

Vacuum Solutions

Application Support

Service



LEYBOLD VACUUM

GA 05.145/3.02



TURBOVAC TW 70 H

Wide-Range Turbomolecular
Pump with Integrated or External
Frequency Converter

150
Years

Operating Instructions

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Figures

The references to the diagrams, e.g. (2/10), consist of the figure number and the item number, in that order.

Warning

Identifies working and operating procedures which must be strictly observed to prevent hazards to persons.

Caution

Indicates working and operating procedures which must be strictly observed to prevent damage to or destruction of the appliance.

We reserve the right to alter the design or any data given in these operating instructions.
The illustrations are approximations.

1 Description

The TURBOVAC TW 70 H 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 S 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 gasses
- operation without a forevacuum pump.

If reactive gases in low concentrations must be pumped please consult with Leybold.

During operation the pressure inside the pump is so low that there is no danger of ignition (at pressures below about 100 mbar). A hazardous condition will be created if flammable mixtures enter the hot pump at pressures above 100 mbar. 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.

Warning



Never expose any parts of the body to the vacuum.

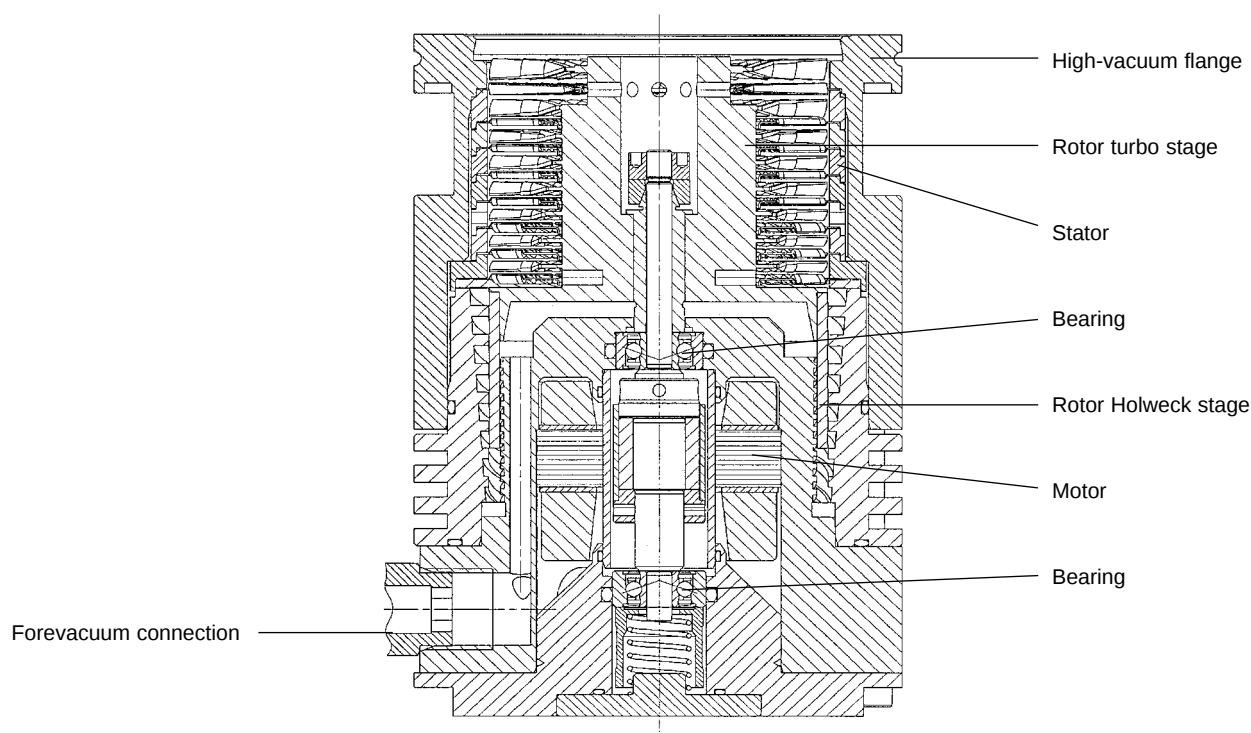


Fig. 1 Section through a TURBOVAC TW 70 H

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.

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

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.

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.

A plastic vacuum hose can be fitted directly to the forevacuum flange using a new high-vacuum tight port fitting, or a DN 16 KF flange is available.

The pump connection cable is fixed and ready to connect to the TURBO.DRIVE S frequency converter.

1.2 Standard equipment

The components of the pump are given in the ordering matrix in Chapter 1.3.1 for each catalog number.

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 forevacuum flange is blank-flanged with centering ring with FPM sealing ring and a clamping yoke.

The high-vacuum 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 Ordering data

1.3.1 Pumps

Catalog Number TURBOVAC TW 70 H

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High-vacuum flange and housing

DN 63 ISO-K

DN 63 CF

DN 40 KF

DN 40 CF

1

2

4

5

Cooling

Air cooling

Water cooling

No forced cooling

2

4

9

Forevacuum connection

Camozzi coupling 10 mm

DN 16 KF

1

3

Frequency converter

without frequency converter

with mounted frequency converter
TURBO.DRIVE S

... with RS 485 interface

... with RS 232 interface

... with Profibus interface

... without interface

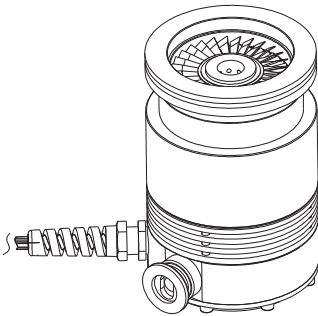
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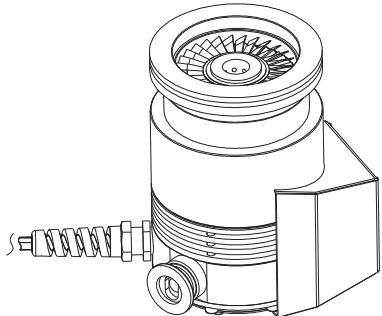
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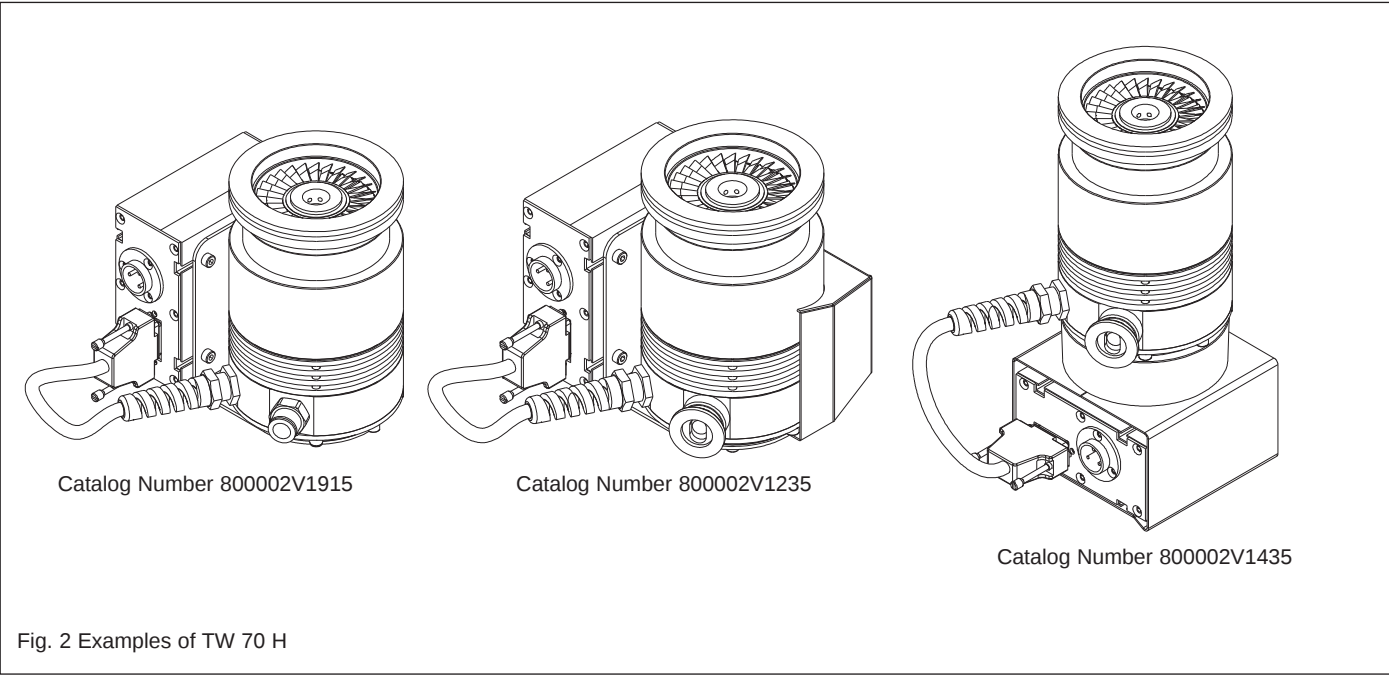
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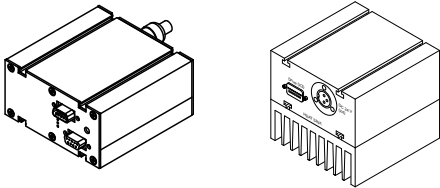
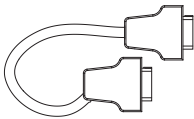
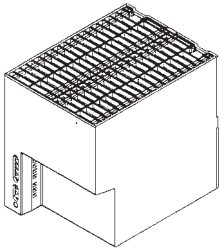
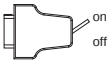
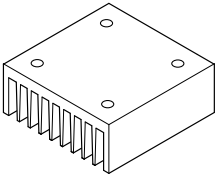
Catalog Number 800002V1934



Catalog Number 800002V1234

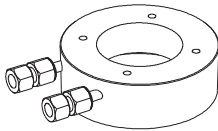
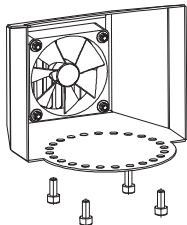
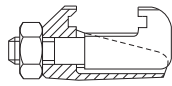
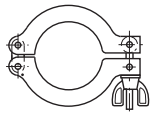


1.3.2 Frequency converter and accessories for the frequency converter

Frequency converter TURBO.DRIVE S Basic unit with RS 232 interface with RS 232 interface and mounted heat sink with RS 485 interface with RS 485 interface and mounted heat sink with Profibus interface	Part No. 800070V0001 800070V0002 800070V0005 800070V0003 ¹⁾ 800070V0006 800070V0004	
Connection line pump - frequency converter (TD Pump cable) 1.0 m long 2.5 m long 3.0 m long 5.0 m long	152 47 864 49 864 40 864 50	
DC Cable 3 m 5 m 10 m 20 m	200 12 732 200 12 733 200 12 735 200 12 734	
Power supply SITOP Power 10 Other power supplies	152 50 on request	
Plug for connector REMOTE with integrated ON/OFF switch for the pump (Sub-D plug, 9 pole)	152 48	
Heat sink for frequency converter	800110V0001	

