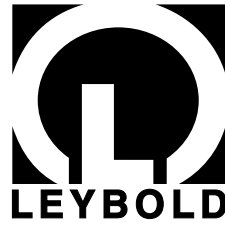


Vacuum Solutions

Application Support

Service



LEYBOLD VACUUM

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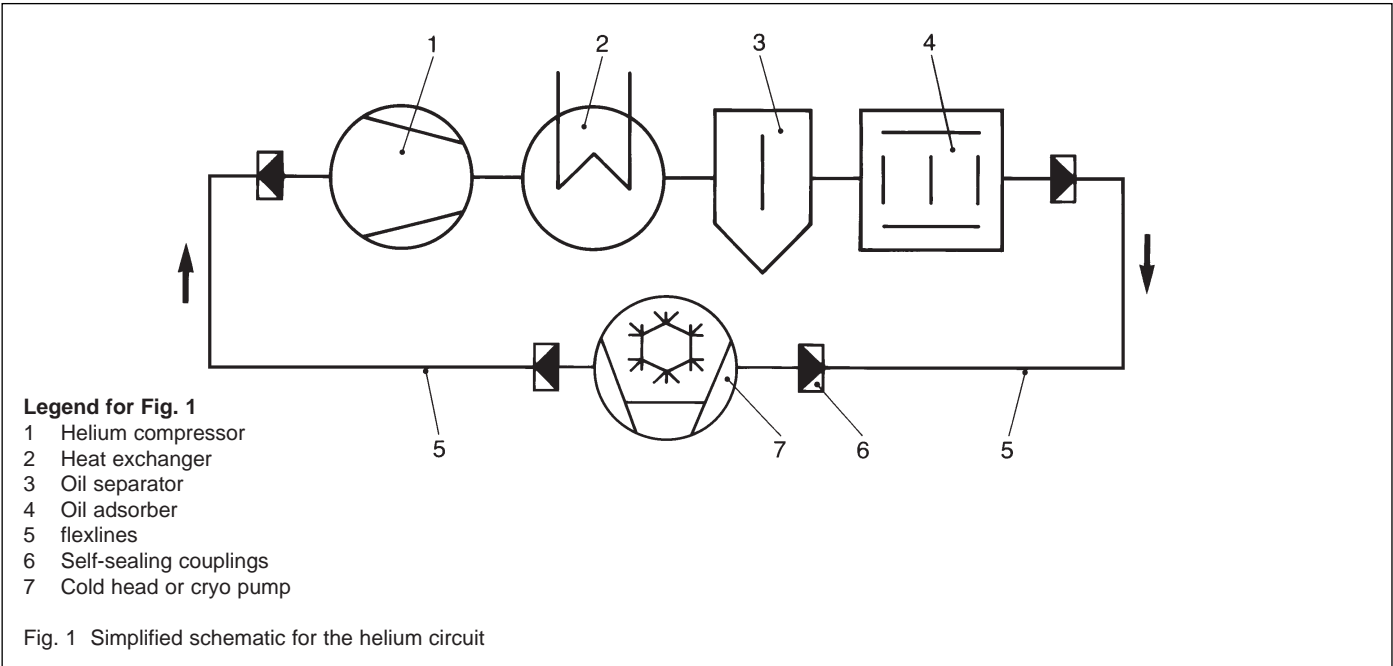


COOLPAK 6000-1

Compressor unit and
accessories for cryogenic
refrigerator units

Cat.-No. 892 35

Operating instructions



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Service personnel shall without fail read the instructions provided for their guidance (ISO 7000-0419).

Precautionary notes used in these instructions:

Warning

This indicates procedures and operations which must be strictly observed to prevent hazards to persons.

Caution

This indicates procedures and operations which must be strictly observed to prevent damage to or destruction of the unit.

Illustrations

In the references to illustrations, such as (1/2), the first number is the figure number, while the second digit identifies the item in the illustration.

We reserve the right to adopt modifications in the engineering design and the specifications indicated here.

The illustrations are not binding.

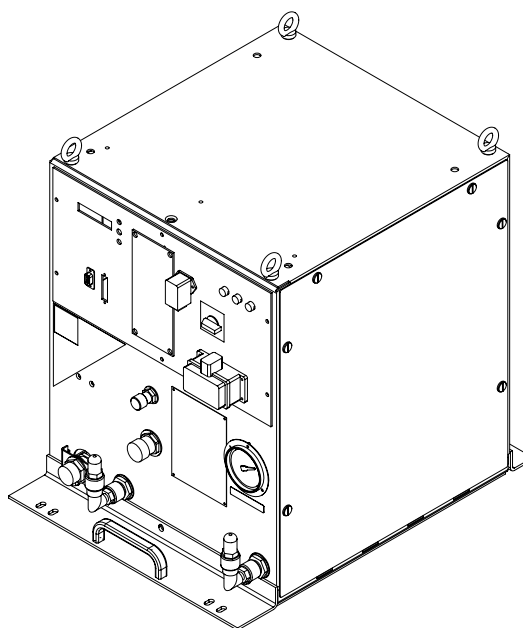


Fig.2 COOLPAK 6000-1 compressor unit

1 Description

Cryogenic refrigeration units comprise:

- the compressor unit,
- the cold head, and
- flexlines.

These operating instructions describe the design and operation of the compressor unit and the associated flexlines.

The compressor unit shall be used only to operate cold heads and other units in which cold heads are installed, e.g. refrigerator cryopumps or cryostats. No other application is permissible.

This compressor unit, COOLPAK 6000-1, is for use with the following cold heads or cryo pumps only:

Cold heads: RGD, RGS, or COOLPOWER 580, 5/100 (..), 120, 120 T.

Cryo pumps: COOLVAC or RPK 5000 and larger.

For multi-unit operation contact Leybold.

Only components manufactured by Leybold may be attached to the compressor units. The installation of other components is permissible only after consultation with Leybold.

These compressor units comply with all the requirements set forth in the European guidelines for awarding the CE seal of approval. In addition, they satisfy the requirements of Underwriters Laboratories (UL) and the Canadian Standards Association (CSA); please refer to the appendix for details.

1.1 Design and function

Compressor units are used to compress helium gas which then expands in the cold head to produce low temperatures.

Every compressor unit comprises the following functional modules:

- helium compressor (1/1),
- heat exchanger (1/2),
- gas purifiers (1/3) and (1/4),
- power module (electrical supply unit).

The compressor unit and the cold head (1/7) are joined by way of flexlines (1/5). The compressor unit, cold head and pressure lines are fitted with self-sealing couplings (1/6) and are charged with high-purity helium gas.

The helium compressor is sealed, lubricated and cooled with oil. The oil is cooled with water in a heat exchanger.

After compression the helium gas is cooled in the heat exchanger (1/2); oil is then removed from the gas at the oil separators (1/3) and in the adsorber (1/4).

Description

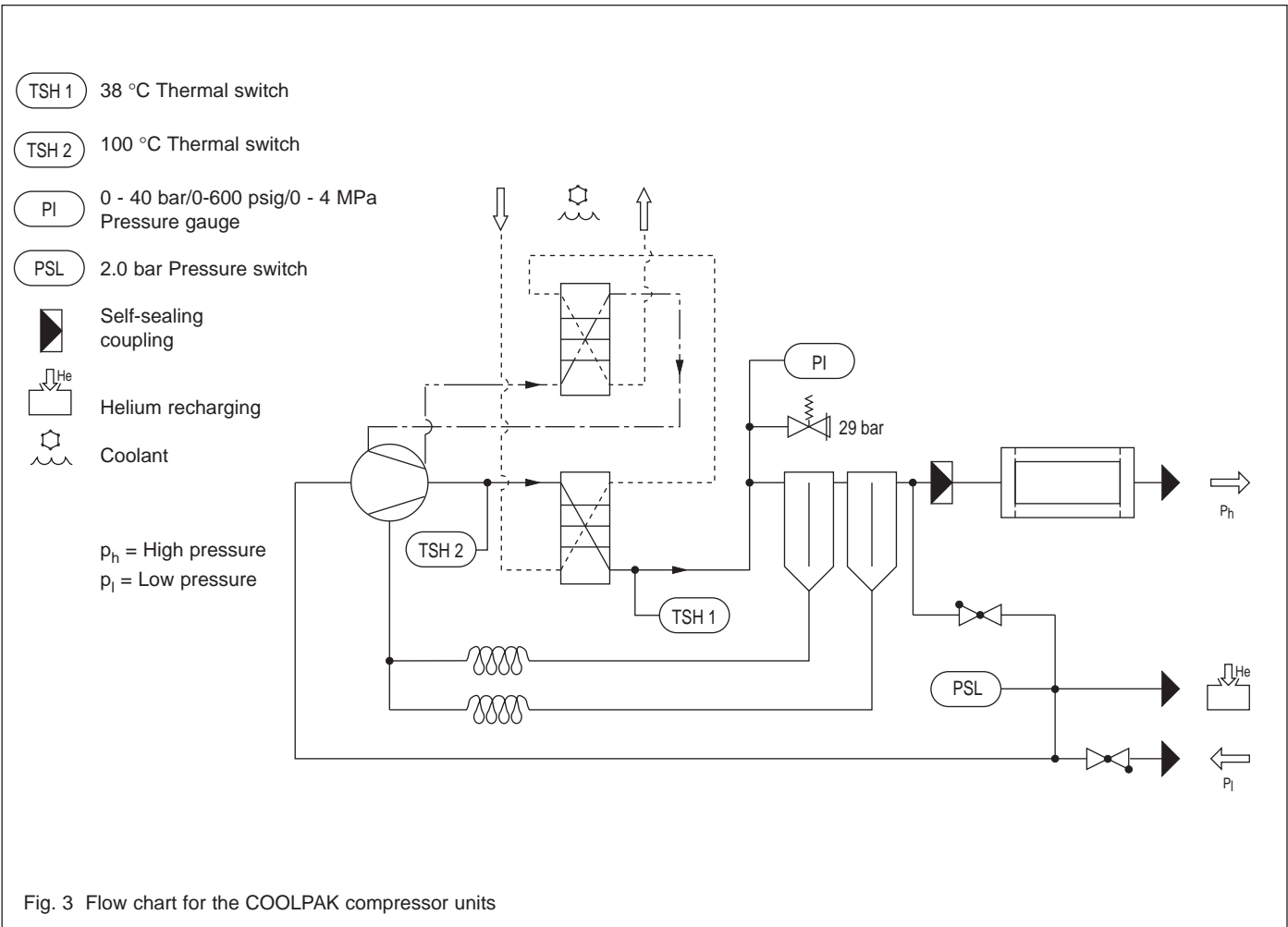


Figure 3 shows the flow diagram for a compressor unit. The oil-lubricated, helium scroll compressor reduces the volume of the helium gas, which becomes very hot in the process. For this reason it is passed through a helium/water counterflow heat exchanger located immediately downstream from the compressor; here the gas temperature is lowered to about the temperature of the coolant. A part of the oil fog swept out of the compressor along with the helium is condensed to droplets here.

Downstream from the heat exchanger the helium is passed through a two-stage oil separator. The condensate from the oil separator is returned to the compressor by means of capillary pipes.

The helium gas exiting the second oil separator will still contain small quantities of oil vapor. To keep this oil from entering the cold head and freezing there, an adsorber is provided downstream from the oil separators. This adsorber shall be replaced in accordance with the maintenance schedule.

To cool the compressor, the oil is pumped through an oil/water counterflow heat exchanger. Oil circulation is maintained by the pressure difference between low and high-pressure helium.

Safety equipment is installed in the compressor units; details will be found in the table on the next page.

Safety equipment and displays in case of corresponding failure

	Safety equipment	Display on the compressor unit
1	Pressure switch (PSL): pressure difference between low-pressure helium and atmospheric pressure < 2.0 bar	1.: SYSTEM ERROR 2.: Pressure Alarm
2	Thermal switch (TSH1): Helium temperature downstream of heat exchanger > 38 °C (100 °F)	1.: SYSTEM ERROR 2.: Helium temp.fail
3	Thermal switch (TSH2): Helium temperature upstream of heat exchanger > 100 °C (212 °F)	1.: SYSTEM ERROR 2.: Oil cct. fail
4	Thermal switch (Klixon) in compressor capsule	1.: SYSTEM ERROR 2.: Compressor fail
5	Motor protection switch (integrated in main switch)	Switch set to 0
6	3 fuses for cold head and input voltage of power module (F1, F2, F3, accessible from outside)	No display or 1.: SYSTEM ERROR 2.: Phase/Fuse ERROR
7	2 fuses for control voltage (internal)	No display
8	Bypass valve: opens a shunt between the high- and low-pressure helium circuits if the pressure differential exceeds the preset value	No display
9	Safety valve: opens the helium circuit to the atmosphere if the high-pressure segment exceeds 29 bar (406 psig; 2.9 MPa)	No display
10	Microprocessor for checking the phase rotation	1.: SYSTEM ERROR 2.: Phase/Fuse ERROR

If any of the safety features from 1 through 7 or 10 opens, this will cause the compressor unit to shut down. Press the SELECT button to read messages 2 and 3.

1.2 Standard equipment

The compressor units are shipped from the factory filled with helium and oil. They are equipped with

- detachable crane eyelets,
- sliding rails,
- an integrated main switch including the motor protection switch.

The self-sealing couplings are closed off with protective caps.

Accessories also supplied with the unit are:

- 2 certificates of compliance with section 9 of the German pressurized vessels code,
- 1 adapter (6 mm Swagelock — 1/4" self-sealing coupling),
- 2 clamping rings (spare parts for water connection),
- 6 spare fuses 0.315 A T
- 1 screwdriver 2.0 mm **exclusively** for mains voltage and cold head motor type selection,
- 1 open-end wrench 1",
- 1 open-end wrench 1³/₁₆".

