Introduction

Atmospheric air taken in by the compressor contains more or less humidity. This means that the compressor compresses a gas mixture consisting of air and water vapour. The saturation limit (dew point) of the water vapour portion depends on the air temperature and the relative atmospheric humidity. Although the absolute humidity of the air delivered remains constant, the maximum possible capacity for retaining water vapour increases. Inversely, as the temperature falls, part of the water vapour condenses and precipitates from the air in the form of water.

Example

If the relative humidity is 100 % and the air temperature is 50 °C, 1 m³ of air will contain 90 g of water. If the temperature of the air taken in falls to 30 °C, 60 g of water is precipitated. This is, after all, 0.06 litre.

Purpose

Air dryers can be fitted in all air compression systems. The purpose of the air dryer is to reduce the amount of water vapour in the compressed air. This is achieved by cold generated adsorption drying in which the compressed air delivered by the compressor is passed through granulates, at the same time lowering the dew point.

This allows the existing water vapour to be absorbed by the granulates. The granulates are regenerated by means of a return flow of air.

Benefit dual-chamber principle

With the single-chamber air dryer, the regeneration process follows in the idle phase of the compressor. In a dual-chamber air dryer, this process is controlled by a solenoid valve with an integrated timer. This procedure ensures that the absorbency of the granulates is maintained even when the compressor works more or less continuously. Dual-chamber air dryer are usually used in vehicles with higher air consumption.

Please note

To gain the best efficiency, the income temperature of the compressed air should be lower than 65 °C. In front of the air dryer no anti freeze devices must be fitted.

432 408

a. **Single Chamber Air Dryer** with a heating system. This air dryer has been replaced by the **432 410/420** series.

432 405 / 406

b. **Dual-chamber air dryers** with unloader **432 405** and without unloader **432 406**. These design types were replaced by **432 431** and **432 432**.

432 410 / 420

c. **Single Chamber Air Dryer** with or without a heating system
432 410 = with a combined unloader
432 420 = without a combined unloader
A heating system can be subsequently fitted.

432 431 / 432

d. **Dual-Chamber Air Dryer** with or without a heating system
432 431 = without a combined unloader
432 432 = with a combined unloader
A heating system can be subsequently fitted.

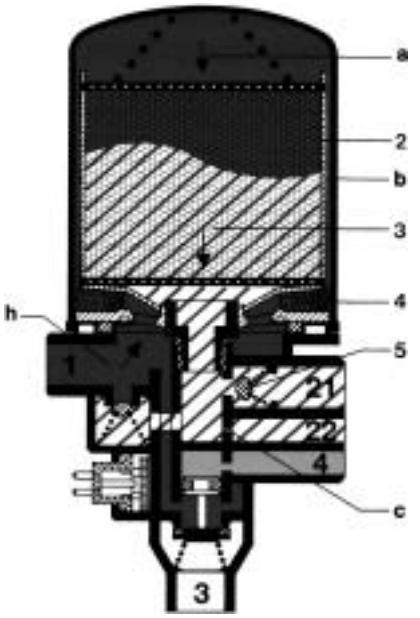
Please note

These air dryers are safe for a maximum operating pressure of 13.0 bar. Special variants (with a special cartridge) for up to 20 bar are available for high-pressure systems. The voltage for the solenoid valve (for dual-chamber air dryers only) is 24 volts.

Dual-chamber air dryers are mainly used in vehicles with high air consumption.

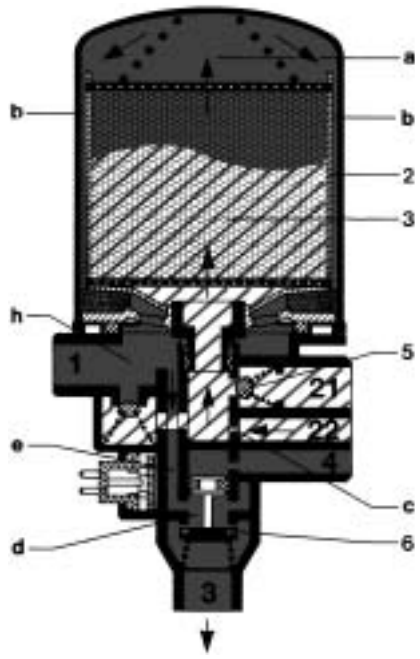
Operation of Air Dryer 432 420
(without Integral Unloader Valve)

