

# TURBOVAC SL 300

Wide-Range Turbomolecular Pump with  
Integrated or External Frequency Converter

Operating Instructions 130000761\_002\_A0

Part Nos.

800170V3005

800170V3006



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# Safety Information

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## Important Safety Information

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

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

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### Warning

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### Caution

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The Oerlikon Leybold Vacuum **TURBOVAC SL 300** 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.

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 respectively 3.55.

## Thermal hazards

During operation the pump can become so hot that there is a danger of burns ( $\geq 70\text{ °C}$ ,  $158\text{ °F}$ ).

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:**

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## 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 insufficient 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 threads.

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.

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## 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.

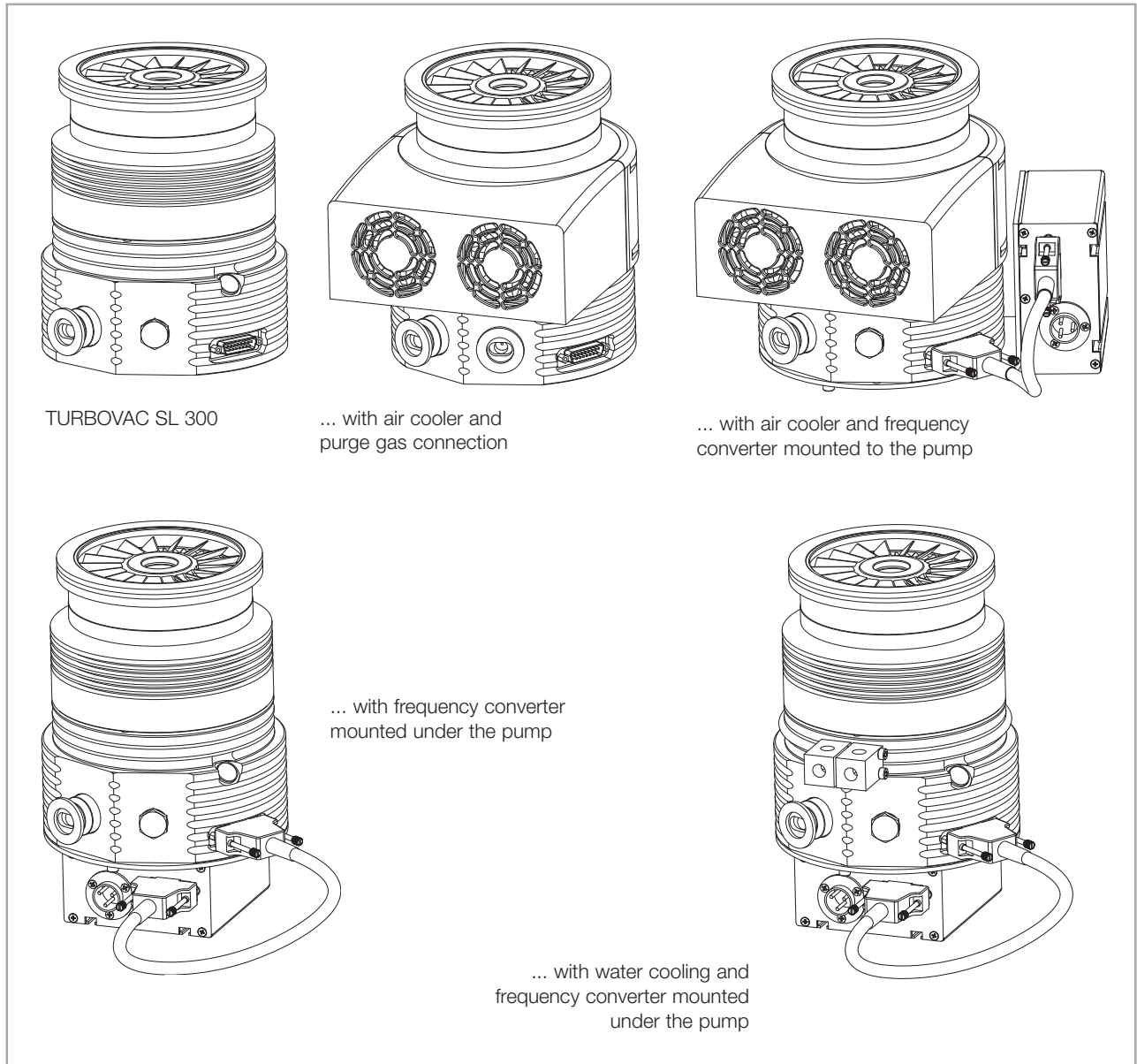


Fig. 1.1 Examples of SL 300

## 1 Description

The TURBOVAC SL 300 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 400 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 5 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.

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PE = Polyethylene

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



## 1.3 Technical data

### TURBOVAC

High-vacuum connection

### SL 300

DN 100 ISO-K / DN 100 CF

Pumping speed (without splinter guard) for

N <sub>2</sub>	270 l·s <sup>-1</sup>
Ar	260 l·s <sup>-1</sup>
He	255 l·s <sup>-1</sup>
H <sub>2</sub>	190 l·s <sup>-1</sup>

Ultimate pressure

with two-stage, oil-sealed rotary vane pump	< 10 <sup>-10</sup> mbar
with SCROLLVAC SC 30	< 8·10 <sup>-10</sup> mbar
with diaphragm pump	< 4·10 <sup>-9</sup> mbar

Max. permissible forevacuum pressure with N<sub>2</sub>  
water cooled

< 8 mbar

Weight

Pump with ISO-K flange	5.2 kg
with TURBO.DRIVE 400	5.8 kg
with TURBO.DRIVE 400 and air cooler	6.3 kg
with TURBO.DRIVE 400 and water cooling	6.1 kg
Pump with CF flange	7.4 kg

Recommended forevacuum pumps

TRIVAC	D 2,5 E
SCROLLVAC	SC 5 / SC 15
Diaphragm pump DIVAC	2.5 VT
(at purge gas operation) TRIVAC	D 8 B

Operating speed

60,000 min<sup>-1</sup>

Run-up time

approx. 4 min

Power consumption

at run-up	115 W
at ultimate pressure	18 W

Forevacuum connection

DN 16 KF

Purge gas connection

M8 or DN 16 KF

Type of protection

IP 20

Noise level

< 49 dB(A)

Ambient temperature

during operation, water cooled pump	+15 - + 35 °C
during operation, air cooled pump	+15 - + 30 °C
storage	-15 - + 70 °C

Max. rel. air humidity

95% (non-condensing)

Purge gas flow

12 sccm / 0,2 mbar l·s<sup>-1</sup>

Purge gas

Nitrogen, Argon or similar

# Description



## Option water cooling

Cooling water connections	G 1/8"
Cooling water data	see Section 2.6

## Option air cooling

Power consumption	6.2 W
Volume flow	80 m <sup>3</sup> /h

## TURBO.DRIVE 400

Supply voltage	24 V  (± 10%)
Residual ripple	< 3 %
Output	
Voltage	0 - 24 V 3~
Power	160 W
Frequency	0 - 1500 Hz
When operating a SL 300	
Nominal voltage	24 V 
Max. power consumption	190 W
Max. peak current, input side	8 A DC
Required power output from the power supply	≥ 200 W
Max. length of the DC cable (shielded)	
at 3 x 1.5 mm <sup>2</sup>	5 m
at 3 x 2.5 mm <sup>2</sup>	20 m
Relay output rating	42 V, 0.5 A
Ambient temperature	
during operation	5 - 45 °C
storage	- 15 - + 70 °C
Relative air humidity	5 to 85 % non condensing
Overvoltage category	II
Contamination grade	2
Temp. of the cooling surface	5 - 55 °C
For Part Nos. 800073V0004 /07	5 - 50 °C
Power consumption	≤ 20 W
Type of protection	IP 20
Weight, approx.	0.5 kg

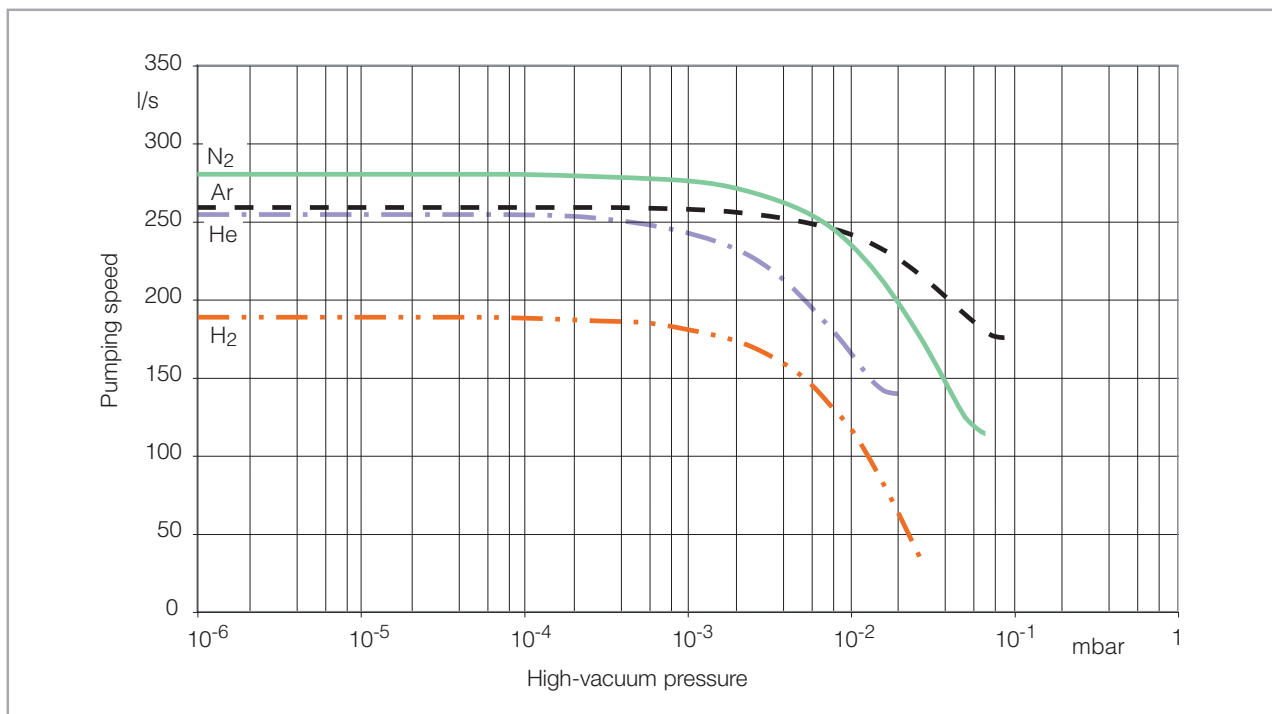


Fig. 1.2 Pumping speed curves of the SL 300

## Purge gas and venting valve

Part No.	113 50	800152V0019
Gas flow rate at 1 bar	0.2 mbar·l·s <sup>-1</sup> (12 sccm)	
Solenoid valves	2, normally closed	
Mains supply	24 V DC	230-100 V AC
Power consumption	4 W	6 W
Connection to pump	DN 10 KF	
Needed for this:		
Adapter M8 – DN10/16KF, P/N	800110V0011	
Including O-ring 9.25 x 1.78 and		
Adapter centering ring DN 10/16 KF with sinter filter		
Gas connection	G1/4-in.	
Recommended for this:		
Adapter with filter including O-ring and gasket	800110V0012	
Dimensions	60 x 65 x 45 mm	61 x 65 x 45 mm

# Description

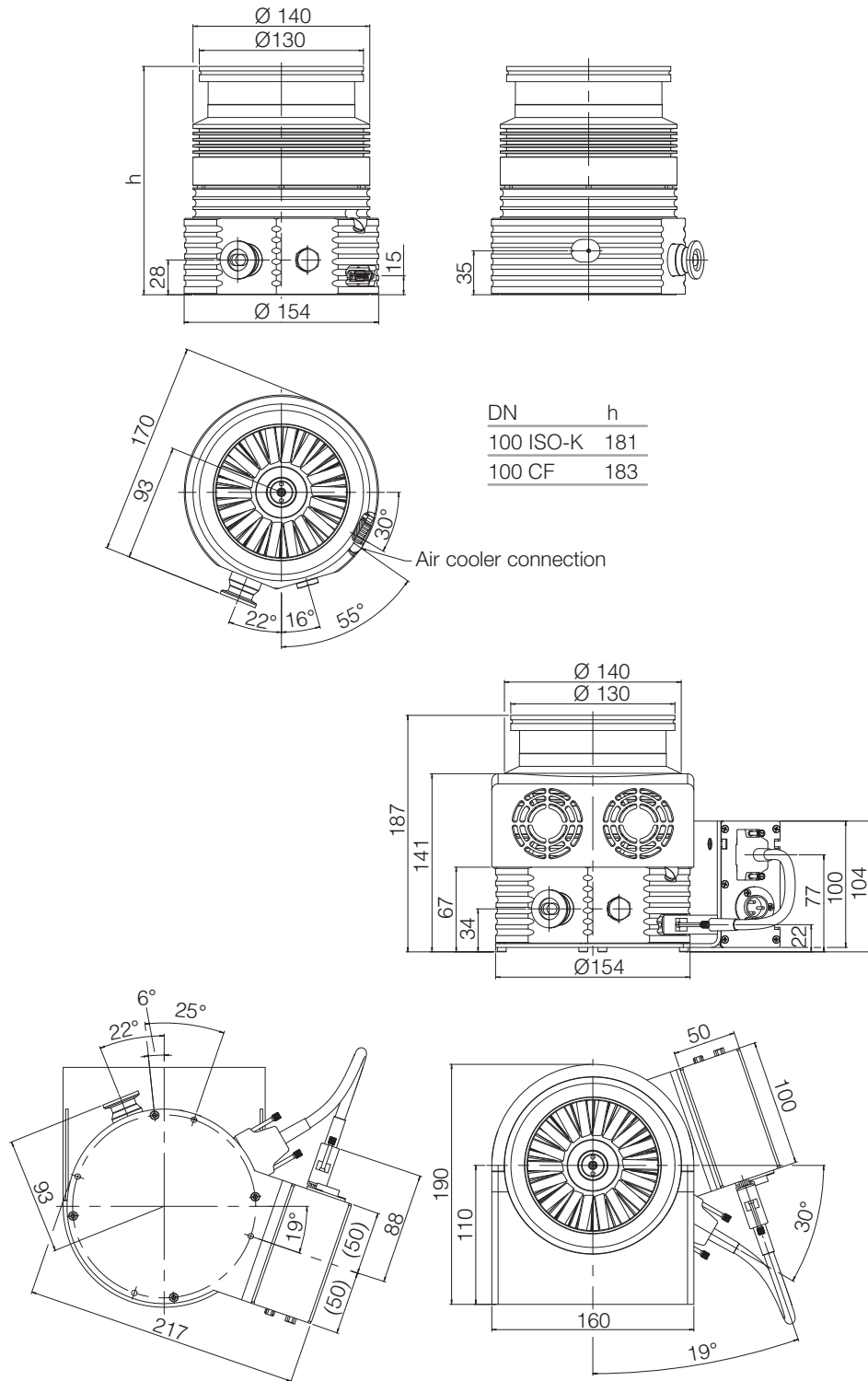


Fig. 1.3 Dimensional drawings for SL 300 pumps (combination examples); dimensions in mm