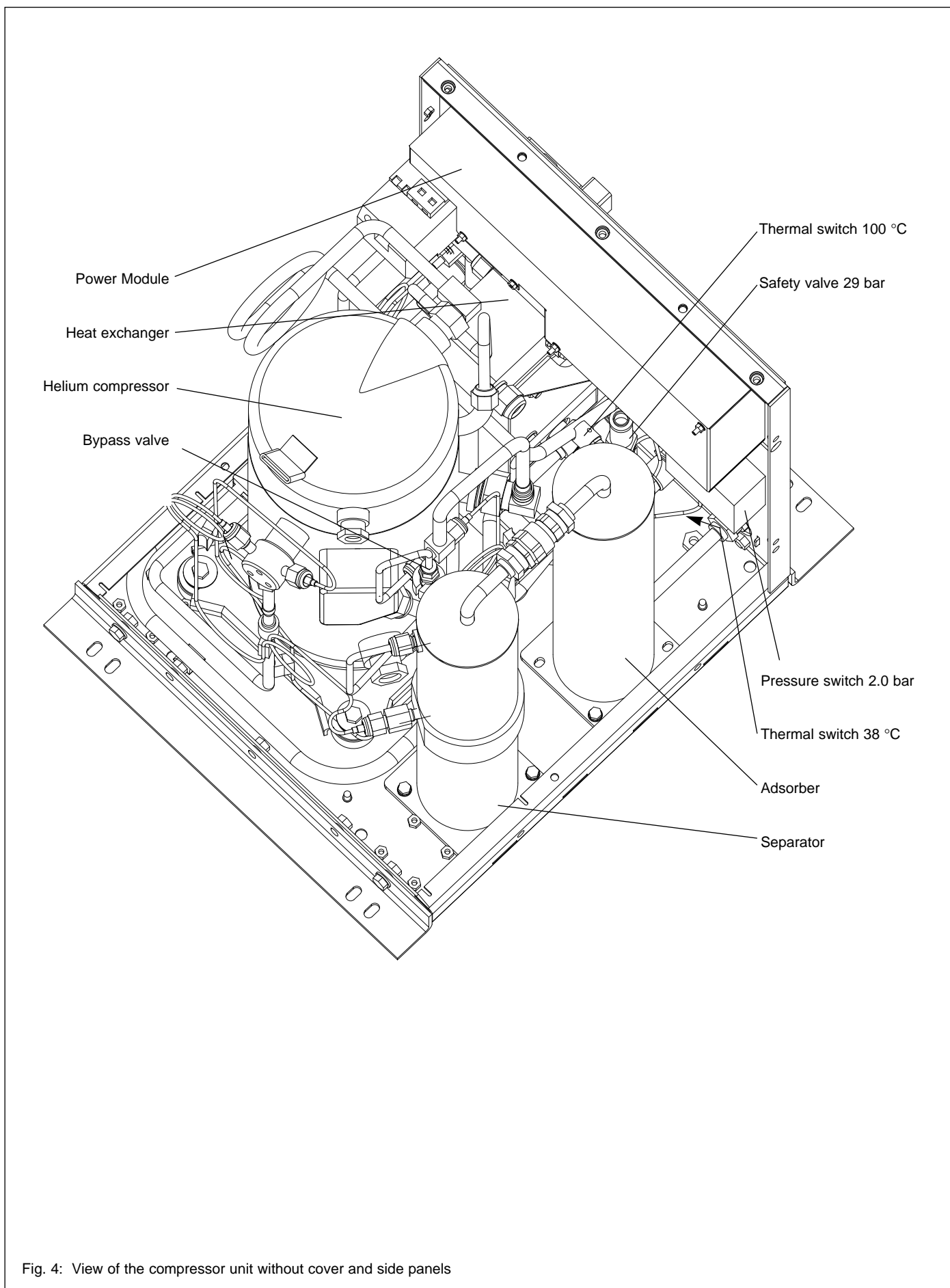


Fig. 4: View of the compressor unit without cover and side panels

1.3 Technical specifications

Compressor unit	COOLPAK 6000-1
Helium fill pressure to be set at the system, at room temp.	
at 50 Hz	15 ₋₁ bar 218 ₋₁₅ psig 1.5 _{-0.1} MPa
at 60 Hz	14 ₋₁ bar 203 ₋₁₅ psig 1.4 _{-0.1} MPa
Factory set Helium filling pressure	15 ₋₁ bar 218 ₋₁₅ psig 1.5 _{-0.1} MPa
Operating pressure in the high-pressure circuit at 50 and 60 Hz and with connection of a RGD 5/100	20±2 bar 290±29 psig 2.0±0.2 MPa
Coolant data	see Section 2.4
Ambient conditions for transportation and storage	see Section 3.4.1
Mains power supply,	
50 Hz, 3-ph, each ± 10 %	380/400 V
60 Hz, 3-ph, each ± 10 %	480 V
Delivered from the factory wired for	400 V
Cold head motor type select (see Section 2.5) factory set to	3-phase (rotary) current
Motor protection switch factory set to	14 A
Electrical power drawn at operation temperature	
at 50 Hz	6.0 - 6.5 kW / 20,500 - 22,200 BTU/h
at 60 Hz	6.5 - 6.9 kW / 22,200 - 23,600 BTU/h
Electrical power drawn at start-up with warm cold head	
at 50 Hz	8.2 kW / 28,000 BTU/h
at 60 Hz	8.7 kW / 29,700 BTU/h
Operating current at operation temperature	
at 50 Hz	9.5 - 10.5 A
at 60 Hz	9.0 - 10.0 A
Operating current at start-up with warm cold head	
at 50 Hz	13.7 A
at 60 Hz	12.0 A
Control voltage for the remote control	+ 24 V DC
Supply voltage for the cold head	240 V AC
Fuses (5x)	0.315 AT (slow blow) 5x20 mm glass tube DIN 41662, IEC 127-2/III
IEC rating for circuit breaker in the mains supply	20 A
Helium connectors: self-sealing couplings ¹⁾	1/2" m
Noise level ²⁾ , at a distance of 1 m	53 dB(A)
Weight	95 kg / 210 lbs

Equipment type Industrial safety standard class I
The safety standard for the device when installed in accordance with these instructions, with the line power and cold head connector lines attached IP 30

1.4 Order information

	Cat.-No.
Compressor unit COOLPAK 6000-1	892 35
Adsorber CACP 6000	893 52

Mains power cords

4xAWG 12, Plug Han 3 HvE/conductor ferrules 2.5 m long, cable turns to the right at power module	200 81 194
0.7 m long, cable turns to the left at power module	200 16 178

Flexlines

One pair each with self-sealing couplings at both ends f ¹⁾	
FL 4.5 (1/2" m, 1/2" f), 4.5 m long (15 feet)	892 87
FL 9.0 (1/2" m, 1/2" f), 9 m long (29.5 feet)	892 88
FL 2.0 ELBOW (1/2" m / 1/2" f), 2 m long	893 66
FL 13.5-SF (1/2" f, 1/2" f), 13.5 m long (45 feet)	893 67
FL 11.3 (1/2" f, 1/2" f), 11.3 m long (37 feet)	893 68
FL 15.0 ELB (1/2" f, 1/2" f), 15 m long (49 feet)	893 69

Installation accessories

with self-sealing couplings, Helium filling pressure at room temperature (16 ₋₁) bar (232 psig)	
90°elbows, 1/2" m / 1/2" f	891 73
Insulating adapter, 1/2" m / 1/2" f	891 76
Line coupler, 1/2" m / 1/2" m	891 71
CRYO SERVICE SET, case with tools for maintenance work at all cold heads and compressor units	890 93
Electric extension cable for the cold-head power cord, 4.5 m long	893 74

1) f=female / inside threads; m=male / outside threads "Aeroquip series 5400" or compatible designs.

2) As per DIN 45 635, Part 1, corresponding to ISO 6081-1986, ISO 11203

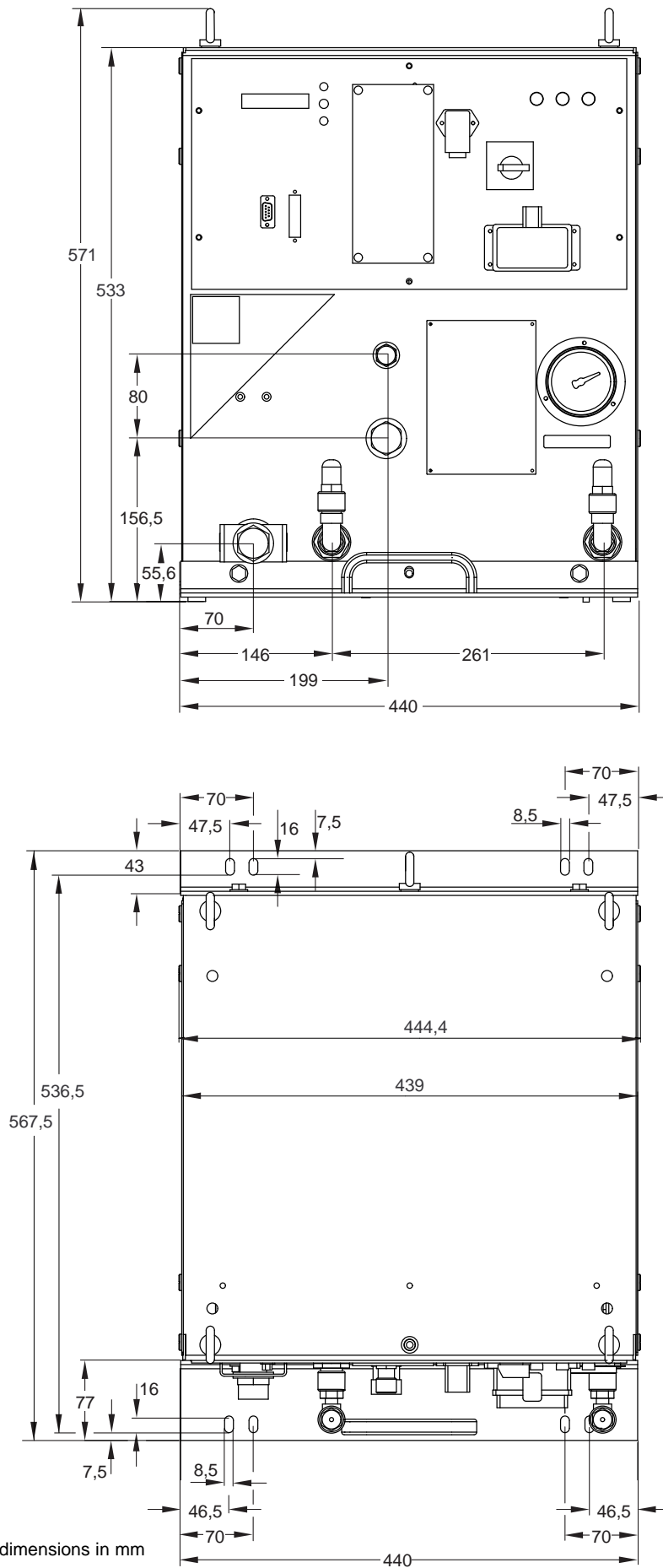



Fig. 5 Dimensional drawing, dimensions in mm

2 Installation

2.1 Safety information

The owner/operator shall ensure that the compressor units are operated only by persons who have been instructed in their use and that they are serviced only by qualified technicians; refer also to the Accident Prevention Regulations for compressors (VBG 16), sections 12 rule 17, mounting and operation information or equivalent local codes. Moreover, the owner/operator must prevent the unauthorized use of the compressor units and the connected equipment.

Warning  The compressor unit and the flexlines are filled with helium at pressures of up to 16 bar (232 psig; 1.6 MPa) when stopped and of up to 29 bar (420 psig; 2.9 MPa) during operation.



The components in the compressor units (e.g. compressor capsule, heat exchanger, piping, separators and adsorber) are under pressure, as are the flexlines; they **must not** be worked either mechanically or thermally.

All valves or switches in the compressor unit **must not** be blocked or modified.

Do not lay flexlines across corridors or passageways – danger of physical damage and corrosion!

Observe minimum bending radius of 20 cm (8") – danger of kinking!

Never damage flexlines with pointed or sharp objects!

Never attempt to make repairs to flexlines!

Never install flexlines which show signs of damage!

When running the compressor unit, provide protective caps at all self-sealing couplings which are not required for operation.

Attach or detach flexlines only with the compressor unit switched off and when the pressure is below 28 bar (406 psig; 2.8 MPa). Once flexlines have been detached, place protective caps on the self-sealing couplings.

Even when switched off, the compressor unit and the flexlines will be under pressure of up to 16 bar (232 psig; 1.6 MPa).

Warning These compressor units shall not be used in an environment subject to explosion hazard.




Warning Potentially fatal voltages are present in the compressor unit. Before beginning any work on the unit, switch it off and isolate it from the power supply network.



The line joining the compressor unit and the cold head may be connected or disconnected only after the compressor unit has been switched off and separated from the line supply. Electrical shock hazard! Moreover, the compressor unit and the cold head could be damaged.

To avoid electrical shock, be sure to ground the compressor unit and all attached devices.

The electrical connection shall be made only by a qualified and licensed electrician in accordance with VDE standard 0105, in compliance with the guidelines set forth in VDE 0100, and observing local codes.

Warning  The compressor capsule, heat exchanger and piping will become so hot during operation, (> 80°C, 176°F) that there will be a danger of burns. Before beginning any work on the compressor, switch it off and allow it to cool down.

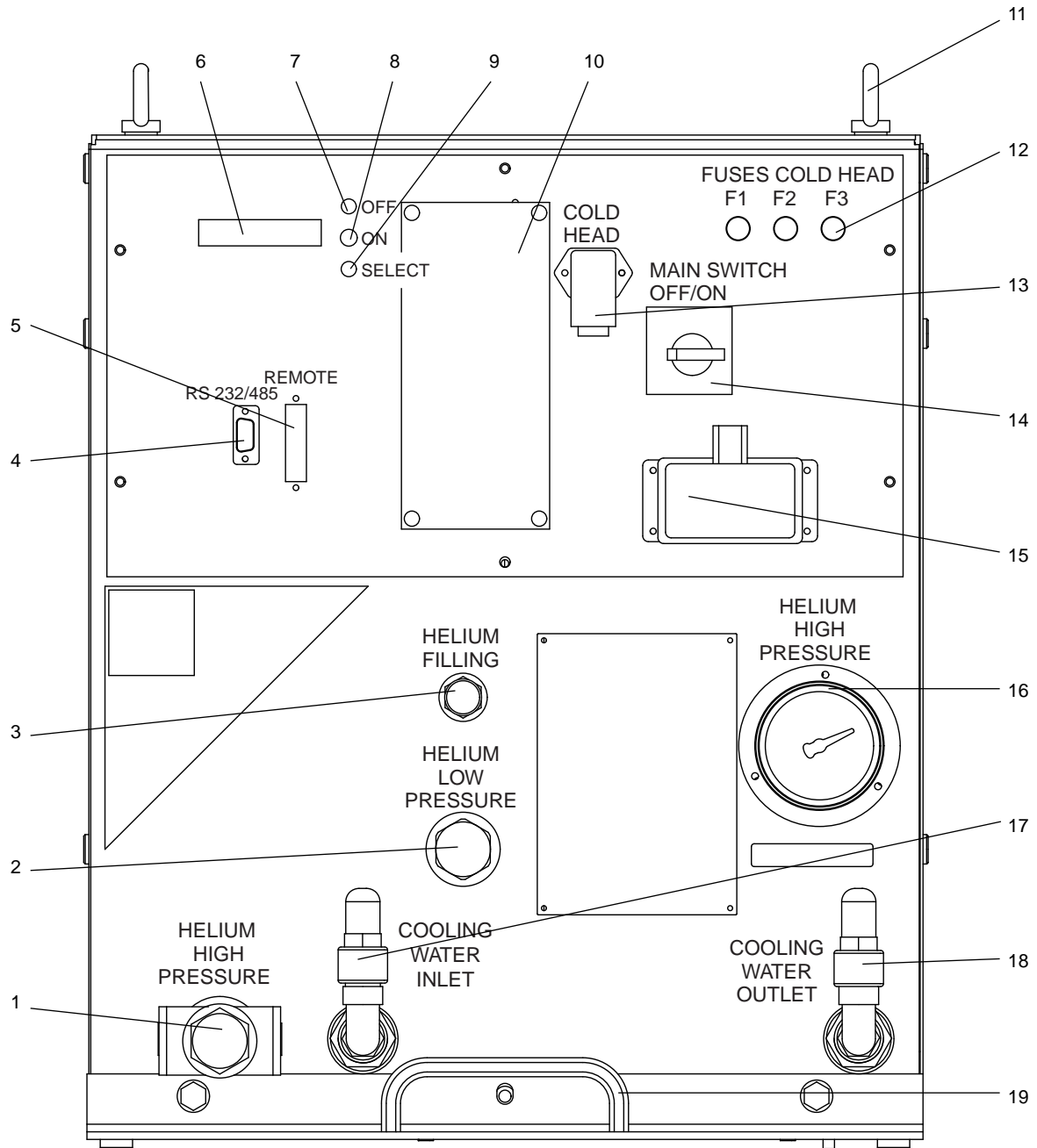


Fig. 6: Connections and controls
See table on right for key

Connections and controls

Item in Fig 6	Description	Remark	Description in Section
1	High-pressure helium connection	marked with red dot	2.6
2	Low-pressure helium connection	marked with green dot	2.6
3	Helium refilling connection	used for releasing and topping up helium	4.1
4	Sub-D connector, 9 pole RS 232/485 interface		3.5
5	Sub-D connector, 25 pole for remote control	See Fig. 12	2.5
6	Display	16 characters	1.1, 3, 5
7	OFF button	Red; used to stop operation of the compressor unit	3
8	ON button	White or black; used to start operation of the compressor unit	3
9	SELECT button	Gray; used to display the hours meter or failure messages	3
10	Cover plate	Terminals for setting the compressor unit to the line voltage and for setting the cold head motor type are located behind the cover plate; see Fig. 11.	2.5
11	Crane eyelets	Detachable	2.2
12	Fuses	Safeguard the input current (primary circuit) of the transformer for the cold head motor and the control voltage	1.3
13	Electrical connection for cold head	bended	2.5
14	Main switch	Connects the power module to the mains supply or disconnects it from the mains supply; simultaneously acts as motor protection switch	2.5, 3
15	Socket	for mains power cord, type HAN3HvE	2.5
16	Pressure gauge	Displays the pressure on the high-pressure helium side of the compressor unit	1.1, 3
17	Coolant inlet	Do not throttle throughput in the inlet line.	2.4
18	Coolant outlet	To set the flowrate use a throttle here	2.4
19	Handle	Do not use for crane	2.2

2.2 Unpacking and inspecting

Unpack the equipment immediately after receipt, even if it is not to be put into operation until later.

