

# SECTION 12: BRAKE AND AIR SYSTEM

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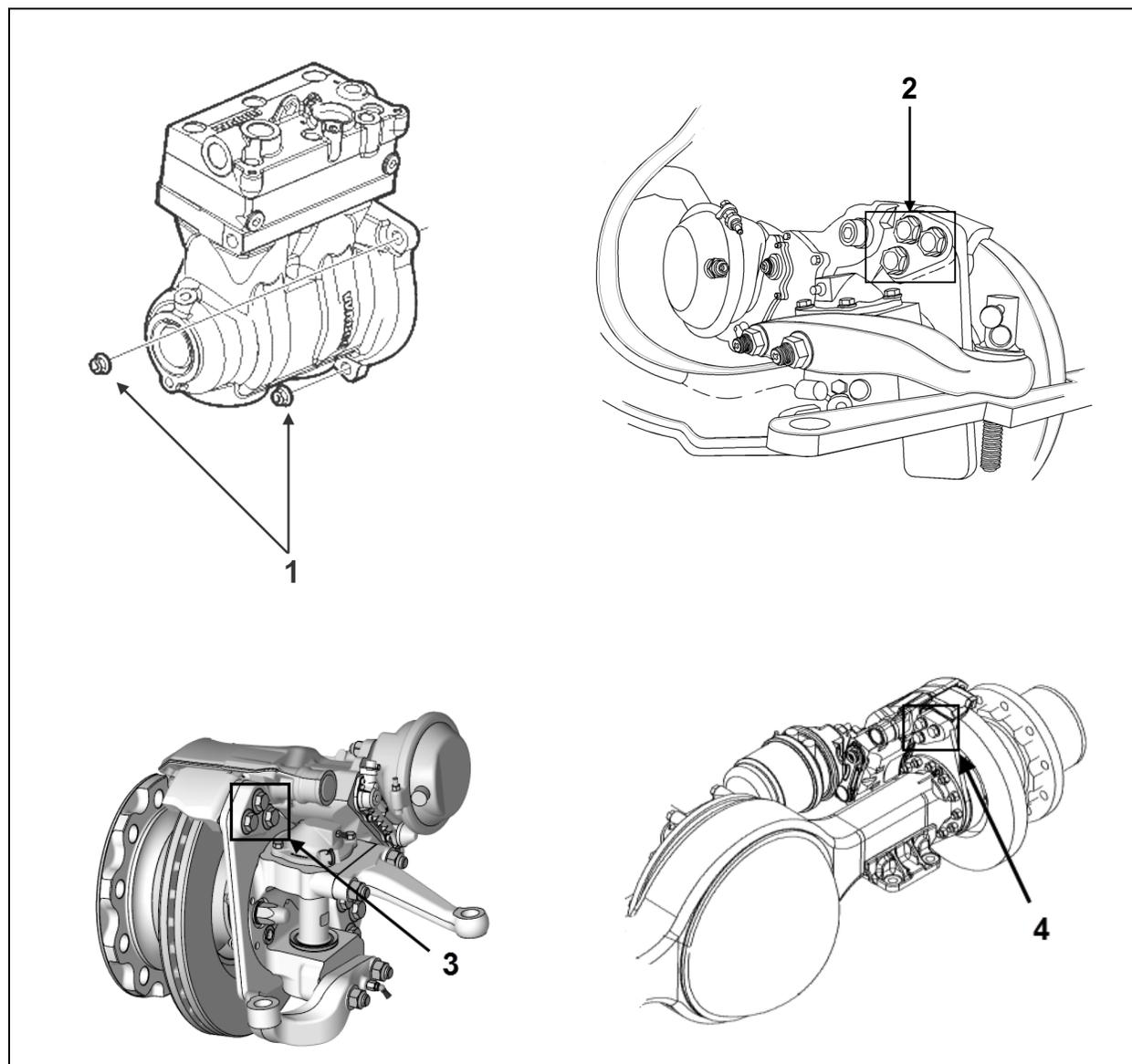
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**SECTION CHANGE LOG**

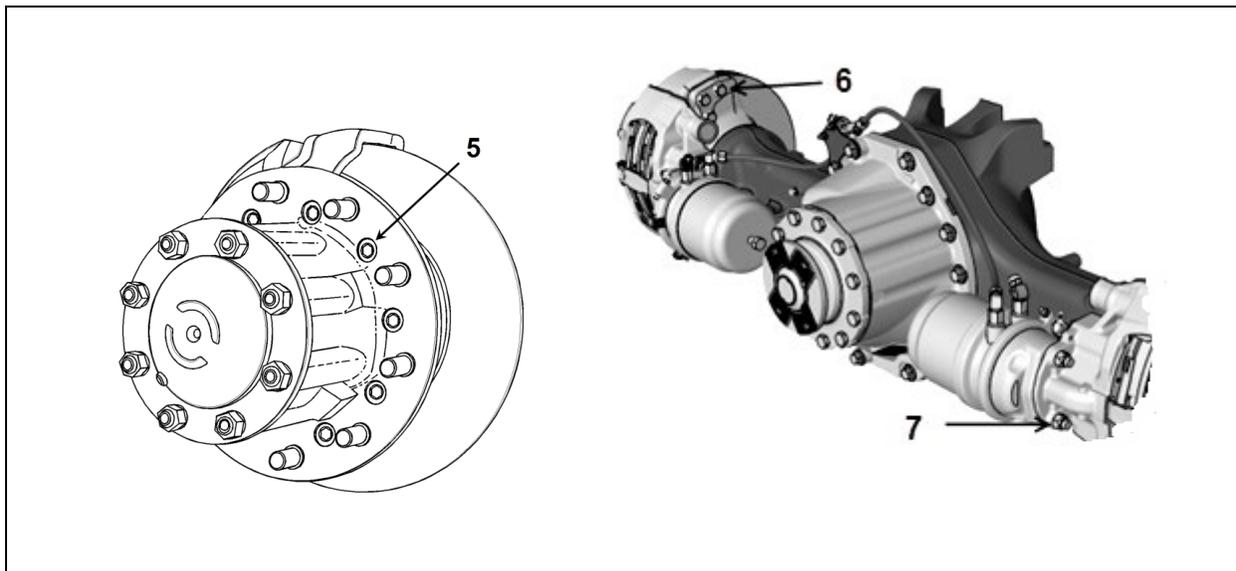
DESCRIPTION		DATE
1		
2		
3		
4		
5		
6		

## 1. TORQUE TABLES

## 1.1 BRAKE AND AIR SYSTEM



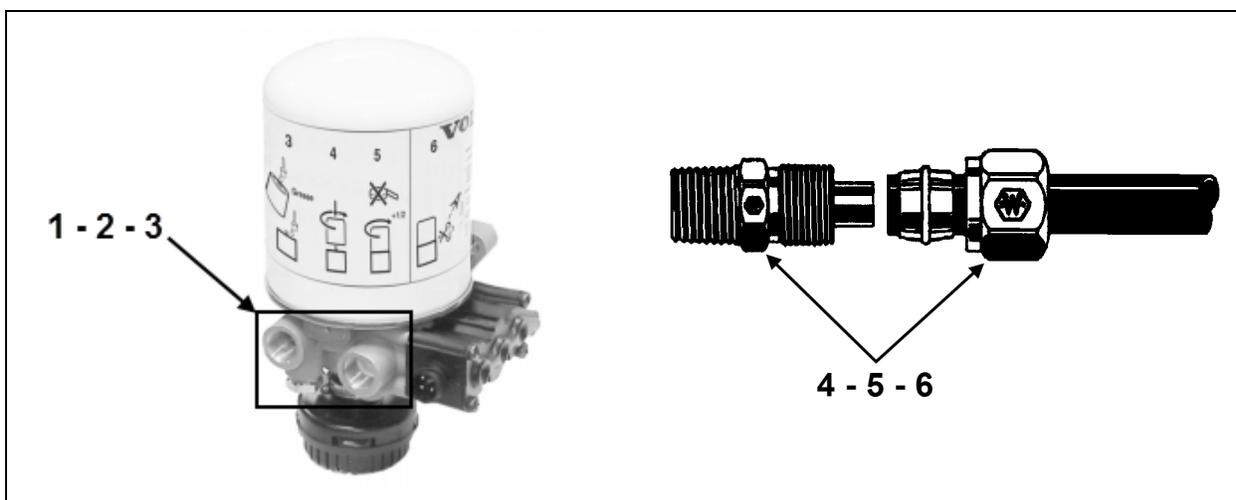
BRAKE AND AIR SYSTEM		
No	DESCRIPTION	TORQUE
1	Compressor flange mounting nuts	63 lb-ft (85 Nm)
2	Front IFS suspension caliper mounting bolts	405-495 lb-ft (549-671 Nm)
3	Front I-beam caliper mounting bolts	433-479 lb-ft (587-649 Nm)
4	Meritor drive axle & Tag axle caliper mounting bolts	405-495 lb-ft (549-671 Nm)



**BRAKE AND AIR SYSTEM**

No	DESCRIPTION	TORQUE
5	Meritor hub to disc cap screws	110-165 lb-ft (149-224 Nm)
6	ZF drive axle caliper mounting bolts	200 lb-ft (271 Nm)
7	ZF drive axle brake chamber mounting bolts	120-150 lb-ft (163-203 Nm)

1.2 MISCELLANEOUS TORQUES



**MISCELLANEOUS TORQUES**

No	DESCRIPTION	TORQUE
1	Air filter/dryer connections - 3/8"-18 NPTF	12 lb-ft (16 Nm)
2	Air filter/dryer connections - 1/4"-18 NPTF	12 lb-ft (16 Nm)

3	Air filter/dryer connections - 1/2"-14 NPTF	37 lb-ft (50 Nm)
4	1/4" NTA-Type Plastic Tubing Connection	3 turns*
5	3/8" to 1/2" NTA-Type Plastic Tubing Connection	4 turns*
6	5/8" to 3/4" NTA-Type Plastic Tubing Connection	3 ½ turns*

\* Hand tight first then tighten using wrench the number of turns specified in table.

## 2. AIR SYSTEM

The basic air system consists of an air compressor, reservoirs, valves, filters and interconnecting lines and hoses. It provides a means for breaking, operating controls and accessories and suspension (refer to Section 16, "Suspension", for complete information on suspension description and maintenance). An air system schematic diagram is annexed in the technical publications box provided with the vehicle for better understanding of the system.

## 3. BRAKES

This vehicle uses both the service brake and emergency/parking brake. The service brake air system is divided into two independent circuits to isolate front brakes from rear brakes, thus providing safe braking in the event that one circuit fails. Front axle brakes operate from the secondary air system, while brakes on both the drive axle and tag axle operate from the primary air system.

### NOTE

*The tag axle service brake operates only when the axle is in normal ride position (loaded and down).*

Furthermore, the brake application or release, which is speed up by pneumatic relay valves (R-14), will start with the rear axles and will be followed by the front axle, thus providing uniform braking on a slippery road. The vehicle is also equipped with an Anti-Lock Braking System (ABS), which is detailed later in this section.

The drive is provided with spring-loaded emergency/parking brakes, which are applied automatically whenever the control valve supply pressure drops below 60 psi (413 kPa). The optional emergency/parking brake override system allows the driver to release spring brakes, and to move the vehicle to a safe parking place, such as in the case of a self-application of these brakes due to a drop in air pressure.

## 4. AIR RESERVOIRS

The air coming from the air dryer is first forwarded to the wet air tank, then to the primary (for the primary brake system), secondary (for the secondary brake system), and accessory (for the pneumatic accessories) air tanks (Figure 2 and Figure 3).

Additional air reservoirs may be installed on the vehicle: the kneeling air tank, emergency/parking brake override air tank and I-Shift transmission air tanks.

### 4.1 OPTIONAL WET TANK AUTOMATIC DRAIN VALVE

The optional wet tank automatic drain valve (Figure 1) is designed to remove liquids from the wet tank each time the brake is applied as the solenoid is connected to the stop light circuit. A built-in heater prevents freeze-ups and keeps the air system clean in all temperature.

#### 4.1.1 Installation

1. Make sure that there is no pressure in the wet tank (emptied tank).
2. Fit the automatic drain valve to the wet tank. Tighten valve finger tight and then tighten an additional 1 ½ turns, do not over tighten.
3. Connect the power cable to the valve connector.
4. Charge the air system and make sure there is no leakage. Also check functioning of the drain valve by applying the service brake.

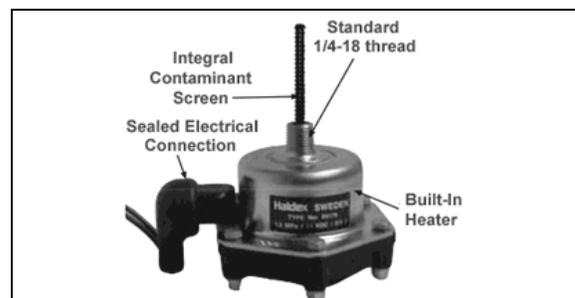


FIGURE 1: WET TANK AUTOMATIC DRAIN VALVE

4.2 MAINTENANCE

**MAINTENANCE**

**Air tanks**

A recommended purge using the bottom drain valve should be done at the intervals specified by the Lubrication And Servicing Schedule in Section 24: LUBRICATION & SERVICING.

It is important to empty the tanks completely to ensure that water and moisture are totally evacuated from the tank.

Ensure that both the accessories and the wet air tanks are purged during pre-starting inspection. In addition, it is good practice to purge these following the information below.

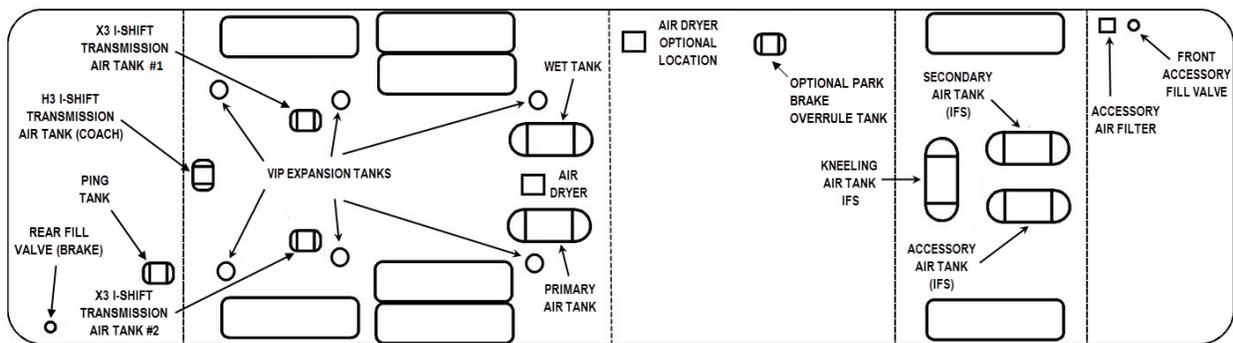


FIGURE 2: INDEPENDENT SUSPENSION AIR TANKS LOCATIONS (SHOWN WITH VIP EXPANSION TANKS)

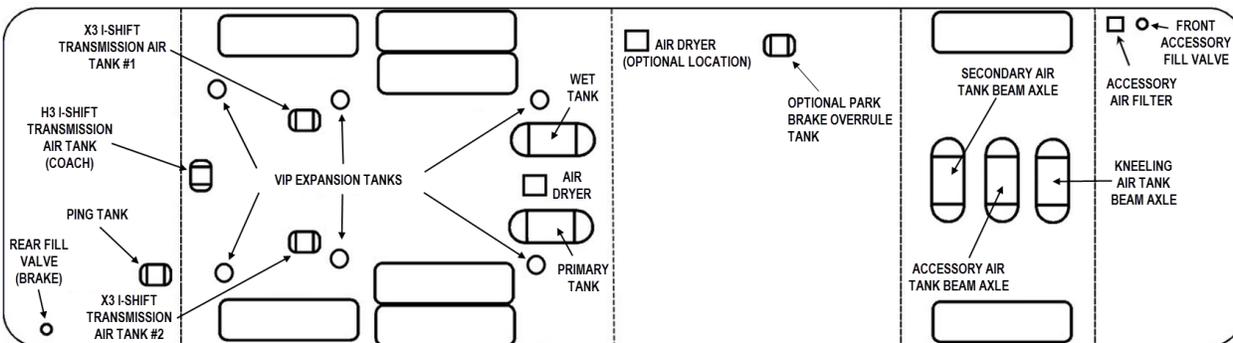


FIGURE 3: I-BEAM AXLE SUSPENSION AIR TANKS LOCATIONS (TYPICAL WITH VIP EXPANSION TANKS)

#### 4.2.1 Wet Air Tank

This reservoir located in front and above the L.H. wheel of the drive axle in the rear wheel housing, is provided with a bottom drain valve.

#### 4.2.2 Primary Air Tank

This reservoir is located above the tag axle, and is provided with a bottom drain valve.

#### 4.2.3 Accessory Air Tank

The accessory air tank is installed at the ceiling of spare wheel compartment and is provided with a bottom drain valve.



FIGURE 4: FRONT SERVICE COMPARTMENT

#### 4.2.4 Secondary Air Tank

Located in the front left wheel housing for the independent suspension equipped vehicles, this tank is set behind the front axle and the accessory air tank for the beam axle equipped vehicles. Tank is provided with a bottom drain valve.

#### 4.2.5 Kneeling Air Tank

The kneeling air tank is installed on vehicles equipped with the Kneeling or Hi/Low-Buoy options. It is located behind the front suspension arms for independent front suspension vehicles and in front of the front axle on vehicles equipped with a beam suspension, tank is provided with a bottom drain valve.

#### 4.2.6 I-Shift Transmission Air Tank

Installed on vehicles equipped with this option, these reservoirs are located in the rear tag axle wheel housing on X Series vehicles, a single tank located between the tag wheels is provided on H Series vehicles. All are provided with a bottom drain valve.

#### 4.2.7 Optional Parking Brakes Override Air Tank

On vehicle equipped with this option, the parking brakes override air tank is installed at the ceiling of the rear baggage compartment, on the L.H. side.

### 4.3 PING TANK

The ping tank is located next to the power steering pump reservoir in the engine compartment; it is accessible through the engine compartment R.H. side door. This tank is used to dissipate heat and to reduce noise produced by the air compressor cycling on and off.

## 5. AIR SYSTEM EMERGENCY FILL VALVES

All vehicles come equipped with two emergency fill valves that enable system pressurization by an external source such as an air compressor.

The rear valve is located in the engine compartment and is accessible from engine compartment R.H. side door (Figure 12).

	<h3>CAUTION</h3>
<p>Maximum allowable air pressure is 140 psi (965 kPa). Air filled through these two points will pass through the standard air filtering system provided by Prevost. Do not fill system by any other point on the system.</p>	

The front valve is located in the front electrical and service compartment close to R.H. side of doorframe (Figure 4).

These two air system emergency fill valves are fitted with the same valve stems as standard tires, and can be filled by any standard external air supply line.

The rear air system emergency fill valve will supply air to wet air tank, primary air tank, secondary air tank and accessories air tank for brakes, suspension and accessories systems while the front fill valve will supply air to accessories only.

## 6. ACCESSORY AIR FILTER

This filter is located inside the front electrical and service compartment (Figure 5). Its main function consists in filtering the air supplied to the suspension /leveling system and the accessory air system.

