delivery check valve.

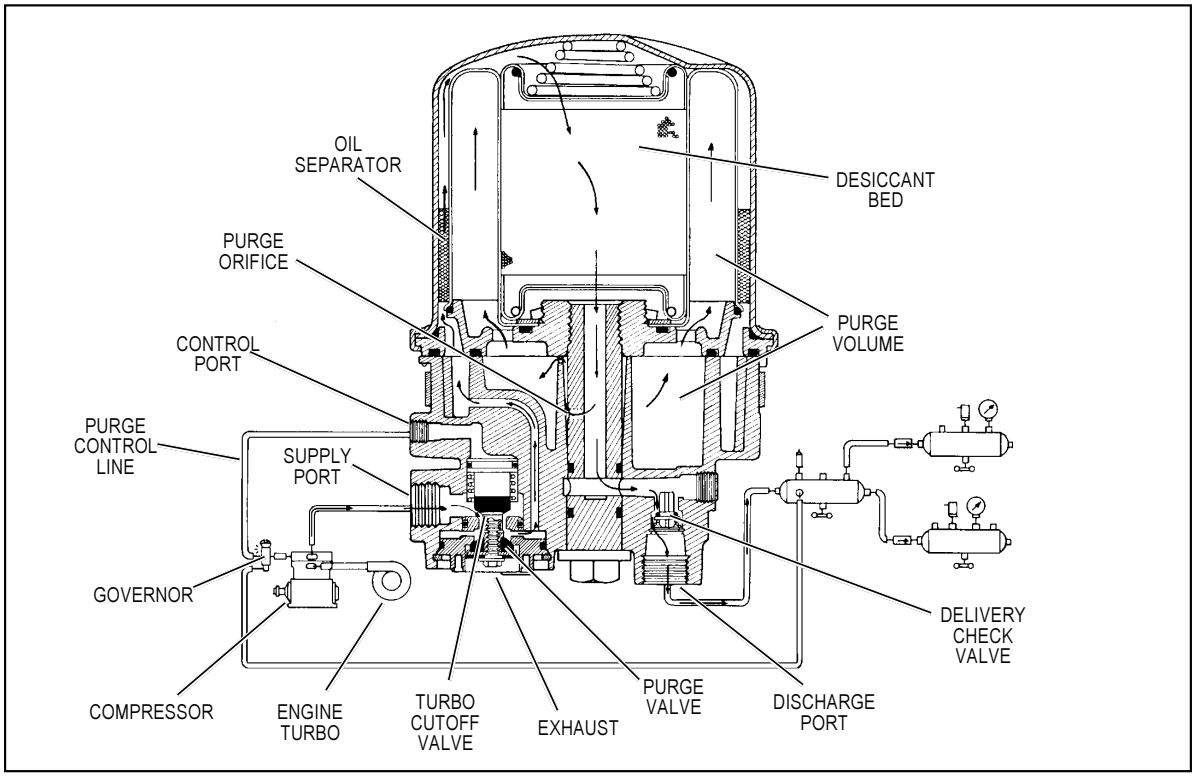


FIGURE 4 - ***AD-IP CHARGE CYCLE***

Dry air flowing through the center of the desiccant cartridge bolt also flows out the cross drilled purge orifice and into the purge volume.

The air dryer will remain in the charge cycle until the air brake system pressure builds to the governor cutout setting.

PURGE CYCLE (refer to Figure 5)

As air brake system pressure reaches the cutout setting of the governor, the governor unloads the compressor (air compression is stopped) and the purge cycle of the air dryer begins. When the governor unloads the compressor, it pressurizes the compressor unloader mechanism and the line connecting the governor unloader port to the AD-IP end cover control port. The purge piston moves in response to air pressure causing the purge valve to open to the atmosphere and the turbo cutoff valve to close off the supply of air from the compressor (this will be further discussed in the *Turbo Cutoff Feature* section). Water and contaminants in the end cover sump are expelled immediately when the purge valve opens. Also, air which was flowing through the desiccant cartridge changes direction and begins to flow toward the open purge valve. Oil and solid contaminants collected by the oil separator are removed by air flowing from the purge volume through the desiccant drying bed to the open purge valve.

The initial purge and desiccant cartridge decompression lasts only a few seconds and is evidenced by an audible burst of air at the AD-IP exhaust.

The actual reactivation of the desiccant drying bed begins as dry air flows from the purge volume through the purge orifice in the desiccant cartridge bolt, then through the center of the bolt and into the desiccant bed. Pressurized air from the purge volume expands after passing through the purge orifice; its pressure is lowered and its volume increased. The flow of dry air through the drying bed reactivates the desiccant material by removing the water vapor adhering to it. Generally 30 seconds are required for the entire purge volume of a standard AD-IP to flow through the desiccant drying bed.

The delivery check valve assembly prevents air pressure in the brake system from returning to the air dryer during the purge cycle. After the 30 second purge cycle is complete the desiccant has been reactivated or dried. The air dryer is ready for the next charge cycle to begin. However the purge valve will remain open and will not close until air brake system pressure is reduced and the governor signals the compressor to charge the system.

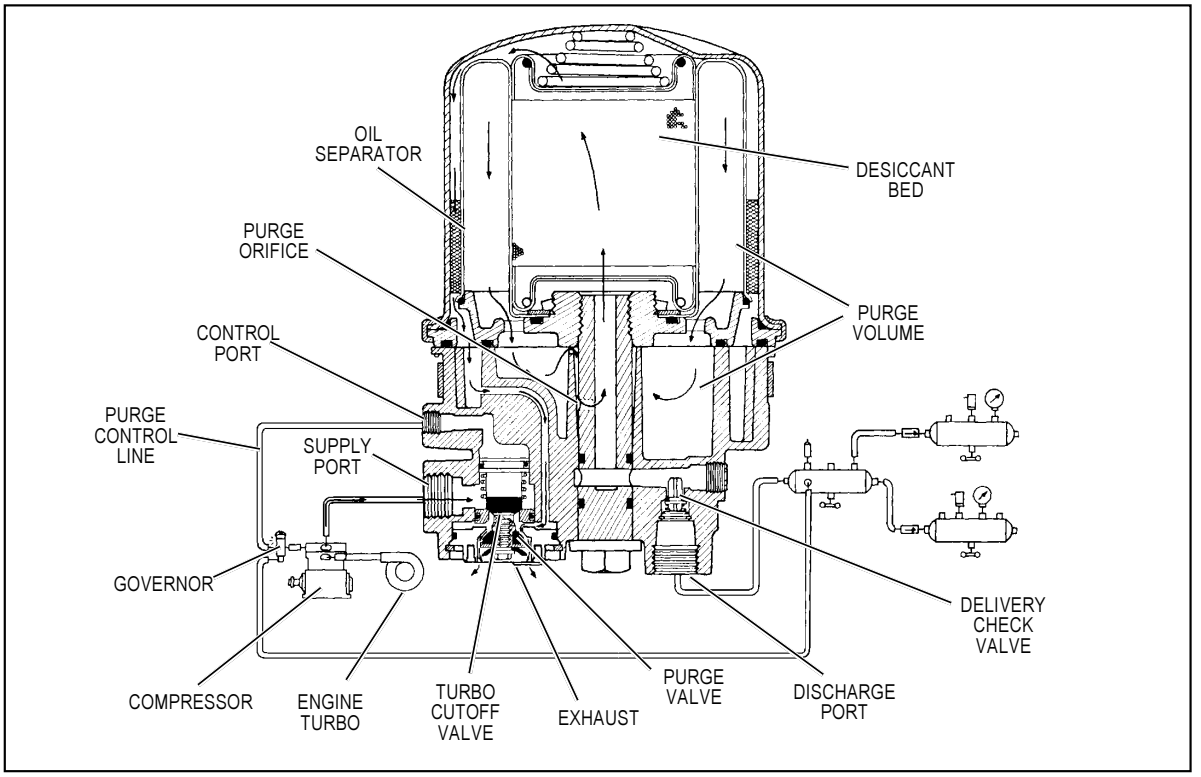


*FIGURE 5 - **AD-IP PURGE CYCLE***

TURBO CUTOFF FEATURE (Refer to Figure 6)

The primary function of the turbo cutoff valve is to prevent loss of engine turbocharger air pressure through the AD-IP in systems where the compressor intake is connected to the engine turbocharger. The turbo cutoff valve also removes the "puffing" of air out the open purge exhaust when a naturally aspirated, single cylinder compressor, equipped with an inlet check valve, is in use.

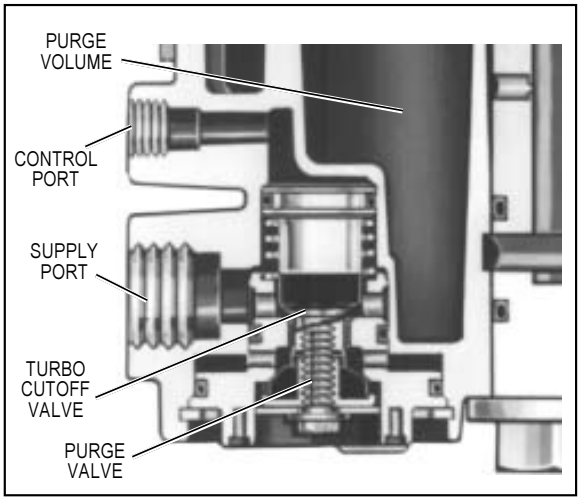


*FIGURE 6 - **AD-IP TURBO CUTOFF***

At the onset of the purge cycle, the downward travel of the purge piston is stopped when the turbo cutoff valve (tapered portion of purge piston) contacts its mating metal seat in the purge valve housing. With the turbo cutoff valve seated (closed position), air in the compressor discharge line and AD-IP inlet port cannot enter the air dryer. In this manner the turbo cutoff effectively maintains turbo charger boost pressure to the engine.

PREVENTIVE MAINTENANCE

Important: Review the warranty policy before performing any intrusive maintenance procedures. An extended warranty may be voided if intrusive maintenance is performed during this period.

Because no two vehicles operate under identical conditions, maintenance and maintenance intervals will vary. Experience is a valuable guide in determining the best maintenance interval for any one particular operation.

Every 900 operating hours, or 25,000 miles or three (3) months:

1. Check for moisture in the air brake system by opening reservoirs, drain cocks, or drain valves and checking for presence of water. If moisture is present, the desiccant cartridge may require replacement; however, the following conditions can also cause water accumulation and should be considered before replacing the desiccant:

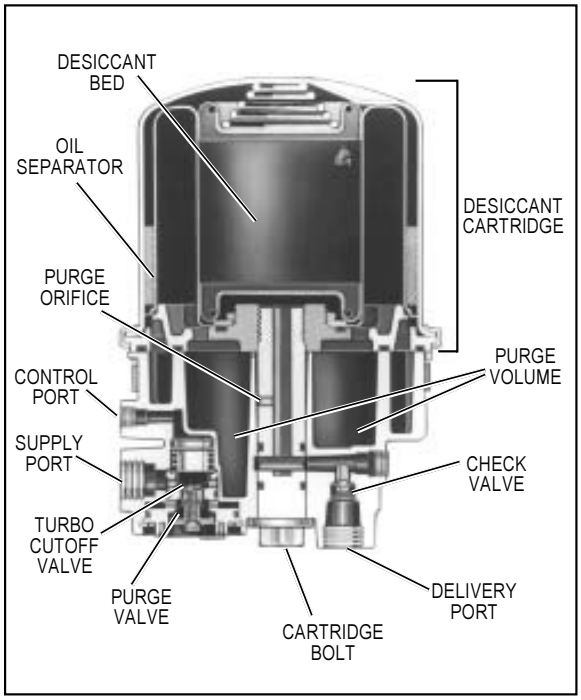


FIGURE 7 - ***AD-IP AIR DRYER SECTIONAL VIEW***

A. An outside air source has been used to charge the system. This air does not pass through the drying bed.

B. Air usage is exceptionally high and not normal for a highway vehicle.

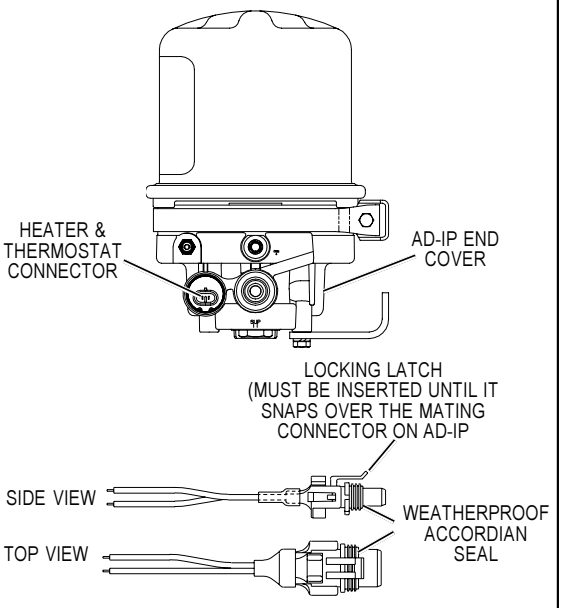
   This may be due to accessory air demands or some unusual air requirement that does not allow the compressor to load and unload (compressing and non-compressing cycle) in a normal fashion. Check for high air system leakage.

C. The air dryer has been installed in a system that has been previously used without an air dryer. The system will be saturated with moisture and several weeks of operation may be required to dry it out.

D. Location of the air dryer is too close to the air compressor. Refer to *Locating AD-IP On Vehicle* section.

E. In areas where more than a 30 degree range of temperature occurs in one day, small amounts of water can temporarily accumulate in the air brake system due to condensation. Under these conditions, the presence of small amounts of moisture is normal and should not be considered as an indication that the dryer is not preforming properly.

Note: A small amount of oil in the system is normal and should not be considered as a reason to replace the desiccant cartridge; oil stained desiccant can function adequately.



A two lead wire harness with attached weather resistant connector is supplied with all replacement and retrofit AD-IP air dryers. One of the two leads is connected to the engine "kill switch" or ignition while the other must be connected to a good vehicle ground. A fuse is installed in the lead carrying vehicle power; install a 10 amp fuse for 12 volt heaters and a 5 amp fuse for the 24 volt heater.

Use 14 AWG wire if it is necessary to lengthen the wire harness leads. Make certain all splices are weatherproofed. Tie wrap or support all electrical wires leading to the AD-IP.

FIGURE 8 - ***AD-IP HEATER AND THERMOSTAT CONNECTOR***

2. Visually check for physical damage to the AD-IP such as chaffed or broken air and electrical lines and broken or missing parts.
3. Check mounting bolts for tightness. Re-torque to 270-385 inch pounds.
4. Perform the *Operation & Leakage Tests* listed in this publication.

WARNING!

This air dryer is intended to remove moisture and other contaminants normally found in the air brake system. Do not inject alcohol, anti-freeze, or other de-icing substances into or upstream of the air dryer. Alcohol is removed by the dryer, but reduces the effectiveness of the device to dry air. Use of other substances can damage the air dryer and may void the warranty.

OPERATION & LEAKAGE TESTS

1. Test the delivery port check valve assembly by building the air system to governor cutout and observing a test air gauge installed in the #1 reservoir. Check all lines and fittings leading to and from the air dryer for leakage and integrity. Note the pressure on the air gauge after governor cutout pressure is reached, a rapid loss of pressure could indicate a failed delivery port check valve. This can be confirmed by shutting the engine off, draining system pressure to a point below governor cutin (usually not less than 95 psi), draining residual air pressure in the compressor discharge line and removing the plug adjacent to the air dryer delivery port from the end cover. With air pressure present at the air dryer delivery, apply a soap solution to the opening where the plug was removed and note that leakage does not exceed a 1 inch bubble in 1 second. If leakage is excessive repair the check valve.
2. Check for excessive leakage around the purge valve. With the compressor in loaded mode (compressing air), apply a soap solution to the purge valve exhaust port and observe that leakage does not exceed a 1 inch bubble in 1 second. If the leakage exceeds the maximum specified, repair the purge valve assembly.
3. Close all reservoir drain cocks. Build up system pressure to governor cutout and note that AD-IP purges with an audible escape of air. “Fan” the service brakes to reduce system air pressure to governor cut-in. Note that the system once again builds to full pressure and is followed by an AD-IP purge.
4. Check the operation of the end cover heater and thermostat assembly during cold weather operation as follows:

   A. Electric Power to the Dryer

   With the ignition or engine kill switch in the ON position, check for voltage to the heater and thermostat assembly using a voltmeter or test light. Unplug the electrical connector at the air dryer and place the test leads on each of the pins of the male connector. If there is no voltage, look for a blown fuse, broken wires, or corrosion in the vehicle wiring harness. Check to see if a good ground path exists.

   B. Thermostat and Heater Operation

   Note: These tests are not required except in cold weather operation.

   Turn off the ignition switch and cool the thermostat and heater assembly to below 40 degrees Fahrenheit. Using an ohmmeter, check the resistance between the electrical pins in the air dryer connector half. The resistance should be 1.5 to 3.0 ohms for the 12 volt heater assembly and 6.0 to 9.0 ohms for the 24 volt heater assembly.

   Warm the thermostat and heater assembly to over 90 degrees Fahrenheit and again check the resistance. The resistance should exceed 1000 ohms. If the resistance values obtained are within the stated limits, the thermostat and heater assembly is operating properly. If the resistance values obtained are outside the stated limits, replace the heater and thermostat assembly.

REBUILDING THE AD-IP AIR DRYER

GENERAL

If, after completing the routine operation and leakage tests, it has been determined that one or more components of the air dryer requires replacement or maintenance, refer to the following list to find the appropriate kit(s).

When rebuilding or replacing components of the air dryer use only genuine Bendix parts. For ease in servicing, the AD-IP has been designed so that any of the following maintenance kits can be installed without removing the air dryer from the vehicle.

MAINTENANCE KITS AVAILABLE:

065624 ..... SERVICE NEW DESICCANT CARTRIDGE KIT

This kit contains the parts necessary to change the desiccant cartridge only.

109493 ..... REMANUFACTURED DESICCANT CARTRIDGE KIT

This kit contains the parts necessary to change the desiccant cartridge only.

5001247 ..... MOUNTING BRACKET KIT

This kit contains the upper and lower brackets as well as the necessary hardware items to mount them.

109498 ..... CARTRIDGE BOLT KIT

Contains a replacement desiccant cartridge bolt and related o-rings.

5003547 ..... PURGE VALVE HOUSING MAINTENANCE KIT

This kit contains the parts necessary to rebuild the purge valve housing.

800404 ..... PURGE VALVE KIT

This kit contains the parts necessary to replace the purge valve.

065626 ..... SERVICE NEW PURGE VALVE HOUSING ASSEMBLY

Contains a service new assembly and related components to accomplish replacement.

109494 ..... DELIVERY CHECK VALVE MAINTENANCE KIT

This kit contains the parts necessary to replace the delivery port check valve.

109495 & 109496 ..... HEATER & THERMOSTAT KIT

Contains a replacement heater and thermostat assembly and related components required for replacement.

IMPORTANT: PLEASE READ AND FOLLOW THESE INSTRUCTIONS TO AVOID PERSONAL INJURY OR DEATH:

When working on or around a vehicle, the following general precautions should be observed at all times.

1. **Park the vehicle on a level surface, apply the parking brakes, and always block the wheels.**
2. **Stop the engine when working around the vehicle.**
3. **Drain the air pressure from all reservoirs before beginning ANY work on the vehicle.**
4. **Following the vehicle manufacturer's recommended procedures, deactivate the electrical system in a manner that removes all electrical power from the vehicle.**
5. **When working in the engine compartment the engine should be shut off. Where circumstances require that the engine be in operation, EXTREME CAUTION should be used to prevent personal injury resulting from contact with moving, rotating, leaking, heated, or electrically charged components.**
6. **Never connect or disconnect a hose or line containing pressure; it may whip. Never remove a component or plug unless you are certain all system pressure has been depleted.**
7. **Never exceed recommended pressures and always wear safety glasses.**
8. **Do not attempt to install, remove, disassemble or assemble a component until you have read and thoroughly understand the recommended procedures. Use only the proper tools and observe all precautions pertaining to use of those tools.**
9. **Use only genuine Bendix replacement parts, components, and kits. Replacement hardware, tubing, hose, fittings, etc. should be of equivalent size, type, and strength as original equipment and be designed specifically for such applications and systems.**
10. **Components with stripped threads or damaged parts should be replaced rather than repaired. Repairs requiring machining or welding should not be attempted unless specifically approved and stated by the vehicle or component manufacturer.**
11. **Prior to returning the vehicle to service, make certain all components and systems are restored to their proper operating condition.**

AD-IP REMOVAL

This air dryer removal process is presented in the event it becomes necessary to replace the entire air dryer. **Normal service and parts replacement does not require removal of the air dryer from the vehicle.**

1. Park the vehicle on a level surface and prevent movement by means other than the brakes.
2. Drain **all** reservoirs to 0 p.s.i. — **Caution:** Compressor discharge line may still contain residual pressure.
3. Identify and disconnect the three air lines from the end cover and note the position of end cover ports relative to the vehicle.
4. Unplug the vehicle wiring harness from the heater and thermostat assembly connector on the end cover assembly.
5. Remove the four bolts that secure both the upper and lower mounting brackets to the vehicle, and remove the air dryer from the vehicle.
6. Mark the relationship of the saddle bracket (5) to the end cover assembly (6). Remove the 5/16" cap screw (1), washer (2), and nut (3) securing the upper mounting strap (4) to the saddle bracket (5). Remove the upper mounting strap (4) from the end cover assembly (6).
7. Mark the relationship of the lower bracket (9) to the end cover assembly (6). Remove the two 3/8" end cover cap screws (7) and two washers (8) that retain the lower mounting bracket (9) to the end cover (6).

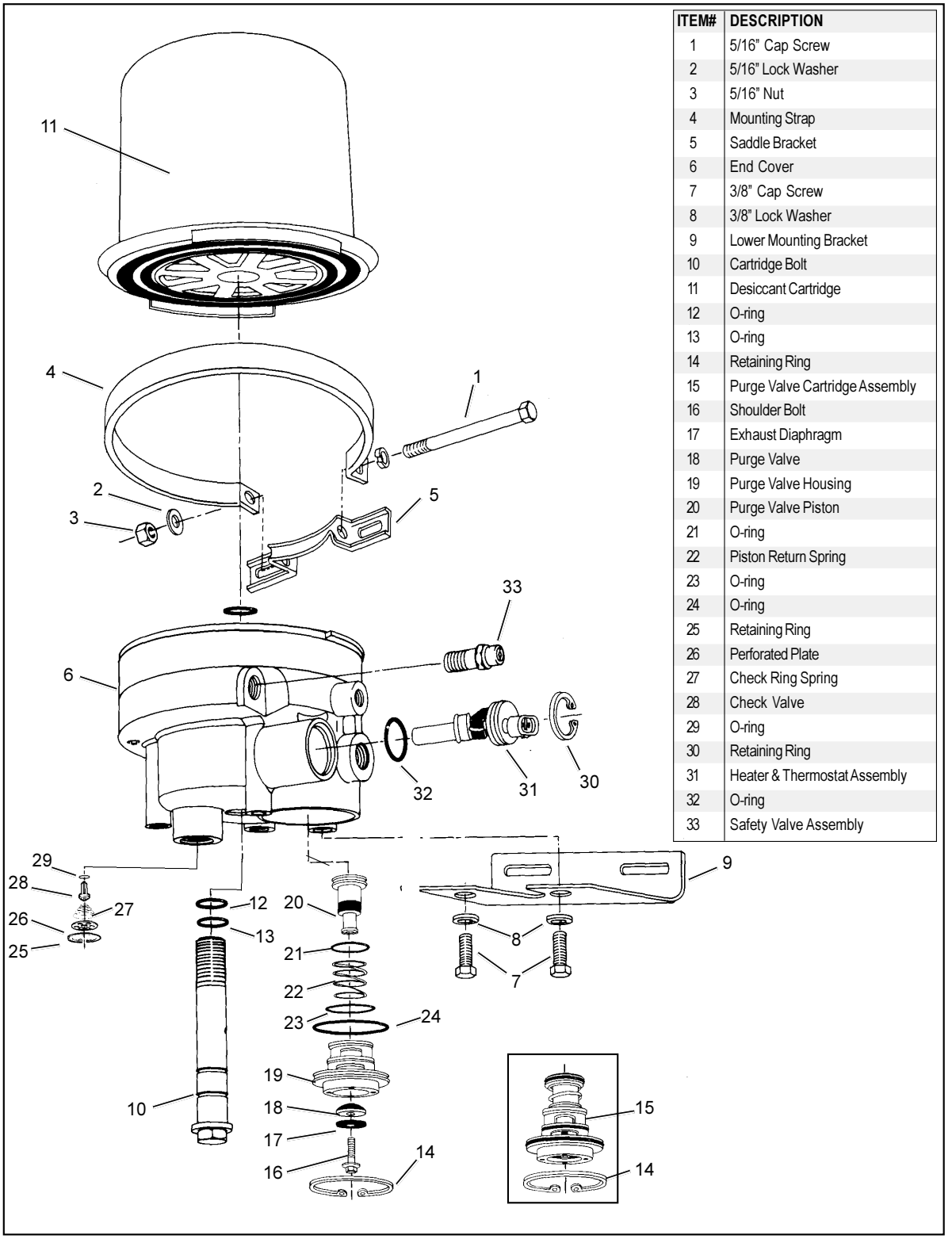
DISASSEMBLY

The following disassembly and assembly procedure is presented for reference purposes and presupposes that a major rebuild of the AD-IP is being undertaken. The replacement parts and maintenance kits available generally do not require full disassembly. The instructions provided with these parts and kits should be followed in lieu of the instructions presented here. Refer to Figure 9 during disassembly.

Caution: While performing service on the AD-IP air dryer, it is not recommended that a clamping device (vise, C-clamp, etc.) be used to hold any die cast aluminum component as damage may result. To hold the end cover, install a pipe nipple in the supply port and clamp the nipple into a vise.

1. Using an adjustable or socket wrench, loosen the desiccant cartridge bolt (10), then separate the desiccant cartridge (11) from the end cover (6). Pull the desiccant cartridge bolt out of the end cover (6).

   Caution: Disassembly of the desiccant cartridge assembly should not be attempted! Detail parts for the cartridge are not available and the cartridge contains a 150# spring which can not be mechanically caged.



ITEM#	DESCRIPTION
1	5/16" Cap Screw
2	5/16" Lock Washer
3	5/16" Nut
4	Mounting Strap
5	Saddle Bracket
6	End Cover
7	3/8" Cap Screw
8	3/8" Lock Washer
9	Lower Mounting Bracket
10	Cartridge Bolt
11	Desiccant Cartridge
12	O-ring
13	O-ring
14	Retaining Ring
15	Purge Valve Cartridge Assembly
16	Shoulder Bolt
17	Exhaust Diaphragm
18	Purge Valve
19	Purge Valve Housing
20	Purge Valve Piston
21	O-ring
22	Piston Return Spring
23	O-ring
24	O-ring
25	Retaining Ring
26	Perforated Plate
27	Check Ring Spring
28	Check Valve
29	O-ring
30	Retaining Ring
31	Heater & Thermostat Assembly
32	O-ring
33	Safety Valve Assembly

FIGURE 9 - ***AD-IP EXPLODED VIEW***

2. Remove both o-rings (12 & 13) from the desiccant cartridge bolt.
3. Remove the retaining ring (14) that secures the purge valve assembly (15) in the end cover (6).
4. Remove the 1/4" shoulder bolt (16) from the bottom of the purge valve housing assembly (19) using a 3/8" socket wrench and a large blade screw driver, inserted in the slot on top of the purge piston (20). Remove the exhaust diaphragm (17), and the purge valve (18) from the purge valve housing (19).
5. Remove the o-rings (23 & 24) from the purge valve housing (19).
6. Remove the purge piston (20) and the return spring (22).
7. Remove the o-ring (21) from the purge piston (20).
8. Remove the retaining ring (25) that secures the delivery check valve assembly in the end cover (6). Remove and separate the perforated plate (26), spring (27), check valve body (28) and o-ring (29).
9. Remove the retaining ring (30) that secures the heater and thermostat assembly (31) in the end cover (6). Gently pull the heater and thermostat (31) out of the end cover (6) and remove the o-ring (32).
10. Using a 9/16" wrench, remove the safety valve assembly (33) from the end cover (6).

CLEANING & INSPECTION

1. Using mineral spirits or an equivalent solvent, clean and thoroughly dry all metal parts except the desiccant cartridge.
2. Inspect the interior and exterior of all metal parts that will be reused for severe corrosion, pitting and cracks. Superficial corrosion and or pitting on the exterior portion of the end cover is acceptable.
3. Inspect the bores of both the end cover and the purge valve housing for deep scuffing or gouges.
4. Make certain that all purge valve housing and end cover passages are open and free of obstructions.
5. Inspect the pipe threads in the end cover. Make certain they are clean and free of thread sealant.
6. Inspect the purge valve housing bore and seats for excessive wear and scuffing.
7. Inspect the purge valve piston seat for excessive wear.
8. Make certain that the purge orifice in the cartridge bolt is open and free of obstructions.
9. Inspect all air line fittings for corrosion. Clean all old thread sealant from the pipe threads.
10. All o-rings removed should be discarded and replaced with new o-rings provided in appropriate kit(s).

ASSEMBLY

Prior to assembly, coat all o-rings, o-ring grooves, and bores with a generous amount of silicone grease. (Refer to Figure 9 during assembly unless otherwise advised.)

1. Install the o-ring (21) in its groove on the O.D. of the purge piston (20). Place the return spring (22) in the bore of the purge valve housing (19), then insert the purge piston (20) into the I.D. of the spring (22).
2. Install and center the exhaust diaphragm (17) over the shoulder bolt (16) making certain that the diaphragm ID is over the bolt shoulder. Then install the purge valve (18) on the shoulder bolt making certain its metal support side is against the diaphragm (17).
3. Push the purge piston (20) into the housing (19) until it bottoms and insert a large blade screw driver in the piston's slotted head. While depressing the purge piston with the screw driver, install the shoulder bolt (16) with exhaust diaphragm (17) and purge valve (18) in the piston. Torque the shoulder bolt (17) to between 60-80 in. lbs.
4. Install the two o-rings (23 & 24) on the purge valve housing (19) placing each in its appropriate location. Install the assembled purge valve housing in the end cover (6) while making certain the purge valve housing is fully seated against the end cover. Secure the purge valve housing in the end cover using the retaining ring (14). Make certain the retaining ring is fully seated in its groove in the end cover (6).
5. Using a 9/16" wrench, install the safety valve assembly (34) into the end cover (6).
6. Install the o-ring (29) on the check valve body (28) and push the o-ring down, over the 3 guide lands until it is in the o-ring groove of the check valve body (28). Install the check valve spring (27) on the check valve body so that the **small** coils of the spring slip over the check valve body. Install the assembled check valve body, o-ring, and spring (27, 28 & 29) in the end cover (6) so that the o-ring rests on its seat in the end cover (6) and the spring is visible.
7. Install the perforated plate (26), in the end cover (6) and secure the check valve assembly using the retaining ring (25). Make certain the retaining ring is fully seated in its groove in the end cover (6).
8. Install the o-ring (32) on the heater and thermostat assembly (31). After making certain the sponge rubber cushion is positioned between the connector body and thermostat, gently push the heater and thermostat assembly (31) into the end cover (6), making certain the heating element enters the small diameter bore in the larger heater and thermostat bore in the end cover (6). Secure the heater and thermostat assembly in the body using the retaining ring (30). Make certain the retaining ring is fully seated in its groove in the end cover (6).

9. Install both o-rings (12 & 13) on the desiccant cartridge bolt (10) and using a twisting motion, insert the assembled desiccant cartridge bolt in the end cover (6).
10. Install the desiccant cartridge (11) on the end cover (6) making certain the cartridge is properly seated and flush on the end cover.

    Note: It may be necessary to rotate the cartridge slightly until the anti-rotation lugs are properly aligned and allow the cartridge to rest flush against the end cover.
11. Using an adjustable wrench or a socket, tighten the desiccant cartridge bolt (10), to secure the desiccant cartridge (11) to the end cover (6). Torque the desiccant cartridge bolt to 50 foot pounds.

    Caution: Do not over torque.

AD-IP INSTALLATION

1. Using the relationship marks made during step 7 of the "AD-IP REMOVAL", install the lower mounting bracket (9) on the end cover (6) and secure it using the two 3/8" cap screws and washers (7 & 8). Torque the cap screws to 300-360 inch pounds.
2. Using the relationship marks made during step 6 of the *AD-IP Removal Procedure*, install the saddle bracket (5) and mounting strap (4) on the end cover (6), and using the 5/16" cap screw (1), washer (2), and nut (3) secure the strap to the saddle bracket. Tighten the 5/16" nut on the upper mounting bracket. Torque to 60-100 in lbs.
3. Install the AD-IP on the vehicle using the four bolts that secure both the upper and lower mounting brackets.
4. Reconnect the three airlines to the proper ports on the end cover (identified during step 3 of the *AD-IP Removal*).
5. Reconnect the vehicle wiring harness to the AD-IP heater and thermostat assembly connector by plugging it into the air dryer connector until its lock tab snaps in place.
6. Before placing vehicle back into service, perform the *Operation and Leakage Tests* stated elsewhere in this manual.

RETROFITTING THE AD-IP AIR DRYER

GENERAL

The following retrofit instructions are presented for reference purposes only since Bendix aftermarket retrofit and replacement air dryers are packaged with the most up-to-date installation instructions. The instructions packaged with the AD-IP should be followed in lieu of those presented here.

The preceding portion of this manual deals with "in-service" repair and or replacement of the AD-IP air dryer. The portion of the manual that follows is concerned with installing an AD-IP on a vehicle not previously equipped with one.

VEHICLE APPLICATION REQUIREMENTS

The basic application requirements presented here apply to a standard air dryer installation. The majority of highway vehicles in use today will meet these basic requirements however, some may not. Examples of vehicles that may not meet the requirements include, refuse trucks, city coaches, bulk trailer unloading operations and other high air consumption systems. While the AD-IP air dryer can be used on these vehicles the standard installation procedure presented in this manual may require modification to assure proper operation and service life. Consult your local authorized Bendix parts outlet or sales representative for additional information.

Charge Cycle Time — The AD-IP air dryer is designed to provide clean, dry air for the brake system. When a vehicle's air system is used to operate non-brake air accessories it is necessary to determine that, during normal daily operation the compressor should recover from governor "cut-in" to governor "cutout" (usually 100 psi to 120 psi) in 90 seconds or less at engine RPMs normal to the vehicle vocation. If the recovery time consistently exceeds this limit, it may be necessary to "bypass" the air accessory responsible for the high air usage. Consult your local authorized Bendix parts outlet or sales representative for additional information.

Purge Cycle Time — During normal vehicle operation, the air compressor must remain unloaded for a minimum of 30 seconds. This minimum purge times is required to ensure complete regeneration of the desiccant material. If the purge time is occasionally shorter than the times specified, no permanent ill effect should be expected, however, if the purge time is consistently less than the minimum, an accessory bypass system must be installed. Contact the nearest authorized Bendix parts outlet or Bendix representative for additional information. **Note:** Reservoir Volume - Total vehicle reservoir volume can impact the Charge and Purge Cycle time. The chart below can be used as a guide in determining if additional help is required.

Total Vehicle Reservoir Volume (Cu. In.)	Air Dryer Model
Less than 9,000	Standard AD-IP
Greater than 9,000	AD-9 Extended Purge or Contact

Bendix Commercial Vehicle Systems LLC

Air Compressor Size — Although the AD-IP air dryer can be used in conjunction with larger compressors, it was designed primarily for units rated for up to 30 CFM. It is recommended that when using the AD-IP air dryer with a compressor which has a rated displacement exceeding 30 CFM that an authorized Bendix parts outlet or Bendix marketing representative be contacted for assistance.

Holset "E or QE" Type Air Compressors - In order for these Holset compressors to function properly when installed with an AD-IP air dryer, the required Holset feed back line and single check valve must be used. The standard AD-IP can be used with a separate feedback line and single check OR the AD-IP DI (Drop In) model can be used. With AD-IP DI in use the separate feed back line and single check valve can be eliminated since these components are part of the air dryer. Refer to Figures 2 & 3.

VEHICLE PREPARATION

1. Park the vehicle on a level surface and prevent movement by means other than the brakes.
2. Drain all reservoirs to 0 p.s.i.

LOCATING AD-IP ON VEHICLE

1. The AD-IP air dryer must be mounted vertically (purge exhaust toward road surface) outside the engine compartment in an area of air flow while the vehicle is in motion. The AD-IP must not be exposed to direct wheel splash. If the air dryer is located directly behind the axle, a mud flap is required.
2. Maintain a minimum clearance of 12" between the air dryer and any potential heat source (e.g. vehicle exhaust). If this is not feasible, a heat shield must be used.
3. Make certain that adequate clearance from moving components (e.g. drive shaft, suspension, pitman arm, etc.) is provided.
4. Locate the air dryer on vehicle so that a minimum of 1/2" inch clearance above the air dryer is available to allow desiccant cartridge removal. A minimum of 8" inches clearance below the air dryer is required to allow for desiccant cartridge bolt removal.
5. When choosing the mounting location for the AD-IP, note the discharge line length requirements stated under the heading *Connecting the Air Lines*, elsewhere in this manual.

   Important Note: Under normal operating conditions, the maximum inlet air temperature for the AD-IP air dryer is 150 degrees Fahrenheit.
6. If possible locate the AD-IP so that the purge exhaust does not expel contaminants on vehicle components. If this is not feasible, the purge exhaust may be redirected away from the vehicle by installing an optional special exhaust cover (part number 112609). The exhaust cover is available as a separate item from authorized Bendix parts outlets. A 1 inch ID hose can be clamped on this special exhaust cover to allow the exhaust to be redirected.

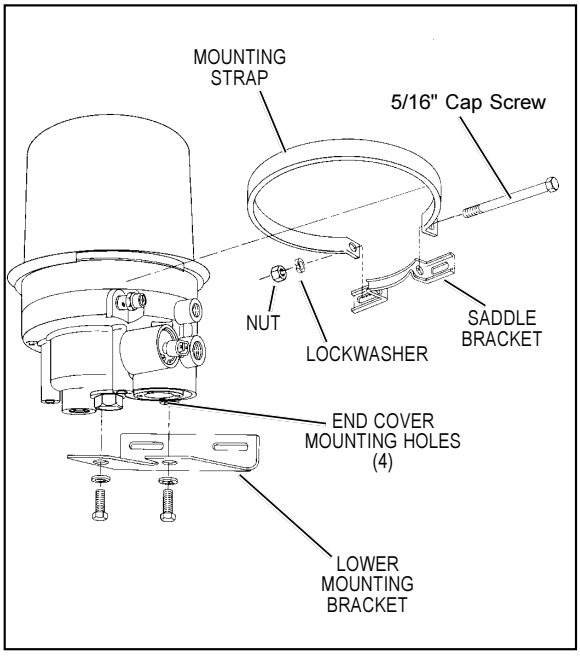


FIGURE 10 - ***AD-IP BRACKET INSTALLATION***

MOUNTING THE AD-IP (Refer to Figure 10)

1. Install the lower mounting bracket on the AD-IP air dryer. To accomplish this, it will be necessary to choose two, of the four available, mounting holes. To determine which two holes to utilize to attach the lower bracket, take into consideration the piping connections required to install the AD-IP air dryer and use those that will best position the unit for ease of installation. Utilizing the two cap screws and washers provided with the AD-IP air dryer retrofit unit, attach the lower mounting bracket and torque to 300-360 in. lbs

   Note: The bracket mounting holes in the end cover may not be pre-tapped. In this case the mounting bolt will self tap the holes on initial installation.
2. Assemble the mounting strap and saddle bracket as illustrated, by utilizing the 5/16" cap screw, lock washer, and nut provided. Place the upper bracket strap in the end cover channel provided for it, then install the saddle bracket and secure the strap to the saddle bracket using the 5/16" cap screw, lock washer, and nut provided. Install but do not tighten the cap screw at this time. Orient the strap and saddle bracket so that it is in a flat plane with the lower bracket. Torque the 5/16" nut to 60-100 in. lbs. to tighten strap onto the shell.

   Note: A universal mounting plate (Pc. No. 248478) is available to facilitate the mounting of the AD-IP air dryer to the vehicle. It can be obtained through an authorized Bendix parts outlet.

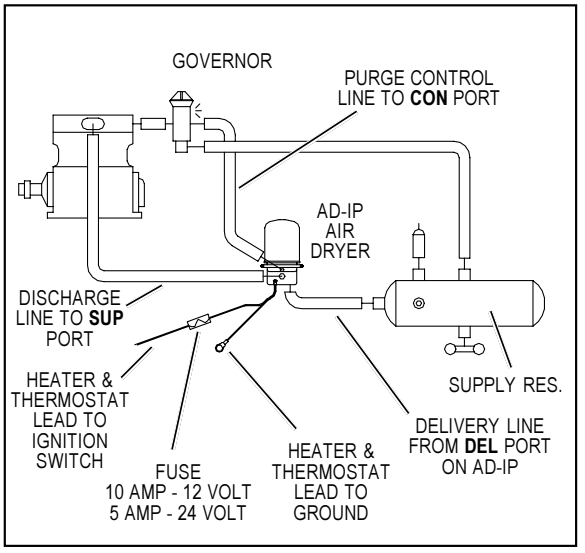


*FIGURE 11 - **AD-IP INSTALLATION***

3. Components and location used to mount the AD-IP on the vehicle must be rigid enough to minimize air dryer vibration.
4. Mount the AD-IP air dryer on the vehicle using 3/8" bolts (grade 5 min.) and washers. Torque to 25 ft. lbs. (300 inch pounds.)

CONNECTING THE AIR LINES

PURGE CONTROL LINE

1. Install a Purge Control air line having a minimum inside diameter of 3/16 inches between the AD-IP end cover control port and an unused unloader port on the governor. The control line must be connected directly to the governor and not in series with automatic drain valves, lubrication systems, etc.
2. The control line should slope downward to the end cover without forming sharp bends or "dips".

COMPRESSOR DISCHARGE LINE

GENERAL:

While minimum diameters are specified, larger line diameters generally improve performance and life and reduce temperatures, particularly in severe applications.

1. The compressor discharge line material should be wire braided "Teflon" hose, copper tubing or a combination of both.
2. The compressor discharge line should slope downward from the compressor discharge port to the AD-IP air dryer supply port without forming water traps, kinks or restrictions. Crossovers from one side of the frame rail to the other, if required, should occur as close as possible to the compressor.
3. Extension fittings and combination fittings (i.e. two supply fittings coupled together) must not be installed at the AD-IP supply port. A straight fitting installed at the AD-IP supply port is preferred; however a 45 deg., or a 90 deg. fitting can be used in that order of preference. Make certain the fitting orientation does not cause the compressor discharge line to "run uphill" to the air dryer supply port.
4. Compressor discharge line lengths and inside diameter requirements are dependent on the vehicle application and are as follows:

Typical P & D, School Bus and Line Haul

The minimum discharge line length is 6 feet and the maximum is 16 feet.

Discharge Line Length	Minimum Line	Other Requirements
6.0 - 9.5 ft.	1/2 in.	None
9.5 - 12.0 ft.	1/2 in.	Last 2-3 feet, including the supply port fitting, must be insulated with 1/2 inch thick closed cell polyethylene pipe insulation.
12.0 - 16.0 ft.	5/8 in.	Last 2-3 feet, including the supply port fitting, must be insulated with 1/2 inch thick closed cell polyethylene pipe insulation.

If the discharge line length must be less than 6 feet or greater than 16 feet, contact your local Bendix Brakes representative or authorized parts outlet for further information.

High Duty Cycle Vehicles (City Transit Bus, Refuse Trucks etc.)

The minimum discharge line length is 10 feet and the maximum is 16 feet.

Discharge Line Length	Minimum Line	Other Requirements
10.0 - 16.0 ft.	1/2 in.	None

If the discharge line length must be less than 10 feet or greater than 16 feet, contact your local Bendix Brakes representative or authorized parts outlet for further information.

DELIVERY LINE

1. Install an air line of the same approximate I.D. as the compressor discharge line between the AD-IP air dryer delivery port and the first (supply) reservoir. This line should also slope downward to the reservoir, if possible.

EXHAUST LINE

1. If it is necessary to direct AD-IP air dryer discharge contaminants away from vehicle components it will be necessary to purchase a special exhaust cover for the AD-IP air dryer (Pc. No. 112609) and install on the unit. A 1 inch (25.4 mm) I.D. hose can be clamped on the special AD-IP air dryer exhaust cover.

WIRING THE HEATER/THERMOSTAT

1. The air dryer is available with either a 12 or 24 volt heater which uses 90 watts of power. Determine the vehicle's electrical system voltage and make certain that the air dryer that is to be installed contains the same voltage heater. The air dryer's part number can be used to determine the air dryers heater voltage requirement. The heater voltage can also be identified by the color of the heater assembly connector as described in the table below.

Air Dryer Heater Voltage	Air Dryer Connector Identification
12 Volts	White, (No other markings)
24 Volts	Gray, or White w/Red Dot

A two lead, 24 inch, wire harness with attached weather resistant connector is supplied with all retrofit and replacement AD-IP air dryers. Connect one of the two leads of the wire harness to the engine kill or ignition switch. The remaining lead of the wire harness must be connected to a good vehicle ground (not to the air dryer or its mounting bracket). A fuse must be installed in the power carrying wire; install a 10 amp fuse for 12 volt heaters and a 5 amp fuse for a 24 volt heater.

3. Use 14 gauge wire if it is necessary to lengthen the wire harness provided with the AD-IP air dryer. Make certain all wire splices are waterproofed using the splice kit provided with all aftermarket AD-IP air dryers.
4. Tie wrap or support all electrical wires leading to the AD-IP air dryer at 6 - 8 inch intervals.

   Note: Wires should have sufficient slack and not completely taught.

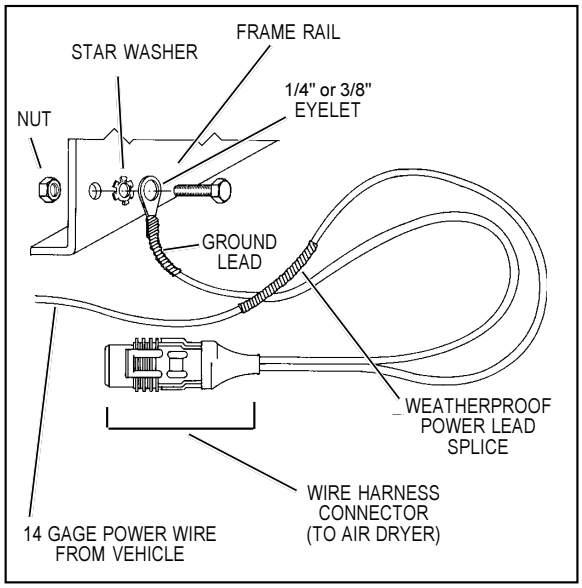


FIGURE 12 - ***WIRING - REMOTE POWER & LOCAL GROUND***

INSTALLING AD-IP WITH HOLSET COMPRESSOR

GENERAL

The vehicle installation guidelines presented in the previous section apply to all AD-IP air dryer installations. Vehicles equipped with the Holset Type E or QE compressor require the following additional considerations.

Standard AD-IP (Refer to Figure 3B)

If the AD-IP is being installed on a vehicle that did not previously have an air dryer or air system aftercooler, a separate feedback line and single check valve must be installed

If the AD-IP is replacing an older style air dryer or air system aftercooler that did not incorporate an integral "Turbo Cutoff" device, the Holset ECON valve must be removed. The feedback line and single check valve must remain in place.

AD-IP "Drop In" Model (Refer to Figure 3C)

If the AD-IP "Drop In" is being installed on a vehicle that did not previously have an air dryer or air system aftercooler, no additional considerations are necessary. Install the AD-IP DI in the manner described in the previous section.

If the AD-IP DI is replacing a standard AD-IP or air dryer or air system aftercooler which incorporated an integral "Turbo Cutoff" device, the old feedback line and single check valve must be removed.

If the AD-IP DI is replacing an older style air dryer or air system aftercooler that did not incorporate an integral "Turbo Cutoff" device, the Holset ECON valve and the old feedback line and single check valve must be removed.

TESTING THE AD-IP

Before placing the vehicle in service, perform the following tests.

1. Close all reservoir drain cocks.
2. Build up system pressure to governor cutout and note that the AD-IP air dryer purges with an audible escape of air.
3. "Fan" the service brakes to reduce system air pressure to governor cut-in. Note that the system once again builds to full pressure and is followed by a purge at the AD-IP air dryer exhaust.
4. It is recommended that the following items be tested for leakage to assure that the AD-IP air dryer will not cycle excessively.
   (A) Total air system leakage (See Bendix publication BW-5057 "Air Brake Handbook.")
   (B) Compressor unloader mechanism.
   (C) Governor.
   (D) Drain cock and safety valve in first (supply) reservoir.
   (E) All air connections leading to and from the first (supply) reservoir.

AD-IP AIR DRYER TROUBLESHOOTING CHART

SYMPTOMS	CAUSE	REMEDY
1. Dryer is constantly "cycling" or purging.	A. Excessive system leakage.	A. Test for excessive system leakage. Allowable leakage: Single vehicle - 1 psi/minute either service reservoir. Tractor trailer - 3 psi/minute either service reservoir.
	B. Excessive leakage in fitting, hoses and tubing connected to the compressor, air dryer and first reservoir.	B. Using soap solution, test for leakage at fittings, drain cock or valve (if any) and safety valve in first reservoir. Repair or replace as necessary.
	C. Defective check valve assembly in AD-IP air dryer end cover.	C. Test check valve. Build system pressure to governor cut-out. Wait 2 minutes for completion of purge cycle. Using soap solution at exhaust of purge valve, leakage should not exceed a 1 inch bubble in less than five seconds. Replace as necessary.
	D. Defective governor.	D. Test governor for proper cut-in and cut-out pressures and excessive leakage in both positions.
	E. Compressor unloader mechanism leaking excessively.	E. Remove air strainer or fitting from compressor inlet cavity. With compressor unloaded, check for unloader piston leakage. Slight leakage permissible.
	F. Holset "E" type compressor.	F. Test the Holset E Compressor unloader system with feedback line and check valve for proper operation. Make certain Holset ECON is not in use with the AD-IP air dryer, if so, remove and retest.
	G. Rapid cycling of the governor due to air starvation at the RES port of the governor.	G. With gauge installed at RES port of governor, pressure should not drop below "Cut-In" pressure at the onset of the compressor "Unloaded" cycle. If pressure drops, check for "kinks" or restrictions in line connected to RES port. Line connected to RES port on governor must be same diameter, or preferably larger than, lines connected to UNL port(s) on governor.
2. Water in vehicle reservoirs.	A. Improper discharge line length or improper line material. Maximum air dryer inlet temperature is exceeded.	A. Refer to section entitled *Connecting the Air Lines* and check line size and length.
	B. Air system charged from outside air source (outside air not passing through air dryer).	B. If system must have outside air fill provision, outside air should pass through air dryer. This practice should be minimized.

AD-IP AIR DRYER TROUBLESHOOTING CHART (Continued)

SYMPTOMS	CAUSE	REMEDY
2. Water in vehicle reservoirs (continued).	C. Air dryer not purging (see Symptom #5).	C. See cause and remedy for Symptom #5.
	D. Purge (air exhaust) time insufficient due to excessive system leakage (see causes for Symptom #1).	D. Check causes and remedies for Symptom #1.
	E. Excessive air usage - Air dryer not compatible with vehicle air system requirement (Improper air dryer/vehicle application).	E. Charge Cycle Time - The AD-IP is designed to provide clean, dry air for the brake system. When a vehicle's air system is used to operate non-brake air accessories it is necessary to determine that; during normal, daily operation the compressor should recover from governor "cut-in" to governor "cut-out" (usually 100 psi to 120 psi) in 90 seconds or less at engine RPM's commensurate with the vehicle vocation. If the recovery time consistently exceeds this limit, it may be necessary to "bypass" the air accessory responsible for the high air usage. An example of where a by-pass system would be required is when the compressor is used to pressurize a tank trailer for purposes of off-loading product. Consult your local authorized Bendix parts outlet or sales representative for additional information. Purge Cycle Time - During normal vehicle operation, the air compressor **must remain unloaded for a minimum of 30 seconds.** This minimum purge time is required to ensure complete regeneration of the desiccant material. If the purge time is consistently less than the minimum, an accessory by-pass system must be installed. Consult your local authorized Bendix parts outlet or sales representative for additional information. Air Compressor Size - Although the AD-IP can be used in conjunction with larger compressors, it was designed primarily for units rated for up to 30 CFM. It is recommended that when using the AD-IP with a compressor which has a rated displacement exceeding 30 CFM that an authorized Bendix parts outlet or Bendix marketing representative be contacted for assistance.
	F. Air by-passes desiccant cartridge assembly.	F. If vehicle uses Holset compressor, inspect feedback check valve for proper installation and operation. Replace desiccant cartridge. Make sure desiccant cartridge assembly is properly installed and sealing rings are in place on mounting surface of desiccant cartridge.
	G. Desiccant requires replacement.	G. Replace desiccant cartridge assembly.

AD-IP AIR DRYER TROUBLESHOOTING CHART (Continued)

SYMPTOMS	CAUSE	REMEDY
3. Safety valve on air dryer "popping off" or exhausting air.	A. Desiccant cartridge plugged.	A. Check compressor for excessive oil passing and/or correct compressor installation. Repair or replace as necessary. Replace desiccant cartridge.
	B. Defective discharge check valve in end cover of the AD-IP.	B. Test to determine if air is passing through check valve. Repair or replace.
	C. Defective fittings, hose or tubing between air dryer and first reservoir.	C. Check to determine if air is reaching first reservoir. Inspect for kinked tubing or hose. Check for undrilled or restricted hose or tubing fittings.
	D. Excessive pressure pulsations from compressor. (Typical single cylinder type).	D. Increase volume in discharge line. Add a ping tank (small reservoir).
	E. Safety valve setting lower than the maximum system pressure.	E. Reduce system pressure or obtain a higher setting safety valve.
4. Constant exhaust of air at air dryer purge valve exhaust or unable to build system pressure. (Charge mode.)	A. Air dryer purge valve leaking excessively.	A. With compressor loaded, apply soap solution on purge valve exhaust, to test for excessive leakage. Repair purge valve as necessary.
	B. Defective governor.	B. Check governor for proper "cut-in", "cut-out" pressure and excessive leakage in both positions. Repair or replace as necessary.
	C. Purge control line connected to reservoir or exhaust port of governor.	C. Purge control line must be connected to unloader port of governor.
	D. Purge valve frozen open - faulty heater and thermostat, wiring, blown fuse.	D. Test heater and thermostat as described in *Preventative Maintenance* Section.
	E. Excessive system leakage.	E. See Symptom #1's Cause and Remedy A.
	F. Purge valve stays open - supply air leaks to control side.	F. Repair purge valve and housing.
5. Can not build system air pressure.	A. Inlet and outlet air connections reversed.	A. Connect compressor discharge to air dryer supply port. Reconnect lines properly.
	B. Check valve between air dryer and first reservoir.	B. Test check valve for proper operation. Repair or replace as necessary.
	C. Kinked or blocked (plugged) discharge line.	C. Check to determine if air passes through discharge line. Check for kinks, bends, excessive carbon deposits, or ice blockage.