a. Drying the Compressed Air



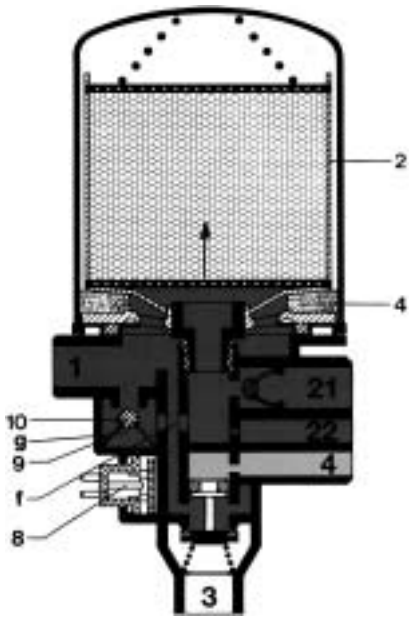
The compressed air entering the air dryer at port **(1)** and chamber (h) flows via the fine filter (4) and the annular duct (b) to the upper side of the granulates cartridge (2). From here (chamber “a”) the compressed air flows through the cartridge (2), its humidity being adsorbed by the surface of the granulates (3). Dried compressed air then flows via the opening check valve (5) to port **(21)** and from there to the downstream components of the compressed air supply system. At the same time, compressed air flows through the throttling port (c) and port **(22)** to the regenerating reservoir.

b. Regeneration of the Granulates



When the unloader valve switches off, port **(4)** is pressurized. This opens the drain valve (6), causing the pressure to fall abruptly in chambers (d), (h) and (a). At the same time, check valve (5) closes. Whilst the condensate which has collected in chamber (d) escapes via vent (3), dry air from the regenerating reservoir flows through the cartridge (2) in the opposite direction. The regenerated air is now in a position to once again adsorb any moisture from the surface of the granulates (3). This humid air can now escape via chamber (a), annular duct (b), chamber (h), duct (e) at the opened drain valve (6). This process ends when the regenerating reservoir is pressureless, or when the unloader switches to delivery once again.

c. Bypass Position

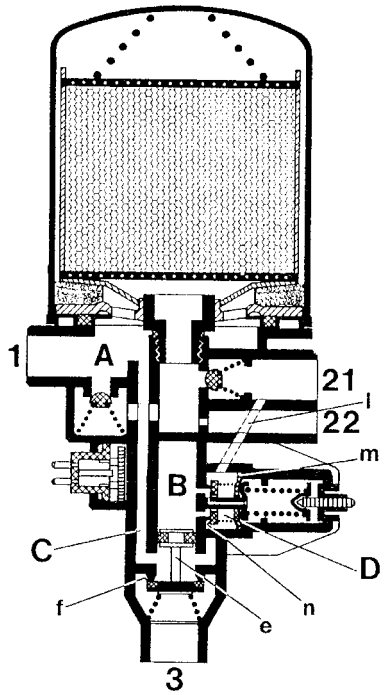


In the event of the filter (4) being heavily soiled so that the compressed air may no longer be able to flow through the cartridge (2), the bypass valve (10) opens automatically. Undried compressed air will then flow from port **(1)** through duct (f) to ports **(21)** and **(22)**. In normal operation, the bypass valve (10) is held closed by the resilience of the spring (9) and the pressure (chamber “g”).

d. Operation of the Heating System

If the air dryer has had a heating cartridge (8) fitted, this will come on at a temperature of approx. 6 °C and go off again at a temperature of approx. 30 °C.

Operation of Air Dryer 432 410
(with integrated combined unloader)



The air is dried as described in 1. above. However, in this type of air dryer the cut-out pressure reaches chamber (D) via hole (l), acting on diaphragm (m). Once the force of the spring has been overcome, inlet (n) opens and the pressurized piston (e) opens outlet (f).

The air delivered by the compressor now escapes via chamber (A), duct (C) and vent (3). Piston (e) simultaneously acts as a relief valve. When the pressure is excessive, the piston (d) automatically opens the outlet (e).

If air consumption causes the supply pressure within the system to fall below the cut-in pressure, the inlet (n) closes and the pressure from Chamber B is reduced through the vent of the unloader valve. The outlet (e) closes and the drying process begins again.

Maintenance

Any vehicle in operation must have its air reservoirs checked regularly for condensate. If any condensate is found, the regenerating function must be checked and the granulates cartridge replaced if necessary. Experience has shown that it may be necessary to replace the granulates after approx. 2 years. For this purpose, the disposable cartridge **432 410 020 2** or the exchange cartridge **432 410 222 7** (M 39 × 1.5) is available. On older units, the securing screw (M 6) needs to be unscrewed first.

On vehicles with high-pressure air dryers, cartridge **432 410 220 2** is to be used (M 42 × 1.5).