1) Previous Part No. 161 11, 136 31

1.3.3 Accessories for the pump

Splinter guard fine	Part No. 200 17 170	
Camozzi coupling	200 04 361	
Water cooling with connection G 1/8" (for fitting to pumps without forced cooling) Adapter G 1/8" - 1/4" Swagelok Tube connector G 1/8" outer dia. 10 mm Tube connector G 1/8" outer dia. 8 mm Sealing ring 10x14x1	800135V0001 200 18 366 800 000 273 224 01 207	
Air cooling (for fitting to pumps without forced cooling)	800136V0001	
Flange heater (only for pumps with CF flange) DN 63 CF, 230 V DN 63 CF, 110 V DN 40 CF, 230 V	854 04 854 07 853 97	
Copper gasket rings for CF flange (Set of 10 pieces) DN 63 CF DN 40 CF	839 44 839 43	
Set of hex. screws with nuts, screws and washers for CF flange DN 63 CF DN 40 CF	838 81 839 01	
Centering ring (Al) with O-ring (FPM) DN 63 ISO-K	268 41	
Clamps (Set of 4 pieces)	267 01	
Centering ring with O-ring for DN 16 KF Al/CR Al/FPM Centering ring with O-ring for DN 40 KF Al/CR Al/FPM	183 26 182 06 183 28 182 08	
Clamping ring (Al) DN 16 KF Clamping ring (Al) DN 40 KF	183 41 183 43	

1.4 Technical data

1.4.1 TURBOVAC

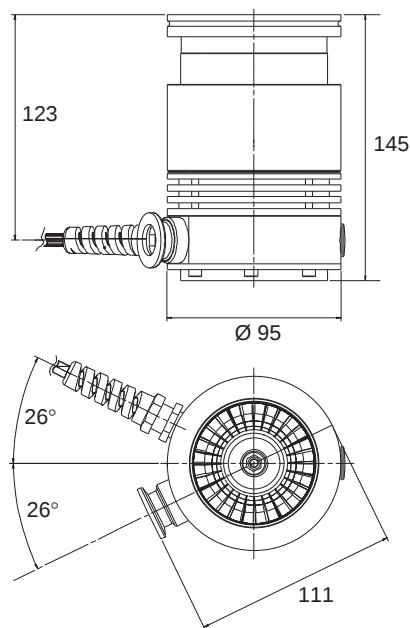
TW 70 H

High-vacuum connection	DN 63 ISO-K / DN 63 CF DN 40 KF / DN 40 CF
Pumping speed (without splinter guard)for	
N ₂	65 l·s ⁻¹
He	55 l·s ⁻¹
Ultimate pressure	
with two-stage, oil-sealed rotary vane pump	< 10 ⁻⁹ mbar
with diaphragm pump achieving ultimate pressure < 5 mbar	< 10 ⁻⁷ mbar
Max. permissible forevacuum pressure	10 mbar
Weight	
Pump	2.3 kg
Pump with TURBO.DRIVE S	3.0 kg
Pump with TURBO.DRIVE S and air cooler	3.2 kg
Pump with TURBO.DRIVE S and water cooler	3.3 kg
Recommended forevacuum pumps	
• TRIVAC	D 2.5 E
• Diaphragm pump DIVAC	0.8 T
Operating speed	72,000 rpm
Run-up time	1.5 min
Forevacuum connection	DN 16 KF or Camozzi coupling
Type of protection	IP 20
Noise level	< 46 dB(A)
Ambient temperature	
during operation	+ 15 - + 45 °C
storage	- 15 - + 70°C
Max. rel. air humidity	approx. 95% ¹⁾ (non-condensing)

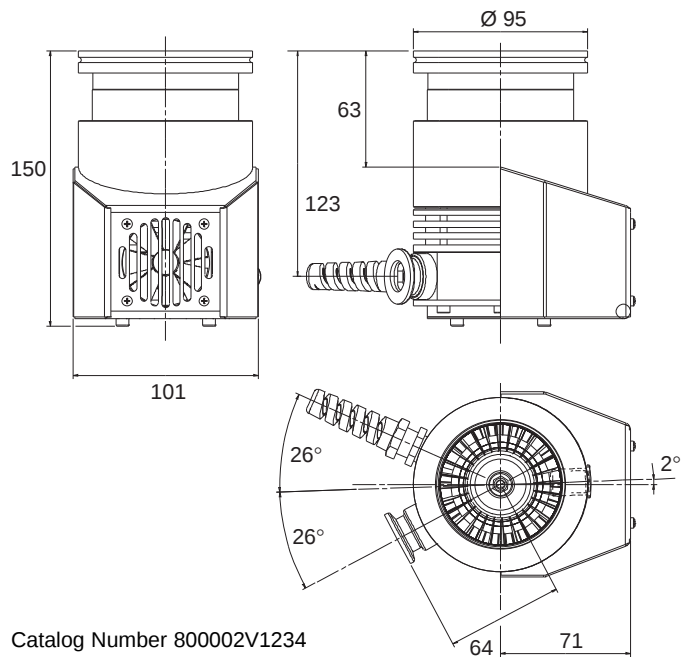
Option pump with water cooling

Cooling water connections	G 1/8"
Cooling water data	see Section 2.4

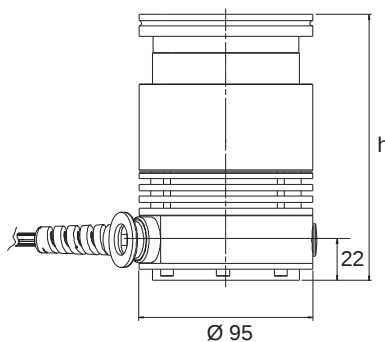
1) More details in Applied technical standard IEC 721-3-3
3K3/ 3Z1/ 3B1/ 3C1/ 3S2/ 3M1



Catalog Number 800002V1934
TW 70 H
with DN 63 ISO-K flange,
no forced cooling,
DN 16 KF forevacuum connection,
without frequency converter



Catalog Number 800002V1234
TW 70 H
with DN 63 ISO-K flange,
air cooling,
DN 16 KF forevacuum connection,
without frequency converter



**Height for different
high-vacuum flanges**

High-vacuum flange DN	h
63 ISO-K	145
63 CF	166
40 CF	170
40 KF	155

Fig. 3a Dimensional drawings for TW 70 H pumps; dimensions in mm

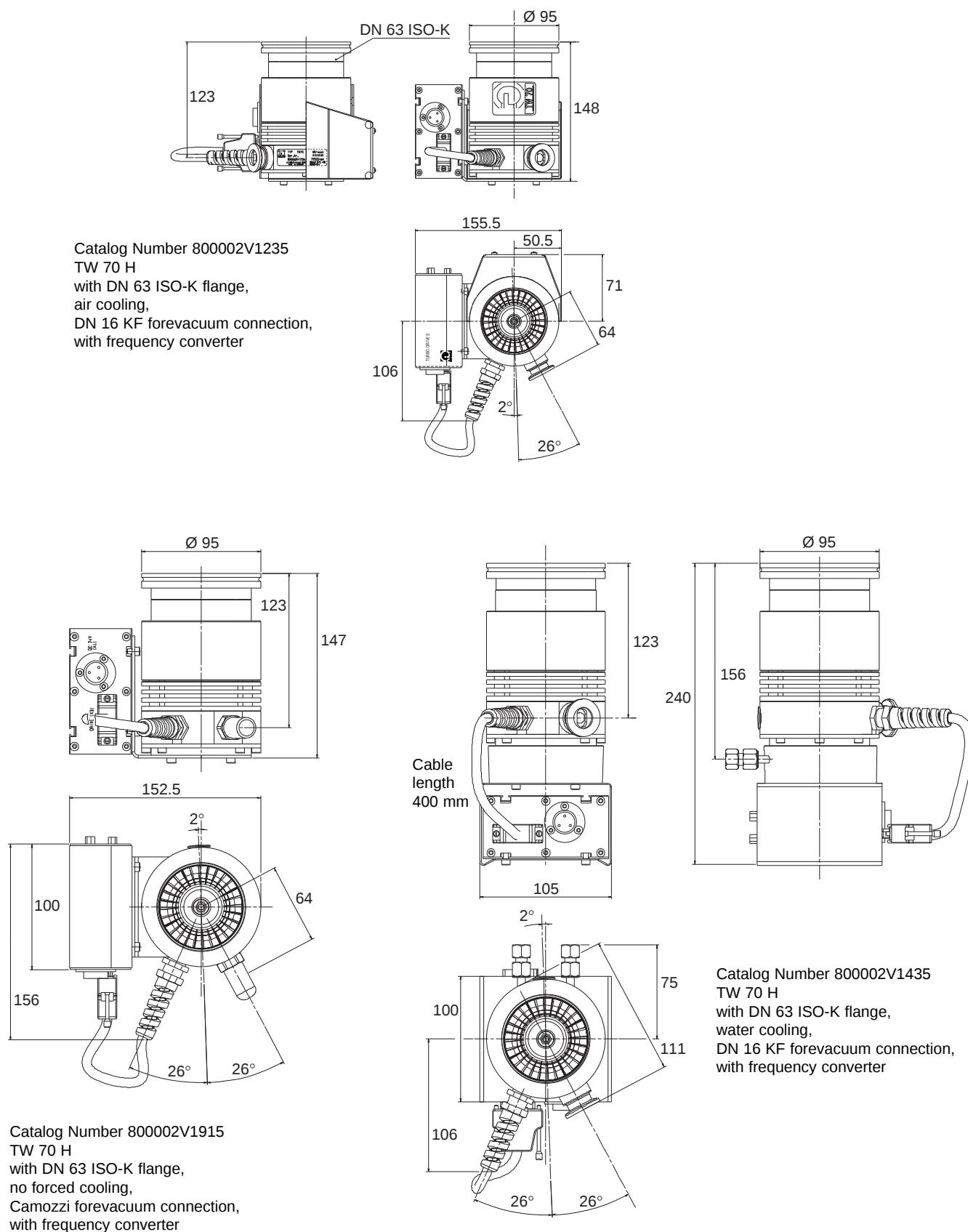


Fig. 3b Dimensional drawings for TW 70 H pumps; dimensions in mm

1.4.2 TURBO.DRIVE S

Supply voltage	24 V DC $\pm$ 5%
Residual ripple	< 2%
Max. power consumption	170 W
Max. continuous current	6 A
Max. current	7 A
Max. length of the DC cable (shielded)	
at 3 x 1.5 mm ²	5 m
at 3 x 2.5 mm ²	20 m
Load capability, relay output	42 V, 0.5 A
Ambient temperature	
during operation	10 - 45 °C
storage	- 15 - + 70 °C
Temp. of the heat transmission surface	10 - 55 °C
Only Part No. 800070V0004	10 - 50 °C
Power loss	$\leq$ 20 W
Relative air humidity acc. to DIN EN 60721	Class F
Type of protection	IP 20
Weight, approx.	0.7 kg
RS 232/485 interface	19 200 Baud
Address for RS 485	0 - 15
Parity	even
Response delay time	2 - 19 ms
Default	10 ms

1.4.3 Power supply SITOP Power 10

AC input voltage	120/230 V, 50/60 Hz
Tolerance	93 - 132 V 187 - 264 V
Recommended circuit breaker (characteristic C)	16 A
Power consumption	270 W
DC output voltage	24 V $\pm$ 1%
DC output current	0 - 10 A
Weight, approx.	1 kg
Mounting	DIN rail
Screw-type terminals	0.5 - 2.5 mm ² 22 - 12 AWG
Ambient temperature	
during operation	0 - 60 °C
storage	-25 - + 85 °C
Cooling	air convection
Type of protection	IP 20
Safety to EN60950	SELV
RI suppression to EN 55022	limit curve B
Noise immunity to EN 50082-2	incl. Table A4
UL508 FILE	E143289