Filter element: 5 microns  
 ¼ PF NPT ports

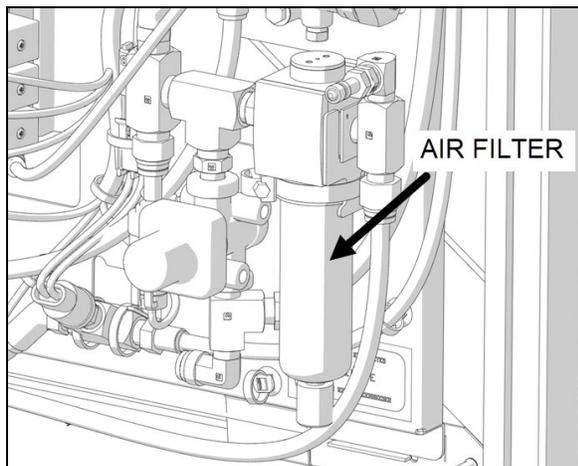


FIGURE 5: ACCESSORY AIR FILTER

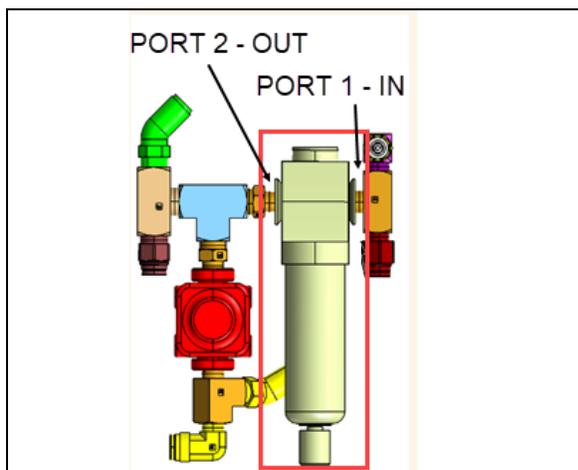


FIGURE 6: ACCESSORY AIR FILTER

## 6.1 ACCESSORY AIR FILTER DRAIN

The bowl is fitted with a manual/semi auto drain. Turn the drain valve to the ON position and then allow draining. Once purged, return to the OFF position.

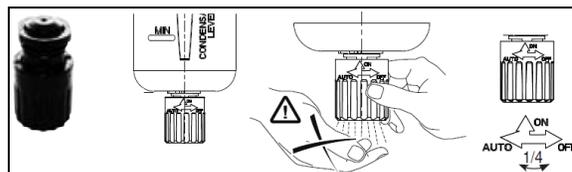


FIGURE 7: DRAIN VALVE

## 6.2 ACCESSORY AIR FILTER ELEMENT REPLACEMENT

Replace the accessory air filter element according to Lubrication and Servicing Schedule. Moreover, the filter element should be changed when differential pressure exceeds 15 psi (105 kPa) between filter inlet and outlet ports.

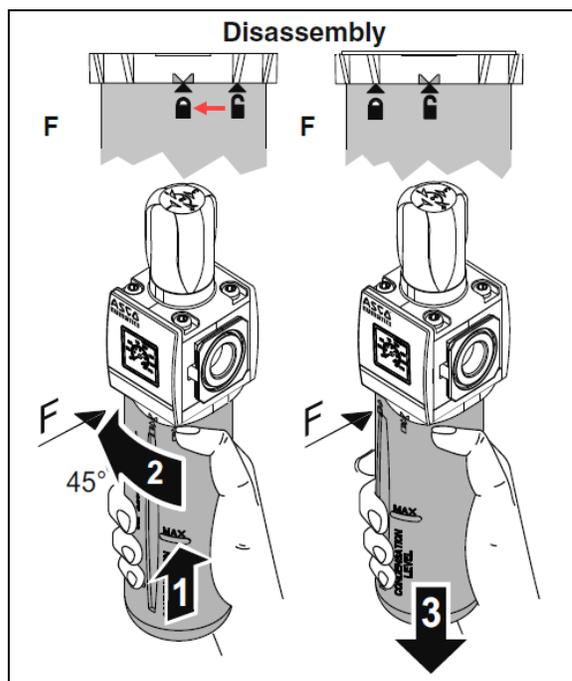


FIGURE 8: ACCESSORY AIR FILTER BOWL REMOVAL

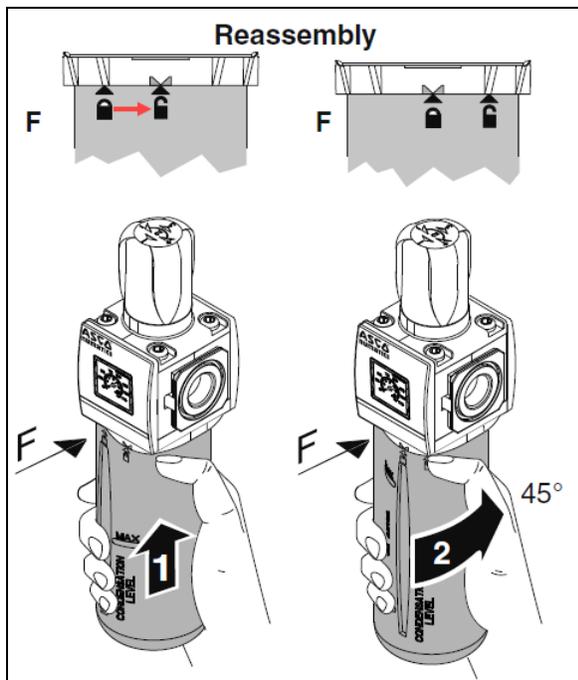


FIGURE 9: ACCESSORY AIR FILTER BOWL INSTALLATION

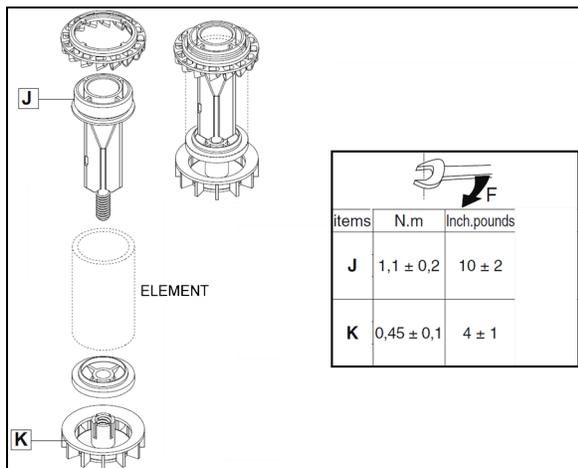


FIGURE 10: ACCESSORY AIR FILTER ARRANGEMENT

### 7. AIR GAUGES (PRIMARY, SECONDARY AND ACCESSORY)

The air pressure gauges, located on the dashboard (see "Operator's Manual" or "Owner's Manual"), are fed from pressure transducer installed on the DC-4 double check valve, located on the pneumatic accessories panel in the front service compartment.

The latter is connected to the air lines running from the primary and secondary air tanks, as shown on the pneumatic system diagram provided with the vehicle. The accessory air gauge is connected to the front pneumatic panel in the front compartment of the vehicle. The vehicle should never be set in motion until the buzzer alarm and warning lights turn off, i.e. when air pressure registers at least 85 psi (414 kPa). Moreover, if pressure drops below 85 psi (414 kPa), the "Low air pressure" warning lights will turn on, and the "Low air pressure" buzzer will sound. Stop the vehicle immediately, determine and correct the cause(s) of pressure loss. Check the gauges regularly with an accurate test gauge. Replace the gauge with a new unit if there is a difference of 4 psi (27 kPa) or more in the reading.

### 8. AIR DRYER

**TORQUE** for connections:

3/8"-18 NPTF= **12 lb-ft** (16 Nm)

1/4"-18 NPTF= **12 lb-ft** (16 Nm)

1/2"-14 NPTF= **37 lb-ft** (50 Nm)

Safety valve dynamic pressure: 290 psi.



FIGURE 11: AIR FILTER DRYER

The electric air dryer is controlled by the multiplex system. If the air dryer should for some reason become powerless, it will cease to function and the desiccant will become *wet through*, while the compressor will continue to charge. Relief is provided via the safety valve.

By using the information from the vehicle electronic system, the air dryer and compressor control is optimized, so that drying of the air is guaranteed and fuel consumption is reduced. This will be noticed as a different compressor start/stop pattern.

The air dryer has a built-in function to prevent freezing or blockage. The function provides temporary relief (air dryer blow clean) at engine shut down. This function eliminates the problem of freezing on a stationary vehicle.

An additional function at vehicle start-up prevents the compressor from charging air during engine cranking and start-up.

The air filter/dryer is located in front of rear wheel housing above drive axle. Its purpose is to remove moisture that could damage the air system before the air enters the system reservoir. The air filter/dryer also filters the air to remove dirt, compressor oil, and other contaminants that can damage the system. Change cartridge every 100,000 miles (160 000 km) or once every two years, whichever comes first.

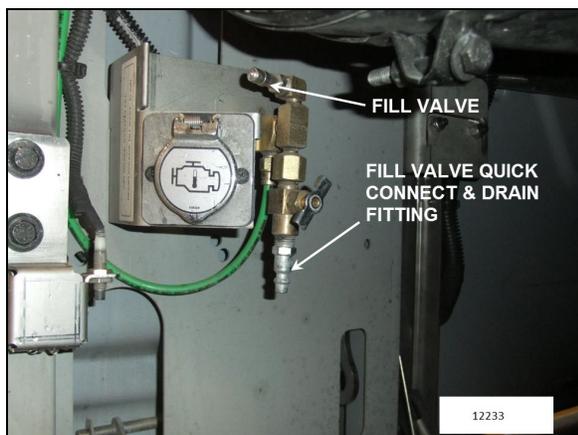


FIGURE 12: REAR VALVE LOCATION (TYPICAL)

The air dryer and wet tank may be purged simultaneously for maintenance purposes using the drain cock on the emergency air system fill valve located in the engine compartment and accessible through the engine compartment R.H. side door (Figure 12).

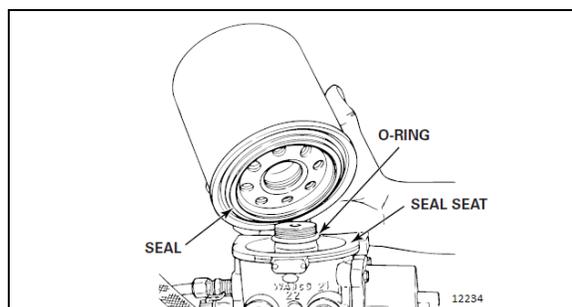
For more information on Meritor Wabco Air dryer, refer to the following manuals included on your Technical Publications USB flash drive:

- **Meritor Wabco System Saver Series Single Cartridge Air Dryers Maintenance Manual 34**

## 8.1 REPLACING THE DESICCANT CARTRIDGE

To replace the desiccant cartridge:

5. Release air dryer pressure by opening the air dryer drain valve (Figure 12).
6. Loosen and remove the old cartridge. Use strap wrench if necessary.
7. Remove and discard O-ring from dryer base.
8. Inspect and clean seal seat. Repair any minor damage.
9. Lubricate and install new O-ring on stem.
10. Lubricate cartridge seal.
11. Thread replacement cartridge onto the base until the seal touches the base. Then, tighten the cartridge ONE additional turn. DO NOT OVERTIGHTEN.



## MAINTENANCE

### Air dryer cartridge

Replace the air dryer desiccant cartridge at the intervals specified by the Lubrication And Servicing Schedule in Section 24: LUBRICATION & SERVICING

## 8.2 AIR LEAK CHECK / WARNING

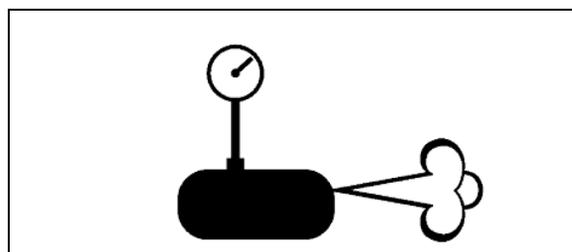


FIGURE 13: AIR LEAK CHECK / WARNING ICON 12228

This icon may appear in the DID if the compressor is charging abnormally which is usually an indication of an air leak.

### 9. OPTIONAL HALDEX CONSEP - SEPARATOR

The optional Consep Air Condenser-Separator is located in the rear wheelhousing, fore of drive axle (Figure 14). When present, the Consep is mounted in the air line between the compressor and the air dryer. It condenses, separates and removes 90% of the oils, liquids and other contaminants. It reduces corrosion and possible failure of air brake system components caused by contamination and significantly increases the air dryer desiccant life.

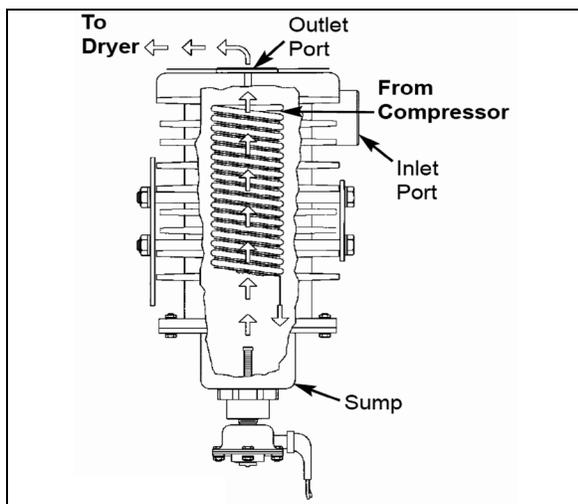


FIGURE 14: HALDEX CONSEP CONDENSER SEPARATOR

The automatic heated drain valve installed on the Consep ensures that liquids are removed upon each brake application for optimum performance. The drain valve's integrated filter prevents damage from large debris.

The automatic drain valve activates when the rear stop lights turn ON, with the prerequisite conditions of having a vehicle speed greater than 2 mph and the engine running.

The solenoid remains energized simultaneously with activation of the rear stop lights to heat up air output to prevent it from freezing. However, Multiplex programming will ensure that the solenoid remains energized for at least of 45 seconds but not longer than 5 minutes.

### 9.1 MAINTENANCE

The Consep requires little maintenance during its long service life. The Consep must be inspected periodically for proper operation. The interval between inspections is determined by the type of service. High compressor duty cycles and high temperatures can cause a buildup of carbon in the condenser, drain valve and filter. This contamination must be removed for proper operation.

For more information on the periodic inspection, refer to **Haldex Consep Condenser Separator, Installation, Maintenance & Inspection L31167** included on your technical publications CD.

### 10. AIR LINES

Nylon-reinforced tubing and flexible hoses are used to connect the units in the pneumatic system, including air brake system, suspension system and accessory systems such as the entrance door, air horns, etc. Furthermore, the nylon tubing is color coded to ease identification. Refer to the following table for the complete color identification code. Service instructions for each type of air line are also provided under the applicable headings.

Color	Circuit
Green	Primary system, Supply/Delivery
Red	Secondary system
Brown	Parking & emergency brake system, trailer Brake
Blue	Suspension
Black & translucent	Accessories, valve exhaust tube
Yellow	Air compressor unload

### 10.1 FLEXIBLE HOSES

A flexible hose is used normally where it is impractical to use copper or nylon tubing due to constant flexing during operation, such as brake chamber hoses or belt tensioner air cylinder hoses. Hose connections should be tested for leakage at least every 6,250 miles (10 000 km) or twice a year, whichever comes first and tightened or replaced if necessary. Any hose, which is chafed, worn or kinked, should be replaced.

Teflon-braided stainless steel hoses used in the engine compartment must be replaced only with similar hoses.

## 10.2 NYLON TUBING

Nylon tubing is used for air lines in areas where usage of this material is suitable. Nylon tubing is flexible, durable, and weather resistant. When replacing an air line, use nylon tubing only where it has been used previously.

Nylon air lines must never be routed in areas where temperature could exceed 200°F (93°C).



### CAUTION

Nylon air lines should be used to replace existing nylon lines only, and must comply with the color identification code to ease pneumatic system troubleshooting.

## 10.3 AIR LINE OPERATING TEST

If any trouble symptom such as slow brake application or slow brake release indicates a restricted or clogged air line, disconnect the suspected tube or hose at both ends and blow through it to clear the passage.

Inspect tubing and hose for partial restriction that may be caused by dents or kinks. If such a condition is found, the tubing or hose should be replaced.

## 10.4 AIR LINE LEAKAGE TEST

With air system fully charged and the brakes applied, coat all tubing and hose connections with a soapy solution to check for air leakage. No leakage is permitted. Leakage can sometimes be corrected by tightening the connection. If this fails to correct the leakage, new fittings, nylon tubing, copper tubing, Teflon-braided stainless steel and flexible hoses must be installed as applicable.

## 10.5 MAINTENANCE

Inspect all lines for cuts, swelling, kinks or other damage or deterioration. Check for lines being

pinched by other components. Retaining clips and ties must be in place.

Any support or bracket should be in good condition and mounted firmly in position. Hose spring guards should be in usable condition and not distorted. Particular attention should be given to long lines. Any supporting component (clips, ties, grommets, etc.) must be secured to prevent against unnecessary vibration and eventual loosening of connection. Any detected leak should be repaired. Be sure nylon lines are not near areas of intense heat. Check for any missing grommets or loose material where chafing or cutting may occur. Replace with new material as required. In general, lines should be securely located in position and free from any binding condition, which would hinder air flow.

## 11. PRESSURE REGULATING VALVES

There is one pressure regulator (Figure 15) for small A/C compressor and accessories alternator drive belt tensioner, and an optional one installed on vehicles equipped with the world transmission output retarder.

The belt tensioner pressure regulating valve is located in the engine compartment above the engine air filter and is used to limit the air pressure in belt tensioners to  $30 \pm 3$  psi ( $207 \pm 20$  kPa) for vehicles equipped with a single belt and  $45 \pm 3$  psi ( $310 \pm 20$  kPa) for vehicles with dual belts arrangement.

The optional regulator is located in the engine compartment, on the engine cradle R.H. side (accessible through the engine R.H. side door). It is used for transmission retarder and should be adjusted to  $80 +0/-5$  psi ( $552 +0/-35$  kPa).

	Air Pressure (psi)	Air Pressure (kPa)
Belt Tensioner	$30 \pm 3$ (Single belt)	$207 \pm 20$
	$45 \pm 3$ (Dual belts)	$310 \pm 20$
Retarder	$80+0/-5$	$552 +0/-35$

## 11.1 MAINTENANCE

Every 100,000 miles (160 000 km) or once every two years, whichever comes first, disassemble the pressure regulating valve and wash all metal parts in a cleaning solvent (Figure 15). Examine the diaphragm; if cracked, worn or damaged, replace with a new one. If the valve is excessively grooved or pitted, it should be replaced. Replace any other part that appears worn or damaged. After reassembly, adjust to the specified pressure setting and check for air leakage.

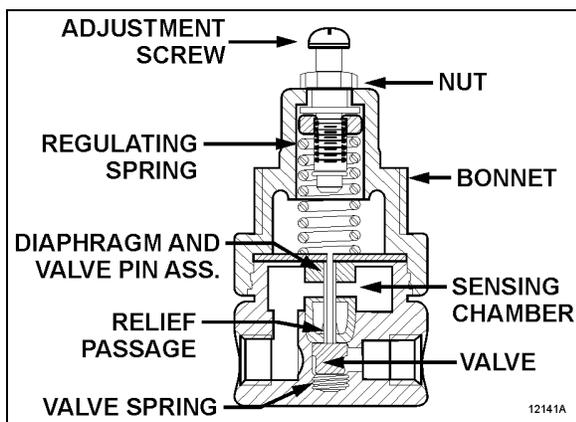


FIGURE 15: AIR PRESSURE REGULATING VALVE

## 11.1.1 Pressure Setting Procedure

Remove the dust cap from the pressure check port (Figure 16). Attach a pressure gauge at this port and check the pressure reading. If the pressure reading is incorrect, adjust as follows:

12. Loosen the locking nut; turn the adjustment screw counterclockwise to decrease pressure by approximately 10 psi (70 kPa) below the required pressure.
13. Turn the adjustment screw clockwise to increase the pressure slowly until the required pressure setting is reached. Tighten the locking nut.
14. Remove pressure gauge and replace dust cap on the pressure check port.

