oerlikon
leybold vacuum

TURBOVAC SL 700

Wide-Range Turbomolecular Pump with Integrated or External Frequency Converter

Operating Instructions 130000762_002_A0

Part Nos.

800051V3001
800051V3002

Contents

Important Safety Information

Warning

Indicates procedures that must be strictly observed to prevent hazards to persons.

Caution

Indicates procedures that must be strictly observed to prevent damage to, or destruction of the product.

The Oerlikon Leybold Vacuum **TURBOVAC SL 700** has been designed for safe and efficient operation when used properly and in accordance with these Operating Instructions. It is the responsibility of the user to carefully read and strictly observe all safety precautions described in this section and throughout the Operating Instructions. The TURBOVAC **must only be operated in the proper condition and under the conditions described in the Operating Instructions**. It must be operated and maintained by trained personnel only. Consult local, state, and national agencies regarding specific requirements and regulations. Address any further safety, operation and/or maintenance questions to your nearest Oerlikon Leybold Vacuum office.

Safety Information

Failure to observe the following precautions could result in serious personal injury!

Mechanical hazards

Warning

Danger of injury!
Avoid exposing any part of the human body to the vacuum. Handle the equipment only while vented.

The pressure in the pump must not exceed 1.2 bar (absolute). The pump is only intended for use in a vacuum. If overpressure may occur in the system you must install a protection device, e.g. an overpressure safety valve.

Danger of explosion!
The standard version of the equipment is **not suited for operation in explosion hazard areas**. Contact us before planning to use the pump under such circumstances.

The high-vacuum flange must be firmly mounted to the vacuum chamber. If the mounting is not sturdy enough, pump blockage could cause the pump to break loose; internal pump components could be thrown in all directions. Never operate the pump (in bench testing, for example) without proper flanging to the vacuum chamber.

The rotor has to be changed after **50,000 hours of operation** or after **10,000 starts/ stops** or cycles at the latest. Due to high-speed and temperature, the service life of the rotor is limited. If the rotor is changed too late, it may be destroyed. Thus in the flange mounts high forces and torque conditions can occur. The mounting screws for the pump may be torn off or sudden twisting of the entire pump can be experienced.

Turbopumps as described in the following operation manual contain a high portion of kinetic energy due to their high rotational speed in combination with the specific rotor mass. In case of a malfunction of the system, for example rotor/stator contact or even a rotor crash, the rotational energy is released.

To avoid the destruction of the equipment and to prevent injuries of the operating staff the leading European manufacturers of vacuum pumps strictly recommend to follow the installation instructions as given in this manual.

After a mains power failure the pump can run up automatically once more.

Electrical hazards

The pump must only be connected to power supplies which meet the requirements for functional extra-low voltages with positive isolation in accordance with IEC 364 (or local regulations) (SELV).

The OEM power supply unit must only be connected by qualified electrical personnel.

Unplug any connectors only when the mains voltage is switched off **and** the pump does no longer turn (the green LED is off).

When the connector cable is attached, the outputs at the frequency converter are not free of voltage.

Qualified personnel

Qualified electrical personnel in this instruction manual means a person who has received electrical engineering instruction or is an electrical expert in accordance with EN 60204, Part 1, 3.30 respectivly 3.55.

Thermal hazards

During operation the pump can become so hot that there is a danger of burns (≥ 70 °C, 158 °F).
Provide protection against contact with the hot components.

Hazards caused by materials and substances

The forevacuum line must be tight. Hazardous gases can escape at leaks or the gases being pumped can react with air or humidity.

If the pump has previously handled hazardous gases, implement the proper precautionary measures before opening the intake or exhaust connection.

If necessary, use gloves, a respirator and/or protective clothing and work under an exhaust hood.

Contaminated parts can be detrimental to health and environment. Before beginning to work, find out whether any parts are contaminated. Adhere to the relevant regulations and take the necessary precautions when handling contaminated parts.

Safety Information

Failure to observe the following precautions could result in damage to the pump:

Caution

The pumps are **not suitable** for pumping aggressive or corrosive media or those which contain dust.

Install a micropore filter when pumping media which contain dust.

Observe the information on media compatibility in Section 3.1 of these operating instructions.

Be careful not to damage the sockets and coolant connections during transportation.

For the pumps with stainless steel housing self-protection of the pump is **not** ensured in case of unsufficient cooling.

Make sure to avoid dripping water or humidity.

The water-cooled pumps need cooling air for the frequency converter.

Ensure correct polarity when connecting the TURBO.DRIVE.
A wrong polarity may cause an internal fuse to blow. The fuse can only be changed by the Oerlikon Oerlikon Leybold Vacuum Service.

The interface connectors have UNC 4-40 threads. Do not use connectors with M3 treads.

The pump may be operated only with suitable connector cables. Route all cables so as to protect them from damage.

Do not expose the pump, the frequency converter or the connections to dripping water.

Disconnect and connect the cable connections only while the pump is turning no longer (green status LED off) and with the mains power switched off (yellow power LED off). Otherwise there is the risk of damaging the frequency converter.

After replacing the pump or when switching on the supply voltage without a connected pump, all changed parameter values will be reset to factory defaults.

The pump must only be opened by such persons who have been authorised by Oerlikon Leybold Vacuum to do so.

Figures

The references to diagrams, e. g. (1/2) consist of the Fig. No. and the Item No. in that order.

We reserve the right to alter the design or any data given in these Operating Instructions. The illustrations are not binding.

Retain the Operating Instructions for further use.

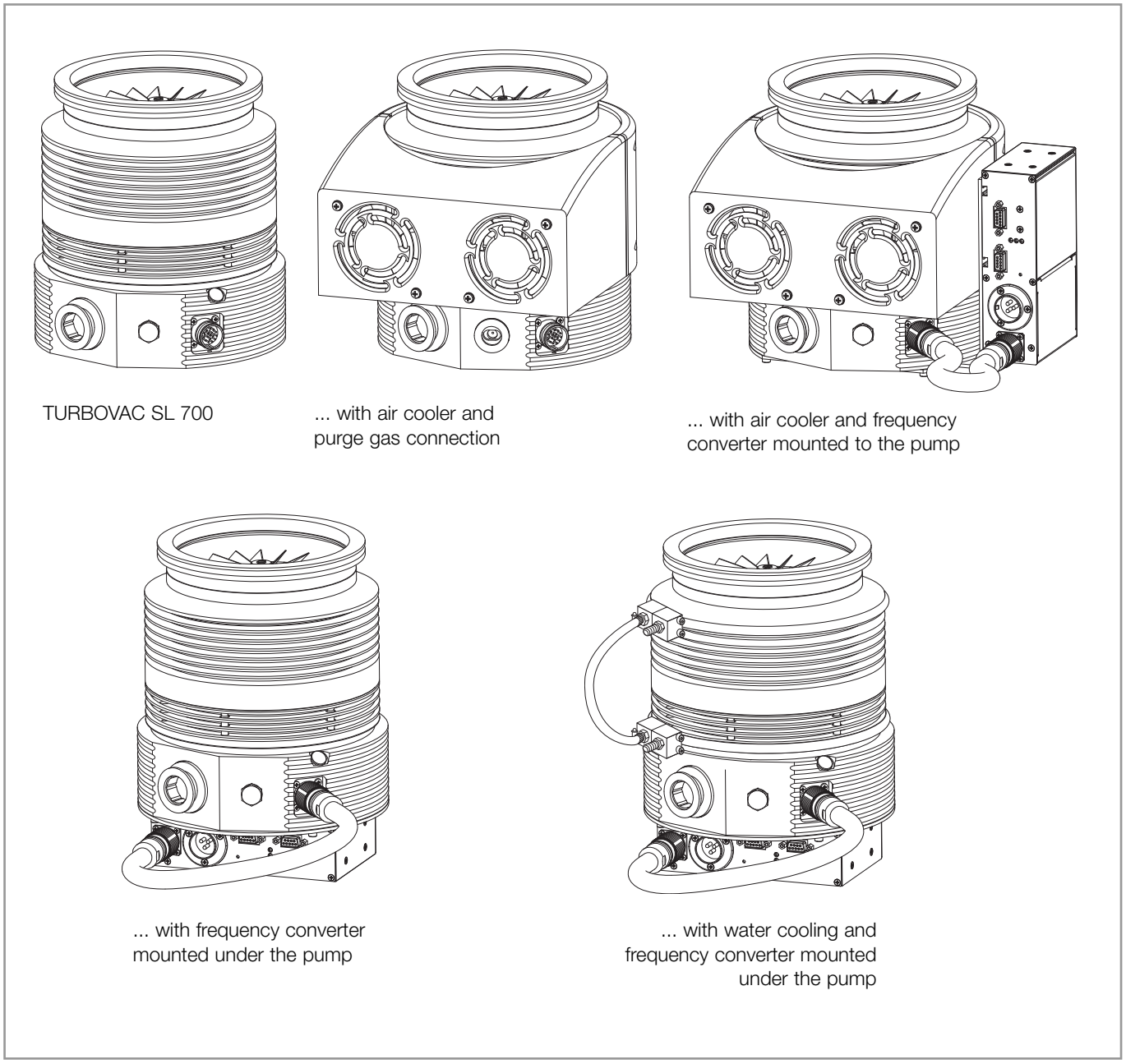


Fig. 1.1 Examples of SL 700

1 Description

The TURBOVAC SL 700 is a wide range turbomolecular pump designed to evacuate vacuum chambers down to pressure levels in the high vacuum range. It is suitable for pumping air and clean gases. The TURBO.DRIVE 700 frequency converter and a forevacuum pump are required for its operation.

Use

Description

1.1 Design

The pumps comprise essentially the pump housing, a multi-stage rotor with the stator group, and the drive.

The first section of the rotor is a turbomolecular pump rotor while the second tile represents a Holweck stage. The Holweck pumping stage increases the permissible forevacuum pressure level markedly when compared with the classic turbomolecular pump.

Bearings The rotor shaft runs in two ceramic ball bearings, lubricated with grease.

Motor The pump is driven by a split-cage DC motor. In this motor the rotor and stator windings are separated by a vacuum-tight can. Consequently the rotor runs inside the vacuum while the stator is outside the vacuum. This eliminates any need of vacuum feedthroughs.

The pump is equipped with a temperature sensor and a resistor code.

Cooling Water cooling or an air cooling fan is available as optional equipment.

The intake flange should be fitted with a wire mesh splinter guard to protect the pump against mechanical damage caused by foreign objects.

Frequency converter The pump is driven by an electronic frequency converter TURBO.DRIVE. All functions like, for example, speed control, pump sensing or temperature monitoring are monitored by the TURBO.DRIVE. This unit is powered by an external power supply.

The TURBO.DRIVE may be installed beside or underneath the pump or up to 10 m away.

Purge gas connection The pumps are equipped with a purge gas facility. The purge gas and venting connection is blanked off by default with a M8 closure screw. A purge gas and venting valve may be connected either directly or by using a M8 – DN16KF adapter.

1.2 Standard equipment

The pumps are shipped sealed in a PE bag with a desiccant to absorb moisture.The maximum useful life of the desiccant is one year.

The high- and forevacuum flanges are covered with protection caps.

The connection elements and the splinter guard are **not** part of the standard equipment.

A suitable DC coupling for the power supply is included: In the case of pumps with integrated frequency converter it is supplied with the pump, in the case of pumps with a separate frequency converter it is supplied with the frequency converter.

PE = Polyethylene
FPM = Fluororubber, resistant to temperatures up to 150°C (302 °F)

1.3 Technical data

TURBOVAC	**SL 700**
High-vacuum connection	DN 160 ISO-K / DN 160 CF
Pumping speed (without splinter guard) for	
N_2	690 $l \cdot s^{-1}$
Ar	630 $l \cdot s^{-1}$
He	580 $l \cdot s^{-1}$
H_2	360 $l \cdot s^{-1}$
Max. gas throughput with water cooling	
N_2	5.6 $mbar \cdot l \cdot s^{-1}$
Ar	4.6 $mbar \cdot l \cdot s^{-1}$
He	2.0 $mbar \cdot l \cdot s^{-1}$
H_2	0.9 $mbar \cdot l \cdot s^{-1}$
Ultimate pressure	
with two-stage, oil-sealed rotary vane pump	< 10^{-9} mbar
Max. permissible forevacuum pressure (see Fig. 2.8)	15 mbar
Weight	
Pump with ISO-K flange	13.9 kg
with TURBO.DRIVE 700	14.8 kg
with TURBO.DRIVE 700 and air cooler	16.0 kg
with TURBO.DRIVE 700 and water cooling	15.1 kg
Pump with CF flange	17.3 kg
Operating speed	48 000 min^{-1}
Run-up time	approx. 5 min
Power consumption	
at run-up	270 W
at ultimate pressure	60 W
Forevacuum connection	DN 25 KF
Purge gas connection	M8 or DN 16 KF
Type of protection	IP 20
Noise level	
with air cooling	< 47 dB(A)
with water cooling	< 44 dB(A)
Ambient temperature	
during operation	10 - 45 °C
storage	-15 - + 60 °C
see Fig. 2.8 for cooling requirements	
Max. rel. air humidity	5 to 85 % non-condensing

Description

Purge gas flow	36 sccm ±5 sccm (36 sccm = 0.6 mbar·l/s)
Purge gas	Nitrogen, Argon or similar
Option water cooling	
Cooling water connections	G 1/8“
Cooling water data	see Section 2.6
Option air cooling	
Power consumption	6.0 W
Volume flow	160 m^3/h
TURBO.DRIVE 700	
Nominal supply voltage	59 V ⎓
Residual ripple	< 2%
Power consumption	
maximum	480 W
at ultimate pressure	150 W
Max. DC current	8 A
DC supply voltage	≥ 53 V < 60 V
Max. length of the DC cable	
at 3 x 1,5 mm^2	5 m
at 3 x 2,5 mm^2	20 m
Load rating, relay output	42 V, 0.5 A
Ambient temperature	
during operation	10 - 45 °C
at standstill	-15 - + 60 °C
Relative air humidity	5 to 85 % non condensing
Overvoltage category	II
Contamination grade	2
Type of protection	IP 20
Weight, approx.	0.7 kg

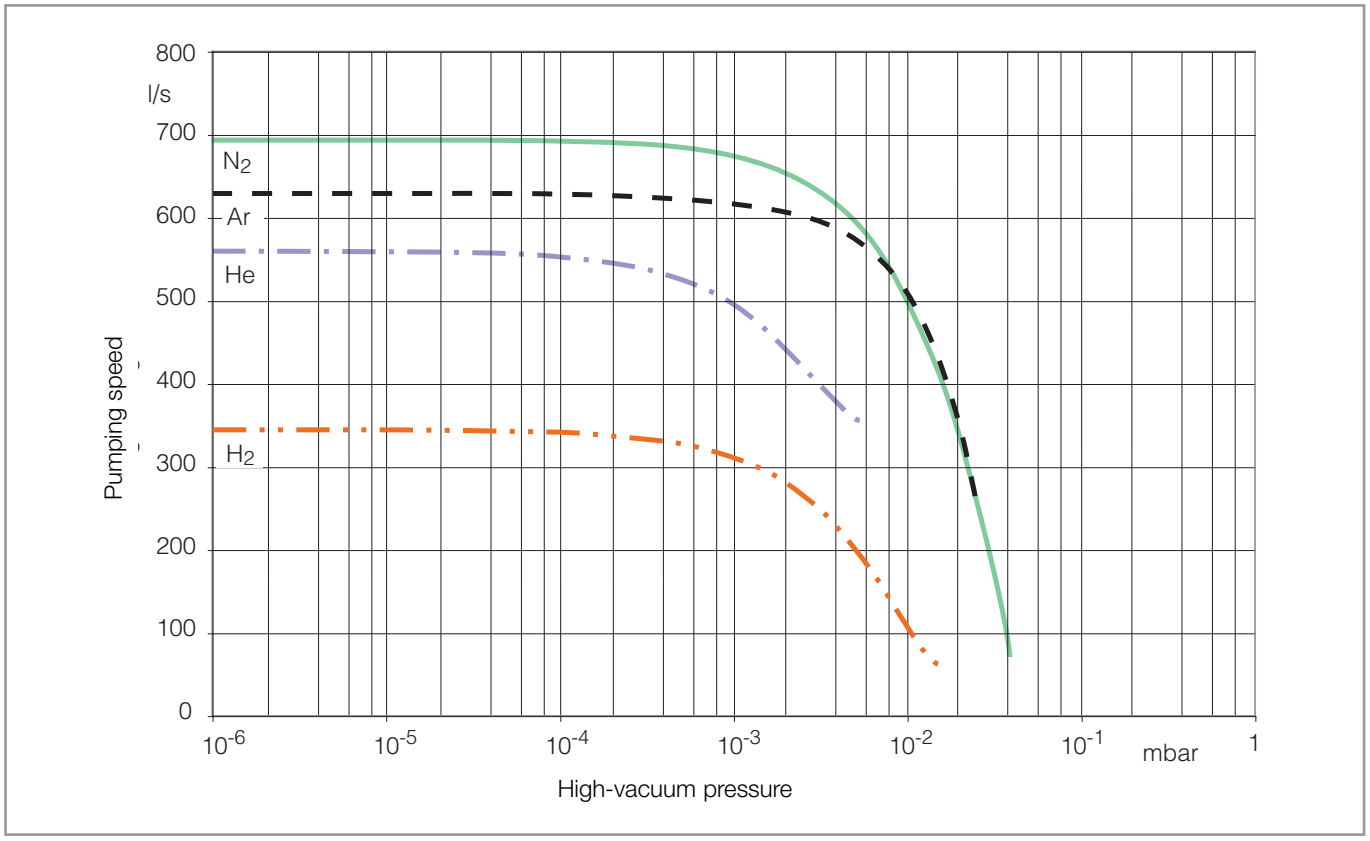


Fig. 1.2 Pumping speed curves of the SL 700

Purge gas and venting valve

Part No.	**800152V0012**	**800152V0040**
Gas flow rate at 1 bar	0.6 mbar·l·s^{-1} (36 sccm)	
Solenoid valves	2, normally closed	
Mains supply	24 V DC	230-100 V AC
Power consumption	4 W	6 W
Connection to pump Needed for this: Adapter M8 – DN10/16KF, P/N Including O-ring 9.25 x 1.78 and Adapter centering ring DN 10/16 KF with sinter filter	DN 10 KF 800110V0011	
Gas connection Recommended for this: Adapter with filter including O-ring and gasket	G1/4-in. 800110V0012	
Dimensions	60 x 65 x 45 mm	61 x 65 x 45 mm