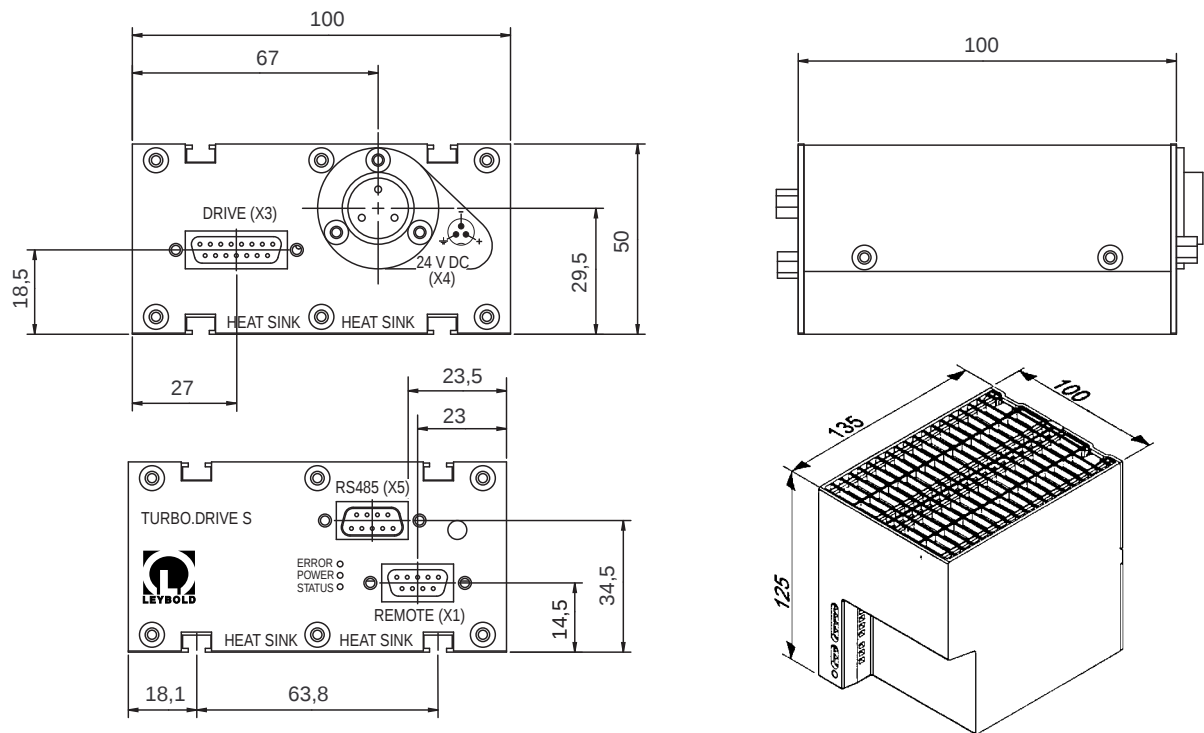


Fig. 4 Dimensional drawing for the TURBO.DRIVE S with RS 485 interface and the SITOP Power 10, dimensions in mm

2 Connections

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 contains dust.
Observe the information on media compatibility at the beginning of these operating instructions.

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



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.

2.1 Operating environment

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

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.

The standard pump version without frequency converter is resistant to radiation up to 10³ Gy.

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.

1 mT (milliTesla) = 10 G (Gauß)

1 Gy (Gray) = 100 rad

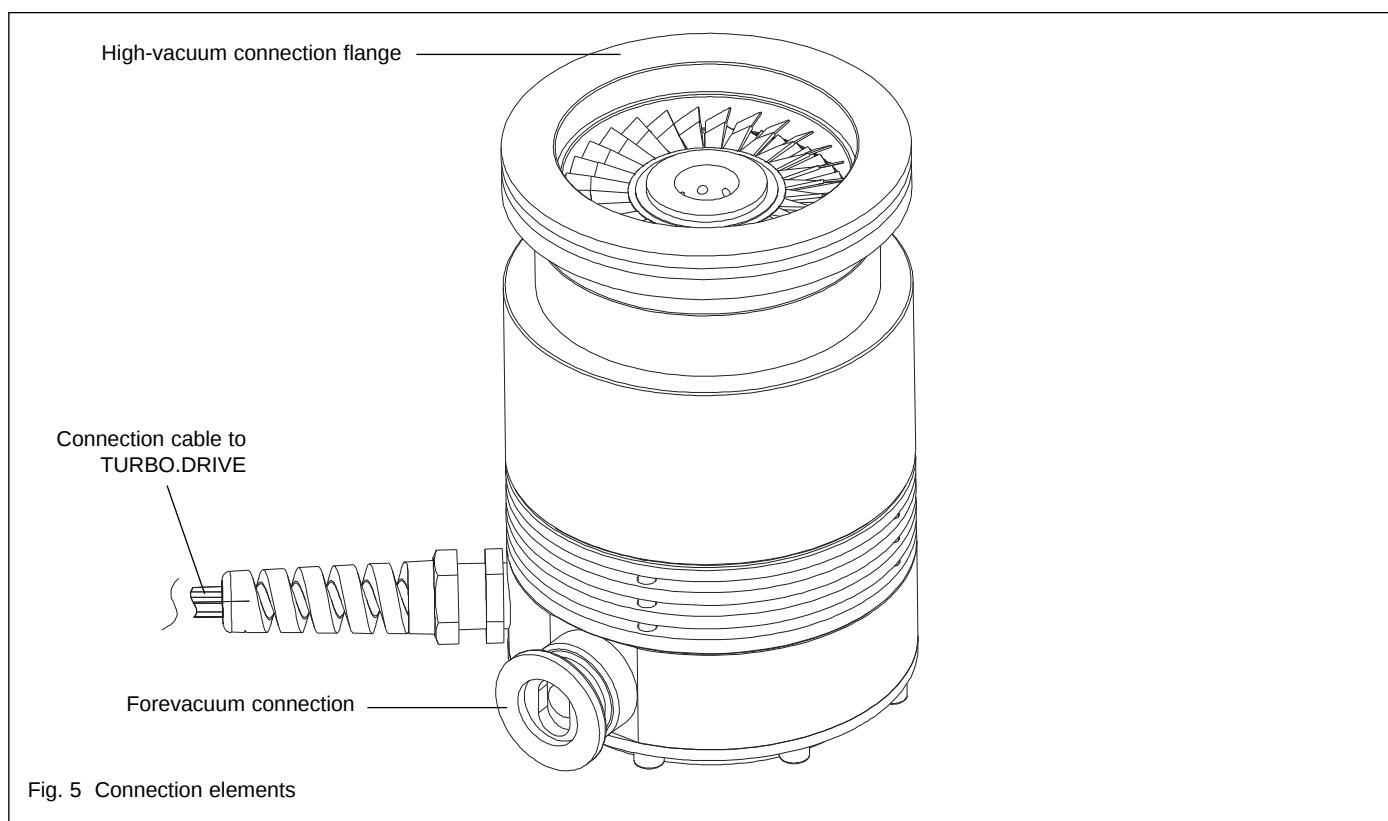


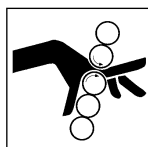
Fig. 5 Connection elements

2.2 Attach the pump to the vacuum chamber

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 470 Nm will have to be absorbed by the system. To accomplish this,

- 4 clamping bolts quality 12.9 or
- 6 clamping bolts quality 8.8

are required for securing an ISO-K type high-vacuum flange.

Clamping bolts made of steel must be torqued down to 35 Nm (26 ft-lb), those made of stainless steel to 50 Nm (37 ft-lb).

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 3 boreholes in the pump's bottom. A rubber foot must be removed from one of the boreholes.

Caution

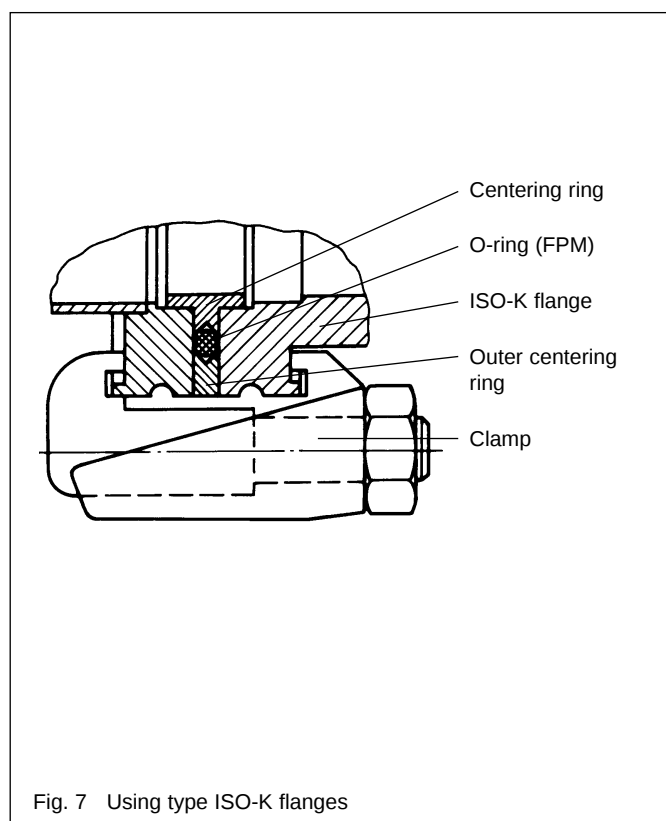
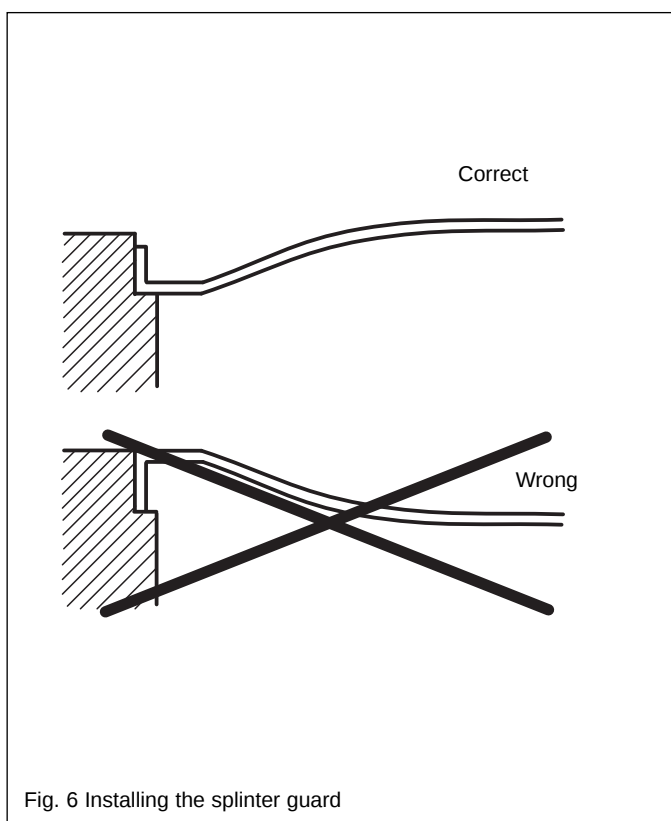
If foreign objects could pass from the vacuum chamber into the pump, install a wire mesh splinter guard. Foreign objects which enter the pump through the intake would cause serious damage to the rotor. Damage resulting from foreign objects in the rotor section are excluded from guarantee coverage.