AD-IP AIR DRYER TROUBLESHOOTING CHART (Continued)

SYMPTOMS	CAUSE	REMEDY
5. Can not build system air pressure.	D. Excessive bends in discharge line (water collects and freezes). E. Refer to Symptom 4, causes E & F.	D. Discharge line should be constantly sloping from compressor to air dryer with as few bends as possible. E. Refer to Symptom 4, Remedies E & F.
6. Air dryer does not purge or exhaust air.	A. Broken, kinked, frozen, plugged or disconnected purge control line.	A. Test to determine air flows through purge control line when compressor unloaded. Check for undrilled fittings. (See Symptom #4, Remedy C.)
	B. Faulty air dryer purge valve.	B. After determining air reaches purge valve (Remedy A above), repair purge valve.
	C. See Causes, B. E, G for Symptom #4.	C. Refer to Remedies B. E, G for Symptom #4.
7. Desiccant material being expelled from air dryer purge valve exhaust (may look like whitish liquid or paste or small beads.) - OR - Unsatisfactory desiccant life.	A. This symptom is almost always accompanied by one or more of Symptoms 1, 2, 3, 4 and 5. See related causes for these Symptoms above.	A. See Causes and Remedies for Symptoms 1, 2, 3, 4 and 5.
	B. Air dryer not securely mounted. (Excessive vibration.)	B. Vibration should be held to minimum. Add bracket supports or change air dryer mounting location if necessary.
	C. Malfunctioning or saturated desiccant cartridge.	C. Replace desiccant cartridge assembly.
	D. Compressor passing excessive oil.	D. Check for proper compressor installation; if symptoms persist, replace compressor.
	E. Desiccant cartridge not assembled properly to end cover. (Loose attachment)	E. Check the torque on the desiccant cartridge to end cover attachment. Refer to assembly section of this data sheet.
8. "Pinging" noise excessive during compressor loaded cycle.	A. Single cylinder compressor with high pulse cycles.	A. A slight "pinging" sound may be heard during system build up when a single cylinder compressor is used. If this sound is deemed objectionable, it can be reduced substantially by increasing the discharge line volume. This can be accomplished by adding an additional four feet of discharge line or adding a 90 cubic inch reservoir between the compressor and the AD-IP air dryer. IMPORTANT: Do not exceed the line lengths requirements specified in this manual.
9. Constant seepage of air at air dryer purge valve exhaust (non-charging mode.)	A. Defective check valve assembly in AD-IP air dryer end cover.	A. Refer to Remedy C, Symptom #1.
	B. Leaking Turbo Cutoff valve.	B. Repair or replace purge valve assembly.
	C. Leaking purge valve control piston o-ring.	C. Repair or replace purge valve assembly.

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AD-IP AIR DRYER TROUBLESHOOTING CHART (Continued)

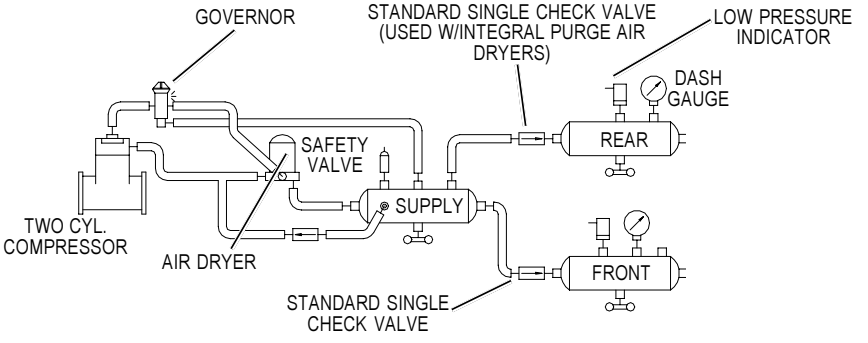
SYMPTOMS	CAUSE	REMEDY
10. The air dryer purge piston cycles rapidly in the compressor unloaded (non-compressing) mode.	A. Compressor fails to "unload".	A. Faulty governor installation; no air line from governor to compressor or line is kinked or restricted. Install or repair air line.

Additional Troubleshooting Information

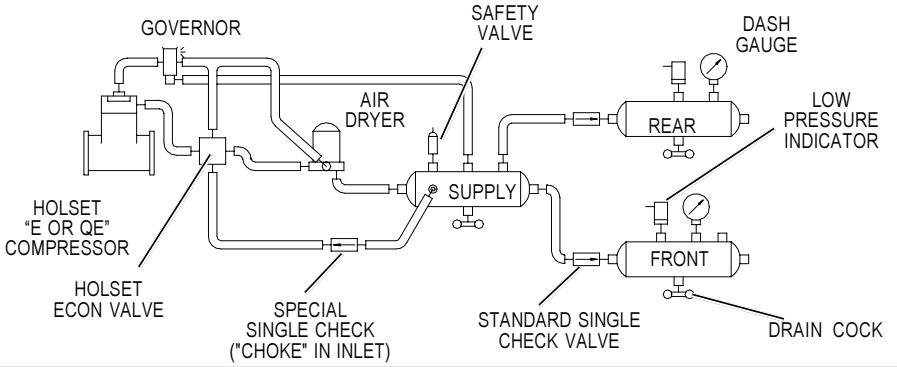
The Troubleshooting procedure presented on pages 18 and 19 has been excerpted from a laminated card entitled: Troubleshooting Charging and Air Supply Systems. The complete card can be obtained from authorized Bendix parts outlets under literature number BW1779. It is presented here because of the air dryers connection to the supply air system and for convenience. The procedure is not all inclusive but rather represents the most commonly encountered complaints.

412

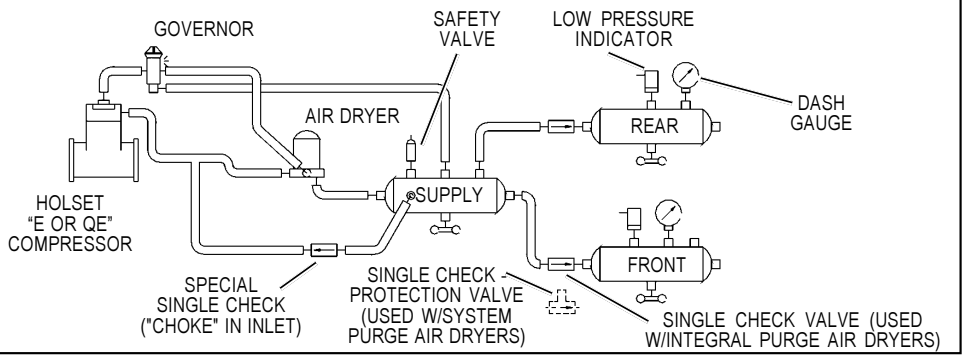
CONVENTIONAL SUPPLY SYSTEM & INTEGRAL PURGE AIR DRYER



HOLSET TYPE "E & QE" COMPRESSOR WITH ECON VALVE



HOLSET TYPE "E & QE" COMPRESSOR W/O ECON VALVE



COMPLAINTS COMMON TO THE CHARGING & AIR SUPPLY SYSTEM

Complaint: Can Not Build System Pressure

- Discharge line plugged or restricted: see Common Test 1.
- Air pressure trapped between governor and compressor unloaders: see Common Test 2.
- Blow Leakage at Air Dryer Exhaust: see Common Test 3.

Complaint: Air system Builds Too Slow

- Discharge line restricted: see Common Test 1.
- Discharge line leakage: see Common Test 5.
- Air Leaking at Air Dryer Exhaust: see Common Test 3.
- Compressor head gasket failure: apply soap solution around cylinder head. If leakage between head and block noted repair or replace comp.
- Air pressure trapped between governor and compressor unloaders: see Common Test 2.
- Air system leakage: see Common Test 4.

Complaint: Can Not Build System Pressure Above "X" psi.

- Blow leakage at compressor unloaders: remove all hardware from comp. inlet then remove governor. With 120 psi shop air applied to comp. unloader port listen for leakage at inlet. If noted, repair leak or replace comp.
- Incorrect setting on governor: verify Safety Valve operation. Drain air from system, remove or disconnect governor from comp. and install gauge in governor unloader (UNL) port. Build system pressure and note when pressure on dash gauge and test gauge are equal. Should be equal at maximum setting of governor.
- Discharge line leakage: see Common Test 5.
- Air system leakage: see Common Test 4.
- Compressor head gasket failure: apply soap solution around cylinder head. If leakage between head and block noted repair or replace comp.

Complaint: Air Dryer Cycles "ON & OFF" Constantly

This complaint caused by leakage, either Service system or Supply system. Service system leakage is shown on dash gauges Supply system leakage is not. *Note: System purge air dryers will purge more often than those with integral purge volume.*

Service system leakage: see Common Test 4.

Supply system component leakage: drain system, install gauge and shop air hose in place of drain cock in supply reservoir. Fill system to 120 psi, shut off shop air and check leakage on following components in order presented:

- Compressor unloader leakage
- Drain system, remove governor from comp. plug governor UNL port and re-test. If leakage OK repair comp. unloader mechanism or replace comp. If leakage NOT OK then next.
- Holset ECON valve (used with Holset Type "E & QE" comp.) missing, malfunctioning, leaking.
- Is ECON valve required but missing? If YES, install, along with special Holset check valve w/choke. If NO and ECON valve present replace ECON valve and special check valve. If NO and ECON not required then next
- Air dryer leakage: Remove line from air dryer inlet and with 120 psi in supply res. soap exhaust and inlet port of air dryer. If leakage greater than 1 inch bubble in 1 second at exhaust port, repair or replace check valve (on dryers with integral purge volume) or replace body assy. on system purge air dryers. If leakage greater than 1 inch bubble in 1 second at inlet port, repair or replace purge valve assy. (on dryers with integral purge volume) or replace turbo cut -off valve on system purge air dryers.

Complaint: System Pressure Goes to 150+ psi

- Drain air system to 0 psi, remove/disconnect governor from comp. Start engine and note air pressure rise on dash gauges. Apply 120 psi shop air to comp. unloader port. If air pressure continues to rise, repair comp. unloaders or replace comp. If air ceases to rise, repair or replace governor.

Complaint: Low Pressure Warning After Only 1 or 2 Applications

- Brakes out of adjustment: adjust brakes.
- Excessive system leakage on service (application) side of system: Build system pressure to 120 psi and shut off engine. With park brakes released, make full service application and note dash gauges for 2 minutes. Pressure drop on either gauge should not exceed 4 psi. (2 psi per min.) If pressure drop excessive, find leakage in service system, if OK, then next.
- Incorrect low pressure switch in use or setting incorrect: Build system to 120 psi. Engine OFF ignition ON, slowly drain air pressure from one service reservoir. Low pressure warning on at minimum 60 psi, maximum 10-15 psi less than governor cut-in pressure.

TESTS COMMON TO MORE THAN ONE COMPLAINT

1. Discharge plugged or restricted

- Connect temporary discharge line from comp. discharge port to supply res. & re-check build-up. If build-up OK replace plugged discharge line. If build-up NOT OK go to next cause.

2. Air pressure trapped between governor and compressor

- Verify Safety Valve operation then remove or disconnect governor from comp. & check build-up.
- If build-up OK, repair or replace governor or line between gov. and comp.
- If build-up NOT OK repair or replace comp.

3. Blow Leakage at Air Dryer Exhaust

- Drain all air from Supply reservoir then remove control air line from Air Dryer, plug line and plug control port in Air Dryer. Re-check build-up.
- If build-up OK, repair or replace governor or line between governor and Air Dryer
- If build-up NOT OK, and below 32 deg. F, turn ignition ON and allow heater to warm Air Dryer then check build-up. If NOT OK, remove wire (connector or terminal) from Air Dryer. Using test light, check wire end or terminal for battery voltage with vehicle ignition ON. If voltage OK, repair or replace Air Dryer heater and thermostat. If voltage NOT OK, Repair or replace the vehicle wire connected to Air Dryer. Retest build-up.
- If build-up still NOT OK or temp. above 32 deg. F, replace Air Dryer purge valve assembly.

4. Air system leakage

- Build system Pressure to governor cut-out, wait 2 minutes for dryer purge completion. Note pressures on dash gauges then watch dash gauges for 2 minutes. Leakage not to exceed 2 psi in 2 mins. for truck, bus, tractor (no trailer).
- If leakage NOT OK on gauges, find leak(s) in service and park system and repair. Retest and if system purge air dryer in use and still not OK repair or replace dyer.
- If leakage OK on gauges, drain air from supply reservoir, remove drain cock and install air gauge. Build system air in supply reservoir and note leakage. If OK continue checking. If NOT OK find leaks and repair.

5. Discharge line leakage

- Soap cover on flex discharge line, if leakage noted replace line.
- Soap fittings to check leakage, tighten as needed.

IMPORTANT: The Complaints, Causes and Remedies presented here should not be considered as the only situations possible. They are only meant to represent the most commonly encountered. It may be necessary to perform additional trouble shooting using the more detailed information presented in service manuals for the specific components.


Bendix

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Service Data

SD-03-3619

PP-DC PARK CONTROL VALVE

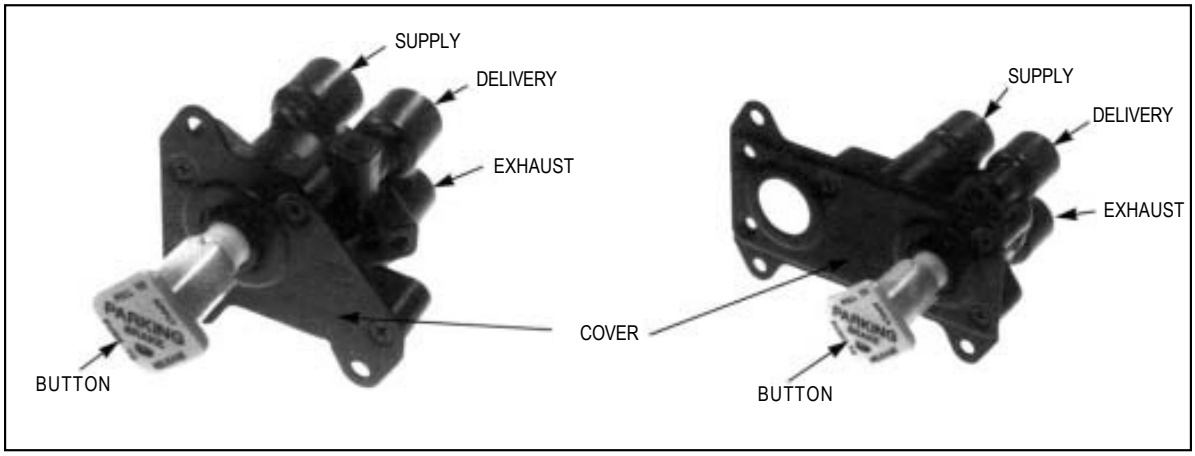

FIGURE 1 - PP-DC PARK CONTROL VALVE

DESCRIPTION

The PP-DC park control valve is a push-pull, manually operable on/off valve. It is dash board-mounted and provides in-cab control of truck or bus parking brakes.

The valve is pressure sensitive-it automatically moves from the applied to the exhaust position if total system pressure drops below 20 to 30 psi. Also, manually pulling the button will apply the parking brakes.

The PP-DC body is made of molded black acetal copolymer, and the cover is available in two mounting variations (see Figure 1). The valve is designed to accept 1/4" P.T. fittings or push-to-connect fittings that use SAE J844D nonmetallic air brake tubing.

Ports:

Port	Embossed I.D.
Primary Reservoir Supply	Supply 11
Secondary Reservoir Supply	Supply 12
Delivery	Delivery 21
Exhaust	Exhaust 3

Operating pressure: 150 psi max.

Operating temperature: -40° to 200°F

Basic valve weight: Approximately .8 lbs.

OPERATION

GENERAL

The PP-DC receives its supply of air from the primary service reservoir or the secondary service reservoir, whichever is at the higher pressure. When the button is pushed in, the valve delivers air to the spring brake chambers (usually through a spring brake valve such as the Bendix SR-1 and a relay or quick release valve). The air releases the spring brakes for normal vehicle operation.

To apply the parking brakes, the button is pulled out, which exhausts the PP-DC delivery and releases air from the spring brake chambers.

If total system pressure drops below 20 to 30 psi, the valve will automatically “pop out,” which removes the hold- off air in the chambers and applies the spring brakes.

PARKING BRAKES RELEASED

To release the parking brakes, the push-pull button is pushed in. The PP-DC plunger moves, closing the exhaust port with the exhaust seal and allowing the plunger o-ring to move past the guide spool. Supply air then travels out the delivery port to release the brakes.

Note that Figure 3 shows the primary service reservoir supplying the PP-DC. The double check valve diaphragm has sealed the secondary reservoir supply port and allows air to pass from the primary reservoir into the PP-DC.

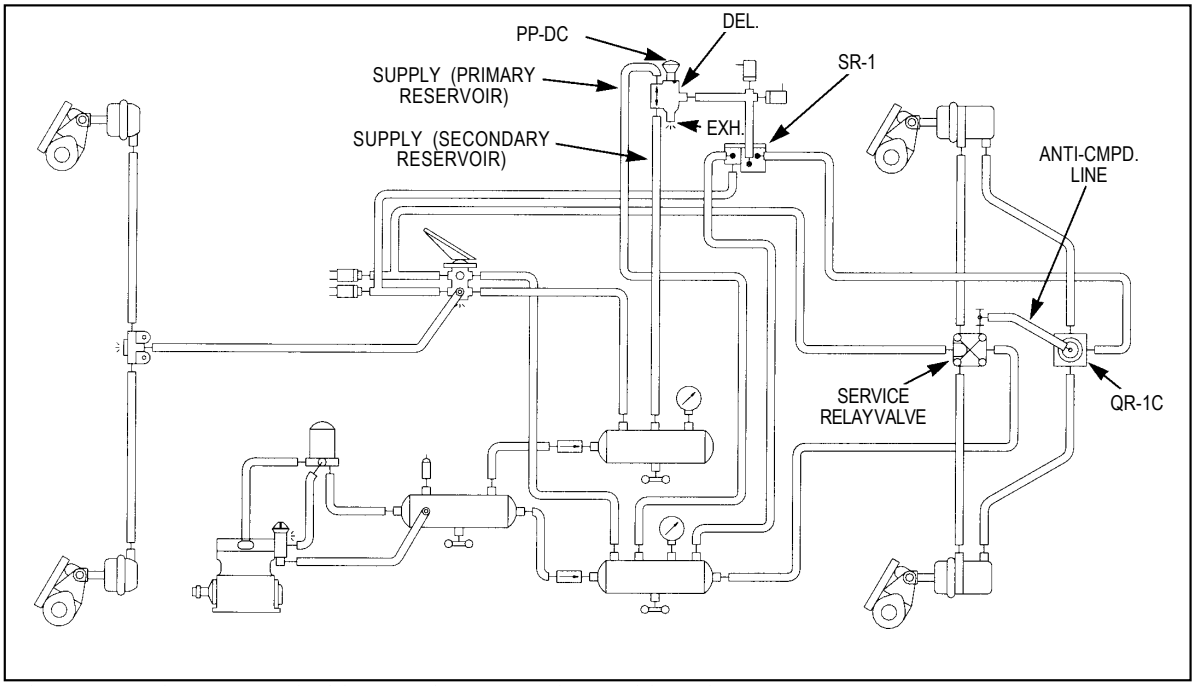

FIGURE 2 - TYPICAL 4 X 2 TRUCK SCHEMATIC WITH PP-DC PARK CONTROL VALVE

If primary service reservoir pressure drops below secondary service reservoir pressure, the double check valve reacts as shown in Figure 4. It seals the primary service reservoir supply port and supplies the PP-DC with air from the secondary service reservoir. As is shown, the push-pull button remains in and the spring brakes remain released.

PARKING BRAKES APPLIED

Figure 5 shows the PP-DC in the parking-brakes-applied position. This will occur if the driver manually pulls out the push- pull button or if total system pressure drops to below 20 to 30 psi.

When the button “pops out,” the exhaust seal moves to open the exhaust port to atmosphere, allowing delivery line pressure to exhaust. The plunger o-ring moves to seal off supply pressure. Spring brake hold-off air is exhausted through the spring brake relay valve.

IMPORTANT! PLEASE READ

When working on or around a vehicle, observe the following general precautions.

1. Park the vehicle on a level surface, apply the parking brakes, and always block the wheels.
2. Stop the engine when working around the vehicle.
3. Drain the air pressure from all reservoirs before beginning ANY work on the vehicle.
4. When working in the engine compartment the engine should be shut off. Where circumstances require that the engine be in operation, EXTREME CAUTION should be used to prevent personal injury resulting from contact with moving, rotating, leaking, heated, or electrically charged components.
5. Never connect or disconnect a hose or line containing pressure; it may whip.
6. Never remove a component or plug unless you are certain all system pressure has been depleted.
7. Never exceed recommended pressures and always wear safety glasses.
8. Do not attempt to install, remove, disassemble or assemble a component until you have read and thoroughly understand the recommended procedures. Use only the proper tools and observe all precautions pertaining to the use of those tools.
9. Use only genuine Bendix replacement parts, components and kits. Replacement hardware, tubing, hose, fittings, etc. should be of equivalent size, type and strength as original equipment and should be designed specifically for such applications and systems.
10. Components with stripped threads or damaged parts should be replaced rather than repaired. Repairs requiring machining or welding should not be attempted unless specifically approved and stated by the vehicle or component manufacturer.

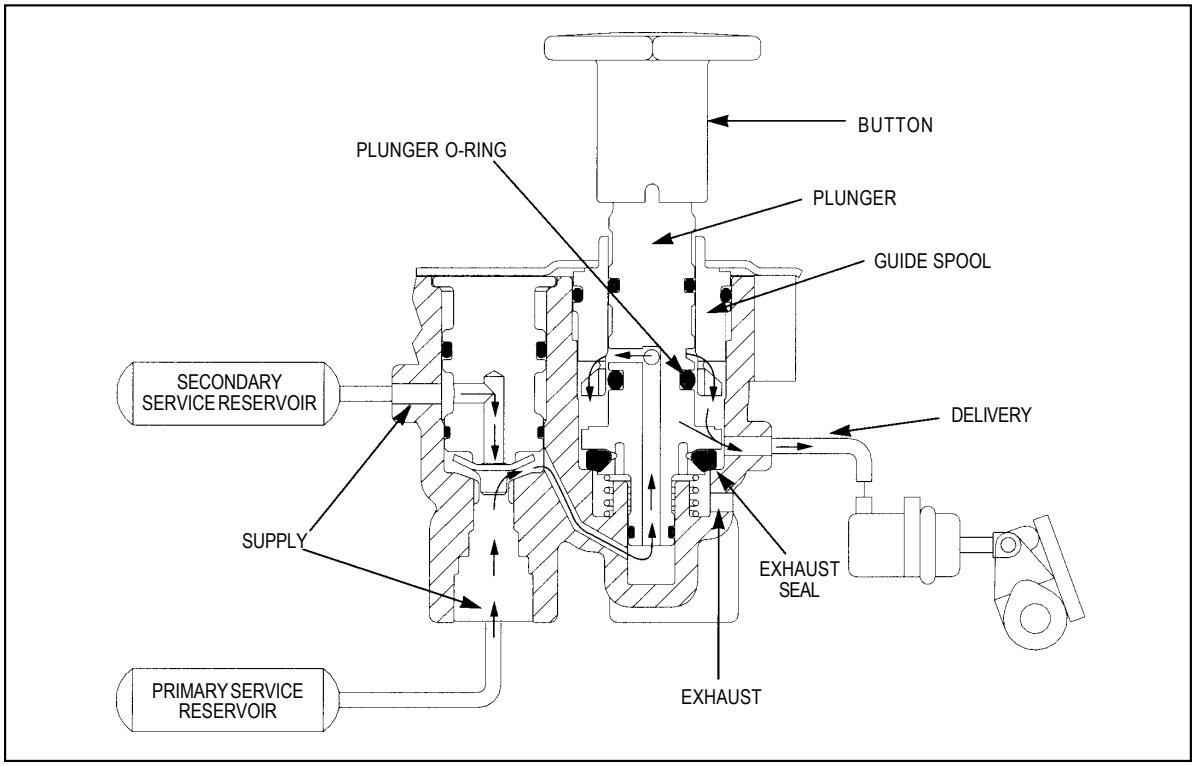

FIGURE 3 - SPRING BRAKES RELEASED (PRIMARY RESERVOIR SUPPLY)

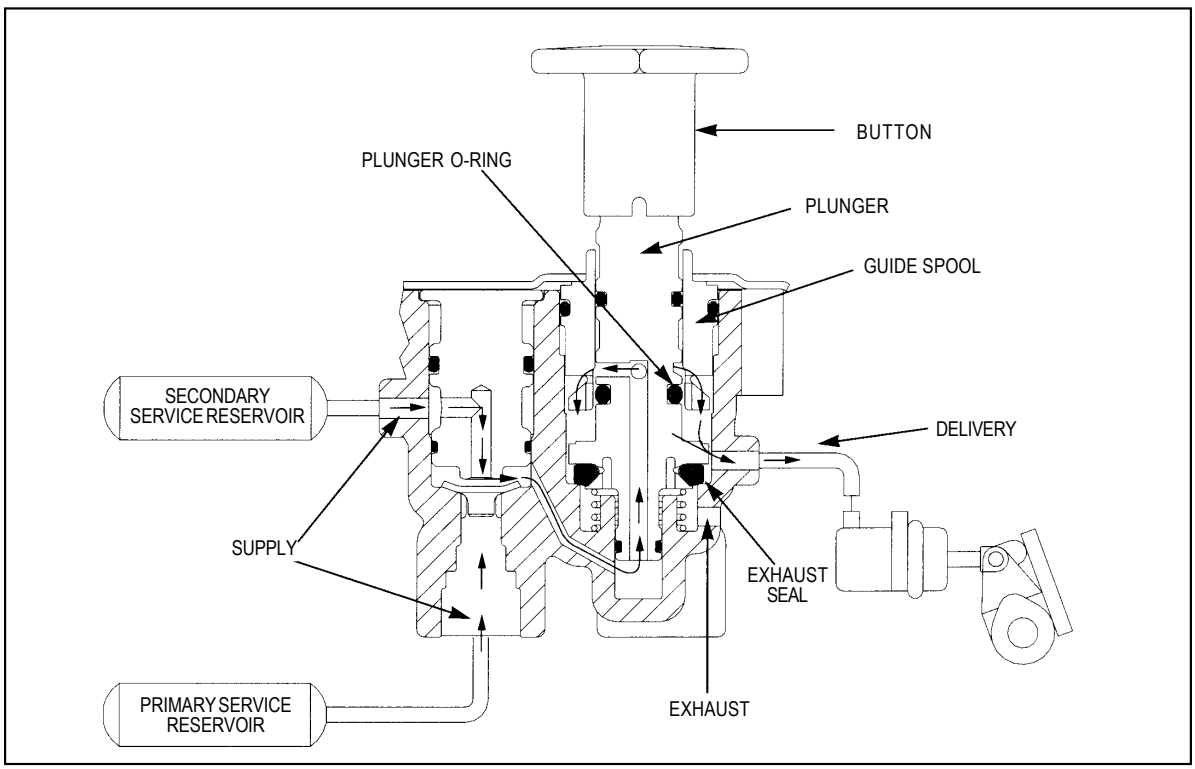

FIGURE 4 - SPRING BRAKES RELEASED (SECONDARY RESERVOIR SUPPLY)

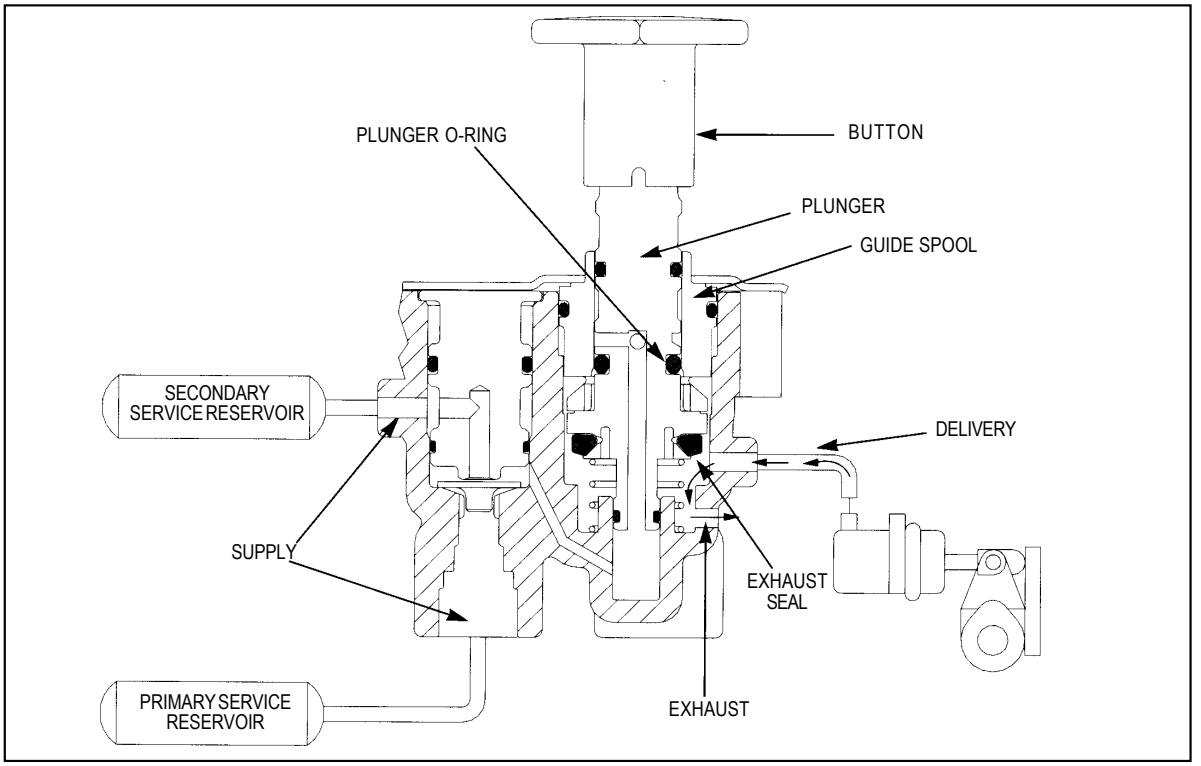

FIGURE 5 - PARKING BRAKES APPLIED

PREVENTIVE MAINTENANCE

1 . Every 3 months; 25,000 miles; or 900 operating hours; or during the vehicle chassis lubrication interval, make the visual inspections noted in “SERVICE CHECKS.”

2. Every 12 months; 100,000 miles; or 3600 operating hours, perform “OPERATIONAL AND LEAKAGE TESTS.”

SERVICE CHECKS

1. Remove any accumulated contaminants. Visually inspect the valve’s exterior for excessive wear or physical damage. Repair/replace as necessary.
2. Inspect all air lines connected to the valve for signs of wear or physical damage. Repair/replace as necessary.
3. Test air line fittings for excessive leakage. Repair/replace as necessary.

LEAKAGE AND OPERATIONAL TESTS

To perform the following tests, connect two separate 120 psi air sources to the PP-DC supply ports. Tee an accurate test gauge into the supply lines, and provide for a means to control supply line pressure. Connect a small volume with a gauge to the delivery port.

LEAKAGE TEST

1. Supply the valve with 120 psi from the primary reservoir supply port. With the button out, coat the exhaust port and the plunger stem with a soap solution. Leakage should not exceed a 1" bubble in 5 seconds. There should be no leakage from the secondary reservoir supply port.
2. With the button out, supply the valve with 120 psi from the secondary reservoir supply port. There should be no leakage from the primary reservoir supply port.
3. With the button in, coat the exhaust port and the plunger stem with a soap solution. Leakage at both areas should not exceed a 1” bubble in 3 seconds.

OPERATIONAL TEST

1. With the button out, supply either supply port with 120 psi of air. Then push the button in. Air pressure should rise in the delivery volume equivalent to supply pressure.
2. Pull the button out. Delivery pressure should exhaust to 0 psi.
3. Build each supply source to 120 psi. Decrease supply pressure at the secondary service reservoir supply port at a rate of 10 psi per second. Primary supply pressure and delivery pressure should not drop below 100 psi.

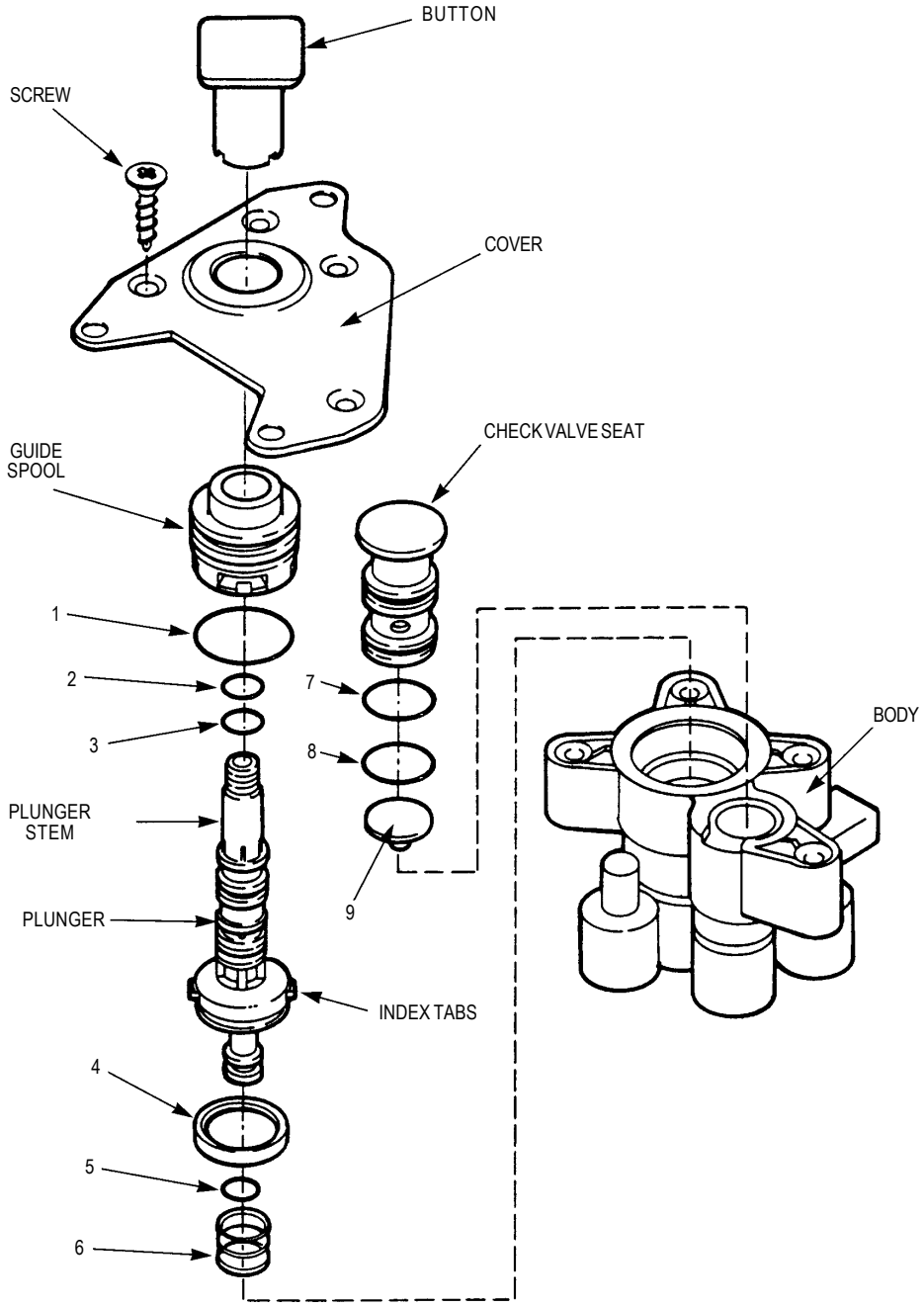

FIGURE 6 - EXPLODED VIEW

Repeat the test for decreasing primary service reservoir pressure.

4. Build each supply source to 120 psi. Then decrease both supply pressures to below 20 to 30 psi. The button should automatically "pop" out when pressure drops within that range.

If the PP-DC fails to function as described, or if leakage is excessive, repair the valve or replace it at the nearest authorized Bendix Commercial Vehicle Systems parts outlet.

REMOVAL

1. Identify and mark or label all air lines and their connections on the valve.
2. Remove the PP-DC from the vehicle and save the mounting hardware.

INSTALLATION

1. Install the PP-DC in its location on the dashboard. Using the mounting hardware saved in "REMOVAL," secure the valve to the vehicle.
2. Reconnect all air lines to the valve using the identification made in "REMOVAL."
3. Perform "OPERATIONAL AND LEAKAGE TESTS" before placing the vehicle back in service.

DISASSEMBLY

The following disassembly and assembly procedures are for reference only. Always have the appropriate maintenance kit on hand and use its instructions in lieu of those presented here. Refer to Figure 6 throughout the procedure.

1. Turn the button counterclockwise to remove it from the plunger stem.
2. Remove the four screws that secure the cover to the body, and remove the cover.
3. Pull the plunger stem to remove the plunger and the guide spool from the body.
4. Remove plunger spring(6) and discard.
5. If necessary, use a screwdriver to carefully remove the check valve seat from the body. Be sure not to damage the check valve seat or the body.
6. Remove and discard check valve seat o-rings(7) and (8).
7. Turn the body upside down and gently tap it on a flat surface to remove check valve(9). Discard the check valve.
8. Remove the guide spool from the plunger. Remove and discard o-ring(1) from the guide spool.
9. Remove and discard o-rings(2), (3) and (5) from the plunger. Also remove and discard exhaust seal(4).

CLEANING & INSPECTION

1. Wash all metal parts in mineral spirits and thoroughly dry.
2. Inspect all re-usable parts for excessive wear or damage. Inspect the body for gouges or deep scuffing. Replace key numbers 1-9 (and any parts not determined usable) with genuine Bendix replacements.

ASSEMBLY

Before assembly, lubricate all o-rings, o-ring grooves, rubbing surfaces and bores with Bendix silicone lubricant (Pc. No. 291126) or equivalent.

1 . Place check valve(9) into its seat in the body with its flat surface facing upward. If necessary, reach into the body to make sure the valve is seated evenly in the bore.
2. Install o-rings(7) and (8) on the check valve seat and install the check valve seat into the body. Make sure the seat is fully seated-its surface should be even with the body's surface.
3. Install plunger spring(6) into the body. Make sure it stands upright and is seated properly in the body bore. (It should surround the protrusion or "lip" at the bottom of the body bore.)
4. Install o-rings(2), (3), (5) and exhaust seal(4) onto the plunger. Then install the plunger into the body. Line up the plunger's index tabs with the spaces in the body bore for ease of installation.
5. Install o-ring(1) onto the guide spool. Then install the guide spool over the plunger and into the body. Press the guide spool into place firmly.
6. Place the cover onto the body and secure with its four screws. Torque to 35 in. lbs.
7. Thread the button clockwise onto the plunger stem. It should take approximately 3 full button revolutions to install it on the plunger. The protrusions on the side of the plunger should line up with the button grooves. Push on the button a number of times to make sure the plunger moves freely throughout its range of motion.

NOTE: BEFORE PLACING THE VEHICLE BACK INTO SERVICE, PERFORM THE "LEAKAGE AND OPERATIONAL TESTS" IN THIS MANUAL.

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Bendix

Service Data

SD-03-9043

421

SR-7 SPRING BRAKE MODULATING VALVE

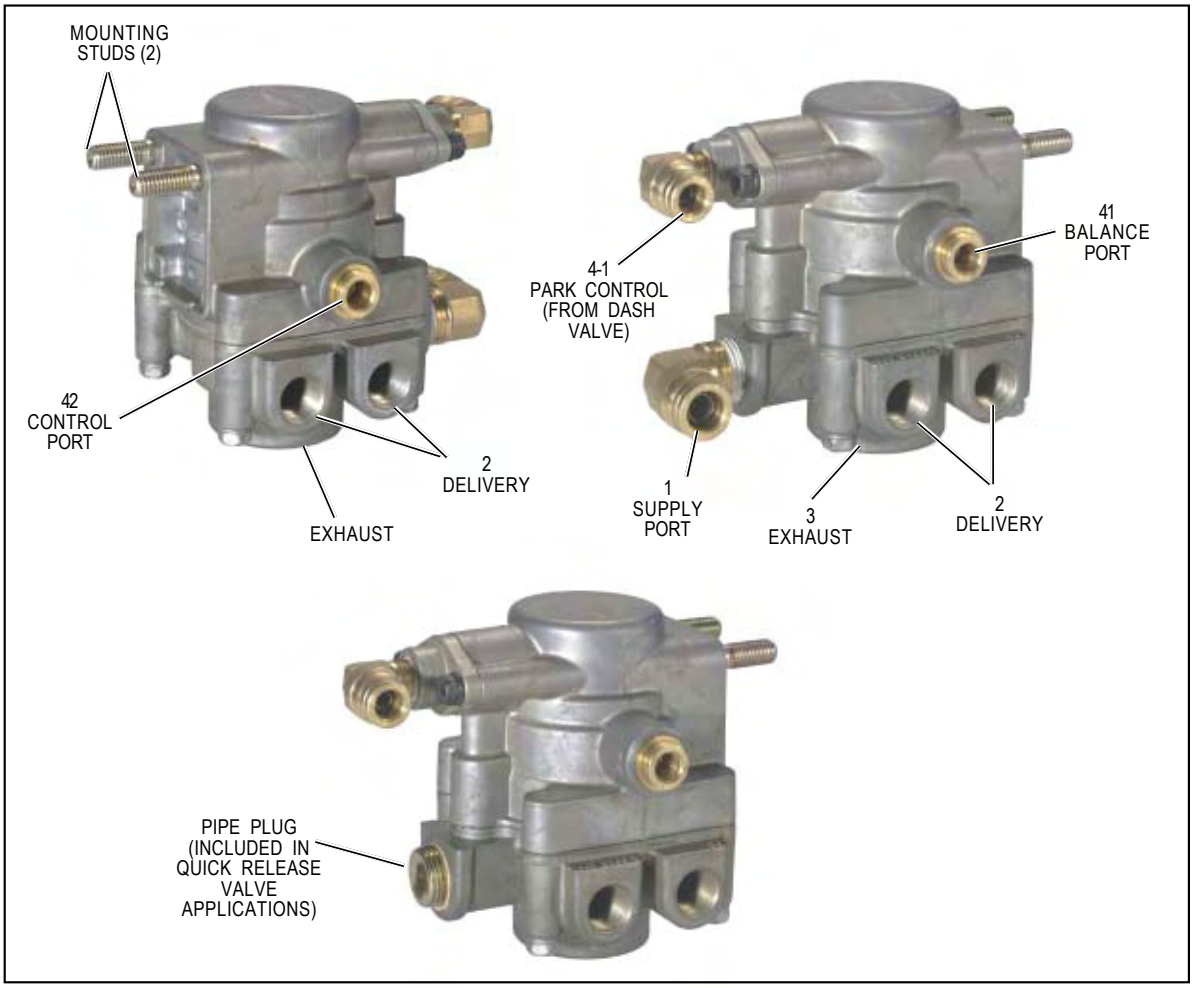

FIGURE 1 - EXTERIOR VIEW

DESCRIPTION

The SR-7 Spring Brake Modulating Valve is used in conjunction with a dual air brake system and spring brake actuator and performs the following functions:

1. Provides a rapid application of the spring brake actuator when parking.
2. Modulates the spring brake actuator application using the dual brake valve should a primary failure occur in the service brake system.
3. Prevents compounding of service and spring forces.

The valve has one park control, one service control, one supply, one balance, four delivery NPTF ports, and an exhaust port protected by an exhaust diaphragm. The valve incorporates two mounting studs for mounting the valve to the frame rail or cross member (where applicable).

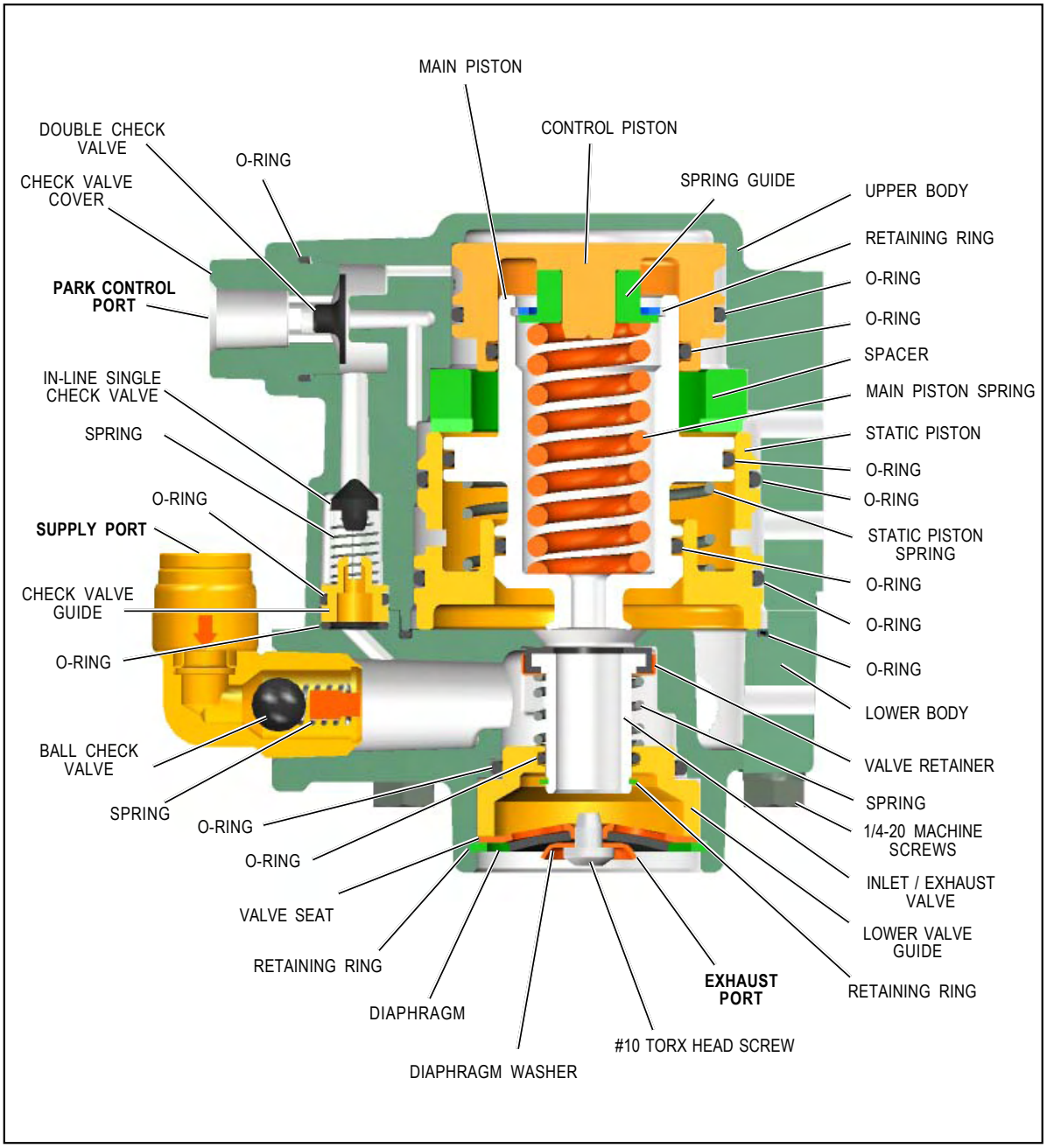

FIGURE 2 - SECTIONAL VIEW OF SR-7 USED IN RELAY VALVE APPLICATIONS

OPERATION

The operation guidelines shown in this manual represent the relay valve based SR-7 (refer to system schematic shown in figure 3). A quick release based valve functions similarly to the relay valve based version with the exception that all air delivered to spring brakes passes through the park control port through the in-line single check valve. The quick release style SR-7 can be easily identified by the pipe plug in the supply port of the valve.

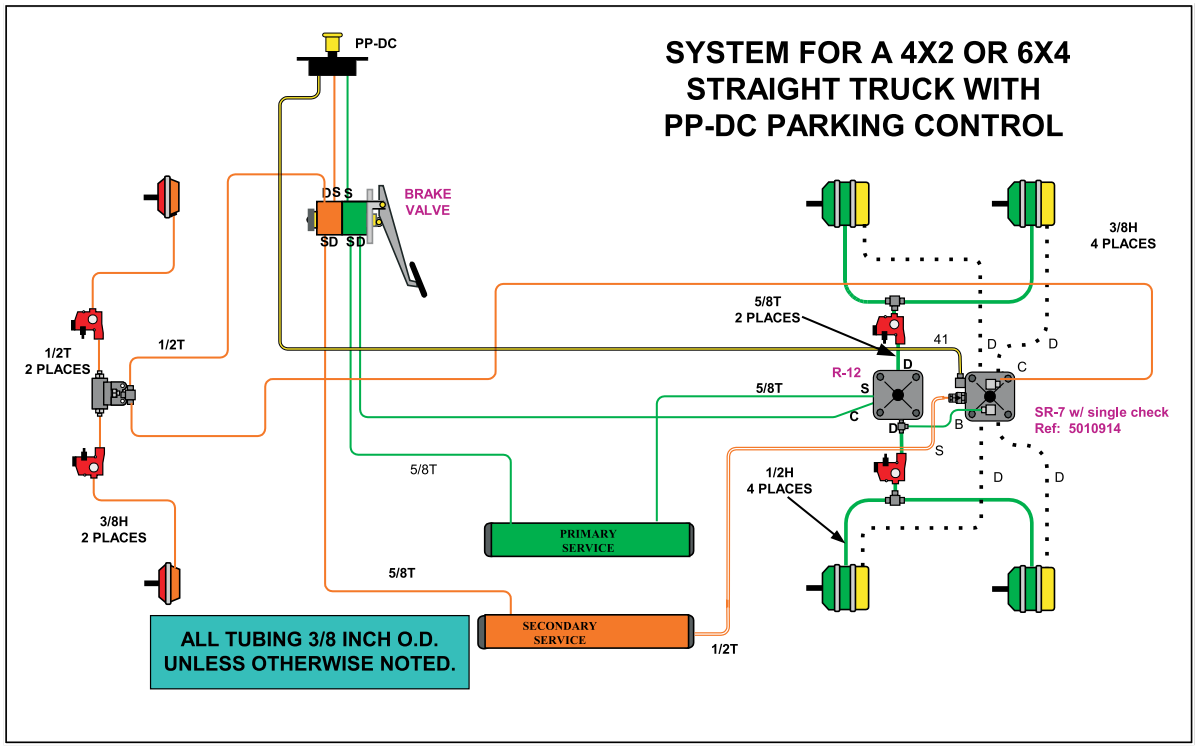

FIGURE 3 - SYSTEM SCHEMATIC WITH PP-DC PARK CONTROL

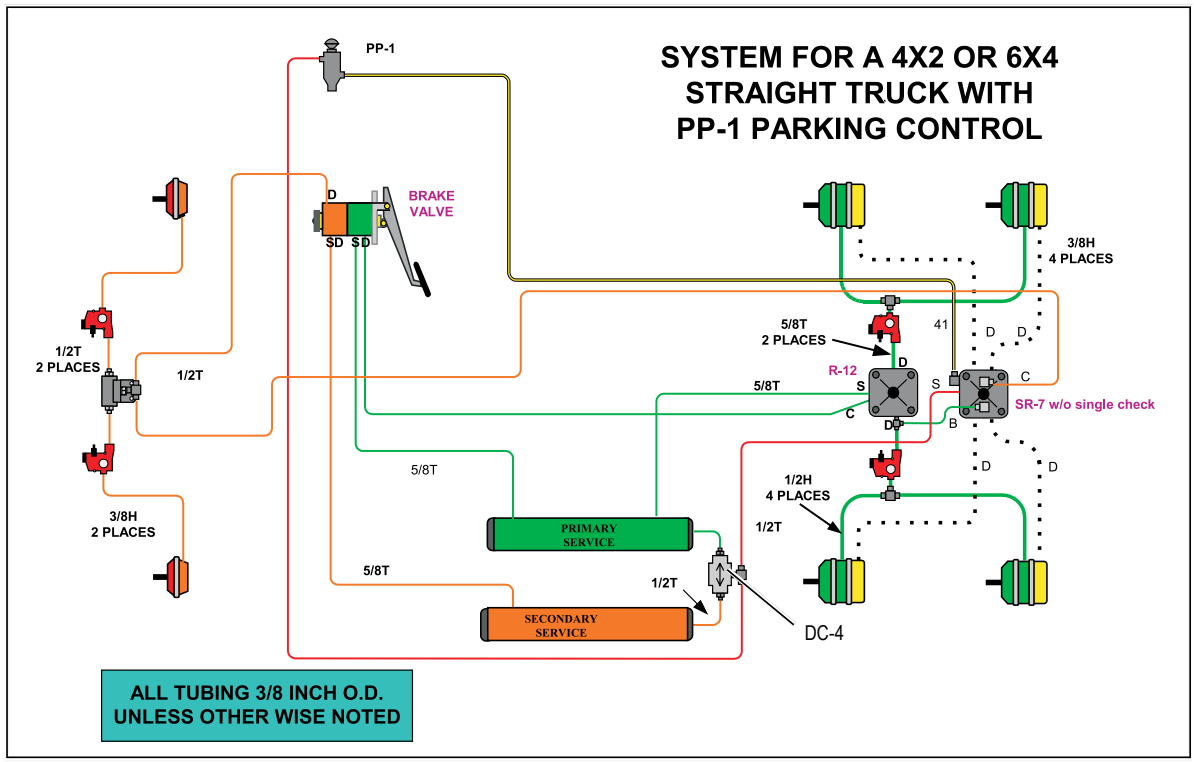

FIGURE 4 - SYSTEM SCHEMATIC WITH PP-1 PARK CONTROL AND DC-4 DOUBLE CHECK VALVE

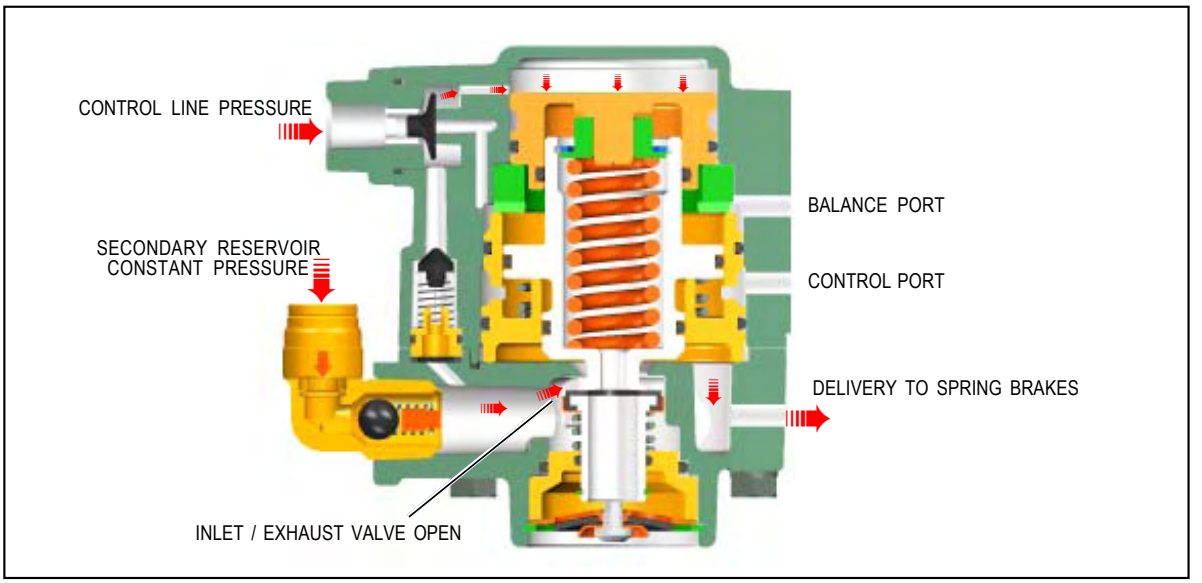

FIGURE 5 - CHARGING LESS THAN 107 PSI

CHARGING SPRING BRAKE ACTUATORS BELOW 107 PSI (FIGURE 5)

With the air brake system charged and the parking brakes released (by pushing the dash valve button in), air enters the park control port. This opens the SR-7 to supply air pressure to the spring brake chambers. As illustrated, air pressure in the chambers is below 107 psi (nominally).

CHARGING SPRING BRAKE ACTUATORS ABOVE 107 PSI (FIGURE 6)

Once the SR-7 valve delivery pressure reaches 107 psi (nominal), the inlet and exhaust are closed (valve lap position). This maintains the spring brake hold-off pressure at 107 psi (nominal).