Description

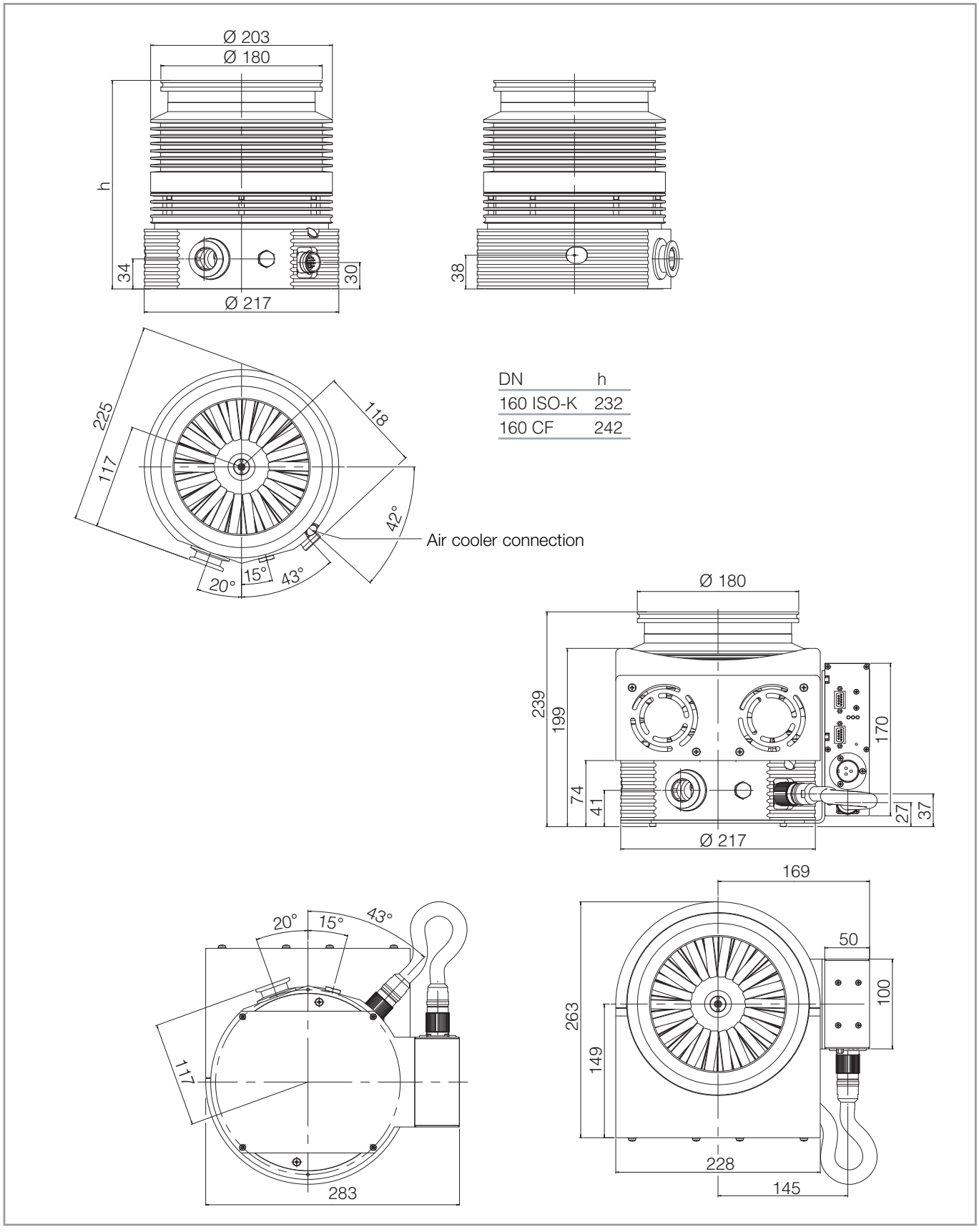


Fig. 1.3 Dimensional drawings for SL 700 pumps (combination examples); dimensions in mm

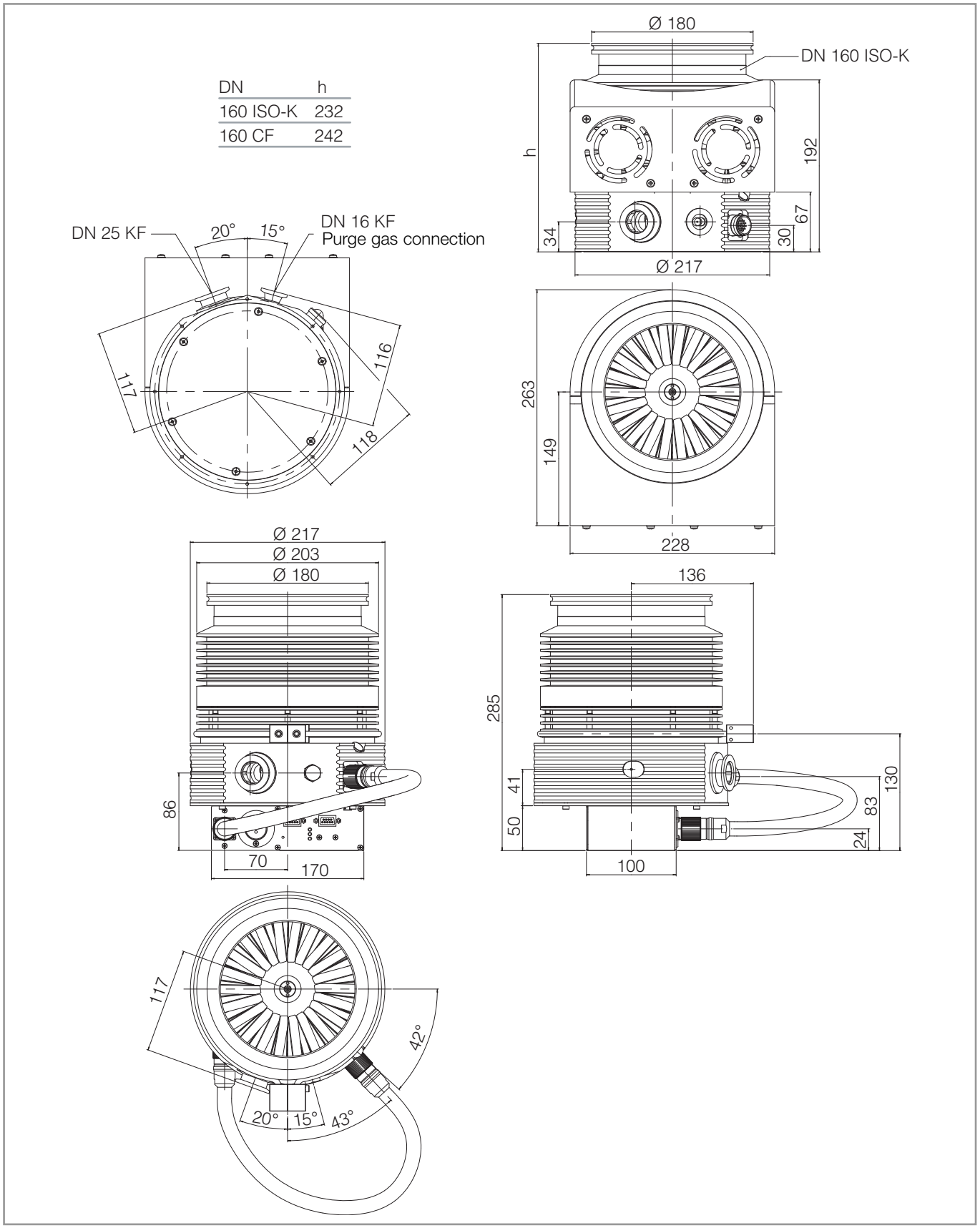


Fig. 1.4 Dimensional drawings for SL 700 pumps (combination examples); dimensions in mm

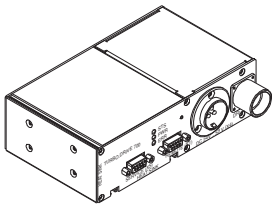
Description

1.4 Ordering data

TURBOVAC SL 700	Part No.
High-vacuum flange DN 160 ISO-K	800051V3001
High-vacuum flange DN 160 CF	800051V3002

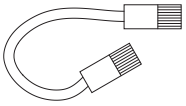
1.5 Accessories

Frequency converter TURBO.DRIVE 700



Basic device with RS 232 interface	800074V0001
with RS 485 interface	800074V0003
with Profibus interface	800074V0004

Connecting cable pump - frequency converter



0.2 m long	800080V0020
0.4 m long	800080V0040
1 m long	800084V0100
2.5 m long	800084V0042
3 m long	800084V0300
5 m long	800084V0500
10 m long	800084V1000

Mounting kit TD 700 for TURBOVAC SL 700

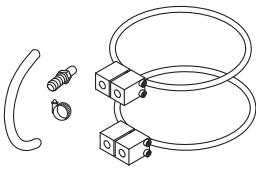
Including 0.2 m long connection cable pump - frequency converter

For installing the frequency converter

... beside the pump	800110V0007
... underneath the pump	800110V0010

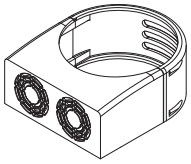
Water cooling for SL 700 — 800135V0004

Consisting of: 2 cooling coils with G 1/8” connections,
4 gaskets for G 1/8”, 4 hose nozzles,
4 hose clamps, 1 hose 10x3, up to 12 bar



Air cooler — 800136V0003

(is powered by the pump)



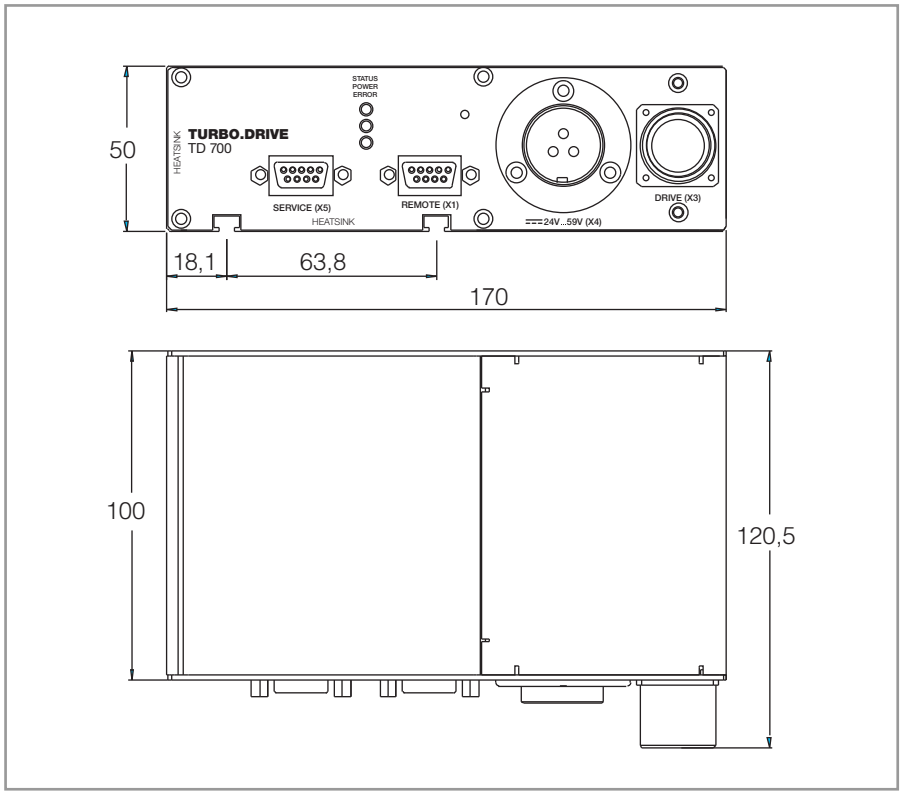
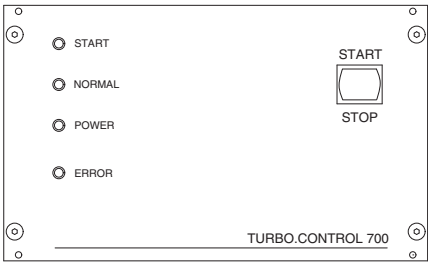
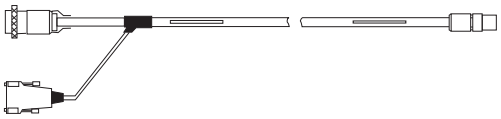
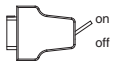
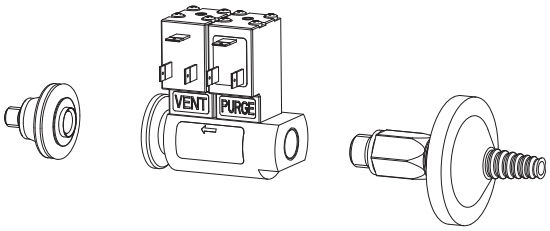
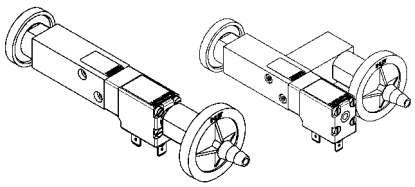


Fig. 1.5 Dimensional drawing for the frequency converter; dimensions in mm

Description

	Part No.	
Power supply and control unit **TURBO.CONTROL 700** ■ supplies the TURBO.DRIVE 700 with 59 V DC ■ plug & play cables ■ desktop unit or rack mountable ■ with power switch ■ with start/stop switch for the turbomolecular pump ■ remote control ■ status LEDs and status relays	800100V0001	
59 V DC control cable **(TURBO.DRIVE 700 – TURBO.CONTROL 700)** 1 m long 3 m long 5 m long 10 m long 20 m long	 800093V0100 800093V0300 800093V0500 800093V1000 800093V2000	
Mains cable for TURBO.CONTROL 700, 3 m long with EURO plug with US plug 6-15P with UK plug	 800102V0002 800102V1002 800102V0003	

Mechanical accessories

Plug for connector REMOTE with integrated **ON/OFF switch** for the pump (Sub-D plug, 9 way)	152 48	
Purge gas and venting valve 0.6 mbar·l/s at 1 bar 24 V DC 230-100 V AC DN 10 KF – G$^{1}/_{4}$”	 800152V0012 800152V0040	
Pump connection: Adapter M8 – DN-16-KF incl. O-ring 9.25 x 1.78 and Adapter centering ring DN 10/16 KF with sinter filter	800110V0011	
Gas side connection: G1/4-in. adapter with filter Including O-ring and gasket	800110V0012	
Venting valve 24 V DC Power failure venting valve 24 V DC	800120V0011 800120V0021	
Spare filter	200 18 517	

	Part No.	
PC software "**Turbo.Drive Server**" for Windows 95 and higher, CD-ROM ■ Display, change, save and compare parameter lists ■ Integration of customer's software ■ Record parameter data The software can also be downloaded from www.oerlikon.com in the menu Oerlikon Leybold Vacuum → Documentation → Download Software	800110V0102	
Adapter RS232/RS485 with world voltage power supply	800110V0101	
GSD file for Profibus DP Can be downloaded from www.oerlikon.com in the menu Oerlikon Leybold Vacuum → Documentation → Download Software		
Splinter guard DN 160 ISO-K Splinter guard DN 160 CF	200 00 307 200 17 247	
Flange heater DN 160 CF (only for pumps with CF flange) 230 V 110 V	 854 37 854 38	

2 Installation

2.1 Conforming utilization

The TURBOVAC SL 700 is a wide range turbomolecular pump designed to evacuate vacuum chambers down to pressure levels in the high vacuum range. It is suitable for pumping air and clean gases. The TURBO.DRIVE 700 frequency converter and a forevacuum pump are required for its operation.

These pumps are **not** suitable for

- pumping liquids or gases containing dust or particulates
- pumping corrosive or reactive gases
- pumping gas mixtures with an oxygen share of > 21 %
- operation without a forevacuum pump.

f reactive gases in low concentrations must be pumped operate the pump with purge gas.

Install a micropore filter when pumping media which contains dust.

Overpressure protection

The pressure in the pump must not exceed 1.2 bar (absolute). The pump is only intended for use in a vacuum. If overpressure may occur in the system you must install a protection device, e.g. an overpressure safety valve.

2.2 Operating environment

Ambient temperature

The maximum permissible ambient temperature is 45 °C (113 °F). Do not expose the pump or the frequency converter to dripping or spraying water

Magnetic field

If the pump is used within a magnetic field, the magnetic induction at the surface of the pump housing may not exceed:

B = 5 mT if impinging radially and
B = 15 mT if impinging axially.

Install shielding equipment as appropriate if these values are exceeded.

Radiation

The standard version is resistant to radiation up to 10^3 Gy.

Places of installation

Places of installation up to 1000 m above sea level (3300 ft) are possible without restrictions. At altitudes over 1000 m heat dissipation by the ambient air is impaired. For higher places of installation, please ask Oerlikon Leybold Vacuum.

The frequency converter must not be operated in explosive gas atmospheres.

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1 mT (milliTesla) = 10 G (Gauß)
1 Gy (Gray) = 100 rad

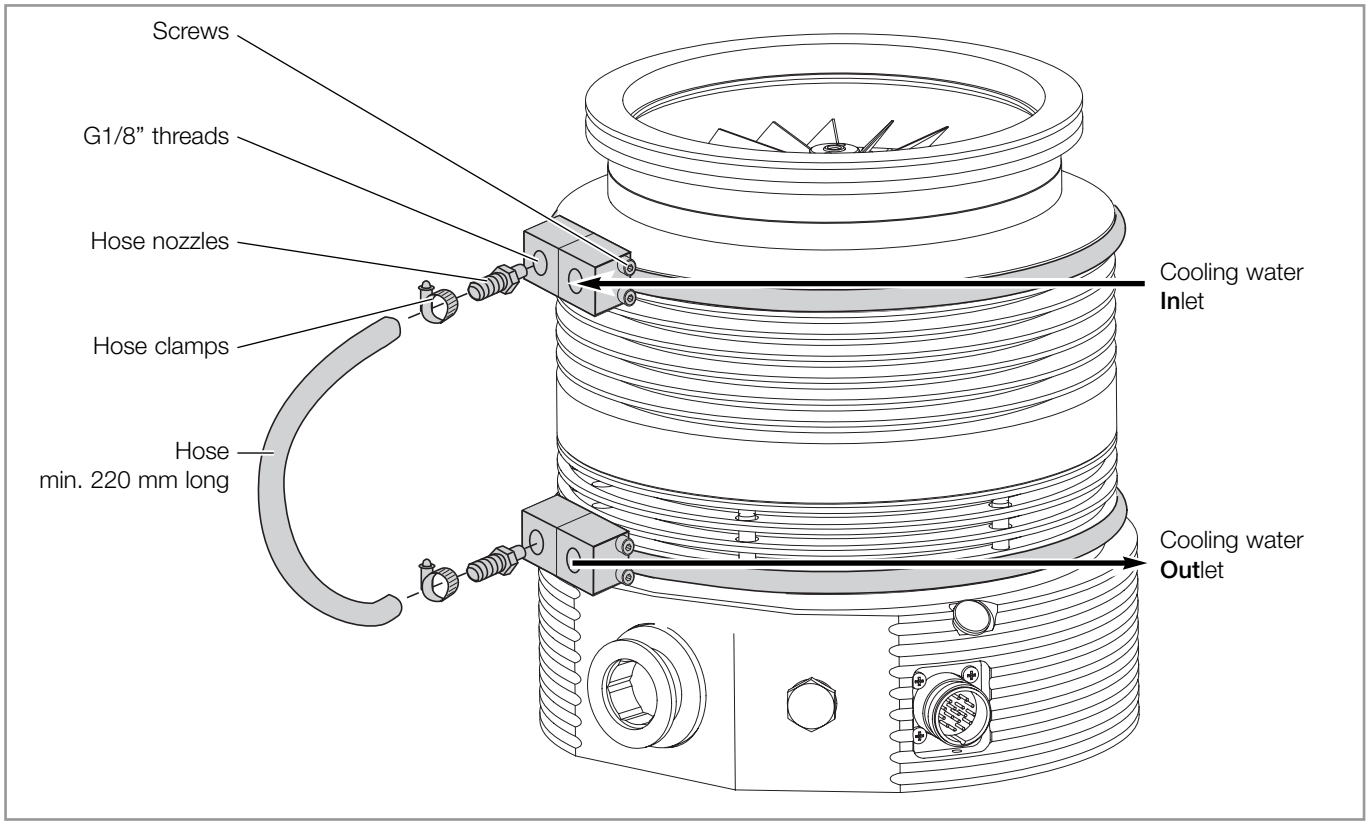


Fig. 2.1 Pump with mounted water cooling

2.3 Fitting accessories

Either a water or air cooling facility and a purge gas and venting valve can be fitted to the pump.

Moreover, the frequency converter may be fitted beside or underneath the pump.

See Fig. 2.1 to 2.3

When fitting the accessories note the following:

- For fitting, place the pump **with the protection cap in place** on its high vacuum flange.
- Fitting the water cooling: The cooling coils may be turned in any position provided flanges and plugs are not in the way.

  Unscrew the four screws, carefully bend the cooling coils open somewhat and fit them to the pump. Install the cooling coils in the uppermost and lowermost groove of the housing. Retighten the four screws.

  Retighten the screws several times. The expansion of the screws and the tubes as well as the frictional resistance at the housing must be compensated.

  Connect the two cooling coils using hose nozzles, hose and hose clamps. When doing so, right and left (in the figure) may be selected freely. The cooling water inlet is at the top and the outlet at the bottom.