Examine shipping cartons and packaging for signs of external damage.

Remove the straps, open the packaging, and lift the compressor unit by the crane eyelets.

Warning When lifting and setting down the compressor unit **do not** reach under the edges of the frame; the hands and feet could be pinched. **Do not** stand under the suspended compressor unit while it is being moved.



Use **only** the crane eyelets for crane transport. Use the handles for manoeuvring the unit in the rack.

Caution **Do not** use the piping or other components to lift or move the compressor unit.

When the compressor unit is being transported or is in storage, it should be tilted by no more than 45° (danger of tipping over) and a maximum of 10° during operation. More severe angles could result in damage to the compressor capsule or oil contamination in the helium circuit.

Check the pressure level indicated at the manometer attached to the compressor; see Section 4.1 for details. If the pressure indicated is too low, top up with helium or notify the Leybold Service Department.

Keep the packaging for re-use in case it should become necessary to return equipment to the factory.

Check the delivery for completeness (see Section 1.2) and make a careful visual check.

If damage is detected, submit damage reports to the carrier and the insurer at once. If it is necessary to replace damaged components, please contact Leybold for instructions.

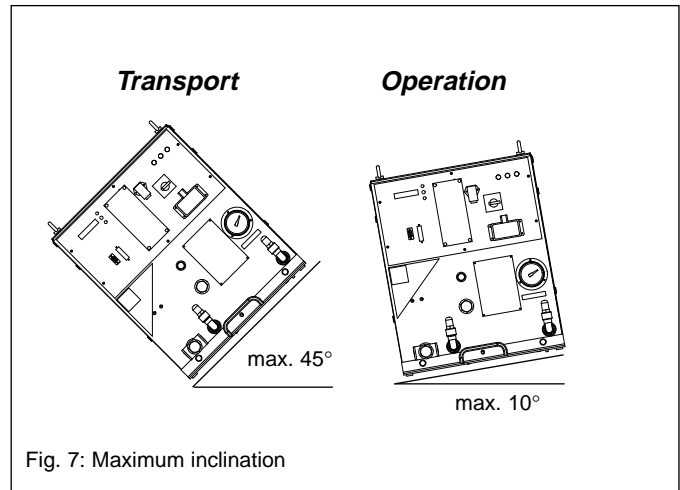


Fig. 7: Maximum inclination

2.3 Mounting

The compressor unit can be set up for operation at a tilt of up to a maximum of 10° in any direction.

At severe angles block the compressor unit to keep it from sliding. In areas subject to earthquake hazard, fasten the compressor unit to the building. The fastening should be able to withstand acceleration of 0.5 g in the horizontal plane and 0.33 g in the vertical plane.

In the baseplate there are mounting holes. For the purpose of damping vibrations we recommend the use of vibration-damping elements.

The unit is prepared for installation in a 19" rack.

The installation site should be dust-free. Protect the compressor unit against strong sunlight.

The crane eyelets can be unscrewed. Remove the eye screws at the front and replace with the M8x10 counter-sunk screws provided. Retain the eye screws for future use.

2.4 Ambient conditions and coolant connection

Ambient temperature

The ambient temperature must be between 5 °C and 40 °C (40 °F to 104 °F) when the compressor unit is in operation.

Ambient air pressure

The minimum ambient air pressure is 700 mbar (700 hPA, 10 psi).

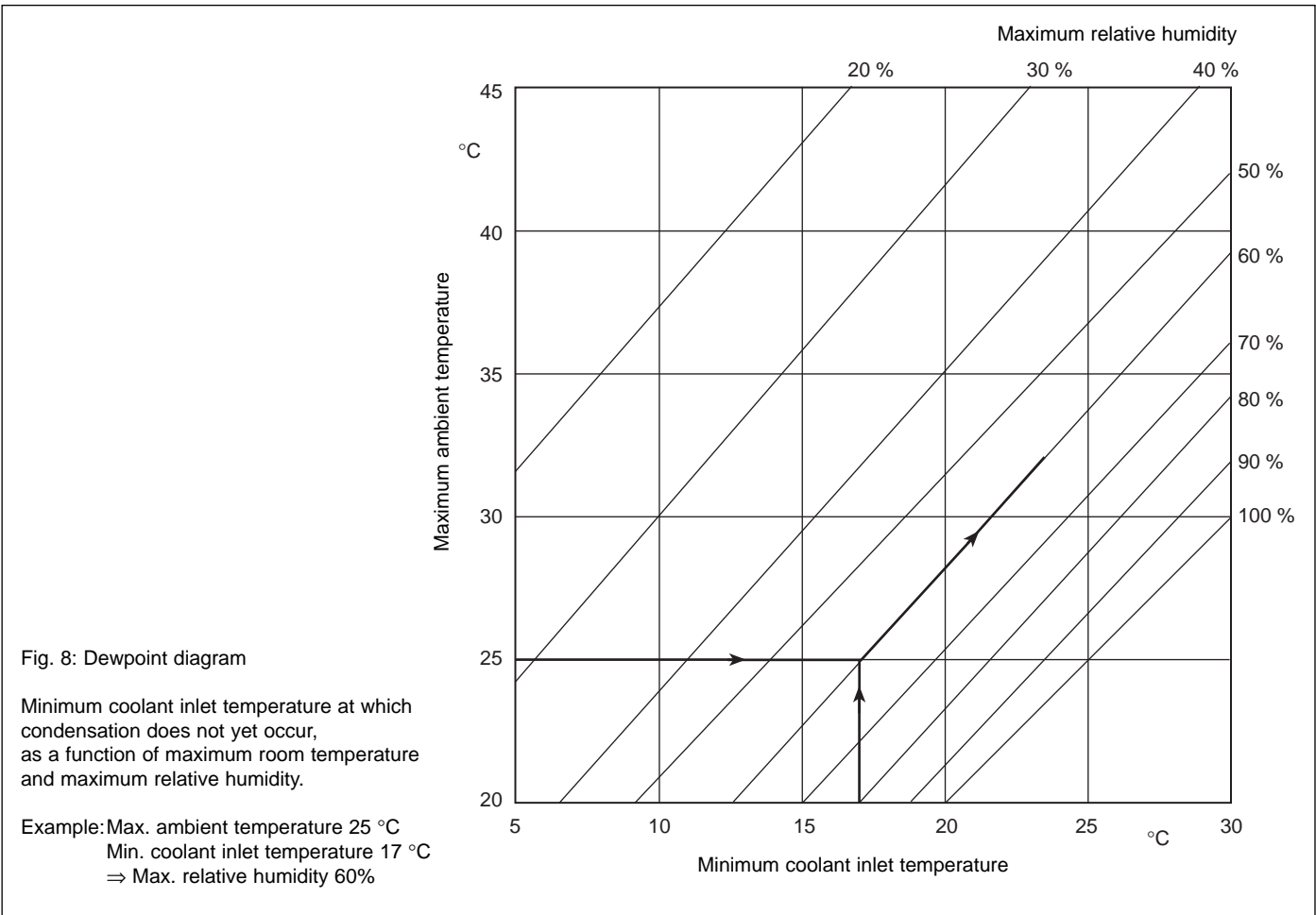
Coolant data

Coolant inlet temperature	5 to 25 °C
Permissible connected coolant pressure	< 8 bar (116 psig; 0.8 MPa)
Min. inlet pressure	2 bar (abs)
Min. absolute pressure at coolant outlet	1 bar (atmospheric pressure)
Coolant port, hose nipples for hoses with an inner diameter	DN 12 1/2" (12 mm)
Hose clamp range	1/2 to 1 1/8" (12 to 28 mm)
Alternative coolant port: outside threads	G 1/2"
Coolant consumption at 25 °C inlet temperature	5 l/min
Max. coolant throughput	10 l/min
Pressure drop Δp between coolant inlet and outlet depending on the throughput	0.2 to 0.6 bar

Water quality

Appearance	Colorless, clear, free of oils and greases
Suspended matter	< 250 mg/l
Particle size	< 150 μm
Electrical conductivity	< 500 $\mu\text{S/cm}$
pH value	7 to 8.5
Total hardness (total alkaline earths)	< 20 °dH
Acid capacity up to pH 4.3	2.5 to 3.5 mmol/l
Carbonate hardness	7 to 10 °dH
Aggressive carbon dioxide	None, not detectable
Oxygen	4 to 5 mg/l
Chloride	< 100 mg/l
Sulfate	< 70 mg/l
Iron	< 0.2 mg/l
Manganese	< 0.1 mg/l
Ammonium	< 10 mg/l
Free chlorine	< 0.2 mg/l
20 °dH (degrees German hardness)	= 3.5 mmol/l
	= 25 °e (degrees English hardness)
	= 36 °f (degrees French hardness)
	= 21 °a (degrees American hardness)

Caution Failure to comply with the coolant data may lead to internal corrosion. This will result in destroying the compressor unit.



Relative air humidity

Only set up the compressor units in a non-condensing atmosphere. See Fig. 8 in this context.

Coolant connection

Remove the end caps from the hose nipples. Secure the water hoses with hose clamps. Do not confuse the inlet and outlet ports!

To set the flow rate, the coolant flow must be throttled in the outlet.

Caution If the coolant flow is throttled in the inlet or if the pressure difference falls below the specified limit, this may lead to insufficient cooling of the oil circuit and compressor failure or damage.

Only use hoses with sufficient pressure resistance (min. 10 bar (1 MPa) at 70 °C, 145 psig at 160 °F).

Pay attention to the coolant data.

If water with properties deviating from specified values is used, calcium deposits in the heat exchanger could restrict the flow of water and adversely impact heat removal.

Have the heat exchanger de-limed at regular intervals by the Leybold Service Department.

If required install a fine filter of 100 µm. Replace it in regular intervals.

To protect the heat exchanger against chemical attack, fully demineralized or very soft water may be used only with the addition of suitable inhibitors.

Permanent operation at ambient and water temperatures below 5°C (40°F) is only possible with additional safety measures. Even if you use anti-freeze the coolant inlet temperature must have the permitted temperature, except from a warm-up time of approx. 15 minutes. If you use anti-freeze, please consult Leybold.

The specific thermal capacity, viscosity, and the corrosive properties of coolant containing additives will differ considerably from those for normal cooling water.

Check the coolant flow rate and temperature at regular intervals.

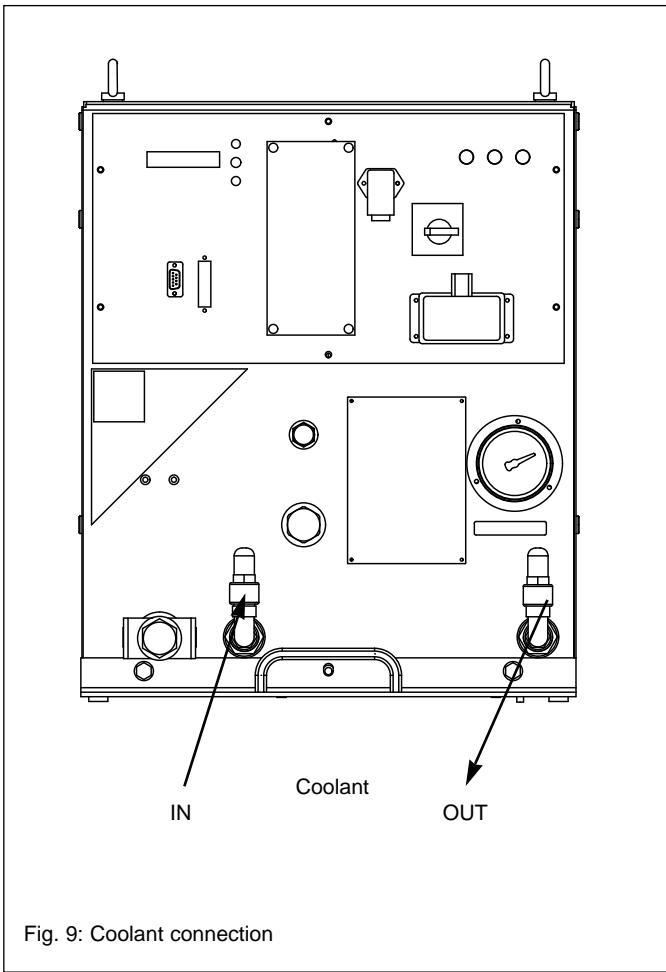


Fig. 9: Coolant connection

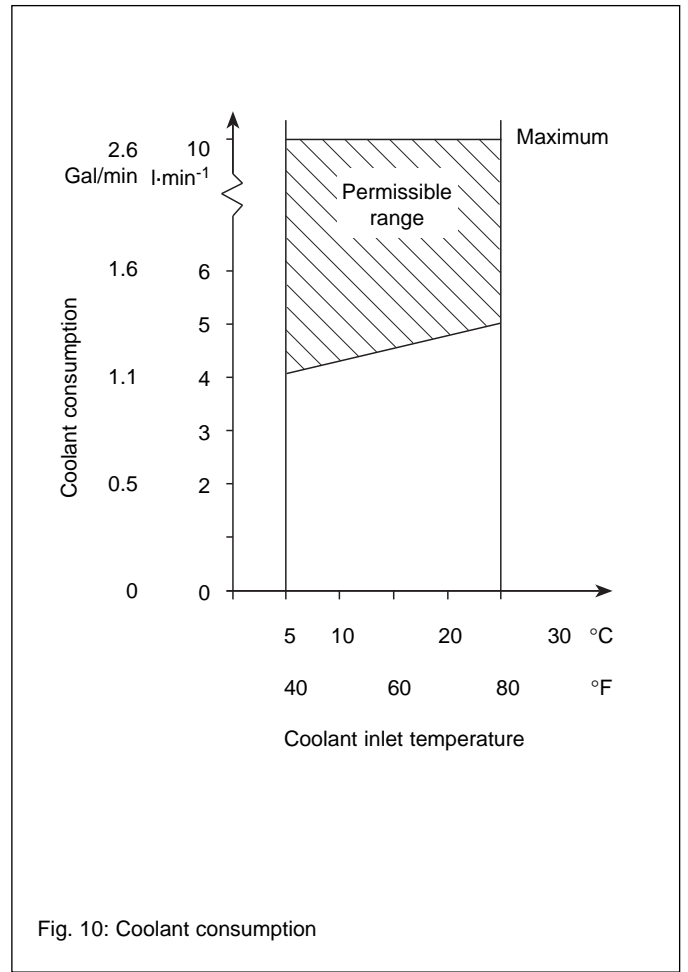


Fig. 10: Coolant consumption

2.5 Electrical connection

Warning Potentially fatal voltages are present in the compressor unit. Before beginning any work on the compressor unit, switch it off and isolate it from the power supply network (lock out and tag power).



The line joining the compressor unit and the cold head may be connected or disconnected only after the compressor unit has been switched off and separated from the line supply. Electrical shock hazard! Moreover, the compressor unit and the cold head could be damaged.

To avoid electrical shock, always connect the equipment to a low impedance ground.

The electrical connection/disconnection shall be made only by a qualified and licensed electrician in accordance with VDE standard 0105, in compliance with the guidelines set forth in VDE 0100, and observing local codes.

