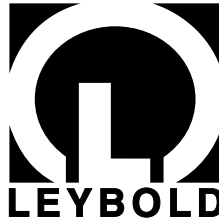


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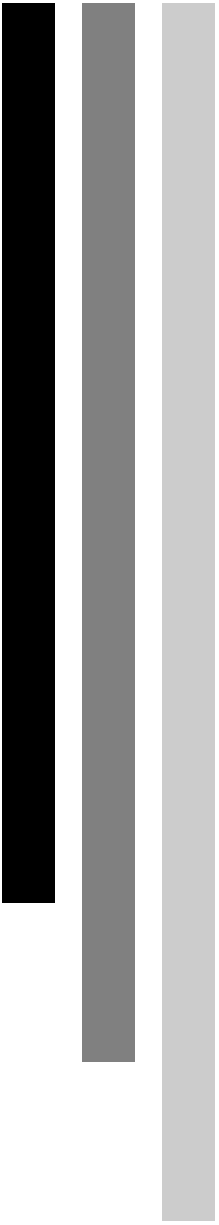
Application Support

Service



LEYBOLD VACUUM

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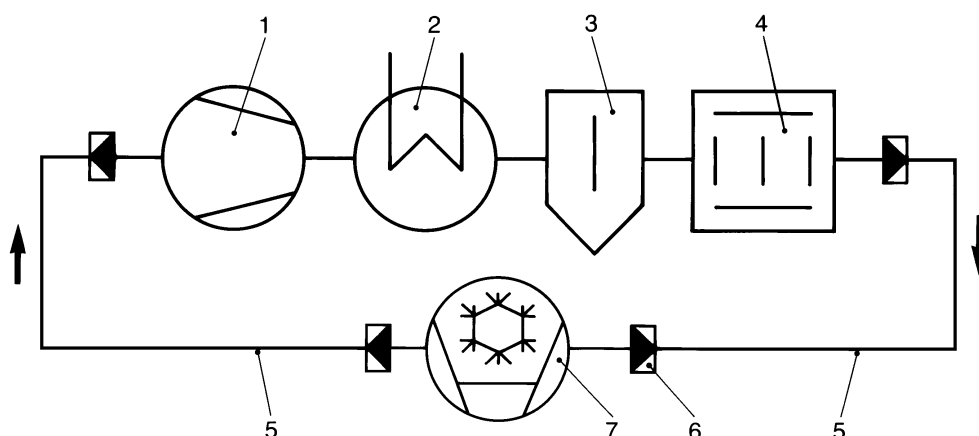


## RW 6000-1

Compressor Unit and  
Accessories for Cryogenic  
Refrigerator Units

Cat.-No.  
891 44

Operating Instructions



Key to Fig. 1

- 1 Helium compressor
- 2 Heat exchanger
- 3 Oil separator
- 4 Oil adsorber
- 5 Flexlines
- 6 Self-sealing couplings
- 7 Cold head or cryo pump

Fig. 1 Simplified schematic for the helium circuit

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

### 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.

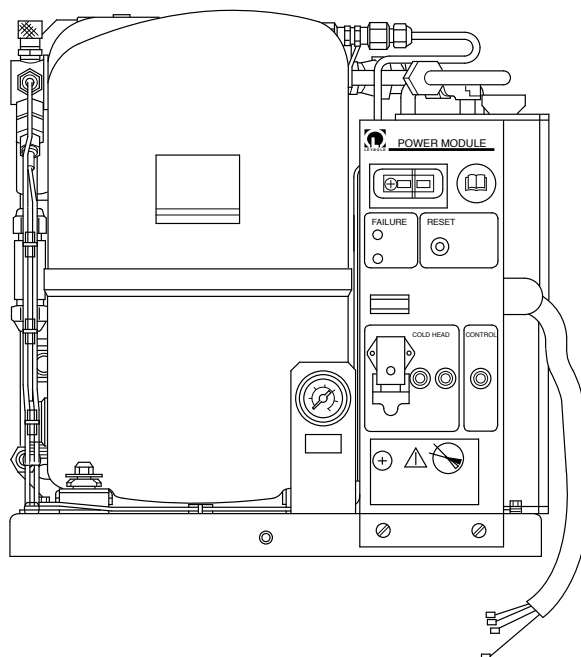


Fig. 2 RW 6000-1 compressor unit; front side

# 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 units and the associated flexlines.

The compressor units 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.

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 have been inspected by the TÜV technical inspectorate for Rhineland and have been awarded GS certification; they 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 is then vaporized 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).

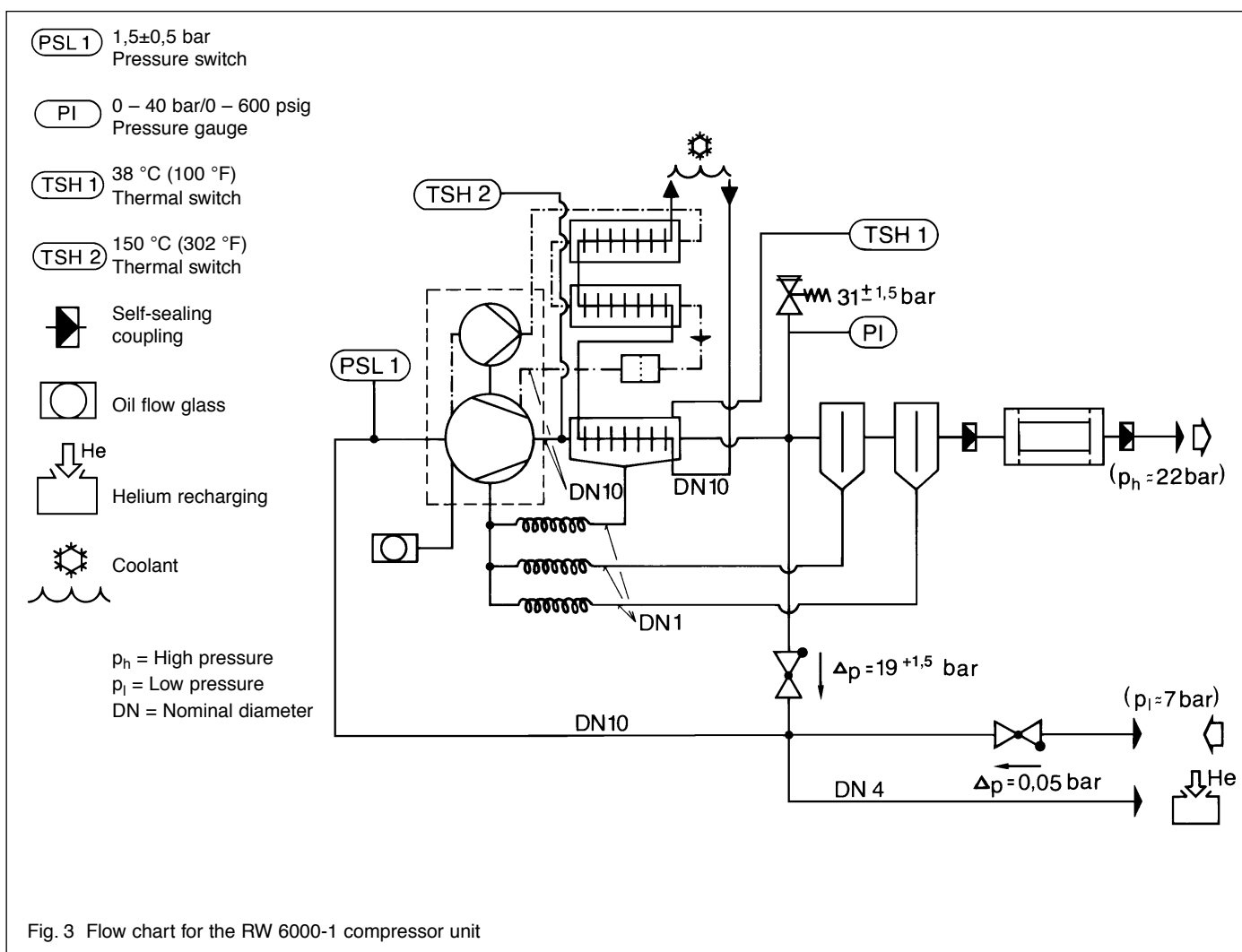


Figure 3 shows the flow diagram for a compressor unit. The oil-lubricated, hermetically sealed helium compressor reduces the volume of the helium gas, which becomes very hot in the process. For this reason it is passed through a helium/water counterflow heat exchanger located immediately downstream from 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 two oil separators connected in series, in which additional oil condensate is removed from the stream of gas. The condensate from the heat exchanger and the oil separators 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.

