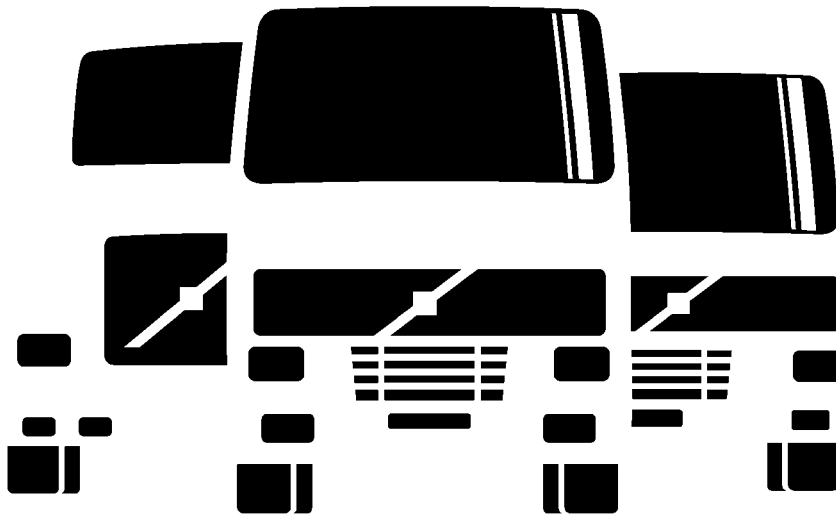


# Service Manual Trucks

Group **560-670**  
Compressed Air Brakes  
VN, VHD



# Foreword

The descriptions and service procedures contained in this manual are based on designs and methods studies carried out up to July 2003.

The products are under continuous development. Vehicles and components produced after the above date may therefore have different specifications and repair methods. When this is believed to have a significant bearing on this manual, supplementary service bulletins will be issued to cover the changes.

The new edition of this manual will update the changes.

In service procedures where the title incorporates an operation number, this is a reference to an V.S.T. (Volvo Standard Times).

Service procedures which do not include an operation number in the title are for general information and no reference is made to an V.S.T.

The following levels of observations, cautions and warnings are used in this Service Documentation:

**Note:** Indicates a situation, handling or circumstance which should be observed.

**Caution:** Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury or damage to property.

**Warning:** Indicates a potentially hazardous situation which, if not avoided, could result in death, serious injury or major damage to property.

**Danger:** Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

**Volvo Trucks North America, Inc.**  
Greensboro, NC USA

**Order number: PV776-TSP194846**

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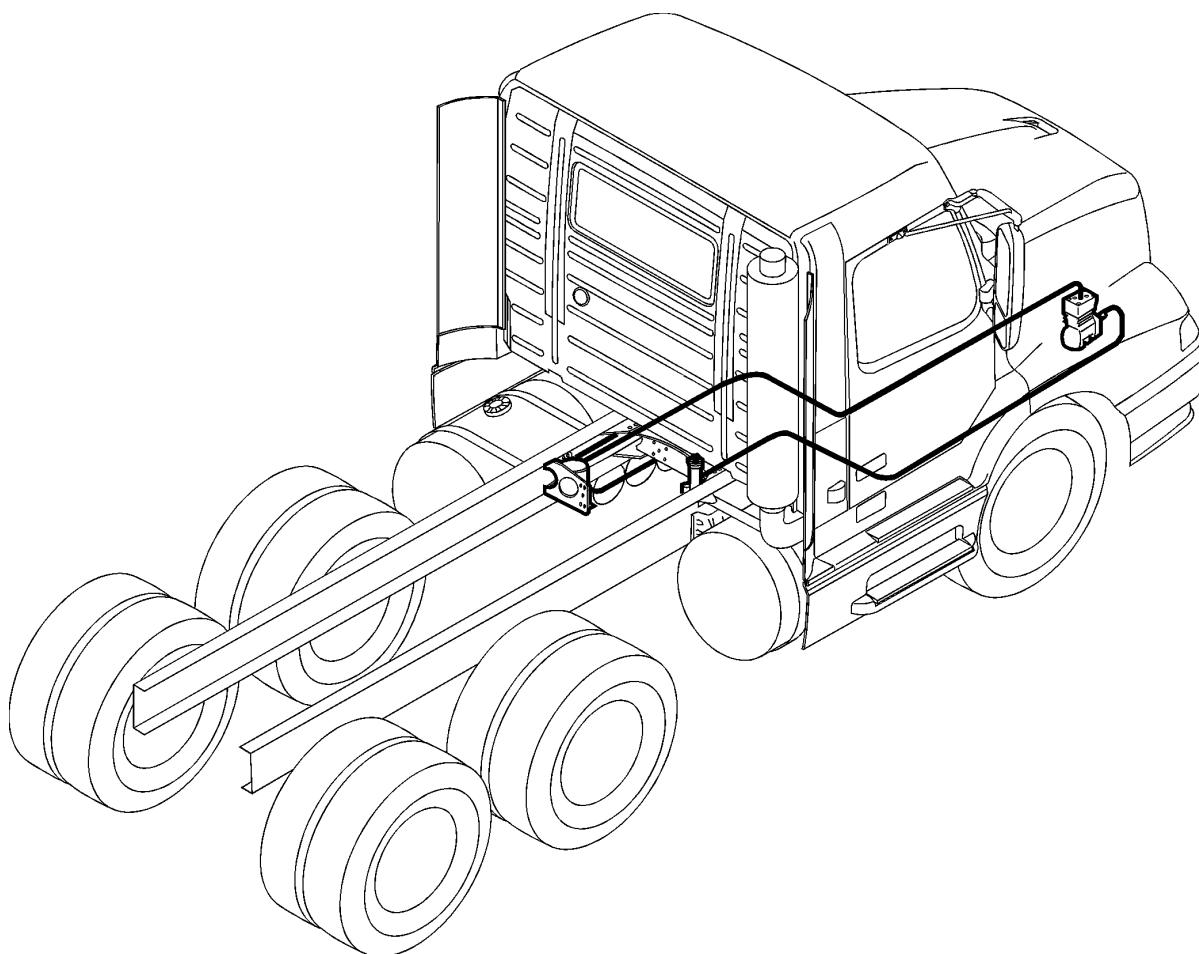
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# General

## Compressed Air Brakes



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This information covers the supply system for the compressed air brakes. The supply system includes compressor, governor, air dryer and other support valves with connecting air lines.

The main components covered are:

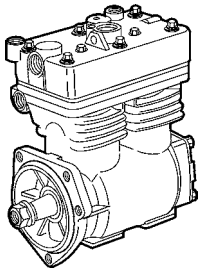
- Compressor, Knorr 2COMP850
- Compressor, Bendix Tu-Flo 550 and 750
- Compressor, Holset SS296, SS296, QE296
- Air Dryer, Bendix AD-IP
- Air Dryer, Midland Pure Air Plus
- Air Dryer, CR Turbo 2000
- Air Dryer, WABCO System Saver 1000/1200/1200E/1200P
- Footvalve
- Governor
- Servo Valve
- Air Tanks
- Air Tubing and Fittings



# Specifications

## Compressor

### Knorr 2COMP850

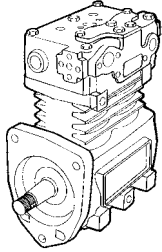


Designation (sales designation: Volvo 26.5 CFM)	2COMP850
Type	Piston Compressor
Number of cylinders	2
Cooling cylinder head	Coolant
Capacity	750 L/min (26.5 cfm)
Maximum pressure	930 kPa (135 psi)
Maximum operating speed	2 700 r/min
Bore	88.0 mm (3.46 in.)
Stroke	50 mm (1.97 in.)

### Tightening torques

	<b>Nm</b>	<b>ft-lb</b>
Mounting flange bolts	85 ± 15	63 ± 10
Drive gear nut	225 ± 25	165 ± 20
Cylinder head bolts	31.5 ± 1.5	23 ± 1
Valve body bolt	31.5 ± 1.5	23 ± 1
Exhaust valve bolt	11 ± 0.5	8.1 ± 0.4
Intake valve bolt	12 ± 1.0	8.8 ± 0.7

## Bendix Tu-Flo 550



Designation (Sales designation: Bendix 13.2 CFM)

Type

Number of cylinders

Cooling cylinder head

Capacity

Maximum pressure

Maximum operating speed

Bore

Stroke

Tu-Flo 550

Piston Compressor

2

Coolant

375 L/min (13.2 cfm)

930 kPa (135 psi)

2400 r/min

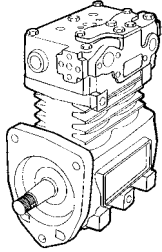
70.6 mm (2.78 in.)

38.1 mm (1.50 in.)

### Tightening torques

	<b>Nm</b>	<b>ft-lb</b>
Mounting flange bolts	85 ± 15	63 ± 10
Drive gear nut	165 ± 13.5	110 ± 10
Cylinder head bolts	53 ± 3.4	39 ± 2.5
Unloader valve cover plate bolts	23 ± 3	17 ± 2.0
Exhaust valve seat	110 ± 13	80 ± 10
Intake valve seat	110 ± 13	80 ± 10

## Bendix Tu-Flo 750



Designation (Sales designation: Bendix 16.5 CFM)

Type

Number of cylinders

Cooling cylinder head

Capacity

Maximum pressure

Maximum operating speed

Bore

Stroke

Tu-Flo 750

Piston Compressor

2

Coolant

470 L/min (16.5 cfm)

930 kPa (135 psi)

2400 r/min

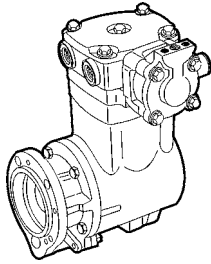
70.6 mm (2.78 in.)

47.5 mm (1.87 in.)

### Tightening torques

	<b>Nm</b>	<b>ft-lb</b>
Mounting flange bolts	85 ± 15	63 ± 10
Drive gear nut	165 ± 13.5	110 ± 10
Cylinder head bolts	53 ± 3.4	39 ± 2.5
Unloader valve cover plate bolts	23 ± 3	17 ± 2.0
Exhaust valve seat	110 ± 13	80 ± 10
Intake valve seat	110 ± 13	80 ± 10

## Holset SS 296/SS 296E/QE 296



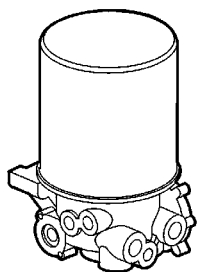
Designation (Sales designation: Cummins 13.2 CFM)	SS296 / SS296E / QE296
Type	Piston Compressor
Number of cylinders	1
Cooling cylinder head	Coolant
Capacity	375 L/min (13.2 cfm)
Maximum pressure	930 kPa (135 psi)
Maximum operating speed	2400 r/min
Bore	92.10 mm (3.625 in.)
Stroke	44.45 mm (1.750 in.)

### Tightening torques

	Nm	ft-lb
Mounting flange bolts	68	50
SS and E unloader housing bolts	14	10
QE unloader housing bolts	27	20
Valve plate housing bolts	28	21
Air compressor support bracket bolts	47	35
Fuel pump mounting bolts	47	35

# Air Dryer

## Air Dryer Wabco System Saver 1000/1200/1200E/1200P



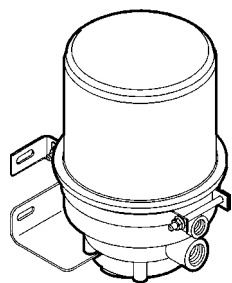
### Wabco 1000

Height	292 mm (11.5 in.)
Maximum width	241 mm (9.5 in.)
Weight	5.0 kg (11 lb)
Voltage	12 V
Maximum compressor capacity	710 L/min (25 cfm)
Heater power	100 W

### Wabco 1200/1200E/1200P

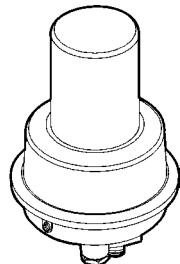
Height	277 mm (10.9 in.)
Maximum width	160 mm (6.3 in.)
Weight	4.1 kg (9 lb)
Voltage	12 V
Maximum compressor capacity	850 L/min (30 cfm)
Heater power	95 W

## Bendix AD-IP



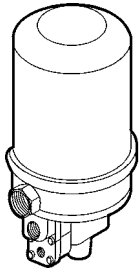
Height	360 mm (14.18 in.)
Maximum width	235 mm (9.27 in.)
Weight	13 kg (28 lb)
Voltage	12 V
Maximum flow capacity	850 L/min (30 cfm)
Heater power	90 W

## Midland Pure Air Plus



Height	384 mm (15.1 in.)
Maximum width	236 mm (9.31 in.)
Weight	8 kg (18 lb)
Voltage	12 V
Maximum flow capacity	710 L/min (25 cfm)
Heater power	95 W

## CR Turbo 2000



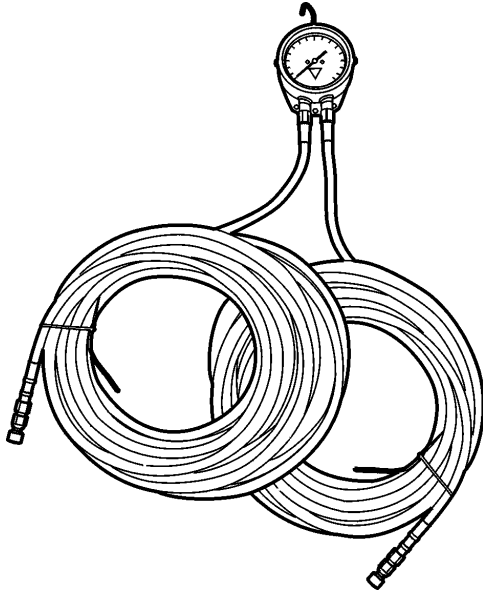
Height	413 mm (16.25 in.)
Maximum width	216 mm (8.5 in.)
Weight	7.5 kg (16.5 lb)
Voltage	12 V
Maximum compressor capacity	850 L/min (30 cfm)
Heater power	75 W



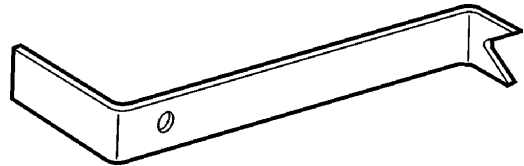
# Tools

## Special Tools

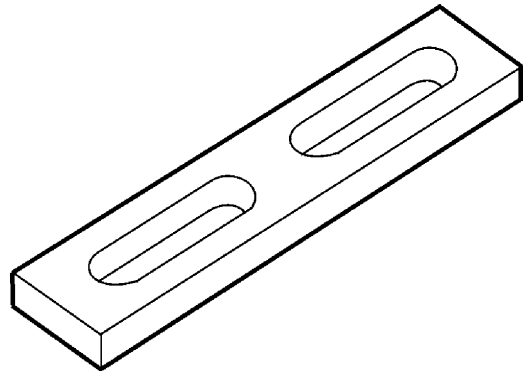
The following special equipment is used when checking air system pressure or safely disconnecting air lines. Equipment is available from Kent-Moore (telephone 1-800-328-6657).



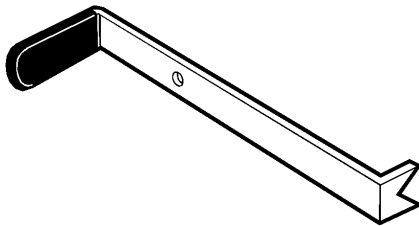
**J-44399** Dual air pressure gauge



**J-44773** Airline release tool



**J-44775** Valve assembly fixture



**J-42189** Air line disconnect tool



# Design and Function

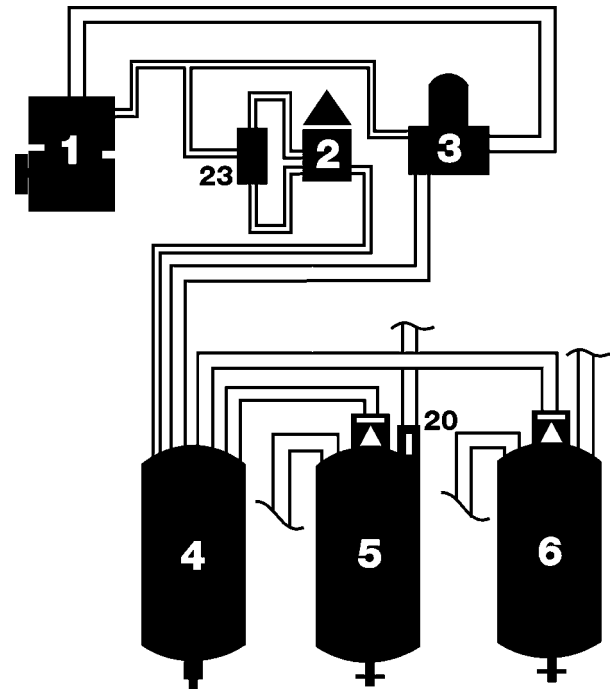
## Air Brake System

### General System Function

The supply system for the compressed air brakes consists of the compressor (1), governor (2), air dryer (3) and storage tanks (4, 5 and 6). Which compressor model is installed is dependent on engine manufacturer specification or customer choice.

A Bendix governor is standard for all compressors. The governor is installed away from the compressor on all vehicles with Volvo engine and Knorr compressor. A servo valve (23) is needed for the governor when installed away from the compressor (see "Servo Valve" page 18 for more information). For air schematics over supply systems on other models, refer to Group 5 air brake system schematics.

Also found in the supply system is the Purge Tank (See "Purge Tank" page 36).

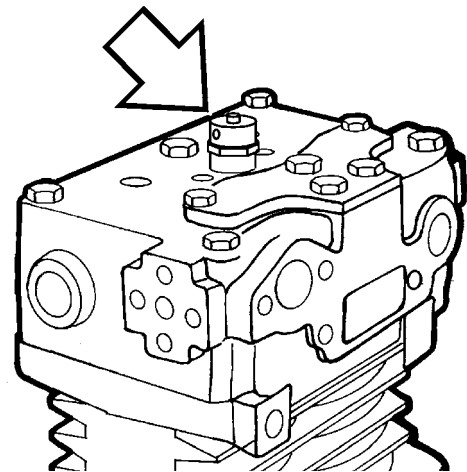


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### Compressor Relief Valve

There have been instances where problems downstream from the compressor has produced high pressures in the compressor resulting in damage to the head gasket. A relief valve has been introduced on some compressors and engine types to prevent damaging overpressure in the compressor.

The relief valve is typically installed in the valve head or very close to it. In the event of an overpressure, air will be released in short bursts from the valve as it opens. Opening pressure is set at 1.7 MPa (250 psi).

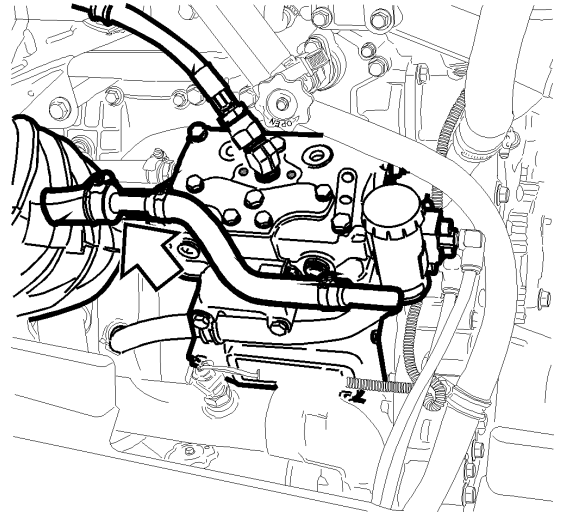


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## Compressor Air Supply

### *Normally Aspirated*

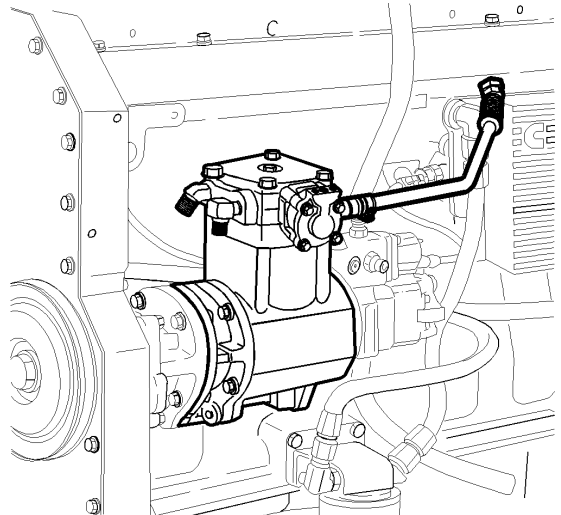
The air supply for compressors installed on all Volvo engines is normally aspirated. The intake piping is connected to the engine air filter piping on the clean side of the filter.