Setting the compressor unit to the line voltage

The compressor unit can be adjusted to operate on various line voltages. Refer to Section 1.3 for the permissible values for the compressor unit and the factory setting. Observe the information on the tag attached to the compressor unit.

Caution If the line voltage differs from the value stated on the tag, it is essential to reconnect the terminals on the Power Module.

Do not use the terminals for 230 V. Using these terminals may damage the power module and the cold head.

To make the setting, first remove the cover plate; see Fig. 11 left. Then the terminals for mains voltage and coldhead motor type are visible. **Do not** use the 2.0 mm screwdriver delivered with the compressor unit. Use a Phillips screwdriver instead. The 2.0 mm screwdriver shall **exclusively** be used on the mains voltage and the motor type selector terminal slits; see below.

Caution Connect all three phase leads - L1, L2 and L3 - to the correct voltage value on the terminal strips CM2 and CM3; see Fig.11 middle. Using the wrong terminals may damage the power supply and the cold head.

To detach the leads from the terminal strips, insert the screwdriver (2 mm width) into the slits, press on the terminals and pull out the lead with a pair of pliers. Hold the screwdriver horizontally and do not jam it.

Insert the leads as far as possible without using the screwdriver. By pulling the leads verify that they are safely fixed. If not repeat the procedure.

Changing the setting of the cold head motor

All Leybold cold heads can be operated in the setting for 2-phase alternating current.

All Leybold cold heads with a type designation beginning with "RGD 5/100" or "COOLPOWER 5/100" can also be operated on 3-phase (rotary) current. The compressor is set this way at the factory.

Caution For all cold heads except RGD 5/100 .. or COOLPOWER 5/100 .. the setting must be 2-phase alternating current.

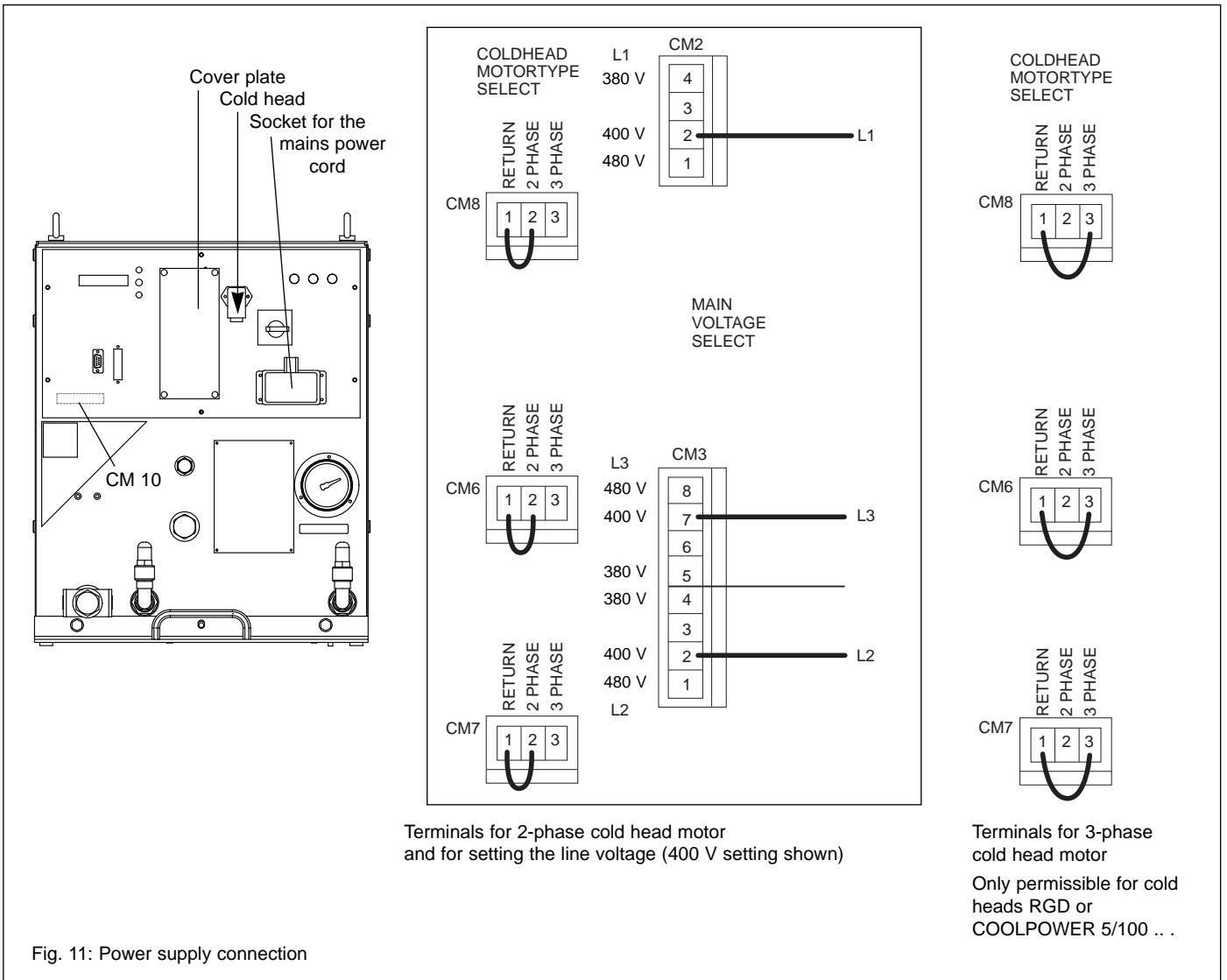
For changing the setting of the cold head motor type reconnect all three terminals CM6 to CM8; see Fig. 11 middle and right.

Screw the cover plate back in place after altering the setting. You are strongly advised to make a note of all changes made, both on the compressor unit and in the Operating Instructions.

Connecting the cold head and power supply

Plug the electrical connecting lead of the cold head into the socket COLD HEAD.

Connect the power cord to the compressor unit's socket and the power cord's terminals to the mains.



Terminals for 2-phase cold head motor and for setting the line voltage (400 V setting shown)

Terminals for 3-phase cold head motor
Only permissible for cold heads RGD or COOLPOWER 5/100 ...

Checking the direction of the rotating field

Check the correct direction of the rotating field of the power supply when first making the connection and after any changes to the electrical connection.

The connector is wired for a clockwise rotating field when shipped.

While pressing the OFF button switch on the master switch. If correctly wired, the display reads

VERSION: Vx.xx

and then

SYSTEM OFF

If the wiring is incorrect, the message

SYSTEM ERROR

is displayed. After pressing the SELECT button the message

Phase/Fuse ERROR

is displayed. As this error message also appears if one of the fuses (6/12) has blown, first check the fuses. If they are OK, disconnect the power from the power leads and reverse two phases on the power supply connection.

Switch off the main switch.

Connecting the Sub-D connectors (option)*

Refer to Section 3.5 for the RS 232 interface.

Warning For protection against thermal cut-outs, if this compressor unit as part of a refrigeration system is used in a medical electrical system (e.g. a MRI system), the compressor unit's operation must be monitored by the higher level control of the medical system, e.g. via the compressor's built-in remote and/or RS 232 interface.

If required, connect the REMOTE connector.

Maximum contact load 30 mA total on signal lines.

Do not apply 24 V DC permanently to pin 3 (Reset).
(Recommendation for reset: pulse > 100 ms)

Caution Do not connect to "free" pins as they are already internally connected.

The compressor unit satisfies EU Directives regulating electromagnetic compatibility (EMC). To ensure that compatibility is maintained, adhere to the following installation instructions:

- Use the prescribed Leybold connector lines to connect the cold head.
- Use shielded cables to connect the Sub-D connectors and attach the shielding to the metal housings of the Sub-D plugs.

Operation via the interfaces

The interfaces can be used to run the compressor unit in parallel to the control buttons for ON, OFF and SELECT. The control lines for the REMOTE interface respond to the rising or falling flank of a +24 V DC signal.

Example:

0 V \Rightarrow +24 V at pins 4 and 6: Compressor ON

+24 V \Rightarrow 0 V at pins 4 and 6: Compressor OFF

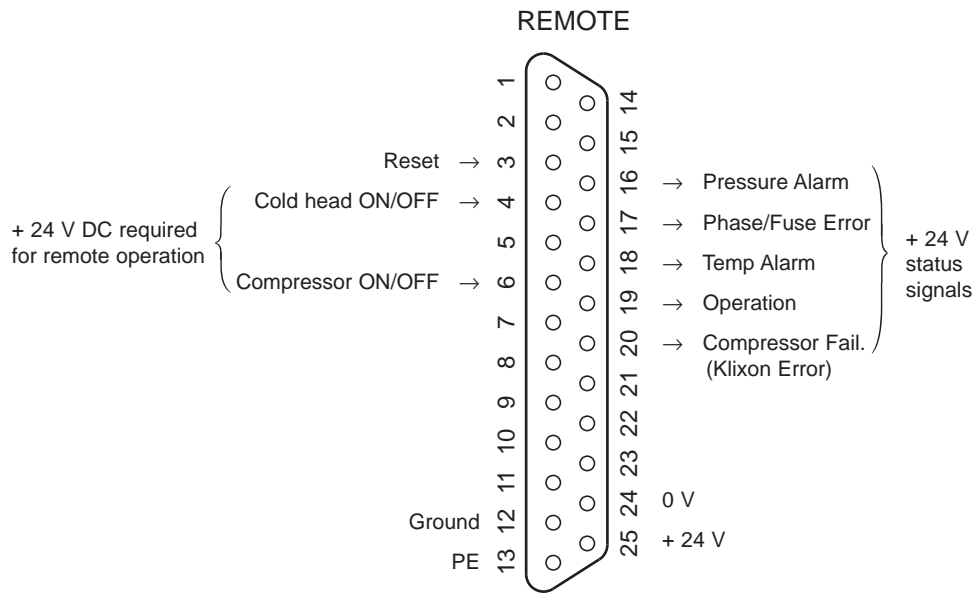
Before changing the operating mode, it is necessary to first switch off the compressor unit and the cold head while in the "old" operating mode and then to switch on again in the "new" operating mode.

Failure to observe this rule may result in undefined operating states, for example:

The compressor unit is running in the REMOTE mode; 24 V is present at pins 4 and 6. The compressor unit is (contrary to the rule) switched off with the OFF button. Then it is off although the 24 V signal is present at pins 4 and 6.

* The required counter plug is available e.g. from Framatome Connectors International:

REMOTE:	
25-pole, solder version, male	DB25P064TX
Metallized housing, straight exit	8655 2181



Pin	+24 V is present	0 V is present
3	Reset	–
4	Cold head on	Cold head off
6	Compressor on	Compressor off
16	Pressure alarm	No pressure alarm
17	Phase/fuse error	No phase/fuse error
18	Temp. alarm	No temp. alarm
19	Compressor in operation	Compressor not in operation
20	Compressor failure	No compressor failure

Fig. 12: Pin assignments on the Sub-D connectors

2.6 Mounting the flexlines

Information for working with self-sealing couplings

The connector lines and elements are equipped with self-sealing couplings. These connectors can be attached and detached without helium escaping.

Unscrew the protective caps from the couplings. Keep the protective caps for further use.

Check all connectors for evidence of dust and grime and, if necessary, use a clean and lint-free cloth or a soft, clean brush (e.g. toothbrush) to clean the fittings.

Never use solvents to clean the connections! The fittings shall never be greased or oiled.

Check that the flat seals are in place on male couplings. Replace missing or defective flat seals.

Use only the supplied open-end wrenches, or open-end wrenches approved by Leybold, to mount flexlines.

Attach or detach flexlines only when the compressor unit is switched off and when the pressure is below 28 bar (406 psig; 2.8 MPa).

Never twist flexlines.

Use one wrench to screw down the coupling and a second to stabilize the connector nipple; see figures 13 and 14.

1/2" coupling:
tighten with 1 ³/₁₆" wrench,
stabilize with 1" wrench.

Tighten down all couplings as far as possible and then back them off by 1/4 turn to relieve strain.

If the flexlines are to be laid in such a way that radii of less than 20 cm (8") are required, it will be necessary to install 90° elbows; see Section 1.4.

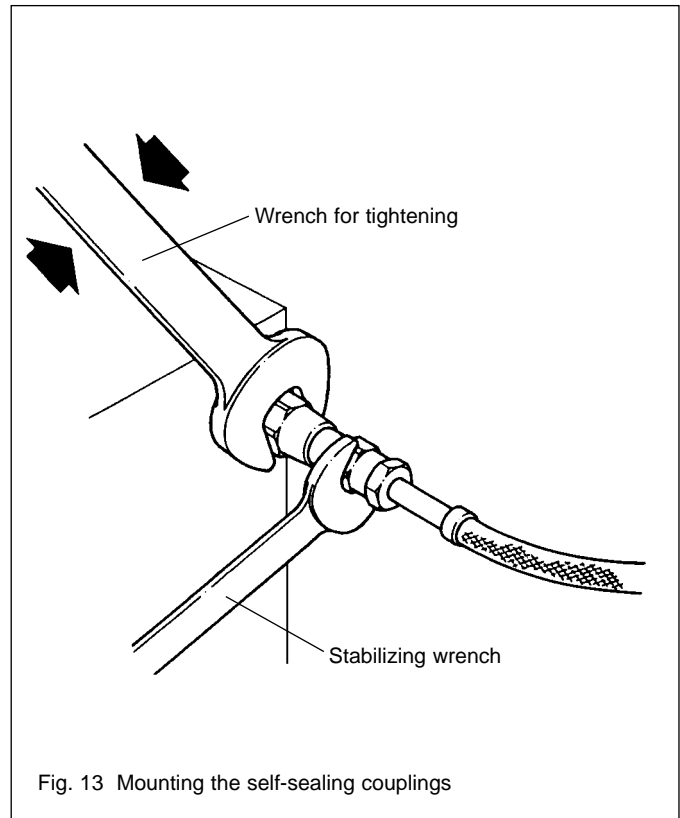
Use insulating adapters for electrical installation; see Section 1.4.

Use hose couplers to extend the flexlines; see Section 1.4 for details.

Connect compressor unit and cold head

Follow the instructions for the work.

Connect the flexlines in sequence, (15/1) to (15/4), corresponding to the direction in which the helium flows.



Caution Do not mix up the high- and low-pressure connections. Interchanging these connections can cause damage inside the cold head.

Do not use a flexline on the high-pressure side which was ever used on the low-pressure side.

Do not connect the high-pressure connection directly to the low-pressure connection (short-circuit). Operation with directly connected high- and low-pressure can damage the compressor unit.

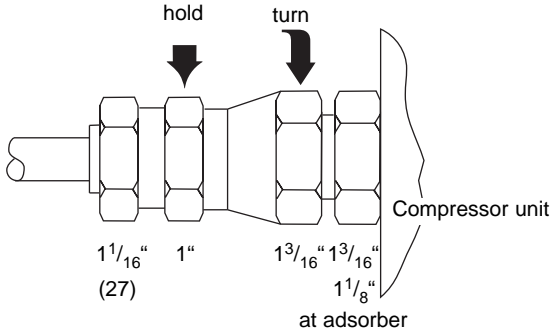
Checking the helium filling pressure

After installation, check the helium filling pressure at the pressure gauge and correct it if required; see Section 4.1 for the correct data and the filling or reducing procedure.

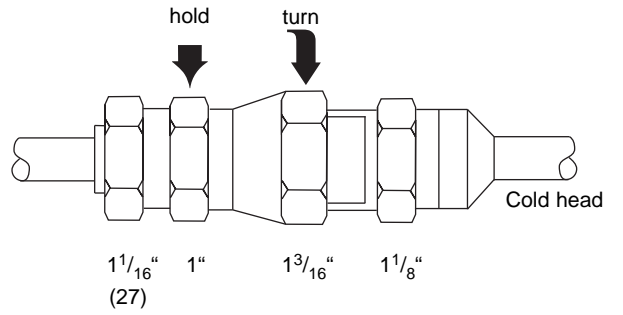
Detach flexlines only with the compressor unit switched off, the cold head warmed up, and when the pressure is below 28 bar (406 psig; 2.8 MPa). See Section 3.4 "Removing from service" for details. Detach the flexlines by unscrewing the couplings in reverse order.