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.

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.

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



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 Leybold Catalog.

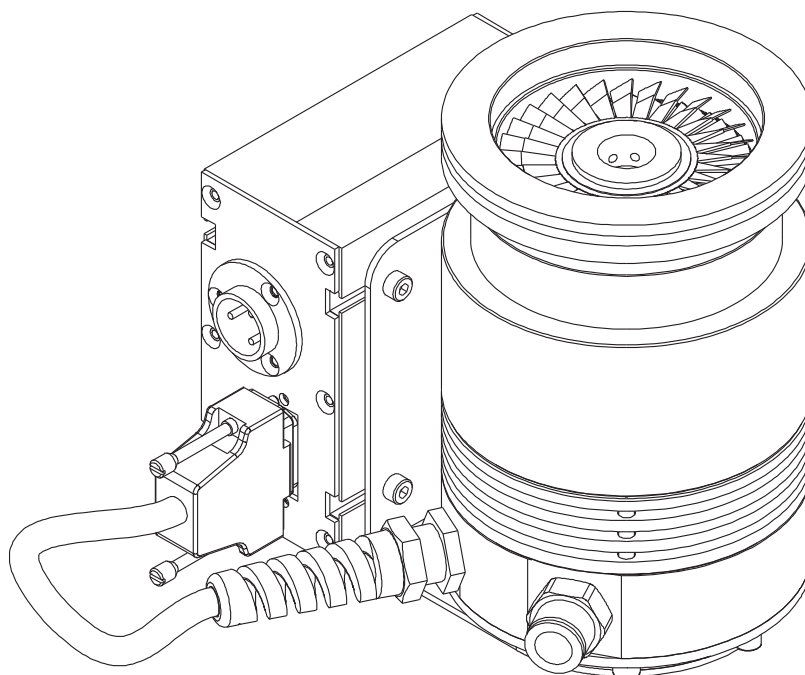


Fig. 8 Forevacuum connection with Camozzi coupling

2.3 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 dry-running diaphragm vacuum pumps or TRIVAC rotary vane pump for this purpose.

For the forevacuum connection a vacuum hose $\varnothing 10 \times 8$ mm will be needed. We recommend a polyamide hose.

Remove the shipping cap from the forevacuum connection. Pull the rear ring and push the forevacuum hose into the connector. Release the ring. The hose will be fixed.

Alternatively you may unscrew the hose connector and use the R 3/8" screw connection for the forevacuum connection.

Warning



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

Figure 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.

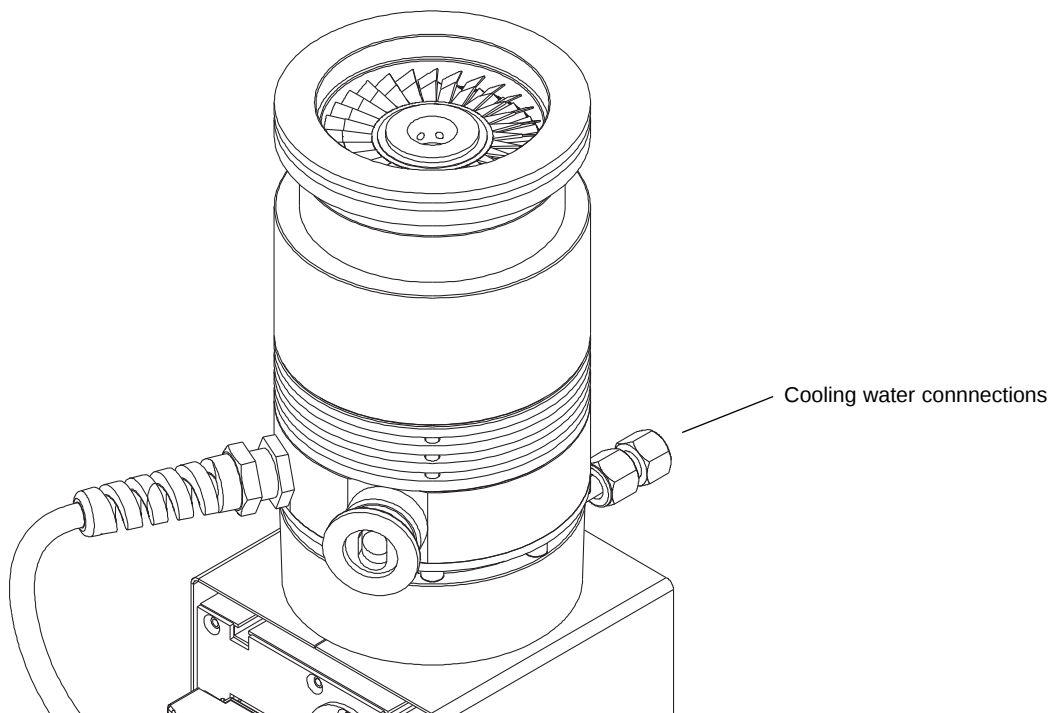


Fig. 9 Pump with water cooling

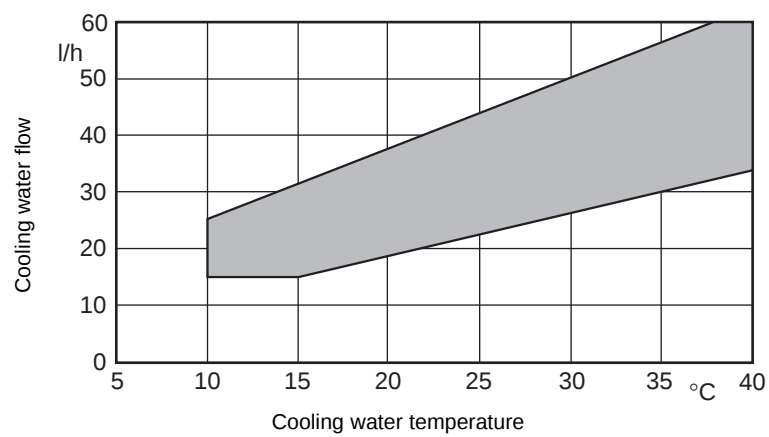


Fig. 10 Cooling water requirements

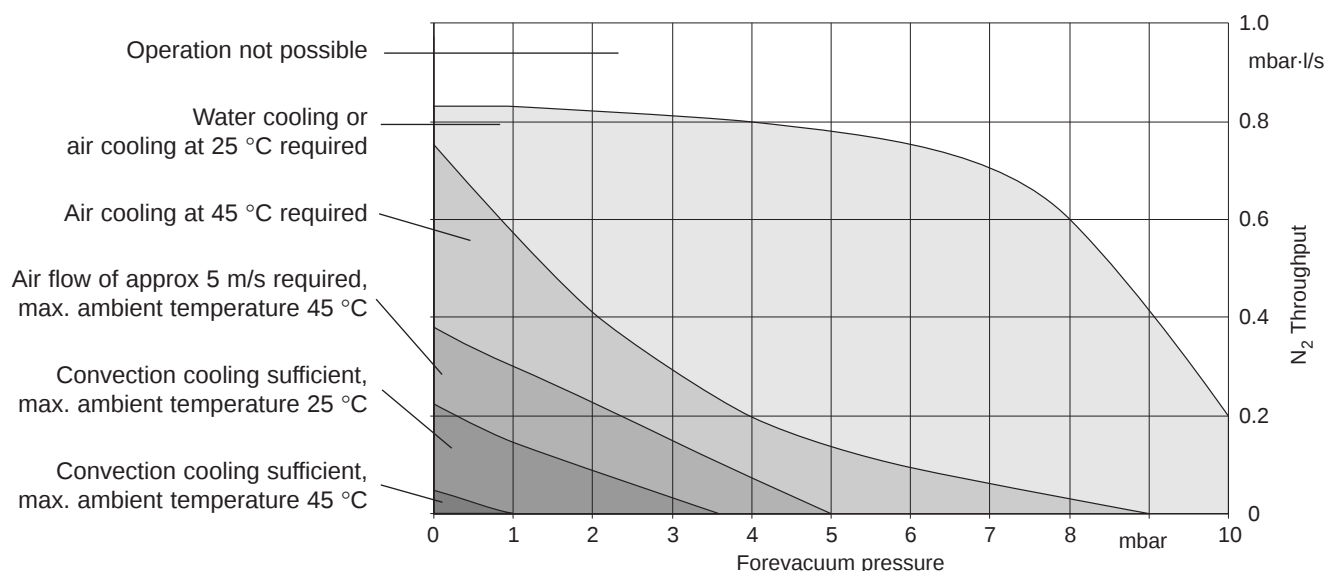


Fig. 11 TW 70 H cooling requirements when pumping Nitrogen or air

2.4 Connect the cooling

When installing the pump into a housing, ensure that the flow of cooling air is not restricted; see Fig. 12.

Caution

The pump must be operated with the air cooling unless you have an agreement from Leybold for different operation.

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.

Cooling water specifications

Feed temperature	10 - 40 °C
Feed pressure	2 to 7 bar absolute
Cooling water requirement	See Fig. 10
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)

Further information on request.

Connecting the cooling water

Screw on the cooling water lines; connections G 1/8".

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.