W5000754

### *Overpressurized Aspiration*

Compressors on Cummins, Detroit Diesel and Caterpillar engines have the air intake connected to the intake manifold of the engine. The air in the manifold is overpressurized by the turbo charger.

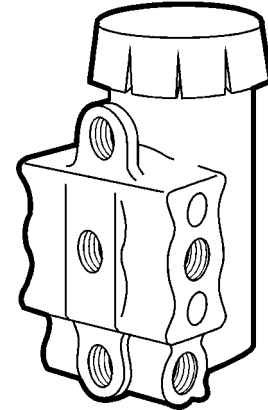


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## Governor

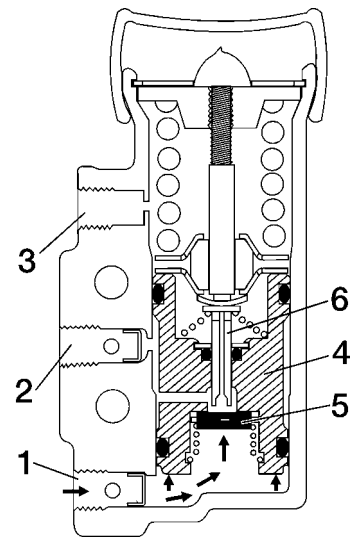
Today's governors are set from the factory. No attempt to adjust the cut out and cut-in pressures should be done. Always replace if faulty. Normal cut out pressure is 900 kPa (130 psi). Cut-in pressure is always 140 kPa (20 psi) less than the cut out pressure.

The governor, operating with the compressor unloading mechanism, automatically controls the air pressure in the air brake or air supply system between a maximum (cut out) pressure and a minimum (cut-in) pressure. The compressor runs continuously while the engine runs, but the actual compression of air is controlled by the governor, actuating the compressor unloading mechanism which stops or starts the compression of the air when the maximum or minimum reservoir pressures are reached.



W5000773

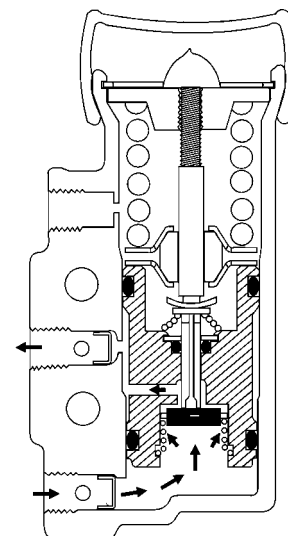
Reservoir air pressure enters the governor at one of its reservoir ports (1) and acts on the piston (4) and inlet/exhaust valve (5). As the air pressure builds up, the piston and valve move together against the resistance of the pressure setting spring.



W5000932

When reservoir air pressure reaches the cut out setting of the governor, the inlet/exhaust valve seats on the exhaust stem (6), closing the exhaust port (3), and then opens the inlet valve when the piston moves up. Reservoir air flows around the inlet valve, through the passage in the piston and out through the unloader port (2) to the compressor unloading mechanism.

As the system reservoir air pressure drops, the force exerted by the air pressure on the piston will be reduced and the governor spring will push the piston down. The inlet valve will close, the piston will move down and open the end of the exhaust stem. With the exhaust open, the air in the unloader line (2) will escape back through the piston, exhaust stem and out through the exhaust port (3).



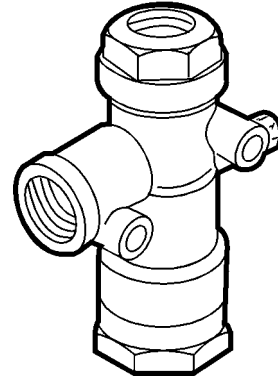
W5000933

## Servo Valve

Volvo engines equipped with the Knorr compressor have a governor located away from the compressor. The governor is equipped with a servo valve for boosting the signal to the compressor.

The servo valve is mounted together with the governor on a panel located on the frame. Depending on the model, the locations are as follows:

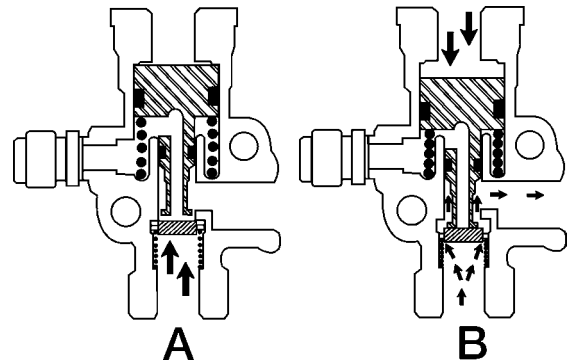
<b>VN/VHD</b>	Outside of left hand frame rail, behind battery box.
<b>Other</b>	Inside of right hand frame rail, close to rear cab support.



W5000765

For governors installed away from the compressor, the servo valve boosts the cut out signal from the governor. Normally, the servo valve is closed (A), with air pressure from the wet tank holding the valve closed.

The governor sends the cut out signal to the servo valve when air pressure has reached maximum system pressure. The signal activates the piston in the servo valve (B) which opens the valve, connecting air flow from the wet tank to the compressor and air dryer. The compressor will unload and the air dryer will go into its regeneration and purge cycle.



W5000930

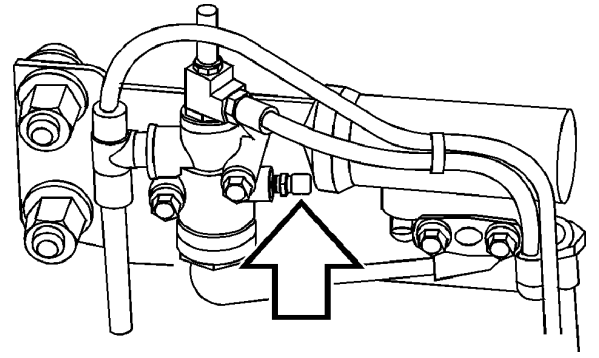
### *Servo Valve Ventilator Cap*

It is possible for the vent cap on the servo valve, P/N 8081072, (see arrow, page 19) to prevent air from exhausting completely, trapping air in the valve. This will cause the compressor to stay in the unloaded mode and/or the air dryer to stay in the purge mode, thus preventing the system pressure from properly building up.

A new vent cap design has been introduced into production. If the above failure should occur, the new vent cap, P/N 8061304, should be installed.

**Note:** This vent cap P/N 8061304 can be used for all models.

The servo valve is only installed on vehicles with Volvo engines equipped with a Knorr compressor. The servo valve/governor location is remote from the compressor. On VN vehicles, it is located between the battery box and the frame or, on later models, just in front of the battery box. VN/VHD location is on the outside of the frame rail, close to the cab support.



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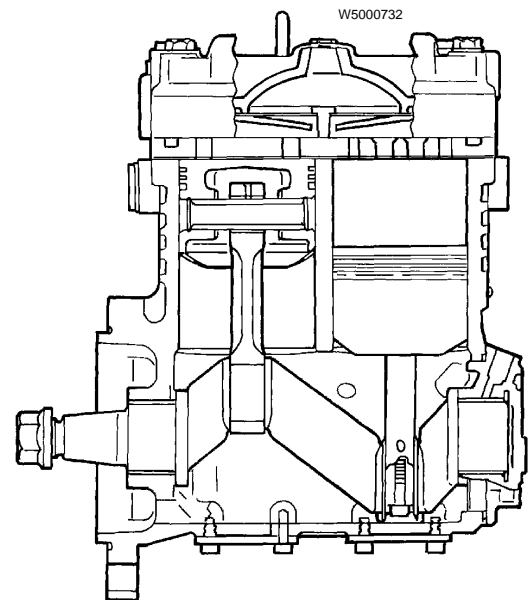
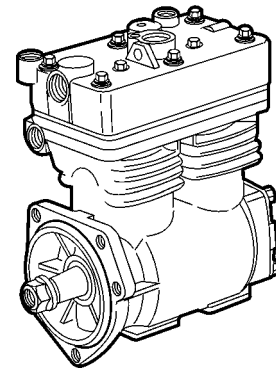
# Compressor

## Knorr 2COMP850

### Design

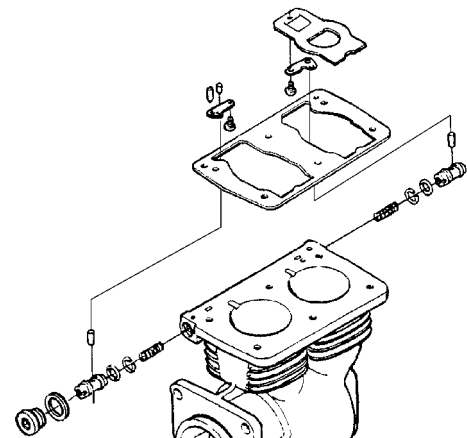
The 2COMP850 is a twin cylinder compressor that is standard equipment on Volvo engines since 1997. The compressor has a built in unloading system, ESS, which stands for Energy Saving System. The system reduces the power requirements for the compressor by approximately 80% when running unloaded and at the same time, oil consumption is reduced.

The Knorr compressor is driven directly from the engine timing gears with a gear wheel attached to the tapered end of the crankshaft with a keyless fit. The crankcase and cylinder block are cast as one unit and are air cooled. The cylinder head is cooled by the engine cooling system. The compressor is lubricated by the engine pressure lubrication system and the oil drains through the timing gear cover and back to the engine oil sump.



W5000733

The two inlet valves, which are also used for the ESS function, are mounted with pivot arms on guide pins which run in grooves in the cylinder block. The pivot arms are connected to the ESS system plungers via pins which are attached to the plungers and protrude above the block face through grooves in the block. When unloading, the plungers are pressed in with the help of compressed air from the governor and servo valve. The plungers work on the pins and pivot arms, pushing on the intake valves which are moved over to the unloading position.



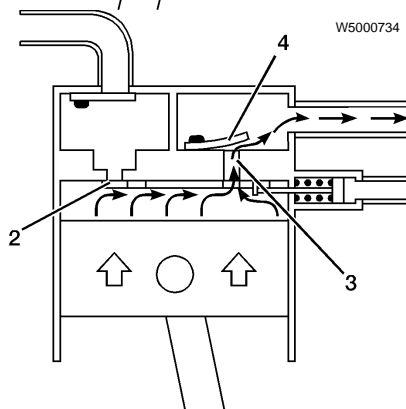
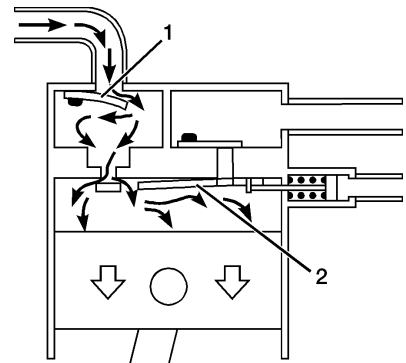
W5000969

## Function

### Charging

When the compressor piston travels downward, the check valve (1) and inlet valve (2) are opened by the vacuum created in the cylinder. The inlet ducts are exposed and air flows into the cylinder.

When the piston moves upward, the inlet valve (2) is closed by the pressure in the cylinder. The air passes out through a hole (3) in the inlet valve and past the outlet check valve (4) into the compressed air system.



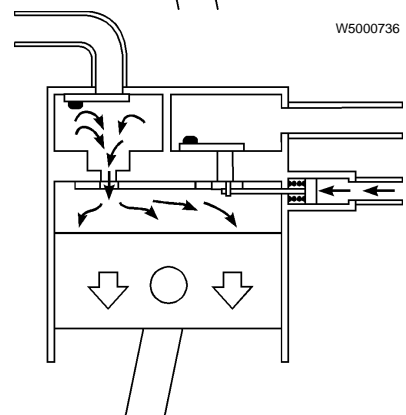
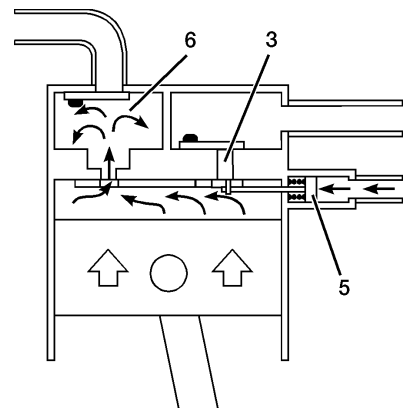
W5000734

W5000735

### Unloading

When the pressure in the system has reached the required level, the governor and servo valve send air to the unloading plunger (5). The plunger is pressed in and moves the inlet valve so that a connection is opened to a chamber (6) in the compressor cylinder head. At the same time, the passage (3) to the outlet valve is closed, which means that the air cannot pass out into the system.

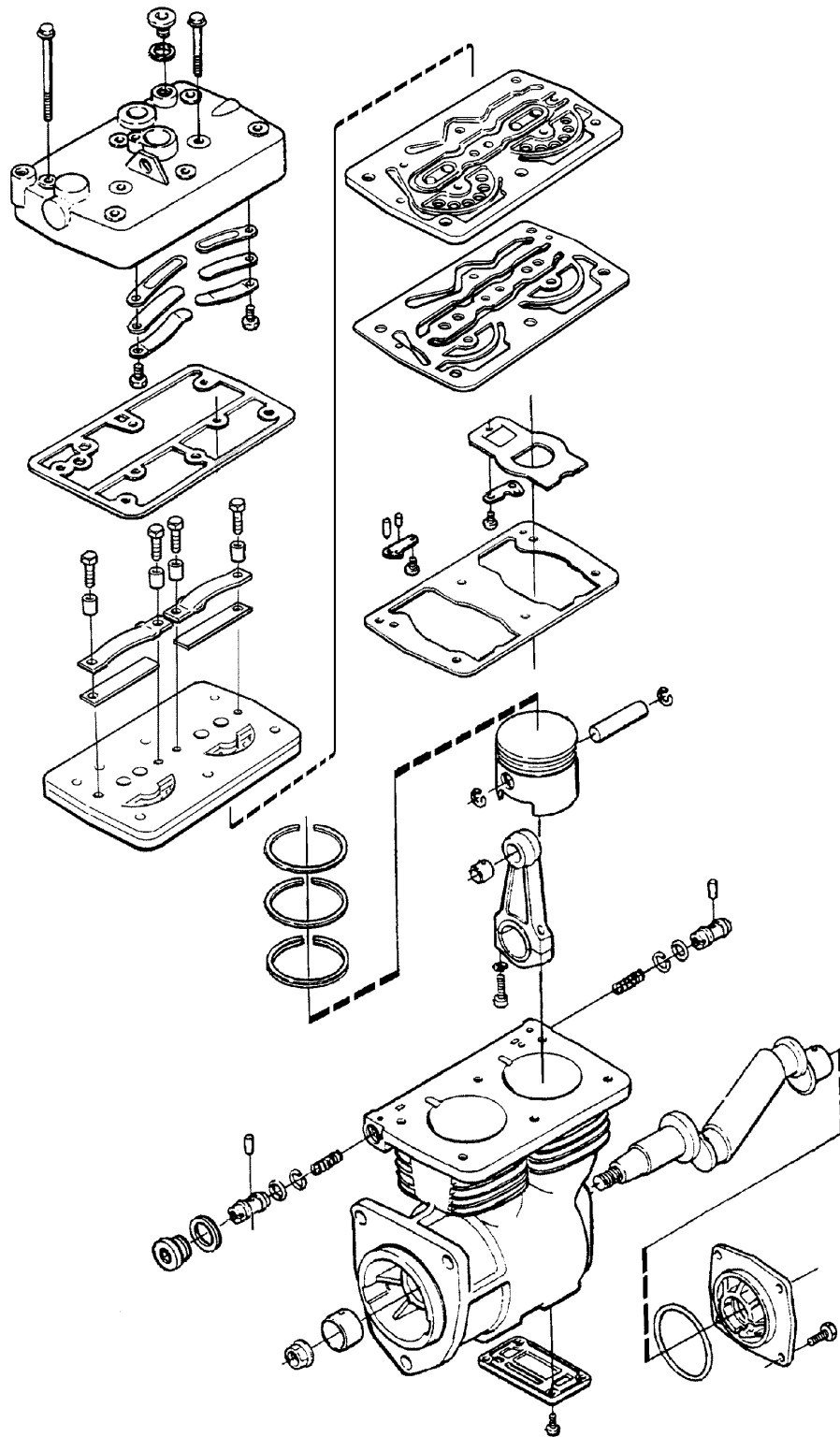
When the piston travels upward, the air in the cylinder is compressed and enters the chamber (6) in the cylinder head. The compressed air will provide a driving force for the piston in its downward movement. With the exception for losses in the form of heat, which is formed during the compression phase, the energy used to compress the air will be re-used as the driving force when the piston travels downward. This results in a compressor with ESS using very little power in the unloading position.



W5000736

W5000737

# Knorr 2COMP850

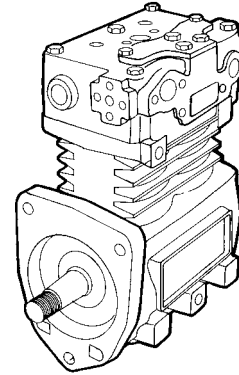


W5000727

## Bendix 550/750

### Design

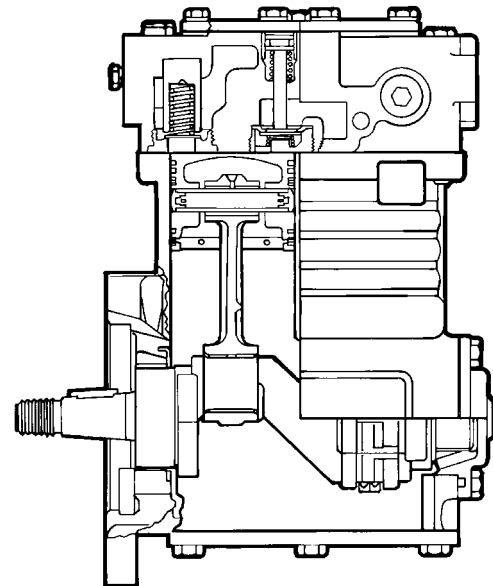
The Tu-Flo air compressor is a two cylinder, single stage, reciprocating compressor. The Tu-Flo 550/750 compressor consists of two major subassemblies, the cylinder head and the crankcase. The cylinder head is an iron casting which houses the inlet, outlet, and unloader valves. The cylinder head also contains the air inlet port and is designed with both top and side air outlet ports. The head is mounted on the crankcase and is secured by six screws.



W5000729

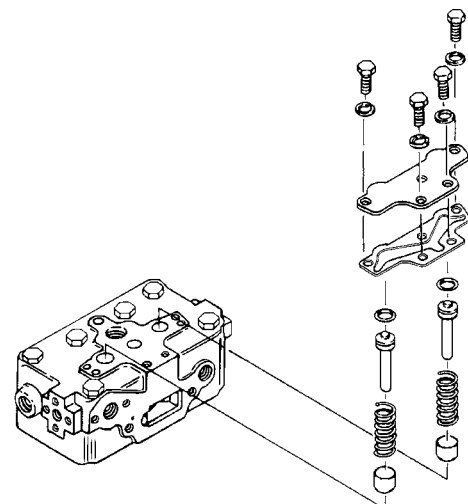
The crankcase houses the cylinder bores, pistons, crankshaft and main bearings, and provides the flange mounting surface.