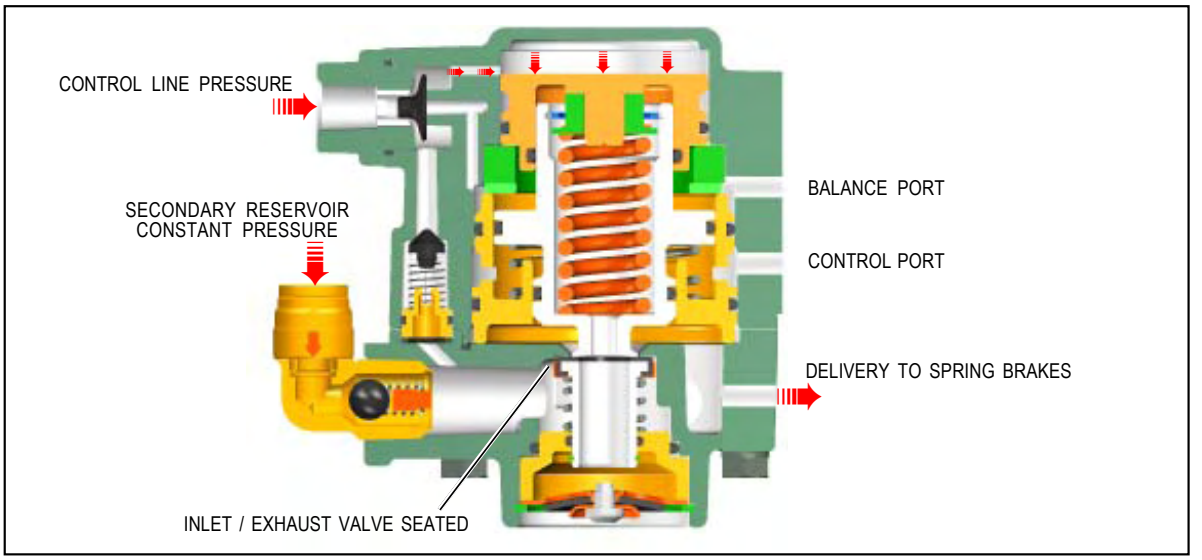

FIGURE 6 - CHARGING GREATER THAN 107 PSI

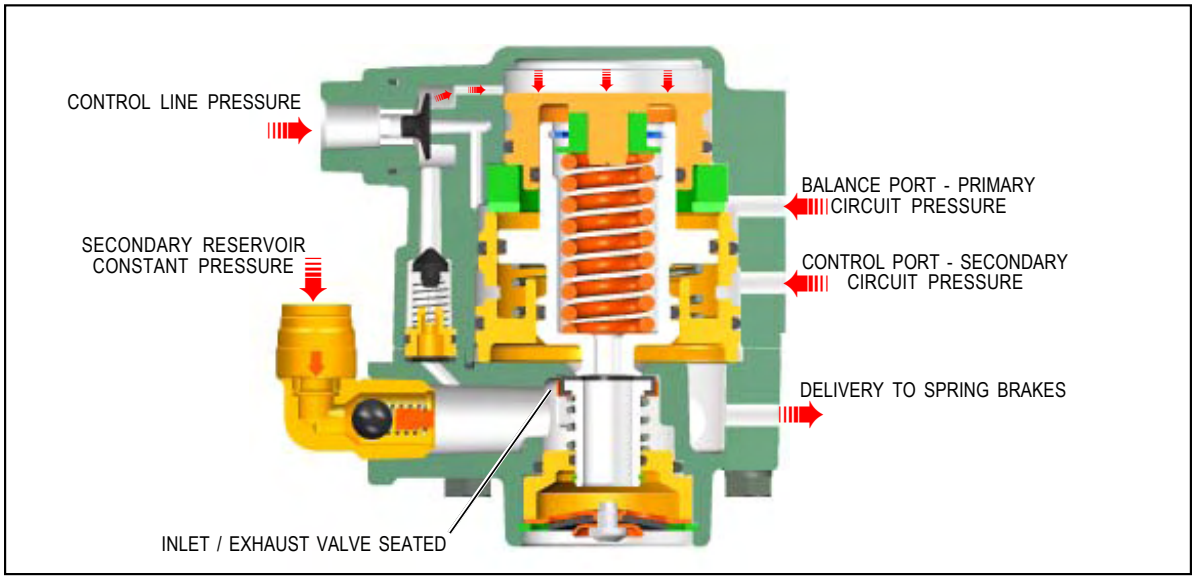

FIGURE 7 - NORMAL SERVICE APPLICATION

NORMAL SERVICE APPLICATION (FIGURE 7)

During a service brake application, the valve remains in the lap position. The SR-7 valve monitors the presence of air pressure in both primary and secondary delivery circuits.

PARKING (FIGURE 8)

Actuating the park brakes (by pulling the dash valve button out) exhausts spring brake air pressure through the SR-7 exhaust port.

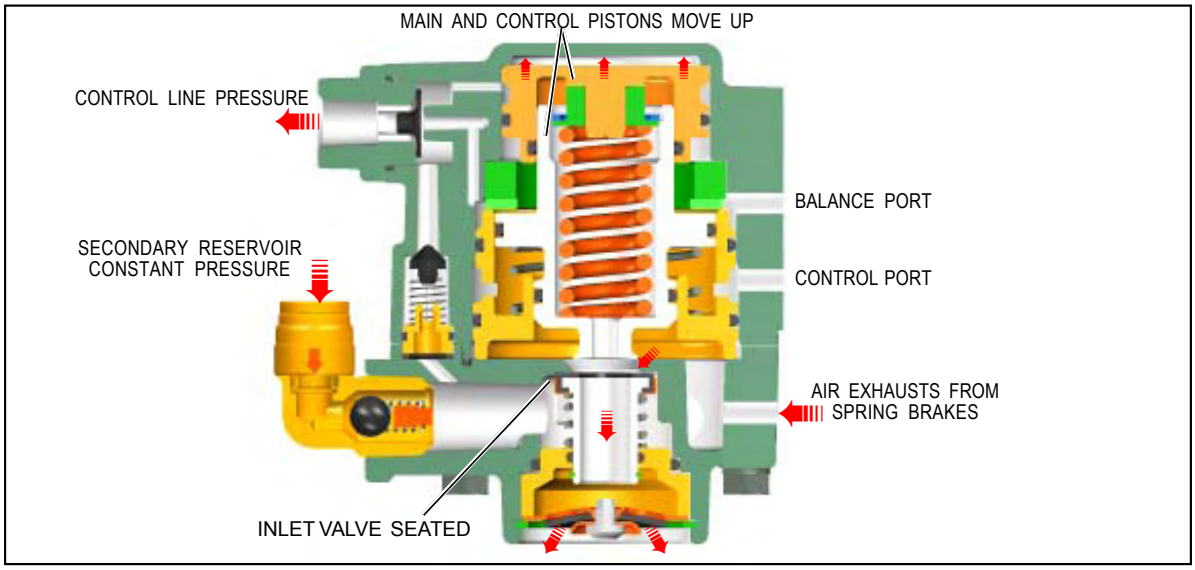

FIGURE 8 - PARKING

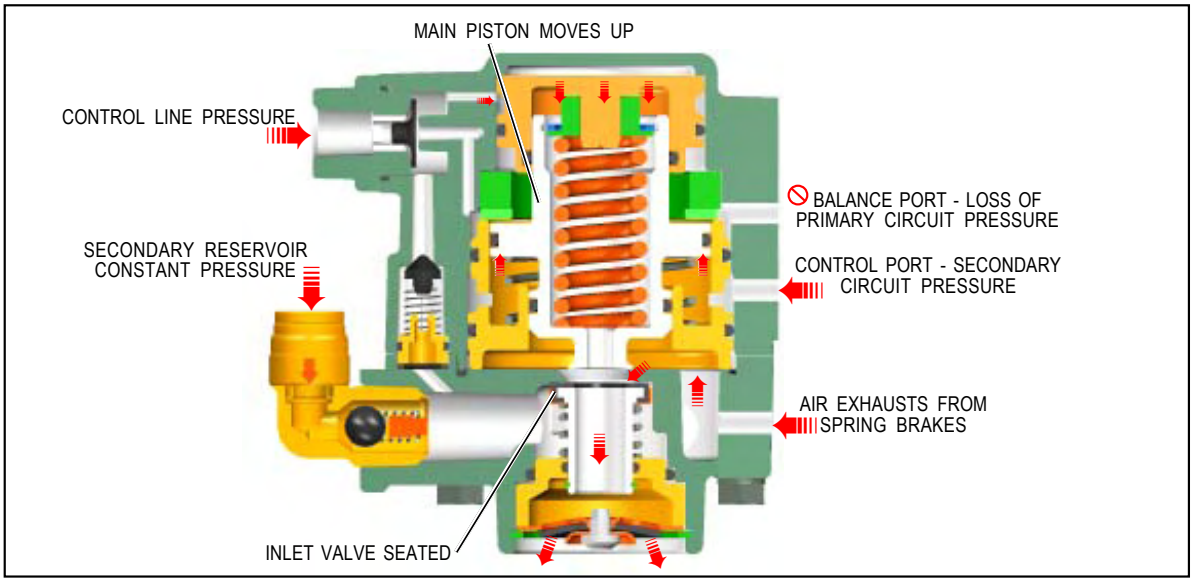

FIGURE 9 - SERVICE APPLICATION LOSS OF PRIMARY CIRCUIT

SERVICE APPLICATION WITH LOSS OF AIR IN PRIMARY CIRCUIT (FIGURE 9)

With the parking brakes released (dash valve button in) and the absence of air in the primary circuit delivery, a service brake application from the secondary circuit causes the pressure in the spring brakes to be exhausted proportionally to this application. This is known as spring brake modulation. A 30 psi service brake application will exhaust the spring brake pressure to approximately 60 psi.

SERVICE APPLICATION WITH LOSS OF AIR IN SECONDARY CIRCUIT (FIGURE 10)

With the parking brakes released (dash valve button in) and the absence of air in the secondary circuit reservoir, the external single check valve in the supply port seals to prevent air leakage to atmosphere from the SR-7 valve. The dash valve delivery air flows through the in-line single check valve and becomes SR-7 supply air. This air is delivered to maintain at least 107 psi (nominal) in the spring brake chambers.

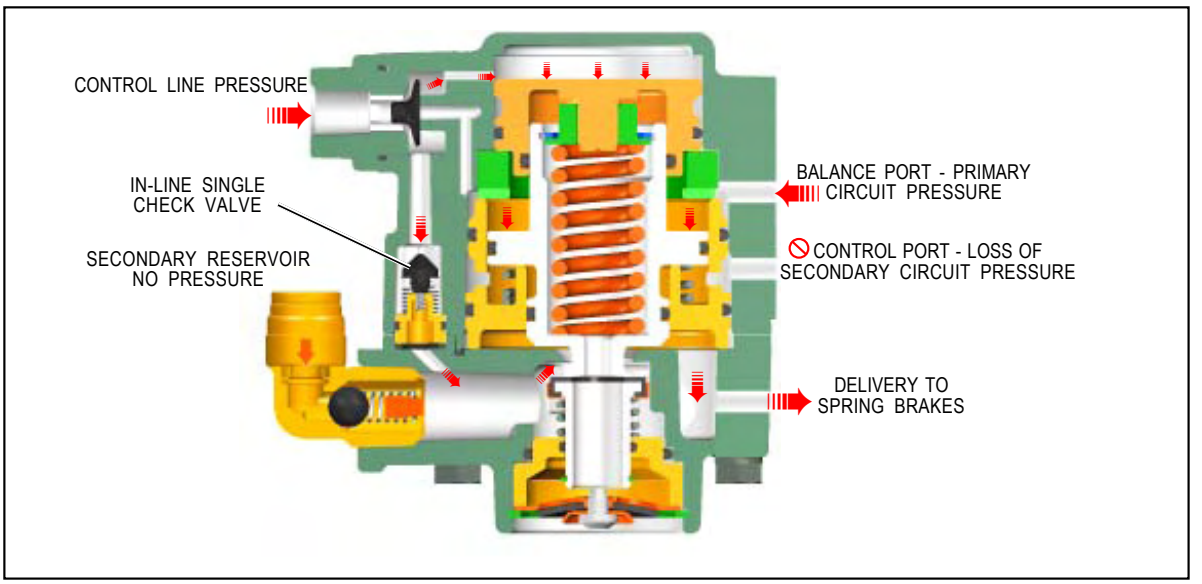

FIGURE 10 - SERVICE APPLICATION LOSS OF SECONDARY CIRCUIT

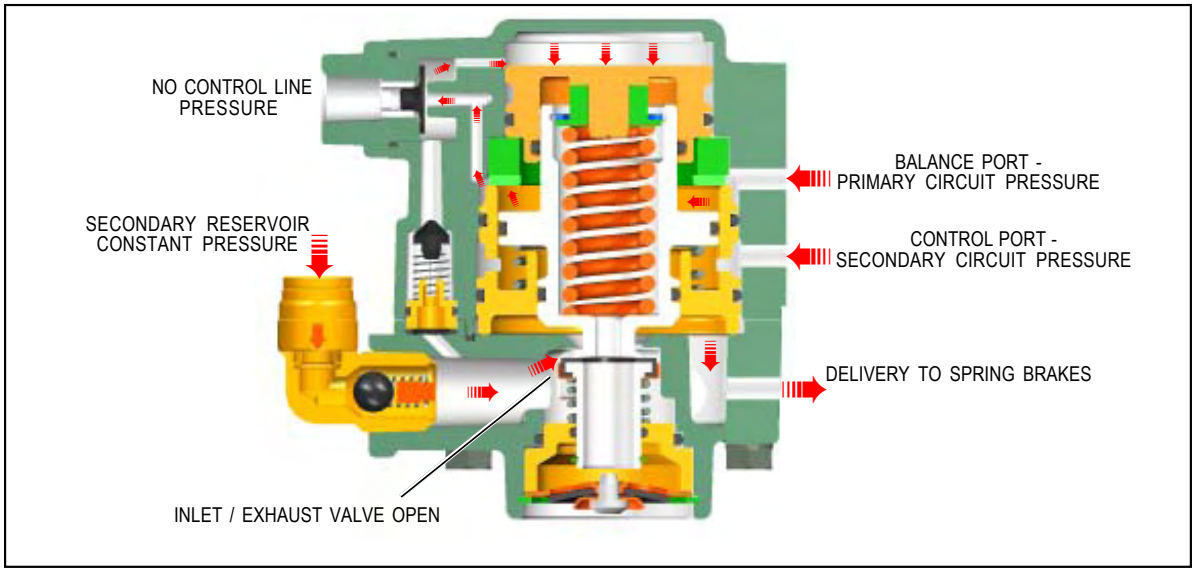

FIGURE 11 - ANTI-COMPOUNDING

ANTI COMPOUNDING (FIGURE 11)

The SR-7 provides anti-compounding of the service and spring brake forces. When the park brakes are actuated (by pulling the dash valve button out), a service brake application will cause the SR-7 to deliver air pressure to the spring brake chambers. Thus the vehicle is held stationary using a service brake application. When the service brake application is released, the delivery pressure is exhausted from the spring brake chambers and the vehicle remains parked using the spring brake actuators.

PREVENTIVE MAINTENANCE

Important: Review the warranty policy before performing any intrusive maintenance procedures. An extended warranty may be voided if intrusive maintenance is performed during this period.

Because no two vehicles operate under identical conditions, maintenance intervals will vary. Experience is a valuable guide in determining the best maintenance interval for a vehicle.

OPERATING TEST

Block vehicle and hold by means other than vehicle brakes. Charge air brake system to governor cut-out pressure.

1. Place parking control valve in “park” position. Observe that spring brake actuators apply promptly. Remove one line from delivery port of the SR-7 valve and install test gauge known to be accurate. Place parking control valve in “release” position. Observe that spring brake actuators release fully.
2. With parking control valve in “release” position, note gauge pressure reading. (Correct spring brake actuator hold-off pressure is 107 psi nominally.)
3. Place parking control valve in “park” position - gauge reading should drop to zero promptly. A lag (more than 3 seconds) in drop of pressure would indicate faulty operation.
4. With the parking control valve in the “park” position, gradually apply foot brake valve and note a pressure reading increase on the gauge installed in the SR-7 delivery port.
5. Place parking control valve in “release” position.
6. Drain the reservoir, which supplies the rear service brake circuit, apply the foot brake valve several times and note that pressure reading on gauge decreases each time foot brake valve is applied (spring brake modulation). After the foot brake valve has been applied several times, pressure on gauge will drop to the point where release of the spring brake actuators will no longer occur.

LEAKAGE TEST

Place the park control valve in the “release” position; using a soap solution, coat all ports including the exhaust port. A 1 inch bubble in three seconds is permitted.

If the valve does not function as described, or if leakage is excessive, it is recommended that it be replaced with a new or remanufactured unit available from a Bendix parts outlet. **DO NOT ATTEMPT TO DISASSEMBLE THE SR-7. THE VALVE CONTAINS HIGH SPRING FORCES THAT COULD RESULT IN PERSONAL INJURY IF DISASSEMBLY IS ATTEMPTED!**

SERVICING THE SR-7

IMPORTANT! PLEASE READ AND FOLLOW THESE INSTRUCTIONS TO AVOID PERSONAL INJURY OR DEATH.

When working on or around a vehicle, the following general precautions should be observed at all times:

1. **Park the vehicle on a level surface, apply the parking brakes, and always block the wheels.**
2. **Stop the engine when working around the vehicle.**
3. **If the vehicle is equipped with air brakes, make certain to drain the air pressure from all reservoirs before beginning ANY work on the vehicle.**
4. **Following the vehicle manufacturer's recommended procedures, deactivate the electrical system in a manner that removes all electrical power from the vehicle.**
5. **When working in the engine compartment the engine should be shut off. Where circumstances require that the engine be in operation, EXTREME CAUTION should be used to prevent personal injury resulting from contact with moving, rotating, leaking, heated, or electrically charged components.**
6. **Never connect or disconnect a hose or line containing pressure; it may whip. Never remove a component or plug unless you are certain all system pressure has been depleted.**
7. **Never exceed recommended pressures and always wear safety glasses.**
8. **Do not attempt to install, remove, disassemble or assemble a component until you have read and thoroughly understand the recommended procedures. Use only the proper tools and observe all precautions pertaining to use of those tools.**
9. **Use only genuine Bendix replacement parts, components, and kits. Replacement hardware, tubing, hose, fittings, etc. should be of equivalent size, type, and strength as original equipment and be designed specifically for such applications and systems.**
10. **Components with stripped threads or damaged parts should be replaced rather than repaired. Repairs requiring machining or welding should not be attempted unless specifically approved and stated by the vehicle or component manufacturer.**
11. **Prior to returning the vehicle to service, make certain all components and systems are restored to their proper operating condition.**

VALVE REMOVAL

1. Prior to removing the SR-7 apply the parking brakes and drain all the vehicle reservoirs.
2. Identify all air lines before disconnecting.
3. Remove the two mounting nuts that secure the valve to the frame rail and remove the valve.

VALVE INSTALLATION

1. Align the mounting studs with the mounting holes on the vehicle frame rail. Tighten the mounting nuts to 180-220 in. lbs.
2. Install the valve onto the vehicle ensuring all ports are connected as marked during disassembly.

TESTING THE REPLACEMENT SR-7 SPRING BRAKE MODULATING VALVE

Perform operating and leakage tests as outlined in "Operating Tests" section.

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Bendix

Service Data

SD-13-4815

EC-30 ABS / ATC CONTROLLER

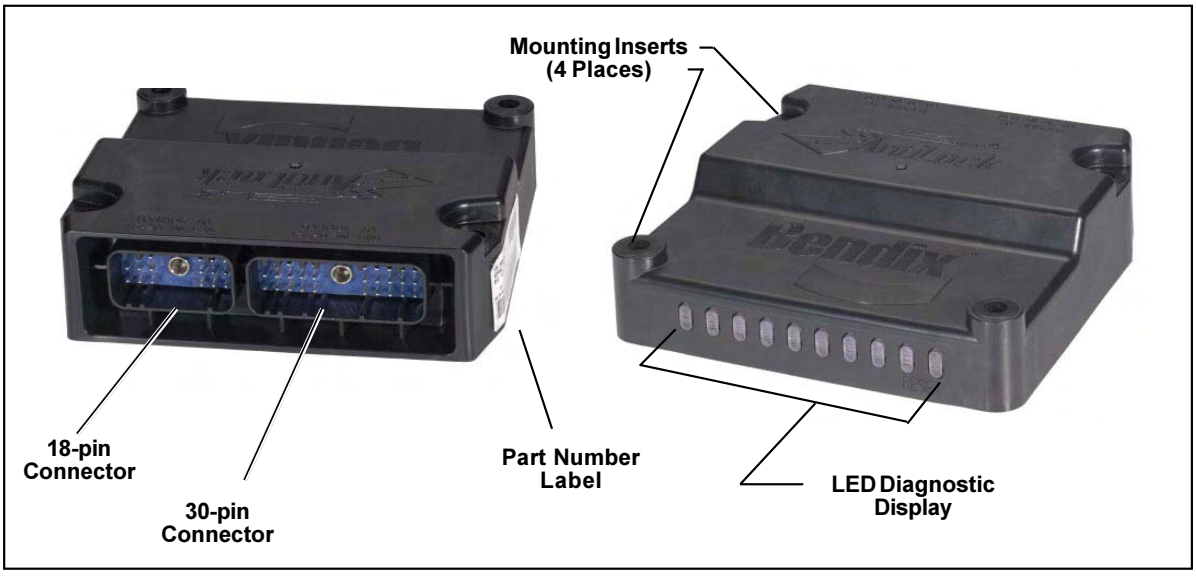

FIGURE 1 - EC-30 CONTROLLER

INTRODUCTION

The EC-30 is an electronic ABS (antilock braking system) controller. It is the base component in a family of ABS assemblies for heavy and medium duty buses, trucks and tractors utilizing pneumatic braking systems.

The ABS function of the EC-30 is designed to optimize slip on all vehicle wheels. The EC-30 provides the vehicle with improved stability and steerability during braking. The EC-30 will also reduce vehicle stopping distance on most surfaces.

In addition to the ABS function, the EC-30 can be configured to provide an ATC (automatic traction control) feature. Bendix ATC can improve vehicle traction during acceleration on adverse road conditions. ATC can utilize engine torque limiting and/or differential braking to improve vehicle traction.

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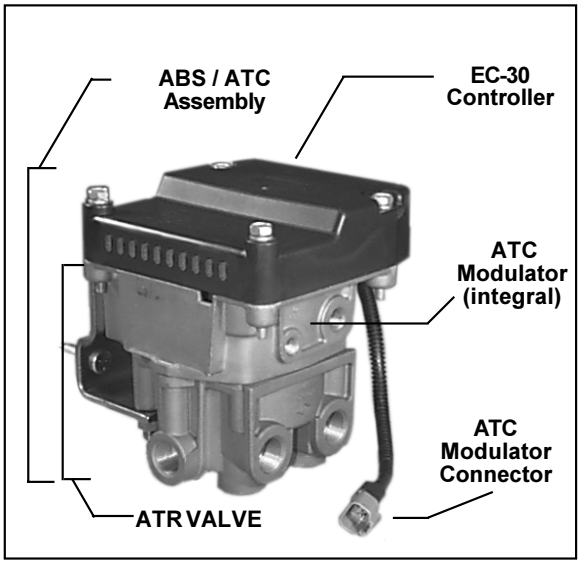

FIGURE 2 - EC-30 WITH ATR VALVE

COMPONENTS

The EC-30 ABS function utilizes the following components:

- Wheel speed sensors (4 or 6, depending on configuration)
- Electro-pneumatic ABS modulator valves (4)
- Dash mounted tractor ABS warning lamp (relay controlled)
- Service brake relay valve
- Dash mounted trailer ABS warning lamp (towing vehicles manufactured after March 1, 2001)
- Blink code activation switch (optional)

The EC-30 ATC function utilizes the following additional components:

- ATC modulator - Integral to the ATR (antilock/traction relay) valve assembly
- Dash mounted ATC active/warning lamp
- Serial communication to engine control module (interfaces with throttle input and engine torque)
- ATC enable/disable switch

ENCLOSURE

The EC-30 electronics are contained in a non-metallic housing and are environmentally protected by a hard epoxy potting compound. The design of the EC-30 electronics is robust against radio, electromagnetic and environmental interference.

A patented LED (light emitting diode) diagnostic display and magnetic reset switch are incorporated in the housing for simple, self-contained diagnostics.

The EC-30 utilizes a 30-pin and an 18-pin wire harness to interface with ABS, ATC and vehicle system components.

EC-30 Comparison to EC-16 and EC-17

The EC-30 has been designed to replace the EC-17 and the EC-16 as the standard Bendix ABS controller for OEM and aftermarket installations. The EC-30 has a black plastic enclosure similar to the EC-17. However, the EC-30 utilizes plastic mounting inserts to reduce mounting bolt corrosion, where the EC-17 utilizes metal mounting inserts. The EC-16 utilizes a totally metal enclosure.

The EC-30 ABS warning lamp power-up sequence has been simplified compared to the EC-17 and EC-16.

The EC-30 ABS warning lamp, at power-up without faults, will illuminate for 2.5 seconds and then turn off.

The ABS warning lamp for EC-17 and EC-16, at power-up without faults, will illuminate for approximately 8 seconds and flash twice before turning off.

ECU Model	Enclosure	ABS Warning Lamp Power-Up Sequence
EC-30	Plastic with Plastic Mounting Inserts	2.5 seconds on, then off
EC-17	Plastic with Metal Mounting Inserts	8 seconds on, two flashes, then off
EC-16	Metal Enclosure	8 seconds on, two flashes, then off

CHART 1 - ECU DIFFERENCES (EC-30, EC-17, EC-16)

MOUNTING

ECU Only

The EC-30 can be bracket mounted to the vehicle cab or chassis as a stand alone ECU. See figure 1.

Valve Mounted EC-30

The EC-30 can be assembled on one of four different valve models. The controller valve assembly is then mounted in place of the standard service brake relay valve on the vehicle. An assembly model designation is assigned when the EC-30 is mounted on an AR (antilock relay) valve or an ATR (antilock/traction relay) valve. See figure 2. Some models include bobtail proportioning and/or ATC functions. See chart 2.

EC-30 / Valve Assembly Models	ABS / ATR Valve	Added Function Provided	Vehicle Application
CR-30	AR-1	None	All
CR-30BP	AR-2	Bobtail Brake Proportioning	Tractors Only
AT-30	ATR-1	ATC	All
AT-30BP	ATR-2	ATC & Bobtail Brake Proportioning	Tractors Only

CHART 2 - EC-30 / VALVE ASSEMBLIES

EC-30 HARDWARE CONFIGURATIONS

The EC-30 ABS ECU is available in different hardware configurations in order to support various ABS, ATC and power line carrier (PLC) features. See chart 3.

EC-30 premium PLC hardware can be configured for four or six sensors, with or without ATC, and PLC can be disabled.

EC-30 basic models can not be configured for six sensors or ATC.

PLC hardware is needed to support PLC communication.

Always verify that you are working with the correct EC-30 by referring to the part number label on the ECU.

EC-30 WITH PLC

Effective March 1, 2001, all towing vehicles must control an in-cab trailer ABS warning lamp. Trailers built after this date will transmit the status of the trailer ABS unit over the power line (blue wire of the J560 connector) to the tractor using PLC communications.

The PLC signal is usually broadcasted by the trailer ABS ECU. The application of PLC technology for the heavy vehicle industry is known as PLC4Trucks. The Bendix EC-30 premium with PLC, and basic with PLC, will support PLC communication in accordance with SAE J2497.

Identifying an EC-30 with PLC

An EC-30 with or without PLC can be identified by the individual part number label on the ECU. Also, an EC-30 may have one of the following labels applied:

White Label:

ECU does not support an in-cab Trailer ABS warning lamp.

Orange Label:

ECU supports IN-CAB Trailer ABS warning lamp.

Measuring / Identifying the PLC Signal

An oscilloscope can be used to verify the presence of a PLC signal on the power line. The PLC signal is an amplitude and frequency modulated signal. Depending on the filtering and load on the power line, the PLC signal amplitude can range from 5.0 mVp-p to 7.0 Vp-p. Suggested oscilloscope settings are (AC coupling, 1 volt/div, 100 µsec/div). The signal should be measured at the power leads of the EC-30. See figures 3 & 4.

The EC-30 will not broadcast PLC messages unless it is specially programmed to do so. With this standard configuration, an ABS trailer equipped with PLC or a PLC diagnostic tool will need to be attached to the vehicle in order to generate a PLC signal on the power line.

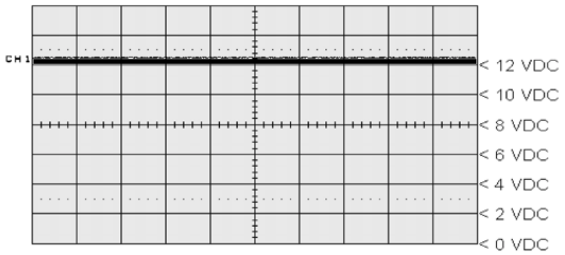

FIGURE 3 - POWER LINE WITHOUT PLC SIGNAL

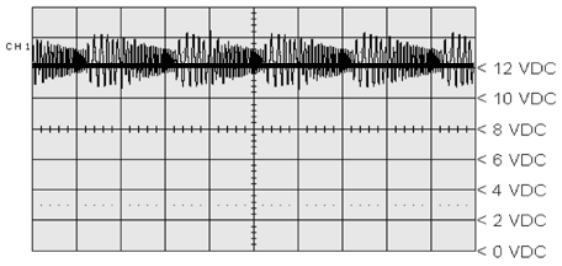

FIGURE 4 - POWER LINE WITH PLC SIGNAL

			Diagnostics			Engine Communication			
EC-30 Hardware Configurations	**Sensors**	**ATC**	**J1587**	**J1939**	**Blink Codes**	**J1922**	**J1939**	**PLC**	**Trailer ABS WL[1]**
Basic	4		X	X	X		X		
Premium	4, 6	X	X	X	X		X		
Basic PLC	4		X	X	X		X	X	X
Premium PLC	4, 6	X	X	X	X		X	X	X
EC-17/EC-16 Service Replacement	4, 6	X	X	X	X	X	X		

[1] Required for all towing vehicles built after March 1, 2001.

CHART 3 - EC-30 HARDWARE CONFIGURATIONS

EC-30 INPUTS

Power and Ground

Power is supplied to the EC-30 from the ignition circuit through a 30 Amp fuse. The EC-30 is grounded to the vehicle chassis. For EC-30 power and ground connector pin locations, see EC-30 system schematic, Figure 14.

Wheel Speed Sensors

Wheel speed data is provided to the EC-30 from the Bendix WS-20 wheel speed sensor. See figure 5 for WS-20 illustration. Working with an exciter ring, wheel speed sensors provide the EC-30 with an AC signal, which varies in voltage and frequency in relation to the speed of the wheel. The EC-30 can be configured to receive wheel speed information from 100 or 86 tooth exciter rings. Vehicle axle configurations and ATC features determine the number of speed sensors that must be used. A vehicle with a single rear drive axle (4x2, 4x4 or 6x2) requires four speed sensors for both ABS and ATC operation. A vehicle with two rear drive axles (6x4) can utilize six speed sensors for optimal ABS and ATC performance. For wheel speed sensor connector pin locations, see the EC-30 system schematic, Figure 14.

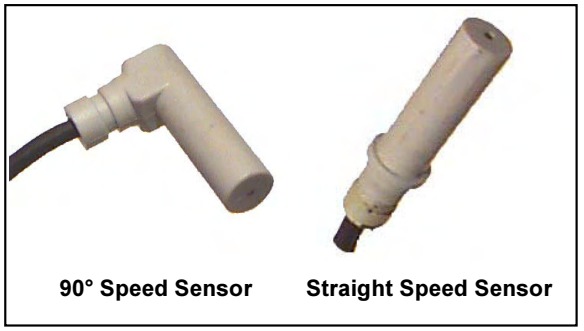

FIGURE 5 - WS-20 WHEEL SPEED SENSORS

ATC Enable/Disable Switch

Premium EC-30 models, configured for ATC, monitor an ATC enable/disable switch to +12 VDC, which allows ATC to be manually deactivated. The ATC active/warning lamp will be on while the ATC is disabled. Pin F2, of the 30-pin connector is the ATC enable/disable switch input.

J1939 - ATC Enable/Disable Switch

The EC-30 can be configured to receive the status of the ATC enable/disable switch over the SAE J1939 serial communications link. A vehicle controller will monitor the position of the ATC enable/disable switch directly, and broadcast a J1939 message indicating its status. When configured in this manner, there will be no wire installed in pin F2 of the 30-pin ECU connector. In the event that J1939 communications is lost between the EC-30 and the vehicle controller, the EC-30 will disable the ATC function.

Blink Code Switch

The EC-30 can be configured to support an optional diagnostic blink code switch to ground, which can be used to activate several functions available through blink code diagnostics. Pin F3, of the 30-pin connector, is the blink code switch input.

Three Position Switch for ATC and Blink Codes

The EC-30 can be configured to receive both the ATC enable/disable signal and the blink code activation signal from a single three-position switch. In this case, the common position of the switch is connected to pin F2 of the 30-pin connector. The normally-open switch position is connected to +12 VDC to disable ATC. The normally-open (momentary) switch position is connected to ground to activate blink codes. When configured in this manner, there is no wire installed in pin F3 of the 30-pin connector, which is normally used for the blink code switch input.

Brake Switch Input

The EC-30 can be configured to support an optional brake switch input. The brake switch input can be used in accordance with ABS and ATC performance. Pin A2, of the 18-pin connector, is the brake switch input.

EC-30 OUTPUTS

ABS Modulators

Bendix ABS modulators (M-21, M-22 or M-30) are controlled by the EC-30 to modify driver applied air pressure to the service brakes during ABS or ATC activation. See figure 6 for illustration. The ABS modulator, an electro-pneumatic control valve, is the last valve that air passes through on its way to the brake chamber. The modulator hold and exhaust solenoids are activated to precisely modify the brake pressure during ABS. The hold solenoid is normally open and the exhaust solenoid is normally closed. The EC-30 is able to control four individual modulator assemblies. For ABS modulator connector pin locations see the EC-30 system schematic, figure 13.

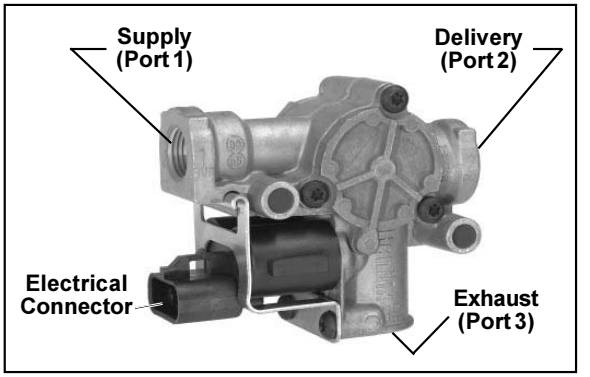

FIGURE 6 - M-30 MODULATOR

ATC Modulator

Premium EC-30 models configured for differential braking ATC will activate the ATC modulator during ATC situations. The ATC modulator is an electrically controlled air valve integral to the ATR valve. Pins D2 and D3, of the 18-pin connector, control the ATC modulator. A connection to the ATC modulator is provided via a two-pin Deutsch connector from the ATR valve. See figure 2.

ABS Warning Lamp

The EC-30 controls an ABS warning lamp to indicate the ABS unit status. The EC-30 provides a ground signal to activate an ABS warning lamp relay and turn the ABS lamp off. The actual ABS warning lamp is connected to the normally-closed contacts of the relay in order to illuminate in a fail-safe manner during an ABS ECU failure. Pin E3, of the 30-pin connector, is the ABS warning lamp output.

J1939 ABS Warning Lamp

The EC-30 can be configured to broadcast the ABS status over the SAE J1939 serial communications link. A vehicle dash controller directly controls the ABS warning lamp. When configured in this manner, there is no wire installed in pin E3 of the 30-pin connector. If J1939 communications is lost between the EC-30 and the vehicle dash controller, the dash controller will activate the ABS warning lamp.

Retarder Disable Relay

The EC-30 controls an engine or transmission retarder disable relay. The retarder activation wire is routed through the normally-closed contacts of the relay. The EC-30 provides a ground path to activate the relay and interrupt power to the retarder during ABS operation . This output may also connect directly to a transmission ECU. Pin K1, of the 30-pin connector, is the retarder disable relay output.

J1939/J1922 Retarder Disable

The EC-30 can be configured to interrupt the engine or transmission retarder over the SAE J1939 serial communications link. (J1922 for some service replacement models). The retarder will be disabled during ABS via the serial communications. When configured in this manner, there is no wire installed in pin K1 of the 30-pin connector. Use of the retarder disable function via the serial link may be essential to ABS performance and is highly recommended for vehicles equipped with a capable retarder.

J1939/J1922 Torque Converter Lock Disable

The EC-30 can be configured to interrupt the automatic transmission torque converter lock function, over the SAE J1939 serial communications link. (J1922 for some service replacement models). The converter lock will be disabled during ABS via the serial communications. Use of the torque converter lock disable function may be essential to ABS performance and is highly recommended for vehicles equipped with a capable transmission.

Trailer ABS Warning Lamp

EC-30 models with PLC can be configured to control a trailer ABS warning lamp (located in the dash) that indicates the status of the trailer ABS unit of one or more trailers or dollies. The EC-30 directly controls the trailer ABS warning lamp by providing a ground path when the lamp is to be activated. Pin E2, of the 30-pin connector, is the trailer ABS warning lamp output.

J1939/J1587 Trailer ABS Warning Lamp

The EC-30 can be configured to broadcast the trailer ABS status over the SAE J1939 or the SAE J1587 serial communications links. In this case, a vehicle controller will directly operate the trailer ABS warning lamp. When configured in this manner, there is no wire installed in pin E2 of the 30-pin connector. In the event that communications is lost between the EC-30 and the vehicle controller, the dash controller will activate the trailer ABS warning lamp.

J1708/J1587 Diagnostic Link (J1939)

The EC-30 provides a J1708/J1587 diagnostic link to communicate with the vehicle and various diagnostic tools. Diagnostics, system configuration, data uploading and downloading and other functions can be performed using this link. The EC-30 is supported by tools such as Bendix ABS Diagnostic Software, the Bendix DCI hand held tool and the MPSI ProLink. The EC-30 may also provide diagnostics using the SAE J1939 serial communications link.

J1939/1922 Engine Torque Reduction - ATC

The EC-30 can be configured to reduce engine torque over the SAE J1939 (J1922 for some service replacement models) serial communications link. The EC-30 will send a J1939 message to reduce engine torque during ATC operation.

ATC Active/Warning Lamp

Premium EC-30 models configured for ATC can control an ATC active/warning lamp to indicate the status of the ATC system. The ATC active/warning lamp flashes when ATC is active and stays on if an ATC system fault is detected or ATC is disabled by the ATC enable/disable switch. The EC-30 directly controls the ATC active/warning lamp by providing a ground path when the lamp is to be activated. Pin C2, of the 30-pin connector, is the ATC active/warning lamp output.

J1939 ATC Active/Warning Lamp

Premium EC-30 models configured for ATC can be configured to broadcast the status of the ATC active/warning lamp over the SAE J1939 serial communications link. In this case a vehicle dash controller directly operates the ATC active/warning lamp. When configured in this manner, there is no wire installed in pin C2 of the 30-pin connector. In the event that J1939 communications are lost between the EC-30 and the vehicle dash controller, the dash controller will activate the ATC active/warning lamp.

POWER-UP SEQUENCE

ABS Warning Lamp at Power-Up

At power-up without detected faults, the ABS warning lamp turns on for 2.5 seconds and then turns off. See figure 7.

ATC Active / Warning Lamp at Power-Up

At power-up, the ATC active/warning lamp displays the ATC control configuration and then turns off. A series of blinks indicates if the ATC is configured for engine torque limiting and differential braking, engine torque limiting only, or differential braking only. See figure 7.

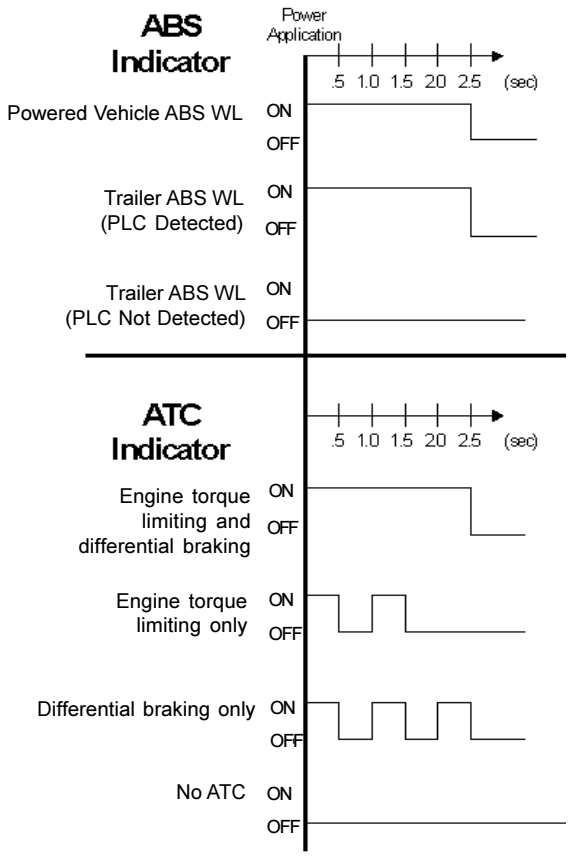

FIGURE 7 - EC-30 POWER-UP LAMP SEQUENCE

Trailer ABS Warning Lamp

At power-up, the trailer ABS warning lamp turns on for 2.5 seconds and then turns off. This only occurs if a PLC trailer or PLC diagnostic tool is connected to the tractor at the time ignition power is applied. Only an EC-30 with PLC installed on a towing vehicle will support the trailer ABS lamp.

Diagnostic LEDs at Power-Up

At power-up, the diagnostic LEDs all turn on, then display the configuration for sensors and the ATC. After showing the configuration, only the green VLT LED will stay on. However, if a fault is detected, the faulted component will be identified by the red LEDs. See chart 4.

LED Power-Up Sequence		LEDs
1st	When power is applied	All LEDs Illuminate
Then the LEDs indicate one of the following:		
2nd	4 Sensors	SEN-RER-FRT
	6 Sensors	SEN-RER-MID-FRT
Then the LEDs indicate one of the following:		
3RD	ATC Engine Limiting	TRC
	ATC Differential Braking	TRC-MOD
	No ATC	N/A
The LEDs will then indicate system status:		
4th	Normal Operation (if no faults)	VLT

CHART 4 - LED POWER-UP DISPLAY OF EC-30 CONFIGURATION

Retarder Disable Relay at Power-Up

At power-up, the EC-30 may toggle the retarder disable relay. If the relay is located in the cab it is usually audible to the operator.

Modulator Chuff Test at Power-Up

At power-up, the EC-30 activates a patented modulator chuff test. The modulator chuff test is an electrical and pneumatic ABS modulator test, that can assist the technician in verifying proper modulator wiring and installation. With brake pressure applied, a properly installed modulator causes a single sharp audible chuff of air pressure by activating the hold solenoid two times and the exhaust solenoid once. If the modulator is wired incorrectly, the modulator will produce a double chuff, or no chuff at all. The EC-30 activates a chuff at each modulator in the following sequence:

Right-Front, Left-Front, Right-Rear, Left-Rear. See figure 8.

The chuff sequence is then repeated for a total of 8 chuffs. If an issue is detected during the modulator chuff test, look for faults and compare the modulator wiring and plumbing to the EC-30 system schematic shown in figure 13.

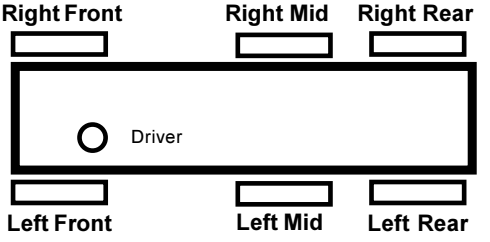

FIGURE 8 - VEHICLE ORIENTATION

ABS OPERATION

Bendix ABS uses wheel speed sensors, ABS modulators and an ECU to control either four or six wheels. By monitoring the wheel slip during braking, and adjusting the brake pressure at each wheel, the EC-30 is able to optimize slip between the tire and the road surface. When excessive wheel slip is detected, the EC-30 controller will activate ABS. The EC-30 controls the ABS modulators to simulate a driver pumping the brakes. However, the EC-30 controller is able to pump each brake on the vehicle independently, and with greater speed and accuracy than a driver.

Front Axle Control

Although both steering-axle wheels are controlled by individual ABS modulators, the EC-30 does not control them completely independently. The EC-30 uses a Modified Individual Regulation (MIR) philosophy which blends the applied braking force between the two steering axle brakes. MIR is used to minimize steering wheel pull while ABS is active on an uneven road surface (e.g. ice and asphalt).

Single Rear Axle Control

On vehicles with a single rear axle (4x2), the rear axle wheels are controlled independently. Therefore, brake application pressure at each wheel is adjusted according to the wheel behavior on the road surface.

Dual Rear Axle Control

For vehicles with dual rear axles (6x2 or 6x4), one ABS modulator controls both right wheels and the other modulator controls both left wheels. Both wheels on each side receive equal brake pressure during an ABS stop. In the case of only four wheel speed sensors, the two rear sensors are located on the lighter rear axle.

Normal Braking

During normal braking, brake pressure is delivered through the ABS modulator and into the brake actuator. If the wheel speed sensors do not detect an excessive slip, the EC-30 does not activate ABS control and the vehicle stops with normal braking.

ATC OPERATION

Just as ABS improves vehicle stability during braking, ATC improves vehicle stability and traction during vehicle acceleration. By adding an ATC modulator and/or engine communication, the EC-30 ATC function uses the same wheel speed information and modulator control as the ABS function. The EC-30 detects excessive drive wheel speed, compares the speed of the front, non-driven, wheels, and reacts to bring the wheel spin under control. The EC-30 can be configured to use engine torque limiting and/or differential braking to control wheel spin. For optimal ATC performance, both methods are recommended.

During ATC activation, the EC-30 will blink the ATC active/warning lamp to advise the driver that drive-wheel spin is occurring. When ATC is no longer active, the ATC active/warning lamp turns off.

Engine Torque Limiting ATC

The engine torque limiting feature allows the EC-30 to reduce engine torque to a suitable level, in relation to the amount of available traction. When the engine torque is controlled, wheel slip can be optimized, producing more traction between the wheel and road surface. Engine torque limiting is especially beneficial in avoidance of a power jackknife and when all drive wheels are on an equally slippery surface. The EC-30 will verify that the driver is pressing the accelerator (using J1939 or J1922) prior to initiating an ATC event.

In order for the engine torque limiting ATC feature to be used, the vehicle must be equipped with an electronically controlled engine and throttle. When configured for engine torque limiting ATC, the EC-30 must be connected to an electronic engine via the SAE J1939 or J1922 serial communications links.

Differential Braking ATC

Differential braking ATC allows the EC-30 to gradually apply the brake on a spinning drive wheel. Since the vehicle's differential tends to drive the wheel that presents the least resistance (the wheel on the most slippery surface), a slight brake application to this wheel forces the differential to drive the wheel on the opposite side. The EC-30 applies brake pressure to both rear-axle ABS modulators by energizing the ATC modulator. The EC-30 can then apply pressure only to the spinning wheel by controlling the ABS modulators.

Differential braking ATC can be activated only when vehicle speed is under 25 mph and one drive wheel is spinning faster than the others.

In the event that differential braking, ATC is active for an excessive time period, the EC-30 will disable ATC to prevent overheating and fading of brakes. The EC-30 will re-enable ATC after a short period of time. The ATC active/warning lamp will be on while the ATC is disabled.

In order for the differential braking control to be used, the vehicle must be equipped with an antilock/traction relay (ATR) valve (ATR-1 or ATR-2). The vehicle also must have an electronically controlled engine throttle.

ATC Enable/Disable Switch

The ATC enable/disable switch allows the operator to enable or disable the ATC feature as necessary. ATC can be disabled while the vehicle is stationary or in motion. However, ATC will not re-enable until the vehicle comes to a complete stop, even with the switch in the enable position. The ATC active/warning lamp will be on while the ATC is disabled.

AUTO-CALIBRATION

Auto-calibration is a feature that allows the EC-30 to compensate for tire size changes throughout the life of the vehicle. Auto-calibration is needed for proper ATC performance. The EC-30 will perform an auto-calibration when the tire size difference exceeds approximately 4 percent.

Tire size (rolling radius) setting information can be retrieved or adjusted by using Bendix ABS Diagnostics Software or MPSI.

If issues occur with the ATC function following a tire size change, contact Bendix or refer to your local authorized Bendix dealer.

EC-30 CONFIGURABLE PARAMETERS

The EC-30 has various configurable function parameters that can be enabled to provide the user with additional or customized features. The default settings for these parameters are chosen by the vehicle OEM. The configurable features include serial communications message broadcasts, alternative lamp control, various I/O recognition, ABS control settings and others. To ensure that the unit you are working with has the correct default settings, use only the correct replacement part number. However, most of these settings can be altered using the Bendix ABS Diagnostic Software program. For further information, contact Bendix or refer to your local authorized Bendix dealer.

EC-30 SELF-CONFIGURATION

The self-configuration feature allows wheel speed sensor and ATC configurations to be altered when activated with a magnet or diagnostic tool. This is generally performed shortly after installing or replacing an EC-30.

Self-Configuration of Wheel Speed Sensors

The number of speed sensors connected to the EC-30 will be detected during the self-configuration process. The EC-30 will configure for six sensors if it detects one or both Mid sensors. If only one Mid sensor is detected, the ABS warning lamp and appropriate diagnostic LEDs will illuminate following the self-configure. If no Mid sensors are detected, the EC-30 will configure for four sensors.

Self-Configuration of ATC

In order to self-configure for engine torque limiting ATC, the following must be connected to the EC-30 and be operational:

- J1939 or J1922 communication link to the engine
- ATC active/warning lamp
- ATC enable/disable switch (must be toggled prior to self-configuration)

In order to self-configure for differential braking ATC, the ATC modulator must also be connected to the EC-30 and be operational.

Some EC-30 part numbers will not support six wheel speed sensors or ATC. To insure that the EC-30 you are working with has the correct hardware capability, use only the correct replacement part number.

EC-30 Self-Configuration Procedure

Verify that all ECU, communication, sensor, ABS modulator and ATC modulator connectors are in place and then turn the ignition power on. Toggle the ATC enable/disable switch, if equipped.

Activate a EC-30 self-configuration by one of the following actions:

- Hold a magnet on the reset location of the diagnostic display for about 20 seconds (until the LEDs begin to rapidly roll), then remove the magnet.
- Press the DCI reset switch for about 20 seconds (until the LEDs begin to rapidly roll), then release the switch.
- Use the self-configuration menu selection on Bendix ABS Diagnostic Software or the MPSI tool.

When the self-configuration process is complete, the EC-30 will automatically go through the power-up sequence and show the new configuration on the diagnostic display. If the EC-30 was properly configured for ATC, the ATC active/warning lamp will also show the ATC configuration. Refer to the EC-30 Power-Up Sequence section.

FAULT DETECTION

The EC-30 contains self-testing diagnostic circuitry that continuously checks for proper operation of the ABS/ATC components and wiring. The EC-30 controls dash mounted warning lamps to advise the driver of the status of the system.

When the EC-30 senses an erroneous system condition, it stores the fault code in memory, activates the appropriate warning lamp and disables all or part of the effected ABS or ATC functions. The faulted component is also identified on the diagnostic display on the EC-30.

In most cases, the EC-30 will automatically reset (self-heal) the active fault code when the fault is corrected. However, repeated occurrences of a given fault will cause the fault code to latch. Once the fault code is latched, a manual reset is required. Latching of faults can assist in the troubleshooting of intermittent faults. The fault code is stored in the EC-30 memory, even when power is removed.

After repair, latched fault codes can be reset by briefly holding a magnet on the reset location of the EC-30 diagnostic display. Fault codes can also be reset with the blink code switch or with a diagnostic tool.

When a fault self-heals or is manually reset, the fault code remains in fault history. Fault history can be retrieved by using blink code diagnostics or a diagnostic tool.

ABS PARTIAL SHUTDOWN

Depending which component the fault is detected on, the ABS and ATC functions may be fully or partially disabled. Even with the ABS warning lamp on, the EC-30 may still provide ABS function on wheels that are not affected by the fault. The EC-30 should be serviced as soon as possible.

Front ABS Modulator Fault

ABS on the affected wheel is disabled. ABS and ATC on all other wheels remains active.

Rear ABS Modulator Fault

ATC is disabled. ABS on the affected wheel is disabled. ABS on all other wheels remains active.

Front Wheel Speed Sensor Fault

The faulted wheel is still controlled by using input from the remaining wheel speed sensor on the front axle. ABS remains active on the rear wheels. ATC is disabled.

Mid or Rear Wheel Speed Sensor Fault

ATC is disabled. In a four sensor system, ABS on the affected wheel is disabled, but ABS on all other wheels remains active.

In a six sensor system, ABS remains active by using input from the remaining rear wheel speed sensor on the same side.

ATC Modulator Fault

ATC is disabled. ABS remains active.

J1939/J1922 Communication Fault

ATC is disabled. ABS remains active.

ECU Fault

ABS and ATC are disabled. The system reverts to normal braking.

Voltage Fault

While voltage is out of range, ABS and ATC are disabled. The system reverts to normal braking. When the correct voltage level is restored, full ABS and ATC function is available. Operating voltage range is 9.0 to 16.0 VDC.

EC-30 DIAGNOSTIC DISPLAY

The EC-30 diagnostic display consists of nine red fault LEDs, one green power LED and an internal, magnetic reset switch. See figure 9 for illustration.

No tools are needed to read the EC-30 diagnostic display. A fault displayed on the LEDs will always be accompanied by the illumination of the ABS warning lamp and/or the ATC active/warning lamp.

Reading a Fault

When a fault is detected, the EC-30 identifies the faulted component with the diagnostic LEDs. When a wheel speed sensor fault, or an ABS modulator fault is detected, the SEN or MOD LED will be accompanied by two location LEDs. An example is FRT-RHT-SEN. When these three LEDs are on, this is an indication of a fault on the front axle(FRT), right side(RHT), wheel speed sensor(SEN). For a complete explanation and troubleshooting of faults displayed by the LEDs, go to section F, Troubleshooting .

The red diagnostic LEDs only indicate active system faults. When a fault self-heals or is manually reset, the fault code remains in fault history. Fault history can be retrieved by using blink code diagnostics or a diagnostic tool.

If faults occur on multiple components, the diagnostic LEDs will display one fault at a time. When the first fault is repaired and the EC-30 is reset, the next fault will be displayed on the LEDs.

Fault Reset

After the fault is corrected, the active fault code and LEDs can be reset by briefly holding a magnet in place at the RESET location of the diagnostic display. All of the LEDs will be on while the magnet is held in place. If one or more LEDs do not go on when the magnet is in place, replace the EC-30. When the magnet is removed from the reset location, only the green VLT diagnostic LED should remain on. If red LEDs are still on, active faults are still present in the system.

Note: An EC-30 self-configuration will occur if a magnet is held at the reset location for greater than 20 seconds.