In the interest of cooling the compressor itself, the oil is pumped through an oil/water counterflow heat exchanger. The oil pump required for this purpose is integrated into the compressor.

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

## Safety Equipment

	Safety equipment	Indication at the compressor unit
1	Pressure switch (PSL1): Pressure differential between low-pressure helium and atmospheric pressure $< 1,5 \pm 0,5$ bar (22 psi)	LOW PRESSURE LED lights
2	Thermal switch (TSH1): helium temperature following the heat exchanger $> 38$ °C (100 °F)	TEMPERATURE LED lights
3	Thermal switch (TSH 2): helium temperature before the heat exchanger $> 150$ °C (302 °F)	TEMPERATURE LED lights
4	Thermal switch (Klixon) inside the compressor capsule	No indication
5	Thermal switch in the power module: power module temperature $> 65$ °C (149 °F)	No indication
6	Motor protection switch (master switch)	Switch is tripped
7	2 circuit breakers for the cold head (240 V AC)	Circuit breaker tripped
8	Circuit breaker for control voltage (24 V DC).	Circuit breaker tripped
9	Bypass valve: opens a shunt between the high- and low-pressure helium circuits if the pressure differential exceeds $19 \pm 1,5$ bar (276 psi)	No indication
10	Safety valve: opens the helium circuit to the atmosphere if the high-pressure segment exceeds $31 \pm 1,5$ bar (435 psig)	No indication
11	Check valve in the low-pressure helium line: keeps oil from flowing back to the cold head	No indication
If any of the safety features from 1 through 8 opens, this will cause the compressor unit to shut down.		

## 1.2 Standard Equipment

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

- mains power cord (2.2 m long), and
- a master switch.

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

Also supplied with the unit are:

- 1 electrical wiring diagram,
- 3 certificates of compliance with section 9 of the pressurized vessels code,
- 1 adapter (6 mm Swagelock  $1/4$ " self-sealing coupling),
- 2 clamping rings (spare parts for water connection).
- 1 open-end wrench 1",
- 1 open-end wrench  $1 \frac{3}{16}$ ".

## 1.3 Technical Specifications

Helium filling pressure at room temp.		
Operation at 50 Hz	bar	16 <sub>-1</sub>
	psig	218 to 232
Operation at 60 Hz	bar	14 <sub>-1</sub>
	psig	189 to 203
Operating pressure in the high-pressure circuit at 50 Hz		
	bar	22±1
	psig	305 to 334
and with connection of an	RGD	5/100-1
Permissible ambient temperature <sup>2)</sup>		
	°C	5 – 40
	°F	40 to 105
Permissible relative humidity, max.	%	90
Coolant inlet temperature <sup>2)</sup>		
	°C	5 – 25
	°F	40 to 80
Permissible coolant connection pressure	bar	8
	psig	116
Coolant connection, hose nipples	Nom.diam	12
Coolant consumption at 25°C (approx. 80°F) inlet temperature		
	l/min	5
	gal/min	1.3
Max. coolant flow rate		
	l/min	10
	gal/min	2.6
Mains power supply, 50Hz, 3-ph., each±5%		
	V	400, 415
Mains power supply, 60Hz, 3-ph., each±5%		
	V	460, 480
Delivered from the factory wired for	V	415
Electrical power drawn at 50 Hz	kW	6.1 – 6.9
Electrical power drawn at 60 Hz	kW	6.5 – 7.2
Operating current at 50 Hz	A	9.8 – 11.1
Operating current at 60 Hz	A	8.6 – 10.2
Mains cord connection plug <sup>3)</sup>	Type	4
Control voltage for the remote control		
	V DC	24
Connection voltage for the cold head		
	V AC	240
Helium connectors: self-sealing couplings <sup>4)</sup>		
		1/2" m
Noise level <sup>5)</sup> , at a distance of 1 m		
	dB(A)	78 - 80
Dimensions (W x H x D)		
	mm	450x445x445
Weight		
	kg	105
	lbs	232

1) --

2) Operation at lower temperatures is possible if the appropriate measures are taken. Please consult the manufacturer for details.

3) Type 4: four conductor ferrules 4,0 mm<sup>2</sup> x 18 mm long (0.7 inch) with designations L1/L2/L3/PE

4) f=female / inside threads; m=male / outside threads „Aeroquip series 5400“ or compatible designs.

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

## 1.4 Order Information

	Cat.-No.
Compressor unit, RW 6000-1	891 44
Adsorber, ARW 2	891 84
<b>Flexlines</b>	
One pair each with self-sealing couplings at both ends	
FL 4.5 (1/2" f <sup>4)</sup> , 1/2" f), 4.5 m long (15 feet)	892 87
FL 9.0 (1/2" f, 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
<b>Installation accessories</b>	
with self-sealing couplings, Helium filling pressure at room temperature (16 <sub>-1</sub> ) 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

## 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.

#### Warning



The compressor unit and the flexlines are filled with helium at pressures of up to 16 bar (232 psig) when stopped and of up to 22 bar (319 psig) 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 **shall not** be worked either mechanically or thermally. The safety pressure relief, bypass and non-return valves in the compressor unit **shall not** be blocked or modified.

The maximum permissible operating pressure for the flexlines and the helium filling adapter when the self-sealing couplings are coupled is 28 bar (406 psig).

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. 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).