The compressor is driven by the engine timing gears and is operating continuously while the engine is running. Actual compression of air is controlled by the compressor unloading mechanism and the governor. The governor is generally mounted on the compressor or close by and maintains the brake system air pressure to a preset maximum and minimum pressure level.



W5000730

The unloader valves are accessible from the top of the cylinder head. After removing the cover plate, the valves are easily serviced.



W5000774

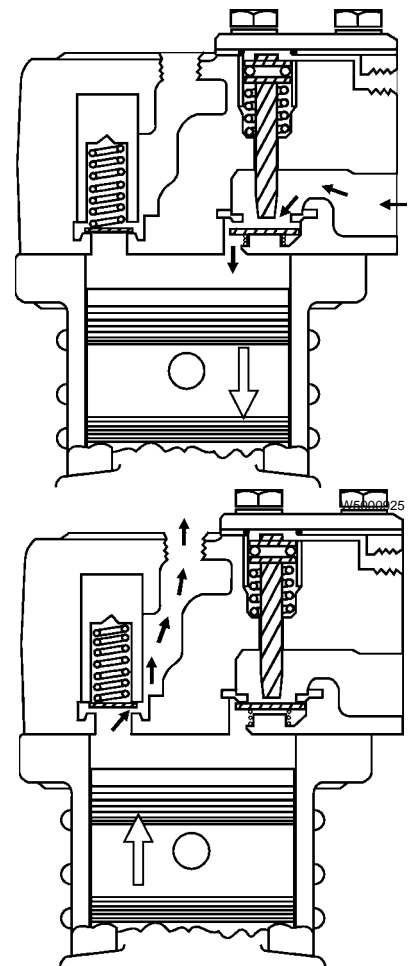
## Function

### *Charging*

During the down stroke of the piston, a slight vacuum is created between the top of the piston and the cylinder head, causing the inlet valve to move off its seat and open. Air, atmospheric or pressurized, flows through the air inlet port and the open inlet valve into the cylinder.

As the piston begins its upward stroke, the air that was drawn into the cylinder on the down stroke is being compressed. Air pressure on the inlet valve plus the force of the inlet spring, returns the inlet valve to its seat so it closes. As the piston continues the upward stroke, compressed air pushes the outlet valve off of its seat and air flows by the open outlet valve into the discharge pipe and out to the reservoirs.

As the piston reaches the top of its stroke and starts down, the outlet valve spring and air pressure in the discharge pipe returns the outlet valve to its seat. This prevents the compressed air in the discharged pipe from returning to the cylinder bore as the intake and compression cycle is repeated.

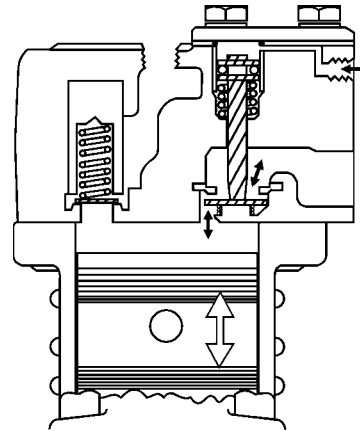


W5000926

### *Unloading*

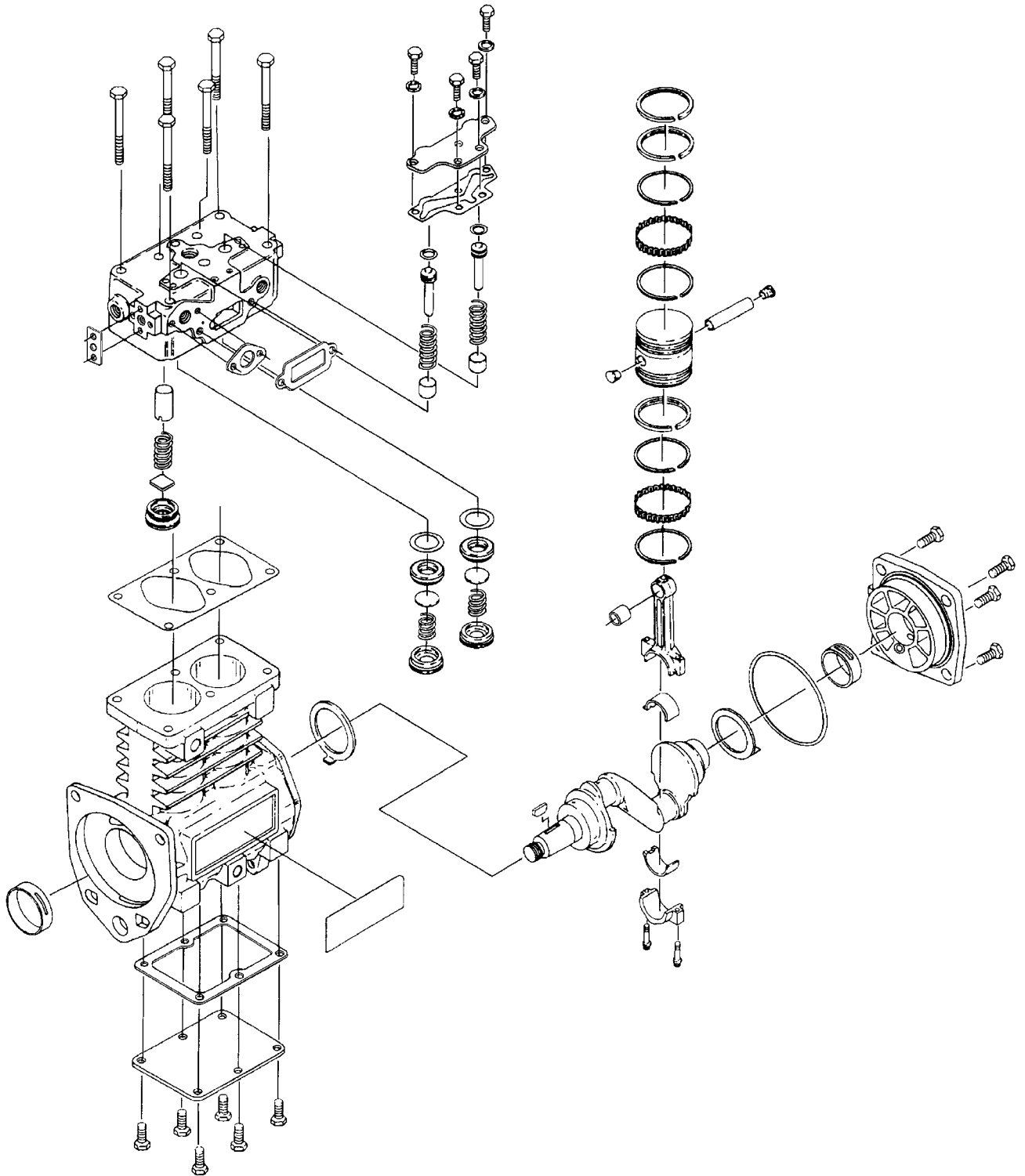
When the compressed air in the reservoir reaches the cut out pressure, the governor sends air from the reservoir to the cavity above the unloader pistons. The unloader pistons move down, holding the inlet valves off of their seats.

With the inlet valves held off of their seats by the unloader pistons, air is pumped back and forth between the two cylinders, and the outlet valves remain closed. When air pressure from the reservoir drops to the cut-in setting of the governor, the governor closes and exhausts the air from above the unloader pistons. The unloader springs force the pistons upward and the inlet valves return to their seats. Compression is then resumed.



W5000731

# Bendix 550/770

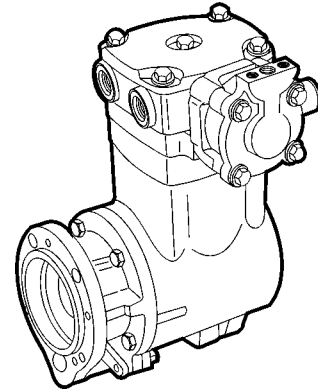


W5000849

## Holset

### Design

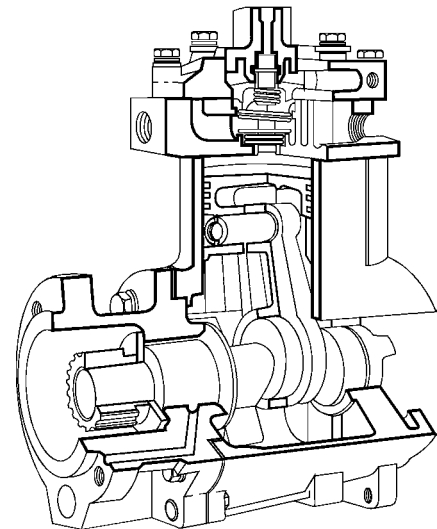
The Holset compressor is a single piston, single stage, reciprocating compressor which supplies compressed air to operate the air brakes and other air driven devices. The compressor runs continually, but has “loaded” and “unloaded” operating modes. The operating mode is controlled by the governor and the compressor unloading assembly.



W5000776

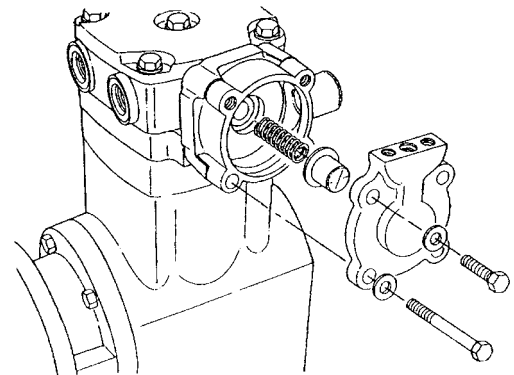
The compressor is flange mounted to the timing gear cover and driven by the timing gears. A sleeve connects the gear with the compressor input shaft.

The compressor is lubricated with pressurized engine oil. The oil provides both lubrication and cooling for bearings, piston rings and cylinder walls. The cylinder head is connected to the engine coolant system.



W5000738

All Holset compressors in Volvo vehicles from 1994 model year have only the QE type off-loading valve. This makes the compressor compatible with all air dryers except the Midland Pure Air Plus.

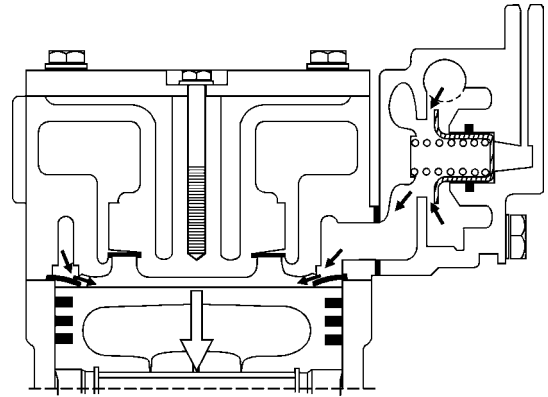


W5000931

## Function

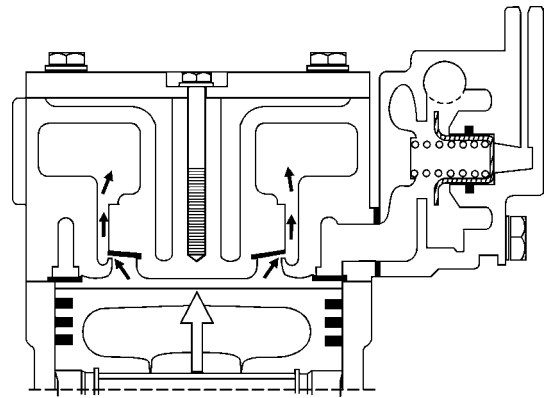
### *Charging*

During the down stroke of the piston, air enters the cylinder through the unloader body and intake valve. When the piston starts the up stroke, the intake valve closes.



W5000927

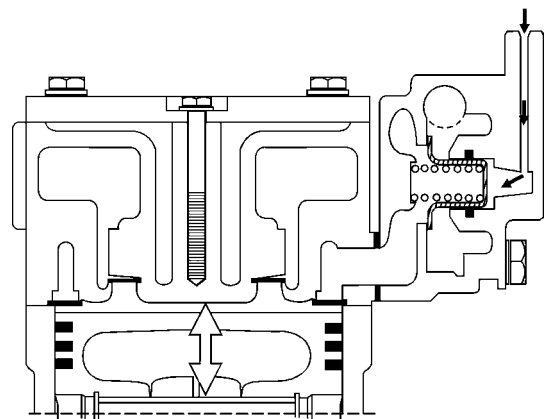
The piston compresses air during the up stroke. The outlet valve opens to let air out to the discharge pipe.



W5000928

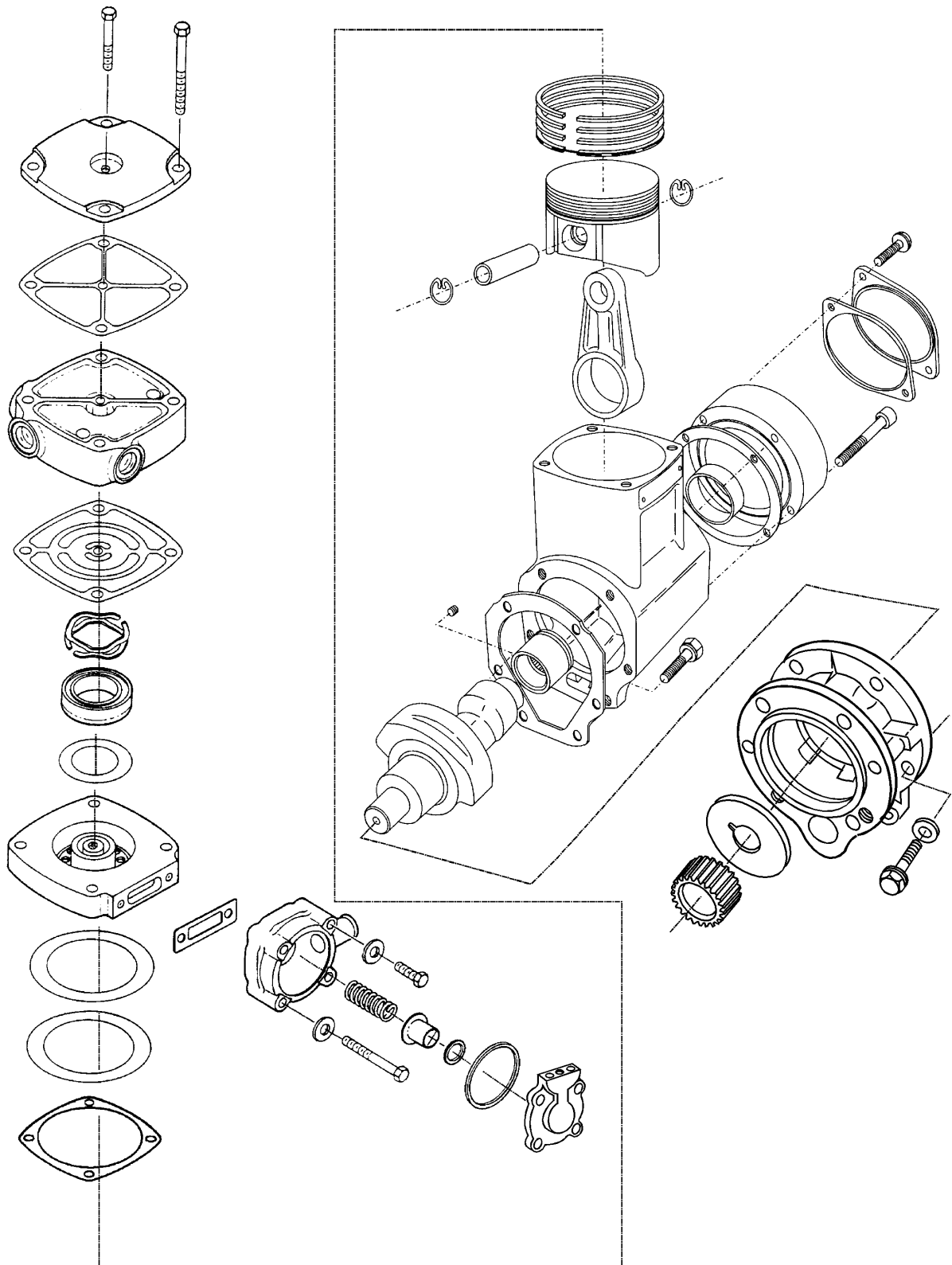
### *Unloading*

When the governor opens at the set cut out pressure, air flows to the unloader valve. The unloader piston will be pushed out to cover the air inlet opening of the compressor. The compressor piston will move up and down with the air compressing and uncompressing without any air being delivered.



W5000929

# Holset QE296



W5000851

# Air Dryer

## Wabco System Saver 1000/1200 Series

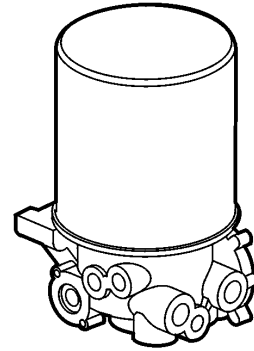
The dryer incorporates valves for both types of compressors used. Desiccant is contained in a disposable cartridge that is screwed onto the valve housing.

**Note:** The Air Dryer Wabco System Saver 1200 Series P does not have a Regeneration Valve to cool air intake. The System Saver relies on the Purge Tank to perform this function.



### WARNING

Do not disassemble the cartridge. No replacement parts are available and the cartridge contains a spring under pressure which can not be mechanically caged. The sudden release of the spring could cause it to be ejected violently, causing serious personal injury.



W5001194

### *Charge Cycle*

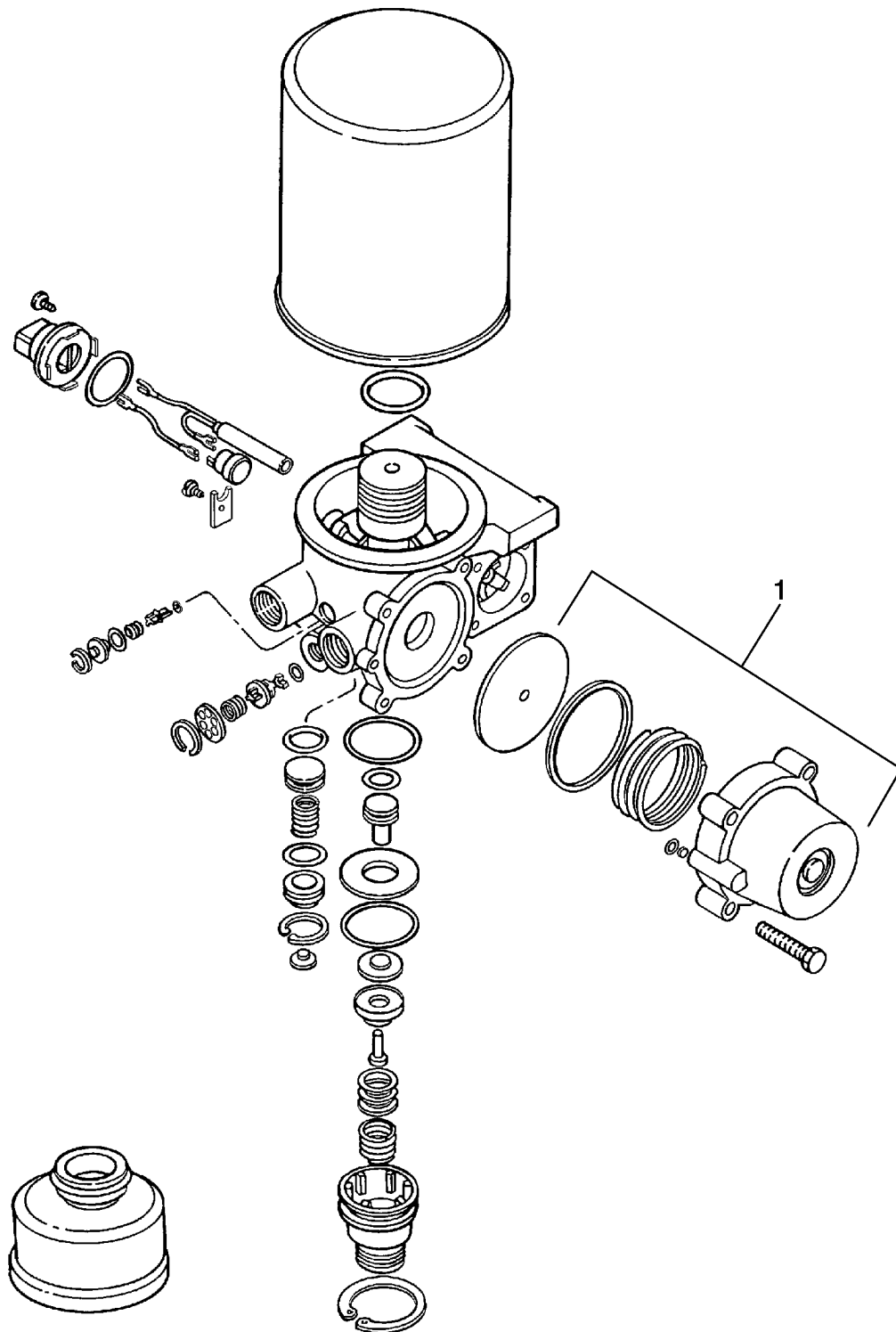
During system pressure build-up, compressed air passes into the air dryer where the coalescent filter removes contaminants and the air is further cooled at the outer walls of the cartridge. Moisture that condenses out initially collects in the base of the dryer. The moisture laden air then flows through the desiccant from the top to the bottom and becomes progressively drier as water vapor is adsorbed.