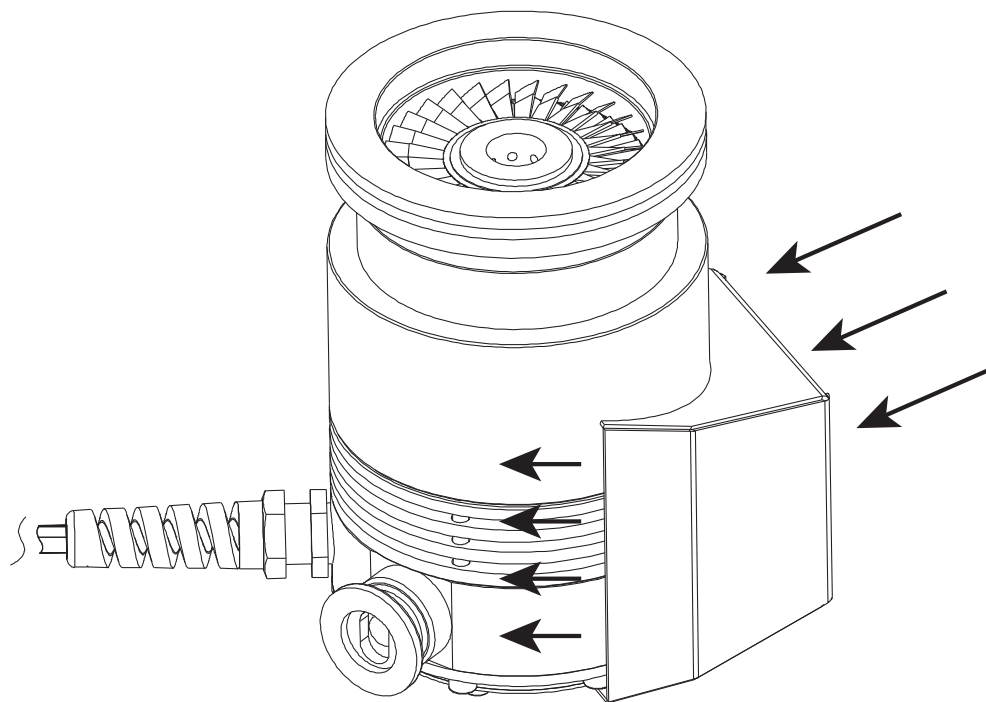


Fig.12 Pump with air cooling

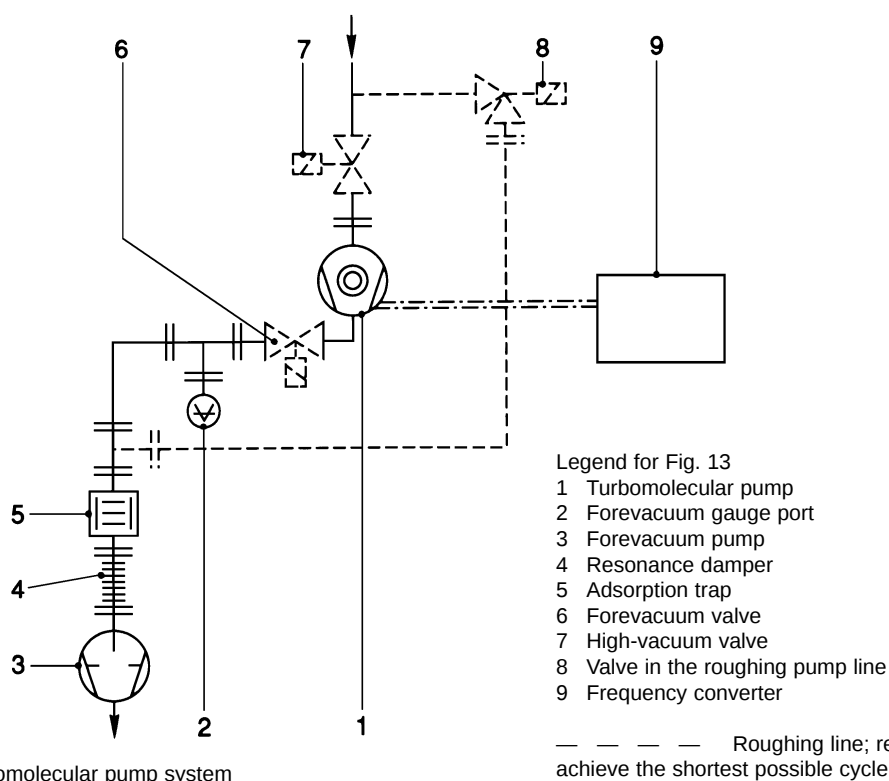
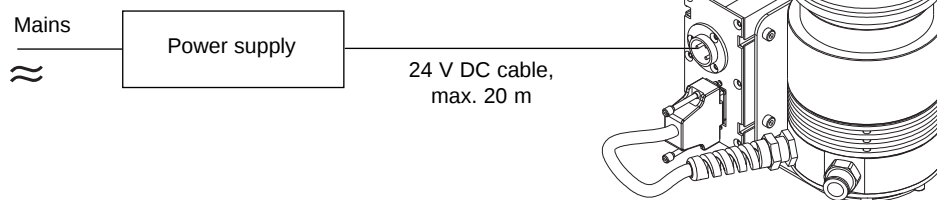
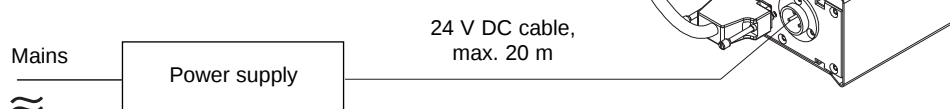


Fig.13 Schematic of a turbomolecular pump system

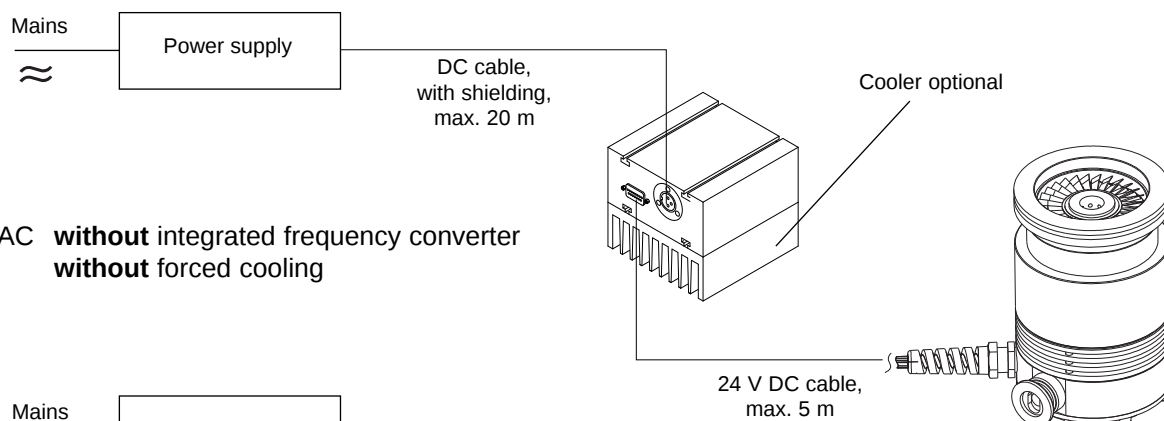
**TURBOVAC with integrated frequency converter
without forced cooling**



**TURBOVAC with integrated frequency converter
with water cooling**



**TURBOVAC without integrated frequency converter
without forced cooling**



**TURBOVAC without integrated frequency converter
with air cooling**

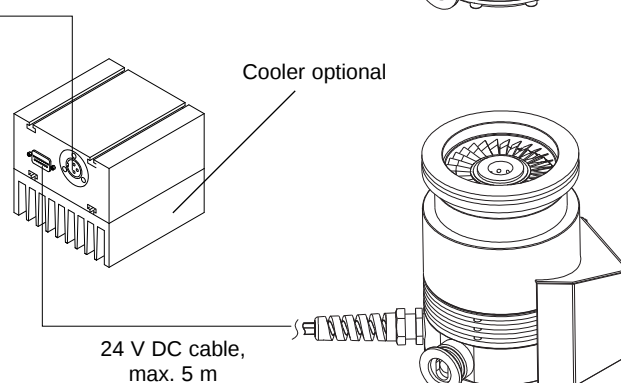
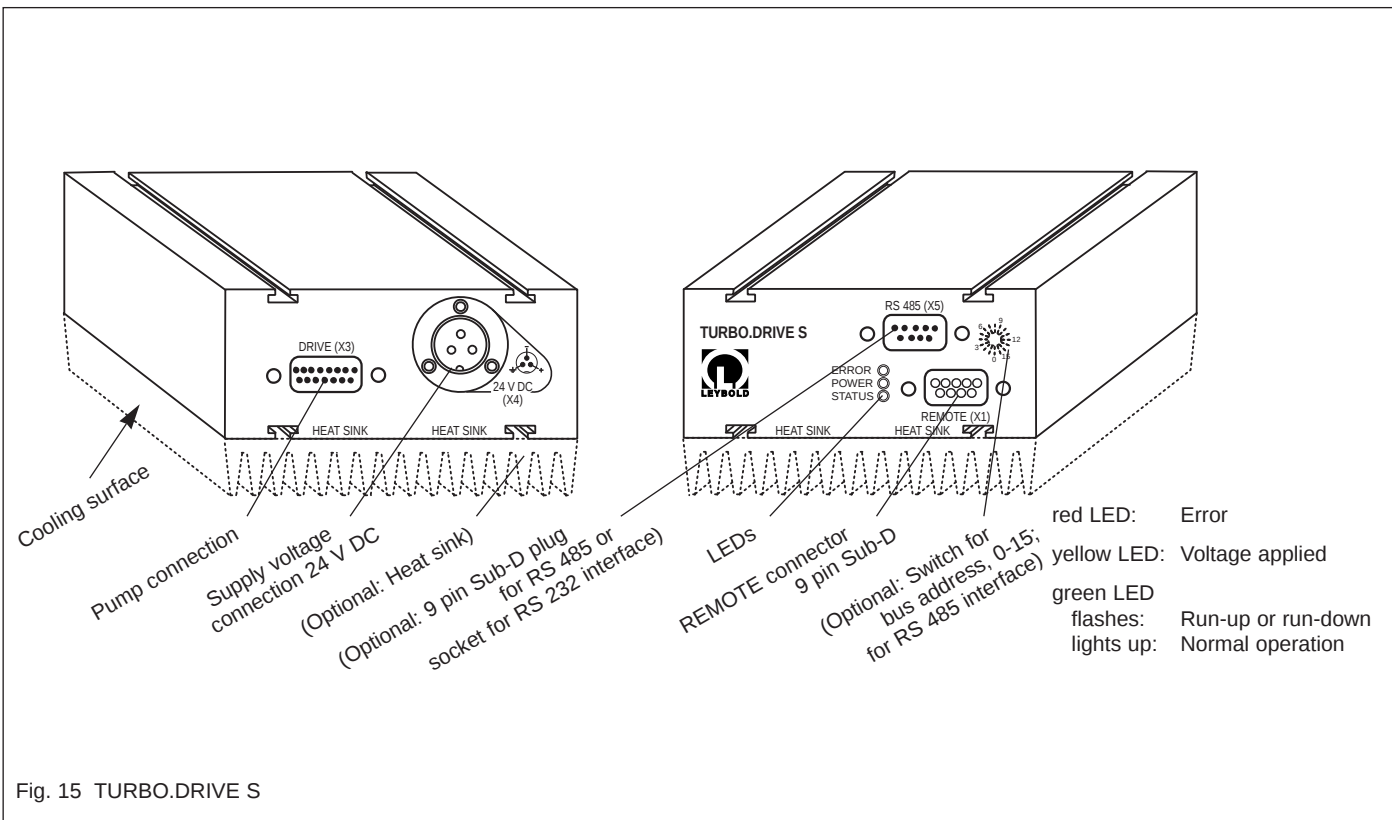


Fig. 14 Examples for connection



2.6 Electrical connection

The TURBO.DRIVE S frequency converter needed to operate the TURBOVAC TW 70 H has either been integrated in the pump or is a separate unit. For connection examples see Fig. 14.

Warning



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

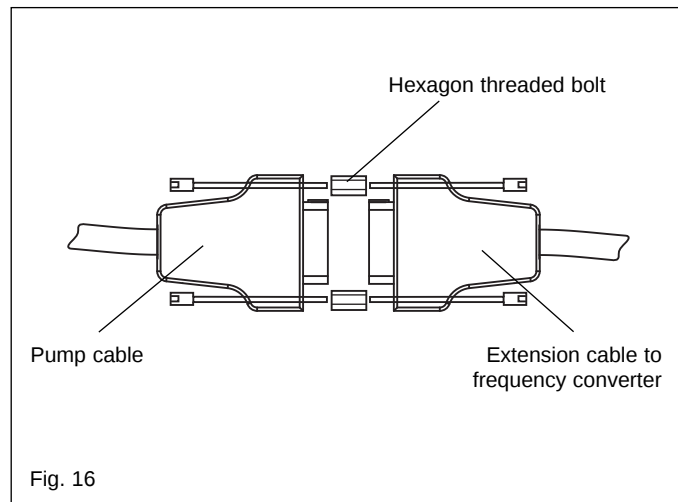
Route all cables so as to protect them from damage.