Once they have been detached, fit protective caps on the couplings.

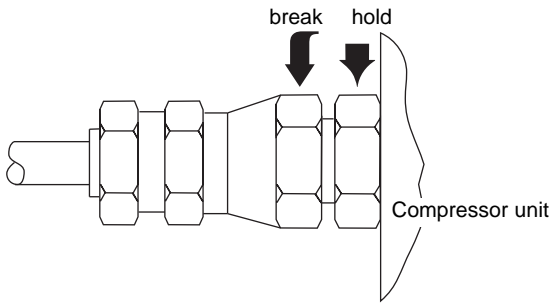
Attaching coupling to the compressor unit



Attaching coupling to the cold head



Unscrewing coupling from the compressor unit



Unscrewing coupling from the cold head

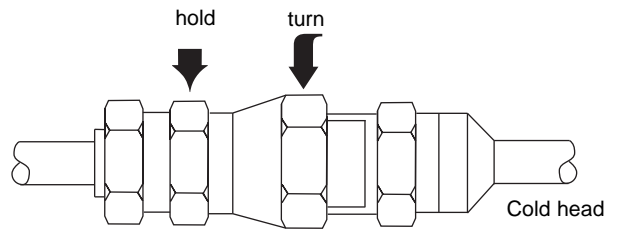
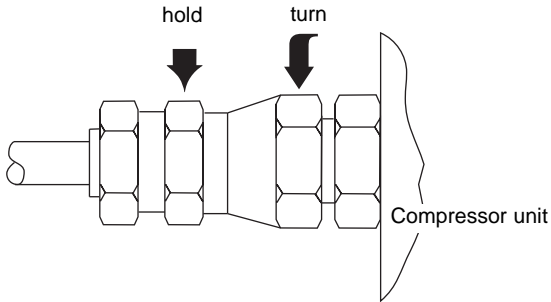
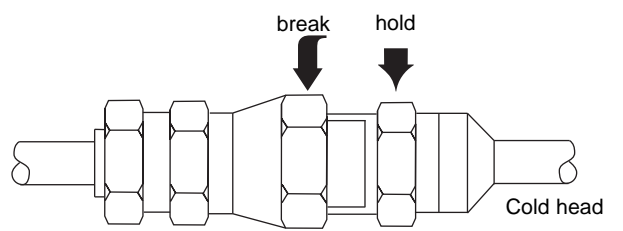
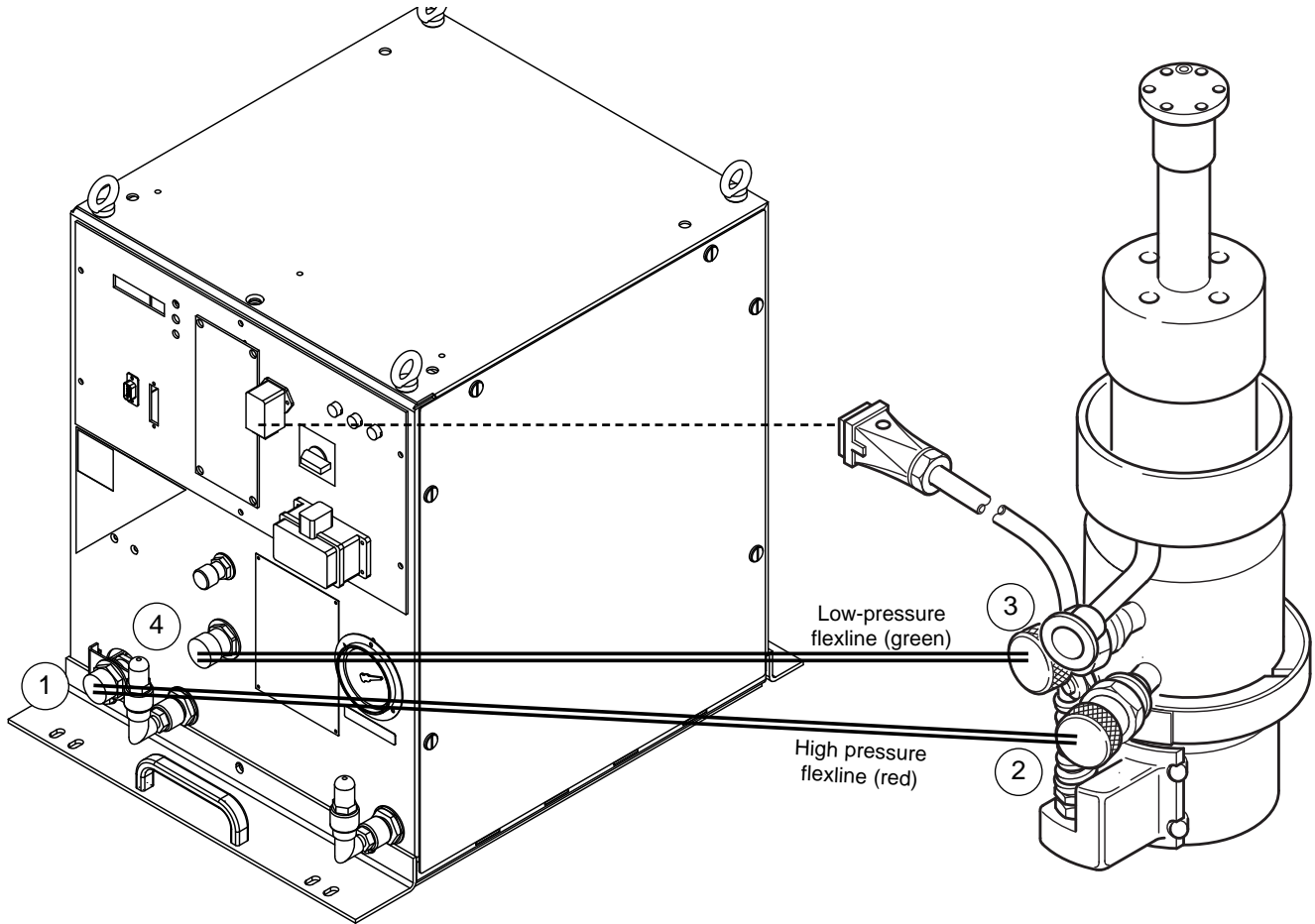


Fig. 14 Attaching and detaching self-sealing couplings

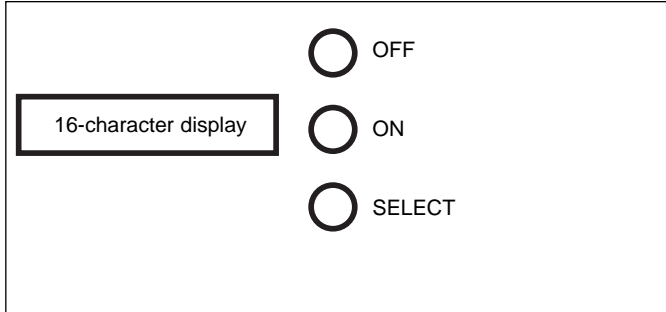


	Flexline	Color	Attached to connection	Color
1.	High-pressure	red	Compressor high-pressure	red
2.	High-pressure	red	Cold head-high-pressure	red
3.	Low-pressure	green	Low-pressure cold head	green
4.	Low-pressure	green	Low-pressure compressor	green

Fig. 15 Connecting the compressor unit and cold head

3 Operation

The compressor unit is mainly operated via 3 buttons:



The SELECT button allows to scroll through the display.

3.1 Switching on

Caution Do not run the compressor unit for more than a few seconds without having connected the flexlines and the cold head. Operation without flexlines and cold head may damage the compressor unit.

Open the coolant supply.

Switch on the main switch.

The display reads

VERSION: Vx.xx

and

SYSTEM OFF

Press the ON button. The following message appears:

SYSTEM ON

The compressor unit starts up together with the cold head, possibly with a few seconds delay. This start delay protects the compressor unit from being restarted immediately after being shut down.

The bypass valve may whistle during start-up until the cold head has reached a temperature below 250 K. This is no problem.

Use the SELECT button to switch the display to the operating hours meter:

Hours 00005

3.2 Normal operation

During operation, check the operating pressure and the coolant flow rate at regular intervals (at least every 6 months).

Refer to Sections 1.3 and 2.4 for nominal values.

If the helium pressure is too low during operation, switch off the compressor unit and find the cause; refer to Section "Troubleshooting".

If the coolant flow rate is insufficient, eliminate potential malfunctions in the water supply or at the water outlet. If deposits of calcium or grime have collected in the heat exchanger, switch off the compressor unit and inform the Leybold Service Department.

Warning The line joining the compressor unit and the cold head may be connected or disconnected only after the compressor unit has been switched off and separated from the line supply. Electrical shock hazard! Moreover, the compressor unit and the cold head could be damaged. Neither should the line plug ever be disconnected while the compressor unit is running.



Before every change of operating mode (buttons / REMOTE / RS 232) it is necessary to first switch off the compressor unit and the cold head while in the "old" operating mode and then to switch on again in the "new" operating mode. Failure to observe this rule may result in undefined operating states; see Section 2.5, "Operation via the interfaces."

Safety devices are integrated into the compressor unit to protect the device during operation; refer to the table in Section 1 for details.

3.3 Switching off

Warning The line joining the compressor unit and the cold head may be connected or disconnected only after the compressor unit has been switched off and separated from the line supply. Electrical shock hazard! Moreover, the compressor unit and the cold head could be damaged. Neither should the line plug ever be disconnected while the compressor unit is running.



Manual shut-down

Switch off the compressor unit at the OFF button.

Allow the coolant to circulate for another 10 minutes after switching off and then shut off the circuit.

Automatic shut-down

The compressor unit is shut down automatically if errors occur e.g. the helium pressure is too low or the helium temperature too high. The display reads

SYSTEM ERROR

The nature of the fault can be ascertained by pressing the SELECT button.

Locate and eliminate the cause of the fault; refer to Section 5, "Troubleshooting".

The compressor unit does not restart automatically.

After having eliminated the fault reset by pressing the OFF button.

SYSTEM OFF

is displayed.

Restart the compressor unit by pressing ON.

Beginning with software Version 3.03 the compressor unit can be restarted, but once only, in spite of the presence of the "He Temp. Fail" error message. This is to accelerate resetting the TSH1 thermostat switch; see Fig. 3. This function may be utilized only after the malfunction has been corrected; refer to Section 5, "Troubleshooting".

If the current consumption is too high, either the motor protection switch is tripped and the main switch is in the "0" position or the display reads

SYSTEM ERROR

and, after scrolling with the SELECT button,

Locked rotor

Automatic restart

Warning Beginning with software Version 3.03 the compressor unit may restart suddenly, even without a reset, if the "Restart active" message is present; refer to Section 5, "Troubleshooting".



Actions following a power failure

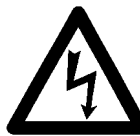
Following a temporary line voltage failure, the compressor unit automatically returns to its previous operating status.

Warning The compressor unit will switch back on automatically when it was at normal operation before.



3.4 Removing from service

Warning The line joining the compressor unit and the cold head may be connected or disconnected only after the compressor unit has been switched off and separated from the line supply. Electrical shock hazard! Moreover, the compressor unit and the cold head could be damaged. Neither should the line plug ever be disconnected while the compressor unit is running.

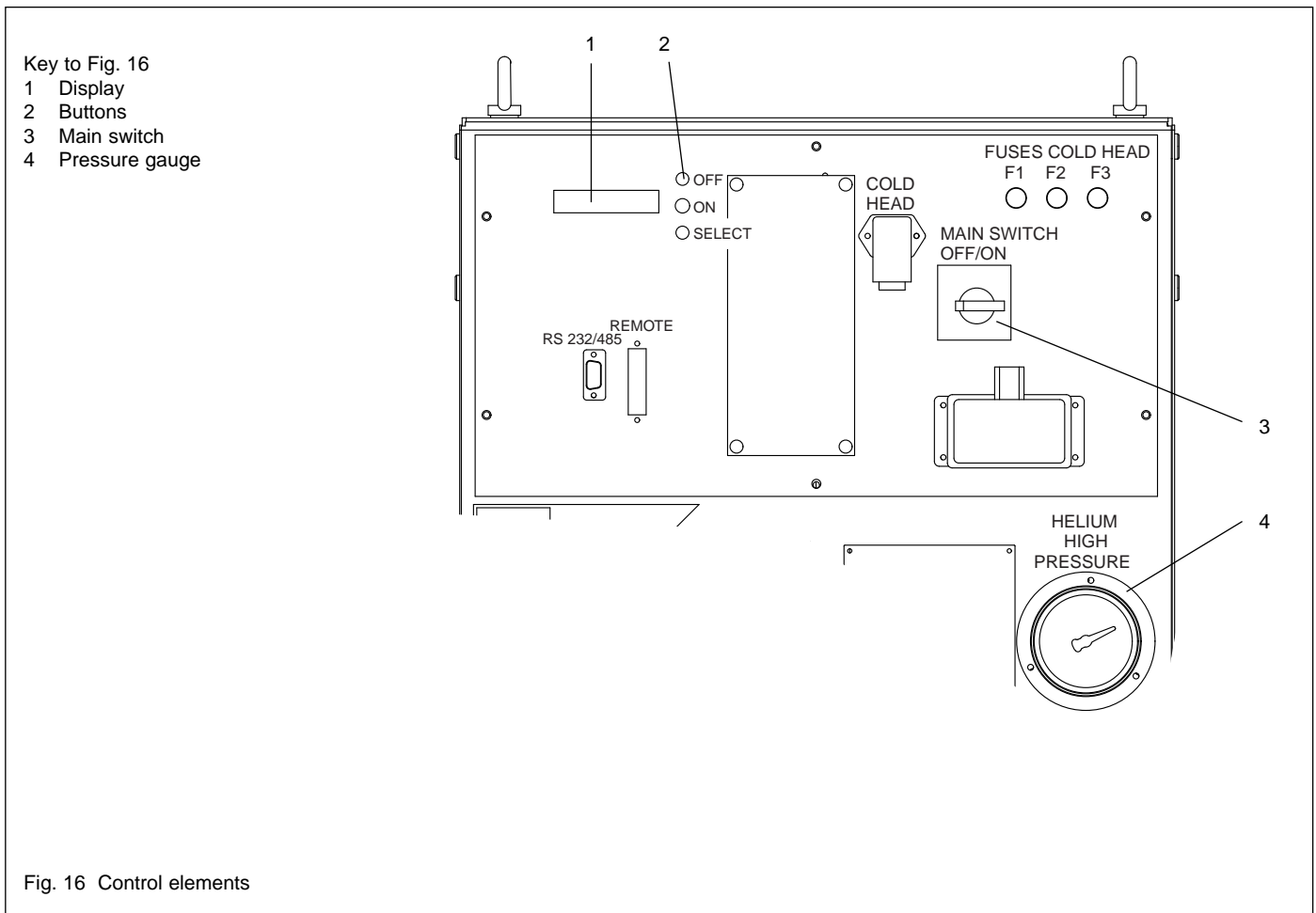


Switch off the compressor unit at the OFF button. Switch off the main switch.

Allow the coolant circulate for a further 10 minutes after shutting down the unit and then close the circuit.

Allow the cold head to warm-up before detaching the flexlines.

Loosening the flexlines with the cold head at low temperatures can result in a loss of helium.



Warning Detaching the flexlines with the cold head at low temperature can, when they heat up, result in a rise in pressure beyond the permissible 28 bar (406 psig; 2.8 MPa) operating pressure. All the self-sealing couplings which are not in use shall be provided with protective caps.

Unscrew the flexlines in a sequence reverse to that described in Section 2.6. Screw protective caps on to the self-sealing couplings. Never ship compressor units, flexlines, cold heads or adsorbers without the appropriate protective caps.

Vent the helium when the compressor unit is to be taken out of service permanently.