Dry air exits at the bottom of the cartridge and flows through the check valve and then exits out to the wet tank.

### *Purge Cycle*

When the compressor unloads, the purge valve opens allowing the initial decompression of the dryer (purge) and expels the water collected in the base of the dryer. The volume of air held in the purge tank back flows through the desiccant. This flow cleans and dries the desiccant preparing it for the next cycle. The air held in the purge tank is the cleanest air from the completed pumping cycle. This provides a more efficient regeneration (purge) cycle.

## Air Dryer Wabco System Saver 1000/1200 Series



1 Regeneration Valve for the Wabco Air Dryer 1000, 1200, 1200E Series

**Note:** The Wabco Air Dryer 1200P Series does not use the Regeneration Valve

W5001211

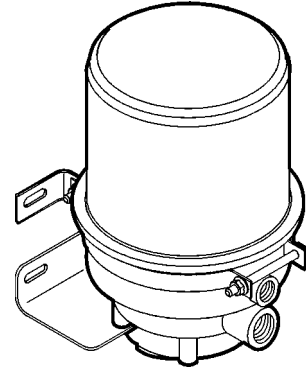
## Bendix AD-IP

This dryer is used in two configurations where one is used exclusively for the Holset compressor. Because of the need for the Holset to have the discharge line fully pressurized also during the unloaded mode, the dryer for the Holset compressor has a check valve arrangement that ties the wet tank pressure cycle into the discharge line during the air dryer purge cycle.



### WARNING

Do not disassemble cartridge. No replacement parts are available and the cartridge contains a spring under pressure which can not be mechanically caged. The sudden release of the spring could cause it to be ejected violently, causing serious personal injury.



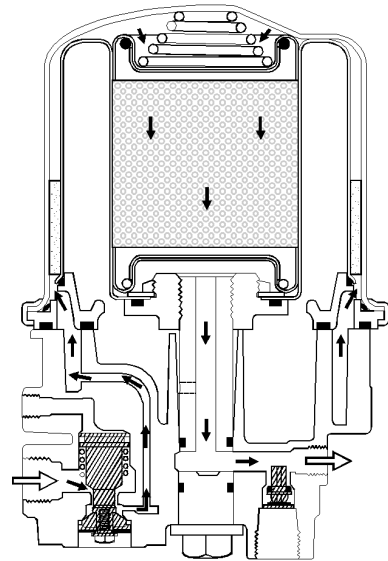
W5000751

### Charge Cycle

During compressor loading, air flows into the supply connection of the housing changing direction several times, thereby reducing the temperature, causing contaminants to condense and drop to the bottom toward the purge valve.

After exiting the housing, air flows into the cartridge. A coalescent filter, located between the outer and inner shells, separates heavier contaminants. Air, along with remaining water vapor, is further cooled as it continues to flow through the desiccant from the top to the bottom and becomes progressively drier as water vapor is adsorbed.

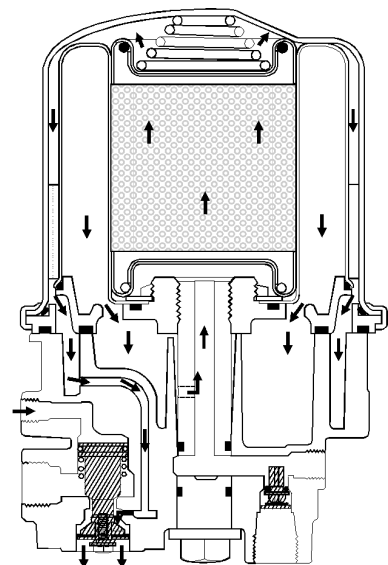
Dry air exits at the bottom of the cartridge and flows through the check valve and then exits the discharge connection for the wet tank. Dry air also flows through the purge orifice to fill up the purge volume storage.



W5000741

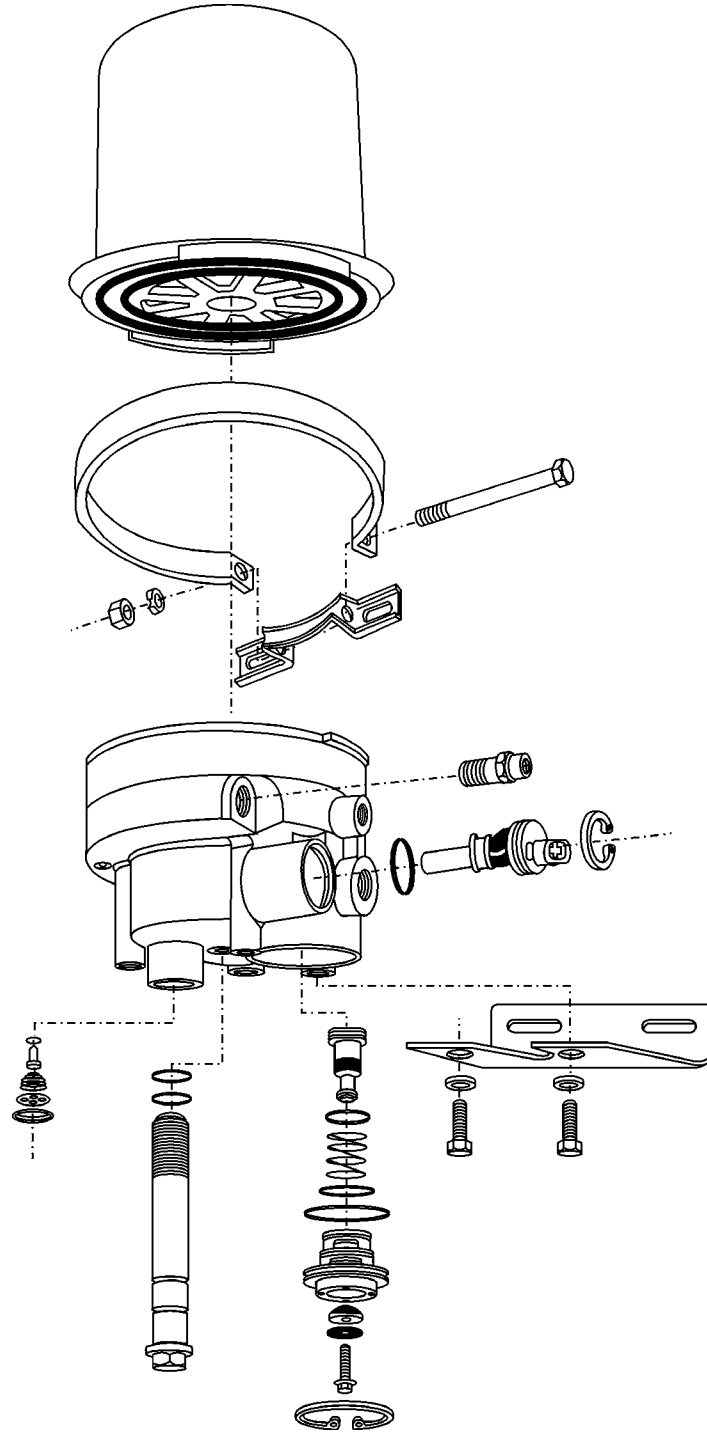
### Purge Cycle

Regeneration of the desiccant takes place during the time it takes for the purge volume to slowly flow back through the purge orifice and into the desiccant bed. There it removes water vapor collected by the desiccant. The regeneration takes approximately 30 seconds.



W5000742

# Bendix AD-IP



W5000778

## CR Turbo–2000

The dryer incorporates valves for both types of compressors used. A separate purge tank is used as there is no internal purge air storage. Desiccant is contained in a disposable cartridge that is screwed onto the valve housing.



### WARNING

Do not disassemble cartridge. No replacement parts are available and the cartridge contains a spring under pressure which can not be mechanically caged. The sudden release of the spring could cause it to be ejected violently, causing serious personal injury.

### Charge Cycle

During compressor loading, air flows into the supply connection of the valve housing where it expands and is cooled. This causes oil and water vapor to condense and fall to the bottom.

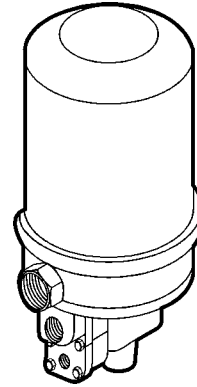
After exiting the valve housing, air flows into the cartridge. A coalescent filter, located between the outer and the inner shells, separates heavier contaminants. Air, along with remaining water vapor, is further cooled as it continues to flow upward between the outer and inner shells. It then flows through the desiccant from the top to the bottom and becomes progressively drier as water vapor is adsorbed.

Dry air exits the bottom of the cartridge, flows through the check valve and then exits the discharge connection onto the wet tank. Dry air also flows through the purge valve or orifice to fill the purge tank.

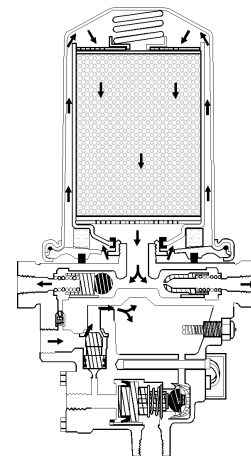
### Purge Cycle

As air pressure reaches the cut out setting of the governor, the compressor unloads and the purge cycle of the dryer begins: The governor sends air to the control connection, thereby closing the turbo valve which closes off the air supply from the compressor. At the same time, the purge valve opens to atmosphere and expels separated contaminants in the initial air pressure release. Air is also flowing from the wet tank back to pressurize the supply line via a check valve.

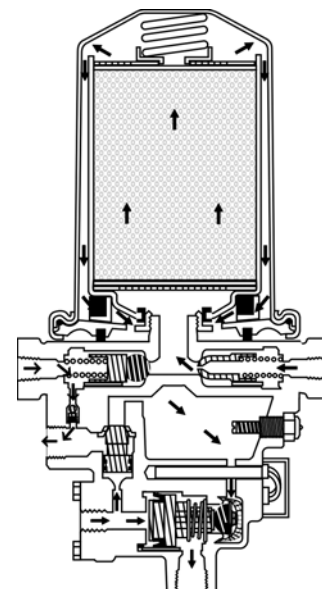
Regeneration of the desiccant takes place during the time it takes for the purge volume to slowly flow back through the purge orifice and into the desiccant bed. There it removes the water vapor collected in the desiccant. The regeneration takes less than a minute.



W5000740



W5000745



W5000746

## Midland Pure Air Plus

A separate, replaceable coalescent filter is used for separating out large particles. This should be changed every 12 months regardless of desiccant cartridge exchange. Desiccant is contained in a disposable cartridge that is screwed on to the valve housing.

**Note:** Midland Pure Air Plus air dryers are not available with Holset compressors.



### WARNING

Do not disassemble the cartridge. No replacement parts are available and the cartridge contains a spring under pressure which can not be mechanically caged. The sudden release of the spring could cause it to be ejected violently, causing serious personal injury.

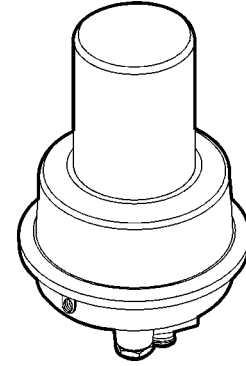
### Charge Cycle

During compressor loading, air flows into the supply connection of the valve housing where it expands and is cooled. This causes oil and water vapor to condense and fall to the bottom.

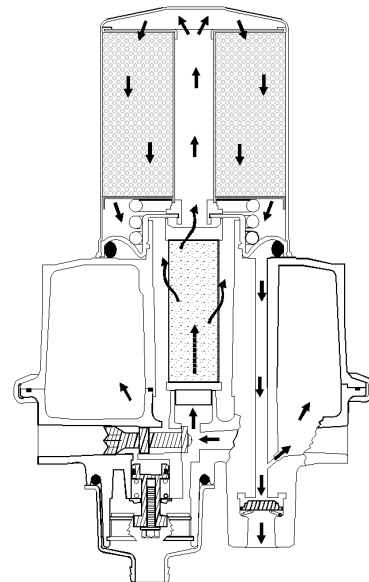
After exiting the valve housing, air flows through the coalescent filter where heavier contaminants are separated. Air, along with remaining water vapor, is further cooled as it moves up into the cartridge. It then flows through the desiccant from the top to the bottom and becomes progressively drier as water vapor is adsorbed. Dry air exits the bottom of the cartridge and flows through the check valve and then exits the delivery connection on the wet tank. Dry air also flows through the purge valve or orifice to fill up the purge tank.

### Purge Cycle

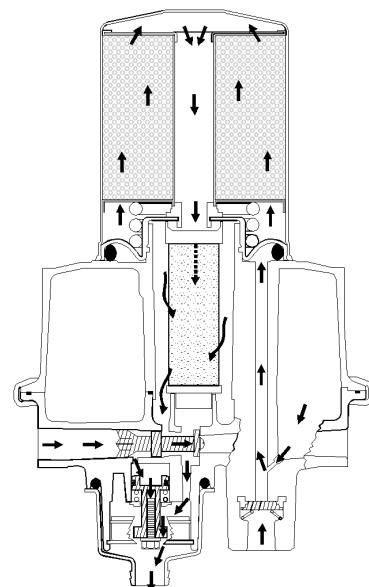
As air pressure reaches the cut out setting of the governor, the compressor unloads and the purge cycle of the air dryer begins: The governor sends air to the control connection, thereby closing the turbo valve which closes off the air supply from the compressor. At the same time, the purge valve opens to the atmosphere.



W5000747



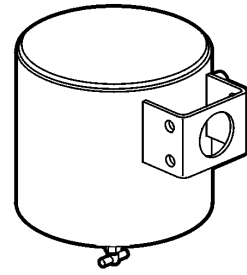
W5000749



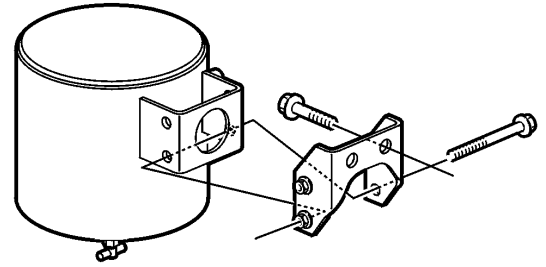
W5000750

## Purge Tank

The new purge tank provides the air volume used to clean or regenerate the Dryer at the end of each compressor pumping cycle. It is used with the Wabco 1200P and the CR Turbo 2000 Dryers. For replacement information see, "Purge Tank, Replacement" page 79. More information is pending.



W5001192



W5001193

## Air Tubing and Fittings

The foldouts represent the brake system as a schematic layout or show actual routing in the vehicle. Foldouts A and B are schematics of the entire brake system on a 4x2 and a 6x4 vehicle. All other foldouts show the brake system valves and tubing in separate circuits. All color on tubing and in the schematic layouts conform to the standardized color scheme listed to the right.

The tubing in the foldouts are colored the same as the actual tubing in the vehicle. This helps the identification and troubleshooting process with less possibility for mistakes.

### TUBING COLOR, PRIMARY

BLUE	Supply System Circuit
RED	Front Service Brake Circuit
GREEN	Rear Service Brake Circuit
ORANGE	Parking Brake Circuit

All tubing is made of nylon and sizes are always measured as an outer diameter (OD). The 1/4 in. tubing is a solid core, single ply extrusion. All other sizes are made of a solid core, covered with a protective, colored layer with fiber reinforcement between the layers. The cover is treated for heat and sunlight resistance.

In areas where great flexibility is needed, air is routed in rubber hoses, for example, between frame and the axles. A hose is built up of three layers of rubber and reinforcement. Hoses are specifically made for each installation to the correct length with crimped on fittings on either end.

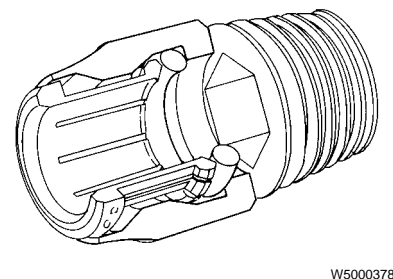
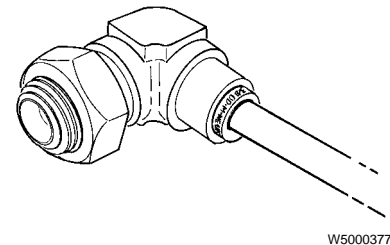
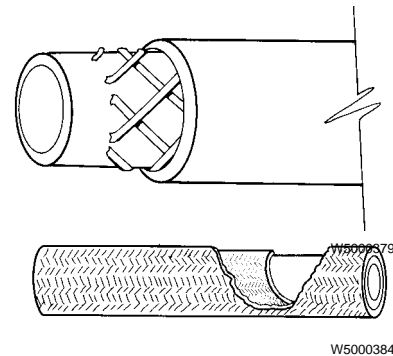
Fittings are typically of the push-connect type. To connect or disconnect tubing is very easy, which simplifies troubleshooting in the air system. New, simple test gauges have been introduced for testing the valves and pressures (See Service Manual: *Air Valves and Components*).

The fitting body is made of brass. An internal O-ring seals on the outside diameter of the tubing and the retaining collar holds the tubing firmly in place. Straight fittings have an internal hex grip, most others have external hex grip. A number of valves also come with push-type connectors already installed in the valve body.

The fitting is designed for letting the tubing rotate to eliminate kinks. The fitting IS NOT designed for locations with continuous movement, such as, between frame and axle. Threads are pre-applied with sealant. A fitting can be reused in the same port up to five times before new sealant needs to be applied.

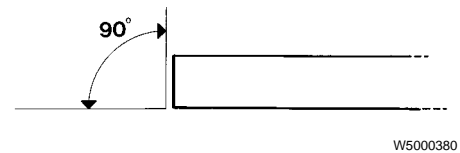
### TUBING COLOR, SECONDARY

BLUE (1/4 in.)	Air Suspension Exhaust
GREY (1/4 in.)	Diff. Lock, Interaxle
GREY (3/8 in.)	Trailer Hand Control
BROWN (1/4 in.)	Diff. Lock, Interwheel
YELLOW (1/4 in.)	Fifth Wheel Air Cylinder
YELLOW (3/8 in.)	Compressor Supply; Exhaust
ORANGE (1/4 in.)	Bobtail Balance Control
BLACK (1/4 in.)	Air Seat; Options Supply
PURPLE (1/4 in.)	Air Suspension - Air Pressure Gauge



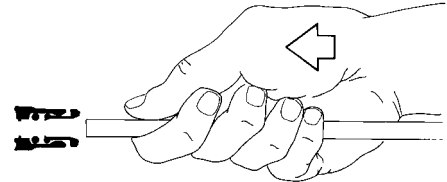
### *Air Tubing Installation*

To ensure a tight seal between tubing and fitting, the tubing end needs to be cut straight. Also, inspect tubing that has been removed for “teethmarks” around the perimeter where the retaining collar holds the tubing in place. If the marks are too deep, that is, can be easily seen or a depression can be felt by running a fingernail across mark, recut the tubing before reinstalling.