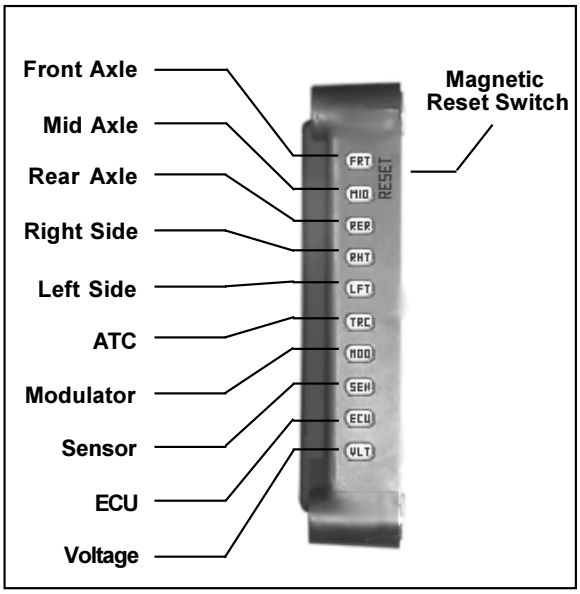

FIGURE 9 - EC-30 LED DIAGNOSTIC DISPLAY

BLINK CODE DIAGNOSTICS

The EC-30 provides diagnostic and configuration functions using blink code diagnostics. When the blink code mode is activated, the EC-30 flashes the ABS warning lamp to communicate active fault codes, fault code history or, ABS and ATC configurations. The blink code diagnostics mode can also be used to reset active fault codes. See chart 5.

The ABS warning lamp illuminates while the blink code switch is pressed. The lamp turns off when the blink code switch is released. The blink code switch is optional and may not be installed on some vehicles (pin F3 of the 30-pin connector).

Following a single display of all available messages, the ABS warning lamp remains on for five seconds and then returns to the normal operating mode. Fault occurrence count information is not displayed with blink code diagnostics.

If wheel speeds are detected during the blink code diagnostics mode, the EC-30 exits the blink code diagnostics and returns to the normal operating mode. The blink code diagnostics mode can only be activated following a power-up, where wheel speeds have not been detected.

Press the Blink Code Switch	Blink Code Action
1 time	Display Active Fault Codes
2 times	Display Fault Code History
3 times	Reset Active Fault Codes
4 times	Display EC-30 Configuration

CHART 5 - BLINK CODE ACTIVATION

Display Active Fault Codes

To display active fault codes, press the blink code switch one time. Following activation, there will be a three second delay, followed by a blink code display of all active fault codes. See chart 7 for fault code definitions.

Display Fault Code History

To display history fault codes, press the blink code switch two times. Following activation, there will be a three second delay, followed by a blink code display of all history fault codes. See chart 7 for fault code definitions.

Reset Active Fault Codes

To reset active fault codes, press the blink code switch three times. Following activation, there will be a three second delay, followed by a blink code message of:

1-1, (System Fully Operational - No Faults Detected)

or

A blink code display of all active fault codes.

The ABS warning lamp will stay on if active faults are still present. See chart 7 for fault code definitions.

Resetting active fault codes with blink code diagnostics does not clear information from the fault history. Fault history can be retrieved by using blink code diagnostics or a diagnostic tool.

Display EC-30 Configuration

To check the ECU configuration, press the blink code switch four times. Following activation, there will be a three second delay, followed by a blink code display of the EC-30 configuration. See chart 6.

1st Digit	Sensors
2	4 Sensors
3	6 Sensors
2nd Digit	Modulators
2	4 Modulators
3rd Digit	ATC
2	Not ATC
3	ATC Engine Torque Limiting Only
4	ATC Differential Brake Only
5	Full ATC (Engine Torque Limiting and Differential Braking)

CHART 6 - BLINK CODES FOR EC-30 CONFIGURATION

1st Digit	2nd Digit	Fault Description	Repair Information	J1587 (SID)	J1587 (FMI)
1	1	No Faults	System Fully Operational - No Faults Detected		
Power / ABS Controller					
1	2	Battery Voltage Too High	Check for corrosion or damaged power wiring and connectors. Verify that ABS unit is powered by a 12-volt supply.	251	3
1	3	Battery Voltage Too Low	Check for corrosion or damaged power wiring and connectors. Measure voltage under load to insure proper levels.	251	4
1	4	ABS Controller Fault (2)	Check for corrosion or damaged power wiring and connectors. Clear/reset faults. If fault returns, replace ECU.	254	2
1	5	ABS Controller Fault (6)		254	6
1	6	ABS Controller Fault (7)		254	7
1	7	ABS Controller Fault (9)		254	9
1	8	ABS Controller Fault (10)		254	10
1	9	ABS Controller Fault (11)		254	11
1	10	ABS Controller Fault (12)		254	12
1	11	ABS Controller Fault (13)		254	13
1	12	ABS Controller Fault (14)		254	14
1	13	ABS Controller Fault (1)		254	1
1	14	ABS Controller Fault (3)		254	3
1	15	ABS Controller Fault (8)		254	8
Wheel Speed Sensors					
2	1	LF Sensor Start	Sensor output low during low-speed vehicle operation. Adjust speed sensor to contact tone ring. Rotate wheel and verify minimum 0.8 volts AC sensor output @ 1 RPS. Verify condition and retention force of sensor clip. Verify proper sensor lead routing and clamping.	1	1
3	1	RF Sensor Start		2	1
4	1	LR Sensor Start		3	1
5	1	RR Sensor Start		4	1
6	1	LM Sensor Start		5	1
7	1	RM Sensor Start		6	1
2	2	LF Sensor Intermittent	Intermittent sensor output. Adjust speed sensor to contact tone ring. Verify condition of tone ring mounting and teeth. Rotate wheel and verify minimum 0.8 volts AC sensor output @ 1 RPS. Verify condition and retention force of sensor clip. Verify proper sensor lead routing and clamping.	1	2
3	2	RF Sensor Intermittent		2	2
4	2	LR Sensor Intermittent		3	2
5	2	RR Sensor Intermittent		4	2
6	2	LM Sensor Intermittent		5	2
7	2	RM Sensor Intermittent		6	2
2	3	LF Sensor Shorted to VBAT	Check for corroded or damaged sensor and ECU wiring and connectors. Verify +12V is not measured at either sensor lead.	1	3
3	3	RF Sensor Shorted to VBAT		2	3
4	3	LR Sensor Shorted to VBAT		3	3
5	3	RR Sensor Shorted to VBAT		4	3
6	3	LM Sensor Shorted to VBAT		5	3
7	3	RM Sensor Shorted to VBAT		6	3
2	4	LF Sensor Shorted to Ground	Check for corroded or damaged sensor and ECU wiring and connectors. Verify no continuity from sensor leads to ground.	1	4
3	4	RF Sensor Shorted to Ground		2	4
4	4	LR Sensor Shorted to Ground		3	4
5	4	RR Sensor Shorted to Ground		4	4
6	4	LM Sensor Shorted to Ground		5	4
7	4	RM Sensor Shorted to Ground		6	4
2	5	LF Sensor Open	Check for corroded or damaged sensor and ECU wiring and connectors. Verify 1500-2500 OHMS across sensor leads.	1	5
3	5	RF Sensor Open		2	5
4	5	LR Sensor Open		3	5
5	5	RR Sensor Open		4	5
6	5	LM Sensor Open		5	5
7	5	RM Sensor Open		6	5

CHART 7 - EC-30 BLINK CODE DEFINITIONS (1 of 3)

1st Digit	2nd Digit	Fault Description	Repair Information	J1587 (SID)	J1587 (FMI)
Wheel Speed Sensors					
2	6	LF Sensor Shorted Across Sensor	Check for corroded or damaged sensor and ECU wiring and connectors. Verify 1500-2500 OHMS across sensor leads.	1	6
3	6	RF Sensor Shorted Across Sensor		2	6
4	6	LR Sensor Shorted Across Sensor		3	6
5	6	RR Sensor Shorted Across Sensor		4	6
6	6	LM Sensor Shorted Across Sensor		5	6
7	6	RM Sensor Shorted Across Sensor		6	6
2	7	LF Sensor Lock Time Out	Sensor output low or missing during vehicle operation above 10 mph. Verify condition of tone ring mounting. Adjust speed sensors to contact tone ring. Rotate wheel and verify minimum 0.8 volts AC sensor output @ 1 RPS. Verify condition and retention force of sensor clips. Verify proper sensor lead routing and clamping.	1	7
3	7	RF Sensor Lock Time Out		2	7
4	7	LR Sensor Lock Time Out		3	7
5	7	RR Sensor Lock Time Out		4	7
6	7	LM Sensor Lock Time Out		5	7
7	7	RM Sensor Lock Time Out		6	7
2	8	LF Sensor Frequency Doubling	Verify condition and retention force of sensor clips. Check for corroded or damaged sensor and ECU wiring and connectors. Verify no continuity from sensor leads to ground. Verify sensor leads are a twisted pair.	1	8
3	8	RF Sensor Frequency Doubling		2	8
4	8	LR Sensor Frequency Doubling		3	8
5	8	RR Sensor Frequency Doubling		4	8
6	8	LM Sensor Frequency Doubling		5	8
7	8	RM Sensor Frequency Doubling		6	8
2	9	LF Sensor High Frequency Noise	Verify condition and retention force of sensor clips. Check for corroded or damaged sensor and ECU wiring and connectors. Verify no continuity from sensor leads to ground. Verify sensor leads are a twisted pair.	1	9
3	9	RF Sensor High Frequency Noise		2	9
4	9	LR Sensor High Frequency Noise		3	9
5	9	RR Sensor High Frequency Noise		4	9
6	9	LM Sensor High Frequency Noise		5	9
7	9	RM Sensor High Frequency Noise		6	9
2	10	LF Sensor Wobble Run	Sensor output intermittent or excessive wobble in exciter ring. Verify condition of tone ring mounting and teeth. Verify proper adjustment of wheel bearings. Adjust speed sensor to contact tone ring. Rotate wheel and verify minimum 0.8 volts AC sensor output @ 1 RPS. Verify condition and retention force of sensor clip. Verify proper sensor lead routing and clamping.	1	10
3	10	RF Sensor Wobble Run		2	10
4	10	LR Sensor Wobble Run		3	10
5	10	RR Sensor Wobble Run		4	10
6	10	LM Sensor Wobble Run		5	10
7	10	RM Sensor Wobble Run		6	10
4	11	LR Sensor Gross Mismatch	Tire Size Mismatch. Verify correct tire size as desired. Verify proper tire inflation. Verify proper number of tone ring teeth per sensed wheel. Verify proper wheel rolling radius setting in ECU.	3	13
5	11	RR Sensor Gross Mismatch		4	13
6	11	LM Sensor Gross Mismatch		5	13
7	11	RM Sensor Gross Mismatch		6	13
2	12	LF Sensor Abnormal Speed	Adjust speed sensor to contact tone ring. Verify proper number of tone ring teeth per sensed wheel. Rotate wheel and verify minimum 0.8 volts AC sensor output @ 1 RPS. Verify condition and retention force of sensor clip. Verify proper sensor lead routing and clamping. Verify condition of tone ring mounting and teeth.	1	12
3	12	RF Sensor Abnormal Speed		2	12
4	12	LR Sensor Abnormal Speed		3	12
5	12	RR Sensor Abnormal Speed		4	12
6	12	LM Sensor Abnormal Speed		5	12
7	12	RM Sensor Abnormal Speed		6	12

CHART 7 - EC-30 BLINK CODE DEFINITIONS (2 of 3)

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1st Digit	2nd Digit	Fault Description	Repair Information	J1587 (SID)	J1587 (FMI)
ABS Modulators					
8	1	LF Modulator Lock Time Out	No wheel response to ABS command. Verify proper modulator activation with brake pressure applied, at power-up (Chuff Test) and/or using diagnostic tool. Possible slow brake release. Check for dragging brakes, dry bearings, faulty return springs, parking brake system faults, restricted brake air lines, over adjusted slacks, out-of-round drums or damaged/loose tone rings.	7	7
8	7	RF Modulator Lock Time Out		8	7
9	1	LR Modulator Lock Time Out		9	7
9	7	RR Modulator Lock Time Out		10	7
8	2	LF Modulator Open / Shorted to GND	Check for corroded or damaged modulator wiring and connections. Verify 3.5 to 5.0 OHMS across HOLD/COMMON. Verify 3.5 to 5.0 OHMS across EXHAUST/COMMON. Verify 7.0 to 10.0 OHMS across EXHAUST/HOLD. Verify no continuity from modulator leads to ground.	7	5
8	8	RF Modulator Open / Shorted to GND		8	5
9	2	LR Modulator Open / Shorted to GND		9	5
9	8	RR Modulator Open / Shorted to GND		10	5
8	3	LF Modulator Shorted to Ground	Check for corroded or damaged modulator wiring and connections. Verify no continuity from modulator leads to ground. Verify 3.5 to 5.0 OHMS across HOLD/COMMON. Verify 3.5 to 5.0 OHMS across EXHAUST/COMMON. Verify 7.0 to 10.0 OHMS across EXHAUST/HOLD.	7	6
8	9	RF Modulator Shorted to Ground		8	6
9	3	LR Modulator Shorted to Ground		9	6
9	9	RR Modulator Shorted to Ground		10	6
8	4	LF Modulator Shorted Solenoid	Check for corroded or damaged modulator wiring and connections. Verify 3.5 to 5.0 OHMS across HOLD/COMMON. Verify 3.5 to 5.0 OHMS across EXHAUST/COMMON. Verify 7.0 to 10.0 OHMS across EXHAUST/HOLD.	7	14
8	10	RF Modulator Shorted Solenoid		8	14
9	4	LR Modulator Shorted Solenoid		9	14
9	10	RR Modulator Shorted Solenoid		10	14
8	5	LF Modulator Shorted to VBAT	Check for corroded or damaged modulator wiring and connections. Verify +12V is not measured at any modulator lead. Verify 3.5 to 5.0 OHMS across HOLD/COMMON. Verify 3.5 to 5.0 OHMS across EXHAUST/COMMON. Verify 7.0 to 10.0 OHMS across EXHAUST/HOLD.	7	3
8	11	RF Modulator Shorted to VBAT		8	3
9	5	LR Modulator Shorted to VBAT		9	3
9	11	RR Modulator Shorted to VBAT		10	3
8	6	LF Modulator Shorted Between	Check for corroded or damaged modulator wiring and connections. Verify 3.5 to 5.0 OHMS across HOLD/COMMON. Verify 3.5 to 5.0 OHMS across EXHAUST/COMMON. Verify 7.0 to 10.0 OHMS across EXHAUST/HOLD.	7	8
8	12	RF Modulator Shorted Between		8	8
9	6	LR Modulator Shorted Between		9	8
9	12	RR Modulator Shorted Between		10	8
Retarder Relay Control					
10	1	Retarder Relay Open	Check ABS retarder control relay wiring and connections. Verify proper activation of ABS retarder control relay at power-up.	13	5
10	2	Retarder Relay Shorted		13	6
ATC - Traction Control					
10	5	Traction Modulator Open	Check for corroded or damaged modulator wiring and connections. Verify 10.0 to 12.0 OHMS across the traction modulator leads.	18	5
10	6	Traction Modulator Shorted to Ground	Check for corroded or damaged modulator wiring and connections. Verify no continuity from traction modulator leads to ground. Verify 10.0 to 12.0 OHMS across the traction modulator leads.	18	6
10	7	Traction Modulator Shorted	Check for corroded or damaged modulator wiring and connections. Verify 10.0 to 12.0 OHMS across the traction modulator leads.	18	14
10	8	Traction Modulator Shorted to VBAT	Check for corroded or damaged modulator wiring and connections. Verify +12V is not measured at any traction modulator lead. Verify 10.0 to 12.0 OHMS across the traction modulator leads.	18	3
Lamps					
10	9	Traction Lamp Open	Check traction lamp wiring and connections. Verify proper illumination of traction lamp at power-up.	24	5
10	10	Traction Lamp Shorted		24	6
10	11	ABS - Warning Lamp Open	Check ABS warning lamp (or ABS warning lamp relay) wiring and connections. Verify proper illumination of warning lamp at power-up.	23	5
10	12	ABS - Warning Lamp Shorted		23	6
11	1	Trailer ABS - Warning Lamp Open (Dash Mounted)	Check ABS warning lamp wiring and connections. Verify proper illumination of warning lamp at power-up.	81	5
11	2	Trailer ABS - Warning Lamp Shorted (Dash Mounted)		81	6
Engine Serial Communications					
11	3	J1939 Data Link Retarder Communication Fault	ECU not communicating with vehicle retarder. Check J1939 wiring and connections to ECU. Verify correct retarder control setting in ECU.	231	12
11	4	J1939 Data Link Engine Communication Fault	ECU not communicating with engine. Check J1939 wiring and connections to ECU. Verify correct engine communications link setting in ECU.	231	5
11	5	J1922 Data Link Engine Communication Fault	ECU not communicating with engine. Check J1922 wiring and connections to ECU. Verify correct engine communications link setting in ECU.	249	5
11	6	J1922 Data Link Retarder Communication Fault	ECU not communicating with vehicle retarder. Check J1922 wiring and connections to ECU. Verify correct retarder control setting in ECU.	249	12

CHART 7 - EC-30 BLINK CODE DEFINITIONS (3 of 3)

BENDIX DCI DIAGNOSTIC TOOL

The Bendix Diagnostic Communication Interface (DCI) is a hand held diagnostic tool that was designed for use with the Bendix EC-17 system and can also be used as a stand alone diagnostic tool for the EC-30. See figure 10 for illustration. The Bendix DCI has the same 10 diagnostic LEDs as the EC-30. A reset button on the DCI duplicates the function of the magnetic reset on the EC-30. There are also two DCI status indicators to indicate power and active communication to the DCI.

To perform diagnostics using the Bendix DCI, plug the DCI into the vehicle's J1587 diagnostic link connector. This connector is generally located on the lower, driver-side portion of the vehicle dash or under the dash panel. See figure 11 for connector location.

Note: The DCI is not RP-1210 compliant and can not be used as the communication link to any diagnostic software intended for use with the EC-30. An RP-1210 compliant communication link from the computer to the vehicle diagnostic connector will be needed.

For further information on the Bendix DCI, or RP1210 compliant tools, contact Bendix or refer to your local authorized Bendix dealer.

FIGURE 10 - BENDIX DCI - DIAGNOSTIC COMMUNICATIONS INTERFACE

Reading a Fault with DCI

When a fault is detected, the DCI identifies the faulted component with the diagnostic LEDs. When a wheel speed sensor fault, or an ABS modulator fault, is detected, the SEN or MOD LEDs will be accompanied by two location LEDs. An example is FRT-RHT-SEN. When these three LEDs are on, this is an indication of a fault on the front axle(FRT), right side(RHT), wheel speed sensor(SEN). For a complete explanation of faults displayed by the DCI LEDs, see section F, Troubleshooting.

The DCI will only indicate active system faults. When a fault self-heals or is manually reset, the fault code remains in fault history. Fault history can be retrieved by using blink code diagnostics or a capable diagnostic tool.

If faults occur on multiple components, the DCI will display one fault at a time. When the first fault is fixed and the EC-30 is reset, the next fault will be displayed on the DCI.

A fault displayed on the DCI will always be accompanied by the illumination of the ABS warning lamp and/or the ATC active/warning lamp.

Fault Reset with DCI

After the fault is corrected, the active fault code and LEDs can be reset by briefly pressing the reset button on the DCI. All of the DCI diagnostic LEDs will be on while the reset button is pressed. When the reset button is released, only the green VLT diagnostic LED should be on. If red LEDs remain on, active faults are still present in the system.

The EC-30 self-configuration will occur when the reset button is pressed for greater than 20 seconds.

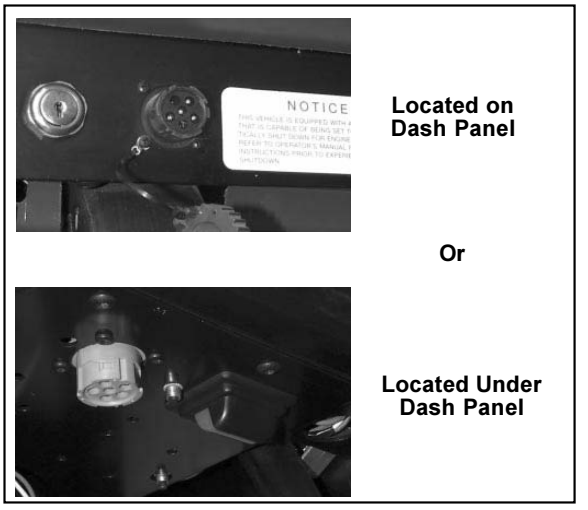


FIGURE 11 - VEHICLE DIAGNOSTIC CONNECTOR LOCATION (J1708/J1587, J1939)

BENDIX ABS DIAGNOSTIC SOFTWARE

Bendix ABS Diagnostic Software is a RP-1210 compliant PC-based program that provides technicians with the highest level of diagnostic information and control of the EC-30. See figure 12. It can also be used to diagnose the EC-15, EC-16, EC-17 and MC-30 (Trailer) ABS units. With Bendix ABS Diagnostic Software, the technician can perform the following:

- Full ABS / ATC diagnostics
- Configuration (ABS, ATC, and more)
- Transfer data
- Perform system and component tests
- Update EC-30 software versions (new features)
- Save and print information

When diagnosing the EC-30 using a personal computer and the Bendix ABS Diagnostic Software, the computer's serial or parallel port can be connected to the vehicle's diagnostic connector (J1708/J1587 or J1939) through an RP1210 compliant communication link.

READ/WRITE (SCRATCHPAD) FUNCTION

Using the Bendix ABS diagnostic software, OEM and fleet service records can be permanently stored in the EC-30. Data contained in the OEM scratchpad area is protected by a special password and can not be revised in the field. Technician and date information must be entered prior to the fleet scratchpad being updated. Some earlier revisions of the EC-30 do not support the read/write function.

For more information on the Bendix ABS Diagnostic Software program, or RP1210 compliant tools, contact Bendix or refer to your local authorized Bendix dealer.

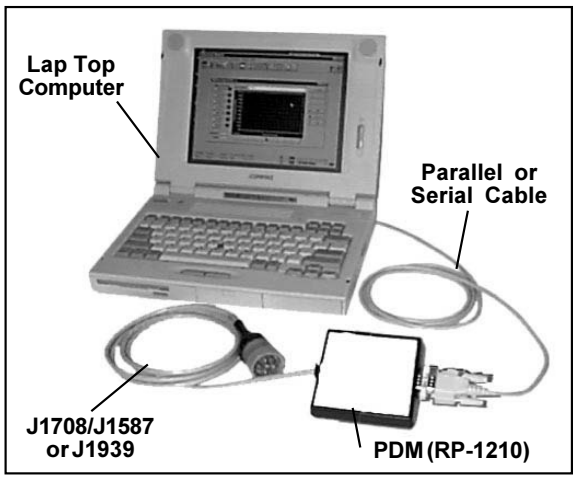


FIGURE 12 - BENDIX ABS DIAGNOSTIC SOFTWARE

NEXIQ (MPSI) BENDIX CARTRIDGE

NEXIQ provides a Bendix cartridge for use with the Pro-Link tool. It can also be used to diagnose the EC-15, EC-16, EC-17 and MC-30 (Trailer) ABS units. See figure 13. For more information on the Bendix diagnostic cartridge from NEXIQ, contact Bendix or refer to your local authorized Bendix dealer. For information on the PLC diagnostic tool, see SD-13-4834.

CONTACTING BENDIX

Bendix.com

The Bendix on-line troubleshooting guide for the EC-30 will help you determine the cause of any conditions that may be preventing 100% performance of your braking system. For additional troubleshooting information on the EC-30, please refer to our literature request section.

The Bendix on-line contacts guide will make it easy for you to find the Bendix contacts you need. From this page, you can navigate to technical support contacts, service engineers, Bendix account managers, international contacts and more. Bendix.com is your complete Bendix resource.

Bendix Technical Assistance Team

For direct personal technical support, call the Bendix technical assistance team at **1-800-AIRBRAKE** (1-800-247-2725), Monday through Friday, 8:00 A.M. to 6:00 P.M. EST, and follow the instructions in the recorded message.

Or, you may e-mail the Bendix technical assistance team at: tbs.techteam@bendix.com.

FIGURE 13 - NEXIQ (MPSI) PRO-LINK TOOL

SAFE MAINTENANCE PRACTICES

IMPORTANT! PLEASE READ AND FOLLOW THESE INSTRUCTIONS TO AVOID PERSONAL INJURY OR DEATH:

When working on or around a vehicle, the following general precautions should be observed at all times:

1. **Park the vehicle on a level surface, apply the parking brakes, and always block the wheels.**
2. **Stop the engine when working around the vehicle.**
3. **If the vehicle is equipped with air brakes, make certain to drain the air pressure from all reservoirs before beginning ANY work on the vehicle.**
4. **Following the vehicle manufacturer's recommended procedures, deactivate the electrical system in a manner that removes all electrical power from the vehicle.**
5. **When working in the engine compartment the engine should be shut off. Where circumstances require that the engine be in operation, EXTREME CAUTION should be used to prevent personal injury resulting from contact with moving, rotating, leaking, heated, or electrically charged components.**
6. **Never connect or disconnect a hose or line containing pressure; it may whip. Never remove a component or plug unless you are certain all system pressure has been depleted.**
7. **Never exceed recommended pressures and always wear safety glasses.**
8. **Do not attempt to install, remove, disassemble or assemble a component until you have read and thoroughly understand the recommended procedures. Use only the proper tools and observe all precautions pertaining to use of those tools.**
9. **Use only genuine Bendix replacement parts, components, and kits. Replacement hardware, tubing, hose, fittings, etc. should be of equivalent size, type, and strength as original equipment and be designed specifically for such applications and systems.**
10. **Components with stripped threads or damaged parts should be replaced rather than repaired. Repairs requiring machining or welding should not be attempted unless specifically approved and stated by the vehicle or component manufacturer.**
11. **Prior to returning the vehicle to service, make certain all components and systems are restored to their proper operating condition. When working on or around a vehicle, the following general precautions should be observed.**
12. **The ATC enable/disable switch must be in the disable position (ATC active/warning lamp should be on) prior to performing any vehicle maintenance where the wheels are lifted off of the ground and moving.**

REMOVING THE EC-30 ASSEMBLY

1. Turn vehicle ignition off.
2. Remove as much contamination as possible prior to disconnecting air lines and electrical connections.
3. Note the EC-30 assembly mounting position on the vehicle.
4. Disconnect the electrical connectors from the EC-30.
5. Remove the four, hex head bolts that secure the EC-30.
6. If the EC-30 is mounted on a valve assembly, it may be necessary to remove all air lines connected to the unit. Remove the EC-30 assembly from the vehicle by removing the mounting bracket or valve.
7. The original mounting hardware can be reused for installation if it is in good condition. If replacement bolts are needed, grade 5 bolts or stronger are required.

INSTALLING A NEW EC-30 CONTROLLER

CAUTION! When replacing the EC-30, verify that the unit you are installing has the correct default settings. Failure to do so could result in a loss of features, such as ATC and PLC, or noncompliance with U.S. regulations such as FMVSS 121. It is recommended to use only the correct replacement part number. However, most configuration settings can be altered using the Bendix ABS Diagnostic Software program.

Verify correct operation of the EC-30 system and warning lamps prior to putting the vehicle back into service. Towing vehicles manufactured after March 1, 2001 must support the trailer ABS warning lamp located on the dash.

For further information, contact either the vehicle manufacturer, Bendix or your local authorized Bendix dealer.

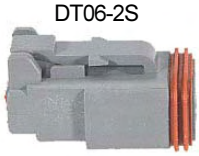
ABS Component	Connector	Wire Terminal	Wire Seal/ Plug	Terminal Lock	Terminal Crimp Tool
EC-30 Harness 30-pin Packard Metri-Pack 150 Series	12034398 	12103881 (18-16 GA) 	Plug 12065266 	N/A	12094429 
EC-30 Harness 18-pin Packard Metri-Pack 150 Series	12040921 			N/A	12155975 
ABS Modulator Harness 3-Pin Packard Metri-Pack 280 Series	12040977 	12077411 (18-16 GA) 	12015323 (18-16 GA) 	12034145 	
Wheel Speed Sensor 2-Pin Packard Metri-Pack 280 Series	15300027 			15300014 	
Wheel Speed Sensor 2-Pin Packard Metri-Pack 280 Series	15300002 	12048159 (18-16 GA) 			
ATC Modulator or Wheel Speed Sensor 2-Pin Deutsch DT Series	DT04-2P 	0460-215-16141 (14-16 GA) 0460-202-16141 (16-18 GA) 	N/A	W2P 	HDT-48-00 
ATC Modulator Harness or Wheel Speed Sensor 2-Pin Deutsch DT Series	DT06-2S 	0462-209-16141 (14-16 GA) 0462-201-16141 (16-18 GA) 	N/A	W2S 	
Wheel Speed Sensor or ATC Modulator 2-Pin Deutsch DTM Series	DTM06-2S-E007 	462-201-20141 (16-18 GA) 	N/A	WM-2S 	
Wheel Speed Sensor 2-Pin Deutsch DTM Series	DTM04-2P 	460-202-20141 (16-18 GA) 	N/A	WM-2P 	

CHART 8 - EC-30 COMPONENT CONNECTORS

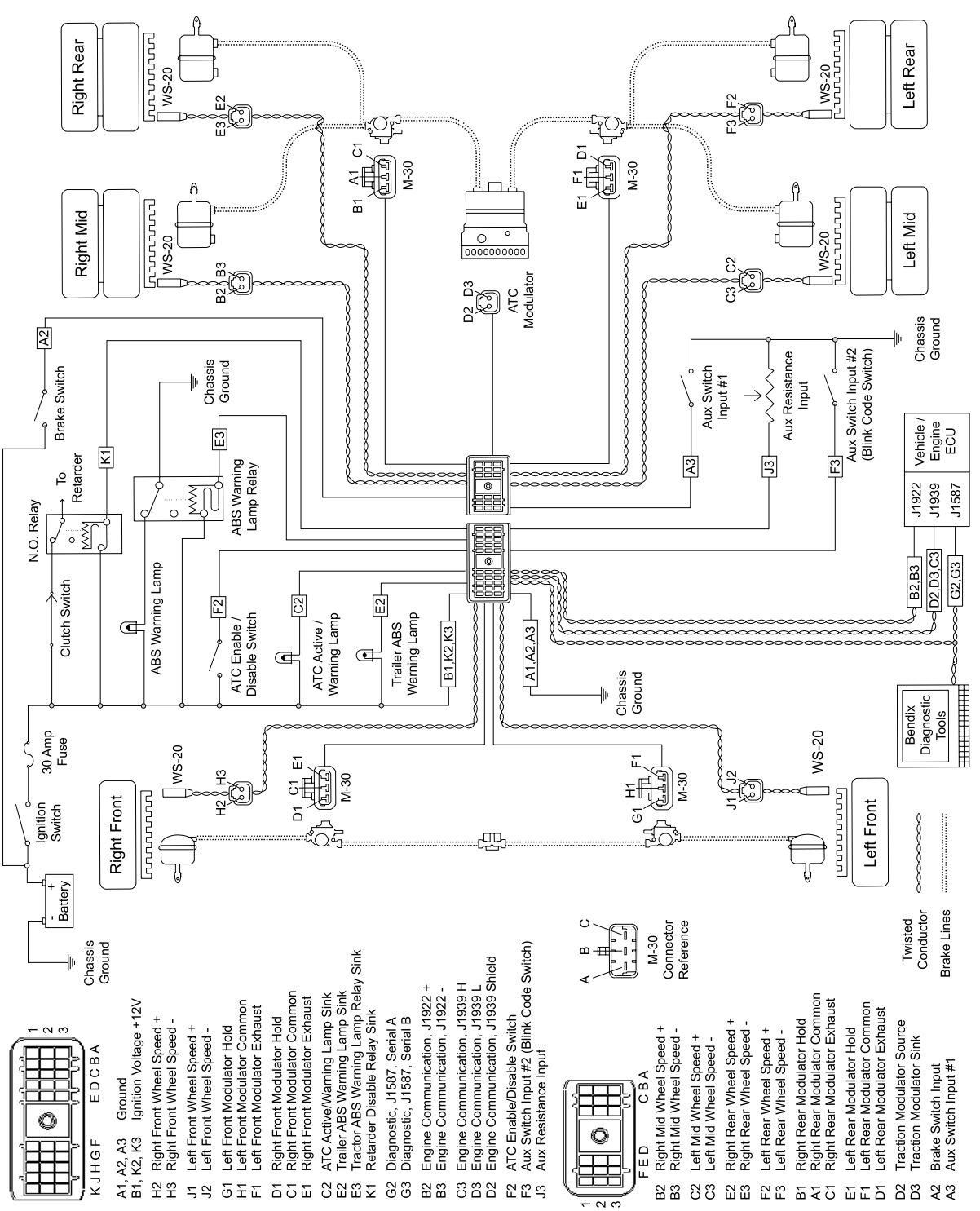


FIGURE 13 - EC-30 SYSTEM SCHEMATIC

18

1. Position and secure the EC-30 in the original mounting orientation using the four hex head bolts. **Torque the hex head EC-30 mounting bolts to 98 in. lbs. Over-tightening the ECU bolts can cause damage to the EC-30.**
2. For a valve-mounted EC-30, position and secure the EC-30 assembly to the vehicle, in the original mounting orientation. Reconnect all air lines to the EC-30 assembly. All air lines and fittings should be checked for leaks prior to returning the vehicle to service.
3. Reconnect the electrical connectors to the EC-30 and **torque the connector retaining jack-screws to 15-20 in. lbs. Over-tightening the ECU connector jack-screw(s) can cause damage to the EC-30.**
4. Apply power and monitor the EC-30 power-up sequence to verify proper system operation.
5. When necessary, it is possible to road test the ABS function by making an abrupt stop from a vehicle speed of about 20 mph to check for proper function. The wheels should not enter a prolonged lock condition and ABS function should be audible. It is the responsibility of the technician to perform the tests in a safe location.
6. When necessary, it is possible to road test the ATC function by accelerating on a road surface with reduced traction. The drive wheels should not sustain substantial spin. Audible bursts of air or engine throttle-down should be noticed. It is the responsibility of the technician to perform the tests in a safe location.

ABS AND ATC WIRING

The vehicle manufacturer designs and supplies the vehicle harnesses for the EC-30. However, Bendix specifies all component connectors. See chart 8 for components. The wiring harness and connectors are weather resistant and sealed at the connector interface. The wire gauge and insulation type used in the wire harnesses is specific to the circuit function, but 16 gauge GXL is most common. Refer to BW-106-A, Bendix ABS Application Guideline, for specific wire harness application information.

When troubleshooting ABS wiring, some general rules should be followed where applicable.

1. Check all wiring and connectors to ensure they are secure and free from visible damage. Check for evidence of wire chafing due to poor routing or poor securing of wires. Check connectors for proper insertion and locking. Verify that the connector leads are properly greased with a nonconductive electrical grease compound and do not show signs of corrosion or exposure to the environment.
2. During wiring repair, a splice must be properly soldered and made waterproof.
3. Do not pierce wire insulation when checking for continuity.
4. Do not deform individual pins or sockets during probing with a volt/ohm meter.
5. Only use the correct crimping tool when replacing wire terminals and connectors.
6. Properly resecure all wiring harness and sensor leads when repairs are made.

TROUBLESHOOTING

Fault information can be retrieved from the EC-30 by using the diagnostic LED display, blink code diagnostics or a diagnostic tool. However, the technician must confirm whether the fault resides in the component, wiring or connectors. The following troubleshooting flow charts will assist the technician in isolating the cause of the fault.

Troubleshooting should always begin by observing the ABS warning lamp and the ATC active/warning lamp during the EC-30 power-up sequence.

If it is necessary to make electrical measurements, always begin by taking voltage and resistance measurements at the 30-pin and 18-pin wire harness connectors.

Once the circuit fault is found, isolate the area needing repair by repeating the measurements at all connections in the affected circuit (modulator, wheel speed sensor, etc.).

No voltage or resistance measurements are to be made on the bulkhead connector pins of the EC-30.

When repairs are made, reconnect the electrical connectors to the EC-30 and **torque the connector retaining jack-screws to 15-20 in. lbs. Over-tightening the ECU connector jack-screw(s) can cause damage to the EC-30.**

Troubleshooting Flowcharts

Section A - Power-up sequence - ABS warning lamp and ATC active/warning lamp

Section B - Power-up sequence - Trailer ABS warning lamp

Section C - ABS warning lamp

Section D - ATC active/warning lamp

Section E - Trailer ABS warning lamp

Section F - Diagnostic LED quick reference

Section G - Power to the EC-30

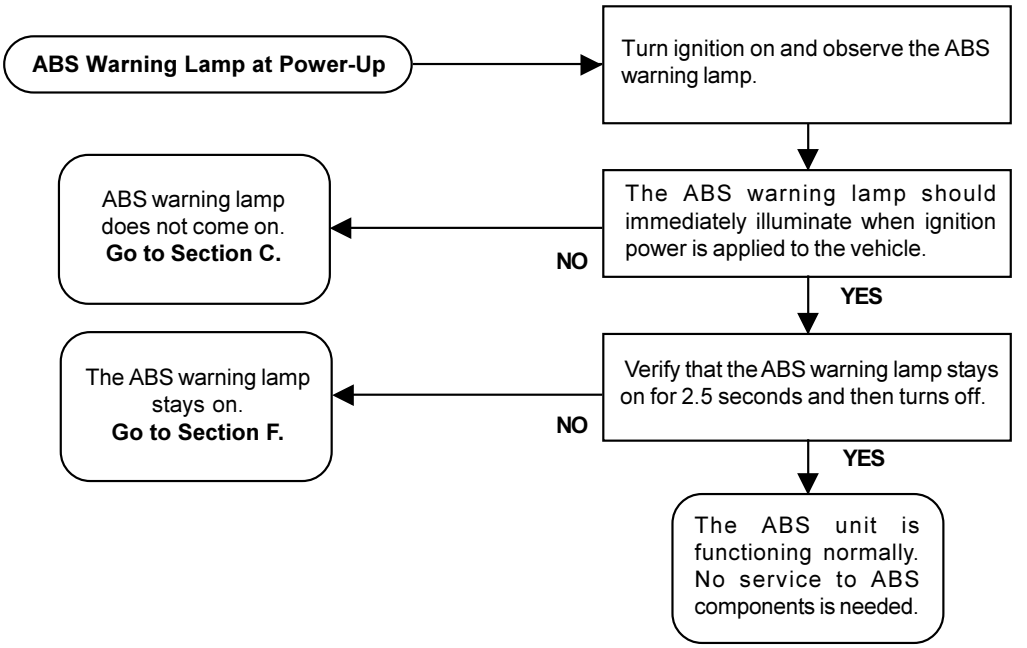
Section H - Wheel speed sensors

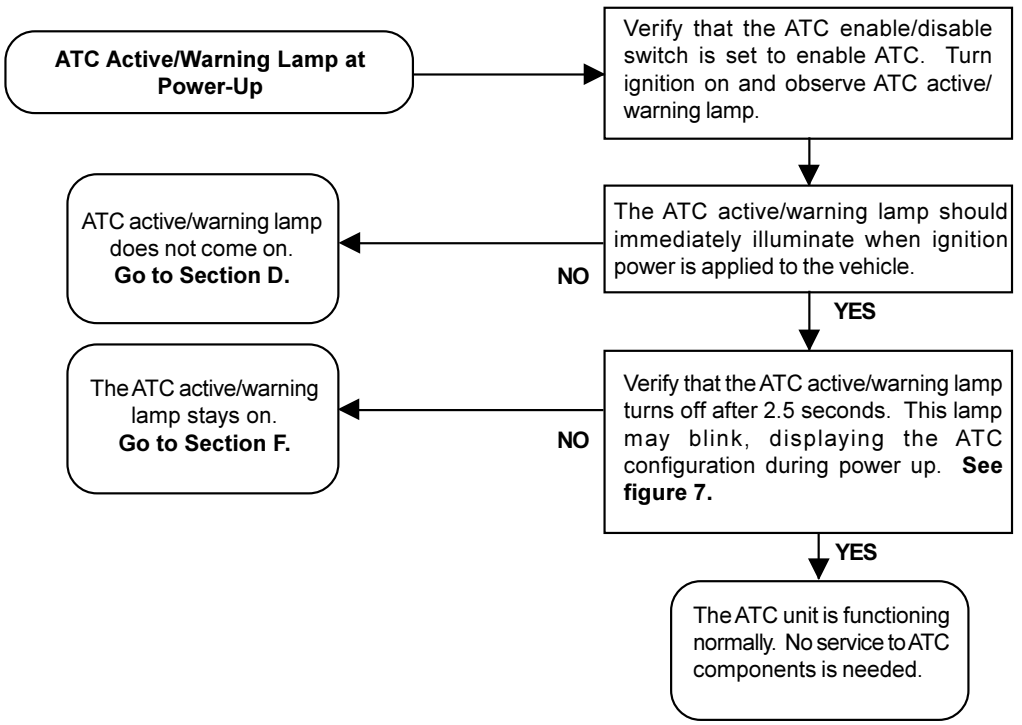
Section I - ABS modulators

Section J - ATC modulator

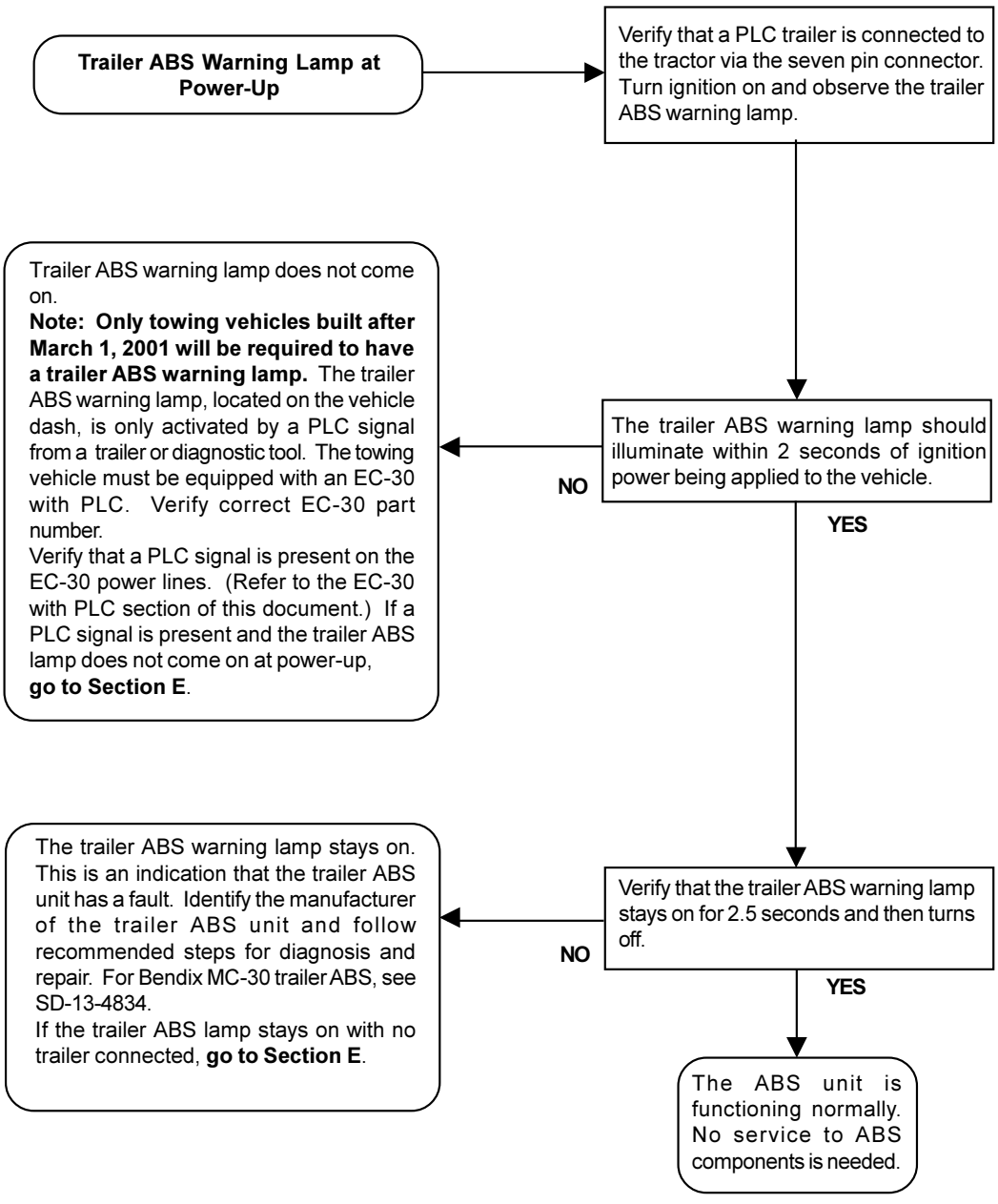
Section K - Serial communication

SECTION A - EC-30 POWER-UP SEQUENCE - ABS WARNING LAMP AND ATC ACTIVE/WARNING LAMP





SECTION B - EC-30 POWER-UP SEQUENCE - TRAILER ABS WARNING LAMP



SECTION C - TROUBLESHOOTING THE ABS WARNING LAMP

ABS Warning lamp did not illuminate during the EC-30 power-up sequence.

Turn the ignition off and disconnect the 30-pin connector from the EC-30.

Turn the ignition on and verify that the ABS warning lamp turns on.

YES → If having the EC-30 connected was preventing the ABS warning lamp from doing a power-up lamp check, verify that power at the EC-30 is getting cycled with the ignition switch, by observing the green VLT LED. Check for corrosion or damage on the 30-pin connector and wiring. If none is found, replace the EC-30.

NO

See Note this page

With ignition on, measure voltage between pin E3 and ground (pins A1, A2 or A3). Verify a measurement equal to battery voltage. (About 12.0 VDC)

NO → With a volt/ohm meter, check the wiring, relay, and fuse. **Refer to figure 13**. When repair is made, reconnect the 30-pin connector to the EC-30 and rerun the power up sequence.
Go to Section A.

YES

With a volt/ohm meter, check the ABS warning lamp, wiring, relay and fuse. **Refer to figure 13.** When repair is made, reconnect the 30-pin connector to the EC-30 and rerun the power up sequence.
Go to Section A.

Note: If there is no wire in pin E3 of the 30-pin connector, the EC-30 is commanding the ABS warning lamp, using the J1939 serial communications link.

In this configuration, the actual lamp is driven by a vehicle dash controller. Obtain the vehicle manual and verify the wiring and function of the ABS warning lamp.

To verify proper EC-30 communication, **go to Section K**.

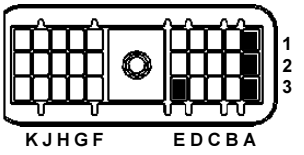
ABS Warning lamp stays on with no red LEDs on.

See Note this page

Turn the ignition off and disconnect the 30-pin connector from the EC-30.

With a volt/ohm meter, check the wiring, relay and fuse. **Refer to figure 13**. When repair is made, reconnect the 30-pin connector to the EC-30 and rerun the power up sequence. If the condition still exists, replace the EC-30. Go to Section A.

30-Pin Connector



E3 — ABS Warning Lamp
A1,A2,A3 — Ground

SECTION D - TROUBLESHOOTING THE ATC ACTIVE/WARNING LAMP

ATC Active/Warning lamp did not illuminate during the EC-30 power-up sequence.

Verify that the EC-30 is configured for ATC by observing the LEDs at power-up, blink code diagnostics or using a diagnostic tool.

With ignition off, remove the 30-pin connector from the EC-30.

See Note this page

Turn ignition on and measure voltage between pin C2 and ground (pins A1, A2 or A3). Verify a measurement equal to battery voltage. (About 12.0 VDC)

YES

NO

With a volt/ohm meter, check wiring, ATC active/warning lamp and fuse. When repair is made, reconnect the 30-pin connector to the EC-30 and rerun the power-up sequence. **Go to Section A**.

ATC active/warning lamp stays on with no red LEDs on.

Verify that the ATC enable/disable switch is in the enable position.

See Note this page

If ATC active/warning lamp remains on, turn ignition off and remove the 30-pin connector from EC-30.

With a volt/ohm meter, check the ATC active/warning lamp circuit and the ATC enable/disable switch wiring. **Refer to figure 13**. When repair is made, reconnect the 30-pin connector to the EC-30 and rerun the power-up sequence. If the condition still exists, replace the EC-30.

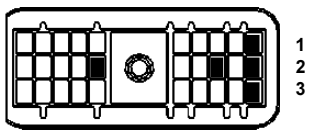
Check for corrosion or damage on the 30-pin connector and wiring. If none is found, replace the EC-30.

Note: If there is no wire in pin C2 of the 30-pin connector, the EC-30 is commanding the ATC active/ warning lamp, using the J1939 serial communications link.

In this configuration, the actual ATC lamp is driven by a vehicle dash controller. Obtain the vehicle manual and verify the wiring and function of the ATC active/warning lamp.

To verify proper EC-30 communication, **go to Section K**.

30-Pin Connector



C2	ATC Active/Warning Lamp
A1,A2,A3	Ground
F2	ATC Enable/Disable Switch

SECTION E - TROUBLESHOOTING THE TRAILER ABS WARNING LAMP

Trailer ABS Warning lamp did not illuminate during the EC-30 power-up sequence.

With ignition off, remove the 30-pin connector from the EC-30.

See Note this page

Turn ignition on and measure voltage between pin E2 and ground (pins A1, A2 or A3). Verify a measurement equal to battery voltage. (About 12.0 VDC)

NO

With a volt/ohm meter, check wiring, trailer ABS warning lamp and fuse. When repair is made, reconnect the 30-pin connector to the EC-30 and rerun the power up sequence. **Go to Section A.**

YES

Only towing vehicles built after March 1, 2001 will be required to have a trailer ABS warning lamp. The trailer ABS warning lamp, located on the vehicle dash, is only activated by a PLC signal from a trailer or diagnostic tool. The towing vehicle must be equipped with an EC-30 with PLC. Refer to the part number and configuration to ensure that the EC-30 supports PLC communications.

Check for corrosion or damage on the 30-pin connector and wiring. If none is found, replace the EC-30.

Trailer ABS lamp stays on with no trailer connected to towing vehicle.

See Note this page

With ignition off, remove the 30-pin connector from EC-30.

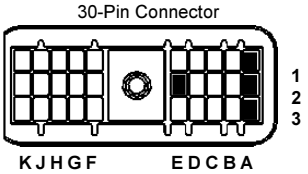
With a volt/ohm meter, verify no continuity from trailer ABS warning lamp connector pin to ground. **Refer to figure 13**. Check for corrosion or damage on the 30-pin connector and wiring. If no issues are found, replace the EC-30.

Note: If there is no wire in pin E2 of the 30-pin connector, the EC-30 is commanding the trailer ABS warning lamp using the J1939 or J1587 serial communications link.

In this configuration, the actual trailer ABS lamp is driven by a vehicle dash controller. Obtain the vehicle manual and verify the wiring and function of the trailer ABS warning lamp.

To verify proper EC-30 communication, **go to Section K.**

30-Pin Connector



E2	Trailer ABS Warning Lamp
A1,A2,A3	Ground

SECTION F - DIAGNOSTIC LED QUICK REFERENCE

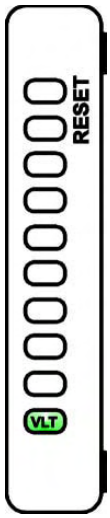
Comparing your EC-30 to the following images, identify the fault indicated by the diagnostic LEDs and follow the instructions in the related troubleshooting section.

Power
System OK - A solid green VLT LED indicates proper voltage is reaching the EC-30. If no red LEDs are on, then no faults are detected.

If either the ABS warning lamp or ATC active/warning lamp is on with no red LEDs, **go to Section C or D.**

Voltage Out of Range - A flashing green VLT LED indicates ECU voltage below 9.0 VDC or above 16.0 VDC. The VLT LED will flash until power is brought into normal range. **Go to Section G.**

No Voltage - When the VLT LED is off, the EC-30 is receiving very low or no voltage. The ECU LED may be on in this case. **Go to Section G.**



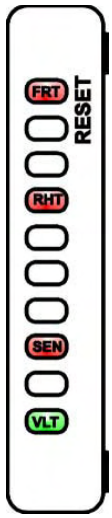
Wheel Speed Sensor Fault
The red SEN LED is on to indicate a fault condition with a wheel speed sensor. The example shown is a front right sensor fault. Troubleshooting and repair are the same for a fault on any wheel speed sensor.

The indicated sensor fault may be a static or dynamic fault.

Static faults are related to wiring or component failures, such as open or short circuits.

Dynamic faults are related to abnormal wheel speed signals or behaviors.

Go to Section H.



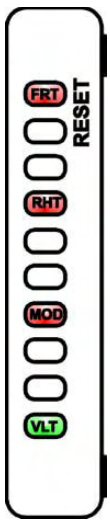
ABS Modulator Fault
The red MOD LED is on to indicate a fault condition with an ABS modulator. The example shown is a front right modulator fault. Troubleshooting and repair are the same for a fault on any ABS modulator.

The indicated modulator fault may be a static or dynamic fault.

Static faults are related to wiring or component failures, such as open or short circuits.

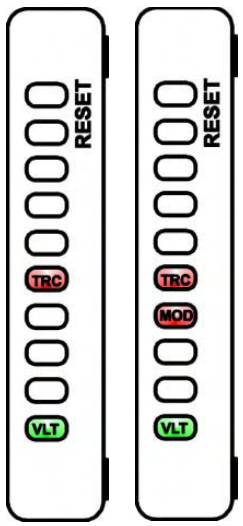
Dynamic modulator faults are related to abnormal wheel speed behaviors during ABS.

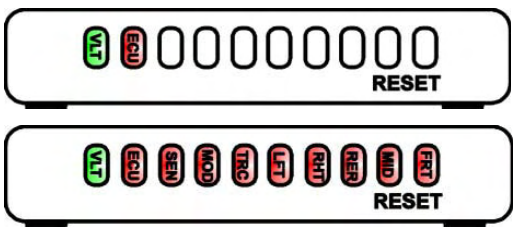
Go to Section I.



ATC Fault
Engine Communication Fault
The red TRC LED is on to indicate a communication fault between the EC-30 and the engine controller.
Go to Section K.

ATC Modulator Fault
The red TRC and MOD LEDs are on to indicate a static fault condition with the ATC modulator. Static faults are related to wiring or component failures such as open or short circuits.
Go to Section J.





ECU Fault - The red ECU LED is on to indicate a fault condition internal to the EC-30. Reset the EC-30 with a magnet. If the fault returns, replace the EC-30. If the red ECU LED is on and the green VLT LED is off, the EC-30 may have very low voltage.

Magnetic Fault Reset - All LEDs will be on while a magnet is held in place at the RESET location. If one or more LEDs do not come on, replace the EC-30. Do not reset fault codes until troubleshooting of the indicated component is complete.

SECTION G - TROUBLESHOOTING POWER TO THE EC-30

ABS Warning lamp is on and green VLT LED is off or flashing.

Turn the ignition off and disconnect the 30-pin connector from the EC-30.

Turn the ignition on and measure voltage between ignition power (pins B1, K2, K3) and ground (pins A1, A2, A3) at the 30-pin connector. It is important to check each power and ground pin combination. The operating range of the EC-30 is 9.0 - 16.0 VDC. Verify a measurement equal to battery voltage. (About 12.0 VDC)

YES

Due to corrosion, damage or poor termination, the wiring and/or connectors may be limiting the electrical current flow to the EC-30. This means that when the EC-30 needs more current, the voltage level may be dropping. In order to measure the voltage under load, place a load, such as a type 1157 stop lamp bulb, between ignition power (pins B1, K2, K3) and ground (pins A1, A2, A3) at the 30-pin connector. While the lamp is in place, measure the voltage across the pins. It is important to check each power and ground pin combination. The operating range of the EC-30 is 9.0-16.0 VDC. Verify a measurement equal to battery voltage. (About 12.0 VDC) The loaded voltage should drop no more than 1.0 VDC from the measured unloaded voltage.

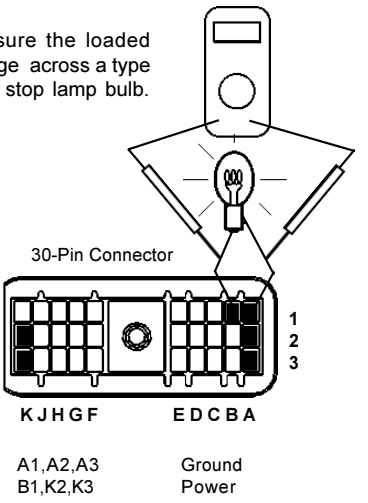
With a volt/ohm meter, check the power and ground wiring. Look for corroded or damaged wires or connectors. If repair is made, reconnect the 30-pin connector to the EC-30 and rerun the power up sequence.
Go to Section A.