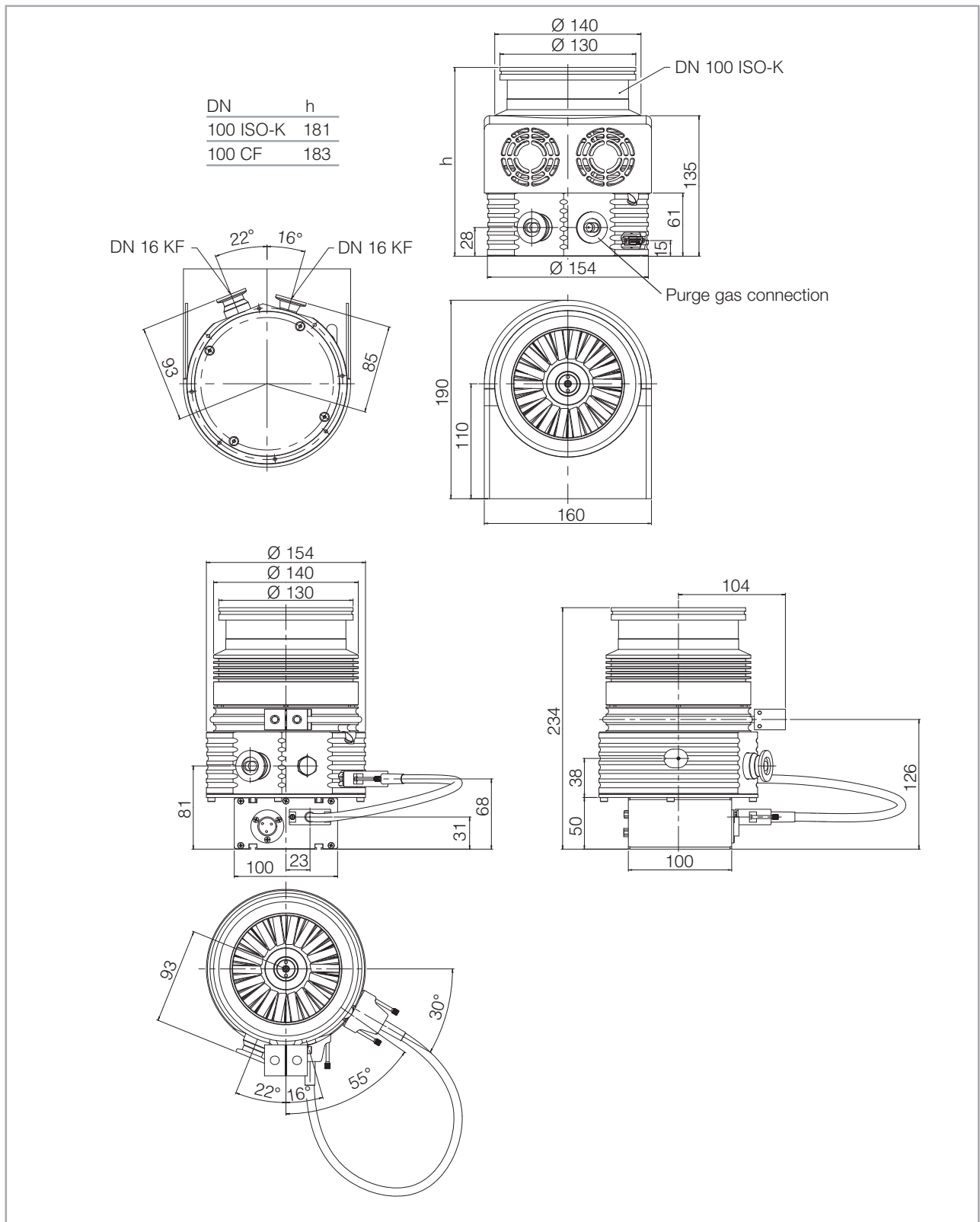


Fig. 1.4 Dimensional drawings for SL 300 pumps (combination examples); dimensions in mm

# Description

## 1.4 Ordering data

### TURBOVAC SL 300

High-vacuum flange DN 100 ISO-K

High-vacuum flange DN 100 CF

### Part No.

800170V3005

800170V3006

## 1.5 Accessories

### Frequency converter TURBO.DRIVE 400

with RS 232 C interface

with RS 485 C interface

with Profibus interface

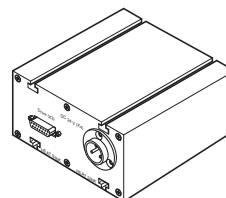
with Ethernet /IP interface

800073V0002

800073V0003

800073V0004

800073V0007



### Connecting cable pump - frequency converter

0.2 m long

800152V0021

0.3 m long

800152V0023

0.4 m long

800152V0022

1.0 m long

152 47

2.5 m long

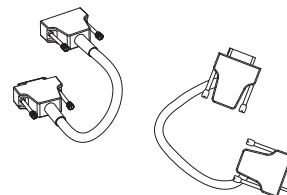
864 49

3.0 m long

864 40

5.0 m long

864 50



### Mounting kit TD 400 for TURBOVAC SL 300

Including 0.2 m long connection cable pump - frequency converter

For installing the frequency converter

... beside the pump

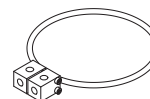
800110V0006

... underneath the pump

800110V0009

Water cooling with G 1/8"connections

800135V0002



### Accessories for water connections

Adapter G 1/8" — 1/4" tube

200 91 671 2x

Gasket

224 01 207 2x

Adapter G 1/8" — Hose nipple 10 mm

200 18 366 2x

Gasket

230 02 106 2x

Adapter G 1/8" — NPT 1/8"

200 12 742 2x

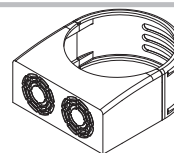
Gasket

238 20 110 2x

Air cooler

800136V0002

(is powered by the pump)



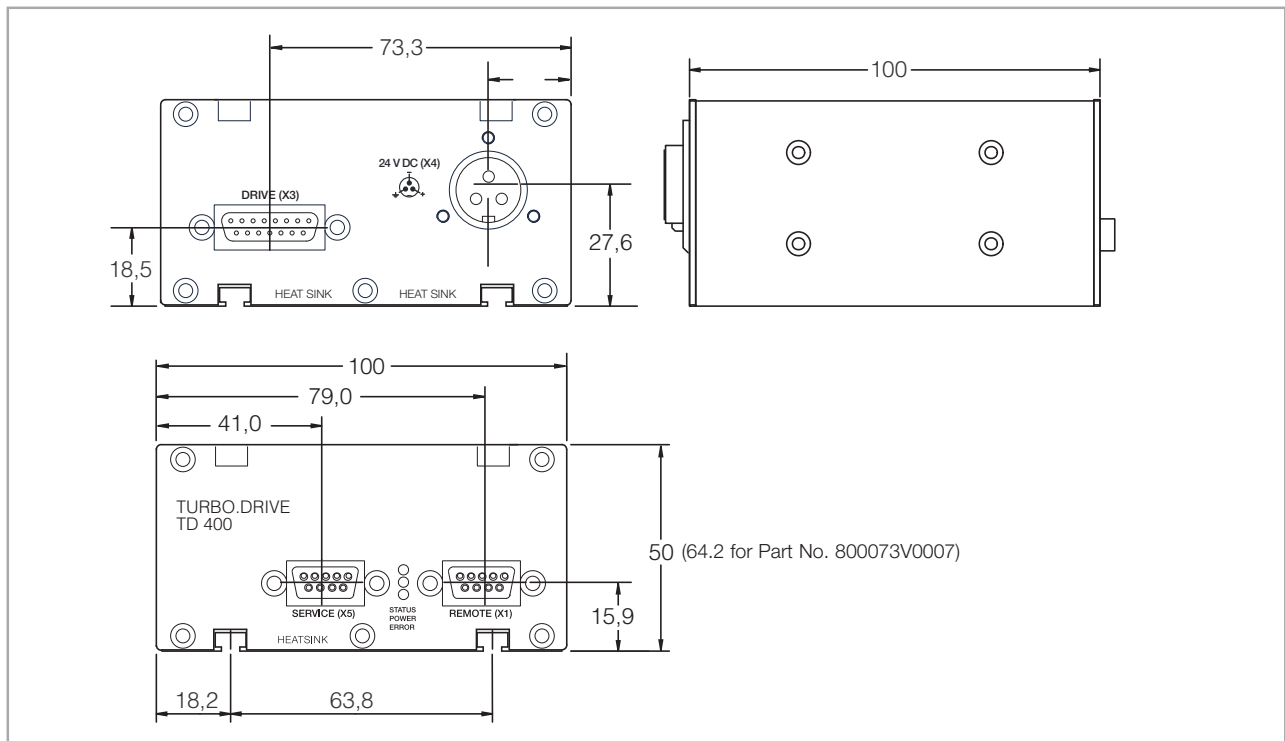


Fig. 1.5 Dimensional drawing for the frequency converter; dimensions in mm

## OEM power supply (with screw terminals)

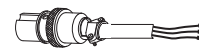
### SITOP 24 V / 10 A

152 50

- supplies the TURBO.DRIVE 400 with 24 V DC
- other power supplies on request

## 24 V DC cable (TURBO.DRIVE 400 – OEM power supply)

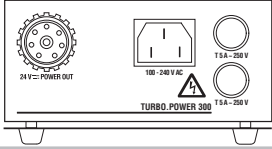
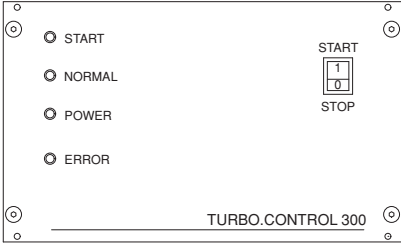
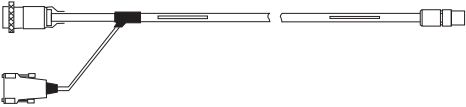

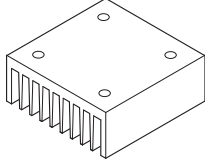
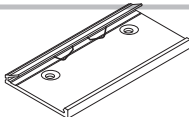
3 m	200 12 732
5 m	200 12 733
10 m	200 12 734
20 m	200 12 735



## Mains cable for power supply, 2 m long

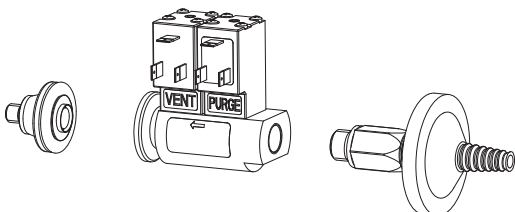
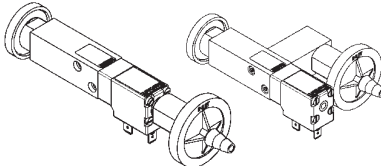



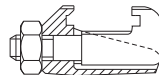

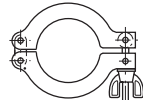
with EURO plug	800102V0001
with US plug 5-15P	800102V1001

# Description

Part No.		
<b>Power supply unit - plug and play</b>		
<b>TURBO.POWER 300</b>	800100V0002	
<ul style="list-style-type: none"> <li>supplies the TURBO.DRIVE 400 with 24 V DC</li> <li>plug &amp; play cables</li> <li>desktop unit or rack mountable</li> </ul>		
<b>24V DC Power cable (TURBO.DRIVE 400 – TURBO.POWER 300)</b>		
1 m	800094V0100	
3 m	800094V0300	
5 m	800094V0500	
10 m	800094V1000	
20 m	800094V2000	
<b>Mains cable for TURBO.POWER 300, 3 m long</b>		
with EURO plug	800102V0002	
with US plug 6-15P	800102V1002	
with UK plug	800102V0003	
<b>Power supply and control unit</b>		
<b>TURBO.CONTROL 300</b>	800100V0001	
<ul style="list-style-type: none"> <li>supplies the TURBO.DRIVE 400 with 24 V DC</li> <li>plug &amp; play cables</li> <li>desktop unit or rack mountable</li> <li>with power switch</li> <li>with start/stop switch for the turbomolecular pump</li> <li>remote control</li> <li>status LEDs and status relays</li> </ul>		
<b>24V DC Control cable (TURBO.DRIVE 400 – TURBO.CONTROL 300)</b>		
1 m	800091V0100	
3 m	800091V0300	
5 m	800091V0500	
10 m	800091V1000	
20 m	800091V2000	
<b>Mains cable for TURBO.CONTROL 300, 3 m long</b>		
with EURO plug	800102V0002	
with US plug 6-15P	800102V1002	
with UK plug	800102V0003	
<b>Mechanical accessories</b>		
Plug for connector REMOTE with integrated <b>ON/OFF switch</b> for the pump (Sub-D plug, 9 way)		
	152 48	
<b>Heat sink for frequency converter</b>		
<b>Top hat rail adaptor</b> (mounting aid for TURBO.DRIVE 400 and TURBO.POWER 300)		
	800110V0003	



# Description

		Part No.	
<b>Purge gas and venting valve</b> 0.2 mbar·l/s at 1 bar 24 V DC 230-100 V AC DN 10 KF – G <sup>1</sup> / <sub>4</sub> "		113 50 800152V0019	
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	
PC software " <b>Turbo.Drive Server</b> " for Windows 95 and higher, CD-ROM			
■ Display, change, save and compare parameter lists			
■ Integration of customer's software			
■ Record parameter data		800110V0102	
The software can also be downloaded from www.oerlikon.com in the menu Oerlikon Leybold Vacuum → Documentation → Download Software			
Adapter RS232/RS485 for 220 V/Euro plug		800110V0101	
GSD file for Profibus DP Can be downloaded from www.oerlikon.com in the menu Oerlikon Leybold Vacuum → Documentation → Download Software			
Splinter guard coarse for DN 100 ISO-K Splinter guard fine for DN 100 ISO-K		800132V0101 800132V0102	
Flange heater DN 100 CF only for pumps with CF flange) 230 V 110 V		854 27 854 28	
Copper gasket rings for CF flange (Set of 10 pieces) DN 100 CF		839 45	
Set of hex. screws with nuts, screws and washers for CF flange DN 100 CF		839 04	
Centering ring (Al) with O-ring (FPM) DN 100 ISO-K		268 42	
Clamps (Set of 4 pieces)		267 01	
Centering ring with O-ring for DN 16 KF Al/CR Al/FPM		183 26 182 06	
Clamping ring (Al) DN 16 KF		183 41	

# Installation

## 2 Installation

### 2.1 Conforming utilization

The TURBOVAC SL 300 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 400 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.

