

Instruction Book for
**Stationary Rotary
Screw Compressors**
ZR3-ZR4-ZR5-ZR6 Pack

Def unit serial # ARP493328

SAFETY PRECAUTIONS FOR STATIONARY COMPRESSOR UNITS

In addition to normal safety rules which should be observed with stationary air compressors, the following safety directions and precautions are of special importance.

When operating this compressor unit, the operator is expected to employ safe working practices and to observe all related local work safety requirements.

The owner is responsible for that the compressor is maintained in a safe operating condition. Compressor parts and accessories shall be replaced if unsuitable for safe operation.

Installation, operation, maintenance and repair shall only be performed by authorized, trained, competent personnel.

Critical ratings (pressures, temperatures, time-settings, etc.) shall be durably marked and maintained.

If any statement in this book, especially with regard to safety, does not comply with local legislation, the stricter of the two shall apply.

The precautions are general and cover several compressor types and equipment, hence some statements may not apply to the unit described in this book.

Installation

(See also the Atlas Copco Compressor Installation Manual)

Apart from general engineering practice conform with the regulations of local authority, the following directives are specially stressed.

1. Any blanking flanges, plugs or caps as well as eventual desiccant bags shall be removed before connecting up the pipes. Distribution pipes and connections shall be of correct size and suitable for the working pressure.
2. Place the compressor where the ambient air is as cool and clean as possible. If necessary install a suction duct. Care shall be taken to minimize the entry of moisture with the inlet air.
3. The aspirated air shall be free from flammable fumes or vapours, e.g. paint solvents, that can lead to internal fire or explosion.
4. Aircooled compressors shall be installed in such a way that an adequate flow of cooling air is available and that the outlet does not recirculate to the inlet.
5. If remote control is installed the compressor shall bear an obvious sign reading

DANGER: THIS COMPRESSOR IS REMOTELY CONTROLLED AND MAY START WITHOUT WARNING.

As a further safeguard persons switching on remotely controlled compressors shall take adequate precautions to ensure that there is no one checking or working on the compressor. To this end, a suitably worded notice shall be affixed to the start equipment.

6. In multiple unit compressor systems manual valves shall be installed to isolate each compressor. Check valves shall not be relied upon for isolating pressure systems.
7. Do not remove or tamper with the safety devices, guards or insulations fitted on the compressor unit. Every pressure vessel or auxiliary installed outside the unit to contain air above atmospheric pressure shall be protected by a pressure-relieving device or devices as required.
8. Pipework or other parts with an external surface temperature in excess of 80°C (175°F) and which may be accidentally touched by personnel in normal operation shall be guarded or insulated. Other high temperature pipework shall be clearly marked.
9. If the unit foundation is not level or can be subject to variable inclination, consult Atlas Copco.

Operation

1. If air hoses are used, they shall be of correct size and suitable for the working pressure. Do not use

frayed, damaged or deteriorated hoses. Use only the correct type and size of hose end fittings and connections. When blowing through a hose, ensure that the open end is held securely. A free end will whip and cause injury. Never direct compressed air at a person. When using it for cleaning down equipment do so with extreme caution and use eye protection.

Do not use compressor air for breathing, unless it is known to be properly purified for such use.

2. Do not operate the compressor in surroundings where there is a possibility of taking in flammable or toxic fumes.
3. Do not operate the compressor at pressures below or in excess of its rating as indicated on the Principal Data sheet.
4. All canopy doors shall be shut during operation.
5. People staying in compressor rooms where the sound pressure level exceeds 90 dB(A) shall use ear protectors.
6. Periodically check that:
 - all guards are in place and secure
 - all hoses and/or pipes are in good condition, secure and not rubbing.
 - there are no leaks
 - all fasteners are tight
 - all electrical leads are secure and in good order
 - pressure relief devices are not obstructed by dirt or paint.

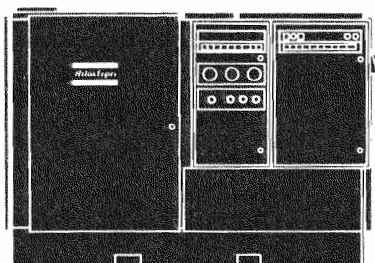
Maintenance

Maintenance and repair work shall only be carried out by adequately trained personnel; if required, under supervision of someone qualified for the job.

1. Use only the correct tools for maintenance and repair work.
2. Use only genuine spare parts.
3. All maintenance work, other than routine attention, shall only be undertaken when the compressor is stopped and the mains is switched off. Ensure that the unit cannot be started inadvertently.
4. Before removing any pressurized component, effectively isolate the unit from all sources of pressure and relieve the entire system from pressure.
5. Do not use flammable solvents for cleaning parts.
6. Observe scrupulous cleanliness during maintenance and when performing repairs. Keep dirt away by covering the parts and exposed openings with a clean cloth, paper or tape.
7. Do not weld or perform any other operation involving heat near the oil system. Oil tanks must be completely purged, e.g. by steam cleaning, before carrying out such operations.

Do not weld or in any way modify any pressure vessel.
8. Make sure that no tools, loose parts or rags are left in or on the compressor, the prime mover or the driving gear.
9. Before clearing the unit for use after maintenance or overhaul, check that operating pressures, temperatures and time-settings are correct and that the control and shut-down devices function correctly.
10. Every six months examine the discharge pipe and discharge pulsation damper for carbon deposits; if excessive, the deposits should be removed.

All responsibility for any damage or injury resulting from neglecting these precautions, or by non-observance or ordinary caution and due care required in handling, operating, maintenance or repair, even if not expressly mentioned in this book will be disclaimed by Atlas Copco.



Instruction Book for Stationary Rotary Screw Compressors ZR3-ZR4-ZR5-ZR6 Pack

Applies to units from following serial numbers onwards :

ZR3 A : ARP 490 212
ZR3 B : ARP 481 765
ZR3 C : ARP 482 234
ZR3 M : ARP 482 538

ZR4 A : ARP 495 042
ZR4 B : ARP 497 379
ZR4 C : ARP 498 125
ZR4 M : ARP 499 121

ZR5 A : ARP 483 539
ZR5 B : ARP 484 260
ZR5 M : ARP 485 016

ZR6 A : ARP 486 196
ZR6 B : ARP 487 125
ZR6 M : ARP 489 013

THIS INSTRUCTION BOOK describes how the subject rotary screw compressors should be operated to ensure optimum working economy and service life.

Read this book before putting the compressor into operation. This is a prerequisite if the machine is to receive proper maintenance from the beginning. The maintenance schedule contains a summary of the measures for keeping the compressor in good repair. The maintenance procedures are simple but must be carried out regularly.

Always have the book available and follow the instructions carefully at the periodic overhauls and major inspections. Record the running time, maintenance work effected, oil replenishments, temperatures, repairs, overhauls, etc. in an operator's logbook. Compressor repair operations should be performed by specially trained personnel, available at Atlas Copco service outlets.

If any further information beyond that contained in this book is desired, please get in touch with Atlas Copco.

In all correspondence concerning this compressor and especially when ordering spare parts always mention the unit serial number, stencilled on the data plate fixed to the compressor.

The company reserves the right to make changes without prior notice.

When operating this compressor unit, the operator is expected to employ safe working practices and to observe any related legal safety requirements.

It shall be the owner's responsibility to assure that the compressor is maintained in a safe operating condition. Compressor parts and accessories shall be replaced if unsuitable for safe operation.

Operation, maintenance and repair shall only be performed by authorized, trained, competent personnel.

Critical ratings, e.g. pressures, temperatures, time-settings, etc., shall be durably maintained.

$$1 \text{ bar} = 100 \text{ kPa} = 1.02 \text{ kg/cm}^2 = 14.5 \text{ psi}$$

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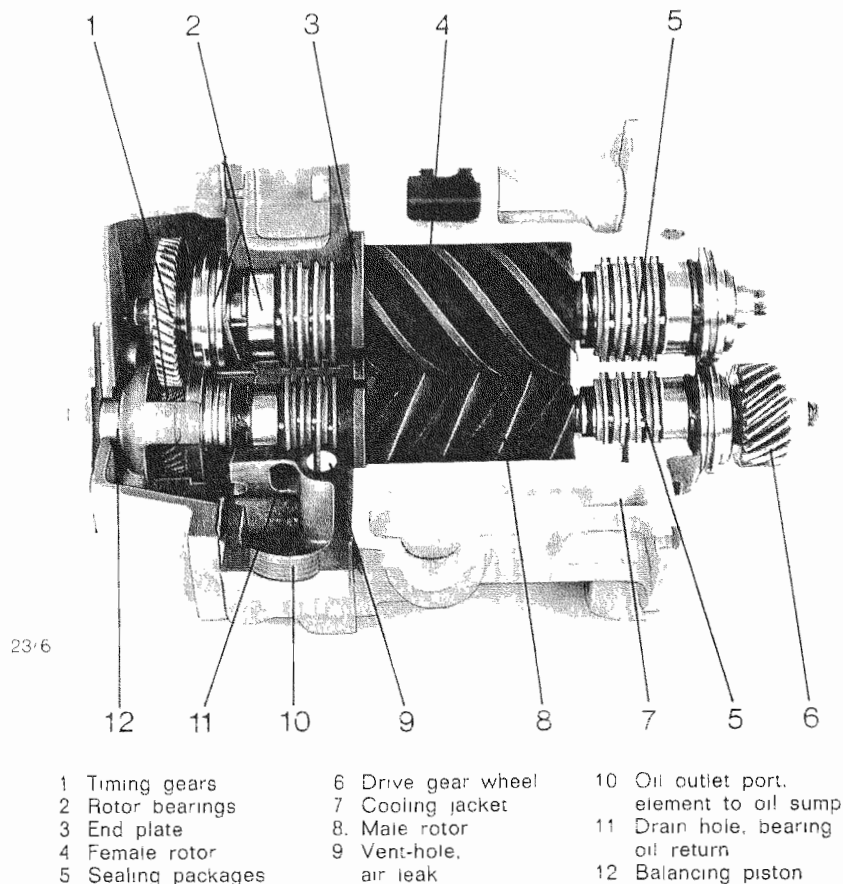


Fig. 1 Cut-away view of a Z compressor element

1. Leading particulars

1.1 General description

ZR Pack machines are stationary two-stage, water-cooled, electric motor driven rotary screw compressors, which deliver completely oil-free air.

Compressor unit

The compressor unit has one low pressure and one high pressure compressor element, each individually bolted to the housing of a common step-up gear. The power from the motor is transmitted to the step-up gear shaft through a flexible coupling ensuring vibration-free running and power transmission.

The compressor is furnished with a data plate on which are stencilled the type, serial number and maximum permissible working pressure. The electric motor is also provided with a data plate.

Drive arrangements

The compressor/motor unit is mounted on a base frame in one of two motor drive arrangements, i.e. Arr. E and Arr. 1. In Arr. E the motor is directly flanged to the compressor step-up gear casing by means of an adapter housing. The power is transmitted through a rubber bolt type coupling and the unit is supported on vibration dampers at three points on the base frame. In Arr. 1 the motor and compressor are separately mounted on a sub-frame, supported on the base frame on vibration dampers. The coupling is of the flexible multi-disk steel type.

Compressor elements

The compressor elements are designed for working pressures(e) of up to 10.5 (152 psi). The maximum working pressure(e) of M version units is limited to 8.5 bar (123 psi). Standard Arr. E units are equipped with an electric motor rated for a maximum working pressure(e) of 8.5 bar (123 psi).