If proper loaded and unloaded voltage is measured at the 30-pin connector and no corrosion or damage is found on the EC-30 connector, replace the EC-30.

NO

With a volt/ohm meter, check the power wiring, ground wiring and fuse. Look for corroded or damaged wires or connectors. When repair is made, reconnect the 30-pin connector to the EC-30 and rerun the power up sequence.
Go to Section A.

Measure the loaded voltage across a type 1157 stop lamp bulb.



SECTION H - TROUBLESHOOTING WHEEL SPEED SENSORS

SEN LED and ABS warning lamp are on.

→ Turn ignition off and remove the 30-pin or 18-pin connector from the EC-30.

Static Wheel Speed Sensor Faults - Using a volt/ohm meter to measure the connector pins of the faulted sensor, verify 1500-2500 OHMS across sensor connector pins. Verify no continuity from sensor connector pins to ground. Verify ignition power is not measured at either sensor connector pins. Check for corroded or damaged sensor and ECU wiring and connectors. Verify proper sensor lead routing and clamping. If a circuit fault is found, isolate the area needing repair by repeating the measurements at all connections in the wheel speed sensor circuit.
Wheel speed sensor fault identified?

YES →

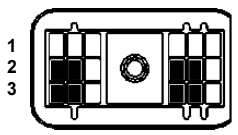
Make repairs to wiring or replace wheel speed sensor. Reconnect all connectors to the EC-30 and sensor. Reset fault codes by briefly holding a magnet in place at the RESET location of the diagnostic display. Then rerun the power up sequence.
Go to Section A.

NO →

Dynamic Wheel Speed Sensor Faults - Rotate the effected wheel and verify a minimum of 0.8 VAC sensor output @ 1 RPS across the wheel speed sensor pins. A properly positioned sensor can output more than 2.0 VAC @ 1 RPS. Adjust speed sensors to contact tone ring. Verify condition and retention force of sensor clips. Verify proper sensor lead routing and clamping. Verify sensor leads are twisted pair. Verify condition of tone ring mounting and teeth. Verify proper number of tone ring teeth per sensed wheel. Verify proper adjustment of wheel bearings. Verify condition of foundation brakes.

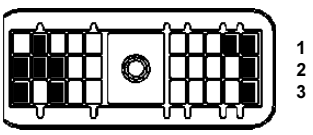
→ Make repairs to wheel speed sensor installation. Reconnect all connectors to the EC-30 and sensor. Reset fault codes by briefly holding a magnet in place at the RESET location of the diagnostic display. Then rerun the power up sequence.
Go to Section A.

18-Pin Connector



B3	Right Mid WS -
B2	Right Mid WS +
C3	Left Mid WS -
C2	Left Mid WS +
E3	Right Rear WS -
E2	Right Rear WS +
F3	Left Rear WS -
F2	Left Rear WS +

30-Pin Connector



H3	Right Front WS -
H2	Right Front WS +
J2	Left Front WS -
J1	Left Front WS +
A1,A2,A3	Ground
B1,K2,K3	Power

SECTION I - TROUBLESHOOTING ABS MODULATORS

MOD LED and ABS warning lamp are on.

Turn the ignition off and remove the 30-pin or 18-pin connector from the EC-30.

Static ABS Modulator Faults - Verify 3.5 to 5.0 OHMS across Hold and Common connector pins. Verify 3.5 to 5.0 OHMS across Exhaust/ Common connector pins. Verify 7.0 to 10.0 OHMS across Exhaust/Hold connector pins. Verify no continuity from modulator connector pins to ground. Verify ignition power is not measured at any modulator connector pins. Check for corroded or damaged modulator wiring and connections. If a circuit fault is found, isolate the area needing repair by repeating the measurements at all connections in the ABS modulator circuit.
ABS modulator fault identified?

YES

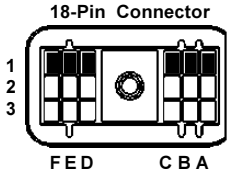
Make repairs to wiring or replace ABS modulator. Reconnect all connectors to the EC-30 and ABS modulator. Reset fault codes by briefly holding a magnet in place at the RESET location of the diagnostic display. Then rerun the power up sequence.
Go to Section A.

NO

Dynamic ABS Modulator Faults - Verify proper modulator activation with brake pressure applied at power-up (chuff test) and/or using diagnostic tool. Check for dragging brakes, dry bearings, faulty return springs, parking brake system faults, restricted brake air lines, over adjusted slacks, out-of-round drums or damaged/loose tone rings.

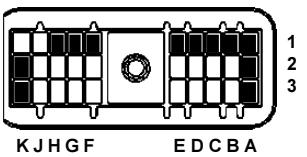
Make repairs to ABS modulator installation or wheel end. Reconnect all connectors to the EC-30 and ABS modulator. Reset fault codes by briefly holding a magnet in place at the RESET location of the diagnostic display. Then rerun the power up sequence.
Go to Section A.

18-Pin Connector



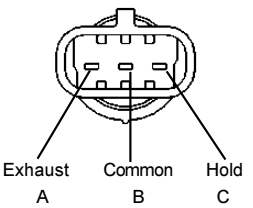
F1	Left Rear Mod Common
D1	Left Rear Mod Exhaust
E1	Left Rear Mod Hold
A1	Right Rear Mod Common
C1	Right Rear Mod Exhaust
B1	Right Rear Mod Hold

30-Pin Connector



H1	Left Front Mod Common
F1	Left Front Mod Exhaust
G1	Left Front Mod Hold
C1	Right Front Mod Common
E1	Right Front Mod Exhaust
D1	Right Front Mod Hold
A1,A2,A3	Ground
B1,K2,K3	Power

Electrical connector on the M-30, M-22 or M-22 Modulator



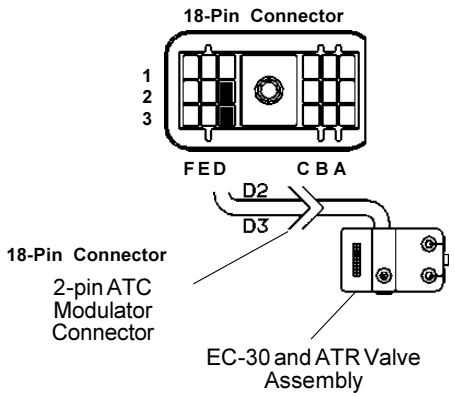
SECTION J - TROUBLESHOOTING THE ATC MODULATOR

TRC and MOD LEDs and ATC active/warning lamp are on.

Turn the ignition off and remove the 18-pin connector from the EC-30.

Verify 10.0 to 12.0 OHMS across the ATC modulator leads. Verify no continuity from ATC modulator connector pins to ground. Verify +12 VDC is not measured at any ATC modulator connector pins. Check for corroded or damaged ATC modulator wiring and connectors. If a circuit fault is found, isolate the area needing repair by repeating the measurements at all connections in the ATC modulator circuit.

Make repairs to wiring or replace ATC modulator. Reconnect all connectors to the EC-30 and ATC modulator. Reset fault codes by briefly holding a magnet in place at the RESET location of the diagnostic display. Then rerun the power-up sequence.
Go to Section A.



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SECTION K - TROUBLESHOOTING EC-30 SERIAL COMMUNICATION

TRC LED and ATC active/warning lamp are on.

Verify proper operation of the electronic engine controller.

Turn ignition off and remove the 30-pin connector from the EC-30. Also remove the 2- or 3-pin connector at engine controller.

For vehicles using **J1939**, verify continuity between the 30-pin connector (pins C3, D2, D3) and the 3-pin engine or dash controller connector.

For vehicles using **J1922**, verify wire continuity between the 30-pin connector (pins B2, B3) and the 2-pin engine or dash controller connector.

For vehicles using **J1587**, verify wire continuity between the 30-pin connector (pins G2, G3) and the 2-pin dash controller connector.

Verify no continuity from serial communication pins to ground (except pin D2). Verify +12 VDC is not measured at any serial communication pin. Check for corroded or damaged serial communication wiring and connections. If a circuit fault is found, isolate the area needing repair by repeating the measurements at all serial communication link connectors.

Make repairs to serial communication wiring. Reconnect all connectors to the EC-30 and engine. Reset any fault codes by briefly holding a magnet in place at the RESET location of the diagnostic display. Then rerun the power-up sequence.
Go to Sections A and B.

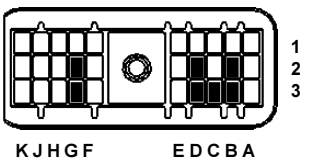
Warning lamp(s) controlled by serial communication link not functioning properly.

If the EC-30 has just been configured or replaced, verify that the EC-30 is configured to operate the warning lamp(s) using the appropriate serial communications link. The Bendix ABS Diagnostic Software program will be needed to verify this level of configuration. If the EC-30 was replaced with the correct replacement part number, this step is not necessary.

If the EC-30 is configured properly, verify proper operation of the vehicle dash controller.

Turn ignition off and remove the 30-pin connector from the EC-30. Also remove the dash controller connector.

30-Pin Connector



C3 Engine Communication, J1939 H
D3 Engine Communication, J1939 L
D2 Engine Communication, J1939 Shield

B2 Engine Communication, J1922 +
B3 Engine Communication, J1922 -

G2 Diagnostic, J1587, Serial A
G3 Diagnostic, J1587, Serial B

NOTES

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MERITOR®
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Revised 03-98

Automatic Slack Adjuster

Maintenance Manual 4B

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Service Notes

MERITOR™

This publication provides maintenance and service procedures for Meritor's automatic slack adjuster. The information contained in this publication was current at the time of printing and is subject to revision without notice or liability.

1. You must understand all procedures and instructions before you begin maintenance and service procedures.
2. You must follow your company's maintenance and service guidelines.
3. You must use special tools, when required, to avoid serious personal injury and damage to components.

Meritor uses the following notations to alert the user of possible safety issues and to provide information that will help to prevent damage to equipment and components.

WARNING

A WARNING indicates a procedure that you must follow exactly to avoid serious personal injury.

CAUTION

A CAUTION indicates a procedure that you must follow exactly to avoid damaging equipment or components. Serious personal injury can also occur.

NOTE: A **NOTE** indicates an operation, procedure or instruction that is important for proper service. A **NOTE** can also supply information that will help to make service quicker and easier.

This symbol indicates that you must tighten fasteners to a specific torque.

Visit Our Web Site

Visit the Technical Library section of **www.meritorauto.com** for additional product and service information on Meritor's heavy vehicle systems component lineup.

Technical Electronic Library on CD

The CD includes product and service information on Meritor's heavy vehicle systems component lineup. $20. Order TP-9853.

Meritor Brakes That Use Automatic Slack Adjusters

- Cam brakes, including Q Plus™ LX500 and MX500 and Cast Plus™ cam brakes
- Air disc brakes

Videos

Automatic Slack Adjuster Installation and Maintenance
Video 90234.

New Generation Automatic Slack Adjuster
Video T-9443V.

How to Order

Call Meritor's Customer Service Center at 800-535-5560.

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Table of Contents

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Asbestos and Non-Asbestos Fibers

⚠ ASBESTOS FIBER WARNING

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

Hazard Summary

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

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

Recommended Work Practices

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

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

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

3. Procedures for Servicing Brakes.

a) Enclose the brake assembly within a negative pressure enclosure. The enclosure should be equipped with a HEPA vacuum and worker arm sleeves. With the enclosure in place, use the HEPA vacuum to loosen and vacuum residue from the brake parts.

b) As an alternative procedure, use a catch basin with water and a biodegradable, non-phosphate, water-based detergent to wash the brake drum or rotor and other brake parts. The solution should be applied with low pressure to prevent dust from becoming airborne. Allow the solution to flow between the brake drum and the brake support or the brake rotor and caliper. The wheel hub and brake assembly components should be thoroughly wetted to suppress dust before the brake shoes or brake pads are removed. Wipe the brake parts clean with a cloth.

c) If an enclosed vacuum system or brake washing equipment is not available, employers may adopt their own written procedures for servicing brakes, provided that the exposure levels associated with the employer's procedures do not exceed the levels associated with the enclosed vacuum system or brake washing equipment. Consult OSHA regulations for more details.

d) Wear a respirator equipped with a HEPA filter approved by NIOSH or MSHA for use with asbestos when grinding or machining brake linings. In addition, do such work in an area with a local exhaust ventilation system equipped with a HEPA filter.

e) **NEVER** use compressed air by itself, dry brushing, or a vacuum not equipped with a HEPA filter when cleaning brake parts or assemblies. **NEVER** use carcinogenic solvents, flammable solvents, or solvents that can damage brake components as wetting agents.

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

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

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

Regulatory Guidance

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

⚠ NON-ASBESTOS FIBERS WARNING

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

Hazard Summary

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

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

Recommended Work Practices

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

2. Respiratory Protection. OSHA has set a maximum allowable level of exposure for silica of 0.1 mg/m^3 as an 8-hour time-weighted average. Some manufacturers of non-asbestos brake linings recommend that exposures to other ingredients found in non-asbestos brake linings be kept below 1.0 f/cc as an 8-hour time-weighted average. Scientists disagree, however, to what extent adherence to these maximum allowable exposure levels will eliminate the risk of disease that can result from inhaling non-asbestos dust.

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

3. Procedures for Servicing Brakes.

a) Enclose the brake assembly within a negative pressure enclosure. The enclosure should be equipped with a HEPA vacuum and worker arm sleeves. With the enclosure in place, use the HEPA vacuum to loosen and vacuum residue from the brake parts.

b) As an alternative procedure, use a catch basin with water and a biodegradable, non-phosphate, water-based detergent to wash the brake drum or rotor and other brake parts. The solution should be applied with low pressure to prevent dust from becoming airborne. Allow the solution to flow between the brake drum and the brake support or the brake rotor and caliper. The wheel hub and brake assembly components should be thoroughly wetted to suppress dust before the brake shoes or brake pads are removed. Wipe the brake parts clean with a cloth.

c) If an enclosed vacuum system or brake washing equipment is not available, carefully clean the brake parts in the open air. Wet the parts with a solution applied with a pump-spray bottle that creates a fine mist. Use a solution containing water, and, if available, a biodegradable, non-phosphate, water-based detergent. The wheel hub and brake assembly components should be thoroughly wetted to suppress dust before the brake shoes or brake pads are removed. Wipe the brake parts clean with a cloth.

d) Wear a respirator equipped with a HEPA filter approved by NIOSH or MSHA when grinding or machining brake linings. In addition, do such work in an area with a local exhaust ventilation system equipped with a HEPA filter.

e) **NEVER** use compressed air by itself, dry brushing, or a vacuum not equipped with a HEPA filter when cleaning brake parts or assemblies. **NEVER** use carcinogenic solvents, flammable solvents, or solvents that can damage brake components as wetting agents.

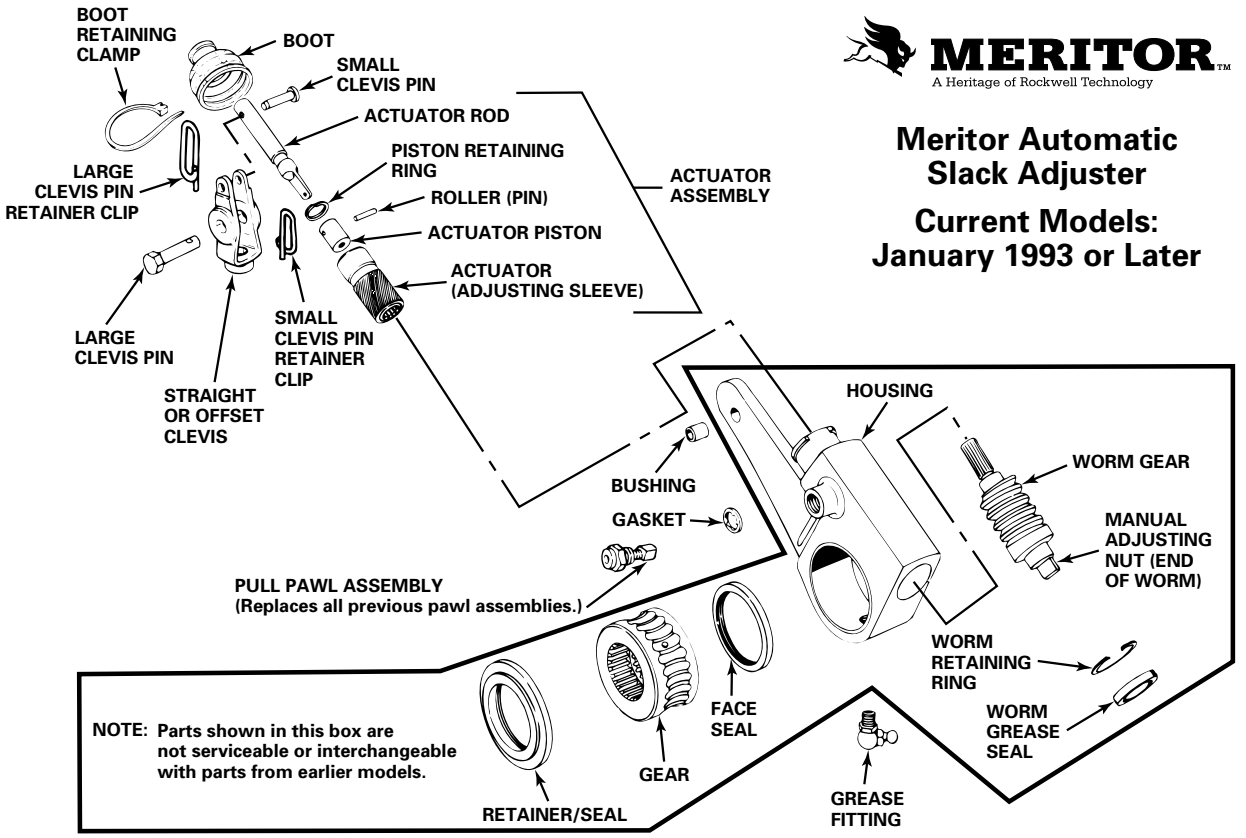
4. Cleaning Work Areas. Clean work areas with a vacuum equipped with a HEPA filter or by wet wiping. **NEVER** use compressed air or dry sweeping to clean work areas. When you empty vacuum cleaners and handle used rags, wear a respirator equipped with a HEPA filter approved by NIOSH or MSHA, to minimize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

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

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

Regulatory Guidance

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



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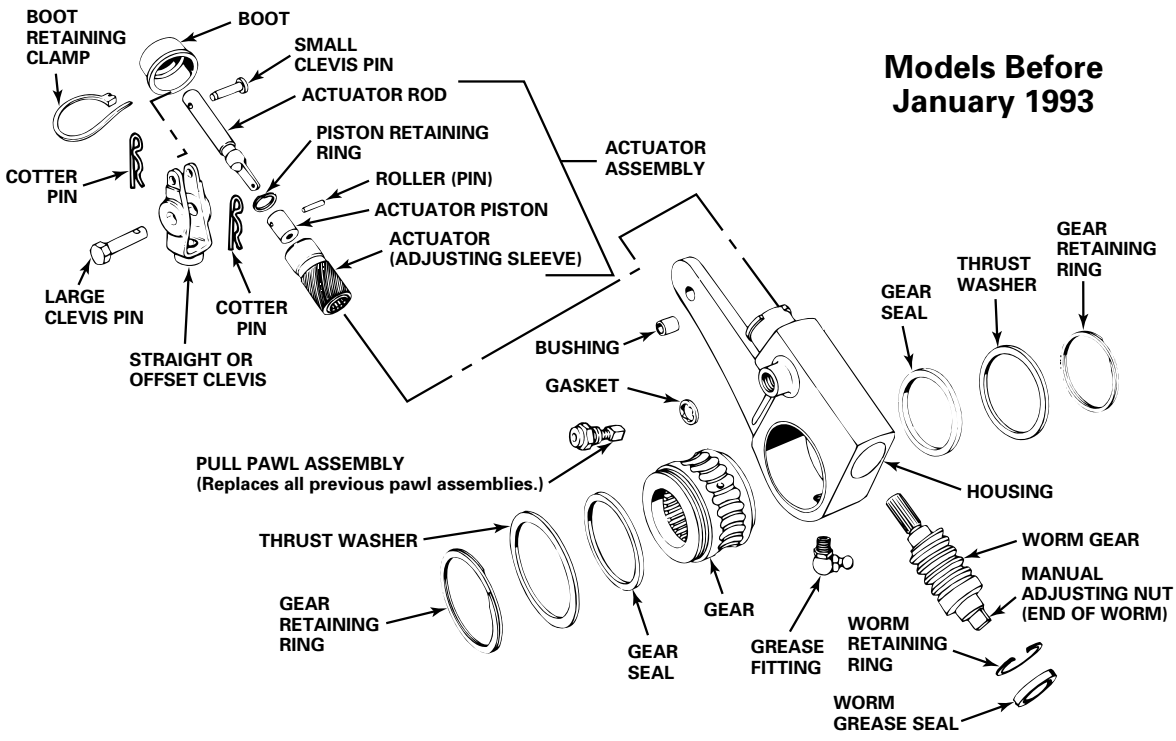
Meritor Automatic Slack Adjuster

Current Models: January 1993 or Later



Models Before January 1993

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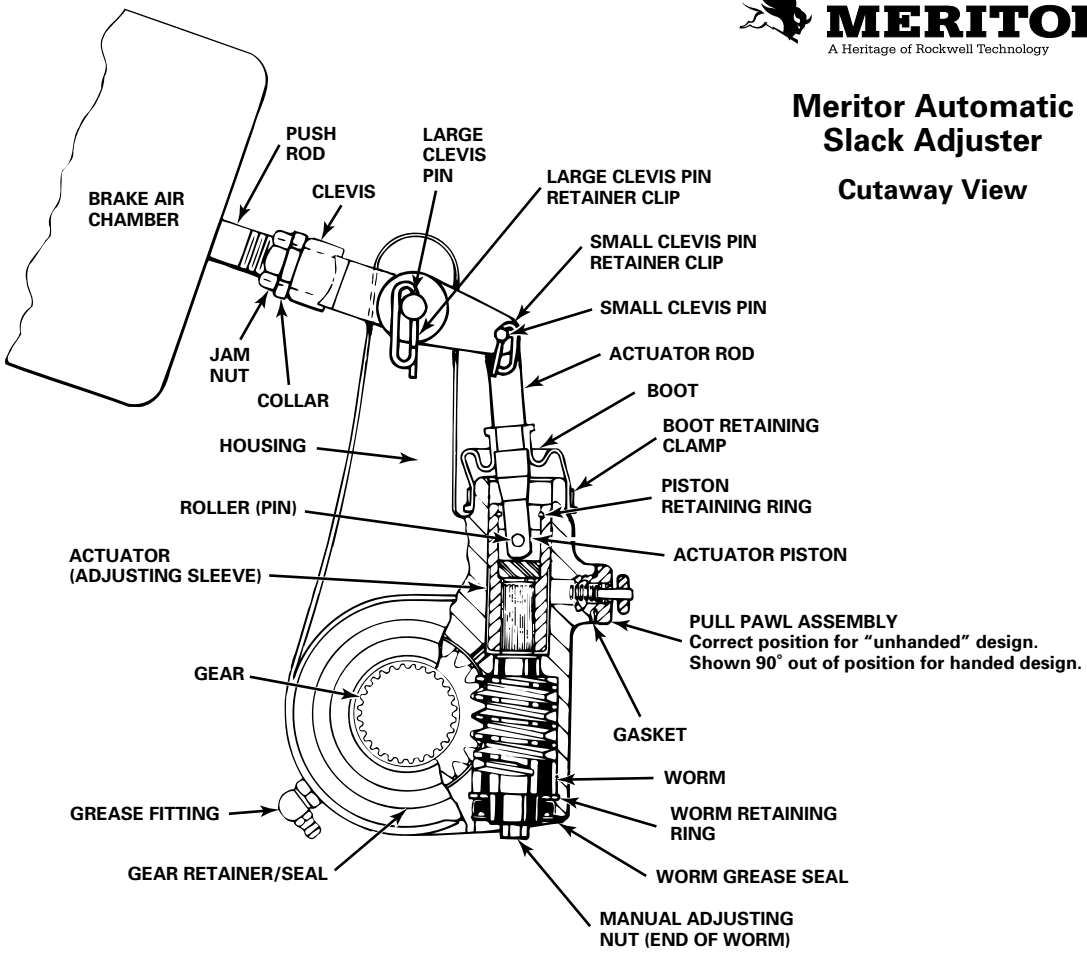
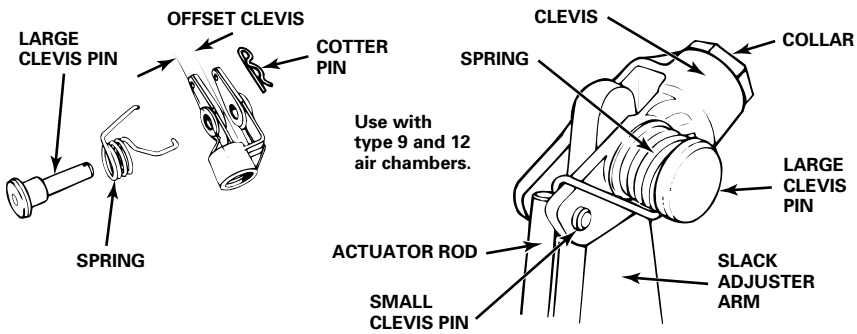
Meritor Automatic Slack Adjuster

Cutaway View



Offset Clevis for Front Axle Slack Adjuster



Section 1
Introduction

MERITOR™

Meritor's Automatic Slack Adjuster

NOTE: As of January 1993 some parts of Meritor's automatic slack adjuster are no longer serviceable and are not interchangeable with parts from earlier models. Refer to Exploded View, pages 2 and 3, for more information.

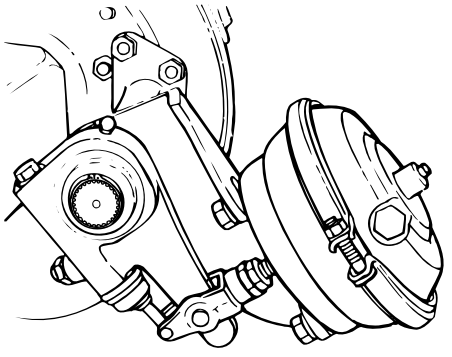
How the Automatic Slack Adjuster Works

Meritor's automatic slack adjuster automatically adjusts the clearance between the brake lining and the brake drum (rotor). When linings wear, this clearance increases and causes the chamber push rod to move a greater distance to apply the brakes.

When you install an automatic slack adjuster, you set the brake chamber stroke measurement, which is the correct clearance between the linings and drum (rotor). **Figure 1.1**.

During operation, if the chamber stroke exceeds the design limit, the automatic slack adjuster will automatically adjust the push rod's return stroke to control clearance between the lining and drum (rotor) and reset the stroke to the correct length.

Figure 1.1



Pressed-In, Sealed Actuator Boot on Meritor Automatic Slack Adjusters Manufactured from July 1998

A pressed-in, sealed actuator boot is standard equipment on Meritor automatic slack adjusters manufactured from July 1998.

The boot features a metal retaining ring with additional material that extends beyond the base of the retainer and forms a seal once the boot is pressed into the slack adjuster body.

- Meritor part numbers will not change.
- All application information is printed on the slack adjuster's identification tag.
- A counterbore is machined into the slack body for easier installation of the press-in boot.

Factory-Installed Automatic Slack Adjusters on Q Plus™ LX500 and MX500 Cam Brake Packages

Q Plus™ LX500 and MX500 brake packages include factory-installed automatic slack adjusters that do not have grease fittings, and lubrication intervals differ from conventional slack adjusters. Refer to Maintenance Manual MM-96173, *Q Plus™ LX500 and MX500 Cam Brakes*, for complete information. Call Meritor's Customer Service Center at 800-535-5560 to order this publication.

Handed and Unhanded Slack Adjusters

There are two automatic slack adjuster designs: **HANDED** and **UNHANDED**. For most applications, install a **HANDED** automatic slack adjuster so that the pawl faces **INBOARD** on the vehicle.

The pawl can be on either side or on the front of the slack adjuster housing. **Figure 1.2**.

Figure 1.2

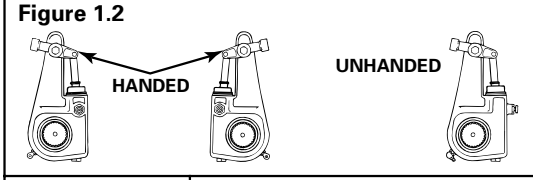
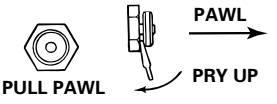


Figure 1.2A

Figure 1.2B



MERITOR™

Section 1
Introduction

Pull Pawls

Pull pawls are spring loaded. Pry the pull pawl at least 1/32-inch to disengage the teeth. **Figure 1.2B**. When you remove the pry bar, the pull pawl will re-engage automatically.

Replace Conventional Pawls with Pull Pawls

When you service an automatic slack adjuster, replace a conventional pawl with a pull pawl. **Figure 1.2A** and **Figure 1.2B**. Install the slack adjuster so that you can remove the conventional pawl or disengage the pull pawl when you adjust the brake.

Clevis Types and Thread Sizes

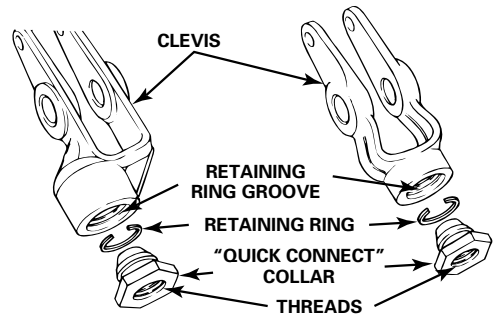
NOTE: Meritor's automatic slack adjusters and clevises are designed to be used as a system. Always replace original components with genuine Meritor replacement parts. Although parts from other manufacturers can look the same, significant differences can exist that can affect brake system performance.

"Quick Connect" Clevis

Some models of Meritor's automatic slack adjuster have a "Quick Connect" clevis. **Figure 1.3**.

- A "Quick Connect" clevis is a three-piece assembly that cannot be separated after it is assembled.
- The collar has a threaded hole for the push rod.
- A "Quick Connect" clevis can be straight or offset. Use an offset clevis when more clearance is necessary between the air chamber and the tire on the front axle.

Figure 1.3

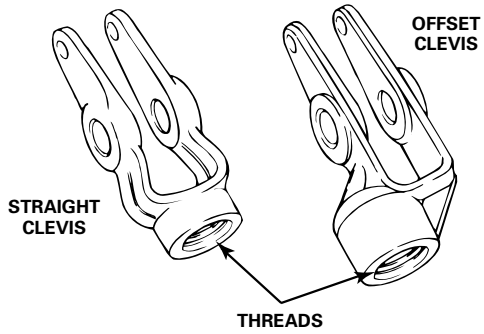


One-Piece Threaded Clevis

Most of Meritor's automatic slack adjusters, including the factory-installed slack adjusters on the new Q Plus™ LX500 and MX500 cam brakes, have a one-piece threaded clevis.

- The clevis has a threaded hole for the push rod. **Figure 1.4**.
- The one-piece threaded clevis can be straight or offset.
- All service replacement automatic slack adjusters have one-piece threaded clevises.

Figure 1.4



Thread Sizes

Straight and offset clevises are available in two thread sizes (including metric threads) to match push rod threads.

Table A: Thread Sizes

Chambers	Thread Sizes
9, 12, 16	1/2"-20 UNF
20, 24, 30, 36	5/8"-18 UNF

Section 2
Remove the Slack Adjuster from the Camshaft

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Removal

WARNING

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

WARNING

When you work on a spring chamber, carefully follow the service instructions of the chamber manufacturer. Sudden release of a compressed spring can cause serious personal injury.

WARNING

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

1. If the brake has a spring brake, compress and lock the spring, so that the brake is released completely. Check that no air pressure remains in the service half of the air chamber.
2. If it is necessary to raise the vehicle, use a jack and support the vehicle with safety stands.

WARNING

When you remove a clevis pin that has a spring, hold the spring with pliers. The spring can disengage from the clevis with enough force to cause serious personal injury.

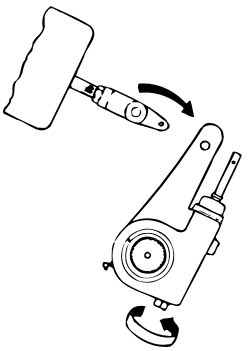
3. Remove both clevis pins.
4. **Remove a conventional pawl or disengage a pull pawl:** Use a screwdriver or equivalent tool to lift the button of a pull pawl assembly at least 1/32-inch from the actuator.

CAUTION

You must disengage a pull pawl or remove a conventional pawl before rotating the manual adjusting nut, or you will damage the pawl teeth. A damaged pawl will not allow the slack adjuster to automatically adjust brake clearance. Replace damaged pawls before putting the vehicle in service.

5. Use a wrench to turn the manual adjusting nut in the direction shown in **Figure 2.1**. Move the slack adjuster away from the clevis.

Figure 2.1



6. Remove the snap ring and washers from the camshaft. Remove the slack adjuster from the camshaft.
7. Remove the clevis from the push rod if the gap between the clevis and the collar of a "Quick Connect" clevis exceeds 0.060-inch (1.52 mm). You do not have to remove the clevis if it is in good condition.

MERITOR™

Section 3
Disassembly

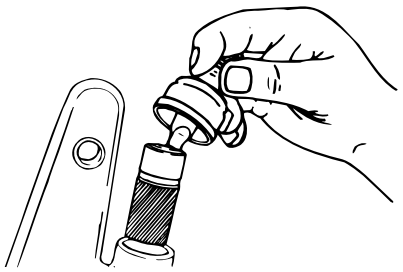
Disassembly

WARNING

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

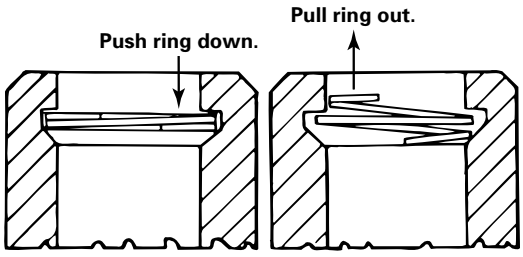
1. Cut the clamp and remove it from the boot. Use a new clamp and boot when you assemble the slack adjuster.
2. Remove the boot from the housing. Pull the actuator assembly from the housing. **Figure 3.1**.

Figure 3.1



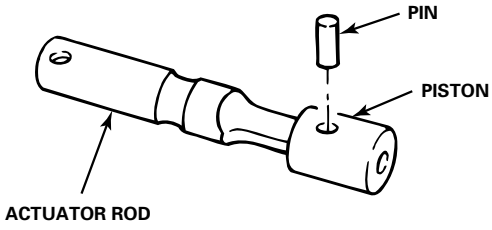
3. Use a small screwdriver to push down on one side of the piston retaining ring to force the ring out of the groove. **Figure 3.2**.
4. Extend the coils of the ring.
5. Use pliers to unwind the ring and pull it out of the groove. **Figure 3.2**.

Figure 3.2



6. Use a new ring when you assemble the slack adjuster.
7. Pull the actuator rod, piston and pin from the actuator.
8. Remove the pin from the rod and piston, if necessary. **Figure 3.3**.

Figure 3.3



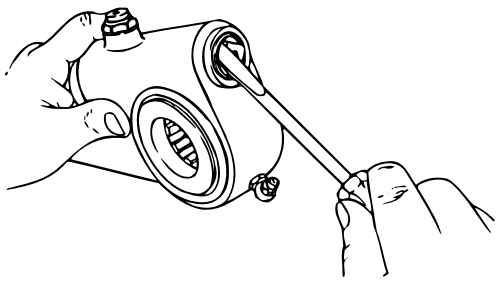
NOTE: You do not have to remove the slack adjuster arm bushing unless it is worn or "egg-shaped."

9. Inspect the condition and fit of the slack adjuster arm bushing.
10. If necessary, install a new bushing onto the clevis pin. Use the clevis pin and mallet to drive out the old bushing while you drive in the new bushing.

NOTE: Steps 11 through 21 apply only to automatic slack adjusters manufactured **BEFORE** January 1993. The gear set and seals are not serviceable on automatic slack adjusters manufactured **AFTER** January 1993. Refer to the exploded views on pages 2 and 3 of this manual for more information.

11. Use a small screwdriver to remove the grease seal from around the worm bore. **Figure 3.4**. Discard the seal. Use a new seal when you assemble the slack adjuster.

Figure 3.4

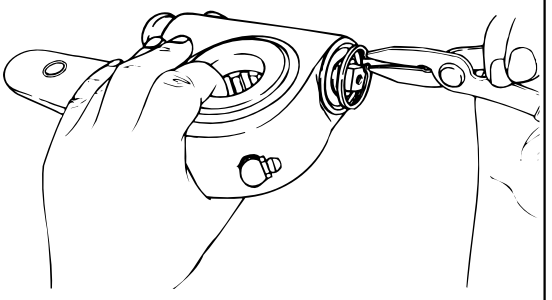


Section 3
Disassembly

MERITOR™

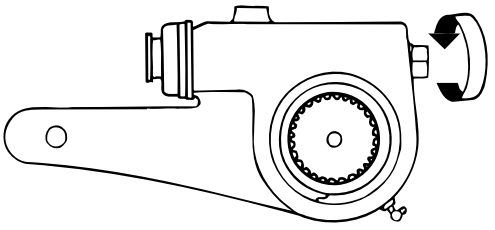
12. Use snap ring pliers to remove the retaining ring from the worm bore. **Figure 3.5**.

Figure 3.5



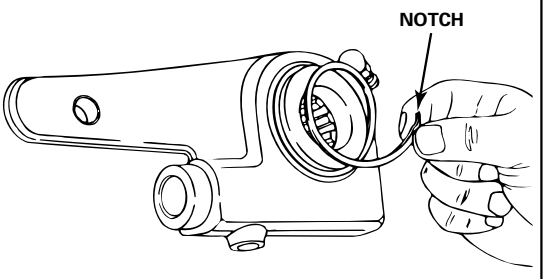
13. Use a wrench to turn the manual adjusting nut and wind the worm out of the bore. **Figure 3.6**.

Figure 3.6



14. Remove the retaining rings and thrust washers from both sides of the gear.
15. Fit a small screwdriver into the notch at the end of the retaining ring.
16. Remove the end of the retaining ring from the groove.
17. Unwind the ring by hand and pull it out of the groove. **Figure 3.7**.

Figure 3.7



18. Remove the thrust washer.

CAUTION

Push one seal out of one side of the slack adjuster housing and the other seal out of the other side of the housing to avoid damaging the seals.

19. Push the gear out of the housing only far enough to enable you to remove one gear seal.
20. Push the gear out of the opposite side of the housing and remove the other seal.
21. Inspect the seals. Discard damaged seals.

MERITOR™

Section 4
Prepare Parts for Assembly

Prepare Parts for Assembly

WARNING

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

WARNING

Solvent cleaners can be flammable, poisonous and cause burns. Examples of solvent cleaners are carbon tetrachloride, emulsion-type cleaners and petroleum-based cleaners. To avoid serious personal injury when you use solvent cleaners, you must carefully follow the manufacturer's product instructions and these procedures:

- ***Wear safe eye protection.***
- ***Wear clothing that protects your skin.***
- ***Work in a well-ventilated area.***
- ***Do not use gasoline, or solvents that contain gasoline. Gasoline can explode.***
- ***You must use hot solution tanks or alkaline solutions correctly. Follow the manufacturer's instructions carefully.***

CAUTION

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

CAUTION

Only use solvent cleaners on metal parts. Damage to parts will result.

Clean Parts

1. Use solvent cleaners to clean all automatic slack adjuster parts that have ground or polished surfaces; for example, the gear, the worm and the inner bores of the housing.
2. Use soap and water to clean non-metal parts.
3. Use soft paper or cloth that is free from dirt, oil or abrasives to dry the parts completely.

Dry Parts After Cleaning

Dry the parts immediately after cleaning. Dry parts with clean paper or rags, or compressed air.

Inspect Parts

1. You must carefully inspect all slack adjuster parts, including pawl teeth, for wear and damage before you assemble the slack adjuster.
2. Replace any part that is worn or damaged.

Corrosion Protection

NOTE: Parts must be clean and dry before you lubricate them.

1. **If you assemble parts immediately after you clean them:** Lubricate parts with grease to prevent corrosion. Parts must be clean and dry before you lubricate them.
2. **If you store parts after you clean them:** Apply a corrosion-preventive material. Store parts in a special paper or other material that prevents corrosion.

Automatic Slack Adjusters

CAUTION

Always replace used clevis pin retainer clips with new ones when servicing the automatic slack adjuster or chamber. Do not reuse clevis pin retainer clips after removing them. Discard used clips. When removed for maintenance or service, clevis pin retainer clips can be bent or "gapped apart" and can lose retention. Damage to components can result.

Check the clevis pins and the bushing in the arm of the slack adjuster. Replace the pins if they are worn. Replace the bushing if its diameter exceeds 0.531-inch (13.5 mm).

Section 5
Assembly

MERITOR™

Assembly

⚠ *WARNING*

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

NOTE: Steps 3 through 11 apply only to automatic slack adjusters manufactured **BEFORE** January 1993. The gear set and seals are not serviceable on automatic slack adjusters manufactured **AFTER** January 1993. If you are working on a current model, skip to Step 10.

Refer to exploded view in the front of this manual for more information.

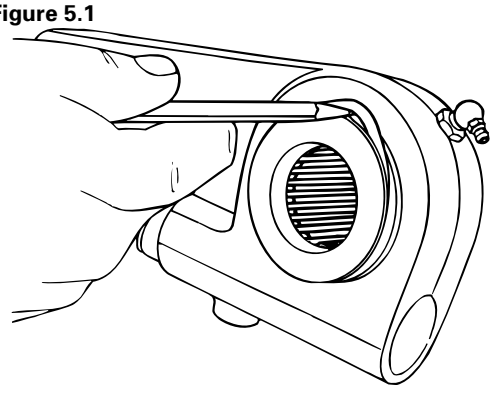
1. Remove any corrosion-preventive material that may have been applied to the parts you will assemble.
2. Use grease to lubricate the gear bore in the housing.

⚠ *CAUTION*

Follow Steps 3, 4 and 5 exactly when you install the seals so that the sharp edges of the worm bore will not damage the seals.

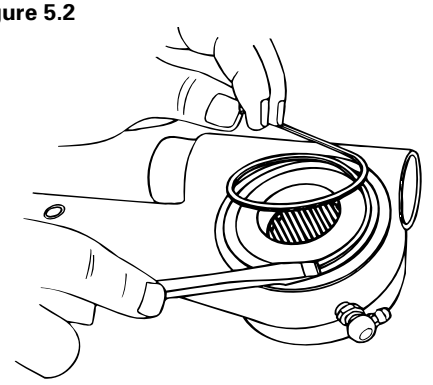
3. Install the gear straight into the bore in the housing without the seals, keeping one seal groove outside of the housing.
4. Install a seal into the groove. **Figure 5.1**.

Figure 5.1



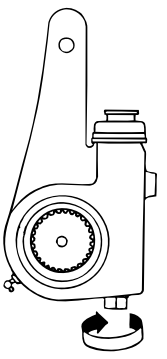
5. Lubricate the seal with grease that meets Meritor's specifications. Compress the seal in its groove. Push the gear into the housing.
6. Push the gear out of the opposite side of the housing only until the other seal groove is visible. Repeat Steps 4 and 5 to install the second seal.
7. Lubricate a thrust washer with grease that meets Meritor's specifications. Refer to Section 10. Install the washer around the gear.
8. Expand the retaining ring coil. Install one end of the coil into the groove in the outer diameter of the gear. Work around the gear and press the coil into the groove. **Figure 5.2**.

Figure 5.2



9. Repeat Steps 7 and 8 for the opposite side of the gear.
10. Install the worm into the bore. Turn the adjusting nut to wind the worm completely into the bore. **Figure 5.3**.

Figure 5.3



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Section 5
Assembly

11. Use snap ring pliers to install the retaining ring into the worm bore.

CAUTION

Install the seal with the lips OUTSIDE of the bore and the metal retainer INSIDE of the bore to prevent contamination from entering the slack adjuster housing. Damage to components can result. Figure 5.4.

CAUTION

Do not hit the seal after it reaches the bottom of the bore. Damage to seal will result.

12. Place the seal directly over the worm bore. Use a hammer and 1-3/16-inch (30.2 mm) diameter seal driver to install the seal straight into the bore. **Figure 5.5**.

Figure 5.4

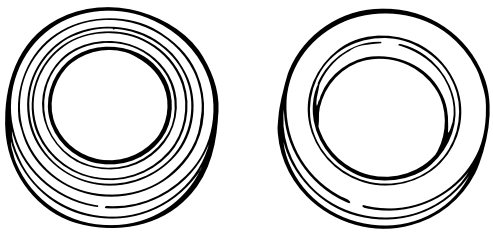
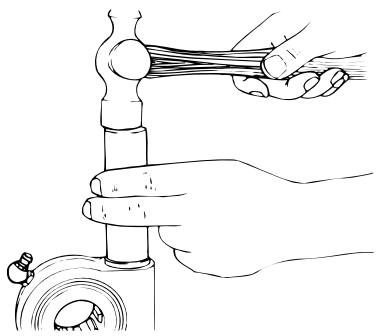
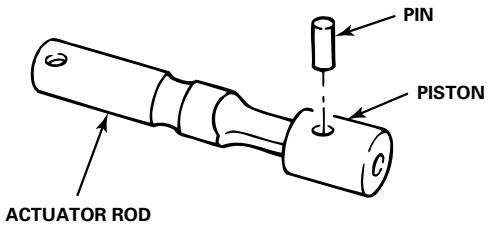


Figure 5.5



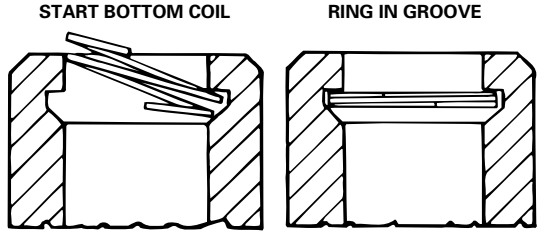
13. If you removed the pin, install it into the rod and piston. **Figure 5.6**.

Figure 5.6



14. Install the actuator rod and piston assembly into the actuator (adjusting sleeve).
15. Slide the piston retaining ring over the rod.
16. Extend the coils of the ring.
17. Use a small screwdriver to press one end of the ring into the groove. **Figure 5.7**.

Figure 5.7



18. Keep the coil extended. Press on the ring and work around the groove until the ring is in the groove completely.
19. Check to ensure that the ring is installed correctly in the groove. You cannot pull the piston out of the actuator if the retaining ring is installed correctly.

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Section 5
Assembly

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20. Install the actuator assembly into the housing so that the actuator slides along the worm splines.
21. Slip the boot over the actuator rod.

NOTE: Do not seal the boot to the tapered part of the actuator rod.

- **If the rod has a groove:** The top of the boot must fit into the groove.
- **If the rod does not have a groove**: Use silicone sealant to seal the top of the boot to the round part of the rod.

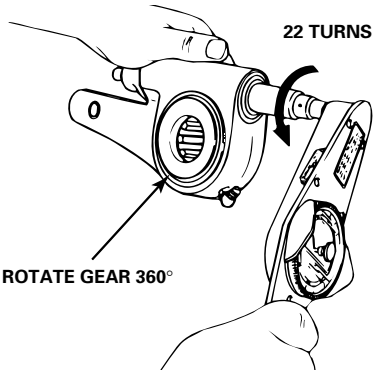
22. Fasten the bottom of the boot to the housing with a retaining clamp.
23. **Conventional Pawl:** Install the pawl assembly into the housing. Tighten the capscrew to a torque of 15-20 lb-ft (20-27 N•m). T
24. **Pull Pawl:** Remove the screwdriver or equivalent tool. The pull pawl will re-engage automatically.
25. Use a grease gun to lubricate the slack adjuster through the grease fitting. If necessary, install a camshaft into the slack adjuster gear to minimize grease flow through the gear holes.
26. Apply lubrication that meets Meritor's specifications until new grease purges from around the camshaft splines and from the pawl assembly. Refer to Section 10.

⚠ CAUTION

In Step 28 turn the adjusting nut only in the direction shown in Figure 5.8. If you turn the adjusting nut in the opposite direction while the pawl is installed, you will damage pawl teeth. Damaged teeth prevent automatic adjustment. Replace damaged pawls before putting the vehicle in service.

27. Use a torque wrench that measures lb-in.
28. As you turn the adjusting nut in the direction shown in **Figure 5.8**, read the torque scale and rotate the gear 360 degrees (22 turns of the wrench).

Figure 5.8



29. The torque value must remain less than 25 lb-in (2.83 N•m) during the complete 360-degree rotation of the gear. T
30. **If the torque value remains less than 25 lb-in (2.8 N•m):** The slack adjuster is working correctly.
31. **If the torque value exceeds 25 lb-in (2.8 N•m):** The slack adjuster is not working correctly. Disassemble the slack adjuster.
    - Check that the slack adjuster is assembled correctly.
    - Check that parts are aligned correctly.

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Section 6
Install the Slack Adjuster Onto the Camshaft

Installing the Slack Adjuster Onto the Camshaft

WARNING

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

WARNING

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

1. Check the camshaft and bushings and seals for wear and corrosion.
2. Turn the camshaft by hand to check for smooth operation.
3. Repair or replace parts as required.
4. Apply the service brake and spring brake several times. Check that the chamber return spring retracts the push rod quickly and completely. If necessary, replace the return spring or the air chamber.
5. The new automatic slack adjuster must be the same length as the one you are replacing. **Table B** below shows the length of slack adjuster that is used with each brake chamber size.
6. Place blocks in front of and behind the vehicle's wheels to prevent it from moving.

Table B: Chamber and Automatic Slack Adjuster Sizes

Length of Slack Adjuster (Inches)	Size of Chamber (Square Inches)
5	9*, 12*, 16, 20, 24, 30
5-1/2	9*, 12*, 16, 20, 24, 30, 36
6	24, 30, 36
6-1/2	30, 36

*Use an auxiliary spring on slack adjusters used with these size chambers. A size 9 or 12 chamber return spring cannot supply enough spring tension to completely retract the slack adjuster.

WARNING

When you work on a spring chamber, carefully follow the service instructions of the chamber manufacturer. Sudden release of a compressed spring can cause serious personal injury.

7. If the brake has a spring brake, compress and lock the spring to completely release the brake. No air pressure must remain in the service half of the air chamber.

CAUTION

Most Meritor automatic slack adjusters manufactured after January 1990 have lubrication holes in the gear splines. Do not operate the actuator before you install the slack adjuster. Lubricant can pump through the holes and onto the splines. Damage to components can result.

8. If the automatic slack adjuster gear has a 10-tooth spline, apply anti-seize compound to the slack adjuster and cam splines. Use Meritor specified O-637, Southwest SA 8249496 or equivalent lubricants.

NOTE: Install the slack adjuster so that you can remove a conventional pawl or disengage a pull pawl when you adjust the brake.

9. Install the slack adjuster onto the camshaft. Position the slack adjuster so that you can remove the pawl when you adjust the brake.
10. If necessary, install spacing washers and the snap ring at a maximum clearance of 0.062-inch (1.57 mm).
11. Install the clevis onto the push rod. Do not tighten the jam nut against the clevis.

Section 6
Install the Slack Adjuster Onto the Camshaft

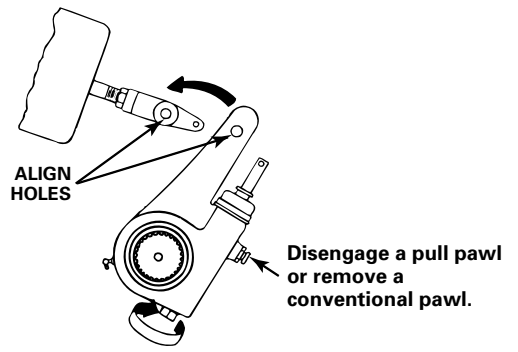
MERITOR™

CAUTION

You must disengage a pull pawl or remove a conventional pawl before rotating the manual adjusting nut, or you will damage the pawl teeth. A damaged pawl will not allow the slack adjuster to automatically adjust brake clearance. Replace damaged pawls before putting the vehicle in service.

12. Disengage the pawl. Turn the manual adjusting nut to align the holes in the slack adjuster arm and the clevis. **Figure 6.1**.

Figure 6.1



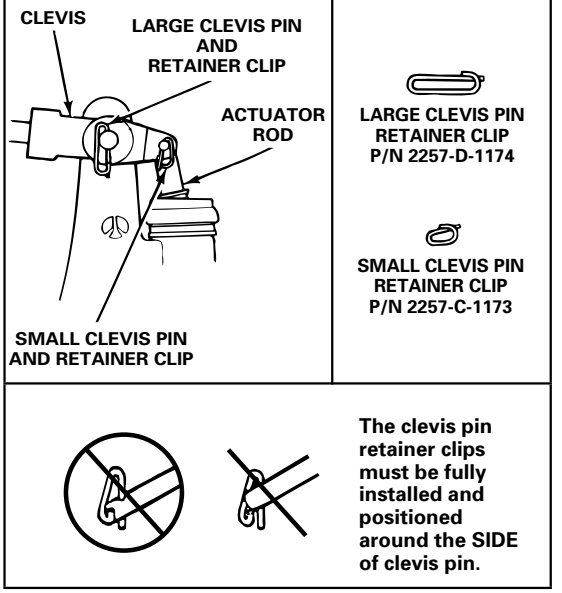
13. **If the slack adjuster has a welded clevis:** Apply anti-seize compound to the two clevis pins. Install the clevis pins through the clevis and the slack adjuster.
14. **If the slack adjuster has a threaded clevis:** Refer to Section 7.

CAUTION

Always replace used clevis pin retainer clips with new ones when servicing the automatic slack adjuster or chamber. Do not reuse clevis pin retainer clips after removing them. Discard used clips. When removed for maintenance or service, clevis pin retainer clips can be bent or "gapped apart" and can lose retention. Damage to components can result.

15. Install new clevis pin retainer clips to hold the clevis in place. **Figure 6.2**.

Figure 6.2



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Section 7
Adjust the Brakes

Check Brake Chamber Push Rod Stroke and Adjust the Clevis Position

WARNING

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

NOTE: You cannot adjust the clevis position on a chamber push rod that is equipped with a welded clevis.

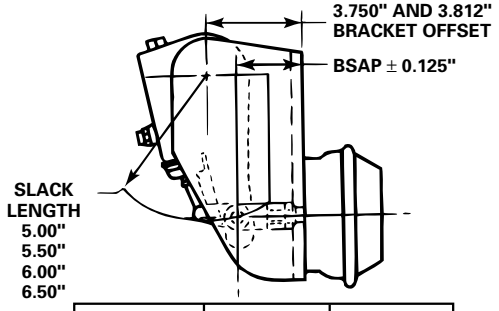
There are two methods you can use to adjust the clevis position on a chamber push rod that is equipped with a threaded clevis:

- The Brake Slack Adjuster Position (BSAP) method for standard and long stroke chambers.
- Meritor's automatic slack adjuster template method for **standard stroke chambers only**.

Brake Slack Adjuster Position (BSAP) Method

When installing the automatic slack adjuster, verify that the BSAP dimension of the chamber matches the table in **Figure 7.1**.

Figure 7.1



SLACK ADJ. SIZE	± 0.125" BSAP	LONG STROKE
5.00"	2.75"	-
5.50"	2.75"	2.25"
6.00"	2.75"	-
6.50"	2.62"	-

Correct position of automatic slack adjuster: 3.750" and 3.812" offsets only. For other bracket offsets, refer to the vehicle manufacturer's specifications.

Automatic Slack Adjuster Templates

Order the correct automatic slack adjuster template from Meritor's Customer Service Center at 800-535-5560.