#### 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.

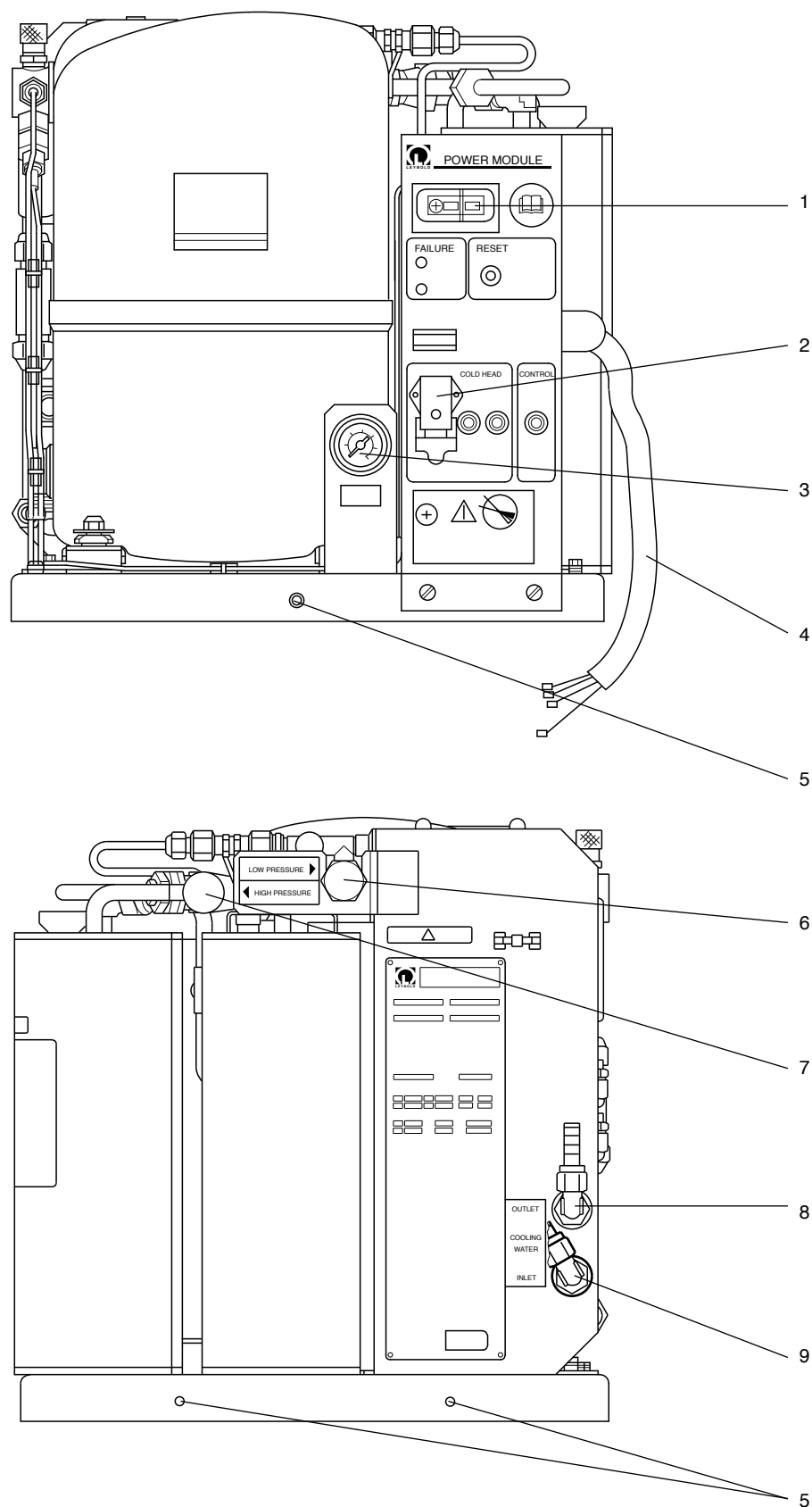
To avoid electrical shock, be sure to ground the compressor unit and all attached devices.

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.



**Key to Fig. 4**

- 1 Master switch
- 2 Electrical connection for the cold head
- 3 Pressure gauge
- 4 Power cord
- 5 Fastening boreholes
- 6 Low-pressure helium connection
- 7 High-pressure helium connection
- 8 Coolant outlet
- 9 Coolant inlet

Fig. 4 Connection elements



## 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 and lift off the packaging.

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.

### 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 a suitable device to lift the compressor unit out of the base section of the packaging. Fasten this lifting device at the M8 boreholes in the base plate; see Fig. 4.

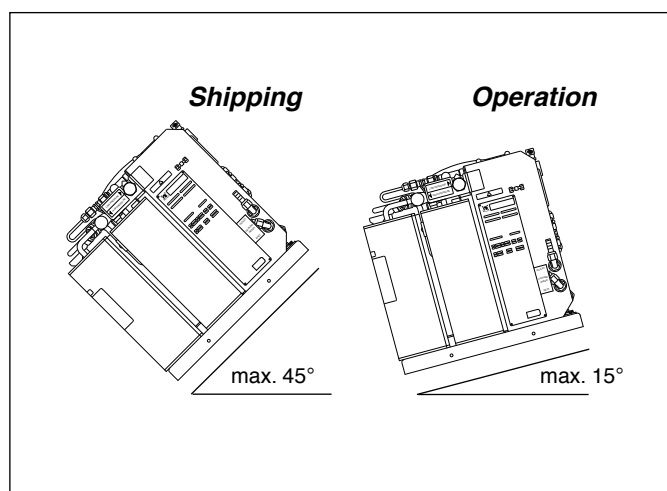
The lifting equipment is not included with the compressor unit. Use a lifting device with sufficient carrying capacity (the unit weighs 105 kg (232 lbs) or more).

### Caution

**Do not** use the piping or other components to grasp 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 15° 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 pressure gauge 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.



## 2.3 Mounting

The compressor unit can be set up for operation at a tilt of up to a maximum of 15° 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.

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

The installation location should be dry (max. relative humidity of 90%) and free of dust.

The ambient temperature must lie between 5°C and 40°C (40°F and 105°F). Operation at lower temperatures is possible if appropriate measures are taken; please inquire of the manufacturer for details.

Protect the compressor unit against intense, direct sunlight.

### Warning

The RW 6000-1 is not equipped with a safety guard (type of protection IP 21); it must therefore be installed in a location where it is protected against contact and water.

## 2.4 Coolant Connection

The compressor units are fitted with nipples to connect the coolant circuit.

Do not confuse the inlet and outlet ports!

Remove the caps from the hose nipples.

Use hose clamps to attach the water hoses.

Use only hoses of sufficient pressure strength (at least 10 bar at 70°C/145 psig at 165 °F).

### **Water quality**

The compressor units are served by counterflow heat exchangers.

To prevent calcium deposits in the heat exchanger, the total of the alkaline earths (water hardness) should be 1.25 to 1.8 mmol/l.

1 mmol/l = 5.5° d (German hardness scale)  
= 7.02° e (English hardness scale)  
= 10.0° f (French hardness scale)  
= 5.85° a (American hardness scale)

The pH value of the cooling water should be between 6 and 8.

The water should be as free of suspended matter as possible.

If there are suspended matter present in the coolant, we recommend installing a water filter with a mesh size of from 100 to 150 micrometers. The quantity of matter in suspension downline from the filter shall be less than 10 mg/l.

In case of doubt, contact your water utility company or Leybold for advice.

Obtain full information on the water quality before connecting the compressor unit to a central recirculating cooling water supply.

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.

Check the cooling water flow rate regularly.

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

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

Add anti-freeze to the water if ambient and water temperatures are below 5°C (40°F). If you use anti-freeze, please consult Leybold as to the proper choice of agent.

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

### **Coolant consumption**

Note the values for coolant temperature, pressure and flow rate given in Section 1.3 of the technical specifications and in Figure 5.

Check the coolant flow rate and temperature at regular intervals.