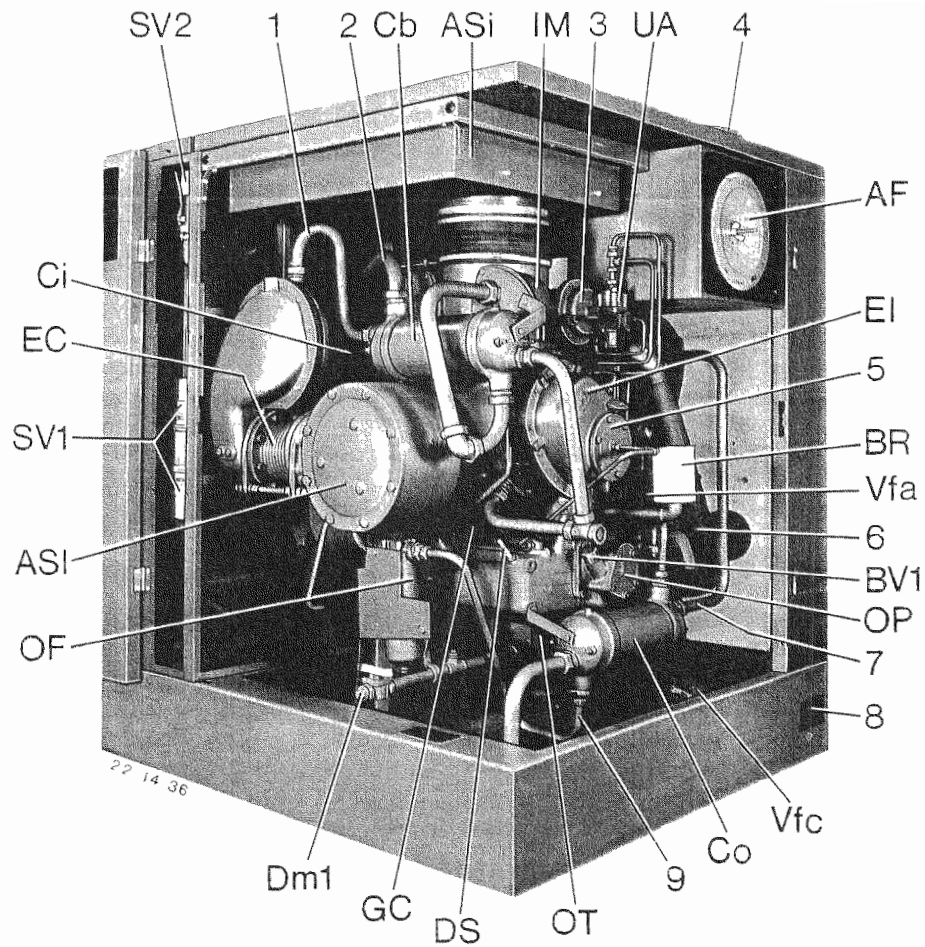


Fig 2. Rear view of ZR4 E compressor

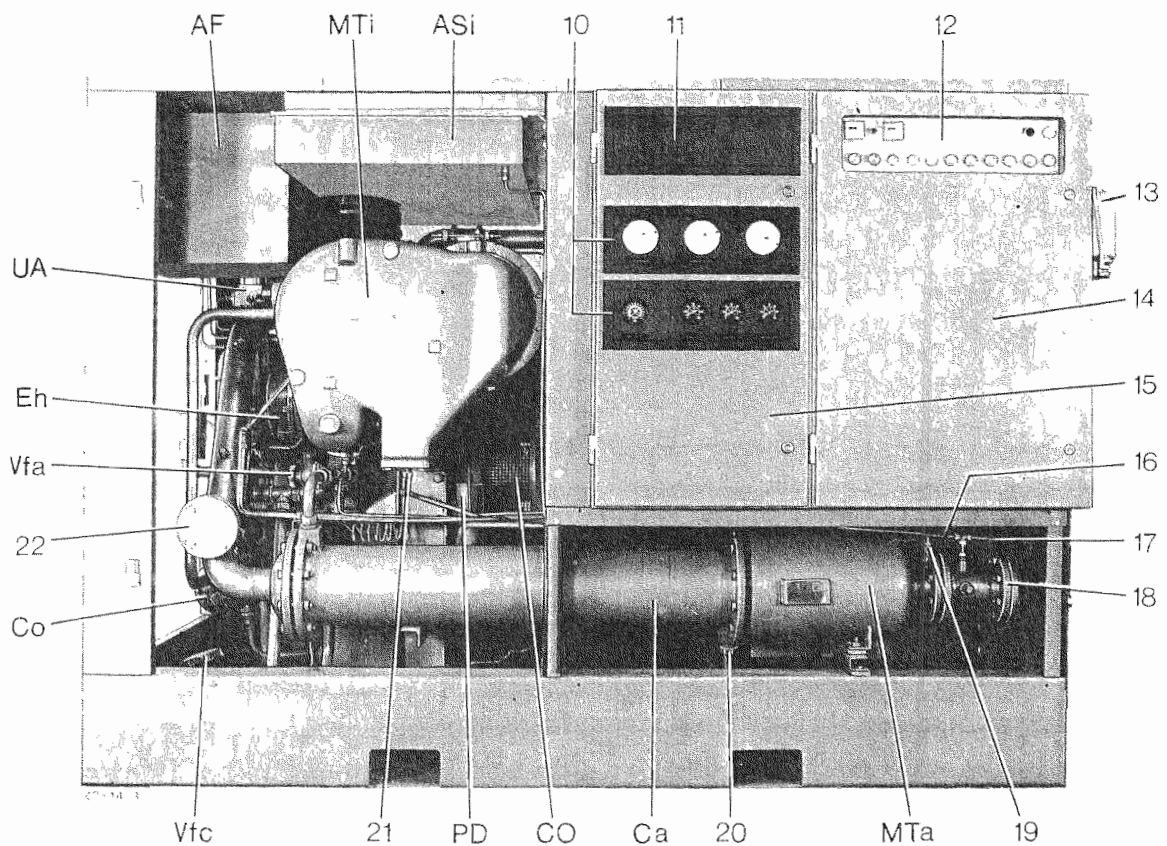


Fig. 3. Front view of ZR4 E compressor

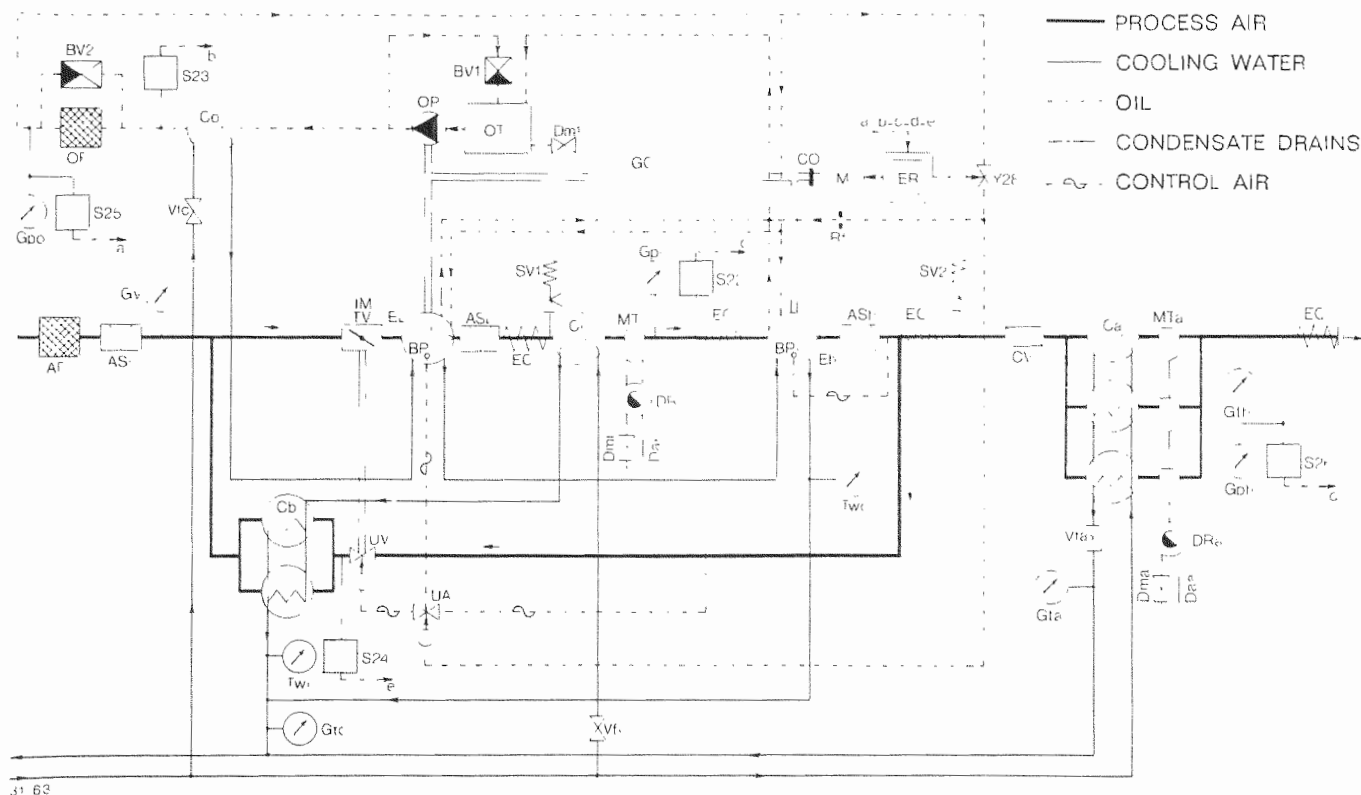


Fig 4. Flow diagram of ZR6 (that of ZR3, -4 -5 units is slightly different)

Compressor unit

AF. Air intake filter
 ASH. Air outlet silencer, HP compressor element
 ASI. Air intake silencer
 ASL. Air outlet silencer, LP compressor element
 BP. Balancing pistons
 BR. Breather, step-up gear casing
 Ca. Aftercooler
 Cb. Bleed-off cooler
 Ci. Intercooler
 CO. Flexible drive coupling
 CV. Check valve
 DP3. Drain plug, pulsation damper
 EC. Expansion compensators
 Eh. HP compressor element
 EL. LP compressor element
 ER. Electric regulator
 GC. Step-up gear casing
 Gph. Working pressure gauge
 Gpi. Intercooler pressure gauge
 Gth. Compressed air outlet temperature gauge
 Gv. Air intake filter service indicator
 IM. Air inlet throttle casing
 M. Prime mover
 MTa. Moisture trap, aftercooler
 MTi. Moisture trap, intercooler
 PD. Pulsation damper, bleed-off pressure switch

S22. Air temperature shut-down safety switch
 S24. Bleed-off pressure shut-down safety switch
 S26. Air pressure switch
 SV1. Intercooler relief valve(s)
 SV2. HP safety valve(s)
 TV. Air inlet throttle valve
 UA. Unloader cylinder head assembly
 UV. HP unloading valve
 Y28. Loading solenoid valve

Lubricating system

BV1. By-pass valve, oil pump
 BV2. By-pass valve, oil filter
 Co. Oil cooler
 Dm1. Drain cock, compressor sump
 DS. Oil filler pipe
 Gpo. Oil pressure gauge
 OF. Oil filter
 OP. Oil pump
 OT. Oil sump, step-up gear casing
 Rf. Flow restrictor, unloader circuit
 S23. Oil temperature shut-down safety switch (on ZR6 only)
 S25. Oil pressure shut-down safety switch

Cooling water system

Daa. Automatic drain outlet, aftercooler
 Dai. Automatic drain outlet, intercooler
 Dma. Drain valve, aftercooler drain receiver

Dmi. Drain valve, intercooler drain receiver
 DRa. Drain receiver, aftercooler
 DRi. Drain receiver, intercooler
 Gta. Aftercooler cooling water outlet temperature gauge
 Gtc. Compressor cooling water outlet temperature gauge
 Twc. Thermometer, compressor cooling water circuit (on ZR6 only)
 Twi. Thermometer, intercooler cooling water circuit (on ZR6 only)
 Vfa. Regulating cock, aftercooler cooling water flow
 Vfc. Regulating cock, compressor cooling water flow
 Vfi. Regulating cock, intercooler cooling water flow (on ZR6 only)

Numbered items on Figs. 2 and 3

- Cooling water inlet pipe to bleed-off cooler
- Blow-off inlet pipe to bleed-off-cooler
- Unloader piston cover
- Air intake aperture

- Balancing piston cover, LP compressor element
- Compressed air outlet pipe, HP air outlet silencer to aftercooler
- Cooling water inlet pipe to intercooler
- Data plate
- Oil inlet pipe to oil cooler
- Instrument panel
- Blind panel, MD air dryer control and indicator panel mounted here, if installed
- Control and indicator panel, perspex front plate removed
- Mains cable entry box
- Regulator cabinet
- Compressor cabinet
- Pipe to working pressure gauge
- Vent pipe to and from aftercooler drain receiver
- Compressed air outlet pipe
- Sensing element, compressed air outlet temperature gauge
- Cooling water inlet pipe, aftercooler
- Drain outlet pipe, intercooler moisture trap
- Blind flange, connection for hot air pipe to MD air dryer

Each compressor element comprises two screw-type precision machined meshing rotors, mounted on ball and roller bearings. There is no surface contact between the rotors and their casing. The male rotors driven by the step-up gear and the female rotors are synchronized through a set of timing gears which maintain the slight clearance between the male and female rotor lobes.

The male rotors have four lobes, the female rotors six flutes. The male rotors consequently revolve at $1\frac{1}{2}$ times the speed of the female rotors. The absence of metal-to-metal contact between the rotors and also between the rotor crests and the compressor casings eliminates the possibility of wear of these parts and power loss through friction.

In order to prevent air and oil leakages along the rotor shafts, sealing rings held in special retainers are fitted on the shafts. Waved spring rings maintain an axial pressure on the sealing rings, but they are otherwise free for radial self-adjustment. The sealing packages located next to the compression space prevent air leakage and those located next to the rotor bearings prevent the lubricating oil from entering the compressor space.

To provide an absolute safeguard against the penetration of oil into the compression space, drains are provided for evacuating any oil that might gather between the oil and air sealing packages.

Lubricating system

Oil is used for lubricating the rotor bearings, timing gears, driving and step-up gears. The oil system includes a gear-type oil pump, a water-cooled oil cooler and a full-flow oil filter.

Cooling system

Water is used throughout for cooling. The compressor elements have cooling jackets for that purpose. An aftercooler maintains the temperature of the discharge air within specified limits. The moisture content of the discharge air is reduced in the water separator incorporated in the aftercooler.

The tubes and end plates of all the coolers are made of stainless steel. The cooling water system includes regulating cocks and thermometers for controlling the outlet water temperature.

Safety devices

On ZR3 Pack units, a relief valve protects the intercooler and a safety valve the aftercooler and HP side of the compressor. ZR4 units have two relief valves. ZR5 units have one and ZR6 units have two safety valves for the protection of the aftercooler and HP side of the compressor, the intercooler is protected by two relief valves.

A check valve in the HP air outlet silencer (ZR3, -4) or outlet pipe system (ZR5, -6) prevents blow-back of compressed air from the main air system during the

compressor off-load periods or when the motor stops unexpectedly, while the compressor is connected to an air main with other compressors.

Pressure and thermal switches safeguard the compressor in the event of too high air temperature, oil pressure or bleed-off pressure failure.

Canopy

The electric motor, compressor, coolers, oil filter, etc. are all enclosed in a modern sectional pressed steel sound-insulated canopy, with doors providing easy access to the compressor for normal maintenance. The front panel of the canopy comprises a bipartite cubicle. The canopy also incorporates an air intake silencer with air intake filter element(s).

Electric equipment

The operation of the unit is governed by an electric regulator, comprising a blocking relay to prevent an automatic re-start if and when the compressor has been stopped through the action of any of the safety switches. All the components of the regulator are housed together with the motor starting equipment in the "regulator cabinet" of the cubicle, the door of which carries the control and indicator panel.

The safety switches are panel-mounted in the "compressor cabinet" of the cubicle, which also serves to house the electrical control unit of the MD air dryer, if installed. The door of this cabinet carries all the pressure and temperature gauges, and may also comprise the control and indicator panel of the air dryer.

Service exchange elements

Atlas Copco service outlets have available LP and HP compressor elements, ready-to-fit and tested-to-factory standards, for immediate replacement on machines due for overhaul. The elements are easy to remove and to install on the compressor step-up gear casing. Downtime is reduced to a minimum while the need for major repairs in the field is eliminated.

Compressor elements are NOT to be dismantled or stripped by customers. After an element has been taken off the compressor it should be returned to Atlas Copco for reconditioning, this in order to benefit the customer with a "service exchange system".

1.2 Compressor air flow (Fig. 4)

Air drawn through the filter element(s) (AF), air intake silencer (ASi) and inlet throttle casing (IM) into LP compressor element (EI) is compressed, then discharged to intercooler (Ci) where the air temperature is brought down to within a specified range.

The cooled air then enters HP compressor element (Eh) where it is further compressed and discharged through outlet silencer (ASh) and HP check valve (CV) to aftercooler (Ca).

During full rated capacity operation of the compressor, air inlet throttle valve (TV) is fully open and HP unloading valve (UV) closed. The valves are simultaneously closed and opened respectively by loading solenoid valve (Y28) through the spring-loaded diaphragm sealed piston of the unloading system, when the working pressure rises above the pre-set maximum pressure.

Under this condition, the air pressure of the HP element is released to the atmosphere via unloading valve (UV), bleed-off cooler(s) (Cb) and the air inlet casing (IM), resulting in closing of check valve (CV). The throttle valve is designed so as to leave a slight air passage in the closed position. Thus, a limited quantity of air continues to be drawn into the compressor in order to maintain the pressure ratio over the HP element at a reasonable value.

An air-operated balancing piston (BP) is fitted behind the male rotor rear thrust bearing of each compressor element. These pistons decrease the load on the front male rotor thrust bearings during loaded operation.

During the load periods the LP balancing piston is actuated by air at intercooler pressure (see "Unloading system") and the HP balancing piston by air at HP outlet pressure (see Fig. 4), while during the off-load periods both pistons are in communication with the atmosphere.

A compressed air outlet temperature gauge (Gth), an intercooler pressure gauge (Gpi), a working pressure gauge (Gph), intercooler relief valves (SV1) (one on ZR3) and a HP safety valve (SV2) (two on ZR6) are comprised in the circuit, as well as a high air temperature switch (S22) and a bleed-off pressure switch (S24), the function of which are described under "1.6 Electrical system and safety devices".

1.3 Cooling water system (Fig. 4)

ZR6

The cooling water system is divided into three circuits: one for the oil cooler (Co) and compressor elements (EI and Eh), one for the intercooler (Ci) and the two bleed-off coolers (Cb), and one for the aftercooler (Ca). The cooling water leaving the oil cooler first flows through the cooling jacket of the LP compressor element and then through that of the HP element. All circuits are provided with a regulating cock (Vfc, Vfi and Vfa). The two first-mentioned circuits have a thermometer (Twc and Twi) fitted in the outlet piping.

ZR3, -4, -5

The cooling water system of these units is different from that shown on the flow diagram, as it consists only of two circuits; one for the compressor and one for the aftercooler.

On its way to the compressor elements the cooling water first passes regulating cock (Vfc) and oil cooler (Co), and then, successively, the intercooler (Ci), bleed-off cooler (Cb), cooling jacket of the LP compressor

element (EI) and from there to the cooling jacket of the HP compressor element (Eh), from where it is drained.

The aftercoolers of ZR5 and ZR6 units have two and three cooling elements respectively. The cooling water for the aftercooler (Ca) is branched off upstream of the compressor cooling water regulating cock(s) and is drained directly.

The intercooler and each aftercooler element is provided with a moisture trap (MTi and MTa), each connected to a condensate drain receiver (DRi and DRa) with an automatic float valve for draining condensate during operation of the unit, and a manually operated drain valve (Dmi and Dma) for draining the receivers after the unit has been stopped.

The compressor and aftercooler cooling water circuits comprise a temperature gauge (Gtc and Gta), the sensing elements of which are fitted in the drain pipes. For regulating the water flow through the aftercooler, a cock (Vfa) is fitted in the drain pipe.

The cooling jacket of the compressor elements consists of two interconnected compartments, the lower parts of which are connected externally by a pipe for draining purposes. Other drain points are also provided. A drain cock should be fitted by the user in the lower part of the main cooling water inlet pipe for draining most of the water from the cooling system. **When the unit is stopped and freezing temperatures are expected, the cooling system must be drained completely.**

The cooling water shall be free from solid impurities. The content of calcium compounds or similar scale-forming substances should preferably not exceed 100-120 mg calcium oxide (CaO) per litre. The use of "hard" water, that is water with a relatively high calcium compound, should be avoided as it will bring about sedimentation and the formation of scale in the whole cooling system.