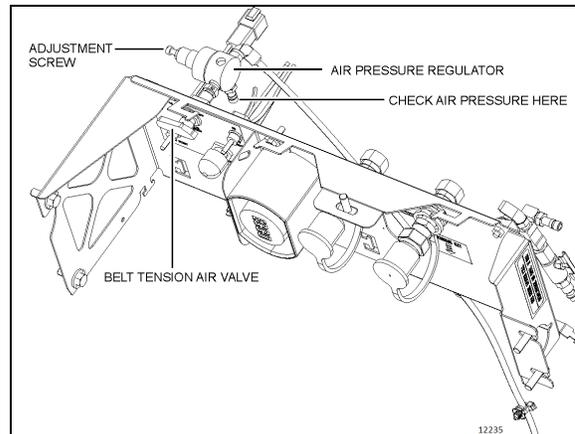


FIGURE 16: AIR PRESSURE REGULATOR (H-SERIES)

## 12. AIR COMPRESSOR

The Wabco System Saver 636 Twin Cylinder air compressor is located on the right side of the engine, at the flywheel end (Figure 17). Its function is to provide and maintain air under pressure to operate devices in brake and air systems.

The compressor is driven by the ring gear, and is water cooled. Engine coolant is fed to the compressor through a flexible hose tapped into the block water jacket and connected to the rear of the compressor. Coolant returns from the top of the compressor (governor side) through a flexible hose to the engine pump.

The air is taken from the air intake manifold and entered in the top of the compressor. The compressed air is pushed into the discharge line located on side of the compressor, which sends air to the air dryer. Lubricating oil is supplied to the compressor by a line from the cylinder block oil gallery connected to the air compressor. Lubricating oil returns to the engine crankcase through the air compressor drive assembly.

Maintenance and repair information on the Wabco 636 Twin Cylinder air compressor is supplied in the applicable booklet, found on your Technical Publications USB flash drive.

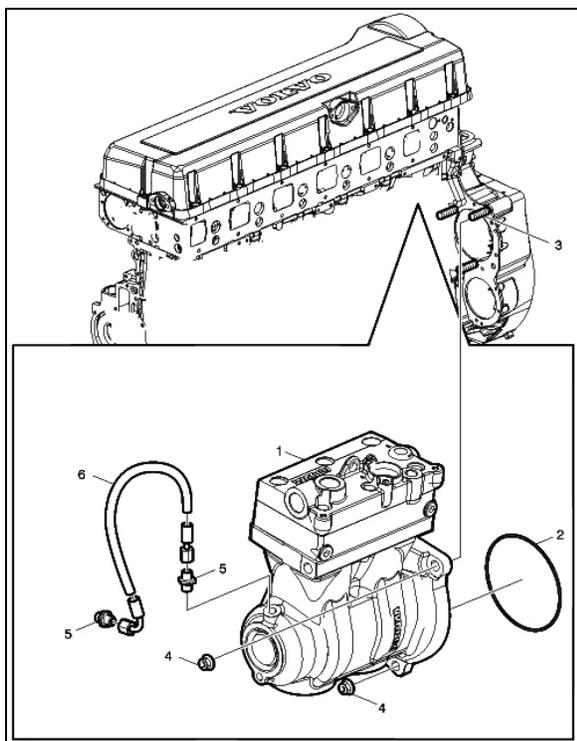


FIGURE 17: AIR COMPRESSOR LOCATION

Item	Description	Notes
1	Air Compressor	Wabco 636
2	O-ring	
3	Stud (3)	M12
4	Flange Nut (3)	
5	Nipple (2)	
6	Hose Assembly	

### 12.1 CARBON DEPOSIT AND OIL CONSUMPTION TEST

Some carbon deposits are normal. This is caused by a small amount of oil passing the piston rings. If heavy carbon deposits are suspected, perform the Oil Consumption Test Paper Method as explained in *Wabco Test Instructions for Compressors\_91200095\_en* available on the Prevost technical Publications site.

If the Oil Consumption Test fails, do the following.

- Make sure there is no restriction on the air inlet to the compressor, that the hose is not kinked, creating a vacuum that would

cause the compressor to pull oil past the rings.

- Make sure the air inlet line is not sucking in unfiltered air. That would cause premature wear to the compressor.

After performing the Oil Consumption Test, if excessive oil is found, the compressor will need to be replaced.

CONDITION	POSSIBLE CORRECTION
Carbon deposits in the compressor. <i>Leakage of air gives the compressor an increased thermal load.</i> <i>This often results in an increased amount of carbon and oil products in the pneumatic system.</i>	Repair air leaks. When necessary, clean, overhaul or change cylinder head/compressor.
Carbon deposits in compressed air system.	Check compressor air supply. Check the air dryer and the pipes between the air dryer and compressor for carbon deposits. Also check that the air passes through the air dryer. Clean or change components that have carbon deposits.

### 12.2 COMPRESSOR REMOVAL AND INSTALLATION

1. Exhaust compressed air from air system by opening the drain valve of each air tank.
2. Drain the engine cooling system. See Section 5: "Cooling System".
3. Access the compressor by the engine R.H. side compartment. Identify and disconnect all air, coolant and oil lines from the compressor assembly.
4. Remove the three compressor flange mounting nuts.

5. Slide air compressor rearward to disengage the hub from coupling. Remove the air compressor.
6. Remove and retain the oil supply tube that runs between the compressor and the engine.
7. Reverse removal procedure for installation.

13. MISCELLANEOUS VALVES

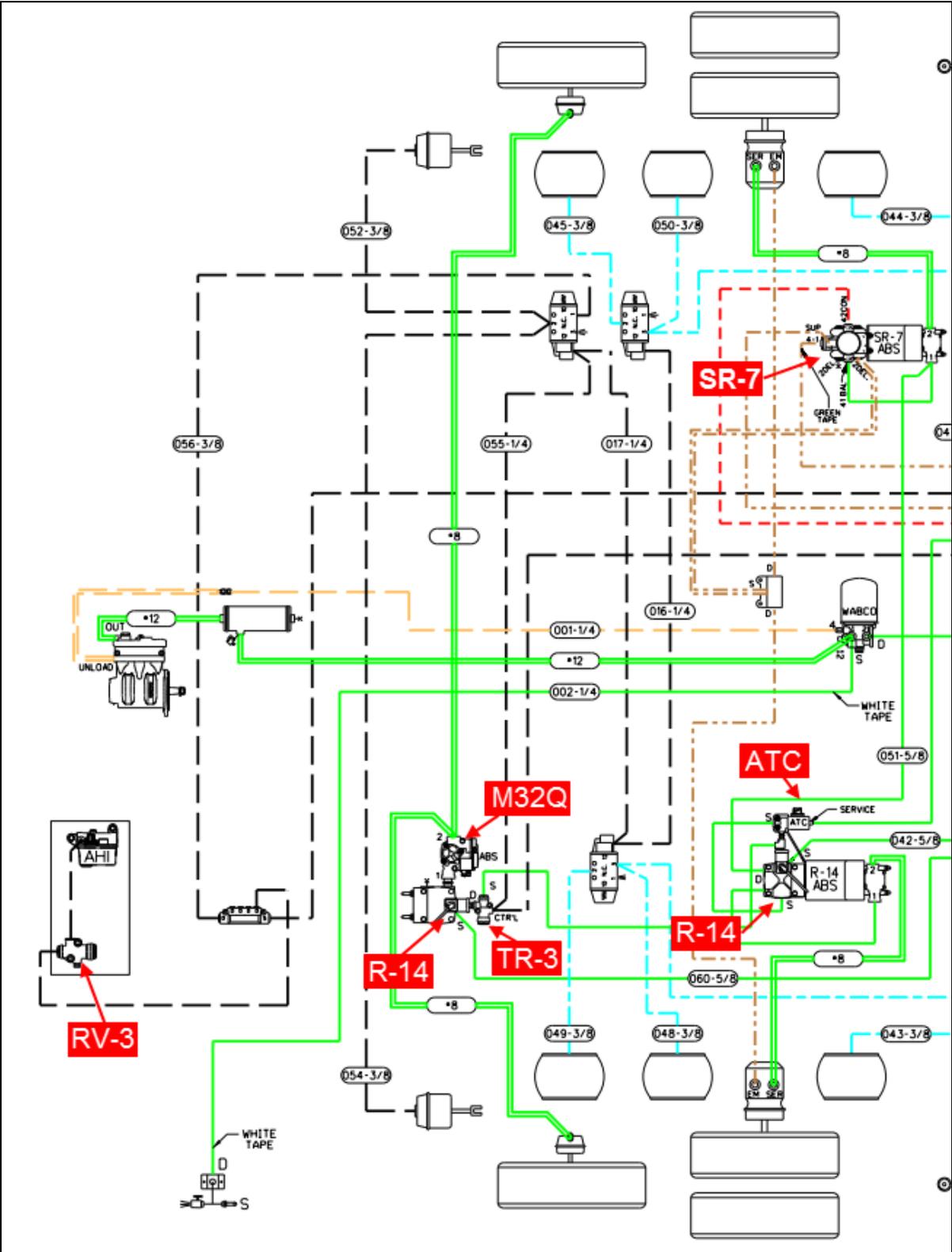


FIGURE 18 : PARTIAL PNEUMATIC DIAGRAM

**SECTION 12: BRAKE AND AIR SYSTEM**

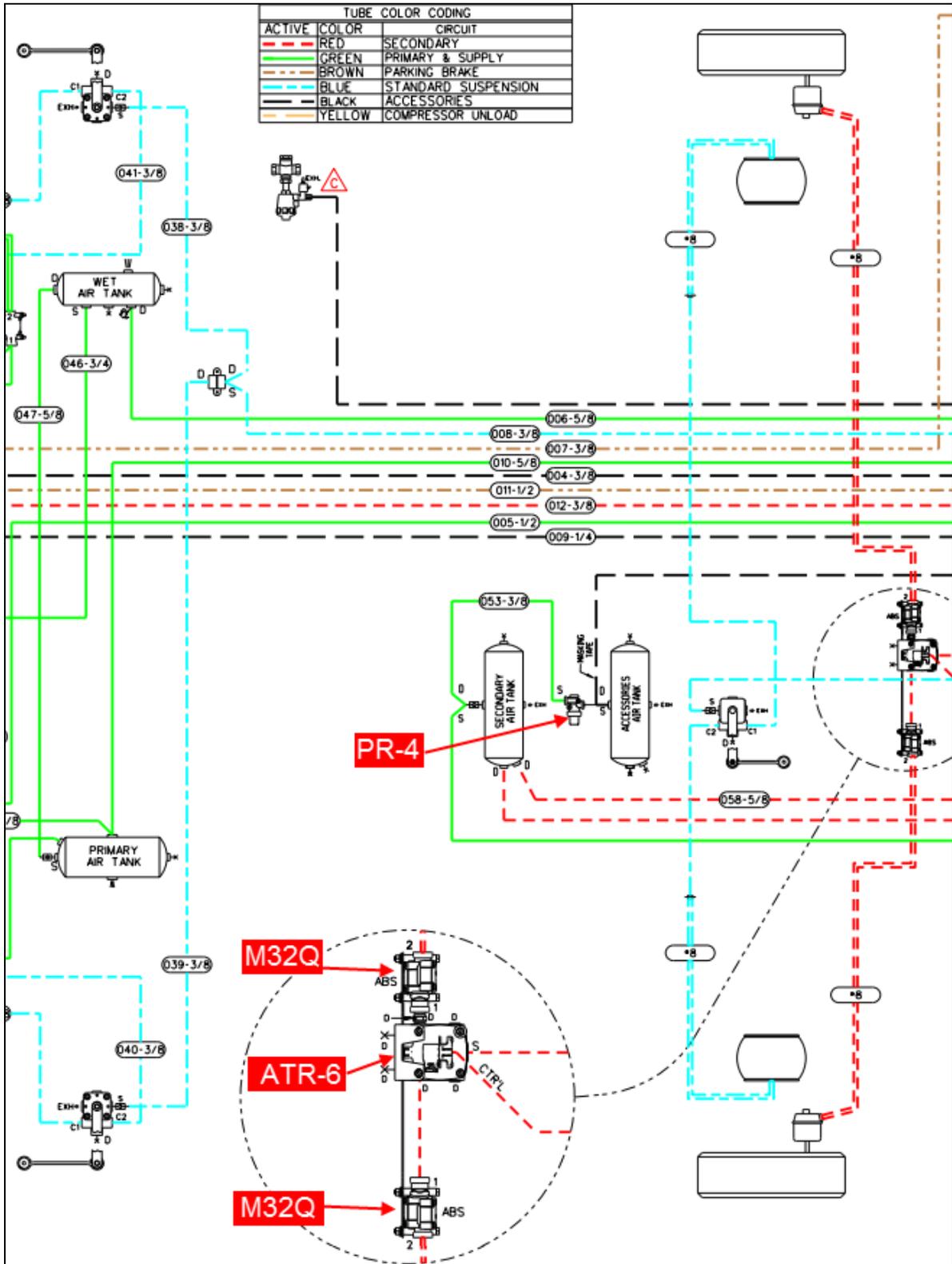


FIGURE 19

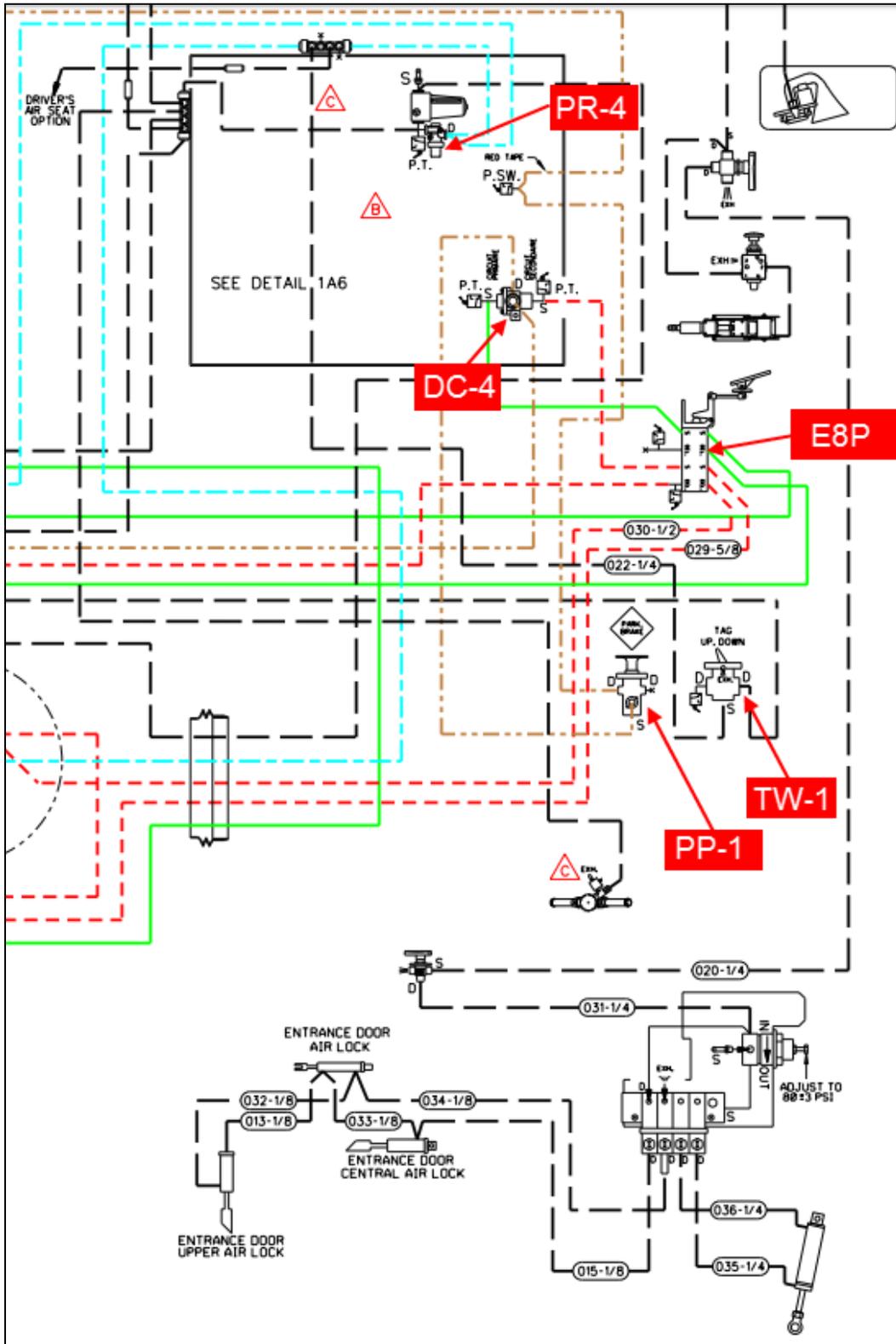


FIGURE 20

## 13.1 EMERGENCY / PARKING BRAKE CONTROL VALVE (PP-1)

A push-pull control valve mounted on the L.H. lateral console is provided for parking brake application or release. The spring brakes are self-actuated whenever the control valve supply pressure drops below 60 psi (414 kPa). In the UP position, brakes are ON. In the DOWN position, brakes are RELEASED. A protective case around the knob prevents accidentally releasing the brakes.

Maintenance and repair information on this valve is supplied in the applicable booklet, found on your Technical Publications USB flash drive, under reference number **Bendix SD-03-3611**.



PP-1®

## 13.2 OPTIONAL EMERGENCY / PARKING BRAKE OVERRULE CONTROL VALVE (RD-3)

A RD-3 control valve is used when the vehicle is equipped with the optional parking brake overrule system. In the case of self-application of spring brakes due to a pressure drop, the brakes can be released by holding down this control valve.

Maintenance and repair information on this valve is supplied in the applicable booklet, found on your Technical Publications USB flash drive, under reference number **Bendix SD-03-3611**.

BENDIX® RD-3™  
VALVE

## 13.3 FLIP-FLOP CONTROL VALVE (TW-1)

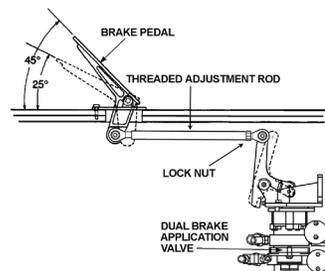
A flip-flop control valve mounted on the L.H. lateral console is provided to unload and lift tag axle air springs. Another one controls the low-buoy system (coaches only). It is a manually operated "on-off" valve.

Maintenance and repair information on this valve is supplied in the applicable booklet, found on your Technical Publications USB flash drive, under reference number **Bendix SD-03-3602**.



### 13.4 DUAL BRAKE APPLICATION VALVE (E-8P)

The E-8P dual brake valve is a floor mounted, foot-operated type brake valve with two separate supply and delivery circuits. This valve is located in the front service compartment.



#### 13.4.1 Brake Pedal Adjustment

After brake pedal replacement or repair, adjust the pedal to its proper position according to the following procedure:

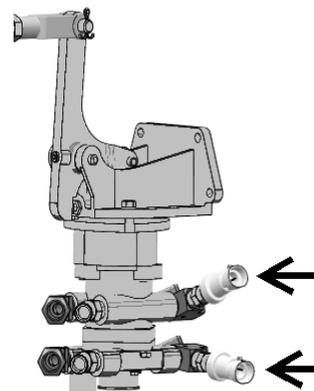
1. Replace the linkage, loosen threaded rod lock nut and screw or unscrew the threaded adjustment rod in order to obtain a 45° brake pedal inclination.
2. Tighten threaded rod lock nut.

#### 13.4.2 Maintenance

Maintenance and repair information on the E-8P dual brake application valve is supplied in the applicable booklet, found on your Technical Publications USB flash drive, under reference number **Bendix SD-03-830**.

### 13.5 STOPLIGHT SWITCHES

Two Electro-pneumatic stoplight switches are mounted on the dual brake application valve (E-8P). The upper one is used for the primary air circuit while the lower one is used for the secondary air circuit. Both switches are connected in parallel and have the same purpose, i.e. completing the electrical circuit and lighting the stoplights when a brake application is made.