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



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

Separating the connections while the mains power is still applied or while the pump is still turning may destroy the TURBO.DRIVE S.

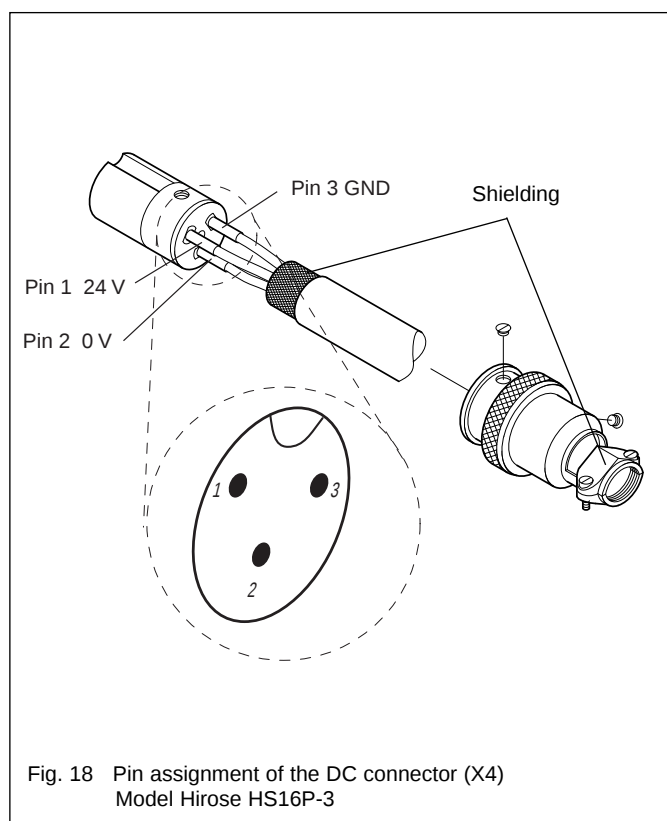
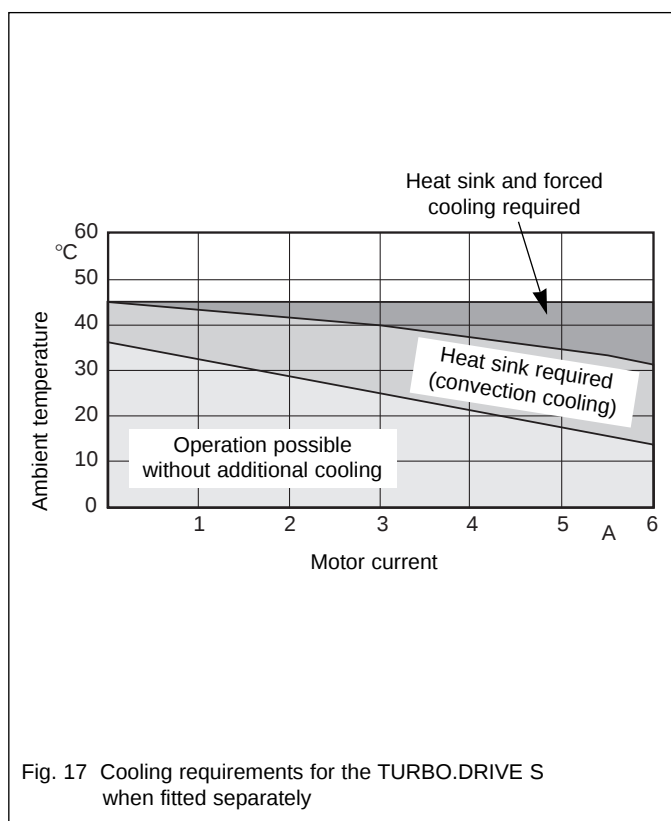


2.6.1 Connecting pump and frequency converter

Only required in the case of a separate 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 which are provided with the cable.

Make sure that the frequency converter is adequately cooled; for this see Section 2.6.3 and also Fig. 17.



2.6.2 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 1.4.3. Peak loads in the kHz range may be present on the DC side. The power supply should have a current limitation or control.

Connect the frequency converter to the 24 V DC power supply at the DC connector X4; see Fig. 19.

Caution

Ensure correct polarity.

Pin 1 + 24 VDC

Pin 2 0 V

Pin 3 GND

Connect the power supply to the mains.

2.6.3 Mounting the frequency converter

The frequency converter can be mounted into a rack. The bottom side of the frequency converter must be cooled sufficiently.

If the frequency converter is installed without the optional cooling fins, adequate cooling must be ensured by other means.

The cooling surface of the frequency converter must not warm up to more than 55 °C (113 °F). When mounting the frequency converter on existing cooling surfaces ensure good surface contact.

For special requirements please contact Leybold.

The frequency converter has an internal SMD fuse T 10 A. It can only be changed by the Leybold Service.

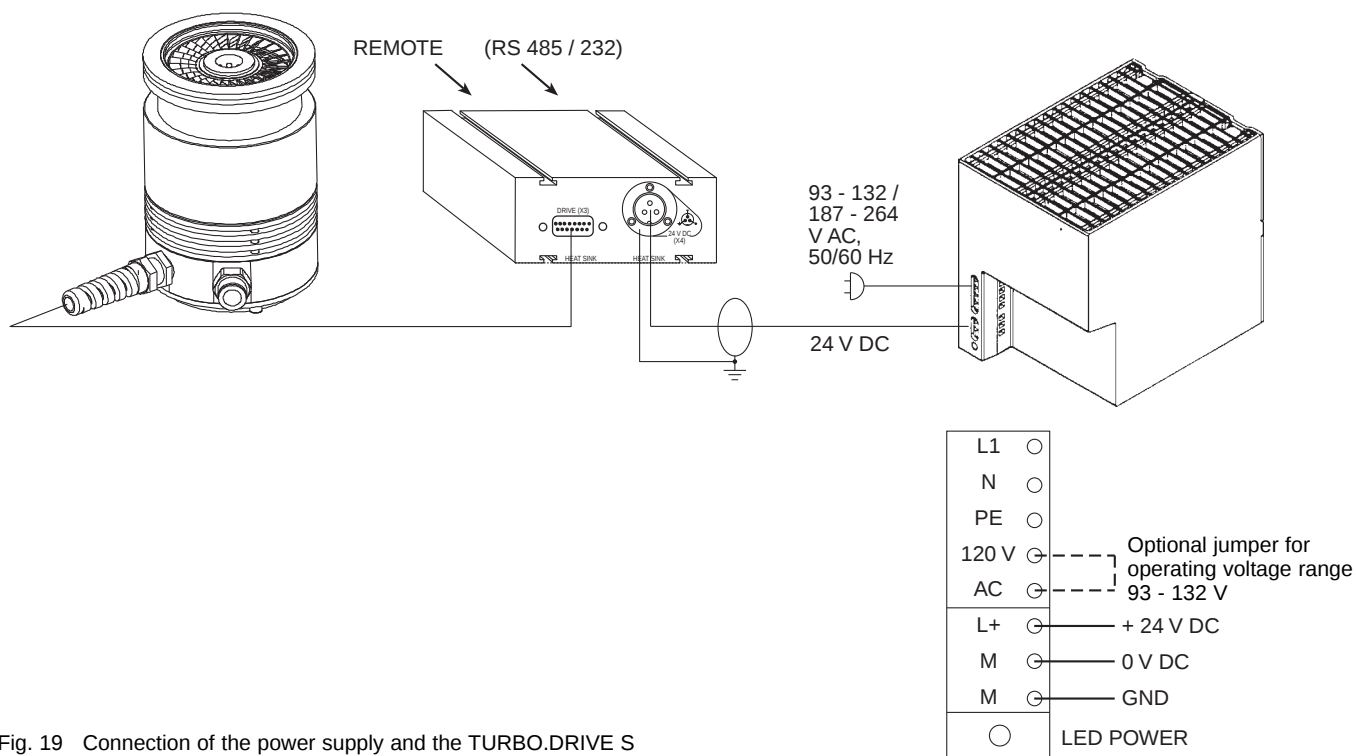
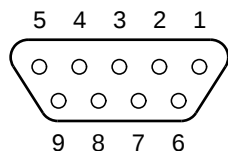
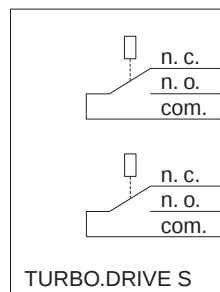


Fig. 19 Connection of the power supply and the TURBO.DRIVE S

Pin assignment of the connector



Relay operation



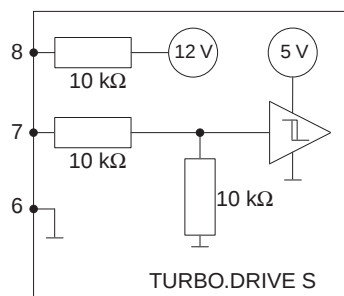
Relay - Normal operation

- While deceleration, acceleration, Stop: 4 connected to 5 (as shown; passive)
- During normal operation ($f > 0,9 \cdot f_{nom.}$): 4 connected to 3 (active)

Relay - Error

- No error: 1 connected to 2 (as shown; passive)
- Error is present: 1 connected to 9 (active)

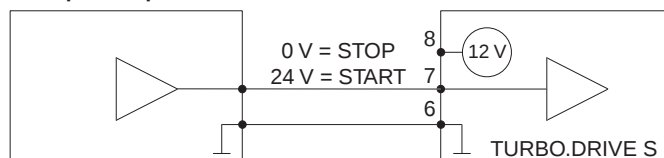
Pin assignment for the Start/Stop input



Switching threshold for the Start/Stop control input:
Low level: < 3 V
High level: > 7 V

Start/Stop operation

Example 1: Operation via a PLC



Example 2: Operation via contacts

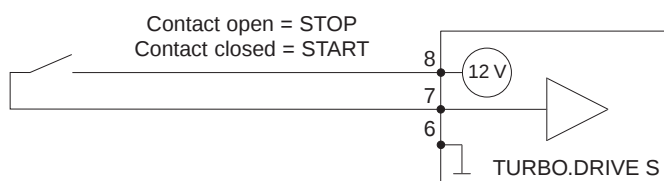


Fig. 20 Pin assignment of the REMOTE (X1) connector

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 S.
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

2.6.4 Interface description

The frequency converter has an optional serial interface RS 485. It is operated with the standardized USS protocol. The frequency converter can be set to addresses 0 to 15. Addresses over 15 are not supported.

For more detailed information concerning the USS protocol please contact Leybold.

The RS 485 bus should be connected as shown in Fig. 22.

The frequency converter can be configured through the parameters shown in the parameter list.

As to the RS 232 and Profibus interfaces please enquire.

