

Special equipment and compressors for underwater activities

# **Low and High pressure Compressors**

## **MCH 14 TECH NITROX**

*VERSION: English*

**INSTRUCTION**

**MANUAL**

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To make the manual easier to read, the following terms have been adopted:



**DANGER**

The term **DANGER** is used when failure to comply with the regulations or tampering with the parts could lead to serious injury or even death.

**WARNING**



The term **WARNING** is used when failure to comply with the instructions could cause damage to the machine and other parts associated with the same or to the surrounding area.

**LABEL APPLIED TO THE COMPRESSORS**

<b>AEROTECNICA COLTRI S.r.l.</b>		<b>CE</b>
Via Colli Storici, 177		
25010 S. Martino d/Battaglia (BS) Italy		
Tel. 030/9910297-9910301		
Fax 030/9910283		
<b>MODEL</b>	<input type="text"/>	
<b>TYPE</b>	<input type="text"/>	
<b>S/N</b>	<input type="text"/>	
<b>YEAR</b>	<input type="text"/>	
<b>MOTOR</b>	<input type="text"/>	
<b>POWER</b>	<input type="text"/>	

To protect exposed persons or objects, a special booklet entitled "**SAFETY REGULATIONS**" is supplied with the machine and must be considered an integral part of the Compressor Instruction Manual.

This manual is the property of **AEROTECNICA COLTRI S.r.l.** and any copying of the same, even partial, is prohibited.

## USE IN BRIEF

The following information must be referred to and applied only when this manual and the “Safety regulations” manual have been read and their contents have been understood and assimilated.



- Check whether or not the area where the machine is installed has suitable ventilation (see chapter 6.1).
- If the machine is installed in a place without the required characteristics above, connect the air intake extension (see chapter 6.2.1).
- Connect the filling hoses to the machine (see chapter 6.2.2).
- Connect the switchboard to the mains power supply (see chapter 6.2.3).
- Check the level of the lubricating oil in the pump unit (see chapter 8.2). If the level is too low, turn off the machine and add or change the oil (see chapter 8.1).
- Turn on the machine using the main switch (see chapter 7.1).
- Check the direction of rotation of the motor. If the direction of rotation does not coincide with the one shown on the belt guard, turn off the machine and invert the two phases on the main power supply (see chapter 7.2).
- Check the operation of the safety valve (see chapter 9.1).
- Check for wear on the cylinders to be filled (see chapter 9.1).
- Set the pressure switch on the control panel to the refill pressure value given on the cylinder (see chapter 8.1).
- Fit the hose attachment on the cylinder and check that the taps on the hose are open (see chapter 9.2).
- Turn on the cylinder tap and start up the compressor (see chapter 9.2).
- When the filling operation has been completed, the compressor is stopped automatically by the pressure switch, turn off the cylinder and the hose taps.
- Press the pressure bleed button and disconnect the cylinder attachment (see chapter 9.2).

# 1 GUARANTEE AND ASSISTANCE

## 1.1 Guarantee

**AEROTECNICA COLTRI S.r.l.** guarantees its compressors against any design or manufacturing defect or fault and against any fault in the materials for a period of twelve months from the delivery of the machine. The customer must inform **AEROTECNICA COLTRI S.r.l.** in writing of any fault and/or defect that may be found within eight days from its discovery by means of a registered letter with advice of receipt or telegramme, otherwise the guarantee will become null and void.

The guarantee is only valid against faults or defects that may arise with the compressor used under proper operating conditions according to the instructions given in this manual and with the maintenance carried out at the intervals as provided for.

The guarantee expressly excludes any faults arising as a result of improper use of the machine, of atmospheric agents and of damage due to transport; the guarantee does not cover the expendable materials and materials required for the periodic maintenance which are at the customer's entire expense. The guarantee will, in any case, become automatically null and void if the compressor is tampered with or if it has been serviced by technicians who are not authorized to do so by **AEROTECNICA COLTRI S.r.l.**

Any compressor that is acknowledged to be faulty due to defects in the design, manufacturing or materials used, will be repaired or replaced free of charge by **AEROTECNICA COLTRI S.r.l.** at its factory in San Martino della Battaglia (BRESCIA). The customer will be responsible for the costs of transport and carriage as well as for any spare parts and expendable materials.

If it should be necessary for service to be carried out under the guarantee at the customer's premises, the latter will be responsible for the travel and transfer costs for the staff sent out by **AEROTECNICA COLTRI S.r.l.**

Taking delivery of the machine and/or of any faulty components or the transfers for the inspection of faults and/or defects as notified by the customer, will not, however, denote any implicit acknowledgement regarding the effectiveness of the guarantee.

Repairs and/or replacements made by **AEROTECNICA COLTRI S.r.l.** during the guarantee period will not extend the duration of the same.

Acknowledgment of the guarantee does not itself imply any liability for compensation on the part of **AEROTECNICA COLTRI S.r.l.**

**AEROTECNICA COLTRI S.r.l.** does not assume any responsibility for injury to persons or damage to property or for any other direct or indirect damage (loss of production or missed profit, etc.) that may be attributable to faults or defects of the compressor, except for those cases in which a serious fault can be attributed to the company.

## 1.2 Assistance

The **AEROTECNICA COLTRI S.r.l.** technicians are available for any kind of routine or additional maintenance work.

The request for technical assistance must be sent to **AEROTECNICA COLTRI S.r.l.** at the following address:

**AEROTECNICA COLTRI S.r.l.**

Via Colli Storici, 177

25010 San Martino della Battaglia (BRESCIA) ITALIA

Fax: +39 030 9910283

e-mail: coltrisub@coltrisub.it

**TECHNICAL DESCRIPTION**

**2**



*This chapter provides a technological description of the machine and its main components.*

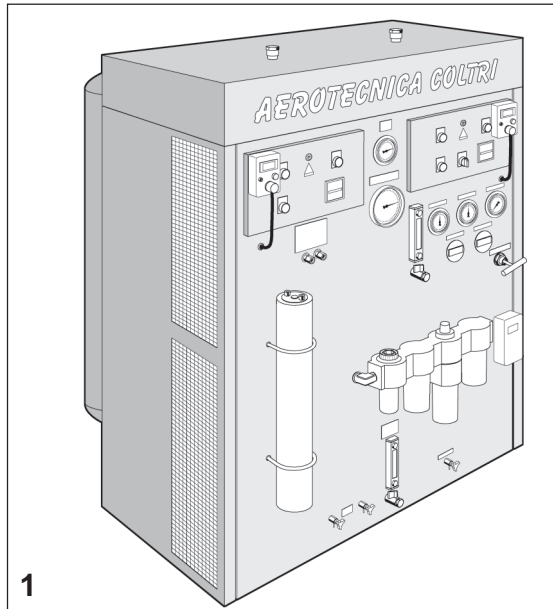
- 2.1 Operating principle ..... 10**
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## 2.1 Operating principle



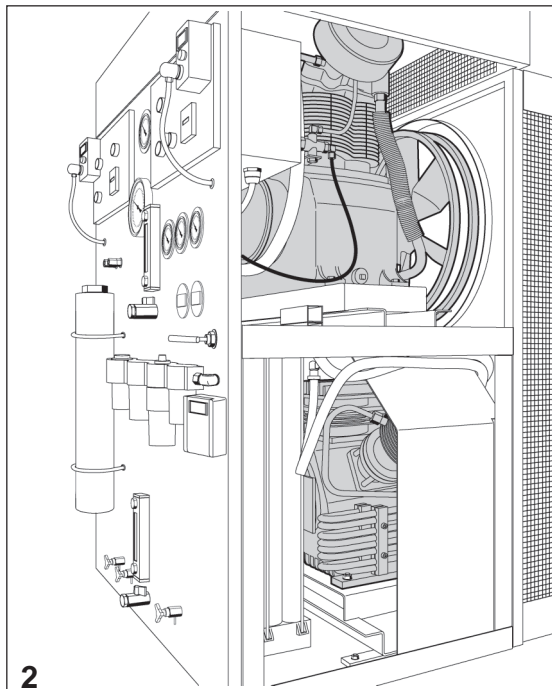
**WARNING :**

**THE FILLING STATION PRODUCES RESPIRABLE AIR/NITROX.**



1

The filling stations in the “**MCH 14 TECH NITROX**” series are of the semi-soundproofed type (Fig. 1).



2

This model is provided with two compressors, the first is low pressure (superior) and the second high pressure (inferior); 2 stage of compression with forced air cooling and 3 stages of compression. (Fig. 2).

This system supplies to output percentages nitrox in oxygen of 22% to 40% for volume.

The alimentation of the low pressure supplies air to the membrane and the membrane supplies nitrox to the high pressure compressor.

This system supplies a breathable gas stream consisting of an elevated oxygen content relative to normal atmospheric content of approximately 21% O<sub>2</sub> by volume. This technique employs gas separation technology utilizing a permeable membrane to separate certain gas molecules from other gas molecules allowing a controlled flow of output gasses of differing oxygen concentrations.

This system produces DNax Nitrox in oxygen concentrations of 22% to 40% at maximum pressures of 3200 - 3700 PSI. A supply gas, in this case, "Grade-E" air, will be required. This supply gas is fed at low pressure (145-185 PSI) to the input port of the membrane. The gas stream is fed through a thermostat-controlled heater. As the gas moves through this assembly, its temperature is raised to 35° (110 degrees F). The purpose of this heater is to even out the variations in gas temperature and produce a more linear performance curve. Once through the heater, the input gas is allowed to pass through the membrane. As the gas passes through the membrane, the gas volume applies pressure against the inside walls of the permeable fibers resulting in the migration across the wall of varying levels of the different constituents of air. Gas volumes of desired O<sub>2</sub> concentrations are achieved in this manner. In this stage the normal oxygen content of the "Grade-E" air second the norms UNI EN 132, CGA-E and DIN 3188 (20.9%) is raised to output percentages upwards of 23% to 40%.

A needle valve in the outlet stream of the waste gas (nitrogen) controls the relative O<sub>2</sub> concentrations while input pressure regulation allows control of the output volume of the membrane. This outlet volume control is required to balance the input requirements of the high-pressure compressor. As the gas volume of desired oxygen concentration is produced it is contained and directed to the inlet port of the high-pressure compressor. An overpressure checkvalve is installed in the inlet fitting of the high-pressure compressor to protect the compressor from over pressurization of the first stage. Negative pressure protection is accomplished in the same manner by installing an under-pressure checkvalve in the ambient air intake side of the membrane output fitting.

As the gas volume is subsequently compressed, it is alternately cooled and raised in pressure again until it reaches its final design output pressure. Final filtration and purification is accomplished at final compressor discharge.

Product gas "DNax" nitrox is available at desired oxygen concentrations (up to 40% O<sub>2</sub> by volume) at maximum pressures of 3200 - 3700 PSI, for filling Nitrox Storage Bottles or SCUBA cylinders.

**Typical Specification for Air :**

- O<sub>2</sub> Percentage: ..... 20-22 %
- CO<sub>2</sub>: ..... 1000 PPM
- CO: ..... 10 PPM
- Hydrocarbons: ..... 25 PPM
- Water: ..... 67 PPM
- Dew Point: ..... - 50° F
- Oil & Particles: ..... 5 mg/m<sup>3</sup>
- Odor: ..... Nessuno

2.2

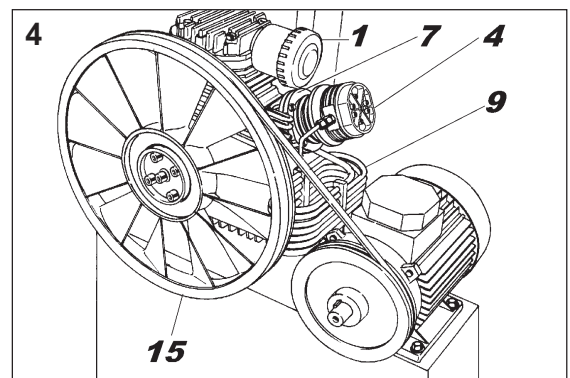
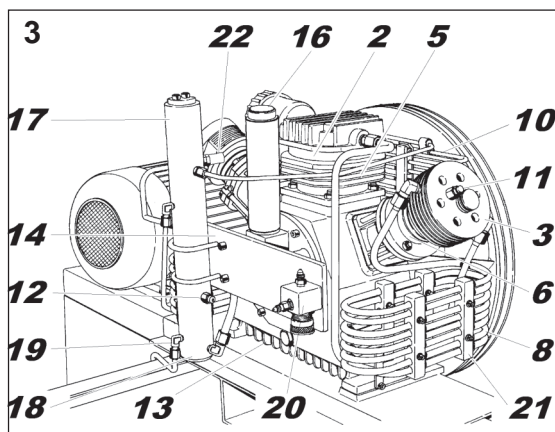
**Description of the pump unit -  
High pressure compressor**

The pumping unit has the task of producing compressed air at high pressure (200-300 bar) and purifying it by means of the decantation and filtering systems until it reaches a level of purity equal to or higher than the limits set by the standards DIN 3188 - UNI EN 132 - CGA/E, or to increase the pressure of the gas inhaled (only inert - non-explosive gases).

This unit consists of the following components (Fig. 3-4):

Table 1

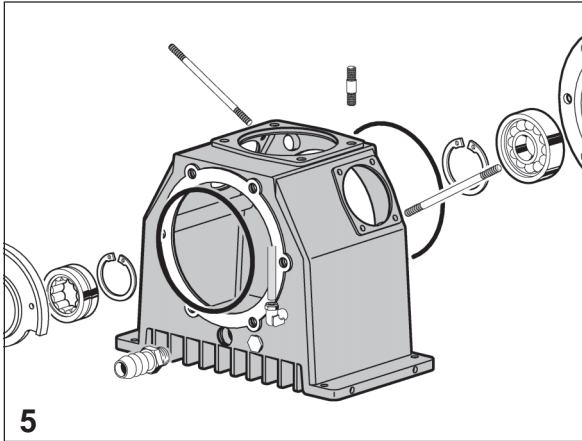
N°	Description	N°	Description
1	Intake filter	12	2 <sup>nd</sup> stage safety valve
2	1 <sup>st</sup> stage head	13	Crankcase
3	2 <sup>nd</sup> stage head	14	Filter-holding bracket
4	3 <sup>rd</sup> stage head	15	Fan
5	1 <sup>st</sup> stage cylinder	16	Oil cap
6	2 <sup>nd</sup> stage cylinder	17	Final condensate separator
7	3 <sup>rd</sup> stage guiding cylinder	18	Condensate separator between stages
8	1 <sup>st</sup> -2 <sup>nd</sup> stage cooling pipe	19	Condensate drain connection
9	2 <sup>nd</sup> -3 <sup>rd</sup> stage cooling pipe	20	Maintenance valve
10	Final cooling pipe	21	Pipe-fastening bracket
11	1 <sup>st</sup> stage safety valve	22	3 <sup>rd</sup> stage or final safety valve





**Crankcase - High pressure compressor**

**2.2.1**

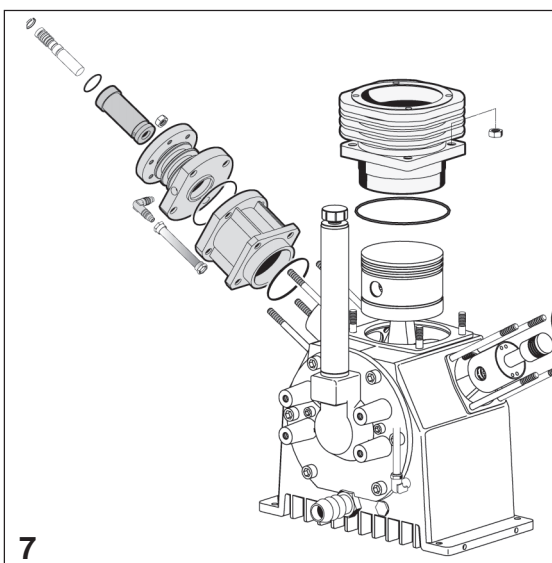
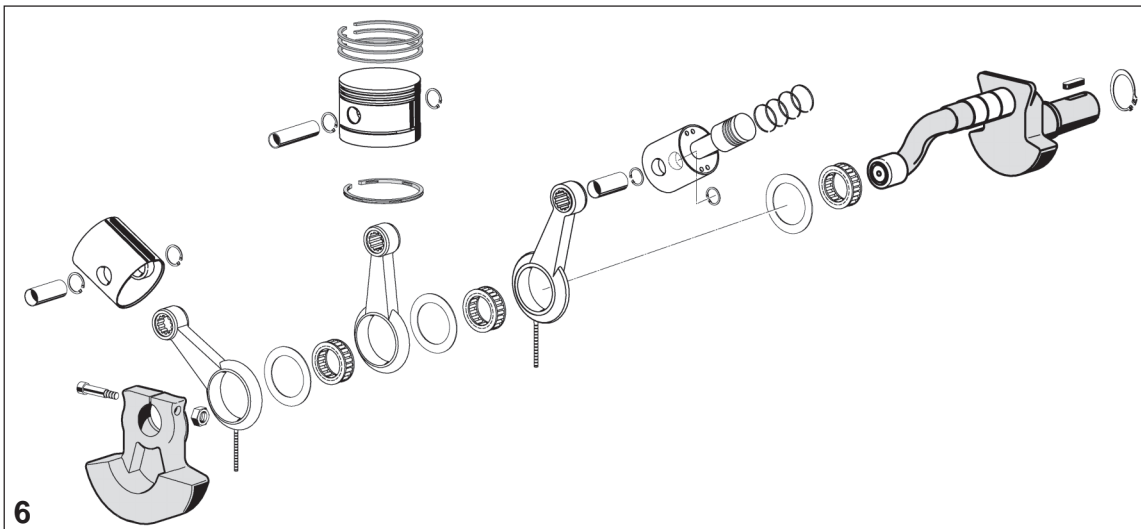


The crankshaft, the pistons and the cylinders also form a part of this unit.

The crankcase (Fig. 5) is made of aluminium alloy, the two flanges with the ball and roller bearings that support the crankshaft are oil-tight with the crankcase due to the O-Rings fitted.

The crankshaft and the connecting rods turn exclusively on roller or ball bearings (Fig. 6).

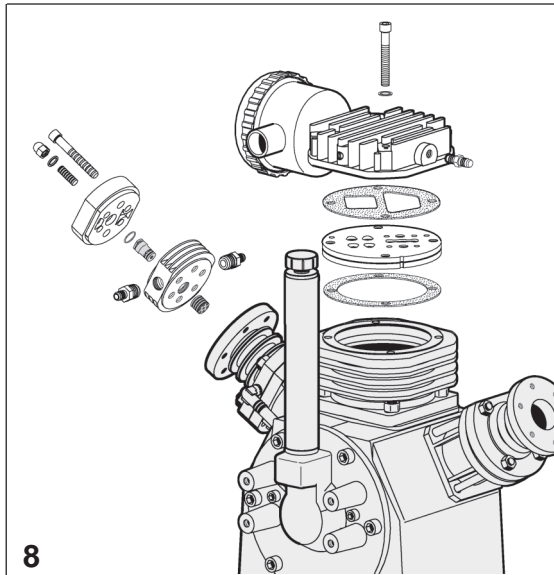
The three connecting rods are fitted on the crankshaft with a single crank angle.



The cylinders are made of cast iron (Fig. 7), while the pistons are made of aluminium and have traditional multiple compression rings. The high pressure stage piston has an anti-wear coating and the relevant cylinder is given a self-lubricating treatment.

**2.2.2**

**Valve head unit (Fig. 8) - High pressure compressor**



The head unit includes the discharge and inlet valves.

The head of the 1<sup>st</sup> stage is of a lamellar type and includes both the inlet and the discharge.

The inlet and discharge valves are located directly in threaded seats on the 2<sup>nd</sup> and 3<sup>rd</sup> stage heads. The inlet valves can be removed using the special pin wrench (cod. SC000480), having first removed the heads.

The discharge valves can be removed from the outside.

See Chapter 11, "Maintenance".

**2.2.3**

**Safety valves - High pressure compressor**

The purpose of the safety valves (see figure 5) is to protect the machine (and the cylinders) from overpressure.

These valves are factory set at the following pressures:

- 1<sup>st</sup> stage safety valve: 8 bar;
- 2<sup>nd</sup> stage safety valve: 50 bar;
- 3<sup>rd</sup> stage safety or final valve: 225 bar - or 330 bar.

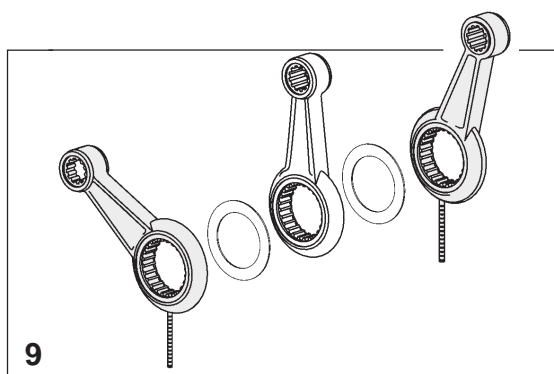


**WARNING**

Under no circumstances may these valves be adjusted to increase the calibrated pressure. If these valves blow, check the cause that has led to the maximum pressure and take steps according to the instructions given in paragraph 12.1. Any tampering with the safety valves causes serious damage and an immediate cancellation of the guarantee.

**2.2.4**

**Lubricating unit - High pressure compressor**



Lubrication is carried out by means of a pin screwed into the end part of the 2<sup>nd</sup> and 3<sup>rd</sup> stages connecting rods (Fig. 9).

The 3<sup>rd</sup> high pressure stage is lubricated by oil vapours.

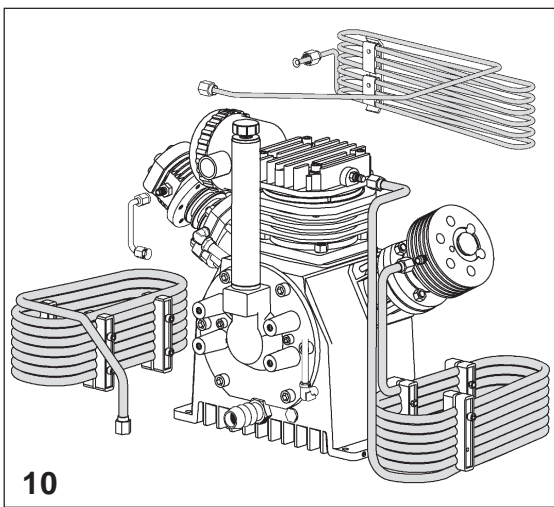
**Pressure maintenance valve - High pressure compressor**

**2.2.5**

This valve is fitted after the final filter. Just a few seconds after the compressor has been started up, it keeps the pressure of the entire system at  $100 \pm 20$  bar (see exploded view Chapter 15), for the purpose of eliminating as much water as possible from the air. It also acts as a non-return valve.

**Cooling pipes (Fig. 10) - High pressure compressor**

**2.2.6**

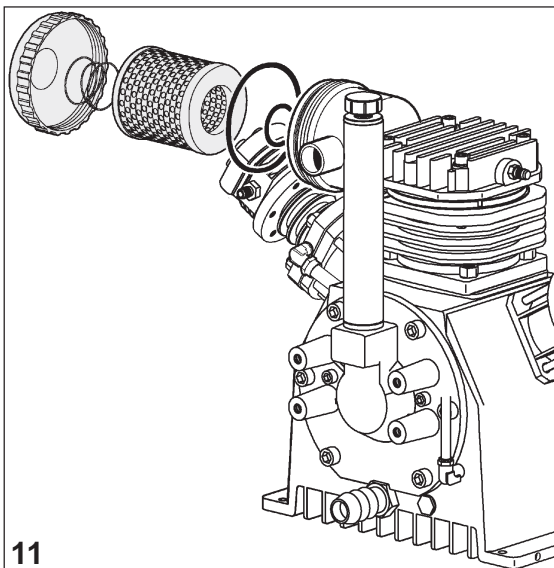


The cooling pipes between the 1<sup>st</sup> and 2<sup>nd</sup> stage, between the 2<sup>nd</sup> and 3<sup>rd</sup> stage and after the 3<sup>rd</sup> stage are made of stainless steel, like those for the passage of air between the separator and the filter.

**Filters - High pressure compressor**

**2.2.7**

**INTAKE FILTER (Fig. 11)**



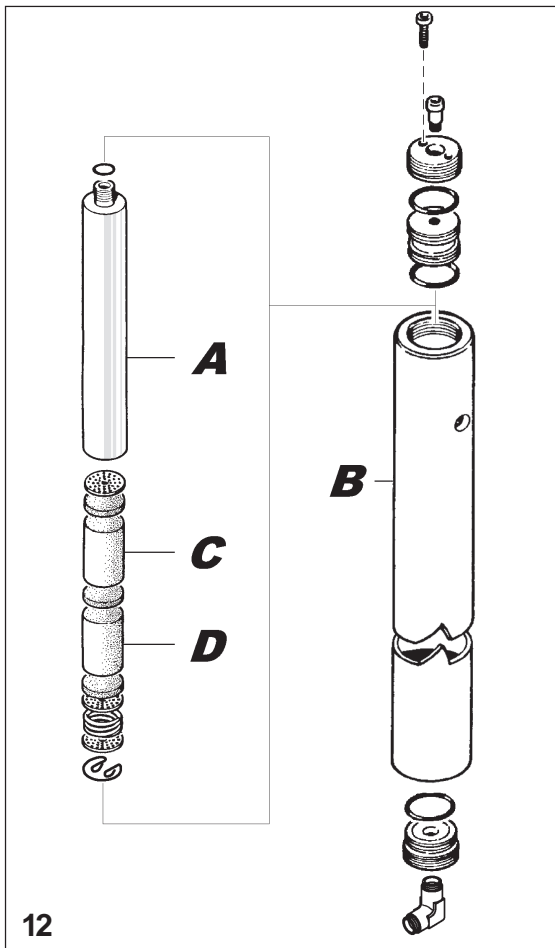
The intake filter is coupled directly to the lid of the 1<sup>st</sup> stage head.

The intake filter consists of a cylindrical aluminium casing provided with a screw cap that holds the filtering cartridge.

A special attachment is provided on the filter for the connection of an extension (optional) which enables air to be taken from the outside when the compressor is installed in a place without ideal ventilation.

For the compressor to operate properly, the filter maintenance must be carried out as provided for and at the intervals recommended (instructions in paragraph 11.6).

**ACTIVATED CARBON FILTER AND MOLECULAR SIEVE (Fig. 12)**



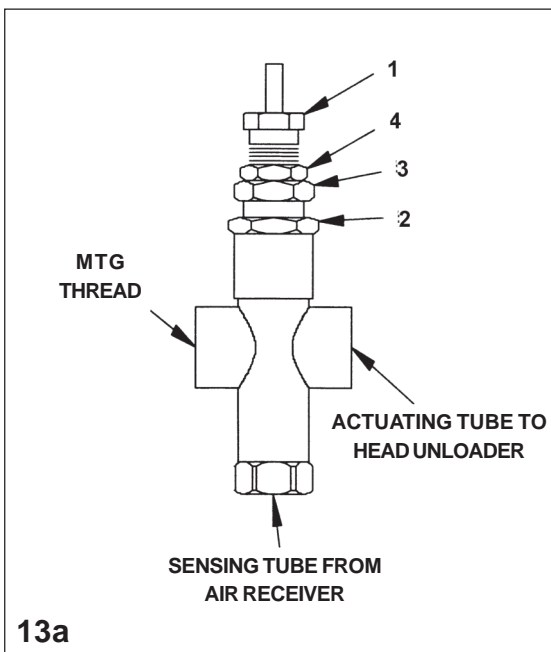
The filter consists of an aluminium tube (B) that holds the filter cartridge (A).

The shell of the cartridge contains the activated carbon (C) and the molecular sieve (D) placed between felt disks.

The condition of the cartridge is of fundamental importance for the quality of the air (see paragraph 11.7 for replacement instructions).

**2.2.8**

**Pilot valves - Low pressure compressor**



The Pilot Valve is designed to act as an automatic “on” and “off” air switch. When in the “on” position it allows air to flow from the tank through the Valve to some device such as a compressor suction unloader, thus actuating it.

In the “off” position (Fig. 13a). this valve stops the flow of air through the valve and release the pressure in the line to the device.

The Pilot Valve works as follows: Tank air pressure acts on the bottom of the valve.

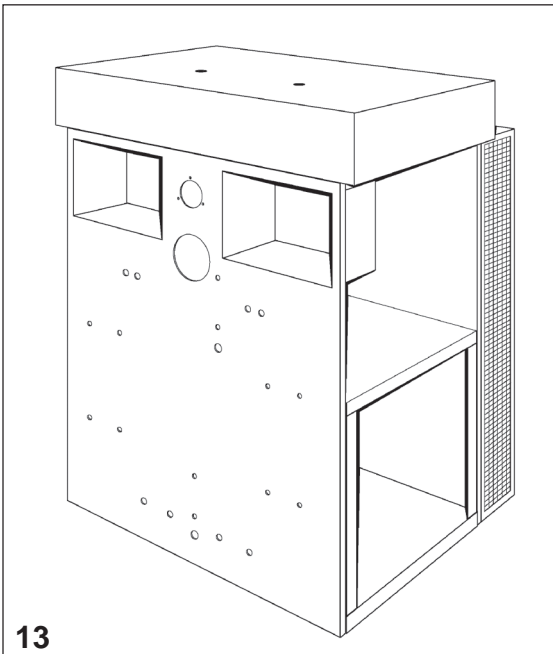
When pressure is great enough to overcome spring force holding valve down on lower seat, it lifts off seat and allows air to flow around valve and out through side opening in Pilot Valve.

When pressure in tank and on valve drops, spring forces valve back down on lower seat.

Air in line to device being actuated can then escape through upper seat and out vent hole. The pressure at which the Pilot Valve is "on" or "off" is controlled by the spring which has been installed at the factory. A small adjustment can be made in the field by changing the spring force by compressing the spring more or less with the adjusting screw provided by the Pilot Valve.

### Frame and sound-proofed casing

2.2.9

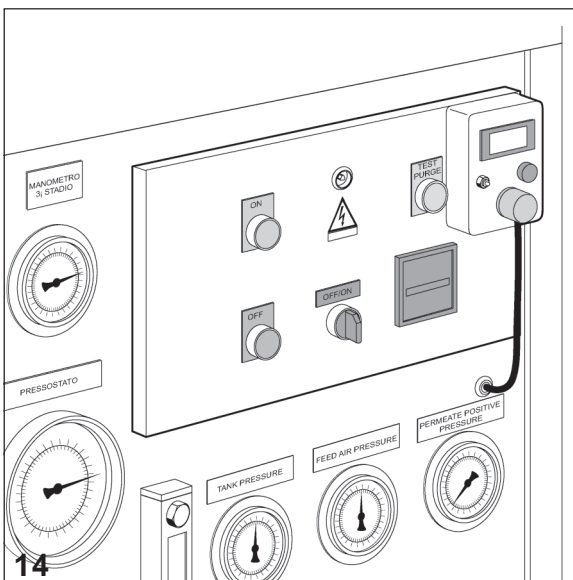


The compressor and the electric motor are fitted on a welded steel frame coated in epoxy resins and are enclosed within a sound-proofed casing covered in sound-deadening, water-repellent and fireproof panels (Fig.13).

The excellent way in which the flow of the cooling air has been designed enables the temperature inside to be just slightly higher than the outside temperature.

### Machine control

2.3



The machine function controls are located on an electric control panel (Fig. 14).

Apart from the various control buttons, this panel also includes an hour counter that enables the number of machine operating hours to be memorized.

The same controls are doubled up on two independent control panels which each control one of the two pump units present inside the filling station.

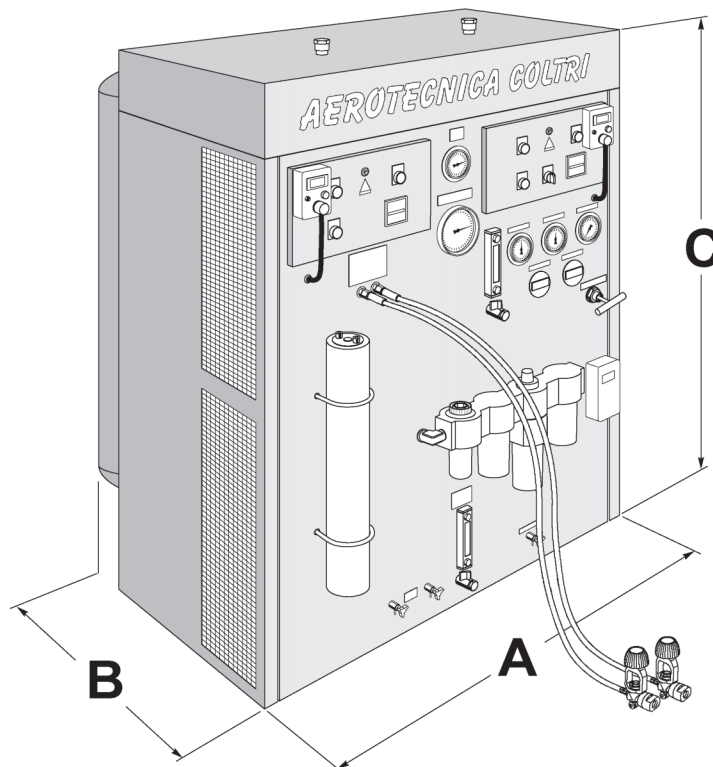
**3****TECHNICAL CHARACTERISTIC**

This chapter provides some technical information concerning the machine.

<b>3.1</b>	<b>Technical characteristics of the pump unit</b> .....	<b>18</b>
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<b>3.2</b>	<b>Noise level</b> .....	<b>20</b>

**3.1****Technical characteristics of the pump unit - low and high pressure compressor**

The pump unit consists of: three compression stages, three cylinders, forced air cooling by means of a large diameter fan, splash lubrication with immersed pins, stainless steel cooling pipes.