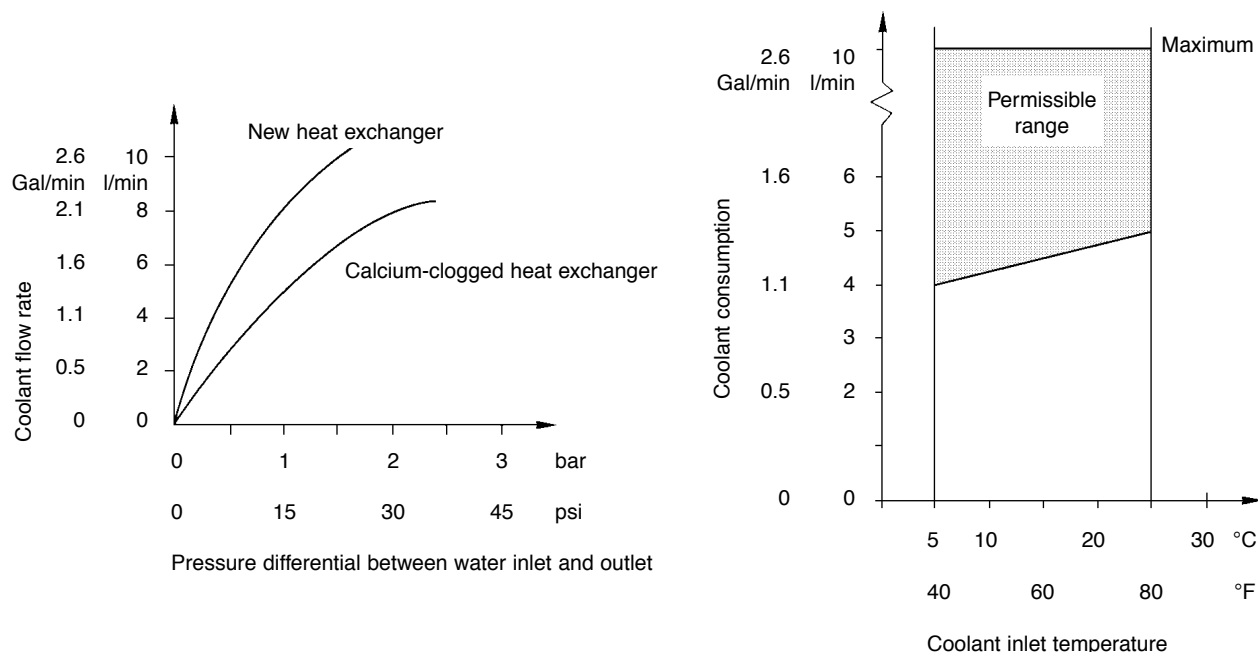


Fig. 5 Charts: Coolant criteria

## 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).

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.

### Set the compressor unit to match the mains voltage

The compressor unit can be adjusted to operate on any of a number of line voltages; the factory setting is indicated in Section 1.3. Observe the specifications shown on the tag attached to the power cord.

### Caution

Where the local power supply differs from this value, it is absolutely necessary to reconnect the terminals at the power module.

To do so, loosen the screws which hold the power module on the base plate and pull out the power module.

Take out the 2 screws at the upper edge of the power module and fold the frontplate forward and down.

Remove 4 screws and take off the left side-panel of the power module.

A terminal plan is affixed to the side-panel. Compare the terminal assignment at the transformers with the terminal plan and change as necessary.

Reinstall the left side-panel, fold up the frontplate and secure it with the screws.

Reconnect the protective earth conductor if it was removed.

Connect the compressor unit to the mains.

### Connect the cold head

Attach the electrical cord from the cold head at the socket (4/2).

An adapter must be used with cold heads which were manufactured prior to 1990.

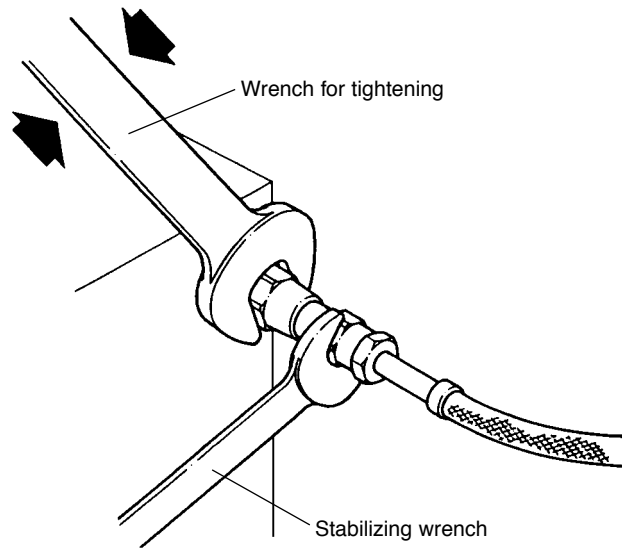


Fig. 6 Mounting the self-sealing couplings

## 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. 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.

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

Attach or detach flexlines only when the pressure unit is switched off.

Never twist flexlines.

Use one wrench to screw down the coupling and a second to stabilize the connector nipple; see figures 8 and 9.

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, (8/1) to (8/4), corresponding to the direction in which the helium flows.

### Caution

**Do not** mix up the high- and low-pressure connections.

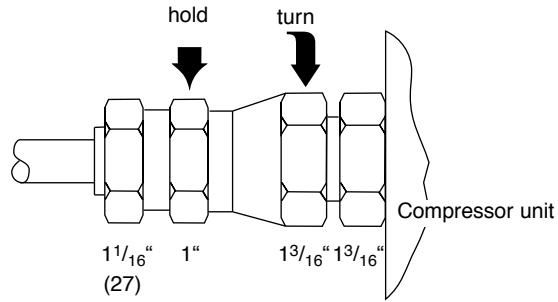
Interchanging these connections can cause damage inside the cold head.

After installation, check the helium filling pressure at the pressure gauge.

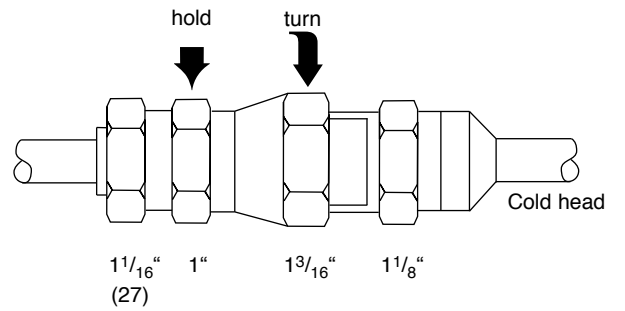
Detach the flexlines by unscrewing the couplings in reverse order.

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

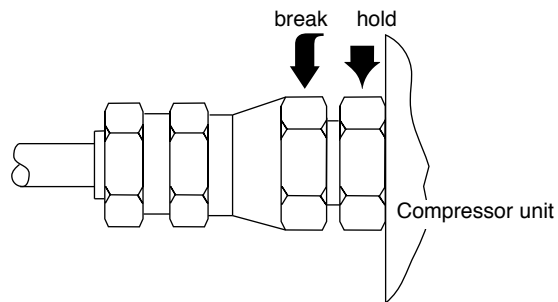
Attaching coupling to the compressor unit



Attaching coupling to the cold head



Unscrewing coupling from the compressor unit



Unscrewing coupling from the cold head

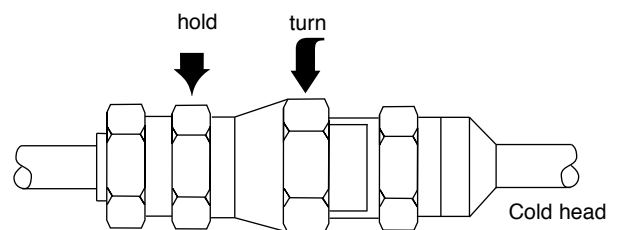
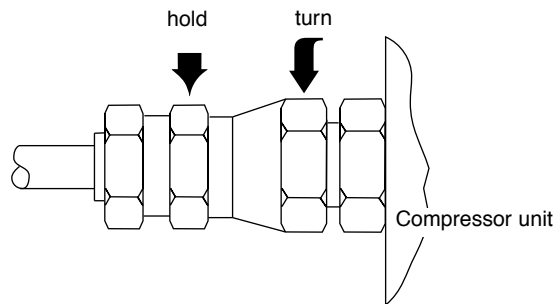
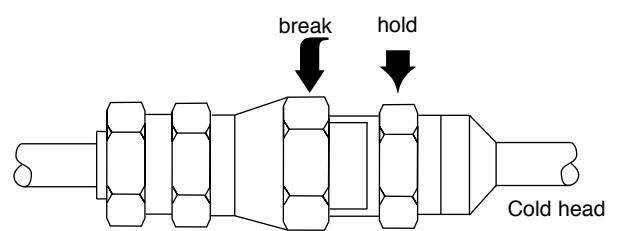