CAUTION

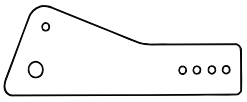
There are five different installation templates for Meritor automatic slack adjusters (Figure 7.2). The templates are NOT interchangeable. You MUST use the correct template and you MUST adjust the clevis position as described below. If you use the wrong template and install the clevis in the wrong position, the slack adjuster will not adjust the brake correctly. If the slack adjuster under-adjusts, then stopping distances are increased. If the slack adjuster over-adjusts, then the linings may drag and damage the brake.

Measure the Slack Adjuster

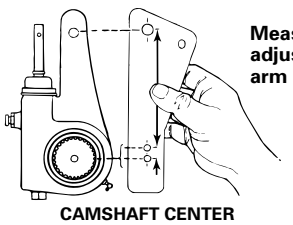
NOTE: For long stroke chambers, use the BSAP method to measure the automatic slack adjuster.

1. Use the correct Meritor automatic slack adjuster template to measure the length of the slack adjuster. The marks by the holes in the small end of the template indicate the length of the slack adjuster. **Figure 7.2.**

Figure 7.2



Color of Template	Part Number	Use to Install Slack Adjusters On
Dark brown	TP-4786	Truck or tractor drum brake
Tan	TP-4787	Trailer drum brake
White	TP-4781	Coach drum brake
Green	TP-4788	Disc brake with offset clevis
Yellow	TP-4789	Disc brake with straight clevis



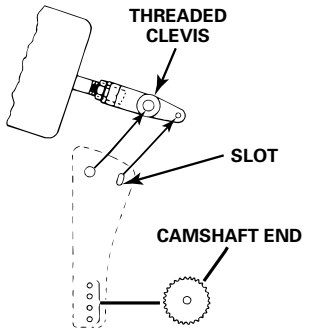
Section 7
Adjust the Brakes

MERITOR™

Install a Threaded Clevis

1. Install the large clevis pin through the large holes in the template and the clevis.
2. Select the hole in the template that matches the length of the slack adjuster. Hold that hole on the center of the camshaft.
3. Look through the slot in the template. If necessary, adjust the position of the clevis until the small hole in the clevis is completely visible through the template slot. **Figure 7.3**.

Figure 7.3



4. Check for these specifications:
   - Thread engagement between the clevis and the push rod must be at least 1/2-inch (12.7 mm). **Figure 7.4**.
   - The push rod must not extend through the clevis more than 1/8-inch (3.18 mm). If necessary, cut the push rod, or install a new push rod with a new air chamber.
5. Tighten the jam nut against the clevis to torque specifications in **Table C**.

Figure 7.4

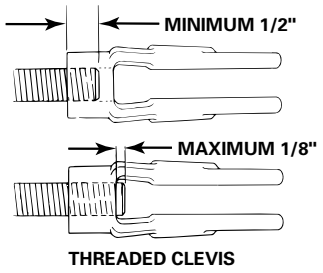


Table C: Jam Nut Torque Specifications

Threads	Torque (T)
1/2-20	20-30 lb-ft (27-41 N•m)
5/8-18	35-50 lb-ft (48-68 N•m)

Free Stroke Measurement

CAUTION

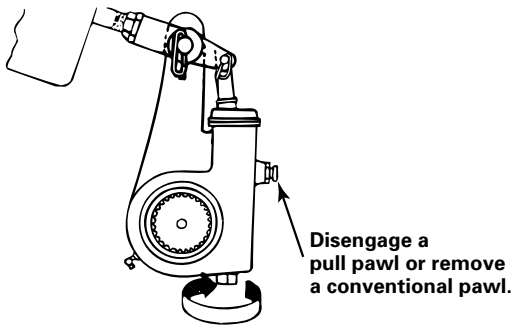
You must disengage a pull pawl or remove a conventional pawl before rotating the manual adjusting nut, or you will damage the pawl teeth. A damaged pawl will not allow the slack adjuster to automatically adjust brake clearance. Replace damaged pawls before putting the vehicle in service.

NOTE: During preventive maintenance on an in-service brake, check both the free stroke as described below and the adjusted chamber stroke as described in Section 9.

On some applications, you may find the in-service free stroke to be slightly longer than specified in Step 5. However, this is not necessarily a concern, as long as the adjusted chamber stroke is within the limits shown in the Commercial Vehicle Safety Alliance (CVSA) charts on page 20.

1. Disengage a pull pawl or remove a conventional pawl.
2. Turn the adjusting nut in the direction shown in **Figure 7.5** until the linings touch the drum, and then turn the adjusting nut in the opposite direction:
   - 1/2 turn for drum brakes
   - 3/4 turn for disc brakes

Figure 7.5



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Section 7
Adjust the Brakes

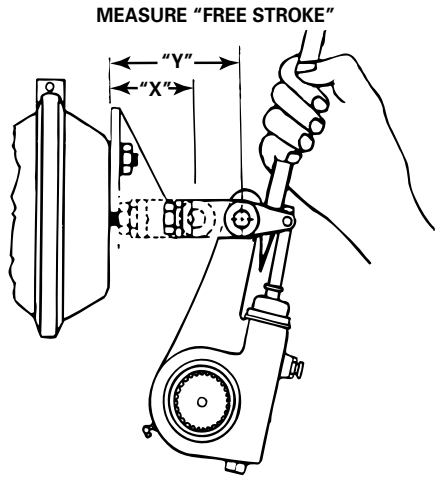
3. Measure the distance from the center of the large clevis pin to the bottom of the air chamber while the brake is released. **Refer to "X" in Figure 7.6.**
4. Use a pry bar to move the slack adjuster so that the linings are against the drum (applying the brakes). Measure the same distance again while the brakes are applied. **Refer to "Y" in Figure 7.6.**

CAUTION

Do not set free stroke shorter than specifications. If free stroke is too short, linings can drag and damage the brake.

5. The difference between measurement "X" and measurement "Y" is the free stroke, which sets the clearance between the linings and drum. Free stroke must be within the following specifications. **Figure 7.6**.
   - Drum Brakes:
     1/2-inch – 5/8-inch (12.7-15.9 mm)
   - Disc Brakes:
     3/4-inch – 7/8-inch (19.1-22.2 mm)

Figure 7.6



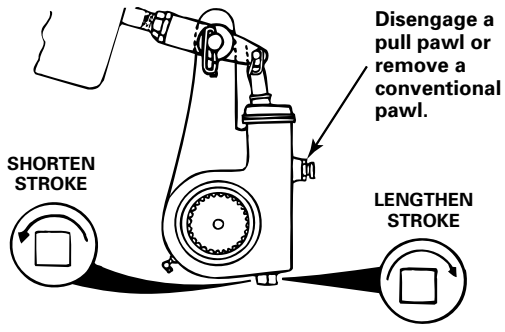
FREE STROKE = "Y" MINUS "X"

Drum brake free stroke must be 1/2" – 5/8" (12.7-15.9 mm).

Disc brake free stroke must be 3/4" – 7/8" (19.1-22.2 mm).

6. If it is necessary to adjust the stroke, turn the adjusting nut 1/8 turn in the direction shown in **Figure 7.7** and check the stroke again. Continue to measure and adjust the stroke until it is adjusted correctly.
7. Release a pull pawl or install a conventional pawl.

Figure 7.7



WARNING

When you work on a spring chamber, carefully follow the service instructions of the chamber manufacturer. Sudden release of a compressed spring can cause serious personal injury.

8. If the brake has spring chambers, carefully release the spring.
9. Test the vehicle to ensure that the brake system is operating correctly before you return the vehicle to service.

Section 8
Diagnostics

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Symptoms	Possible Causes	Corrective Actions
Adjusted stroke is too long. **No adjustment.**	The slack adjuster part number is incorrect.	Check with WD or OEM.
	The clevis angle is incorrect.	Use correct template or BSAP setting to install clevis correctly.
	Excessive wear exists between the clevis and collar (more than 0.060" [1.52 mm]).	Replace with threaded clevis.
	The jam nut at the clevis is loose.	Tighten to specification. (T)
	There is a worn clevis pin bushing in slack arm (ID larger than 0.53" [13.46 mm]).	Replace bushing.
	There is a weak or damaged air chamber spring. Spring force must be at least 32 lb (142.4 N) at first push rod movement.	Replace return spring or air chamber.
	The spring brake does not retract fully.	Repair or replace spring brake.
	There are worn or damaged teeth on the pawl or actuator.	Replace pawl or actuator.
	High torque is required to rotate worm when slack is removed from vehicle. In service slack maximum worm torque: 45 lb-in (5.09 N•m) (T) New or rebuilt slack maximum worm torque: 25 lb-in (2.83 N•m) (T)	Rebuild or replace slack adjuster.
	Excessive looseness exists between the splines of the camshaft and the slack adjuster gear.	Replace powershaft, gear or automatic slack adjuster as needed.
	A cam brake has worn components (cam bushing, for example).	Replace components.
Adjusted stroke is too short. **Linings drag.**	OEM replacement linings are not installed. Linings exhibit excessive swell or growth.	Use Meritor-approved linings.
	The slack adjuster part number is incorrect.	Check with WD or OEM.
	The clevis angle is incorrect.	Use correct template to install clevis correctly.
	The jam nut at the clevis is loose.	Tighten to specification.
	The spring brake does not retract fully.	Repair or replace spring brake.
	The manual adjustment is incorrect.	Adjust brake. Refer to Section 7.
	Poor contact exists between the linings and the drum. The drum is out-of-round.	Repair or replace drums or linings.
	Brake temperature is not even.	Correct brake balance.

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Section 9
Inspection

Commercial Vehicle Safety Alliance (CVSA) Guidelines to Measure Push Rod Travel (Adjusted Chamber Stroke)

Use the following procedures to check in-service push rod travel (adjusted chamber stroke) on truck or tractor air brakes with automatic slack adjusters.

Hold the ruler parallel to the push rod and measure as carefully as possible. An error in measurement can affect CVSA re-adjustment limits, which state that "any brake 1/4-inch or more past the re-adjustment limit, or any two brakes less than 1/4-inch beyond the re-adjustment limit will be cause for rejection."

WARNING

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

WARNING

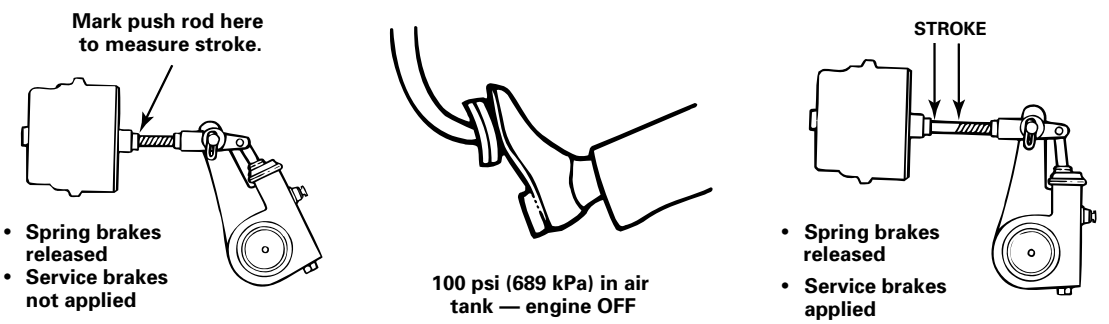
When you work on a spring chamber, carefully follow the service instructions of the chamber manufacturer. Sudden release of a compressed spring can cause serious personal injury.

1. The engine must be **OFF.** If the brake has spring chambers, carefully release the spring.
2. Check the gauges in the cab to ensure that air pressure in the tanks is 100 psi (689 kPa).
3. Determine the size and type of brake chamber you are inspecting.
4. With the brakes released, mark the push rod where it exits the chamber. **Figure 9.1**. Measure and record the distance.
5. Have another person apply and hold the brakes one full application. **Figure 9.1**.
6. Measure push rod travel distance (adjusted chamber stroke) from where the push rod exits the brake chamber to your mark on the push rod. Measure and record the distance. **Figure 9.1**.
7. **To determine push rod travel (adjusted chamber stroke):** Subtract the measurement you obtained in Step 4 from the measurement you obtained in Step 6. The difference is the push rod travel (adjusted chamber stroke).
   - Push rod travel (adjusted chamber stroke) must not be greater than the stroke length shown in the CVSA reference charts for the size and type of air chamber you are inspecting.
   - If push rod travel (adjusted chamber stroke) is greater than the maximum stroke shown in the CVSA reference charts, inspect the slack adjuster and replace it if necessary.

Alternate Method for Determining Push Rod Travel (Adjusted Chamber Stroke)

Use the above procedure, except in Step 4 and Step 6, measure the distance from the bottom of the air chamber to the center of the large clevis pin on each of the brakes.

Figure 9.1



Section 9
Inspection

MERITOR™

Commercial Vehicle Safety Alliance (CVSA) North American Out-of-Service Criteria Reference Charts

NOTE: A brake found at the adjustment limit is not a violation.

Table D: "Standard Stroke" Clamp-Type Brake Chamber Data

Type	Outside Diameter (inches)	Brake Adjustment Limit (inches)	
6	4-1/2	1-1/4	Should be as short as possible without lining to drum contact
9	5-1/4	1-3/8	
12	5-4/16	1-3/8	
16	6-3/8	1-3/4	
20	6-25/32	1-3/4	
24	7-7/32	1-3/4	
30	8-3/32	2	
36	9	2-1/4	

* For 3" maximum stroke type 24 chambers

Table E: "Long Stroke" Clamp-Type Brake Chamber Data

Type	Outside Diameter (inches)	Brake Adjustment Limit (inches)	
16	6-3/8	2.0	Should be as short as possible without lining to drum contact
20	6-25/32	2.0	
24	7-7/32	2.0	
24*	7-7/32	2.5	
30	8-3/32	2.5	

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Section 10
Lubrication and Maintenance

Lubricants

Table F: Conventional Automatic Slack Adjuster Grease Specifications

Component	Meritor Specification	NLGI Grade	Grease Type	Outside Temperature
Automatic Slack Adjuster	O-616-A	1	Clay Base	Down to -40°F (-40°C)
	O-692	1 and 2	Lithium Base	Down to -40°F (-40°C)
	O-645	2	Synthetic Oil, Clay Base	Down to -65°F (-54°C)
Clevis Pins	Any of Above	See Above	See Above	See Above
	O-637	1-1/2	Calcium Base	Refer to the grease manufacturer's specifications for the temperature service limits.
	O-641	—	Anti-Seize	

Anti-Seize Compound

Meritor lubricant specification O-637 (part number 2297-U-4571) is a corrosion control grease. Do not mix this grease with other greases. This compound is also available from the Southwest Petro-Chemical Division of Witco Chemical Corporation, 1400 South Harrison, Olathe, KS 66061, as "Corrosion Control," part number SA 8249496.

- Use anti-seize compound on the clevis pins of all slack adjusters.
- Also use anti-seize compound on the automatic slack adjuster and cam splines if the slack adjuster gear has no grease groove and holes around its inner diameter.

Factory-Installed Automatic Slack Adjusters on Q Plus™ LX500 and MX500 Cam Brake Packages

Q Plus™ LX500 and MX500 cam brake packages include factory-installed automatic slack adjusters that do not have grease fittings, and lubrication intervals differ from conventional slack adjusters.

Refer to Maintenance Manual No. MM-96173, *Q Plus™ LX500 and MX500 Cam Brakes*, for complete information. Order this publication by calling Meritor's Customer Service Center at 800-535-5560.

Maintenance

Inspections and Lubrication

Inspect and lubricate the slack adjuster according to one of the following schedules. Use the schedule that gives the most frequent inspection and lubrication. Also inspect and lubricate the slack adjuster whenever you reline the brakes.

- The schedule of chassis lubrication used by your fleet.
- The schedule of chassis lubrication recommended by the chassis manufacturer.
- Every six months.
- A minimum of four times during the life of the linings.

Section 10
Lubrication and Maintenance

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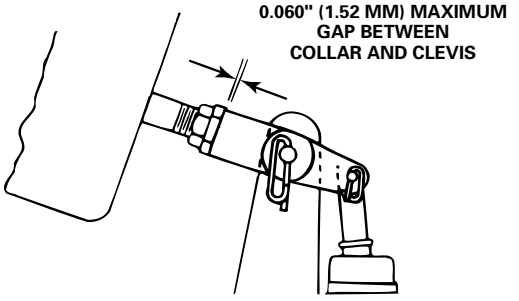
At Brake Reline

1. Before you perform brake maintenance, check the free stroke and the adjusted chamber stroke as described in Section 7.
2. If the free stroke is not correct, refer to the Diagnostics table on page 18 to correct the stroke before you adjust the chamber stroke.
3. Inspect the boot for cuts or other damage. If the boot is cut or damaged, remove the pawl and inspect the grease.
4. If the grease is in good condition, replace the damaged boot with a new boot.
5. Use a grease gun to lubricate the slack adjuster through the grease fitting. If necessary, install a camshaft into the slack adjuster gear to minimize grease flow through the gear holes.
6. Lubricate until new grease purges from around the inboard camshaft splines and from the pawl assembly.
7. Measure the gap between the clevis and the collar on a "Quick Connect" clevis. Replace the clevis if the gap exceeds 0.060-inch (1.52 mm). **Figure 10.1**.

Figure 10.1



Slack Adjusters Manufactured Before 1993

1. Remove the slack adjuster when these conditions are apparent:
   - The grease is dry or contaminated.
   - The pawl or actuator is worn.
2. Disassemble the slack adjuster.
3. Replace any worn or damaged parts.
4. Use new seals and a new boot when you assemble the unit.

ArvinMeritor™
Commercial Vehicle Systems

Meritor Heavy Vehicle Systems, LLC
2135 West Maple Road
Troy, MI 48084 USA
800-535-5560
arvinmeritor.com

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SERVICE MANUAL

Truck and Trailer Applications

AUTOMATIC BRAKE ADJUSTERS

Innovative Vehicle Technology

Table of Contents

Important Notice
This symbol is used throughout this manual to call attention to procedures where carelessness or failure to follow specific instructions may result in personal injury and/or component damage.

The description and specifications contained in this service publication are current at the time of printing. Haldex Brake Products Corp. reserves the right to discontinue or modify its models and/or procedures and to change specifications at any time without notice.

Operation

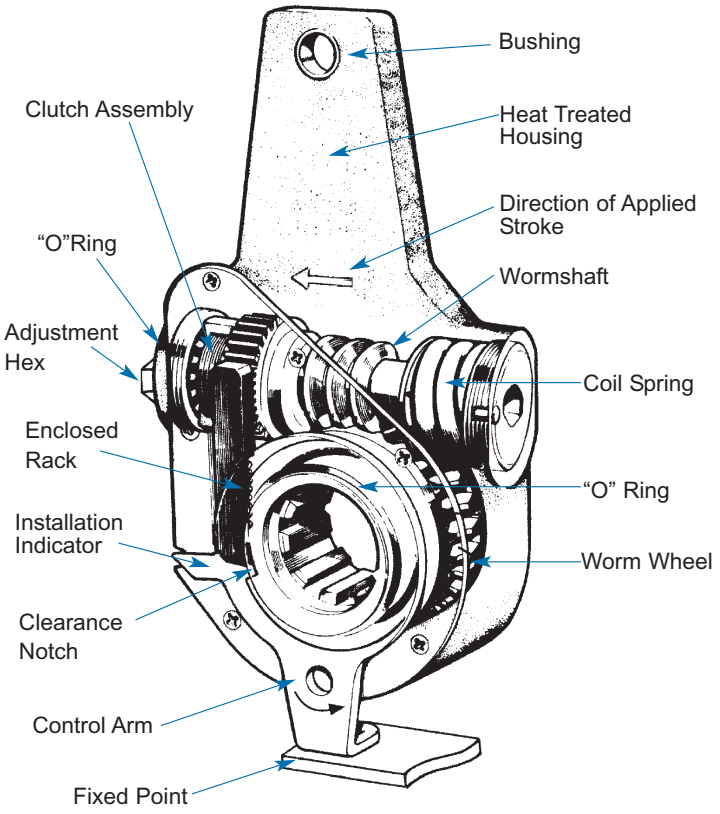
The Haldex automatic brake adjuster is a clearance sensing brake adjuster that maintains a nominal distance or clearance between lining and drum.

When the Brake Applies:

Upon brake application, the brake adjuster rotates and moves the shoes into contact with the drum. The clearance notch corresponds to the normal lining-to-drum clearance. As the brake application continues, the rack moves upward and rotates the one-way clutch which slips in this direction. As the brake torque increases, the coil spring load is overcome and the wormshaft is displaced axially, releasing the cone clutch.

When the Brake Releases:

When the brake begins its return stroke, the coil spring load returns to normal and the cone clutch is again engaged. The rack is pulled back to its original position in the notch, and any additional travel brought about by lining wear causes the rack to turn the locked one-way clutch and rotates the wormshaft through the locked cone clutch. The wormshaft then rotates the worm wheel and camshaft, adjusting the brakes.

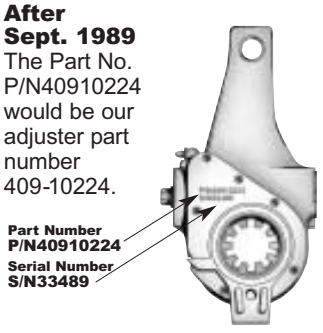


Brake Adjuster Identification

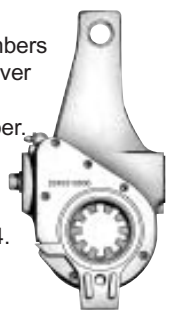
Part Number:
409 prefix = Reduced maintenance adjuster
429 prefix = No-Lube™ adjuster

Serial Number:
First 3 digits = Day of year built
Last 2 digits = Year of build

After Sept. 1989
The Part No. P/N40910224 would be our adjuster part number 409-10224.



Prior to Sept. 1989
The first three numbers stamped on the cover plate is the brake adjuster part number. For example: 224 would be our adjuster part number 409-10224.



Typical Applications

Steer Axle

Figures 1–4 show typical brackets for automatic brake adjuster applications on steer axle brake assemblies. Refer to pages 4 and 5 for detailed installation procedures.

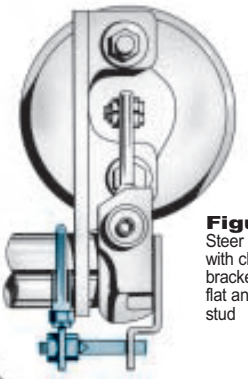


Figure 1
Steer axle with clamp bracket and flat anchor stud

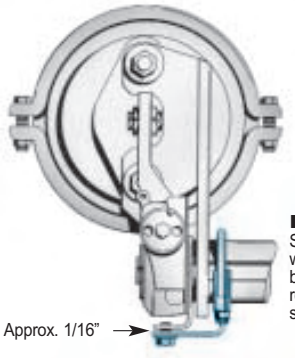


Figure 2
Steer axle with clamp bracket and round anchor stud

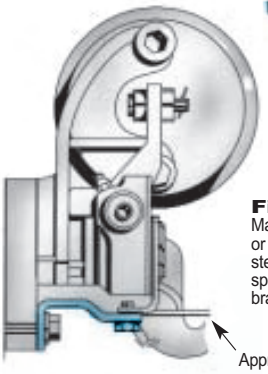


Figure 3
Mack 16,000# or higher rated steer axles with spider mounted bracket

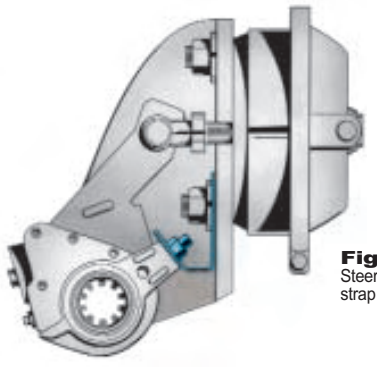


Figure 4
Steer axle with strap bracket

492

Drive Axle

Figures 5–8 show typical brackets for automatic brake adjuster applications on drive axle brake assemblies. Refer to pages 4 and 5 for detailed installation procedures.

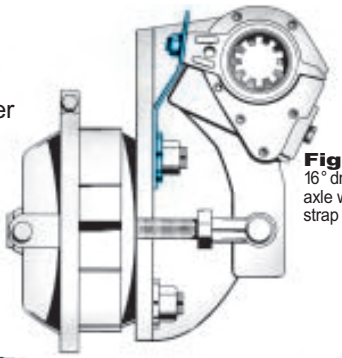


Figure 5
16° drive axle with strap bracket

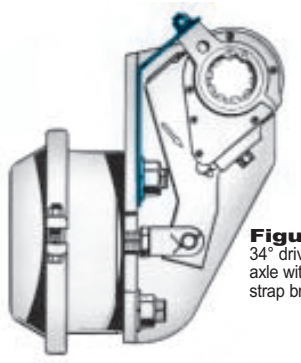


Figure 6
34° drive axle with strap bracket

Figure 7
Mack drive axle with clamp bracket and flat anchor stud

Figure 8
0° Kenworth drive axle with strap bracket, for 8 bag air ride

Note: Refer to fundamental parts identification and location on page 10.

Typical Applications

Trailer Axle

Figures 9–12 show typical brackets for automatic brake adjuster applications on trailer axle brake assemblies. Refer to pages 4 and 5 for detailed installation procedures.

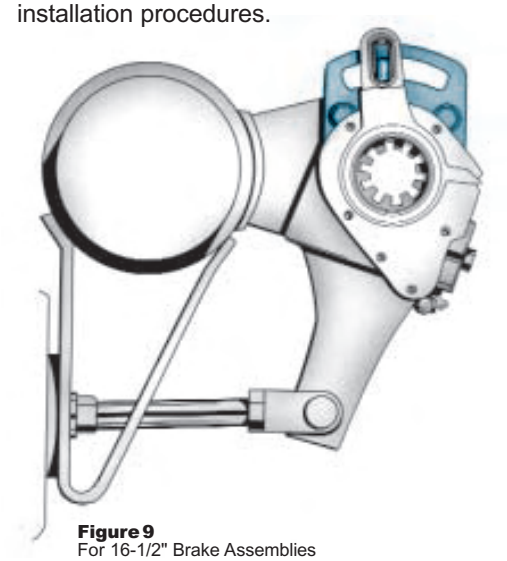


Figure 9
For 16-1/2" Brake Assemblies

Figure 10
For 12-1/4" Brake Assemblies

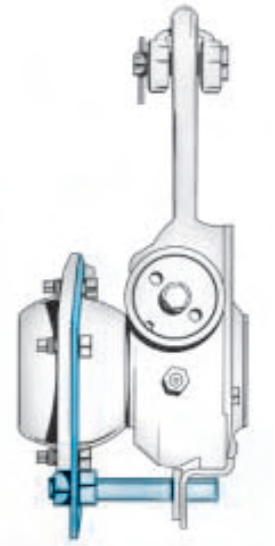


Figure 11
Integral cam support anchor bracket for 12-1/4" and 16-1/2" brakes

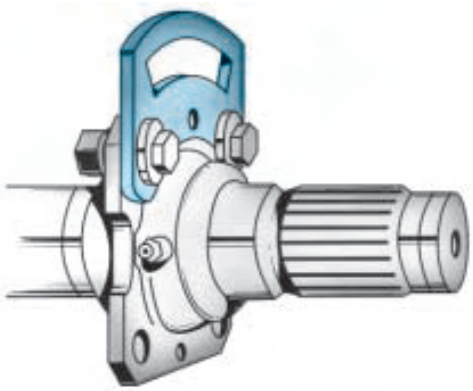


Figure 12
Bolt-on cam support anchor bracket for 12-1/4" and 16-1/2" brakes

Note: Refer to fundamental parts identification and location on page 10.

Installation Procedures

Note: Configuration of anchor bracket and brake adjuster housing may vary, depending upon axle. Refer to typical applications on Page 2 and 3.

Step 1

Note: Block wheels to prevent vehicle from rolling. Ensure system tank pressure is above 100 PSI.

- Check that the push rod is fully retracted; apply air to release spring brake. If air is not available, spring brake must be manually caged back.
- Install anchor bracket loosely as illustrated (fig. 13).
- Some strap brackets have two mounting holes. Proper mounting location is determined by the length of adjuster arm. 5" and 5-1/2" adjuster arm lengths utilize the shorter hole location while 6" and 6-1/2" length adjusters utilize the longer hole locations.
- Do not tighten anchor bracket fasteners at this time.
- Apply “Anti-Seize” type lubricant to camshaft splines.

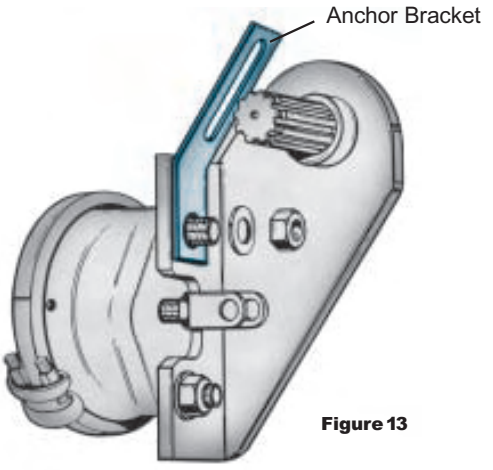


Figure 13

Step 2

- Install the brake adjuster onto the camshaft with the adjusting hex pointing away from the brake chamber (fig. 14).
- Secure the brake adjuster on the camshaft. Use at least one inner washer and enough outer washers to allow no more than .060 movement of adjuster on camshaft. (Per TMC recommended practice RP609-A.)

Note: Do NOT pull push rod out to meet the brake adjuster.

- Rotate the 7/16" adjusting hex nut CLOCKWISE until the clevis hole lines up with the brake adjuster arm hole.
- Apply anti-seize to clevis pin, install and secure with cotter pin.

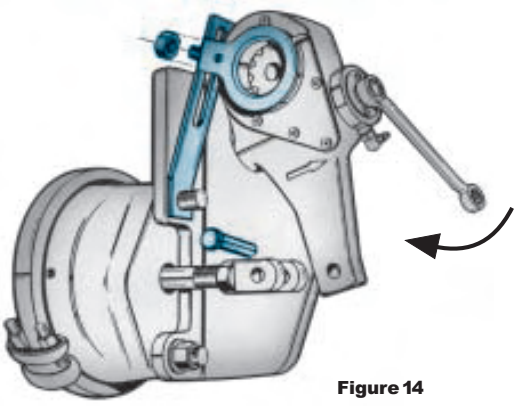


Figure 14

Installation Procedures

Step 3

- Rotate the control arm away from the adjusting hex toward the air chamber, until it comes to a definite internal stop (fig. 15).
- Most adjusters will be equipped with an "Installation Indicator." Indicator must fall within the slot for proper installation with brakes fully released (fig. 16).
- **If the control arm position is wrong, tight brakes will occur (fig. 17).**
- Tighten all anchor bracket fasteners (make sure the control arm does not move from its position while tightening fasteners).

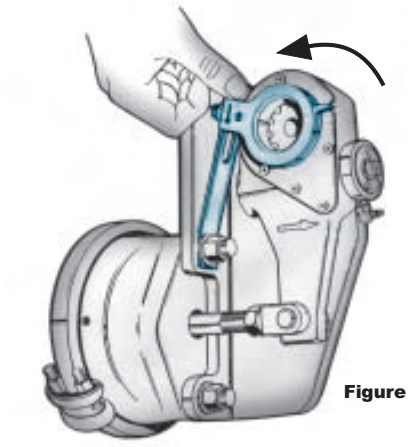


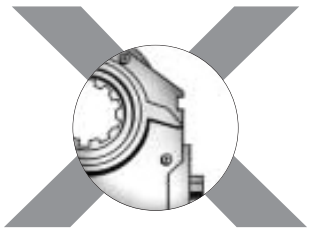
Figure 15

Step 4

- The adjuster must be manually adjusted at this time.
- Rotate the adjusting hex clockwise until the lining lightly contacts the drum.
- Then back-off the adjuster by turning the adjusting hex counter-clockwise 1/2 of a turn (fig. 18).
- A minimum of 13 ft. lbs. is necessary to overcome the internal clutch. A ratcheting sound will be present.
- **Do NOT use an impact wrench or internal damage will occur!**
- **FINAL INSPECTION.** With full service brake application, assure that spring brakes are released, and check that the "Installation Indicator" is within the slotted area. **IF NOT, REPEAT Step 3.**

Note: To ensure proper fit and function, always replace both adjuster and mounting bracket.

Correct
(Brakes released)
Figure 16



INCORRECT
(Brakes released)
Figure 17

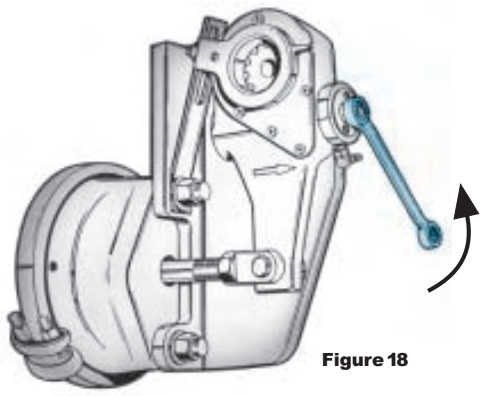


Figure 18

Routine Visual/Operational Checks

- **Haldex strongly recommends that routine visual/operational checks, including brackets and control arms, be performed at each Preventative Maintenance Service Interval.**

- **Adjusters or anchor brackets that have visual damage, or which fail the operational checks, MUST be replaced immediately.**

- **Automatic adjusters should not be operated as manual adjusters except as may be necessary to get the vehicle off the road for service.**

Service and Lubrication Intervals

Adjuster Type	Manufacture Date	Lubrication Interval	Type of Lubricant	Visual Check Interval
Standard Adjuster 409-10...	Prior to 6/1/96	50,000 miles or every 3 months	Standard Chassis Grease	Each Preventative Maintenance Service Interval
Reduced Maintenance Adjuster 409-10...	After 6/1/96	Once a year	Standard Chassis Grease	Each Preventative Maintenance Service Interval
No-Lube™ Adjuster 429-10...	After 6/1/96	None	Sealed Unit	Each Preventative Maintenance Service Interval

Notes:

No-Lube™ automatic brake adjusters are manufactured without a grease fitting and are identified by a 429 prefix.

Moly-disulfide grease should not be used because it may affect the function of the internal friction clutches and reduce the reliability of the automatic adjustment.

In no case should the lubrication interval exceed the published intervals shown above.

Foundation Brake Operational Check and Troubleshooting

Note: ■ Block wheels to prevent vehicle from rolling.
■ Ensure system tank pressure is at 90-100 psi.
■ Check that push rod is fully retracted; apply air to release spring brake.

North American Commercial Vehicle Safety Alliance (CVSA) Uniform Vehicle Inspection Criteria

The applied stroke of the brake should be checked per CVSA guidelines at 90-100 PSI reservoir pressure. **Applied stroke** should be at or less than the specified adjustment limits as follows:

Standard Clamp Type Brake Chamber			
Type	Adjustment Limit	Type	Adjustment Limit
9	1-3/8"	24	1-3/4"
12	1-3/8"	30	2"
16	1-3/4"	36	2-1/4"
20	1-3/4"		

Long Stroke Type Brake Chamber			
Type	Adjustment Limit	Type	Adjustment Limit
16L	2"	24LS	2-1/2"
20L	2"	30LS	2-1/2"
24L	2"		

NOTE: Long stroke chambers are identified with square air ports or port bosses and special trapezoid ID tags.

Free Stroke

Measuring the Free Stroke

Free stroke is the amount of movement of the adjuster arm required to move the brake shoes against the drum. With brakes released, measure from the face of the chamber to the center of the clevis pin “A” (fig. 19). Use a lever to move the brake adjuster until the brake shoes contact the drum “B” (fig. 19). The difference between the fully retracted and drum contact measurement “B”–“A” (fig. 19), is the free stroke. The free stroke range should fall between 3/8"–3/4".

Free Stroke Within Range

If the free stroke is good, but the applied stroke is too long, there is probably a problem with the foundation brake. Check the following and reference CVSA out-of-service criteria:

Component	Cause	Action
Brake drums	Cracked or out of round	Replace or check drum run out
Brake shoes	Shoe span out of spec	Refer to OEM specs and replace if necessary
Brake shoes	Uneven lining wear	Check spider concentricity
Brake shoes	Shoe pad missing	Remove & replace shoes
Brake shoes	Cracked shoes	Remove & replace shoes
Cam bushings	Excessive movement	Remove & replace cam bushings per OEM specs
Camshaft	Flat spots on cam head	Replace camshaft
Camshaft	Cracked/broken splines	Replace camshaft
Camshaft	Worn bearing journals	Replace camshaft
Chamber bracket	Broken/bent	Replace bracket
Clevis yoke and pin	Worn	Remove & replace
Return springs	Broken/stretched or missing	Remove & replace springs
Rollers	Flat spots, grooved pin/worn	Remove & replace roller and pin
Rollers	Wrong size	Remove & replace with correct parts
Spider anchor pins	Grooved or scored/worn	Replace spider or pins, as appropriate for OEM

Free Stroke Above the Range

If the free stroke is above the range and the applied stroke is too long, there is a problem with the foundation brake or the adjuster. Check the following:

Component	Cause	Action
Camshaft	Binding	Remove, replace, lubricate camshaft
Camshaft bushings	Excessive movement	Remove and replace cam bushings per OEM specs
Camshaft bushings	Binding shaft	Lubricate camshaft bushings or replace
Air chamber return springs	Broken, weak, missing	Replace chamber
Air chamber push rod	Binding on chamber housing	Check adjuster for proper shimming and air chamber position for proper adjuster arm length
Air system	Not exhausting completely	Check for cause of air problem and repair
Shoe return springs	Broken, weak, missing	Replace springs
Automatic brake adjuster	Unknown	Check automatic brake adjuster for proper installation. Refer to Installation Instructions on pages 4 & 5.
Automatic brake adjuster	Unknown	Refer to Automatic Brake Adjuster Checking Procedures and Operational Check on pages 9 & 10.

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Free Stroke Below the Range

If the free stroke is less than 3/8", a dragging brake can occur. Check the following:

Component	Cause	Action
Wheel bearing	Out of adjustment	Readjust per OEM specs
Automatic brake adjuster	Unknown	Check automatic brake adjuster for proper control arm position. Refer to Installation Instructions on pages 4 & 5.
Automatic brake adjuster	Unknown	Refer to Automatic Brake Adjuster Checking Procedures and Operational Check on pages 9 & 10.

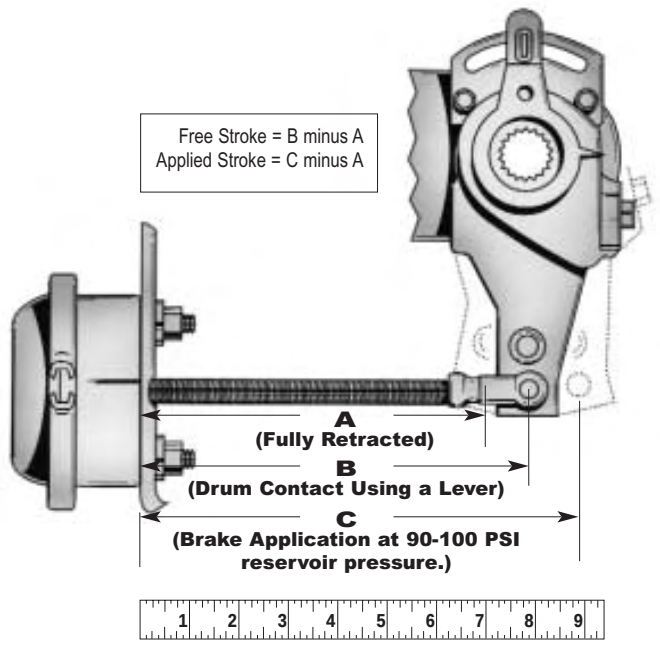


Figure 19
Stroke Measurements
(taken from face of air chamber to center of clevis pin)

Automatic Brake Adjuster Checking Procedures

If the brake adjuster is not maintaining the proper applied stroke, before removing the brake adjuster, check the condition of the foundation brake (see pages 7 & 8). **If after inspecting the foundation brake** no apparent problems are found, inspect the automatic brake adjuster to determine if it is operating properly. The inspection can be performed on or off the vehicle using the following procedures.

Note:
- Block wheels to prevent vehicle from rolling.
- Ensure system tank pressure is at 90-100 PSI.
- Check that push rod is fully retracted; apply air to release spring brake.
- If air is not available, spring brake must be manually caged back.
- Do not use air tools on brake adjuster!

On Vehicle Inspection

Component	Cause	Action
Tight or dragging brakes	Control arm mispositioned	Realign control arm and anchor bracket. Check installation procedures on pages 4 & 5.
Excessive chamber push rod travel	Improper anchor bracket connection to control arm	If anchor bracket to control arm connection is worn, loose, bent or broken, it must be re-secured or replaced.
	Low clutch torque	Rotate the 7/16" adjustment hex one full turn counterclockwise. Replace brake adjuster if the torque is less than 13 ft. lbs. or no racheting sound occurs.
	Unknown	Perform automatic brake adjuster operational check (see below).

Automatic Brake Adjuster Operational Check

Functional operation of the brake adjuster can be performed on the vehicle by using the following procedure:

- Block wheels to prevent vehicle from rolling.
- Ensure tank pressure is at 90-100 psi.
- Check that the push rod is fully retracted; apply air to release spring brake. If air is not available, spring brake must be manually caged back.

Manually de-adjust brakes (turn adjustment hex counterclockwise one full turn) to create an excessive drum to lining clearance condition. (A ratcheting sound should occur.)

Make a full service brake application. On release, allow sufficient time for brake to fully retract.

During the brake release, observe rotation of the adjustment hex (attaching a wrench on the hex or scribing the hex will make this rotation easier to see).

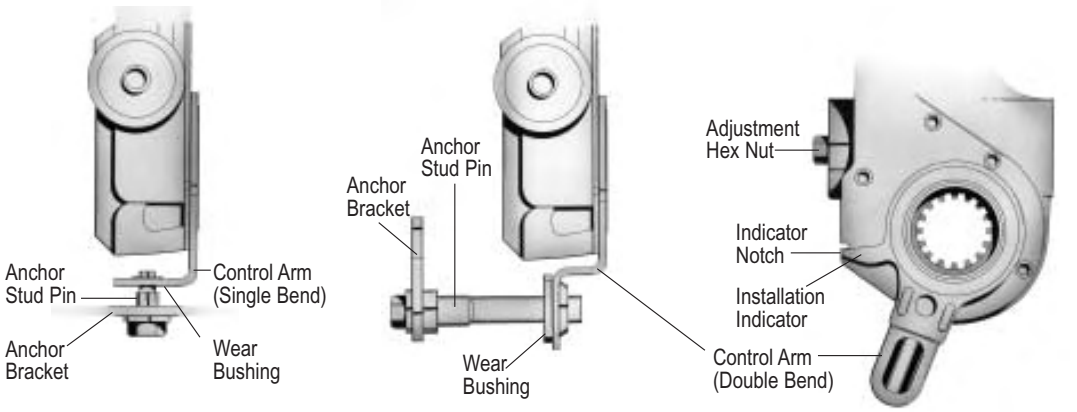
This rotation indicates that an excessive clearance condition has been determined by the brake adjuster, and it is making an adjustment to compensate. On each subsequent brake release, the amount of adjustment and push rod travel will be reduced until the desired clearance is achieved.

If rotation of the adjustment hex is not observed, refer to Foundation Brake Operational Check and Troubleshooting Procedures on pages 7 and 8. If foundation brake assembly checks out okay and hex still does not turn, check control arm and mounting bracket for possible worn, bent or broken components. If the control arm and mounting bracket check out okay, replace the adjuster and hardware per procedures on pages 4 & 5.

Off Vehicle Inspection

Component	Cause	Action
Adjuster not functioning properly	Low clutch torque	Place adjuster arm in vise. Rotate the 7/16" adjustment hex counterclockwise one full turn to check de-adjustment torque. After control arm stops rotating, a minimum of 13 ft. lbs. will be required and a ratcheting sound will occur. Replace brake adjuster if the torque is less than 13 ft. lbs. or no de-adjustment ratcheting sound is present.
	Control Arm slippage	Place adjuster arm in vise. Rotate the control arm counterclockwise until the control arm rotates to an INTERNAL STOP. If the installation indicator goes past the indicator notch or does not stop rotating (arm slips freely), replace the brake adjuster.
	Unknown	If torque is above 13 ft. lbs., scribe a line on the adjustment hex. Manually pull the brake adjuster control arm clockwise then push back counter-clockwise until the installation indicator stops in the indicator notch. The hex will move in a clockwise direction when the control arm of the brake adjuster is pushed back counterclockwise. Replace adjuster is hex does not move.
	Worn/missing control arm wear bushing, and anchor stud pin, if applicable.	Remove and replace pin and bushings. If adjuster has passed the above checks, re-install adjuster on vehicle, with new hardware.

Typical Parts Identification and Location

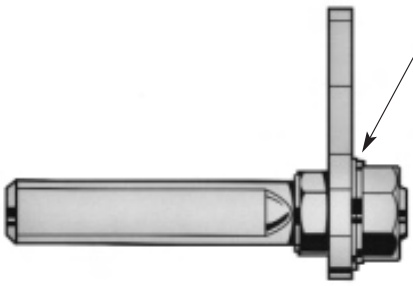


Torque Specifications

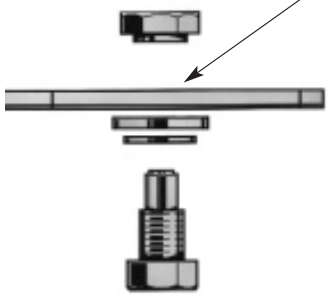
Note: Tighten all fasteners to manufacturer's recommendations unless otherwise specified below.

Round Anchor Stud Pin with Fabricated Ring Clamp
Torque to 15-20 ft. lbs. when installed

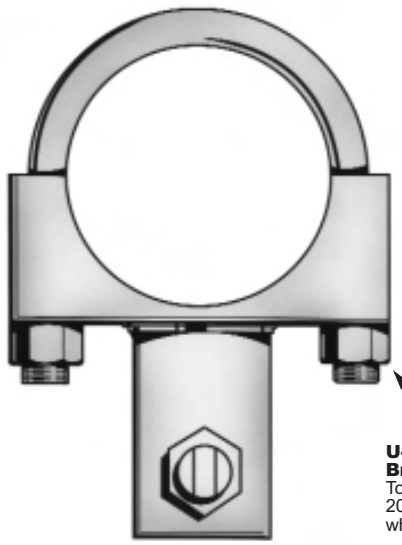
3/8"-16 Nut and Bolt
Torque to 15-20 ft. lbs. when installed



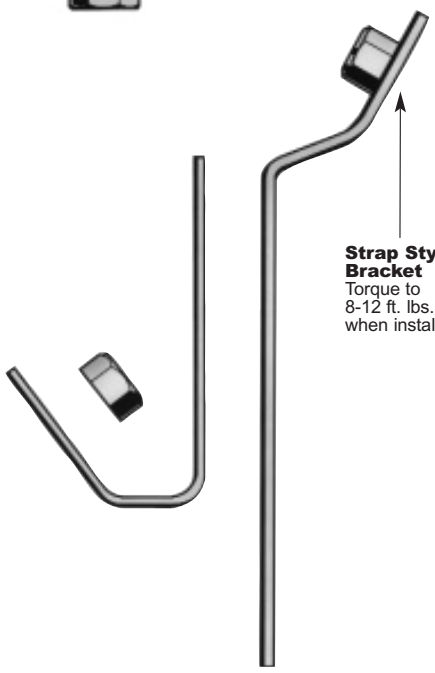
Flat Anchor Stud Pin
Torque to 40-50 ft. lbs. when installed



Round Anchor Stud Pin with Slide Nut
Torque to 15-20 ft. lbs. when installed



U-Bolt Style Bracket
Torque to 20-30 ft. lbs. when installed



Strap Style Bracket
Torque to 8-12 ft. lbs. when installed

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Frequently Asked Questions

1. Will the side of the brake adjuster with the installation indicator always face in?

No. Haldex adjusters are normally unhanded. Always install with the adjusting hex pointing away from the air chamber.

2. My adjuster doesn't have an installation indicator; should I be concerned?

No. A few applications aren't manufactured with installation indicators. However, the set-up and function are the same regardless. Refer to pages 4 & 5 for proper installation procedures.

3. Why is there resistance when backing off the adjuster?

It takes approximately 20-25 lb. ft. of torque to back off the adjustment hex. (A ratcheting sound should occur.)

4. How far do I back off the automatic brake adjuster at a brake reline?

1/2 turn. (NOTE: for the first 1/8 turn you may not hear the ratcheting; this is normal.)

5. How do I know if I need an offset, angled or straight-armed adjuster?

Haldex manufactures the right adjuster arm for your specific application. Haldex adjusters are unhanded (no lefts or rights) in the majority of applications. Please refer to the Haldex Parts and Cross Reference Guide for your specific application (ABA10001).

6. Why does my replacement ABA look different from the original I took off?

The Haldex ABA replacement adjuster has been designed to fit a number of applications. It is the same original equipment quality and design of the adjuster you removed; however, it may look different on the outside. If you use all the parts included in the kit, the results will be the same as the original equipment adjuster.

7. Why is the applied stroke pressure range 90-100 psi at the reservoir?

This is the pressure recommended by the CVSA (Commercial Vehicle Safety Alliance). Anything beyond 100 psi measures deflection within the foundation brake and not true push rod stroke.

8. Some brake chambers have round port openings and some square; what is the difference?

Standard brake chambers are identified by round ports. Long stroke chambers are identified by square ports and trapezoid ID tags.

9. Can I vary the amount of lining-to-drum clearance by moving the control arm?

No, that clearance is set at the factory. If long or short stroke continues, please refer to the foundation brake checking procedures on pages 7 & 8 of this manual.

10. Can I use an air ratchet on the adjuster?

No. It will damage the internal mechanism of the adjuster and render it inoperative.

11. Can I access the adjuster through the rear cover?

No, do not tamper with the rear cover—it will release the factory set pressure on the spring and destroy the adjuster and its ability to properly function.

12. How much control arm bushing and anchor stud pin wear is acceptable before replacement is required?

No more than 1/16."

13. What is the acceptable amount of camshaft bushing wear?

Automatic adjusters cannot compensate for worn foundation brake parts. Please refer to the foundation brake manufacturer's recommendations for maximum bushing and camshaft wear limits.

14. Can wheel bearing adjustment affect the brake adjuster?

Yes. Improper wheel bearing adjustment could result in improper brake adjustment. It is necessary to refer to the axle manufacturer's wheel bearing adjustment recommendations. A loose bearing preload could cause a tight brake.

(continued on page 13)

Frequently Asked Questions (continued)

15.Are all Haldex automatic brake adjusters pre-lubed?

Yes. All Haldex brake adjusters are lubricated at the factory. Please consult the Service and Lubrication Section on Page 6 for proper lubrication guidelines.

16.Can I use moly lube with the Haldex automatic brake adjuster?

No. A high concentration of moly-disulfide can lower the friction capabilities in the adjusting clutch parts and decrease automatic adjustment reliability.

17.Can I purchase anchor bracket wear items separately (i.e., anchor stud pins, wear bushings)?

Yes. Normal wear items like anchor stud pins and wear bushings are available. Refer to the Haldex Parts and Cross Reference Guide, ABA10001. Otherwise, contact Haldex Technical Assistance for the appropriate bracket kit at 1-800-643-2374.

18.Does the control arm need to be properly set and secured?

Yes. Without proper placement and attachment, the adjuster will not function properly. Make sure the control arm, anchor bracket and wear items are in good working order to assure the adjuster will operate as designed.

19.If automatic adjustment stops, can I operate as a manual brake adjuster?

No. Completely check out foundation brake and adjuster to determine cause of problem. Repair or replace as needed to restore automatic adjustment.

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Additional Information Available

Additional parts and service information on Haldex Automatic Brake Adjusters may be found in the following materials:

Service Information

Installation and Maintenance Wall Chart	L60047HBS
Installation Video	ABA10017
Service Manual (Truck/Trailer)	L30033HBS

Parts Information

Parts and Cross Reference Guide (Truck/Trailer)	ABA10001
Supplemental Automatic Brake Adjuster Kits	ABA10007

These materials may be ordered by contacting your Customer Service Representative at 1-800-643-2374. Or, you may log in to our website www.hbsna.com with your customer password to place your order.

Commercial Vehicle Systems

North American Sales Division
Haldex Brake Products Corporation
10707 N.W. Airworld Drive
Kansas City, MO 64153-1215
Phone: (816) 891-2470
Fax: (816) 880-9766

North American Sales Division
Haldex Limited
525 Southgate Drive, Unit 1
Guelph, Ontario CANADA N1G 3W6
Phone: (519) 826-7723
Fax: (519) 826-9497

www.hbsna.com

9/03 25M ART L30033

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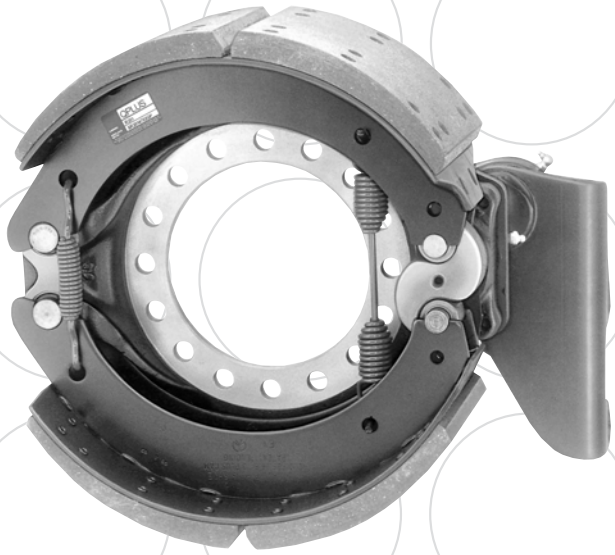
Maintenance Manual 4

Cam Brakes

Revised 10-03



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Service Notes

About This Manual

This manual provides maintenance and service information for Meritor cam brakes.

Before You Begin

1. Read and understand all instructions and procedures before you begin to service components.
2. 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.
3. Follow your company's maintenance and service, installation, and diagnostics guidelines.
4. Use special tools when required to help avoid serious personal injury and damage to components.

Hazard Alert Messages and Torque Symbols

⚠ WARNING

A Warning alerts you to an instruction or procedure that you must follow exactly to avoid serious personal injury and damage to components.

⚠ CAUTION

A Caution alerts you to an instruction or procedure that you must follow exactly to avoid damage to components.

This symbol alerts you to tighten fasteners to a specified torque value.

How to Obtain Product and Service Information

On the Web

Visit the DriveTrain Plus™ by ArvinMeritor Tech Library at arvinmeritor.com to easily access product and service information. The Library also offers an interactive and printable Literature Order Form.

ArvinMeritor's Customer Service Center

Call ArvinMeritor's Customer Service Center at 800-535-5560.

Technical Electronic Library on CD

The DriveTrain Plus™ by ArvinMeritor Technical Electronic Library on CD contains product and service information for most Meritor, ZF Meritor LLC and Meritor WABCO products. $20. Specify TP-9853.

How to Obtain Tools, Supplies and Brake Service Kits

Call ArvinMeritor's Commercial Vehicle Aftermarket at 888-725-9355 to obtain Meritor tools and supplies. You can also obtain the following brake conversion kits.