Installation

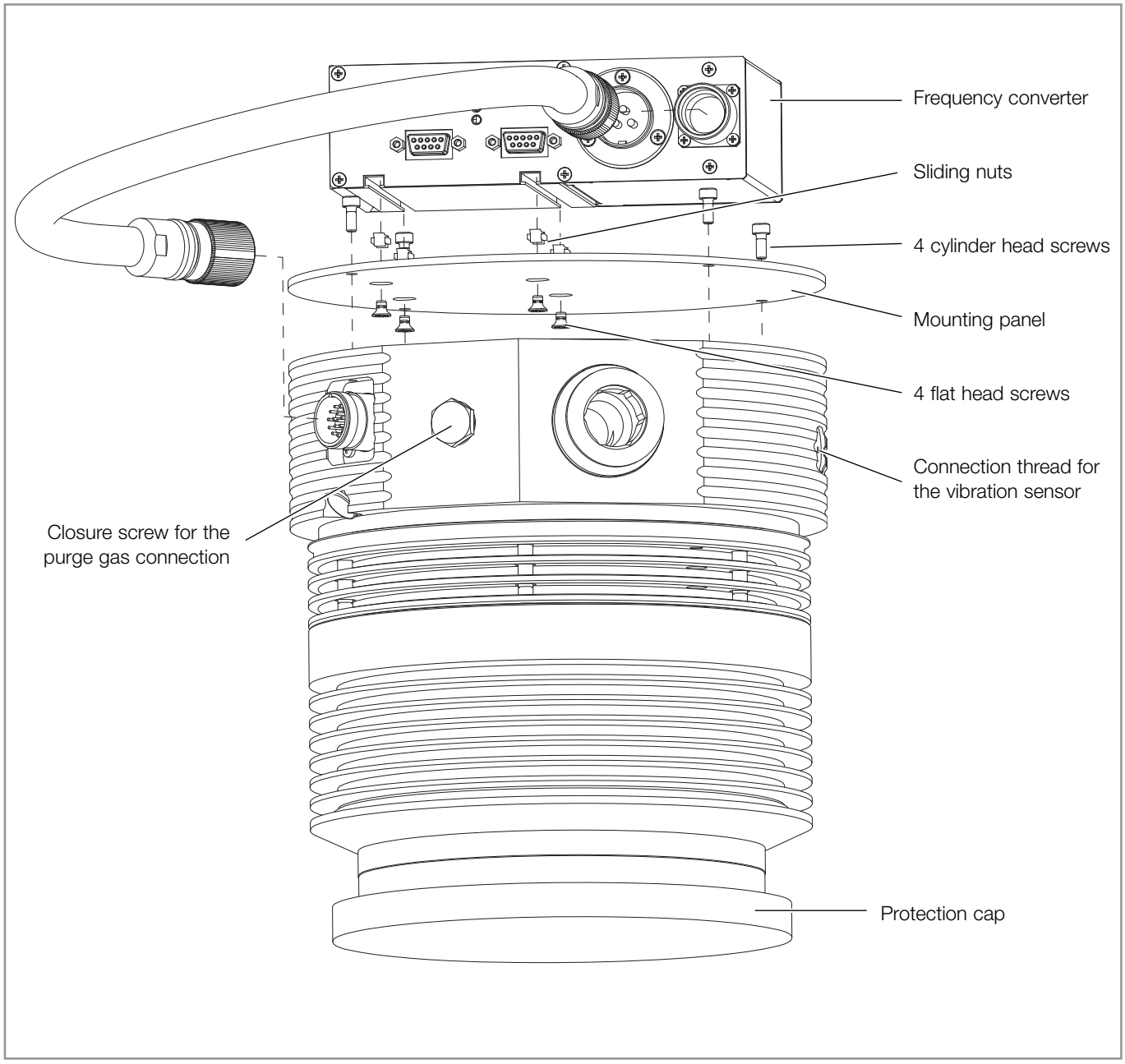


Fig. 2.2 Mounting the frequency converter underneath the pump

- The stop plate serves as a mounting aid. With it, the sliding nuts can be moved to their correct position.
- The attached parts may, provided flanges and plugs are not in the way, be fitted in 90° increments as required.
- When fitting as shown in the figures, the 0.2 m long cable will do for the frequency converter. When the power supply connector shall point in the other direction, then the 0.4 m long cable will be needed.

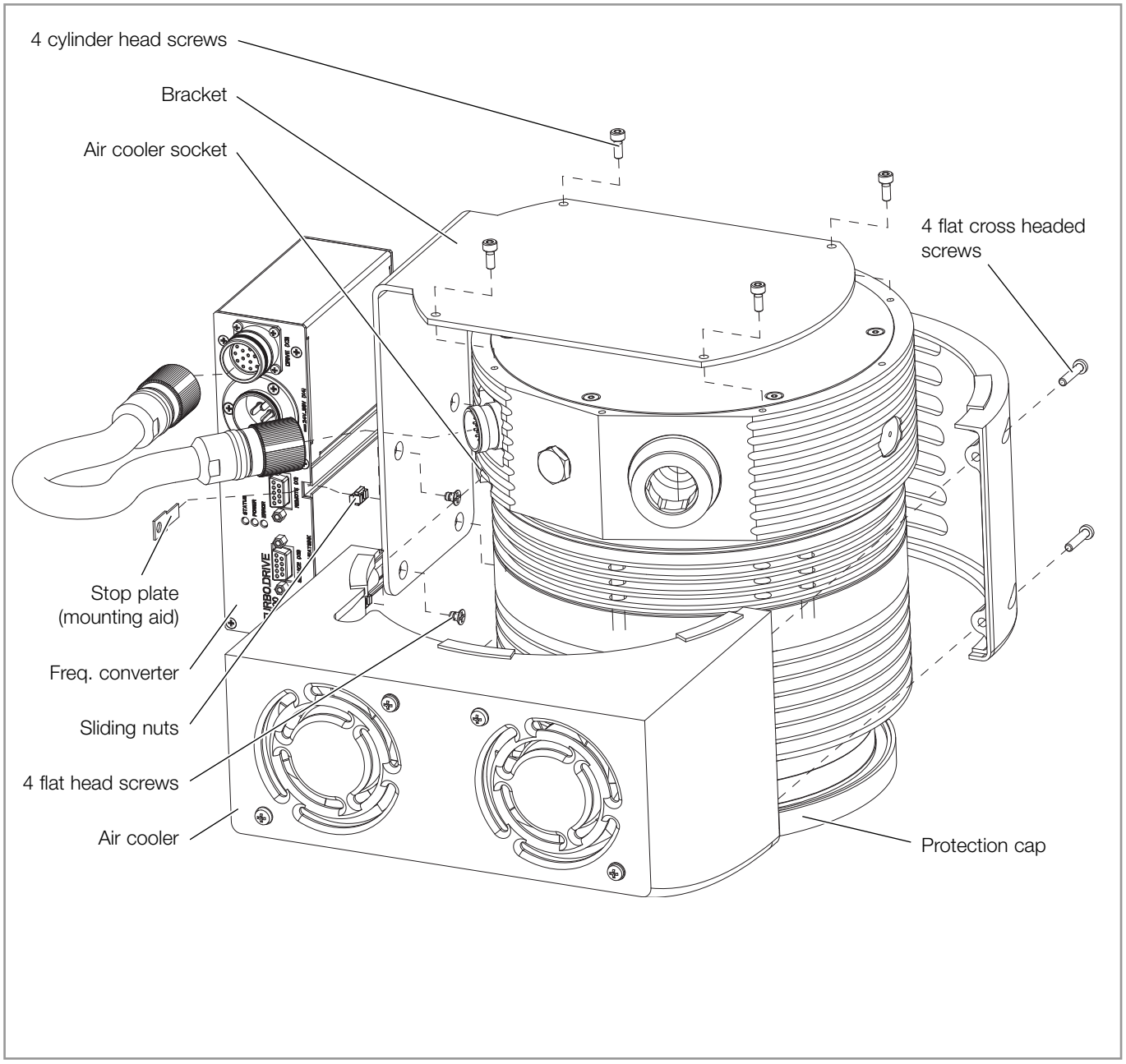


Fig. 2.3 Mounting air cooling and frequency converter beside the pump

- Insert the connecting cable from the air cooler into the air cooler socket. When fitting, be sure not to pinch the cable.
- As the purge gas and venting valve use either valves with a M8 screw-in thread or screw in the M8 – DN16KF adapter and connect the valve to it. See also Section 2.7.

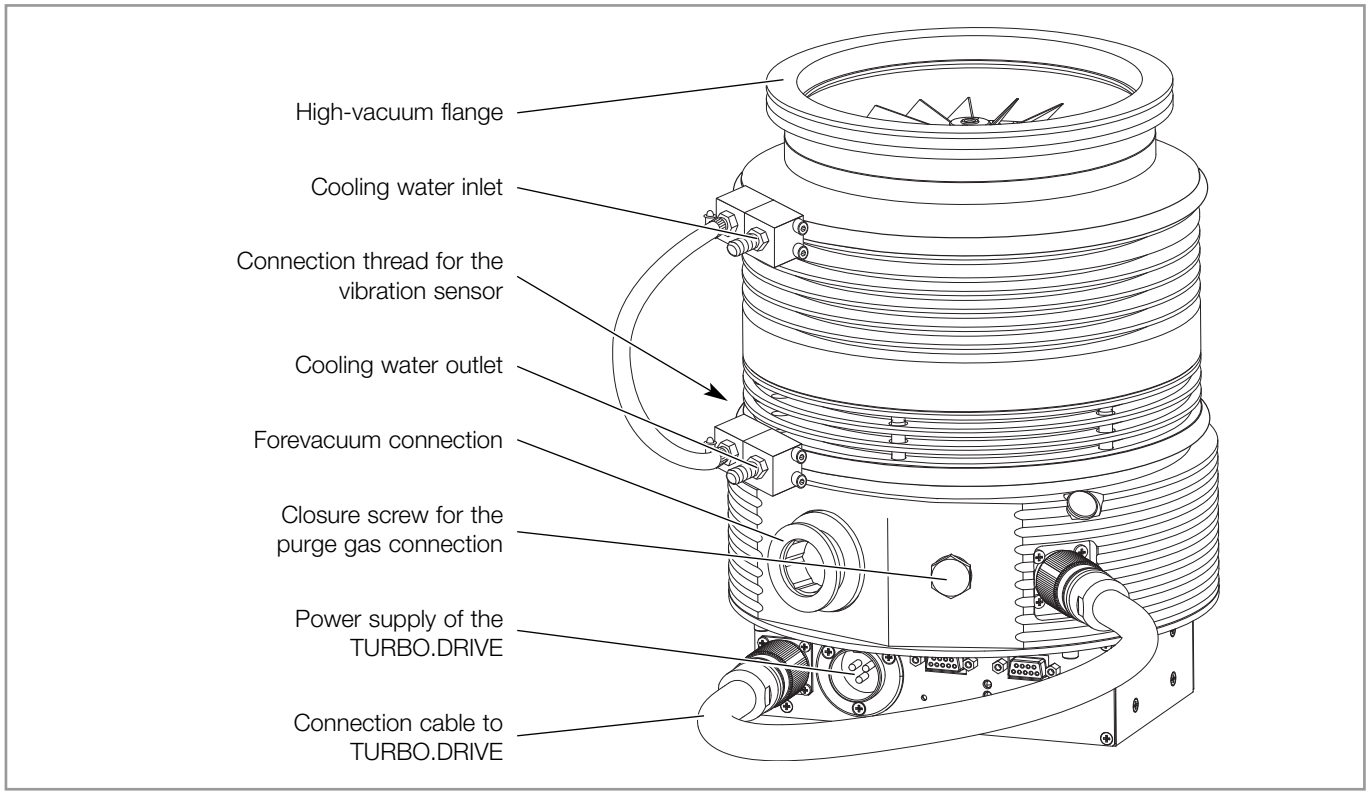


Fig. 2.4 Connection elements

2.4 Attach the pump to the vacuum chamber

Do not stand below the pump while connecting or removing it.

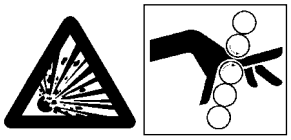
Do not open the packaging until immediately before installation.

Do not remove the covers and blind flanges on the pump until just before attachment to the equipment to ensure that assembly is carried out under the cleanest possible conditions.

Caution

Never touch the rotor. Touching the rotor may cause injury and damage the rotor bearing.

Warning



The high-vacuum flange must be solidly mounted to the vacuum chamber. If the mounting is not sturdy enough, pump blockage could cause the pump to break loose; internal pump components could be thrown in all directions.
Never operate the pump (in bench testing, for example) without proper flanging to the vacuum chamber.

If the pump should suddenly seize, an ensuing deceleration torque of up to 1930 Nm will have to be absorbed by the system. To accomplish this, the following is required:

ISO-K flange: 10 steel clamps, strength at least 8.8, torque 30 Nm

CF flange: stainless steel screws, strength at least A2-70, torque 20 Nm

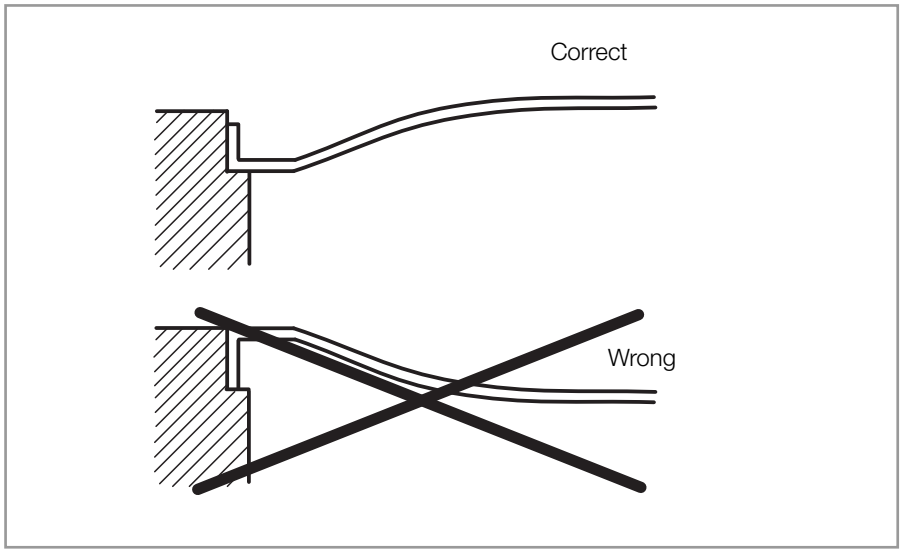


Fig. 2.5 Installing the splinter guard

In most applications the pump is flanged to the high-vacuum flange at the apparatus. The pump can be mounted and operated in any desired attitude.

No support is required. If nonetheless an additional fastening is requested you can use the 4 boreholes in the pump's bottom.

Caution

If foreign objects could pass from the vacuum chamber into the pump, install a wire mesh splinter guard. Foreign objects which enter the pump through the intake would cause serious damage to the rotor. Damage resulting from foreign objects in the rotor section are excluded from guarantee coverage.

Insert the splinter guard so that the surface curvature is at the top and apply some pressure lightly at the rim so that the splinter guard engages.

If dust could pass from the vacuum chamber into the pump, then a micropore filter must be installed between the vacuum chamber and the pump.

Radiation shield

The rotor must not be exposed to hot surfaces above 100 °C. Install an optical radiation shield if required.

Vibrations

The pump is precision balanced and is generally operated without a resonance damper. To decouple extremely sensitive equipment and to prevent transfer of external vibrations to the pump a special resonance damper is available for mounting at the high-vacuum flange.

If several pumps are to be mounted to a system, you must consult our Applications Dept. in order to prevent that the pumps will be excited by vibrations by each other.

Besides the forevacuum connection it is possible to connect a vibration sensor: thread M3, 9.3 mm deep.

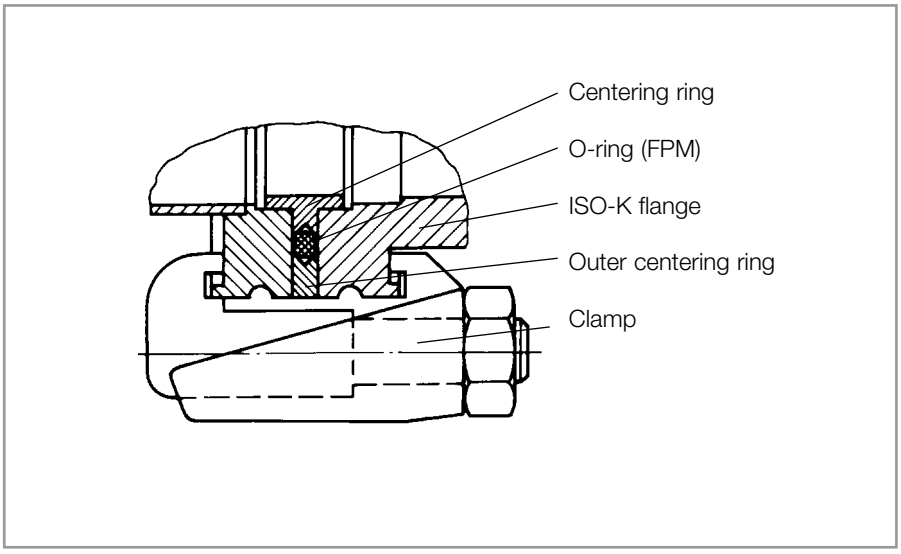


Fig. 2.6 Using type ISO-K flanges

Detach the shipping flange from the high-vacuum flange and remove the desiccant. Pay attention to scrupulous cleanliness when making the connection.

Warning

During operation the pump can become so hot that there is a danger of burns (up to approx. 80 °C, 176 °F).
Provide protection against contact with the hot components.

Design with ISO-K clamp flange

Lay the O-ring on the centering ring.

The O-ring must be positioned so as to be smooth and flat; it must not be twisted. Then position the outer ring.

A collar flange with circlip and the appropriate gasket may be used to connect the pump.

A collar flange is required when using ultra-vacuum sealing gaskets.

The order numbers for the flange components are given in the Oerlikon Leybold Vacuum Catalog.

2.5 Forevacuum connection

The high vacuum pressure level which can be achieved is a function of the volume of gas flow Q to be pumped and the forevacuum pressure.

Forevacuum pump

We recommend using the dry-running SCROLLVAC SC 15 or SC 30 pumps or TRIVAC rotary vane pump for this purpose.

Connect the clean forevacuum line. The connecting flanges must be clean an undamaged. The cross section of this line must be so wide that safe operation of the pump can be ensured.

Warning

The forevacuum line must be tight. Hazardous gases can escape at leaks or the gases being pumped can react with air or humidity.

Fig. 2.13 is a schematic diagram of a pump system incorporating a turbomolecular pump and a TRIVAC forevacuum pump with an anti-suckback valve.

Safety valve

A separate safety valve must be provided for oil-sealed forevacuum pumps without an anti-suckback valve. The safety valve prevents oil flowing back from the forevacuum pump into the turbomolecular pump when the system is not running.

Adsorption trap

To ensure that the forevacuum space at the turbomolecular pump is kept largely free of oil vapors during operation, as well, we recommend installing an adsorption trap in the forevacuum line. Alternatively purge the forevacuum line with inert gas. In this case the pressure in the forevacuum line must be over 10^{-2} mbar.

Provide a roughing line to achieve the shortest cycle times.

Ensure that the pump is sufficiently isolated against vibrations generated by the forevacuum pump.

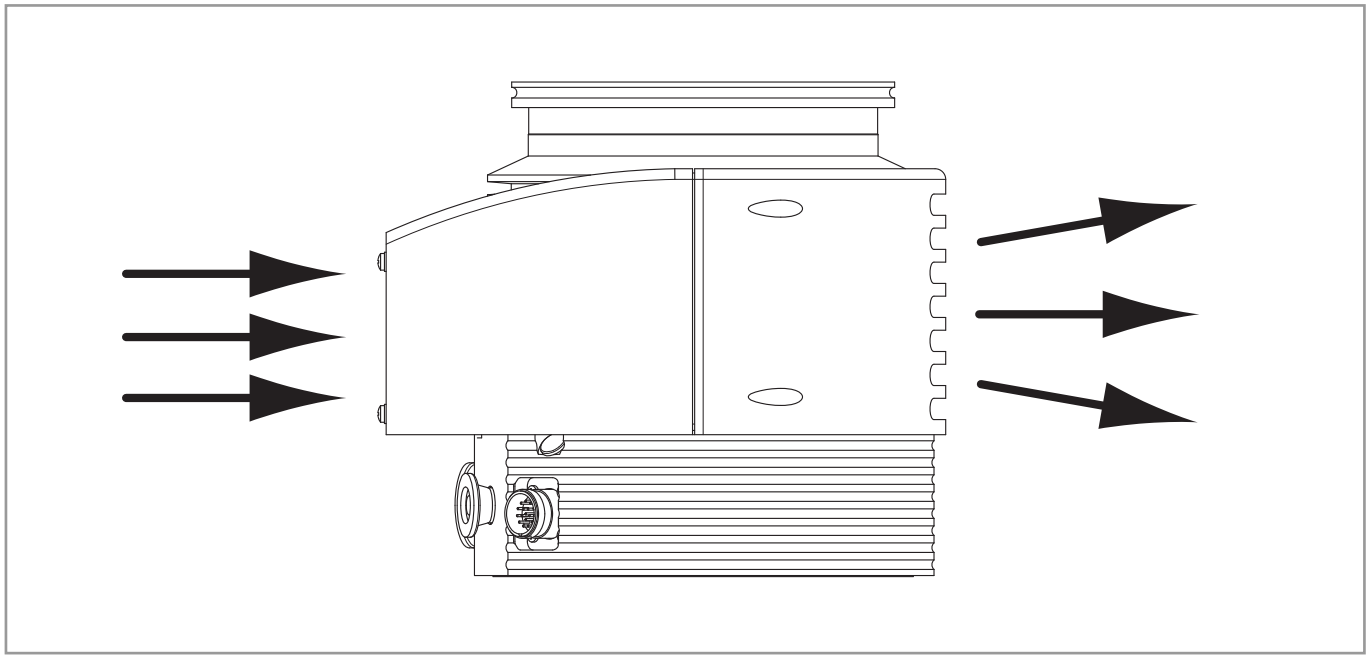


Fig. 2.7 Pump with air cooling

2.6 Connect the cooling

Cooling of the pump depends on the required pumping power and the ambient temperature.