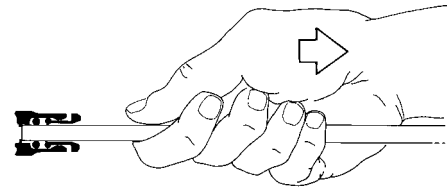
W5000380

Installing is done by aligning tubing in a straight line with the fitting opening. Push until the tubing stops against the bottom of the fitting.



W5000381

When the tubing has bottomed in the fitting, pull back to make the collar retaining teeth engage the tubing. Do not pull too hard, only enough to ensure that the collar has gripped the tubing.

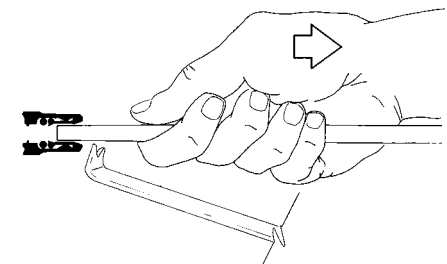


W5000382

### *Air Tubing Removal*

To make removal easier, remove tubing when valve or component is still in place.

To disconnect, push the tubing into the fitting until it bottoms. Use release tool J-42189 to push in the collar and then pull out tubing while holding the collar in.



W5000580

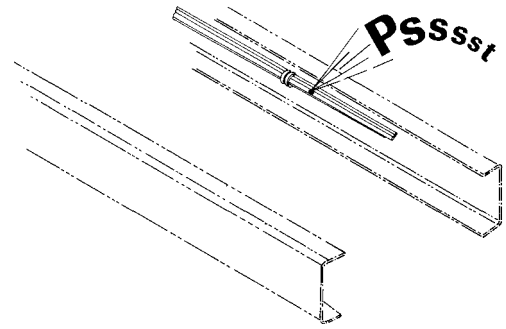
## Air Tubing Repair

In the event that tubing has been severed as the result of an accident or if tubing needs to be lengthened for rerouting, there are certain procedures that must be followed.

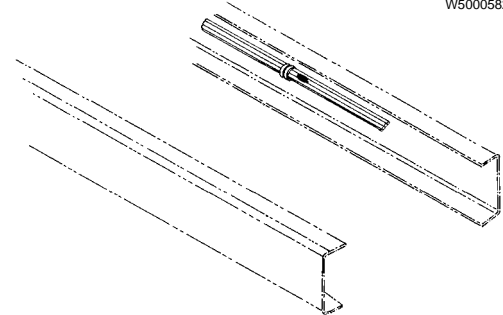
In general, there are no restrictions against repairing tubing versus replacing it. A repaired tubing has the same integrity as the rest of the system if the repairs are done properly. Tube to tube fittings are available for 1/4, 3/8 and 1/2 in. tubing.

Damage to one tube is repaired so that the repair fitting is close to a bracket for support. Prepare the tubing as outlined on the previous page. Push the tubing ends into the fitting. Leak test fitting at full pressure after system pressure has been established again.

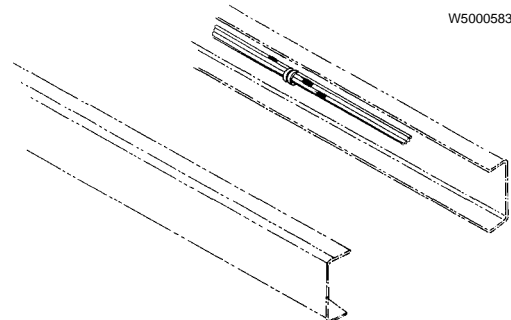
If a whole bundle of tubing needs to be repaired or lengthened, make sure the fittings are staggered instead of installed at the same length. Put the larger fittings close to a bracket for support and the smaller fittings further away.



W5000582



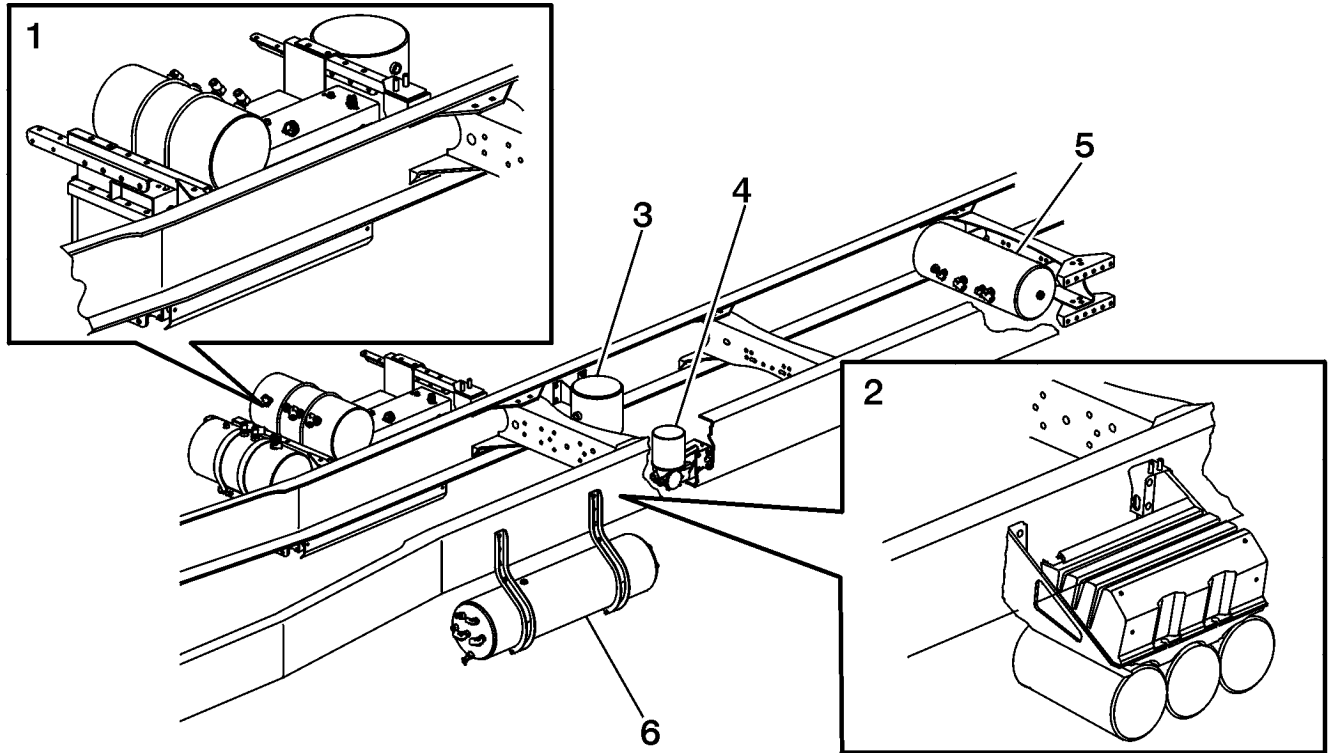
W5000583



W5000584

## Air Tank Mounting

Air Tanks are found in several locations on the VN and VHD vehicles. The illustration shows the standard mounting for the various air tanks. For Air Tank replacement instructions see, "Air Tank, Replacement" page 81.



W5001147

1 VHD – Right Side frame rail Option

2 VN/VHD – Left Side frame rail

3 Purge Tank

4 Air Dryer VN/VHD

5 Crossmember Mounted VHD

6 Dual Compartment Wet Tank and Rear Brake Tank

# Troubleshooting

## Compressor Troubleshooting

Symptom	Cause	Remedy
Long charging time or will not build air pressure (does not stop pumping).	<ul style="list-style-type: none"> <li>• Intake pipe is blocked.</li> <li>• Discharge pipe leaking or blocked.</li> <li>• Inlet or outlet valves faulty.</li> <li>• Unloader valves sticking.</li> <li>• Slipping drive components.</li> <li>• Air dryer purge valve leaking or frozen. Blocked dryer cartridge.</li> <li>• Automatic drain valve on reservoir leaking or frozen.</li> <li>• Governor faulty.</li> </ul>	<ul style="list-style-type: none"> <li>• Check pipe.</li> <li>• Check pipe and fittings for leaks/blockage.</li> <li>• Replace compressor.</li> <li>• Replace unloader valves.</li> <li>• Inspect drive components.</li> <li>• Clean or thaw out the valve. Replace valve if necessary.</li> <li>• Clean or thaw out the valve. Replace if necessary.</li> <li>• Replace governor (make sure the control tubing is OK).</li> </ul>
Compressor builds too much or not enough air pressure.	<ul style="list-style-type: none"> <li>• Governor faulty.</li> <li>• Compressor fails to unload.</li> </ul>	<ul style="list-style-type: none"> <li>• Replace governor.</li> <li>• Check for sticking unloader valves. Test governor and inspect tubing.</li> </ul>
Compressor constantly cycles.	<ul style="list-style-type: none"> <li>• Excessive fluid in reservoirs.</li> <li>• Governor faulty.</li> <li>• Compressed air system leaks.</li> </ul>	<ul style="list-style-type: none"> <li>• Drain reservoirs.</li> <li>• Replace governor.</li> <li>• Checks for leaks in unloader valves, reservoirs, tubing, fittings, air dryer and drain valve.</li> </ul>
Compressor noisy.	<ul style="list-style-type: none"> <li>• Loose drive gear or drive components.</li> <li>• Worn compressor.</li> </ul>	<ul style="list-style-type: none"> <li>• Inspect compressor drive for loose components.</li> <li>• If low running time, check for proper oil pressure, coolant flow and duty cycle. Replace compressor.</li> </ul>
External oil or coolant leaks.	<ul style="list-style-type: none"> <li>• Porous casting.</li> <li>• Leaking supply lines or fittings.</li> <li>• Cracked crankcase or head.</li> <li>• Damaged mounting gasket between compressor and timing gear housing.</li> </ul>	<ul style="list-style-type: none"> <li>• Replace compressor.</li> <li>• Check fasteners and seals.</li> <li>• Replace compressor.</li> <li>• Check fastener torque, replace gasket if necessary.</li> </ul>

<b>Symptom</b>	<b>Cause</b>	<b>Remedy</b>
Compressor head gasket failure.	<ul style="list-style-type: none"> <li>● Restricted discharge line or dryer cartridge, loose head bolts or faulty gasket.</li> <li>● Wintertime freeze-up in discharge line.</li> </ul>	<ul style="list-style-type: none"> <li>● Check for restrictions, bolt torque, change gasket (consider installing relief valve).</li> <li>● Check for low spots in the slope of the discharge line where water can collect.</li> </ul>
Compressor passes excessive amounts of oil into the air system.	<ul style="list-style-type: none"> <li>● Restricted air inlet.</li> <li>● Restricted oil return to engine.</li> <li>● Worn piston rings due to dirt in air supply, high operating temperature due to exterior dirt accumulation or low coolant flow.</li> <li>● Excessive engine crankcase pressure.</li> <li>● Runs loaded for excessive time.</li> </ul>	<ul style="list-style-type: none"> <li>● Check pipe.</li> <li>● Check oil return for problems.</li> <li>● Check supply piping for leaks. Clean compressor. Check operating temperature of compressor. Replace compressor.</li> <li>● Test engine crankcase pressure and check crankcase ventilation.</li> <li>● Drain reservoirs. Check for leaks in supply and accessory systems.</li> </ul>

## Air Dryer Troubleshooting

Symptom	Cause	Remedy
Dryer is constantly cycling or purging.	<ul style="list-style-type: none"> <li>Excessive fluid in reservoirs.</li> <li>Governor faulty.</li> <li>Excessive system leakage.</li> </ul>	<ul style="list-style-type: none"> <li>Drain reservoirs.</li> <li>Replace governor.</li> <li>Check for leaks in unloader valves, reservoirs, tubing, fittings, air dryer and drain valve.</li> </ul>
Air leaks from exhaust port during pressure build-up.	<ul style="list-style-type: none"> <li>Purge valve worn.</li> <li>Dirt stuck in purge valve.</li> <li>Frozen purge valve.</li> <li>Governor faulty.</li> <li>Control air lines connected to the wrong port.</li> </ul>	<ul style="list-style-type: none"> <li>Clean or replace valve.</li> <li>Clean or replace valve.</li> <li>Check heater.</li> <li>Replace governor.</li> <li>Check connections against air line schematic.</li> </ul>
Air dryer does not unload when the compressor unloads.	<ul style="list-style-type: none"> <li>Purge valve is worn, stuck closed or is frozen shut.</li> <li>Tubing between governor and air dryer leaking, damaged or kinked.</li> </ul>	<ul style="list-style-type: none"> <li>Clean or replace purge valve. Check heater.</li> <li>Repair or replace the air tubing.</li> </ul>
Purge cycle is too long (more than 30 to 40 seconds).	<ul style="list-style-type: none"> <li>Purge valve stuck open.</li> <li>Turbo valve is leaking.</li> <li>Outlet valve stuck open.</li> </ul>	<ul style="list-style-type: none"> <li>Replace valve.</li> <li>Replace valve.</li> <li>Replace valve.</li> </ul>
Excessive amounts of water in air reservoirs.	<ul style="list-style-type: none"> <li>Desiccant saturated.</li> <li>Insufficient purge time due to leaks in the air system.</li> <li>Excessive temperature of air going into air dryer.</li> <li>Air dryer not purging.</li> </ul>	<ul style="list-style-type: none"> <li>Replace desiccant cartridge.</li> <li>Check for leaks in supply system or in accessories.</li> <li>Compressor runs hot (inlet air to dryer maximum 65°C [150°F]).</li> <li>Check purge valve. Check tubing from air dryer to the governor; WABCO: Tubing between wet tank and air dryer kinked or blocked.</li> </ul>

<b>Symptom</b>	<b>Cause</b>	<b>Remedy</b>
Safety valve opens (if equipped).	<ul style="list-style-type: none"><li>● Output valve blocked.</li><li>● Tubing blocked downstream from air dryer.</li><li>● Safety valve faulty.</li><li>● Desiccant cartridge plugged.</li><li>● Governor faulty so compressor overcharges.</li></ul>	<ul style="list-style-type: none"><li>● Clean or replace valve.</li><li>● Check for blockage, kinks or faulty components.</li><li>● Replace valve.</li><li>● Replace desiccant cartridge.</li><li>● Replace governor.</li></ul>
Air dryer valves freeze up.	<ul style="list-style-type: none"><li>● Heater or thermostat inoperative.</li></ul>	<ul style="list-style-type: none"><li>● Check fuse. Check for defective wiring, heater element or thermostat.</li></ul>

# Service Procedures

## General Work Practices



### DANGER

Before working on a vehicle, set the parking brakes, place the transmission in neutral and chock the wheels. Failure to do so can result in unexpected vehicle movement and can cause serious personal injury or death.



### WARNING

Before beginning any service work on any part or the air system, be certain that the air pressure has been released. Failure to do so may cause components to violently separate causing serious eye and or personal injury.



### WARNING

Always wear appropriate eye protection to prevent the risk of eye injury due to contact with engine debris or fluids.



### WARNING

**HOT ENGINE!** Keep yourself and your test equipment clear of all moving parts or hot engine parts and/or fluids. A hot engine and/or fluids can cause burns or can permanently damage test equipment.



### WARNING

Do not work near the fan with the engine running. The engine fan can engage at any time without warning. Anyone near the fan when it turns on could be seriously injured. Before turning on the ignition, be sure that no one is near the fan.

## Inspection

It is of the utmost importance that the compressor receives a clean supply of air. The air strainer must be properly installed and kept clean. If the compressor intake is connected to the engine air cleaner, this connection must be properly installed and maintained. Check the drive for proper alignment belt tension, etc. Inspect the oil supply and return lines. Be sure these lines are properly installed and that the compressor is getting the proper supply of oil, and just as important that the oil is returning to the engine. Check the coolant lines to and from the compressor. Check the unloader mechanism for proper operation.

## Operation Test

Vehicles manufactured after the effective dates of FMVSS 121, with the minimum required reservoir volume, must have a compressor capable of raising the air system pressure from 585 – 690 kPa (85 – 100 psi) in 25 seconds or less. This test is performed with the engine operating at maximum recommended governed speed.

## Air Leak Test

Air leaks past the discharge valve can be detected as follows: Remove the discharge line and cylinder head from the compressor and apply shop air back through the discharge port. Coat the discharge valve seats with soapy water. Air leaks should not exceed a one inch diameter soap bubble in 3 seconds.

The unloader pistons can be checked for air leaks as follows: Build up the air system to governor cut out and shut the engine off. Listen for escaping air at the compressor intake. To pinpoint air leaks, apply a small amount of oil around the unloader pistons. No leaks are permitted. If the compressor does not function as described above, or leakage is excessive, replacement is recommended.

## 5611-03-02-02 Compressor, Replacement (Knorr)

Before beginning this procedure read the General Work Practices section ( "General Work Practices" page 45) for further information.

See "Knorr 2COMP850" page 20 for important service information before beginning this procedure.

See "Knorr 2COMP850" page 22 for an exploded view of the Knorr compressor.

### **DANGER**

Before working on a vehicle, set the parking brakes, place the transmission in neutral, and block the wheels. Failure to do so can result in unexpected vehicle movement and can cause serious personal injury or death.

### **WARNING**

Do not work near the fan with the engine running. The engine fan can engage at any time without warning. Anyone near the fan when it turns on could be seriously injured. Before turning on the ignition, be sure that no one is near the fan.

### **WARNING**

**HOT ENGINE!** Keep yourself and your test equipment clear of all moving parts or hot engine parts and/or fluids. A hot engine and/or fluids can cause burns or can permanently damage test equipment.

### **WARNING**

Before beginning any service work on any part of the air system, be certain that the air pressure has been released. Failure to do so may cause a component to violently separate causing serious personal injury.

## Removal

1

Chock wheels. Empty the compressed air system of all air. Drain the coolant into an appropriate container.

**2**

Turn the ignition switch OFF and disconnect the battery.

**CAUTION**

If there are other ground cables connected to the battery (such as engine ECU, satellite system, etc.), disconnect those grounds first, then remove the battery ground cable. Electronic modules may be damaged when additional grounds are connected/disconnected without the main battery ground connected. Always disconnect the main battery ground **last**.

**3**

Remove the air compressor supply line from the air filter piping to the turbo. Then remove the air filter piping to the turbo.

**4**

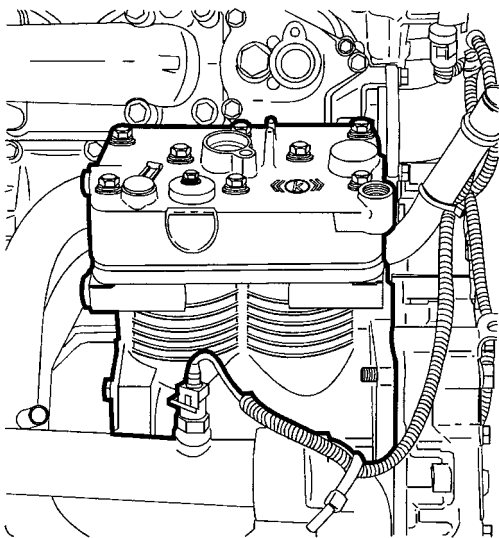
Remove all hoses and lines that are connected to the air compressor.

- Air discharge line.
- Water line (Supply) to the compressor.
- Water line (Return) from the compressor.
- 2 air lines to the air governor.
- Oil supply line.

**5**

Note the position of the fittings and remove them.

**Note:** VE D12: Unplug the sensor in the water outlet pipe on the water pump.



W5000775

**6**

Remove the 4 compressor mounting bolts. Lift compressor out.

**Installation****7**

Position the air compressor into place.

**8**

Install and torque the 4 mounting bolts to  $85 \pm 15$  Nm ( $63 \pm 10$  ft-lb).

---

$85 \pm 15$  Nm  
( $63 \pm 10$  ft-lb)

**9**

Install all fittings and reconnect all hoses and lines to the air compressor. Install coolant lines, discharge line and governor tubing.