Please note

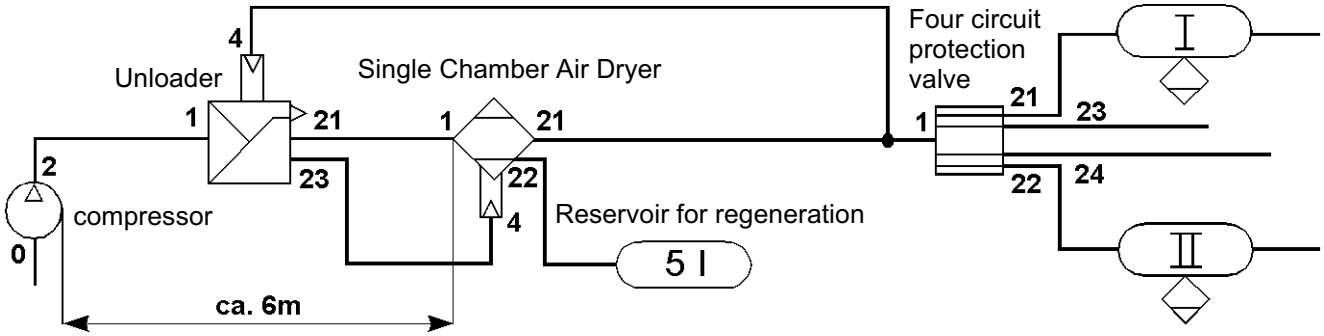
Whole cartridges or granulates must be treated as hazardous waste. Whilst replacement, the exchanged cartridge will be taken back.

Testing

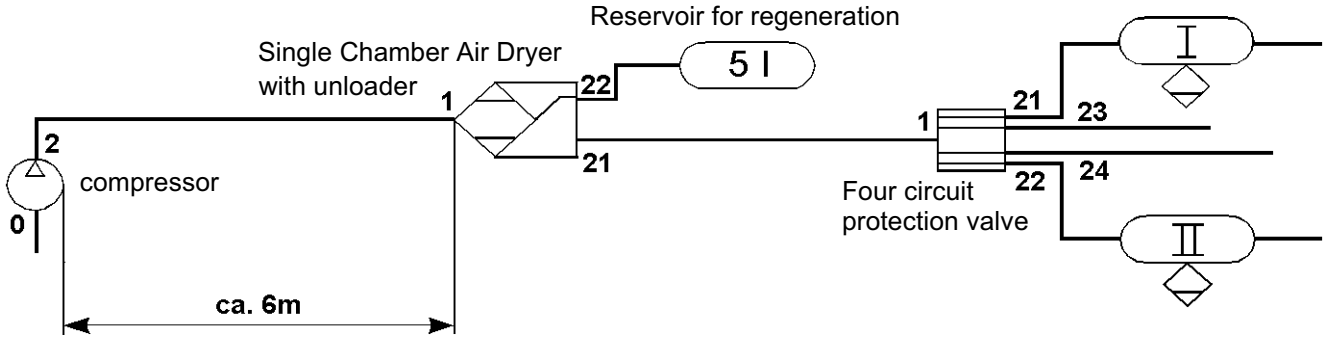
The air dryer must be checked for tightness and proper regenerating function. Fill compressed air system until the unloader valve cuts out, and switch off the engine. At the vent of the air dryer, the regenerating air must flow out for approx. 10 seconds.