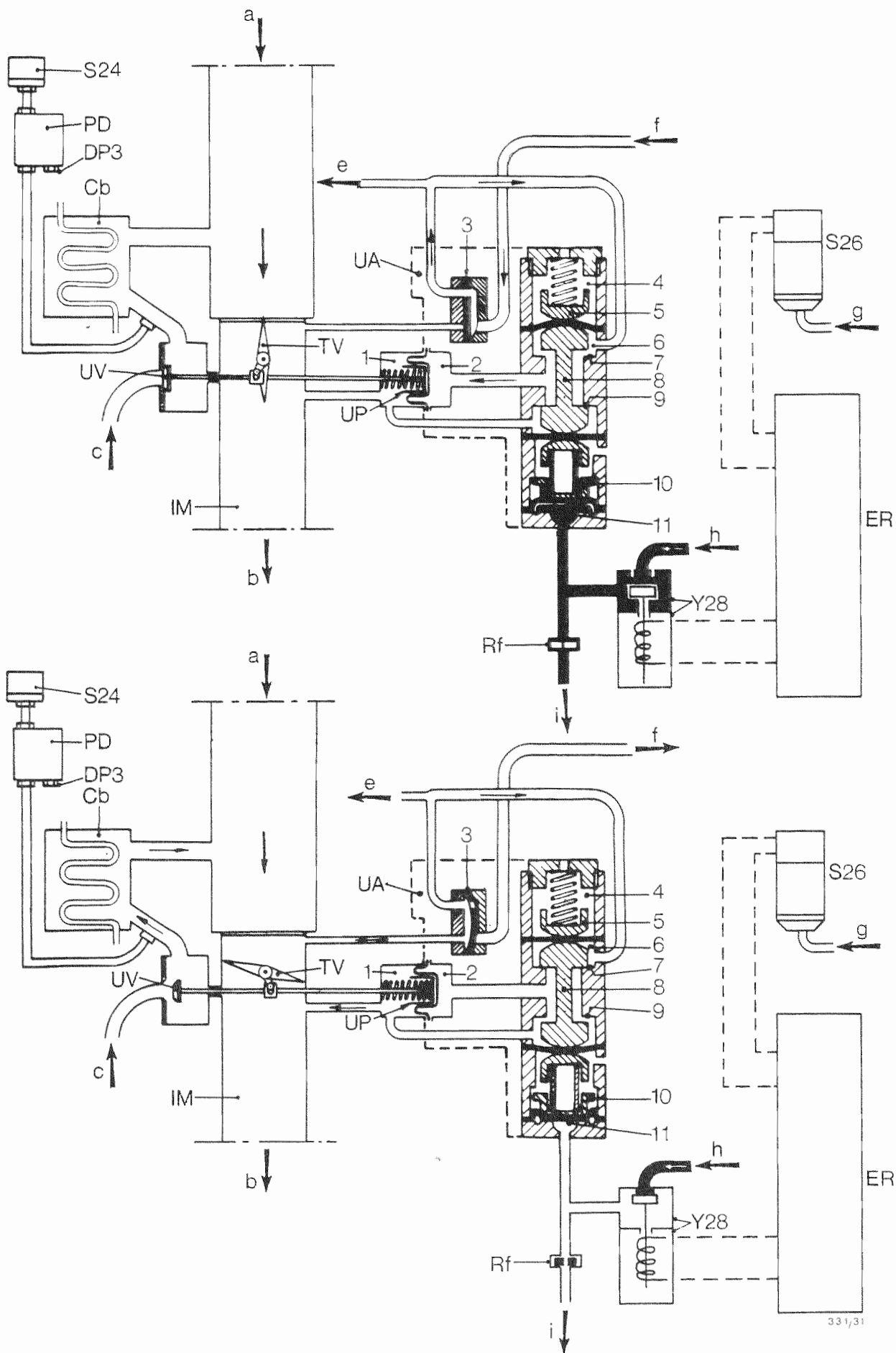
1.4 Lubricating system (Fig. 4)

Oil from the oil sump (OT), located in the bottom of the step-up gear casing (GC), is pumped through the lubricating system by a gear-type oil pump (OP) mounted on the front of the step-up gear casing. The pump is gear-driven from the compressor main drive shaft.

The oil is pumped through the water-cooled oil cooler (Co) and from there it passes through the full-flow (twin) oil filter (OF) before entering the LP and HP compressor element oil pipes and ducts to lubricate the front and rear rotor bearings, step-up and timing gears. From the different compartments the oil then flows back to the oil sump.

A by-pass valve (BV1) in the oil pump housing opens and allows oil to by-pass back to the sump whenever the maximum permissible pressure is exceeded on the delivery side of the pump. The step-up gear casing is vented to the atmosphere through a breather.

A by-pass valve (BV2) in the header of the oil filter (ZR3 and ZR4) or in each of the oil filter elements (ZR5 and ZR6), open(s) when the pressure drop over the



COMPRESSOR LOADED

COMPRESSOR UNLOADED

filter is above normal due to clogging of the filter element(s). The oil will then be pumped unfiltered to the lubricating points. Regular filter maintenance is therefore imperative, as unfiltered oil may eventually lead to bearing failure.

An oil pressure gauge (Gpo), as well as a low oil pressure safety switch (S25) and a loading solenoid valve (Y28) are incorporated in the system.

Apart from lubrication, the oil under pressure is also used to open the air inlet throttle valve when the solenoid valve is energized by the electric regulator (ER). A restrictor washer (Rf) is fitted in the oil return pipe of the solenoid valve. Thus, when the valve is activated, sufficient oil pressure will prevail in the system upstream of the restrictor for operating the unloading mechanism.

1.5 Unloading system (Fig. 5)

Basically the unloading system is an on-off system, operated by an air pressure switch which senses the pressure variations in the air discharge system.

The function of the system is to control the air output of the compressor in relation to the air consumption of the equipment connected to the air net and to maintain the pressure in the air net within a selected range, i.e. between the pre-set upper and lower limits of the working pressure.

The air delivery control is effected by closing the compressor air inlet whereby air delivery is completely stopped (0 % air output). At the same time, the compressor is unloaded by the opening of the air discharge outlet to the air inlet upstream of the throttle valve. Compression is resumed to the full rated capacity (100 % air output) at the end of the unloading period.

Unloading/loading

The pneumatic side of the air pressure switch (S26) is connected to the air discharge pipe, the electrical side to the electric regulator.

If the air consumption is less than the full rated capacity of the compressor, the pressure in the air net will increase.

When the pressure in the air net has reached the pre-set upper limit of the working (maximum) pressure, the air pressure switch (S26) will be operated by air at working pressure, the electric contact of the switch opens with the result that loading solenoid valve (Y28) is de-energized through the electric regulator. This will cause the unloader assembly (UA) to operate, i.e. the throttle valve (TV) to close and the HP unloading valve (UV) to open. The air delivery is now completely stopped, the compressor runs unloaded (0 % air output).

If the pressure in the air net decreases to the pre-set lower limit of the working (loading) pressure, the contact of the air pressure switch closes so that the solenoid valve is energized again. Unloading is stopped, the throttle valve opens, the HP unloading valve closes and the air delivery resumed to the full rated capacity of the compressor (100 % output).

The unloading and loading pressures are the opening and closing operating pressures of the air pressure switch.

The unloader assembly comprises a shuttle valve (8), one side of which is actuated by oil pressure admitted to chamber (11) from the compressor lubricating circuit. The other side is actuated by spring pressure.

The loaded and unloaded operation cycle of the compressor is as follows :

Loaded operation

The pressure in the air net is less than the pre-set maximum pressure and the contact of air pressure switch (S26) is closed. Under this condition :

1. Loading solenoid valve (Y28) is energized ; oil under pressure is present in chamber (11).
2. Starting plunger (10) and shuttle valve (8) have moved against the spring force of plunger (5). Port (9) is closed and port (7) open.
3. Switching valve (3) admits air at intercooler pressure (f) to the balancing piston of the LP compressor element and to chamber (2) of unloader piston (UP) via chamber (6). The atmospheric pressure inlet port of the switching valve is closed.

Cb. Bleed-off cooler
DP3. Drain plug, pulsation damper
ER. Electric regulator
IM. Air inlet throttle casing
PD. Pulsation damper
Rf. Oil flow restrictor
S24. Bleed-off pressure safety switch
S26. Air pressure switch
TV. Air inlet throttle valve
UA. Unloader assembly

UP. Unloader piston
UV. HP unloading valve
Y28. Loading solenoid valve
a. Filtered AIR IN
b. To LP compressor element
c. From HP air outlet silencer
e. To balancing piston of LP compressor element

f. Connected to intercooler
g. Air at working pressure
h. Inlet from lube oil circuit
i. Outlet to sump
1. Chamber, piston spring side
2. Chamber, piston pressure side
3. Diaphragm type switching valve

4. Chamber, atmospheric pressure
5. Unloader plunger
6. Shuttle valve chamber, spring-loaded side
7. Intercooler pressure port
8. Shuttle valve
9. Vacuum port
10. Starting plunger
11. Chamber, oil from lubricating circuit

Fig. 5. Unloader assembly

- 4 Atmospheric pressure is present in chamber (1) of unloader piston (UP). The pressure difference between chambers (1) and (2) keeps throttle valve (TV) fully open and HP unloading valve (UV) closed.

The compressor delivers its maximum rated output.

Unloaded operation

The pressure in the air net (g) has reached the pre-set maximum pressure. The contact of the air pressure switch opens.

- 1 Solenoid valve (Y28) is de-energized and the oil pressure consequently released from chamber (11).
- 2 Plunger (10) and shuttle valve (8) are moved by spring force, intercooler pressure air inlet port (7) is closed. Port (9) is open.
3. The intercooler pressure is released from chamber (2) and replaced by atmospheric pressure. This causes spring-loaded unloader piston (UP) to close throttle valve (TV) and to open HP unloading valve (UV) fully. The compressed air present between the HP compressor element and the unloading valve is blown off through bleed-off cooler (Cb), the check valve upstream of the aftercooler closes and prevents blow-back of compressed air from the net.
4. As soon as the throttle valve has closed, a vacuum prevails in unloader piston chambers (1) and (2), and in the intercooler (f) as well. This causes switching valve (3) to operate so that atmospheric pressure instead of air at intercooler pressure is admitted to the balancing piston of the LP compressor element(e).

This condition will prevail until the pressure in the air net has decreased to the pre-set loading pressure of the air pressure switch.

The compressor can at all times be manually unloaded by means of a toggle switch fitted on the control panel; it is also precluded from automatic loading after starting-up through the same switch.

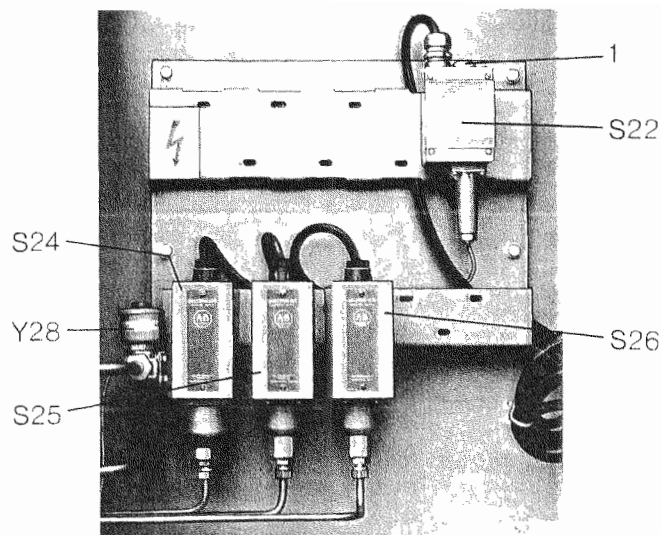
1.6 Electrical system and safety devices

Arrangement E compressor units are completely equipped and wired, and require only connection to the mains supply line. The electrical system comprises the following main components:

- a. Electric motor with terminal box
- b. Motor starting equipment
- c. Transformer for control voltage
- d. Electric regulator
- e. Safety devices

Motor starting equipment

The starting equipment and basic electrical service diagram of the motor are not dealt with in this book, as they depend on the type of motor installed. The basic electrical service diagram is, however, supplied with the machine.



- | | |
|---|-----------------------------|
| S22. HP air inlet temperature safety switch | S26. Air pressure switch |
| S24. Bleed-off pressure safety switch | Y28. Loading solenoid valve |
| S25. Oil pressure safety switch | 1. Temperature setting knob |

Fig. 6. Compressor panel of ZR3, -4, -5 units

Electric regulator and safety devices

The electric regulator and safety devices are housed in a cubicle consisting of two cabinets, named regulator and compressor cabinets. The regulator cabinet also houses the voltage transformer and motor starting equipment.

Compressor cabinet

Safety devices in the form of pressure and thermal switches are connected to various points of the compressor. They serve to automatically stop the electric motor and thus prevent damage resulting from a dangerous operating condition. All the switches are mounted and grouped together with the air pressure switch and loading solenoid valve on a panel inside the compressor cabinet, the door of which also carries the instrument panel.

The switches are connected to the electric circuit of the regulator via a terminal strip. The control panel of the regulator has individual fault indicator lamps. If an abnormal or dangerous operating condition arises during running, the operative switch will break the circuit to the regulator, thus causing the motor to stop and the fault indicator lamp of the switch concerned to light up. The lighting of the lamp assists in tracing the cause of the trouble.

All the switches with their characteristics are listed in the table.

Safety switches in compressor cabinet

Ref.	Designation	Connected to	Tripping cause	Contact				Setting value	
				Unit at rest		Unit running		Breaks at	Makes at
				Open	Closed	Open	Closed		
S25	Oil pressure	Outlet piping of oil filter	Oil pressure too low	•			•	1.4 bar(e) 20 psig	
S22	HP air inlet temperature	Intercooler air outlet manifold	Intercooler air outlet temperature too high		•		•	60°C 140°F	
S24	Bleed-off pressure	Pulsation damper, which is in turn connected to bleed-off piping downstream of HP unloading valve	Bleed-off pressure too high when compressor is unloaded		•		•	0.3 bar(e) 4.3 psig	
S23	Oil temperature (on ZR6 units only)	Oil cooler outlet piping	Oil temperature too high		•		•	80°C 176°F	

Attention : The switches are adjusted at the factory. Do not set the temperature switches to open their contact at a higher temperature. If the unit has shut down through the action of a safety switch, the fault should first be traced and remedied before a new starting attempt is made.

Regulator cabinet

Basically the compressor control equipment, which is housed in this cabinet, is an on-off regulator with built-in delay circuits for timing the required interval before the compressor is loaded when started up (loading delay), and before the electric motor is stopped after the compressor has been unloaded (idling delay).

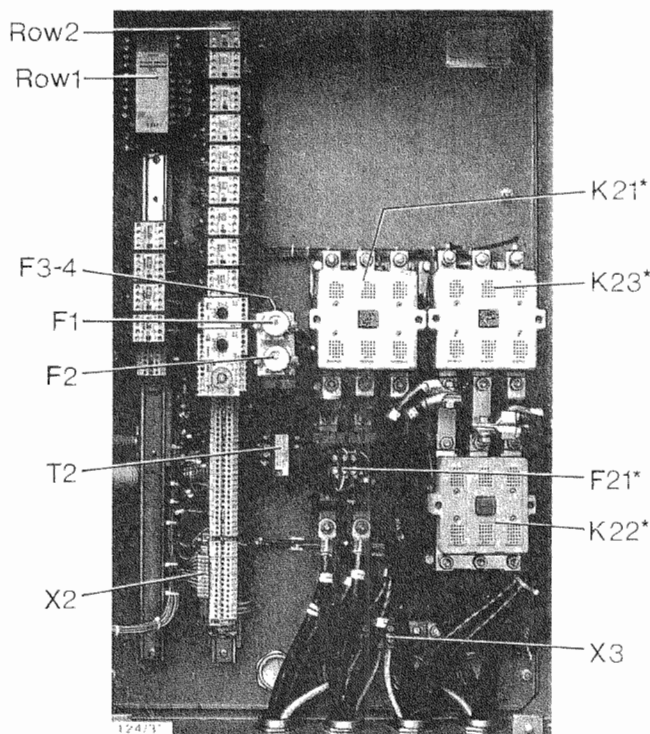
The regulator adapts the operation of the compressor, i.e. loading, unloading, stopping and restarting according to the variations in the compressed air demand, and serves to protect the compressor and motor from overloads. When the current is switched off at the end of the working shift or after a power failure, it also takes care of automatically unloading the compressor.

The regulator consists of a relay panel, and a control and indicator panel attached to the door of the cabinet. The wires between the panels are grouped in a plastic sheath.

Relay panel (Fig. 7)

The panel comprises two time relays, 13 relays, two voltage transformers, four fuses and a terminal strip.