**Note:** Torque for water line hose clamps is  $3 \pm 0.5$  Nm ( $25 \pm 4$  in-lb).

---

$3 \pm 0.5$  Nm  
( $25 \pm 4$  in-lb)

**10**

Reconnect the air filter pipes from the air filter to the turbo and the air supply line to the air compressor.

**Note:** Torque for bolt and clamp assembly on the compressor air supply line is  $24 \pm 4$  Nm ( $18 \pm 3$  ft-lb).

---

$24 \pm 4$  Nm  
( $18 \pm 3$  ft-lb)

**11****CAUTION**

Connect the main battery ground cable first. If there are other ground cables connected to the battery (such as engine ECU, satellite system, etc.), connect those grounds last. Electronic modules may be damaged when additional grounds are connected/ disconnected without the main battery ground connected. Always connect the main battery ground **first**.

Connect the battery cable.

**12**

Fill coolant and then start engine. Run the engine to check for air or liquid leaks and air compressor operation.

**Note:** Maximum coolant fill rate is  $2\frac{1}{2}$  gallons per minute (10 liters per minute).

## 5612-03-02-05 Compressor Unloader Valve, Replacement (Knorr)

Before beginning this procedure read the General Work Practices section ( "General Work Practices" page 45) for further information.

See "Knorr 2COMP850" page 20 for important service information before beginning this procedure.

See "Knorr 2COMP850" page 22 for an exploded view of the Knorr compressor.



### **DANGER**

Before working on a vehicle, set the parking brakes, place the transmission in neutral, and block the wheels. Failure to do so can result in unexpected vehicle movement and can cause serious personal injury or death.



### **WARNING**

Do not work near the fan with the engine running. The engine fan can engage at any time without warning. Anyone near the fan when it turns on could be seriously injured. Before turning on the ignition, be sure that no one is near the fan.



### **WARNING**

**HOT ENGINE!** Keep yourself and your test equipment clear of all moving parts or hot engine parts and/or fluids. A hot engine and/or fluids can cause burns or can permanently damage test equipment.

**WARNING**

Before beginning any service work on any part of the air system, be certain that the air pressure has been released. Failure to do so may cause a component to violently separate causing serious personal injury.

**Removal****1**

Drain all coolant from system into drain pan. Chock the wheels and release all air from compressed air system into an appropriate container.

**2**

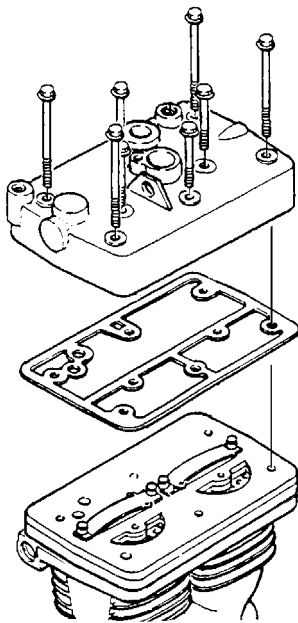
Disconnect the governor unloader line and remove fitting from unloader port. Visually check unloader port for trash or corrosion. Remove plug from opposite side.

**3**

Disconnect air supply line, discharge line, and coolant lines from compressor head.

**4**

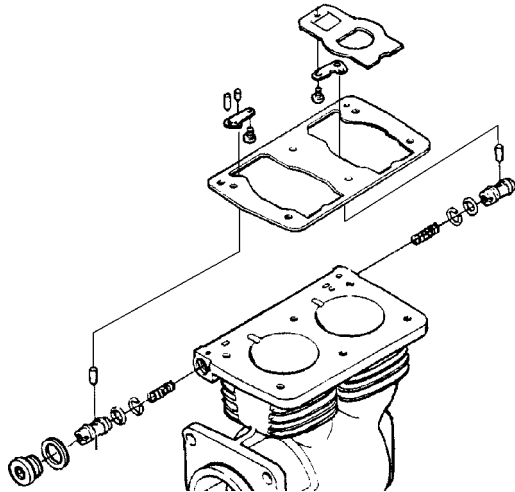
Remove the eight head bolts and lift off cylinder head. Remove cylinder head gasket.



T5007311

**5**

Remove the valve body and gasket.



W5000969

**6**

Remove the pivot arms and intake valve plates. Push in on ESS piston and remove guide pin. Repeat for opposite side. Remove ESS pistons from the bore.

## Installation

**7**

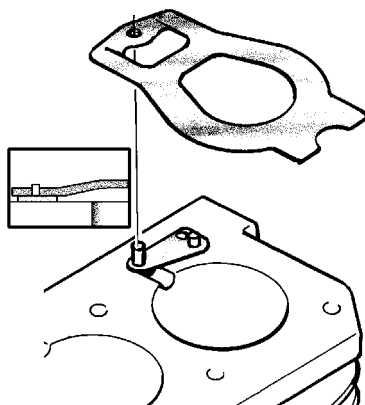
Clean ESS pistons, install new O-rings (open O-ring should be closest to the spring) and apply a small amount of silicone grease to prevent sticking. Replace valves if necessary.

**8**

Install pistons into the bore. Adjust the piston position for installing the guide pins. Press new guide pins into the pistons.

**9**

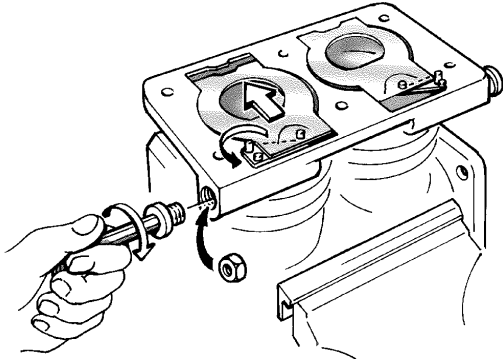
Install new guide pins into the block. Install the studs, pivot arms and intake valves on the block face.



T5007340

**10**

Install the metal gasket with the red side facing downward, carefully placing it into position. Make sure that the intake valves are not trapped between the metal gasket and block face.



T5007321

**11**

Press in the ESS pistons so that the intake valves move to the unloading position and are not trapped by the metal gasket. This can be done by placing a small nut behind the plug and tightening it down until the valve has moved over.

**12**

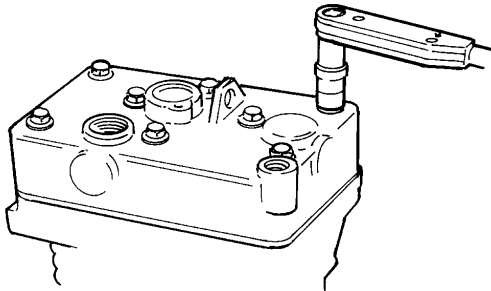
Install the valve body on the block. Make sure it is correctly positioned on the guide pins. Install head gasket and head. Oil the head bolt threads and install them.

**13**

Tighten the head bolts in two steps. First to a torque of 15 Nm (11 ft-lb) and then to the final torque of 30 – 33 Nm (22 – 24 ft-lb).

---

15 Nm  
(11 ft-lb)  
, 30 – 33 Nm  
(22 – 24 ft-lb)



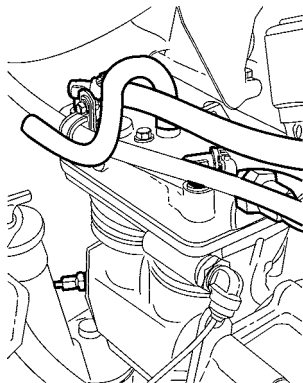
T5007323

**14**

Remove the plugs and nuts from the ESS pistons. Use a drift to press pistons in to check for proper operation, indicating that the intake valves are not trapped by the metal gasket.

**15**

Install air supply line, discharge line, and coolant lines to compressor head. Install plug and fittings and unloader line.



W5000850

## 5611-03-02-04 Compressor Cylinder Head Gasket, Replacement

### Knorr

Before beginning this procedure read the General Work Practices section ( "General Work Practices" page 45) for further information.

1

#### **DANGER**

Before working on a vehicle, set the parking brakes, place the transmission in neutral, and block the wheels. Failure to do so can result in unexpected vehicle movement and can cause serious personal injury or death.

#### **WARNING**

Before beginning any service work on any part of the air system, be certain that the air pressure has been released. Failure to do so may cause a component to violently separate causing serious eye and or personal injury.

#### **WARNING**

Hot Engine! Keep yourself clear of all moving or hot engine parts. A hot engine can cause serious burns.

#### **CAUTION**

Before installing the replacement gaskets make sure all surfaces on the Knorr Compressor and head are clean and free of debris.

Chock the front wheels and release all air from the compressed air system.

### Removal

2

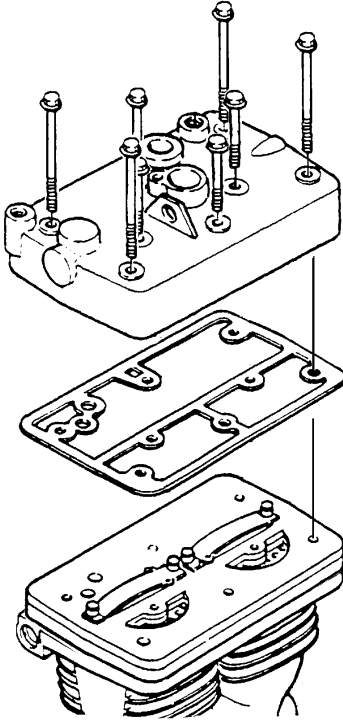
Drain all coolant from the coolant system into a drain pan.

3

Disconnect the governor unloader line, air supply line, discharge line and coolant line from the compressor head.

**4**

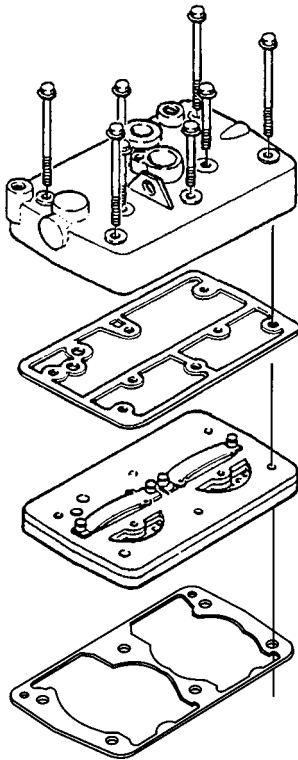
Remove the eight head bolts and lift off the cylinder head and gasket.



T5007311

**5**

Remove the valve body and the head gasket.



W5001052

## Installation

### 6

Install the head gasket between the valve body and compressor housings carefully placing it into position.

**Note:** Make sure that the intake valves are not trapped between the head gasket and the compressor housing surface.

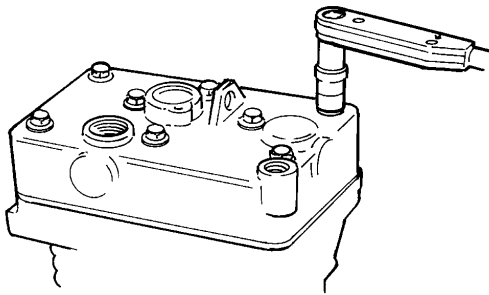
### 7

Install the valve body on the compressor housing making sure it is correctly positioned on the guide pins. Install the gasket and compressor head. Oil the head bolt threads and install them.

### 8

Torque the head bolts to 15 Nm (11 ft-lb) and then to a final torque of 30 – 33 Nm (22 – 24 ft-lb).

**Note:** To prevent warping or cracking, the use of a cross method is recommended when torquing the air compressor head bolts.



T5007323

---

15 Nm  
(11 ft-lb)  
, 30 – 33 Nm  
(22 – 24 ft-lb)

### 9

Remove the plug and fitting for the air governor line from the ESS (Energy Saver System) valve locations. Using a drift, press the ESS valves inward to check for proper operation.

**Note:** If the ESS valves go in with ease this indicates that the intake valves are not trapped by the head gasket.

### 10

Install the air supply line, discharge line, and coolant line to the compressor head. Install the plug, fittings and unloader line.

### 11

Fill coolant system with coolant and start the engine.

**Note:** Maximum coolant fill rate is 2 ½ gallons per minute or 10 liters per minute

### 12

Run the engine to check for air compressor operation, as well as any air or coolant leaks.

**Note:** The compressor must be capable of raising the air system pressure from 585 – 690 kPa (85 –100 psi) in 25 seconds or less.

---

585 – 690 kPa  
(85 –100 psi)

## 5611-03-02-02 Compressor, Replacement (Bendix 550/750)

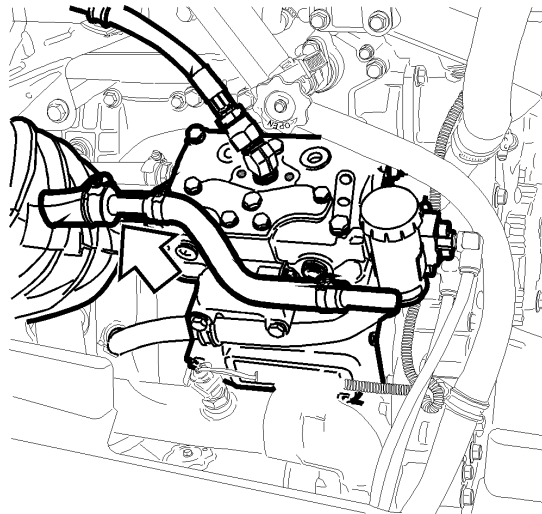
Before beginning this procedure read the General Work Practices section ( "General Work Practices" page 45) for further information.

See "Bendix 550/750" page 23 for important service information before beginning this procedure.

See "Bendix 550/770" page 26 for an exploded view of the Bendix compressor.

### DANGER

Before working on a vehicle, set the parking brakes, place the transmission in neutral, and block the wheels. Failure to do so can result in unexpected vehicle movement and can cause serious personal injury or death.



W5000754

**WARNING**

Before beginning any service work on any part of the air system, be certain that the air pressure has been released. Failure to do so may cause a component to violently separate causing serious personal injury.

**Removal****1**

Chock wheels. Empty compressed air system from all air. Drain the coolant.

**2**

Turn the ignition switch OFF and disconnect the battery.

**CAUTION**

If there are other ground cables connected to the battery (such as engine ECU, satellite system, etc.), disconnect those grounds first, then remove the battery ground cable. Electronic modules may be damaged when additional grounds are connected/disconnected without the main battery ground connected. Always disconnect the main battery ground **last**.

**3**

Remove the compressor air supply piping. If necessary, remove any other components that are in the way.

**4**

**Note:** (For Volvo VE D12 engine): Disconnect the sensor in the water outlet pipe on the water pump.

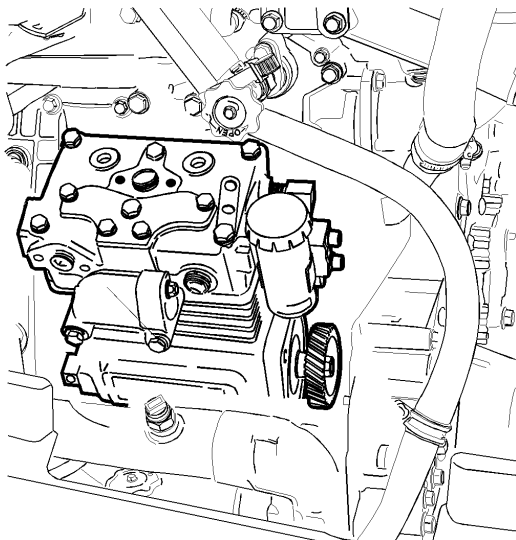
**5**

Remove all hoses and lines that are connected to the air compressor.

- Air discharge line.
- Water line (Supply) to the compressor.
- Water line (Return) from the compressor.
- 2 air lines to the air governor.
- Oil supply line (If equipped).
- Oil return line (If equipped).

**6**

Note the position of all fittings and remove them.



W5000755

**7**

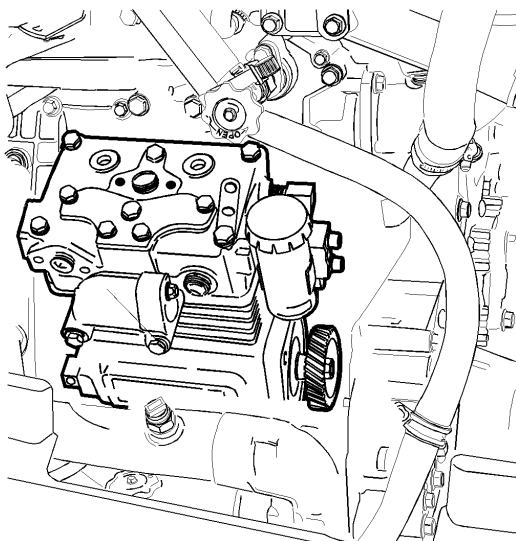
Remove the 4 compressor mounting bolts.

**8**

Lift and remove the air compressor.

**Installation****9**

Position the air compressor into place.

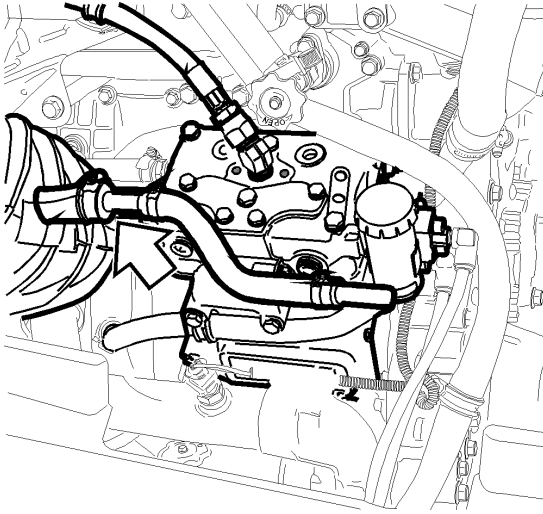


W5000755

**10**Install and torque the 4 mounting bolts to  $85 \pm 15$  Nm ( $63 \pm 10$  ft-lb).

---

 $85 \pm 15$  Nm  
( $63 \pm 10$  ft-lb)



W5000754

**11**

Install all fittings and reconnect all hoses and lines to the air compressor.

**Note:** Torque for water line hose clamps is  $3 \pm 0.5$  Nm ( $25 \pm 4$  in-lb).

---

$3 \pm 0.5$  Nm  
( $25 \pm 4$  in-lb)

**12**

Reconnect the air filter pipe to the turbo and the air supply line to the air compressor. Tighten bolt and clamp assembly on the compressor air supply line to a torque of  $24 \pm 4$  Nm ( $18 \pm 3$  ft-lb). Then hook up the air governor tubing.

---

$24 \pm 4$  Nm  
( $18 \pm 3$  ft-lb)

**13****CAUTION**

Connect the main battery ground cable first. If there are other ground cables connected to the battery (such as engine ECU, satellite system, etc.), connect those grounds last. Electronic modules may be damaged when additional grounds are connected/ disconnected without the main battery ground connected. Always connect the main battery ground **first**.

Connect the battery cable.

**14**

Fill coolant and then start engine. Look over compressor connections for possible leaks.

**Note:** Maximum coolant fill rate is  $2\frac{1}{2}$  gallons per minute (10 liters per minute).

## 5612-03-02-05

# Compressor Unloader Valve, Replacement

### (Bendix 550/750)

Before beginning this procedure read the General Work Practices section ( "General Work Practices" page 45) for further information.

See "Bendix 550/750" page 23 for important service information before beginning this procedure.

See "Bendix 550/770" page 26 for an exploded view of the Bendix compressor.

#### ! DANGER

Before working on a vehicle, set the parking brakes, place the transmission in neutral, and block the wheels. Failure to do so can result in unexpected vehicle movement and can cause serious personal injury or death.