Schematic for Testing and Installation

Schematic 1: 432 420



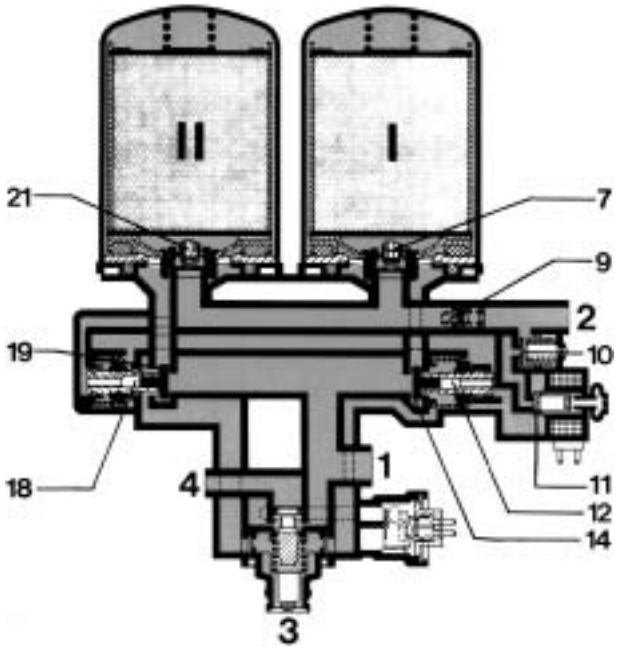
Schematic 2: 432 410



Retrofit

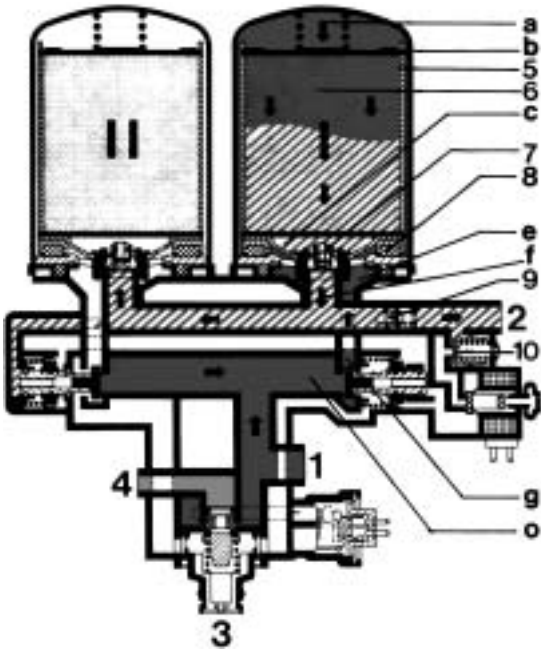
When fitting an air dryer, please follow our instructions for installation. These are available from our Service Division

a. Initial Filling of the Air Dryer



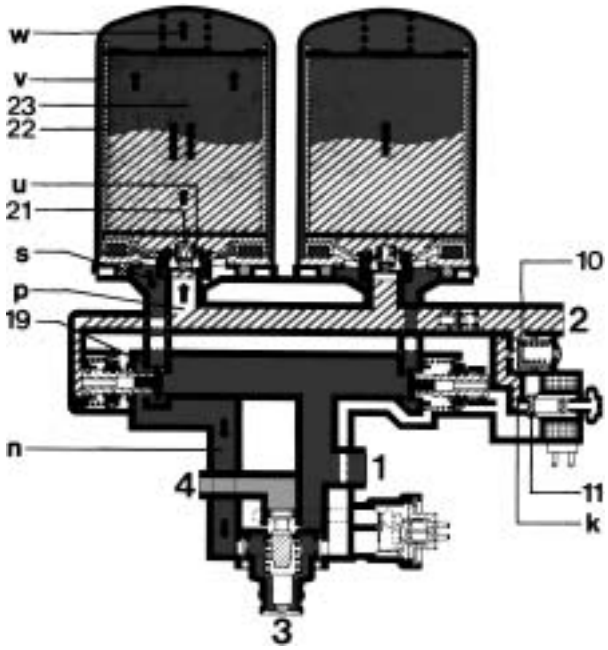
When not pressurized, the check valves (7), (9), (21), the charging valve (10) and the solenoid valve (11) are closed. Valve (12) on the inlet side (14) and valve (18) the outlet side (19) are open. For this reason, the air dryer is always filled from reservoir I, because of the function of the charging valve (10).

b. Drying the Compressed Air in Reservoir I



The air entering at port **(1)** flows via ducts (o) and (g), the annular chamber (e), the filter (8) and the gap (b) into chamber (a) above the granulates cartridge (5). Via the sieve plates and felt disks above the cartridge (5), the compressed air passes through the granulates (6), its humidity remaining on its surface by adsorption. The compressed air now flowing into chamber (c) opens the check valve (7) and the pressure in duct (f) increases. This causes the check valve (9) to open. Dry air can now flow via port **(2)** to the downstream components of the braking system. At the same time, compressed air flows to the closed charging valve (10).

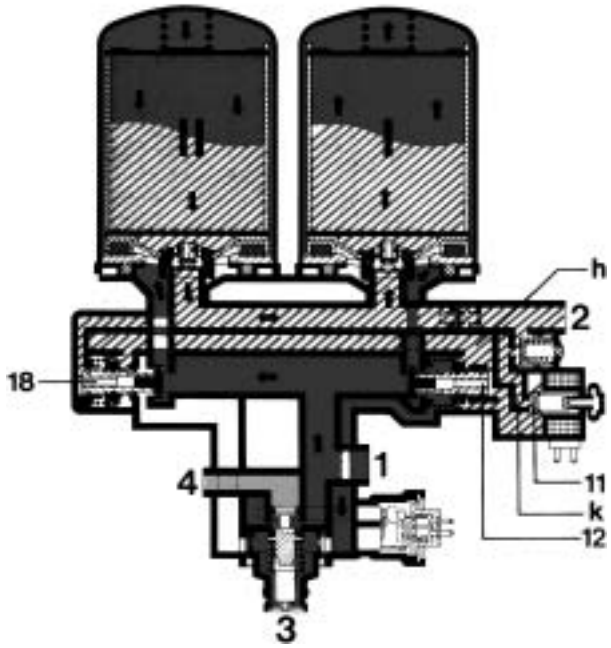
c. Regeneration of the Granulates in the reservoir II and opening of the charging valve



In order to be able to generate the granulates (23) in reservoir **II**, the compressed air in duct (p), because the check valve (21) is closed, flows via the nozzle bore (u) into the granulates cartridge (22). The dry compressed air passes through the granulates from below, thus adsorbing any moisture present on the surface of the granulates (23). The air which is now humid and expanding, flows via chamber (w), gap (v), annular chamber (s), the opened outlet valve (19) and duct (n) and escapes to atmosphere through vent **(3)**.