The function of the time relay for delayed loading (K8) is to temporarily break the circuit to the loading solenoid valve (Y28 - Fig. 6) and to override the oil pressure safety switch during automatic starting. The relay should make the circuit to the solenoid valve approx. 20 seconds after the RESET/START button on the control panel has been pressed. By this time the motor should have reached its normal operating speed and the oil pressure switch should have closed. This switch is normally open when the motor is stopped and the oil pressure zero, it closes when the oil pressure is normal. A toggle switch (S3 - Fig. 11) for manually breaking the circuit to the solenoid is provided.



Row 1 (from the top downwards):

T1 - K30 - K31 - K32 - K33 - X4

Row 2 (from the top downwards):

K1 - K2 - K3 - K4 - K5 - K6 - K7 - K9 - K11 - K24* - K8 - K10 - X1

See legend of Fig. 8 for denomination of components.

* Components of starting equipment

F21 Thermal overload relay

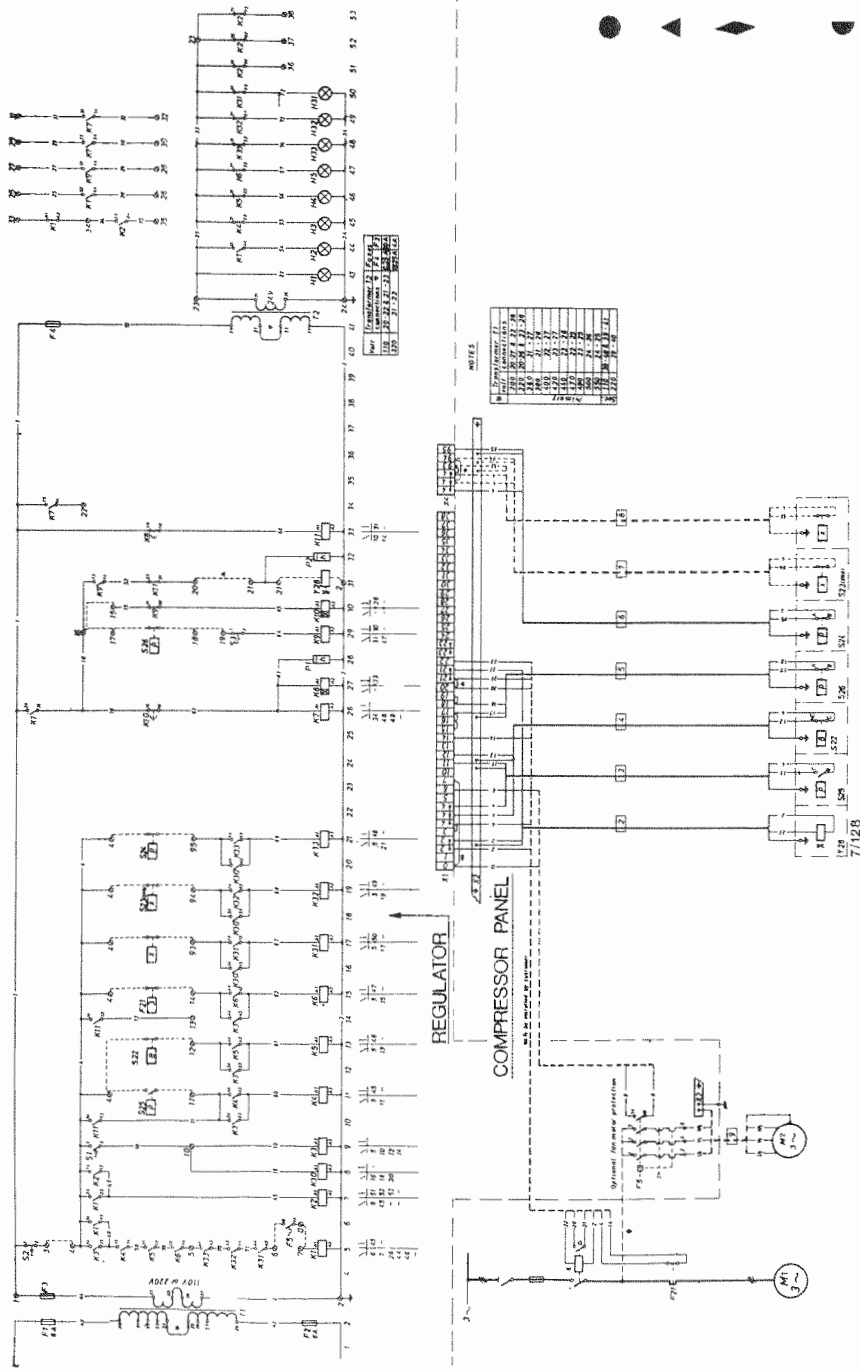
K21 Line contactor

K22 Star contactor

K23 Delta contactor

K24 Time relay, star/delta switching-over

Fig. 7 Regulator cabinet with motor starting equipment, ZR4 E compressor (typical example)



- If a safety switch is installed, disconnect corresponding bridge on strip X4.
- ▲ If delta contact of star/delta starter is used, remove bridge 20-21 on strip X1
- ◆ For high voltage compressor motors, use separate supply and starter for fan motor, controlled by contact of relay K7 available at terminals 31-32 on strip X1
- Power consumption of motor starter : max. 500VA.

- Regulator**
- F1/2. Fuses 6 A, transformer T1 primary side
 - F3. Fuse, transformer T1 secondary side
 - F4. Fuse, transformer T2 primary side
 - F5. Electro-magnetic circuit breaker, fan motor M2
 - F21. Overload relay, compressor motor M1
 - H1. VOLTAGE ON indicator lamp
 - H2. AUTOMATIC OPERATION indicator lamp
 - H3. OIL PRESSURE fault indicator lamp
 - H4. High HP AIR INLET TEMPERATURE fault indicator lamp
 - H5. MOTOR OVERLOAD fault indicator lamp
 - H31. Spare fault lamp
 - H32. Spare fault lamp ; on ZR6 : OIL TEMPERATURE fault indicator lamp
 - H33. BLEED-OFF PRESSURE fault indicator lamp
 - K1. Blocking relay
 - K2. Auxiliary relay, remote general fault circuit
 - K3. Reset relay
 - K4. Shut-down relay, oil pressure switch S25
 - K5. Shut-down relay, air temperature switch S22
 - K6. Shut-down relay, motor overload relay F21
 - K7. Auxiliary relay, motor starter
 - K8. Time relay for delayed loading (20 seconds)
 - K9. Loading relay
 - K10. Time relay for delayed motor stopping (20 minutes)
 - K11. Auxiliary relay, loading relay
 - K30. Auxiliary reset relay
 - K31. Shut-down relay for lamp H31 and extra safety device
 - K32. Shut-down relay for lamp H32 and extra safety device ; on ZR6 : oil temperature switch S23
- Compressor panel**
- S22. HP air inlet temperature safety switch
 - S23. Extra safety device ; on ZR6 : oil temperature safety switch
 - S24. Bleed-off pressure safety switch
 - S25. Oil pressure safety switch
 - S26. Air pressure switch
 - Y28. Loading solenoid valve
 - M1. Compressor motor
 - M2. Fan motor (on Arr 1 units only)
- K33. Shut-down relay, bleed-off pressure switch S24**
- P1. Hourmeter, motor
 - P2. Hourmeter, compressor
 - S1. Push button, RESET/START
 - S2. Push button, STOP
 - S3. Toggle switch, UNLOADED/NORMAL compressor operation
 - T1. Transformer, control circuit
 - T2. Transformer, lamp circuit
 - X1/4. Terminal strips
 - X2. Earthing strip

Fig. 8. Service diagram of regulator and compressor panel

The time relay for delayed motor stopping (K10) limits the frequency of motor starts during operation by determining the period during which the compressor runs unloaded without interruption. It is normally factory-set for a compressor idling period of approx. 20 minutes. The setting may be changed, as required, but is limited by the maximum permissible number of motor starts per hour (consult motor data).

Control and indicator panel (Fig. 11)

The panel comprises the following switches, lamps and indicators

Marking	Description and function
RUNNING TIME (P1)	Hourmeter indicating total running time of compressor motor
UNLOAD/NORMAL (S3)	Toggle switch for manually unloading the compressor
LOADING TIME (P2)	Hourmeter indicating total loaded running time of compressor unit
RESET/START (S1)	Push button to start compressor and to reset operative regulator shut-down relay and simultaneously start unit again after a fault has occurred
STOP (S2)	Push button to stop compressor
VOLTAGE ON (white) (H1)	Indicator lamp for signalling that voltage has been switched on and supplied to starting and control equipment
AUTOMATIC OPERATION (green) (H2)	Indicator lamp for signalling that regulator is ready for starting the motor. Remains alight after starting and during normal operation. Will go out if a safety device trips due to an abnormal operating condition.
OIL PRESSURE (red) (H3)	Fault indicator lamp: lights up when oil pressure safety switch reacts to too low a pressure. The regulator stops the motor
AIR TEMPERATURE HP INLET (red) (H4)	Fault indicator lamp: lights up when HP air inlet temperature safety switch reacts due to temperature of air leaving intercooler being too high. The regulator stops the motor
MOTOR OVERLOAD (red) (H5)	Fault indicator lamp: lights up when overload relay trips, which happens when the motor current exceeds permissible maximum. The regulator stops the motor
BLEED-OFF PRESSURE (red) (H33)	Fault indicator lamp: lights up when bleed-off pressure safety switch reacts to too high a pressure at the moment the compressor is unloaded. The regulator stops the motor
On ZR6 unit only OIL TEMPERATURE (red) (H32)	Fault indicator lamp: lights up when oil temperature safety switch reacts to too high an oil temperature. The regulator stops the motor
On ZR3, -4, -5 units: (H31) (red) . blank	Lamp is connected to regulator. Can be used for additional safety device *
	Extra fault indicator lamp for additional safety device. Lamp is connected to regulator *

* In the standard version, the input terminals provided for the additional controls are bridged; thus, the spare fault indicator lamps always light up when the voltage is switched on (lamp test), although they are not actually involved in the operation of the unit.

No lamps are installed behind the three windows (X - Fig. 11), they are available for eventual extra controls, provided that adaptation is made.

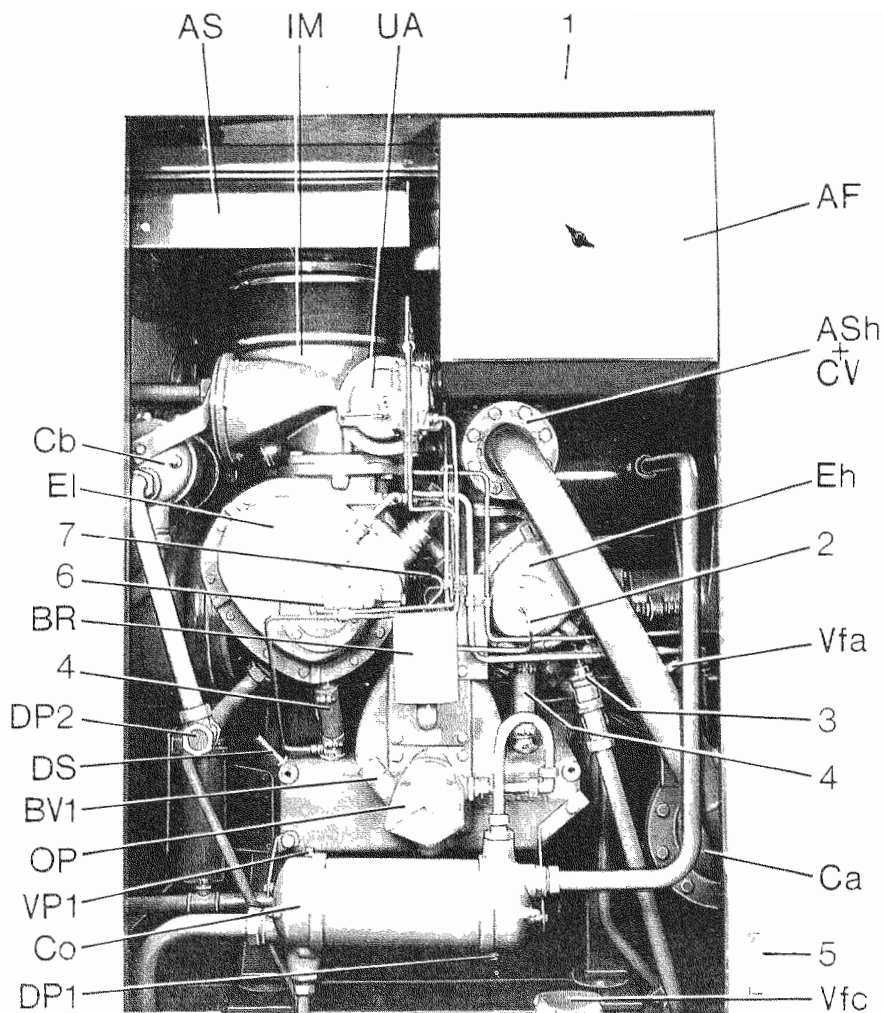
1.6.1 Operation and trouble shooting

A separate ASB (Service Bulletin) dealing with the operation and trouble shooting of the electric regulator is available on request.

2. Operating instructions

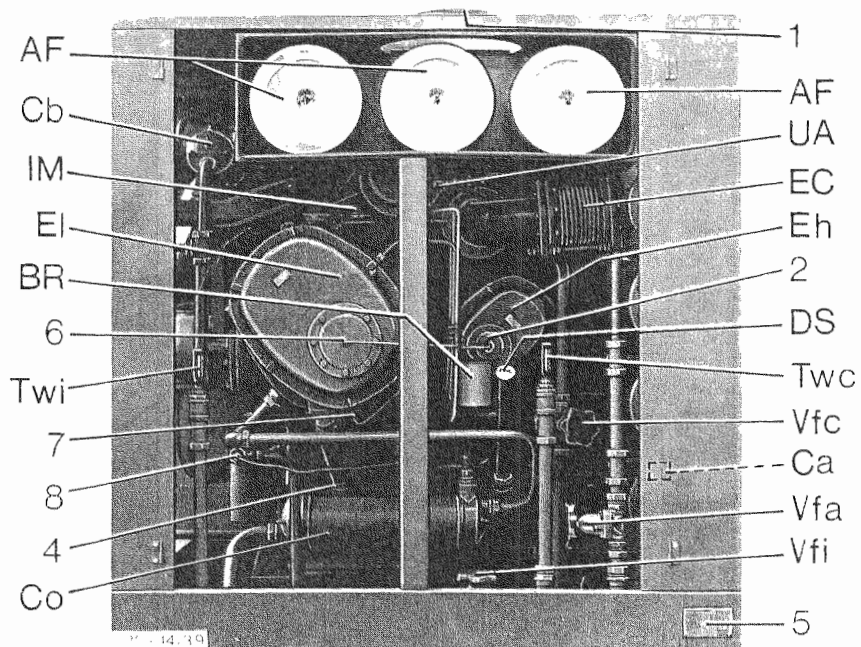
2.1 Preparation for initial start-up

- On an Arr E unit, ascertain that the wooden wedges are removed from between the motor and compressor coupling flanges.
 - Make sure that all the bags with silicagel placed in the moisture trap of the intercooler have been removed. The bags are accessible after removal of the adhesive tape closing off the manifold flange bottom orifice. Install the moisture trap flange and connect the pipe of the drain receiver to the flange after removal of the silicagel bags.
 - On an Arr 1 unit supplied ex-factory with a motor check the motor alignment, as it may have been disturbed during transportation or installation.
 - Check the drain piping. The lines should pitch slightly downwards, away from the compressor. **The open ends must never dip into the water of the sewer.**
 - Make sure that the water supply is connected and open to give proper flow.
 - Fill the compressor sump to the MAX. mark on the dipstick with oil as specified in section "3.4 Lubrication". Do not overfill.
 - Check the electrical connections, which should be in accordance with local codes. The electrical source must have the same voltage and frequency as indicated on the motor data plate. Have the electrical connections to the power source made by a qualified electrician.
- The installation must be earthed and protected against short circuits by cartridge fuses of the inert type in all three phases. A circuit breaker should be installed in the immediate vicinity of the unit.
- Check for correct direction of rotation as indicated by the arrow on the motor housing.** On Arr. E units, the coupling can be observed through the access openings in the motor to compressor adapter housing. **Stop the compressor immediately after the slightest indication of rotation.** If the rotation direction is wrong, reverse two of the input line connections.
- Check that the connection at the primary side of the transformer for control voltage corresponds to the supply voltage. Connect the voltage selecting wire(s) to the correct terminals.