#### ! WARNING

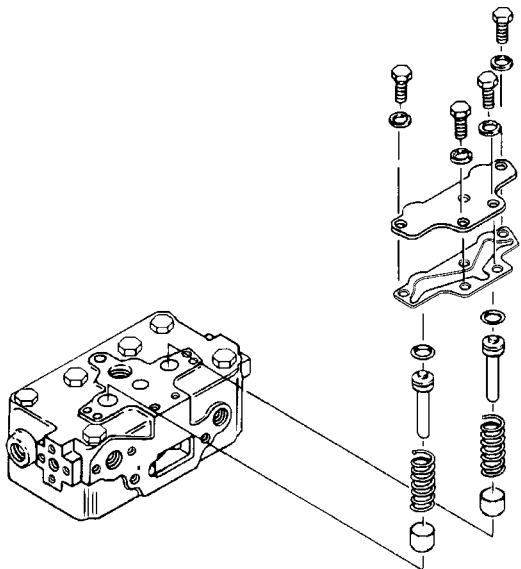
Before beginning any service work on any part of the air system, be certain that the air pressure has been released. Failure to do so may cause a component to violently separate causing serious personal injury.

### Removal

**1**  
Chock wheels. Empty compressed air system of all air.

**2**  
Remove the cover capscrews and remove the unloader cover.

**Note:** A new unloader kit should be used when rebuilding.



W5000774

**3**  
Remove the unloader cover gasket. Remove unloader pistons from compressor.

## Installation

### 4

Install the new springs and unloader pistons in their bores, being careful not to cut the O-rings.

**Note:** The unloader pistons in the kit are pre-lubricated with a special lubricant and do not require additional lubricant.

### 5

Install the unloader cover gasket. Install the unloader cover and hand tighten the capscrews.

### 6

Tighten the cover capscrews to a torque of  $23 \pm 3$  Nm ( $17 \pm 2$  ft-lb) in a crossing pattern, after first snugging all screws by hand.

---

$23 \pm 3$  Nm  
( $17 \pm 2$  ft-lb)

## 5611-03-02-02 Compressor, Replacement (Holset)

Before beginning this procedure read the General Work Practices section ( "General Work Practices" page 45) for further information.

See "Holset" page 27 for important service information before beginning this procedure.

### **DANGER**

Before working on a vehicle, set the parking brakes, place the transmission in neutral, and block the wheels. Failure to do so can result in unexpected vehicle movement and can cause serious personal injury or death.

### **WARNING**

Before beginning any service work on any part of the air system, be certain that the air pressure has been released. Failure to do so may cause a component to violently separate causing serious personal injury.

### **WARNING**

Before beginning any service work on any part of the air system, be certain that the air pressure has been released. Failure to do so may cause a component to violently separate causing serious personal injury.

### Removal

1

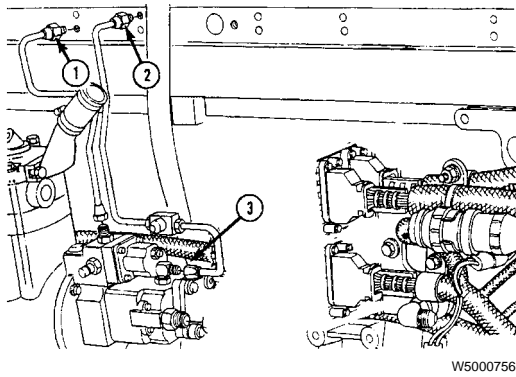
Chock wheels. Empty compressed air system of all air. Drain the coolant.

2

Turn the ignition switch OFF and disconnect the battery.

### **CAUTION**

If there are other ground cables connected to the battery (such as engine ECU, satellite system, etc.), disconnect those grounds first, then remove the battery ground cable. Electronic modules may be damaged when additional grounds are connected/disconnected without the main battery ground connected. Always disconnect the main battery ground **last**.



W5000756

**3**

Remove the fuel filter and O-ring.  
Remove all of the fuel lines;

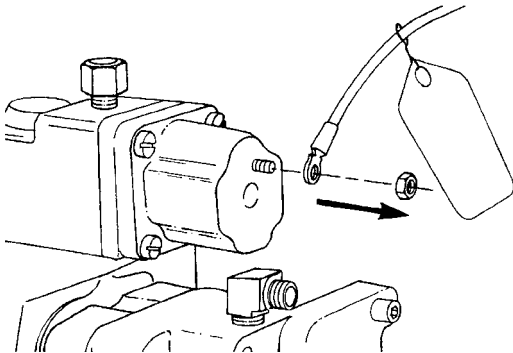
- 1 Fuel inlet line.
- 2 Fuel supply line to head.
- 3 Fuel vent line.

**4**

Disconnect discharge line from the compressor.  
Disconnect compressor intake air pipe.

**5**

Disconnect the fuel solenoid wire.



W5000757

**6**

Remove the four fuel pump mounting bolts and fuel pump support bracket.

**7**

Remove the two air governor mounting bolts and air tubing.

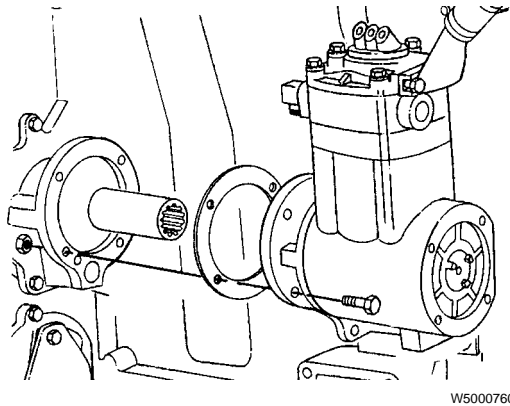
**8**

Disconnect compressor coolant lines.

**9**

Remove the two power steering pump mounting bolts.

**Note:** Removing the power steering pump allows access to the compressor mounting bolts.



W5000760

**10**

Remove the four air compressor mounting bolts and lift the air compressor away from the engine. Remove all fittings from compressor.

**Installation****11**

Replace the O-rings on coolant fittings and put sealant on the air fittings. Tighten the fittings to a torque of 47 Nm (35 ft-lb). Install all air and coolant fittings with the proper sealants applied.

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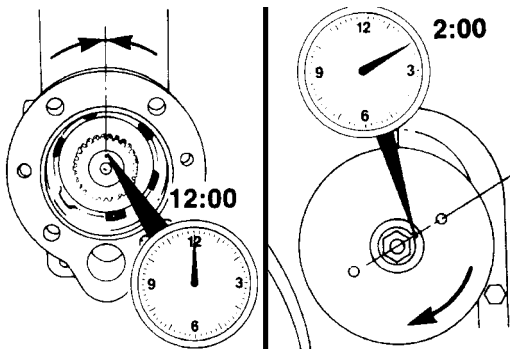
47 Nm  
(35 ft-lb)

**12**

Clean the air compressor mounting surface on the engine.

**13**

Position the air compressor crankshaft timing mark at the 12 o'clock position. Position the accessory drive shaft dowel pin at the 2 o'clock position.



W5000758

**14**

Install the air compressor onto the engine with new mounting gaskets. Tighten the bolts hand tight, then tighten the bolt to a torque of 65 Nm (50 ft-lb).

---

65 Nm  
(50 ft-lb)

**15**

Install the coolant lines.

**Note:** Replace the rubber grommet on the coolant outlet tube. Tighten the coolant tube to a torque of 40 Nm (30 ft-lb).

---

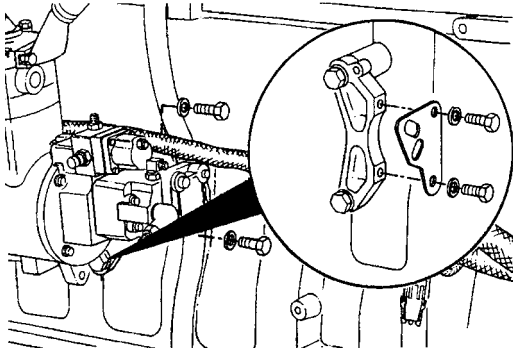
40 Nm  
(30 ft-lb)

**16**

Clean the fuel pump mounting surface and install new gaskets and spider. Install the fuel pump with the four mounting bolts. Tighten the bolts to a torque of 47 Nm (35 ft-lb).

---

47 Nm  
(35 ft-lb)



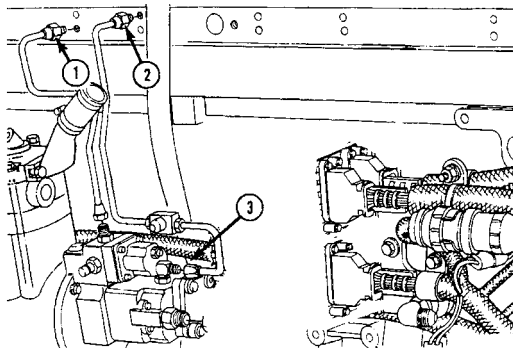
W5000759

**17**

Install fuel pump support bracket and tighten the bolt to a torque of 47 Nm (35 ft-lb).

---

47 Nm  
(35 ft-lb)



W5000756

**18**

Install fuel lines hand tight.

- 1 Tighten fuel inlet line (1) to head, 35 Nm (25 ft-lb).
- 2 Tighten supply line (2) to 35 Nm (25 ft-lb).
- 3 Tighten vent line (3) to 75 Nm (55 ft-lb).

---

35 Nm  
(25 ft-lb)  
, 35 Nm  
(25 ft-lb)  
, 75 Nm  
(55 ft-lb)

**19**

Install the wire to the fuel solenoid and tighten.

**20**

Install the air discharge line. Tighten to a torque of 75 Nm (55 ft-lb).

---

75 Nm  
(55 ft-lb)

**21**

Install the air compressor air intake pipe, use new O-rings. Tighten bolts to a torque of 47 Nm (35 ft-lb). Tighten clamp to a torque of 5 Nm (40 in-lb).

---

47 Nm  
(35 ft-lb)  
, 5 Nm  
(40 in-lb)

**22**

Install compressor air governor with the two mounting bolts and connect air tubing (use new gasket). Tighten to a torque of 16 Nm (12 ft-lb).

---

16 Nm  
(12 ft-lb)

**23**

Install fuel filter with new O-ring.

**24**

Clean the gasket surface on the engine and power steering pump before mounting. Install pump with the two bolts and tighten them to a torque of 8 Nm (48 ft-lb).

---

8 Nm (48 ft-lb)

**25**

Fill the radiator with coolant. Coolant fill rate is 2 1/2 gallons per minute (10 liters per minute).

**26****CAUTION**

Connect the main battery ground cable first. If there are other ground cables connected to the battery (such as engine ECU, satellite system, etc.), connect those grounds last. Electronic modules may be damaged when additional grounds are connected/disconnected without the main battery ground connected. Always connect the main battery ground **first**.

Connect the battery cable.

**27**

Run the engine to check for leaks and air compressor operation.

**Note:** It may be necessary to prime fuel system before running the engine.

## 5612-03-02-02

# Compressor Unloader Valve and Head, Replacement

### Holset QE296

Before beginning this procedure read the General Work Practices section ( "General Work Practices" page 45) for further information.

See "Holset" page 27 for important service information before beginning this procedure.

See "Holset QE296" page 29 for an exploded view of the Holset unloader valve.

#### **DANGER**

Before working on a vehicle, set the parking brakes, place the transmission in neutral, and block the wheels. Failure to do so can result in unexpected vehicle movement and can cause serious personal injury or death.

#### **WARNING**

Before beginning any service work on any part of the air system, be certain that the air pressure has been released. Failure to do so may cause a component to violently separate causing serious personal injury.

### Removal

**1**

Chock wheels. Empty compressed air system of all air.

**2**

#### **WARNING**

Always wear appropriate eye protection to prevent the risk of eye injury due to contact with engine debris or fluids.

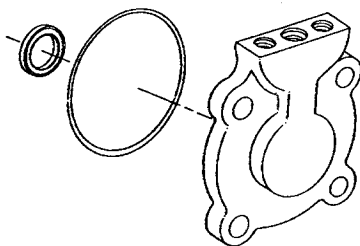
Hold the unloader valve body down and remove the four screws.

**3**

Remove the valve body together with the unloader valve spring.

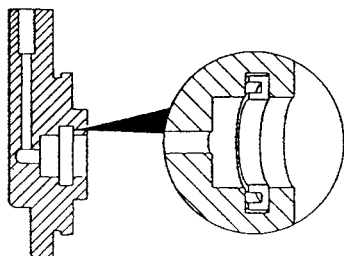
**4**

Remove the unloader valve cap. Remove the rectangular vee seal and O-ring. Use a pick, if necessary, to remove the seals. Do not damage the groove. Remove the intake manifold and gasket.



W5000770





W5000769

## Installation

### 10

Install a new rectangular vee seal into the unloader body.

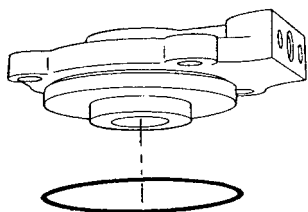
**Note:** The seal must be installed with the lip facing in.

### 11

Liberaly lubricate the unloader valve bore above and below the vee seal with high temperature grease. (Accrolube Lubrication Teflon Grease or equivalent.)

### 12

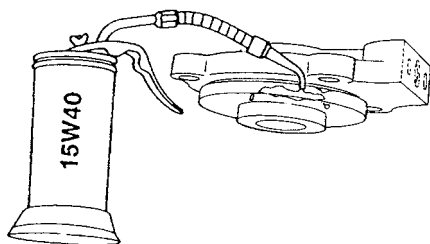
Install a new O-ring seal on the unloader valve body.



W5000768

### 13

Use clean 15W40 oil or Accrolube Lubrication Teflon Grease (or equivalent) to lubricate the seal.



W5000767

### 14

Install in order into the valve plate:

- 1 Exhaust valve retainer with the groove facing up.
- 2 Align wave spring gaps 180 degrees from each other and place them in the exhaust valve retainer groove.

### 15

Orient the valve plate to the valve head. Use orientation marks made during removal.

### 16

Assemble cover, cover gasket, head, head gasket and valve plate. Install the short screw with washer through the center hole. Tighten the screw to a torque of 14 Nm (120 in-lb).

---

14 Nm  
(120 in-lb)

**17**

Install the valve assembly gasket on the cylinder block. Carefully place the intake valve and valve retainer in the valve plate. Install the valve assembly onto the compressor block.

**18**

Install the four valve plate assembly screws. Tighten the screws to a torque of 28 Nm (21 ft-lb).

---

28 Nm  
(21 ft-lb)

**19**

Install the intake manifold to the valve head. Install the unloader cap in the cover. Place the spring in the manifold and install the unloader cover to the manifold with the four screws. Tighten the screws to a torque of 27 Nm (20 ft-lb). Install governor to the unloader.

---

27 Nm  
(20 ft-lb)

## 5612-03-02-02

# Compressor Unloader Valve and Head, Replacement

### Holset SS/E/ST

Before beginning this procedure read the General Work Practices section ( "General Work Practices" page 45) for further information.

See "Holset" page 27 for important service information before beginning this procedure.

#### **DANGER**

Before working on a vehicle, set the parking brakes, place the transmission in neutral, and block the wheels. Failure to do so can result in unexpected vehicle movement and can cause serious personal injury or death.

#### **WARNING**

Before beginning any service work on any part of the air system, be certain that the air pressure has been released. Failure to do so may cause a component to violently separate causing serious personal injury.

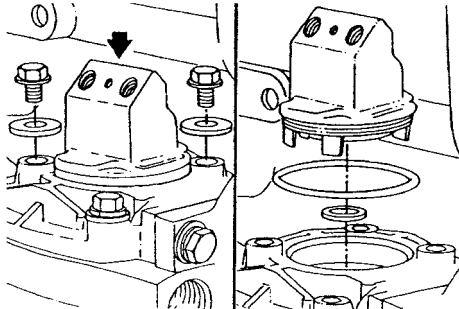
#### **WARNING**

Before beginning any service work on any part of the air system, be certain that the air pressure has been released. Failure to do so may cause a component to violently separate causing serious personal injury.

### Removal

1

Chock wheels. Empty compressed air system of all air.



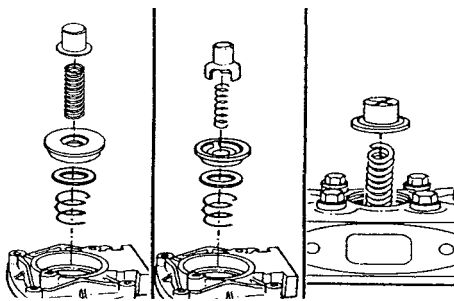
W5000772

2

**WARNING**

Always wear appropriate eye protection to prevent the risk of eye injury due to contact with engine debris or fluids.

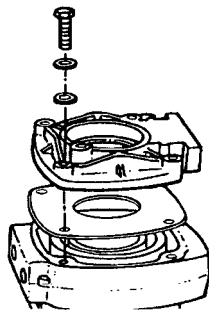
Hold the unloader valve body and remove the two captive washer capscrews and the two plain washers. Then remove the unloader valve body, O-ring seal, and the rectangular ring seal.



W5000771

3

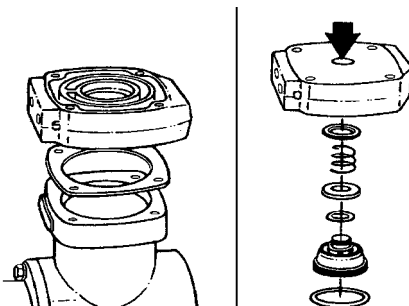
Remove the unloader valve cap and the unloader valve spring. Then remove the intake valve seat, valve, and intake valve spring.



W5000853

4

Remove capscrews, lock washers and plain washers that hold cover and head to the cylinder block. Remove cover and discard gasket.



W5000854

5

Remove the head and discard gasket. Hold the head bottom side up and use thumb pressure to remove the exhaust valve seat assembly. Remove the O-ring seal from the exhaust valve seat. Remove the exhaust valve.

**6**

Remove the compression spring and wear plate from the head.

**Installation****7**

Install the new rectangular ring seal into the unloader body.

**Note:** The seal must be installed with the grooved side up.

**8**

Install the unloader cap in the body. Install a new O-ring seal on the unloading valve body. Use clean 15W-40 oil to lubricate the seal.

**9**

Install the wear plate and compression spring in the head. Then install the exhaust valve on the exhaust valve seat.

**10**

Install the O-ring seal on the seat. Use clean 15W-40 oil to lubricate the O-ring seals. Use hand pressure to install the exhaust valve assembly in the head.

**11**

Use new gaskets to install the cylinder head and cover. Install the flat washers, lock washers and capscrews.

**12**

Tighten the cylinder head capscrews in an alternating sequence:

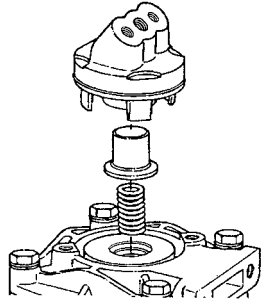
- 1 7 Nm (5 ft-lb)
- 2 14 Nm (10 ft-lb)
- 3 20 Nm (15 ft-lb)
- 4 27 Nm (20 ft-lb)

---

7 Nm (5 ft-lb)  
, 14 Nm  
(10 ft-lb)  
, 20 Nm  
(15 ft-lb)  
, 27 Nm  
(20 ft-lb)

**13**

Install the intake valve spring with the tang down. Install the intake valve. Install the intake valve seat with the flange side up.



W5000856

**14**

Install the unloader valve cap spring. Install a new O-ring to the valve body. Install the unloader valve body.

**15****CAUTION**

Do not overtighten these screws. Compressor damage will result.

Hold the unloader valve body down and install the washers and screws. Tighten the screws to a torque of 14 Nm (10 ft-lb). Install governor to the unloader body.

## 5618-03-02-03 Air Dryer, Replacement

Before beginning this procedure read the General Work Practices section ( "General Work Practices" page 45) for further information.

See "Wabco System Saver 1000/1200 Series" page 30, "Bendix AD-IP" page 32, "CR Turbo-2000" page 34, and "Midland Pure Air Plus" page 35 for important service information before beginning this procedure.

See page 31 and page 33 for an exploded view of the air dryers.

**DANGER**

Before working on a vehicle, set the parking brakes, place the transmission in neutral, and block the wheels. Failure to do so can result in unexpected vehicle movement and can cause serious personal injury or death.