- A kit to convert Q Series cam brake shoes, except models with cast shoes, to Q Series brakes with quick change shoes
- A kit to convert standard 16.5-inch Q Series cam brakes to Q Plus™ cam brakes

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

Contents

Asbestos and Non-Asbestos Fibers

⚠ ASBESTOS FIBERS WARNING

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

Hazard Summary

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

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

Recommended Work Practices

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

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

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

3. Procedures for Servicing Brakes.

a. Enclose the brake assembly within a negative pressure enclosure. The enclosure should be equipped with a HEPA vacuum and worker arm sleeves. With the enclosure in place, use the HEPA vacuum to loosen and vacuum residue from the brake parts.

b. As an alternative procedure, use a catch basin with water and a biodegradable, non-phosphate, water-based detergent to wash the brake drum or rotor and other brake parts. The solution should be applied with low pressure to prevent dust from becoming airborne. Allow the solution to flow between the brake drum and the brake support or the brake rotor and caliper. The wheel hub and brake assembly components should be thoroughly wetted to suppress dust before the brake shoes or brake pads are removed. Wipe the brake parts clean with a cloth.

c. If an enclosed vacuum system or brake washing equipment is not available, employers may adopt their own written procedures for servicing brakes, provided that the exposure levels associated with the employer's procedures do not exceed the levels associated with the enclosed vacuum system or brake washing equipment. Consult OSHA regulations for more details.

d. Wear a respirator equipped with a HEPA filter approved by NIOSH or MSHA for use with asbestos when grinding or machining brake linings. In addition, do such work in an area with a local exhaust ventilation system equipped with a HEPA filter.

e. **NEVER** use compressed air by itself, dry brushing, or a vacuum not equipped with a HEPA filter when cleaning brake parts or assemblies. **NEVER** use carcinogenic solvents, flammable solvents, or solvents that can damage brake components as wetting agents.

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

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

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

Regulatory Guidance

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

⚠ NON-ASBESTOS FIBERS WARNING

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

Hazard Summary

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

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

Recommended Work Practices

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

2. Respiratory Protection. OSHA has set a maximum allowable level of exposure for silica of 0.1 mg/m^3 as an 8-hour time-weighted average. Some manufacturers of non-asbestos brake linings recommend that exposures to other ingredients found in non-asbestos brake linings be kept below 1.0 f/cc as an 8-hour time-weighted average. Scientists disagree, however, to what extent adherence to these maximum allowable exposure levels will eliminate the risk of disease that can result from inhaling non-asbestos dust.

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

3. Procedures for Servicing Brakes.

a. Enclose the brake assembly within a negative pressure enclosure. The enclosure should be equipped with a HEPA vacuum and worker arm sleeves. With the enclosure in place, use the HEPA vacuum to loosen and vacuum residue from the brake parts.

b. As an alternative procedure, use a catch basin with water and a biodegradable, non-phosphate, water-based detergent to wash the brake drum or rotor and other brake parts. The solution should be applied with low pressure to prevent dust from becoming airborne. Allow the solution to flow between the brake drum and the brake support or the brake rotor and caliper. The wheel hub and brake assembly components should be thoroughly wetted to suppress dust before the brake shoes or brake pads are removed. Wipe the brake parts clean with a cloth.

c. If an enclosed vacuum system or brake washing equipment is not available, carefully clean the brake parts in the open air. Wet the parts with a solution applied with a pump-spray bottle that creates a fine mist. Use a solution containing water, and, if available, a biodegradable, non-phosphate, water-based detergent. The wheel hub and brake assembly components should be thoroughly wetted to suppress dust before the brake shoes or brake pads are removed. Wipe the brake parts clean with a cloth.

d. Wear a respirator equipped with a HEPA filter approved by NIOSH or MSHA when grinding or machining brake linings. In addition, do such work in an area with a local exhaust ventilation system equipped with a HEPA filter.

e. **NEVER** use compressed air by itself, dry brushing, or a vacuum not equipped with a HEPA filter when cleaning brake parts or assemblies. **NEVER** use carcinogenic solvents, flammable solvents, or solvents that can damage brake components as wetting agents.

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

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

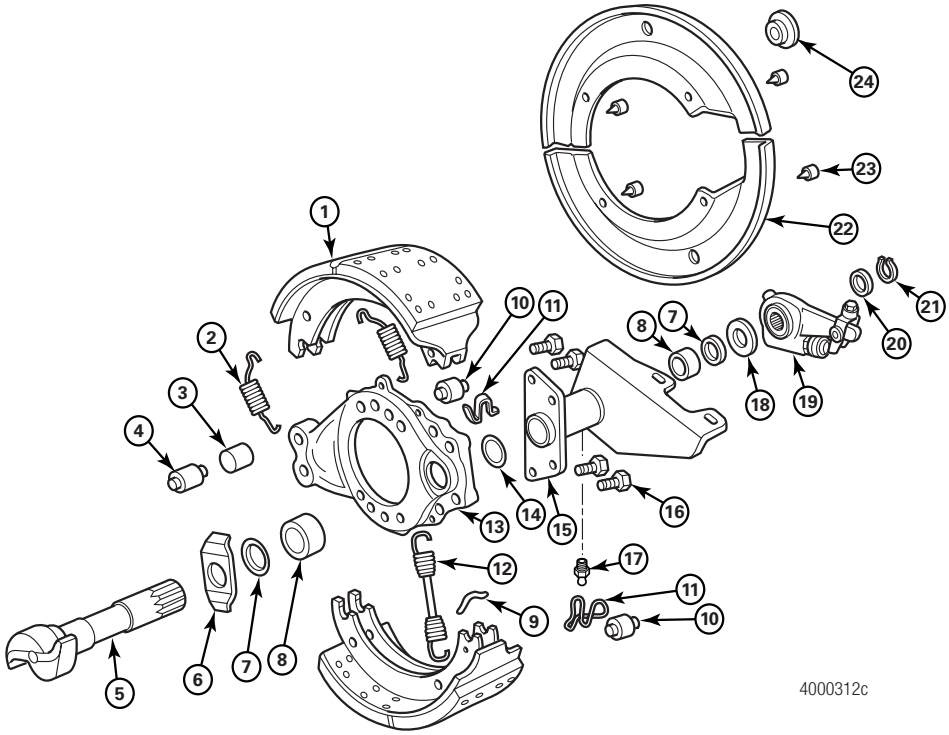
6. Waste Disposal**.** Dispose of discarded linings, used rags, cloths and HEPA filters with care, such as in sealed plastic bags. Consult applicable EPA, state and local regulations on waste disposal.

Regulatory Guidance

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

1 Exploded Views

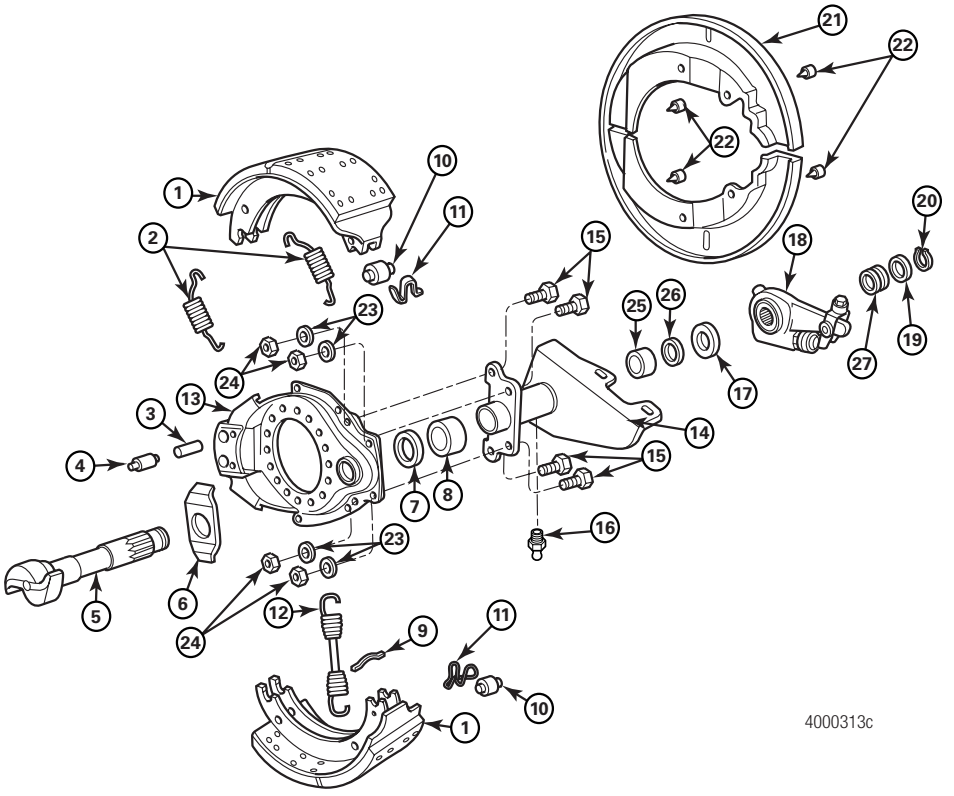
15- and 16.5-Inch Q Plus™ and Q Series Cam Brakes with Cast Spiders



Item	Description	Item	Description
1	Shoe and Lining Assembly	13	Cast Brake Spider
2	Shoe Retaining Spring	14	Chamber Bracket Seal
3	Anchor Pin Bushing	15	Camshaft and Chamber Bracket
4	Brake Shoe Anchor Pin	16	Chamber Bracket Capscrew
5	"S" Head Camshaft	17	Grease Fitting
6	Cam Head Washer	18	Thick Camshaft Washer
7	Camshaft Grease Seal	19	Automatic Slack Adjuster
8	Camshaft Bushing	20	Spacing Washer
9	Return Spring Pin	21	Camshaft Snap Ring
10	Brake Shoe Roller	22	Dust Shield
11	Shoe Roller Retainer	23	Dust Shield Capscrew
12	Brake Shoe Return Spring	24	Plug

1 Exploded Views

16.5-Inch Q Plus™ Cam Brake with a Stamped Spider



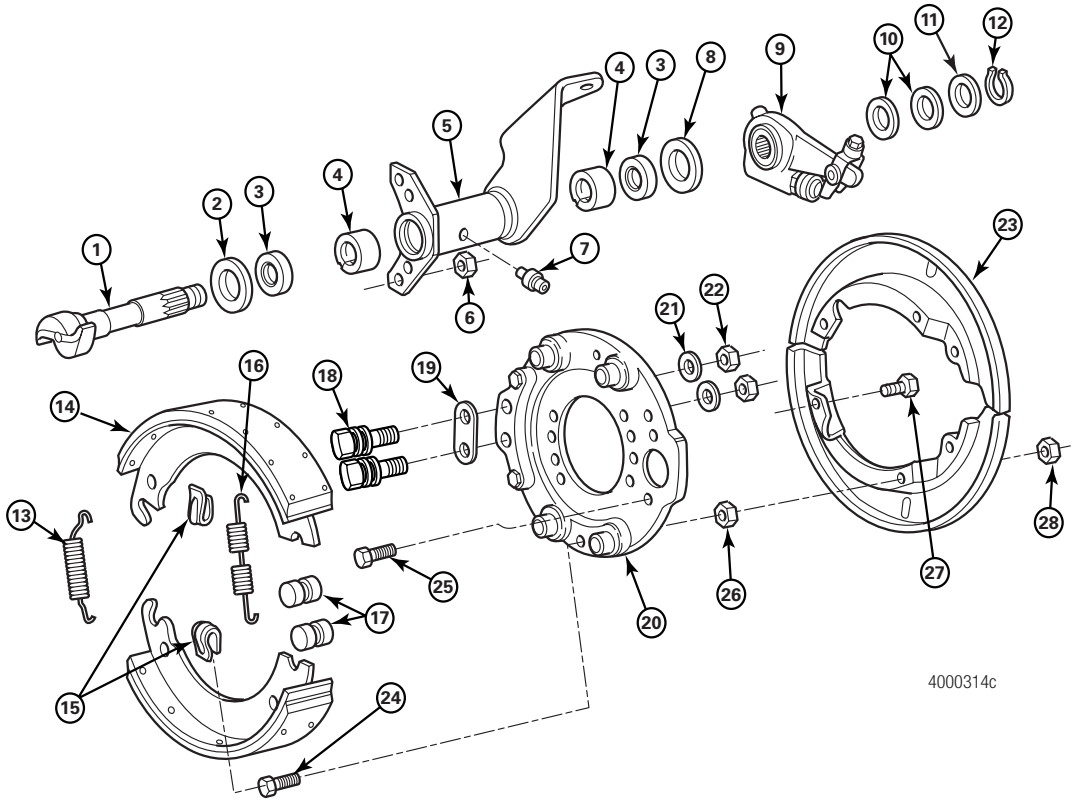
Item	Description
1	Shoe and Lining Assembly
2	Shoe Retaining Spring
3	Anchor Pin Bushing
4	Brake Shoe Anchor Pin
5	"S" Head Camshaft
6	Cam Head Washer
7	Camshaft Seal
8	Camshaft Bushing
9	Return Spring Pin
10	Brake Shoe Roller

Item	Description
11	Shoe Roller Retainer
12	Brake Shoe Return Spring
13	Stamped Brake Spider
14	Camshaft and Chamber Bracket
15	Grade 8 Capscrew
16	Grease Fitting
17	Thick Camshaft Washer
18	Automatic Slack Adjuster
19	Spacing Washer

Item	Description
20	Camshaft Snap Ring
21	Dust Shield
22	Dust Shield Capscrew
23	Hard Washer (4)
24	Grade 8 Nut (4)
25	Camshaft Bushing
26	Camshaft Seal
27	Thin Spacing Washer

1 Exploded Views

15-Inch Q Series Cam Brakes



Item	Description
1	Camshaft
2	Cam Head Washer
3	Camshaft Grease Seal
4	Camshaft Bushing
5	Camshaft Bracket
6	Camshaft Bracket Nut
7	Grease Fitting
8	Spacing Washer
9	Automatic Slack Adjuster
10	Camshaft Spacers
11	Hardened Washer

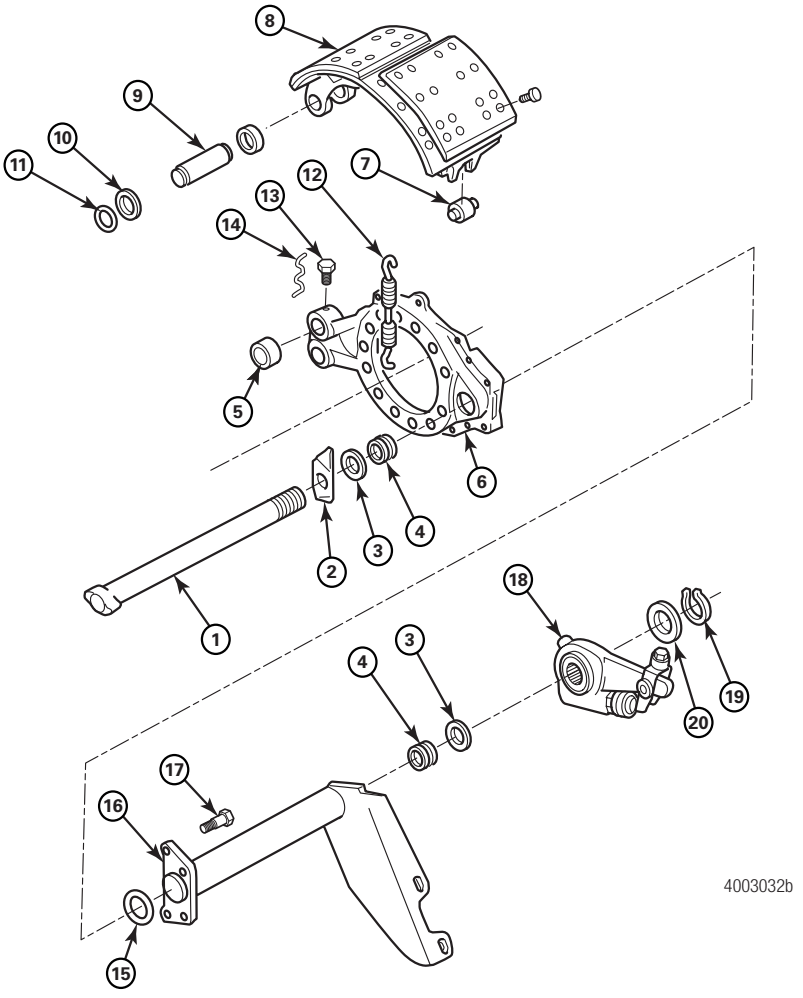
Item	Description
12	Camshaft Snap Ring
13	Shoe Retaining Spring
14	Shoe and Lining Assembly
15	Anti-Rattle Clips
16	Shoe Return Spring
17	Brake Shoe Rollers
18	Brake Shoe Anchor Pins
19	Support Plate
20	Backing Plate
21	Anchor Pin Washer
22	Anchor Pin Nut

Item	Description
23	Dust Shield
24	Shoe Clip Bolt
25	Camshaft Bracket Bolt
26	Clip-to-Backing Plate Nut
27	Dust Shield Capscrew
28	Dust Shield Nut

511

1 Exploded Views

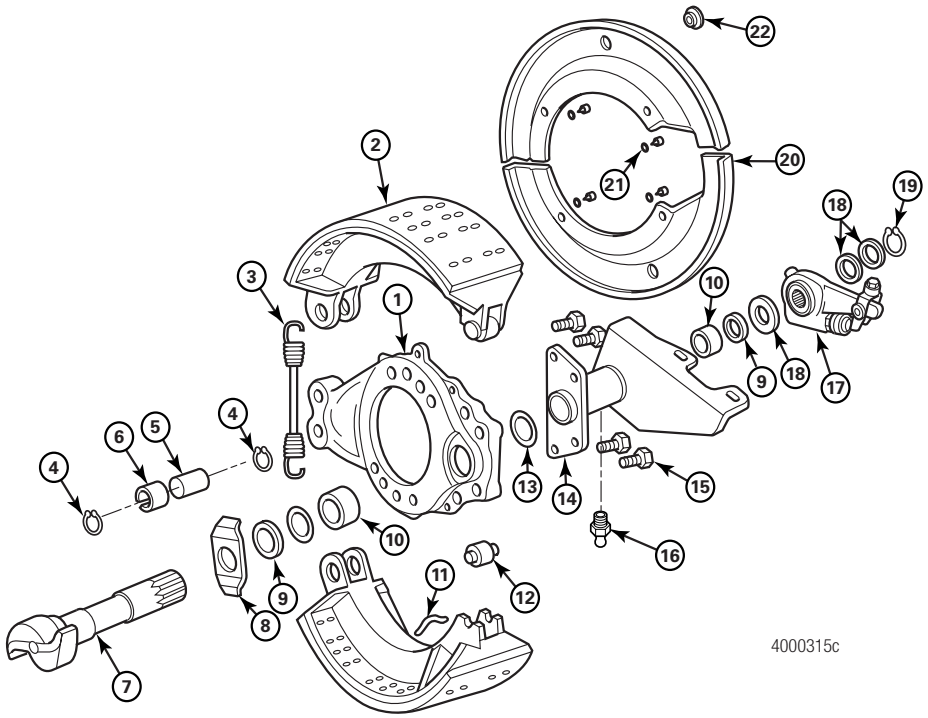
Cast Plus™ Cam Brake



Item	Description	Item	Description	Item	Description
1	Camshaft	8	Brake Shoe and Lining Assembly	15	Chamber Bracket Seal
2	Cam Head Washer	9	Anchor Pin	16	Chamber Bracket
3	Camshaft Seal	10	Anchor Pin Washer	17	Chamber Bracket Capscrew
4	Camshaft Bushing	11	Anchor Pin Snap Ring	18	Slack Adjuster
5	Anchor Pin Bushing	12	Brake Shoe Return Spring	19	Snap Ring
6	Brake Spider	13	Anchor Pin Set Screw	20	Camshaft Spacing Washers
7	Brake Shoe Roller	14	Anchor Pin Set Screw Lock Wire		

1 Exploded Views

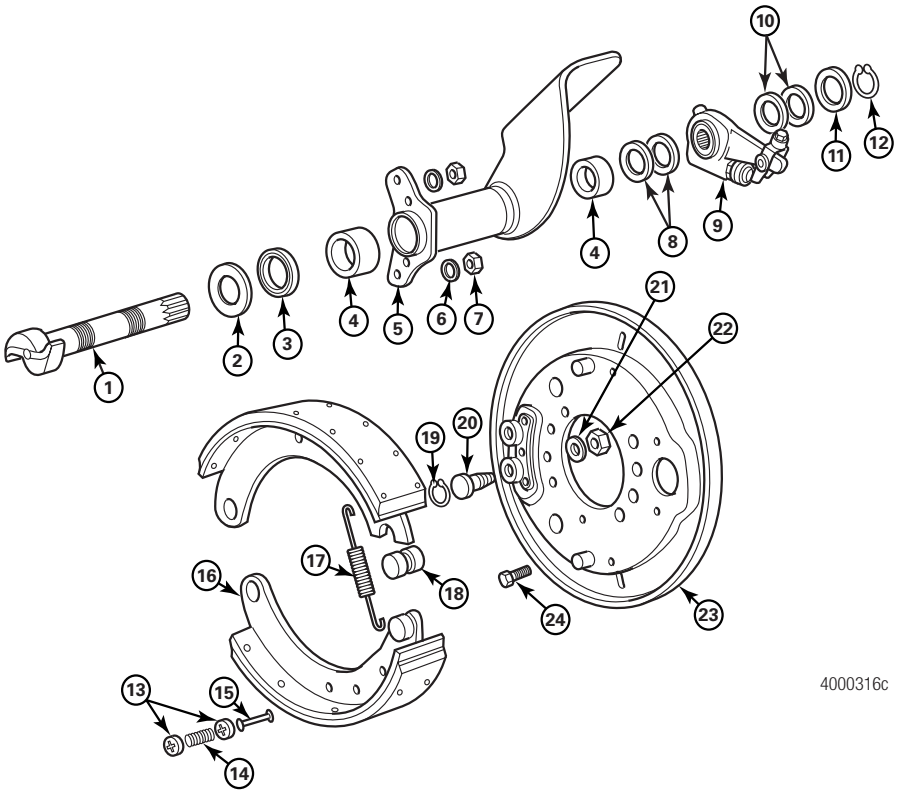
16.5-Inch P Series Cam Brakes



Item	Description	Item	Description
1	Brake Spider	12	Cam Roller
2	Shoe and Lining Assembly	13	Camshaft Bracket Seal
3	Brake Shoe Return Spring	14	Camshaft and Chamber Bracket
4	Anchor Pin Snap Ring	15	Camshaft Bracket Capscrew
5	Brake Shoe Anchor Pin	16	Grease Fitting
6	Anchor Pin Bushing	17	Automatic Slack Adjuster
7	"S" Head Camshaft	18	Spacing Washer
8	Cam Head Washer	19	Camshaft Snap Ring
9	Camshaft Grease Seal	20	Dust Shield
10	Camshaft Bushing	21	Dust Shield Capscrew
11	Return Spring Pin	22	Plug

1 Exploded Views

15-Inch T Series Cam Brakes



Item	Description	Item	Description
1	Camshaft	13	Anti-Rattle Spring Retainer
2	Cam Head Washer	14	Anti-Rattle Spring
3	Camshaft Grease Seal	15	Anti-Rattle Rod
4	Bushing	16	Shoe and Lining Assembly
5	Camshaft and Chamber Bracket	17	Shoe Return Spring
6	Bracket Lock Washer	18	Brake Shoe Roller
7	Bracket Nut	19	Anchor Pin Snap Ring
8	Spacing Washer	20	Brake Shoe Anchor Pin
9	Automatic Slack Adjuster	21	Anchor Pin Washer
10	Spacer Washer	22	Anchor Pin Nut
11	Hardened Washer	23	Backing Plate
12	Camshaft Snap Ring	24	Dust Shield Capscrew

2 Introduction

Description

Cam Brakes

Q Plus™

Q Plus™ brakes have the following features. Figure 2.1.

- More lining thickness increases service life and mileage between relines.
- A redesigned S-cam and heavy-duty shoe return spring allow additional shoe travel.
- An improved camshaft bushing contributes to longer service life.
- The trailer axle version of the 16.5 x 7.0-inch Q Plus™ brake uses a heavy-duty, bolt-on camshaft bushing.

Figure 2.1

Q Plus™ LX500 and Q Plus™ MX500

For complete maintenance and service information on Meritor Q Plus™ LX500 and MX500 cam brakes, refer to Maintenance Manual MM-96173, Q Plus™ LX500 and MX500 Cam Brakes. To obtain this publication, refer to the Service Notes page on the front inside cover of this manual.

Q Plus™ LX500 and Q Plus™ MX500 brakes have the following features. Figure 2.2.

- The Q Plus™ LX500 cam brake and the Q Plus™ MX500 cam brake both include an Extended Lube Feature and Meritor factory-installed automatic slack adjusters.
- The Q Plus™ MX500 cam brake also includes all features found in the Q Plus™ LX500 brake plus special long-life brake shoes and linings.

Figure 2.2

515

Cast Plus™

Cast Plus™ brakes have the following features. Figure 2.3.

- The Cast Plus™ brake is spec'd for heavy-duty, off-highway and people-mover applications.
- Uses the Meritor Q Plus™ cam brake linings, that provide increased service life and mileage between relines.
- A redesigned S-cam and heavy-duty shoe return spring allow additional shoe travel.
- An improved camshaft bushing contributes to longer service life.
- The brake uses the Meritor cast P Series brake shoe design.

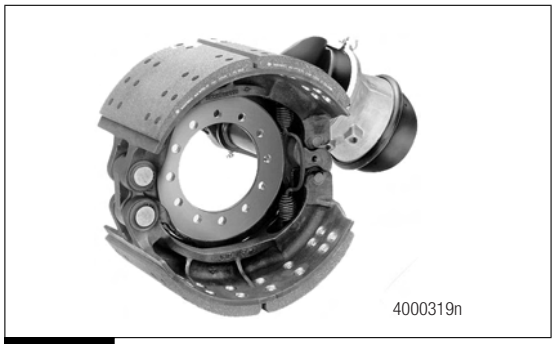


Figure 2.3

2 Introduction

Q Series Brakes

Q Series brakes have the following features. Figure 2.1.

- Open anchor pins for quick change service.
- Single web shoe, 15-inch only.
- Two shoe retainer springs in addition to the shoe return springs.
- Available in 16.5-inch diameter with 5, 6, 7, 8.625 and 10-inch widths with 0.75-inch tapered brake lining.
- Available in 15.0-inch diameter for front non-drive axle applications.

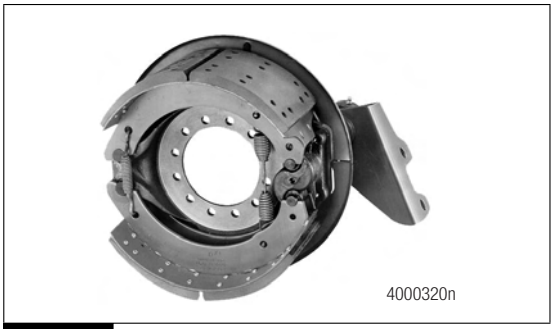


Figure 2.4

P Series

P Series brakes have the following features. Figure 2.5.

- 16.5-inch and 18-inch diameters with 7-inch wide cast shoes.
- 0.75-inch tapered brake lining.

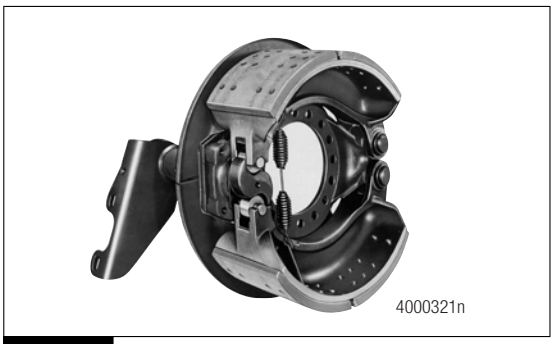


Figure 2.5

T Series

T Series brakes have the following features. Figure 2.6.

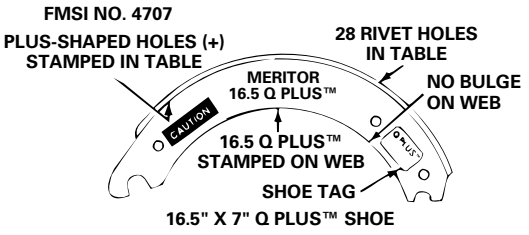
- 15-inch diameter with 3.5-inch and 4-inch widths for smaller capacity axles.
- 0.438-inch thick lining.

Figure 2.6

2 Introduction

Differences Between Q Plus™ and Q Series Cam Brakes

Q Plus™ Components



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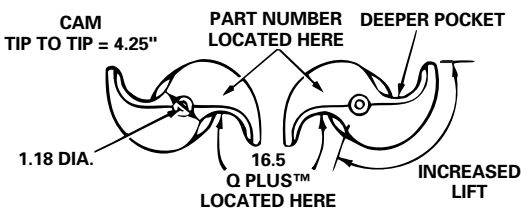

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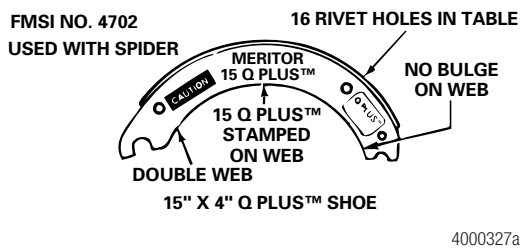

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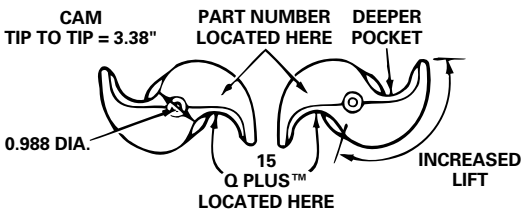

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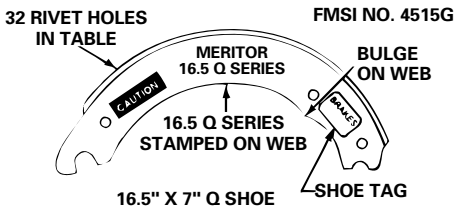
Q Series Components



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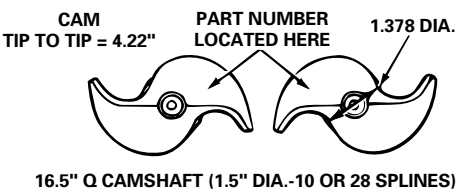

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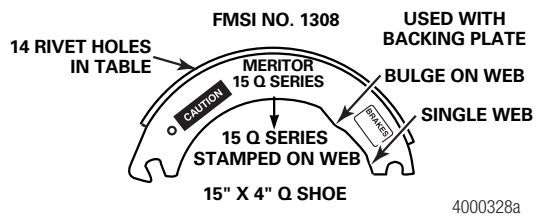

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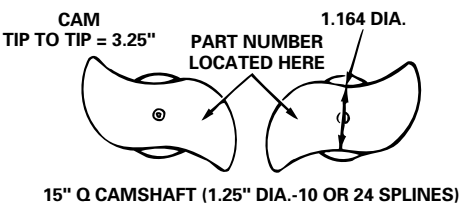

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2 Introduction

Table A

Camshafts	Shoes	Return Springs
Q Plus™	Q Plus™	Heavy-duty (blue)
Q Plus™	Q Series	Standard
Q Series	Q Series	Standard

Cam Brake Tips

Air Chambers

To ensure correct brake balance, all brake chambers on the same axle must be the same size and type to help ensure a balanced brake system for maximum lining wear and drum life.

Brake Kits

Meritor brake shoes, rollers, camshafts and shoe return springs are designed to perform as a system. Always install original equipment manufacturer spec-level components during maintenance or when you upgrade from standard to long-life brakes to help ensure correct brake performance and maximum lining life.

Cam Heads

Cam heads can look the same, but that doesn't mean they will perform the same in your brake system. Two cam head profiles can appear to be identical, but very small differences in cams from different manufacturers can be significant enough to affect the performance of your brakes. To ensure a balanced brake system and optimum lining and drum life, always install the correct replacement cam. Table A shows Q Plus™ cams to be serviced with Q Series shoes.

Cam Rollers

To avoid flat spots, lubricate a cam roller directly in the web roller pocket and not at the cam-to-roller contact area. Flat spots can affect brake adjustment and result in premature brake wear or reduced braking performance.

Drums

To help ensure balanced braking, even lining and drum wear, and correct function of the automatic slack adjuster, do not install a cast drum and a composite drum on the same axle.

A cast drum and a composite drum each absorbs and dissipates heat differently. When drum types and weights are mixed, different rates of heat absorption and dissipation occur that can affect the brake system.

Hardware

When you service cam brakes, replace all the springs, anchor pins, bushings and rollers — not just the shoe return springs — to help ensure maximum braking performance.

Linings

Insist on the same brand of quality original equipment manufacturer friction lining material to help ensure fewer relines and compatibility with your present system.

Replacement Parts

Always use original equipment manufacturer quality standard parts. Meritor brakes work as a system, and when you replace original parts with will-fit parts, you can compromise the performance of the entire system.

Return Springs

Replace cam brake return springs at every cam brake reline. The return spring is critical to alignment, accurate return of the brake away from the drum and correct automatic slack adjustment.

Trailer Cam Brakes

Long-life bushings require correct lubrication for maximum performance and bushing life. Although you do not have to replace spider cam bushings on trailer axles as frequently, Meritor recommends that you lubricate the bushings at least four times during the life of your brake lining.

Automatic Slack Adjusters

Automatic doesn't mean maintenance-free. Correctly installed and lubricated automatic slack adjusters help to ensure maximum brake system performance.

Never mix automatic slack adjusters on the same axle. When you replace automatic slack adjusters, always use replacement parts that were originally designed for the brake system to help ensure even brake wear, balanced braking and maximum brake performance.

3 Removal and Disassembly

Hazard Alert Messages

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 and service.

ASBESTOS AND NON-ASBESTOS FIBERS
⚠ WARNING

Some brake linings contain asbestos fibers, a cancer and lung disease hazard. Some brake linings contain non-asbestos fibers, whose long-term effects to health are unknown. You must use caution when you handle both asbestos and non-asbestos materials.

Removal

Wheel Components

⚠ 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 or fall over. Serious personal injury and damage to components can result.

1. Park the vehicle on a level surface. Block the wheels to prevent the vehicle from moving.
2. Use a jack to raise the vehicle so that the wheels to be serviced are off the ground. Support the vehicle with safety stands.

⚠ WARNING

Before you service a spring chamber, carefully follow the manufacturer's instructions to compress and lock the spring to completely release the brake. Verify that no air pressure remains in the service chamber before you proceed. Sudden release of compressed air can cause serious personal injury and damage to components.

3. If the brake has spring chambers, carefully cage and lock the spring, so that the spring cannot actuate during assembly.

Automatic Slack Adjuster

NOTE: If the slack adjuster is not a Meritor automatic slack adjuster, refer to the manufacturer's literature for the correct service procedures.

For complete maintenance and service information on Meritor automatic slack adjusters, refer to Maintenance Manual 4B, Automatic Slack Adjuster. To obtain this publication, refer to the Service Notes page on the front inside cover of this manual.

⚠ CAUTION

You must disengage a pull pawl or remove a conventional pawl before rotating the manual adjusting nut, or you will damage the pawl teeth. A damaged pawl will not allow the slack adjuster to automatically adjust brake clearance. Replace damaged pawls before putting the vehicle in service.

1. Disengage the pull pawl. Use a screwdriver or equivalent tool to pry the pull pawl at least 1/32-inch (0.8 mm) to disengage the teeth. Figure 3.1.
   - **If the slack adjuster has a conventional pawl:** Remove the pawl. Figure 3.1.

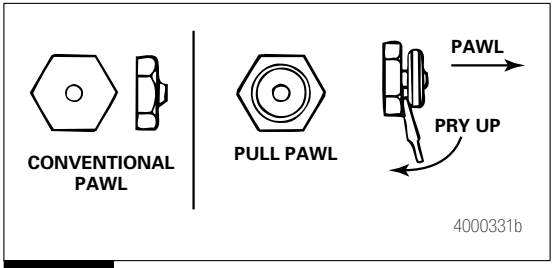

Figure 3.1

2. Use a wrench to turn the manual adjusting nut CLOCKWISE until the brake shoes are fully retracted, and the lining clears the drum. Figure 3.2.

3 Removal and Disassembly

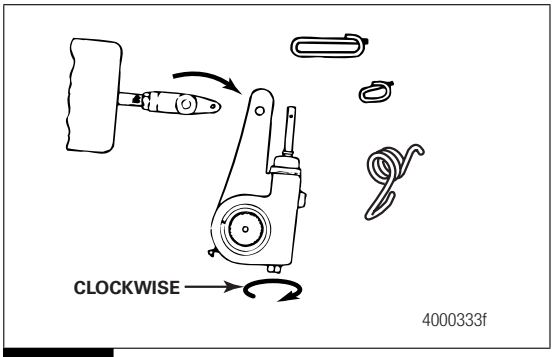

Figure 3.2

⚠ WARNING

When you remove a clevis pin that has a spring, hold the spring with pliers. The spring can disengage from the clevis with enough force to cause serious personal injury.

3. Remove both clevis pins, and retainer clips or cotter pins. Move the slack adjuster away from the clevis. Discard the retainer clips and cotter pins and replace with new clips and pins.
4. Follow the manufacturer's instructions to remove the wheel and drum from the axle.

Brake Shoes

All Q Plus™ and Q Series 15-Inch and 16.5-Inch Brakes

1. Push DOWN on the bottom brake shoe. Pull on the brake shoe roller retainer clip to remove the bottom roller. Figure 3.3.

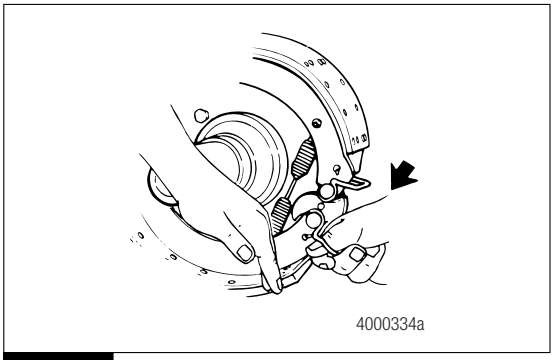

Figure 3.3

2. Lift the top brake shoe and pull on the brake shoe roller retainer clip to remove the top roller.
3. Lift the bottom shoe to release the tension on the brake shoe return spring. Figure 3.4.

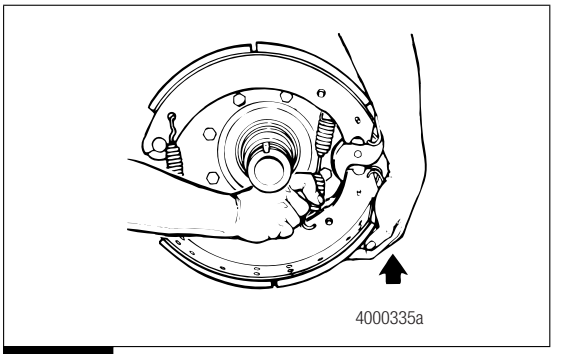

Figure 3.4

4. Rotate the bottom shoe to release the tension on the brake shoe retainer springs. Figure 3.5.

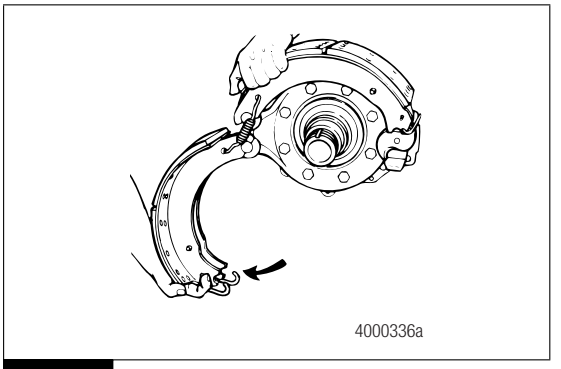

Figure 3.5

5. Remove the shoe retainer springs and the brake shoes.

3 Removal and Disassembly

P Series and Cast Plus™ Brakes

Some trailer axle P Series brakes have anchor pins that are secured with lock pins. Use a steel rod to make a tool to drive out the lock pins. Figure 3.6.

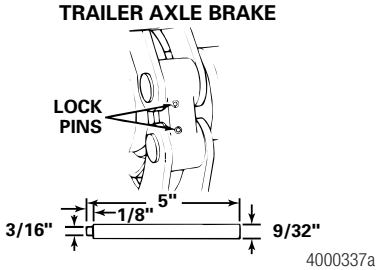

Figure 3.6

NOTE: The current anchor pin arrangement is shown in Figure 3.7. Older P Series brakes can include additional parts.

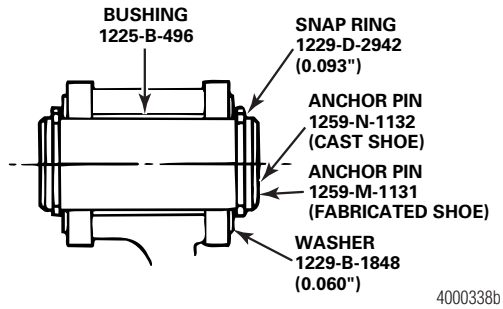

Figure 3.7

1. Remove the anchor pin snap ring, washer, retainer, felts, seals or capscrews as required.

⚠ WARNING

Use a brass or synthetic mallet for assembly and disassembly procedures. Do not hit steel parts with a steel hammer. Pieces of a part can break off and cause serious personal injury.

2. Use a brass drift to remove the top anchor pin. Figure 3.8.

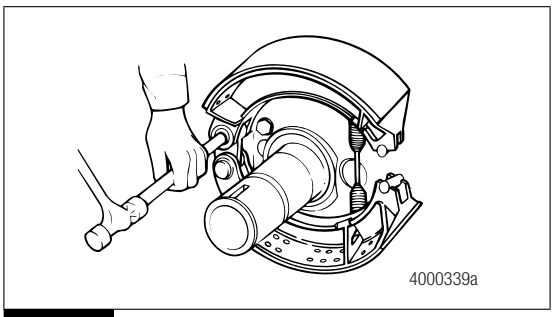

Figure 3.8

3. Rotate the top shoe to release the tension on the brake shoe return spring. Remove the shoe. Figure 3.9.

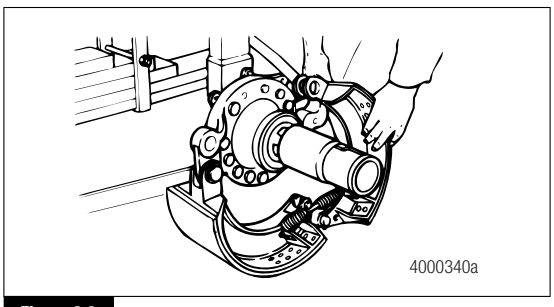

Figure 3.9

4. Use a brass drift to remove the bottom anchor pin. Remove the bottom shoe. If necessary, remove the rollers. Figure 3.10.

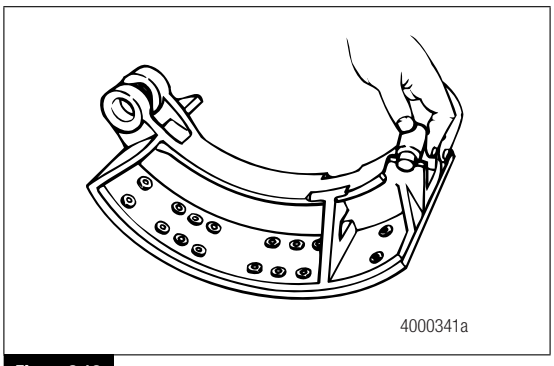

Figure 3.10

3 Removal and Disassembly

T Series Cam Brakes

1. Remove the anti-rattle spring retainer and spring from the anti-rattle rod.
2. Push DOWN on the bottom brake shoe to provide enough clearance to remove the bottom brake shoe roller. Remove the roller.
3. Lift the top brake shoe. Remove the top brake shoe roller. Remove the anchor pin snap ring and the anchor pin.
4. Rotate the bottom shoe to release the tension on the brake shoe retainer springs. Remove the shoe retainer springs and the brake shoes.

Check and Adjust

Cam-to-Bushing Radial Free Play and Axial End Play

Before you remove the automatic slack adjuster and camshaft, move the camshaft as shown in Figure 3.11. Use a feeler gauge to verify that the cam-to-bushing radial free play and axial end play are within specification.

- **If radial free play movement is less than 0.030-inch (0.76 mm):** Do not replace the bushings and seals.
- **If radial free play movement exceeds 0.030-inch (0.76 mm):** Replace the bushings and seals.
- **If axial end play movement exceeds 0.060-inch (1.52 mm):** Remove the snap ring. Add an appropriate number of spacing washers between the slack adjuster and snap ring to achieve the correct specification of 0.005-0.060-inch (0.127-1.52 mm).

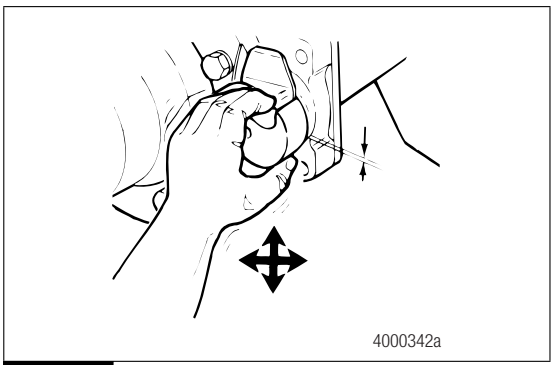

Figure 3.11

Removal

Automatic Slack Adjuster and Camshaft

1. Remove the snap ring, washers and spacers from the camshaft.
2. Remove the automatic slack adjuster from the camshaft.
   - **If the slack adjuster has a quick connect clevis, and the gap between the clevis and clevis collar exceeds 0.060-inch (1.52 mm):** Replace the clevis with a one-piece threaded clevis.
3. Remove the camshaft from the spider. Use the correct size driver to remove the camshaft bushings from the spider and spider bracket.

4 Prepare Parts for Assembly

Hazard Alert Messages

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.

ASBESTOS AND NON-ASBESTOS FIBERS
⚠ WARNING

Some brake linings contain asbestos fibers, a cancer and lung disease hazard. Some brake linings contain non-asbestos fibers, whose long-term effects to health are unknown. You must use caution when you handle both asbestos and non-asbestos materials.

Clean, Dry and Inspect Parts

Clean and Dry Parts

⚠ WARNING

Solvent cleaners can be flammable, poisonous and cause burns. Examples of solvent cleaners are carbon tetrachloride, and emulsion-type and petroleum-base cleaners. Read the manufacturer's instructions before using a solvent cleaner, then carefully follow the instructions. Also follow the procedures below.

- **Wear safe eye protection.**
- **Wear clothing that protects your skin.**
- **Work in a well-ventilated area.**
- **Do not use gasoline, or solvents that contain gasoline. Gasoline can explode.**
- **You must use hot solution tanks or alkaline solutions correctly. Read the manufacturer's instructions before using hot solution tanks and alkaline solutions. Then carefully follow the instructions.**

⚠ CAUTION

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

Use soap and water to clean non-metal parts. Dry parts immediately after cleaning with soft, clean paper or cloth, or compressed air.

Corrosion Protection

1. If you assemble the parts immediately after you clean them, lubricate the parts with grease to prevent corrosion. Parts must be clean and dry before you lubricate them.
2. If you store the parts after you clean them, apply a corrosion-preventive material. Store the parts in a special paper or other material that prevents corrosion.

Inspect Parts

1. Check the spider for expanded anchor pin holes and for cracks. Replace damaged spiders and anchor pin bushings.
2. Check the camshaft bracket for broken welds, cracks and correct alignment. Replace damaged brackets.
3. Check the anchor pins for corrosion and wear. Replace worn or damaged anchor pins.
4. Check the brake shoes for rust, expanded rivet holes, broken welds and correct alignment. Replace a shoe with any of the above conditions.
   A. For 16.5-inch brake shoes only, anchor pin holes must not exceed 1.009-inches (25.63 mm) in diameter. The distance from the center of the anchor pin hole to the center of the roller hole must not exceed 12.779-inches (32.46 cm). Replace brake shoes with measurements that do not meet specifications. Figure 4.1.
   B. For 15-inch brake shoes only, anchor pin holes must not exceed 1.009-inches (25.63 mm) in diameter. The distance from the center of the anchor pin hole to the center of the roller hole must not exceed 11.685-inches (29.68 cm). Replace brake shoes with measurements that do not meet specifications. Figure 4.1.

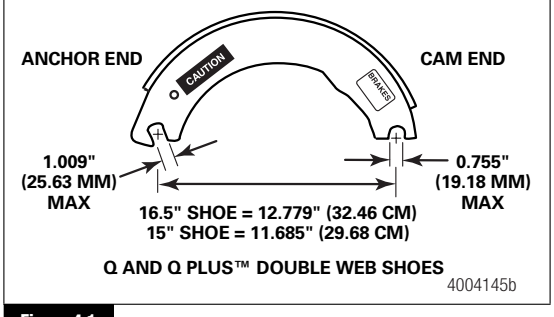

Figure 4.1

4 Prepare Parts for Assembly

5. Check the camshaft for cracks, wear and corrosion. Check the cam head, bearing journals and splines. Replace worn or damaged camshafts.
6. Inspect the large and small clevis pins and retainer clips for wear and damage. Replace worn or damaged parts.

⚠ CAUTION

Always replace used clevis pin retainer clips with new ones when you service an automatic slack adjuster or chamber. Do not reuse retainer clips. Discard used clips. When you remove a retainer clip, it can bend or "gap apart" and lose retention. damage to components can result.

NOTE: If you remove cotter pins from a slack adjuster during maintenance and service procedures, Meritor recommends that you install clevis pin retainer clips at assembly.

7. Inspect the clevis pin retainer clips or cotter pins for wear and damage. Replace worn or damaged retainer clips and cotter pins. Do not reuse clevis pin retainer clips. Always replace used retainer clips with new ones. Discard used clips.

⚠ WARNING

Do not operate the vehicle with the brake drum worn or machined beyond the discard dimension indicated on the drum. The brake system may not operate correctly. Damage to components and serious personal injury can result.

⚠ CAUTION

Replace the brake drum if it is out-of-round. Do not turn or rebore a brake drum, which decreases the strength and capacity of the drum. Damage to components can result.

8. Use the following procedure to inspect the brake drums.
   A. Check the brake drums for cracks, severe heat checking, heat spotting, scoring, pitting and distortion. Replace drums as required. Do not turn or rebore brake drums, which decreases the strength and heat capacity of the drum.
   B. Measure the inside diameter of the drum in several locations with a drum caliper or internal micrometer. Figure 4.2.
      - **If the diameter exceeds the specifications supplied by the drum manufacturer:** Replace the drum.

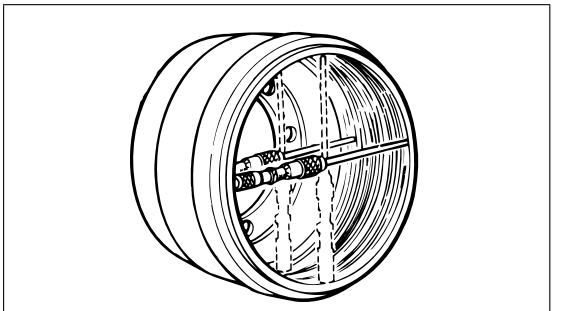

Figure 4.2

9. Check the dust shields for wear and damage. Repair or replace worn or damaged parts as necessary.

Automatic Slack Adjuster

1. If the slack adjuster has a quick connect clevis, check the gap between the clevis and the collar.
   - **If the gap exceeds 0.060-inch (1.52 mm):** Replace the clevis with a one-piece threaded clevis.
2. Check the clevis pins, clips and bushing in the slack adjuster arm for wear and damage. Replace worn or damaged parts. Check the bushing's diameter to ensure it does not exceed 0.531-inch (13.5 mm).
   - **If the bushing diameter exceeds 0.531-inch (13.5 mm):** Replace the bushing.

⚠ CAUTION

You must disengage a pull pawl or remove a conventional pawl before rotating the manual adjusting nut, or you will damage the pawl teeth. A damaged pawl will not allow the slack adjuster to automatically adjust brake clearance. Replace damaged pawls before putting the vehicle in service.

NOTE: When you service an automatic slack adjuster with a conventional pawl, replace the conventional pawl with a pull pawl.

3. Disengage the pull pawl. Use a screwdriver or equivalent tool to pry the pull pawl at least 1/32-inch (0.8 mm) to disengage the teeth. Figure 4.3.
   - **If the slack adjuster has a conventional pawl:** Remove the pawl. Figure 4.3.

4 Prepare Parts for Assembly

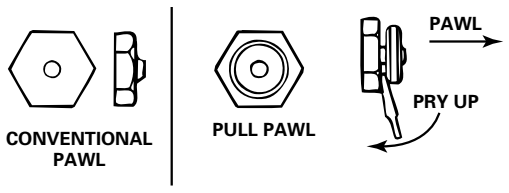

Figure 4.3

⚠ CAUTION

You must turn the adjusting nut COUNTERCLOCKWISE when you check gear torque on an automatic slack adjuster. If you turn the adjusting nut incorrectly, you will damage the pawl teeth. A damaged pawl will prevent the slack adjuster from automatically adjusting the clearance between the linings and drum. Damage to components can result.

4. Use a lb-in torque wrench and turn the adjusting nut COUNTERCLOCKWISE (Figure 4.4) to rotate the gear 360 degrees, or 22 turns of the wrench, as you read the torque scale on the wrench. The value should be less than 25 lb-in (2.83 N•m) as you rotate the gear.
   - **If the torque value is less than 25 lb-in (2.8 N•m) as you rotate the gear:** The slack adjuster is operating correctly.
   - **If the torque value exceeds 25 lb-in (2.8 N•m) as you rotate the gear:** Replace the slack adjuster.

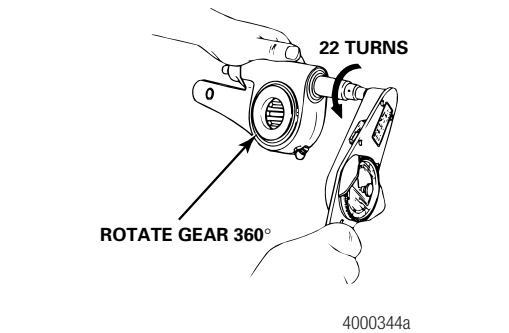

Figure 4.4

5. Re-engage the pull pawl. Remove the screwdriver or equivalent tool. The pull pawl will re-engage automatically.
   - **If the slack adjuster has a conventional pawl:** Install the pawl assembly into the housing. Tighten the capscrew to 12-17 lb-ft (16-23 N•m). T

   NOTE: If necessary, install a camshaft into the slack adjuster gear to minimize grease flow through the gear holes.

6. Use a grease gun to apply Meritor specification O-616-A, O-692 or O-645 lubricant to the slack adjuster grease fitting, until grease flows from around the camshaft splines and pawl assembly. Refer to Section 7 for more lubricant information.

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Camshafts

NOTE: Install new camshaft bushings and seals whenever you install a new camshaft.

1. Tighten all spider bolts to the correct torque. Figure 4.5. T

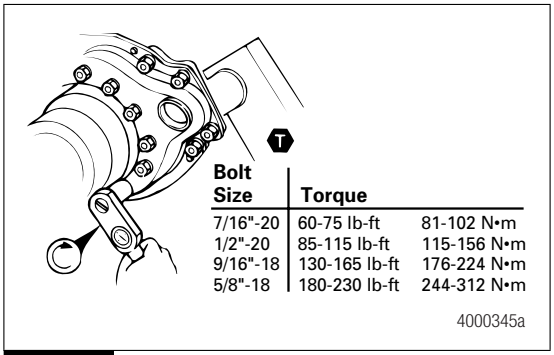


Figure 4.5

2. Use a seal driver to install new camshaft seals and new bushings into the cast spider and camshaft bracket. Figure 4.6.
   - **If the brake has a stamped spider:** Install both bushings into the bracket. Install the seals with the seal lips toward the slack adjuster to ensure grease purges at the slack end. Figure 4.7.