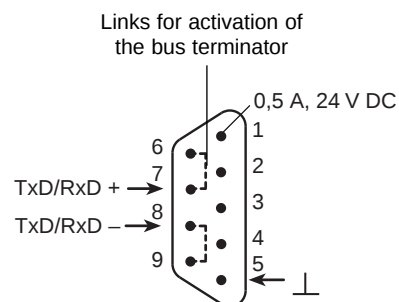


Fig. 21 Pin assignment of the interface connector „RS 485“

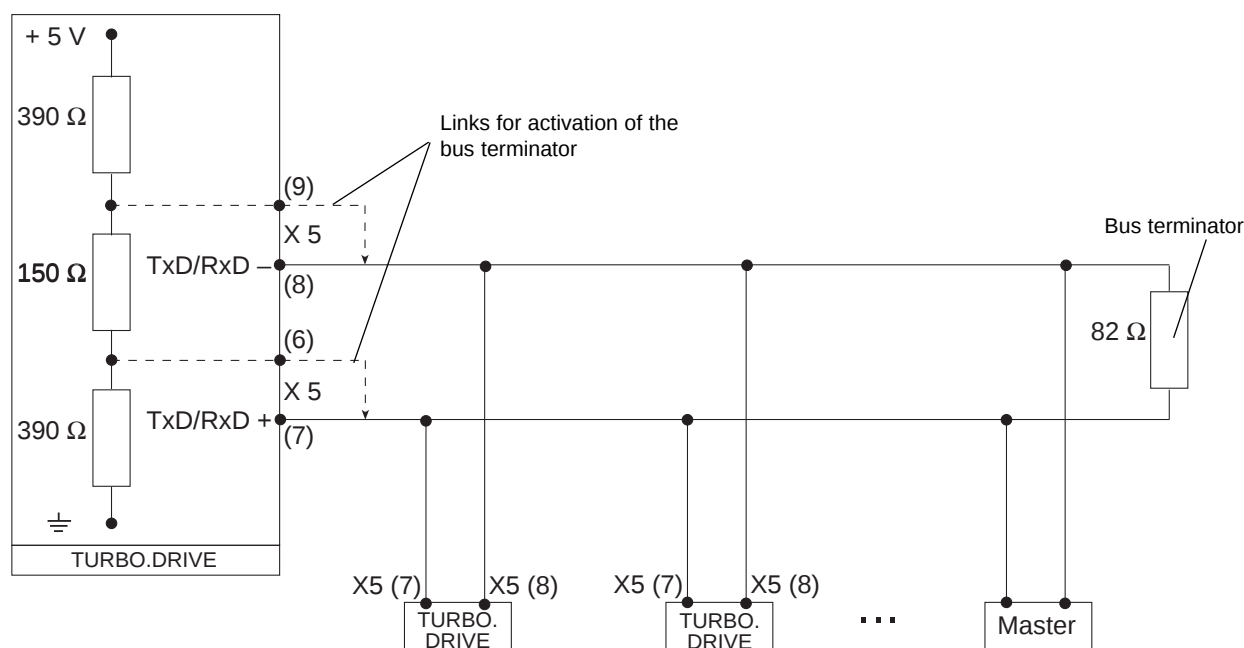


Fig. 22 Connection of the RS 485 bus

Parameter list

r = readable, w = writable

No.	Designation	Range	Unit	Default	Format	r/w	Description
0	Dummy parameter	-	-	-	U16		No function
1	Type of frequency converter	130 / 131	-	-	U16	r	TURBO.DRIVE S = 130 TURBO.DRIVE L = 131
2	Software version	2.x.x	-	-	U16	r	
3	Actual rotor frequency	0...1300	Hz	-	U16	r	The max. frequency depends on the pump type.
4	Actual converter supply voltage	18...30	V	-	U16	r	Nominal value for TURBO.DRIVE S: 24V
5	Actual motor current	0... 60	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.
11	Actual converter temperature	0...150	°C	-	U16	r	Measured internal converter temperature
12	Operating mode for Start/Stop	0...2	-	0	U16	r/w	P12 = 0 (default): via REMOTE (X1); see Fig. 20 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

No.	Designation	Range	Unit	Default	Format	r/w	Description
17	Max value setting for motor current	5 ... 75	0,1 A	45	U16	r/w	Maximum permissible motor current
18	Nominal pump frequency	750...1200	Hz	1200	U16	r	Highest permissible frequency
19	Minimum setpoint frequency for the pump	375..600	Hz	600	U16	r	Lowest permissible frequency
20	Minimum frequency level	375..600	Hz	-	U16	r	When the pump is accelerating this frequency must be reached within the maximum passing time (P183).
23	Pump type	0...4	-	3	U16	r	
24	Setpoint frequency	P19 ... P18	Hz	1200	U16	r/w	Adjustable between P19 to P18
25	Frequency dependent normal operation level	0..100	%	90	U16	r/w	If P29 = 0: Defines the normal operation level. Normal operation if $P3 \geq P24 \times P25$
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 $P5 \leq P27$
29	Selection of the normal operation function	0 / 1	-	0	U16	r/w	Normal operation relay function: 0 = frequency dependent (see P25) 1 = current dependent (see P27)
32	Maximum run up time	30...2000	s	720	U16	r/w	Max. permissible acceleration time from starting the pump's drive until reaching the normal operation level ($P24 * P25$)
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
125	Current bearing temp.	0...150	°C		U16	r	Measured bearing temperature (identical to P127)
127	Current bearing temp.	0...150	°C	-	U16	r	Measured bearing temperature (identical to P125)
132	Bearing temperature shutdown level	30...150	°C	67	U16	r	Max. permissible bearing temperature $P125 > P132$ causes the pump to be switched off
133	Motor temperature shutdown level	30...150	°C	90	U16	r	Max. permissible motor temperature $P7 > P133$ causes the pump to be switched off
171	Error code memory for the last 8 error events Error codes see next table	0...8		0	Array 0..7 U16	r	Sequential permanent memory; the last error code which has occurred is saved at the memory location with the index 0, the oldest is at index 7
176	Error operating hours memory for the last 8 error events	0...19 years	0.01 h	-	Array 0..7 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 USS protocol string of the frequency converter's serial interface. We recommend not to change the default setting (10 ms)
183	Max. passing time	10...2000	s	500	U16	r	During acceleration the pump must pass through the range of critical frequencies from 60 Hz to P20

No.	Designation	Range	Unit	Default	Format	r/w	Description
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
303	Pump status word	-	-	-	U16	r	Meaning of the bits: Bit 0 Normal operation = 1 Bit 1 Ready for switch on = 2 Bit 2 Speed is increasing = 4 Bit 3 Speed is dropping = 8 In case of an error P303 has the value of 0 (not ready to be switched on)
312	Cat. No. code	0 ... 65535	-	-	U16	r	
315	Serial No. code	1 ... 231-1	-	-	U32	r	The 9 resp. 10 least significant bits of the original serial No.
316	Hardware identifier	0...100	-	-	U16	r	Hardware version index of the converter

Error codes for parameter P171

Code	Type of error	Description of the error
0	No error	–
1	Overspeed error	Nominal speed of the pump (P 18) has been exceeded by over 10%
2	Pass through time error	Max. pass through time during run up has been exceeded: from 60 Hz to minimum frequency level; P3 < P20 after P183 has elapsed
3	Bearing temperature error	Maximum bearing temperature has been exceeded: P125 > P132; P127 > P132
4	Short circuit error	Short circuit in the pump's motor or the connecting cable
5	Converter temperature error	Maximum temperature for the converter has been exceeded: P11 > 65°C
6	Run up time error	Maximum run up time during run up has been exceeded from starting to normal operation: P3 < P24 * P25 after P32 has elapsed
7	Motor temperature error	Maximum motor temperature has been exceeded: P7 > P133
8	Pump error	Pump could not be identified or no pump is connected.

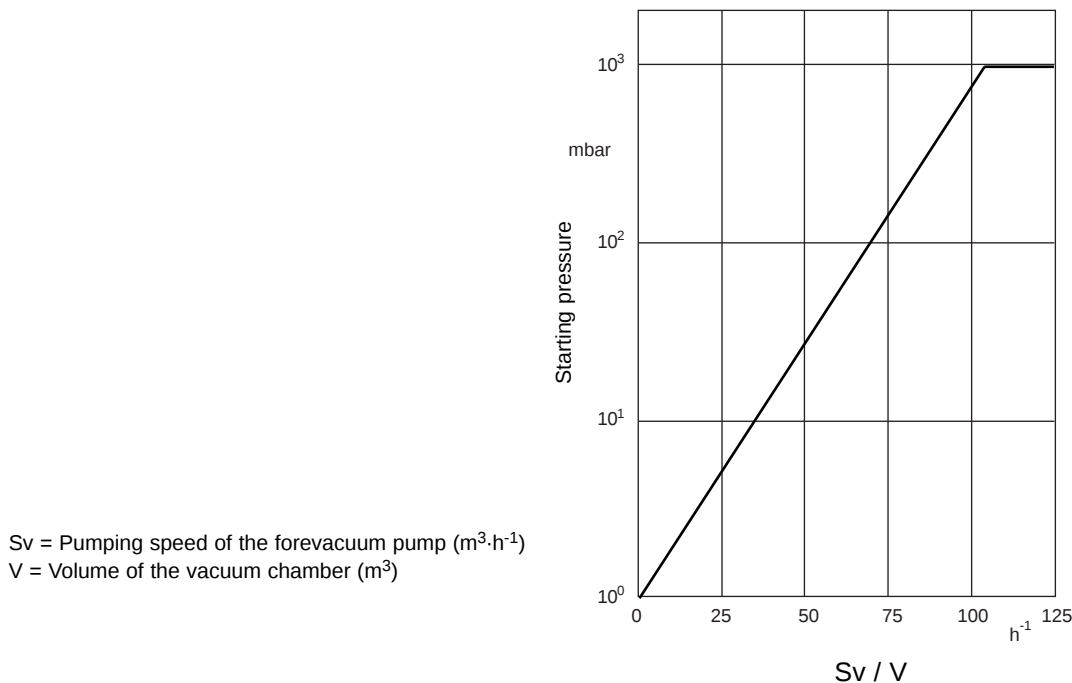


Fig. 23 Determining the starting pressure of a turbomolecular pump when evacuating large volumes

3 Operation

Warning



The turbomolecular pump must only be operated in the proper condition and under the conditions described in the Operating Instructions.

3.1 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 Figure 23.

Switch on the turbomolecular pump at the frequency converter

- by connecting contacts 7 and 8 at the REMOTE (X1) connector. (For example via a remote control or with the aid of the plug with integrated ON/OFF switch: see Section 1.3 Ordering data)

or

- by a start command via the interface; see Section 2.6.4.

For the power supply units offered or recommended by Leybold: 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.

Warning



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.

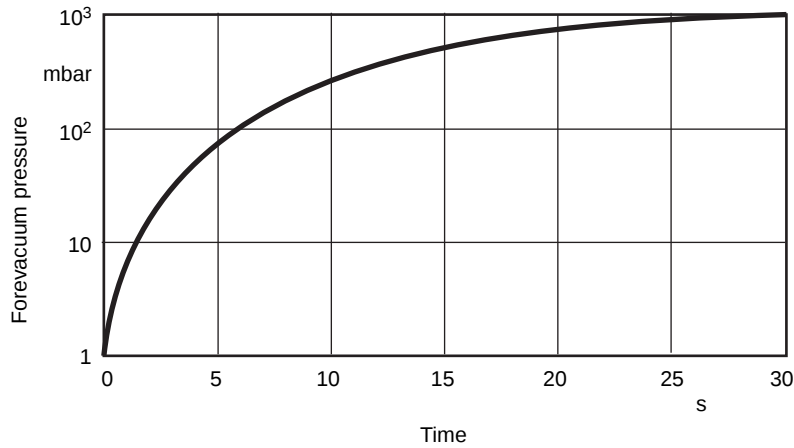


Fig. 24 Maximum rise in pressure

3.2 Shutting down

Switch off the pump at the frequency converter.