**3.1.1****Sizes and weights (Fig. 15)**

15

## Machine series MCH 14 TECH NITROX

## 3.1.2

Table 1

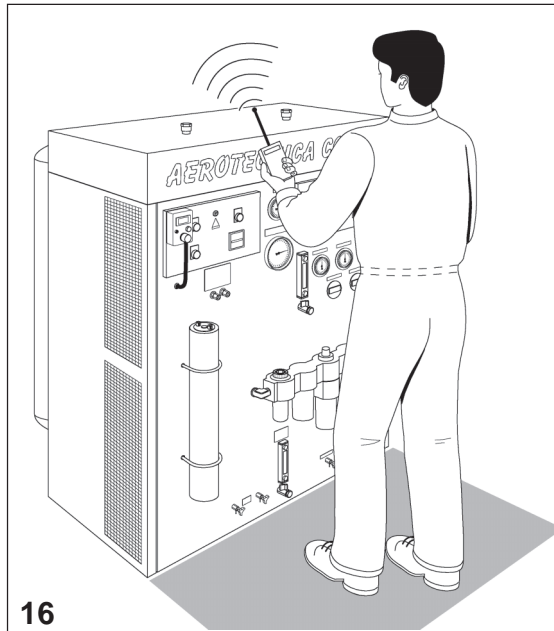
<b>High pressure compressor:</b>	
Maximum Block Output Pressure	300 bar - 4700 psi
Final System Discharge Pressure	225 bar - 3200 psi
Number of Stages	3
Number of Cylinders	3
Capacity	ca 230 Lt/min. 14 m <sup>3</sup> /h 5 - 8.0 SCFM
Lubricant	Synthetic Nitrox
Condensate Drains	2 manual 1 automatic
Max. non-continuous peak pressure for NITROX	225 o 330 bar - 3200 o 4700 psi
Max. non-continuous peak pressure for AIR	
Cylinder diameter	95/38/14 mm
Speed of rotation	1350 r.p.m.
Piston stroke	40 mm
Intermediate pressures	<b>1° stage</b> : 5 bar/70 psig <b>2° stage</b> : 40 bar/570 psig <b>3° stage</b> : 225-330 bar/3200-4800 psig
Power motor	2x 5,5Kw-7,5HP
Tension and frequency (three-phase)	400V - 50Hz 440V - 60Hz 230V - 50Hz 230V - 60Hz
Membrane Operating Temperature Range	38-46 °C - 100-115 Fahrenheit
Input Operating Pressure Range	Air UNI EN 132 - DIN 3188 - CGA/E
Input Gas Composition	14 - 28 m <sup>3</sup> /h
Output Gas Composition	Nitrox: 26% - 40% - air
Output Gas Volume (Stabilized):	@ 32% - 40% (5-10 SCFM ) - 9-18 m <sup>3</sup> /h
Membrane Operating Temperature Range	max 200psi - 14 bar
<b>Low pressure compressor:</b>	
Maximum Block Output Pressure	13 bar
Number of Stages	2
Number of Cylinders	2
Capacity	23.5 SCFM - 40 m <sup>3</sup> /h
Tension and frequency (three-phase)	400V - 50Hz 440V - 60Hz 230V - 50Hz 230V - 60Hz
Lubricant	Synthetic Nitrox
Condensate Drains	1 manuale 1 automatic

\* Membrane input pressure regulated to balance compressor requirements.

**3.2**

**Noise level**

The **MCH 14 TECH NITROX** series of compressors have been designed and built with the objective of reducing acoustic pressure to a minimum.



The reading of the machine noise level was taken from the “operator’s work place” (Fig. 16), with the following methods and results

**Table 2**

METHODS OF MEASUREMENT ISO 3746	MCH 14 TECH NITROX
Level of acoustic pressure at the operator’s work place Level of acoustic power Peak level	dB(A) 75 dB(A) 97,1 -
INSTRUMENTS	
Bruel & Kjacr sound level integrating meter Microphone for sound level meter Gauge	Mod. 2231 cl. 1 Mod. 4155 cl. 1 Mod. 4230 cl. 2

Whenever the machines are used in environments where the daily noise level to which the operators are exposed is higher than 80 dBA, the employer must take steps to apply all the measurements necessary to safeguard the operator’s health. In particular, the operators must, if necessary, use all the individual protection devices to protect themselves from the noise level.



**PRECAUTIONS FOR USE AND MAINTENANCE**

**4**

Refer to the specific "Safety Regulation Manual" which is supplied enclosed with this manual (and which forms an integral part of the same).



4.1 Machine area diagrams ..... 22  
 4.1.1 Safety devices ..... 23  
 4.1.2 Residual risk areas ..... 25

**WARNING**



**THE COMPONENTS YOU WILL BE USING CONTAIN ELEMENTS THAT MAY EXPOSE YOU TO BOTH LOW AND HIGH-PRESSURE GAS STREAMS. GAS, EVEN UNDER MODERATE PRESSURE, WILL CAUSE EXTREME BODILY HARM IF NOT TREATED WITH CARE.**

**DO NOT ALLOW ANY GAS STREAM TO BE DIRECTED AT ANY PART OF THE BODY. ANY HIGH-PRESSURE HOSE END OR FITTING WILL CAUSE EXTREME HARM IF IT COMES LOOSE FROM ITS RESTRAINT (OR TERMINATION) AND STRIKES ANY BODY PART. USE APPROPRIATE CARE IN MAKING ALL CONNECTIONS.**

**Cautionary Operational Note:** This system contains automatic condensate drains. Use Auto Purge feature to test for proper operation. However, when compressor is in operation, open manual condensate drain bleeder valves at least once a day to ensure that the auto drain is working properly.

**Cautionary Operational Note:** DO NOT USE ANY FORM OF MINERAL OIL IN ANY COMPRESSOR IN THIS SYSTEM. Use only EZ 1000 Compressor Lubricant.

**Cautionary Operational Note:** DO NOT USE THIS SYSTEM TO PRODUCE ABOVE 40% O<sub>2</sub> CONCENTRATION.

**Cautionary Operational Note:** THE NITROGEN EXITING FROM THE NEEDLE VALVE MUST BE VENTED OUTSIDE. SUFFOCATION AND DEATH CAN OCCUR IF NITROGEN IS ALLOWED TO COLLECT IN AN ENCLOSED SPACE.

**Cautionary Operational Note:** When pumping nitrox, do not pump above 3700psi.

**Cautionary Operational Note:** Temperature inside the Silent Tech 8 cabinet should never exceed 115 degrees F. Do not operate at that temperature.

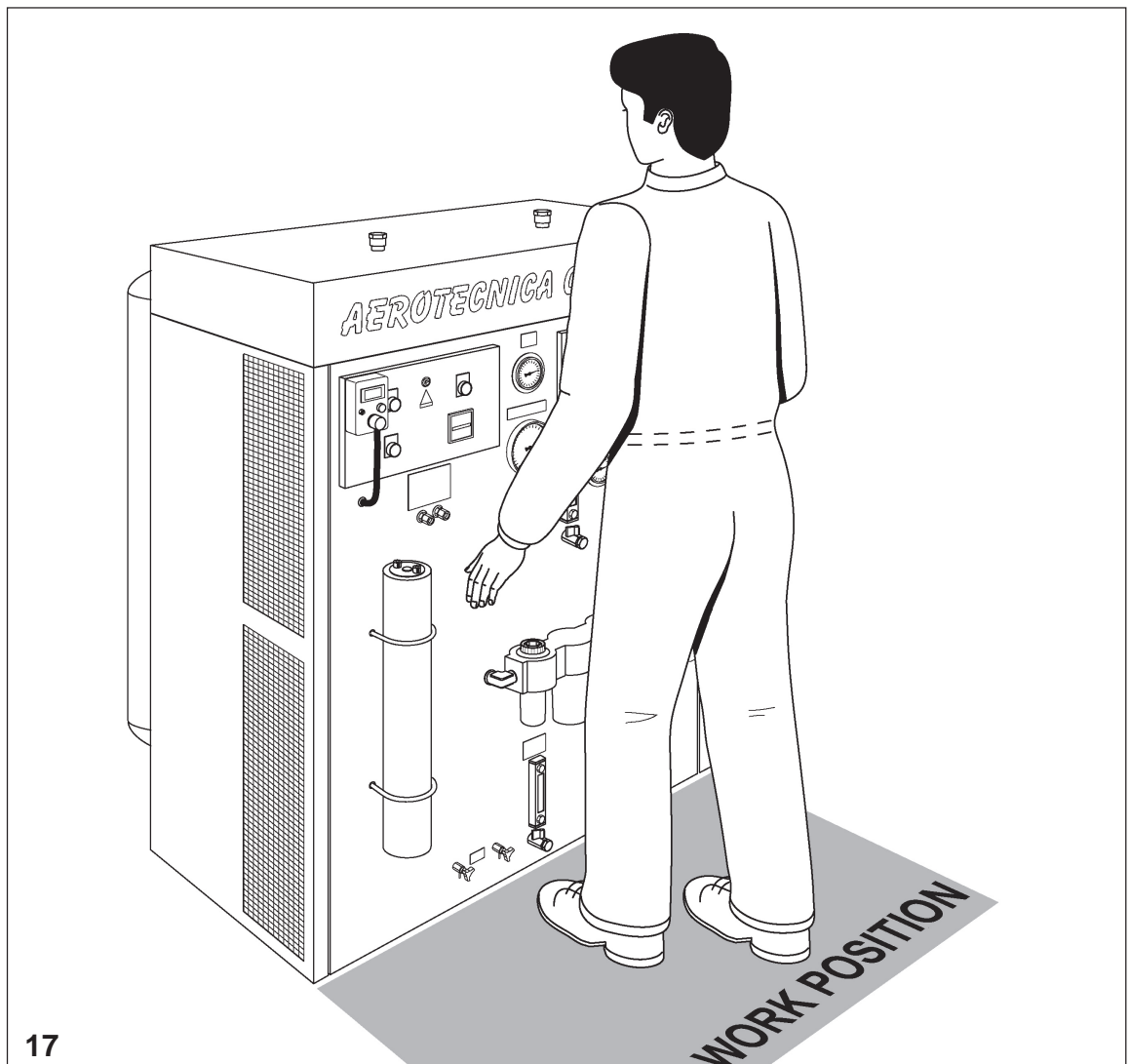
**4.1****Machine area diagrams**

The **MCH 14 TECH NITROX** series of compressors are electrically driven, automatically operated machines.

Therefore the term “operator” as repeatedly defined in this manual refers to the following professional figures:

- **PERSON IN CHARGE OF MAINTENANCE**, this is the person entrusted with the handling, installation, start-up, regulation, cleaning, repair, changing of the tooling and maintenance of the machine.  
This person must be a qualified member of staff who has followed courses of specialization and who has had experience with the handling, installation, start-up and maintenance of machines and plants of a mechanical, electrical and pneumatic type.  
It is always advisable for the person in charge of maintenance to follow a training and specialization course on the machine given by the **AEROTECNICA COLTRI S.r.l.** technicians.
- **PERSON IN CHARGE OF OPERATION**, this is the person responsible for operating the machine whose work must be limited only to filling the cylinders and the control operations.  
This person must be perfectly acquainted with all the machine instructions and operating methods as described in this manual and the regulation manual.

It is absolutely prohibited for the person in charge of operation to carry out any tasks other than those described above or to work in areas other than those marked in figure 17.



**Safety devices**

**4.1.1**

The **MCH 14 TECH NITROX (Fig.18)** series of compressors are equipped with a series of protection guards fitted with screws and safety devices to guarantee the operator's safety, by limiting the work area and ensuring good operating conditions.

The figure shows the safety devices provided on the compressors and the information labels applied.

**Model "MCH 14 TECH NITROX" compressor**

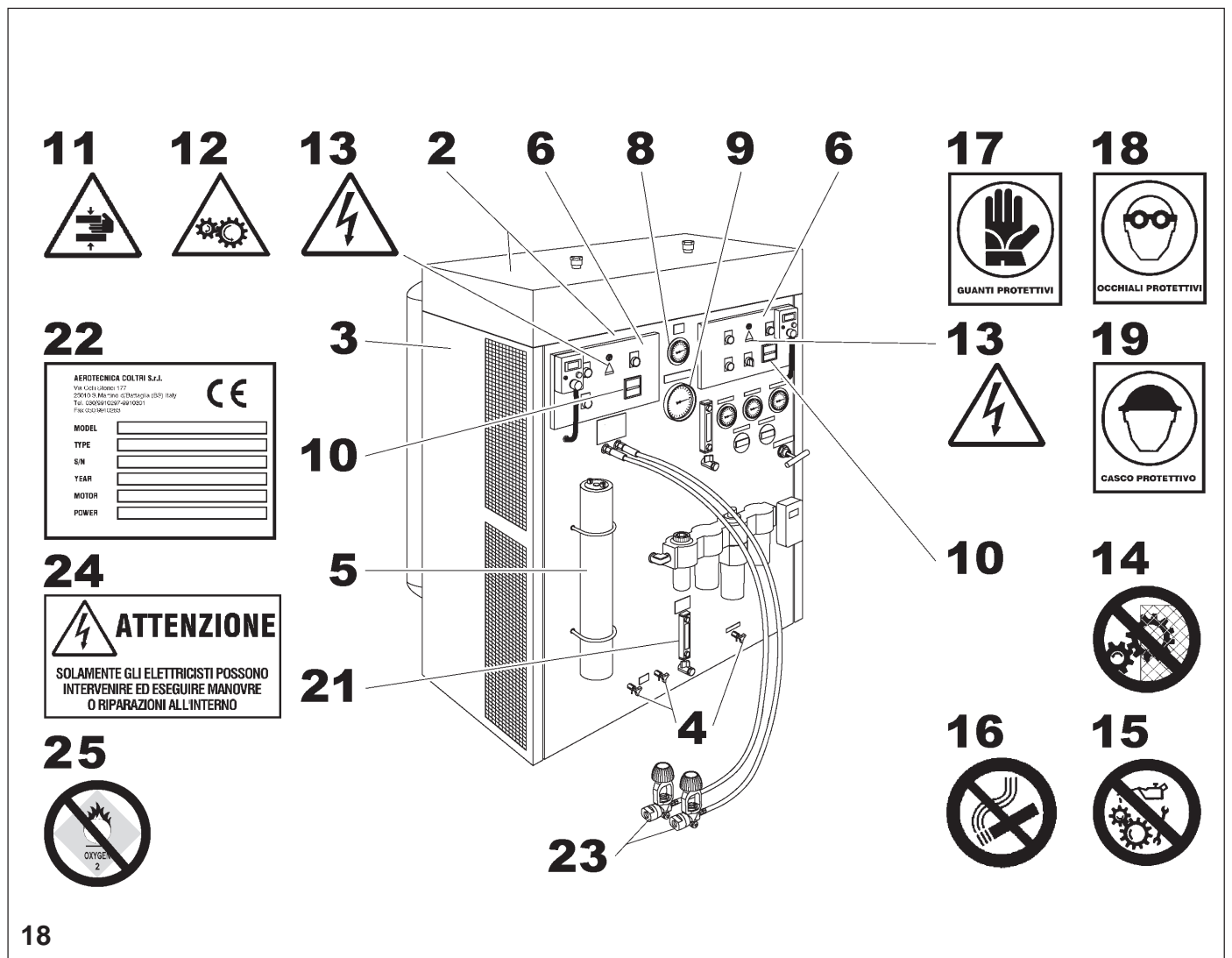


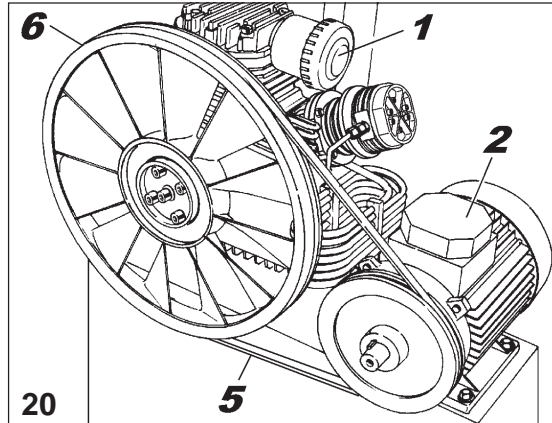
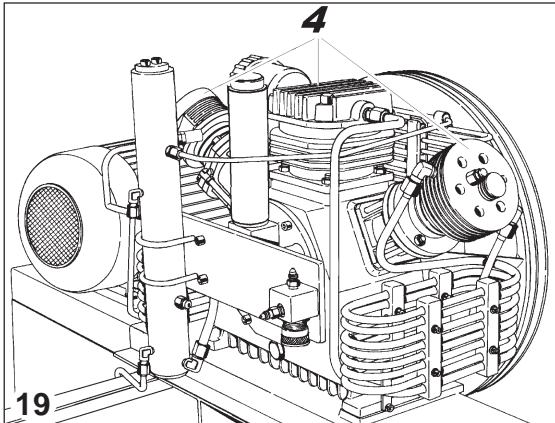
Table 1

POSITION	SAFETY DEVICE	DESCRIPTION	INSPECTION
1	Safety valves.	Protect the third stage and the cylinders from being overfilled; it is calibrated during the inspection of the compressors.	The safety valve must be checked at each filling operation; start up the compressor with the cylinder valves closed and the filling cock open. Check that the safety valve starts operating correctly with the pressure gauge, open the valves and proceed with the filling.
2	Sound-proofed frame.	Built of steel.	Periodically check its integrity.
3	Side panels.	Fixed with locks.	Periodically check their integrity.
4	Manual condensate discharge taps (automatic for all models except the Standard models).	The condensate is a milky-white emulsion formed of oil and water. The absorption of water by the filter causes wear on the filter itself and consequent contamination.	Open the discharge taps every 10-15 minutes and make sure the condensate comes out visibly and consistently. If the condensate is discharged automatically, check that it operates correctly by opening the manual discharge taps. The condensate should be present in minimum quantities.
5	Activated carbon filter and molecular sieve.	The quality of the air depends to a great extent on the conditions of the filter and sieve.	The cartridge must be replaced before the air becomes foul smelling. For the frequency of replacement, see the instructions in Chapter 11, "Maintenance".
6	Electrical switchboard built to EN 60204-1 regulations with IP 54 level of protection and fitted with a lock and key.		
7			
8	Pressure gauge showing the operating pressure.		
9	Pressure switch that can be manually calibrated showing the maximum cylinder filling pressure; when the set pressure is reached, the compressor turns off.		
10	Sealed hour counter to memorize the actual hours of operation in order to be able to carry out the maintenance procedures at the proper intervals.		
11	Danger of crushing hands symbol (if the side panels are removed).		
12	Danger of moving parts symbol.		
13	Danger of voltage present symbol.		
14	Removal of safety devices prohibited symbol.		
15	Work on moving parts prohibited symbol.		
16	Smoking prohibited symbol.		
17	Gloves compulsory picture diagram.		
18	Goggles compulsory picture diagram.		
19	Helmet compulsory picture diagram.		
20	Rating plate on the electric motor giving data concerning voltage, phases, frequency, breaking capacity.		
21	Pump unit oil level indicator.		
22	Machine plate showing the CE mark.		
23	Hose area : danger of direct contact by the operator if breakage should occur during cylinder filling.		
24	Voltage warning plate. Only qualified staff may intervene.		
25	Warning sign presence of oxygen - DANGER OF EXPLOSION		
(see "Safety Regulations" enclosed)	Warning to use the machine and carry out maintenance in accordance with the instruction manual.		
(see chapter 11)	Warning to cut off the power supply before carrying out any maintenance work.		

**Residual risk areas**

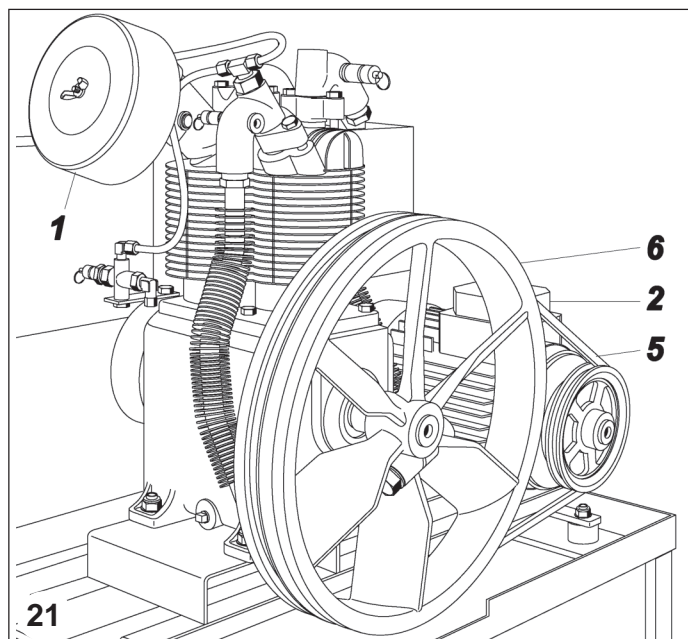
**4.1.2**

In some areas of the machine there are some residual risks that could not be eliminated during the design phase or protected by guards due to the particular operation of the compressors model **MCH 14 TECH NITROX** (Fig. 19-20-21). Each operator must be aware of the residual risks present on the machine in order to avoid possible accidents.



**Table 2**

POSITION	DESCRIPTION
1	Danger of polluting the air produced owing to the possibility of mixing fumes or vapours from the lubricating oil with the compressed air produced.
2	Electrical danger. Use the machine with suitable protection from the electrical power supply especially in the presence of water and humidity.
3	Danger deriving from the noise emitted by the compressor if maintenance work is carried out without the safety guards.
4	Pump unit area : danger from heat. For any maintenance operation (requiring the removal of the safety guard) wait about 30 minutes after turning off the engine.
5	Transmission belt area: danger of crushing or dragging by the belts when maintenance work is carried out without the safety guards.
6	Cooling fan area: danger of impact and abrasion if the cylinders are filled without the safety guards.



# 5

## UNPACKING AND HANDLING THE MACHINE



This chapter provides the instructions necessary for unpacking and handling the machine.

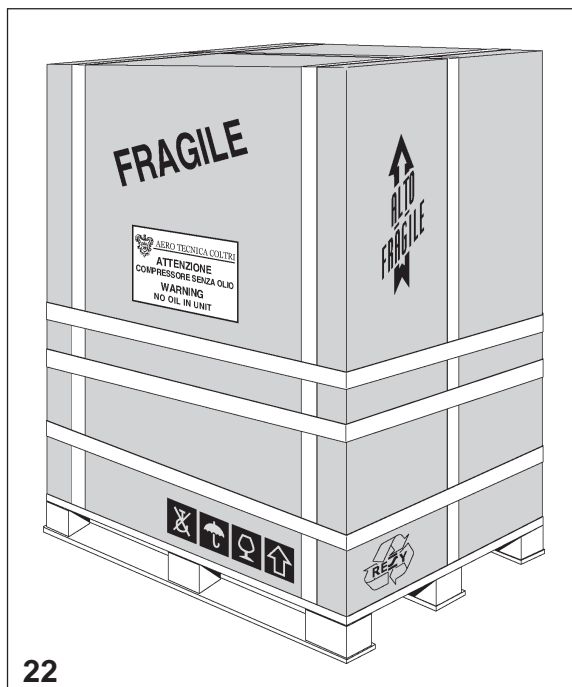
5.1	Unpacking the machine .....	26
5.2	Pack contents .....	27
5.3	Handling the machine .....	27

### 5.1

#### Unpacking the machine

The machines in the **MCH 14 TECH NITROX** series are delivered fully assembled, but with the hoses supplied separately.

The compressors are packed in cardboard boxes fitted on europallets to make handling and transportation easier.



To unpack the boxes containing the machine, follow the instructions given on the outside of the boxes with great care (Fig. 22).

## Pack contents

5.2

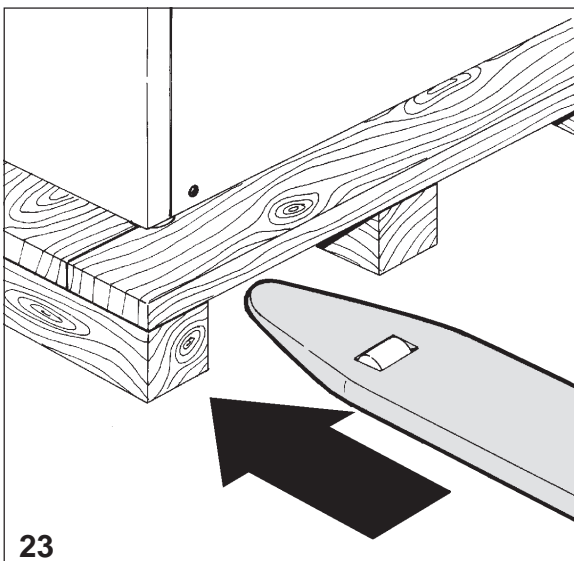
The standard equipment with which the machine is supplied is:

- 2 1200 mm filling tubes with tap;
- operating and maintenance booklet;
- enclosure with the Instruction Manual (Safety regulations);
- lubricating oil in cans (4 lt ).

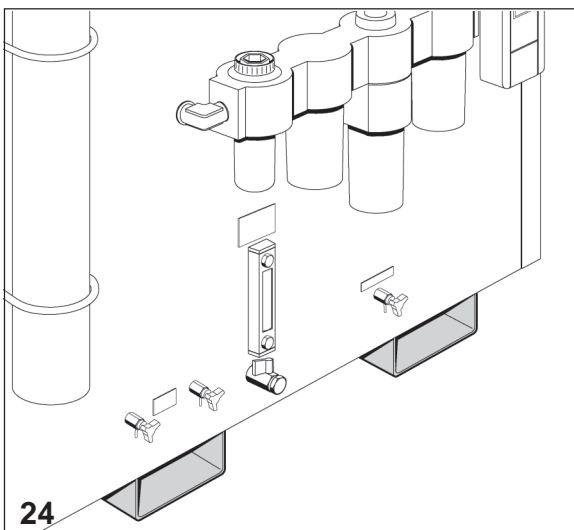
## Handling the machine

5.3

Having removed the compressor from its pack as described in the previous paragraph, the machine can be moved to its place of installation.



To carry out this operation, it is necessary to use a fork-lift truck or transpallet (of a suitable capacity), the forks of which must be positioned between the feet of the europallet on which the machine is placed (Fig. 23).



Model **MCH 14 TECH NITROX** is fitted with special side members fixed under the structure (Fig. 24) that enable the machine to be lifted with a fork-lift truck even when it is not on a europallet.

## 6

## INSTALLATION



*This chapter provides a description of the operations for installing the machine.*

*The following instructions presume that the operator has already become familiar with the regulations given in Chapter 4, "Precautions for use and maintenance".*

<b>6.1</b>	<b>Positioning</b> .....	<b>28</b>
<b>6.2</b>	<b>Connections</b> .....	<b>29</b>
	<b>6.2.1 Connecting the air intake extension</b> .....	<b>29</b>
	<b>6.2.2 Connecting the filling hoses</b> .....	<b>33</b>
	<b>6.2.3 Electrical connections</b> .....	<b>34</b>

## WARNING



Before proceeding with the installation operations described below, read Chapter 4, "Precautions for use and maintenance" carefully and proceed as directed.

## 6.1

## Positioning

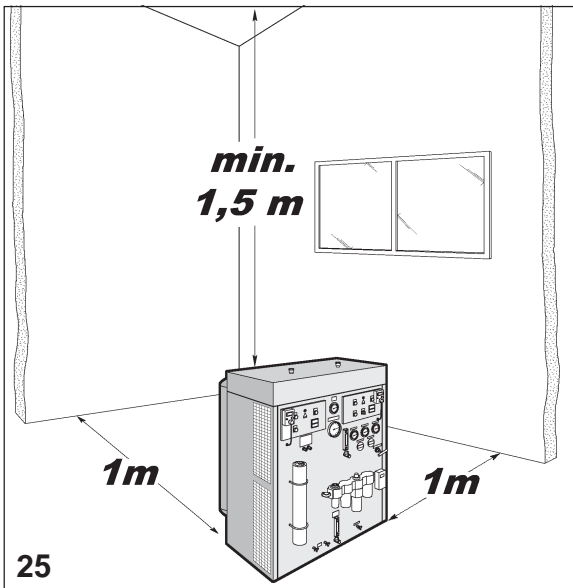
- 1 Position the machine in the chosen area and check that it is on a level (it should not be set at an angle of more than 5° to assure perfect lubrication). For the machine sizes, see paragraph 3.1.2 "Sizes and weights".

## WARNING

Compressors to be used on board boats can be certified with inspections by R.I.Na (Italian Register of Shipping), to be requested separately.

- 2 Check that in the place chosen for installation there are suitable ventilation conditions:
  - a good change of air (several windows), no dust and no risks of explosion, corrosion or fire.
- 3 When operating in environments with a temperature of over 40 °C (104°F), it is necessary air-conditioning must be provided for the environment.





- 4 Position the machine at a minimum distance of 1 m. from the surrounding walls and at a distance of not less than 1.5 m. from the ceiling in order not to compromise the proper operation and cooling of the pump unit (Fig. 25).

- 5 Make sure that the machine is in a well-lit area, so that each detail can be clearly made out (especially the writing on the plates).

Add artificial lighting to the area if the natural lighting is not sufficient for the requirements mentioned.

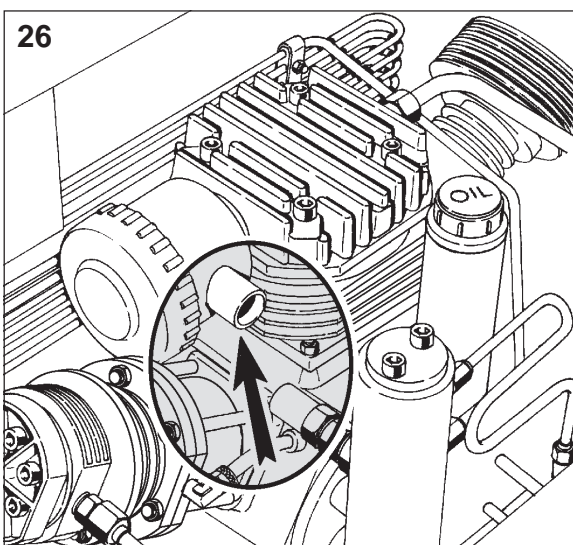
## Connections

6.2

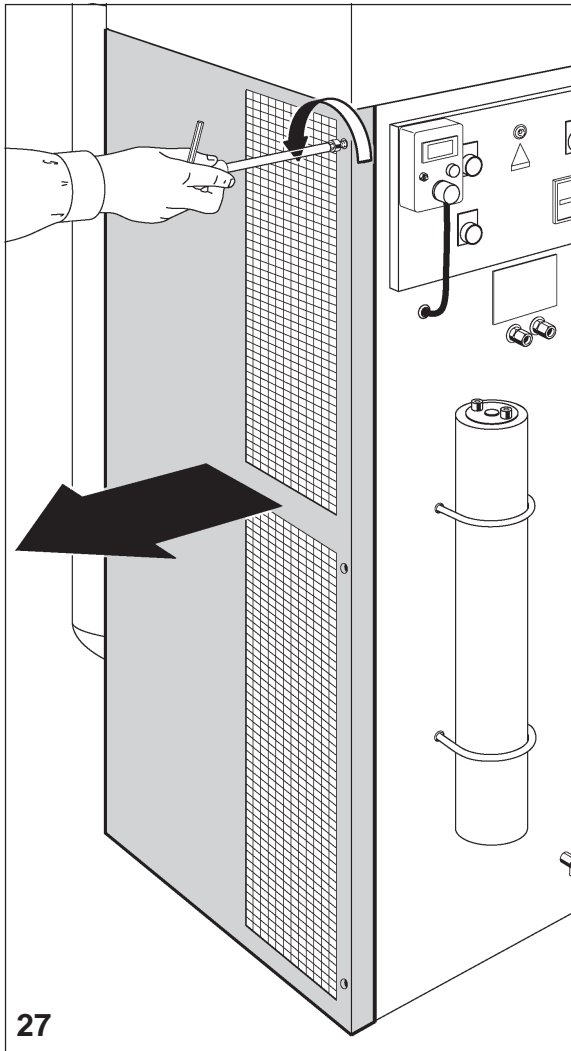
### Connecting the extension for the air intake

6.2.1

If the machine is installed in a place without the ventilation features as referred to in the previous paragraph, it is necessary to fit the system with an extension to take in air from the outside or from a place with the above-mentioned ventilation characteristics.



This extension which is supplied as an optional, must be connected to the appropriate intake attachment (Fig. 26).



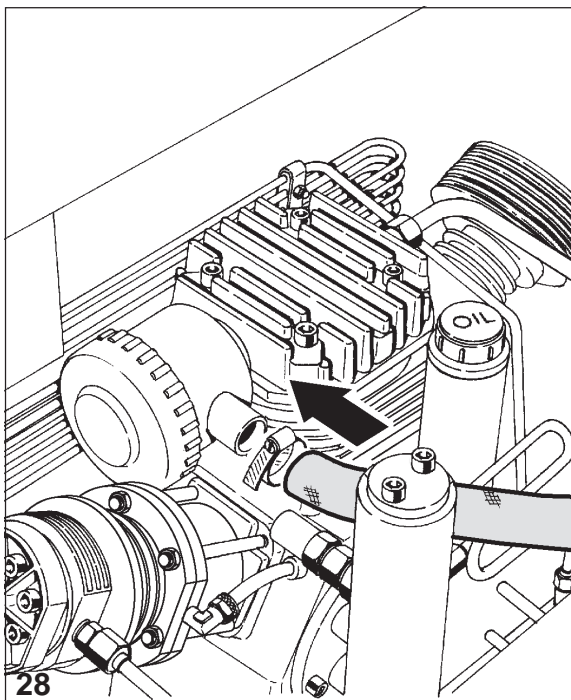
To connect the extension, proceed as follows:

- 1 Remove the left-hand side protective cover (looking at the compressor from the **front**), by unscrewing the fixing screws (Fig. 27).