For 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 35 °C. Do not expose the pump or the frequency converter to dripping or spraying water.

#### Magnetic field

The pump must not be installed within a magnetic field.

#### Radiation shield

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

#### 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. Please consult us.

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

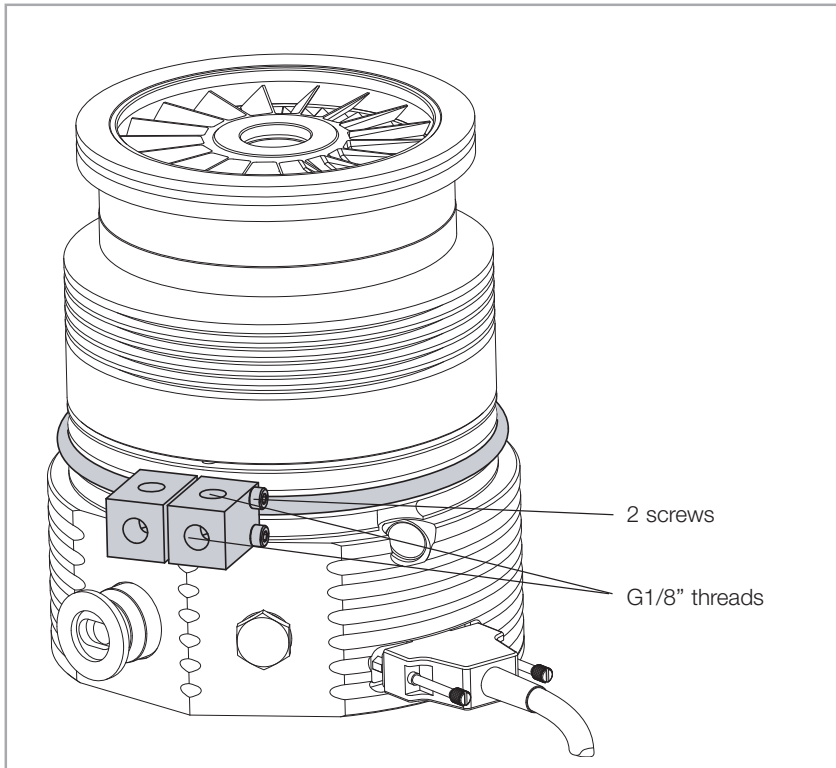


Fig. 2.1 Pump with mounted water cooling

## 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: Unscrew 2 screws and bend the cooling coil cautiously a little bit open. Mount it to the pump and fix the 2 screws.

The cooling water may be connected radially or axially to the connecting piece of the cooling coil; see Fig. 2.1. Blank off the unused G 1/8" threads using the screw-in stoppers and gaskets supplied.

# Installation

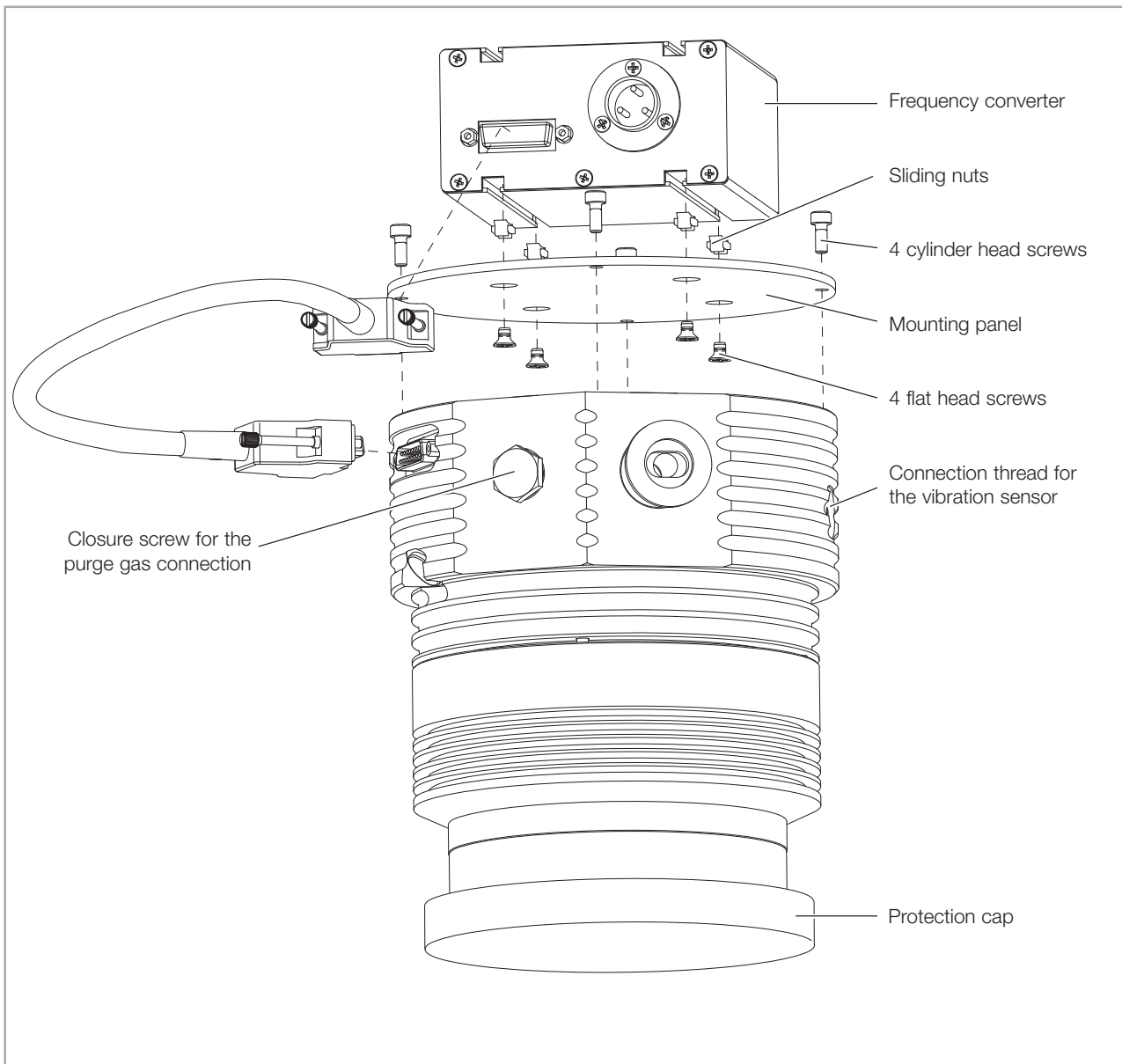


Fig. 2.2 Mounting the frequency converter underneath the pump

- 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.

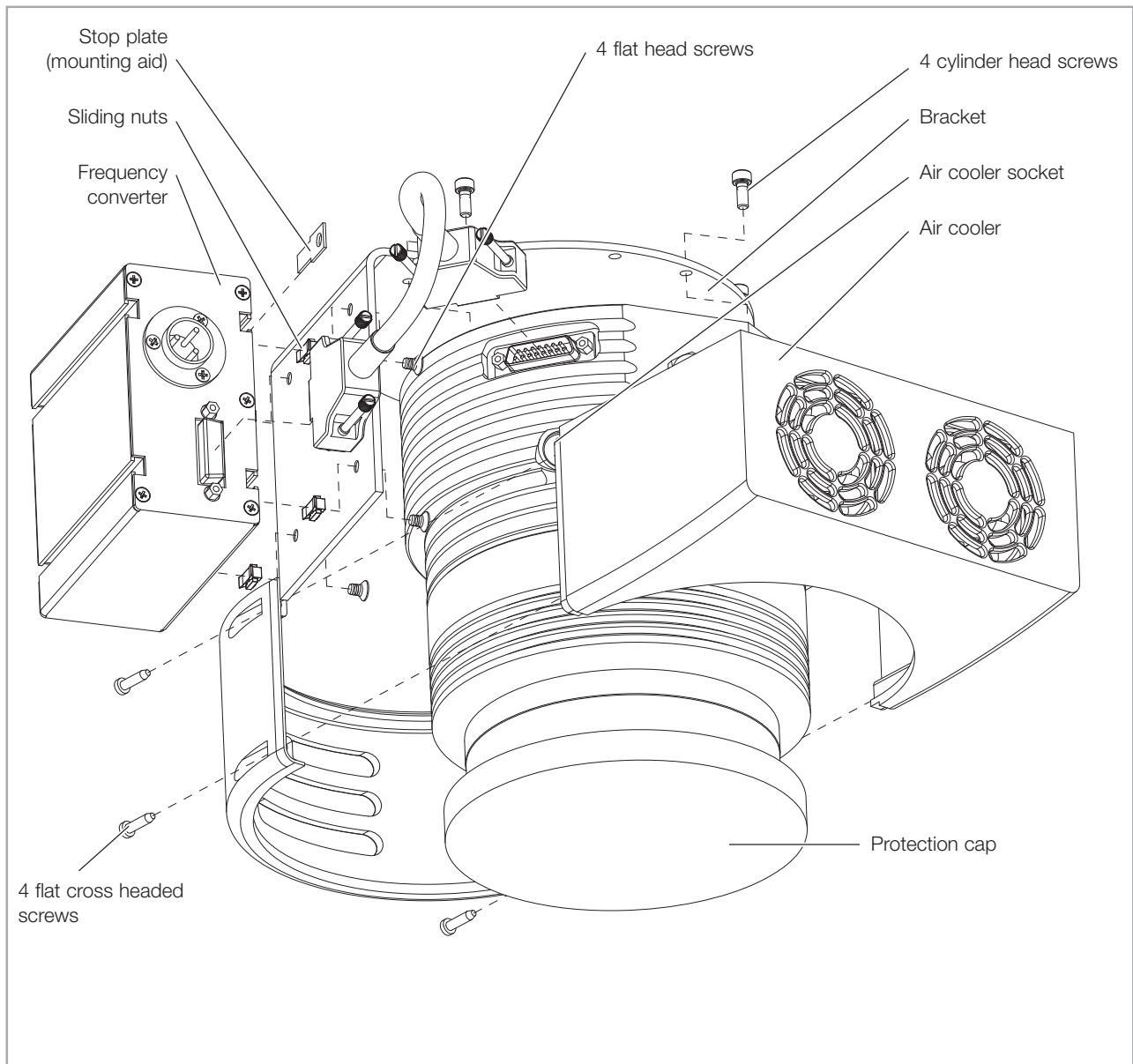


Fig. 2.3 Mounting air cooling and frequency converter beside the pump

- 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.

# Installation

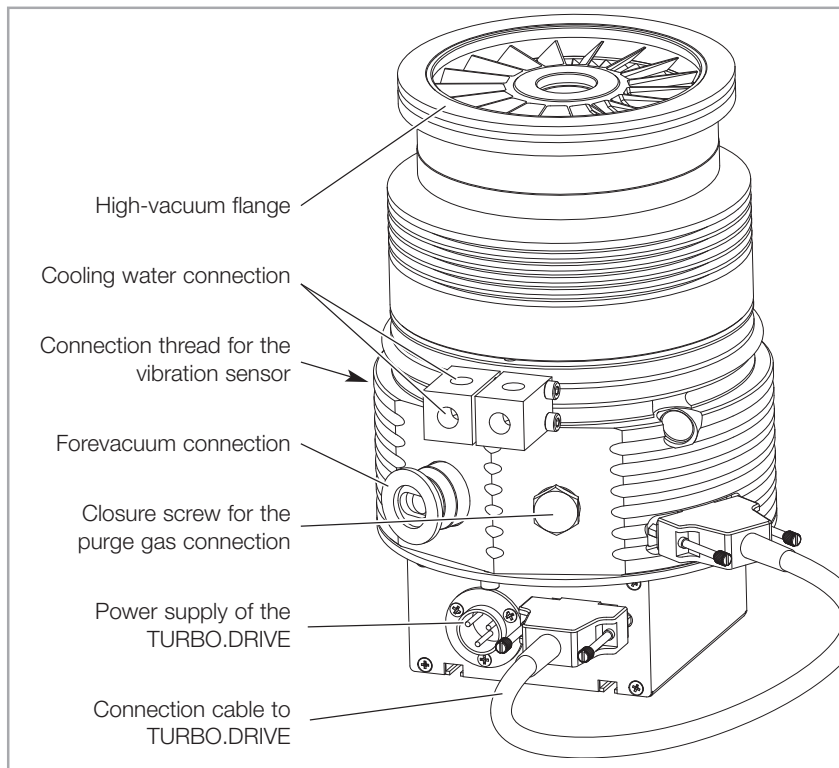


Fig. 2.4 Connection elements

## 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 800 Nm will have to be absorbed by the system. To accomplish this, the following is required:

ISO-K flange: 6 steel clamps, strength at least 8.8, torque 30 Nm

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

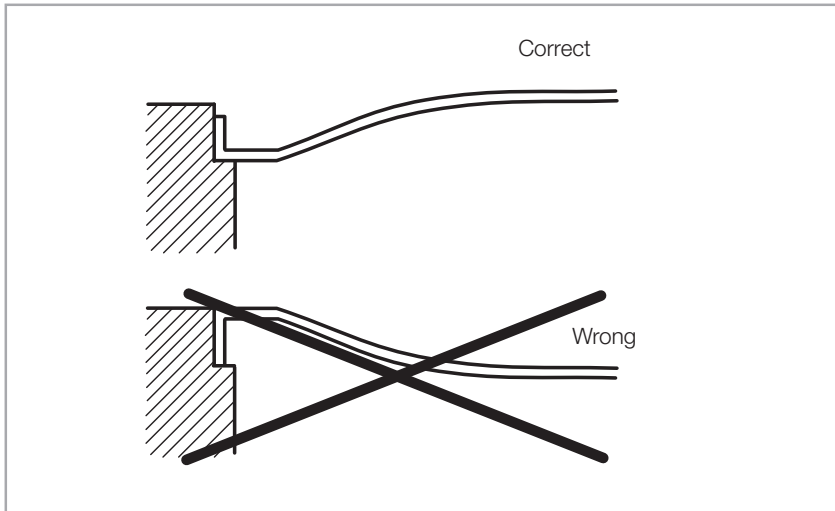


Fig. 2.5 Installing the splinter guard

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.