### 13.6 PARKING BRAKE ALARM SWITCH

Refer to the appropriate booklet (Bendix, SL-5 Stop Light Switch; reference no. SD-06-1804), found on your Technical Publications USB flash drive.

The parking brake alarm uses the same switch as the stoplights. It is mounted on the spring brake valve and operates in conjunction with a NC relay to sound a warning alarm by completing the electrical circuit when the ignition key is turned OFF with parking brake released.

## 13.7 BRAKE RELAY VALVE (R-14)

The primary air system includes two brake relay valves being supplied by the dual brake valve, and which function is to speed up the application and release of the service brakes.

One R-14 valve located above the drive axle supplies the drive axle service brake air line, while the other R-14 valve supply the tag axle service brake air line and act as interlock valves. These valves are accessible from under the vehicle at the level of the tag axle.

Maintenance and repair information on these valves is supplied in the applicable booklet, found on your Technical Publications USB flash drive, under reference number **Bendix SD-03-1064**.



## 13.8 ANTILOCK TRACTION RELAY VALVE (ATR-6)

The ATR-6 Antilock Traction Relay valve is a service relay valve fitted with a modified cover containing a control solenoid. It contains both air and electric components to provide the service braking and traction control (differential braking) as well as ESC advanced stability system ABS functions. It is located above the front axle.

Maintenance and repair information on these valves is supplied in the applicable booklet, found on your Technical Publications USB flash drive, under reference number **Bendix SD-13-4861**.

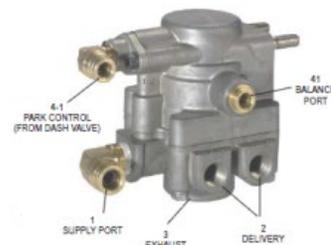


## 13.9 SPRING BRAKE VALVE (SR-7)

The spring brake valve is located above the drive axle. The SR-7 Modulating Valve is used in conjunction with a dual air brake system and spring brake actuator and performs the following functions:

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

Maintenance and repair information on the spring brake valve is supplied in the applicable booklet, found on your Technical Publications USB flash drive, under reference number **Bendix SD-03-9043**.



### 13.10 PRESSURE PROTECTION VALVE (PR-4)

Maintenance and repair information on the pressure protection valve is supplied in the applicable booklet, found on your Technical Publications USB flash drive, under reference number **Bendix SD-03-2010**.

The air system includes two pressure protection valves. One valve is installed on the manifold block, and insures at all times a minimum pressure of 70 psi (482 kPa) in the suspension air system in the event that a pressure drop occurs in either the suspension air system or accessory air system. This valve is located in the front service compartment beside the air filter.

The other valve is installed on the accessory air tank, and insures a minimum pressure of 70 psi (482 kPa) in the accessory air system in the event that a pressure drop occurs in either the suspension air system or braking air system (refer to Figure 2 and Figure 3 for accessory air tank location).



PR-2™ PRESSURE PROTECTION VALVE

### 13.11 SHUTTLE-TYPE DOUBLE CHECK VALVE (DC-4)

Maintenance and repair information on the shuttle-type double check valve is supplied in the applicable booklet, found on your Technical Publications USB flash drive, under reference number **Bendix SD-03-2202**.

The double check valve is located on the pneumatic accessories panel in the front service compartment. In the event of a pressure drop in either the primary or secondary system, this unit will protect the emergency /parking brake control valve and the intact portion of the air system from pressure loss.



### 13.12 PRESSURE REDUCING VALVE RV-3

The Bendix RV-3 pressure reducing valve is a normally open pressure control device. The function of the RV-3 valve is to reduce system air pressure and maintain a constant specified pre-set pressure below that of system pressure. A pressure reducing valve is installed upstream of the AHI module (Aftertreatment hydrocarbon injector).

Maintenance and repair information on the pressure reducing valve is supplied in the applicable booklet, found on your Technical Publications USB flash drive, under reference number **Bendix SD-03-3515**.



## 13.13 ANTILOCK MODULATOR (M-32QR)

The M-32QR (quick release) antilock system modulator is high capacity, on/off air valve that incorporate a pair of electrical solenoids for control. The solenoids provide the electro-pneumatic interface between the antilock controller electronics and the air brake system. The modulator is used to control the braking function on individual or dual service actuators during antilock activity.

Maintenance and repair information on the antilock modulator valve is supplied in the applicable booklet, found on your Technical Publications USB flash drive, under reference number **Bendix SD-13-4870**.



## 13.14 INVERSION VALVE (TR-2, TR-3)

The TR-2 & TR-3 valves are normally open, pilot-operated, inverting, on-off, two-way valves. As control pressure is reduced to the point that the piston return spring or springs overcomes the force on the control piston, the valve will deliver full supply pressure at the delivery port.

Maintenance and repair information on the antilock modulator valve is supplied in the applicable booklet, found on your Technical Publications USB flash drive, under reference number **Bendix SD-13-4650**.



## 13.15 INLINE QUICK RELEASE VALVE (QR-L)

The QR-L quick release valve is a quick release valve. Its purpose is to “speed up” the release of air from air lines and devices it is attached to. Although primarily intended to enhance air system performance by rapidly exhausting supply or control air pressure from vehicle air lines, it can be used in a variety of different applications. It is uniquely suitable as an air system performance enhancement due to its 0 psi crack and differential pressure. Supply and delivery pressure is the same throughout the air pressure range.

Maintenance and repair information on the inline quick release valve is supplied in the applicable booklet, found on your Technical Publications USB flash drive, under reference number **Bendix SD-03-906**.



## 14. EMERGENCY DOOR OPENING VALVES

Two emergency door opening three-way valves are installed on passenger coaches. One is in the front service compartment, readily accessible. The other one is on the R.H. side lateral console, close to the entrance door. When used, the valve releases pressure in the door locking cylinder, thus allowing the door to be manually opened.

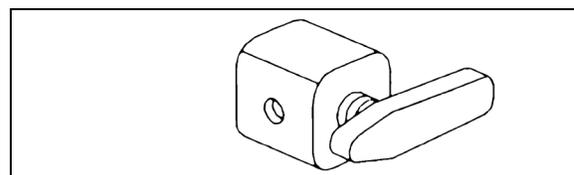


FIGURE 21: THREE WAY VALVE 12186

## 14.1.1 Interior Valve Maintenance

When needed, this valve can be changed according to the following procedure:

1. Unscrew the front R.H. decorative panel in order to access the valve.
2. Unscrew and remove the valve handle.
3. Unscrew and remove the valve retaining ring.
4. Push the valve inside the console.
5. Disconnect the air tubes.
6. Reverse the procedure to install a new valve.

### 15. AIR HORN VALVE

The air horn solenoid valve is located in the front service compartment. The air horn activating button is on the center of the steering wheel. Refer to section 23 "ACCESSORIES" for more information.

### 16. AIR SYSTEM TROUBLESHOOTING

The following list has been designed to help in troubleshooting some of the most common problems in the air system and main causes. For air brakes troubleshooting, refer to "*Air Brakes Troubleshooting*" in this section. For more troubleshooting information, refer to the manufacturer's brochures, found on your Technical Publications USB flash drive.

#### **Air pressure doesn't rise to or doesn't maintain a normal setting:**

- Defective air gauge (registering incorrectly).
- Excessive leaking in air system.
- Reservoir drain cock open.
- Governor poorly adjusted or defective.
- Defective compressor.
- Worn compressor or excessive wear on piston and/or ring.

#### **Air pressure rises to normal setting too slowly:**

- Excessive leaking in air system.
- Clogged engine air cleaner.
- Faulty pressure sensor.
- Worn compressor or excessive wear on piston and/or ring.

- Engine speed too low.

#### **Air pressure rises above a normal setting:**

- Defective air gauge (registering incorrectly).
- Faulty sensor.
- Restriction in line between governor and compressor unloading mechanism.
- Air filter/dryer built-in governor poorly adjusted or defective.

#### **Air pressure drops quickly when engine is stopped:**

- Leaks in compressor discharge valve.
- Leaks in air lines.
- Leaks in air system valves.

### 17. BRAKE OPERATION

The vehicle braking system uses both service and parking air-operated brakes. The air system is divided into two independent circuits to isolate the front axle brakes and the rear axle brakes (drive and tag), thus providing safe brake operation in the event that one circuit of the system fails. The primary circuit is connected to the drive and tag axle brakes, while the secondary circuit is connected to the front axle brakes. The tag axle service brakes operate only when the axle is in the normal driving (loaded) position. The spring-type emergency brakes are mounted on the drive and tag axles, and will apply automatically if primary system pressure falls below 60 psi (413 kPa).

The optional parking brake override system can cancel the parking brakes, enabling the driver to move the vehicle to a safe parking place. On vehicles equipped with this option, operate the system by pushing down and holding the control knob located on the R.H. side of the driver's seat (see "*Operator's Manual*" for more details).

Furthermore, brake application or release, which is sped up by a pneumatic relay valve (R-14), will start with the rear axles and be followed by the front axle, thus providing uniform braking on a slippery surface. The vehicle is also equipped with an Anti-lock Brake System (ABS), detailed later in this section.

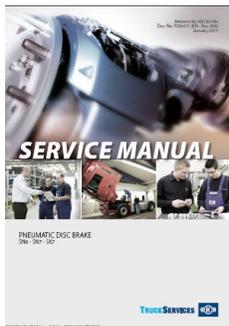
Brake and air system maintenance consists of periodic inspections. Check all parts for damage

and brake adjustment (refer to subsequent headings in this section for more details). Ensure all fasteners are tight (refer to “Torque Tables” for recommended tightening torques).

**18. DISC BRAKES**

*Knorr-Bremse SN7* disc brakes are used on all axles. The front and drive axle discs are actuated by 24 inch<sup>2</sup> effective area air brake chambers (22 inch<sup>2</sup> for front I-Beam axle), while on tag axle, the brake chambers have a 14 inch<sup>2</sup> effective area for service brake and a 16 inch<sup>2</sup> effective area for emergency/parking brakes. The *Knorr-Bremse SN7* brakes are supplied with automatic clearance adjusters as standard equipment for easier adjustment.

For detailed maintenance procedures, refer to ***Knorr-Bremse Pneumatic Disc Brake Y006471 Service Manual*** included on the Technical Publications USB flash drive and also available on Prevest Technical Publications site.



**18.1 INSPECTION POINTS**

The following inspection points will ensure long-life and trouble-free operation of the disc brake.

### MAINTENANCE

Check brake pad & disc wear visually (this is independent of any electronic wear indicator fitted to the vehicle) at the intervals specified by the Lubrication and Servicing Schedule in Section 24: LUBRICATION & SERVICING.

### MAINTENANCE

**With every pad replacement or once a year whichever comes first:**

1. Check correct functioning of the adjuster (see 18.2.6).
2. Check that caliper operates smoothly over its full range of movement (see 18.2.6).
3. Check the adjuster cap for correct fitting and condition (item 37).
4. Check the sealing elements for correct fitting and condition (items 9, 58) (see 18.2.10 Caliper Guide Pin Seals & 18.2.11 Tappet & Boot Assemblies).
5. Check the caliper bearing in the area of the rubber bush/guide sleeve (item 6) (see 18.2.8 step 2).
6. Check the caliper running clearance (see 18.2.7).
7. Check fitting and condition of the cover (item 10) and cover (item 68, bearing variants may exist).

### MAINTENANCE

Moisture and dirt is the enemy. Special care should be awarded to the condition of the various sealing elements, boots and caps to prevent any moisture or dirt intrusion in the caliper. Any missing or damaged sealing element, boot or cap should be replaced immediately.

At each pad replacement, make sure the caliper operates smoothly over its full range of movement. If the caliper shows the following signs, replacement of the rubber bush/guide sleeve (item 6, Figure 22), guide pin (items 4 & 5 Figure 23, screw (items 39 & 40) and cap (items 10 & 68) is required.

- excessive or abnormal play
- movement along guide pins is hard or impossible (due to corrosion or dirt)
- A missing guide pin cap

If an individual wheel has heated abnormally, please refer to Bendix *BW7514\_Single wheel end thermal overload checklist*. This checklist

will help you through standard verifications required by the brake manufacturer before filing a warranty claim.

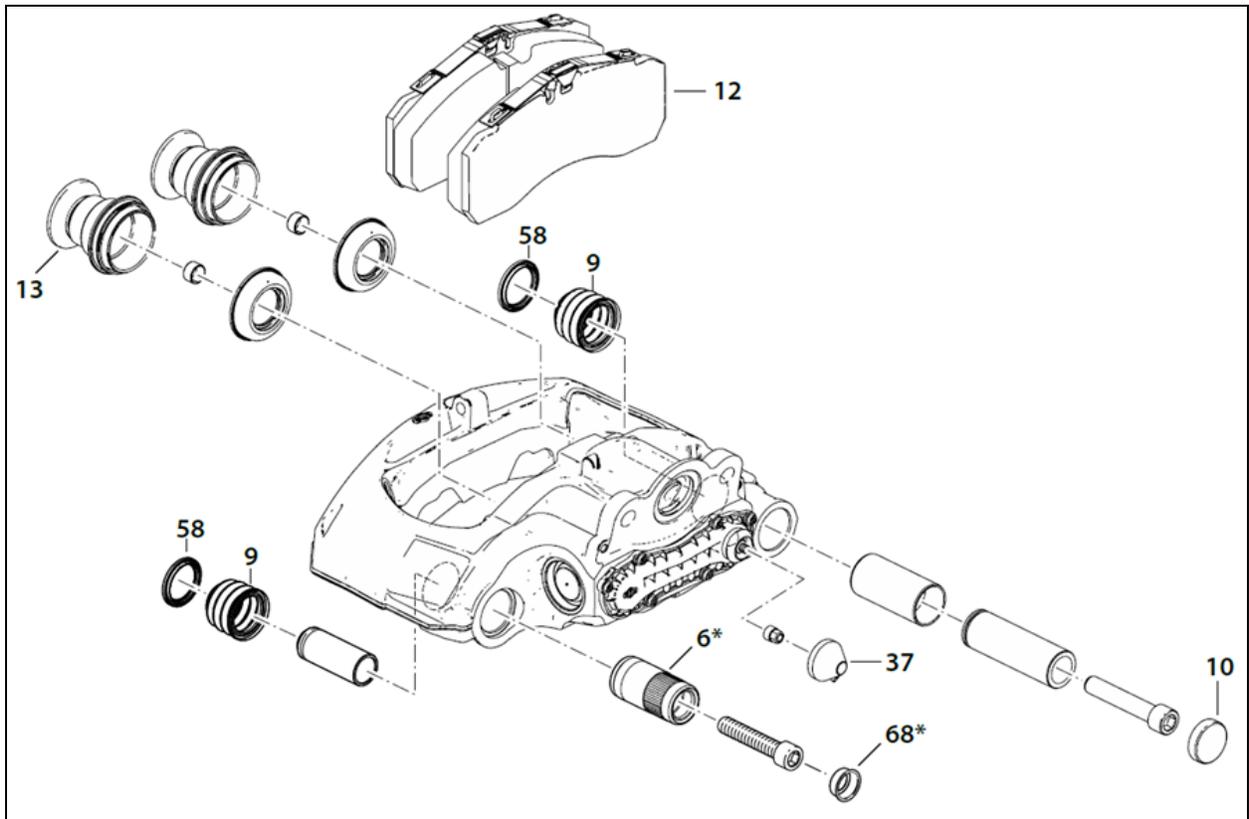


FIGURE 22: INSPECTION POINTS IDENTIFICATION

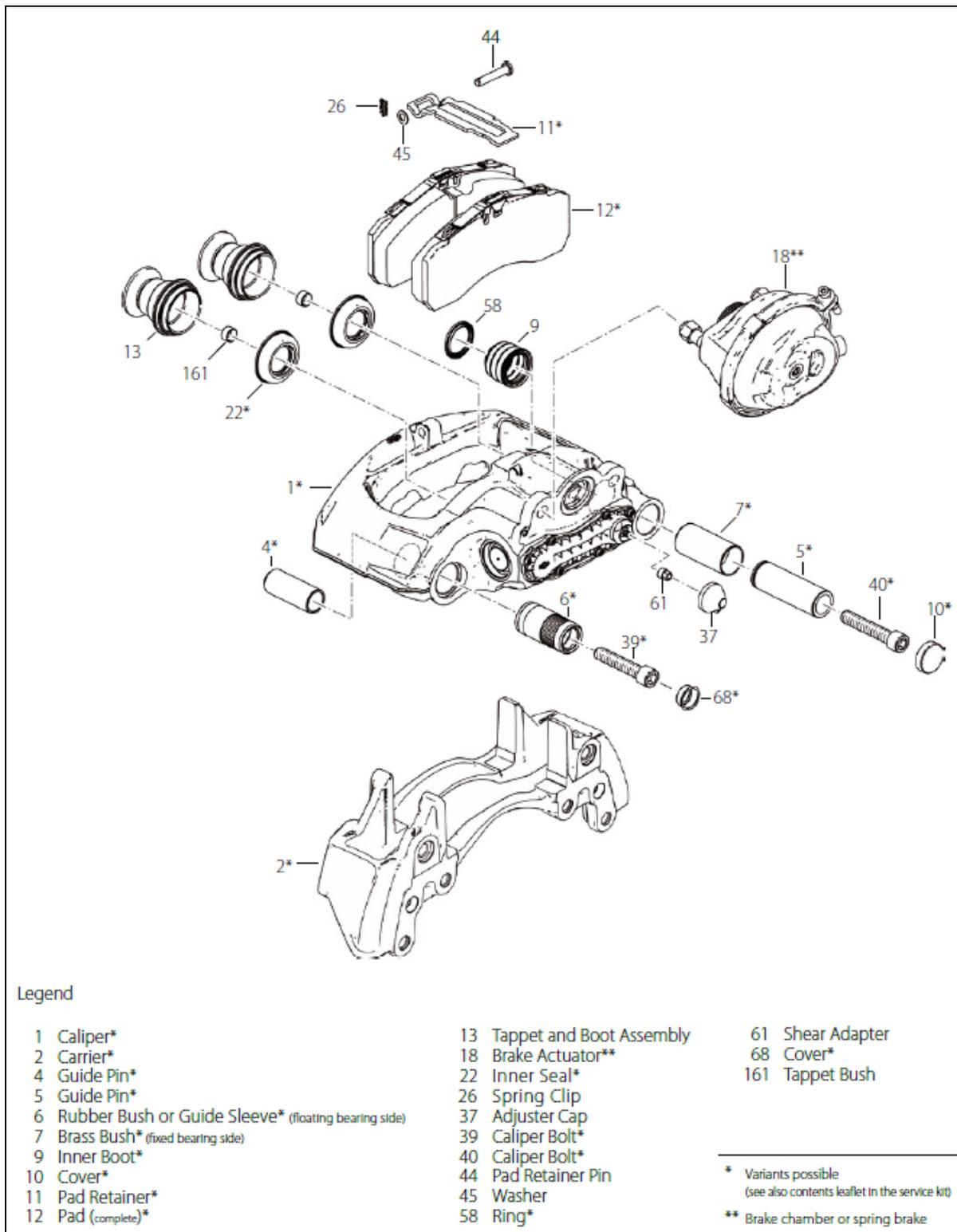
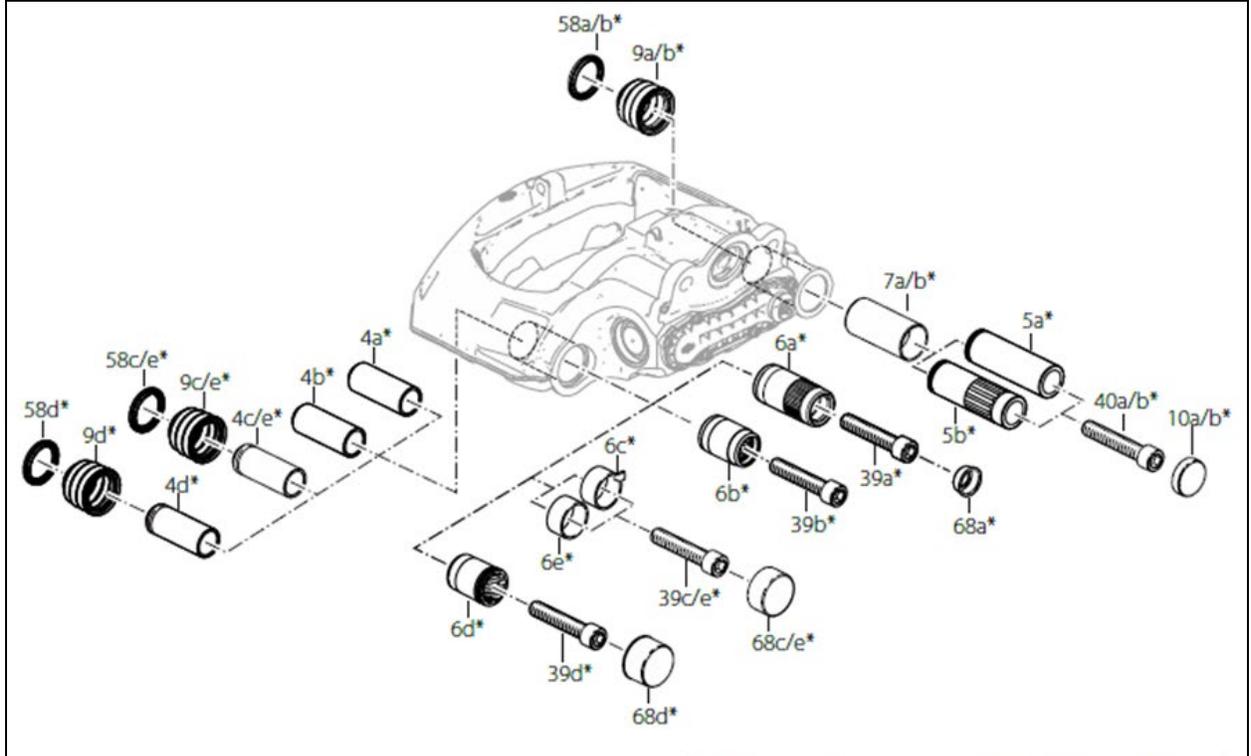