**WARNING**

Before beginning any service work on any part of the air system, be certain that the air pressure has been released. Failure to do so may cause a component to violently separate causing serious personal injury.

**Removal****1**

Drain all air from the compressed air system.

**2**

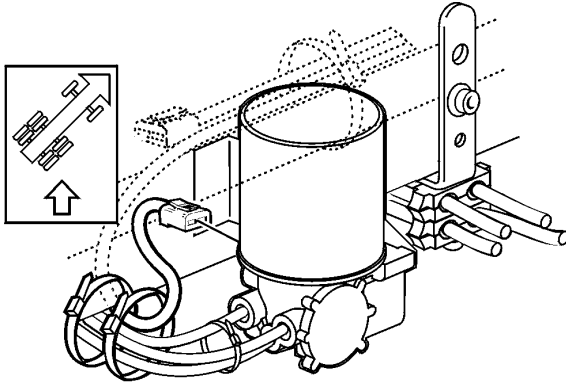
Remove the air lines.

**3**

Remove the mounting bolts.

**4**

Remove the fittings.



W5001212

**Installation****5**

Install the fittings onto the dryer.

**6**

Re-attach the air dryer and tighten the bolts to a torque of 18 Nm (25 ft-lb).

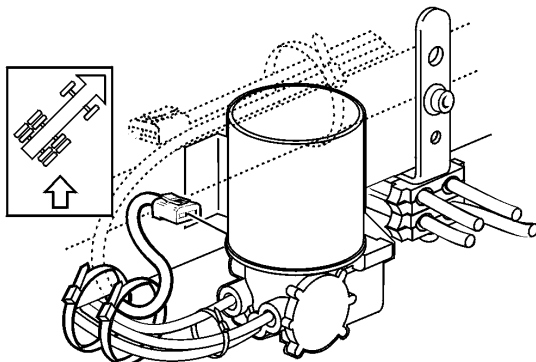
---

 18 Nm  
 (25 ft-lb)
**7**

Install the air lines.

**8**

Start the engine and check for air leaks.



W5001212

## 5618-03-02-11

### Air Dryer Desiccant Cartridge, Replacement

Before beginning this procedure read the General Work Practices section ( "General Work Practices" page 45) for further information.

See "Wabco System Saver 1000/1200 Series" page 30, "Bendix AD-IP" page 32, "CR Turbo-2000" page 34, and "Midland Pure Air Plus" page 35 for important service information before beginning this procedure.

See page 31 and page 33 for an exploded view of the air dryers.

#### **DANGER**

Before working on a vehicle, set the parking brakes, place the transmission in neutral, and block the wheels. Failure to do so can result in unexpected vehicle movement and can cause serious personal injury or death.

#### **WARNING**

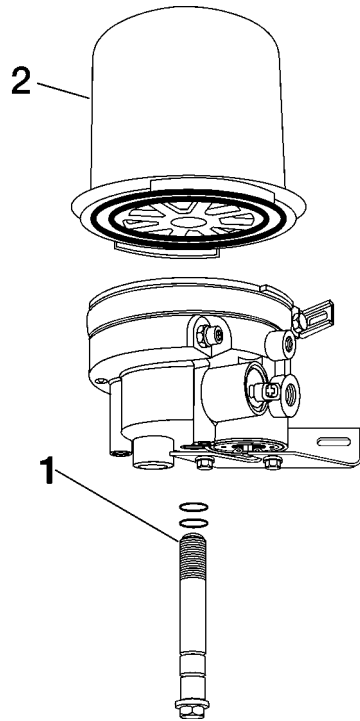
Before beginning any service work on any part of the air system, be certain that the air pressure has been released. Failure to do so may cause a component to violently separate causing serious personal injury.

#### **WARNING**

Before beginning any service work on any part of the air system, be certain that the air pressure has been released. Failure to do so may cause a component to violently separate causing serious personal injury.

#### Removal

- 1 Drain all air from the compressed air system.



Bendix AD-IP Air Dryer

W5000852

2

**WARNING**

Do not disassemble cartridge. No replacement parts are available and the cartridge contains a spring under pressure which can not be mechanically caged. The sudden release of the spring could cause it to be ejected violently, causing serious personal injury.

Drain all air from the compressed air system.

3

WABCO System Saver 1000/1200 Series, Midland Pure Air Plus and RC Turbo 2000 air dryers only require the use of a strap wrench to replace desiccant cartridge. They are spin on type cartridges. On Bendix AD-IP air dryers, use a 1 1/8 in. wrench or socket to loosen desiccant cartridge bolt. Remove desiccant cartridge bolt (1) with its two O-rings.

**Installation**

4

Inspect all O-rings for splits, cracks, and possible reuse. If defective, replace.

5

When installing new cartridge make certain the cartridge is properly seated and flush on end cover and that all sealing surfaces are clean.

**Note:** For the AD-IP dryer, it may be necessary to rotate cartridge until anti-rotation lugs align to allow cartridge to properly seat. After new desiccant cartridge has been seated, reinstall cartridge bolt with its two O-rings and tighten to a torque of 68 Nm (50 ft-lb).

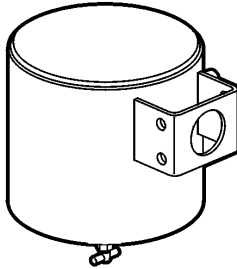
68 Nm  
(50 ft-lb)

## 5621-03-02-03

### Purge Tank, Replacement

Before beginning this procedure read the General Work Practices section ( "General Work Practices" page 45) for further information.

See "Purge Tank" page 36 for important service information before beginning this procedure.



W5001192

1

#### DANGER

Before working on a vehicle, set the parking brakes, place the transmission in neutral, and block the wheels. Failure to do so can result in unexpected vehicle movement and can cause serious personal injury or death

Park the vehicle on a level surface with the transmission in neutral and the front wheels chocked.

2

#### WARNING

Before beginning any service work on any part of the air system, be certain that the air pressure has been released. Failure to do so may cause a component to violently separate causing serious personal injury.

#### WARNING

Always wear appropriate eye protection to prevent the risk of eye injury due to contact with engine debris or fluids.

Deplete the air system pressure.

3

Disconnect the air line using Special Tool J-44773

**Note:** Observe the orientation of fitting when performing this step.

J-44773

4

Remove the mounting bolts to the air tank bracket.

**5**

Remove the fittings from the air tank and install them into the replacement air tank.

**6**

Install the replacement air tank and connect the air line.

**7**

Start the vehicle to build up the air system pressure and check for proper operation.

## 5621-03-02-01

### Air Tank, Replacement

Before beginning this procedure read the General Work Practices section ( "General Work Practices" page 45) for further information.

**1**

For an illustration of the various Air Tank locations on VN and VHD vehicles see "Air Tank Mounting" page 40.

#### **DANGER**

Before working on a vehicle, set the parking brakes, place the transmission in neutral, and block the wheels. Failure to do so can result in unexpected vehicle movement and can cause serious personal injury or death.

Park the vehicle on a level surface with the transmission in neutral and the front wheels chocked.

**2**

#### **WARNING**

Before beginning any service work on any part of the air system, be certain that the air pressure has been released. Failure to do so may cause a component to violently separate causing serious personal injury.

#### **WARNING**

Always wear appropriate eye protection to prevent the risk of eye injury due to contact with engine debris or fluids.

Drain the complete air system.

**3**

Cut all zip ties securing the airlines and the air tank drain fitting cable

**4**

Disconnect any airlines using special tool J-44773 (Airline Release Tool).

J-44773

**5**

Remove any air valve bracket to allow for the removal of the air tank mount bolts.

**6**

Remove any brackets or straps and fittings and plugs from the air tank.

**7**

Remove the air tank from the vehicle.

**8**

Install the fittings and plugs into the replacement air tank using pipe sealant.

**9**

Install the replacement air tank and start the mount bolts.

**10**

Tighten the air tank mount bolts.

**11**

Secure any air valves or brackets.

**12**

Connect any airlines and secure them with zip ties.

**13**

Start the vehicle and build the system to check for leaks and proper operation

## 5614-03-02-01 Governor, Replacement (Bendix)

Before beginning this procedure read the General Work Practices section ( "General Work Practices" page 45) for further information.

See "Governor" page 17 for important service information before beginning this procedure.



### DANGER

Before working on a vehicle, set the parking brakes, place the transmission in neutral, and block the wheels. Failure to do so can result in unexpected vehicle movement and can cause serious personal injury or death.



### WARNING

Always wear appropriate eye protection to prevent the risk of eye injury due to contact with engine debris or fluids.

**WARNING**

Before beginning any service work on any part of the air system, be certain that the air pressure has been released. Failure to do so may cause a component to violently separate causing serious personal injury.

**Removal**

- 1**  
Completely drain all air from the compressed air system.
- 2**  
Remove the air lines from the governor.
- 3**  
Remove the two mounting bolts that hold the governor in place.
- 4**  
Remove the air line fittings from the old governor.

**Installation**

- 5**  
Install the fittings to the new governor and align to the correct position for proper connection.
- 6**  
Install the governor to the air compressor or bracket.
- 7**  
Install the air lines to the governor fittings.
- 8**  
Install the governor and tighten the bolts to a torque of 18 Nm (25 ft-lb).  

---

**18 Nm**  
(25 ft-lb)
- 9**  
Start the engine and build up the system air pressure. Check for air leaks and proper operation.

**5516-03-02-01**

**Parking Brake Valve, Replacement**

For the service procedure, see "Dash Valve, Replacement" page 85.

**5631-03-02-02**

**Parking Brake/Trailer Supply Valve, Replacement (Dash)**

For the service procedure, see "Dash Valve, Replacement" page 85.

**5711-03-02-01**

**Trailer Brake Control Valve, Replacement**

For the service procedure, see "Dash Valve, Replacement" page 85.

## Dash Valve, Replacement

Before beginning this procedure read the General Work Practices section ( "General Work Practices" page 45) for further information.

### DANGER

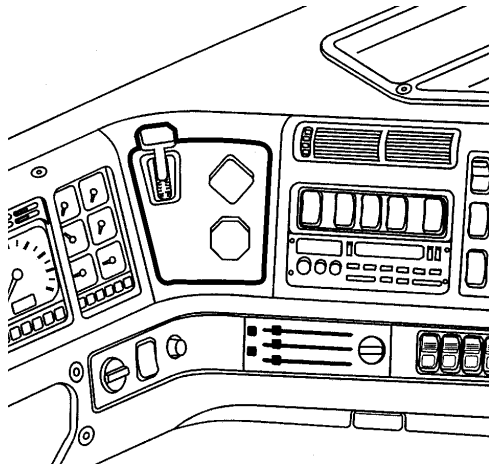
Before working on a vehicle, set the parking brakes, place the transmission in neutral, and block the wheels. Failure to do so can result in unexpected vehicle movement and can cause serious personal injury or death.

### WARNING

Before beginning any service work on any part of the air system, be certain that the air pressure has been released. Failure to do so may cause a component to violently separate, which can result in serious personal injury.

### WARNING

Always wear appropriate eye protection to prevent the risk of eye injury due to contact with engine debris or fluids.



W5001037

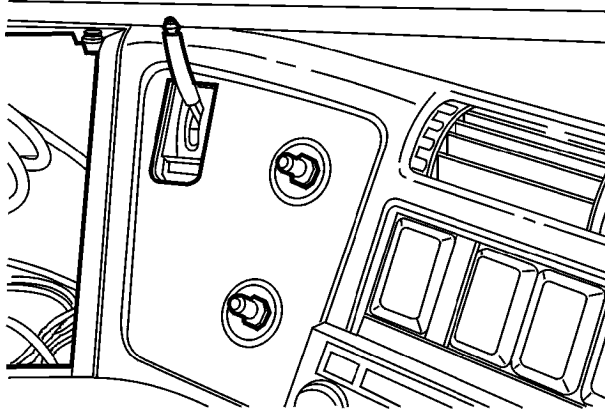
**1**

Park the vehicle on a level surface and chock the wheels. Make sure the vehicle is in neutral and the brakes have been released. Drain the air system of all air pressure.

### Removal

**2**

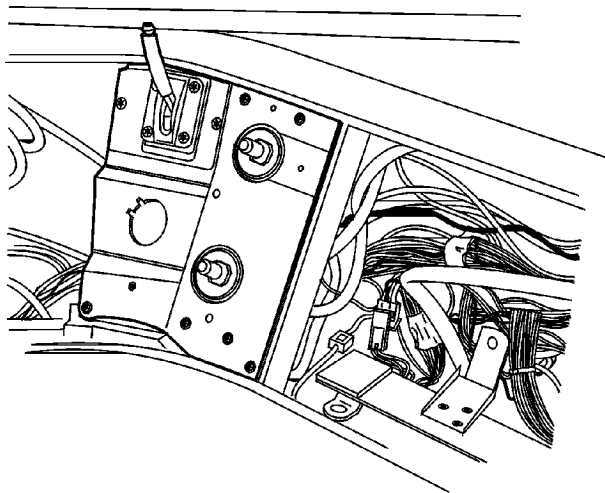
Remove the electrical center covers. Unbolt the instrument cluster and lay the instrument cluster to the side.



W5001038

**3**

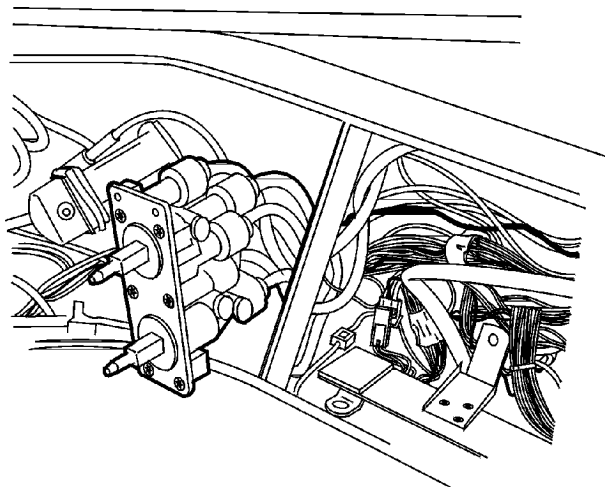
Pull the handle off the trailer hand brake valve and remove the trailer hand brake cover. Using a small punch, drive the pins out of the parking brake knob and the trailer supply knob and remove them.



W5001039

**4**

Remove the dash cover for the trailer hand brake valve and manifold dash valve, and unbolt the dash panel.



W5001040

**5**

Disconnect the lower radio support and lay the dash panel over.

**6**

Unbolt the manifold dash valve and remove the mounting plate.

**7**

Disconnect the air lines to the valves and remove the valve from the bracket.

### **Installation**

**1**

Install the new valve and connect the air lines.

**2**

Install the trailer hand brake and the manifold dash valve to the mounting plate and install the mounting plate.

**3**

Move the dash panel into place and reconnect the lower radio support.

**4**

Install the dash panel and the dash cover for the trailer hand brake valve and manifold dash valve.

**5**

Install the knobs on the parking brake and the trailer supply, and install the cover to the trailer hand brake valve.

**6**

Install the instrument cluster and electrical center covers.

**7**

Start the vehicle to build up air pressure, and check the valves for leaks and proper operation.

## 5631-03-02-01

### Foot Brake Valve, Replacement

Before beginning this procedure read the General Work Practices section ( "General Work Practices" page 45) for further information.

1



#### **DANGER**

Before working on a vehicle, set the parking brakes, place the transmission in neutral and block the wheels. Failure to do so can result in unexpected vehicle movement and can cause serious personal injury or death.



#### **WARNING**

Always wear appropriate eye protection to prevent the risk of eye injury due to contact with engine debris or fluids.

Park the vehicle on a level surface with the transmission in neutral, and chock the front wheels.

#### **Removal**

2

Remove the lower dash panel, on the left side, under the steering column.

3

Remove the center and right side sections fo lower dash panels under the steering column.

4

Remove the lower cover off of the steering column.

**5****WARNING**

Before beginning any service work on any part of the air system, be certain that the air pressure has been released. Failure to do so may cause a component to violently separate, which can result in serious personal injury.

Deplete air system pressure.

**6**

**Note:** Note location of air lines for replacement. Disconnect air lines.

---

J-42189

**7**

Remove the nuts from the footvalve and remove the footvalve.

**8**

Remove the fittings from the old footvalve and install the fittings onto the new footvalve.

**Note:** Remove the fittings one at a time for proper orientation.

---

J-44775

**Installation****9**

Set the new footvalve into position for mounting.

**10**

Connect the air lines to the new footvalve.

**11**

Install the mounting nuts on the new footvalve and tighten to  $24 \pm 4$  Nm ( $18 \pm 3$  ft-lb).

---

$24 \pm 4$  Nm  
( $18 \pm 3$  ft-lb)

**12**

Start the vehicle and check for air leaks and proper operation.

**13**

Install the lower cover to the steering column.

**Note:** Refer to Service Bulletin 563.01 (See "Foot Brake Valve Leak Test, Checking" page 90.) for air leak test procedure.

**14**

Install the left side lower dash panel under the steering column.

**15**

Install the center and right side sections of the lower dash panels under the steering column.

## 5631-06-02-01 Foot Brake Valve Leak Test, Checking

Before beginning this procedure read the General Work Practices section ( "General Work Practices" page 45) for further information.

### **DANGER**

Before working on a vehicle, set the parking brakes, place the transmission in neutral, and block the wheels. Failure to do so can result in unexpected vehicle movement and can cause serious personal injury or death.

### **WARNING**

Before beginning any service work on any part of the air system, be certain that the air pressure has been released. Failure to do so may cause a component to violently separate, which can result in serious personal injury.

**1**

Park the vehicle on a level surface and chock the front wheels.

**2**

Start the engine and build the system air pressure to the governor cut out pressure, then stop the engine.

**3**

Apply and release the foot brake valve twice.

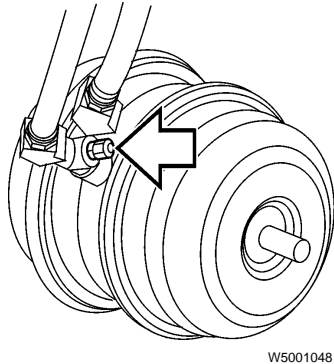
**4**

Spray the foot brake valve with soapy water and check the foot brake valve in the unapplied position. When conducting this test be sure that leakage does not exceed a one inch diameter soap bubble in three seconds.

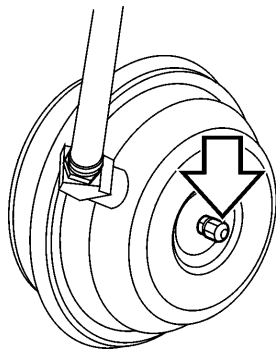
**Note:** Spray all fittings and joints of the foot brake valve with soapy water before checking for leakage.

**5**

Apply the foot brake valve to 100% application and check for leakage using the guidelines in step 4.



W5001048



W5001049

Fig. 1: Locations for the delivery air pressure gauge connections.

## 6

After checking for leakage in the unapplied and applied positions make a brake application of approximately 20 psi (137.9 kPa) for a delivery pressure check.

## 7

If a delivery air pressure gauge is available, make the connection at the left rear most brake chamber. The arrows in figure 1 identify the correct locations for connecting the delivery air pressure gauge.

**Note:** The connection location depends on the type of brake chamber being used.

**Note:** In order to maintain constant delivery pressure, it may be necessary to use a block of wood or support mechanism beneath the pedal to check the foot brake valve at delivery pressure.

## 8

If a delivery air pressure gauge is unavailable, deflect the pedal to between 1/3 and 1/2 of its full travel and check for leakage using the guidelines in step 4.

## 9

If the foot brake valve passes these three tests, the valve is good.







# Operation Numbers

5611-03-02-02 Compressor, Replacement .....	47
5612-03-02-05 Compressor Unloader Valve, Replacement .....	50
5611-03-02-04 Compressor Cylinder Head Gasket, Replacement .....	54
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5612-03-02-05 Compressor Unloader Valve, Replacement .....	61
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5618-03-02-11 Air Dryer Desiccant Cartridge, Replacement .....	77
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