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.

---

## Caution

---

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.

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.

## Vibrations

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.

# Installation

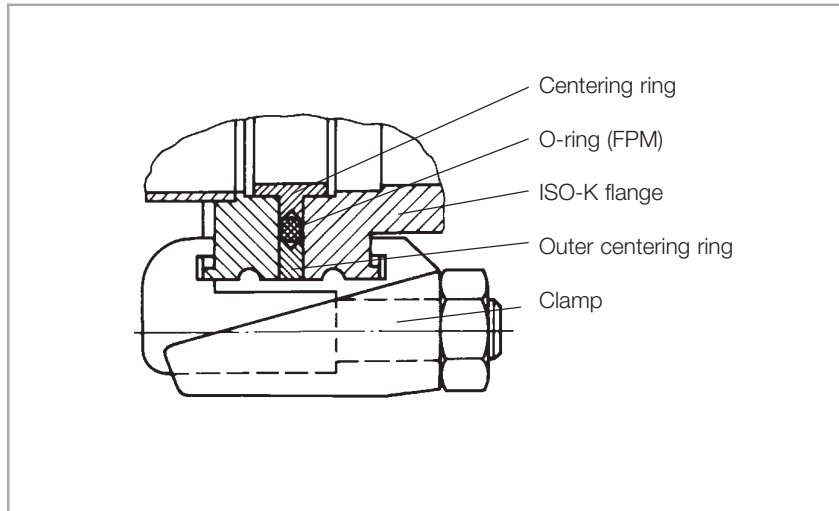


Fig. 2.6 Using type ISO-K flanges

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.

We recommend using the dry-running SCROLLVAC SC 15 pump, a diaphragm vacuum pump or TRIVAC rotary vane pump for this purpose.

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

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.

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.

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.

### Forevacuum pump

---

#### Warning



### Safety valve

### Adsorption trap

# Installation

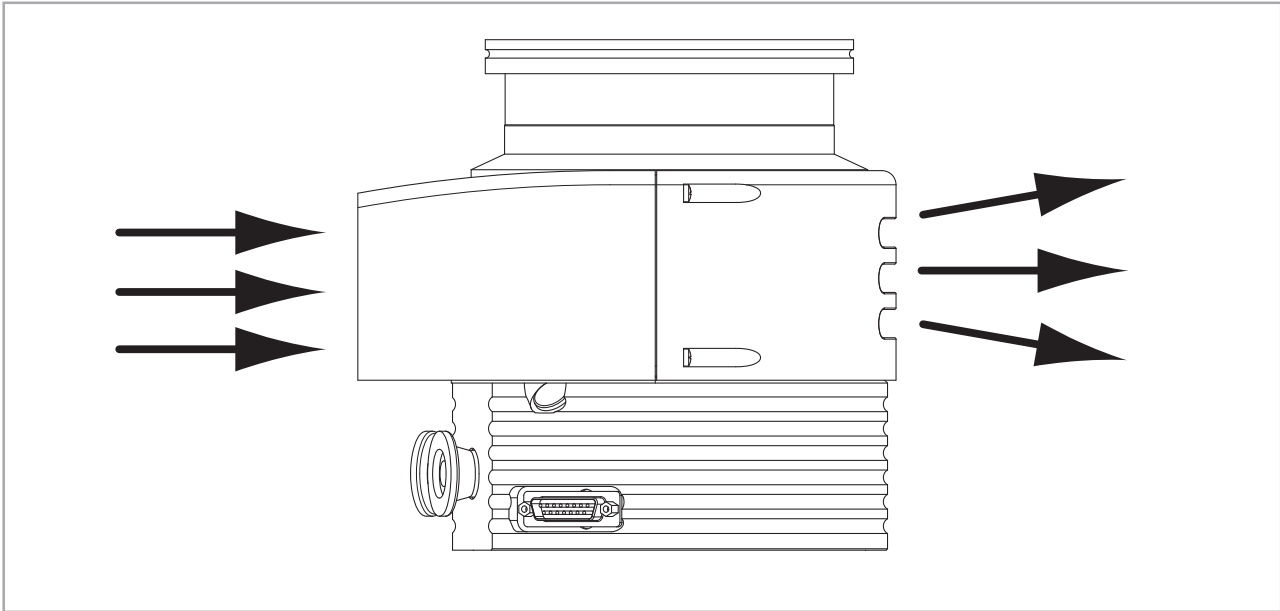


Fig. 2.7 Pump with air cooling

## 2.6 Connect the cooling

Cooling of the pump depends on the required pumping power and the ambient temperature. When the pump is insufficiently cooled it will shut down.

High gas throughputs, cyclic operation or high ambient temperatures will necessitate air or water cooling.

Air or water cooling can be mounted to the pump.; 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.

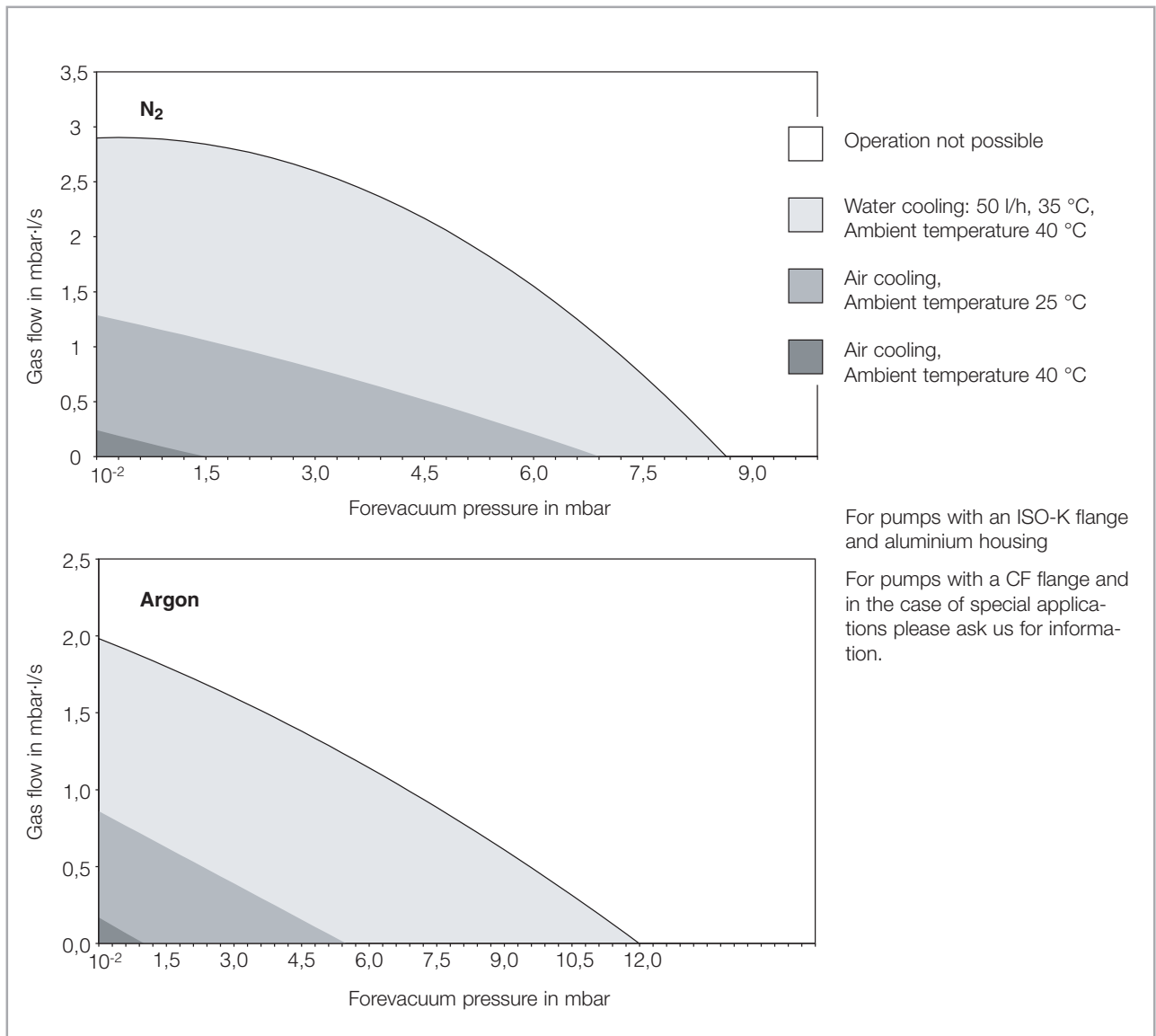


Fig. 2.8 Cooling requirements of the SL 300

# Installation

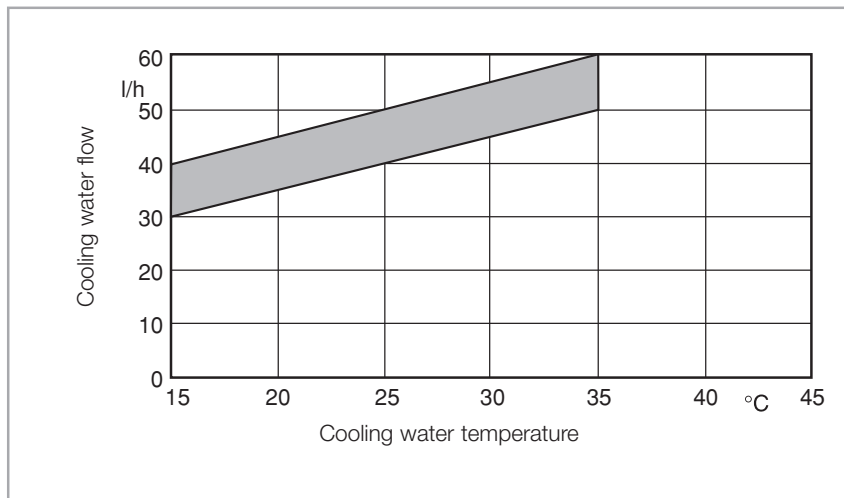


Fig. 2.9 Cooling water requirements

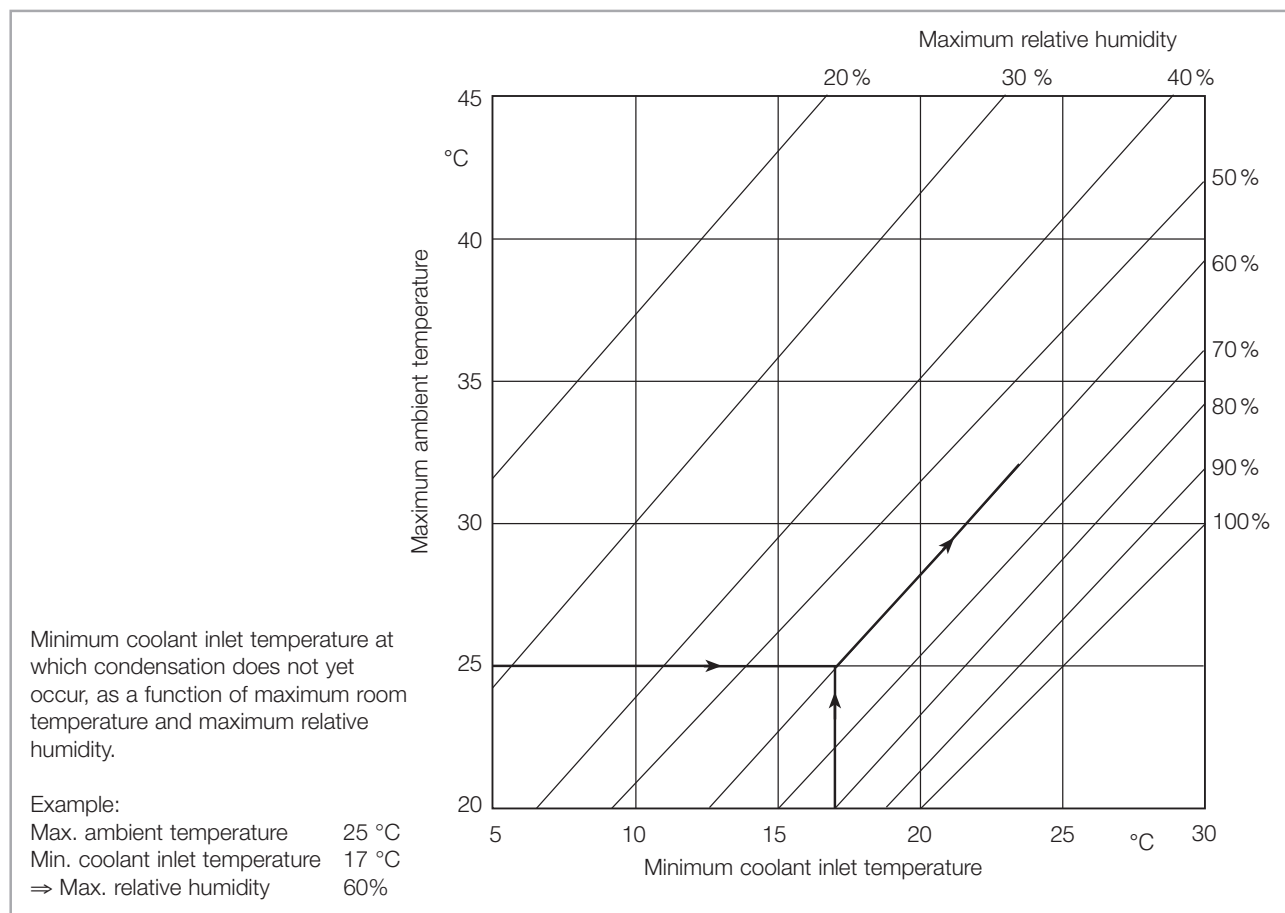


Fig. 2.10 Dewpoint diagram

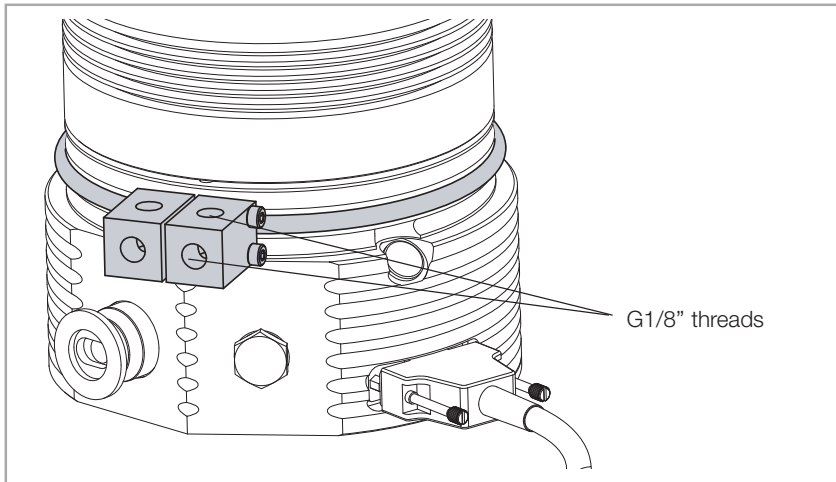


Fig. 2.11 Pump with water cooling

## Cooling water specifications

Feed temperature	15 - 35 °C
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".