When the pumps are insufficiently cooled they will shut down.

The pump must only be operated with forced cooling. Install an air or water cooling, depending on the load.; see Section 2.3, Part Nos. see Section 1.5.

Air cooling

When installing air cooled pumps within a system ensure that sufficient quantities of fresh air are freely available. The air cooling facility is powered via the pump.

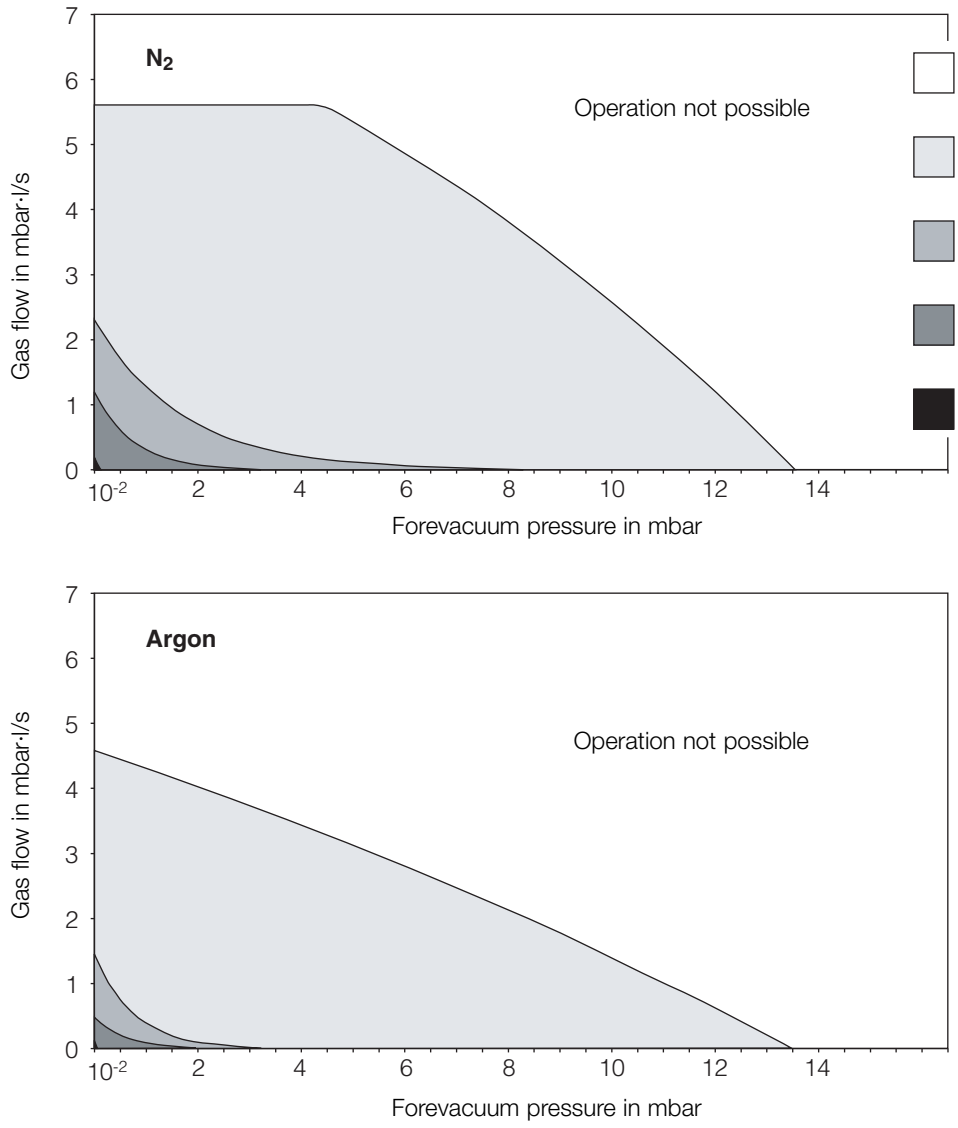


Fig. 2.8 Cooling requirements of the SL 700

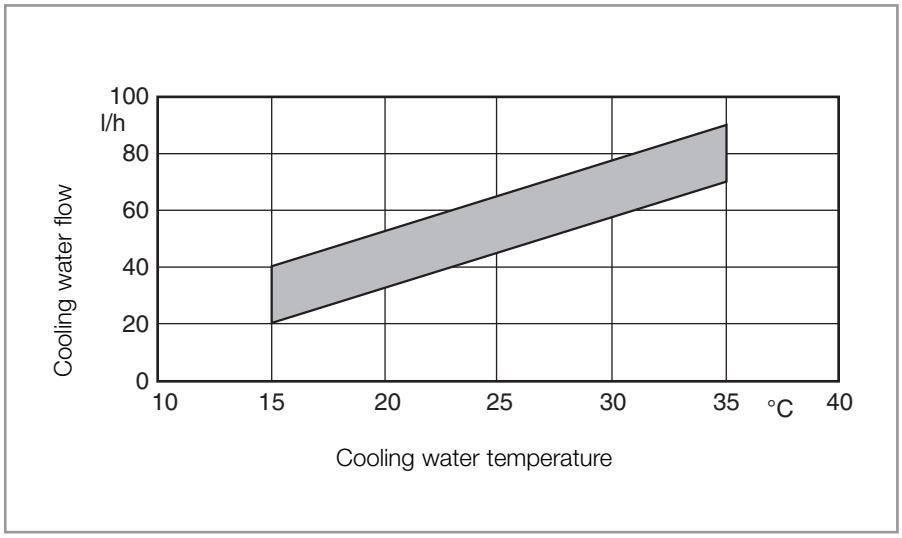
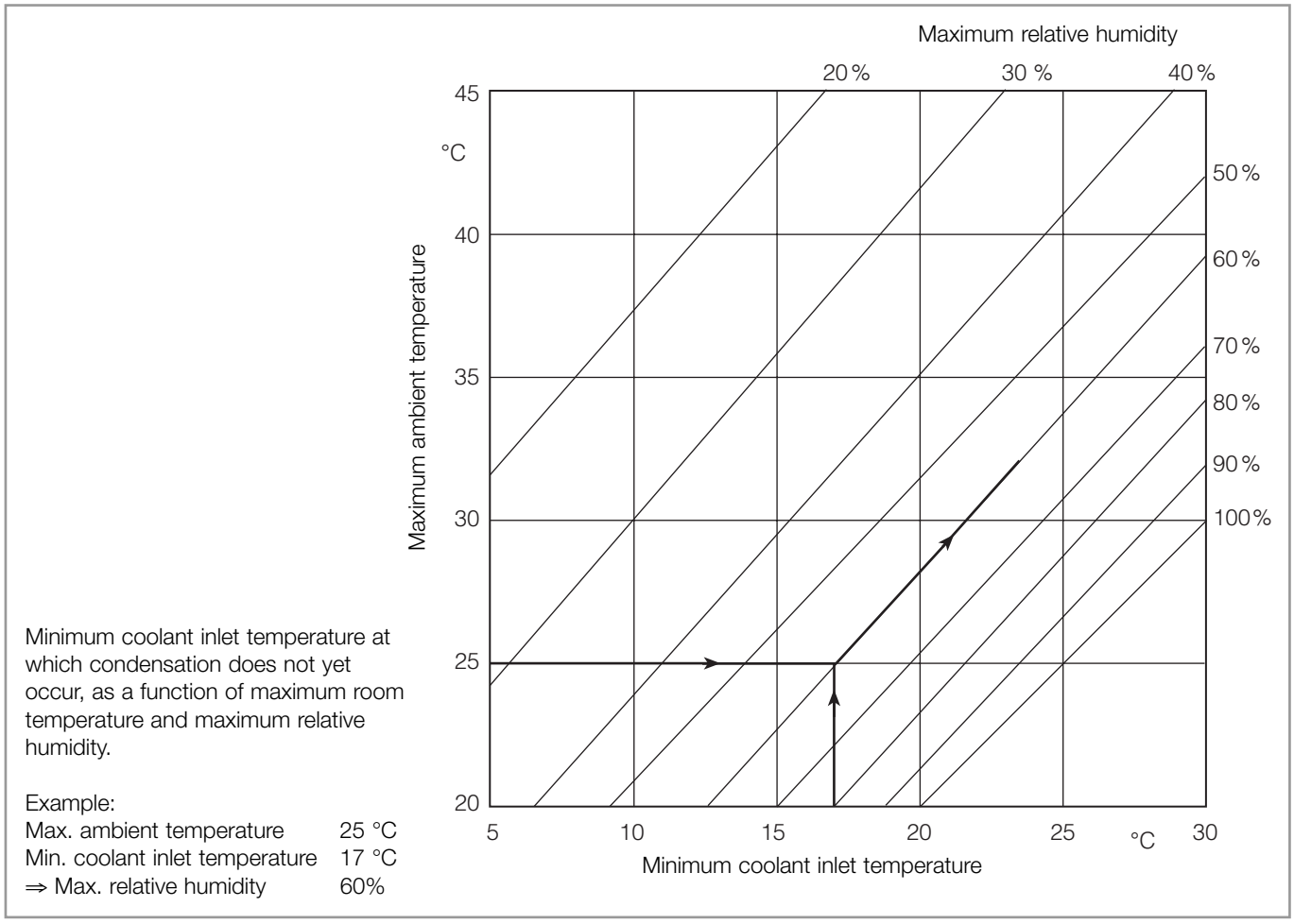


Fig. 2.9 Cooling water requirements



Minimum coolant inlet temperature at which condensation does not yet occur, as a function of maximum room temperature and maximum relative humidity.

Example:

Max. ambient temperature	25 °C
Min. coolant inlet temperature	17 °C
⇒ Max. relative humidity	60%

Fig. 2.10 Dewpoint diagram

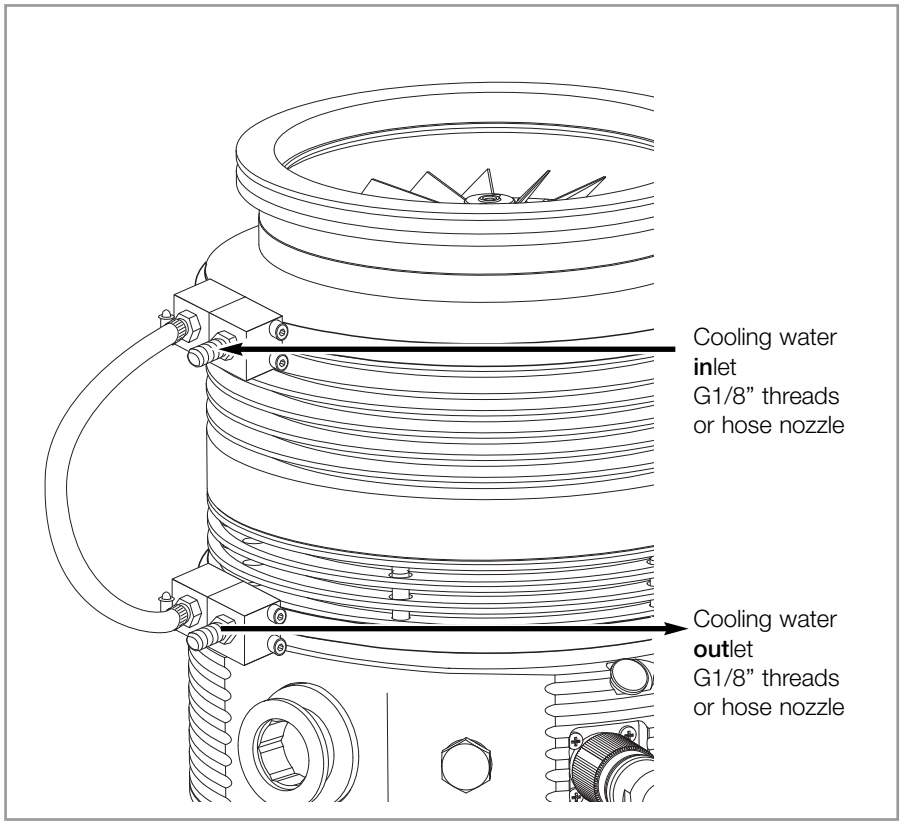


Fig. 2.11 Pump with water cooling

Cooling water specifications

Feed temperature	15 - 35 °C non-condensing
Feed pressure	3 to 7 bar absolute
Cooling water requirement	See Fig. 2.9
Appearance	colourless, clear, free of oils and greases
Sediments	< 250 mg/l
Particle size	< 150 µm
pH value	7 to 8.5
Overall hardness (total alkaline earths)	max. 20 ° German hardness scale (= 3.57 mmol/l)

Connecting the cooling water

Screw on the cooling water lines. Cooling water connection: G 1/8“.

Adjust the cooling water temperature so that the formation of condensate is avoided.

When switching the cooling water supply on and off by means of an electrically actuated valve, connect the valve so that it will be switched on and off together with the pump.

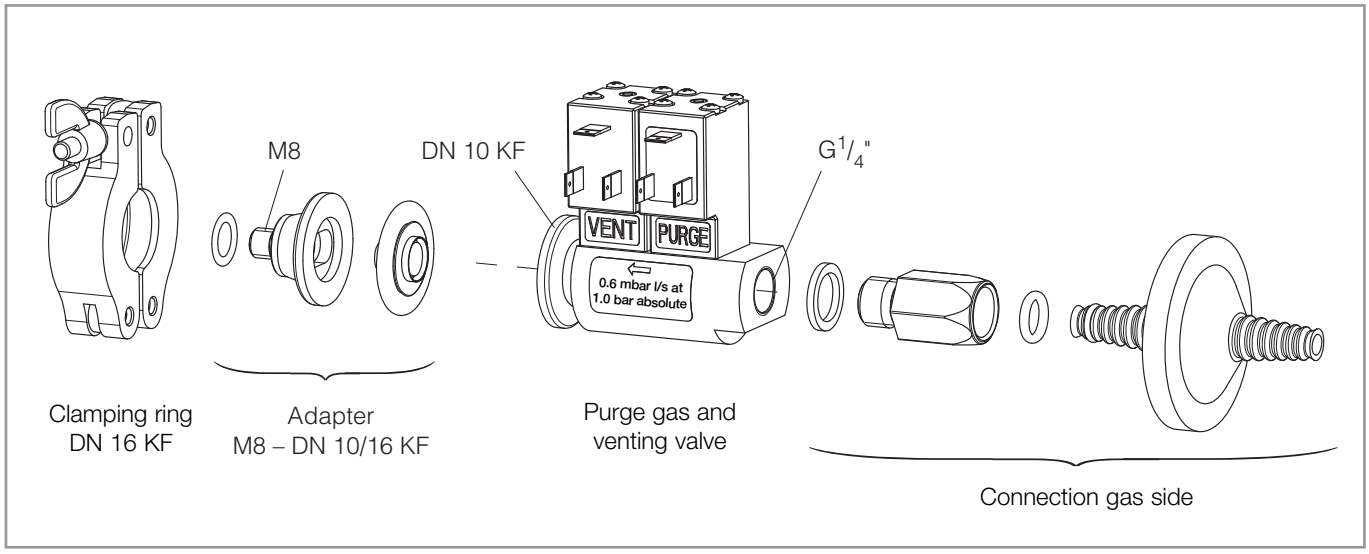


Fig. 2.12 Connecting the purge gas and venting valve

2.7 Connecting the purge gas / venting valve

The pumps are equipped with a purge gas facility. The purge gas and venting connection has been blanked off as a standard with a M8 closure screw. A purge gas and venting valve or a power failure venting valve or a venting valve may be either connected directly or using a M8 – DN16KF adapter.

The power failure venting valve or venting valve vents the pump and the fore-vacuum line when the pump is switched off and thus keeps oil vapor from diffusing back from the forevacuum line.

A choke nozzle in the vent port ensures that the pump is not vented too fast.

When having to decide which gases need or not need to be pumped with purge gas we are available to provide assistance.

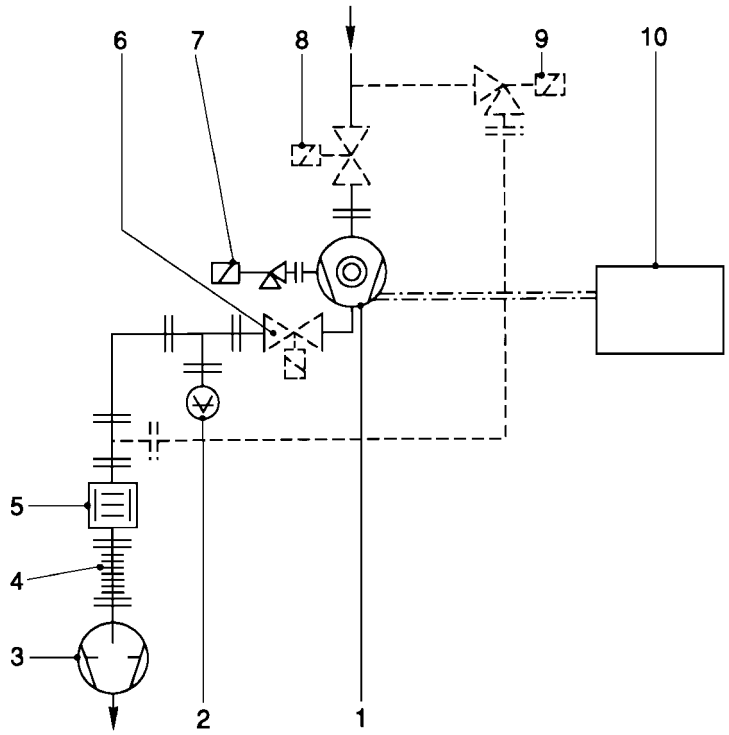
Refer to Section 3.1 for suited gases.

When operating the pump with purge gas, the pump needs to be vented via the purge gas valve after having shut down the pump, see Section 3.4.

Consider the additional purge gas flow when selecting a suitable backing pump.

We recommend a purge gas flow of 0.6 mbar·l/s (36 sccm) with Nitrogen.

The pressure in the pump must not exceed 1200 mbar (0.2 bar over-pressure).



1 Turbomolecular pump
2 Forevacuum gauge port
3 Forevacuum pump
4 Resonance damper
5 Adsorption trap
6 Forevacuum valve
7 Purge gas and venting valve
8 High-vacuum valve
9 Valve in the roughing pump line
10 Frequency converter

— — — — Roughing line; recommend to achieve the shortest possible cycle times

Fig. 2.13 Schematic of a turbomolecular pump system

2.8 Electrical connection

The TURBO.DRIVE 700 frequency converter needed to operate the TURBOVAC SL 700 has either been integrated in the pump or is a separate unit. For connection examples see Fig. 2.14 and 2.15.

The pump may be operated only with a suitable frequency converter and suitable connector cables.

Warning

Route all cables so as to protect them from damage.

Do not expose the pump, the frequency converter or the connections to water.

Caution

Disconnect and connect the cable connections only while the pump is turning no longer (green status LED off) and with the mains power switched off (yellow power LED off). Otherwise there is the risk of damaging the TURBO.DRIVE.

2.8.1 Connecting pump and frequency converter

Connect the pump to the frequency converter using a suitable connecting cable.

Make sure that the frequency converter is adequately cooled; for this see Section 2.8.3 and also Fig. 2.17.