3.4.1 Transport and storage

Store the compressor unit in a dry place. The maximum relative air humidity is 95%, non-condensing.

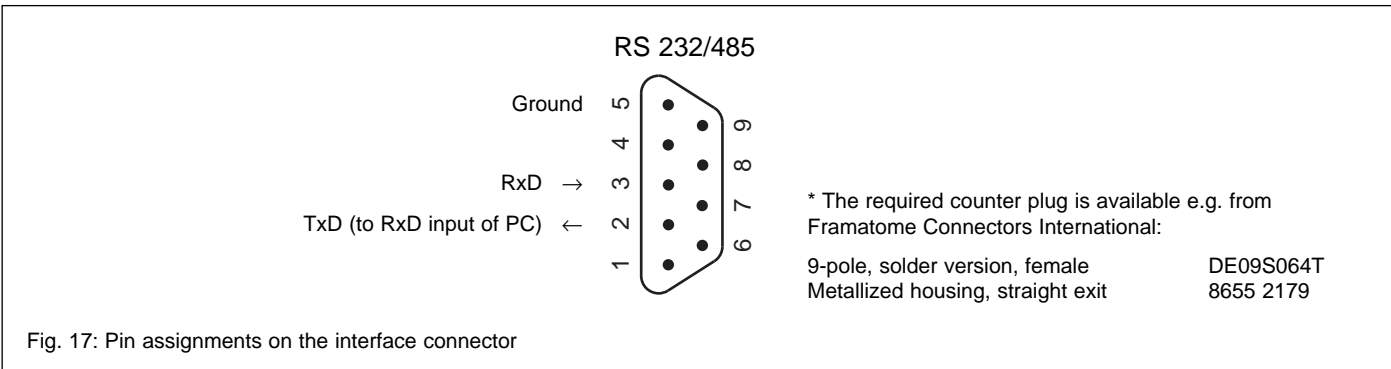
The permissible ambient temperature when transporting and storing the unit is $-20\text{ }^{\circ}\text{C}$ to $+40\text{ }^{\circ}\text{C}$ ($-4\text{ }^{\circ}\text{F}$ to $+104\text{ }^{\circ}\text{F}$). Temperatures above $40\text{ }^{\circ}\text{C}$ ($104\text{ }^{\circ}\text{F}$) may lead to gas evolution from the adsorber and thus may contaminate the flexlines and the cold head.

The ambient atmospheric pressure must be 700 mbar or above.

Warning Even after the unit is switched off, the compressor unit, the cold head and the flexlines will be under pressure of up to 16 bar (232 psig; 1.6 MPa). Observe the appropriate safety regulations.

If there is danger of freezing temperatures, drain the coolant prior to storing or shipping the compressor unit.

The compressor unit may be tilted by a maximum of 45° during shipment and storage.



3.5 Interface description

The compressor unit satisfies EU Directives regulating electromagnetic compatibility (EMC). To ensure that compatibility is maintained, use shielded cables to connect the Sub-D connectors. Connect the shielding to the metal housings of the Sub-D plugs.

Before every change of operating mode (buttons / REMOTE / RS 232) it is necessary to first switch off the compressor unit and the cold head while in the "old" operating mode and then to switch on again in the "new" operating mode. Failure to observe this rule may result in undefined operating states; see Section 2.5, "Operation via the interfaces."

The interface is available **from software version 2.0**.

Format:

- 4800,1,8,N,1
- 4800 BAUD
- 1 start bit
- 8 data bits
- no parity
- 1 stop bit

Pin assignment at 9 pin sub D of COOLPAK:

- pin 2: TxD (output of COOLPAK to RxD input of PC)
- pin 3: RxD (input)
- pin 5: GND

Communication with COOLPAK

- No handshake is needed (no XON/XOFF).
- During communication the COOLPAK is always the slave and the PC always the HOST.
- The host (PC) can send two types of messages, i. e. commands and data requests.
- The format of these messages is always as follows:
 - Byte 1: STX (= 02h = controle-B; h = hexa decimal)
 - Bytes 2..4 Command or data request
 - Bytes 5..X Command or requested data
 - Byte X+1 CR (= Carriage Return = 0Dh)
- With the exception of the first and the last byte all bytes are ASCII type (20h..7Fh).
- The maximum theoretical value for X is 126.
- In messages with more than one data value the individual data are separated from each other by a forward slash ("/" = 2Fh).
- All used letters are ASCII capitals.
- All used numbers are ASCII decimals.
- Messages with wrong formats are ignored (no response).

Example 1 (command message):

	No. of Bytes	Description
Send by HOST: STX "SYS1" CR	[1+4+1]	switch system ON
Response from COOLPAK: STX "SYS2" CR	[1+4+1]	SYSTEM ERROR

Example 2 (request data message):

Send by HOST: STX "DAT" CR	[1+3+1]	request data
Response from COOLPAK: STX "DAT"	[1+3]	
"2.08"	"/" [4+1]	software version
"004307"	"/" [6+1]	(Leybold internal use only)
"14175"	"/" [5+1]	COOLPAK hours counter (resetable by Leybold; identical to the one on the display)
"23.5/01.7/06.9/"	[15]	(Leybold internal use only)
"003"	"/" [3+1]	Switch-ON timer [seconds] (0 = system can be switched on without any delay; prevents switching on immediately after switching off)
"1"	"/" [1+1]	Command status of system (0 =OFF, 1=ON, 2 =SYSTEM ERROR; the compressor is only switched on, if the command status is ON and the switch-ON timer reached zero)
"1"	"/" [1+1]	Actual compressor status (0 =OFF, 1=ON)
"1/0/"	[4]	not used
"02"	"/" [2+1]	Number of still active errors
"1010000000000000"	"/" [16+1]	1 = error active; 0 = error not active error 1 is active (SYSTEM ERROR) error 3 is active (Locked rotor error)
"4"	[1]	Number of recorded and logged errors (≤ 8)
	CR	End of message

Commands to and data from COOLPAK

Host command	Description	COOLPAK response	Description
STX "SYS" "x" CR	Switch system x = 0 OFF x = 1 ON STX "SYS1" CR; will also reset after failures, if failure is no longer active (except OVERLOAD)	STX "SYS" "y" CR see example 1	System Status y = 0 OFF y = 1 ON y = 2 SYSTEM ERROR
STX "DAT" CR	Request data	see example 2 and definition of error codes	see example 2 and definition of error codes
STX "ERR" CR	Request logged errors	STX "ERR" "xx" "yyyy" "P" "xx" "yyyy" "P" "xx" "yyyy" CR	xx = Error code (00 < xx ≤ 16) yyyy = Hours counter See also definition of error codes

Definition of Error Codes

Error code	Error Message on Display	Description
1	SYSTEM ERROR	One or more of the errors below have occurred in the past or are still active.
2	Compressor fail	KLIXON error; the thermal switch inside of the capsule has interrupted the capsule operation due to overheating.
3	Locked rotor	The current drawn, when switching on, was too high.
4	OVERLOAD	The compressor unit has failed 3 times to run with a "Locked rotor" message; a reset will be impossible in this case without LEYBOLD service (probably severe problem with capsule).
5	Phase/fuse ERROR	The phase sequence of the line voltage is incorrect or one of the fuses F2 or F3 has blown.
6	Pressure alarm	The compressor unit has tripped via the low pressure switch; probable cause is a big He leak in the system.
7	Helium temp. fail	The compressor unit has tripped via the 38 °C thermal switch; failure of coolant supply or insufficient cooling.
8	Oil circuit fail	The compressor unit has tripped via the 100 °C thermal switch; possible causes are insufficient cooling or incorrect connection to water supply.
9	RAM ERROR 1 RAM ERROR 2	RAM error
10	ROM ERROR	ROM error
11	EEPROM ERROR	EEPROM error
12	DC Voltage error	(Is no longer displayed from software Version 2.08) Is only a warning, which will not prevent compressor unit from running, but may also be due to real problems. Possible causes may be wrong mains voltage setting close to the limits or slightly outside the allowed tolerances or a wrong control voltage due to too high load, e. g. malfunctioning cold head motor or too high load on remote and/or RS232 interface.
13	MAINS LEVEL !!!!	The lines voltage setting is wrong or fuse F2 has blown (in this case additionally error message 5 appears "Phase/fuse error"); may only appear during set-up of the system.
14 ..16		not used

4 Maintenance

Warning Separate the compressor unit safely from mains power supply before beginning any work.



After making repairs to the electrical equipment, the compressor unit may not be returned to service without conducting an electrical safety test. It is for this reason that work of this type may be carried out only by trained and qualified personnel or by the Leybold Service Department.

Maintenance work carried out improperly will jeopardize the safety, longevity and availability of the equipment and will void the warranty.

Any work which is not described in these operating instructions may be carried out only by the Leybold Service Department or by personnel specially trained by Leybold for this purpose.

4.1 Helium gas pressure adjustment

Warning Observe all safety regulations when working with pressurized gas cylinders.



If the helium pressure in the compressor unit has fallen below the minimum level, it will be necessary to recharge with helium. If the helium pressure in the compressor unit is too high release helium.

Helium filling pressures

Minimum value

Operation at 50 Hz	14 bar (203 psig; 1.4 MPa)
Operation at 60 Hz	13 bar (189 psig; 1.3 MPa)

Nominal value

Operation at 50 Hz	15 bar (218 psig; 1.5 MPa)
Operation at 60 Hz	14 bar (203 psig; 1.4 MPa)

When making measurements and when topping up or draining helium at the compressor unit, switch the unit off and allow it to cool down to room temperature and the cold heads being served to warm up.

Detaching the flexlines when the cold head is at low temperature can result in a loss of helium.

Warning Detaching the flexlines with the cold head at low temperature can, when they heat up, result in a rise in pressure beyond the permissible 28 bar (406 psig; 2.8 MPa) operating pressure.



Warning The maximum permissible operating pressure for the helium filling adapter when the self-sealing couplings are detached is 28 bar (406 psig; 2.8 MPa). Do not exceed this pressure level when setting the pressure reducer.



Warning All pressure lines and components of the helium circuit must have been joined properly, and any open couplings must be provided with protection caps.



Warning Keep the face and bodily openings away from the adapter discharge orifice.

Compressed gas can induce asphyxiation effects at high concentration. Do not inhale helium or use it to create a "squeaky voice" effect.



Releasing helium gas

A helium filling/drain adapter is provided for this purpose with the compressor unit. Unscrew the protective cap from the filling/drain connection (6/3).

Slowly and carefully screw the self-sealing couplings of the adapter onto the filling/drain connection.

Caution Do not screw the adapter on too quickly as there is otherwise the danger that too much helium will escape or that oil will be swept along with the helium out of the compressor.

Once the correct helium filling pressure has been reached, remove the filling/drain adapter. Put back the protective cap on the filling/drain connection (6/3).

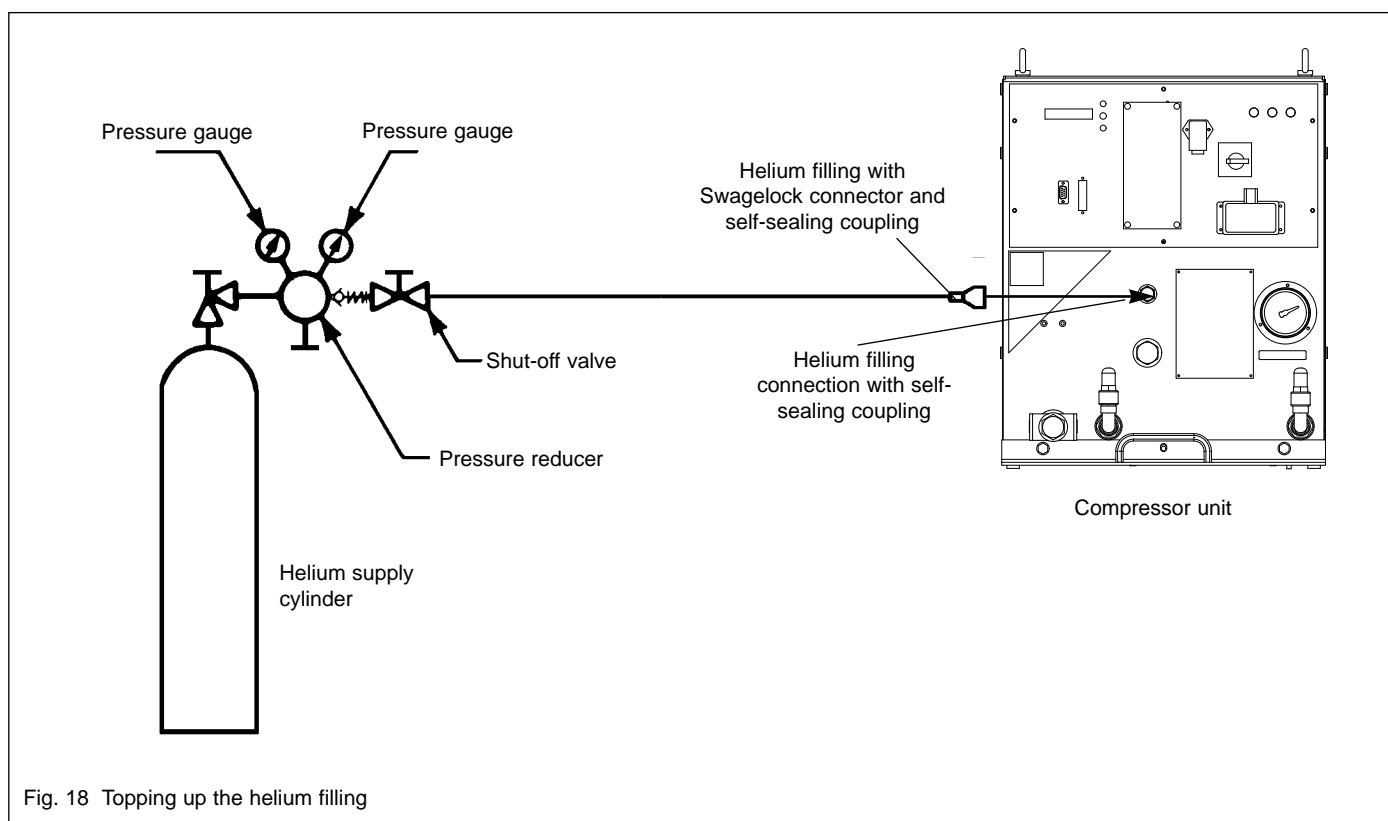


Fig. 18 Topping up the helium filling

Topping up helium gas

Caution Only helium of the highest purity (99.999% or better) shall be used.

Use the pressure reducer and a suitable high-flexline to connect the helium cylinder to the helium filling adapter supplied with the unit; do not yet tighten the Swagelock connector.

Open the valve at the cylinder.

Open the pressure reducer and the shut-off valve slightly so that the high flexline and the filling adapter are purged with helium.

Tighten down the Swagelock connector after purging the configuration several times.

Set the pressure in the supply line to correspond to the set-point value of the compressor unit. If there is insufficient pressure in the supply line, oil can pass from the compressor unit into the supply line.

Observe the instructions given in Section 2.6.

Connect the coupling at the helium filling adapter to the helium filling nipple.

Refill the compressor unit up to nominal value.

Detach the coupling from the helium filling nipple.

Close the valve at the supply cylinder.

Seal the helium filling nipple at the front of the compressor unit tightly with a protective cap.

Warning The filling hose at the helium cylinder will still be under pressure of up to 16 bar (232 psig; 1.6 MPa). Relieve pressure from the line before detaching the filling connector.



4.2 Replacing the adsorber

The adsorber is provided to keep the oil vapor out of the flow of helium gas. It will have to be replaced after about 18,000 hours of operation. Otherwise oil can collect in the cold head as a result of incomplete adsorption of the oil vapors. This will cause a reduction in cooling performance; extreme contamination of the helium gas may cause the cold head to cease functioning entirely.

Caution When making this replacement use only the appropriate adsorber supplied by Leybold; refer to Section 1.4.