Fig. 7 Attaching and detaching self-sealing couplings

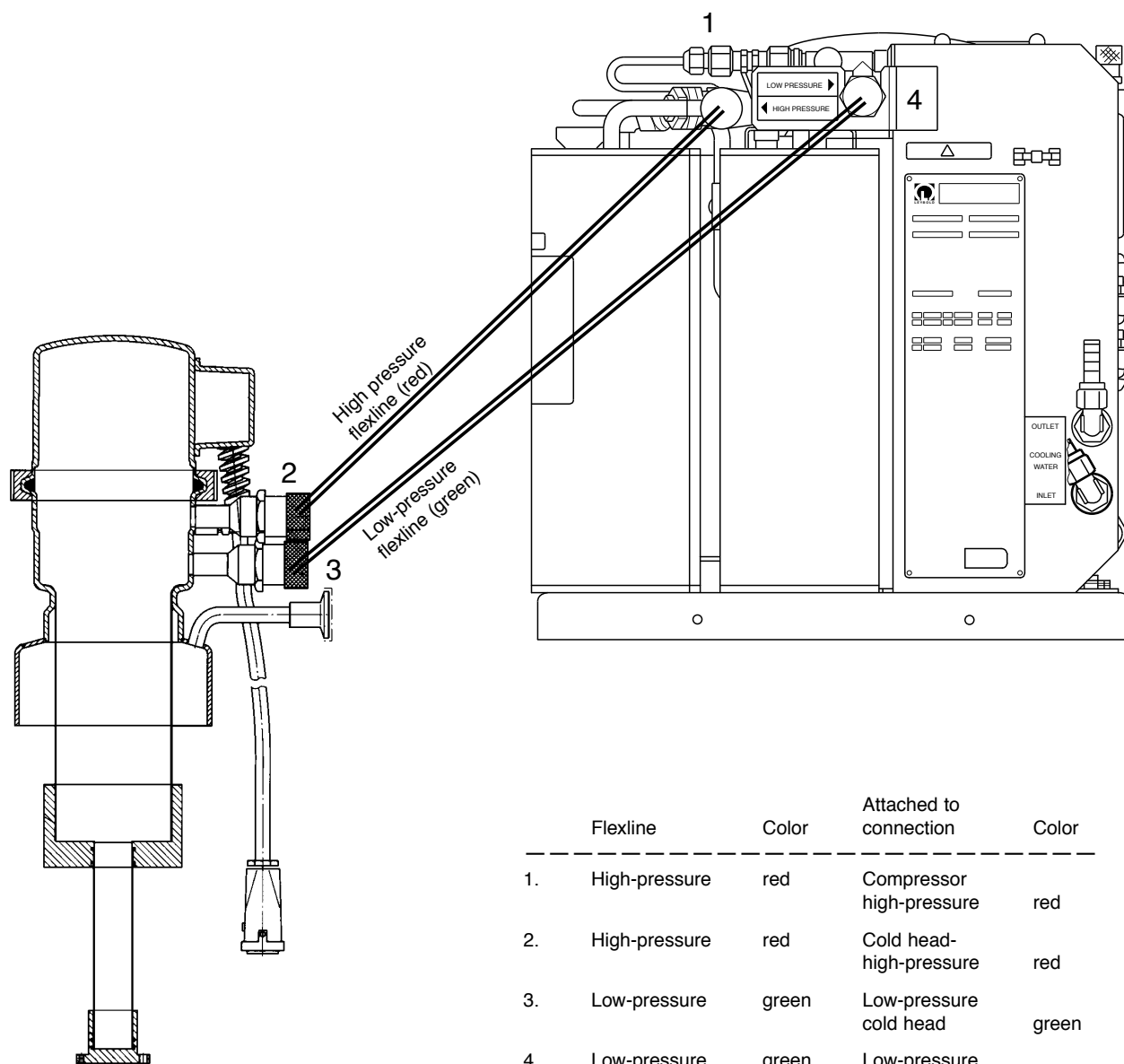


Fig. 8 Connecting the compressor unit and cold head

## 2.7 Start-up

### Check the phase sequence

Check the mains connection for correct phase sequence each time the unit is connected to the power supply and following every modification of the electrical connections.

The cable ends are marked with L1, L2, L3 and PE. When connected this way, the clockwise phase sequence remains.

If the phase sequence is incorrect, the compressor unit will be shut down after about 5 minutes in operation and the "TEMPERATURE" error message will appear (thermal switch TSH 2).

Since malfunctions in the coolant supply can trigger the same error message, check for correct coolant connection, flow rate and temperature. If the coolant delivery volume and temperature are sufficient, then the difficulty is probably due to inverted polarity. Isolate the mains cable from the power supply and interchange two phases at the mains connection.

### Helium filling pressure

#### Caution

If the RW 6000-1 is connected to 60 Hz line voltage, the helium filling pressure may not exceed 14<sub>-1</sub> bar at room temperature.

Release helium, if necessary. A helium filling adapter is provided for this purpose with the compressor unit. Unscrew the protective cap from the drain connection (11/2).

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

#### Warning



Do not screw the adaptor 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.

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.

Once the correct helium filling pressure has been reached, remove the adapter once again. Replace the protective cap on the drain connector.

## 3 Operation

### 3.1 Switching on

Open the coolant inlet.

Switch on the compressor unit at the master switch. Voltage will be supplied to the connector circuit for the cold head at the same time and the cold head connected here will be started.

After a longer period in service, operating pressure should stabilize at approx. 22 bar (319 psig), read at the compressor gauge on the compressor. During the starting phase, pressure will temporarily be higher.

### 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 Section 1.3 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.

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

#### Manual shut-down

Turn off the compressor unit at the master switch.

Allow the coolant to circulate for 10 minutes following shutdown and then close off the circuit.

#### Automatic shut-down

The compressor unit will be shut down automatically if insufficient helium pressure or excessive helium temperature is detected.

The malfunction message will remain visible in the display even after the effects have diminished; the compressor unit will not restart automatically.

The malfunction indication will remain stored in memory even in case of a power failure.

Find and rectify the cause of the malfunction. Then press the RESET button. The compressor unit will then restart.

If a circuit breaker is tripped, the compressor unit will automatically be switched off.

Find and eliminate the cause of the malfunction. The compressor will restart when the button on the circuit breaker is pressed.

The compressor unit will be switched off in case of excessive motor current. In this case the master switch will be at its "0" position.

Locate and eliminate the cause of the malfunction and switch the compressor unit back on at the master switch.

If the temperature of the compressor motor is too high, the compressor unit will be switched off without indication of the malfunction.

#### Warning



The compressor unit will switch back on automatically once the compressor motor has cooled down (approx. 1 to 2 hours).

If the power module gets too hot, the compressor unit will be switched off without indication of the malfunction.