Installation

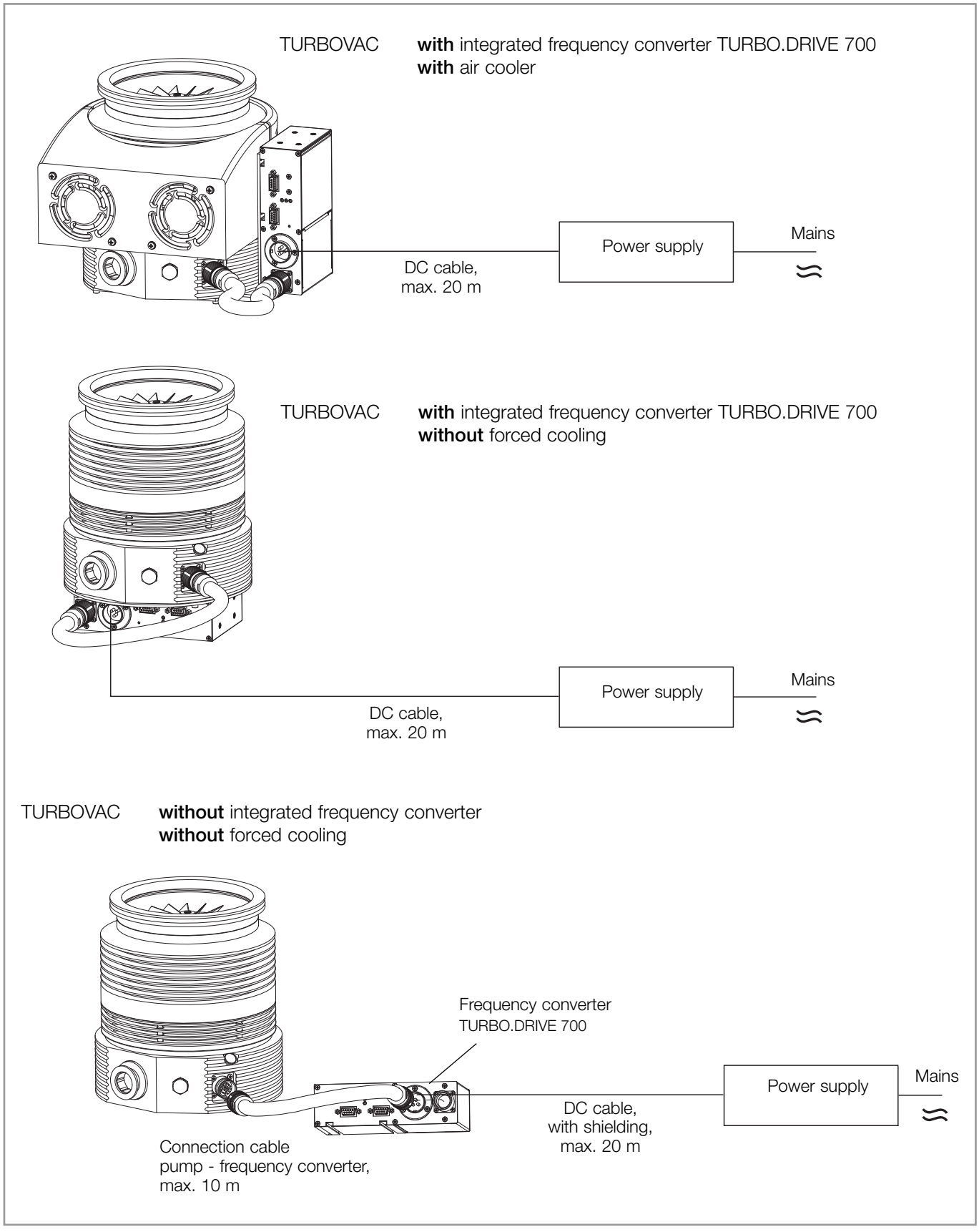


Fig. 2.14 Examples for connection

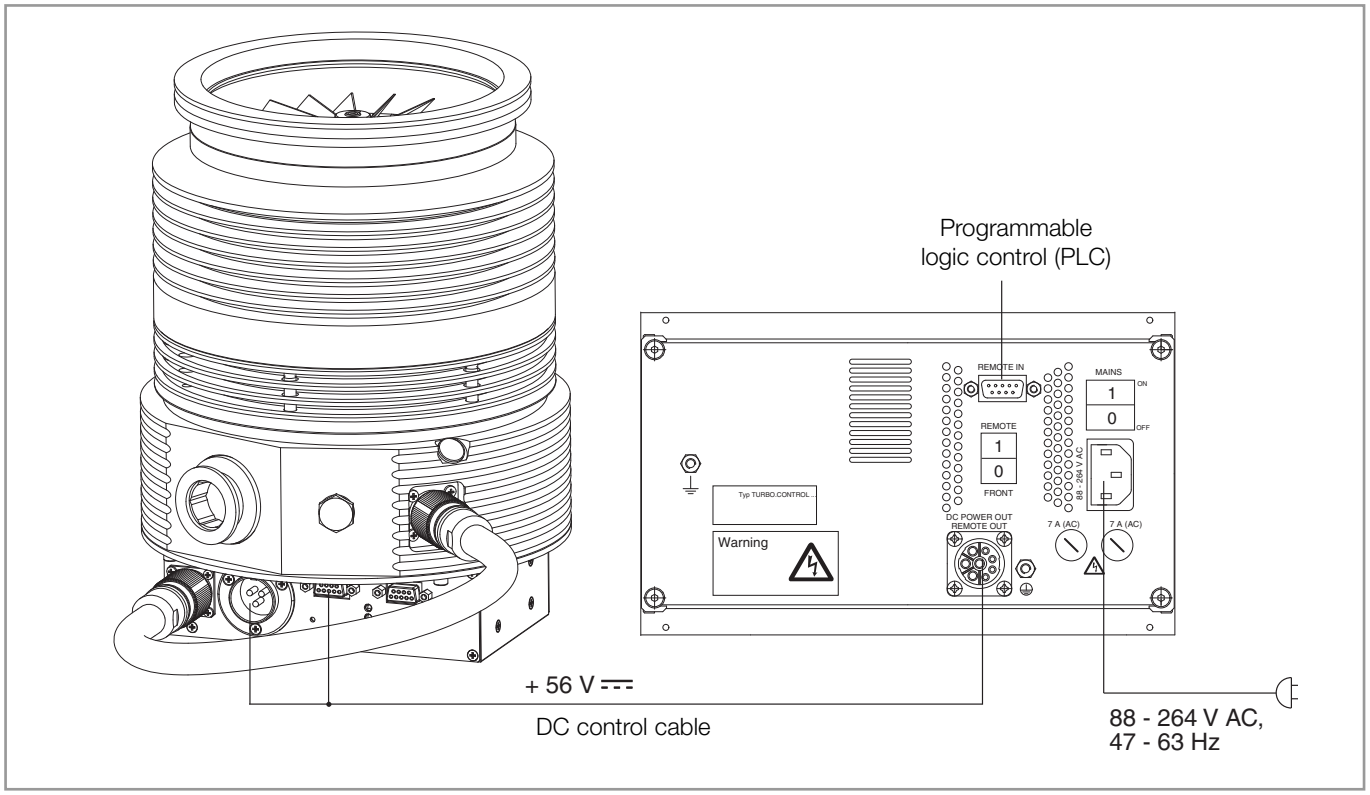


Fig. 2.15 Connection schematic for TURBO.CONTROL 700

2.8.2 Connecting the power supply

The frequency converter must only be connected to power supplies which meet the requirements for functional extra low voltage with positive isolation in accordance with IEC 364 (VDE 0100, Part 410, or local regulations) (SELV).

Warning

The power supply must meet the requirements given in Section 1.3. Peak loads in the kHz range may be present on the DC side. The power supply should have a current limitation or control.

When connecting several frequency converters to a single power supply, then each frequency converter must be fused separately.

Connect the frequency converter to the 59 V DC power supply or to the TURBO.CONTROL 700.

Caution

Ensure correct polarity.

Pin 1	+ 59 V ⎓
Pin 2	0 V
Pin 3	GND

The frequency converter is equipped with an internal fuse. It can only be replaced by Oerlikon Leybold Vacuum staff.

Connect the power supply to the mains.

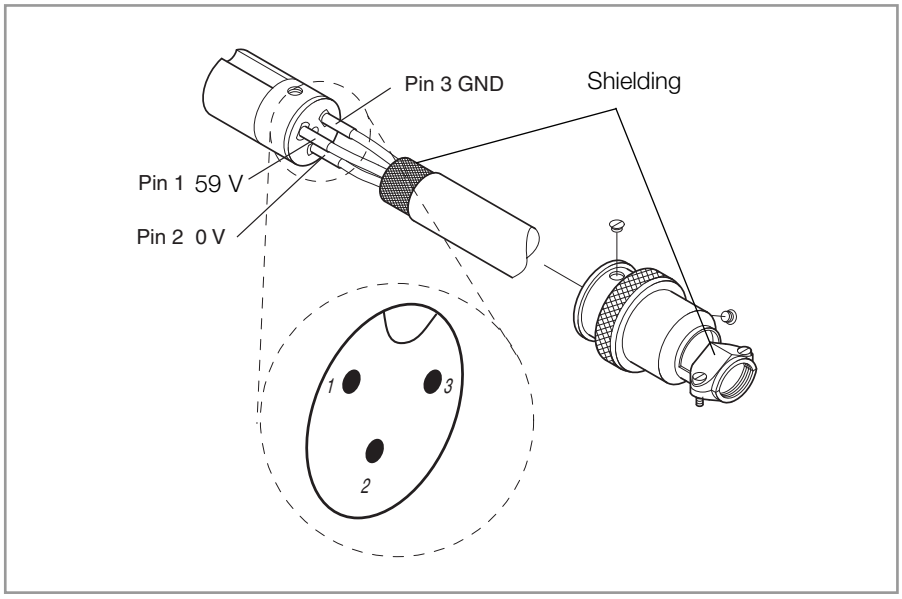


Fig. 2.16 Pin assignment of the DC connector (X4) Model Hirose HS21P-3; view from the soldered side

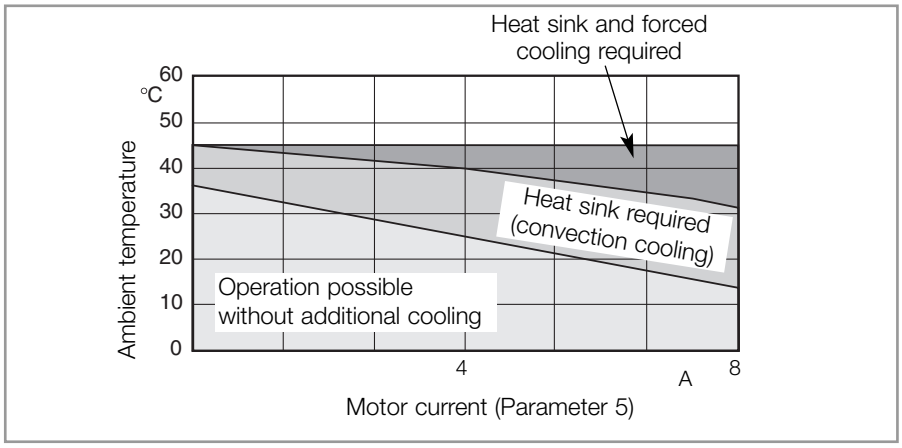
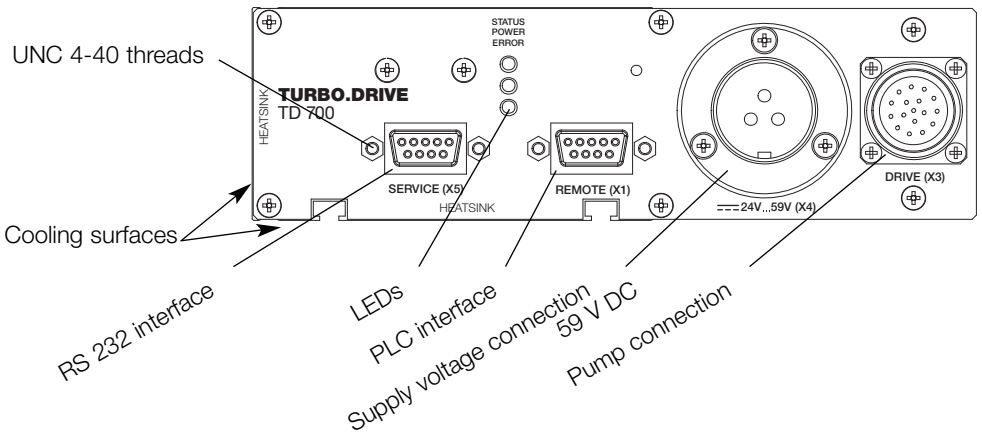


Fig. 2.17 Cooling requirements for the TURBO.DRIVE 700 when fitted separately

Emergency shut down: By shutting down the power supply voltage. Please note the information on shutting down and emergency shut down provided in Section "3.4 Shutting down".

2.8.3 Mounting the frequency converter

The frequency converter may be affixed with the aid of the enclosed M4 sliding nuts. The bottom side of the frequency converter must be cooled sufficiently.



Green LED STATUS

off:	Pump at standstill (< 3 Hz)
flashes slowly 1/s:	Start command is present (about 10 s after start)
flashes fast 3/s:	Running up or running down
on:	Normal operation

Yellow LED POWER

off:	No supply voltage
flashes:	Supply voltage too low or too high
on:	Supply voltage is present

Red LED ERROR

off:	No error, no warning
flashes:	Warning is present, pump can be operated possibly with some restrictions
on:	Fault is present, pump stopped or can not be operated

Fig. 2.18 View of the TURBO.DRIVE 700

Installation

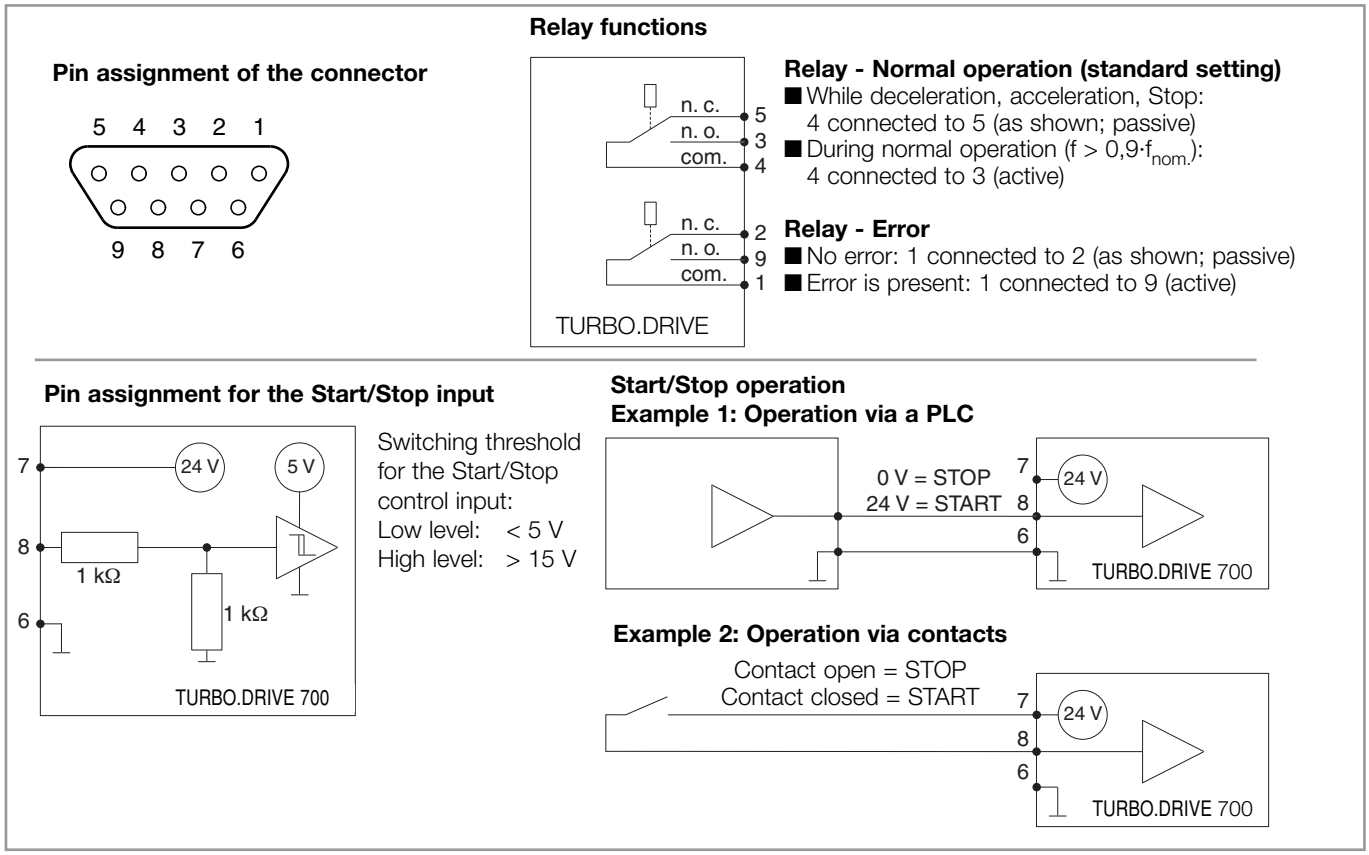


Fig. 2.19 Pin assignment of the REMOTE (X1) connector

2.8.4 Relay status

Input data / status				Output data					Operating mode
Start/ stop signal	Pump rotating	Normal frequency ≥ 90% of setpoint frequency	Error is present	Motor drive	Relay NORMAL OPERATION	Relay ERROR	LED STATUS	LED ERROR	Other modes are not possible; they indicate a failure affecting the TURBO.DRIVE.
Stop	no	no	no	off	passive	passive	off	off	Pump not operating
Stop	yes	no	no	off	passive	passive	flashes	off	Pump is decelerating
Stop	yes	yes	no	off	passive	passive	flashes	off	Just after stop; pump was in the normal operating mode before that
Start	no	no	no	on	passive	passive	off	off	Just after start
Start	yes	no	no	on	passive	passive	flashes	off	Pump is accelerating
Start	yes	yes	no	on	active	passive	green	off	Pump is in the normal operating mode
Stop	no	no	yes	off	passive	active	off	red	Error is present; pump is at standstill
Stop	yes	no	yes	off	passive	active	flashes	red	Error is present; pump is decelerating
Stop	yes	yes	yes	off	passive	active	flashes	red	Error has just occurred
Start	no	no	yes	off	passive	active	off	red	Error is present; pump is at standstill
Start	yes	no	yes	off	passive	active	flashes	red	Error is present; pump is decelerating
Start	yes	yes	yes	off	passive	active	flashes	red	Error has just occurred

3 Operation

3.1 Media compatibility / purge gas

The TURBOVAC SL 700 is suitable for pumping air and clean gases.

These pumps are **not** suitable for

- pumping liquids or gases containing dust or particulates
- pumping corrosive or reactive gases
- pumping gas mixtures with an oxygen share of > 21 %

If reactive gases in low concentrations must be pumped operate the pump with purge gas.

Danger of ignition

During normal operation the pressures within the pump will be so low that many gas mixtures will be incapable of igniting. But due to pressure bursts during switching processes or due to malfunctions, for example, pressures can be attained rendering such gas mixtures ignitable. During operation the pump can reach temperatures as high as 110°C (230 °F). Ignition sparks could occur in case of damage to the pump and these could ignite explosive mixtures.

We would be glad to consult with you as regards the media which can safely be handled with this unit.

Install a micropore filter when pumping media which contains dust.

Suited gases

Suited for venting or purging are all gases,

- which will not cause corrosion or pitting in aluminium and steel and
- which in connection with process deposits in the pump will not cause corrosion or sticking.

For venting and as the purge gas we recommend inert gases like nitrogen or argon. The temperature of these gases should be between 5 °C and 80 °C , max. relative humidity should not exceed 10 ppm.

The gas must be clean.

In individual cases and after consultation also dry, filtered, oil-free air or filtered ambient air may be used (filter mesh < 1µm).

Change the filters after some time, at least annually.

3.2 Interfaces

The frequency converter has a RS 232 interface as standard (SERVICE X5) and is optionally equipped with serial interfaces:

- RS 485
- Profibus DP

The TURBO.DRIVE 700 is configured through the parameters according to the parameter list. Pxxx denotes parameter value xxx.