FIGURE 23: DISC BRAKE COMPONENTS



\* Variants possible (see also contents leaflet in the service kit)

Floating Bearing (6) variants:



FIGURE 24: IDENTIFICATION OF GUIDE & SEAL VARIANTS

## 18.2 FUNCTIONAL AND VISUAL CHECK

## 18.2.1 Wear Check of Pads

The thickness of the pads must be checked regularly dependent on the usage of the vehicle. The pads should be checked corresponding to any legal requirements that may apply. Even if a wear indicator is fitted and connected, this must be at least every 3 months.

Brake pads have to be checked on a regular basis depending on the vehicle operation. The remaining thickness of the pads should never be less than 0.079 in (2 mm). When replacing brake pads, all four pads on an axle have to be changed at the same time. There is no inner or outer pad, since all pads are the same. Once removed, worn pads should be replaced in their original position.

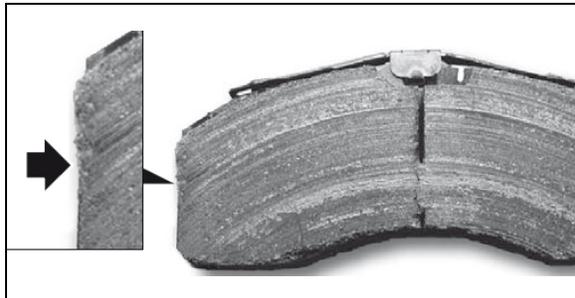


FIGURE 25: MINOR BREAKOUTS AT THE EDGES ARE PERMITTED (SEE ARROW)



FIGURE 26: MAJOR BREAKOUTS ON THE SURFACE OF THE BRAKE PAD ARE NOT PERMITTED

If the thickness of the friction material at its thinnest point is less than 0.079 inch or 2 mm (measurement C), the pads must be replaced.

- A= Overall thickness of new brake pad: 1.181 in (30 mm)
- B= Backplate SN7 type: 0.354 in (9 mm)
- C= Minimal thickness of friction material: 0.079 in (2 mm)
- D= Minimum allowed thickness in worn condition for backplate and friction material: 0.433 in (11 mm)

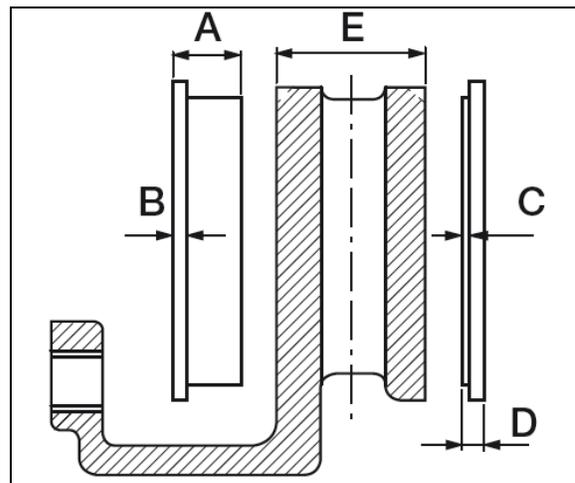


FIGURE 27: BRAKE PADS DIMENSIONS

### Exaggerated wear difference between inner and outer brake pads

The total thickness of the friction material of the inner and outer pad should be equal. If the difference between the two pads is greater than 3.5 mm, then the following checks are necessary:

- Bearing clearance check (see 18.2.7 & 18.2.8).
- Free movement of the brake pads in the caliper (see 18.2.6).
- Possible collision with other parts on the axle or vehicle body.
- Excessive dirt and grime present.
- Piping of the compressed air line

Example 1)

E=0.748 in (19 mm)

F=0.590 in (15 mm) > NOT OK

Example 2)

$E=0.453$  in (11.5 mm)

$F=0.512$  in (13 mm) > OK

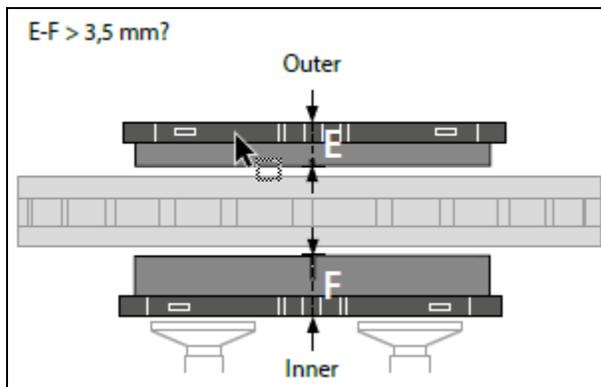


FIGURE 28: EXAGGERATED WEAR DIFFERENCE BETWEEN INNER AND OUTER BRAKE PADS

### Exaggerated tangential oblique wear of brake pads

The total thickness of the friction material at either end of the pad should be equal. If the difference between the two ends is greater than 2 mm, then the following checks are necessary:

- Bearing clearance check (see 18.2.7 to 18.2.9).
- Free movement of the brake pads in the caliper (see 18.2.6).
- Possible collision with other parts on the axle or vehicle body.
- Excessive dirt and grime present.
- Piping of the compressed air line. In addition, the piping must be replaced.

Example 1)

$G=21$  mm

$H=18$  mm > NOT OK

Example 2)

$G=18$  mm

$H=19$  mm > OK

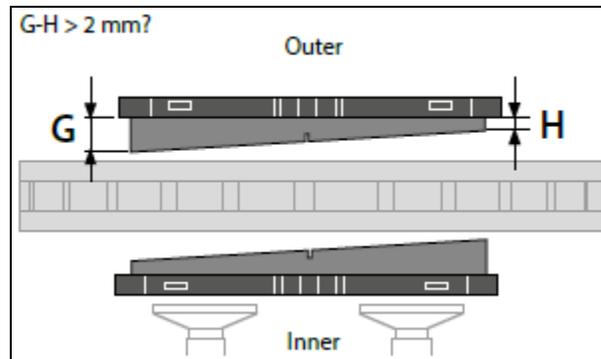


FIGURE 29: EXAGGERATED TANGENTIAL OBLIQUE WEAR OF BRAKE PADS

### Exaggerated taper wear of brake pads

The total thickness of the friction material in the radial direction should be equal. If the difference between the top and bottom ends is greater than 1 mm, then the following checks are necessary:

- Bearing clearance check ((see 18.2.7 to 18.2.9).
- Free movement of the brake pads in the caliper (see 18.2.6).
- Possible collision with other parts on the axle or vehicle body.
- Excessive dirt and grime present.

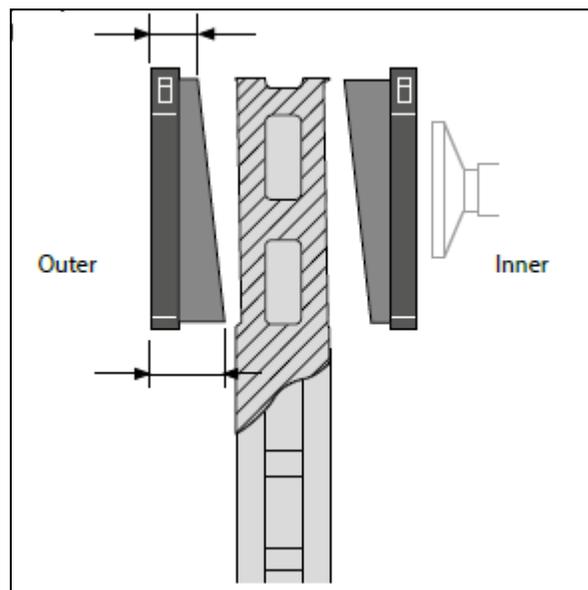


FIGURE 30: BRAKE PAD WITH EXAGGERATED TAPER WEAR

## 18.2.2 Wear Check of Disc

Measure the thickness of the brake disc at the thinnest point. Be aware of possible burring at the edge of the disc.

M= Total thickness of the brake disc

New condition = 1.77 in (45 mm)

Worn condition = 1.457 in (37 mm) (the disc must be replaced).

If the disc dimension  $M \leq 1.535$  in (39 mm) or  $N \leq 0.039$  in (1 mm), it is recommended that the disc should be renewed when the brake pads are changed.

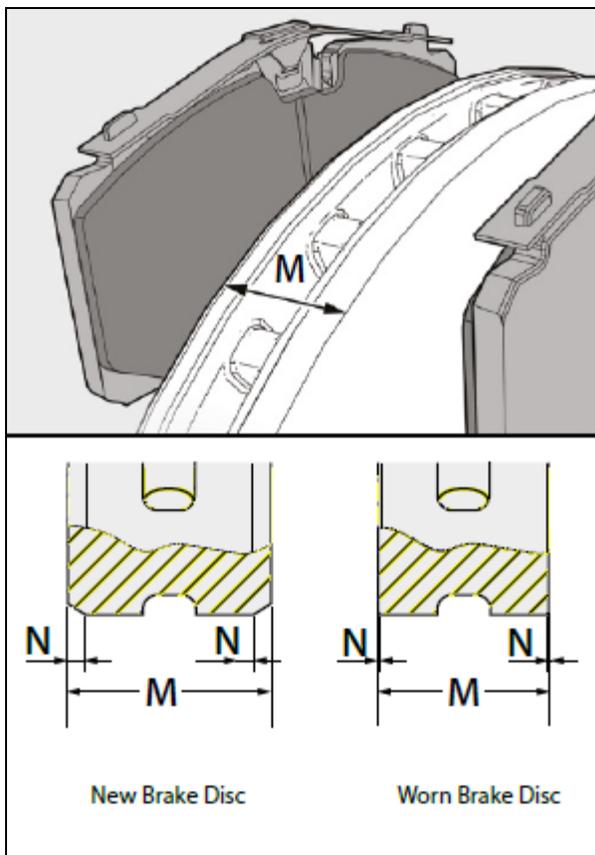


FIGURE 31: BRAKE DISC THICKNESSES AND OPTICAL WEAR INDICATOR

Check the discs per axle at each change of pads for grooves and cracks. If necessary, replace the disc.

The figure shows possible surface conditions of the brake disc.

A1 = Small cracks spread over the surface are allowed.

B1 = Cracks less than 0.059 in (1.5 mm) deep or wide, running in a radial direction are allowed.

Cracks to a max. length of  $0.75 \times 'a'$  are allowed (a = width of the friction ring).

C1 = Unevenness of the disc surface less than 1.5 mm deep is allowed.

D1 = Cracks going through to the cooling duct or onto the inner or to the outer edge of the friction ring are not allowed and the disc **MUST BE REPLACED**.

The photograph shows a real-life example of such cracks and wear grooves.

**Note:**

*In case of surface conditions A1, B1 or C1, the disc can continue to be used until the minimum thickness  $A = 37$  mm is reached.*

Knorr-Bremse discs are normally service-free and grinding when changing pads is not necessary. However, grinding could be useful, e.g. to increase the load-bearing surface of the pads after severe grooving on the entire friction surface has occurred. To meet safety requirements, the minimum thickness after machining must be greater than 39 mm.

In addition, the recommendations of the vehicle manufacturer about the machining of the brake disc **MUST** be followed.

**WARNING**

Grinding of splined disc is not allowed.

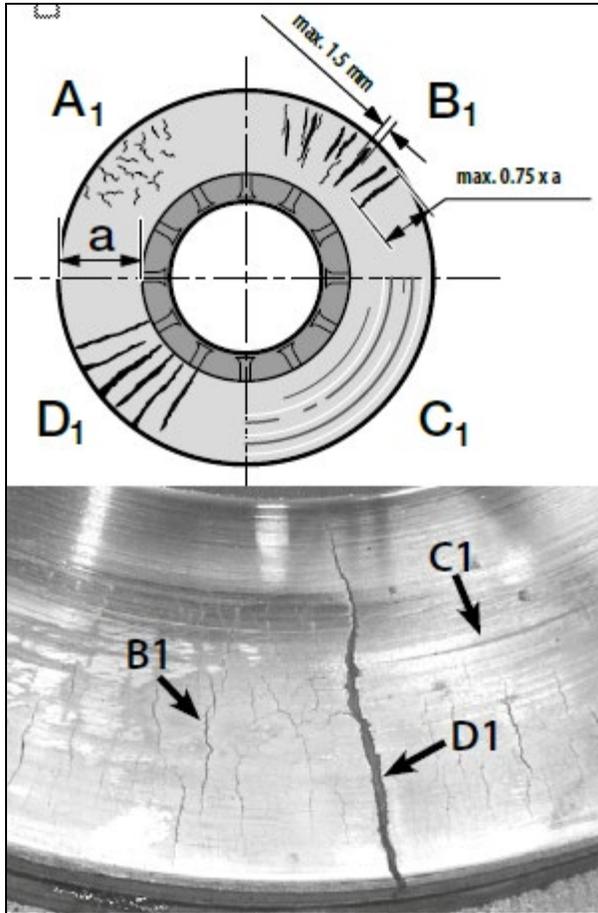
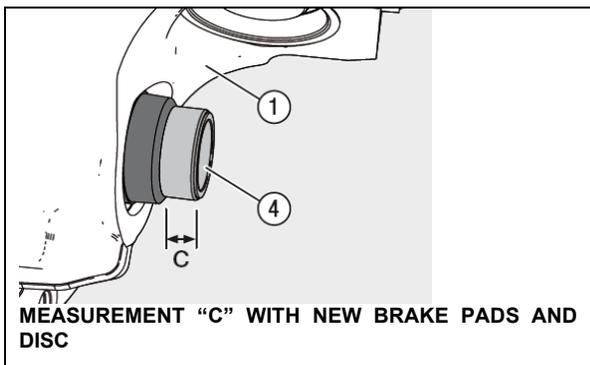


FIGURE 32: TOLERANCES AND EXAMPLES OF CRACKS AND GROOVES

18.2.3 Wear Check of Pads/Disc – Drive Axle Equipped With a Rubber Bushing and Exposed Guide Pin

The pads/disc wear can be visually determined without removing the wheel by checking the position of the caliper (1) compared to the fixed guide pin (4).



MEASUREMENT "C" WITH NEW BRAKE PADS AND DISC

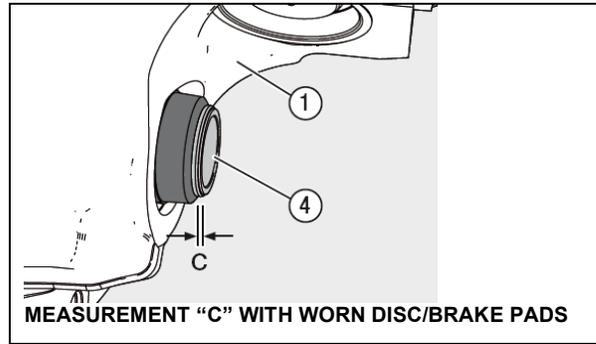


FIGURE 33: BRAKE PAD WEAR CHECK ON THE DRIVE AXLE

If measurement "C" is less than 0.039" (1 mm), this condition requires a check of the brake pad thickness and the brake disc with the wheel removed. If any minimal tolerance limits have been reached, the pads and/or disc must be changed.

18.2.4 Wear Check of Pads/Disc – Front and Tag Axle – Equipped With Visual Wear Indicator

The condition of the pads can be checked without removing the wheel by checking the position of the caliper compared to the tip of the wear indicator or carrier depending on vehicles.

In one variant of the visual wear indicator (Figure 34), if the side of the caliper (flat surface around guide pin cap) lines up with the tip of the wear indicator (i.e. measurement A would be 0.0 in), the brake pad thickness and the brake disc must be checked with the wheel removed. If any minimal tolerance limits have been reached, the pads and/or disc must be changed.

Alternately, brake pad wear can be checked using carrier to caliper position. When points "P" and "R" align the brake pad thickness and brake disc must be checked with the wheels removed (FIGURE 35). If any minimal tolerance limits have been reached, the pads and/or disc must be changed.

Refer to **Knorr-Bremse Pneumatic Disc Brake Y006471 Service**.