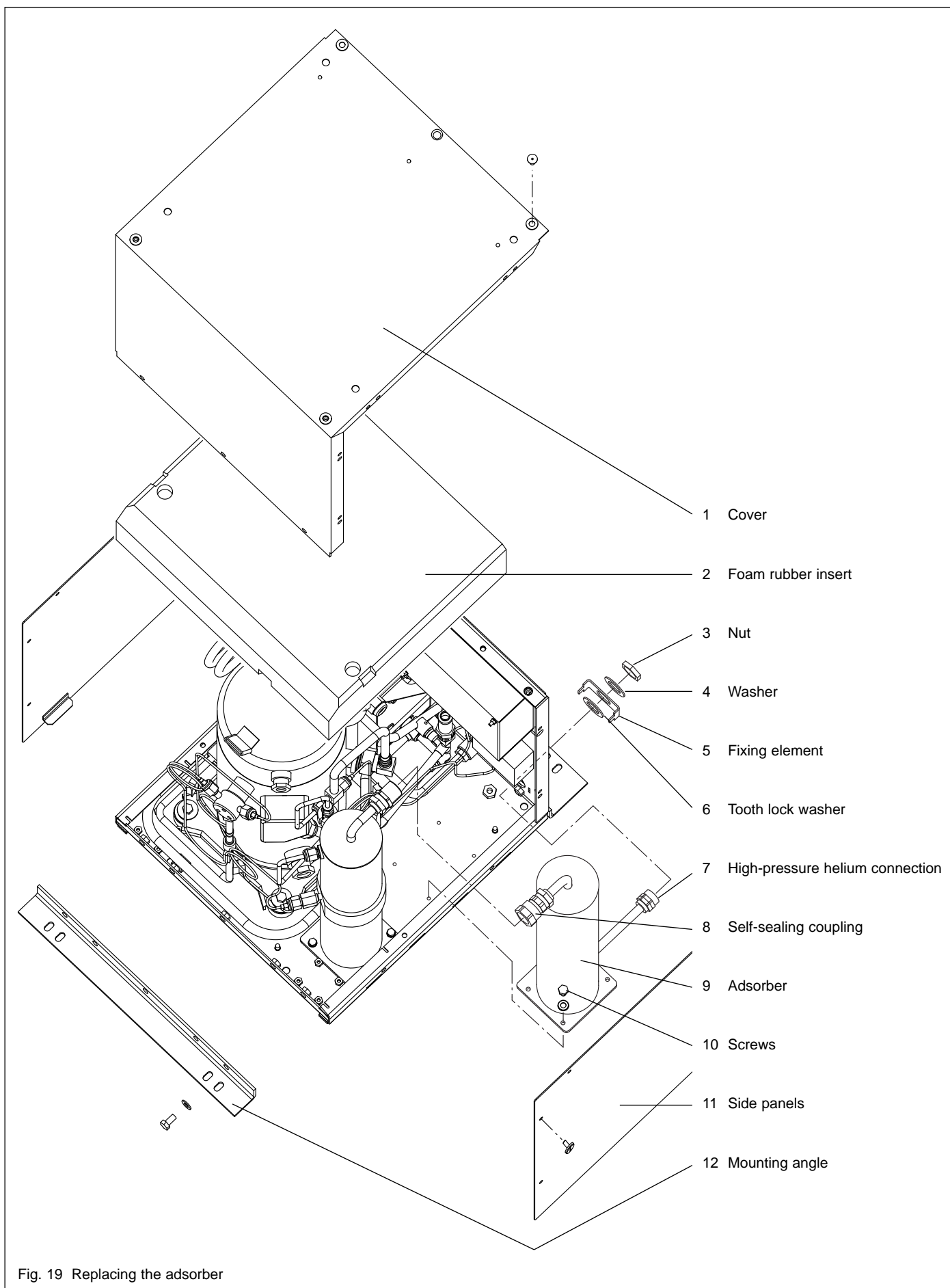


Fig. 19 Replacing the adsorber

Switch off the compressor unit and separate it from mains power supply before changing the adsorber.

Allow the cold head to warm up before disconnecting the flexlines.

Detaching the flexlines with the cold head at low temperature can cause a loss of helium.

Warning Detaching the flexlines with the cold head at low temperature can, when they heat up, result in a rise in pressure beyond the permissible 28 bar (406 psig) operating pressure. All the self-sealing couplings which are not in use shall be provided with protective caps.



Observe the instructions for the work given in Section 2.6.

Unscrew the high-pressure flexline from the compressor unit (19/7).

Remove the side panels (19/11).

Unscrew the mounting angle (19/12) and remove the cover (19/1).

Lift off the foam rubber insert (19/2). If the insert should remain inside the cover, then it need not be removed from the cover.

Unscrew the 2 screws (19/10) (M6x16, wrench size 10 mm)

Detach the self-sealing coupling (19/8) and slide the adsorber towards the operator side during the process.

Unscrew the nut (19/3) and remove the washer (19/4), the fixing element (19/5), and the tooth lock washer (19/6).

Tilt the adsorber and pull it out at the side. The high-pressure helium connection is left on the adsorber.

Remove the protective caps from the new adsorber and install the new adsorber in reverse order.

The new adsorber is filled with helium of highest purity to a level of 16 bar (232 psig; 1.6 MPa).

Seal the old adsorber with the protective caps and forward it to Leybold for reconditioning.

Warning The adsorber may contain pressure of up to 16 bar (232 psig; 1.6 MPa) even after it is removed from the system.



Reattach the high-pressure flexline to the compressor unit.

4.3 Changing the fuses for the control voltage

Warning Separate the compressor unit from mains power supply before beginning any work.



See Fig. 20.

Unscrew the 6 hex head screws that hold the power module (8 mm key). Pull out the power module a little bit and fold it down.

Unscrew the 3 nuts that hold the power module's cover (7 mm key) and remove the cover.

Change the fuses.

Caution Replace fuses F4 and F5 only with the correct ones: 0.315 A T.

Remount the power module in reverse order.

4.4 Leybold service

If you send equipment to LEYBOLD indicate whether it is free of substances damaging to health or whether it is contaminated. If it is contaminated also indicate the nature of hazard. To do so, you must use a preprinted form which we shall send to you upon request.

A copy of this form is printed at the end of the Operating Instructions: "Declaration of Contamination of Vacuum Equipment and Components".

Either fasten this form at the equipment or simply enclose it with the equipment.

This declaration of contamination is necessary to comply with legal requirements and to protect our staff.

LEYBOLD must return any equipment without a declaration of contamination to the sender's address.

Completed maintenance work

Maintenance work	Date	Reading at the operating hours meter	Helium filling pressure beforehand	Helium filling pressure afterward
Filled with helium				
Filled with helium				
Filled with helium				
Filled with helium				
Filled with helium				
Adsorber exchanged				
Adsorber exchanged				
Adsorber exchanged				
Adsorber exchanged				
Adsorber exchanged				

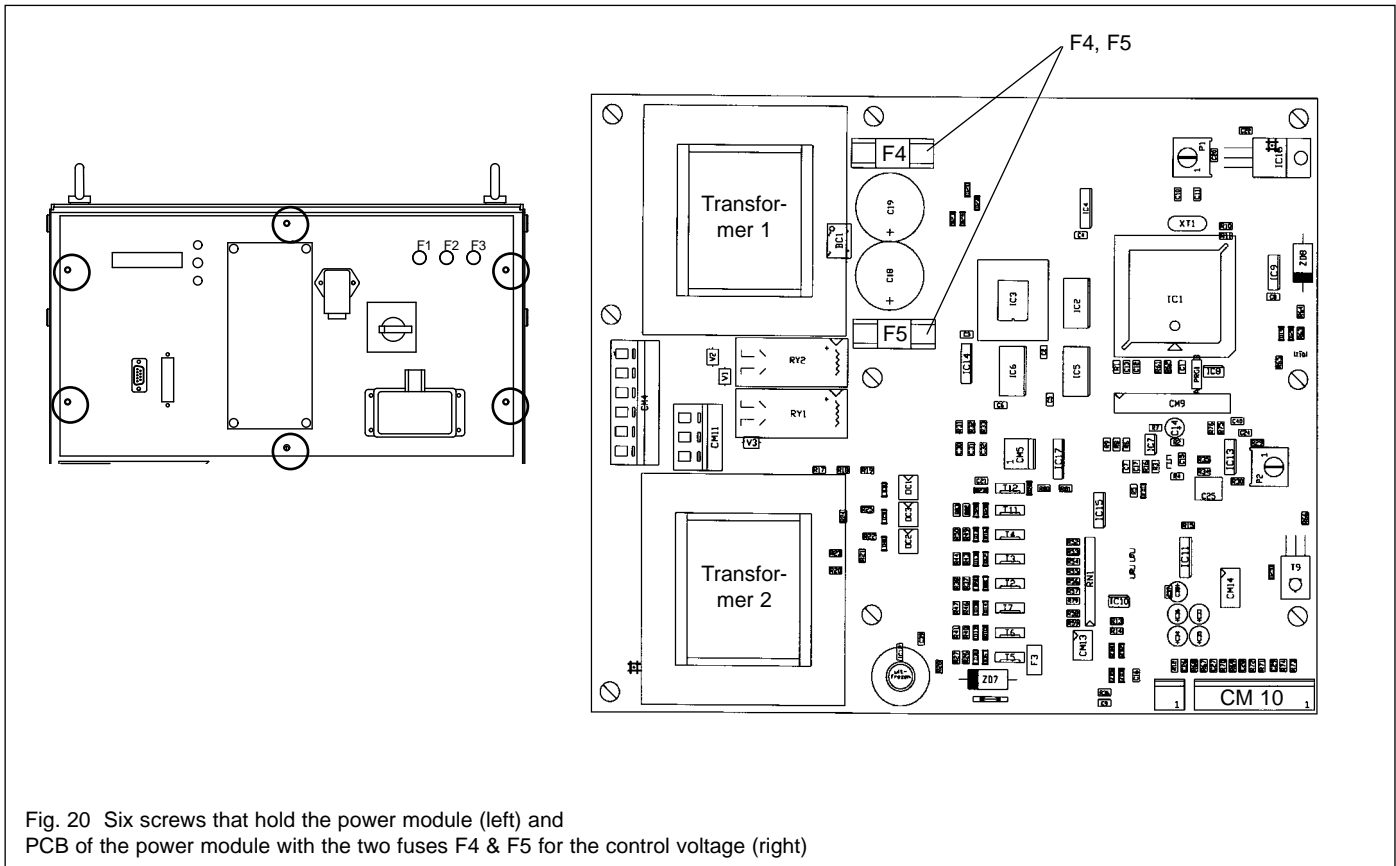


Fig. 20 Six screws that hold the power module (left) and PCB of the power module with the two fuses F4 & F5 for the control voltage (right)

5 Troubleshooting

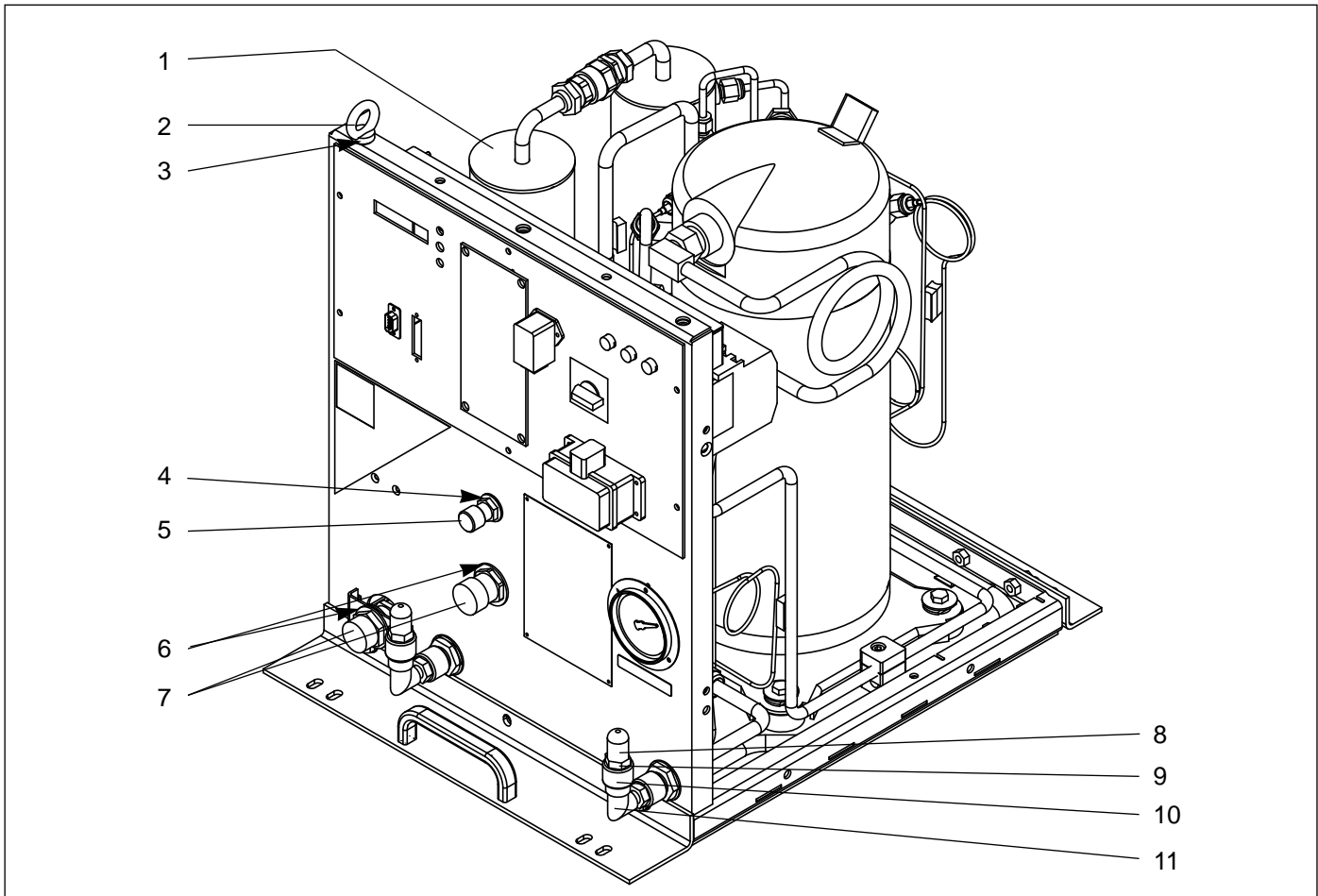
Malfunction	Possible cause	Recommended corrective action	Repair note*
1. The compressor unit fails to run; no error is displayed.	<p>Fault in connection to power supply.</p> <p>Line voltage has failed, is too low or too high.</p> <p>Main switch (motor protection switch) has tripped.</p> <p>Fuse F1 for input voltage of Power Module or both fuses F2 and F3 have blown.</p> <p>One or both fuses on the main PCB in the Power Module (F4, F5) have blown.</p>	<p>Check power lead and plug.</p> <p>Check line voltage and line voltage setting of compressor unit.</p> <p>Locate and eliminate cause of overloading; see faults 2 to 5. If switch trips again when restarting, notify Leybold Service Department.</p> <p>Locate and eliminate cause of overloading. Replace fuse.</p> <p>Locate and eliminate cause of overloading. Replace fuse. If this does not fix the problem, notify Leybold Service Department.</p>	<p>—</p> <p>2.5</p> <p>—</p> <p>1.3</p> <p>1.3, 4.3</p>
2. The compressor unit fails to run; a Pressure Alarm message is displayed, the pressure switch has tripped.	Leak in helium circuit.	Check helium pressure and top up helium, if necessary. If fault occurs frequently, notify Leybold Service Department.	4.1
3. The compressor unit fails to run; a Helium temp.fail or Oil cct. fail message is displayed, one of the thermal switches has tripped; see table in Section 1.1 for details.	<p>Water coolant circuit not open.</p> <p>Insufficient water coolant throughput.</p> <p>Water coolant flowrate set by throttle in the inlet.</p> <p>Insufficient water coolant inlet pressure.</p> <p>Water coolant inlet temperature too high.</p> <p>Water coolant connections reversed.</p> <p>As of software Version 3.03: After rectifying the cause of the malfunction leading to a "Helium temp. fail" disruption, the reset point at the TSH1 thermostat switch is not attained; see Fig. 3.</p> <p>Heat exchanger congested.</p> <p>Ambient temperature too high.</p> <p>Compressor motor too hot.</p>	<p>Insure sufficient water coolant supply.</p> <p>Insure sufficient water coolant supply.</p> <p>Set flowrate by throttle in the outlet.</p> <p>Insure sufficient water coolant inlet pressure.</p> <p>Insure sufficient water coolant supply.</p> <p>Connect water coolant lines correctly.</p> <p>As of software Version 3.03 the TSH1 reset can be accelerated by using the ON button to switch on the compressor. The compressor will then run for 90 seconds, provided that no other malfunction has been detected. If after 90 seconds the temperature has not fallen below the switching point at TSH1, then the compressor will shut down; the "He-Temp.90s fail" error message will be issued. It will then be possible to switch the compressor on again only after another 30 minutes have elapsed or the temperature has fallen below the TSH1 switching point.</p> <p>Notify Service Department.</p> <p>Change installation site.</p> <p>Notify Service Department.</p>	<p>2.4</p> <p>2.4</p> <p>2.4</p> <p>2.4</p> <p>2.4</p> <p>2.4</p> <p>2.4</p> <p>—</p> <p>—</p> <p>2.4</p> <p>—</p>
3a. Compressor unit does not run; error message He-Temp.90s fail	See malfunction 3, "As of software Version 3.03: ..."		—
4. A Helium temp.fail message is displayed after one of the fuses F4 or F5 has been changed.	The plug CM 10 was unplugged and then plugged incorrectly.	Plug CM 10 correctly.	See Fig. 11 for pos. of CM 10

* Repair note: Refer to the Section indicated.