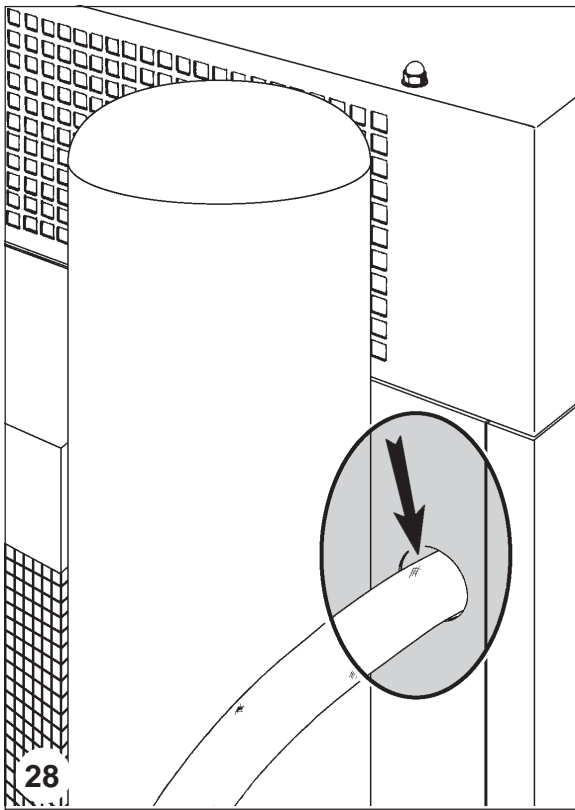


**WARNING**

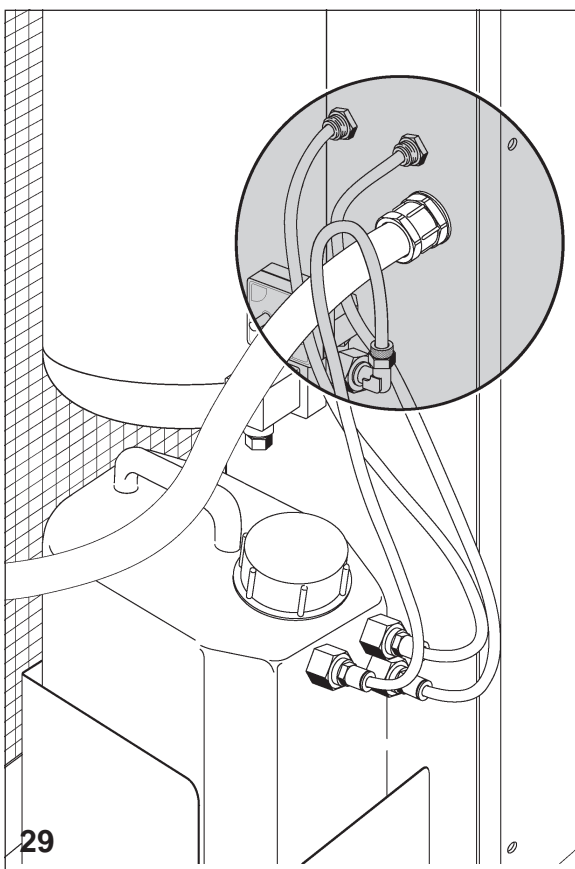
Only use a flexible pipe provided with a steel spiral internal reinforcement to prevent bending and a consequent reduction in the cross section.

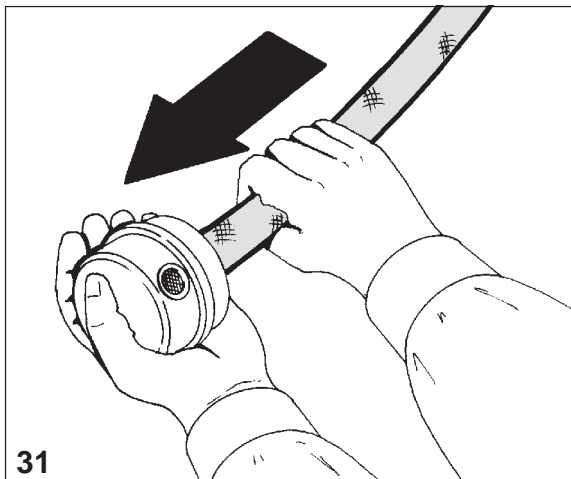


- 2 Connect the extension pipe to the connector (Fig. 28).

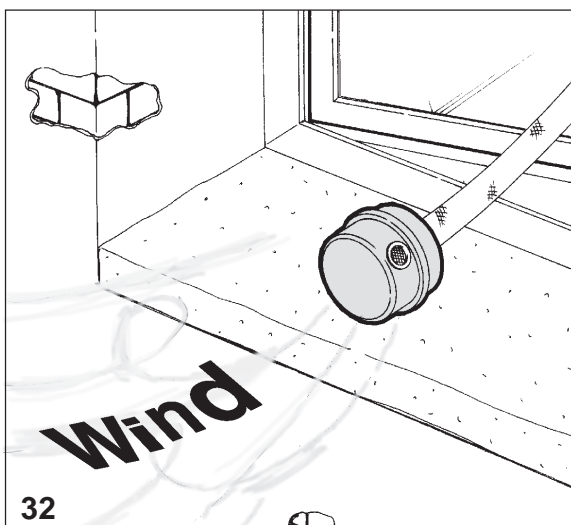


- 3 Pass the pipe through the hole located in the rear guard (Fig. 29-30).

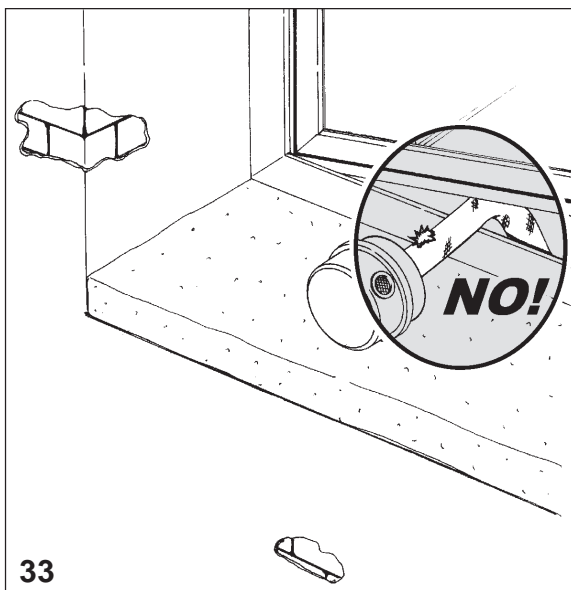




31



32



33

4 Fit the additional intake filter on the end of the extension pipe (Fig. 31).

5 Position the end of the extension on which the intake filter is fitted (air intake) in a ventilated place protected from atmospheric agents.

6 Direct the air intake in a position "upwind" (Fig. 32).

7 Make sure that there are no bends or breakages along the length of the pipe (Fig. 33).

If the extension should have broken during the connection to the head, it must be replaced.



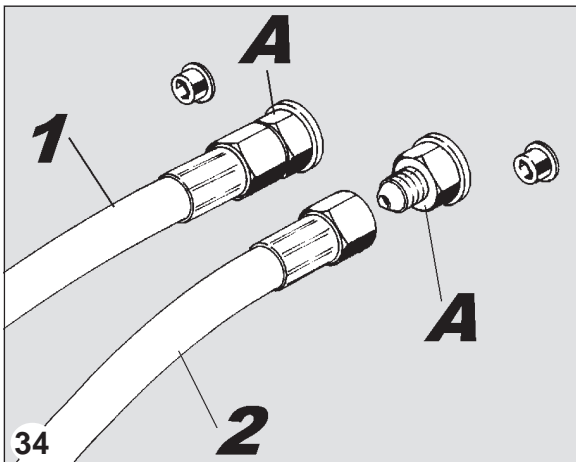
**WARNING**

Make sure that the air intake is away from exhaust fumes given off by internal-combustion engines or harmful fumes.

The following operations must be carried out twice (**bearing in mind that this model is double**).

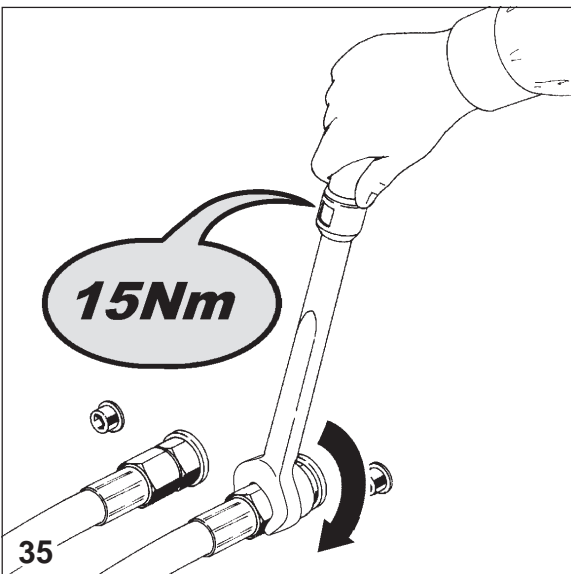
**Connecting the filling hoses**

**6.2.2**



- 1 Screw hose N° 1 into the special attachment "A" (Fig. 34) without securing it too tightly (see point 4).

- 2 Connect hose N°2 in the same way as described in the previous point.
- 3 A torque wrench should be available to fasten the hoses.



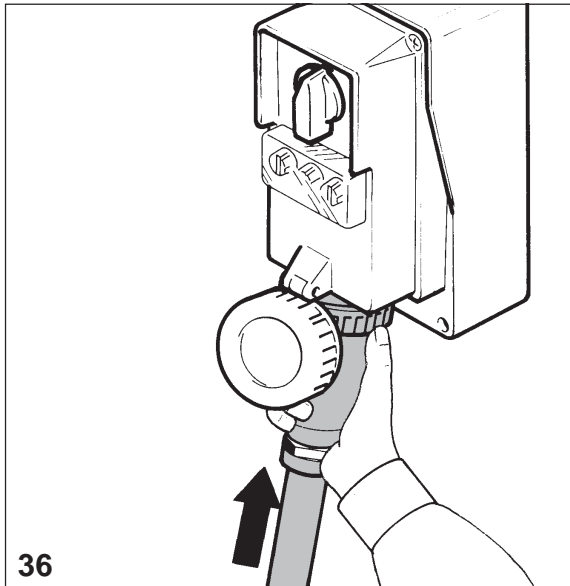
- 4 Tighten the hoses to the machine with a torque wrench setting of 15Nm (Fig. 35).

**NOTE:**

- the hoses should be replaced every so often (every year or every 1000 hours) or when they show signs of being scratched. For this purpose, check the number of operating hours of the hoses that are to be disconnected (on the hour counter).
- The minimum radius of curvature of each hose must not be less than 250 mm.

## 6.2.3

## Electrical connections



The compressor is delivered equipped with an electrical cable and a 4 pin plug 32A (Fig. 42).

- 1 For the electrical connection, the plug simply has to be connected to a mains power supply socket.

**WARNING**

Before fitting the plug, make sure that the installation has been set up in accordance with the regulations in force in the country where the compressor has been installed.

- 2 Also check that the details on the machine rating plate are compatible with the mains power supply, especially the nominal current and input voltage.

- 3 The mains power supply should be provided with an effective grounding system. It is particularly important to check that the earth resistance value complies with the protection and operating requirements of the electrical installation of the compressor.

**WARNING**

An effective machine earthing system is of fundamental importance for safety purposes.

## CONTROL PANEL

7

This chapter provides a description of the functions carried out by the various devices fitted on the control panel.

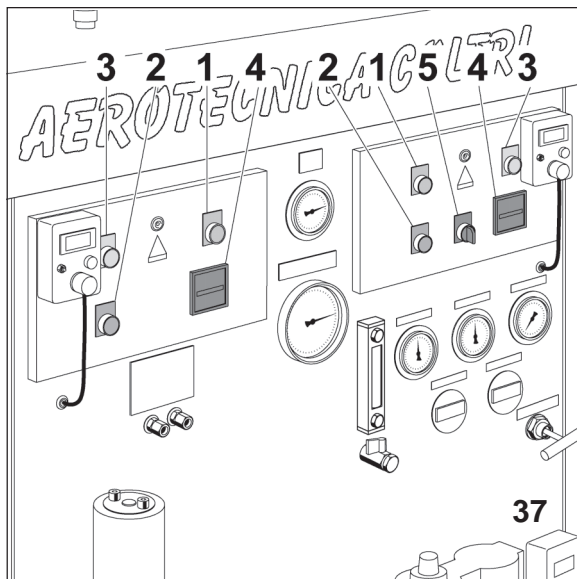


7.1	Control panel.....	34
7.2	Indication and control devices .....	35

## Pannello di comando

7.1

The control panel has three operating buttons and the hour counter to memorize the number of machine operating hours (Fig. 37).

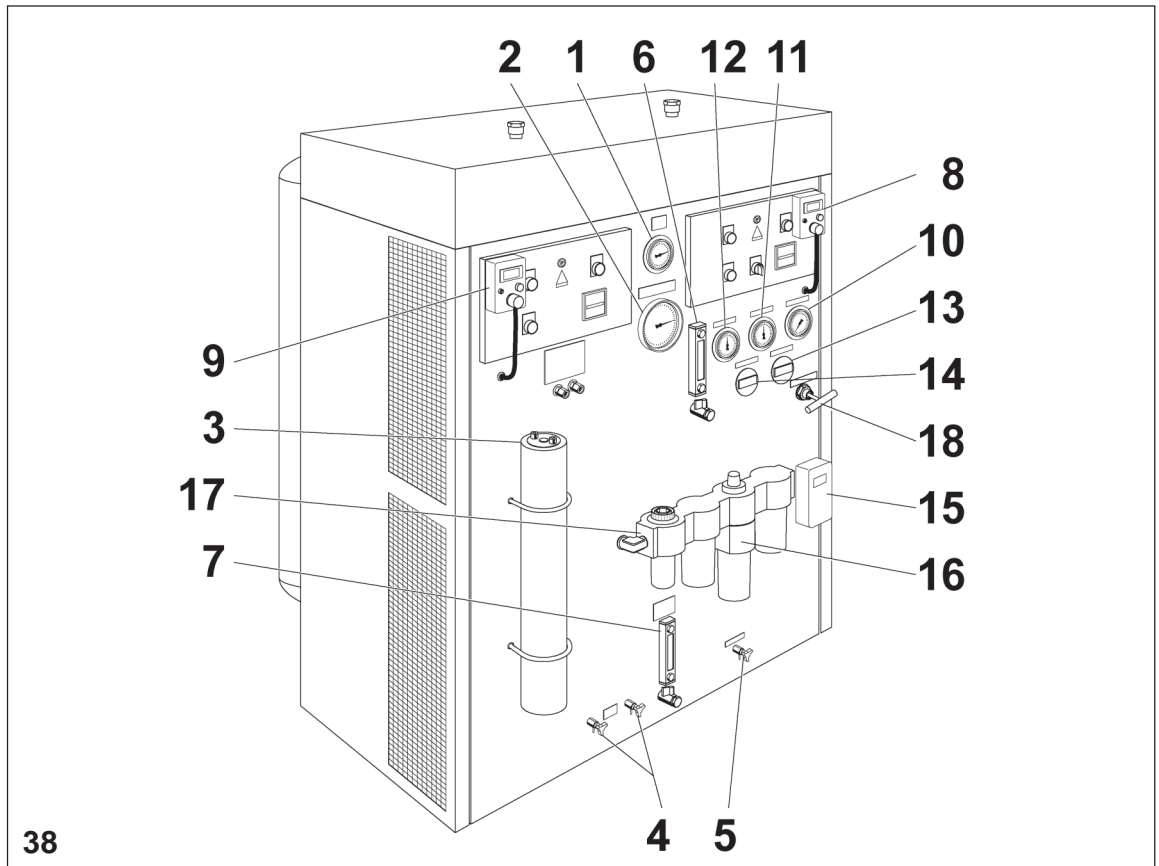


- 1 ON** - green button.  
To start the compressor.  
The button has a light inside that comes on when it is pressed.  
(The general switch must be in the "ON" position).
- 2 OFF** - red button.  
To stop the compressor.  
The button has a light inside that comes on when the power supply is connected.
- 3 MANUAL DRAIN** - yellow button.  
To drain the condensate.  
This function permits the pressure present inside the condensate separators and the filter to be discharged, draining off the condensate through the electromagnetically-controlled valves.  
This operation is normally carried out by the timer at regular intervals.
- 4 HOUR COUNTER**  
It enables the actual operating hours to be memorized in order to be able to carry out the maintenance work as provided for.
- 5 GENERAL SWITCH ON/OFF**  
This function permits the electrovalve under store air tank to low pressure for feed the membrane.

## 7.2

## Indication and control devices

Apart from the control panel, the front panel of the machine is also fitted with some devices to control the pressure, the discharge of the condensate, the strainer filter and the level of the lubricating oil (Fig. 38)



- 1 Pressure gauge HP**  
It indicates the working high pressure
- 2 Pressure switch**  
It enables the maximum cylinder filling pressure to be set and displayed. During the cylinder filling phase, the pressure switch stops the compressor when it reaches the maximum pressure as shown by the red cursor.
- 3 Sieve filter**  
The purpose of this device is to withhold the impurities present in the air before they enter the cylinders.
- 4 Condensate discharge taps HP (high pressure)**  
They enable the condensate that has accumulated during machine operation to be discharged by hand. The condensate is discharged automatically by the machine by means of electromagnetically-controlled valves.
- 5 Condensate discharge taps store tank**  
LP compressor (low pressure).
- 6 Lubricating oil level indicator**  
LP compressor (low pressure).

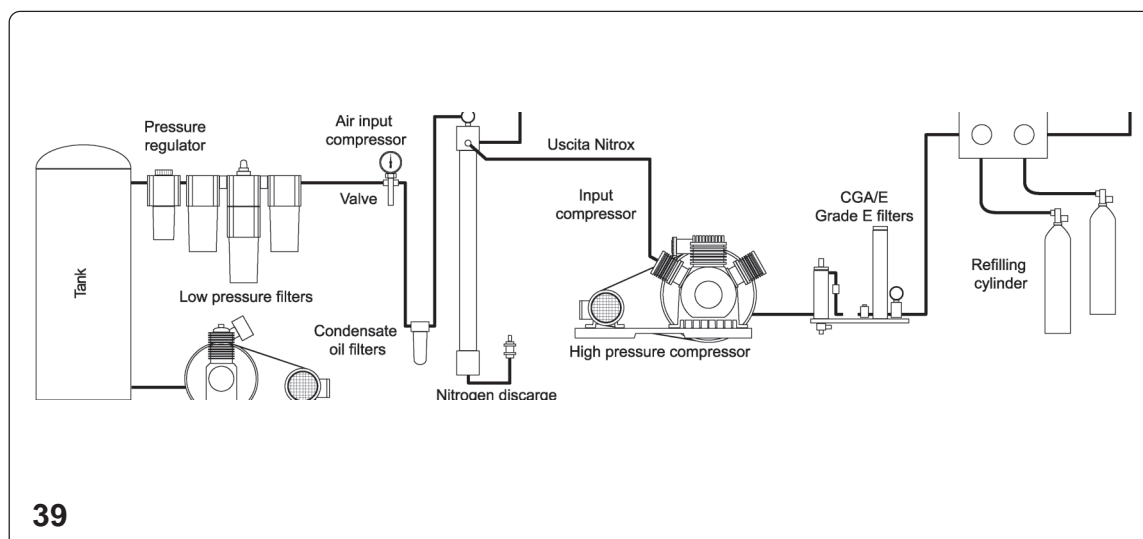


- 7 HP compressor (high pressure) lubricating oil level indicator
- 8 Percentage O<sub>2</sub> analyser situated at the exit of the membrane
- 9 Percentage O<sub>2</sub> analyser situated at the exit of the refilling ramp
- 10 Positive pressure control gauge of the HP suction compressor
- 11 Membrane supply pressure control pressure gauge
- 12 Accumulation tank pressure control pressure gaug
- 13 Temperature thermometer fitted inside casing frame
- 14 Heater temperature thermometer
- 15 Heating system thermostat
- 16 Battery oil feeder filters
- 17 Membrane supply pressure regulator
- 18 Percentage O<sub>2</sub> regulation needle valve (nitrogen discharge)

## System configuration

Typical low pressure/high pressure configuration

**NOTE:** this drawing is for illustrative purposes only. Actual configuration subject to change without notice.



## 8

## START UP

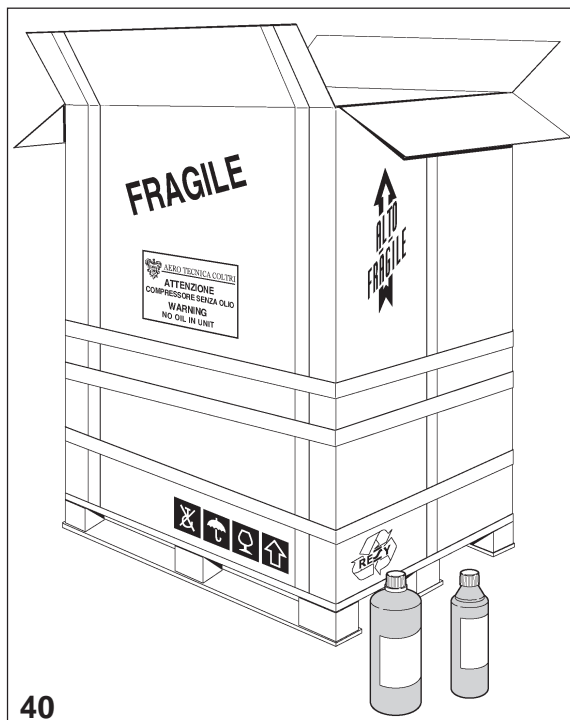


This chapter describes the operations regarding the machine start up phase.

The following instructions presume that the operator has already become familiar with the precautions given in Chapter 4 "Precautions for use and maintenance" and that the machine has been installed according to the instructions given in the previous chapter.

8.1	Filling the machine .....	38
8.2	Checks .....	39
8.3	Calibrate analyzers .....	42
8.4	Low pressure compressor Pilot Valve .....	43
8.4.1	Pressure adjustment .....	43
8.4.2	Differential pressure adjustment .....	43

## 8.1 Filling the machine



## WARNING

Before proceeding with the start up operations described below, read chapter 4, "Precautions for use and maintenance" very carefully and follow the advice given.

Fill the lubricating oil sump of the pump unit when the machine is switched off.

The machine is delivered without lubricating oil which is collected in the cans that can be found inside the machine packaging (Fig. 40).



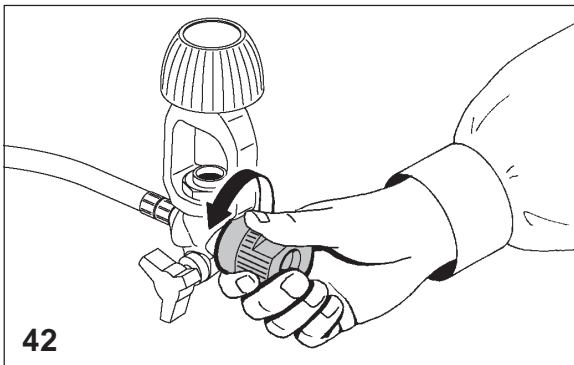
The oil is added by removing the two oil caps located on the upper cover of the machine (Fig. 41) unscrewed.

The quantity of oil to be poured in is 1.5 lt. for the high pressure compressor and 2 lt. for the low pressure compressor and the level should be checked with the machine turned off, bearing in mind that an excess amount of oil may cause infiltrations in the cylinders and a deposit on the valves. On the contrary, if the oil level is too low, the pin of the connecting rod is prevented from providing the correct lubrication with the possibility of causing a seizure of the cylinders.

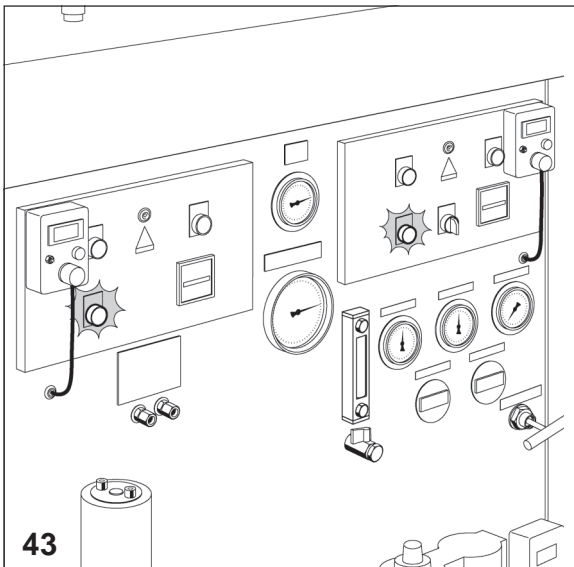
To check the quantity of oil poured in, see the following paragraph.

## Checks

## 8.2

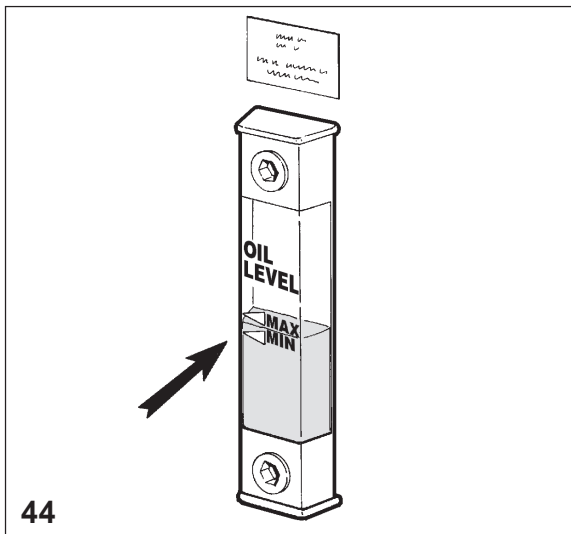


1 Turn on the manual condensate discharge taps (Fig. 42).



2 Turn the machine on by moving the general switch to the "ON" position. Check that the machine has been switched on by looking to see the red light of the "OFF" buttons (Fig.43).

3 Run the compressors for about 10 minutes then leave it at a standstill for 20 minutes.



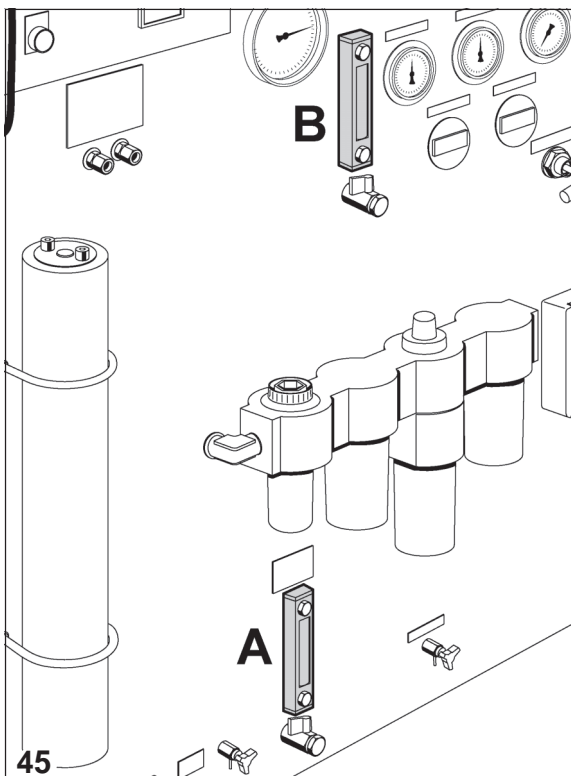
- 4 Check the level of the lubricating oil of the pump unit by looking at the indicator located on the relative oil caps. The indicators are marked by the letters "A" and "B" (Fig. 44-45) and correspond to the same marks also shown on the relative oil caps.

When oil has to be added, this indication will be used to establish, according to the indicator, which cap has to be unscrewed for the filling operation.

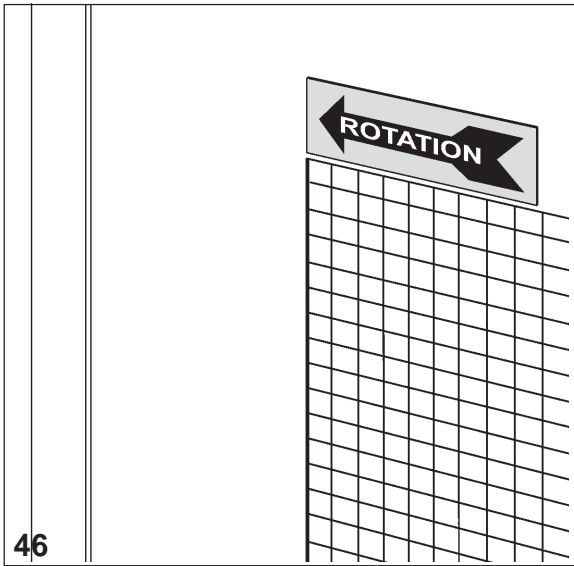
If the level is too low, top the oil up following the instructions given in the previous paragraph.

If the level is too high, discharge some of the oil as described in chapter 11.4 "Changing the lubricating oil".

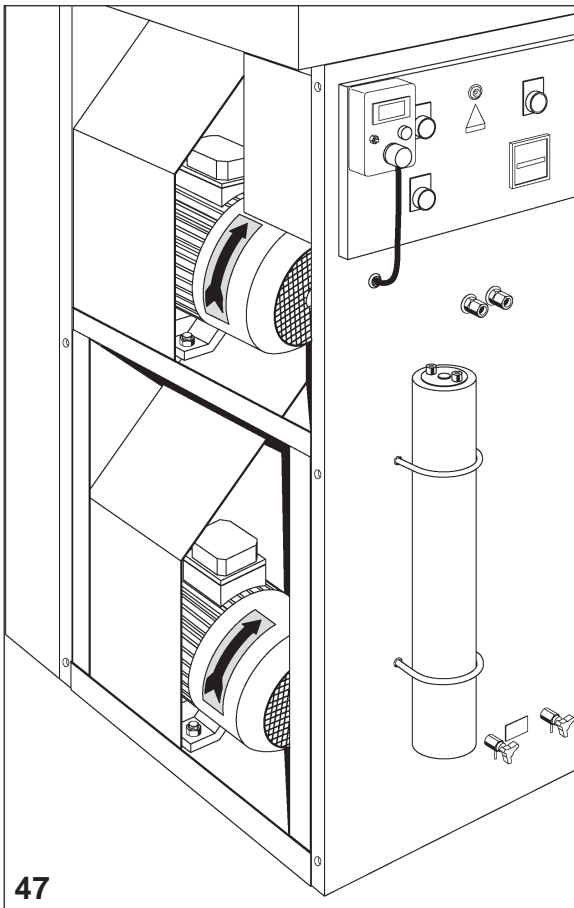
To dispose of the oil, refer to chapter 10.2, "Disposal of waste".



- 5 The operation to check the level of the lubricant must be carried out when the machine arrives and then before starting up the compressor. It must be remembered that if the level is too low or too high it may compromise the running of the compressor.
- 6 In order to check the correct connection of the electrical phases, the engine should be turned on and the direction of rotation checked.

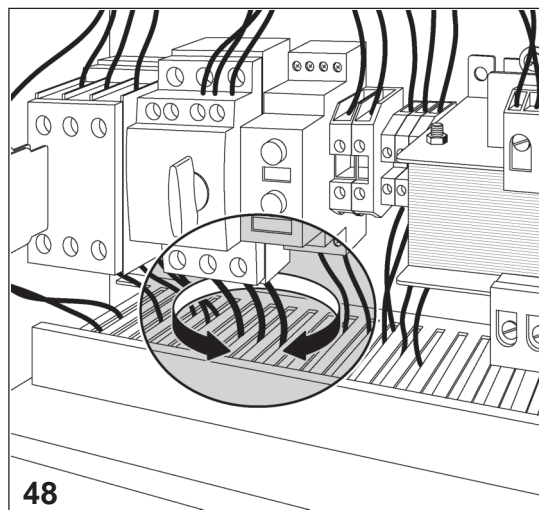


If the direction of rotation does not correspond with that shown by the arrow located on the front panel covering the fan or directly on the motors (Fig. 46-47) that can be seen by removing the side panel on the side of the motor, the power supply must be switched off and two of the three phases must be inverted on the main power line (Fig. 48).



**WARNING**

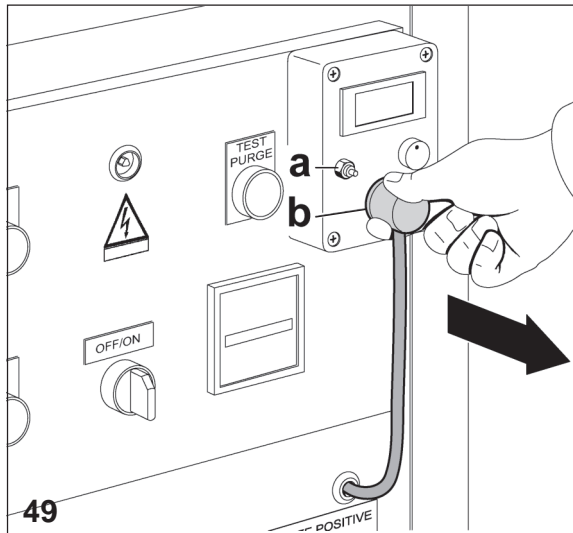
The yellow/green wire corresponds to the earthing. **DO NOT** disconnect or invert this wire.



### 8.3 Calibrate analyzers

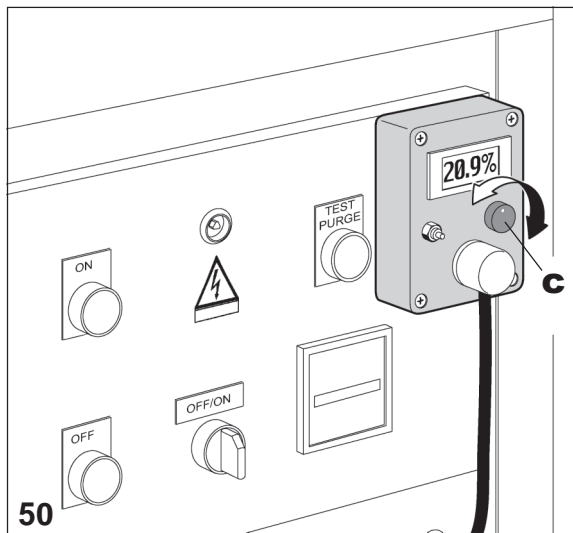
Calibrate both the analyzers to 20.9 as follow:

please read analyzer manual for more specific instructions, especially if analyzers will be located in a **hot and/or high humidity area.**



- Remove the fitting covering the sensor "a" (Fig. 49);
- Remove the fitting covering the sensor "b" (Fig.49).

- Expose the sensor to ambient air for approximately (15) seconds.



- Adjust the meter until the reading "c" stabilizes to 20.9% (Fig. 50).
- Re-connect the sensor fitting to the analyzer.



#### WARNING

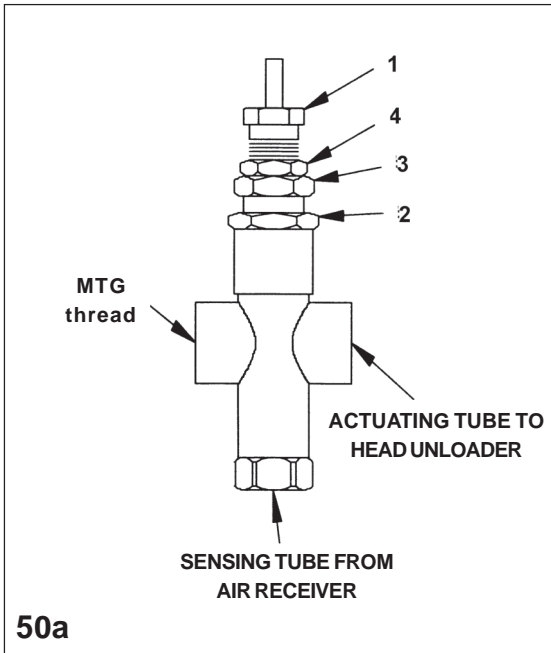
Never connect an O<sub>2</sub> analyzer directly to a high or low pressure air/nitrox source.