The cooling water may be connected radially or axially to the connecting piece of the cooling coil. Blank off the unused G 1/8" threads using the screw-in stoppers and gaskets supplied.

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.

# Installation

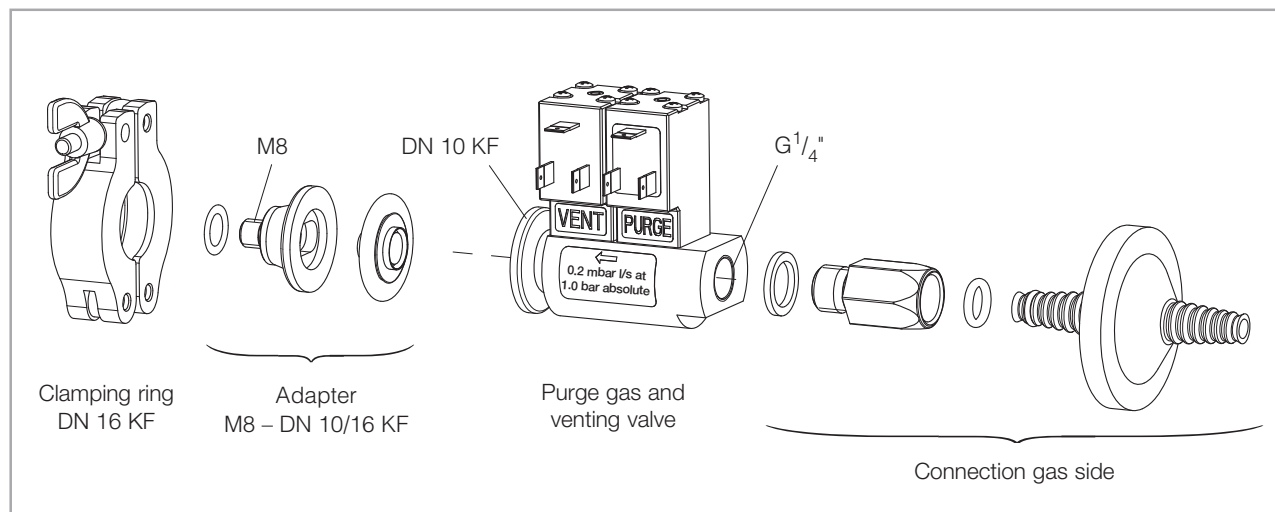


Fig. 2.12 Connecting the purge gas and venting valve

## 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 forevacuum 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 3.5.

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

We recommend a purge gas flow of 0.2 mbar·l/s (12 sccm) with Nitrogen.

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

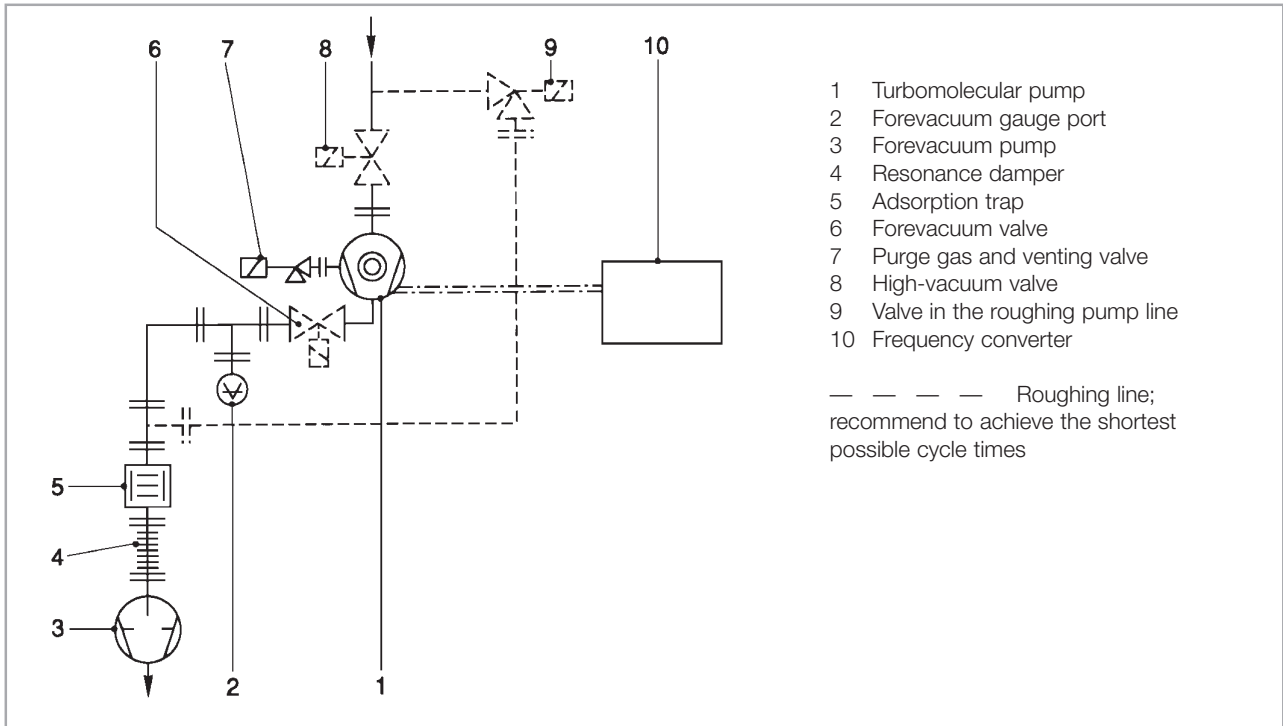


Fig. 2.13 Schematic of a turbomolecular pump system

## 2.8 Electrical connection

The TURBO.DRIVE 400 frequency converter needed to operate the TURBO-VAC SL 300 has either been integrated in the pump or is a separate unit. For connection examples see Fig. 2.14 and 2.15.

---

### Warning



The pump may be operated only with a suitable frequency converter and 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 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 (15 way Sub-D plug X3). Connect the Sub-D-plugs with the hexagon threaded bolts UNC 4/40x6 at the pump connector.

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



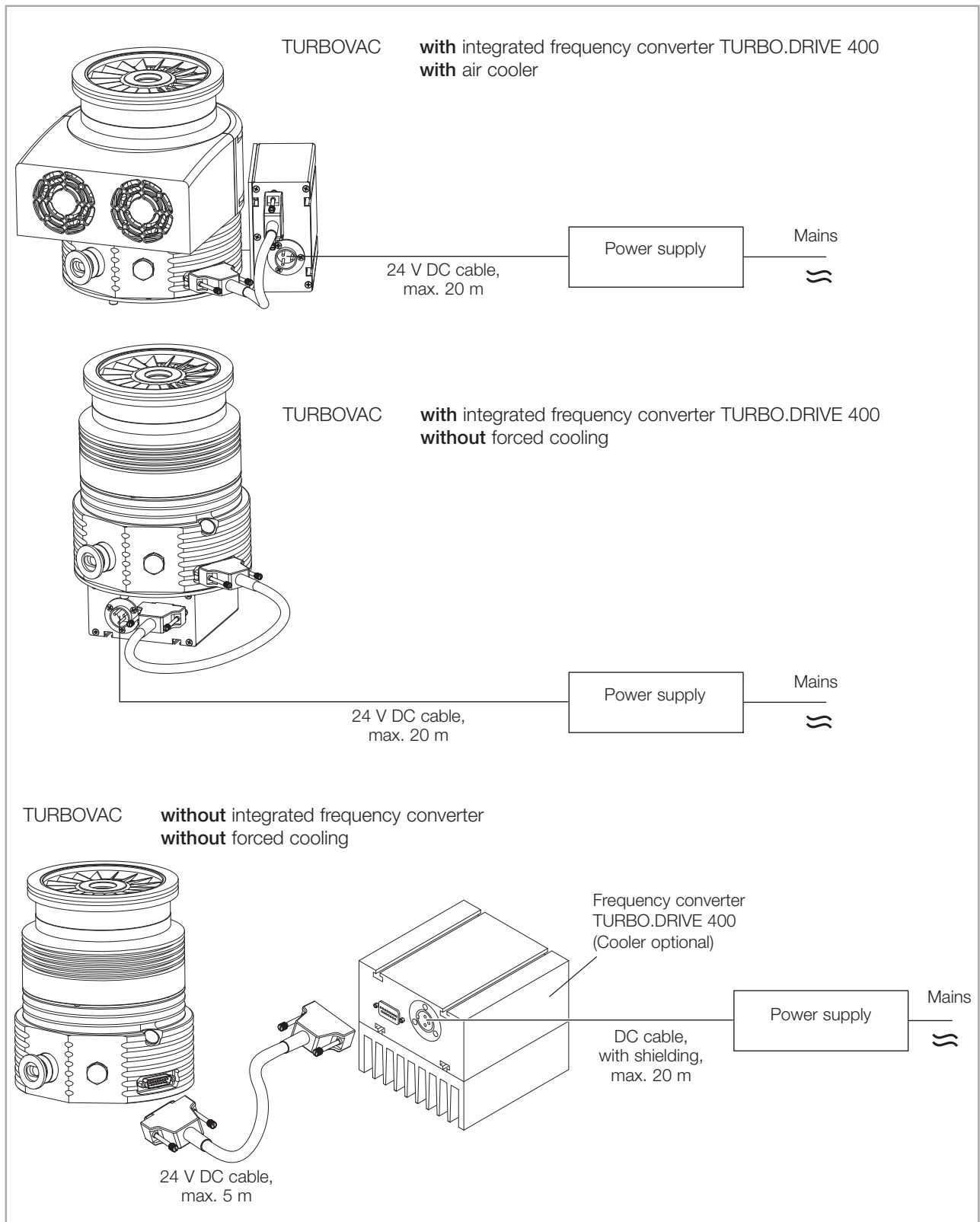


Fig. 2.14 Examples for connection

# Installation

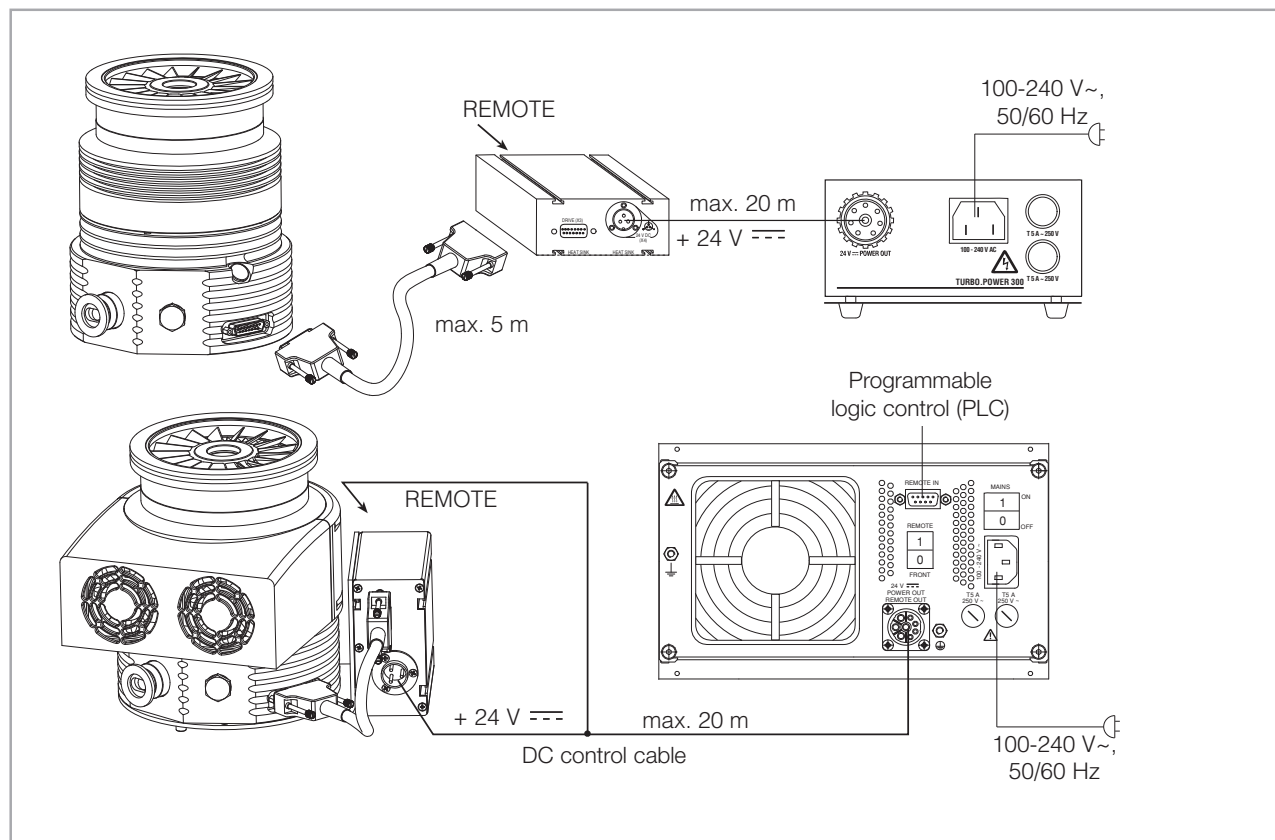


Fig. 2.15 Examples for connection  
top: TURBOVAC with separate frequency converter to TURBO.POWER 300,  
bottom: TURBOVAC with integrated frequency converter to TURBO.CONTROL 300

## 2.8.2 Connecting the power supply

### Warning



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).