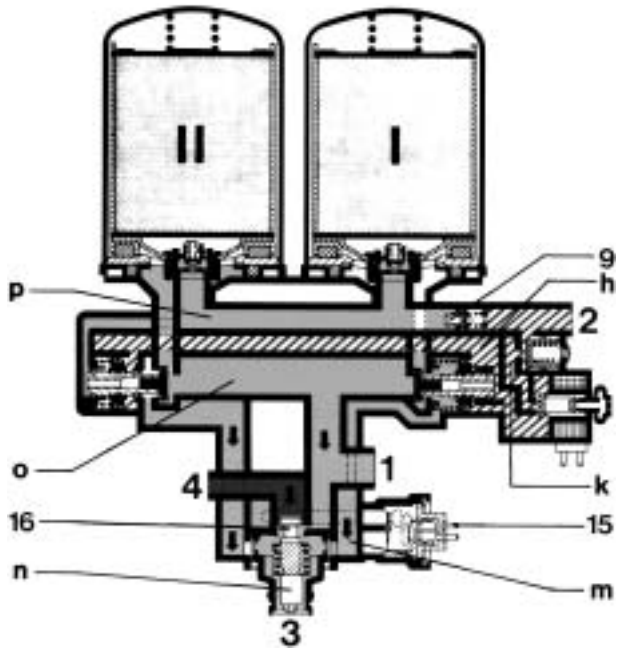
When the pressure at port **(2)** has risen to approx. 4.5 to 5.0 bar, charging valve (10) opens, thus pressurizing the duct (k) leading to the solenoid valve (11). This ensures that when **first filling** the system, the drying process always begins in **reservoir I**.

d. Reversal of the Air Dryer



At pre-set intervals the solenoid valve (11) is opened by an integrated timer. This causes the compressed air to pass from duct (k) to duct (h), The pressurizing of the valves (12) and (18) causes a reversal of the air dryer. As described under **"Drying"** and **"Regeneration"**, the drying process now takes place in reservoir **(II)**, and regeneration is achieved in reservoir **(I)**. Because of the integrated timer in the solenoid valve (11), this process repeats itself roughly every **60 seconds**.

e. Automatic Draining



When the cut-out pressure is reached, the unloader pressurizes port **(4)** of the air dryer. This causes the drain valve (16) to be opened, allowing any condensate at port **(1)** to excape via vent **(3)**. At the same time, the pressure in ducts (m), (n), (o) and (p) falls. The closing check valve (9) maintains the pressure in port **(2)** and in ducts (h) and (k). Venting port (4) causes the drain valve (16) to close again. Thus allowing the pressure in the air dryer to build up once again.

f. Operation of the Heating System

If the air dryer has had a heating cartridge (15) fitted, this will come on at a temperature of approx. 6°C and go off again at a temperature of approx. 30°C.

Maintenance

If any condensate is found when the air reservoir is checked, which should be done regularly when the vehicle is being operated, the regenerating function must be checked and the granulates cartridge replaced if necessary. Experience has shown that it may be necessary to replace the granulates after approx. 2 years. Therefore, a replacement with the disposable cartridge **432 410 020 2** or with WABCO-exchange cartridge **432 410 222 7** is to done.