ZR4 compressor

- AF Air intake filter and elements
- AS Air intake silencer
- ASH Air outlet silencer HP compressor element
- BR Breather step-up gear casing
- BV1 By-pass valve, oil pump
- Ca Aftercooler
- Cb Bleed-off cooler
- Co Oil cooler
- CV Check valve
- DP1 Drain plug oil cooler oil side
- DP2 Drain plug LP element cooling jacket and bleed-off cooler
- DS Oil level dipstick (on ZR5 -6 also oil filler pipe)
- EC Expansion compensator
- Eh HP compressor element
- Ei LP compressor element
- IM Air inlet throttle casing
- OP Oil pump
- Twc Thermometer compressor cooling water circuit
- Twl Thermometer intercooler cooling water circuit
- UA Unloader cylinder head assembly
- Vfa Regulating cock aftercooler cooling water flow
- Vfc Regulating cock compressor cooling water flow
- Vfi Regulating cock intercooler cooling water flow
- VP1 Vent plug, oil cooler oil side



ZR6 compressor

- 1 Air intake aperture
- 2 Air pressure feed pipe HP balancing piston
- 3 Sensing element, compressor main cooling water outlet temperature gauge
- 4 Oil return hose, compressor element to sump
- 5 Data plate
- 6 Air pressure feed pipe LP balancing piston
- 7 Interconnecting pipe, LP element cooling jacket compartments
- 8 Sensing element, oil temperature safety switch

Fig 9 Non-drive end view of compressors

- 9 Remove the bridge between terminals 15 and 16 on regulator strip X1, if it is desired that the electric motor will **not** be cut out automatically approx. 20 minutes after the compressor has been unloaded.

2.2 Operating precautions

- 1 Distribution pipework and eventual air hoses must be of correct size and suitable for the working pressure. Do not use frayed, damaged or deteriorated hoses. Use only the correct type and size of hose end fittings and connections.

When blowing through a hose, ensure that the open end is held securely. A free end will whip and cause injury.

Do not play with compressed air. Never apply it to your skin or direct it at another person. Never use

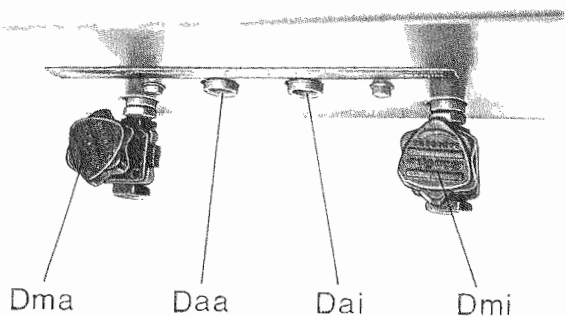
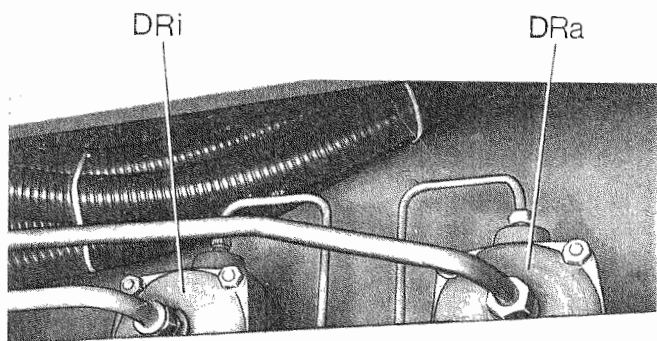
it to clean dirt from your clothes. When using it for cleaning down equipment do so with extreme caution and use the required protection.

Do not use compressed air for breathing, unless it is known to be properly purified for such use.

2. Do not operate the compressor in surroundings where there is a risk of taking in flammable or toxic fumes.
3. Do not operate the compressor at pressures in excess of its rating as indicated on the Principal Data sheet.
4. The doors shall be shut during operation. People staying in compressor rooms where the sound pressure level exceeds 90 dB(A) shall use ear protectors.
5. In case of remote control, provide the compressor with an obvious warning reading e.g.

DANGER : THIS COMPRESSOR IS REMOTELY CONTROLLED AND MAY START UNEXPECTEDLY

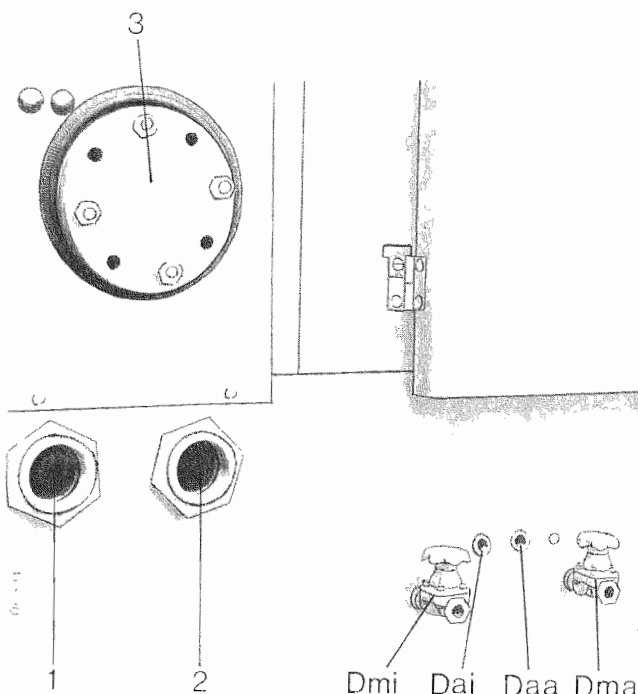
and the remote control panel with a suitably worded notice for the operator to first make sure that the compressor is clear for operation before starting, i.e. that no one is checking or working on the unit.



ZR3, -4

Daa Automatic drain outlet aftercooler
 Dai Automatic drain outlet, intercooler
 Dma Drain valve, aftercooler drain receiver
 Dmi Drain valve, intercooler drain receiver

DRa Drain receiver aftercooler*
 DRI Drain receiver intercooler*
 1 On ZR3, -4 cooling water inlet pipe
 On ZR5, -6, cooling water outlet pipe



ZR5, -6

2 On ZR3, -4, cooling water outlet pipe
 On ZR5, -6, cooling water inlet pipe
 3 Compressed air outlet pipe

* Accessible after removal of cover plate

Fig 10 Condensate drains

2.3 Each time before starting

- 1 Check the oil level Top up, if necessary, to the MAX. mark on the dipstick (DS - Fig. 9) with the correct type of lubricating oil.
- 2 Check that the condensate drain valves (Dmi and Dma - Fig. 10) of the intercooler and aftercooler drain receivers are closed.
- 3 Check that the cooling water drain cock (customer's installation) in the main inlet line is closed.
- 4 Check that toggle switch (S3 - Fig. 11) is placed in the UNLOADED position.
- 5 Open the main cooling water inlet valve.
- 6 Open the water flow regulating cocks (Vfc and Vfa - Fig. 9) of the compressor and aftercooler circuits. On ZR6, also open the cock (Vfi - Fig. 9) of the intercooler and bleed-off cooler circuit

This step can be dispensed with if, after previous operation of the unit, the above-mentioned cocks have not been closed after stopping.

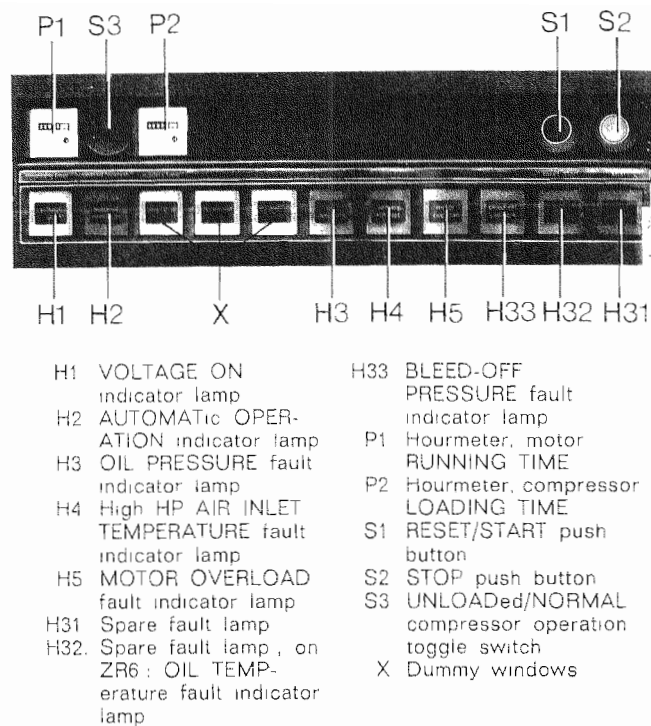


Fig. 11 Control and indicator panel

2.4 Starting (Fig. 11)

1. Switch on the voltage at the main circuit breaker and check that the VOLTAGE ON lamp H1 lights up. All red fault indicator lamps H3, H4, H5, H31, H32 and H33 also light up (lamp test), except AUTOMATIC OPERATION lamp H2.
2. Press RESET/START button S1. After starting check
 - a. that AUTOMATIC OPERATION lamp H2 is alight.
 - b. that all the red lamps H3, H4, H5, H31, H32 and H33 are out.
 - c. that hourmeter RUNNING TIME P1 is counting the total motor running time.
 - d. the lubricating oil pressure (Gpo - Fig. 12).
 - e. the intercooler pressure (Gpi - Fig. 12).

Instructions regarding the number of starts

- a. With regard to the temperature rise in the rotor windings of the motor, the number of normal starts should be limited to maximum four starts per hour. An interval of 15 minutes between each start should be observed.
- b. In order to limit the frequency of motor starts during the automatic operation cycle of the unit, the time relay for delayed motor stopping (K10 - Fig. 7) should never be set for a compressor idling period shorter than 15 minutes. A setting of a shorter period is only permissible in connection with an operational test. Do not adjust the setting when the voltage is switched on.
- c. If the motor is prevented from starting by any mechanical cause, only one extra start in the course of tracing the cause of the trouble can be made in one hour

2.5 Compression starting

1. Open the compressed air outlet valve.
2. Move toggle switch S3 to NORMAL to open the air inlet throttle valve and load the compressor. Check that hourmeter LOADING TIME P2 records the total compressor loading time.

As soon as the pre-set working pressure is reached and registers on gauge (Gph - Fig. 12), the air pressure switch will unload the compressor. Hourmeter LOADING TIME P2 then stops counting.

3. With the compressor running loaded, regulate the cooling water flow through the main compressor circuit.

This is only necessary when :

- a. the unit is started-up for the first time.
- b. the water flow regulating cock(s) should have been closed after stopping.
- c. the setting of the cock(s) should have been accidentally disturbed or if slight resetting is required.

For optimum operation, i.e. for efficient cooling in the intercooler and to avoid excessive cooling in the bleed-off cooler(s), the cooling water outlet temperature or the difference between the inlet and outlet water temperatures should be as shown in section "3.3.2 Readings on gauges" .

On ZR3, -4, -5 units, the water outlet temperature is controlled by cock (Vfc - Fig. 9), ZR6 units have

two cocks (Vfc and Vfi - Fig. 9) installed in the main circuit. The cooling water outlet temperature is indicated on gauge (Gtc - Fig. 12), and on ZR6 units also on thermometers (Twc and Twi - Fig. 9). Turning the hand wheel of the cock(s) clockwise will increase the water outlet temperature

On ZR6 units, adjust the two cocks until the same temperatures register on the gauge and the two thermometers

- 4 Under load condition, adjust the cooling water flow through the aftercooler by means of cock (Vfa - Fig. 9) to obtain the most suitable water and compressed air outlet temperatures (Gta and Gth - Fig. 12).

2.6 During operation

Consult section "3.3 Preventive Maintenance Schedule", under "Daily"

2.7 Stopping

- 1 Move toggle switch S3 to UNLOADED.
- 2 Press STOP button S2, at which AUTOMATIC OPERATION lamp H2 goes out and the compressor stops.

The VOLTAGE ON lamp H1, as well as the fault indicator lamps H3, H4, H5, H31, H32 and H33 will remain alight as long as the voltage has not been switched off at the main circuit breaker

- 3 Close the main cooling water inlet valve, and the compressed air outlet valve.
- 4 Open the drain valves of the intercooler and aftercooler drain receivers. Close the valve of the latter after the condensate has been drained.
- 5 When freezing temperatures are expected, drain the cooling system completely by opening the main drain cock (customer's installation) and by removing the drain plugs from the intercooler and LP compressor element water inlet pipe, the vent plug on top of the intercooler inlet flange and the two copper pipes that interconnect the cooling jacket compartments of the LP and HP compressor elements.

3. Maintenance

3.1 Electric motor

Refer to the motor manufacturer's instruction leaflet and data plate for full particulars of motor maintenance.

The absolute necessity of using the **correct type and quantity of grease** for lubricating the bearings, and the **greasing and motor air path cleaning intervals** are specially stressed. If operating in a rather hazardous environment, clean the air path at shorter intervals.

3.2 Safety precautions

Maintenance and repair work shall only be carried out by adequately trained personnel.

In addition to the many normal common sense safety rules, which should be observed with this type of machinery, the following additional safety precautions are specially stressed.

- 1 Use only the correct tools for maintenance and repair works.
- 2 All maintenance work, other than routine attention, shall only be undertaken when the compressor is stopped. Ensure that the unit cannot be started inadvertently, e.g. by taking out the main fuses and placing a warning tag on the fuse holders and control panel.
- 3 Before removing any pressurized component, effectively isolate the unit from all sources of pressure and relieve the entire system from pressure. Do not rely on check valves to isolate pressure systems.
- 4 Do not use flammable solvents or carbon tetrachloride for cleaning parts. Take safety precautions against toxic vapours of cleaning liquids such as chlorinated hydrocarbon.
- 5 Observe scrupulous cleanliness during maintenance and when performing repairs. Keep dirt away by covering the parts and exposed openings with a clean cloth, paper or tape.
- 6 Do not weld or in any way modify any pressure vessel. Do not weld or perform any other operation involving heat near the oil system.
- 7 Make sure that no tools, loose parts or rags are left in or on the compressor or its drive parts.
- 8 Before clearing the unit for use after maintenance or overhaul, check that operating pressures and temperatures are correct and that the control and shut-down devices work correctly.

All responsibility for any damage or injury resulting from neglecting these precautions, or by non-observance of ordinary caution and due care required in handling, operating, maintenance or repair, even if not expressly mentioned in this book, will be disclaimed by Atlas Copco.

3.3 Preventive maintenance schedule for the compressor

The schedule contains a summary of the maintenance instructions. Turn up the section dealing with the component or part concerned and read it through carefully before taking any maintenance measures.

Whichever INTERVAL comes first	Operation	Notes	Section
DAILY or every 8 running hours	Check unloading and loading pressures Gph	See table of Fig. 12	
	Check intercooler pressure Gpi		
	Check oil pressure Gpo		
	Check aftercooler water outlet temperature Gta		
	Check compressor water outlet temperature Gtc		
	Check compressed air outlet temperature Gth		
	Check air intake filter service indicator Gv		
	Check oil level before starting	M1	3.3.1
	Drain condensate from intercooler and aftercooler drain receivers after stopping		2.7
	Check that condensate is discharged from intercooler and aftercooler drain receivers during loading	M2	3.3.1
WEEKLY or every 50 hours	Drain condensate from pulsation damper of bleed-off pressure safety switch	M3	3.3.1
	Clean down unit		
	Drain condensate from air receiver, if installed		
	Check for water or oil leaks. Inspect all air pipes and tubes. Tighten leaking connections; replace damaged gaskets or tubes	M4	3.3.1
Every 6 MONTHS	Remove air intake filter element(s); clean by air jet and inspect		4.2.2
	Clean breather of step-up gear casing	M5	3.3.1
Once a year	Have lubricating oil analysed. If not analysed, change oil and oil filter element(s)	M6	3.3.1 3.4
	Dismantle and clean float valves of drain receivers		
	Replace air intake filter element(s)		4.2
	Replace rolling diaphragm of unloader piston	M9	4.4
	Dismantle and inspect parts of unloader cylinder head assembly	M9	
	Remove and inspect rubber diaphragm of compressor element balancing pistons	M9	
	Remove and inspect check valve	M9	
	Test safety valves	M9	4.4
	Test safety switches	M9	4.4
	Check cooling efficiency of intercooler and aftercooler Pressure test all the coolers	M7/M9	
	Measure pressure ratio of compressor elements	M8/M9	
	Have operation of electrical interlockings, motor breakers, etc. tested by a qualified electrician		
	On Arr 1, check motor alignment	M9	
	On Arr E, inspect rubber bushes of coupling	M9	

3.3.1 Notes on maintenance schedule

M1 Always maintain the level near the upper mark and never allow it to drop to the lower mark on the dipstick

On ZR3, -4 units, the breather assembly must be removed from the oil filler pipe when lubricating oil is to be added, and each time the oil is changed. **Never add oil through the breather.**

M2. Take immediate remedial action if the automatic drain of the intercooler does not discharge condensate, as this may cause damage to the HP compressor element. If the unit cannot be stopped, slightly open the manual drain of the intercooler drain receiver to prevent the condensate from entering the HP element.