The power supply must meet the requirements given in Section 1.5. 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.

### 24 VDC cable

Connect the frequency converter to the 24 V DC power supply or to the TURBO.CONTROL 300 or to the TURBO.POWER 300 via the 24 V DC cable.

### Caution

Ensure correct polarity.  
Pin 1 + 24 VDC  
Pin 2 0 V  
Pin 3 GND

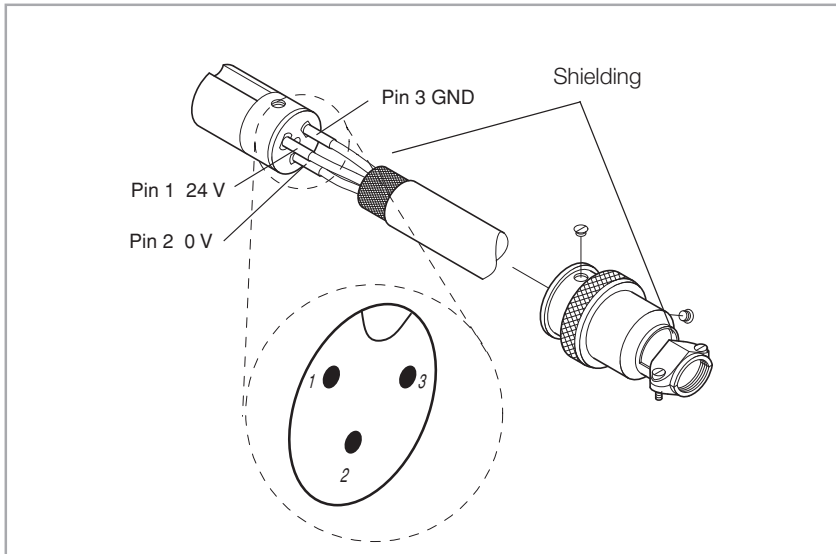


Fig. 2.16 Pin assignment of the DC connector (X4) Model Hirose HS16P-3

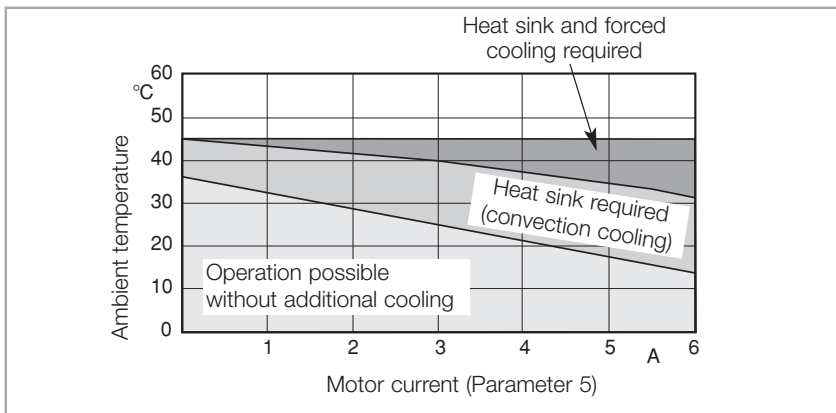


Fig. 2.17 Cooling requirements for the TURBO.DRIVE 400 when fitted separately

The frequency converter is equipped with an internal 8 AT (slow blow) fuse. It can only be replaced by Oerlikon Leybold Vacuum staff.

Connect the power supply to the mains.

**Emergency shut down:** By shutting down the power supply voltage. Please note the information on shutting down and emergency shut down provided in Section "3.5 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.

If the frequency converter is mounted without the optional heat sink ensure sufficient cooling by other means.

# Installation

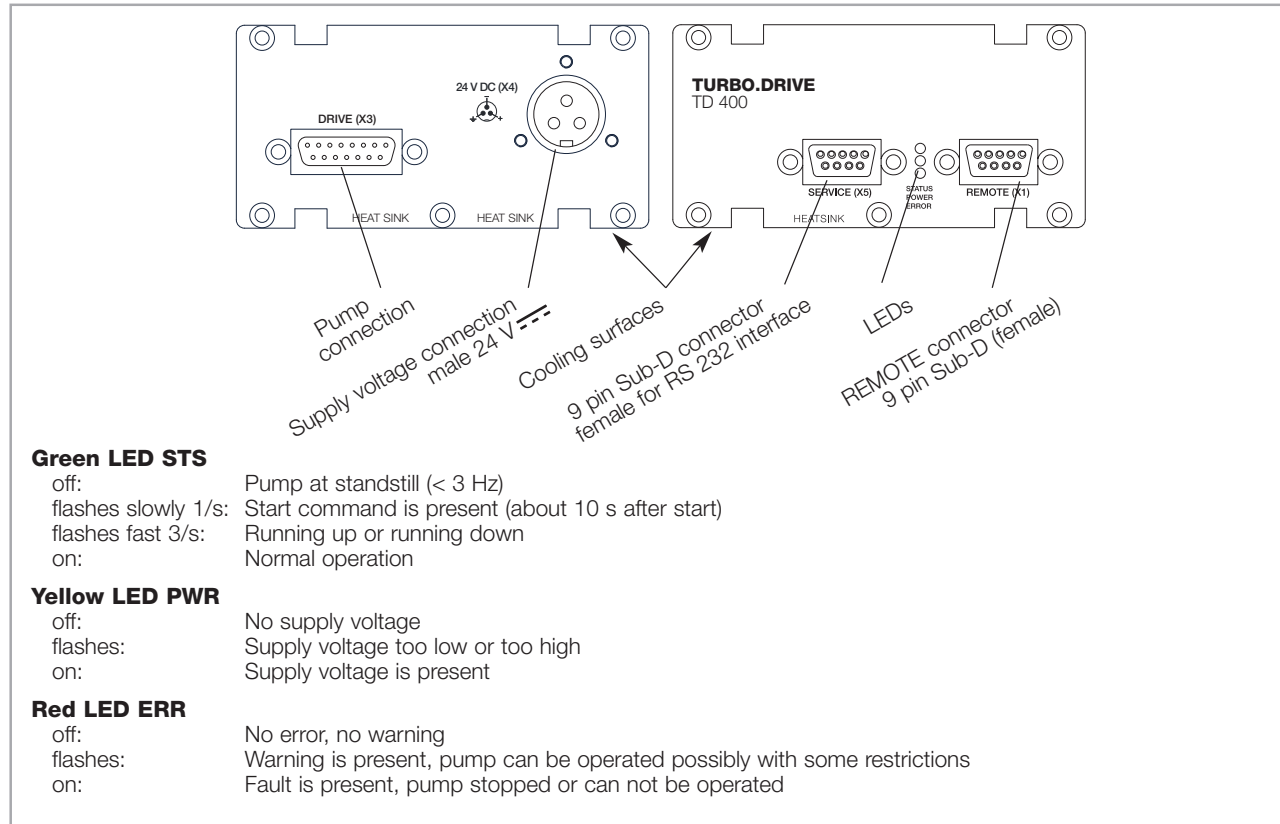


Fig. 2.18 TURBO.DRIVE 400, front and rear side

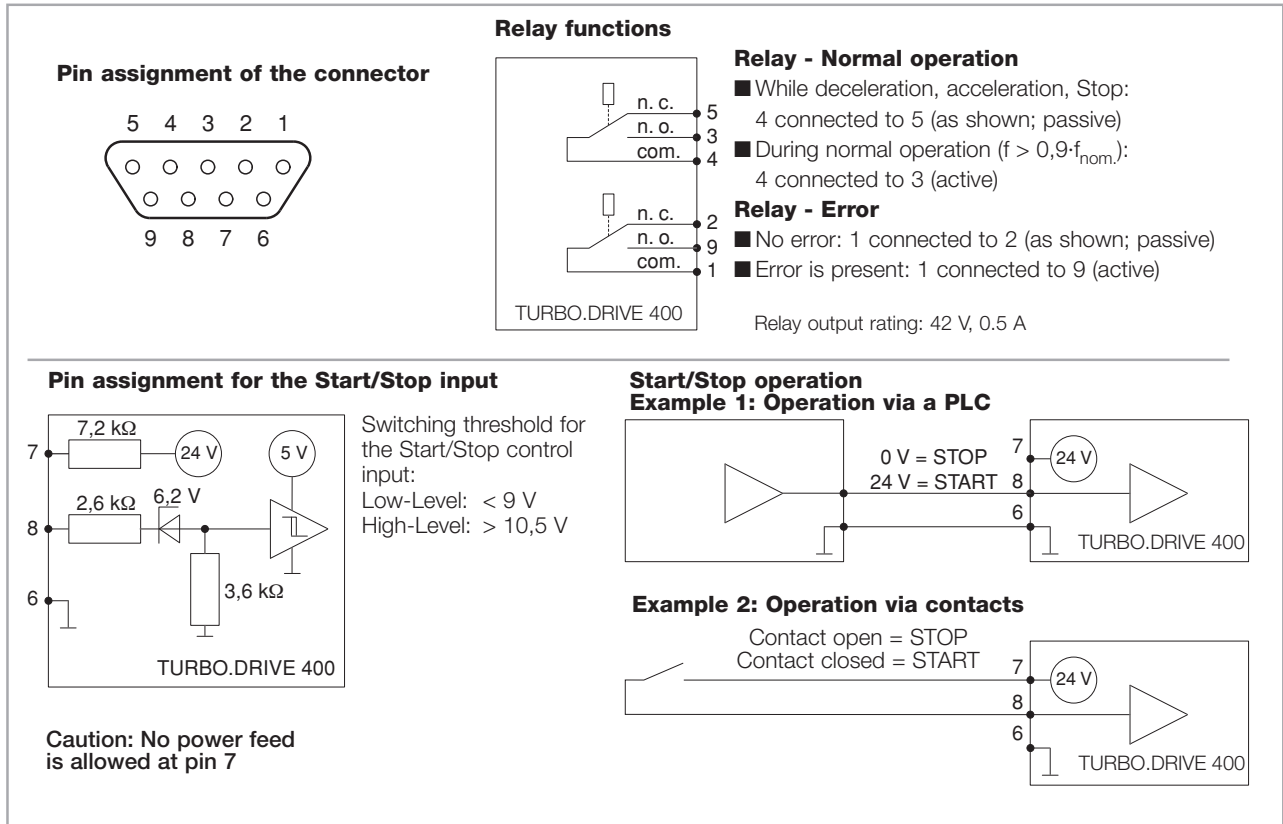


Fig. 2.19 Pin assignment of the REMOTE (X1) connector

# Installation

## 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 (green)	LED ERROR (red)	Other modes are not possible; they indicate a failure affecting the TURBO.DRIVE 400.
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 300 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.

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.

#### **Danger of ignition**

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 for venting or purging are all gases,

#### **Suited 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 Start-up

The TURBO.DRIVE 400 offers the possibility of gently running in pumps which were not operated for a period between 6 and 12 months. Before starting, set up parameter 119 correspondingly.

Turbomolecular pumps which were not operated for a period of over 12 months should be returned to us. For more information on this please contact your local sales partner.

# Interfaces

## 3.3 Interfaces

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

- RS 485 C
- Profibus DP
- Ethernet/IP

The TURBO.DRIVE 400 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.

In the case of BETA units simultaneous operation of the RS 232 interface in parallel to the RS 485 interface or the Profibus interface is not yet reliably supported. For this reason only one interface at a time should be connected to the unit.