4 Prepare Parts for Assembly

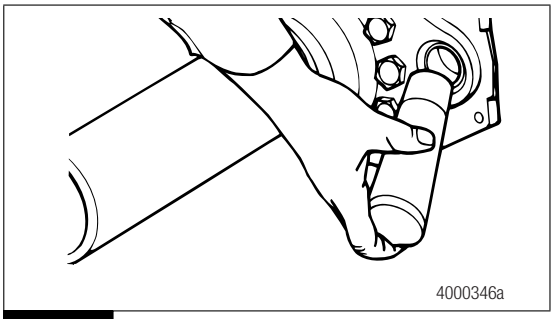


Figure 4.6

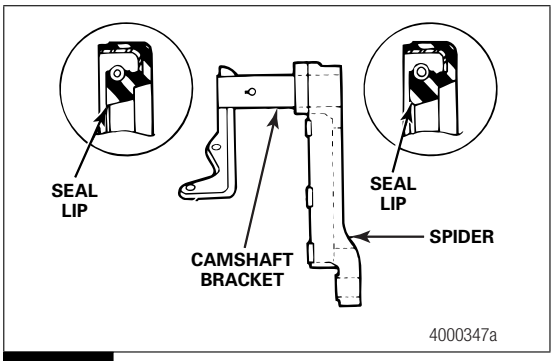


Figure 4.7

3. If the camshaft bracket has been removed, install the chamber bracket seal and bracket onto the spider. Tighten the capscrews to the correct torque. Figure 4.5.

Meritor Automatic Slack Adjusters are Color-Coded According to Brake Type and Air Chamber Size

Meritor uses either black, red, yellow, green or blue to color-code an automatic slack adjuster's internal actuator piston according to brake type and air chamber size.

Meritor uses a mylar tag on the body of the current-design slack adjuster to identify the color of the internal actuator piston. A color-coded tie wrap was used on previous-design slack adjusters.

Mylar Tag — Current Design

A mylar tag is attached to the current-design slack adjuster with a press-in boot. The color of the actuator piston is printed on the mylar tag. Figure 4.8.

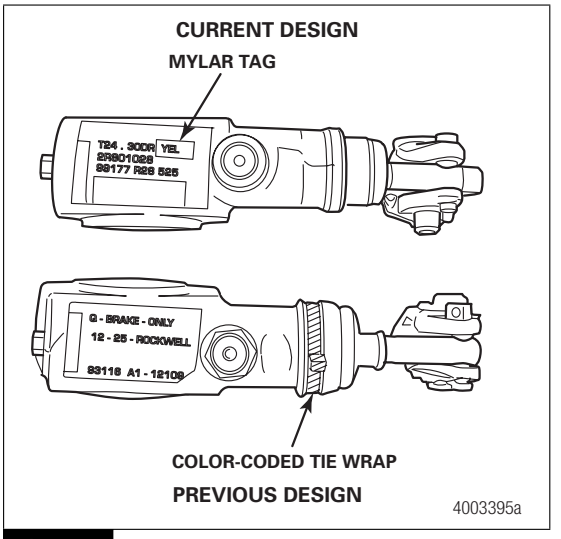


Figure 4.8

Color-Coded Tie Wrap — Previous Design

On previous-design slack adjusters, a color-coded tie wrap attaches the boot to the slack adjuster body. The tie wrap color matches the color of the actuator piston. Figure 4.8.

When You Replace an Automatic Slack Adjuster

The original equipment manufacturer paints the chassis and slack adjusters black, which includes the mylar tag or tie wrap, depending on the slack adjuster model.

When you replace an automatic slack adjuster, the color of the actuator piston on the new slack adjuster must match the color of the actuator piston on the in-service slack adjuster you'll replace.

Check either the mylar tag or color-coded tie wrap attached to the body of the new slack adjuster to identify the color of the actuator piston. To ensure a correct installation, this color must match the color of the actuator piston on the in-service slack adjuster you'll replace.

- **If you are unsure of the color of the actuator piston on the in-service slack adjuster:** Remove the piston boot to see the color of the actuator piston to ensure a correct installation. The color must be the same as the new slack adjuster you'll install.

For a complete color-coding list, refer to Parts Catalog PB-8857, Brake, Trailer Axle and Wheel Attaching Parts. To obtain this publication, refer to the Service Notes page on the front inside cover of this manual.

5 Assembly and Installation

Hazard Alert Messages

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.

Do not use the straight-center bar shoe return spring with the Q Plus™ camshaft. The shoe spring can interfere with the camshaft and affect braking performance. Serious personal injury and damage to components can result.

ASBESTOS AND NON-ASBESTOS FIBERS
⚠ WARNING

Some brake linings contain asbestos fibers, a cancer and lung disease hazard. Some brake linings contain non-asbestos fibers, whose long-term effects to health are unknown. You must use caution when you handle both asbestos and non-asbestos materials.

⚠ CAUTION

Only install a Q Plus™ camshaft in a Q Plus™ brake. A Q Series hammerclaw camshaft will not provide enough clearance between the brake shoe and the brake drum. Brake drag and damage to components can result.

To install a new brake drum so that it fits correctly over a Q Plus™ brake shoe, you must install a Q Plus™ camshaft to prevent damage to components.

Installation

Camshaft

1. Install the cam head thrust washer onto the camshaft. Apply Meritor specification 0-617-A or 0-617-B grease to the camshaft bushings and journals.
2. Install the camshaft through the spider and bracket so that the camshaft turns freely by hand. Figure 5.1.

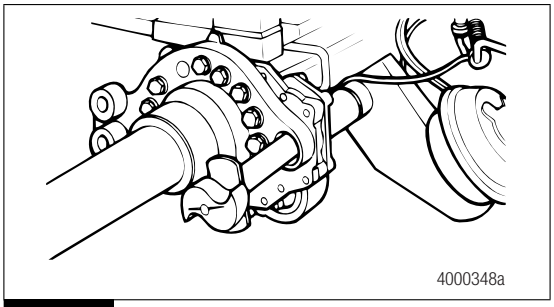


Figure 5.1

Replace a Q Series or P Series Camshaft with a Q Plus™ Camshaft

For all front and drive axle 16.5-Inch Q Series, 16.5-Inch and 18-Inch P Series brakes, when you replace a Q Series or P Series camshaft with a Q Plus™ camshaft, continue to follow maintenance and service procedures for a Q Series or P Series brake and a Q Plus™ camshaft.

The Q Plus™ S-cam replaced the Q Series and P Series S-cam. Because of the larger lift requirements and deeper pockets on the Q Plus™ S-cam, the P Series cast shoe roller does not fully seat in the pocket. Figure 5.2. This cam profile does not affect the performance of the cast shoe brake.

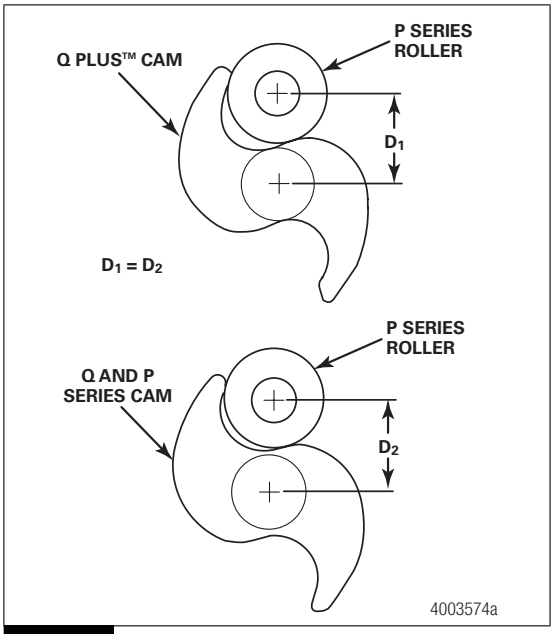


Figure 5.2

5 Assembly and Installation

Replace a Hammerclaw Camshaft with a Standard Q Plus™ Camshaft

For front axles only, a standard Q Plus™ camshaft and a shoe return spring with an offset center bar replaces the hammerclaw Q Series camshaft and shoe return spring with a straight center bar on the 16.5 x 5-inch and 6-inch Q Series cam brake. Figure 5.3 and Figure 5.4.

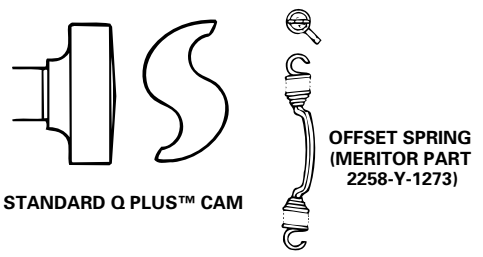


Figure 5.3

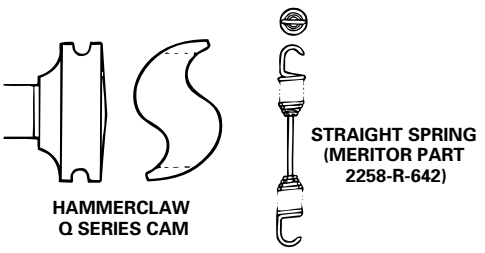


Figure 5.4

A Q Plus™ camshaft has deeper roller pockets than a Q Series camshaft and has "Q Plus" forged into one of the pockets. You may notice a larger gap between the brake lining and the drum after you assemble the brake shoe and shoe return spring with an offset center bar. Figure 5.5. The excess gap will be eliminated when you correctly adjust the brake.

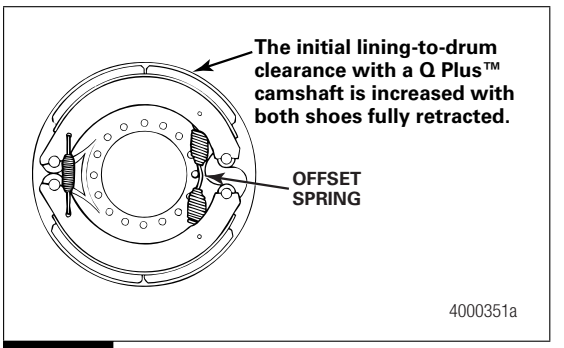


Figure 5.5

1. Follow Step 1 and Step 2 under Q Plus™ and Q Series 16.5-Inch Brakes in this section to replace a Q Series hammerclaw camshaft with a standard Q Plus™ camshaft.
2. Continue to follow service and maintenance procedures for a Q Plus™camshaft and Q Series brake.

Shoe Return Spring

Install the new offset shoe return spring with the open end of the spring hooks toward the camshaft. Figure 5.6.

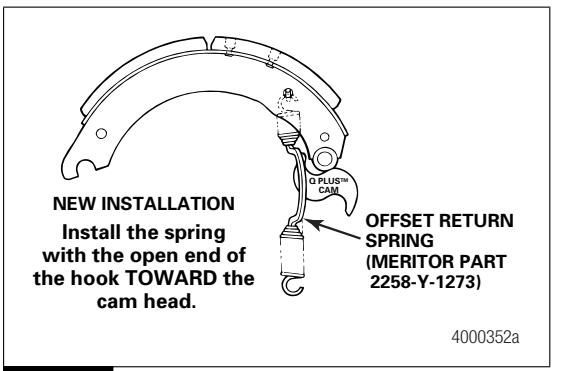


Figure 5.6

5 Assembly and Installation

Automatic Slack Adjuster onto the Camshaft

NOTE: If the slack adjuster is not a Meritor automatic slack adjuster, refer to the manufacturer's literature for the correct service procedures.

1. Check the camshaft and bushings and seals for wear and corrosion. Turn the camshaft by hand to check for smooth operation. Repair or replace parts as required.
2. Apply the service brake and spring brake several times. Check that the chamber return spring retracts the push rod quickly and completely. If necessary, replace the return spring or the air chamber.
3. Verify that the new automatic slack adjuster is the same length as the one you are replacing. Refer to Table B.

Table B: Chamber and Automatic Slack Adjuster Sizes

Length of Slack Adjuster (Inches)	Size of Chamber (Square Inches)
5	9, 12, 16, 20, 24, 30[1]
5-1/2	9, 12, 16, 20, 24, 30, 36[1]
6	24, 30, 36
6-1/2	30, 36

[1] Use an auxiliary spring on slack adjusters used with size 9 and 12 chambers. A size 9 or 12 chamber return spring cannot supply enough spring tension to completely retract the slack adjuster.

⚠ WARNING

Before you service a spring chamber, carefully follow the manufacturer's instructions to compress and lock the spring to completely release the brake. Verify that no air pressure remains in the service chamber before you proceed. Sudden release of compressed air can cause serious personal injury and damage to components.

4. If the vehicle has spring brakes, follow the chamber manufacturer's instructions to compress and lock the springs to completely release the brakes. Verify that no air pressure remains in the service chambers.

⚠ CAUTION

Most Meritor automatic slack adjusters manufactured after January 1990 have lubrication holes in the gear splines. Do not operate the actuator rod before you install the slack adjuster. Lubricant can pump through the holes and onto the splines. Damage to components can result.

5. If the automatic slack adjuster gear has a 10-tooth spline, apply Meritor specification O-637, part number 2297-U-4571, anti-seize compound, or equivalent. This anti-seize compound is a corrosion-control grease. Do not mix this grease with other greases.

   NOTE: Install the slack adjuster so that you can remove a conventional pawl or disengage a pull pawl when you adjust the brake.

6. Install the slack adjuster onto the camshaft. Position the slack adjuster so that you can access the pawl when you adjust the brake.
7. Verify that camshaft axial end play is 0.005-0.060-inch (0.127-1.52 mm).
   - **If axial end play exceeds 0.060-inch (1.52 mm):** Remove the snap ring. Add an appropriate number of spacing washers to achieve the correct specification.
8. Install the clevis onto the push rod.

⚠ CAUTION

You must disengage a pull pawl or remove a conventional pawl before rotating the manual adjusting nut, or you will damage the pawl teeth. A damaged pawl will not allow the slack adjuster to automatically adjust brake clearance. Replace damaged pawls before putting the vehicle in service.

9. Disengage the pull pawl or remove a conventional pawl. Turn the manual adjusting nut to align the holes in the slack adjuster arm and clevis. Figure 5.7.

5 Assembly and Installation

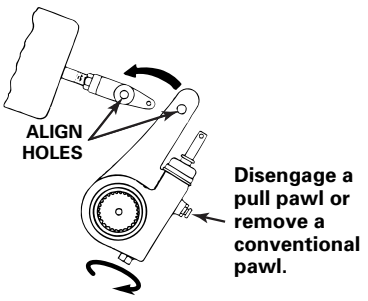


Figure 5.7

Welded Clevis

1. Check the clevis position. Apply Meritor specification O-637, part number 2297-U-4571, anti-seize compound or equivalent to the large and small clevis pins. This anti-seize compound is a corrosion-control grease. Do not mix this grease with other greases.

⚠ CAUTION

Always replace used clevis pin retainer clips with new ones when you service an automatic slack adjuster or chamber. Do not reuse retainer clips. Discard used clips. When you remove a retainer clip, it can bend or "gap apart" and lose retention. Damage to components can result.

2. Install new clevis pin retainer clips or cotter pins to secure the clevis pins. Retainer clips must be fully installed and positioned around the side of the clevis pin. Figure 5.8.

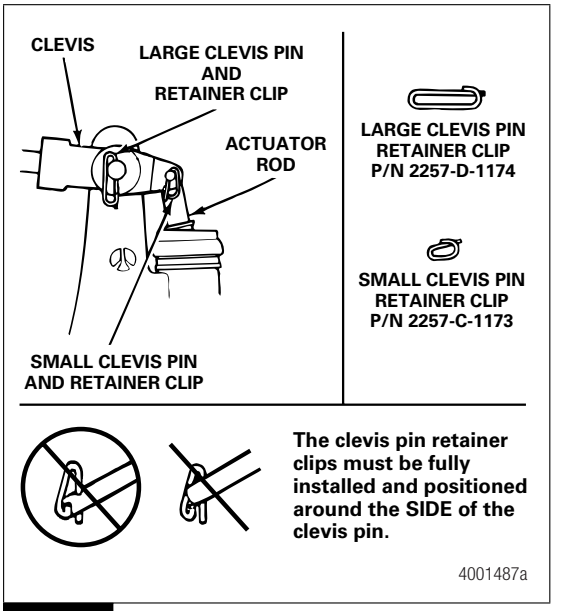


Figure 5.8

Threaded Clevis

Adjust the Clevis Position on the Chamber Push Rod

Use the automatic slack adjuster template method for standard stroke chambers only.

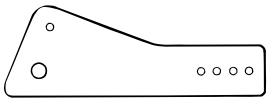
⚠ CAUTION

There are five different installation templates for Meritor automatic slack adjusters. The templates are not interchangeable. You must use the correct template and you must adjust the clevis position as described below. If you use the wrong template and install the clevis in the wrong position, the slack adjuster will not adjust the brake correctly. If the slack adjuster underadjusts, then stopping distances are increased. If the slack adjuster overadjusts, then the linings may drag and damage the brake.

To obtain the correct automatic slack adjuster template, refer to the Service Notes page on the front inside cover of this manual.

1. Use the correct Meritor automatic slack adjuster template to measure the length of the slack adjuster. The marks by the holes in the small end of the template indicate the length of the slack adjuster. Figure 5.9.

5 Assembly and Installation



Color of Template	Part Number	Applications
Dark brown	TP-4786	Truck or tractor drum brake
Tan	TP-4787	Trailer drum brake
White	TP-4781	Coach drum brake

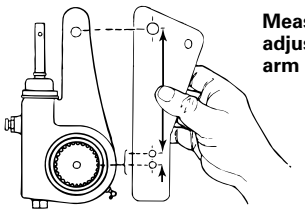


Figure 5.9

2. Install the large clevis pin through the large holes in the template and the clevis.
3. Select the hole in the template that matches the length of the slack adjuster. Hold that hole on the center of the camshaft.
4. Look through the slot in the template to see if the small clevis hole completely aligns within the slot.
   - **If the small clevis hole doesn't align within the slot:** Adjust the clevis until you can see the small clevis pin hole within the slot. Figure 5.10.

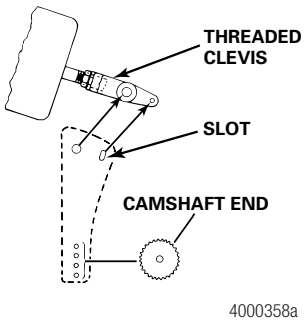


Figure 5.10

5. Verify that the thread engagement between the clevis and push rod is 0.5-0.625-inch (12.7-15.9 mm). Figure 5.11.

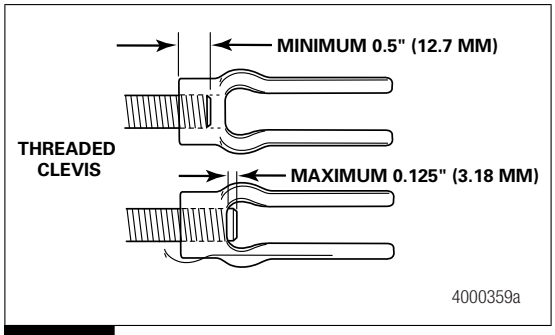


Figure 5.11

6. Verify that the push rod does not extend through the clevis more than 0.125-inch (12.7 mm).
   - **If the push rod extends through the clevis more than 0.125-inch (12.7 mm):** Cut the push rod or install a new air chamber and push rod.
7. Tighten the jam nut against the clevis to the torque specification in Table C.

Table C: Jam Nut Torque Specifications

Threads	Torque
1/2-20	20-30 lb-ft (27-41 N•m)
5/8-18	35-50 lb-ft (48-68 N•m)

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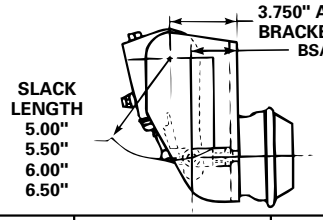
5 Assembly and Installation

Brake Slack Adjuster Position (BSAP) Method for Standard Stroke and Long Stroke Chambers

When you install the slack adjuster, verify that the BSAP chamber dimension matches the table in Figure 5.12.



Slack Adjuster Size	Standard Stroke Chamber Clevis (1.38") 1.38"	Long Stroke Chamber Clevis (1.30") 1.30"
5.00"	2.75"	2.25"
5.50"	2.75"	2.25"
6.00"	2.75"	2.25"
6.50"	2.62"	2.25"

±0.125" Tolerance. You must use the correct clevis with the correct chamber type.

Correct positions of the automatic slack adjuster are 3.750-inch and 3.812-inch offsets only. For other bracket offsets, refer to the vehicle manufacturer's specifications.

Figure 5.12

Brake Shoes

NOTE: Meritor recommends that you replace the springs, rollers, anchor pins and cam bushings at each reline.

When the brake is disassembled, or when necessary, lubricate the anchor pins and rollers where these parts touch the brake shoes.

Do not allow grease to contact the area of the camshaft roller that touches the camshaft head.

Q Plus™ and Q Series 16.5-Inch Brakes

1. Use Meritor specification 0-617-A or 0-617-B grease to lubricate the brake shoe roller pin and anchor pin. Figure 5.13.

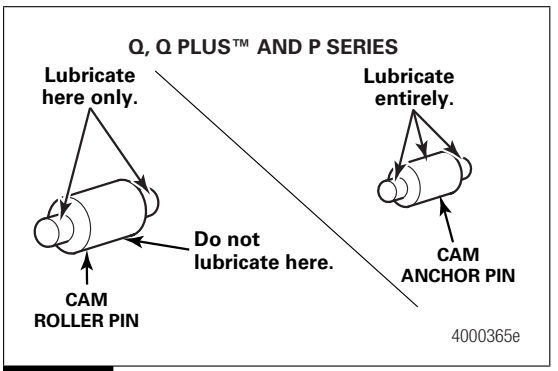


Figure 5.13

2. Place the upper brake shoe into position on the top anchor pin. Hold the lower brake shoe on the bottom anchor pin. Install two new brake shoe retaining springs. Figure 5.14.

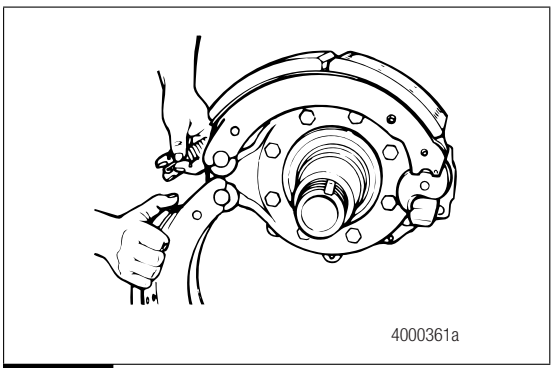


Figure 5.14

3. Rotate the lower brake shoe forward. Install a new brake shoe return spring with the open end of the spring hooks toward the camshaft. Figure 5.15.

5 Assembly and Installation

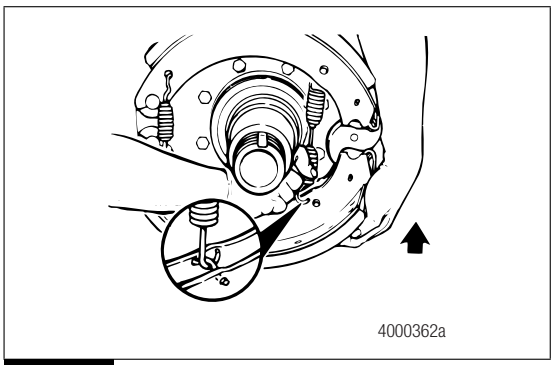


Figure 5.15

4. Pull each brake shoe away from the camshaft to enable you to install the brake shoe roller and roller retainer. Press the retainer ears to fit into the retainer between the brake shoe webs. Figure 5.16.

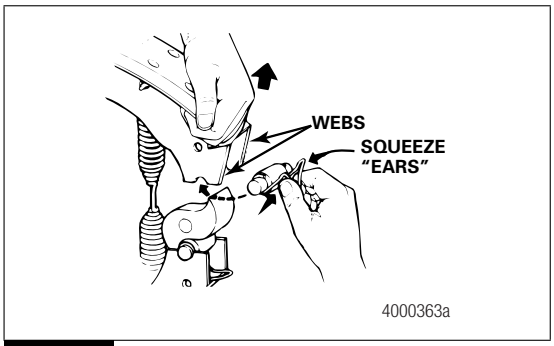


Figure 5.16

5. Push the brake shoe roller retainer into the brake shoe until the ears lock into the shoe web holes. Figure 5.17.

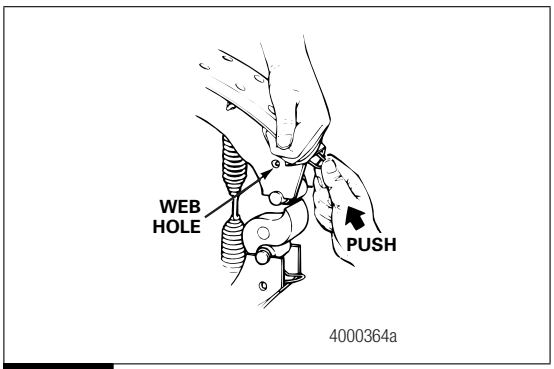


Figure 5.17

Q Series 15-Inch Cam Brake

1. Use Meritor specification O-617-A or O-617-B grease to lubricate the roller pin and anchor pin. Figure 5.18.

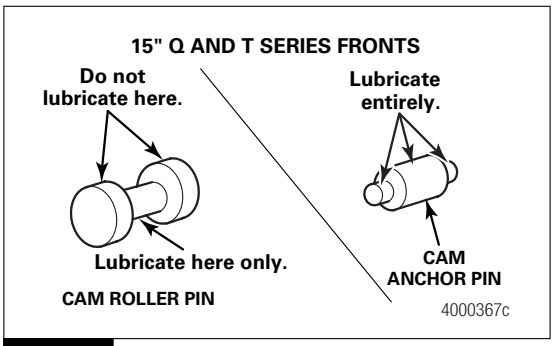


Figure 5.18

2. Install the anchor pins, washers and nuts to the spider if you removed these parts previously. Tighten the anchor pin nuts to 325-375 lb-ft (441-509 N•m). T

3. Install a new brake shoe return spring with the open end of the spring hooks toward the camshaft. Install the brake shoes onto the anchor pins. Figure 5.19.

5 Assembly and Installation

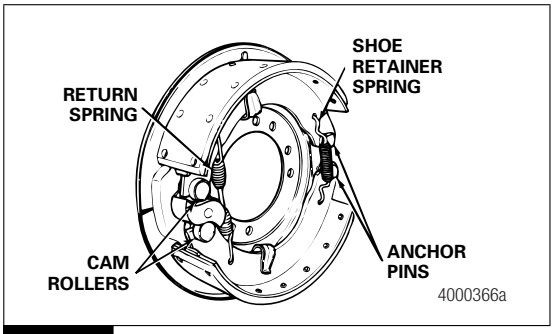


Figure 5.19

4. Hold the bottom brake shoe in position. Install the shoe return spring. Pull the brake shoe away from the camshaft to enable you to install the roller and roller retainer.

P Series and Cast Plus™ Cam Brakes

1. Lubricate the camshaft roller pin and anchor pin with Meritor specification 0-617-A or 0-617-B grease. Figure 5.13.
2. Install the anchor pin bushings. If necessary, align the holes in the bushings with the holes in the spider.
3. Install a new cam roller and cam roller retainers.
4. Install the lower brake shoe in position on the spider.
5. Use a hammer and brass drift to install the anchor pin. If necessary, align the groove on the anchor pin with the holes in the spider and bushing.
6. Install the anchor pin washers, felts, seals, retainers and snap rings, if required. Install lock pins or lock screws, if required. Tighten the screws to 10-15 lb-ft (13.6-20.3 N•m). T
7. Install a new shoe return spring onto the brake shoe. Figure 5.20. Place the upper brake shoe into position over the spider. Repeat Step 4 and Step 5.

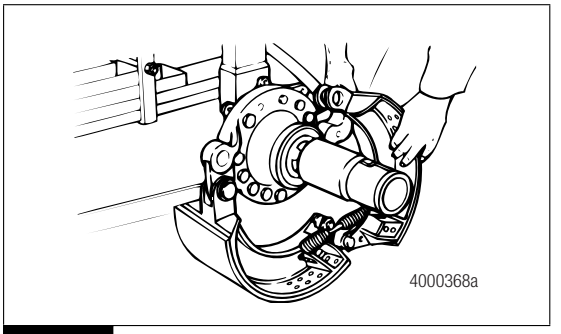


Figure 5.20

T Series Cam Brake

1. Lubricate the roller pin and anchor pin with Meritor specification 0-617-A or 0-617-B grease. Figure 5.18.
2. Install the anchor pins, washers and nuts onto the backing plate if you removed these parts previously. Tighten the anchor pin nuts to 185-350 lb-ft (251-475 N•m). T
3. Install the anti-rattle rod. Install the brake shoe onto the anchor pins and anti-rattle rod.
4. Install the anchor pin snap rings, anti-rattle spring and anti-rattle retainer spring onto the anti-rattle rod.
5. Pull the brake shoe away from the camshaft to enable you to install the brake shoe roller. Install a new brake shoe return spring onto the brake shoe.

Drum and Wheel

Follow the manufacturer's instructions to install the drum and wheel onto the axle.

6 Adjustment

Hazard Alert Messages

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.

Before you service a spring chamber, carefully follow the manufacturer's instructions to compress and lock the spring to completely release the brake. Verify that no air pressure remains in the service chamber before you proceed. Sudden release of compressed air can cause serious personal injury and damage to components.

ASBESTOS AND NON-ASBESTOS FIBERS ⚠ WARNING

Some brake linings contain asbestos fibers, a cancer and lung disease hazard. Some brake linings contain non-asbestos fibers, whose long-term effects to health are unknown. You must use caution when you handle both asbestos and non-asbestos materials.

Adjust the Brakes

Measure Free Stroke

When you perform preventive maintenance procedures on an in-service brake, check both the free stroke and adjusted chamber stroke. Refer to the procedures in this section.

Free stroke sets the clearance between the linings and drum. The in-service free stroke may be slightly longer than 0.5-0.625-inch (12.7-15.9 mm) specified in this procedure. This is acceptable if the adjusted chamber stroke is within the limits shown in Table D and Table E.

⚠ CAUTION

You must disengage a pull pawl or remove a conventional pawl before rotating the manual adjusting nut, or you will damage the pawl teeth. A damaged pawl will not allow the slack adjuster to automatically adjust brake clearance. Replace damaged pawls before putting the vehicle in service.

1. Disengage a pull pawl. Use a screwdriver or equivalent tool to pry the pull pawl at least 1/32-inch (0.8 mm) to disengage the teeth.
   - **If the slack adjuster has a conventional pawl:** Remove the pawl.
2. Use a wrench to turn the adjusting nut COUNTERCLOCKWISE until the brake shoes contact the drum. Figure 6.1. Then back off the adjusting nut 1/2 turn in the opposite direction.

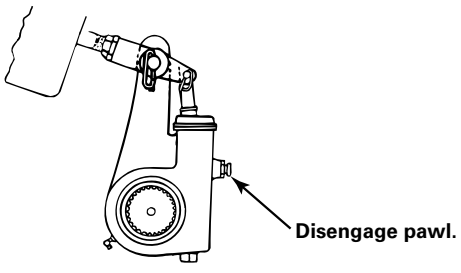


Figure 6.1

3. Measure the distance from the center of the large clevis pin to the bottom of the air chamber while the brake is released. The measurement you obtain is X in Figure 6.2.

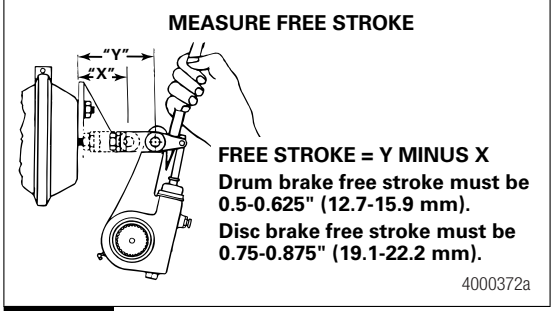


Figure 6.2

6 Adjustment

4. Use a pry bar to move the slack adjuster and position the linings against the drum, brakes applied. Measure the same distance again while the brakes are applied. The measurement you obtain is Y in Figure 6.2.

⚠ CAUTION

Do not set free stroke shorter than 0.5-0.625-inch (12.7-15.9 mm) for drum brakes. If the measurement is too short, linings can drag. Damage to components can result.

5. Subtract X from Y to obtain the in-service free stroke. The measurement must be 0.5-0.625-inch (12.7-15.9 mm) for drum brakes. Figure 6.2.
   - **If the free stroke measurement is not within specification:** Turn the adjusting nut to adjust free stroke. Figure 6.3. Follow the steps above to check free stroke again, until the measurement is within specification.

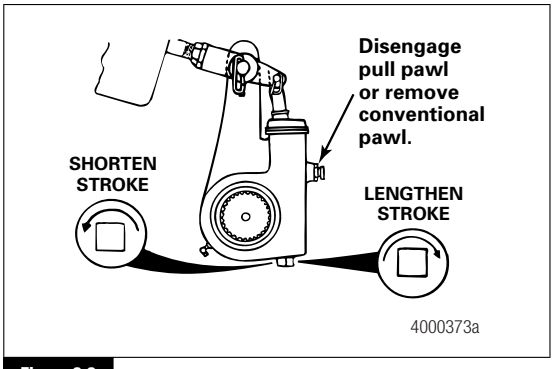


Figure 6.3

6. Re-engage the pull pawl by removing the screwdriver or equivalent tool. The pull pawl will re-engage automatically.
   - **If the slack adjuster has a conventional pawl:** Install the pawl assembly into the housing. Tighten the capscrew to 12-17 lb-ft (16-23 N•m).
7. If the brakes have spring chambers, carefully release the springs. Test the vehicle before you return it to service.

Commercial Vehicle Safety Alliance (CVSA) Guidelines

Measure Push Rod Travel or Adjusted Chamber Stroke

Use the following procedure to check in-service push rod travel or adjusted chamber stroke on truck and tractor brakes.

NOTE: Hold the ruler parallel to the push rod and measure as carefully as possible. A measurement error can affect CVSA re-adjustment limits. CVSA states that "any brake 1/4-inch or more past the re-adjustment limit, or any two brakes less than 1/4-inch beyond the re-adjustment limit, will be cause for rejection."

1. The engine must be OFF. If the brake has a spring chamber, follow the manufacturer's instructions to release the spring. Verify that no air pressure remains in the service section of the chamber.
2. Verify that pressure is 100 psi (689 kPa) in the air tanks. Determine the size and type of brake chambers on the vehicle.
3. With the brakes released, mark the push rod where it exits the chamber. Measure and record the distance. Have another person apply and hold the brakes on full application. Figure 6.4.

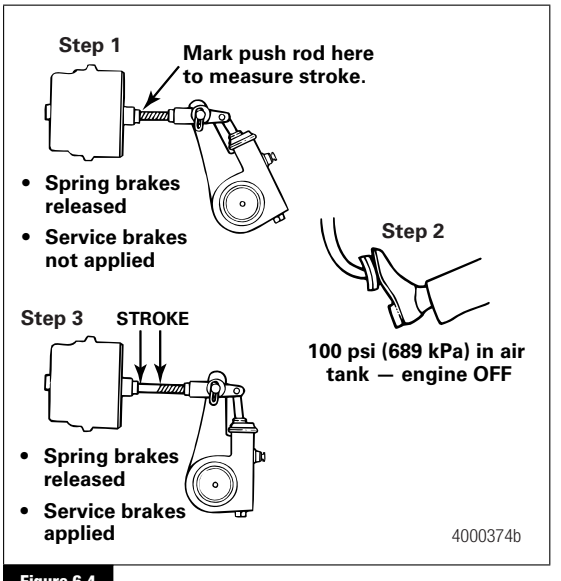


Figure 6.4

6 Adjustment

4. Measure the push rod travel or adjusted chamber stroke from where the push rod exits the brake chamber to your mark on the push rod. Measure and record the distance. Figure 6.4.
5. Subtract the measurement you recorded in Step 3 from the measurement you recorded in Step 4. The difference is the push rod travel or adjusted chamber stroke.
6. Refer to Table D or Table E to verify that the stroke length is correct for the size and type of air chambers on the vehicle.
   - **If push rod travel or adjusted chamber stroke is greater than the maximum stroke shown in Table D or Table E:** Inspect the slack adjuster and replace it, if necessary.

Table D: Standard Stroke Clamp-Type Brake Chamber Data

Type	Outside Diameter (inches)	Brake Adjustment Limit (inches)
6	4-1/2	1-1/4
9	5-1/4	1-3/8
12	5-4/16	1-3/8
16	6-3/8	1-3/4
20	6-25/32	1-3/4
24	7-7/32	1-3/4
30	8-3/32	2
36	9	2-1/4

Table E: Long Stroke Clamp-Type Brake Chamber Data

Type	Outside Diameter (inches)	Brake Adjustment Limit (inches)
16	6-3/8	2.0
20	6-25/32	2.0
24	7-7/32	2.0
24[1]	7-7/32	2.5
30	8-3/32	2.5

[1] For 3" maximum stroke type 24 chambers.

Alternate Method to Measure Push Rod Travel or Adjusted Chamber Stroke

Use the CVSA procedure, except in Step 3 and Step 4, measure the distance from the bottom of the air chamber to the center of the large clevis pin on each of the brakes.

CVSA North American Out-of-Service Criteria Reference Tables

Information contained in Table D and Table E is for reference only. Consult the CVSA's Out-of-Service Criteria Handbook for North American Standards, Appendix A. Visit their website at http://64.35.82.7/ to obtain the handbook.

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7 Maintenance

Hazard Alert Messages

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.

During lubrication procedures, if grease flows from the seal near the camshaft head, replace the seal. Remove all grease or oil from the camshaft head, rollers and brake linings. Always replace linings contaminated with grease or oil, which can increase stopping distances. Serious personal injury and damage to components can result.

ASBESTOS AND NON-ASBESTOS FIBERS

⚠ WARNING

Some brake linings contain asbestos fibers, a cancer and lung disease hazard. Some brake linings contain non-asbestos fibers, whose long-term effects to health are unknown. ou must use caution when you handle both asbestos and non-asbestos materials.

Lubrication

Cam Brakes

Refer to Table F for grease specifications.

Table F: Cam Brake Grease Specifications

Components	Meritor Specification	NLGI Grade	Grease Type	Outside Temperature
Retainer Clips	O-616-A	1	Clay Base	Down to –40° F (–40° C)
Anchor Pins	O-617-A	1	Lithium 12-Hydroxy Stearate or Lithium Complex	Refer to the grease manufacturer's specifications for the temperature service limits.
Rollers, Journals Only	O-617-B	2		
Camshaft Bushings				
	O-645	2	Synthetic Oil, Clay Base	Down to –65° F (–54° C)
	O-692	1 and 2	Lithium Base	Down to –40° F (–40° C)
Camshaft Splines	Any of above	Refer to above	Refer to above	Refer to above
	O-637[1]	1-1/2	Calcium Base	Refer to the grease manufacturer's specifications for the temperature service limits.
	O-641	—	Anti-Seize	

[1] Do not mix Meritor specification O-637 grease, part number 2297-U-4571, a calcium-base, rust-preventive grease, with other greases.

7 Maintenance

Camshaft Bushings

Meritor recommends that you install new camshaft bushings whenever you install a new camshaft.

Lubricate through the fitting on the bracket or spider until new grease flows from the inboard seal.

Rollers and Anchor Pins

When you disassemble the brake, or when necessary, lubricate the anchor pins and rollers where these parts touch the brake shoes.

Do not allow grease to contact the area of the roller that touches the camshaft head. Figure 7.1 and Figure 7.2.

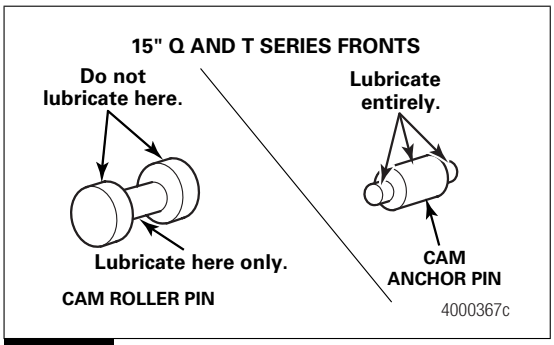

Figure 7.1

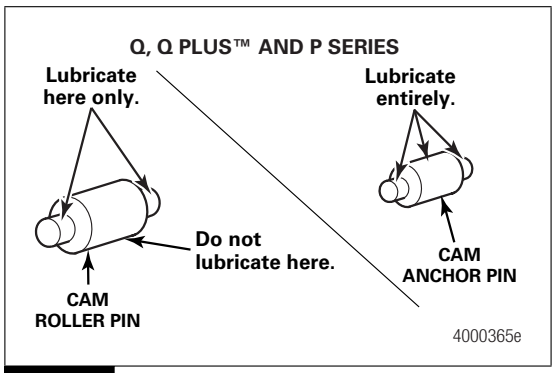

Figure 7.2

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Automatic Slack Adjuster

Inspect and lubricate the automatic slack adjuster according to one of the schedules below. Use the schedule that requires the most frequent inspection and lubrication, and whenever you reline the brakes. Refer to Table G for grease specifications.

- Vehicle manufacturer's schedule
- Fleet's schedule
- Every six months
- A minimum of four times during the life of the linings

Table G: Automatic Slack Adjuster Grease Specifications

Components	Meritor Specification	NLGI Grade	Grease Type	Outside Temperature
Automatic Slack Adjuster	O-616-A	1	Clay Base	Down to –40° F (–40° C)
	O-645	2	Synthetic Oil, Clay Base	Down to –65° F (–54° C)
	O-692	1 and 2	Lithium Base	Down to –40° F (–40° C)
Clevis Pins	Any of above	Refer to above	Refer to above	Refer to above
	O-637[1]	1-1/2	Calcium Base	Refer to the grease manufacturer's specifications for the temperature service limits.
	O-641	—	Anti-Seize	

[1] Do not mix Meritor specification O-637 grease, part number 2297-U-4571, a calcium-base, rust-preventive grease, with other greases.

7 Maintenance

Anti-Seize Compound

Use anti-seize compound on the clevis pins of all automatic slack adjusters.

For a conventional automatic slack adjuster, use anti-seize compound on the slack adjuster and camshaft splines if the slack adjuster gear does not have a grease groove and holes around its inner diameter.

Factory-Installed Automatic Slack Adjusters on Q Plus™ LX500 and MX500 Cam Brake Packages

Q Plus™ LX500 and MX500 cam brake packages include factory-installed automatic slack adjusters that do not have grease fittings. Also, lubrication intervals are different than intervals for conventional slack adjusters.

For complete maintenance and service information on the Meritor LX500 and MX500 cam brakes, refer to Maintenance Manual MM-96173, Q Plus™ LX500 and MX500 Cam Brakes. To obtain this publication, refer to the Service Notes page on the front inside cover of this manual.

Intervals

Applications

On-Highway

Q Plus™, Cast Plus™ and Q Series brakes, for every 100,000 miles (160 000 km) or every six months, whichever comes first.

P Series brakes, for every 50,000 miles (80 000 km) or every six months, whichever comes first.

Off-Highway

At least every four months when you replace the seals and reline the brakes.

Every two weeks during the first four-month period, inspect for hardened or contaminated grease and for the absence of grease to help determine lubrication intervals.

Lubricate more often for severe-duty applications.

Specialty

Lubricate every six months, at each reline or every 10,000 miles (16 000 km).

Adjust the Brakes

NOTE: Adjust the wheel bearings before you adjust the brakes.

Clean, inspect and adjust the brakes every time you remove a wheel hub.

Adjust the brakes when the chamber stroke exceeds CVSA limits in Section 6.

Adjust the brakes as frequently as necessary for correct operation.

Check for correct lining-to-drum clearance, push rod travel and brake balance.

Reline the Brakes

⚠ CAUTION

Reline the brakes when the lining thickness is 0.25-inch (6.3 mm) at the thinnest point. The rivets or bolts must not touch the drum. Damage to components will result.

Meritor recommends that you replace the springs, rollers, camshaft bushings and anchor pins at each reline.

Reline the brakes when the lining thickness is 0.25-inch (6.3 mm) at the thinnest point.

Replace shoe retainer springs, check the drum, and perform a major inspection when you reline the brakes.

Important Information on Linings and Primary Shoe Locations

Use the Correct Lining Material

Use the lining material specified by the vehicle manufacturer. This will help to ensure that the brakes perform correctly and meet Department of Transportation (DOT) performance regulations.

Also note that the drums and linings on a front axle can be different than drums and linings on a rear axle. Figure 7.3.

7 Maintenance

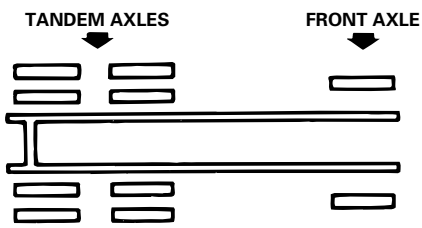

Figure 7.3

Single Axles

Always reline both wheels of a single axle at the same time.

Always install the same type linings and drums on both wheels of a single axle.

Tandem Axles

Always reline all four wheels of a tandem axle at the same time.

Always install the same type linings and drums on all four wheels of a tandem axle.

Combination Friction Linings

⚠ CAUTION

When you install combination friction linings, you must install the *primary* lining on the *primary* brake shoe. If you install combination friction linings incorrectly, damage to components will result. Carefully follow instructions included with the replacement linings.

You can combine brake linings, which means that the linings you install on the primary shoe will have a different friction rating than the linings you install on the secondary shoe.

However, you must install the primary lining on the primary shoe. Carefully follow the instructions included with the replacement combination linings.

Primary Shoe Locations

The first shoe past the camshaft in the direction of wheel rotation is the primary shoe. Figure 7.4. The primary shoe can be either at the top or bottom position, depending on the location of the camshaft.

If the camshaft is behind the axle, the top shoe is the primary shoe.

If the cam is in front of the axle, the top shoe is the primary shoe.

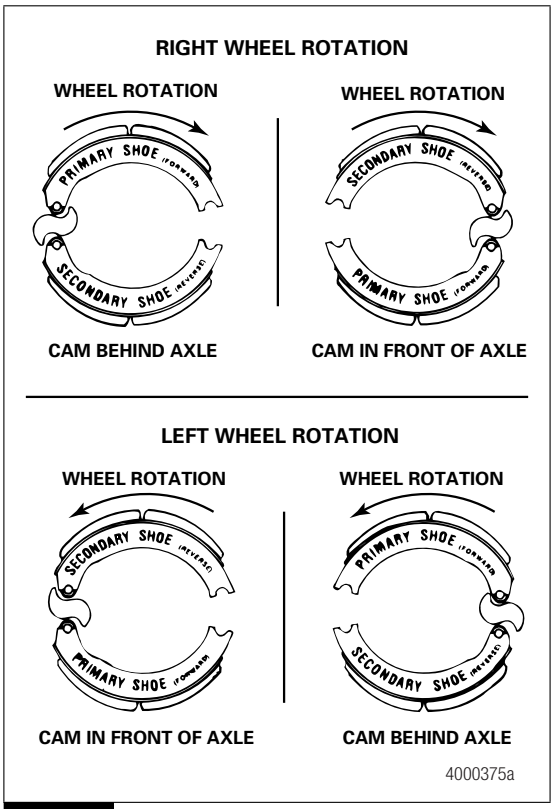

Figure 7.4

Major Overhaul

Perform a major overhaul at every second reline, or as necessary. Replace the shoe return springs. Replace the damaged or worn parts with genuine Meritor parts. Check the components for the following conditions.

- Spiders for distortion and loose bolts
- Anchor pins for wear and correct alignment
- Brake shoes for wear at anchor pin holes or roller slots
- Camshafts and camshaft bushings for wear
- Brake linings for grease on the lining, wear and loose rivets or bolts
- Drums for cracks, deep scratches or other damage

7 Maintenance

Inspection

Before You Return the Vehicle to Service

⚠ WARNING

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

1. Check the complete air system for worn hoses and connectors. With the air pressure at 100 psi (689 kPa), the brakes released and the engine off, tractor air pressure loss must not exceed 2 psi (13.8 kPa) per minute. Total tractor and trailer loss must not exceed 3 psi (20.7 kPa) per minute.
2. Verify that the air compressor drive belt is tight. Air system pressure must rise to approximately 100 psi (689 kPa) in two minutes.
3. The governor must be checked and set to the specifications supplied by the vehicle manufacturer.
4. Both the tractor and trailer air systems must match the specifications supplied by the vehicle manufacturer.
5. Both wheel ends of each axle must have the same linings and drums. All four wheel ends of tandem axles also must have the same linings and drums. It is not necessary for the front axle brakes to be the same as the rear drive axle brakes. Figure 7.5.

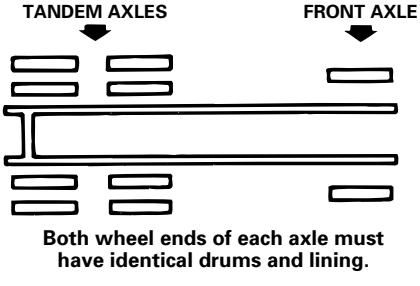

Figure 7.5

6. Always follow the specifications supplied by the vehicle manufacturer for the correct lining to be used. Vehicle brake systems must have the correct friction material and these requirements can change from vehicle to vehicle.
7. The return springs must retract the shoes completely when the brakes are released. Replace the return springs each time the brakes are relined. The spring brakes must retract completely when they are released.
8. The air chamber area multiplied by the length of the automatic slack adjuster is called the AL factor. This number must be equal for both ends of a single axle and all four ends of a tandem axle. Figure 7.6.

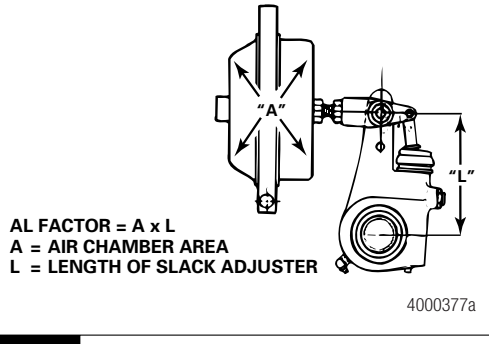

Figure 7.6

8 Diagnostics

Troubleshooting

⚠ WARNING

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

Refer to Table H for cam brake diagnostic information.

Table H: Cam Brake, All Models

Symptoms	Possible Causes	Corrective Actions
The adjusted stroke is too long.	The slack adjuster part number is incorrect.	Check with the warehouse distributor or original equipment manufacturer.
No adjustment occurs.	The clevis is installed at the wrong angle (BSAP or template).	Use the correct template or BSAP setting to install the clevis correctly.
	Wear between the clevis and collar is excessive, more than 0.060-inch (1.52 mm).	Replace with a threaded clevis.
	The jam nut at the clevis is loose.	Tighten to specification.
	The clevis pin bushing in the slack arm is worn. The inside diameter of the bushing is larger than 0.53-inch (13.46 mm).	Replace the bushing.
	The return spring in the air chamber is weak or broken. Spring force must be at least 32 lb (142.4 N) at the first push rod movement.	Replace the return spring or air chamber.
	The spring brake does not retract fully.	Repair or replace the spring brake.
	The teeth on the pawl or actuator are worn or stripped.	Replace the slack adjuster.
	High torque is required to rotate the worm when the slack is removed from the vehicle. • In service slack, maximum worm torque: 45 lb-in (5.09 N•m) • New or rebuilt slack, maximum worm torque: 25 lb-in (2.83 N•m)	Replace the slack adjuster.
	Looseness between the camshaft splines and automatic slack adjuster gear is excessive.	Replace the powershaft, gear or automatic slack adjuster as needed.
	Components, such as the cam bushing, are worn.	Replace the components.
	The non-original equipment manufacturer replacement linings may have excessive swell or growth.	Use Meritor-approved linings.

8 Diagnostics

Table H: Cam Brake, All Models (cont.)

Symptoms	Possible Causes	Corrective Actions
The adjusted stroke is too short.	The slack adjuster part number is incorrect.	Check with the warehouse distributor or original equipment manufacturer.
	The clevis is installed at the incorrect angle.	Use the correct template to install the clevis correctly.
The linings drag.	The jam nut at the clevis is loose.	Tighten to specification.
	The spring brake does not retract fully.	Repair or replace the spring brake.
	The manual adjustment is incorrect.	Adjust the brake.
	There is poor contact between the linings and the drum, or the drum is out-of-round.	Repair or replace the drums or linings.
	There is a brake temperature imbalance.	Correct the brake balance.

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9 Specifications

Torque Specifications

Cam Brakes

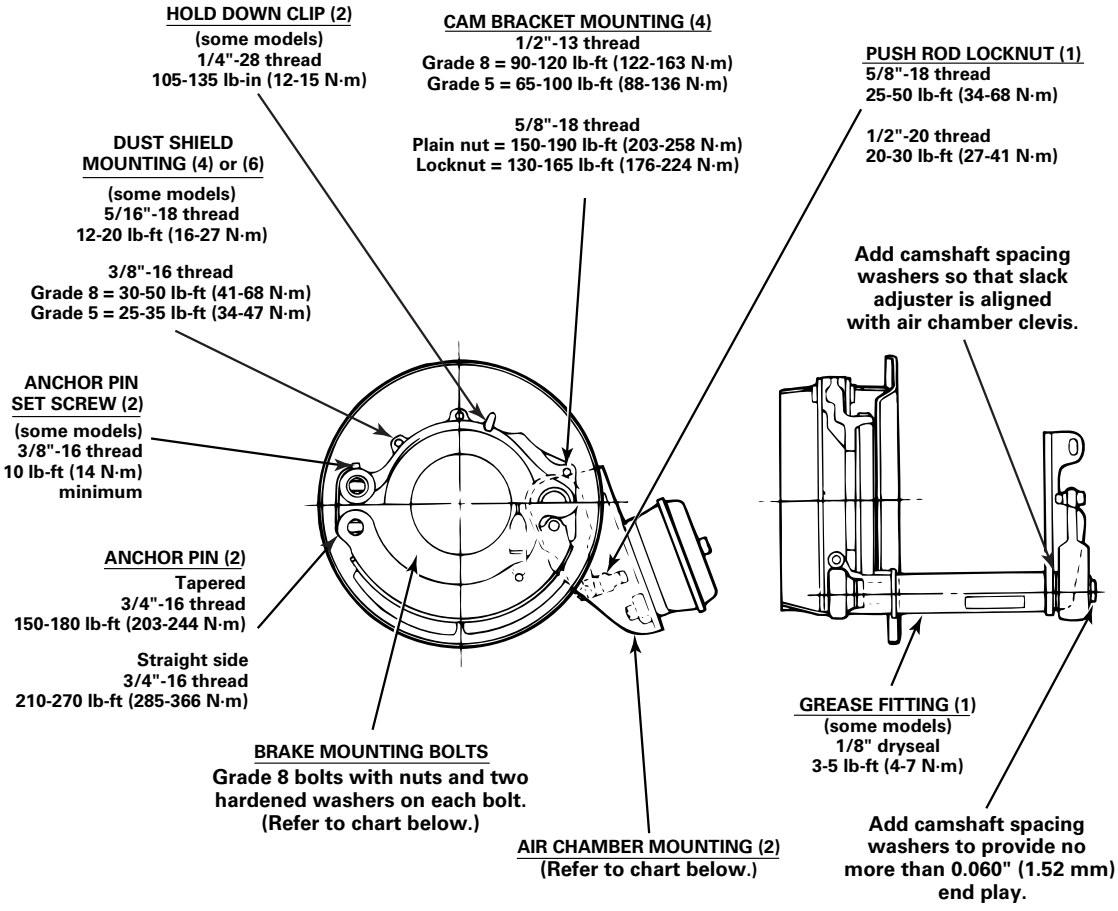

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Table I: Brake Mounting Bolts

Bolt Size, Grade 8	Torque, lb-ft (N•m)
7/16″-20	60-75 (81-102)
1/2″-20	85-115 (115-156)
9/16″-18	130-165 (176-224)
5/8″-18	180-230 (244-312)

9 Specifications

Table J: Air Chamber Mounting, Grade 8 Nuts and Hard Flat Washers

Chamber Size	9	12	16	20	24	30	36	Spring Chamber
Bendix	20-30 lb-ft (27-41 N•m)		30-45 lb-ft (41-61 N•m)			45-65 lb-ft (61-88 N•m)		65-85 lb-ft (88-115 N•m)
Haldex	35-50 lb-ft (48-68 N•m)			70-100 lb-ft (95-136 N•m)				
MGM	35-40 lb-ft (48-54 N•m)			133-155 lb-ft (180-210 N•m)				
Anchorlok/ Haldex	—			130-150 lb-ft (177-203 N•m)				

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