The PC software "TURBO.DRIVE Server" allows convenient access by the user to the parameters of the frequency converter.

Applications which can be implemented with the aid of the serial interface:

Application	Benefits to the customer	How to do it
Networking of several pumps and other equipment	Savings relating to the costs for signalling cables	With Field Bus systems like RS485 or Profibus
Automation	Savings related to repetitive manual work	For example by a control computer
Avoidance or warnings before overload operation or process changes	■ Maintenance can be scheduled ■ Improved reliability of sensitive production processes in a vacuum	Monitoring of: ■ Motor current P5 ■ Ball bearing temperature P125 or P127 ■ Motor temperature P7 ■ Frequency converter temperature P11
Troubleshooting	Quick analysis of problems	Reading of error memories P171(P174) and P176
Starting the pump with a delay if a several consumers are connected to the same PSU	Cost savings through smaller power supply units if peak loads can be reduced	With P36, delay
Frequency converter as a simple pressure gauge, since motor current is dependent on the vacuum conditions	Dispensing with pressure gauges	Monitor motor current P5; second function for“Normal Operation” relay: relay switches as soon as the motor current threshold is tripped. Adjust second function: P29 Set motor current threshold: P27
Lowering the normal operation threshold	Normal operating mode is attained faster, processes can be started faster	Reduce frequency threshold through P25

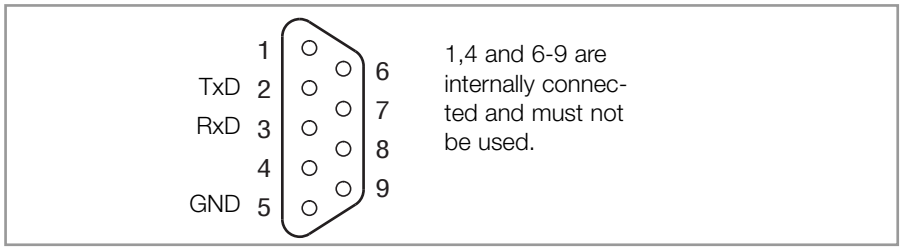


Fig. 3.1 Pin assignment for the socket at the frequency converter (female) SERVICE X5

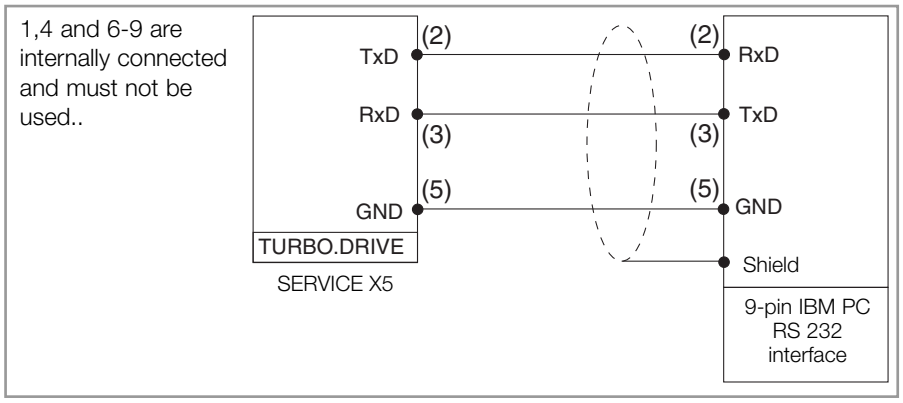


Fig. 3.2 Providing a RS 232 connection

3.2.1 RS 232 C interface (SERVICE X5)

Standards	DIN 66020
Protocol	acc. to VDI/VDE 3689
Transmission rate	19200 baud
Response delay	default setting 10 ms (parameter 180)
Address range	non-addressable
Max. cable length	5 m
Interface connector	9 way Sub-D type, socket on the instrument (female) thread UNC4-40

Note: If on the controlling side an RS 232 interface in accordance with the PC standard with a 9-pin Sub-D male connector is present, then a straight through cable as shown in Fig. 3.2 may be used.

Refer also to Operating Instructions GA 05.281

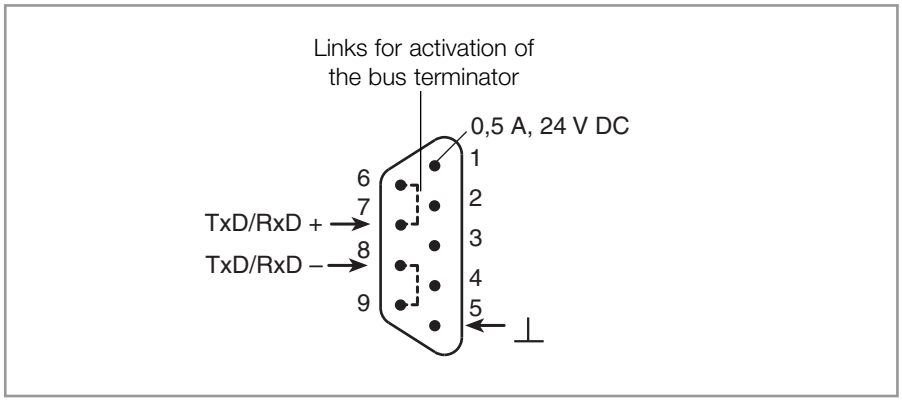


Fig. 3.3 Pin assignment for the socket at the frequency converter for RS 485 interface (male)

3.2.2 RS 485 interface

Standards	ISO/IEC 8482, EIA 485
Protocol	acc. to VDI/VDE 3689
Transmission rate	19200 baud fixed
Response delay	default setting 10 ms (parameter 180)
Address range	0 ... 15
Max. cable length	50 m (with bus termination)
Type of cable	2 wire twisted pair (twisted pair cable)
Differential voltage levels (see also “Standards”)	logic "0": transmitter: 1.5 ... 5 V receiver: > 0.3 V
	logic "1": transmitter: - 1,5 ... - 5 V receiver: ≤ - 0,3 V
Interface connector	9 way Sub-D type, socket on the instrument (male) thread UNC4-40

Note: After having changed the bus address through the rotary switch , the frequency converter must be switched off (yellow power LED off) and then on again so as to enable the new address setting.

Bus addresses over 15 can only be set via Parameter 37.

Refer also to Operating Instructions GA 05.281

3.2.3 Profibus DP

The Profibus DP used has been defined in the standards EN 50170 and VDI/VDE 3689.

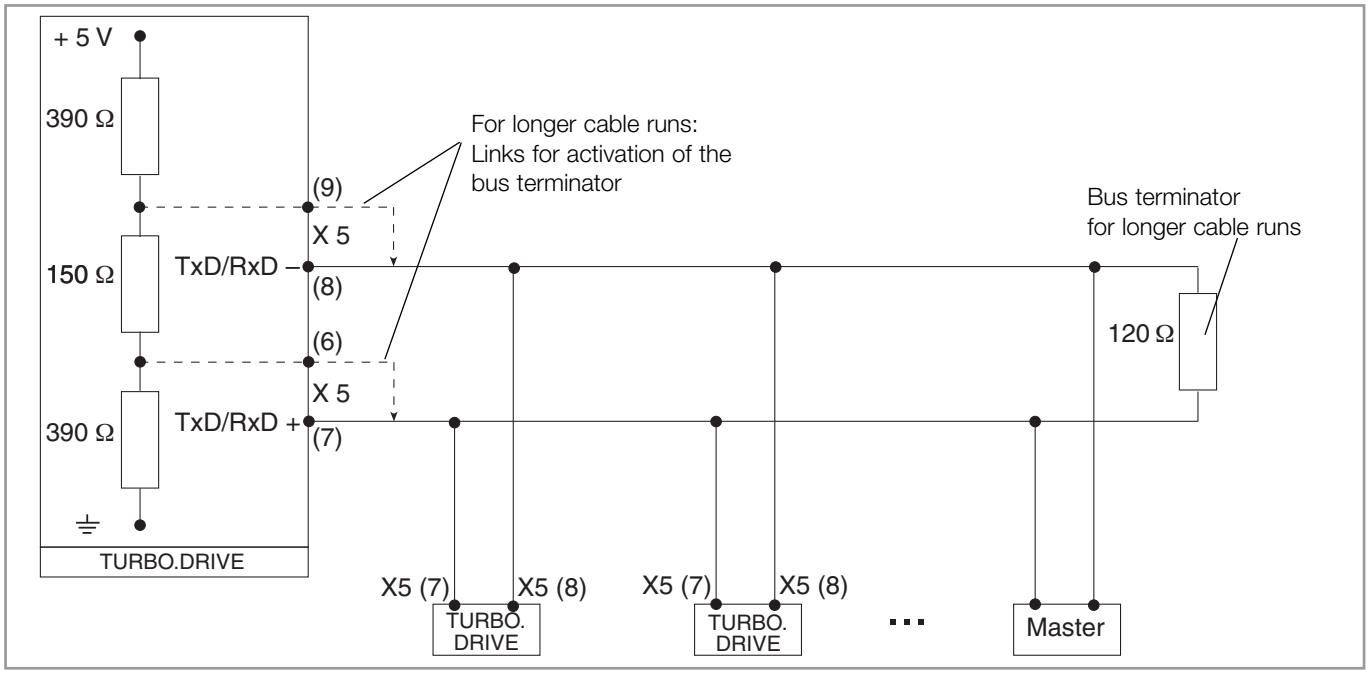


Fig. 3.4 Connection of the RS 485 bus

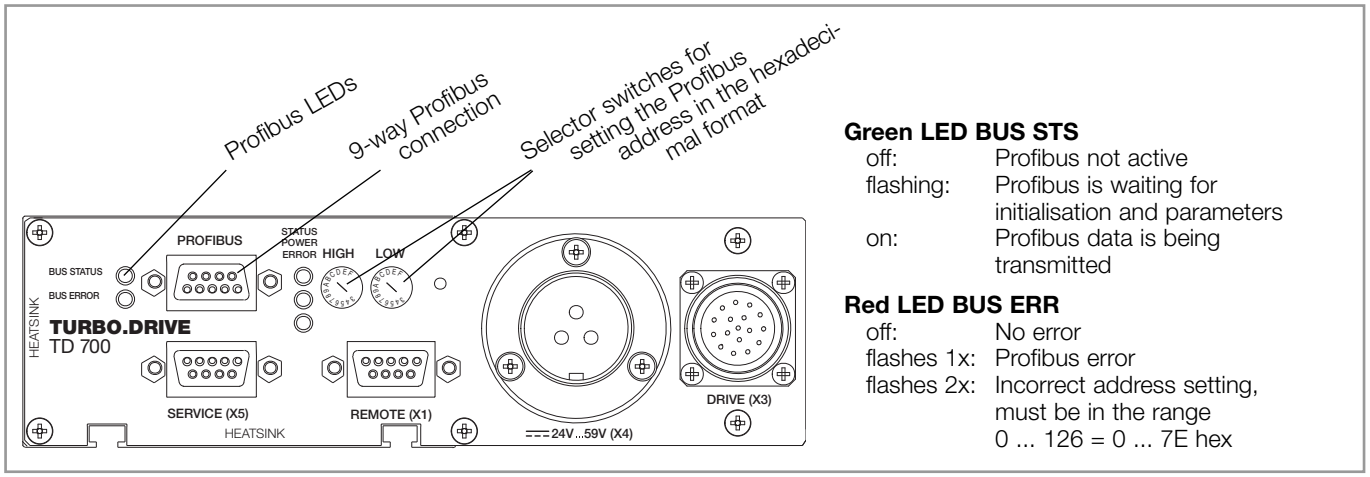


Fig. 3.5 TURBO.DRIVE 700 with additional Profibus interface

For more information on the Profibus system:

"The New Rapid Way to Profibus DP",
Manfred Popp, Profibus Nutzerorganisation e.V.,
Haid-und-Neu-Str. 7
76131 Karlsruhe, Germany
P/N: 4.072
www.profibus.com

Upon request we shall be pleased to provide detailed information on the hardware and the protocol used for the data.

Refer also to Operating Instructions GA 05.281

3.2.4 Parameter list

No.	Designation	Range	Unit	Default	Format	r/w	Description
0	Dummy parameter	-	-	-	U16		No function
1	Type of frequency converter	132 / 134	-	-	U16	r	TURBO.DRIVE 700 = 134
2	Software version	xx.yy.zz	-	1.14.00	U16	r	xx.yy: version, zz: correction index
3	Actual rotor frequency	0...1300	Hz	-	U16	r	The max. frequency depends on the pump type.
4	Actual converter supply voltage	24...59	V	-	U16	r	Nominal value for TURBO.DRIVE 700: 59V
5	Setpoint for the motor current	0... 80	0.1A	-	U16	r	
7	Actual motor-temperature	0...150	°C	-	U16	r	Measured coil temperature for the motor
8	Permanently save the changed parameter data in the EEPROM	-	-	-	U16	w	A write command will cause the data to be saved. The parameter value itself is not processed and saved. After a reset or switching on the supply voltage with a different pump connected or without a pump, all parameters will be reset to their defaults.
11	Actual converter temperature	0...150	°C	-	U16	r	Measured internal converter temperature
12	Operating mode for	0...2	-	0	U16	r/w	P12 = 0 (default): via REMOTE (X1); P12 = 1: via serial interface P12 = 2: Start: REMOTE (X1) at Start **and** serial interface sends Start signal Stop: REMOTE (X1) at Stop **or** serial interface sends Stop signal.
16	Motor temperature warning threshold	30...150	°C	54	U16	r	Exceeding the motor temperature warning threshold results in a warning
17	Max. value setting for motor current	5 ... 75	0,1 A	75 (45)	U16	r/w	Maximum permissible motor current (value in brackets for water-cooled pump)
18	Nominal pump frequency	750...1200	Hz	800	U16	r	Highest permissible frequency
19	Minimum setpoint frequency for the pump	P20 ... P18	Hz	600	U16	r/w	Lowest permissible frequency
20	Minimum frequency level	0 ... P19	Hz	575	U16	r	When the pump is accelerating this frequency must be reached within the maximum passing time (P183). After the end of acceleration: Switch-off threshold because of overload; see error 106
23	Pump type	00...55	-	42 or 43	U16	r	42 = SL 700, air-cooled 43 = SL 700 w/o air cooler / water-cooled
24	Setpoint frequency	P19 ... P18	Hz	800	U16	r	Nominal pump frequency
25	Frequency dependent normal operation level	0..100	%	90	U16	r/w	If P29 = 0: Defines the normal operation level. Normal operation if P3 ≥ P24 x P25
27	Motor current dependent normal operation level	5...75	0,1 A	20	U16	r/w	If P29 = 1: Defines the normal operation level. Normal operation if P5 ≤ P27

No.	Designation	Range	Unit	Default	Format	r/w	Description
29	Selection of the relay functions	0 ... 4	-	0	U16	r/w	The normal operation and error relays can be set to special functions if required.
	P29 = 0 means:	the **normal operation relay** is active when the normal operation frequency is exceeded (P3 ≥ P24 * P25) the **error relay** is active in case of an error					
	P29 = 1 means:	the **normal operation relay** is active when the current falls below the normal operation threshold (P5 ≤ P27) the **error relay** is active in case of an error					
	P29 = 2 means:	the **normal operation relay** controls e.g. a venting valve, activated via the field bus interface (Bit 12 in the control word of the data transfer protocol) the **error relay** controls e.g. a purge gas valve, activated via the field bus interface (Bit 11 in the control word of the data transfer protocol) (makes only sense at interface operation}					
	P29 = 3 means:	the **normal operation relay** is active when the normal operation frequency is exceeded (P3 ≥ P24 * P25); the **error relay** is active when **no** error exists					
	P29 = 4 means:	the **normal operation relay** is active when the current drops below the normal operation threshold (P5 ≤ P27); the **error relay** is active when **no** error exists					
32	Maximum run up time	30...2000	s	720 (1500)	U16	r/w	Max. permissible time during which the pump must attain the normal operation threshold (P24 x P25) with the start signal present (value in brackets for water-cooled pump)
36	Start delay time	0...255	0.1 min.	0	U16	r/w	Pause time after the Start command until the pump's drive is started
37	RS485 address	0 ... 31	-	0	U16	r/w	Parameterizable RS485 address; a change of this parameter setting will only be effective ■ after the power supply has been switched off and on and ■ if the addresses 1, 2 and 3 are **not connection coded** via SERVICE (X5)
38	Start counter	0 ... 65535	-	-	U16	r	Counts the total number of pump starts
40	Error counter	0 ... 65535	-	-	U16	r	Counts the total number of errors
90	Error mode	1/2	-	2	U16	r/w	Selection of the error code table which is saved in P171 2 = standard setting 1 = compatible to T1600
125	Current bearing temp.	0...150	°C	-	U16	r	Measured bearing temperature (identical to P127)
126	Bearing temperature warning threshold	30...150	°C	65	U16	r	Exceeding the bearing temperature warning threshold results in a warning
127	Current bearing temp.	0...150	°C	-	U16	r	Measured bearing temperature (identical to P125)
132	Bearing temperature shutdown level	30...150	°C	70	U16	r	Max. permissible bearing temperature; P125 > P132 causes the pump to be switched off

No.	Designation	Range	Unit	Default	Format	r/w	Description
133	Motor temperature shutdown level	30...150	°C	55	U16	r	Max. permissible motor temperature; P7 > P133 causes the pump to be switched off
139	Current reduction factor	30...100	%	100	U16	r/w	Is used for the reduction of the maximum current drawn by the frequency converter, e.g. for adaption of low performance power supplies (Note: values < 100 reduce the pump performance and increase the run-up time) A change in the current reduction factor will onlybecome effective after writing any value to parameter 8 and when switching after this the supply voltage off and on.
171	Error code memory for the last 40 error events	0...39	-	0	Array 0..39 U16	r	Sequential permanent memory; the individual error codes are accessed via parameter 171 with additional index no. in the parameter order identifier of the interface protocol. The last error code which has occurred is saved at the memory location with the index 0, the oldest is at index 39. See below for the error codes.
174	Rotor frequency at the time of error	0...1300	Hz	-	U16	r	Sequential permanent memory of the last 40 rotor frequency values, which have been saved at the time of an error. The individual error codes are accessed via parameter 174 with additional index no. in the parameter order identifier of the interface protocol. The last error code which has occurred is saved at the memory location with the index 0, the oldest is at index 39.
176	Error operating hours memory for the last 40 error events	0...19 years	0.01 h	-	Array 0..39 U32	r	Analogous to P171 (error code memory)
180	Response delay time	2...19	msec	10	U16	r/w	Pause time between received and transmitted interface protocol string of the frequency converter's serial interface RS 232 and RS 485. We recommend not to change the default setting (10 ms)
183	Max. passing time	10...2000	s	500 (1000)	U16	r	Max. permissible time during which the pump must - with the start signal present - have passed through the critical speed range between 60 Hz and P20 (value in brackets for water-cooled pump)
184	Converter operating hours counter	0...19 Years	0,01h	-	U32	r	Totals the operating hours for the converter when the pump's drive is active
199	Converter date of manufacture	01.01.00 ... 31.12.99	-	-	U32	r	
227	Warnings bits 1	0 ... 65535	-	-	U16	r	Active warnings described bit per bit; for the meaning see below

No.	Designation	Range	Unit	Default	Format	r/w	Description
303	Pump status word	-	-	-	U16	r	Meaning of the bits: Bit 0 = 1 Normal operation Bit 1 = 1 Ready for switch on Bit 2 = 1 Speed is increasing Bit 3 = 1 Speed is dropping Bit 4 = 1 Generator operation Bit 5 = 1 Stand-by In case of an error P303 has the value of 0 (not ready to be switched on)
312	Cat. No. code	0 ... 2^{31}-1	-	-	U32	r	Abbreviated description of the Cat. No. of the pump or of the converter Examples: 800072V1003 = 721003 830070V0101 = 300700101
315	Serial No. code	1 ... 2^{31}-1	-	-	U32	r	The 9 least significant bits of the original serial No.
316	Hardware identifier	0...100	-	-	U16	r	Hardware version index of the converter