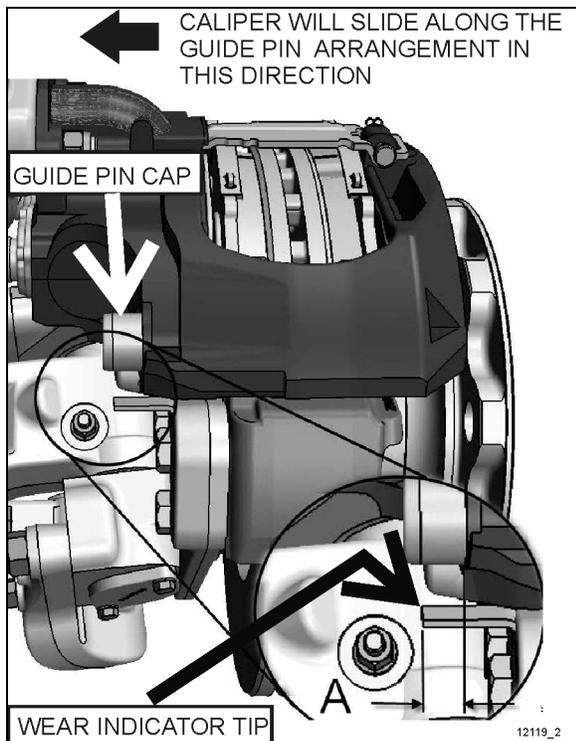


FIGURE 34: BRAKE PAD WEAR CHECK ON THE FRONT AND TAG AXLE 12119

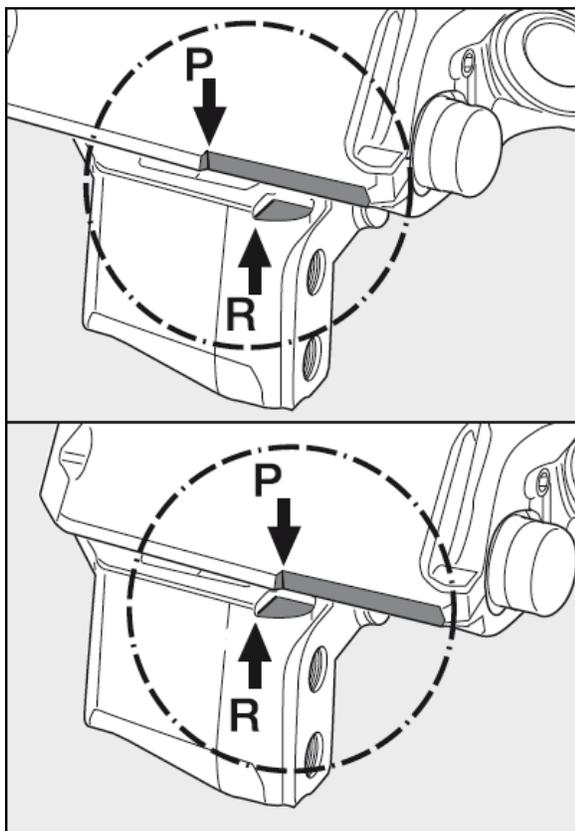


FIGURE 35: PAD WEAR CHECK FRONT AND TAG AXLE

### 18.2.5 Continuous Wear Sensor option

Some vehicles have a potentiometer installed directly on the brake caliper.

Wear percentage can be consulted via the DID. Access the « Brake Lining Remaining » MENU

**Front axle** wear sensors are connected to multiplex module **A44**.

**Right hand** (curbside) wear sensors for both rear axles are connected to **A50**

**Left hand** (road side) wear sensors for both rear axles are connected to **A51**

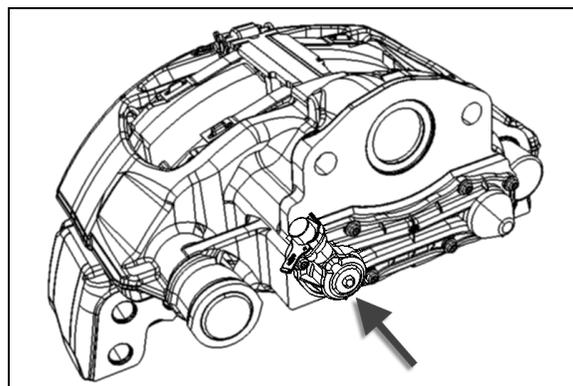


FIGURE 36: POTENTIOMETER

### 18.2.6 Checking Correct Functioning of the Adjuster / Checking That Caliper Operates Smoothly Over Its Full Range of Movement

1. Before starting work, ensure that the wheels are chocked and the vehicle cannot roll away.
2. Ensure that service brake and parking brake are in the released condition.
3. Check the supply pressure of the brake system. Connect an additional external supply to prevent pressure drop.
4. Jack up the axle and remove the wheel.
5. Check the brake disc temperature, it should be between 14°F and 122°F (-10°C and 50°C).

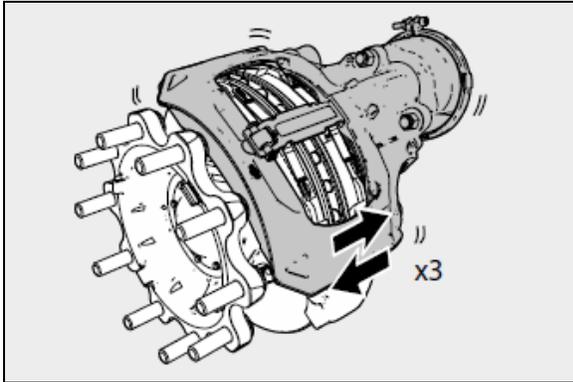


FIGURE 37: PUSH CALIPER THREE TIMES IN AXIAL DIRECTION

6. Push and pull caliper three times in axial direction to assess any existing air gap (see Figure 37). If no movement is possible, clean the disc brake and if necessary, replace the bearings. Once movement is obtained, continue as follows:
7. Pull off the adjuster cap (37) using the tag, taking care not to lose the shear adapter (61) (see Figure 38).

*Removal of the adjuster cap (37) with a screwdriver, or similar, is not allowed since the seal may be damaged.*

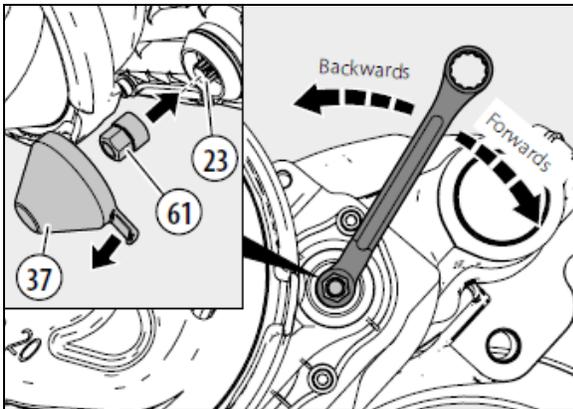


FIGURE 38: REMOVE CAP, INSERT NEW BRAKE PADS, SET THE STARTING GAP

8. Insert new brake pads.
9. Set the starting gap by turning the adjuster (23) with the shear adapter (61) backwards and then forwards (note that when turning backwards a noticeable clicking can be heard and felt), until a value of 0.051 in (1.3 mm) air gap has been achieved (measure between the brake pad and tappets (13)).
10. Apply the brakes 20x with medium pressure.

11. Check the gap between each of the tappets (13) and inboard pad backplate (12). This must be measured over the whole tappet surface of both tappets using two feeler gages simultaneously (feeler gages must be at least 8 ½ in / 220 mm long) (see Figure 39).
12. If the gap difference between the two tappets is > 0.009 in / 0.25 mm **then the caliper bearing clearance must be checked** (see 18.2.7 Caliper check - Caliper Running Clearance & 18.2.8 Caliper check - Caliper Movement Along Guide Pins).
13. In addition, each gap must measure between 0.023 - 0.047 in (0.6 - 1.2 mm).

*If the clearance is too great, there is a danger of brake failure. If the clearance is too small, there is a danger of overheating that may lead to consequential damage.*

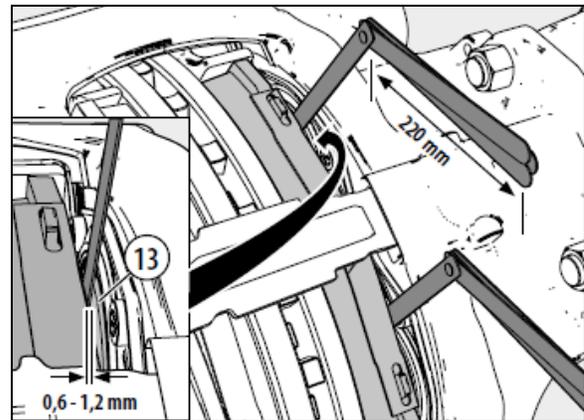
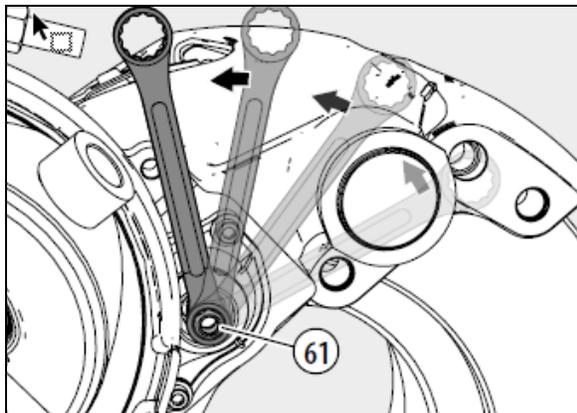


FIGURE 39: CHECK GAP BETWEEN TAPPETS AND INBOARD PAD

**If the air gap is larger than 0.047 in / 1.2 mm, the adjuster must be checked as follows:**

14. Turn the adjuster with adapter (61) **3 clicks** anticlockwise (increasing the air gap) (see Figure 40).

*Make sure the ring spanner or socket can turn freely clockwise during the following procedure.*

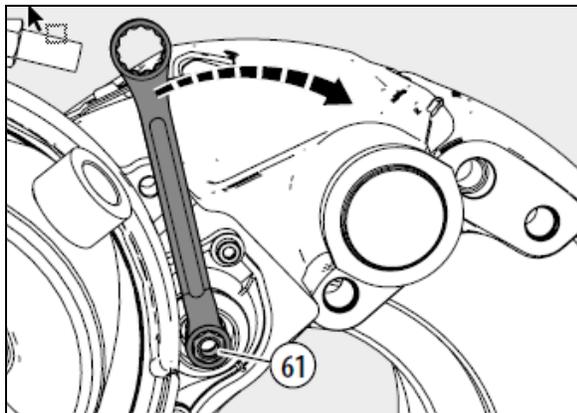


**FIGURE 40: TURN ADAPTER 3 CLICKS ANTICLOCKWISE**

15. As a visual aid, position a ring spanner or socket onto the adjuster (including Adapter (61)) as shown. Apply the brakes 5 to 10 times, the spanner or socket should turn clockwise (viewed from actuator side) in small increments if the adapter is functioning correctly (see Figure 41 and note below).

*Note: As the number of applications increases, incremental movement of the ring-spanner or socket will decrease.*

*If the spanner or socket does not turn or turns only with the first application or turns forward and backward with every application, the automatic adjuster has failed and the caliper must be replaced.*

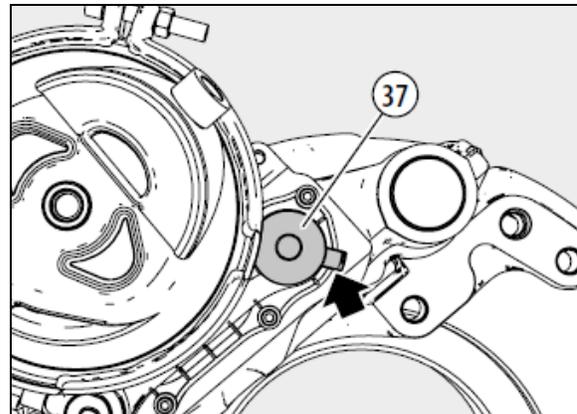


**FIGURE 41: APPLY THE BRAKE 5-10 TIMES, SPANNER TURNS CLOCKWISE**

16. If necessary, clean the contact area of the cap. Lightly grease the contact surface of the cap with white grease. The tag of the adjuster cap (37) should be positioned as shown by the arrow in the adjacent figure. This ensures

access is maintained for subsequent removal (see Figure 42).

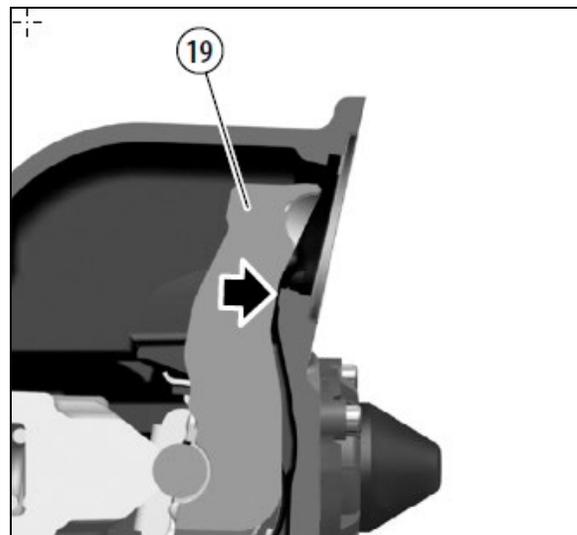
*Note: A new adjuster cap (37) should be fitted even if the brake pads are not being replaced.*



**FIGURE 42: TAB POSITIONING OF THE CAP**

**If the air gap is smaller than 0.023 in / 0.6 mm, the parameters and functions must be checked as follows:**

17. Check functioning of the brake actuator.
18. Remove brake actuator.
19. Check position of the lever (19) inside the caliper in its released state (see arrow).



**FIGURE 43: CHECK LEVER POSITION**

20. Remove brake pads (12). If necessary, remove dirt from brake pads, caliper and carrier.

-Check brake pads for wear from the tappets and if necessary replace brake pads.

- Check for abnormal wear of the contact areas of the carrier. If necessary, replace the carrier.

21. Check the brake disc.
22. Check caliper running clearance (see 18.2.7 & 18.2.8).
23. Fit the brake pads.
24. Fit the brake actuator.
25. Recheck the adjuster (see 18.2.6).

If the air gap is still smaller than 0.6 mm between both tappets, the brake caliper must be replaced.

### 18.2.7 Caliper check - Caliper Running Clearance

The Knorr Bremse air disc brake is designed to move freely, with minimal force.

1. Before starting work, ensure that the wheels are chocked and the vehicle cannot roll away.
2. Ensure that service brake and parking brake are in the released condition.
3. By pushing and pulling the caliper in an axial direction by hand (see arrows in Figure 44), a movement of 0.6 - 1.1 mm must be possible.

If, even using a high level of hand pressure (no tools), the caliper is not moveable, the caliper guide pin seals must be further examined (see 18.2.10 & 18.2.11).

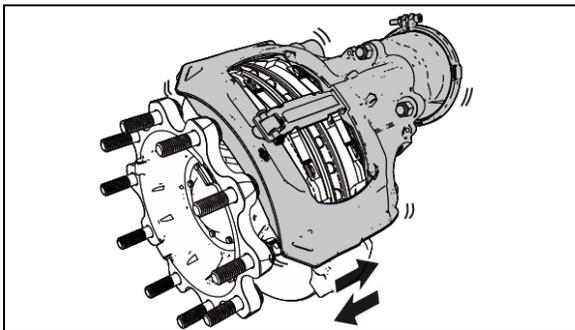


Figure 44: running clearance

### 18.2.8 Caliper check - Caliper Movement Along Guide Pins

1. With the open bearing variant (6b), clean the protruding area of the guide pin (4b) from outside of the caliper and if neces-

sary remove any light corrosion using an emery cloth.

2. Lightly apply grease to the protruding area of the guide pin (4b).
3. Remove brake pads.
4. Fully wind back the tappets (13) using a ring spanner and shear adapter (61) (see Figure 45).

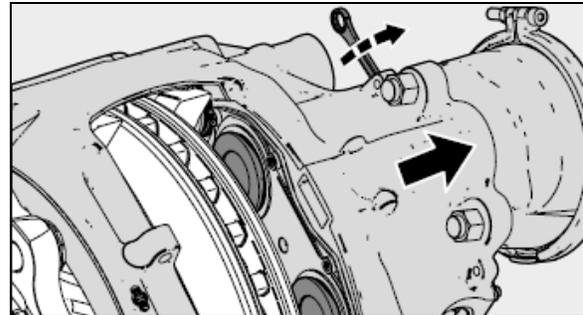


FIGURE 45: REWIND TAPPETS COMPLETELY AND PUSH CALIPER IN DIRECTION OF MIDDLE OF VIEW

5. Push caliper inboard towards vehicle's center (see Figure 46).

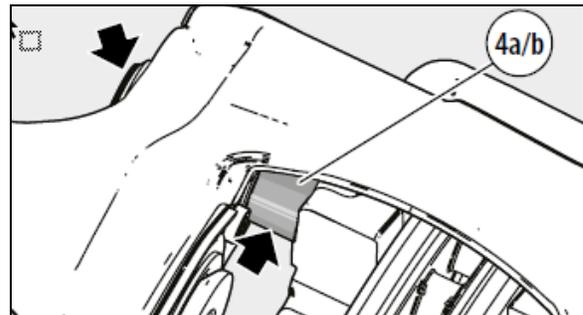


FIGURE 46: FREE GUIDE PIN OF DIRT

6. With both open bearing variants (6a and 6b), clean guide pin (4a or 4b) from the inner area of the caliper, removing any dirt or corrosion.
7. Lightly apply grease to guide pin (4a or 4b).
8. Caliper (1) must slide freely along the whole length of the guide pin arrangement; movement should be greater than 0.984 in / 25 mm. (see Figure 47).

If the caliper does not move at least 0.984 in / 25 mm, the caliper guide pin seals must be examined (see 18.2.10 & 18.2.11).

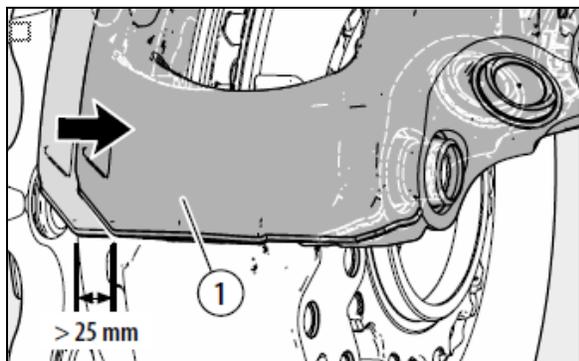


FIGURE 47: FREE MOVEMENT OF CALIPER > 0.984 IN / 25 MM

### 18.2.9 Clearance Measurement Check of Bearing Variants (6)

**Note:** Before commencing (removing the wheel), make sure there is no contact between caliper and axle, vehicle, chassis sections or carrier. In such cases, it will be necessary to replace the caliper bearings (see *Knorr-Bremse Pneumatic Disc Brake Y006471 Service Manual*).

To measure the clearance, the following steps must be taken:

1. Remove the wheel.
2. Remove pad retainer.

To achieve the correct reading it is necessary to have a pair of new brake pads fitted. If the clearance measuring is not taking place during a brake pad replacement, the current position of the assembled pads must be noted before removing, so that they can be re-assembled in the same position.

Remove old pads and replace with a pair of new pads.

3. Fasten a magnetic dial-gage holder to the carrier (2) on the floating bearing side of the caliper (1). Use the casting tag on the caliper (1) as the measuring point - see arrows A (see Figure 48).
4. Set the dial gage to zero.
5. Place a suitable tool (e.g. screwdriver with at least 200 mm in length) in a central position between carrier (2) and caliper (1) and lever them in opposite directions (using normal hand-force).

6. Read the maximum value of the bearing clearance on the dial gage and compare with the values in the table (see Table).

If the clearance exceeds the given tolerance, the complete bearing will need replacing using the relative service kit.

If the clearance measuring is not taking place during a brake pad replacement, the new pads should be removed and the previously marked brake pads fitted in their original positions, otherwise renew the brake pads as an axle set and adjust the air gap (refer to *Knorr-Bremse Pneumatic Disc Brake Y006471 Service Manual*).