#### Actions following a power failure

When power is restored after a temporary failure of the line voltage, the compressor unit will automatically return to its previous operating status.



**Key to Fig. 9**

- 1 Master switch
- 2 Indicator: Helium too warm
- 3 Reset button
- 4 Indicator: Insufficient pressure
- 5 Operating hours meter
- 6 Circuit breaker for control voltage
- 7 Circuit breaker for cold head
- 8 Pressure gauge

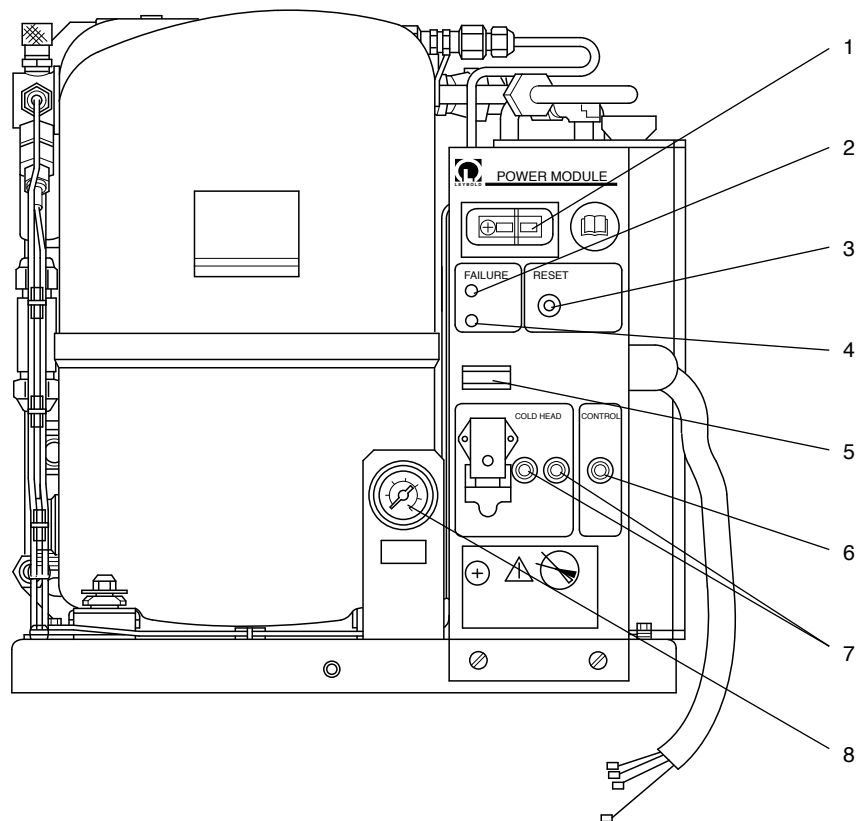


Fig. 9 Control elements

### 3.4 Shut-down

Switch off the compressor unit at the master switch.

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

Allow the cold head being served 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) operating pressure for the disconnected flexline. 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.

Store the compressor unit in a dry place.

**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).

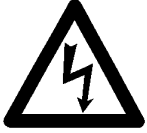
Observe the appropriate safety regulations.

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, to a maximum of 15° during operation.

# 4. Maintenance

## Warning



Separate the compressor unit 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 Topping up Helium Gas

## 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.

### Helium filling pressure

Operation at line frequency

#### Minimum values

50 Hz	15 bar
60 Hz	13 bar

#### Nominal values

50 Hz	16 bar
60 Hz	14 bar

When making measurements 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) operating pressure for the disconnected flexline. All the self-sealing couplings which are not in use shall be provided with protective caps.

## Caution

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

## Warning



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

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.

Use a 19 mm open-end wrench to tighten the couplings.

Connect the coupling at the helium filling adapter to the

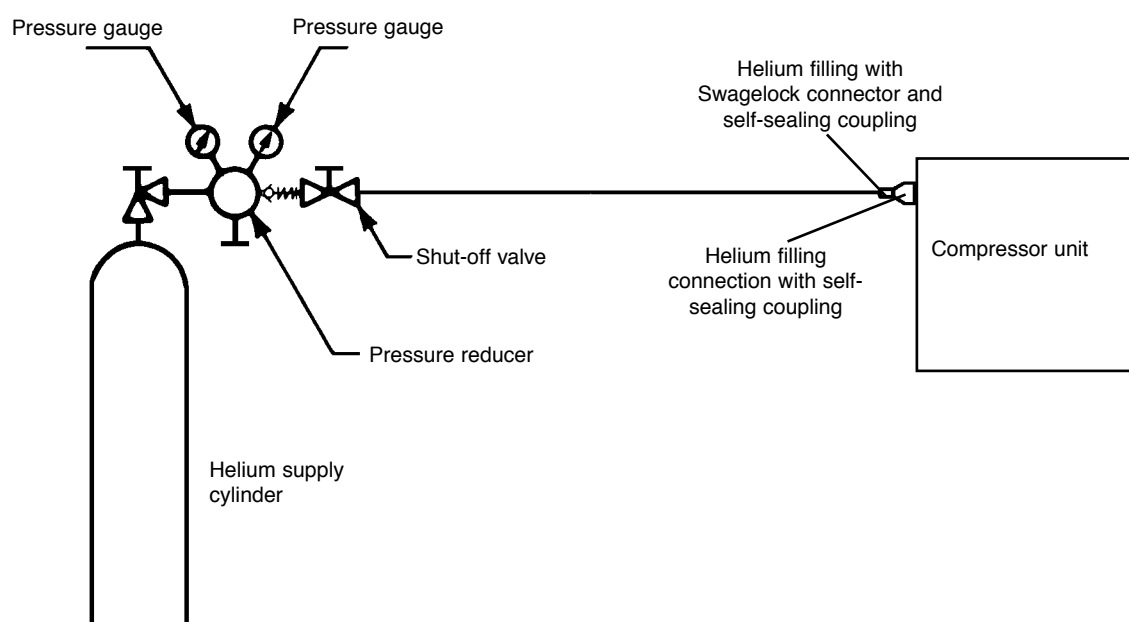


Fig. 10 Topping up the helium filling

helium filling nipple (11/1).

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). Relieve pressure from the line before detaching the filling connector.



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.

**Key to Fig. 11**

- 1 Helium filling and discharge connection
- 2 Self-sealing coupling
- 3 High-pressure helium connection
- 4 Adsorber
- 5 Nut (behind the base plate)

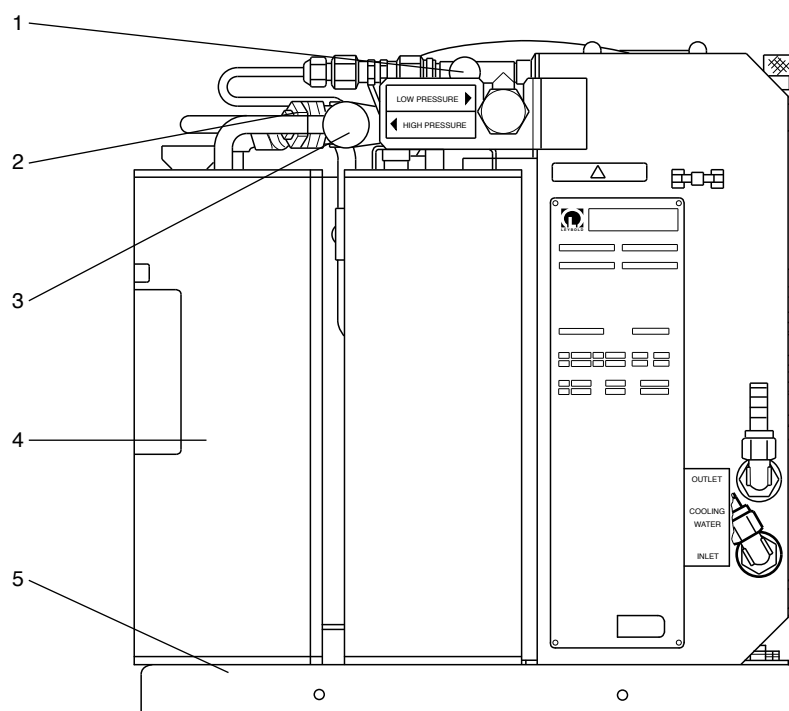


Fig. 11 Maintenance

## 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.

Switch off the compressor unit in preparation for replacing 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 for the disconnected flexline. 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 (11/3).