## High pressure compressor Pilot Valve

8.4

### Pressure adjustment

8.4.1



Proceed with the following instructions while compressor is running (Fig. 50a):

1. Loosen locknut (4) and back off several turns. Do not turn differential adjuster (3).
2. Check reading on the tank pressure gauge at 12 bar (170 psig). Turn the regulation screw clockwise to increase pressure or counterclockwise to decrease pressure.
3. After pressure is set, tighten locknut (4). Be careful not to move the nut of threaded cap (1).

### Differential pressure adjustment

8.4.2

Proceeding with the following instructions while compressor is running:

1. Loosen locknut (2) and back off several turns.
2. Controllare il manometro sul serbatoio.  
Check reading on the tank pressure gauge. Set the pressure to 2 bar ( 30 psi) differential (unload at 12 bar - 170 psi, and reload at 10 bar -140 psi). Turn nut (3) clockwise to increase differential pressure or counterclockwise to decrease differential pressure.
3. After pressure is set, tighten locknut (2). Be careful not to move the nut of threaded cap (3).

## 9

## USE



*This chapter describes the operations required for filling the cylinders.*

*The following instructions presume that the operator has already become familiar with the precautions given in Chapter 4 "Precautions for use and maintenance" and that the machine has been started up according to the instructions given in the previous chapter.*

<b>9.1 Preliminary operations</b> .....	<b>43</b>
<b>9.2 Filling the cylinders</b> .....	<b>46</b>

## WARNING

Before proceeding to use the machine as described below, read chapter 4, "Precautions for use and maintenance" very carefully and follow the advice given.

## 9.1

## Preliminary operations

- 1 Check that the safety valve is operating properly by starting up the compressor with the end cocks turned off so that the pressure in the circuit rises quickly and the valve blows at the set pressure.

The valve is factory set at a pressure of 225 bar

## WARNING

Under no circumstances may the calibration pressure of these valves be increased. Any tampering with the safety valves may cause serious damage to the machine or to persons and a cancellation of the guarantee.

- 2 Check the condition of the cylinders to be filled.

## WARNING

Only use inspected cylinders provided with the relative approval. The cylinder operating and filling pressure values are given on the cylinders themselves. It is prohibited to exceed this filling pressure value.



## WARNING

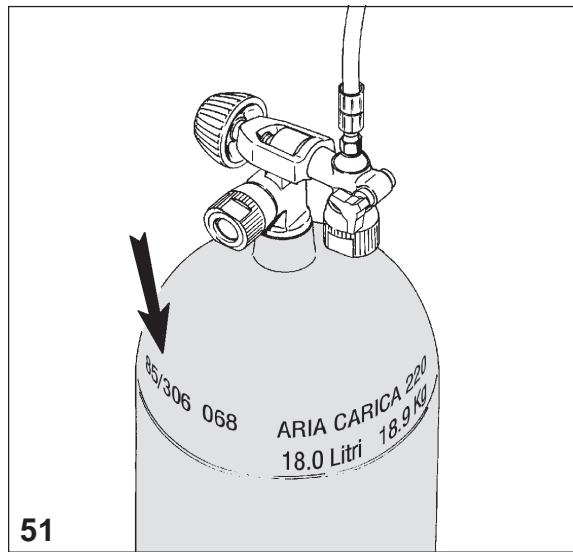
Only use inspected cylinders provided with the relative approval.

The cylinder operating and filling pressure values are given on the cylinders themselves.

It is prohibited to exceed this filling pressure value.



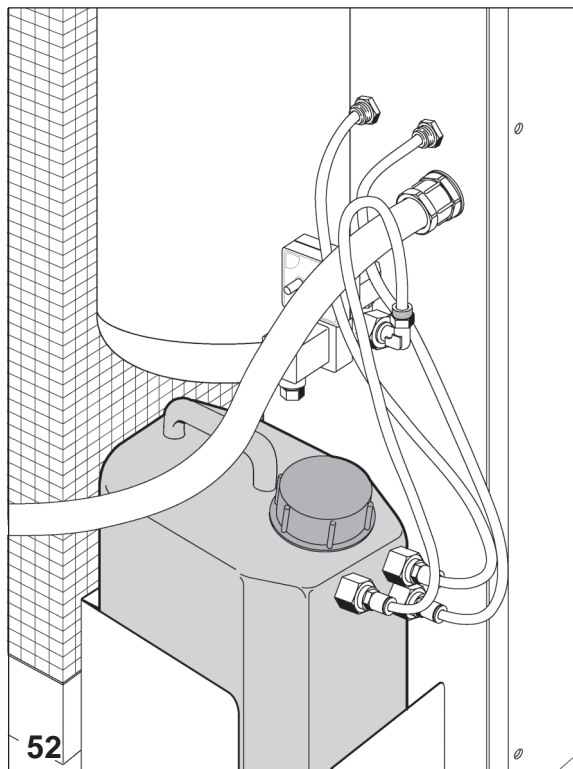




After filling, the cylinders must not be emptied completely, even during winter storage, to prevent damp air from getting in (Fig. 51).

- 3 Check the condition of the hoses and the relative attachments.  
See paragraph 6.2.2 "Connecting the filling hoses".

#### AUTOMATIC CONDENSATE DISCHARGE

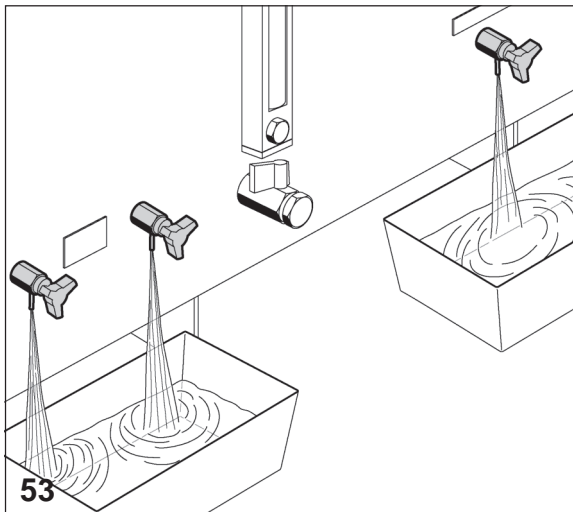


- 4 For the models provided with an automatic condensate discharge, a special condensate collection tank has been fitted in the side compartment of the compressor (Fig. 52).

The outlet of water vapourized with lubricating oil should be considered normal during filling: the quantity is in direct relation to the percentage of humidity present in the air.

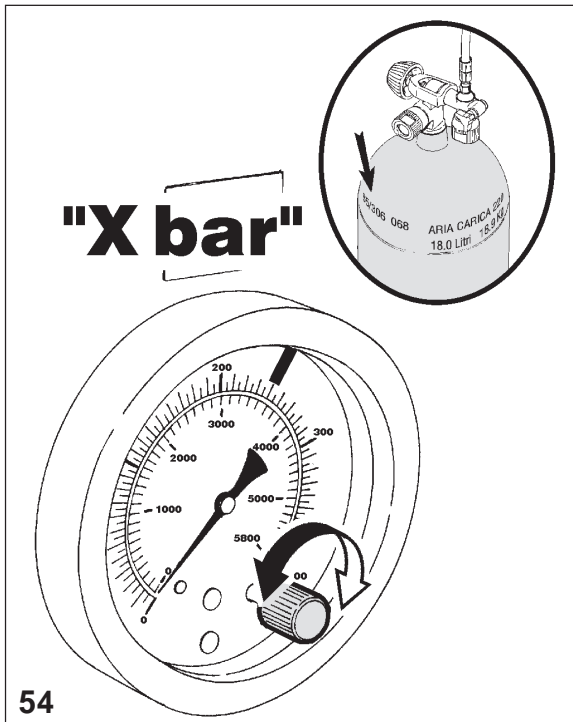
The condensate must be disposed of according to the instructions given in chapter 10.2 "Disposal of waste".

## MANUAL CONDENSATE DISCHARGE



- 5 Place a container under the two condensate sniffle valves and then proceed with the manual discharge by turning on the respective taps (Fig. 53).

This operation should also be carried out during the cylinder filling operations, every 15/20 minutes only on the models without an automatic condensate discharge feature.



- 6 Set the pressure switch on the control board to the pressure value given on the cylinder using the external knob and positioning the red cursor on the required machine switch-off pressure (Fig. 54).

**Filling the cylinders**

**9.2**

During this operation, the operator's position is that shown in chapter 3.2 "Noise level".

**WARNING**

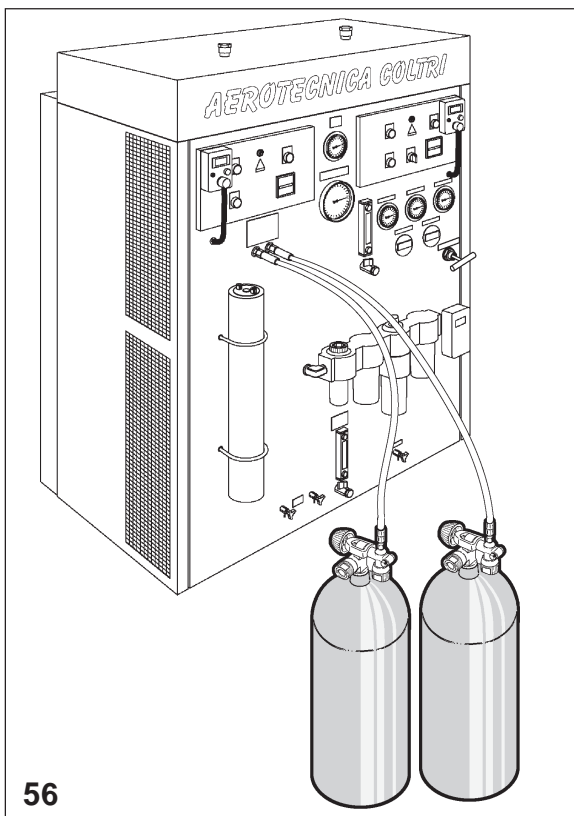
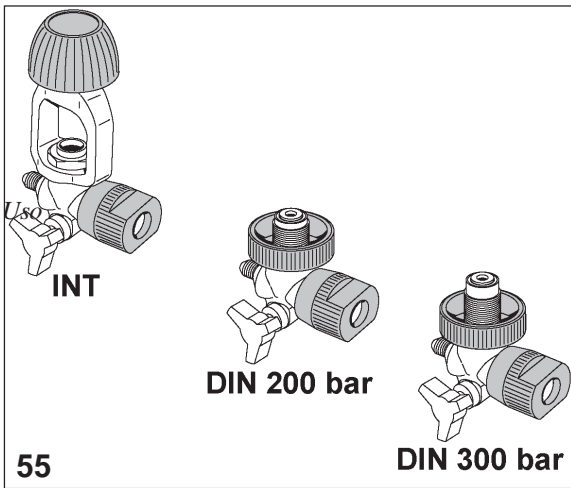
During the filling of the cylinders it is compulsory for staff who are not involved with the task to keep a distance of at least three metres. Furthermore, it is not permitted to disconnect the hoses from the connectors or from the filling tap while the machine is under pressure.



**INDICATION**

During the cylinder filling phase, it is advisable to immerse the cylinders in cold water in order to reduce the drop in pressure when the cylinders cool down.

The attachments: INT - DIN 200 and DIN 300 (Fig. 55) are available.

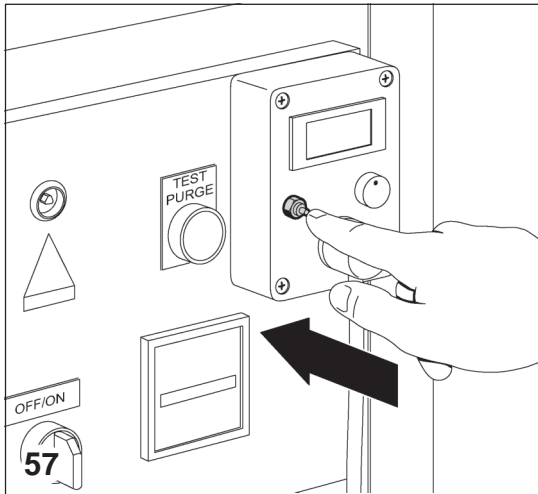


Each filling hose can be connected to a cylinder so that more than one cylinder can be filled at the same time.

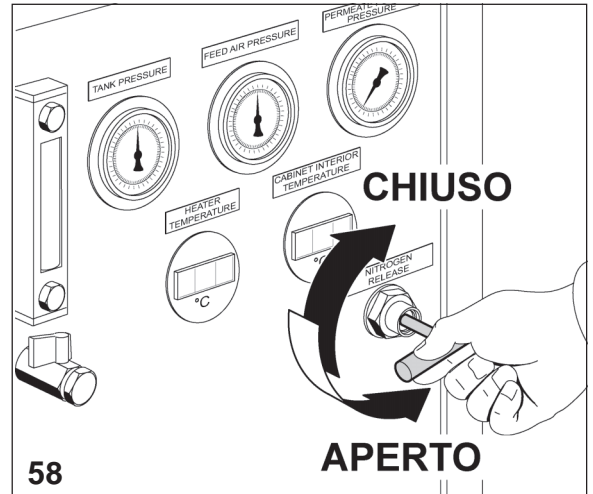
The following operations must be repeated for each hose that is to be connected to the cylinder to be filled. Furthermore, it should be borne in mind that each control panel on the machine is provided with controls that carry out the same functions (see chapter 7).

Each panel controls a pump unit, the right panel for the low pressure pump unit and, the left panel for the high pressure pump unit while the 2 hoses are connected together and can fill up to 2 cylinders using the compressors, together can be filled at the Nitrox gas or only the high pressure compressor can be filled at the air (Fig. 56).

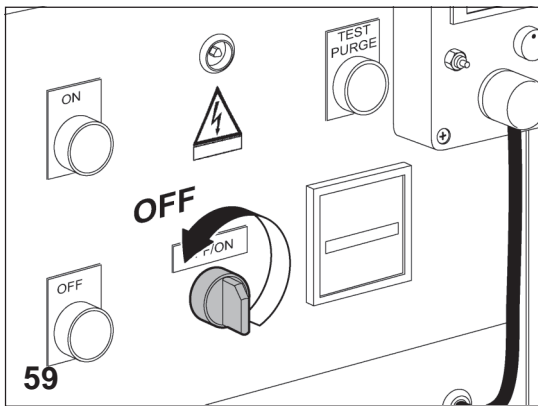
**STEP 1**



Switch on the analyser (Fig. 57).



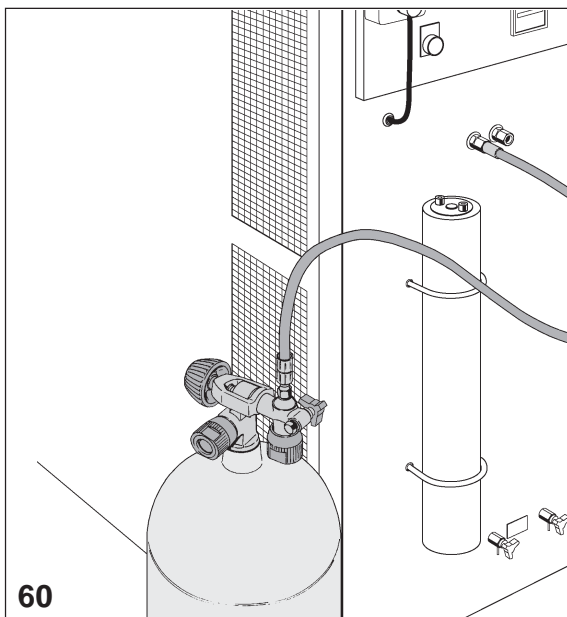
Close (clockwise), then open, (counter clockwise), the Nitrogen Valve 1/2 turn. (Fig. 58).



Make sure the low pressure feed air shut-off switch is off. (Fig. 59).

Set up one fill bottle and attach the hoses to high pressure compressor.

**STEP 2**

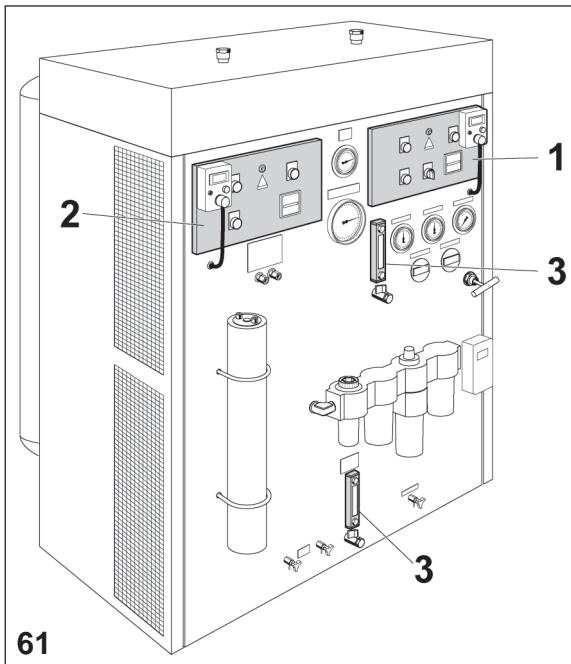


**NOTE:** Only one fill whip is attached at this point to a tank. The other whip is used to control compressor pressure during setup only.

The second bottle or storage tanks can be attached after Step 9 (Fig. 60).

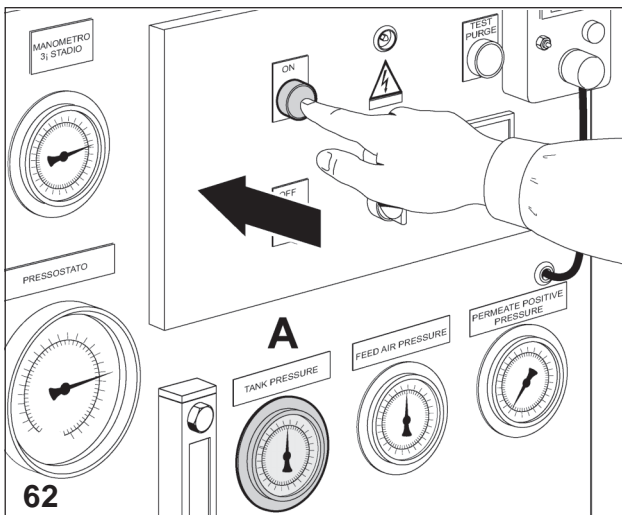
60

**STEP 3**



- 1 - Low pressure panels
- 2 - High pressure panel and gauges
- 3 - Oil levels

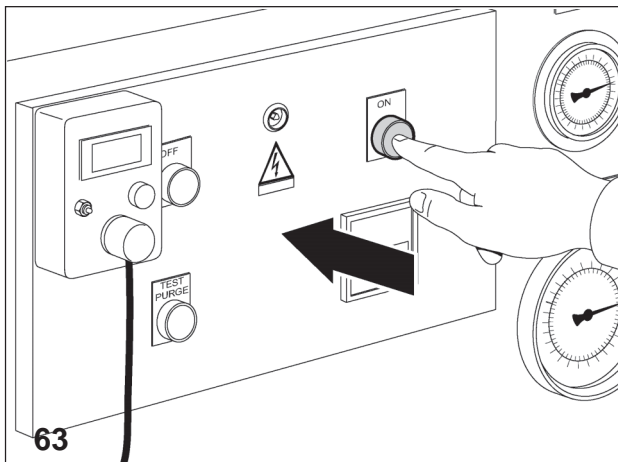
**NOTE:** before turning on the compressors, check the lubricant levels gauges (Pos.3 Figura 61) for both compressors.



**Low pressure Compressor**

Turn on low pressure compressor and allow tank to come up to full pressure approximately 13 bar (185 psi) (range 12-13 bar 175-190 psi) see the value on the manometer "A" (Fig. 62).

**NOTE :** Il compressore è dotato di un depressore per il funzionamento a vuoto raggiunta la pressione massima.



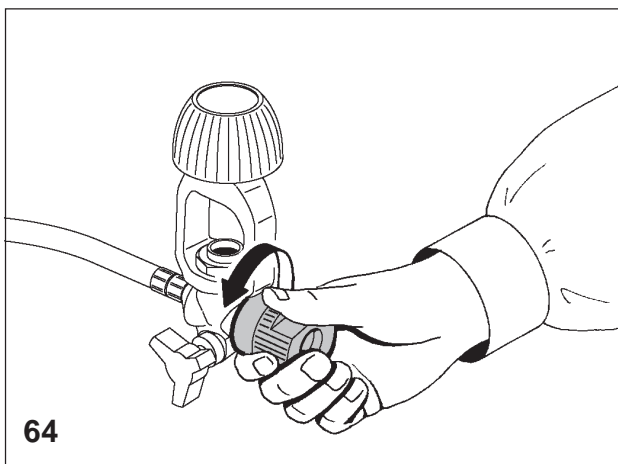
### High pressure compressor

High pressure Compressor

Turn on HP compressor. Allow pressure to build up to approximately 160 bar (2300psi) (Fig. 63).

**NOTE:** Auto shut-off occurs at 220 bar (3200psi), see Parag. 9.1 (pag. 55).

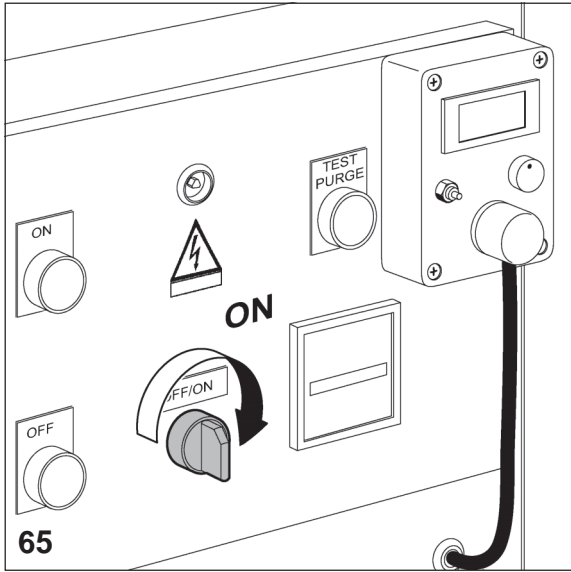
Manual restart will be necessary.



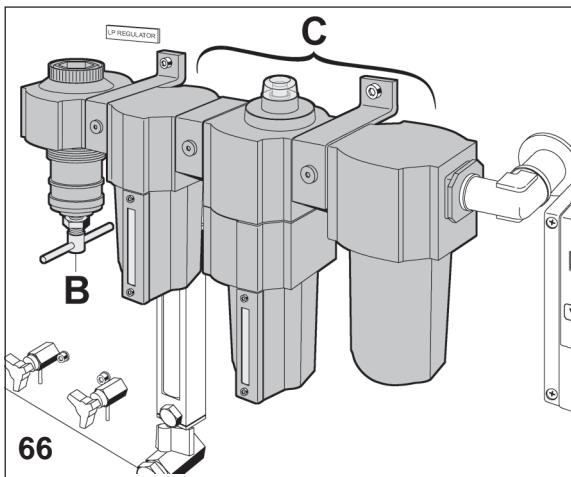
Crack open the unconnected fill whip to maintain 160 bar (2300 psi).

**AIR STREAM CAUTION:** do not direct any gas stream at any part of the body.

**STEP 4**

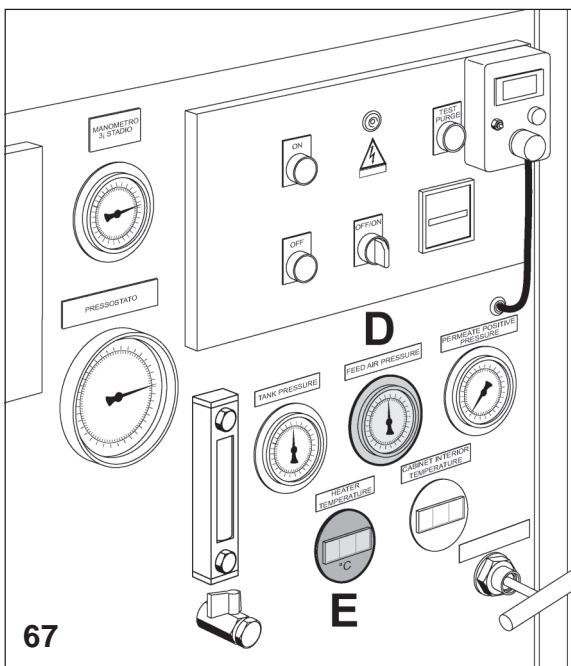


Turn on membrane system by turning LP feed air valve switch to ON position (Fig. 65).



Feed air will now pass through the LP regulator “B” and LP filtration “C” and continue on to the membrane heater (Fig. 66).

LP regulator and thermostat have been factory set and may only need fine-tuning.

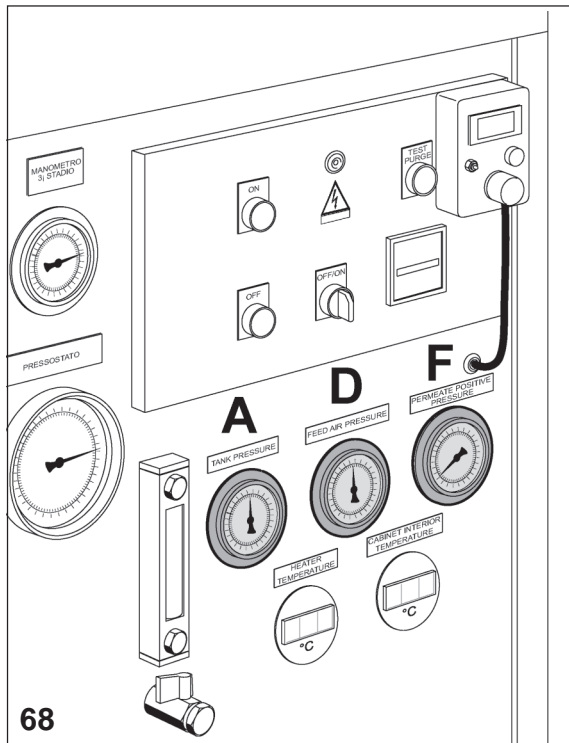


Allow system to stabilize and come up to pressure and temperature, (approximately 5-8 minutes).

Regulator pressure “D” range will be approximately 10-12 Bar.

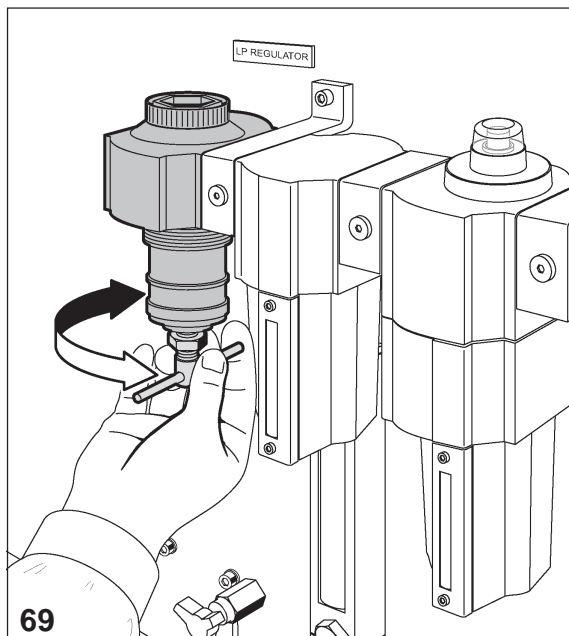
Temperature “E” range will be between 35 °C and 43 °C (95° – 110° F) (Fig. 67).

**STEP 5**



When permeate pressure gauge “F” reaches 0,07 bar (1psi) (approximately 3-5 minutes), system is now ready to be adjusted to the nitrox percentage level needed for the fill. (Fig. 68).

**NOTE:** If permeate pressure gauge does not reach (1psi), slightly adjust the LP regulator as follows: Pull down the bottom of the regulator to unlock.



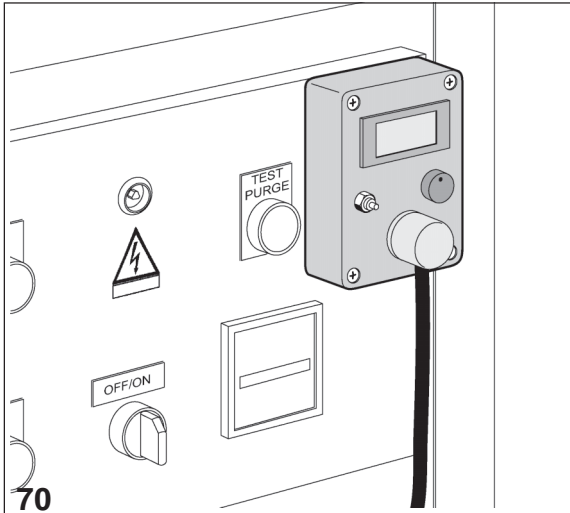
Then adjust. Clockwise increases pressure; counter clockwise decreases pressure.

If the psi is lower than 1, adjust the regulator up slightly. If the psi is higher than 1, lower the regulator slightly. (Fig. 69).

**NOTE:** Regulator pressure “D” will never be higher than tank pressure “A” (Fig. 68).

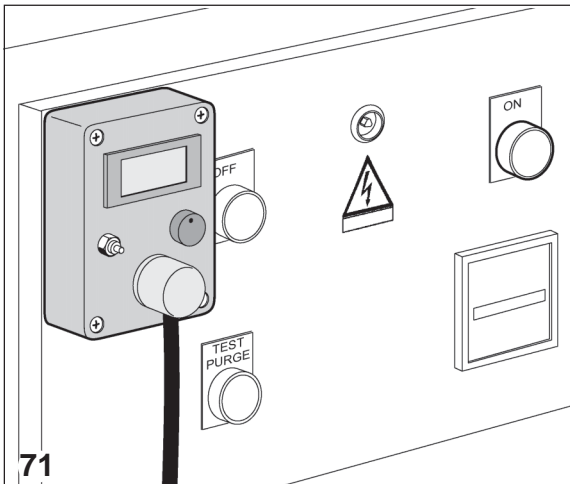


**STEP 6**



The nitrox percentage can now be read at both O<sub>2</sub> analyzers on the compressor panel.

The analyzer labeled “Membrane Output” analyzes the permeate gas at the membrane output port (Fig. 70).



The analyzer labeled “HP Outlet” analyzes the gas after it has passed through the HP compressor and filtration.

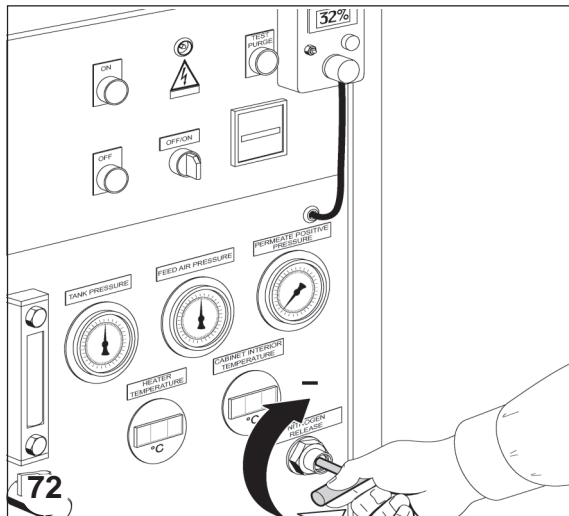
This is the analyzer that indicates the O<sub>2</sub> of the nitrox fill (Fig. 71).

**NOTE:** Both analyzers should have the same reading within + or - .5%.

**NOTE:** Actually two things will happen: as we start supplying nitrox we start to displace the compressors need for air - we can hear the suction getting quieter at the same time the needle of the nitrox permeate pressure gauge starts to rise. We continue to add pressure to the system until we get about 1psi of Nitrox pressure.

You are now pumping nitrox through the compressor, through the purification filter system, out through the HP Fill Whip. You are venting through the fill whip all nitrox until both analyzers show the chosen % + or - 0.5% O<sub>2</sub>. The system should stabilize within 5-8 minutes. If the system doesn't stabilize within 8 minutes, you should call us for trouble shooting assistance **AEROTECNICA COLTRI S.r.l.**

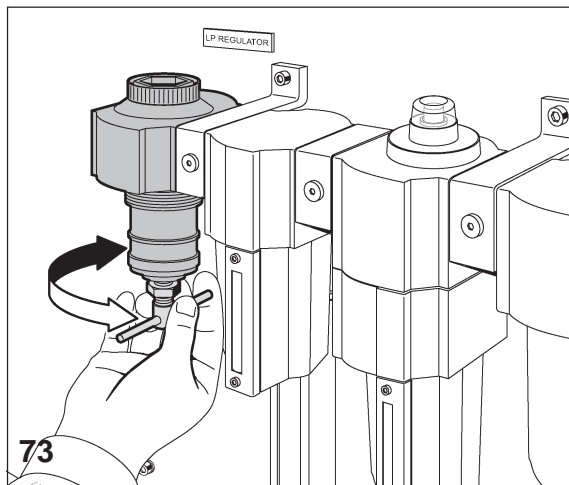
## STEP 7



Slowly adjust, no more than a fraction turn, the nitrogen valve until the chosen percentage of nitrox is achieved.

Clockwise decreases O<sub>2</sub> reading; counter clockwise increases O<sub>2</sub> reading.

Wait approximately 1 minute before any additional adjustment is made (Fig. 72).



Keep in mind the permeate pressure gauge needs to remain at approximately 0,07 - 0,1 bar (1-1.5 psi) and a slight adjustment with the LP regulator may be needed. (See Step 5) (Fig. 73).

For example, if the psi is lower than 1, adjust the regulator up slightly. If the psi is higher than 1.5, lower the regulator slightly.

## STEP 8

When the proper concentration of nitrox is achieved and the permeate pressure gauge reads 1psi, the HP Fill Whip can now be closed and the dive tanks or storage cylinders can now be filled according to the manufacturer recommendation.