Malfunction	Possible cause	Recommended corrective action	Repair note*
<p>5. The compressor unit fails to run; a Phase/Fuse ERROR* message is displayed, fuse F2 or F3 has blown or the phase sequence of the line voltage is incorrect.</p> <p>** or Fuse ERROR L1 or Fuse ERROR L2 or Fuse ERROR L3</p>	<p>Faulty wiring, electrical overload.</p> <p>Cold head motor defective.</p>	<p>Check connections; if necessary, replace fuses or reverse 2 phases of power supply.</p> <p>Check cold head motor; if necessary, replace.</p>	2.5
<p>6. The cold head performance declines; also refer to the Operating Instructions for the cold head or the cryopump.</p>	<p>Adsorber saturated.</p> <p>Incorrect electrical connection of cold head.</p> <p>Drop in helium pressure.</p>	<p>Replace adsorber. Adsorber must be replaced after every 18,000 hours of operation.</p> <p>Check connections.</p> <p>Check helium pressure and top up helium, if necessary; if fault occurs frequently, notify Leybold Service Department.</p>	<p>4.2</p> <p>2.5</p> <p>4.1</p>
<p>7. A Phase/Fuse ERROR message is displayed, but the compressor unit runs.</p> <p>(In software Versions 2.05 and before the message DC Voltage error is displayed.)</p>	<p>The line voltage setting is wrong.</p> <p>Control voltage is wrong because of too high load (e.g. cold head motor malfunctioning).</p> <p>The mains voltage is close to the limits of +10% or -10% of the specified terminal settings.</p>	<p>Set the compressor unit to the correct line voltage.</p> <p>Check cold head; if necessary, replace.</p> <p>Measure the mains voltage to verify that it is close to the specified limits. In this case simply ignore the message.</p>	<p>2.5</p> <p>—</p> <p>—</p>
<p>8. A MAINS LEVEL !!! message is displayed.</p>	<p>The line voltage setting is wrong.</p> <p>Fuse F2 has blown. In this case additionally error message 5 appears "Phase/fuse error" when pressing the SELECT button.</p>	<p>Set the compressor unit to the correct line voltage.</p> <p>Ignore the MAINS LEVEL !!! message and correct the malfunction as described in malfunction 5.</p>	<p>2.5</p> <p>—</p>
<p>9. The compressor unit fails to run; an Locked rotor message is displayed.</p>	<p>The current drawn when switching on was too high.</p>	<p>Check input power connections; then try to start the compressor unit again. After the compressor unit has failed 3 times to run with an Locked rotor message, the display will show "OVERLOAD". Notify Leybold Service Department.</p>	<p>2.5</p> <p>—</p>
<p>10. The compressor unit fails to run; a OVERLOAD message is displayed.</p>	<p>The compressor unit has failed 3 times to run with an Locked rotor message; see malfunction 9.</p>	<p>Notify Leybold Service Department.</p>	—
<p>11. The compressor unit fails to run; a Compressor fail message is displayed.</p>	<p>Thermal switch in compressor capsule (Klixon) has tripped; compressor capsule too hot.</p> <p>Compressor motor malfunctioning.</p>	<p>Locate and eliminate cause of overheating; see malfunction 3 for possible causes and corrective actions. Wait 2 - 3 hours to let the compressor capsule cool down, then restart.</p> <p>Notify Leybold Service Department.</p>	<p>2.4</p> <p>—</p>

Malfunction	Possible cause	Recommended corrective action	Repair note
12. One of the following messages is displayed: RAM ERROR 1 RAM ERROR 2 ROM ERROR EEPROM ERROR	—	Notify Leybold Service Department.	—
13. Beginning with software Version 3.03: The compressor unit stops with error message Restart active! and then restarts automatically	The line voltage has failed either completely or intermittently in one or more phases. The compressor automatically restarts after the malfunction disappears.	No action required unless <ul style="list-style-type: none"> • the disruption lasts longer than 5 minutes (⇒ Restart fail!!! error message) or • the disruption recurs 5 times in 10 minutes (⇒ Brown outs!!! error message) 	—
14. Beginning with software Version 3.03: The compressor unit does not run; error message: Restart fail!!!	Line voltage fails in one or more phases for longer than 5 minutes.	Eliminate the cause of the disruption and then restart the compressor unit. Use an uninterruptable power supply if necessary.	—
15. Beginning with software Version 3.03: The compressor unit does not run; error message: Brown outs!!!!	The line voltage has failed in one or more phases at least 5 times within 10 minutes.	Eliminate the cause of the disruption and then restart the compressor unit. Use an uninterruptable power supply if necessary.	—
In addition to all displayed errors SYSTEM ERROR is displayed.	—	—	3.3

6 Spare parts



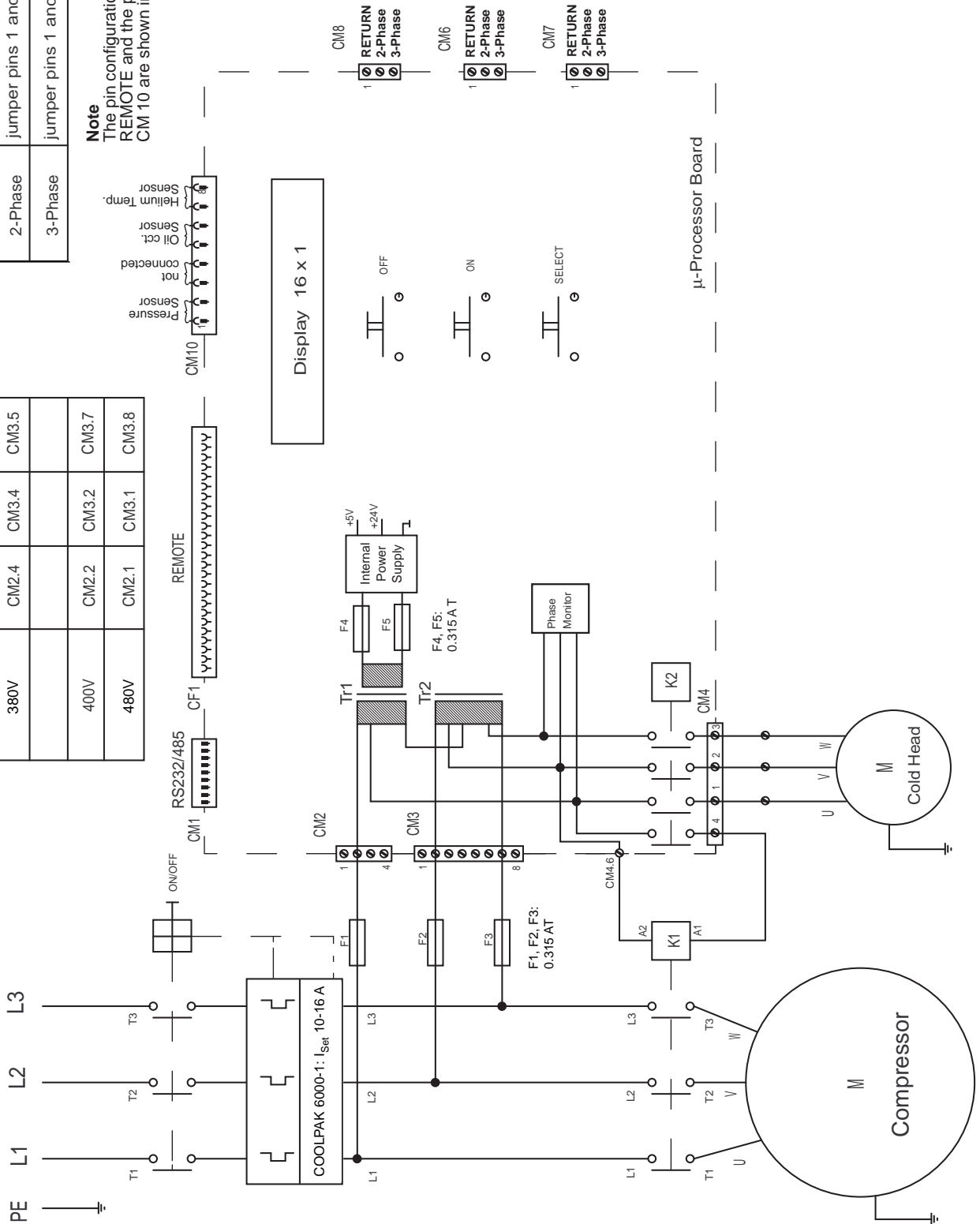
Item	Quantity	Description	Dimensions (mm) / Material		Ref. No.
1	1	Adsorber CACP 6000	ø101	Steel	893 52
2	3	Crane eyelets	M 8		201 13 101
3	3	Washer	A 8.4	Stainless steel	221 01 206
4	1	Flat gasket	1/4"		725 52 219
5	1	Protective cap	1/4"		200 19 837
6	2	Flat gasket	1/2"		725 52 220
7	2	Protective cap	1/2"		950 00 004
8	2	Hose nipple	DN 12	Brass	200 19 460
9	2	Nut	G 1/2"	Brass	200 49 033
10	2	Clamping ring	ø12	Brass	200 49 052
11	2	Threaded elbow joint (incl. Pos. 9, 10)	G 1/2"x12		200 49 053
not shown	1	Thermal switch	38 °C		200 15 764
not shown	1	Thermal switch	100 °C		200 15 765
not shown	5	Fuse 0.315 AT (slow blow) glass tube	5x20 ,DIN 41662, IEC 127-2/III		520 25 310
not shown	1	Filling adapter	1/4"		200 20 074
not shown	1	Open-ended wrench	1"		200 19 692
not shown	1	Open-ended wrench	1 3/16"		200 19 693
not shown	1	Screwdriver	0,4x2,0x70	Stainless steel	200 49 110

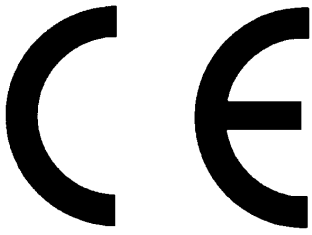
Electrical Schematic

Cold Head Motor	CONFIGURATION
2-Phase	jumper pins 1 and 2 of CM6, CM7, CM8
3-Phase	jumper pins 1 and 3 of CM6, CM7, CM8

Line Voltage	L1	L2	L3
380V	CM2.4	CM3.4	CM3.5
400V	CM2.2	CM3.2	CM3.7
480V	CM2.1	CM3.1	CM3.8

Note
The pin configuration for connector REMOTE and the position of connector CM 10 are shown in Section 2.5.





EC Conformance Declaration



We, the Leybold Vacuum GmbH, declare herewith that the products listed below, on the basis of their design and engineering as well as in the embodiment which we have placed on the market, comply with the applicable safety and health requirements set forth in EC guidelines.

This declaration becomes invalid if modifications are made to the product without consultation with us.

When operating with pressurised components like helium flexlines, gas manifolds, cold heads or cryo pumps, compliance with the fundamental safety requirements as laid down through EC directives is mandatory. This includes attentive reading and observation of all Operating Instructions of the system components used.

The protection aims of the EMC Guideline can only be attained when properly using Leybold components like cold head, cryo pump, controllers and cables.

Designation of the products: Helium compressor unit

Model: COOLPAK 6000-1

Catalog number: 892 35

Conformity assessment procedures in accordance to EC Pressure Equipment Directive:

Assembly compressor unit	Module A
- Separator	Module A
- Adsorber	Module A
- Safety valve	Module B

Cologne, May 29, 2002

Dr. Mattern-Klosson, Managing Director

The products comply with the following guidelines:

- EC Machinery Guidelines (89/392/EEC) in the 91/368/EEC version
- EC Low-Voltage Guidelines (73/23/EEC)
- EEC Directive on Elektromagnetic Compatibility (89/336/EEG), measured with a typical test configuration
- EC Pressure Equipment Directive (97/23/EG)

Applicable, harmonized standards:

- EN 292-1 and -2
Machinery Safety – Basic Terminology
- EN 1012-1
Safety Requirements for Compressors
- EN 60204-1
Electrical Equipment for Industrial Machinery
- EN 50081-1: EMC, Generic Emission Std
- EN 50082-2: EMC, Generic Immunity Std

Applied national standards and technical specifications:

- VBG 16/01.93 Compressors
- VBG 4/04.79 Electrical Operating Machinery and Plant
- DIN VDE 0113- Electrical Equipment
- AD-2000 Rulings A2, B0, HP30 W0
- DK 621.642-986 Pressurized Vessels Code
- GSG, Section 3, Par. 1, Equipment Safety Code

Cologne, May 29, 2002

Dr. Häfner, Head of Cryogenics Design

Certifications

The Leybold refrigeration units listed below comply as complete systems with the requirements of Underwriters Laboratories (UL) as "Recognized Component" (UR) and the cUR certification awarded by Underwriters Laboratories for the Canadian Standards Association.

The overall system comprises the COOLPAK 6000-1 compressor unit with the CACP 6000 Adsorber and one or more "RGS, RGD, or COOLPOWER" cold heads, the type "FL" flexlines and the accessories for single- and multiple-head operation (type "GD" gas distributor, type "MC" electrical distribution unit, etc.).

These Leybold refrigerator units are registered under the recognition mark UR/cUR reference No. SA 8676. Labelling for the system as a whole is to be found only on the data plate for the compressor unit.



Warn and operation references to Certification

Caution If helium is added in the field or unit is recharged the filling pressure should not exceed 16₋₁ bar (232_{-14,5} psig). (Unit and ambient temperature 20 °C) The admissible filling pressure dependent on the unit design and operational conditions is defined in the Operating Instructions in Section "1.3 Technical specifications".

The system is to be used with up to 4 Leybold cold heads type "RGS, RGD, or COOLPOWER" using Leybold flexible pressure lines type "FL". For operation of more than 1 cold head use Leybold electrical manifold "MC" and suitable Leybold gas manifolds.

When the charcoal adsorber is replaced replace it with the new Leybold adsorber type "CACP 6000".



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