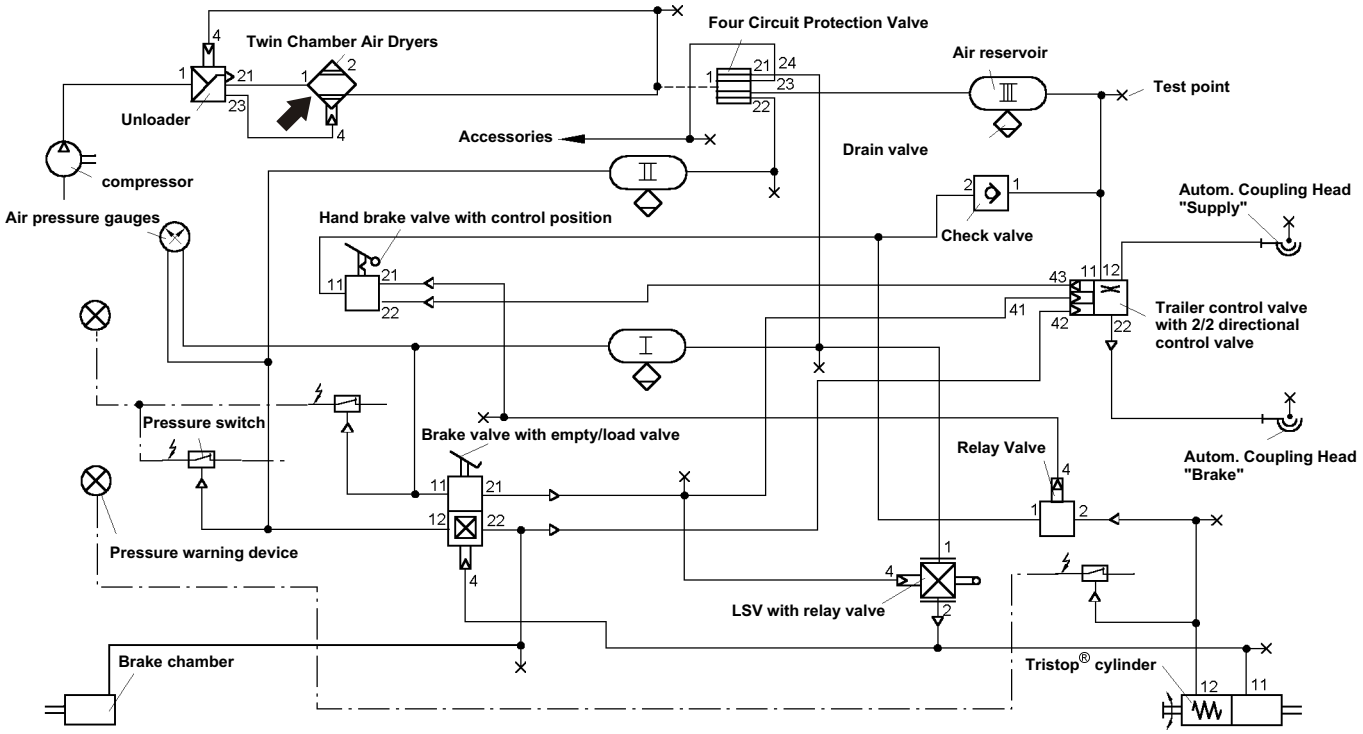
Please note

Whole cartridges or granulates must be treated as hazardous waste. Whilst replacement, the exchanged cartridge will be taken back.

Testing

The air dryer must be checked for tightness and to make sure it functions properly by checking the air reservoirs (occurrence of water condensate). In addition, the switching pulse of the solenoid valve with the timer must be checked (every 60 s), and the exhaust air streams compared. At the moment of reversal, the air dryer will briefly blow off more strongly from the vent.

Schematic for Testing and Installation



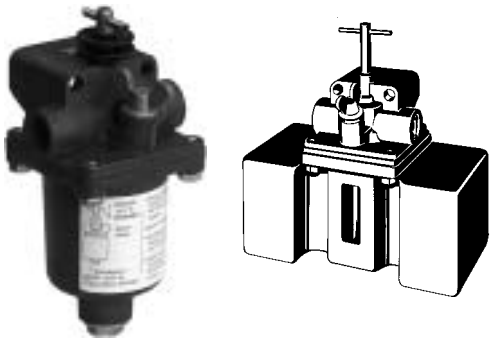
Purpose

Evaporators were applied to vehicle brake systems before air dryers were developed. Their purpose is to provide the highest possible degree of operational safety for air braking systems at below-freezing temperatures. This is achieved by lowering the freezing point of the water contained in the compressed air.

The most commonly used anti-freezers either use the evaporation principle, or anti-freeze agent is injected manually or automatically into the air compression system. Only alcohol-based anti-freeze agents may be used. We recommend the use of **"Wabcothyl"**.

Design types

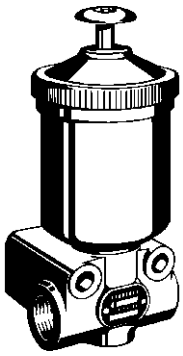
432 199 030 0 **432 199020 0**



a. The anti-freezer uses the evaporation principle. The variants differ merely in terms of the size of the reservoir used. Volumes are:

432 199 030 0 = 200 cm³ anti-freeze agent
432 199 020 0 = 1,100 cm³ anti-freeze agent
432 199 100 0 = 2,000 cm³ anti-freeze agent

432 002



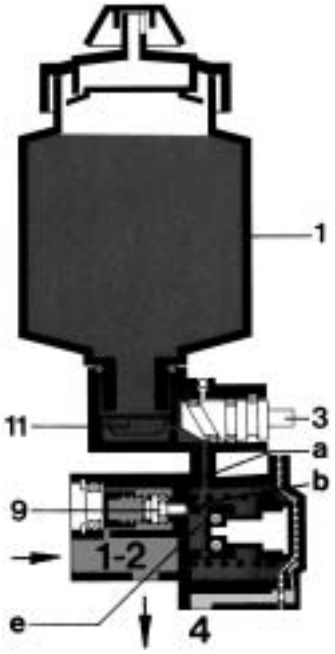
b. Anti-freeze pump
The anti-freeze pump is operated manually to inject anti-freeze agent into the line connected. Its reservoir contains up to 340 cm³ of anti-freeze agent.