M3. A drain plug is provided on the damper. The most practical interval between draining operations may be determined by experience, as the amount of condensate mainly depends on the operating conditions.

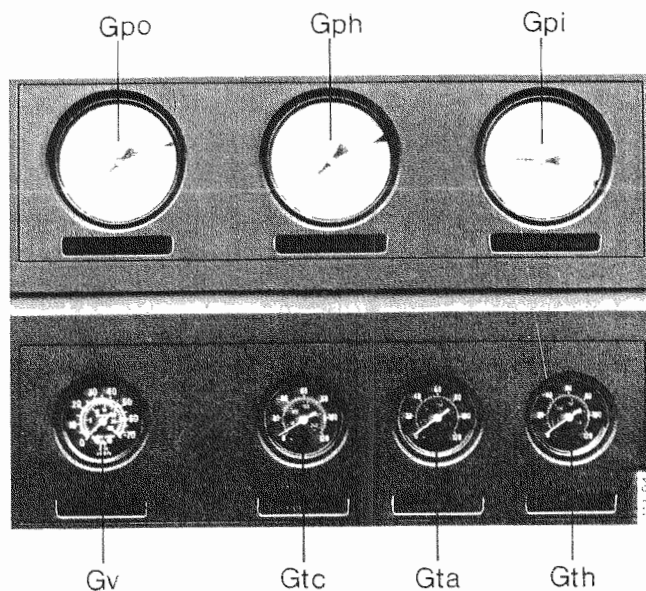


Fig. 12. Instrument panel gauges

3.3.2 Readings on gauges

Ref.	Marking	Indicates	Reading
Gph	DISCHARGE PRESSURE	Compressed air (net) pressure immediately downstream of aftercooler	Modulates during loading, depending on air consumption. After unloading between max. and min. pre-set values
Gpi	INTERCOOLER PRESSURE	Pressure prevailing between LP and HP compressor elements	a. During unloading : vacuum between — 0.80 and — 0.65 bar (— 11.5/— 9.5 psi) corresponding to 0.2/0.35 bar(a) (3/5 psia) b. During loading : between 2-2.7 bar(e)* (29-39 psig) at normal working pressure
Gpo	OIL PRESSURE	Oil pressure in main line after oil filter	Average 2.3 bar(e) (33 psig). Should not be allowed to drop below 1.4 bar(e) (20 psig)
Gta	WATER TEMPerature, aftercooler	Aftercooler cooling water outlet temperature	15-30°C (27-54°F) ** above that of incoming cooling water, during loading
Gtc	WATER TEMPerature COMPressor	Compressor cooling water outlet temperature	15-30°C (27-54°F) ** above that of incoming cooling water, during loading
Gth	AIR TEMPerature OUTLET	Compressed air temperature immediately after aftercooler	Normally 10-15°C (18-27°F) above cooling water inlet temperature
Gv	FILTER INDICATOR	Vacuum prevailing between air filter and LP compressor element for the purpose of determining when filter cartridge(s) is (are) clogging	When pointer reads 45 mbar (18" w.c.) or comes up to red line or field during loading, service cartridge(s). Never clean cartridges more than 5 times

* When judging the condition of the machine by the intercooler pressure, remember that it mainly varies in direct proportion with the barometric pressure and to a lesser extent with the working pressure, ambient temperature and cooling water inlet temperature.

** Never set the cooling water flow regulating cocks for a water outlet temperature exceeding 50°C (122°F) without authorization of an Atlas Copco service representative.

M4. Especially check the LP and HP balancing piston pipes. Repair even the slightest leak. Replace damaged or pinched pipes. An inoperative balancing piston means overloading of the male rotor thrust bearings, which may cause serious damage.

M5. Remove the breather, dismantle and wash the two steel mesh pads in diesel fuel oil or some similar cleaning solvent. Wash the sinter bronze filter disk in trichlorethylene. Dry the parts with compressed air, reassemble and reinstall the breather.

M6. Have sample of oil analysed in specialized laboratory to determine if it is oxidized or deteriorated beyond the rejection limits. Based upon the oil sample analysis the optimum oil change interval can be established.

If the oil is not analysed, it should be changed yearly.

Change the oil as follows: drain the compressor sump and oil cooler. A drain cock is provided on the sump and a drain plug on the cooler. Close the cock and reinstall the plug after draining. Replace the oil filter element(s).

Refill the sump to the upper mark on the dipstick with fresh oil of the correct type. Remove the vent plug on top of the oil cooler and fill it with the same type and brand of oil. Reinstall the plug.

Start the unit and run it for a few minutes; check the oil level again. Top up, if necessary.

M7. The difference in temperature between the incoming water and the outgoing air of the intercooler and aftercooler should never exceed 25°C (45°F) during loading. Use a sensitive thermometer of the surface contact type (electric) to measure the temperatures at the various points. Have the entire cooling system cleaned if the cooling efficiency is insufficient.

M8. Special gauges are to be used and a record of the measured values should be kept over the years of operation of the unit. Based on this record the condition of the compressor elements can be judged.

M9. These operations should preferably be carried out by an Atlas Copco service representative.

3.4 Lubrication

The use of a high quality TURBINE OIL containing rust and oxidation inhibitors, and having good water separation properties is recommended. The viscosity grade should be ISO VG 68, in conformity with the specifications of ISO 3448 (International Organization for Standardization). In order to cover a wide temperature range the viscosity index should be minimum 95.

The following grades of the most commonly available brands of TURBINE OILS have been found suitable. Equivalent grades of other reputable makes can of course also be used. Once a brand has been adopted, keep to it. Never mix different brands or grades of oil.

Make	Grade	Make	Grade
Esso	Teresso 68	Aral	Kosmo! TL 68
BP	Energol THB 68	Castrol	Perfecto T 68
Gulf	Harmony 68	Chevron	OC Turbine oil 68
Shell	Turbo oil T 68	Elf	Turbelf 68
Total	Preslia 68	Fina	Bakola 68
Mobil	DTE heavy medium	Texaco	Regal oil R & O 32

Hydraulic oils with a viscosity grade conform to ISO VG 68 may also be used. If in any doubt, consult Atlas Copco.

The rejection limits are as follows:

- Water contents: max. 0.1 %
- Total acidity number: max. 1 TAN
- Non-soluble contents: max. 0.08 %.

3.5 Storage

An ASB (Service Bulletin) dealing with storage before installation, as well as with storage after operation is available on request.

4. Adjustments and servicing procedures

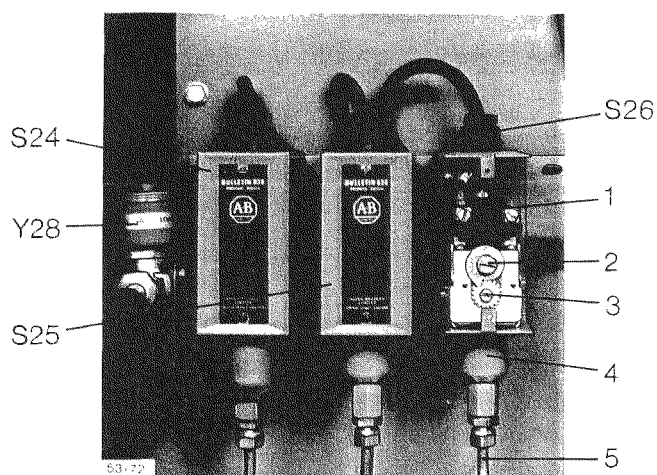
4.1 Setting of the air pressure switch

The adjustment of the unloading of the compressor is effected by means of the air pressure switch (S26 - Fig. 13) installed in the compressor cabinet.

The pressure switch controls:

- a. The maximum operating pressure(e) in the range of 1.1-8.5 bar (16-123 psi) on Arr. E and M versions, and 1.1-10.5 bar (16-152 psi) on Arr. 1 units.
- b. The pressure difference between the pre-set maximum pressure and that at which compression is resumed (loading pressure).

Before any adjustment is made, always ascertain that the pressure switch breaks the circuit to the loading solenoid valve (Y28 - Fig. 13) when the pressure in the compressed air discharge system has reached the pre-set maximum pressure, and that the control oil from the unloader assembly is drained as otherwise the compressor will not unload (see Fig. 5). Also ascertain that the loading solenoid valve is energized at decreasing pressure in the air discharge system and that control oil is admitted to the unloader assembly.



- | | |
|---------------------------------|---|
| S24. Bleed-off pressure switch | 1 Change-over switch |
| S25. Oil pressure safety switch | 2. Adjusting screw, working pressure |
| S26. Air pressure switch | 3. Adjusting screw, pressure differential |
| Y28. Loading solenoid valve | 4. Bellows housing |
| | 5. Pipe to compressor air discharge pipe |

Fig. 13. Detail of air pressure switch

Setting of the maximum pressure

The maximum operating or unloading pressure is controlled by adjusting screw (2 - Fig. 13).

If unloading of the compressor occurs at too low a pressure gradually turn the adjusting screw clockwise.

If unloading occurs at too high a pressure : gradually turn the adjusting screw anti-clockwise.

Setting of the pressure difference

The pressure difference is controlled by adjusting screw (3 - Fig. 13).

To reduce the pressure difference turn the adjusting screw clockwise and to increase the pressure difference turn the adjusting screw anti-clockwise.

The adjustment range is between 0.14-1.27 bar (2-18 psi).

4.2 Air intake filter

The air intake compartment of the compressor houses one or more filter elements of the cartridge dry replaceable paper type

All indrawn air passes through the filter element(s) for removing dust and other solid foreign matter before entering the LP compressor element. Maximum protection against wear due to the ingress of dust is possible only if the cartridge(s) is (are) serviced and renewed at regular intervals.

4.2.1 Recommendations

1 Scheduled service based on a set number of operating hours is not required. The cartridge(s) must be serviced as soon as the pointer of the service indicator (Gv - Fig. 12) reaches the red line or field, i.e. corresponds to 45 mbar (18" w.c.) during the loading periods of the compressor.

When the cartridge(s) is (are) new, the pressure drop is between 3-7 mbar, depending on the compressor type. This is hardly noticeable on the gauge. However, after some time of operation, the gauge should clearly show the degree of clogging during loading. If, after some time of operation, the pointer still does not show at all or drops back to an improbably low value, this points to a leak in the air inlet system.

2. Inspect the cartridge(s) after six months of operation.
3. The cartridge(s) may be cleaned not more than five times. Never use a cartridge for longer than one year.
4. In dusty operating conditions where it will be necessary to service or replace the cartridge(s) too frequently, an appropriate **pre-filter of the dry type** should be installed.
5. For minimum compressor down-time, replace the dirty cartridge(s) by (a) new or cleaned one(s). Always have new cartridges at hand.
6. Discard the cartridge(s) when damaged or torn.

4.2.2 Servicing

- 1 Stop the compressor and remove the filter housing cover
2. Using a damp cloth, clean out any accumulated dust and foreign material from the filter chamber. Clean the cover

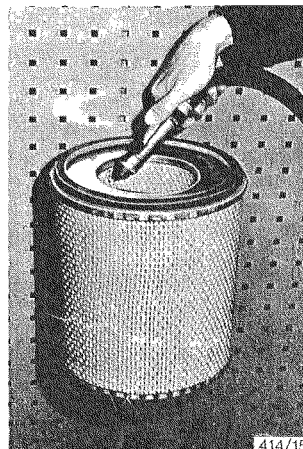


Fig 14 Removing dust from the cartridge by air jet

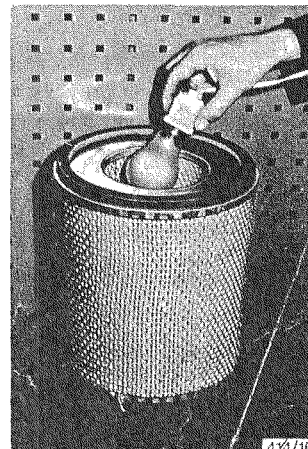


Fig 15 Inspecting the cartridge

3. Remove the cartridge(s). Clean and inspect the cartridge sealing surface(s) of the filter chamber. Take care that no dirt drops inside the suction silencer.
4. Install the new or cleaned cartridge(s) into place and reassemble.

4.2.3 Cleaning the cartridge(s)

Carefully knock the end faces of the cartridges alternately on a flat surface, e.g. the palm of a hand or a car tyre. Do not strike the side or bottom on a hard surface. This will remove much of the heavy dry contaminant. Then blow dry air up and down the pleats on the **inside** of the cartridges (Fig. 14), subsequently blow up and down the length of the pleats on both sides of the cartridges. The air pressure(e) may not exceed 5 bar (73 psi) and a reasonable distance must be maintained between the hose nozzle and the pleats.

If the contaminant is of a sooty nature, wash the cartridges in lukewarm water in which a good **non-foaming** household detergent is dissolved. A recommended detergent is MANN 053.

Rinse thoroughly with a gentle soft water stream until the drain water is clear. Air-dry the cartridges after washing. Do not heat to hasten drying. Never install wet cartridges.

Inspect each cartridge for damage by placing a bright light inside it (Fig. 15). Thin spots, pin holes or the slightest rupture of the paper will render the cartridges unfit for further use. New cartridges must also be inspected for tears or punctures before they are installed.

4.3 Oil filter

On ZR3 and ZR4 units, the oil filter assembly comprises an element bolted to an adapter head (Fig. 16). ZR5 and ZR6 units are equipped with twin oil filters of the throw-away type screwed on to a common adapter head. The latter type of filters have an incorporated by-pass valve.

The oil filter element(s) should be replaced each time the compressor lubricating oil is changed.

Servicing of the oil filter on ZR3 and ZR4 units

1. Place a drain pan under the filter, unscrew through-bolt (11), remove bowl (9) and withdraw filter element (3). Discard the element.
2. Remove circlips (4) from bolt (11) and withdraw guide (5), gasket (6), washer (7) and spring (8). The through-bolt together with its gasket (10) can now be removed.
3. Rinse the bowl and all other filter parts in a suitable cleaning solvent and blow dry by air jet. Clean the filter adapter and bowl mounting recess, and inspect the gaskets. Renew the gaskets if they are hardened or damaged.
4. Place gasket (10) on bolt (11) and insert the latter in the bowl.

- 1 Adapter head with by-pass valve
- 2 Gasket, adapter head
- 3 Element
- 4 Circlip
- 5 Guide
- 6 Gasket, element
- 7 Washer
- 8 Spring
- 9 Bowl
- 10 Gasket, bolt
- 11 Through-bolt

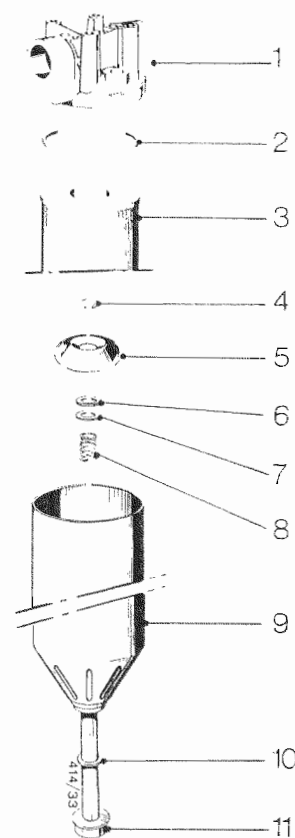


Fig. 16. Oil filter of ZR3, -4 units

5. Place spring (8) on the through-bolt, then washer (7), gasket (6), guide (5) and secure by fitting circlips (4).
6. Place the new element in the filter bowl. Fit the retained or new gasket (2) on the adapter head.
7. Position the filter bowl on the adapter recess and tighten the through-bolt finger-tight. Rotate the bowl slightly, right and left, to be sure it is properly seated and draw up the through-bolt tight.