Monitor compressor operation. The Auto Condensate Drains will activate every 10-15 minutes. (Remember to manually drain bleed valves once a day. See Page 17)

## AUTO DRAIN FEATURE

**Operational Note: Drop in low pressure analyzer percentage reading!**

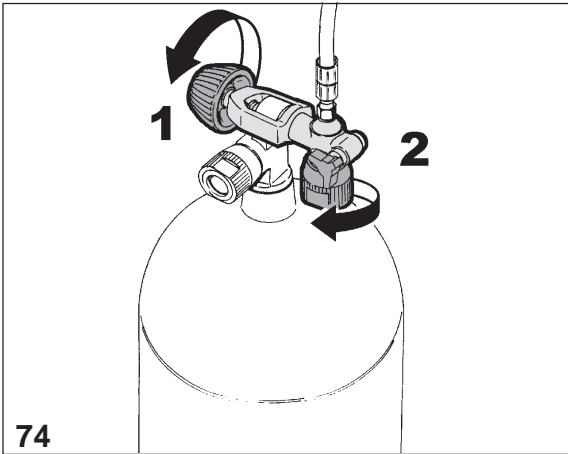
When the compressor's auto drain engages and dumps condensate, the O<sub>2</sub> analyzer reading will go down due to pressure decrease in the system. It will return to the previous reading within seconds after the auto drain sequence stops.

**STEP 9**

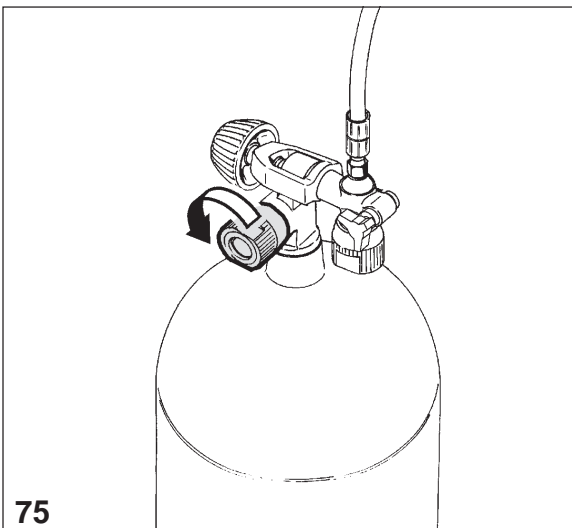
Check all system gauges :

GAUGE	RECOMMENDED SETTING/MAXIMUM ALLOWABLE READING
Temperature	110° F / 43° C
Feed air pressure to regulator	12-13 bar (175-190 psi)
Feed air pressure to membrane	10-12 bar (150-180 psi)
Nitrox delivery pressure to compressor (permeate stream)	0,07 a 0,18 bar (1 a 2.5 psi)
Oxygen analyzers	Showing the proper reading for intended fill

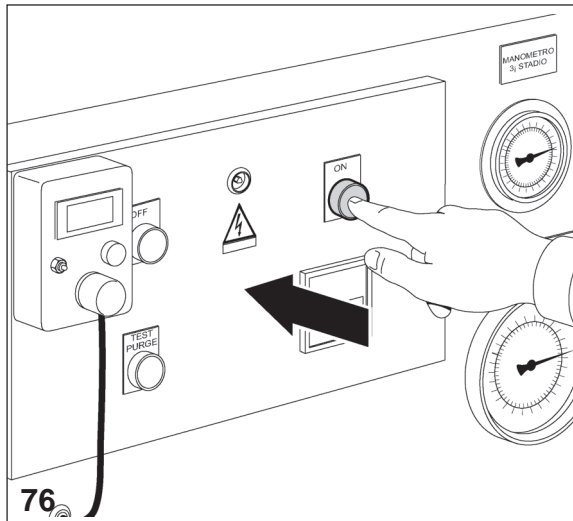
**AIR READING**



1 Fit hose attachment "1" to the cylinder valves and turn on tap "2" (Fig. 74).

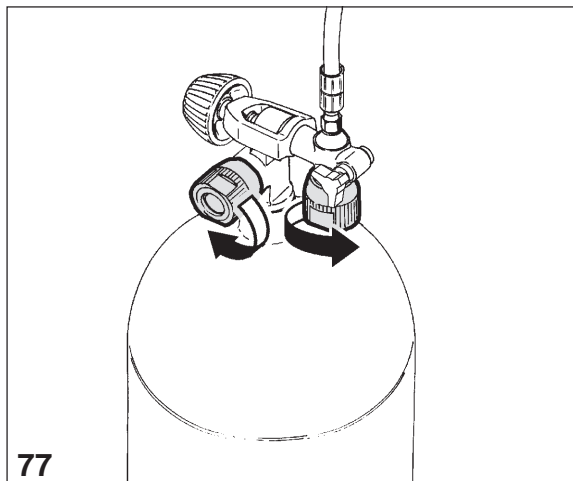


2 Turn on the cylinder tap (Fig. 75).

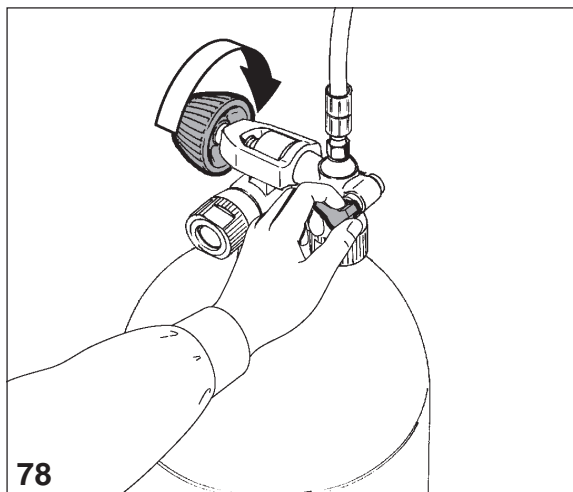


3 Start up the HP compressor by pressing the corresponding button. (General switch to "ON" and then press the green button) (Fig. 76) (left panel).

4 When the cylinder has been filled, the compressor is stopped automatically by the pressure switch.



5 Turn off the cylinder tap and that of the hoses (Fig. 77).



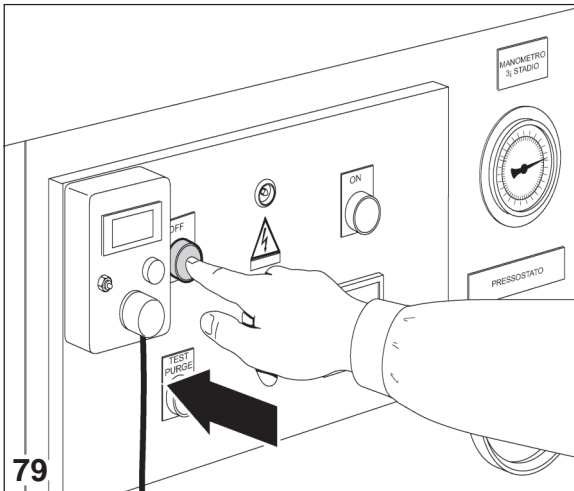
6 Press the pressure bleed button on the filling tap and then disconnect the cylinder attachment (Fig. 78).

Auto Drains will bleed valves every 12 – 15 minutes.

When fill is complete, follow shutdown steps 1,2, 4-5.



**CAUTION: DO NOT TURN ON LP COMPRESSOR FOR AIR FILLS ONLY. DOING SO CAN DAMAGE THE MEMBRANE.**



If an emergency situation should arise during the filling of the cylinders, press the “OFF” button located on the control board (Fig. 79).

The machine is provided with an emergency system that automatically blocks it when:

- 1) the pressure set on the pressure switch is reached;
- 2) there is a temporary cut in the power supply;
- 3) the heat release of the electric motor trips due to an overload.

After an emergency stop and before proceeding with a subsequent operation, it is necessary to check that the cause of the emergency has been eliminated.

## **SHUTDOWN STEPS**

1. After filling is complete, close tank.
2. HP Compressor and LP compressor will automatically shut down at 220 bar (3200 psi).
3. Turn off LP feed air switch. Membrane system and LP filtration will automatically drain.
4. Vent fill whips at the yoke.
5. Remove fill whip from nitrox bottle/tank.

# 10

## MACHINE SHUTDOWN AND DISMANTLING PROCEDURES



This chapter provides instructions to be followed for extended storage or for the dismantling of the machine.

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<b>10.2</b>	<b>Disposal of waste products</b> .....	<b>58</b>
<b>10.3</b>	<b>Dismantling the machine</b> .....	<b>59</b>



### WARNING

Before carrying out any procedure on the machine, read Chapter 4, "Precautions for use and maintenance" with care.

## 10.1

### Instructions for extended storage

If the compressor is not to be used for prolonged periods, remove the activated carbon cartridge from the strainer filter.

Run the compressor idle for a few minutes to drain off any residue condensate. Stop the compressor, remove the intake filter, start up the compressor again spraying a few drops of oil into the intake hole so that a light film of lubricant is sucked in and penetrates the internal parts of the compressor.

Stop the compressor and refit the intake air filter. Clean the external parts and try to remove any saline humidity and oily deposits. Protect the compressor from dust and water by storing it in a clean, dry place.



### WARNING: DEPRESSURIZE THE UNIT.

Turn the machine off using the general switch (position "0") and remove the power plug.

Carry out a general cleaning operation on the machine and all its components.

## 10.2

### Disposal of waste products

When using the compressor, **special waste products** are produced. It must be remembered that waste from industrial processes, agricultural, artisan and commercial activities and service industries cannot be disposed of together with normal urban waste either because of their quality or quantity. Old or obsolete machinery is also to be considered as special waste.

Special care must be taken with the disposal of worn active carbon filters which, being a waste product that cannot be disposed of together with normal urban waste, must be dealt with in compliance with the laws in force in the country where the compressor is installed.

It is important to remember that the loading and discharge of waste oil, special waste products and toxic or harmful waste products deriving from industrial or artisan processes must be registered. The collection of waste oils and special toxic or harmful waste products must be carried out by specially authorized companies.

The disposal of waste oils in particular must be carried out in accordance with the regulations in force in the user's country.

## **Dismantling the machine**

## **10.3**

**The operations required for dismantling and demolishing the machine must be carried out by qualified staff.**

To dismantle the machine, follow the regulations imposed by the laws in force in the user's country. Before demolishing the machine, an inspection must be requested by the competent authority with the issuing of a relative report.

**WARNING: DEPRESSURIZE THE UNIT.**

Disconnect the machine from the power supply.

Remove any interfacing that there may be between the compressor and other machines, checking carefully that any interfacing between other machines that are still in use remain operative.

Empty the tank containing the lubricating oil and store it according to legal requirements.

Proceed with the stripping of the individual machine components, grouping them together according to their composition. The machine consists mainly of components made of steel, stainless steel, cast iron, aluminium and plastic.

Finally, send the materials for scrap in accordance with the laws in force in the country where the compressor is installed.

**During all the dismantling phases, follow the safety warnings given in this manual with great care.**



## MAINTENANCE

*This chapter includes instructions concerning the preventive, routine and additional maintenance operations.*

*In the specifications for the preventive maintenance operations for the various devices indication is also given of the frequency of such procedures.*

*Before consulting the chapter, read Chapter 4 "Precautions for use and maintenance" with care.*

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<b>11.11.7</b>	<b>Control valve .....</b>	<b>75</b>
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<b>11.12</b>	<b>Maintenance programme .....</b>	<b>76</b>



### WARNING

All the routine and additional maintenance operations must be carried out with the machine at a standstill (the compressor at a standstill) and with the power supply disconnected.

The residue pressure in the machine (pump circuit) must be eliminated.



### WARNING: DEPRESSURIZE THE UNIT.

Any operation carried out on the machine must only be undertaken having read and carefully applied the regulations listed in Chapter 4 "Precautions for use and maintenance".



**All the operations described in the following paragraphs, must be repeated twice (one for every component that is the same).**



**General notes**

**11.1**

To keep the machine in good working condition, it must be cleaned very thoroughly. Having been designed and built according to the most advanced technological criteria, this type of filling station requires very limited preventive and routine maintenance operations. However, it is essential to follow the indications given in this chapter very carefully and to follow the intervals between operations as suggested.

During the guarantee period no responsibility is taken for any damage or operating faults due to a failure to comply with the regulations in force. The following paragraph enables all the routine and additional maintenance operations carried out on the machine to be recorded. This paragraph should be filled in carefully and any operations carried out to solve problems should also be reported.

**Preventive maintenance (Table 1)**

**11.2**

Table 1

		INTERVALS									
		1 gg	15 min	30 min	25 h	50 h	125 h	250 h	500 h	1000 h	5000 h
1	Replace the activated carbon cartridge, see par. 11.7					●					
2	Check the compressor oil level				○						
3	First compressor oil change				●						
4	Change compressor oil							●			
5	Intake filter cartridge				○		●				
6	Operation of the end safety valve				○						
7	Operation and tightness of the filling valve				○						
8	Alignment of the compressor needle with the <b>O</b> when the compressor is depressurized				○						
9	Tightening of the cooling pipes						○				
10	Tightening of the connecting pipes						○				
11	Belt tension and wear							○		●	
12	Hose replacement									●	
13	2 <sup>nd</sup> and 3 <sup>rd</sup> stage intake and discharge valves								●		
14	Internal cleaning of end separator							○			
15	Tightening of all the screws							○			
16	General cleaning							○			
17	Replacement of the external casing of the strainer filter										○
18	Replacement of 1 <sup>st</sup> stage head									○	
19	The purification cartridge installed in the system is a standard L-Factor cartridge.	○									
20	Use the same cartridge when replacing approved substitute. If system is located in high humidity and high heat, purification cartridge must be derated by 50%.	○									
21	Periodically, manually drain separator. Do not use this system to produce greater than 40% oxygen concentration.	○									
22	Use only synthetic oil NITROX LP compressor.						●				

●= replacement

○= inspection, cleaning

**11.3****Changing the lubricant oil**

The quantity of oil for the lubrication of the pump unit must be checked every 25 hours.

To carry out this operation, see chapter 8 "Start up".

The oil must be changed every 250 operating hours or yearly.

When changing the oil, do not use a mixture of different oils.

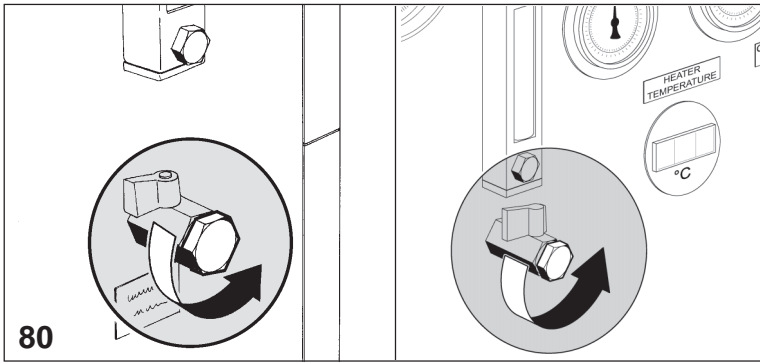
The oil must have the following characteristics:

**LOW PRESSURE COMPRESSOR - Table 2**

<b>Sump capacity</b>	cu.cm. litres/gallons	2000 2
<b>Recommended oils</b>		AEROTECNICA COLTRI SPECIAL SYNTHETIC OIL SYNTHETIC NITROX EZ 1000
<b>Viscosity of the oil</b>	summer winter	above +10 °C (50 °F) SAE 20 W/40 from +10 °C to -15 °C (50° a 5 °F) SAE 10 W below -15 °C (5 °F) SAE 5 W
<b>Maximum tilt of the compressor with the oil level at maximum</b>	degrees	~ 5

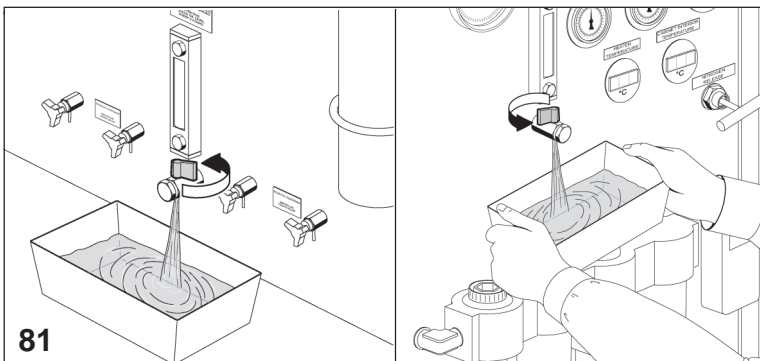
**HIGH PRESSURE COMPRESSOR - Table 3**

<b>Sump capacity</b>	cu.cm. litres/gallons	1.5/0.476
<b>Recommended oils</b>		AEROTECNICA COLTRI SPECIAL SYNTHETIC OIL SYNTHETIC NITROX EZ 1000
<b>Viscosity of the oil</b>	summer winter	above +10 °C (50 °F) SAE 20 W/40 from +10 °C to -15 °C (50° a 5 °F) SAE 10 W below -15 °C (5 °F) SAE 5 W
<b>Maximum tilt of the compressor with the oil level at maximum</b>	degrees	~ 5



To change the oil, proceed as follows:

1 Use a way with a minimum capacity of 2.5 lt. capacity under the oil discharge tap (Fig. 80).



2 Unscrew the hexagonal closing cap located in front of the oil discharge.

3 Open the oil discharge two taps (Fig. 81) and discharge all the oil in the sumps.

4 Close the discharge tap and replace the hexagonal closing cap.

5 Carry out the filling operations as described in chapter 8 "Start up".

## NOTES:

- 1) Do not mix oil types, weights, or brands. Consult factory for the use of synthetic lubricants.
- 2) For the first 100 hours of compressor operation, a careful and regular check of the oil level should be made. Maintain oil level at the full line.

## WARNING

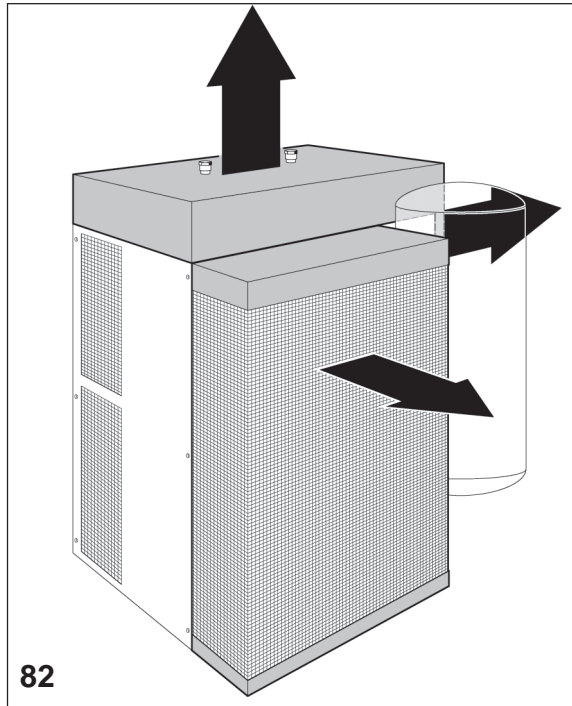
To dispose of waste oils follow the instructions given in chapter 10.2 "Disposal of waste products" with great care.



## 11.4

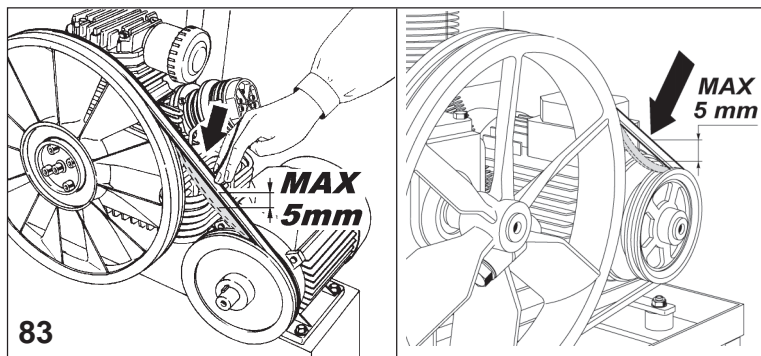
## Checking the drive belt

The drive belt is checked by measuring the yield of the same.

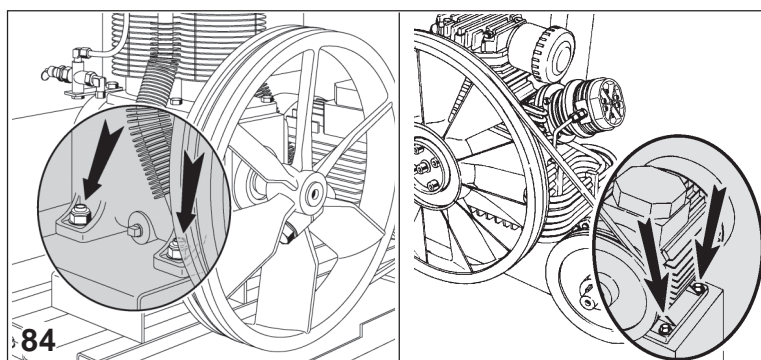


This operation must be carried out every 250 machine operating hours as described below:

- 1 Remove the protective cover as shown in figures 82 by unscrewing the fixing screws.



- 2 By exerting a pressure of at least 5 Kg., check that the belt does not yield by more than 5 mm. compared to its original position (Fig. 83).



If this distance should exceed 5 mm., intervene by loosening the motor fastening screws (Fig. 84), remove the drive belt and move the motor away from the compressor by a few millimetres by sliding it along the slots. Tighten the motor fastening screws.

Refit the belt, placing it in the race provided in the motor pulley and in the innermost race of the fan, turning it by hand to enable the belt to go over the diameter of the fan and to fit into the race.

- 3 Carry out the measurement procedure again and if necessary, repeat the operations until a maximum distance of 5 mm. is reached.
- 4 Replace the covers securing the appropriate screws tightly (see point 1).

**WARNING:** never operate the compressors without the protection belt. Its removal will expose rotating parts, which could cause injury to the operator or damage the machine.



## Suction filtre

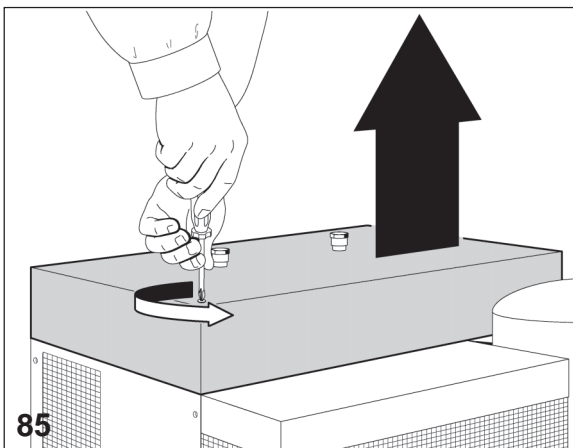
**11.5**

## LP Moisture/Oil Vapor Filters

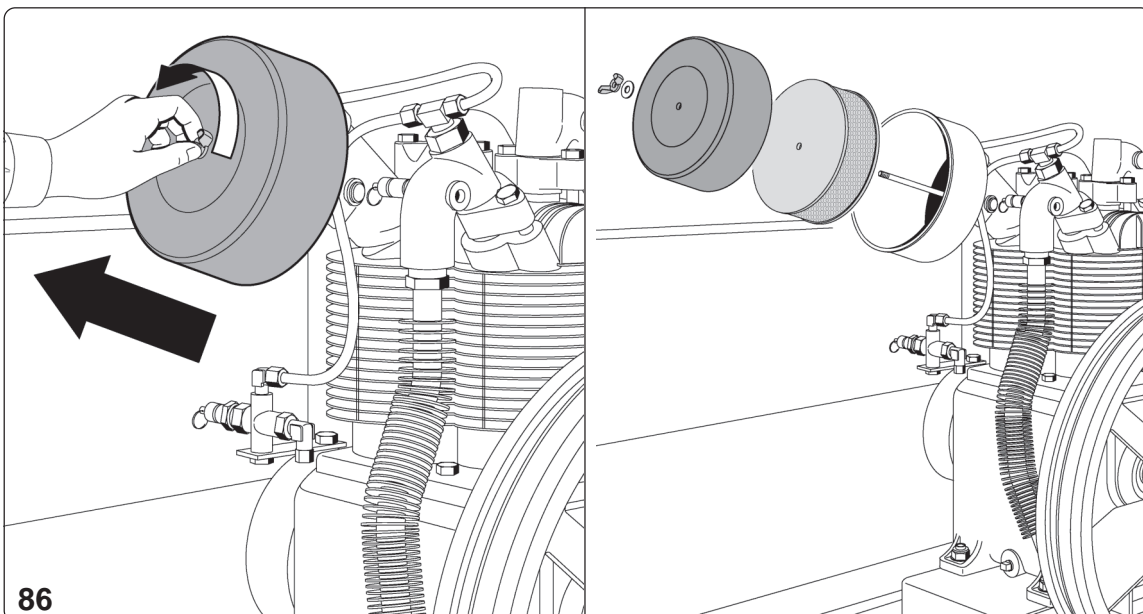
**11.5.1**

This system uses three stage moisture / oil vapor filters as a final filtration point for the “Grado-E” UNI EN 132 - DIN 3188 - CGA/E air prior to entering the membrane. The purpose of this filtration is to prevent the passing of any residual oil vapor / moisture into the membrane.

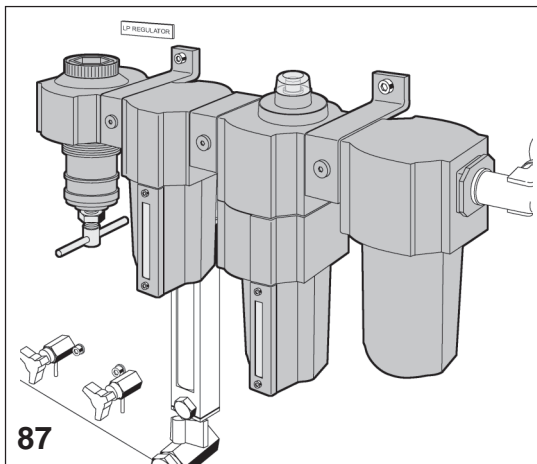
**NOTE:** Membrane life expectancy with proper filtration is 10 years.



Remove the upper protective cover by unscrewing the securing screws (Fig. 85).



Unscrew the wing nut positioned above the filter cover by hand or with pliers.



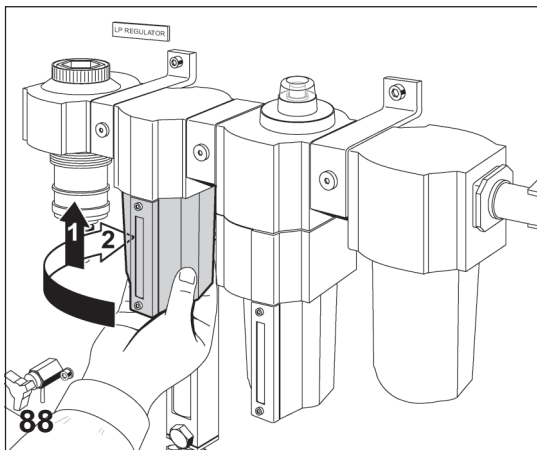
The housings are attached directly on the front panel. (Fig. 87).

**WARNING:** Special attention needs to be given to the arrangement of the three LP filtration bowls. Properly reinstall each element and bowl to the correct housing. Improper sequence can cause damage to downstream components.

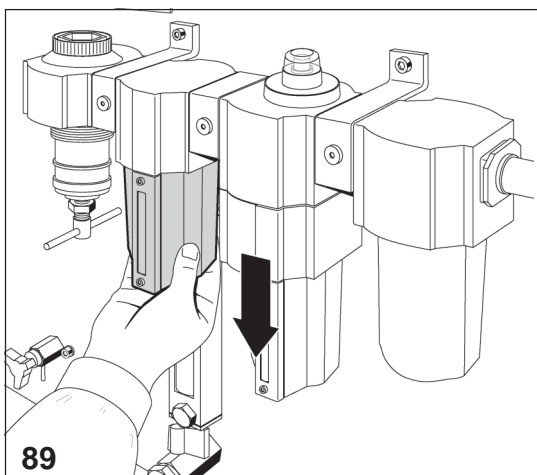
**Gas flow input is as follows:**

- Bowl 1 - HF-7 with sight gauge and auto drain float
- Bowl 2 - HF-5 with sight gauge and auto drain float
- Bowl 3 - HF-1 no sight gauge or auto drain float

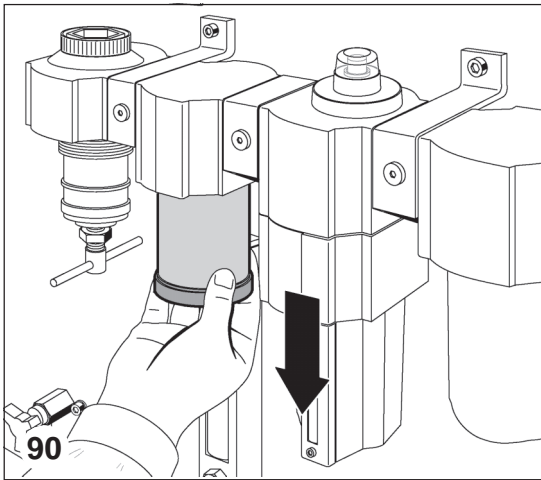
Inspect the filter cartridges as shown:



- Push up on the bottom housing and rotate counter-clockwise. (Fig. 88);



- Lower the bottom housing off to expose the filter elements. (Fig. 89);

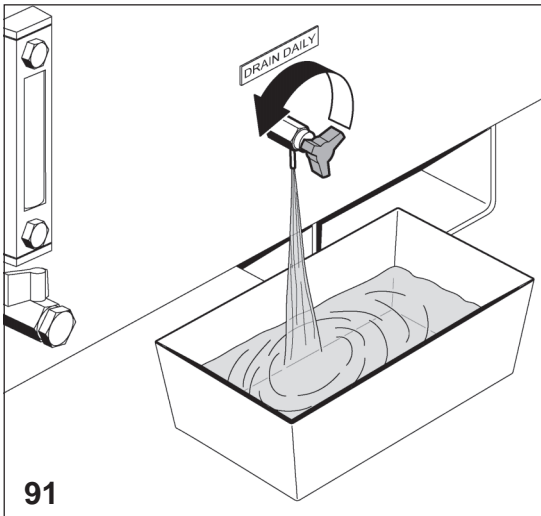


- Pull the filter element in a downward motion. The element will pull off the mounting post. (Fig. 90).

- Replace the elements and reassemble in reverse order.

**Operational Note:** Visual gauges on top of the housings assist with replacement intervals. Elements should be visually inspected quarterly and replaced on demand. The interior of the bowls can be cleaned with a diluted solution of Simple Green™ and flushed thoroughly with clean water.

This will assist to prolong the life of the element, bowl, and auto drain.



### **Condensate tank**

To manually discharge the tank, first place a suitable container under the tap, open the ball valve (tap) situated on the front panel and leave open until the tank has emptied (Fig. 91).

The low pressure compressor has been created to operate for about 5000 hours.

## **Suction filter - High pressure compressor**

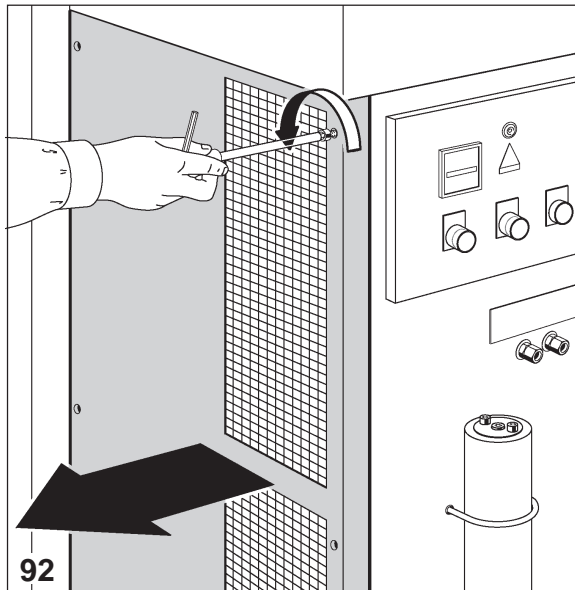
## **11.5.2**

The intake filter must be checked to make sure it is in good order every 25 operating hours.

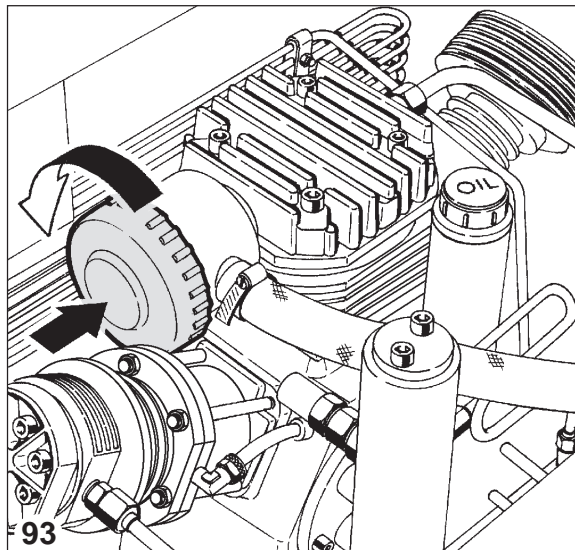
The filter is cleaned by blowing air inside the cartridge when it has been removed.

Replace the cartridge turning it by 60° compared to its initial position.

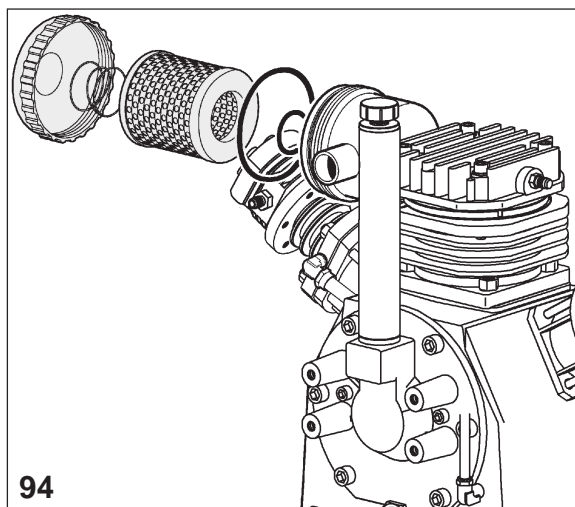




- 1 Remove the left-hand side protective cover (looking at the compressor from the **front**), by unscrewing the fixing screws (Fig. 92).



- 2 Press cap n° 1 lightly and turn it in an anti-clockwise direction (Fig. 93).



- 3 Remove the filter and replace it with a new one (Fig. 94).  
To order a new spare filter, refer to chapter 14 "Spare parts".

- 4 Refit the safety guard and tighten the screws (see point 1).



**Activated carbon filter and molecular sieve - high pressure compressor**

**11.6**

The cartridges must be replaced before the air becomes foul-smelling.

The quality of the air depends to a large extent on the condition of the filtering cartridge. For this reason, it is important to comply with the intervals as specified.