7. Fit the wheels. After replacing the wheel check that it runs interference free.

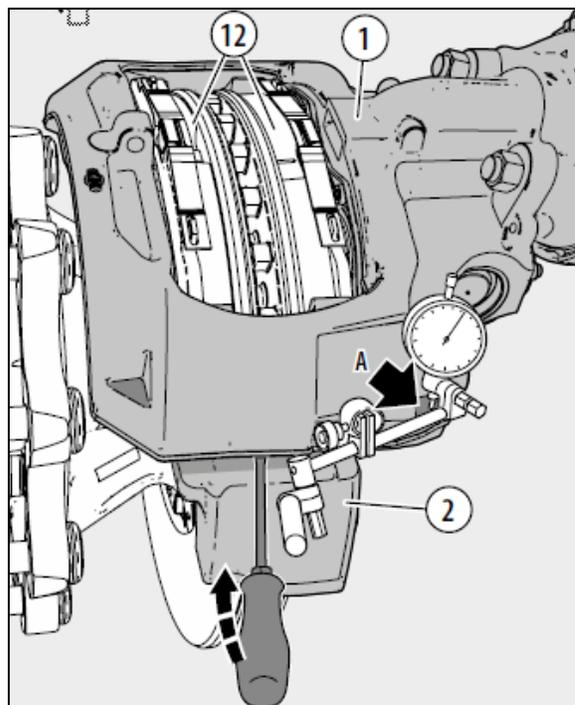


FIGURE 48: OBTAINING MAXIMUM VALUE OF BEARING CLEARANCE

Bearing variants (6)	Max. bearing clearance
6a Rubber Bush	2 mm
6b Open Bearing	2 mm
6c Guide Sleeve	1 mm
6d Capped Rubber Sleeve	2 mm
6e Guide Sleeve	1 mm
Maximum bearing clearance tolerances of bearing variants	

### 18.2.10 Checking Sealing Elements – Caliper Guide Pin Seals

The guide pin (5a or 5b) (as fitted to the fixed bearing side) is sealed with cover (10a or 10b) and inner boot (9a or 9b).

The floating bearing side with guide pin (4c, 4d or 4e) is sealed with inner boot (9c, 9d or 9e) and with cover (68c 68d or 68e). All variants (9), (10) and (68) must be free of any signs of damage (see Figure 49).

Check for correct location and fitting.

If necessary, remove pads (12) to inspect the inner boots (9).

If necessary, repair caliper with suitable service kit.

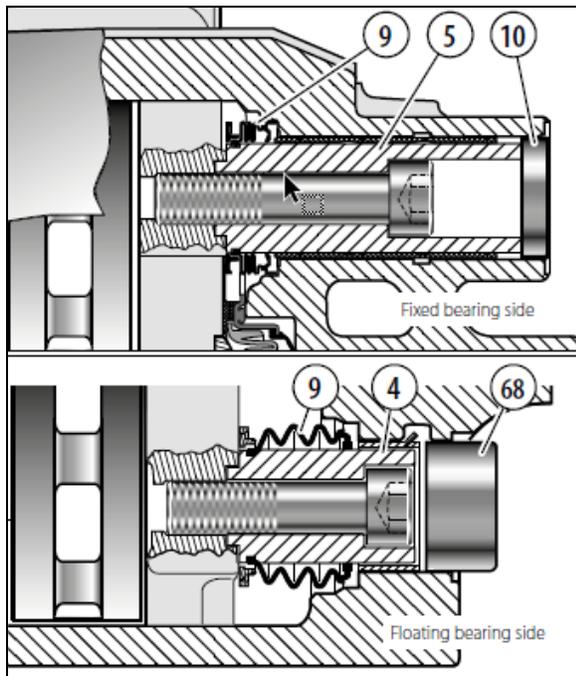


FIGURE 49: CHECKING OF GUIDE PIN AND SEALS

### 18.2.11 Checking Sealing Elements – Tappet and Boot Assemblies

Remove pads (12) (refer to **Knorr-Bremse Pneumatic Disc Brake Y006471 Service Manual**).

Screw out the tappets (13) using the shear adapter (61) clockwise until the boots are clearly visible (see Figure 50).

**The tappets must not be extended more than 1.181 in / 30 mm, otherwise synchronization is lost and the caliper must be replaced.**

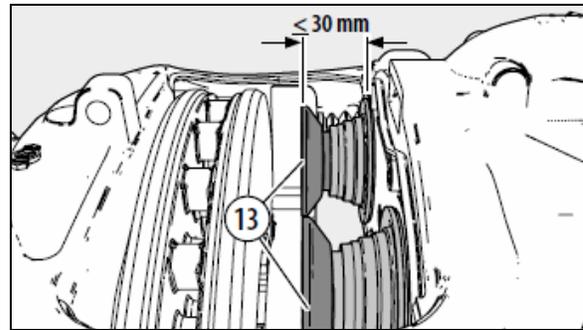


FIGURE 50: SCREW OUT TAPPETS - MAX. 1.181 IN / 30 MM

The rubber boots on the tappets (13) must not have any cuts/tears or show any other signs of damage. Check for correct location and fitting.

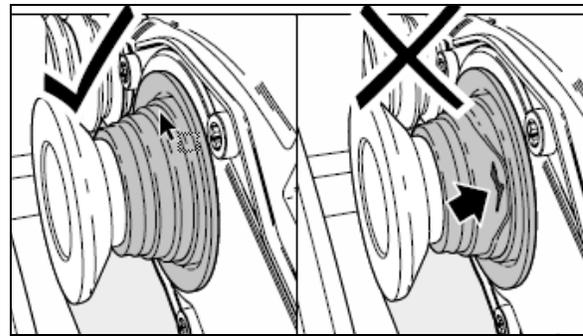


FIGURE 51: CHECK RUBBER BOOTS FOR DAMAGE

*Note: The penetration of dirt and moisture into the brake will lead to corrosion and impair the function of the clamping mechanism and wear adjuster.*

If necessary replace tappet and boot assemblies (refer to **Knorr-Bremse Pneumatic Disc Brake Y006471 Service Manual**).

## 18.3 PAD REPLACEMENT

Brake pad replacement procedure has slightly changed with the introduction of the new N2G adjuster on the vehicles.

*The full wording of the processes is included in the latest Knorr-Bremse service manual.*

**Refer to Knorr-Bremse Pneumatic Disc Brake Y006471 Service Manual.**

After fitting new pads,

1. Turn the adjuster (thru shear adapter) clockwise  until the pads come into contact with the disc.

2. Then turn back the adjuster counter-clockwise  $\cup$  **three “clicks”** and check the caliper running clearance.
  - During the turning of the adjuster, you will notice a changed clicking noise. It is not caused by a defect of the mechanism.
  - Also the “feel” during the rotation of the adjuster and the position of the spanner after the 3 clicks has changed.

Depending on the age of the vehicle, it may have installed on it two different design levels of disc brake and so there may be 2 different clicking noises and final positions of the adjuster on the vehicle.

### 19. SAFE SERVICE PROCEDURES

Most recently manufactured brake linings no longer contain asbestos fibers. Instead of asbestos, these linings contain a variety of ingredients, including glass fibers, mineral wool, aramid fibers, ceramic fibers, and carbon fibers. At present, OSHA (Occupational Safety and Health Administration) does not specifically regulate these non-asbestos fibers, except as nuisance dust. Medical experts do not agree about the potential long-term risks from working with and inhaling non-asbestos fibers. Nonetheless some experts think that long-term exposure to some non-asbestos fibers could cause diseases of the lung, including pneumoconiosis, fibrosis, and cancer. Therefore, lining suppliers recommend that workers use caution to avoid creating and breathing dust when working on brakes that contain non-asbestos fibers.



### WARNING

Whenever possible, work on brakes in a separate area away from other operations.

Always wear a respirator approved by NIOSH (National Institute of Occupational Safety and Health) or MSHA (Mine Safety and Health Administration) during all brake service procedures. Wear the respirator from removal of the wheels through assembly.



### WARNING

NEVER use compressed air or dry brushing to clean brake parts or assemblies. OSHA recommends that you use cylinders that enclose the brake. These cylinders have vacuums with high efficiency (HEPA (Health and Environment Protection Agency)) filters and workman's' arm sleeves. If such equipment is not available, carefully clean parts and assemblies in open air.

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

If you must grind or machine brake linings, take additional precautions, contact with fiber dust is higher during these operations. In addition to wearing an approved respirator, do such work in an area with exhaust ventilation.

When cleaning the work area, NEVER use compressed air or dry sweeping to clean the work area. Use an industrial vacuum with a HEPA filter and rags soaked in water and wrung until nearly dry. Dispose of used rags with care to avoid getting dust into the air. Use an approved respirator when emptying vacuum cleaners and handling used rags.

Wash your hands before eating, drinking or smoking. Do not wear your work clothes at home. Vacuum your work clothes after use and then launder them separately, without shaking, to prevent fiber dust from getting into the air.

Material safety data sheets on this product, as required by OSHA, are available from Rockwell and Knorr-Bremse.

### 20. AIR BRAKE TROUBLESHOOTING

The following tests and check lists have been designed to identify the cause(s) of a sluggish performance and/or leaks in the system. These tests require very little time to perform, and give you a general idea of the system condition. Each test is provided with a corresponding check list

which will guide you to the most common causes of problems.

Before performing any test, check all air lines for kinks or dents, and hoses for signs of wear, drying out or overheating.



## WARNING

When working on or around brake system and its related components, the following precautions should be observed:

Always block vehicle wheels. Stop engine when working under a vehicle. Keep hands away from chamber push rods and adjusters as they may apply when system pressure drops.

Never connect or disconnect a hose or line containing air pressure. It may whip as air escapes. Never remove a component or pipe plug unless you are sure all system pressure has been depleted.

Never exceed recommended air pressure and always wear safety glasses when working with air pressure. Never look into air jets or direct them at anyone.

Never attempt to disassemble a component until you have read and understood the recommended procedures. Some components contain powerful springs and injury can result if not properly disassembled. Use only proper tools and observe all precautions pertaining to the use of those tools.

Always clean connecting piping and/or fittings, and coat pipe threads with Teflon pipe sealant before installing any air brake system component.

### Pressure Build-Up / Low Pressure Warning / Cutoff Point / Air Filter/Dryer Built-in Governor Cutout

CONDITION: Vehicle leveled, parking brake applied.

1. Completely drain wet, primary and secondary air reservoirs only.
2. Start engine and run at fast idle. Low pressure warning lights should be "On".
3. Start checking pressure at 50 psi (344 kPa).
4. Low pressure warning lights and buzzer should go off at or above 85 psi (415 kPa).

5. At 85 psi (586 kPa), run engine at full rpm, then check that build up time to 100 psi (690 kPa) is 13 seconds or less.
6. Air filter/dryer built-in governor cut-out. Cuts out at the correct pressure of 140 psi (965 kPa).
7. Air filter/dryer built-in governor cut-in. Cuts in around 122 psi (841 kPa).

For common corrections, refer to the following check list:

#### High or Low Warning Cutoff Point

- Perform a telltale light and gage test. Replace entire cluster if found defective.

#### High or Low Air Filter/Dryer Built-in Governor Cutout Point

- Perform a telltale light and gage test. Replace entire cluster if found defective.

OR

- Repair or replace air filter/dryer as necessary after checking that compressor unloader mechanism operates correctly.

#### More than 13 seconds to build-up pressure from 85 to 100 psi (585 - 690 kPa) at full engine RPM

- Perform a telltale light and gage test. Replace entire cluster if found defective.
- Check compressor strainer or inlet line. If restricted, clean or replace element or faulty line.
- Check compressor head or discharge line for carbonization or restriction. Clean or replace as necessary.
- If discharge valves leak, pull head and correct or replace cylinder head.
- If drive is slipping, replace gear.
- If inlet valves are stuck, open or leaking severely, replace unloader kit, inlet valves and/or seats as necessary.
- If drain cock is found open, close it.
- Listen for air leaks and repair.
- Redo list to check all items repaired or replaced.

#### Air Supply Reservoir Leakage

**CONDITION:** Full pressure, engine stopped, parking brake applied

1. Allow at least 1 minute for pressure to stabilize.
2. Stop engine, then check air pressure gage for 2 minutes. Note any pressure drop.
3. Pressure should not drop by more than 3 psi (20 kPa) per minute.

For common corrections, refer to the following check list:

Excessive air loss:

- With the primary air system at normal operating pressure 122-140 psi (841- 965 kPa), coat all air line connections and pneumatic components with a water and soap solution. Bubbles will indicate an air leak, and none should be permissible. Repair or replace defective parts.
- Listen for leaks and correct as required.
- Redo test to check all items repaired or replaced.

### Brake System Air Leakage

**CONDITION:** Full pressure, engine stopped, parking brake released.

1. Apply service (foot) brakes, allow at least 1 minute for pressure to stabilize.
2. Hold down foot valve for 1 minute while observing air pressure gage on the dashboard.
3. Pressure drop should not be more than 3 psi (20 kPa) per minute.

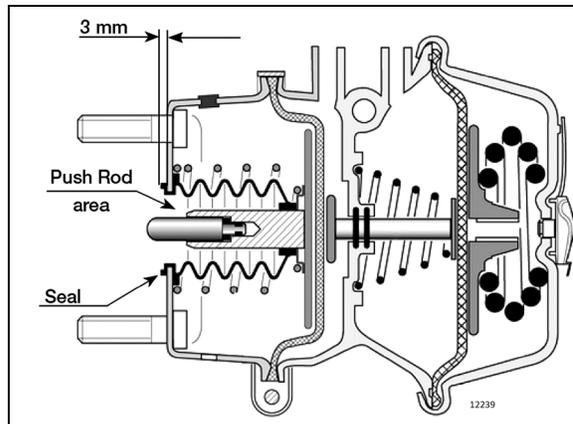
For common corrections, refer to the following check list.

**Excessive leakage on brake service side:**

- With the primary air system at normal operating pressure 122-140 psi (841- 965 kPa) and foot brake applied, coat all air line connections and brake pneumatic components with a water and soap solution. Bubbles will indicate an air leak, and none should be permissible. Repair or replace defective parts.
- Listen for leaks and correct as required.
- Redo test to check all items repaired or replaced.

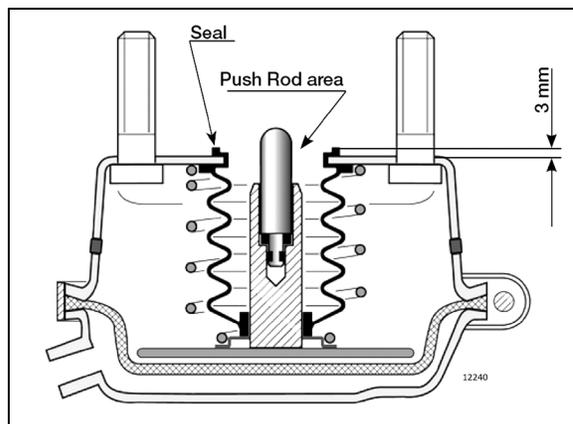
## 21. BRAKE AIR CHAMBER

This vehicle uses “Knorr-Bremse” brake chambers on all axles. The drive axle chambers consist of two separate air chambers, each having its own diaphragm and push rod. They are used as a service brake chamber, an emergency brake in case of air pressure loss and a spring-applied parking brake. Refer to **FIGURE 52**.



**FIGURE 52: DRIVE AXLE BRAKE AIR CHAMBER**

The front and tag axle brake air chambers are used only for service brake duty (**FIGURE 53**).



**FIGURE 53: FRONT AND TAG AXLE BRAKE AIR CHAMBER**

### 21.1 MAINTENANCE

Every 6,250 Miles (10 000 km) or twice a year, whichever comes first depending on type of operation:

Check all hoses and lines. They should be secure and in good condition.

Every 100,000 Miles (160 000 km) or once a year, whichever comes first depending on type of operation:

1. Disassemble and clean all parts.
2. Install new diaphragm or any other part if worn or deteriorated.

**NOTE**

*When the diaphragm, spring, or both are replaced, they should be replaced in the corresponding chamber on the same axle.*

3. Perform an airtightness test:
  - a) Make and hold a full brake application.
  - b) Coat clamping ring(s) with a soapy solution. If leakage is detected, tighten clamping ring only enough to stop leakage. **Do not over-tighten** as this can distort sealing surface or clamping ring. Coat area around push rod hole (loosen boot if necessary). No leakage is permitted. If leakage is detected, the diaphragm must be replaced.

## 21.2 EMERGENCY/PARKING BRAKE MANUAL RELEASE

**DANGER**

Never stand in the axis line of the spring brake chambers, especially when caging the spring.

**Drive Axle**

1. Block the wheels to prevent the vehicle from moving.
2. Remove the release stud tool from its storage place on drive axle brake air chamber.
3. Remove the access plug from the end of the spring chamber, and then insert the release stud through the opening. Turn the release stud 1/4 turn (clockwise) to anchor it into the spring plate. Install the flat washer and nut, and then turn the nut clockwise to cage the spring. Repeat on the opposite side.

**DANGER**

Make sure the release stud is properly anchored in spring plate receptacle prior to caging the spring.

4. To manually reset the emergency/parking brake, turn the nut counterclockwise. Reinstall access plugs on the spring chambers, and release stud tools in their storage places.

**Tag Axle**

1. Block the wheels to prevent the vehicle from moving.
2. Turn the release bolt counterclockwise to cage the power spring (approx. 2.5 inches (6 cm)). Repeat on the opposite side.
3. To manually reset the emergency/parking brake, turn the bolt clockwise.

## 21.3 BRAKE CHAMBER REMOVAL

**WARNING**

To prevent personal injuries, brakes should be inoperative prior to working on any of their components.

To prevent personal injuries, brake chambers should be made inoperative by releasing spring tension prior to disposal.

1. Block the wheels to prevent the vehicle from moving.
2. Safely support vehicle at the recommended body jacking points.
3. To gain access to a given brake air chamber, the corresponding wheel can be removed (refer to Section 13: "Wheels, Hubs and Tires").
4. Exhaust compressed air from system by opening the drain valve of each reservoir.
5. For the drive and tag axles brake chambers, manually release spring brakes (refer to "Emergency/Parking Brake, Manual Release" procedure in this section).
6. Disconnect air line(s) from brake chamber.
7. Remove the cotter pin connecting brake chamber and adjuster (drive axle).
8. Unbolt and remove the brake chamber from vehicle.

## 21.4 BRAKE CHAMBER INSTALLATION

Reverse removal procedure, and then check brake adjustment.

**CAUTION**

Always clean air lines and fittings, and coat pipe threads with Teflon pipe sealant before reconnecting air lines. Make sure the drain hole of the brake chamber is in the lower position for proper moisture evacuation.

## 21.5 BRAKE CHAMBER DISASSEMBLY

**DANGER**

Spring brake chambers, on drive and tag axles contain an extremely high compressive force spring, which can possibly cause serious injury if special precautions are not taken when working around this area.

To avoid such injury, the following recommendations must be applied:

- Prevost recommends the installation of a new spring brake chamber if it is found to be defective.
- Spring brake chamber maintenance and/or repair must be performed by trained and qualified personnel only.
- Before manually releasing spring brakes, visually check spring brake for cracks and/or corrosion.
- On "MGM" brake chambers (drive axle), make sure the release stud is properly anchored in spring plate receptacle prior to caging the spring.
- Never stand in the axis line of the spring brake chambers, especially when caging the spring.

**WARNING**

To prevent personal injuries, brakes should be inoperative prior to working on any of their components.

1. Block the wheels to prevent the vehicle from moving.
2. Safely support vehicle at the recommended body jacking points.

**NOTE**

*To gain access to a given brake air chamber, the corresponding wheel can be removed (refer to Section 13: "Wheels, Hubs and Tires").*

3. Exhaust compressed air from air system by opening the drain valve of each reservoir.
4. For the drive and tag axles brake chambers, manually release spring brakes (refer to "Emergency/Parking Brake Manual Release" procedure in this section).
5. Remove clamp ring, remove and discard the existing diaphragm. Install the new diaphragm squarely on body.
6. Reverse the procedure for assembly. Tap clamp ring to ensure proper seating. Check for proper operation before placing vehicle in service.

**22. ANTI-LOCK BRAKING SYSTEM (ABS)**

This system has been designed to ensure stability and permit steering control of vehicle during hard braking, and to minimize its stopping distance whatever the road conditions are. On slippery roads and generally in emergency situations, over-braking frequently induces wheel lock. The anti-lock braking system provides maximum braking performance while maintaining adequate steering control on slippery roads.

The ABS continuously monitors wheel behavior during braking. Sensors on each wheel of front and drive axles (tag axle is slave to drive axle) transmit data to a four channel electronic processor which senses when any wheel is about to lock. Modulator valves quickly adjust the brake pressure (up to 5 times per second) to prevent wheel locking. Each wheel is therefore controlled according to the grip available between its tire and the road.