### 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 Profibus
Automation	Savings related to repetitive manual work	For example by a control computer
Avoidance of warnings and warnings before overload operation and early detection of a failing pump	<ul style="list-style-type: none"> <li>■ Precise planning for maintenance</li> <li>■ Improved reliability of sensitive production processes in a vacuum</li> </ul>	Monitoring of: <ul style="list-style-type: none"> <li>■ Motor current P5</li> <li>■ Motor temperature P7</li> <li>■ Frequency converter temperature P11</li> </ul>
Standby operation	<ul style="list-style-type: none"> <li>■ Extending the service life for the ball bearings</li> <li>■ Cutting energy consumption</li> </ul>	Reducing the rotor's frequency through P24
Troubleshooting	Quick analysis of problems	Reading of error memories P171, P174 and P176: error code, speed, operating hours for error
Slow pressure control by changing the pumping speed	Dispensing with a flow controller	Changing the rotor frequency through parameter 24
Reducing the maximum motor current	Cost savings through smaller power supply units if peak loads can be reduced	With P139, motor current reduction factor
Starting the pump with a delay if 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 thresh.: P27
Lowering the normal operation threshold	Normal operating mode is attained faster, processes can be started faster	Reduce frequency threshold through P25



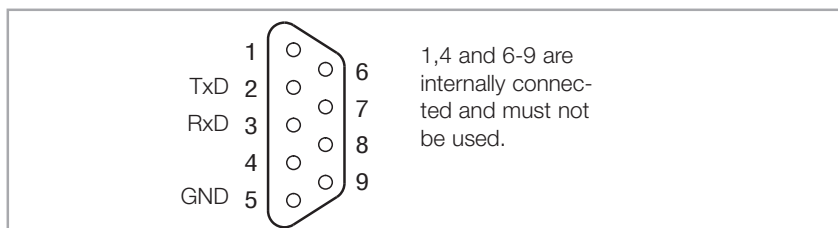


Fig. 3.1 Pin assignment for the socket at the frequency converter (female) SERVICE X5

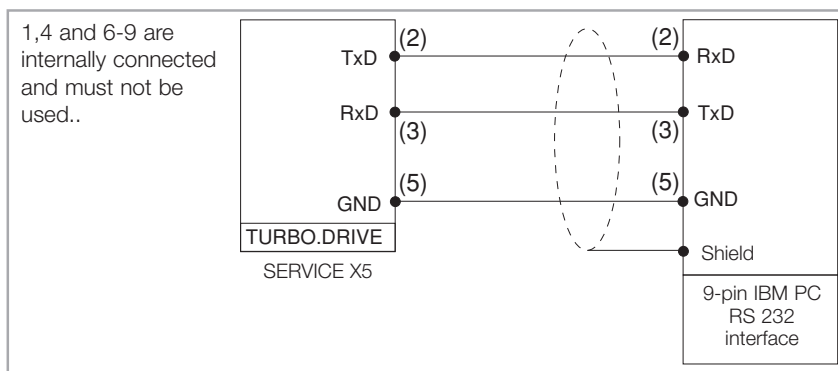


Fig. 3.2 Providing a RS 232 connection

### 3.3.1 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

# Interfaces

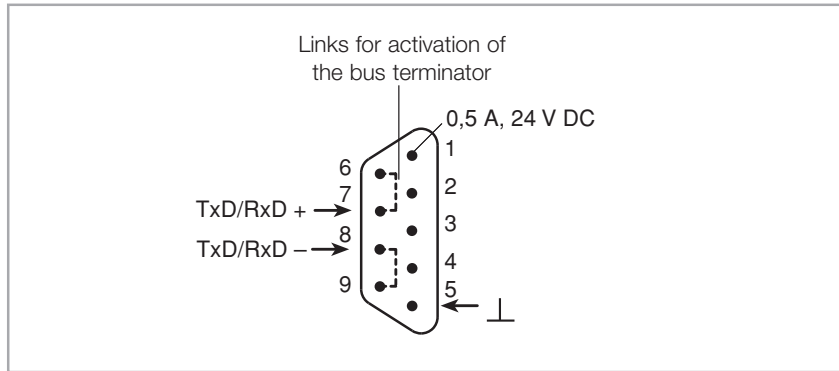


Fig. 3.3 Pin assignment for the socket at the frequency converter for RS 485 interface (male)

## 3.3.2 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

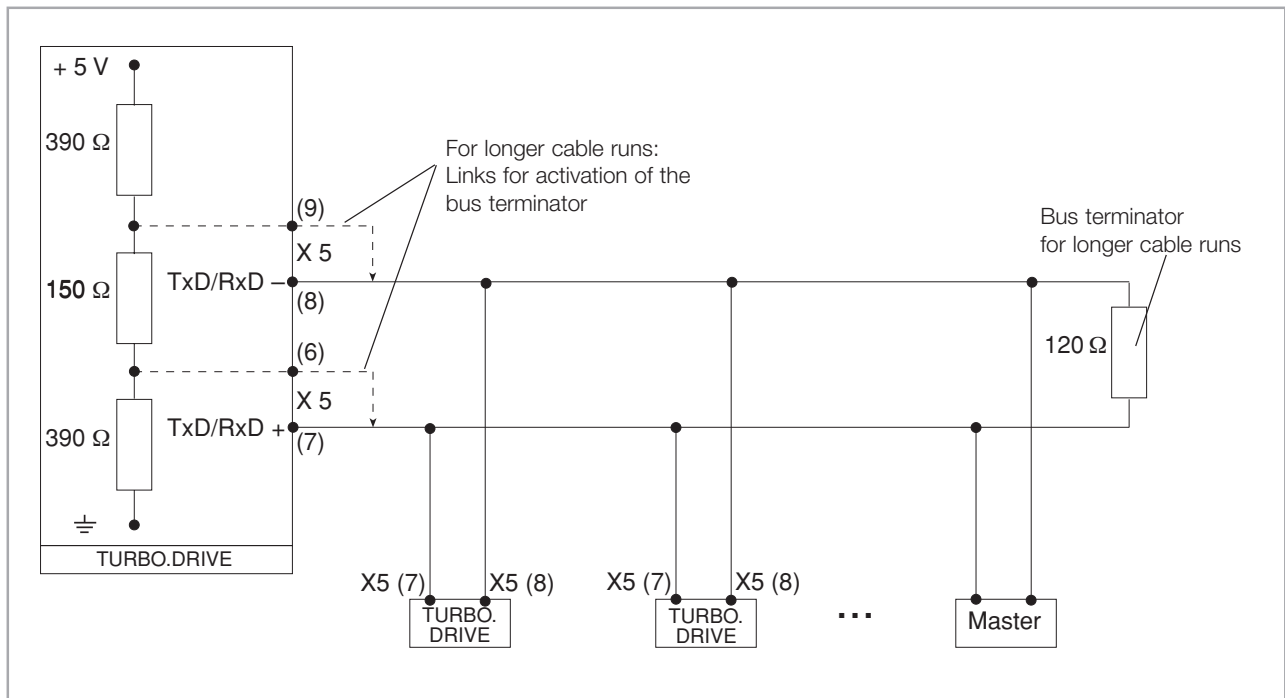


Fig. 3.4 Connection of the RS 485 bus

### 3.3.3 Profibus DP

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

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](http://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

### 3.3.4 Ethernet/IP interface

See additional Operating Instructions 17200908. The Operating Instruction will be delivered on a CD with Part No. 800073V0007 or can be downloaded from our website.

# Interfaces

## 3.3.5 Parameter list

r = readable, w = writable

No.	Designation	Min.	Max.	Default	Unit	r/w	Format	Description
1	Converter type	0	65535	0		r	u16	136 = Turbo.Drive 400
2	Software version	0	65535	10000		r	u32	xx.yy: version, zz: correction index
3	Actual frequency	0	65535	0	Hz	r	u16	Actual rotor frequency
4	Actual intermediate circuit voltage	0	1500	30	0,1 V	r	u16	Actual intermediate circuit voltage of the converter
5	Actual current	0	150	0	0,1 A	r	u16	Actual motor current
6	Actual electrical power	0	65535	0	0,1 W	r	u16	Actual drive input power
7	Actual motor temperature	-10	150	0	°C	r	i16	Actual value of the motor temperature.
8	Save data command	0	65535	0		/w	i16	A write command with any value saves temporary data into nonvolatile memory.
11	Actual converter temperature	-10	150	0	°C	r	i16	Actual heat sink temperature of the converter.
16	Motor temperature warning threshold	0	150	54	°C	r	i16	Exceeding the motor temperature warning threshold results in a warning.
17	Nominal motor current	5	60	5,0	0,1 A	r	u16	Maximum permissible motor current
18	Maximum frequency	750	1200	1000	Hz	r	u16	Highest permissible frequency
19	Minimum frequency	0	1200	525	Hz	r	u16	Lowest permissible frequency
20	Critical frequency	0	1200	500	Hz	r	u16	Minimum frequency level. When the pump is accelerating this frequency must be reached within the maximum passing time (P183).
23	Pump type	0	255	2		r	u16	6= SL 300
24	Setpoint frequency	0	1200	1000	Hz	r/w	u16	Setpoint of the rotor frequency
25	Normal operation	35	99	95	%	r/w	u16	Setpoint of the frequency dependent normal operation level
27	Current norm. oper.	5	60	20	0,1 A	r/w	u16	Motor current dependent normal operation level; ; If P29[0] = 1: Defines the normal operation level. Normal operation if P5 <= P27 Parameter cannot be changed during operation of the system
29	Relay function X1	0	8	0		r/w	u16	If required, special functions can be assigned to the normal operation and the error relay.

Field 0 specifies the function for normal operation:

- 0 = Frequency dependent
- 1 = Motor current dependent
- 2 = Fieldbus controlled
- 3 = Trigger current bearing temperature (P122)
- 4 = Venting function (P247/P248)
- 5 = Pump at standstill (f < 3)
- 6 = Start command is present
- 7 = Ready for switch on (=STW Bit1)
- 8 = No mains power failure or no generator operation (P303 Bit 4 =1 = generator operation)

Field 1 specifies the function for the error relay:

- 0 = Energised when an error is present
- 1 = Deenergised when an error is present
- 2 = Fieldbus controlled

No.	Designation	Min.	Max.	Default	Unit	r/w	Format	Description
32	Max. run-up time	30	2000	720	s	r/w	u16	Max. permissible time during which the pump must attain the normal operation threshold (P24*P25) with the start signal present.
36	Start delay time	0	255	0	0,1 min	r/w	u16	Delays the start of the pump to allow lead-time for the fore vacuum pump for example.
37	RS485 address	0	31	0		r/w	u16	Parameterizable RS485 address; The address is specified either through the address switch or a value entered here provided the address switch is set to 0. A change of this parameter setting will only be effective after the power supply has been switched off and on.
119	Bearing run-in function	0	1	0		r/w	u16	0=deactivated 1=new pump type starts with run-in sequence
Run in using the run-in sequence specified through the pump table without run-up time monitoring								
	Run-in speed 1 [Hz]	Run-in time 1 [s]	Run-in speed 2 [Hz]	Run-in time 2 [s]	Run-in speed 3 [Hz]	Run-in time 3 [s]		
	200	3600	430	5400	580	5400		
122	Normal TMS	20	70	40	°C	r/w	u16	Switch-on temperature for fan when P29[0]=3. For P125 > P122 the normal operation relay is energised.
125	Motor temperature	-10	150	0	°C	r	i16	like P7
126	Bearing temperature warning threshold	-10	150	60	°C	r	i16	not used for SL 300
127	Motor temperature	-10	150	0	°C	r	i16	like P7
128	Motor temperature lower warning threshold	-10	150	2	°C	r	i16	Falling below the motor temperature lower warning threshold results in a warning.
131	Motor temperature lower error threshold	10	150	-10	°C	r	i16	Falling below the motor temperature lower error threshold causes the pump to be switched off.
132	Bearing temperature error threshold	-10	150	67	°C	r	i16	not used for SL 300
133	Motor temperature error threshold	-10	150	56	°C	r	i16	Exceeding the motor temperature error threshold causes the pump to be switched off.
134	Enable cooling fan on turbopump	0	19	19		r/w	116	0 = Cooling fan off 19 = Cooling fan on
139	Current reduction factor e.g. for adaptation of low performance power supplies. Note: values < 100 reduce the pump performance and increase the run-up time.	30	100	100	%	r/w	u16	Is used for the reduction of the maximum consumption current,
140	Intermediate circuit current	0	150	0	0,1 A	r	i16	Actual average intermediate circuit current of the converter.
150	Standby frequency	0	1200	350	Hz	r/w	u16	Standby operation frequency setpoint
151	Enable standby	0	1	0		r/w	u16	0 = normal speed (P24); 1 = standby speed (P150)

# Interfaces

No.	Designation	Min.	Max.	Default	Unit	r/w	Format	Description
171	Error code memory	0	65535	0		r	u16	Indexed parameter for storing the most recent 40 error codes. The individual error memory entries are accessed via this parameter with additional index number. The last error code is accessed with index 0 and the oldest with index 39. See Section 5 Troubleshooting for the error codes.
174	Error rotor frequency	0	65535	0	Hz	r	u16	Actual speed, when error occurred. Access analogously as for parameter 171.
176	Error operating hours	0	2147483647	0	h	r	u32	Operating hours, when error occurred. Access analogously as for parameter 171.
179	Fallback PZD1	0	65535	1024		r/w	u16	Response when cancelling the control rights or in the case of a communication interruption of the bus adapter Behaviour in case bit 10 in the control word of the bus adapter is cancelled or when interrupting the communication between converter and bus adapter (see also P182). Here it is assumed that the respective bus adapters perform a cyclic communication on the USS side, so that the respective converter electronics is capable of detecting a communication interruption The bits in parameter 179 represent an equivalent to the control word in the USS protocol. The actions linked to these bits are run provided bit 10 in the control word (USS protocol for bus adapter) is cancelled or if there are interruptions in the communication between converter and bus adapter. Here bit 10 is of special significance: Bit 10 = 0 The control rights are returned to the next lower priority level. All other bits are not relevant. Bit 10 = 1 The control rights remain unchanged. The actions linked to the other bits are run.
180	Resp. delay time	0	20	10	ms	r/w	u16	Response delay time; Pause time between received and transmitted USS protocol string of the frequency converter's serial interface RS232 and RS485. We recommend not to change the default setting (10ms).
182	Watchdog timer USS	0	65535	10	0,1 s	r/w	u16	Delay when cancelling the control rights of the bus adapter and time-out in the case of a communication interruption Defines the time characteristic when cancelling bit 10 in the control word of the USS protocol or when an interruption in the communication between bus adapter and converter and electronics is detected. Handling when cancelling bit 10 or when there is an interruption on the communication side of the USS bus adapter, is the same. Value 0.0: Indefinite time delay. In this way a change of the control right is inhibited. Values 0.1 ..6553.5: A change in the control right corresponding to the setting of parameter 179 is only effected after the time span defined through parameter 182 has elapsed.
183	Max. passing time	0	1800	500	s	r	u16	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.
184	Converter operating hours	0	2147483647	0	0,01 h	r	u32	Counts the operating hours of the converter during active pump operation.
227	Warning bits 1	0	65535	0		r	u16	Active warnings described bit per bit. See Section 3.3.6.
247	Vent on frequency	0	1200	300	Hz	r/w	u16	Frequency at which the venting valve shall be switched on in the event of a mains power failure. Power failure venting can be enabled through P240.
248	Vent off frequency	0	1200	5	Hz	r/w	u16	Frequency at which the venting valve shall be switched off in the event of a mains power failure. Power failure venting can be enabled through P240.
249	Generator operation	0	1	0		r/w	u16	0 = inactive 1 = active

No.	Designation	Min.	Max.	Default	Unit	r/w	Format	Description
303	Actual operating status	0	65535	0		r	u16	Bit 0: Normal operation Bit 1: Ready for switch on Bit 2: Speed is increasing Bit 3: Speed is dropping Bit 4: Generator operation Bit 5: Standby Bit 6: reserved Bit 7: reserved
312	Catalog number of converter	0	127		:CHAR [8000xxV000x]	r	u16	Catalogue number of the converter. One ASCII char per index.
313	Product name (Index 0...10 usable)	0	127	[TD_400]	:CHAR :CHAR	r r	u16 u16	Product name of the converter. One ASCII char per index. Only for DeviceNet purpose
315	Serial number of converter (Index 0...10 usable)	0	127		:CHAR [xxxxxxxxxx]	r	u16	Serial number of the converter. One ASCII char per index.
918	Act. Profibus addr.	0	65535	0		r	u16	Active Profibus address
947	Current error number	0	65535	0		r	u16	Currently pending error. See Section 5 Troubleshooting.