Replacement of the oil filter elements on ZR5 and ZR6 units

1. Place a drain pan under the elements. Using the handle of a spanner, bar or screwdriver in the slot at the bottom of the elements, loosen the latter and screw them off by hand.
2. Clean the element seats on the adapter head.
3. Lightly oil the rubber gasket of the new elements and screw them into place until the gaskets contact their seats. Then tighten one half turn only.
4. Check the tightness of the filter element gaskets a few minutes after the unit has been started.



REGULATING AND INSTRUMENT

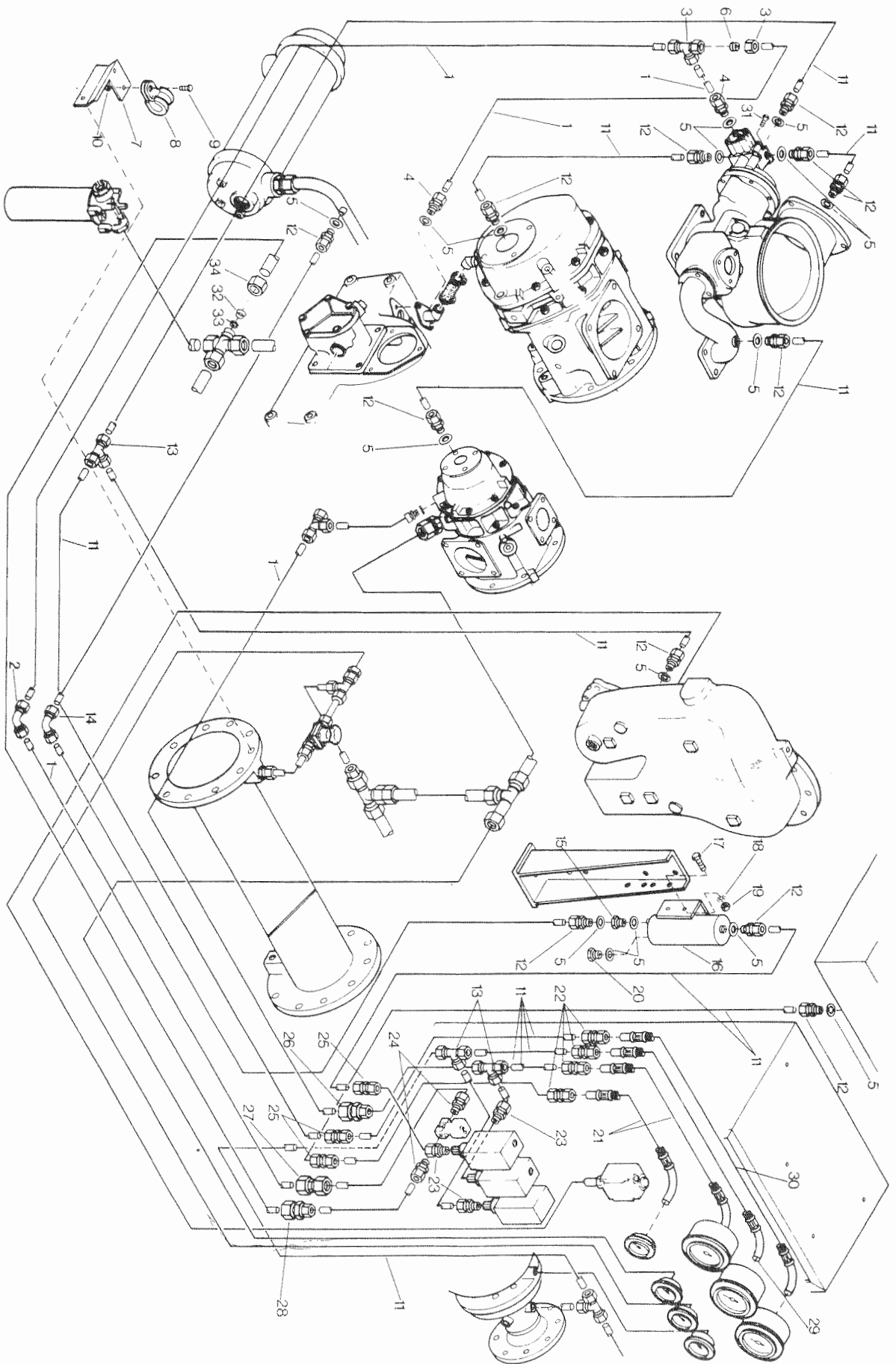
CONNECTIONS

REGEL- EN INSTRUMENTAANSLUITINGEN REGLERINGS- OCH INSTRUMENT- ANSLUTNINGAR

REGEL- UND INSTRUMENTANSCHLÜSSE CONNEXIONS DE REGULATION ET DES INSTRUMENTS

CONEXIONES DE REGULACIÓN Y DE LOS INSTRUMENTOS

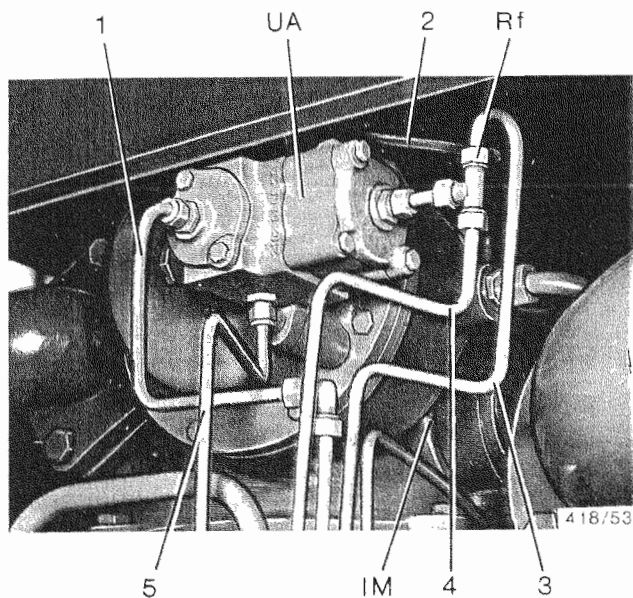
Part number Onderdeelnr. Detailnummer Ref.	Qty. Aant. Anz. Qté Ctd.	Description	Beschrijving	Benämning	Bezeichnung	Désignation	Designación
1 2900 0143	AR	Copper tube	Koperen pijp	Kopparror	Kupferrohr	Tuyau en cuivre	Tubo en cobre.
2 581 1261-01	1	Elbow, compl	Knie kompl	Rörkrök, kompl	Krummer, kompl	Coude, compl	Codo, compl
— 584 0324-01	2	Sleeve	Verloopsok	- Reduceringstylisa	- Muffe	- Manchon	- Manguito
— 584 2326-01	2	Nut	Moer	- Mutter	- Mutter	- Ecrou	- Tuerca
3 581 2213-01	1	Tee, complete	T-stuk, kompl	T-nippel, kompl	T-Stück, kompl	Té, compl	Conexión en «T», compl
— 584 0324-01	3	Sleeve	Verloopsok	- Reduceringstylisa	- Muffe	- Manchon	- Manguito
— 584 2326-01	3	Nut	Moer	- Mutter	- Mutter	- Ecrou	- Tuerca
4 581 0060-01	1	Straight coupling,	Rechte koppeling,	Rak koppeling	Gerade Kupplung,	Accouplement droit,	Acoplamiento recto,
— 584 0324-01	1	Sleeve	Kompl	kompl	kompl	kompl	compl
— 584 2326-01	1	Nut	Moer	- Mutter	- Mutter	- Manchon	- Manguito
5 653 1062	14	Washer	Onderlegplaatje	Bricka	U-Scheibe	Ecrou	Tuerca
6 2252 6725	1	Restrictor	Restrictor	Restrictor	Begrenzer	Restricteur	Restrictor
7 2252 1340	1	Support	Stut	Hållare	Halterung	Support	Soporte
8 1613 0801 02	15	Clamp (1x13)	Klembeugel (1x13)	Klammer (1x13)	Schelle (1x13)	Fixation (1x13)	Abrazadera (1x13)
1613 0801-05	26	Clamp (1x8)	Klembeugel (1x8)	Klammer (1x8)	Schelle (1x8)	Fixation (1x8)	Abrazadera (1x8)
1613 0801-07	7	Clamp (1x15)	Klembeugel (1x15)	Klammer (1x15)	Schelle (1x15)	Fixation (1x15)	Abrazadera (1x15)
9 147 1244 03	5	Screw (M6x12)	Vijs (M6x12)	Skrav (M6x12)	Schraube (M6x12)	Vis (M6x12)	Tornillo (M6x12)
147 1246 03	27	Screw (M6x16)	Vijs (M6x16)	Skrav (M6x16)	Schraube (M6x16)	Vis (M6x16)	Tornillo (M6x16)
10 266 2108	16	Nut	Moer	Mutter	Mutter	Ecrou	Tuerca
11 2900 0134	AR	Copper tube	Koperen pijp	Kopparror	Kupferrohr	Tuyau en cuivre	Tubo en cobre.
12 581 0028-01	11	Straight coupling,	Rechte koppeling,	Rak koppeling,	Gerade Kupplung,	Accouplement droit,	Acoplamiento recto,
— 584 0314-01	1	Sleeve	Kompl	kompl	kompl	kompl	compl
— 584 2314-01	1	Nut	Moer	- Mutter	- Mutter	- Manchon	- Manguito
13 581 2208-01	3	Tee, complete	T-stuk, kompl	T-nippel, kompl	T-Stück, kompl	Té, compl	Conexión en «T», compl
— 584 0314-01	3	Sleeve	Verloopsok	- Reduceringstylisa	- Muffe	- Manchon	- Manguito
— 584 2314-01	3	Nut	Moer	- Mutter	- Mutter	- Ecrou	- Tuerca
14 581 1256-01	1	Elbow	Knie	Rörkrök	Krummer	Coude	Codo
— 584 0314-01	2	Sleeve	Verloopsok	- Reduceringstylisa	- Muffe	- Manchon	- Manguito
— 584 2314-01	2	Nut	Moer	- Mutter	- Mutter	- Ecrou	- Tuerca
15 2252 8344-80	1	Restrictor	Restrictor	Restrictor	Begrenzer	Restricteur	Restrictor
2252 8344-82	1	Restrictor	Restrictor	Restrictor	Begrenzer	Restricteur	Restrictor
2252 0834	1	Air damper	Luchtdemper	Luftdämpare	Luftdämpfer	Amortisseur d'air	Amortiguador de aire
17 147 1362-03	2	Screw	Schroef	Skrav	Schraube	Vis	Tornillo
18 333 3232	2	Lock washer	Borgplaatje	Låsbricka	Sicherungsring	Rondelle de blocage	Arandela de cierre
19 266 2111	2	Nut	Moer	Mutter	Mutter	Ecrou	Tuerca
20 686 4202	1	Plug	Plug	Propp	Stopfen	Bouchon	Tapon
21 2250 6227	2	Flexible tube	Slang	Slang	Schlauch	Flexible	Tubo flexible
22 581 0912-01	4	Straight coupling,	Rechte koppeling,	Rak koppeling,	Gerade Kupplung,	Accouplement droit,	Acoplamiento recto
— 584 0310-01	1	Sleeve	Kompl	kompl	kompl	kompl	compl
— 584 2310-01	1	Nut	Moer	- Mutter	- Mutter	- Manchon	- Manguito
— 584 0314-01	1	Sleeve	Verloopsok	- Reduceringstylisa	- Muffe	- Manchon	- Manguito
— 584 2314-01	1	Nut	Moer	- Mutter	- Mutter	- Ecrou	- Tuerca
— 584 0314-01	1	Sleeve	Verloopsok	- Reduceringstylisa	- Muffe	- Manchon	- Manguito
— 584 2314-01	1	Nut	Moer	- Mutter	- Mutter	- Ecrou	- Tuerca



CONTROL CUBICLE
INSTRUMENTENKAST
KONTROLLPANELHUS
INSTRUMENTENKASTEN
ARMOIRE DES INSTRUMENTS
CAJA DE INSTRUMENTOS

Ref.	Part number Underdeelnr. Detailnummer Teilnummer No. de détail No. de la pieza	N. B.	Qty. Aant. Antz. Qté	Description	Beschrijving	Benämning	Bezeichnung	Désignation	Designación
34	1099 0384-11		1	- Valve	- Klap	- Ventil	- Ventil	- Soupape	- Vávula
	220V - 50Hz				220V - 50Hz	220V - 50Hz	220V - 50Hz	220V - 50Hz	220V - 50Hz
	1099 0384-13	(As)(C)	1	- Valve	- Klap	- Ventil	- Ventil	- Soupape	- Vávula
	110V - 60Hz				110V - 60Hz	110V - 60Hz	110V - 60Hz	110V - 60Hz	110V - 60Hz
	1099 0384-12		1	- Valve	- Klap	- Ventil	- Ventil	- Soupape	- Vávula
	220V - 60Hz				220V - 60Hz	220V - 60Hz	220V - 60Hz	220V - 60Hz	220V - 60Hz
	2252 2120-01	1)	1	- Label	- Plaatje	- Schild	- Schild	- Etiquette	- Etiqueta
	2252 2120-02	2)	1	- Label	- Plaatje	- Schild	- Schild	- Etiquette	- Etiqueta
	2252 2120-03	3)	1	- Label	- Plaatje	- Schild	- Schild	- Etiquette	- Etiqueta
	2252 2120-04	4)	1	- Label	- Plaatje	- Schild	- Schild	- Etiquette	- Etiqueta
	2252 2120-05	5)	1	- Label	- Plaatje	- Schild	- Schild	- Etiquette	- Etiqueta
	1098 1001-04		1	- Warn mark	- Waarschuwings- plaatje	- Varningskylt	- Warntafel	- Plaque de signalisation	- Placa de aviso
35	2253 3864		1	- Bracket	- Steun	- Hållare	- Halterung	- Support	- Soporte
36	1619 2841		3	Thermometer	Thermometer	Thermometer	Thermometer	Thermomètre	Termómetro
37	653 1100		3	Washer	Onderlegplaatje	Bricca	U-Scheibe	Rondelle	Arandela
38	605 8816		1	Reducer	Verloopsstuk	Reduceringsskycke	Reduzierstück	Réducteur	Reductor
39	653 1124		1	Washer	Onderlegplaatje	Bricca	U-Scheibe	Rondelle	Arandela
40	1098 1301-02		30	Cable ty	Kabelklem	Klammer	Kabelklemme	Etrier	Estrizo
	1098 1301-04		2	Cable ty	Kabelklem	Klammer	Kabelklemme	Etrier	Estrizo
41	1619 5444		1	Gauge	Manometer	Manometer	Manometer	Manomètre	Manómetro
42	581 0216-03		1	Straight coupling	Rechte koppeling, kompl.	Rak koppeling, kompl.	Gerade Kupplung, kompl.	Accouplement droit, compl.	Acoplamiento recto, compl.
	584 0310-01		1	Sleeve	Verloopsok	Reduceringssylsa	Mulle	Manchon	Manquito
	584 2310-01		1	Nut	- Moer	- Mutter	- Mutter	- Tuerca	- Tuerca
43	1619 2843-01		1	Press gauge	Manometer	Manometer	Manometer	Manomètre	Manómetro
44	1619 2843-02		1	Press gauge	Manometer	Manometer	Manometer	Manomètre	Manómetro
45	1619 2843-03		1	Press gauge	Manometer	Manometer	Manometer	Manomètre	Manómetro
46	333 3214		9	Lock washer	Borgplaatje	Låsbricka	Sicherungsring	Rondelle de blocage	Arandela de cierre
47	266 2106		9	Nut	- Moer	- Mutter	- Mutter	- Tuerca	- Tuerca
48	584 0022		3	Seal ring	Atdichting	Tätingsring	Dichtungsring	Joint	Junta
49	584 2022		3	Nut	- Moer	- Mutter	- Mutter	- Tuerca	- Tuerca
50	1619 2766		4	Boil	Bout	Bult	Bolzen	Boulon	Perno
51	2253 5194	6)	2	Support	- Stut	- Hållare	- Halterung	- Support	- Soporte
52	2253 5192	6)	2	Support	- Stut	- Hållare	- Halterung	- Support	- Soporte
53	1020 5170	6)	4	Rubber buffer	Rubberen demper	Gummidämpare	Gummdämpfer	Amortisseur en caoutchouc	Amortiguador en caucho
54	266 2108	6)	8	Nut	- Moer	- Mutter	- Mutter	- Tuerca	- Tuerca
55	160 6040		9	Screw	Schroef	Skruv	Schraube	Vis	Tornillo
56	653 0905-05		1	Gasket	Pakking	Packning	Dichtung	Joint	Junta

- 1) «Oil pressure switch»
2) «High temperature switch»
3) «Air pressure switch»
4) «Bleed-off pressure switch»
5) «Solenoid valve loading»
6) Turbine drive



- | | |
|---------------------------------------|--|
| IM. Air inlet throttle casing | 2 Pipe to throttle casing |
| Rf Oil flow restrictor fitted in Tee | 3 Pipe to compressor oil sump (oil return) |
| UA Unloader cylinder head assembly | 4 Pipe to loading solenoid valve |
| 1 Pipe to intercooler outlet manifold | 5. Pipe to LP balancing piston |

Fig 17 Unloader head with air and oil connections on ZR5, -6 (On ZR3, -4, the mounting is slightly different)

4.4 Unloader assembly, safety valves and switches

The unloader assembly is one of the most active and important parts of the compressor plant. Its principal component part, i.e. the air inlet throttle valve is mounted

on permanently sealed ball bearings and the ram or unloader piston on dry low-friction type bushes. These features ensure long service life without lubrication or adjustments. The unloader piston is sealed by a rolling diaphragm.