- Disconnect contacts 7 and 8 at the REMOTE (X1) connector

or

- apply a stop command via the interface

or

- for the power supply units offered or recommended by Leybold switch off the DC voltage.

Switch off the forevacuum pump.

When using oil-sealed forevacuum pumps, vent the turbomolecular pump before it comes to a stop; refer to Section 3.3.

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.

Warning



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 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.

3.3 Venting

When using oil-sealed forevacuum pumps, vent the pump each time it is shut down to prevent possible return diffusion of oil vapors from the forevacuum line to the high-vacuum side.

Use dry nitrogen, for example, for venting purposes.

The pump can be vented from the high-vacuum side.

When using a dry-running forevacuum pump, the pump can be vented via the forevacuum port.

When using oil-sealed forevacuum pumps **do not** vent the pump through the forevacuum port since oil vapors could enter the pump in this way.

The pump can be vented when it is running at full speed.

Caution

The values shown along the curve for pressure rise in Figure 24 must be maintained in all cases.

3.4 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.

3.5 Removing the pump from the system

Shut down the pump and vent as described in Sections 3.2 and 3.3.

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.

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 air-tight 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 Leybold.

4 Maintenance

The turbomolecular pump requires no routine maintenance.

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 Service by LEYBOLD

Whenever you send a pump to Leybold, indicate whether the pump 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; we will forward the form on request.

A copy of the form is printed at the end of these operating instructions: „Declaration of contamination of vacuum equipment and components“.

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

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

Pumps which are not accompanied by a contamination statement will be returned to the sender.

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?

- 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 S:

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

Malfunction	Possible cause	Corrective action
Red ERROR LED is on: Error code1: Overspeed error	EMC problems TURBO.DRIVE S faulty	Check connecting cable, insert it properly Switch the power supply voltage off and then on again Inform Leybold 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 loses its speed	Forevacuum or high-vacuum pressure too high. Gas volume too great. Power supply overloaded Bearing defective.	Check the forevacuum pump and use a different forevacuum pump if necessary. Seal leak; install a higher-capacity vacuum pump if necessary. Reduce the number of consumers or use a stronger power supply or switch on the consumers one after the other. Have the pump repaired (may be done only by a Leybold service technician).
Red ERROR LED is on: Error code 3 + 7: bearing temperature error and motor temperature error	Forevacuum pressure too high. Gas volume too great or leak in the system. Fan defective. Ambient temperature too high. Bearing defective.	Check the forevacuum pump and use a different forevacuum pump if necessary. Seal leak; install a higher-capacity vacuum pump if necessary. Replace the fan (may be done only by a Leybold service technician). Feed cooler air to the pump or install water cooling. Have the pump repaired (may be done only by a Leybold service technician).
Red ERROR LED is on: Error code 4: Short circuit error	Short circuit in the pump's motor Short circuit in the connecting cable	Inform Leybold Service. Check to see if the connecting cable is undamaged, exchange it if required.
Red ERROR LED is on: Error code 5: converter temperature error	TURBO.DRIVE S integrated in the pump: Inadequate cooling of the pump operation at too high loads Separate TURBO.DRIVE S: Ambient temperatures too high Inadequate cooling of the TURBO.DRIVE S Operation at too high loads	See corrective action for error code 3 + 7. Improve the cooling situation: Install a fan Ensure better thermal linking to the cooling surface and ensure a lower temperature at the cooling surfaces Avoid exposure to the heat generated by other equipment. See corrective action for error code 3 + 7.
Red ERROR LED is on: Error code 8: pump error TURBO.DRIVE S can not detect the type of connected pump.	Pump not connected to TURBO.DRIVE S Wrong connector cable pump - frequency converter. Power supply builds up the DC too slowly Power supply overloaded	Check connecting cable Use standard cable; see Section 1.3) (ConeNect doesn't work) Use power supply recommended by Leybold Reduce the number of consumers when switching on or use a stronger power supply.

Malfunction	Possible cause	Corrective action
Yellow power LED is not on.	No DC power Internal SMD fuse has blown	Check cables and power supply. Inform Leybold Service. The following may cause a blown SMD fuse: • DC power miswired • 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.
Turbomolecular pump does not start, ERROR LED does not light.	Operation mode set wrongly. Interface protocol error No RS 485 communication. REMOTE connector (X1) connected wrongly.	Change parameter 12. Use USS protocol. Connect bus as shown in Section 2.6. Connect as shown in Fig. 20.
Turbomolecular pump produces loud running noises and vibrations.	Rotor out of balance. Bearing defective.	Have the rotor balanced (may be done only by a Leybold service technician). Have the bearing replaced (may be done only by a Leybold service technician).
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. Have the pump cleaned (may be done only by a Leybold service technician). Check the ultimate pressure of the forevacuum pump and install a higher-capacity vacuum pump if necessary. Check parameters.

EEC Manufacturer's Declaration

in the sense of EEC Directive on Machinery 89/392/EEG, Annex IIb



We - 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.

At the same time we herewith certify conformity with EEC Directive on Low-Voltages 73/23/EEG.

When using the appropriate Leybold accessories, e.g. connector lines, valves, or fans, the protection level prescribed in the EMC Guidelines will be attained.

Designation: Turbomolecular pump

Model: TW 70 H

Catalog numbers: 80000xVxxxx

„X“: Variable 0 to 9

Applied harmonized standards:

- | | |
|---------------------|-----------|
| • EN 292 Part 1 & 2 | Nov. 1991 |
| • EN 1012 Part 2 | 1996 |
| • EN 60 204 | 1993 |
| • EN 61 010-1 | 1993 |

Applied national standards and technical specifications:

- | | |
|----------------|-----------|
| • DIN 31 001 | Nov. 1984 |
| • DIN ISO 1940 | Dec. 1993 |

Cologne, Jan 24, 2001

A handwritten signature in black ink, appearing to read 'Reinelt', written over a horizontal line.

Dr. Reinelt, Business Area Manager
Turbomolecular pumps

Cologne, Jan 24, 2001

A handwritten signature in black ink, appearing to read 'Beyer', written over a horizontal line.

Dr. Beyer, Design Department Manager
Turbomolecular pumps



Declaration of Conformity

as defined by the EMC guideline 89/336/EWG
with revisions 91/263/EWG and 93/68/EWG

Product: TURBO.DRIVE S



RIR-TDS2-EMV

2000-12-07

We herewith declare sole responsibility for the product

1. Product: Inverter
2. Manufacturer: Indramat Refu GmbH
Uracher Straße 91
72555 Metzingen / Germany
3. Type: TURBO.DRIVE S,
Cat. Nos.: 800070Vxxxx,
161 11, 136 31
4. including the following options: RS 232 interface, RS 485
interface, integrated Profibus DP, built on heat sink
5. from date of manufacture: 2000-12-01
6. Applied standards: EN 50081 Part 2: Electromagnetic
compatibility (EMC) / Generic
emission standard
EN 50082 Part 2: Electromagnetic
compatibility (EMC) / Generic
immunity standard 06/93

meet the requirements outlined in the EG requirements on
89/336/ EWG (EMC guideline) with revisions 91/263/EWG and
93/68/EWG.

Explanation

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

Test were run using a typical construction in a test assembly
that conforms with the standards. The legal requirements
made of resistance to interference and resistance to emission
of interference limit values and standards are outlined in the
above-referenced documentation.

This Indramat Refu product is intended for installation into an
end product. The test results are not applicable to every instal-
led state in every end product. This declaration does not the-
refore guarantee the EMC characteristics of the end product.

Metzingen, 2000-12-07

Michael Kimmich
Head of Quality Management

Stephan Scholze
Head of Development

We reserve the right to make changes in the conformity declaration.
Presently applicable edition can be obtained upon request.

Indramat Refu GmbH

Uracher Straße 91 • D-72555 Metzingen
Phone +49 (0) 71 23 / 9 69-0 • Fax +49 (0) 71 23 / 9 69-120





Declaration of Conformity

as per EG Low-Voltage Guidelines 73/23/EWG,
Attachment III B

Product: TURBO.DRIVE S



RIR-TDS2-NSR

2000-12-07

We herewith declare sole responsibility for the product

1. Product: Inverter

2. Manufacturer: Indramat Refu GmbH
Uracher Straße 91
72555 Metzingen / Germany

3. Type: TURBO.DRIVE S,
Cat. Nos.: 800070Vxxx,
161 11, 136 31

4. including the following options: RS 232 interface, RS 485
interface, integrated Profibus DP, built on heat sink

5. from date of manufacture: 2000-12-01

6. Applicable standard: EN 61010 Part 1: Safety
requirements for electrical
equipment for measurement,
control and laboratory use., 03/94

EN 60204 Part 1: Safety of
machinery - Electrical equipment of
machines, 06/93

including the required accessories, as agreeing with EG guide-
lines 72/23/EWG, and 93/68/EWG.

Explanation

This product is a component intended for further assembly.
Due to the features resulting therefrom, the product cannot
initially meet requirements made of finished products, machi-
nes or plants. It must thus be used for mounting/assembly only.

An evaluation of electrical and mechanical safety, environ-
mental conditions (e.g., extrinsic objects and/or humidity) must
be performed after mounting/assembly in the finished product.

The EMC characteristics of this product can change in a moun-
ted/ assembled state. An EMC check must thus be made for
the finished product (final unit, machine or plant) by the manu-
facturer of the finished unit, machine or plant.

Metzingen, 2000-12-07

Michael Kimmich
Head of Quality Management

Stephan Scholze
Head of Development

We reserve the right to make changes in the conformity declaration.
Presently applicable edition can be obtained upon request.

Indramat Refu GmbH

Uracher Straße 91 • D-72555 Metzingen
Phone +49 (0) 71 23 / 9 69-0 • Fax +49 (0) 71 23 / 9 69-120



Declaration of Contamination of Vacuum Equipment and Components

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

This declaration can only be completed and signed by authorized and qualified staff.

1. Description of Vacuum Equipment and Components

- Equipment type/model: _____
- Code No.: _____
- Serial No.: _____
- Invoice No.: _____
- Delivery date: _____

2. Reason for Return

3. Condition of the Vacuum Equipment and Components

- Has the equipment been used?
yes ☐ no ☐
- What type of pump oil/liquid was used? _____
- Is the equipment free from potentially harmful substances?
yes ☐ (go to Section 5)
no ☐ (go to Section 4)

4. Process related Contamination of Vacuum Equipment and Components:

- toxic yes ☐ no ☐
- corrosive yes ☐ no ☐
- explosive*) yes ☐ no ☐
- biological hazard*) yes ☐ no ☐
- radioactive*) yes ☐ no ☐
- other harmful substances yes ☐ no ☐

*) Vacuum equipment and components which have been contaminated by biological explosive or radioactive substances, will not accepted without written evidence of decontamination!

Please list all substances, gases and by-products which may have come into contact with the equipment:

Trade name Product name Manufacturer	Chemical name (or Symbol)	Dangerous material class	Measures if spillage	First aid in case of human contact
1.				
2.				
3.				
4.				
5.				

5. Legally Binding Declaration

I hereby declare that the information supplied on this form is complete and accurate. The despatch of the contaminated vacuum equipment and components will be in accordance with the appropriate regulations covering Packaging, Transportation and Labelling of Dangerous Substances.

Name of organisation or company: _____

Address: _____ Post code: _____

Tel.: _____

Fax: _____ Telex: _____

Name: _____

Job title: _____

Date: _____ Company stamp: _____

Legally binding signature: _____



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