Loosen the nut (11/5) with a 13-mm open-end wrench.

Use the assembly wrench supplied to detach the self-sealing coupling (11/2).

Remove the adsorber (11/4).

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).

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

### Warning



The adsorber contains pressure of up to 16 bar (232 psig) even after it is removed from the system.

Reattach the high-pressure flexline to the compressor unit.

## Completed Maintenance Work

Maintenance work	Date	Reading at the operating hours meter	Helium filling pressure beforehand	Helium filling pressure afterwards
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				

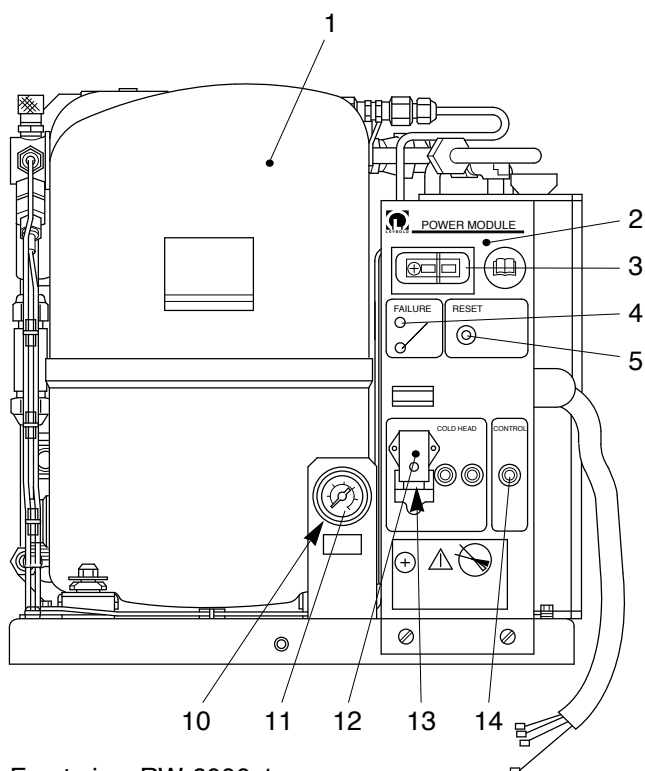
# 5 Troubleshooting

Malfunction	Possible cause	Recommended Corrective Actions	Repair note
1. Compressor unit does not start after being switched on; no malfunction is indicated.	Connection to the mains power supply is interrupted. Mains power has failed or the voltage is too low. Motor protection switch has tripped.  Helium compressor is overheated.  Power module is too hot.	Check the power cord and plug.  Check the mains voltage.  Check the setting of the motor protection switch and correct, if necessary. If the switch trips again at the next starting attempt, notify the Leybold Service Department.  Eliminate the cause of the malfunction; see malfunction 6.  Allow the power module to cool down.	--  Wiring diagram Wiring diagram  3.3  3.3
2. Compressor unit does not start after being switched on; "low pressure" indicator lights.	Low pressure switch has opened.	Check the helium pressure. If sufficient pressure is found, press the reset button; the compressor unit will start. If helium pressure is too low, refer to malfunction 5.	3.3
3. Compressor unit does not start after being switched on; "TEMPERATURE" indicator lights.	Thermal switch TSH1 or TSH2 has tripped; see malfunction 6 for causes.  Helium compressor is running in the wrong direction.	Allow the compressor unit to cool down and then press the reset button; the compressor unit should start. If the thermal switch trips again, refer to malfunctions 4 and 5.  Check phase sequence at the line power connection.	3.3  2.7
4. Compressor unit does not start after being switched on; one of the circuit breakers has tripped.	Defective wiring; electrical overload.	Check the connections at the cold heads; check the remote control. Reset the circuit breakers; the compressor unit will start. If the circuit breakers are again tripped, notify the Leybold Service Department.	2.5
5. Compressor unit shuts itself down; "LOW PRESSURE" malfunction message.	Helium circuit is leaking.	Check the helium pressure and top up if necessary; if this malfunction appears frequently, then notify the Leybold Service Department.	4.1
6. Compressor unit shuts itself down; "TEMPERATURE" malfunction message.	Coolant circuit not open. Coolant flow rate insufficient. Coolant inlet temperature too high. Coolant connections reversed. Heat exchanger clogged. Ambient temperature too high. Helium compressor turning in the wrong direction. Oil level too low.	Insure sufficient supply of coolant. Insure sufficient supply of coolant. Insure sufficient supply of coolant. Connect the coolant lines correctly. Notify the service technician. Change the site. Check the phase sequence and reverse if necessary. Notify the service technician.	2.4 2.4 2.4 2.4 -- 2.3 2.7 --
7. One of the circuit breakers has tripped.	See malfunction 4.	See malfunction 4.	--
8. Compressor unit shuts itself down; no malfunction is indicated.	See malfunctions 1 and 6. Helium pressure too high.	See malfunctions 1 and 6. Notify the service technician.	-- --
9. Cold head performance has deteriorated. See also the Operating Instructions for the cold head or for the cryopump.	Adsorber is loaded to capacity.  The electrical connections to the cold head are not correct.  Helium pressure has dropped off.	Replace the adsorber. The adsorber must be changed after every 18,000 hours of operation. Check the connections.  See malfunction 5.	4.2  --  --

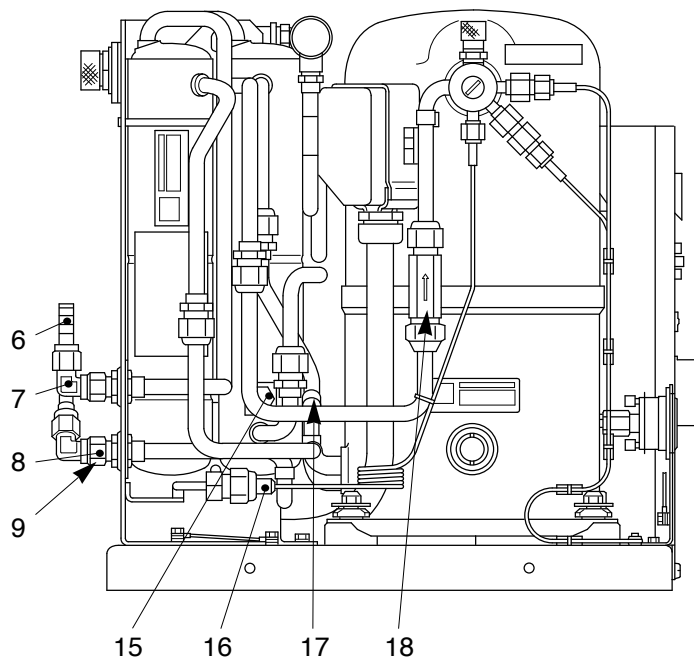
\* Repair note: See the Section indicated.