3.2.5 Warning codes for parameter 227

Bit	Bit 15 **binary value** Bit 0 ← MSB ... LSB →	**Hexadecimal value**	**Decimal value**	**Designation**	**Condition / description of the warning**
0	0000 0000 0000 0001	0001	1	Motor temperature warning	P7 > P16
1	0000 0000 0000 0010	0002	2	Converter temperature warning	P11 > 70 °C
2	0000 0000 0000 0100	0004	4	Bearing temperature warning	P125 > P126 or P127 > P126
3	0000 0000 0000 1000	0008	8	Bearing temperature warning	P127 > P126 or P125 > P126
4	0000 0000 0001 0000	0010	16	not used	-
5	0000 0000 0010 0000	0020	32	not used	-
6	0000 0000 0100 0000	0040	64	Overspeed warning	P3 > (P24 + 10 Hz)
7	0000 0000 1000 0000	0080	128	not used	-
8	0000 0001 0000 0000	0100	256	High load warning	P5 > (P17 * P21) effective P32 seconds after the start and if P21 < 100%
9	0000 0010 0000 0000	0200	512	not used	-
10	0000 0100 0000 0000	0400	1024	Switch-off threshold exceeded; can only be reset by the Oerlikon Leybold Vacuum Service	P125 > P132 or P127 > P132
11	0000 1000 0000 0000	0800	2048	Overload warning	P3 < P25 * P24
12	0001 0000 0000 0000	1000	4096	not used	-
13	0010 0000 0000 0000	2000	8192	not used	-
14	0100 0000 0000 0000	4000	16384	Power supply warning	P4 > P805 or P4 < P806
15	1000 0000 0000 0000	8000	32768	not used	-

3.2.6 Error codes for parameter P171

Code	Type of error	Condition / Description of the error	Pump switched off
0	No error	–	no
1	Overspeed error	Nominal speed of the pump (P 18) has been exceeded by over 10%	no
2	Pass through time error	Max. time for passing through the critical frequencies of 60 Hz to P20 has been exceeded: 60 Hz < P3 < P20 after P183 has elapsed with the start signal present	yes
3	Bearing temperature error	Maximum bearing temperature has been exceeded: P125 > P132 or P127 > P132	yes
4	Short circuit error	Short circuit in the pump's motor or the connecting cable	yes
5	Converter temperature error	Maximum temperature for the converter has been exceeded: P11 > 85°C	yes
6	Run up time error	Max. time after which the pump must enter its normal operation mode has been exceeded: P3 < P24 x P25 after P32 has elapsed with the start signal present	yes
7	Motor temperature error	Maximum motor temperature has been exceeded: P7 > P133	yes
8	Pump error	Pump could not be identified or no pump is connected.	yes
60	Short circuit error	Short circuit in the pump's motor	yes
61	Bearing temperature warning	Bearing temperature warning threshold has been exceeded: P125 > P126 or P127 > P128	no
62	Bearing temperature warning	Bearing temperature warning threshold has been exceeded: P127 > P126 or P125 > P128	no
101	Overload warning	The frequency has dropped below the normal operation frequency by high load: P3 < P25 * 24 (after normal operation has been reached)	no
103	Power supply error	No power supply during active operation of the pump	no
106	Overload error	Upper critical limit frequency has been exceeded by overload (P3 < P20 after P32 from start after run-up)	yes
116	Permanent overload error	Max. overload time has been exceeded: P3 < P25* P24 for longer than P32	yes
117	Motor current error	No motor current or motor current too low (I_{set} > 1 A and P5 < 0.2 A)	yes
118	Motor connection error	Error in the motor connection cable	yes
125	High load warning	Max. permissible permanent current has been exceeded: P5 > P17 * P21 for longer than P32 from start after run-up	no
126	Bearing temperature sensor error	Error at the bearing temperature sensor (Resistance not in the plausible range; –20 °C < T < 150 °C)	yes
127	Bearing temperature sensor error	Error at the bearing temperature sensor (Resistance not in the plausible range; –20 °C < T < 150 °C)	yes
128	Motor temperature sensor error	Error at the motor temperature sensor (Resistance not in the plausible range; –20 °C < T < 150 °C)	yes

Code	Type of error	Condition / Description of the error	Pump switched off
131	Permanent high load error	Max. high load time has been exceeded: P5 > P17 * P21 for longer than 2 * P32	yes
143	Overspeed error	Pumping speed has been exceeded by more than 15 % (P3 > P18 x 1.15)	yes
144	Profibus address error	Wrong Profibus address set (must be 0 ... 126)	yes
145	Profibus error	Error during cyclic exchange of data over the Profibus, the watchdog timer has responded	yes
201	CPU error	Error in the micro computer	yes
202	PLL-synchronisation warning	Error in the pump's speed synchronisation wiring	no
203	Parameter value error	Parameter value internally not valid; data error	yes
205	Data plausibility error	Internal data error (open loop)	yes
207	Motor blocked error	Rotor blocked	yes
208	PLL error	PLL synchronisation error	yes
212	Shut down	Emergency off	
213	Overvoltage error	Power supply voltage too high (UZK > 80 V)	yes
214	Undervoltage error	Power supply voltage too low (level depends on pump)	yes
216	Memory test error	Error in external memory	yes
217	Pump identification resistor error	Wrong or missing pump identification resistor	yes
222	Hardware test error		yes
223 - 226	Logical unit error	Error in the programmed logigal unit	yes
227	Pump model can not be operated	No set of parameters defined for the recognized pump model	yes

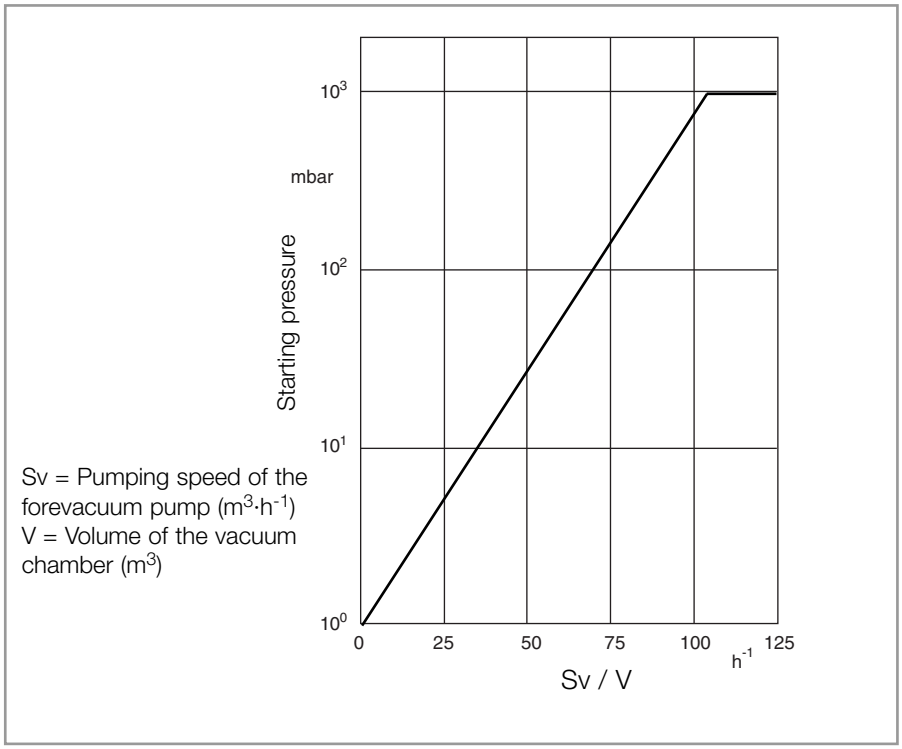


Fig. 3.6 Determining the starting pressure of a turbomolecular pump when evacuating large volumes

3.3 Switching on

Switch on the 59 V DC power supply. The yellow LED at the frequency converter lights up.

Starting pressure

The maximum starting pressure for the turbomolecular pump can be read from the graph in Fig. 3.6.

Switch on the turbomolecular pump at the frequency converter

- via pins 7 and 8 of the socket REMOTE (X1) (see Fig. 2.19) (For example via a remote control or with the aid of the plug with integrated ON/OFF switch: see Section 1.5 Accessories).
- by a start command via the interface; see Section 3.2.
- For the power supply units offered or recommended by Oerlikon Leybold Vacuum: If the contacts 7 and 8 at the REMOTE (X1) connector are closed the pump starts automatically when the DC voltage is switched on (provided parameter 12 is set to 0).

The turbomolecular pump accelerates. The green LED flashes. When the pump reaches normal operation the green LED lights up permanently.

Avoid the influences of shock and vibration when the pump is running.

Caution

Exposure of the pump to accelerating forces must be avoided or reduced to such an extent that the rotor unit will not be excited by vibrations. In the case of critical applications you must consult our Applications Dept. first.

During operation the pump can become so hot that there is a danger of burns (up to approx. 80°C, 176 °F).

Warning

After a mains power failure the pump can run up automatically once more.

3.4 Shutting down

Switch off the pump at the frequency converter.

- via contacts 7 and 8 of the socket REMOTE (X1), if parameter 12 = 0.
- apply a stop command via the interface, if parameter 12 = 1 or 2.
- for the power supply units offered or recommended by Oerlikon Leybold Vacuum switch off the DC voltage.

After switching off, the green status LED will flash until the rotor of the turbomolecular pump is at standstill. This may take several minutes. With the DC power supply off, the turbomolecular pump will act as a generator supplying the frequency converter with energy as indicated by the yellow power LED.

Generator operation

Switch off the forevacuum pump.

Venting

When using oil-sealed forevacuum pumps, vent the turbomolecular pump before it comes to a stop; refer to Section 3.5.

When using TRIVAC pumps the built-in anti-suckback valve will close automatically, shutting off the forevacuum line. In forevacuum pumps without a vacuum retention valve, close the valve in the forevacuum line.

When the system is not operating, ensure that neither ambient air nor cleaning media can enter the pump.

If a failure occurs the turbomolecular pump will be shut down automatically. The red LED at the frequency converter lights up.

Emergency shut down

In the case of an emergency shut down, the pump is switched off as described above. The rotor of the turbomolecular pump may be stopped faster by venting the pump.

Under vacuum conditions the pump may take up to one hour to run down, when venting to atmospheric pressure it may take up to one minute. During the time the pump is running down, the green LED at the frequency converter will flash, indicating that the rotor has not yet arrived at standstill.

Warning

When shutting down by **switching off the power supply voltage**, there will be only enough power for the LEDs down to a speed of the pump of approximately 200 Hz. Thus the pump may still turn without a LED being on. For this reason, when switching off without venting, wait for approximately 15 minutes after the LEDs have turned off until the pump has arrived at standstill.

Warning

Unplug any connectors only when the mains voltage is switched off **and** the pump does no longer turn (the green LED is off).

3.5 Venting

Refer to Section 3.1 for suited gases.

Venting Methods

There are three different methods of venting the turbomolecular pump.

In the case processes requiring a purge gas, the pump must be vented via the **purge gas and venting valve** when shutting the pump down.

When additionally venting the vacuum chamber, the venting function of the purge gas and venting valve must be opened before opening the chamber valve. This will ensure the presence of a higher pressure in the area of the ball bearings compared to the remaining vacuum area. This will prevent particles, dust or aggressive gases from being forced through the bearings into the not yet vented motor chamber of the pump.

Cautious venting of the pump is possible from the **high vacuum side**, since here the bearing forces will be lowest. When doing so, no free jet of gas must be allowed to form on the rotor so as to avoid exposing the rotor to additional forces.

When venting the pump through its **foreline connection**, neither oil nor particles may be entrained in the gas flow from the forevacuum side into the pump.

Speed of the Pressure Rise

Speed
Pressure rise curve

All turbomolecular pumps may be vented at full speed. However, the pressure must not increase faster than specified through the pressure rise curve.

Particles

The pump must be vented significantly slower when there is the risk of particles entering into the pump from the process. During venting, the flow must be of the laminar type in both the vacuum chamber and the turbomolecular pump.

The speed of the pressure rise during venting of the running pump will greatly influence the load on the rotor/stator pack and the bearings. The slower the pump is vented, the longer the service life of the bearings will be.

The pump must not be vented to pressures above atmospheric pressure.

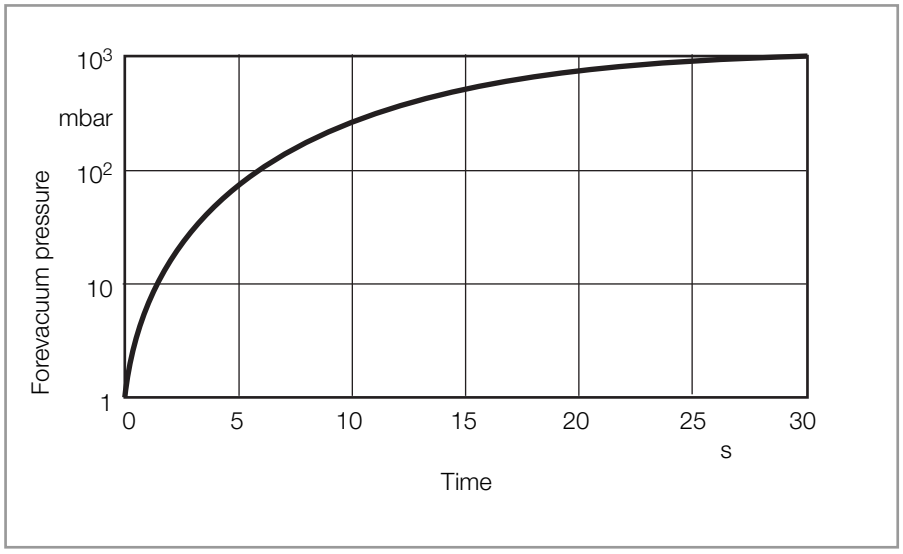


Fig. 3.7 Maximum rise in pressure

3.6 Bakeout

For TURBOVACs with CF flange

If pressures in the range of 10^{-8} mbar or below are to be developed, the vacuum chamber and the components installed therein will have to be baked out. In addition, the TURBOVAC can be baked out using the flange heater provided for this purpose.

Protect the rotor against intensive, direct heat radiation. The high vacuum flange must not be heated to more than 100 °C (212 °F). When baking out at the forevacuum side – at a sorption trap, for example – ensure that the components attached direct are not heated to more than 100 °C (212 °F).

The forevacuum pump must be in operation so as to eliminate the vapors liberated at the sorption trap.

3.7 Changing the start delay time

Generally it will make sense to let the turbomolecular pump run up immediately after applying the start command. However when operating two or more turbomolecular pumps off a single power supply unit, it may make sense to start the pumps one after the other. One way of achieving this is to enter a start delay time differing from 0.

To set up the start delay time proceed as follows:

With the aid of a Windows PC and the PC software “TURBO. DRIVE Server” change the setting for the parameter 36 “Start delay time”.

So as to retain the value saved for parameter 36 when switching the pump off, the parameter value needs to be saved permanently. For this enter any value (for example 1) for parameter 8. Thereafter changed parameters will be saved permanently.

After replacing the pump or when switching on the supply voltage without a connected pump, all changed parameter values will be reset to factory defaults.

For special applications further parameters can be changed. Please ask us.

3.8 Removing the pump from the system

Shut down the pump and vent as described in Sections 3.4 and 3.5.

Warning

If the pump has previously handled hazardous gases, implement the proper precautionary measures before opening the intake or exhaust connection.

If necessary, use gloves, a respirator and/or protective clothing and work under an exhaust hood.

Disconnect the pump only when it has come to a full stop. The green LED at the frequency converter must have gone out.

Then switch the mains power off and wait until the yellow power LED is off. Then only disconnect any cable connections.

Hazardous gases

Deposits

The pumps may be contaminated with process gases. These gases may be toxic and hazardous to health. In addition, deposits with similarly dangerous properties may have formed. Many of these gases and deposits form acids when they come into contact with humid air. This will result in serious corrosion damage to the pump.

Desiccant

To avoid health hazards and corrosion damage when the pumps are detached from the system, fasten a container of desiccant under the transport cover of the high-vacuum connection and then close the pump immediately at all flange connections. Store the pump, with a desiccant, in an airtight PE bag.

Corrosion damage due to faulty packing will nullify the guarantee.

Pack the pump so that it cannot be damaged during shipping and storage. Pay particular attention to protection for the flanges and the electrical plug.

Observe the instructions in Section 4.2 if you forward the pump to Oerlikon Leybold Vacuum.

4 Maintenance

After 20,000 operating hours at the latest a standard bearing exchange will be required. This can only be done by Oerlikon Leybold Vacuum Service.

The rotor has to be changed at the latest
- after **50,000 hours of operation** or
- after **10,000 starts/ stops** or cycles .

This can only be done by Oerlikon Leybold Vacuum Service.

Warning

Due to high-speed and temperature, the service life of the rotor is limited. If the rotor is changed too late, it may be destroyed. Thus in the flange mounts high forces and torque conditions can occur. The mounting screws for the pump may be torn off or sudden twisting of the entire pump can be experienced.

At high pump loads - for example during cyclic operation, at high gas throughputs or at high ambient temperatures - the aforementioned maintenance work should be carried forward.

When an adsorption trap is used, regenerate or renew the adsorption agent regularly; refer to the operating instructions provided with the trap.

The frequency converter is maintenance free.

4.1 Cleaning

If required clean the turbomolecular pump of dust with a dry cloth.

4.2 Oerlikon Leybold Vacuum Service

Whenever you send us in equipment, indicate whether the equipment is contaminated or is free of substances which could pose a health hazard. If it is contaminated, specify exactly which substances are involved. You must use the form we have prepared for this purpose.

Contamination

A copy of the form has been reproduced at the end of these Operating Instructions: “Declaration of Contamination for Compressors, Vacuum Pumps and Components”. Another suitable form is available from www.oerlikon.com → Oerlikon Leybold Vacuum → Documentation → Download Documents.

Form

Attach the form to the equipment or enclose it with the equipment.

This statement detailing the type of contamination is required to satisfy legal requirements and for the protection of our employees.

We must return to the sender any equipment which is not accompanied by a contamination statement.

5 Troubleshooting

Warning

When the connector cable is attached, the outputs at the frequency converter are not free of voltage.

Before you start searching for the source of the problem, you should carry out a few simple checks:

Are the connections in good working order?

- Power supply - mains,
- DC power supply to the frequency converter,
- Connector cable between the frequency converter and the pump.

Is the forevacuum pressure sufficient?

After having removed the cause for the error reset the error message at the TURBO.DRIVE:

- In case of errors with error codes 1 to 7 by applying a STOP signal via the socket REMOTE (X1) or a reset sequence via the serial interface or by switching the mains power off.
- In case of error code 8 by switching the mains power off.

The error codes can only be read if a serial interface is present.

The following table has been provided as a guide when determining the causes of errors.

To remove possible faults, staff having different qualifications is required:

- **Operator** of the system
- Qualified **maintenance staff** of the system operator or qualified staff from the vendor erecting the system
- Staff from **Oerlikon Leybold Vacuum (OLV)**

In some cases also a combination of the above will be needed, for example, check by the operator, rectification of the fault by maintenance staff.