An ASB (Service Bulletin) dealing with the renewal of the diaphragm is available on request. An ASB dealing with the testing of the safety valves and safety switches may also be obtained.

5. Problem solving

If the unit fails to operate normally, the following chart has been prepared as a guide to solve the various mechanical problems which could possibly arise.

If the motor has cut out through the action of a safety switch, and before starting any repair work on the unit, switch off the voltage at the circuit breaker and make sure that a safeguard has been placed to prevent unintentional "switch-on".

Always check the bulbs of the fault indicator lamps during starting, as the lamps must be relied upon to indicate which switch has stopped the unit, thus assisting in tracing the cause of the trouble. Any of the bulbs can be replaced, if necessary, after removal of their plastic front panel.

Tracing of an electrical fault must be performed by a qualified electrician. Always make sure that the wires are in good condition, i.e. not chafed, damaged or broken and that they are clamped tight to their terminals.

Possible mechanical faults and their remedies

CONDITION	POSSIBLE FAULTS	REMEDY
1 Motor cuts out immediately after starting (within approx. 20 s) and OIL PRESSURE fault indicator lamp H3 lights up	a. Oil pressure too low b. Oil pressure safety switch remains stuck in open position c. Time relay K8 for delayed loading incorrectly set (trips too soon)	a. See 11 b. Remove and test switch c. Set relay to cut out approx. 20 seconds after start switch has been pressed
2. Toggle switch S3 for manually unloading the compressor moved from position UN-LOADED to NORMAL, but compressor does not load (hourmeter LOADING TIME and loading solenoid valve are inoperative)	Air pressure in air net is above pre-set working pressure, i.e. air pressure switch S26 is open	Close air outlet valve or wait until pressure in air net is lower than pre-set loading pressure of air pressure switch

CONDITION	POSSIBLE FAULTS	REMEDY
3. Toggle switch S3 for manually unloading the compressor moved from position UNLOADED to NORMAL; hourmeter LOADING TIME operates but compressor does not load	<p>Air inlet throttle valve does not open due to :</p> <p>a. Loading solenoid valve (Y28) inoperative</p> <p>b. Throttle valve operating mechanism jammed or unloader cylinder defective</p>	<p>a. See 11. If in order, remove and check solenoid</p> <p>b. With unit stopped proceed as follows. Disconnect oil pressure feed pipe (4 - Fig. 17) from unloader and connect unloader port to independent compressed air source of approx. 2 bar(e). Disconnect pipe (1 - Fig. 17) and intermittently admit air at a pressure of 2 bar to unloader. This should cause throttle valve to operate, which is audible :</p> <ul style="list-style-type: none"> - throttle valve is operative : remove unloader cylinder, dismantle and inspect parts - throttle valve remains inoperative : remove unloader piston cover and inspect rolling diaphragm of piston. If in order, check piston for free axial movement by hand. If jammed, remove throttle casing, dismantle and replace defective parts
4. Air temperature switch S22 trips, AIR TEMP. HP INLET fault indicator lamp H4 lights up and motor stops	<p>a. Insufficient cooling water flow through cooling system</p> <p>b. Cooling water inlet temperature too high</p> <p>c. Air temperature switch incorrectly set</p> <p>d. Restriction in cooling system due to formation of scale or settling down of dirt</p>	<p>a. Check and increase water flow</p> <p>b. Decrease inlet water temperature, if possible</p> <p>c. Set switch to trip at 60°C (140°F). Do not set at a higher temperature</p> <p>d. Clean cooling system (consult Atlas Copco)</p>
<p>5. Bleed-off pressure switch S24 trips (<input type="checkbox"/>). BLEED-OFF PRESSURE fault indicator lamp H33 lights up and motor stops</p> <p><input type="checkbox"/> During loading</p> <p><input type="checkbox"/> During unloading</p>	<p>a. HP unloading valve leaks</p> <p>b. Unloader piston diaphragm worn or perforated</p> <p>c. Unloader piston hampered in its movement</p> <p>d. Leaking connection in pipe between intercooler and unloader cylinder head</p> <p>e. Check valve in compressor discharge system malfunctioning or out of order</p> <p>f. Throttle valve does not fully close</p> <p>g. Bleed-off pressure switch incorrectly set (opens too soon)</p>	<p>a. Remove and inspect valve and seat</p> <p>b. Remove and inspect rolling diaphragm</p> <p>c. With unloader piston diaphragm removed, check piston for free axial movement. Remove throttle casing and replace piston rod bushes, if necessary</p> <p>d. Check and correct as necessary</p> <p>e. Remove and inspect valve</p> <p>f. Check unloader piston for free axial movement. Remove throttle casing and replace bushes or bearings, as the case may be</p> <p>g. Check and correct setting</p>
6. On ZR6 units : oil temperature switch S23 trips, OIL TEMP. fault indicator lamp H32 lights up and motor stops	<p>a. Insufficient cooling water flow through compressor element cooling system</p> <p>b. Cooling water inlet temperature too high</p> <p>c. Oil temperature switch incorrectly set (trips too soon)</p> <p>d. Cooling efficiency of system reduced due to scale formation or settling down of dirt</p>	<p>a. Check and increase water flow</p> <p>b. See 4b</p> <p>c. Check and correct setting. Do not set at a higher temperature than 80°C (176°F)</p> <p>d. See 4d</p>
7. Compressor capacity or working pressure is lower than normal	<p>a. Air pressure switch incorrectly set (opens too soon)</p> <p>b. Throttle valve does not fully open or HP unloading valve leaks</p> <p>c. HP safety valve(s) or intercooler relief valve leaking</p> <p>d. Compressor element(s) out of order</p>	<p>a. See "Setting of the air pressure switch"</p> <p>b. Inspect unloader assembly, pipes and connections; repair even slightest leak. Remove elbow pipe from between HP air outlet silencer and air inlet casing; remove valve seat and valve cone, clean and inspect</p> <p>c. Remove leaking valve, clean and inspect. Replace if not air-tight after reinstalling</p> <p>d. Consult an Atlas Copco service representative</p>

CONDITION	POSSIBLE FAULTS	REMEDY
8. Compressor does not unload and causes HP safety valve(s) to blow	a. Air pressure switch incorrectly set (opens too late) b. Air leak at connections of air pressure switch feed pipe c. Throttle valve remains stuck in open position	a. Check setting. See "Setting of the air pressure switch" b. Inspect and tighten leaky connection(s) c. Inspect unloader assembly
9. Wrong idling delay	Time relay K10 out of adjustment	Change to correct setting. If correct setting cannot be obtained, replace time relay
10. Unloading pressure or pressure difference cannot be adjusted	Air pressure switch out of order	Test pressure switch at various settings. Replace switch if it does not respond
11. Low compressor oil pressure	a. Oil level too low b. Oil filter element clogged c. By-pass valve in oil pump stuck in open position d. Oil pump failure	a. Top up level to upper mark on dipstick b. On ZR3, -4, dismantle filter, clean bowl and inspect element; replace, if necessary. On ZR5, -6, replace elements c. Remove by-pass valve, clean and inspect d. Remove pump and inspect parts for wear
12. Discharge cooling water milky; leakage between air and water system	O-ring or sealing ring between intercooler and moisture trap damaged or worn	Stop compressor immediately. Remove sealing ring and replace O-ring
13. Excessive oil fumes or air flow coming from gear case breather	Balancing piston diaphragm of compressor element cracked	Remove balancing piston cover from timing gear covers and inspect diaphragms. Replace defective diaphragm
14. Water droplets show on dipstick	O-ring or tube(s) of oil cooler leak	Remove and dismantle oil cooler. Pressure test core. Replace O-rings and change lubricating oil
15. Condensate does not discharge from intercooler and/or aftercooler drain receivers during loading	a. Discharge pipe(s) clogged or pinched b. Float valve(s) malfunctioning or defective	a. Check and correct, as necessary b. Remove float valve assembly, clean and inspect
16. Air filter service gauge does not indicate or pointer suddenly drops to low value during loading	a. Connection of gauge pipe leaking b. Filter element not properly installed c. Filter element ruptured d. Leak in inlet system	a. Check and correct, as necessary b. Check seating c. Remove and inspect. Replace, if in doubt about condition d. Inspect and tighten system connections
17. Intercooler pressure below normal*	a. Choked air intake filter element(s) b. Intercooler relief valve(s) leaking c. Air leak at gaskets in circuit between LP and HP compressor elements d. Pipe between intercooler and unloader or LP balancing piston leaking or broken (throttle valve does not fully open). This fault might also cause air temperature switch S22 to trip due to leaking of compressed air through open HP unloading valve e. LP compressor element not in order	a. Replace filter element(s) b. Remove valve(s). Clean and inspect c. Tighten screws of leaking connection. Replace gasket, if necessary d. Check and correct as necessary e. Consult an Atlas Copco service representative
18. Intercooler pressure above normal*	a. Insufficient cooling water flow through cooling system b. Cooling water inlet temperature too high c. Scale deposits on pipes and internal walls of intercooler d. HP compressor element not in order	a. Check and increase water flow b. Decrease inlet water temperature, if possible c. See 4d d. See 17d

* Note that the intercooler pressure varies in direct proportion with the barometric pressure.

6. Principal data

Common data

Number of compression stages		2
Maximum working pressure (effective) :		
- Arr E - all versions and Arr 1 - M version	bar	8.5
	psi	123
- Arr 1 - A, B and C versions	bar	10.5
	psi	152
Normal working pressure(e)	bar	7
	psi	102
Maximum pressure ratio		12
Intercooler pressure(e)* at normal working pressure :		
- During loading	bar	2 - 2.7
	psi	29 - 39
- During unloading	bar	0.65/0.80
	psi	9.5/11.5
Max. cooling water pressure(e)	bar	3
	psi	44
Max. cooling water inlet temperature	°C	35
	°F	95
Cooling water outlet temperature, normal/max.	°C	40/50
	°F	104/122
Opening pressure(e) of intercooler relief valve(s)	bar	3.7
	psi	53.5
Opening pressure(e) of HP safety valve(s) :		
- Arr E - all versions and Arr 1 - M version	bar	9.3
	psi	135
- Arr 1 - A, B and C versions	bar	11
	psi	159
Setting of oil pressure switch.....	bar(e)	1.4
	psig	20
Setting of oil temperature switch (on ZR6 units only)	°C	80
	°F	176
Setting of air temperature switch	°C	60
	°F	140
Setting of bleed-off pressure switch	bar(e)	0.3
	psig	5
Lubricating oil capacity :		
- Initial fill/refill ZR3 (approx.)	l	30/24
	US gal	7.93/6.3
- Ditto ZR4 (approx.)	l	65/55
	US gal	17.2/14.6
- Ditto ZR5, ZR6 (approx.)	l	85/75
	US gal	22.5/20

* Varies mainly in direct proportion with the barometric pressure.

Specific data : Arr. E and 1 - 50 Hz frequency units

Compressor type	ZR3						ZR4			ZR5			ZR6		
	A	B	C	M	A	B	A	B	C	A	B	M	A	B	M
Temperature of air leaving after-cooler at continuous operation and normal working pressure *	24/28	24/28	24/28	30	24/28	24/28	23/26	23/26	23/26	23/24	23/24	26	23/25	23/25	27
..... °C	75/82	75/82	75/82	86	75/82	75/82	73/79	73/79	73/79	73/75	73/75	79	73/77	73/77	81
..... °F															
Cooling water consumption at normal working pressure with water temperature rise stated :															
- Compressor : 30°C	0.49	0.40	0.27	0.60	0.49	0.40	0.87	0.72	0.58	1.43	1.12	1.74	2.43	1.92	3.00
15°C	0.98	0.80	0.53	1.20	0.98	0.80	1.75	1.45	1.16	2.86	2.25	3.47	4.86	3.84	5.99
54°F	7.77	6.34	4.28	9.51	7.77	6.34	13.79	11.49	9.19	22.67	17.75	27.58	38.52	30.43	47.56
27°F	15.53	12.68	8.40	19.02	15.53	12.68	27.74	22.98	18.39	45.37	35.67	55.01	77.04	60.87	94.95
- Aftercooler : 30°C	0.35	0.29	0.19	0.43	0.35	0.29	0.62	0.52	0.41	1.02	0.80	1.24	1.73	1.37	2.14
15°C	0.70	0.57	0.38	0.85	0.70	0.57	1.25	1.03	0.83	2.04	1.61	2.48	3.47	2.74	4.28
54°F	5.55	4.60	3.01	6.82	5.55	4.60	9.83	8.24	6.50	16.17	12.68	19.66	27.42	21.72	33.92
27°F	11.10	9.03	6.02	13.47	11.10	9.03	19.81	16.33	13.16	32.34	25.52	39.31	55.01	43.43	67.85
Net weight :															
- Arr. E, with Siemens motor (approx.)	2300	2125	2080	2460	2300	2125	3600	3600	3510	5500	5500	6700	7500	7200	8350
..... kg	5060	4675	4575	5410	5060	4675	7920	7920	7720	12100	12100	14750	16500	15840	18370
..... lb															
- Arr. 1, without motor, incl. motor hood (approx.)	1700	1700	1700	1700	1700	1700	2750	2750	2750	4500	4500	4500	5500	5500	5500
..... kg	3750	3750	3750	3750	3750	3750	6050	6050	6050	9900	9900	9900	12100	12100	12100
..... lb															

Specific data : Arr. 1 - 60 Hz frequency units

Compressor type	ZR3						ZR4			ZR5			ZR6		
	A	B	C	M	A	B	A	B	C	A	B	M	A	B	C
Temperature of air leaving after-cooler at continuous operation and normal working pressure *	30	28	25		28	26	28	26	24	26	24	23	27	25	23
..... °C	86	82	77		82	79	82	79	75	79	75	73	81	77	73
..... °F															
Cooling water consumption at normal working pressure with water temperature rise stated :															
- Compressor : 30°C	0.60	0.50	0.33		1.08	0.88	1.08	0.88	0.58	1.71	1.41	1.07	2.95	2.37	1.86
15°C	1.20	1.00	0.60		2.16	1.77	2.16	1.77	1.15	3.43	2.82	2.13	5.90	4.74	3.72
54°F	9.51	7.93	5.23		17.12	13.95	17.12	13.95	9.19	27.10	22.35	16.95	46.75	37.56	29.48
27°F	15.85	15.85	9.51		34.24	28.05	34.24	28.05	18.23	54.36	44.70	33.76	93.51	75.13	58.96
- Aftercooler : 30°C	0.40	0.34	0.22		0.82	0.68	0.82	0.68	0.46	1.26	1.06	0.80	2.11	1.69	1.33
15°C	0.80	0.68	0.45		1.63	1.36	1.63	1.36	0.91	2.52	2.12	1.59	4.21	3.39	2.66
54°F	6.34	5.39	3.48		12.99	10.78	12.99	10.78	7.29	19.97	16.80	12.68	33.44	26.78	21.08
27°F	12.68	10.78	7.13		25.83	21.55	25.83	21.55	14.42	39.94	33.60	25.52	66.73	53.73	42.16
Net weight, approx.	1700	1700	1700		2750	2750	2750	2750	2750	4500	4500	4500	5500	5500	5500
..... kg	3750	3750	3750		6050	6050	6050	6050	6050	9900	9900	9900	12100	12100	12100
..... lb															

* At following conditions : Air intake pressure (absolute) 1 bar = 14.5 psi
 Air and cooling water inlet temperatures 15°C = 59°F
 Cooling water temperature increase 15°C = 27°F