The frequency of replacement has been calculated for use of the compressor with intake air at a temperature of 20 °C (68 °F), see table 4. If the temperatures differ, apply the coefficients given in the following table 3 to the duration of the filter:

**Table 4**

°C	°F	Coefficienti moltiplicativi
50	122	0.20
40	104	0.34
30	86	0.57
20	68	1
10	50	1.85
5	41	2.60
0	32	3.80

**Table 5**

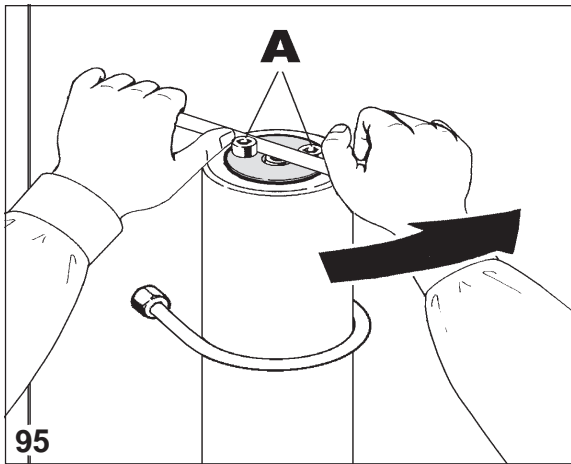
MODEL	N° OF 10 LITRE CYLINDERS TO BE FILLED		VOLUME OF FILTERED AIR	DURATION OF THE FILTER
	200 bar	300 bar only air		
MCH 14 TECH NITROX	322	214	m <sup>3</sup> 644	ore 50

Check the sealing O-Rings and replace them if they are damaged.

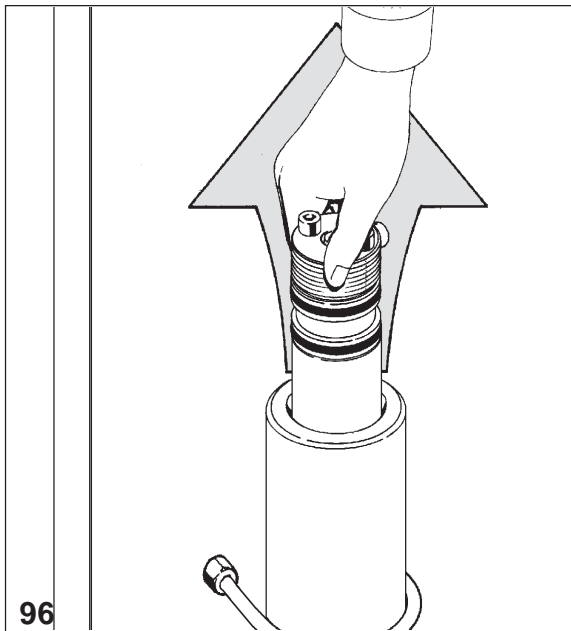
Leave the cartridge in the filter when the compressor is not in use.

Maintain a pressure of 40-70 bar inside the filter to prevent outside damp from getting in.

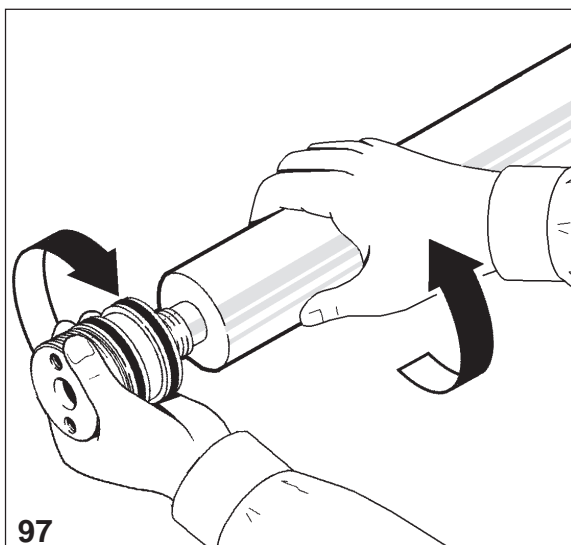
To replace the activated carbon filter, proceed as follows:



- unscrew the external cap using a lever between the screws "A" (Fig. 95);



- remove the external cap and the internal cap (Fig. 96);



- unscrew the used cartridge from the internal (Fig. 97) and then screw in the new one;

- screw up the internal cap having lubricated or replaced the sealing O-Rings if they are worn and having lubricated the threads of the external cap using silicone grease.

### WARNING

The used activated carbon filter cannot be disposed of together with urban waste. To dispose of it, follow the instructions given in chapter 10.2, "Disposal of waste products" with great care.



## Filling hose - High pressure compressor

**11.7**

The filling hose must be in good condition especially in the area of the connections.

The plastic sheath that covers the hose must not show any signs of abrasion otherwise if any humidity infiltrates, it could corrode the steel plait and reduce its resistance. The hose must be replaced periodically (annually) and/or when it shows signs of wear. Failure to comply with this regulation could cause serious danger to the operators. Make sure that the minimum radius of curvature of the hose is not less than 250 mm.

To connect the hose, follow the instructions given in chapter 6.2.2, "Connecting the filling hose".

## Inlet and discharge valves - High pressure compressor

**11.8**

The 2<sup>nd</sup> stage inlet valve can be removed for maintenance purposes while those of the 1<sup>st</sup>, 2<sup>nd</sup> (only discharge) and 3<sup>rd</sup> stages must be entirely replaced. The seats must be cleaned carefully using petrol and soft brass or nylon brushes.

The torque wrench setting for the head bolts of the 3<sup>rd</sup> stage is initially 1 Kgm. Having moved the head closer, tighten the bolts to 2.2 Kgm, making sure that the piston is at the bottom dead centre during the operation.

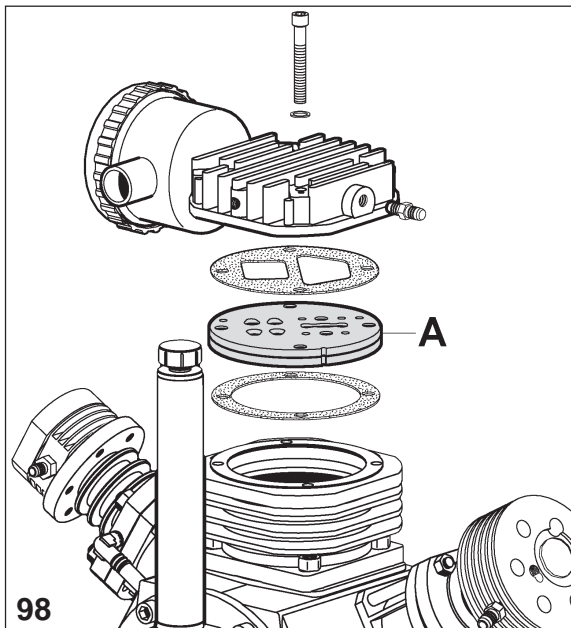
Avoid using steel brushes or screwdrivers. The interval between maintenance operations is 400-600 working hours. If any parts are damaged or worn, they must be replaced. The discharge valves can be removed from the outside while the inlet valves can only be removed when the head of the cylinder has been taken off.

**NOTE:** the valve replacement procedure must be carried out at the work bench by specialized technicians who have specific equipment for the stripping operation.

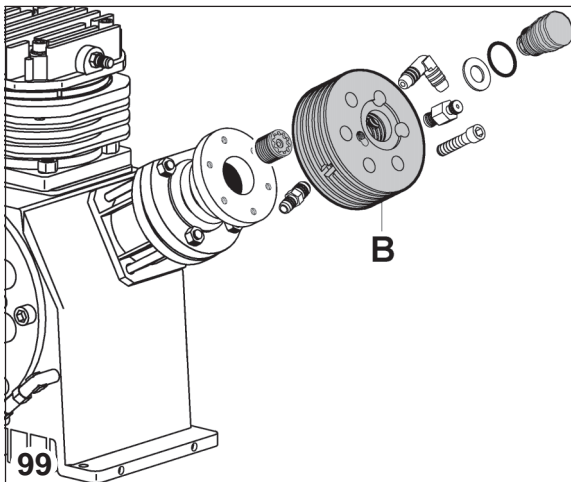
In any case, it is preferable to contact **AEROTECNICA COLTRI S.r.l.** who will supply the necessary technical assistance.

## 11.9

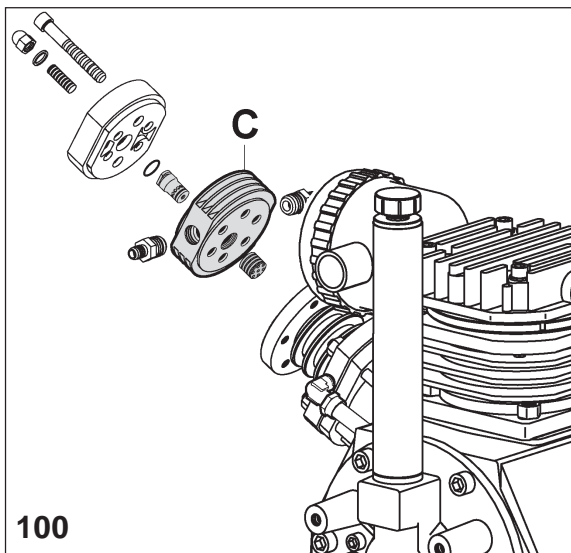
## Valve heads - High pressure compressor



- The head of the 1<sup>st</sup> stage (A) is of the lamellar type (Fig. 98). It must be fitted so that the word "TOP" remains upwards and the flaps correspond with the openings in the cover of the head. Replace every 1000 hours.



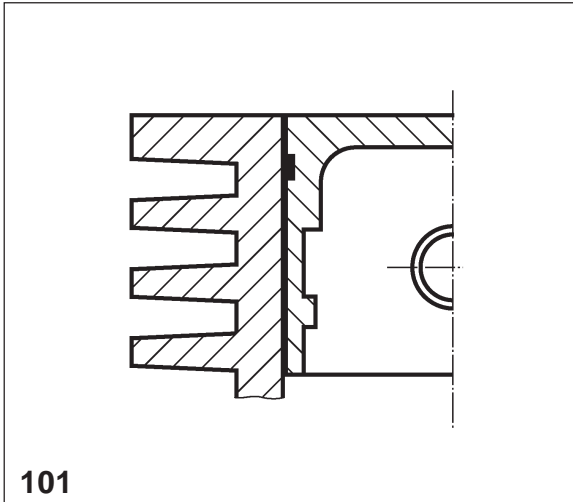
- The head of the 2<sup>nd</sup> stage (B) is made of aluminium (Fig. 99), the valves are screwed in; the inlet valve inside is removed using a special pin wrench while the discharge valve is on the outside and is removed with a non-adjustable wrench or a box wrench.



- The head of the 3<sup>rd</sup> stage (C) is made of aluminium (Fig. 100), the inlet valve is screwed inside and can be removed using a special pin wrench while the discharge valve is on the outside and is kept in position by the threaded dowel which is screwed into the cover.

## Cylinders - High pressure compressor

11.10



After removing the cylinders, it is necessary to check, when they are replaced, that the piston at the maximum point and the upper edge of the cylinder are on the same level (Fig. 101).

Adjust any differences that there may be by making the base of the cylinder thicker using gaskets.

## General maintenance instructions for the low pressure compressor

11.11

### Pressure discharge valve

11.11.1

This is a safety valve.

Each valve is checked at the correct time for the maximum pressure permitted by the characteristics of the tank and for the pressure for of the unit on which it is installed. If it blows, all the air in the tank will have to be let out, so that it can then be reset correctly.

Do not make any changes.

### Tank drainage valve

11.11.2

This valve must be opened daily to let out the condensate.

Do not open the valve if compressor pressure exceeds 1.7 bar (25 psi).

The compressor is equipped with an automatic drainage system, that requires to be manually drained once a week.

**11.11.3****Pressure on/off**

This switch is automatic and starts the compressor at a low pressure and turns it off when it has reached the maximum pressure level set.

It is pre-set to start and switch off the compressor at the correct pressure for the unit on which it is installed. **Do not change settings.**

**11.11.4****Belts**

The belts must be tight in order to prevent slippage.

If the belts slip or creak, follow as for “Verifying belt transmission” in paragraph 11.4 of this manual.

**WARNING**

If the belts are too tight the motor and its bearings will be overloaded and there is a risk of overheating or seizure

**11.11.5****Compressor valves**

If the compressor is unable to pump air or fills slowly, turn off the mains, remove the valve and clean carefully using compressed air and a soft wire brush.

After cleaning, it is absolutely essential to check that all the parts have been reinstalled exactly in their original position and that all the joints are tight otherwise the compressor will not function correctly.

When all the valves have been installed and the joints are tight, close the tank's manual valve and vent for the final check. The washers on the valves should be replaced every time the valves are removed from the pump.

**11.11.6****Centrifugal discharger and discharge pressure valve**

The centrifugal discharger is activated by two regulating weights. It is completely closed and lubricated by the compressor guard. When the compressor is activated the regulating weights open automatically, compressing the main spring, thus allowing the discharge pressure valve to close.

When the compressor stops, the main spring returns the regulating weights to their normal position, opening the discharge pressure valves and emptying the compressor. This prevents the start motor overloading. If air continues to come out of the regulating or discharge pressure valves in operation phase, it means that the discharge pressure valves have not closed correctly and that they may have remained open due to the presence of a foreign substance.

To solve this, the discharge regulation valve cover must be removed. Clean it carefully and reinstall the parts in the order they were removed. The escape of air can also be caused by slow belts, that prevent the compressor reaching the correct speed.

## Control valve

11.11.7

This valve closes when the compressor stops, preventing air escaping from the tank through the discharge pressure valve.

If air continues to escape through the discharge valve when the compressor has stopped, it means that the control valve is leaking. To solve this problem, remove the control valve and clean the disc and where it is seated.

If the control valve is very worn, replace it.

### WARNING

Before removing the control valve, check that there is no air pressure in the unit and that it is not connected to the mains as this could injure the operator or damage the machinery.



## Pressure interstage discharge valves

11.11.8

Used to protect against excessive interstage pressure and is set at a maximum pressure of 5 bar (75 psi).

DO NOT RESET.

If the discharge pressure valve blows, it means that there are problems. Switch off the compressor immediately, establish where the malfunction is and correct it. Check the cylinder head valves. If the necessary repairs are not carried out, it could cause serious damage and the compressor could be damaged beyond repair.

Any tampering with the interstage discharge pressure valve cancels any guarantee.

**11.12****Maintenance programme**

Use the following pages to note the routine and additional maintenance operations carried out on the machine.

If the maintenance programme is filled in accurately, it will be easier for the technician to intervene if assistance is required.

Date: .....

Operation carried out: .....

Date: .....

Operation carried out: .....

Date: .....

Operation carried out: .....

Date: .....

Operation carried out: .....

Date: .....

Operation carried out: .....

Date: .....

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Operation carried out: .....

Date: .....

Operation carried out: .....



# TROUBLESHOOTING

# 12

This chapter describes the faults that may arise during machine operation.

For each fault, the cause and the solution to be adopted are specified.



## 12.1 List of faults ..... 79

### List of faults

### 12.1

Table 1 below lists all the faults that may arise during operation and the relative solution.

Table 1

PROBLEM	CAUSE	SOLUTION
The electric motor does not start	A phase is missing	Check the fuses
The safety valve of the 1 <sup>st</sup> stage discharges	The 2 <sup>nd</sup> stage valves are not working	Perform maintenance operations or replace the valves
The safety valve of the 2 <sup>nd</sup> stage discharges	The 3 <sup>rd</sup> stage valves are not working	Replace them
The speed of rotation and capacity are reduced	The motor power is insufficient	Check the motor and the power line
	The belt slips	Tighten the belt
The capacity is reduced without a reduction in the speed of rotation	The valves are not working	Contact the technical assistance service
	The 3 <sup>rd</sup> stage piston is worn	Contact the technical assistance service
	The connections are loose or the gaskets leak	Check for leaks with water and soap and eliminate them
	The intake filter is blocked	Replace it
	The intake extension is bent	Straighten it, use a semi-rigid pipe
	The piston or compression rings are worn	Contact the technical assistance service
Smell of oil in the air	The filter cartridge is worn	Replace it
	The compression rings are worn	Contact the technical assistance service
The compressor overheats	Wrong direction of rotation	Check the direction of rotation by inverting the two phases in the plug
	The cooling pipes are dirty	Contact the technical assistance service
	The valves are not completely closed (causing an overload of another stage)	Contact the technical assistance service

**12.1.1**

**Low pressure compressor**

**SERVICE PROBLEM**

A	Motor will not start
B	Motor is Noisy or Overheats
C	Motor Stops
D	Compressor Runs Hot
E	Compressor Pumps Too Slowly
F	Compressor Won't Shut Off
G	Noisy Check Valve
H	Excessive belt Wear
I	Abnormal Pressure Fluctuation
J	Air Escapes From Unloader Muffler When Running
K	Air Escapes From Unloader Muffler When Stopped
L	Interstage Pressure Relief Valve Pops Off Continuously
M	Compressor Cycles (runs) too Often
N	Starter Kicks out

**POSSIBLE CAUSE OF PROBLEM**

	N	M	L	K	J	I	H	G	F	E	D	C	B	A	
1															1
2															2
3															3
4															4
5															5
6															6
7															7
8															8
9															9
10															10
11															11
12															12
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15															15
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17															17
18															18
19															19
20															20
21															21
22															22

**FOR EXPLANATION SEE NEXT PAGE**

N	M	L	K	J	I	H	G	F	E	D	C	B	A
---	---	---	---	---	---	---	---	---	---	---	---	---	---

## EXPLANATION ON TABLE REGARDING POSSIBLE PROBLEMS

1/2 Check all fuses and the on/off switches for the motor to ensure that power is being supplied. Check for any slow or faulty cables.

1. A magnetic starter includes a reset button which is used to restart the motor in the event of disruption to the power supply.

4/5 A pressure switch makes use of a diaphragm to open and close a series of points, that may develop a hole or become dirty with use. Clean by rubbing lightly with sand paper or replace it. See the relevant instructions for the pressure switch.

**WARNING:** disconnect the unit from the mains before checking the pressure switch.

6. Low voltage is the principal cause of problems with the motor. Contact the electricity supplier for a voltage check.

7. Most electric motors have a screened bearing. Check specifications of the motor manufacturer.

8. Water in the form of steam, is compressed together with the intake air and at the condensate of the tank. The tank must be drained daily, so that it functions at maximum capacity. To effect drainage, eliminate the tanks pressure, open the valve at the bottom of the horizontal or vertical tank. If the compressor is equipped with a tank with automatic drainage, manual drainage should be carried out once a week.

**WARNING:** do not open the drainage valve if pressure exceeds 1.7 bar (25 PSIG).

9. The casing of the bearings and the cables must be clean, given that dirt acts as an insulator.

This can be carried out simply by blowing away the dirt or by using a wire brush.

10. The belts must be fairly tight to enable the necessary energy to be transmitted to the compressor. If they are too tight, the motor will overload. If by pressing on a belt the upper part is in line with the lower part of the belt adjacent, the tension is correct. If it is necessary to adjust the tension, move the device or the motor into the slots at the bottom of the tank until the position required is obtained.

**WARNING:** before checking or adjusting the belts, disconnect the unit from the mains.

Reinstall the protection belt after having adjusted the belts.

11. The fans (pulleys) must rotate in the direction indicated by the arrows.

12. The compressor valves may be blocked with carbon or other external substances. To clean them, remove the manifold and take out the valves. Remove the screws in the centre of the valve and clean all components. Where they are seated and the disc can be wrapped in sand paper if they are very dirty. If the result achieved is not satisfactory, replace with new components. Reassemble and install, making sure that all components are placed in their original position.

13. All tubes that carry air from the compressor to the tank and from the tank to the air devices must be secure. To identify possible leaks from the joints, apply a soap solution to them.

14. For modifications to the Pilot Valve, consult paragraph 8.4.

15. In the event of loose joints check the Pilot Valve.



16. The centrifugal discharge valve may jam because of a foreign body. To clean it, unscrew the hexagonal screw positioned at the base of one of the dischargers, remove the spring and the ball. To remove the ball, it may be necessary to “shake” the fan. Clean or replace, whichever is necessary.
- 17/18 Before carrying out maintenance to the control valve, make sure that the pressure inside the tank is equal to ZERO. Replace the control valve.
19. Compressors that have deteriorated a great deal that pump oil, may deposit carbon between the after-cooler tube and the control valve, restricting the airflow and eventually obstructing these components completely. They must, therefore, be cleaned or replaced.
- WARNING:** before carrying out such an operation, disconnect the unit from the mains and eliminate the pressure in the tank
20. The motor pulley and the fly wheel must be aligned to prevent deterioration of the side panels of the belts. If this is not the case, disconnect the unit from the mains and adjust the pulley by loosening the screw and positioning the pulley in the correct direction.
- WARNING:** before adjusting the pulley, disconnect from the mains.
21. It is necessary to periodically clean the entry filter, to allow air to pass freely. To clean the filter, remove the thumb nut, the metallic casing and the filter cartridge. The filter cartridge can be cleaned by blowing it with an air nebuliser, if not excessively dusty. Filters that are very dirty should be replaced. NEVER clean the filter with flammable oil, cleaning fluid or flammable solvents.
22. Particular attention should be paid to the oil in the casing as it guarantees correct and long term function. Check and replace frequently, as indicated in the relevant compressor instructions.



## REGISTRER

13



13.1 Register ..... 83

It is obligatory to display a machine log book (register), which contains refill gas registration and the following list of information.

The machine log book should NOT be made up of loose pages and must be durable.

It must contain at least the following information:

- Date;
- Tank matriculation number;
- Check on oxygen (O<sub>2</sub>) content by qualified company and signature;
- Operator check for oxygen content (O<sub>2</sub>) and signature;
- "Mod" Form filled out by hand by the operator (in depth explanation of operation);
- Company that certifies the nitrox and file number.

# 14

## MACHINE DIAGRAMS

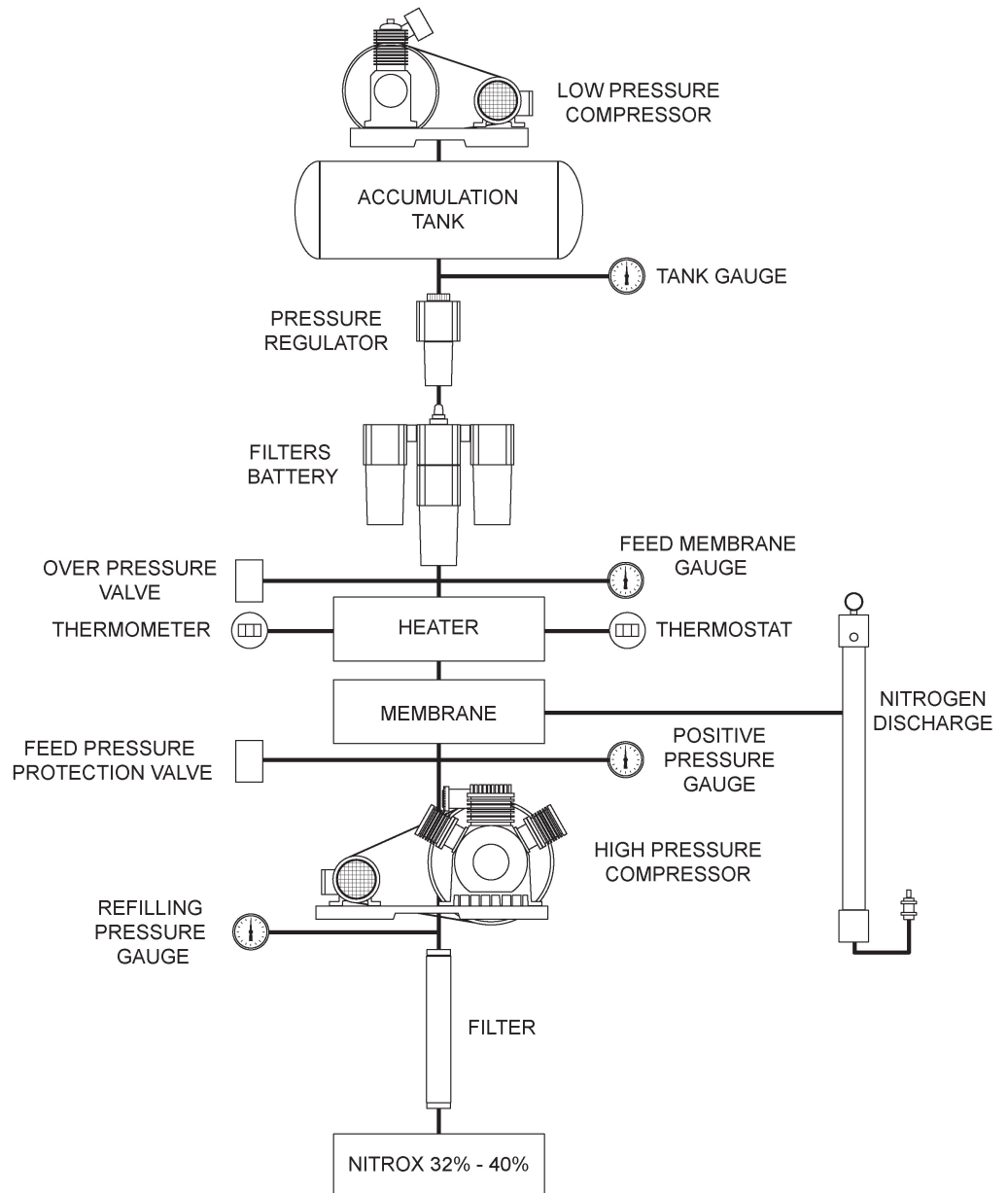


This chapter provides the plans and diagrams of the systems installed on the machine.

13.1 Compression diagram ..... 84  
 13.2 Electrical diagram ..... 86

### 14.1

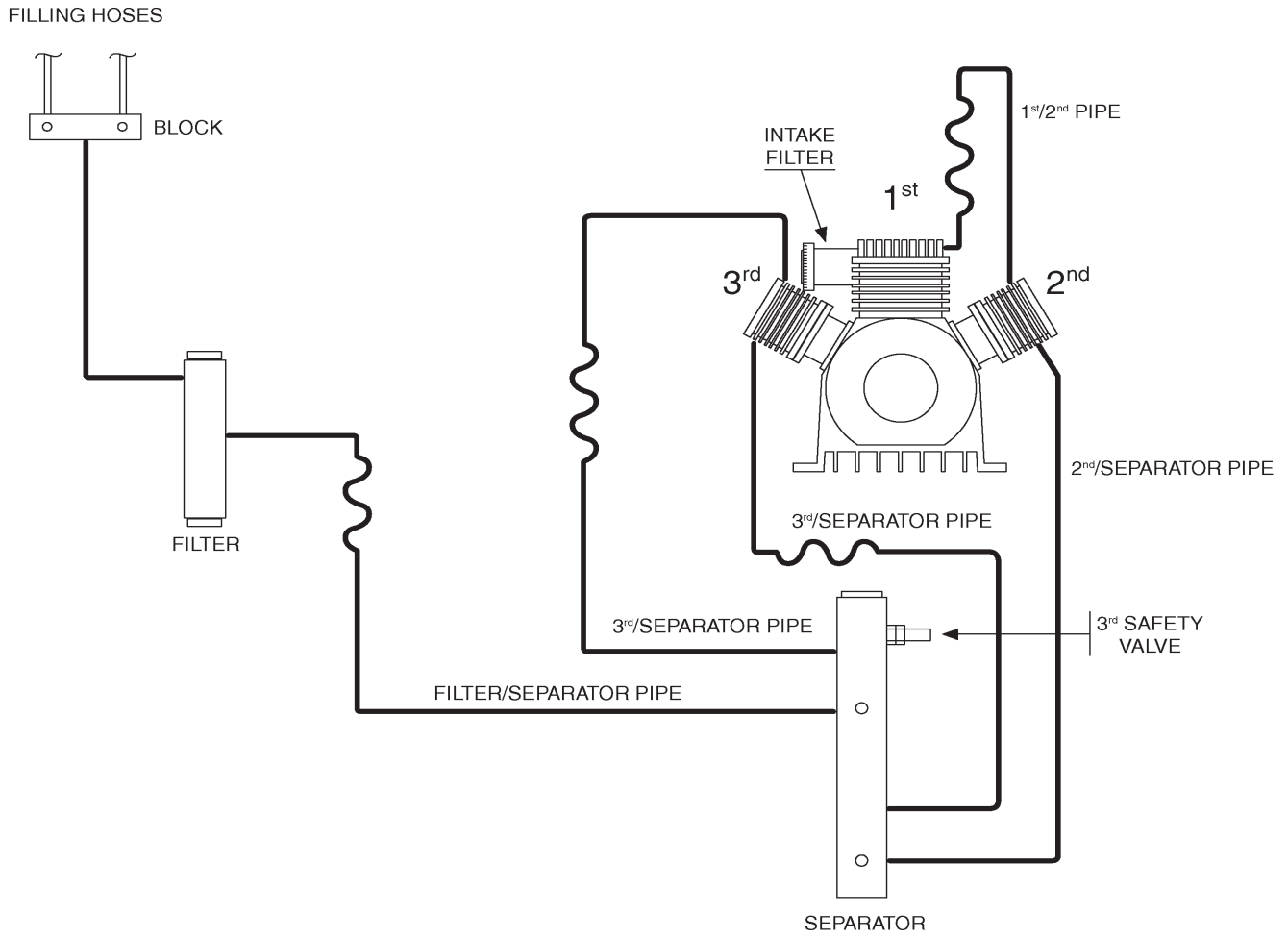
## NITROX compression diagram



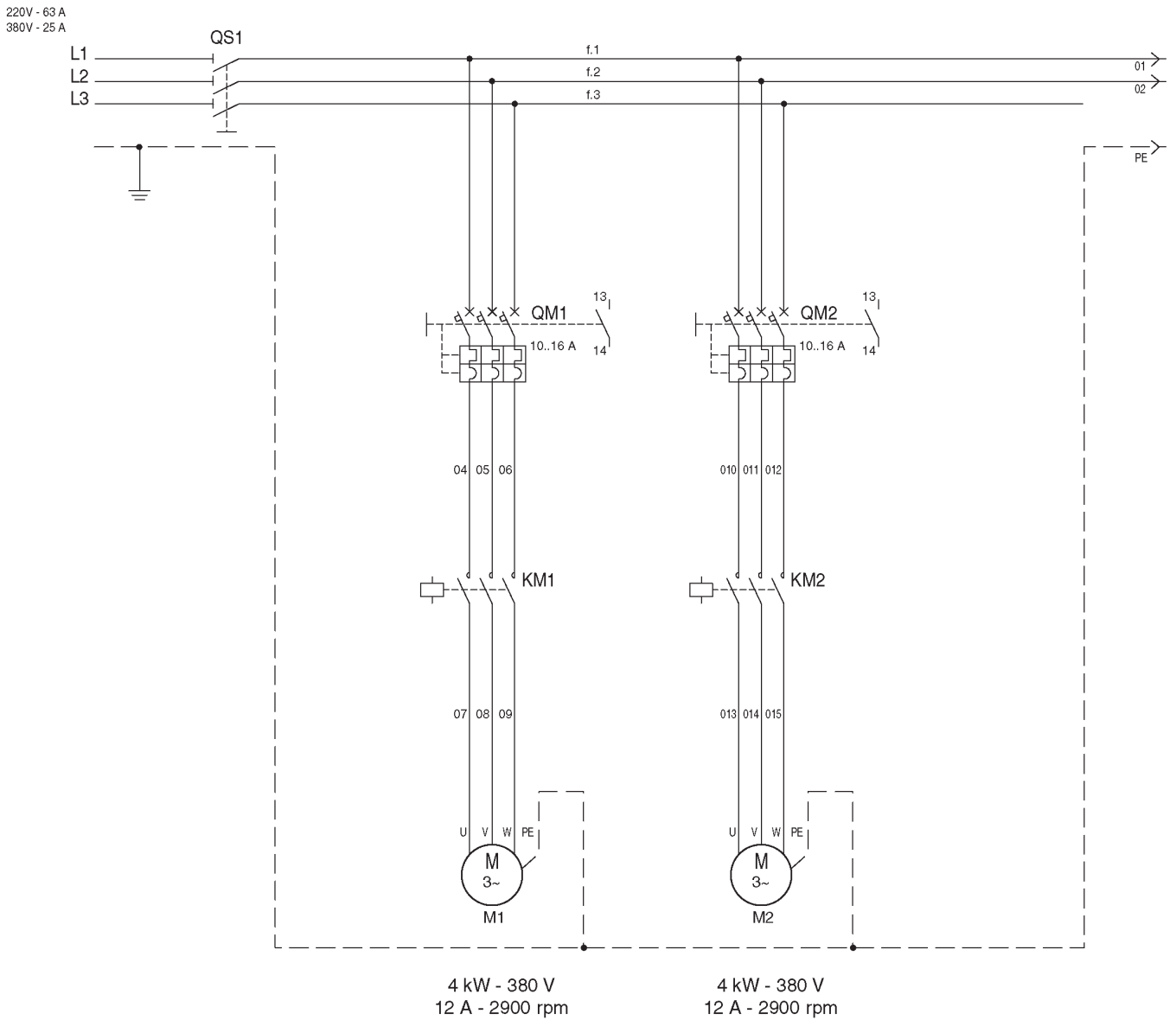


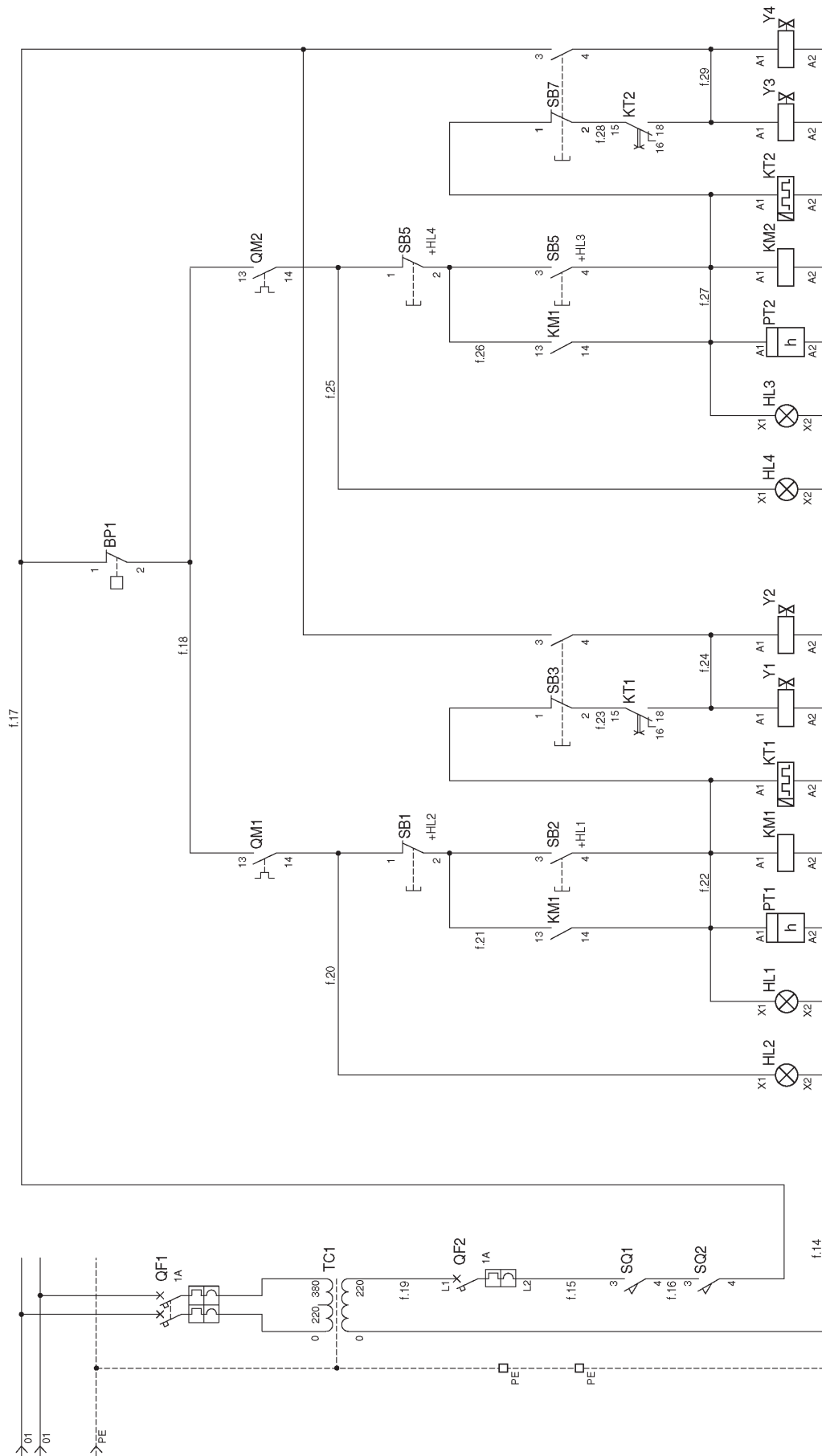
**Compression diagram- High pressure compressor - only air**