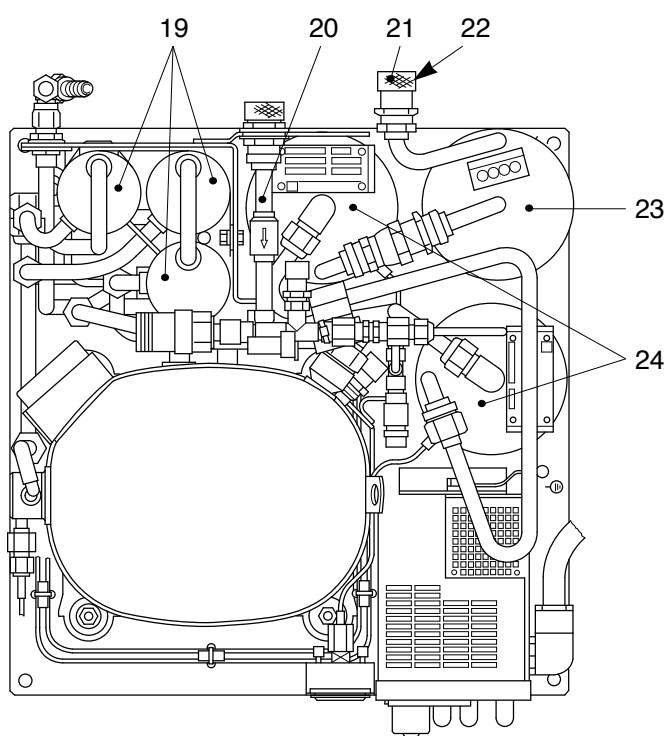
## 6 Spare Parts



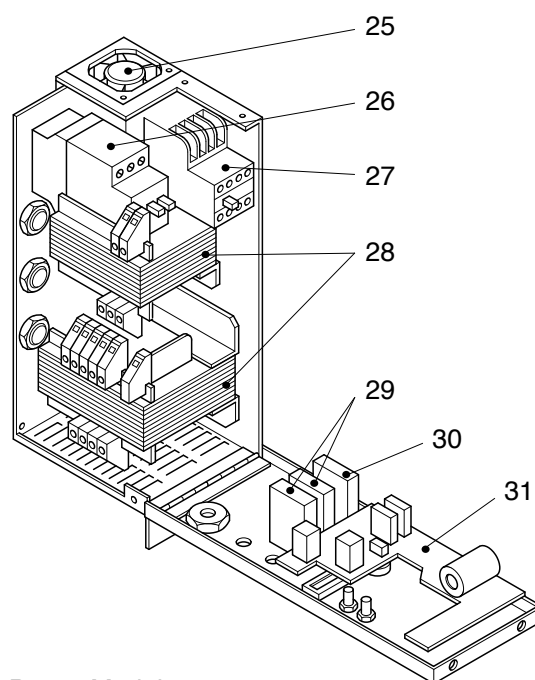
Front view RW 6000-1



Lateral view RW 6000-1



Top view RW 6000-1

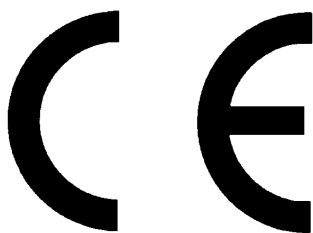


Power Module



<b>Item</b>	<b>Quantity</b>			<b>Description</b>	<b>Characteristics</b>	<b>Ref. No.</b>
	RW 6000-1					
1	1			Compressor	CHN1	200 20 160*)
2	1			Power Module	High voltage	200 80 580*)
3	1			Push button		200 80 360
4	2			Light emitting diode	24 V DC	200 80 362*)
5	1			Press-switch	3 A	200 80 363*)
6	2			Hose nipple	DN 12; Ms	200 19 460
7	2			Angle screw fitting	M 16 x 1 x 12; Ms	200 20 932
8	2			Nut	M 16 x 1	200 20 933
9	4			Spring ring	ø 12 mm	200 20 934
10	1			Gasket	5,4 x 9,3 x 3,2; Cu	234 50 217*)
11	1			Pressure gauge	0 - 40 bar	200 19 849*)
12	1			Housing	IP 54	200 80 011*)
13	1			Jack	380 V/ 10 A; 4 pol.	200 80 009*)
14	3			Cage	M 10 x 1; IP 54	200 80 419
15	1			Thermal switch	38° C	200 49 098
16	1			Capillary tube		200 20 154*)
17	1			Thermal switch	150° C	200 49 096
18	1			Oil filter		390 26 017*)
19	1			Heat exchanger	3 cartridges	200 20 937*)
20	1			Low-pressure line compl.		200 20 204*)
21	2			Aeroquip-coupling		950 00 003*)
22	2			Gasket ring	17 x 1,9 mm	350 20 704*)
23	1			Adsorber	ARW2	891 84
24	2			Separator		200 20 455*)
25	1			Fan	24 V DC	380 91 004
26	1			Safety switch	10 - 16 V	200 80 277*)
27	1			Contactore	24 V DC	200 80 276*)
28	1			Set of transformers	High Voltage	200 81 088*)
29	2			Automatic circuit breaker	0,6 A	200 80 418*)
30	1			Automatic circuit breaker	3 A	200 80 417*)
31	1			PCB		200 80 583*)

components identified with an asterisk \*) may be replaced only by the LEYBOLD service department  
or by personnel specially trained by LEYBOLD for this work



## 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 using the appropriate Leybold accessories, e.g. cold head, electrical manifold, or remote control, the protection level prescribed in the EMC Guidelines will be attained.

Designation of the products:

(Helium) compressor unit

Model:

RW 6000-1

Catalog number:

891 44

Cologne, Jan. 5, 1996

Dr. Mattern-Klosson, Division Manager  
Cryo Technology

### **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

### **Applicable, harmonized standards:**

- EN 292-1 and -2: 1991  
Machinery Safety – Basic Terminology
- pr EN 1012-1: 1993  
Safety Requirements for Compressors
- EN 60204-1: 1985  
Electrical Equipment for Industrial Machinery
- EN 50081-1: 1992 EMC, Generic Emission Std
- EN 50082-2: 1992 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 0113-1/02.86 Electrical Equipment
- AD Brochures A2, B0, W0
- DK 621.642-986 Pressurized Vessels Code
- GSG, Section 3, Par. 1, Equipment Safety Code

Cologne, Jan. 5, 1996

Teply, Engineer  
Cryo Technology

LVGK.0104.02.01.96

## National and International Certifications

All the compressor units described in these operating instructions have been certified by the TÜV Technical Inspectorate Rhineland, Safety and Environmental Protection Ltd., and awarded the GS safety certificate.

These Leybold compressor units have been registered under GS certificate No. S 9319521 01.

The label is applied to the data plate on the compressor unit.



The Leybold refrigeration units listed below comply as complete systems with the requirements of Underwriters Laboratories (UL) and the Canadian Standards Association (CSA) and, as of 1995, in lieu of CSA testing, the cUL certification awarded by Underwriters Laboratories for the Canadian Standards Association.

The overall system comprises the RW 6000-1 compressor unit with the ARW 2 Adsorber and one or more "RGS" or "RGD" 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 UL/cUL reference No. SA 8676 (LISTED Cryogenic Refrigeration System 71x2) and CSA reference No. LR 92490-2. Labelling for the system as a whole is to be found only on the data plate for the compressor unit.





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