932 002

d. Automatic anti-freeze pump
with dry-running properties. It can be fitted upstream or downstream from the unloader. It delivers 0.2 or 0.5 cm³ per injection process.

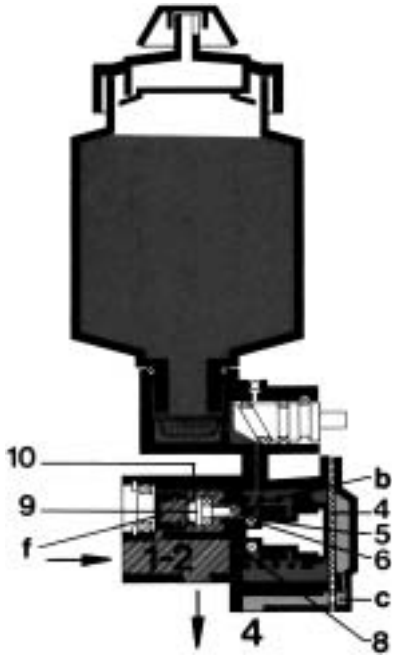
Operation of Automatic Anti-Freeze Pump with Control Port (4)

a. Filling Position



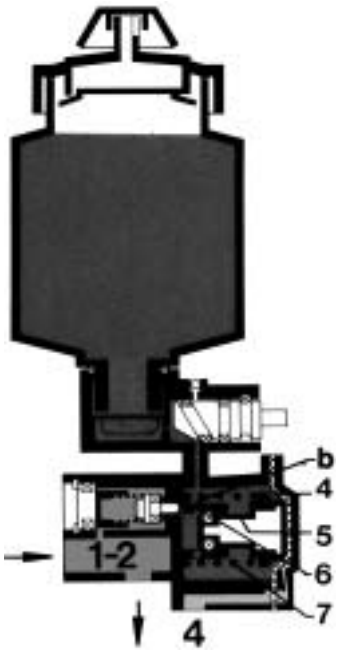
When first filling the pump **(at temperatures below +5 °C)** the shut-off cock (3) must be turned to position **"I"**. This allows the anti-freeze agent filled into reservoir (1) to flow through sieve (11), duct (a) and hole (b) into chamber (3). The valve (9) pressurized by air and the load of the spring is closed.

b. Actuating Position



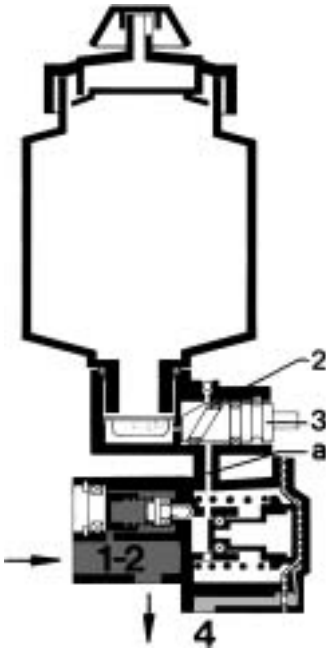
When the unloader valve is switched on, Port **(4)** and chamber (c) above the diaphragm (4) are pressurized. This causes the piston (5) to rest on the housing stop (8), and the O-ring (6) covers hole (b). Since the pressure of the enclosed fluid is now higher in front of the valve (9) than behind it, the valve opens and the anti-freeze agent **(0.2 or 0.5 cm³)** is injected into chamber (f). As the pressure falls, the valve (9) is closed again immediately by the force of spring (10) and the compressed air in chamber (f). The compressed air at ports **(1 – 2)** picks up anti-freeze agent as it passes and evaporates.