**14.2**



### 14.3 Electrical diagram





POS.	KEY
	GENERAL
QS1	MAIN SWITCH
QF1	PRIMARY AUXILIARY PROTECTION SWITCH
TC1	AUXILIARY TRASFORMER (380/220 OR 220/220)
QF2	SECONDARY AUXILIARY PROTECTION SWITCH
BP1	PRESSURE SWITCH
SQ1	DOOR MICROSWITCH
SQ2	DOOR MICROSWITCH
	MOTOR M1
QM1	OVERLOAD RELAY MOTOR PROTECTION SWITCH
KM1	MOTOR CONTROL CONTACTOR
M1	MOTOR
SB1	STOP BUTTON
SB2	STOP BUTTON
SB3	DRAIN BUTTON
HL2	READY STATE RUNNING SIGNAL (GREEN)
HL1	RUNNING SIGNAL (RED)
PT1	HOUR COUNTER
KT1	CHARGE-DRAIN
Y1	SOLENOID VALVE CHARGING
Y2	SOLENOID VALVE DRAINING
	MOTOR M2
QM2	OVERLOAD RELAY MOTOR PROTECTION SWITCH
KM2	MOTOR CONTROL CONTACTOR
M2	MOTOR
SB5	STOP BUTTON
SB6	STOP BUTTON
SB7	PURGE PUSH DRAIN BUTTON
HL4	READY STATE RUNNING SIGNAL (GREEN)
HL3	RUNNING SIGNAL (RED)
PT2	HOUR COUNTER
KT2	CHARGE-DRAIN TIMER
Y3	SOLENOID VALVE CHARGING
Y4	SOLENOID VALVE DRAINING

**SPARE PARTS**

**15**

**15.1 Exploded view of the machine parts ..... 89**

*Crankcase ..... 91*

*Piston rod unit ..... 93*

*Cylinder unit ..... 95*

*Valve head unit ..... 97*

*Cooling pipes ..... 99*

*Filtering system ..... 101*

*Condensate separator ..... 103*

*Pulley - Crankcase and Cylinder - Low pressure compressor ..... 104*

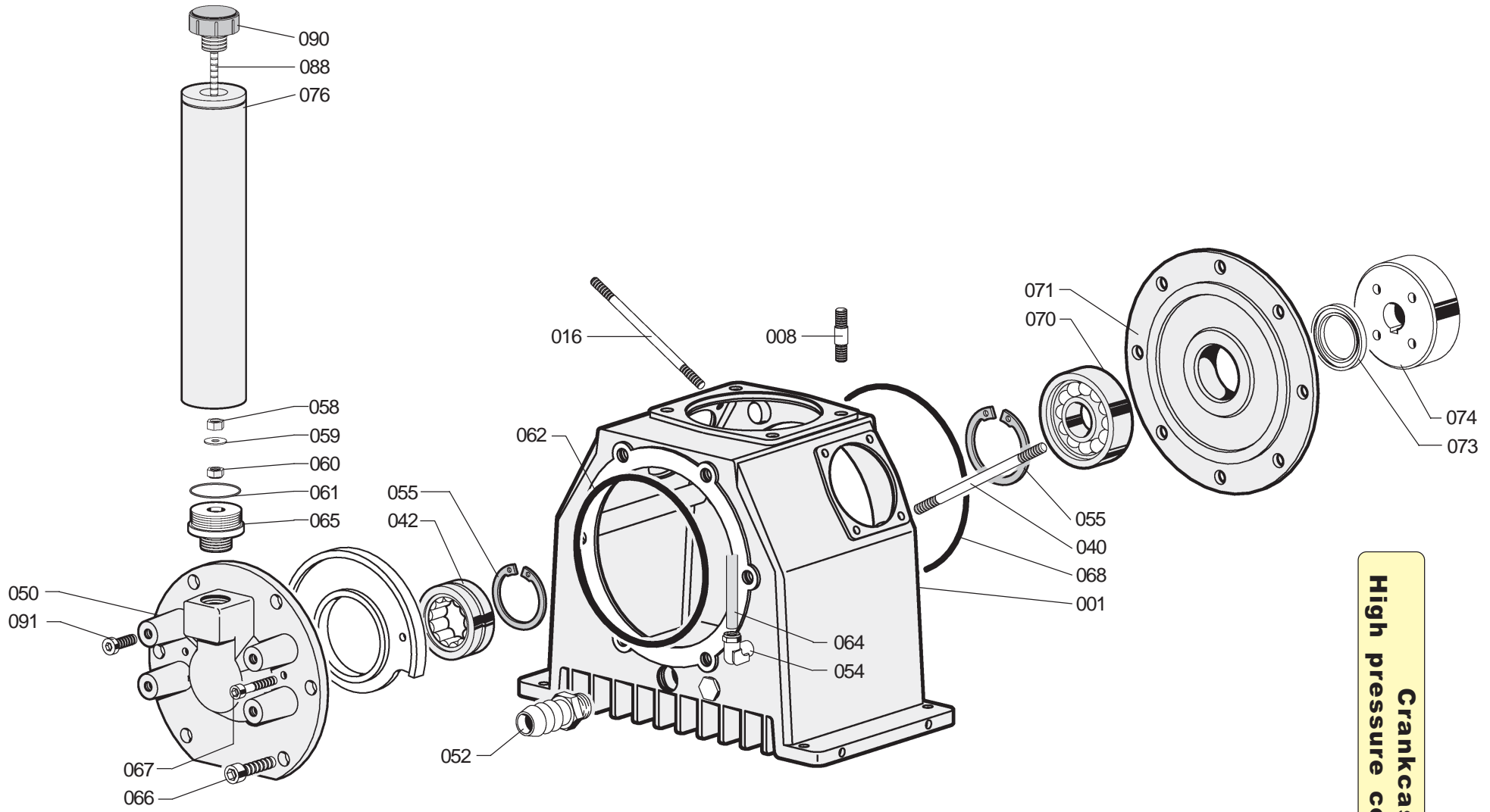
*Piston rod unit - Low pressure compressor ..... 105*

*Cylinder, valve and filter unit - Low pressure compressor ..... 106*

*Description of the pump unit low pressure and pipes ..... 107*

**Exploded view of the machine parts**

**15.1**



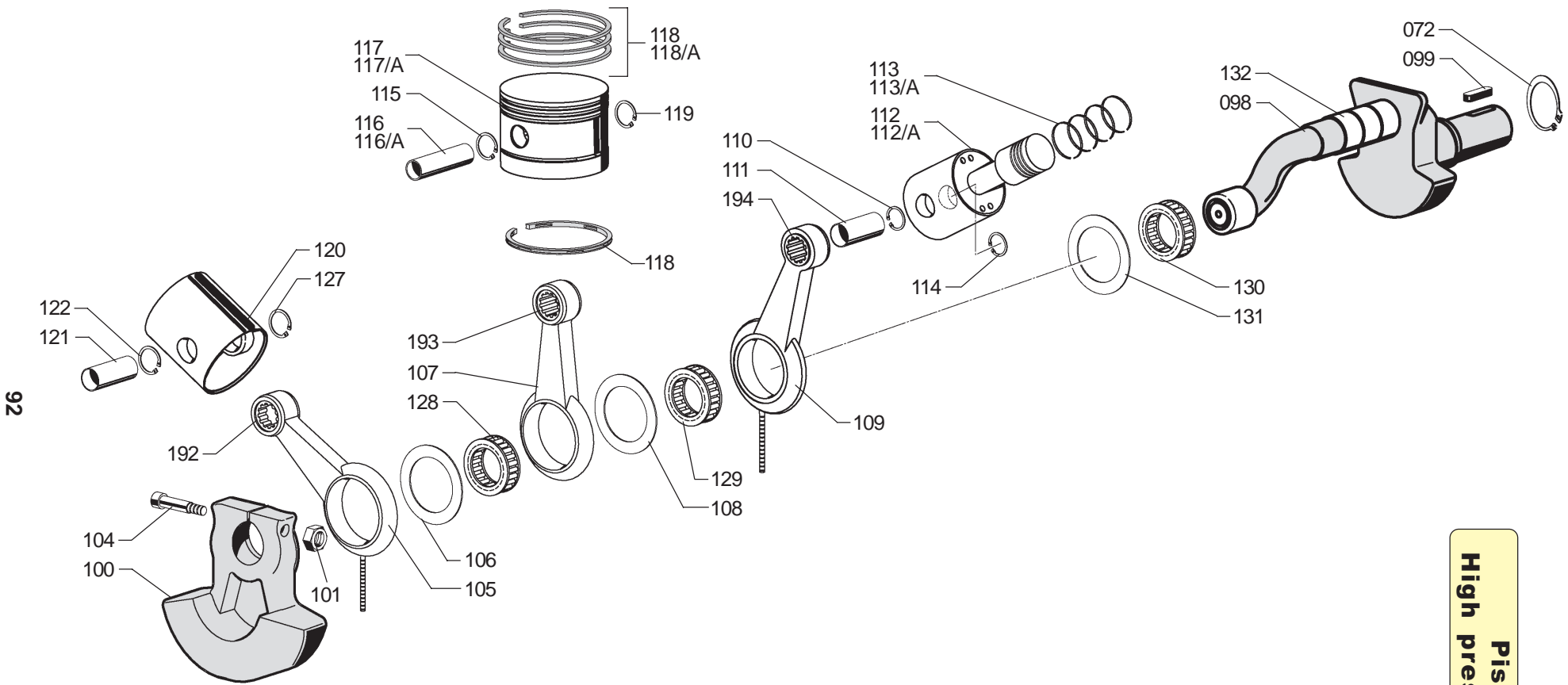
**Crankcase**  
**High pressure compressor**

## Crankcase

### High pressure compressor

POSIZ.	CODICE	DESCRIZIONE
001	13-00-0001	MONOBLOCCO
008	13-01-0008	TIRANTE PRIMO STADIO
016	13-03-0016	TIRANTE TERZO STADIO
040	13-02-0040	TIRANTE SECONDO STADIO
042	13-00-0042	CUSCINETTO RULLI FLANGIA NU305
050	13-00-0050	FLANGIA LATO FILTRI
052	13-00-0052	RACCORDO PORTATUBO SCARICO OLIO
054	13-00-0021	RACCORDO ANGOLO 1/8 TUBO 8 mm RILSAN
055	13-00-0055	ANELLO ELASTICO SEEGER J 62
058	13-00-0018	DADO 8 mm
059	13-00-0009	RONDELLA PIANA 8 mm
060	13-00-0018	DADO 8 mm
061	13-00-0061	O-RING TUBO CARICO OLIO
062	13-00-0062	O-RING FLANGIA
064	13-00-0064	TUBO CONTROLLO LIVELLO OLIO
065	13-00-0065	RACCORDO TUBO CARICO OLIO
066	13-00-0048	VITE 8x25 TCE
067	13-00-0067	VITE 6x35 TCE
068	13-00-0062	O-RING FLANGIA
070	13-00-0070	CUSCINETTO A SFERE 6302
071	13-00-0071	FLANGIA LATO VENTOLA
073	13-00-0073	PARAOLIO 30-48-8
074	13-00-0074	MOZZO PORTAVENTOLA
076	13-00-0076	TUBO CARICO OLIO CON FLANGIA SUPERIORE
088	13-00-0088	ASTA FILETTATA 8 mm
090	13-00-0090	TAPPO CARICO OLIO
091	13-00-0048	VITE 8x25 TCE

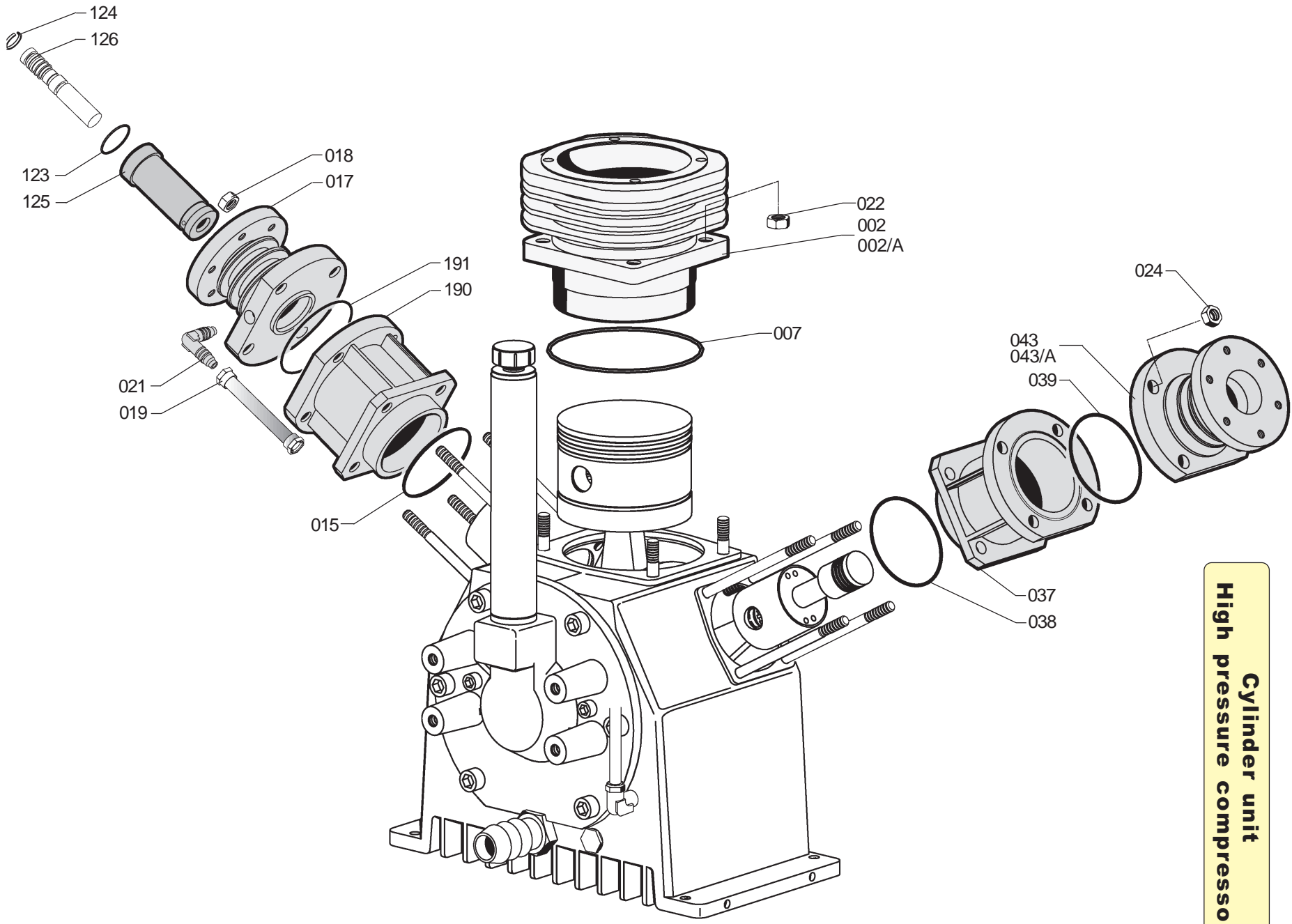
**Piston rod unit  
High pressure compressor**





**Piston rod unit  
High pressure compressor**

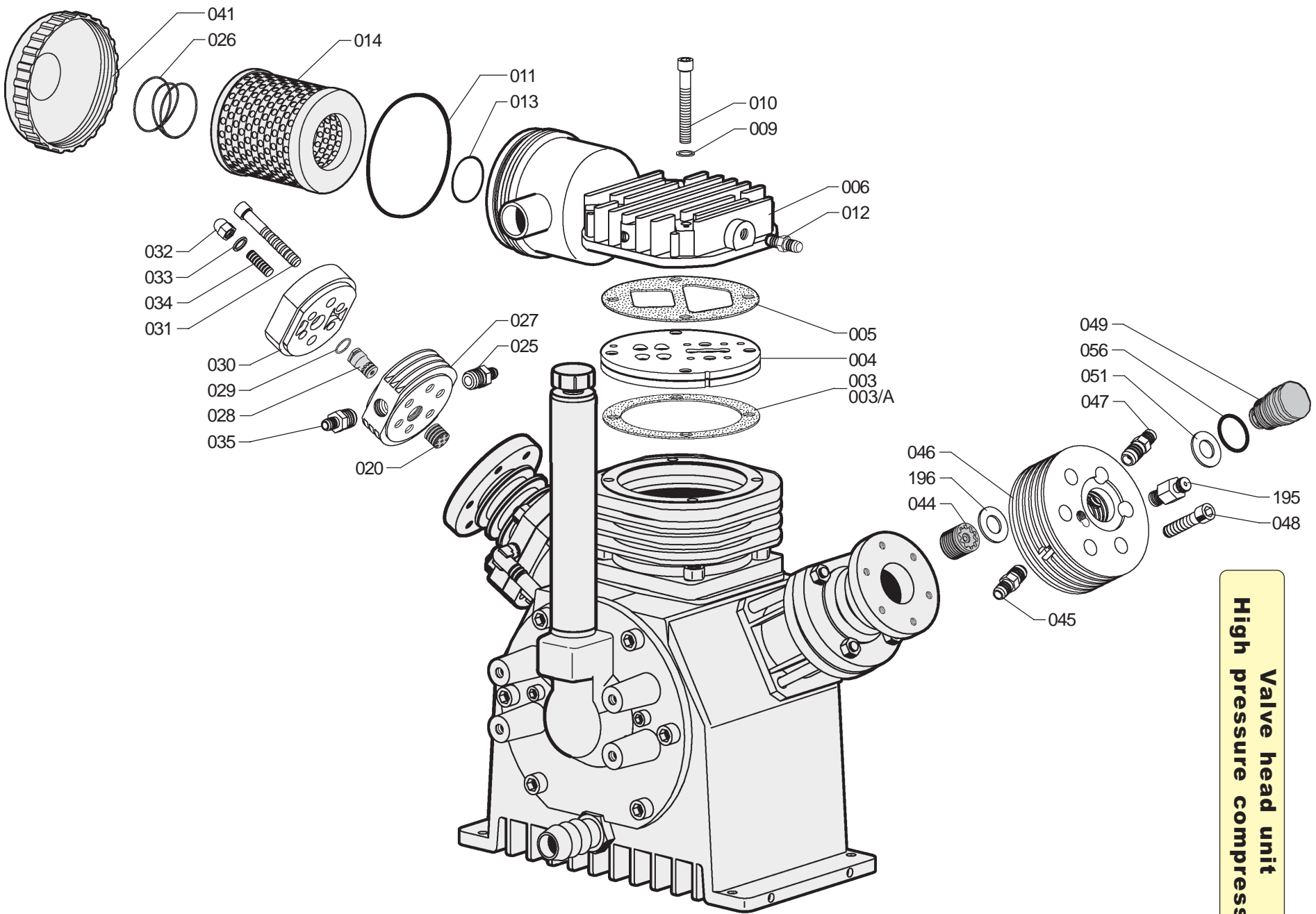
POS.	CODE	DESCRIPTION
072	13-00-0072	SEEGER RETAINING RING A 30
098	13-00-0098	CRANKSHAFT
099	13-00-0099	KEY
100	13-00-0100	COUNTERWEIGHT
101	13-00-0101	8 mm. SELF-LOCKING NUT
104	13-00-0104	8x65 TCE SCREW
105	13-00-0105	THIRD STAGE CONNECTING ROD ASSEMBLY
106	13-00-0106	SPACER
107	13-01-0107	FIRST STAGE CONNECTING ROD ASSEMBLY
108	13-00-0106	SPACER
109	13-00-0105	SECOND STAGE CONNECTING ROD ASSEMBLY
110	13-00-0110	SEEGER RETAINING RING
111	13-02-0111	2nd STAGE PIN
112	13-02-0112	SECOND STAGE 36 mm. PISTON
112/A	16-02-0112	SECOND STAGE 38 mm. PISTON
113	13-02-0113	2nd STAGE 36 mm. PISTON RINGS
113/A	16-02-0113	2nd STAGE 38 mm. PISTON RINGS
114	13-00-0110	SEEGER RETAINING RING
115	13-00-0110	SEEGER RETAINING RING
116	13-01-0116	FIRST STAGE 88 mm. PIN
116/A	16-01-0116	FIRST STAGE 95 mm. PIN
117	13-01-0117	FIRST STAGE 88 mm. PISTON
117/A	16-01-0117	FIRST STAGE 95 mm. PISTON
118	13-01-0118	1st STAGE 88 mm. PISTON RINGS
118/A	16-01-0118	1st STAGE 95 mm. PISTON RINGS
119	13-00-0110	SEEGER RETAINING RING
120	13-03-0120	GUIDING SLIDING BLOCK
121	13-02-0111	3rd STAGE PIN
122	13-00-0110	SEEGER RETAINING RING
127	13-00-0110	SEEGER RETAINING RING
128	13-00-0128	ROLLER CAGE
129	13-00-0128	ROLLER CAGE
130	13-00-0128	ROLLER CAGE
131	13-00-0106	SPACER
132	13-00-0132	HARDENED RING
192	13-00-0192	ROLLER CAGE
193	13-00-0192	ROLLER CAGE
194	13-00-0192	ROLLER CAGE



**Cylinder unit  
High pressure compressor**

**Cylinder unit  
High pressure compressor**

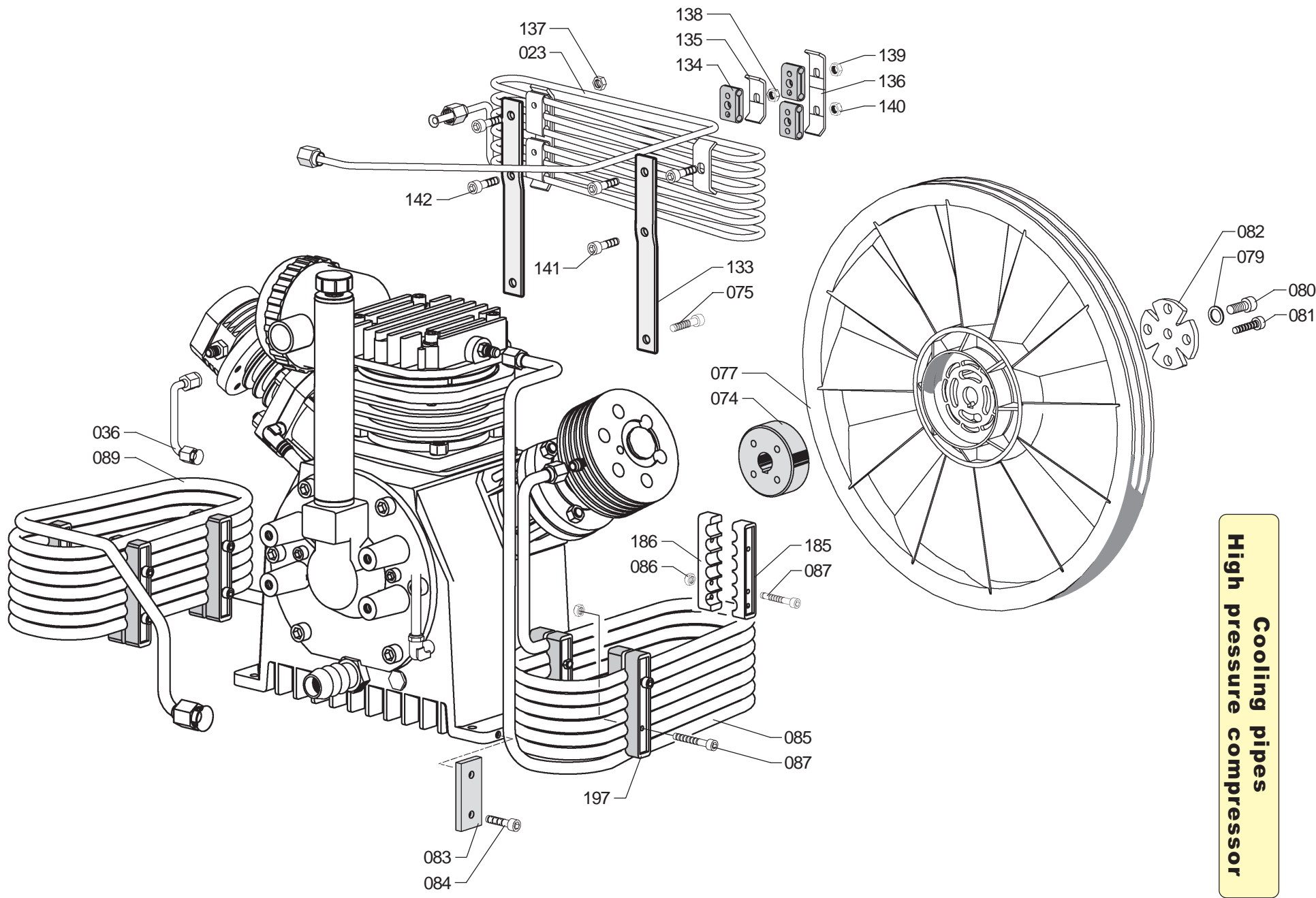
POS.	CODE	DESCRIPTION
002	13-01-0002	FIRST STAGE 88 mm. CYLINDER
002/A	16-01-0002	FIRST STAGE 95 mm. CYLINDER
007	13-01-0007	FIRST STAGE CYLINDER O-RING
015	13-00-0015	THIRD STAGE CYLINDER O-RING
017	13-02-0017	THIRD STAGE GUIDING CYLINDER
018	13-00-0018	8 mm. BOLT
019	13-00-0019	LUBRICATION INDICATOR PIPE
021	13-00-0021	CORNER 1/8 PIPE FITTING 8 mm. RILSAN
022	13-00-0018	8 mm. NUT
024	13-00-0018	8 mm. NUT
037	13-02-0037	SECOND STAGE 60 mm. GUIDING CYLINDER
038	13-00-0015	GUIDING CYLINDER O-RING
039	13-00-0039	SECOND STAGE CYLINDER O-RING
043	13-02-0043	SECOND STAGE 36 mm. CYLINDER
043/A	16-02-0043	SECOND STAGE 38 mm. CYLINDER
123	13-03-0123	3rd STAGE VITON O-RING
124	13-03-0124	SET OF 3rd STAGE PISTON RINGS
125	13-03-0125	14 mm. THIRD STAGE CYLINDER
126	13-03-0126	14 mm. THIRD STAGE PISTON
190	13-03-0190	THIRD STAGE 60 mm GUIDING CYLINDER
191	13-00-0039	THIRD STAGE GUIDING CYLINDER O-RING



**Valve head unit  
High pressure compressor**

**Valve head unit  
High pressure compressor**

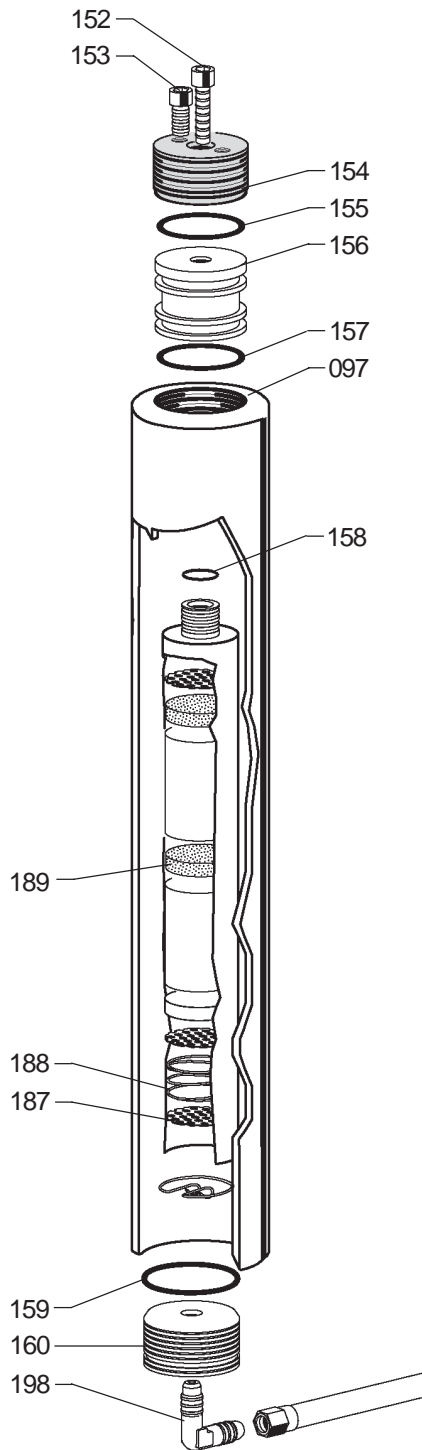
POS.	CODE	DESCRIPTION
003	13-01-0003	FIRST STAGE 88 mm. GASKET
003/A	16-01-0003	FIRST STAGE 95 mm. GASKET
004	13-01-0004	FIRST STAGE HEAD WITH VALVES
005	13-01-0005	FIRST STAGE GASKET
006	13-01-0006	FIRST STAGE HEAD COVER
009	13-00-0009	8 mm. FLAT WASHER
010	13-00-0010	SCREW 8x55 TCE
011	13-01-0011	INTAKE FILTER COVER O-RING
012	13-00-0012	STRAIGHT 1/4 PIPE FITTING 10 mm
013	13-01-0013	INTAKE FILTER O-RING
014	SC000370	LUBRICATION INDICATOR PIPE
020	13-03-0020	THIRD STAGE INLET VALVE
025	13-00-0025	STRAIGHT 1/4 - PIPE FITTING 6 mm.
026	13-01-0026	INTAKE FILTER SPRING
027	13-03-0027	THIRD STAGE HEAD
028	13-03-0028	THIRD STAGE EXHAUST VALVE
029	13-03-0029	VITON O-RING FOR THIRD STAGE EXHAUST VALVE
030	13-03-0030	3rd STAGE HEAD COVER
031	13-00-0031	8x50 TCE SCREW
032	13-00-0032	STAINLESS STEEL 8 mm. CAP NUT
033	13-03-0033	8 mm. COPPER WASHER
034	13-03-0034	8x25 STAINLESS STEEL DOWEL
035	13-00-0035	STRAIGHT 1/4 PIPE FITTING 8 mm.
041	13-01-0041	INTAKE FILTER COVER
044	13-02-0044	SECOND STAGE INLET VALVE
045	13-02-0045	LONG STRAIGHT 1/4 PIPE FITTING 10
046	13-02-0046	SECOND STAGE HEAD
047	13-02-0047	LONG STRAIGHT 1/4 PIPE FITTING 10
048	13-00-0048	8x25 TCE SCREW
049	13-02-0049	SECOND STAGE EXHAUST VALVE
051	13-02-0051	SECOND STAGE COPPER GASKET
056	13-02-0056	VITON O-RING FOR 2nd STAGE VALVE
195	13-00-0195	FIRST STAGE SAFETY VALVE
196	13-02-0051	SECOND STAGE COPPER GASKET



**Cooling pipes  
High pressure compressor**

POS.	CODE	DESCRIPTION
023	13-03-0023	6 mm. COOLING PIPE
036	13-00-0036	8 mm. PIPE
074	13-00-0074	FAN-HOLDING HUB
075	13-00-0075	8x30 TCE SCREW
077	13-00-0077	COOLING FAN
079	13-00-0079	12 mm. FLAT WASHER
080	13-00-0080	12x35 TCE SCREW
081	13-00-0081	10x40 TCE SCREW
082	13-00-0082	FAN FLANGE
083	13-00-0083	GALVANIZED PIPE-HOLDING BRACKET
084	13-00-0084	6x15 TCE SCREW
085	13-00-0085	1st-2nd STAGE 10 mm. COOLING PIPE
086	13-00-0086	6 mm. NUT
087	13-00-0087	6x30 TCE SCREW
089	13-00-0089	10 mm. 2nd-3rd STAGE COOLING PIPE
133	13-00-0133	6 mm. PIPE-HOLDING BRACKET
134	13-00-0134	VIBRATION-DAMPING PIPE-HOLDING RUBBER WASHER
135	13-00-0135	SINGLE 6 mm. PIPE-HOLDING BRACKET
136	13-00-0136	DOUBLE 6 mm. PIPE-HOLDING BRACKET
137	13-00-0137	SELF-LOCKING 6MA NUT
138	13-00-0137	SELF-LOCKING 6MA NUT
139	13-00-0137	SELF-LOCKING 6MA NUT
140	13-00-0137	SELF-LOCKING 6MA NUT
141	13-00-0141	6x25 TCE SCREW
142	13-00-0141	6x25 TCE SCREW
186	13-00-0186	3-HOLE PIPE-HOLDING BRACKET
197	13-00-0197	2-HOLE PIPE-HOLDING BRACKET

**Filtering system  
High pressure compressor**

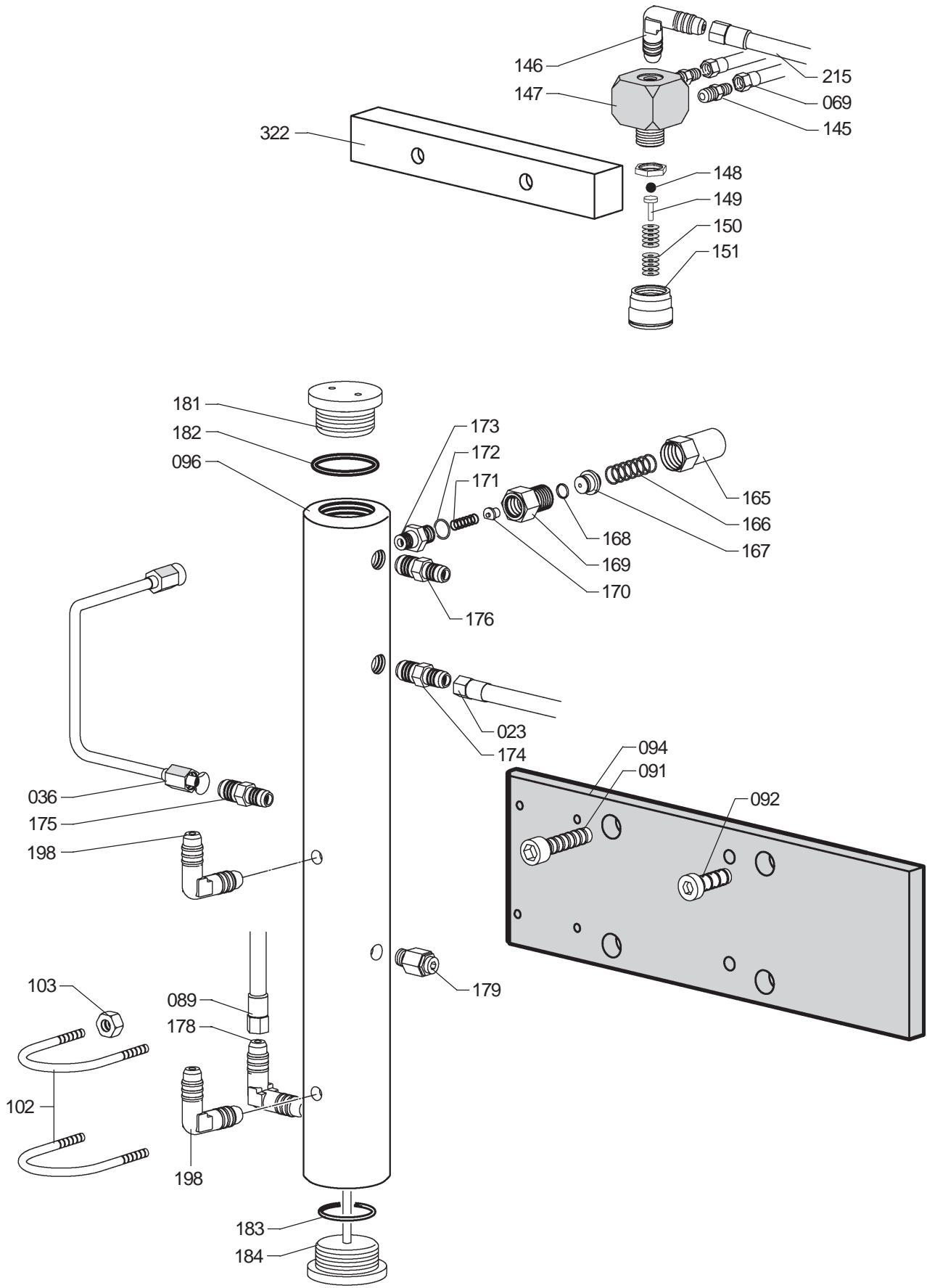




**Filtering system  
High pressure compressor**

POS.	CODE	DESCRIPTION
097	13-00-0097	CLEANER FILTER
152	13-00-0152	VITE 8x30 TCE
153	13-00-0153	VITE 8x12 TCE
154	13-00-0154	UPPER FILTER CAP
155	13-00-0155	FILTER CAP O-RING
156	13-00-0156	INTERNAL FILTER CAP
157	13-00-0155	FILTER CAP O-RING
158	13-00-0158	FILTER CARTRIDGE O-RING
159	13-00-0155	FILTER CAP O-RING
160	13-00-0160	LOWER FILTER CAP
187	13-00-0187	MESH DISK DIAM. 39 mm.
188	13-00-0188	FILTER CARTRIDGE INTERNAL SPRING
189	13-00-0189	FELT DISK DIAM. 40 mm
198	13-00-0144	CORNER 1/8 PIPE FITTING 6 mm.