With this device, the vehicle is brought to a halt in the shortest possible time, while remaining stable and under the driver's control.

Since the braking system has dual circuits, the ABS is also provided with a secondary system should a fault develop in the ABS. Anti-lock systems are a parallel system which does not hinder brake functioning in case of failure. Braking system functions in normal, non-anti-

lock controlled operation during ABS system failure.

The ABS system consists of two diagonally related circuits, only the half of the system which has sustained damage or other fault is switched off (i.e. wheels return to normal non-ABS braking). The other diagonal half remains under full ABS control.

**NOTE**

*ABS is active on service brake, transmission retarder, engine brake, but is inactive on emergency/parking brake.*

**NOTE**

*The ABS system is inoperative at speeds under 4 mph (6 km/h). Illumination of ABS telltale indicator at these speeds is normal.*

**CAUTION**

Disconnect the ECU or pull the ABS fuse before towing vehicle.

## 22.1 TROUBLESHOOTING AND TESTING

For detailed information, troubleshooting and testing refer to Bendix booklet “*Bendix Service Data EC80 ESP Controller (SD-13-4986)*” found on the Technical Publications USB flash drive and web site.

## 22.2 ABS COMPONENTS

The main components of the ABS system are listed hereafter. Refer to each component for its specific function in the system and for proper maintenance.

## 22.3 BENDIX EC-80 CONTROLLER

This control unit, also known as ABS module, is located in the front electrical and service compartment. According to the data transmitted by the sensors (number of pulses/sec is proportional to the speed of each wheel), the electronic control unit determines which wheel is accelerating or decelerating. It then establishes a reference speed (average speed) from each wheel data, and compares the speed of each

wheel with this reference speed to determine which wheel is accelerating or decelerating.

As soon as wheel deceleration or wheel slip threshold values are exceeded, the electronic control unit signals a solenoid control valve to limit the excessive brake pressure produced by the driver in the appropriate brake chamber.

## Maintenance

No specific maintenance is required. The ECU is not serviceable. When found to be defective, replace.

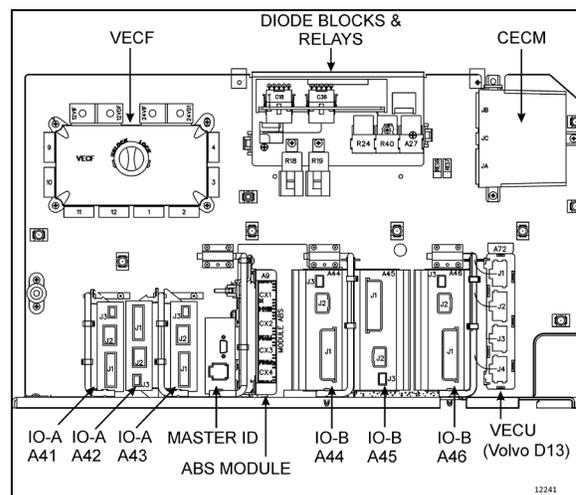


FIGURE 54: ABS ECU LOCATION

**CAUTION**

In order to protect the ABS electronic control unit from voltage surges, always disconnect before performing any welding procedure on vehicle.

## 22.4 SENSORS

The sensors are mounted on the front and drive axle wheel hubs (Figure 55). The inductive sensors consist essentially of a permanent magnet with a round pole pin and a coil. The rotation of the toothed wheel alters the magnetic flux picked up by the coil, producing an alternating voltage, the frequency of which is proportional to wheel speed. When wheel speed decreases, magnetic flux decreases proportionately. Consequently, the electronic control unit will command the solenoid control

valve to decrease the pressure at the corresponding brake chamber.

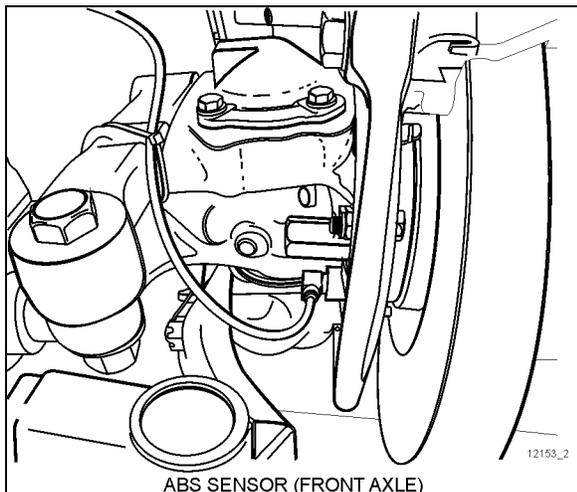


FIGURE 55: ABS SENSOR LOCATION

**Maintenance**

No specific maintenance is required for sensors, except if the sensors have to be removed for axle servicing. In such a case, sensors should be lubricated with special grease (Prevost #680460) before reinstallation. Refer to paragraph "Sensor Installation" for details.

**NOTE**

The resistance value, when sensors are checked as a unit, must be equal to 1,75 kohms. To check the sensors for proper output voltage after the sensors and toothed wheels have been assembled to the axle, connect a suitable AC voltmeter across the output terminals. With the hubs rotating at 30 rpm, the output voltages should read from 50 to 1999 mV to be acceptable.

**Sensor Installation**

The following procedure deals with sensor installation on the axle wheel hubs. Read procedure carefully before reinstalling a sensor, as its installation must comply with operational tolerances and specifications.

1. Apply recommended lubricant (Prevost #680460) to spring clip and sensor.



**CAUTION**

Use only this type of grease on the sensors.

2. Insert spring clip in the holder on hub. Make sure the spring clip tabs are on the inboard

side of the vehicle. Push in until the clip stops.

3. Push the sensor completely inside the spring clip until it is in contact with the tooth wheel. Ensure mounting is rigid, as it is an important criterion for adequate sensor operation.

**NOTE**

This installation should be of the "press fit" type.

22.4.1 Spring clip

The spring clip retains the sensor in its mounting bracket close to the toothed pulse wheel. The gap between the sensor end and teeth is set automatically by pushing the sensor in the clip hard up against the tooth wheel, and the latter knocks back the sensor to its adjusted position (Figure 56).

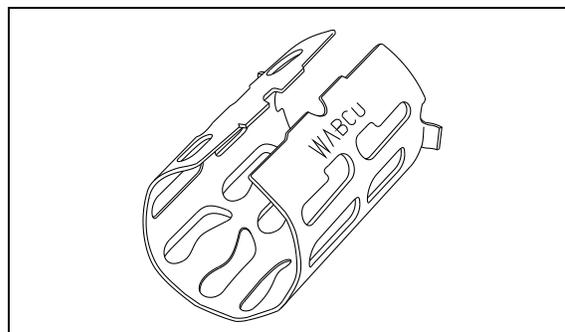


FIGURE 56: SPRING CLIP 12161

**Maintenance**

The spring clip requires no specific maintenance.



**MAINTENANCE**

**ABS & ELECTRONIC STABILITY CONTROL SYSTEMS**

Check the proper functioning of ABS and ESC systems at the intervals specified by the Lubrication And Servicing Schedule in Section 24: LUBRICATION & SERVICING. To do so, perform the "Component Test" using Bendix ACom Diagnostics software.

Bendix ACom Diagnostics software is available for download at [www.bendix.com](http://www.bendix.com).

### 23. BENDIX AUTOMATIC TRACTION CONTROL (ATC) – ELECTRONIC STABILITY CONTROL (ESC)

In addition to the ABS function, vehicle is equipped with a Traction Control System (TCS) feature. This feature is provided by the Bendix ESP EC-80 controller. Bendix refers to this feature as **Automatic Traction Control (ATC)**. Bendix ATC can improve vehicle traction during acceleration, and lateral stability while accelerating through curves. ATC utilizes **Engine Torque Limiting (ETL)** where the ECU communicates with the engine's controller and/or **Differential Braking (DB)** where individual wheel brake applications are used to improve vehicle traction.

The ESP EC-80 model controller also provides an ABS-based Electronic Stability Control (ESC) feature. Bendix refers to it as **ESC Electronic Stability Control**.

The Bendix ESC system is an ABS-based stability system that enhances vehicle stability by both reducing engine throttle and by applying vehicle braking based on actual vehicle dynamics

ESC stability system consists of Yaw Control (YC) and Roll Stability Program (RSP) features.



#### DANGER

**Bendix ESC system may reduce the vehicle speed automatically.**

ESC can make the vehicle **decelerate automatically**. ESC can slow the vehicle with or **without the operator applying the brake**, and **even when the throttle is being applied**.



#### CAUTION

Even with ESC-equipped vehicles, the driver remains responsible for ensuring vehicle stability during operation.

## 23.1 COMPONENTS

### 23.1.1 EC-80 controller's ABS function

- Six (6) Bendix® WS-24™ wheel speed sensors. Each sensor is installed with a Bendix Sensor Clamping Sleeve;
- Five (5) Bendix® Pressure Modulator Valves (M-40QR);
- Dash-mounted vehicle ABS Indicator Lamp;
- Service brake relay valve;
- Dash-mounted trailer ABS Indicator Lamp.

### 23.1.2 EC-80 controller's ATC function

- Drive axle traction control valve;
- TCS status/indicator icon in the DID;
- Dash-mounted TCS Mud/Snow switch;
- J1939 serial communication to engine control module.

### 23.1.3 EC-80 controller's ESC/RSP function

- Front Axle Traction Control Valve integral to the service brake relay valve;
- Dash-mounted ESC status/indicator lamp;
- Bendix SAS-70 Steering Angle Sensor (mounted to the steering column);
- Bendix YAS-70 Yaw Rate/Lateral Acceleration Sensor (mounted to a cross member forward of the drive axle);
- Brake Demand Sensors (installed in the primary and secondary delivery circuits);
- An additional Modulator Valve (Bendix® M-40QR™ Pressure Modulator Valve) that controls pressure applied to the trailer brakes during system intervention.

## 23.2 BENDIX M-40QR PRESSURE MODULATOR VALVE

This Bendix M-40QR (quick release) Pressure Modulator Valve (PMV) is operated by the EC-80 controller to modify driver applied air pressure to the service brakes during ABS, ATC, RSP or YC activation. The PMV is an electro pneumatic control valve and is the last valve that air passes through on its way to the brake chamber. The modulator hold and release solenoids are activated to “modulate” or “control” the brake pressure during an antilock braking

event. The hold solenoid is normally open and the release solenoid is normally closed, such that the PMV nominally allows air to flow through. This design allows for air delivery to brake chambers in the event of electrical trouble. This is an "On/Off" type valve, i.e., during an antilock activity, the valve exhausts air from the brake chamber when in a ABS event, the electronic unit senses that the corresponding wheel speed is decreasing in relation to the other wheels.

The EC-80 controller also utilizes an additional PMV for control of the trailer service brakes during stability interventions.

### 6s/5m Configuration

Prevost vehicles utilize a 6 sensors/5 pressure modulator valves configuration, with the tag axle having two sensors, but only one Pressure Modulator Valve. In this case, the PMV controls both wheels on the tag axle. The tag axle wheels would receive equal brake pressure, based on the wheel that is currently experiencing the most wheel slip.

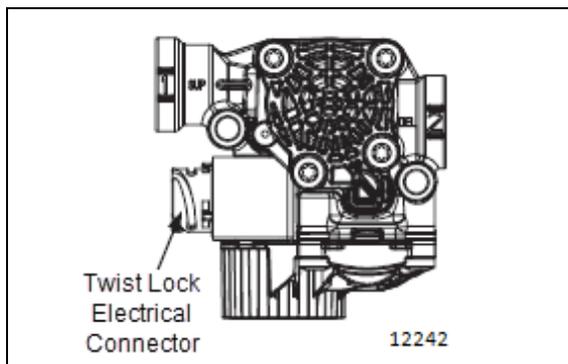


FIGURE 57: M-40QR PRESSURE MODULATOR VALVE

### Maintenance

#### NOTE

*On older vehicles, when replacing for the first time the older modulator valve M-32QR by the newer M-40QR modulator valve, it is important to replace both left and right valves on the vehicles drive axle or front suspension.*

*Modulator valve model can be easily identified by their different side cover and exhaust section.*



Maintenance, removal and installation information of this valve is supplied in Bendix booklet, found on your Technical Publications USB flash drive, under reference number SD-13-4958.

### 23.3 ABS WITH ELECTRONIC STABILITY CONTROL (ESC)

#### Overview

Bendix ESC stability system reduces the risk of rollovers, jackknifing and other loss of control. ESC features include Roll Stability Program (RSP) and Yaw Control. During operation, the ECU of the Bendix ABS system constantly compares performance models to the vehicle's actual movement, using the wheel speed sensors of the ABS system, as well as lateral, yaw, and steering angle sensors. If the vehicle shows a tendency to leave an appropriate travel path, or if critical threshold values are approached, the system will intervene to assist the driver.

#### Roll Stability Program

Bendix RSP, an element of the overall ESC system, addresses rollover conditions. In the case of a potential roll event, the ECU will override the throttle and quickly apply pressure at all wheel ends to slow the vehicle. The level of braking application during an RSP event will be proportional to roll risk.

#### Yaw Stability

Yaw stability counteracts the tendency of a vehicle to spin about its vertical axis. During operation, if the friction between the road surface and the tires is not sufficient to oppose lateral (side) forces, one or more of the tires can slide, causing the vehicle to spin. These events are referred to as either an “under-steer” situation (where there is a lack of vehicle response to steering input due to the slide on the front axle) or an “over-steer” (where the vehicle’s rear end slides out due to tire slide on the rear axle) situation. Factors that influence yaw stability are: wheelbase, suspension, steering geometry, weight distribution front to rear, and vehicle track width.

### Yaw Control

Yaw Control corresponds to a wide range of low to high friction surface scenarios including rollover, jackknife and loss of control. It is the recommended system for all power vehicles and especially critical for vehicles pulling trailers. In the case of vehicle slide (over-steer or under-steer situations), the system will reduce the throttle and then brake one or more of the “four corners” of the vehicle (in addition to potentially applying the trailer brakes), thus applying a counter-force to better align the vehicle with an appropriate path of travel.

For example, in an over-steer situation, the system applies the “outside” front brake; while in an under-steer condition, the “inside” rear brake is applied.

## 23.4 BENDIX® SAS-70 STEERING ANGLE SENSOR

The Steering Angle Sensor (SAS) is used to provide driver steering input to the controller. It reports the steering wheel position to the controller utilizing a dedicated serial communications link that is shared with the YAS-70 sensor. The controller supplies the power and ground inputs to the SAS-70 sensor.

The SAS-70 sensor installed on Prevost vehicles is the 90° connector.

### 23.4.1 Removal of the steering angle sensor

#### Service Checks:

1. Check all wiring and connectors. Some installations also include an intermediate connector from the steering angle sensor to the main vehicle wire harness. Make sure all connections are free from visible damage.
2. Examine the sensor. Make sure the sensor, its mounting screws, and the interface between the hub and the steering column are not damaged.

#### Diagnostics:

The steering angle sensor is only operational in conjunction with an EC-80 ECU. No independent diagnostics can be performed on the sensor.

#### Removal:

1. Remove steering column upper, middle and lower covers.
2. The steering angle sensor is located near the universal joint.
3. Unplug sensor cable assembly from body of sensor. Squeeze the mounting tabs and pull gently on connector until it disengages.
4. Disconnect steering column upper U-joint.
5. Unscrew all three of the mounting screws that hold the body of the sensor to the steering column body.
6. Slide the sensor over the column to remove. Take note if the sensor label is facing upward or downward.

#### Installation:

1. Obtain a new sensor. The sensor is not repairable in the field.
2. Slide the sensor over the column. The center hub of the sensor must be aligned with the corresponding notch in the column. The sensor label should be facing in the same direction as the removed sensor.

**TORQUE: 9-12 lb-in (1.02-1.36 Nm)**

3. Reconnect the steering column U-joint.  
**TORQUE: 35-39 lb-ft (47-53 Nm)**
4. Reconnect the connector. Ensure that there will be no force applied to the sensor because the connector is pulling on the sensor body.
5. If the wire harness leading to the sensor is being replaced, ensure that it is adequately tie wrapped so that the full motion of the

steering column can be achieved without pulling apart the connectors.

6. Reinstall the steering column covers. The sensor is not protected against dirt or water intrusion, so care must be taken not to introduce these elements during installation.

### Steering Angle Sensor Calibration

The steering angle sensor calibration can only be achieved when the sensor is powered by the Advanced ABS ECU. No stand-alone sensor calibration can be carried out. The calibration procedure is performed using Bendix® ACom™ Diagnostic V4.0 or higher. See “Troubleshooting Diagnostic Trouble Codes: Steering Angle Sensor (SAS-70)” for the calibration procedure using this tool.

The sensor **must** be recalibrated after any of these situations:

- Replacement of the steering angle sensor;
- Any opening of the connector hub from the steering angle sensor to the column;
- Any maintenance or repair work on the steering linkage, steering gear or other related mechanism;
- Adjustment of the wheel alignment or wheel track;
- After an accident that may have led to damage of the steering angle sensor or assembly.



### WARNING

If the steering angle sensor is not properly recalibrated as needed, the yaw control system may not function properly, which can result in incidents leading to loss of vehicle control.

## 24. FITTING TIGHTENING TORQUES

**NTA-Type Plastic Tubing:** Hand tighten nut. From that point, tighten using a wrench the number of turns indicated in the following chart.

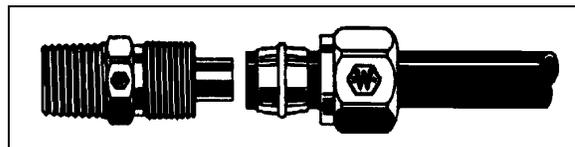


FIGURE 58: HOSE FITTING 12055

Tubing diameter (inch)	Number of additional turns required following manual tightening
1/4	3
3/8 to 1/2	4
5/8 to 3/4	3 ½

### NOTE

Use Loctite pipe sealant to seal pipe thread (Prevost number 680098).

**25. SPECIFICATIONS****Air Compressor**

Make ..... Meritor Wabco  
 Model ..... SS636  
 Capacity (at 1250 rpm) ..... 37.4 cfm (1,059 m<sup>3</sup>/min.)

**Air Dryer**

Make ..... Meritor Wabco  
 Model ..... System Saver  
 Cut in pressure ..... 122 psi  
 Cut-out pressure ..... 140 psi

**Flip-Flop Control Valve**

Make ..... Bendix  
 Model ..... TW-1  
 Type ..... On-Off

**Emergency/Parking Brake Control Valve**

Make ..... Bendix  
 Model ..... PP-1  
 Automatic release pressure ..... 60 psi (414 kPa) nominal

**Dual Brake Application Valve**

Make ..... Bendix  
 Model ..... E-10P

**Spring Brake Valve**

Make ..... Bendix  
 Model ..... SR-1

**Pressure Protection Valve**

Make ..... Bendix  
 Model ..... PR-4  
 Nominal closing pressure ..... 70 psi (482 kPa)  
 Prevost number ..... 641137

**Shuttle-Type Double Check Valve**

Make ..... Bendix  
 Model ..... DC-4

**Air Pressure Regulator**

Make ..... Norgren  
 Adjustable output range ..... 0-80/85 psi (0-552/586 kPa)

**Air Filter Element**

Make ..... Norgren  
 Type ..... With manual drain

**Front Axle Brake Chambers**

Make ..... Knorr-Bremse  
 Type ..... 24-inch

**Drive Axle Brake Chambers**

Make ..... Knorr-Bremse  
Type .....24-inch as service -24-inch as emergency

**Tag Axle Brake Chambers**

Make ..... Knorr-Bremse  
Type .....16-inch

**Brake Lining (All Axles)**

Make ..... Knorr-Bremse