c. Reversing Position



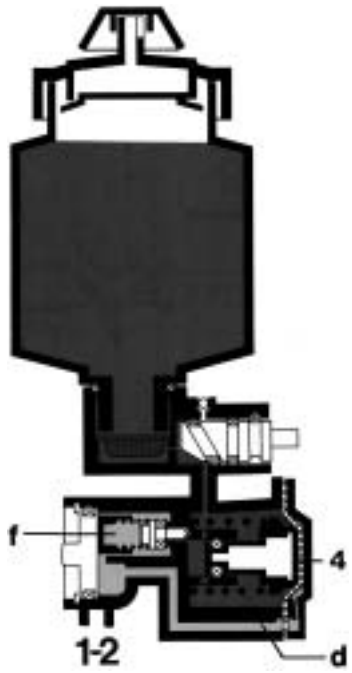
When the unloader valve once again switches to idle, port **(4)** is vented. The force of spring (7) can now return the piston (5) and the diaphragm (4) back to their original positions, and the O-ring (6) releases the feeder hole (b), allowing more anti-freeze agent to enter.

d. Taking out of Operation the Anti-Freeze Pump



By moving the shut-off cock (3) into the **"0"** position, the O-ring (2) closes duct (a). No anti-freeze agent can now flow in. Because of the pump's dry-running properties it is not necessary to top up with anti-freeze agent during the season when temperatures do not fall below zero.

e. Anti-Freeze Pump Without Control Port (4)



In this variant the anti-freeze pump is not located upstream but downstream from the unloader valve. Thus the control pulse in the line between the compressor and the unloader valve is transferred directly from chamber (f) via duct (d) to the diaphragm (4).

Maintenance

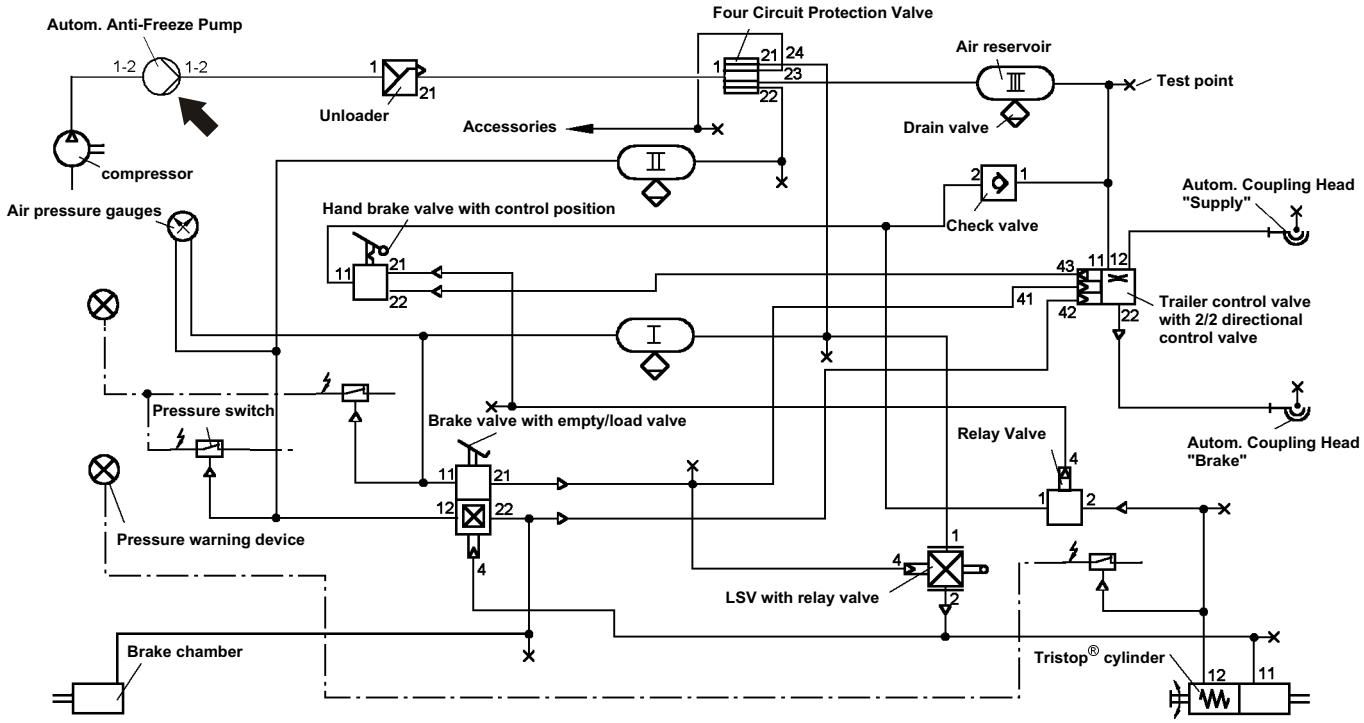
No special maintenance is required.

Testing

When the anti-freeze pump is switched on **(Position I)**, the fluid level should be checked daily, and topped up as required

Schematic for Testing and Installation

(Scheme of the pump in front of the unloader)



Schematic for Testing and Installation

(Scheme of the pump behind of the unloader)