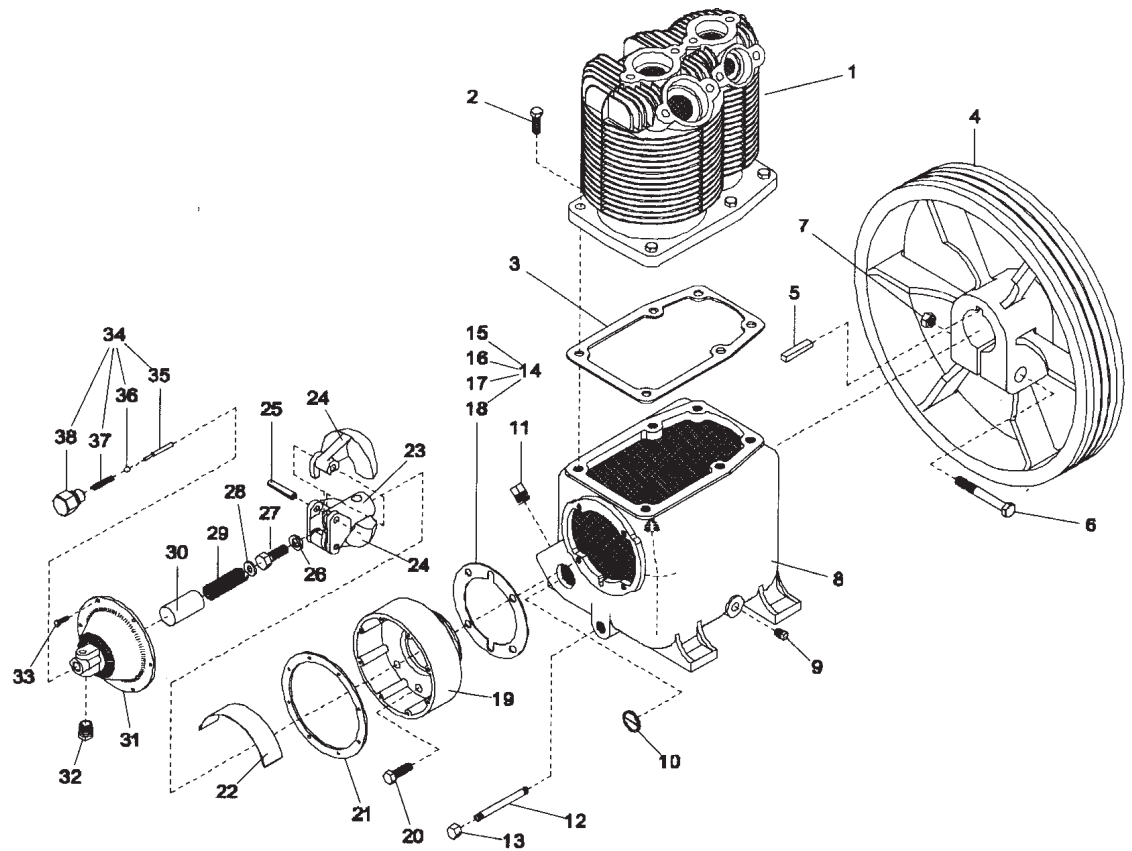
**Condensate separator  
Low pressure compressor**



**Condensate separator  
Low pressure compressor**

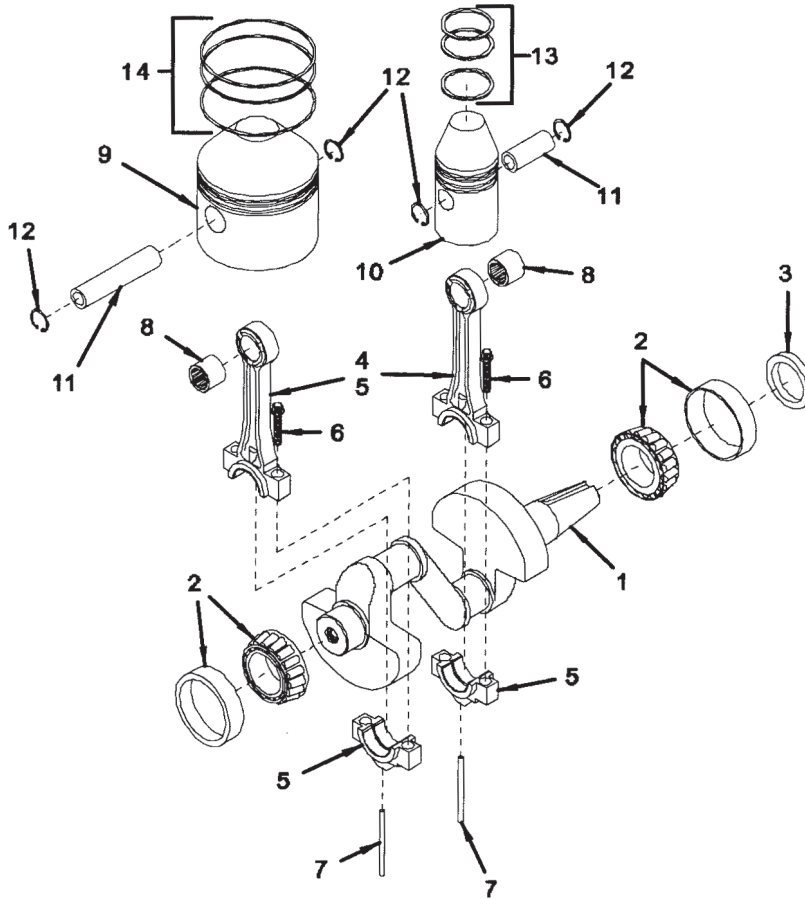
POS.	CODE	DESCRIPTION
023	13-03-0023	6 mm. COOLING PIPE
036	13-00-0036	8 mm. PIPE
069	13-04-0226	HP 300 mm. PIPE
089	13-00-0089	10 mm. 2nd-3rd STAGE COOLING PIPE
091	13-00-0048	8x25 TCE SCREW
092	13-00-0092	LOWERED 8x20 TCE SCREW
094	13-00-0094	FILTER-HOLDING PLATE
096	13-00-0096	CONDENSATE SEPARATOR
102	13-00-0102	SEPARATOR-HOLDING BRACKET
103	13-00-0018	8 mm. NUT
145	13-00-0025	STRAIGHT 1/4 - PIPE FITTING 6 mm.
146	13-00-0146	CORNER 1/4 - PIPE FITTING 6 mm.
147	13-00-0147	V.M.P. BODY
148	13-00-0148	V.M.P. STEEL BALL
149	13-00-0149	SMALL V.M.P. PISTON
150	13-00-0150	SET OF BELLEVILLE WASHERS
151	13-00-0151	V.M.P. CAP
165	13-00-0165	SAFETY VALVE ADJUSTMENT COVER
166	13-00-0166	SAFETY VALVE SPRING
167	13-00-0167	SMALL SAFETY VALVE PISTON
168	13-00-0168	SMALL S.V. PISTON O-RING
169	13-00-0169	SAFETY VALVE BODY
170	13-00-0170	NYLON SAFETY VALVE SEAT
171	13-00-0171	SAFETY VALVE SEAT SPRING
172	13-00-0172	SAFETY VALVE O-RING
173	13-00-0173	SAFETY VALVE CONNECTOR
174	13-00-0174	STRAIGHT 1/8 PIPE FITTING 6
175	13-00-0174	STRAIGHT 1/8 PIPE FITTING 6
176	13-00-0174	STRAIGHT 1/8 PIPE FITTING 6
178	13-00-0178	CORNER 1/4 PIPE FITTING 10 mm.
179	13-03-0179	SECOND STAGE SAFETY VALVE
181	13-00-0181	UPPER SEPARATOR/FILTER SEPARATOR CAP
181/A	13-00-181A	UPPER 1/8 HOLE SEPARATOR CAP
182	13-00-0182	UPPER SEPARATOR CAP O-RING
183	13-00-0182	UPPER SEPARATOR CAP O-RING
184	13-00-0184	LOWER SEPARATOR CAP
198	13-00-0144	CORNER 1/8 - PIPE FITTING 6 mm.
215	13-04-0215	HP 400 mm. PIPE
322	13-04-0430	ALUMINIUM BLOCK

**Pulley - Crankcase and cylinder  
Low pressure compressor**



ITEM	PART NO.	NAME	REQ.	ITEM	PART NO.	NAME	REQ.
1	P12237D	Cylinder	1	19	NR80A	Gov. Housing	1
2	M2345	Screw, Hex Head Cap	6	20	M472	Screw, Hex Head Cap	4
3	NR29A	Gasket, Cylinder Flange	1	21	SE1489	Gasket, Gov Housing Cover	1
4	NR7A	Flywheel	1	22	NR104	Plate, Gov Baffle	1
5	U8	Key	1	23	SE583B	Spindle, Gov. Wt.	1
6	M1915	Screw, Hex Head Cap	1	24	SE582	Gov. Wt.	2
7	M465	Nut, Hex	1	25	SE 592A	Pin, Gov. Wt.	2
8	M1820	Crankcase	1	26	M466	Washer, Spring Lock	1
9	M2326	Pipe Plug	1	27	RE1494	Screw, Hex Head Cap	1
10	RE714	Gauge, Oil Level	1	28	M912A	Washer, Flat	1
11	M459	Pipe Plug (Oil Fill)	1	29	SE590	Spring, Gov. Main	1
12	M492	Pipe, Oil Drain	1	30	SE587	Sleeve, Spring	1
13	M461	Cap, Oil Drain	1	31	RE10100A	Cover, Gov. Housing	1
14	Z130	Gasket Set, Gov. Housing	1	32	Z4593	MUFFLER ASSY, UNLOADER	1
15	SE1430	Gasket, Gov. Housing (.030" Thick)	1	33	M2400	Screw, Hex Head Machine	8
16	SE1430A	Gasket, Gov. Housing (.005" Thick)	1	34	Z12414A	RELEASE VALVE ASSY. KIT	1
17	SE1430B	Gasket, Gov. Housing (.010" Thick)	1	35	SE586B	Plunger, Release Valve	1
18	SE1430C	Gasket, Gov. Housing (.015" Thick)	1	36	P07841A	Ball Release Valve	1
				37	SE591	Spring, Release Valve	1
				38	NR101	Body, Release Valve	1
					Z764	GASKET SET, COMPLETE PUMP	1

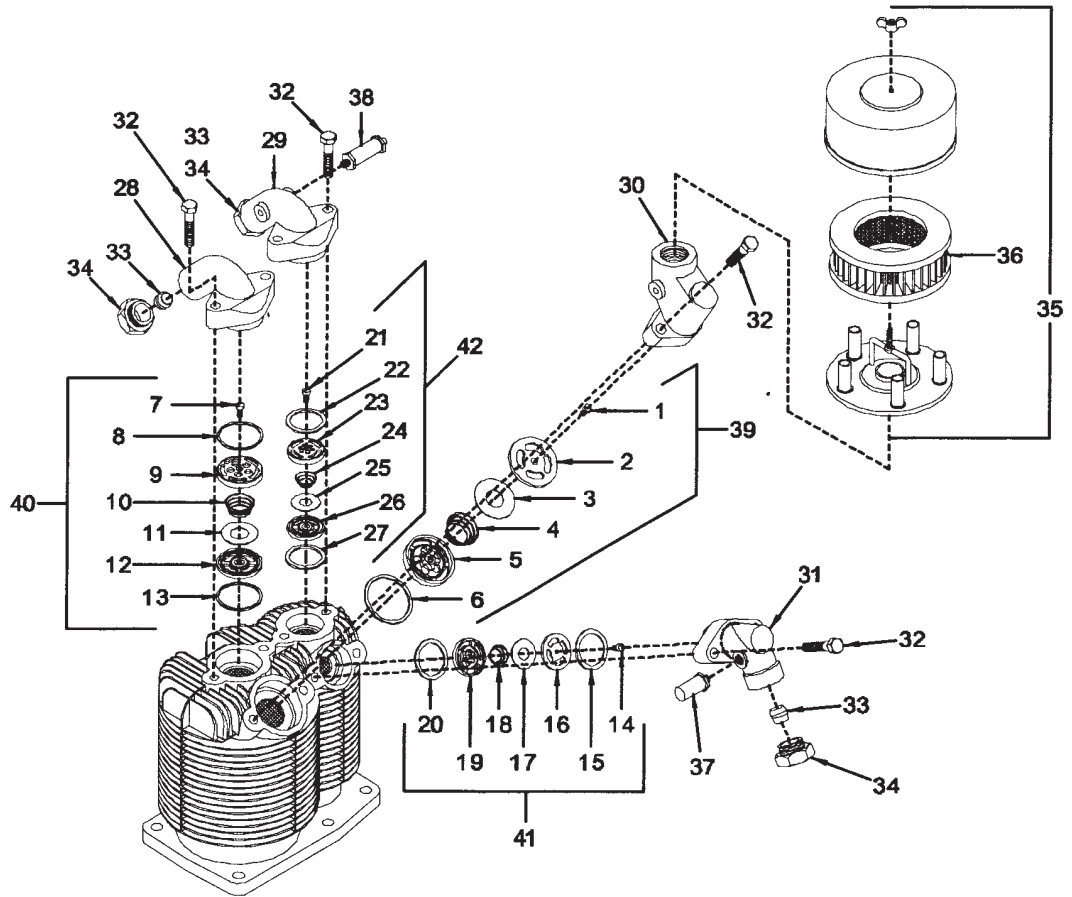
**Piston rod unit  
Low pressure compressor**



ITEM	PART NO.	NAME	REQ	ITEM	PART NO.	NAME	REQ
1	R105	Crankshaft (R-10D only)	1	8	R1037	Bearing, Piston Pin	2
	R155	Crankshaft (R-15B only)	1	9	ZR154	Piston, Low Pressure w/Pin	1
2	ZNR16	ASSY; Main Bearing	2	10	ZP2709C	Piston, High Pressure w/Pin	1
3	OSN4	Oil Seal	1	11	R1021	Pin, Piston	2
4	Z750	KIT, CONNECTING ROD ASSY. (Items 5,6,7 & 8)	1	12	R10102	Ring, Piston Pin Retaining	4
		R-15B, Low Pressure & High Pressure	2	13	Z797	RING SET, HIGH PRESSURE PISTON	1
		R-10D, Low Pressure	1	14	Z798	RING SET, LOW PRESSURE PISTON	1
	Z752	KIT, CONNECTING ROD ASSY. (Items 5,6,7 & 8)	1		Z9100	KIT, HIGH PRESSURE PISTON ASSY. (Items 10, 11, 12 & 13)	1
		R-10D, High Pressure (side only)	1		Z799	KIT, LOW PRESSURE PISTON ASSY. (Items 9, 11, 12 & 14)	1
5	NSS	Connecting Rod	1		Z9101	KIT, COMPLETE RING SET (Items 13 & 14)	1
6	M1583	Bolt, Connecting Rod	4				
7	R1024	Dipper, Oil (R-10D only)	2				
	R1524	Dipper, Oil (R-15B only)	2				

NOTE: NSS= Not Sold Separately

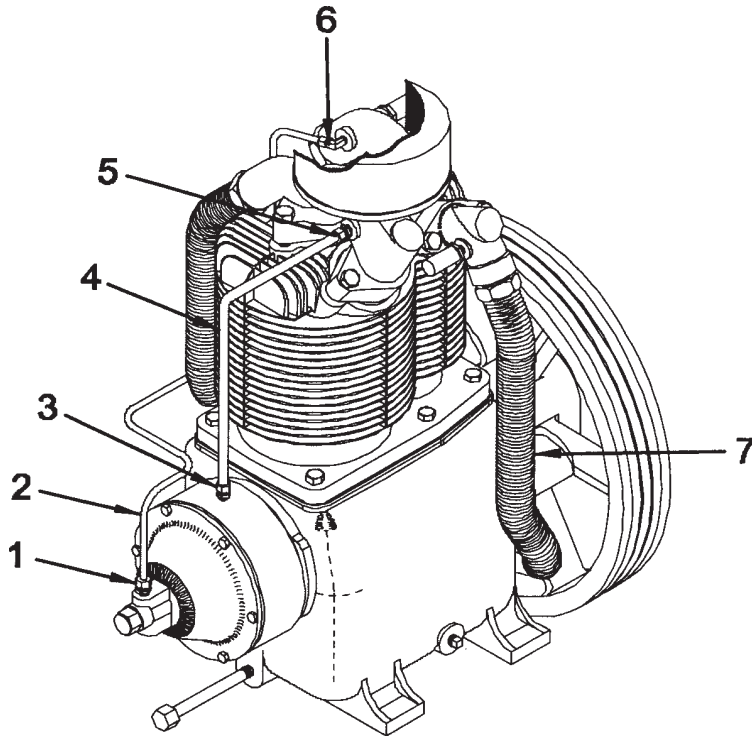
**Cylinder - Valve and Filter unit  
Low pressure compressor**



ITEM	PART NO.	NAME	REQ.	ITEM	PART NO.	NAME	REQ.
1	P04544A	Screw, Hex Head Machine	1	23	M2100	Cage, Exhaust Valve	1
2	RE1471A	Seat, Intake Valve	1	24	RE760	Spring, Valve	1
3	RE1470	Disc, Valve	1	25	RE1062	Disc, Valve	1
4	RE1458	Spring, Valve	1	26	RE757A	Seat, Exhaust Valve	1
5	M2098	Cage, Intake Valve	1	27	P04136	Gasket, Valve	1
6	P04134A	Gasket, Valve	1	28	RE102E	Manifold, LP Exhaust	1
7	M3220	Screw, Hex Head Machine	1	29	P12303B	Manifold, HP Exhaust	1
8	P04135A	Gasket, Valve	1	30	P09669C	Manifold, LP Intake	1
9	M2099	Cage, Exhaust Valve	1	31	P12302B	Manifold, HP Intake	1
10	RE1059	Spring, Exhaust Valve	1	32	P05005A	Screw, Hex Head Cap (All Manifolds)	8
11	RE1061	Disc, Valve	1	33	SE542	Ferrule	3
12	M2097	Seat, Exhaust Valve	1	34	SE541	Nut, compression	3
13	P04135A	Gasket, Valve	1	35	P04999A	Intake Filter	1
14	M3220	Screw, Hex Head Machine	1	36	P05050A	Filter Element	1
15	P09191A	Gasket, Valve	1	37	P03592A	Interstage Pressure Relief Valve	1
16	P09172B	Seat, Intake Valve	1	38	P09704A	Pressure Relief Valve	1
17	RE1062	Disc, Valve	1	39	Z812	VALVE ASSY, LP INTAKE*	1
18	RE760	Spring, Valve	1	40	Z813	VALVE ASSY, LP EXHAUST	1
19	M2101	Cage, Intake Valve	1	41	Z5117	VALVE ASSY, HP INTAKE*	1
20	P09170A	Gasket, Valve	1	42	Z115	VALVE ASSY, HP EXHAUST	1
21	M3220	Screw, Hex Head Machine	1		Z5155	COMPLETE VALVE SET w/GASKETS*	
22	P04137A	Gasket, Valve	1		Z5156	COMPLETE VALVE GASKET SET	

\* See page 20, Unloader Kit, for intake valves for head unloader pumps. Use Z6795 - Complete Valve Set for Head Unloader Pumps.

**Pump unit  
Low pressure compressor**



ITEM	PART NO.	NAME	REQ.
1	M2863	Compression Fitting	1
2	ZSB250A	Tube, Unloading w/Fittings	1
3	M2864	Compression Fitting	1
4	ZUB375	Breather Tube w/Fittings	1
5	M2864	Compression Fitting	1
6	M2868	Compression Fitting	1
7	Z9140	Intercooler w/Fittings	1

**16.1****Introduction**

- 16.1.1** The Mini O2DII oxygen analyser has been designed to measure oxygen levels from between 0.1 and 100%.
- 16.1.2** The analyser is used to check levels of oxygen present in cylinders or monitoring a gas mixing control panel, but should never be used for both operations at the same time. If the analyser is used to measure the level of oxygen coming out of a mixing panel, a second Mini O2DII should be used to check the cylinders.
- 16.1.3** The Mini O2DII has a large display and works thanks to an oxygen electrochemical sensor with an internal temperature compensated for at least two years. Energy is supplied by a 9V, 400 hour battery that enables operation for three years before it has to be changed.
- 16.1.4** The Mini O2DII, an autonomous unit, water and shock resistant, has been designed specifically for underwater sector – sport (NITROX), commercial and military – where hostile environmental conditions are the norm and not the exception.
- 16.1.5** The Mini O2DII is supplied ready to use. A seal is fixed to the front of the sensor to protect it, this should be removed before use. Check the machine for any damage and check that the seal on the sensor is intact. Contact the supplier in the event of damage to the machine or if the seal has been broken or not in the correct place.

**WARNING:**

**Read these instructions before using the analyser !**





**Controls****16.2**

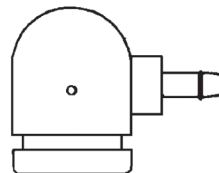
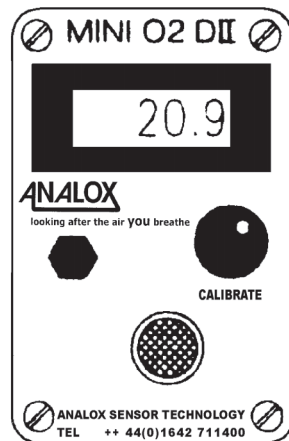
- 16.2.1** The analyser has an in-built on/off switch which is at the side or on the front of the machine. Move the switch upwards or downwards to switch the machine on and move it to the central position to switch it off. When the unit is switched on, the screen of the analyser will show an oxygen value but the machine should not be used until after calibration (see section 3.0).
- 16.2.2** The flat battery signal is a symbol in the form of a battery that appears in the corner of the screen. If it appears, change the battery before using the instrument (see section 7.0 Maintenance).
- 16.2.3** At the front of the machine there is an impermeable calibration handle. Turn it fully from left to right and then fully to the left, the reading should increase and then decrease. (If the reading does not change, see section 7.0 Maintenance).

**WARNING:**

**DO NOT use when the FLAT BATTERY symbol appears !**



## OXYGEN ANALYSER MINI O2DII



**16.3****Air calibration**

- 16.3.1** Before using the machine it is essential to carry out the air calibration each time. The instructions are as follows:
- 16.3.2** Make sure that the sensor seal and any other flow adapter has been removed and that the reading on the screen has stabilised.
- 16.3.3** Expose the analyser to clean air for two minutes and regulate the calibration handle until the screen shows 20.9 (if not possible, refer to paragraph 3.4 or to the Maintenance section).
- 16.3.4** Normal calibration is sometimes not possible at very high altitudes. In this case check the real pressure in BARs and multiply by the percentage of atmospheric oxygen (20.9%). Therefore, set the reading during calibration to the level calculated (equal to the percentage of oxygen at the surface). When measuring the level of oxygen in the sample, divide the reading by the same atmospheric pressure value to obtain the real percentage of oxygen present in the sample.
- For example: At an atmospheric pressure of 0.8 BAR corresponds to a percentage of oxygen at the surface of  $20.9\% \times 0.8 = 16.7\%O_2$ . If the sample reading is 32.0%, this value should be divided by 0.8 to obtain the real percentage of oxygen,  $32.0/0.8 = 40.0\%O_2$  real percentage.
- 16.3.5** The analyser is now ready to measure oxygen.

**WARNING**

**The analyser is sensitive to partial oxygen pressure.**

**Calibration must always be carried out at the same atmospheric pressure as the oxygen measurement.**

## Operation

## 16.4

- 16.4.1** The analox Mini O2DII is supplied with a single DII adapter that enables the analyser to be connected directly to the outlet of the nitrox tank.
- 16.4.2** Make sure that the sensor seal has been removed. Connect the DII adapter to the analyser pushing the adapter onto the turret of the sensor. The O-ring on the sensor makes fastening easy.
- 16.4.3** Hold the DII adapter, turned towards you, firmly against the cylinder outlet. Slowly open the cylinder valve until gas can be heard hissing through the flow adapter.

### WARNING

Open the cylinder valve

VERY CAREFULLY



- 16.4.4** Close the cylinder valve after fifteen seconds when the Mini O2DII shows a stabilised reading. If in doubt, carefully repeat the process and make sure the flow of gas is gentle.

- 16.4.5** A couple of seconds after the gas flow has stopped, the reading will begin to change to the surrounding level of air of 20.9% O<sub>2</sub>, the reading should therefore be taken when the gas flow is open.

### WARNING

Do not pressurise the sensor as the readings will be inexact.



## Accessories

## 16.5

- 16.5.1** Transport / Storage

The box supplied contains the MiniO<sub>2</sub> DII, adapter and paper for correcting humidity.

## 16.6

## Troubleshooting

SYMPTOM	REASON	SOLUTION
Battery symbol	Flat battery	Change the battery
Empty screen	Switched off Bad connection	Switch on Check screen connection Check battery connection
Zero reading	Sensor not inserted Expired sensor	Check connection Check sensor
Irregular reading	Pressure on the sensor Radio transmission Old or faulty sensor Condensation on sensor	Check flow Move the machine away Replace sensor Dry the face of the sensor
Reading does not change when the calibration handle is turned	Faulty connections Sensor broken	Check connections Replace sensor
Sections of the screen are missing	Faulty screen	Return to vendor
Impossible to calibrate	Faulty sensor Sensor not in the air High altitude	Replace sensor Check the flow adapter Calculate percentage equivalent to 20.9 x bar
Varied Reading	Rapid temperature changes	Do not move the analyser from one temperature to the next immediately before use.

## Maintenance

## 16.7

### 16.7.1 Replacing the battery.

- a) Unscrew the 4 screws that are in each corner of the apparatus and lift the cover carefully.
- b) Slid the battery from the spring support and disconnect the electrical wire.
- c) Connect the electric wire to the new battery and slide the battery behind the spring support.
- d) Replace the cover carefully and replace the screws making sure that the sensor is well connected.
- e) Make sure that the wires are not trapped.

### 16.7.2 Replacing the sensor

- a) Serial number for replacing the sensor: 9100-9212-5A
- b) Remove the 4 screws that are in each corner of the machine and lift the cover carefully.
- c) Take out the flow adapter if installed and slide the sensor out of the cover.
- d) Disconnect the online connections from the sensor.
- e) Destroy the old sensor according to local regulations in force regarding materials containing lead and potassium hydroxide solutions.
- f) Take the new sensor out of its bag and check for any leakage. Connect it to the online sensor connections and slide it through the cover.

Replace the cover carefully and replace the screws making sure that the sensor is well connected.

Make sure that the wires are not trapped.

**16.8****Care of the Mini O2DII**

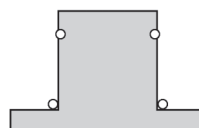
- 16.8.1** Even though the Mini O2DII has been designed to be water resistant, avoid immersion in liquids and do not leave outside without protection.
- 16.8.2** The Mini O2DII has been built to withstand minimal blows or falls but being a precision oxygen analyser it should be taken care of to guarantee correct long term efficiency.
- 16.8.3** Use a damp cloth to clean the Mini O2DII.
- 16.8.4** Protect the Mini O2DII from direct sunlight for long periods and do not expose it to extreme temperatures both high and low.
- 16.8.5** The Mini O2DII sensor is an electrochemical mechanism containing a corrosive electrolyte. Always check that it is not leaking and avoid contact with parts of the body or clothes. In the event of contact with the electrolyte, wash the effected part abundantly with water – see Safety Instructions.

**WARNING**

**If you notice a slimy or burning sensation in your fingers or other parts of the body after having worked on the sensor, wash abundantly with water.**

**If the burning sensation persists, call a doctor!**

**ANALOX 9212  
OXYGEN SENSOR**



glo Environmental Protection Ltd.  
sior Technology Ltd.

metonex Court  
Dunham Park, Silesley,  
85 5JA England  
44 (11) 1642 711410



**Safety information for the Mini O2DII****16.9**

- 16.9.1** Flat batteries should be destroyed according to the local regulations in force.
- 16.9.2** Used sensors or those that leak or are damaged in another way, should be destroyed safely according to the local regulations in force.
- 16.9.3** If the sensor contains KOH, a potassium hydroxide solution, a dangerous substance, which can cause the following effects:

**WARNING**

**SKIN: potassium hydroxide is corrosive –  
Contact with the skin can cause a chemical burn.**

**INGESTION: can cause injury or be fatal if ingested**

**EYES: contact with the eyes can cause permanent loss of sight.**

**FIRST AID PROCEDURE:**

**SKIN: wash the affected part abundantly with water and take off contaminated clothing. If burning persists, call a doctor.**

**INGESTION: Drink large quantities of fresh water.  
Do not induce vomiting. Call a doctor.**

**EYES: Wash abundantly with water for at least 15 minutes  
and call a doctor immediately.**

**Information on handling of the sensor****16.9.4**

MiniO2DII oxygen sensors are usually supplied in sealed bags. Before opening the bag make sure that there is no leakage from the sensor. The sensors are also sealed and in normal circumstances are not dangerous to health. Nevertheless, if there has been a leakage of potassium hydroxide from the electrolyte, use rubber gloves and wear protective glasses for use with chemicals when handling or cleaning it. Rinse contaminated surfaces with water.

**16.10****Details**

Interval	0.1 – 100.0% Oxygen
Precision	+/- 1% of the reading
Definition	0.1% Oxygen
Reaction time	90 in less than 15 seconds
Type of sensor	Analox 9212-5
Sensor life	More than 36 months in air 24 months guarantee in air
Battery	Alkaline 9V (PP3)
Battery life	4000 hours. Up to 36 months of continuous use.
Operating temperature	From -5° a 50° C
Storage temperature	From -5° a 50° C
Pressure	Sensitive to partial oxygen pressure



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