Malfunction	Possible cause	Corrective action	Responsible
Red ERROR LED is on: Error code1: Overspeed error	EMC influence	Check connecting cable, insert it properly Switch the power supply voltage off and then on again	Operator/ maintenance staff Operator
	TURBO.DRIVE faulty	Replace frequency converter.	Maintenance staff/ OLV service
Red ERROR LED is on: Error code 2 + 6: pass through timer error and run up time error ■ Pump runs up too slowly ■ Pump looses its speed	Forevacuum or high-vacuum pressure too high.	Check the forevacuum pump and use a different forevacuum pump if necessary.	Operator/ maintenance staff
	Gas volume too great.	Seal leak; install a higher-capacity vacuum pump if necessary.	Maintenance staff
	Power supply overloaded	Reduce the number of consumers or use a stronger power supply or switch on the consumers one after the other.	Operator/ maintenance staff
	Bearing defective.	Repair the pump.	OLV service
Red ERROR LED is on: Error code 3 + 7: bearing temperature error and motor temperature error	Forevacuum pressure too high.	Check the forevacuum pump and use a different forevacuum pump if necessary.	Operator/ maintenance staff
	Gas volume too great or leak in the system.	Seal leak; install a higher-capacity vacuum pump if necessary.	Maintenance staff
	Fan defective.	Replace the fan.	OLV service
	Ambient temperature too high.	Feed cooler air to the pump or install water cooling.	Maintenance staff
	Bearing defective.	Repair the pump.	OLV service
Red ERROR LED is on: Error code 4: Short circuit error	Short circuit in the pump's motor	Repair the pump.	OLV service
	Short circuit in the connecting cable	Check to see if the connecting cable is undamaged, exchange it if required.	Operator/ maintenance staff
Red ERROR LED is on: Error code 5: converter temperature error	Inadequate cooling of the pump; operation at too high loads	See error code 3 + 7.	–
	Ambient temperatures too high. Inadequate cooling of the TURBO.DRIVE	Improve the cooling situation: E.g. avoid exposure to the heat generated by other equipment.	Maintenance staff
Red ERROR LED is on: Error code 8: pump error TURBO.DRIVE can not detect the type of connected pump.	Pump not connected to TURBO.DRIVE	Check connecting cable	Operator
	Power supply builds up the DC too slowly	Use power supply recommended by Oerlikon Leybold Vacuum	Maintenance staff
	Power supply overloaded	Reduce the number of consumers when switching on or use a stronger power supply.	Operator/ maintenance staff

Troubleshooting

Malfunction	Possible cause	Corrective action	Responsible
Yellow power LED is not on.	No DC power	Check cables and power supply.	Operator/ maintenance staff
	DC power miswired.	Ensure correct polarity of the DC cable.	Maintenance staff
	Frequency converter defective.	Replace frequency converter. The following may damage the frequency converter: ■ Disconnection of the DC cable while the pump was still rotating ■ Non-compliance with the note related to connecting several pump to a single power supply.	Maintenance staff/ OLV service
Red LED flashes.	Warning message. See Section “3.2.5 Warning codes” for the possible reasons of the warning.	The pump can continue to run, as long as operation limits are only exceeded for a short time. In case of longer exceeding send pump and frequency converter to the OLV Service.	Operator/ OLV service
Yellow LED flashes.	Warning message: Supply voltage too low or too high.	The pump can continue to run. Check the reason for wrong voltage and eliminate the fault.	Operator/ maintenance staff
Turbomolecular pump does not start, ERROR LED does not light.	Operation mode set wrongly, e. g. with TURBO.DRIVE Server.	Change parameter 12.	Operator/ Maintenance staff
	Interface protocol error	Use USS protocol.	Operator/ Maintenance staff
	No communication via the serial interface.	Connect bus as shown in Section 3.2.	Maintenance staff
	REMOTE connector (X1) connected wrongly.	Connect as shown in Fig. 2.19.	Maintenance staff
	Wrong Profibus address set.	Set address between 0 and 126	Operator/ Maintenance staff
Turbomolecular pump produces loud running noises and vibrations.	Rotor out of balance.	Balance the rotor.	OLV service
	Bearing defective.	Replace the bearing.	OLV service
Turbomolecular pump does not reach ultimate pressure.	Measurement instrument defective.	Inspect the measurement sensor.	Operator/ Maintenance staff
	Measurement sensors soiled.	Clean or replace the sensors.	Maintenance staff
	Leaks at the equipment, lines or the pump.	Check for leaks.	Maintenance staff
	Pump soiled.	Clean the pump.	OLV service
	Forevacuum pump provides insufficient pumping speed or ultimate pressure which is too high.	Check the ultimate pressure of the forevacuum pump and install a higher-capacity vacuum pump if necessary.	Operator/ maintenance staff
	Frequency parameters programmed wrongly.	Check parameters.	Operator/ Maintenance staff
Green LED blinks, yellow LED lights up weakly.	Frequency converter defective.	Wait for pump standstill (several minutes), then switch off the power supply for 5 seconds and switch it on again.	Operator
Running pump can not be stopped via X1.	Pump has been started via theserial interface, the interface controls the pump.	Disconnect the DC supply or connect serial interface and stop via bus. Check parameter 12.	Operator/ Maintenance staff

6 Waste disposal

The equipment may have been contaminated by the process or by environmental influences. In this case the equipment must be decontaminated in accordance with the relevant regulations. We offer this service at fixed prices. Further details are available on request.

Contamination

Contaminated parts can be detrimental to health and environment. Before beginning with any work , first find out whether any parts are contaminated. Adhere to the relevant regulations and take the necessary precautions when handling contaminated parts.

Warning

Separate clean components according to their materials, and dispose of these accordingly. We offer this service. Further details are available on request.

When sending us any equipment, observe the regulations given in Section “4.2 Oerlikon Leybold Vacuum service”.

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EC Manufacturer's Declaration

in the spirit of Appendix IIb to the 98/37/EG Machinery Guidelines

We - Oerlikon Leybold Vacuum GmbH - herewith declare that operation of the incomplete machine defined below, is not permissible until it has been determined that the machine into which this incomplete machine is to be installed, meets the regulations of the EEC Directive on Machinery.

When using the appropriate Oerlikon Leybold Vacuum accessories, e.g. connector lines and when powering the pump with the specified frequency converters, the protection level prescribed in the EMC Guidelines will be attained.

Designation of the products: Turbomolecular pump with integrated or external frequency converter

Model: **TURBOVAC SL 700**

Part Nos.: 800051V3xxx

Related, harmonized standards

- EN 1012 - 2: 1996 Compressors and vacuum pumps. Safety requirements. Part 2: Vacuum pumps

Cologne, 6.08.08

Dr. Ulrich Jung
Vice-President
Head of Product Development

Cologne, 5.8.08

i.A.

Harald Udelhoven
Head of Quality Management

Oerlikon Leybold Vacuum GmbH
Bonner Strasse 498
D-50968 Cologne
Phone: +49-221-347 0
Fax: +49-221-347 1250
documentation.vacuum@oerlikon.com

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CE

EC Conformance Declaration

We, the Oerlikon Leybold Vacuum GmbH, declare herewith that the products listed below, in the embodiment which we have placed on the market, comply with the applicable EC guidelines.

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

Maintaining the EMC guideline assumes an EMC adapted installation of component within the plant or machine.

Designation of the products: Turbomolecular pump with integrated or external frequency converter

Model: **TURBOVAC SL 700**

Part Nos.: 800051V3xxx

The products comply to the following guidelines

- EC Low-Voltage Equipment Guidelines (2006/95/EG)
- EC Directive on Electromagnetic Compatibility (2004/108/EG)

Related, harmonized standards

- EN 61010-1: 2001 Safety requirements for electrical equipment for measurement, control and laboratory use - Part 1: General requirements
- EN 61326-1: 2006 Electrical equipment for measurement, control, and laboratory use - EMC requirements

Cologne, 1.08.08

Dr. Ulrich Jung
Vice-President
Head of Product Development

Cologne,

i.A.

Harald Udelhoven
Head of Quality Management

Oerlikon Leybold Vacuum GmbH
Bonner Strasse 498
D-50968 Cologne
Phone: +49-221-347 0
Fax: +49-221-347 1250
documentation.vacuum@oerlikon.com

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Declaration of Contamination of Compressors, Vacuum Pumps and Components

The repair and / or servicing of compressors, vacuum pumps and components will be carried out only if a correctly completed declaration has been submitted. **Non-completion will result in delay**. The manufacturer can refuse to accept any equipment without a declaration.

A separate declaration has to be completed for each single component.

This declaration may be completed and signed only by authorised and qualified staff.

Customer/Dep./Institute: _____

_____

Address _____

_____

Person to contact: _____

Phone: _____ Fax: _____

End user: _____

Reason for return ☒ **applicable please mark**

❑ **Repair** ❑ chargeable ❑ warranty

❑ **Exchange** ❑ chargeable ❑ warranty

❑ exchange already arranged / received

Return only: ❑ rent ❑ loan ❑ for credit

Calibration: ❑ DKD ❑ Factory calibration

❑ Quality test certificate DIN 55350-18-4.2.1

A. Description of the Leybold product

Material description: _____

Catalog number: _____

Serial number: _____

Type of oil (Forevacuum pumps): _____

Failure description: _____

_____

Additional parts: _____

Application Tool: _____

Application Process: _____

B. Condition of the equipment

	No[1)]	Yes	No
1. Has the equipment been used[1)]	❑	❑ →	
2. Drained (Product/service fluid)	↓	❑	❑
3. All openings sealed airtight		❑	
4. Purged		❑	❑

If yes which cleaning agent: _____

and which method of cleaning: _____

[1)] if answered with "No" go to **D**. ←

Contamination:	No[1)]	Yes
toxic	❑	❑
corrosive	❑	❑
flammable	❑	❑
explosive[2)]	❑	❑
radioactive[2)]	❑	❑
microbiological[2)]	❑	❑
other harmful substances	❑	❑

↓

C. Description of processed substances (Please fill in absolutely)

1. What substances have come into contact with the equipment:
Trade name and / or chemical term of service fluids and substances processed, properties of the substances; According to safety data sheet (e.g. toxic, inflammable, corrosive, radioactive)

Tradename: Chemical name:

a) _____

b) _____

c) _____

d) _____

	No	Yes
2. Are these substances harmful?	❑	❑ ←
3. Dangerous decomposition products when heated?	❑	❑

If yes, which? _____

[2)] Components contaminated by microbiological, explosive or radioactive products/substances will not be accepted without written evidence of decontamination.

D. Legally binding declaration

I / we hereby declare that the information supplied on this form is accurate and sufficient to judge any contamination level.

Name of authorised person (block letters): _____

Date _____ Signatur of authorised person _____

firm stamp

Index

Sales and Service

Germany

Oerlikon
Leybold Vacuum GmbH
Bonner Strasse 498
D-50968 Cologne
Phone: +49-(0)221-347 1234
Fax: +49-(0)221-347 1245
sales.vacuum@oerlikon.com
www.oerlikon.com

Oerlikon
Leybold Vacuum GmbH
Sales Area North/Northeast
Branch Office Berlin
Industriestrasse 10b
D-12099 Berlin
Phone: +49-(0)30-435 609 0
Fax: +49-(0)30-435 609 10
sales.vacuum.bn@oerlikon.com

Oerlikon
Leybold Vacuum GmbH
Sales Area South/Southwest
Branch Office Munich
Sendlinger Strasse 7
D-80331 Munich
Phone: +49-(0)89-357 33 9-10
Fax: +49-(0)89-357 33 9-33
sales.vacuum.mn@oerlikon.com
service.vacuum.mn
@oerlikon.com

Oerlikon
Leybold Vacuum GmbH
Sales Area West & Benelux
Branch Office Cologne
Bonner Strasse 498
D-50968 Cologne
Phone: +49-(0)221-347 1270
Fax: +49-(0)221-347 1291
sales.vacuum.kn@oerlikon.com

Oerlikon
Leybold Vacuum GmbH
Service Competence Center
Emil-Hoffmann-Strasse 43
D-50996 Cologne-Suerth
Phone: +49-(0)221-347 1439
Fax: +49-(0)221-347 1945
service.vacuum.kn@oerlikon.com

Oerlikon
Leybold Vacuum GmbH
Mobil Customer Service
Emil-Hoffmann-Strasse 43
D-50996 Cologne-Suerth
Phone: +49-(0)221-347 1765
Fax: +49-(0)221-347 1944
service.vacuum.kn@oerlikon.com

Oerlikon
Leybold Vacuum
Dresden GmbH
Zur Wetterwarte 50, Haus 304
D-01109 Dresden
Service:
Phone: +49-(0)351-88 55 00
Fax: +49-(0)351-88 55 041
info.vacuum.dr@oerlikon.com

Europe

Belgium

Oerlikon
Leybold Vacuum Nederland B.V.
Belgisch bijkantoor
Leuvensesteenweg 542-9A
B-1930 Zaventem
Sales:
Phone: +32-2-711 00 83
Fax: +32-2-720 83 38
sales.vacuum.zv@oerlikon.com
Service:
Phone: +32-2-711 00 82
Fax: +32-2-720 83 38
service.vacuum.zv@oerlikon.com

France

Oerlikon
Leybold Vacuum France S.A.
7, Avenue du Québec
Z.A. Courtaboeuf 1 - B.P. 42
F-91942 Courtaboeuf Cedex
Sales and Service:
Phone: +33-1-69 82 48 00
Fax: +33-1-69 07 57 38
sales.vacuum.or@oerlikon.com

Oerlikon
Leybold Vacuum France S.A.
Valence Factory
640, Rue A. Bergès - B.P. 107
F-26501 Bourg-lès-Valence Cedex
Phone: +33-4-75 82 33 00
Fax: +33-4-75 82 92 69
info.vacuum.vc@oerlikon.com

Great Britain

Oerlikon
Leybold Vacuum UK Ltd.
Unit 2
Silverglade Business Park
Leatherhead Road
UK-Chessington, Surrey KT9 2QL
Sales:
Phone: +44-13-7273 7300
Fax: +44-13-7273 7301
sales.vacuum.ln@oerlikon.com
Service:
Phone: +44-20-8971 7030
Fax: +44-20-8971 7003
service.vacuum.ln@oerlikon.com

Italy

Oerlikon
Leybold Vacuum Italia S.p.A.
8, Via Trasimeno
I-20128 Milano
Sales:
Phone: +39-02-27 22 31
Fax: +39-02-27 20 96 41
sales.vacuum.mi@oerlikon.com
Service:
Phone: +39-02-27 22 31
Fax: +39-02-27 22 32 17
service.vacuum.mi@oerlikon.com

Netherlands

Oerlikon
Leybold Vacuum Nederland B.V.
Proostwetering 24N
NL-3543 AE Utrecht
Sales and Service:
Phone: +31-(30) 242 6330
Fax: +31-(30) 242 6331
sales.vacuum.ut@oerlikon.com
service.vacuum.ut@oerlikon.com

Spain

Oerlikon
Leybold Vacuum Spain, S.A.
C/. Huelva, 7
E-08940 Cornellà de Llobregat
(Barcelona)
Sales:
Phone: +34-93-666 46 16
Fax: +34-93-666 43 70
sales.vacuum.ba@oerlikon.com
Service:
Phone: +34-93-666 49 51
Fax: +34-93-685 40 10
service.vacuum.ba@oerlikon.com

Sweden

Oerlikon
Leybold Vacuum Scandinavia AB
Box 9084
SE-40092 Göteborg
Sales and Service:
Phone: +46-31-68 84 70
Fax: +46-31-68 39 39
info.vacuum.gt@oerlikon.com
Visiting/delivery address:
Datavägen 57B
SE-43632 Askim

Switzerland

Oerlikon
Leybold Vacuum Schweiz AG
Leutschenbachstrasse 55
CH-8050 Zürich
Sales:
Phone: +41-44-308 40 50
Fax: +41-44-302 43 73
sales.vacuum.zh@oerlikon.com
Service:
Phone: +41-44-308 40 62
Fax: +41-44-308 40 60
service.vacuum.zh@oerlikon.com

America

USA

Oerlikon
Leybold Vacuum USA Inc.
5700 Mellon Road
USA-Export, PA 15632
Phone: +1-724-327-5700
Fax: +1-724-325-3577
info.vacuum.ex@oerlikon.com
Sales:
Eastern & Central time zones
Phone: +1-724-327-5700
Fax: +1-724-333-1217
Pacific, Mountain, Alaskan &
Hawaiian time zones
Phone: +1-480-752-9191
Fax: +1-480-752-9494
Service:
Phone: +1-724-327-5700
Fax: +1-724-325-3577

Latin America

Oerlikon
Leybold Vacuum USA Inc.
Brazilian Office
Av. Dória 360 cj. 12 Campo Belo
04635-070 São Paulo SP BRAZIL
Sales:
Phone: +55 11-3554 3117
Fax: +55 11-3554 3117
Nelson.Batistucci@oerlikon.com

Asia

P.R. China

Oerlikon
Leybold Vacuum (Tianjin)
International Trade Co. Ltd.
Beichen Economic
Development Area (BEDA),
No.8 Western Shuangchen Road
Tianjin 300400
China
Sales and Service:
Phone: +86-22-2697 0808
Fax: +86-22-2697 4061
Fax: +86-22-2697 2017
sales.vacuum.tj@oerlikon.com
service.vacuum.tj@oerlikon.com

Oerlikon
Leybold Vacuum
(Tianjin) Co. Ltd.
Beichen Economic
Development Area (BEDA),
No.8 Western Shuangchen Road
Tianjin 300400
China
Sales and Service:
Phone: +86-22-2697 0808
Fax: +86-22-2697 4061
Fax: +86-22-2697 2017
info.vacuum.tj@oerlikon.com
service.vacuum.tj@oerlikon.com

Oerlikon
Leybold Vacuum (Tianjin)
International Trade Co. Ltd.
Shanghai Branch:
Add: No.33
76 Futedong San Rd.
Waigaoqiao FTZ
Shanghai 200131
China
Sales and Service:
Phone: +86-21-5064-4666
Fax: +86-21-5064-4668
info.vacuum.sh@oerlikon.com
service.vacuum.tj@oerlikon.com

Oerlikon
Leybold Vacuum (Tianjin)
International Trade Co. Ltd.
Guangzhou Office and
Service Center
1st F, Main Building
Science City Plaza,
No.111 Science Revenue,
Guangzhou Science City
(GZSC) 510663, Guangzhou,
China
Sales:
Phone: +86-20-8723-7873
Phone: +86-20-8723-7597
Fax: +86-20-8723-7875
info.vacuum.gz@oerlikon.com
service.vacuum.tj@oerlikon.com

Oerlikon
Leybold Vacuum (Tianjin)
International Trade Co. Ltd.
Beijing Branch:
1-908, Beijing Landmark Towers
8 North Dongsanhuan Road
Chaoyang District
Beijing 100004
China
Sales:
Phone: +86-10-6590-7622
Fax: +86-10-6590-7607
sales.vacuum.bj@oerlikon.com

India

Oerlikon
Leybold Vacuum India Pvt Ltd.
EL-22, J Block
MIDC Bhosari
Pune 411026
India
Sales and Service:
Phone: +91-20-3061 60000
Fax: +91-20-2712 1571
sales.vacuum.pu@oerlikon.com
service.vacuum.pu@oerlikon.com

Japan

Oerlikon
Leybold Vacuum
Japan Co., Ltd.
Headquarter
23-3, Shin-Yokohama
3-chome
Tobu A.K. Bldg. 4th Floor
Kohoku-ku
Yokohama-shi 222-0033
Sales:
Phone: +81-45-471-3330
Fax: +81-45-471-3323
info.vacuum.yh@oerlikon.com
sales.vacuum.yh@oerlikon.com

Oerlikon
Leybold Vacuum
Japan Co., Ltd.
Osaka Sales Office
5-13, Kawagishi-machi
Suita-chi
Osaka 564-0037
Phone: +81-6-6393-5211
Fax: +81-6-6393-5215
info.vacuum.os@oerlikon.com
sales.vacuum.os@oerlikon.com

Oerlikon
Leybold Vacuum
Japan Co., Ltd.
Tsukuba Technical Service Center
Kogyo Danchi
21, Kasuminosato,
Ami-machi, Inashiki-gun
Ibaraki-ken, 300-0315
Service:
Phone: +81-298 89 2841
Fax: +81-298 89 2838
info.vacuum.iik@oerlikon.com
sales.vacuum.iik@oerlikon.com

Korea

Oerlikon
Leybold Vacuum Korea Ltd.
3F. Jellzone 2 Tower, 159-4
Jeongja-Dong, Bundang-Gu
Sungnam-Si, Gyeonggi-Do
Korea 463-384
Sales:
Phone: +82-31 785 1367
Fax: +82-31 785 1359

623-7, Upsung-Dong
Cheonan-Si
Chungcheongnam-Do
Korea 330-290
Service:
Phone: +82-41 589 3035
Fax: +82-41 588 0166

Singapore

Oerlikon
Leybold Vacuum
Singapore Pte Ltd.
1 Science Park Road
Singapore Science
Park 2
#02-12, Capricorn Building
Singapore 117528
Sales and Service:
Phone: +65-6303 7000
Fax: +65-6773 0039
sales.vacuum.sg@oerlikon.com
service.vacuum.sg@oerlikon.com

Taiwan

Oerlikon
Leybold Vacuum Taiwan Ltd.
No 416-1, Sec. 3
Chung-Hsin Rd., Chu-Tung
Hsin-Chu, Taiwan, R.O.C.
Sales and Service:
Phone: +886-3-500 1688
Fax: +886-3-583 3999
sales.vacuum.hc@oerlikon.com
service.vacuum.hc@oerlikon.com

Oerlikon
Leybold Vacuum USA Inc.
5700 Mellon Road
USA-Export, PA 15632
Phone: +1-724-327-5700
Fax: +1-724-325-3577
info.vacuum.ex@oerlikon.com

Oerlikon
Leybold Vacuum GmbH
Bonner Strasse 498
D-50968 Cologne
Phone: +49-(0)221-347 0
Fax: +49-(0)221-347 1250
info.vacuum@oerlikon.com

oerlikon
leybold vacuum

www.oerlikon.com

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