# Interfaces

## 3.3.6 Warning codes for parameter 227

P227, Bit	Designation	Meaning	Possible cause	Remedy
0	Motor temperature warning	The motor temperature has passed the warning threshold	Forevacuum pressure too high. Gas flow too high Fan defective Water cooling switched off	Check the ultimate pressure of the backing pump and install a bigger backing pump if req. Seal leak, check process Replace fan Switch on water cooling
1	Converter temperature warning	Overtemperature at the power output stage or within the frequency converter	Ambient temperature too high Poor cooling	Ensure max. ambient temperature of 45°C Improve cooling
2	not used			
3	Motor under-temperature warning	The minimum permissible motor temperature (warning threshold) is not reached.	Ambient temperature too low Pump cooling too high	Ensure min. ambient temperature of 0°C Reduce water cooling
4, 5	not used			
6	Overspeed warning			
7, 8, 9, 10	not used			
11	Overload warning	The pump speed has dropped under the normal operation threshold	Forevacuum pressure too high. Gas flow too high	Check the ultimate pressure of the backing pump and install a bigger backing pump if req. Seal leak, check process
12, 13	not used			
14	Power supply voltage warning	Supply voltage failure during active operation of the pump $P4 > U_{max}$ or $P4 < U_{min}$	Intermediate circuit voltage too low or maximum time for generator operation was exceeded. DC power supply voltage below 24V Mains voltage failure	
15	Fan voltage has failed			



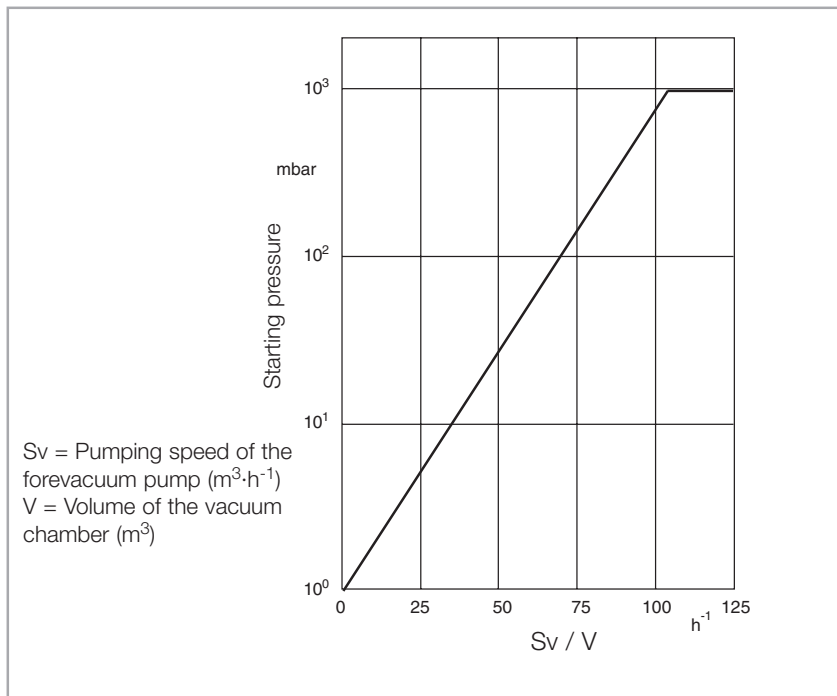


Fig. 3.5 Determining the starting pressure of a turbomolecular pump when evacuating large volumes

### 3.4 Switching on

Switch on the 24 V DC power supply. The yellow LED at the frequency converter lights up.

The maximum starting pressure for the turbomolecular pump can be read from the graph in Fig. 3.5.

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 3.3.
- 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.

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.

### Starting pressure

### Caution

# Operation

---

## Warning



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



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

## 3.5 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.

## Generator operation

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.

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 3.6.

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.

---

## Warning



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.

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.

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

---

**Warning**

### 3.6 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

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

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.

**Speed**  
**Pressure rise curve**

**Particles**

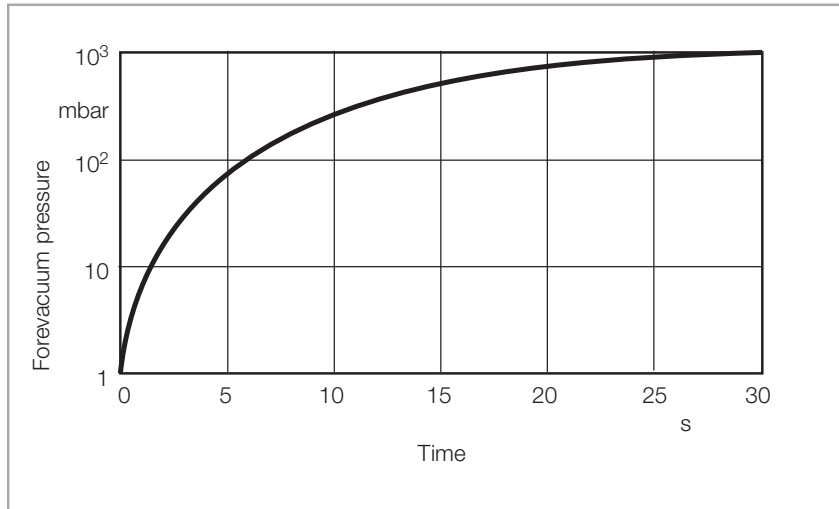


Fig. 3.6 Maximum rise in pressure

### 3.7 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. 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.

### 3.8 Removing the pump from the system

Shut down the pump and vent as described in Sections 3.5 and 3.6.

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.

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.

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.

---

#### Warning



#### Hazardous gases

#### Deposits

#### Desiccant

## 4 Maintenance

We recommend a standard bearing change after 15,000 operating hours at the latest. Moreover, we are recommending an exchange of the rotor unit after 45,000 operating hours at the latest.

Such maintenance work can only be done by the Oerlikon Leybold Vacuum Service. If required contact the Oerlikon Leybold Vacuum service center nearest to your location. You can find the address on our internet page [www.oerlikon.com](http://www.oerlikon.com).

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

#### Contamination

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.

#### Form

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](http://www.oerlikon.com) → Oerlikon Leybold Vacuum → Documentation → Download Documents.

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

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

---

### Warning



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?

- Mains connection,
- 24 V DC cable 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 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.

# Troubleshooting

Error code	Designation	Meaning	Possible Cause	Remedy	Shut-down
1	Overspeed warning	The actual frequency exceeds the setpoint by over 10 Hz.	Frequency converter defective	Contact Oerlikon Leybold Vacuum Service.	no
2	Pass through time error	The pump has not reached the minimum speed after the maximum run-up time has elapsed.	Forevacuum pressure too high. Gas flow too high Rotor blocked	Check the ultimate pressure of the backing pump and install a bigger backing pump if req. Seal leak, check process Check if the rotor turns freely. Contact Oerlikon Leybold Vacuum Service if the rotor is damaged or blocked.	yes
3	not used				
4	Short circuit error				yes
5	Converter temperature error	Overtemperature at the power output stage or within the frequency converter	Ambient temperature too high Poor cooling	Ensure max. ambient temperature of 45°C Improve cooling	yes
6	Run-up time error	The pump has not reached the normal operating frequency after the maximum run-up time.	Forevacuum pressure too high. Gas flow too high	Check the ultimate pressure of the backing pump and install a bigger backing pump if req. Seal leak, check process	yes
7	Motor temperature error	The motor temperature has exceeded the shut-down threshold.	Forevacuum pressure too high. Gas flow too high Fan defective Water cooling switched off	Check the ultimate pressure of the backing pump and install a bigger backing pump if req. Seal leak, check process Replace fan Switch on water cooling	yes
8	Pump error	Pump couldn't be identified or no pump is connected	Pump not connected correctly to frequency converter Frequency converter software not current, Hardware defective	Check connection between pump and frequency converter Contact Oerlikon Leybold Vacuum Service Contact Oerlikon Leybold Vacuum Service	yes



# Troubleshooting

Error code	Designation	Meaning	Possible Cause	Remedy	Shut-down
82	Fan voltage has failed				no
83	Motor temperature low warning				no
84	Motor overtemperature warning				no
101	overload warning	The pump speed has dropped under the normal operation threshold	Forevacuum pressure too high. Gas flow too high	Check the ultimate pressure of the backing pump and install a bigger backing pump if req. Seal leak, check process	no
103	Supply voltage warning	Intermediate circuit voltage too low or maximum time for generator operation was exceeded.	DC supply voltage below 24V Mains voltage has failed	Check the voltage at the power supply and if required set up correctly Remedy the cause for the mains power failure	no
106	overload error	The pump speed has dropped under the minimum speed	Forevacuum pressure too high. Gas flow too high	Check the ultimate pressure of the backing pump and install a bigger backing pump if req. Seal leak, check process	yes
111	Motor undertemperature error	The minimum permissible motor temperature is not attained.	Ambient temperature too low Pump cooling too high	Ensure min. ambient temperature of 0°C Reduce water cooling	yes
116	Permanent overload error	The speed of the pump has dropped below the normal operation threshold and has stayed there for a longer period of time.	Forevacuum pressure too high. Gas flow too high	Check the ultimate pressure of the backing pump and install a bigger backing pump if req. Seal leak, check process	yes
117	Motor current error	Motor current less than nominal current	Cable fault Faulty connector	Contact Oerlikon Leybold Vacuum Service	yes
128	Motor temperature sensor error	Motor temperature sensor defective	Sensor defective, short circuit or broken cable	Contact Oerlikon Leybold Vacuum Service	yes
143	Overspeed error				yes

# Troubleshooting

Error code	Error	Possible Cause	Remedy	Shut-down
–	Yellow power LED is not on	No DC power DC power miswired Frequency converter defective	Check cables and power supply Ensure correct polarity of the DC cable. Replace frequency converter. The following may damage the freq. 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.	–
div.	Red LED flashes	Warning message. See Section “3.3.6 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.	no
–	Turbomolecular pump does not start, ERROR LED does not light.	Interface protocol error No communication via the serial interface. REMOTE connector (X1) connected wrongly. REMOTE and SERVICE connectors mixed up. Wrong Profibus address set.	Use USS protocol. Connect bus as shown in Section 3.3. Connect as shown in Fig. 2.19 Connect correctly. Set address between 0 and 126.	–
–	Turbomolecular pump produces loud running noises and vibrations.	Rotor out of balance Bearing defective	Balance the rotor Replace the bearing	no
–	Turbomolecular pump does not reach ultimate pressure.	Measurement instrument defective Measurement sensors soiled Leaks at the equipment, lines or the pump Pump soiled Forevacuum pump provides insufficient pumping speed or ultimate pressure which is too high. Frequency parameters programmed wrongly	Inspect the measurement sensor Clean or replace the sensors Check for leaks Clean the pump Check the ultimate pressure of the forevacuum pump and install a higher-capacity vacuum pump if necessary Check parameters.	no
–	Running pump can not be stopped via X1	Pump has been started via the serial interface, the interface controls the pump	Disconnect the DC supply or connect serial interface and stop via bus	no

## 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.

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.

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".

### Contamination

---

#### Warning



## 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 300**

Part Nos.: 800170V3xxx

### 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



Harald Udelhoven  
Head of Quality Management

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documentation.vacuum@oerlikon.com



## 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 300**

Part Nos.: 800170V3xxx

### The products comply to the following guidelines

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

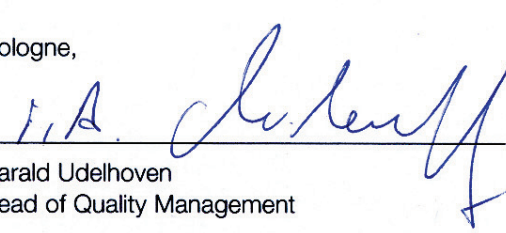
### Related, harmonized standards

- 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,

  
\_\_\_\_\_  
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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: _____	<b>Reason for return</b> <input checked="" type="checkbox"/> applicable please mark
Address _____	<input type="checkbox"/> <b>Repair</b> <input type="checkbox"/> chargeable <input type="checkbox"/> warranty
Person to contact: _____	<input type="checkbox"/> <b>Exchange</b> <input type="checkbox"/> chargeable <input type="checkbox"/> warranty
Phone: _____ Fax: _____	<input type="checkbox"/> exchange already arranged / received
End user: _____	<b>Return only:</b> <input type="checkbox"/> rent <input type="checkbox"/> loan <input type="checkbox"/> for credit
	<b>Calibration:</b> <input type="checkbox"/> DKD <input type="checkbox"/> Factory calibration
	<input type="checkbox"/> Quality test certificate DIN 55350-18-4.2.1

<b>A. Description of the Leybold product</b>	Failure description: _____
Material description: _____	
Catalog number: _____	Additional parts: _____
Serial number: _____	Application Tool: _____
Type of oil (Forevacuum pumps): _____	Application Process: _____

B. Condition of the equipment				Contamination:	
No <sup>1)</sup>	Yes	No		No <sup>1)</sup>	Yes
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	→	toxic	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		corrosive	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		flammable	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		explosive <sup>2)</sup>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		radioactive <sup>2)</sup>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		microbiological <sup>2)</sup>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		other harmful substances	<input type="checkbox"/>

1. Has the equipment been used<sup>1)</sup> ☐

2. Drained (Product/service fluid) ☐

3. All openings sealed airtight ☐

4. Purged ☐

If yes which cleaning agent: \_\_\_\_\_

and which method of cleaning: \_\_\_\_\_

<sup>1)</sup> if answered with "No" go to D. ←

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) _____	
2. Are these substances harmful? <input type="checkbox"/> No <input type="checkbox"/> Yes	
3. Dangerous decomposition products when heated? <input type="checkbox"/> No <input type="checkbox"/> Yes	
If yes, which? _____	

**<sup>2)</sup> Components contaminated by microbiological, explosive or radioactive products/substances will not be accepted without written evidence of decontamination.**

<b>D. Legally binding declaration</b>	
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): _____	firm stamp
Date _____ Signatur of authorised person _____	

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