œrlikon
leybold vacuum

TURBOVAC TW 70 H

Wide-Range Turbomolecular Pump with Integrated or External Frequency Converter

Operating Instructions GA05145_002_A1

Part Numbers

800002Vxxxx,
800003Vxxxx

Contents

Important Safety Information

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

Warning

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

Caution

The Oerlikon Leybold Vacuum **TURBOVAC TW 70 H** 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.

Safety Information

Electrical hazards

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

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

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

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

Qualified personnel

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

Thermal hazards

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

Hazards caused by materials and substances

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

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

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

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

Safety Information

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

Caution

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

Install a micropore filter when pumping media which contain dust.

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

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

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

Make sure to avoid dripping water or humidity.

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

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

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

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

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

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

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

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

Figures

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

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

Retain the Operating Instructions for further use.

High-vacuum flange

Rotor turbo stage

Stator

Bearing

Rotor Holweck stage

Motor
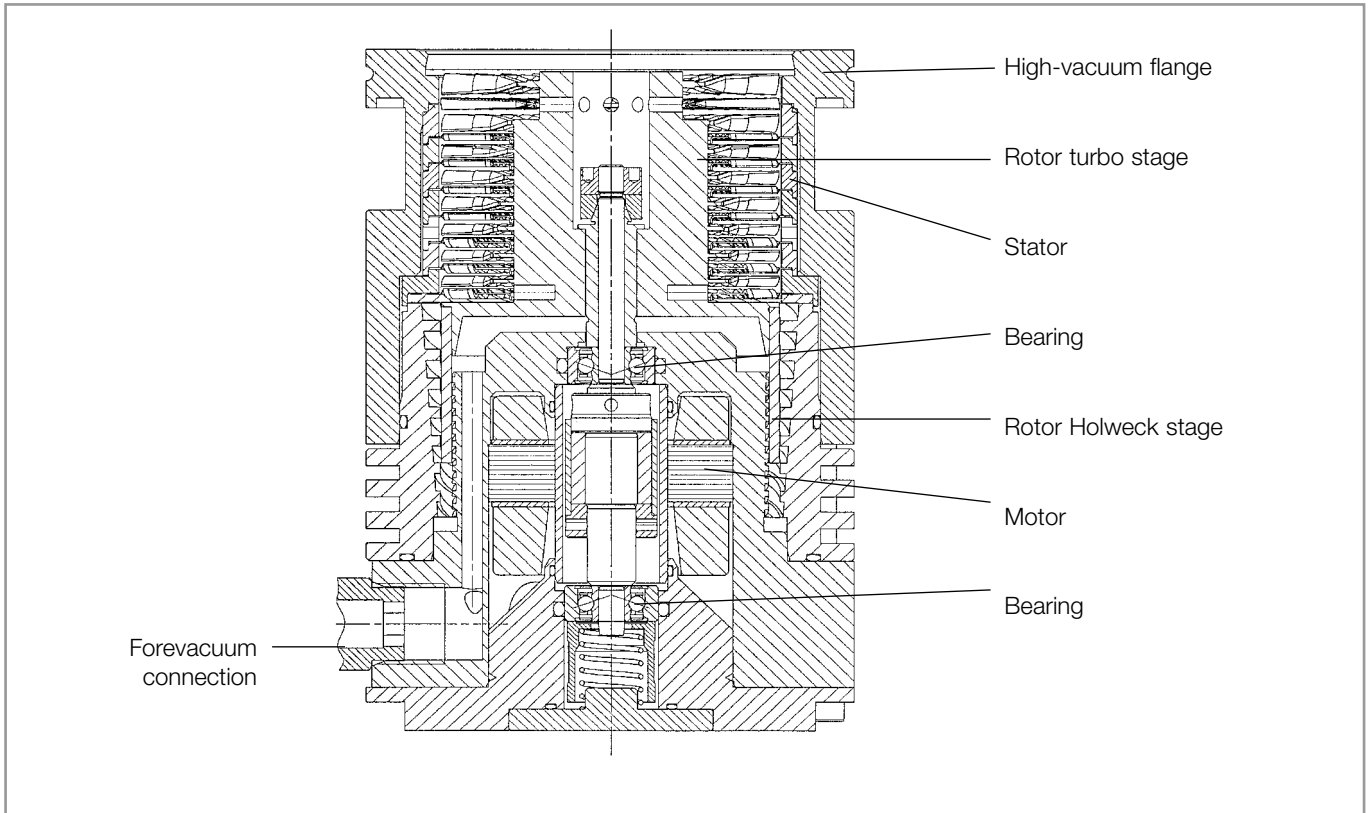
Bearing

Forevacuum connection

Fig. 1 Section through a TURBOVAC TW 70 H

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 400 frequency converter and a forevacuum pump are required for its operation.

Use

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.

Bearings

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.

Motor

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

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

Cooling

Description

Part no. 800002V1934

Part no. 800002V1235
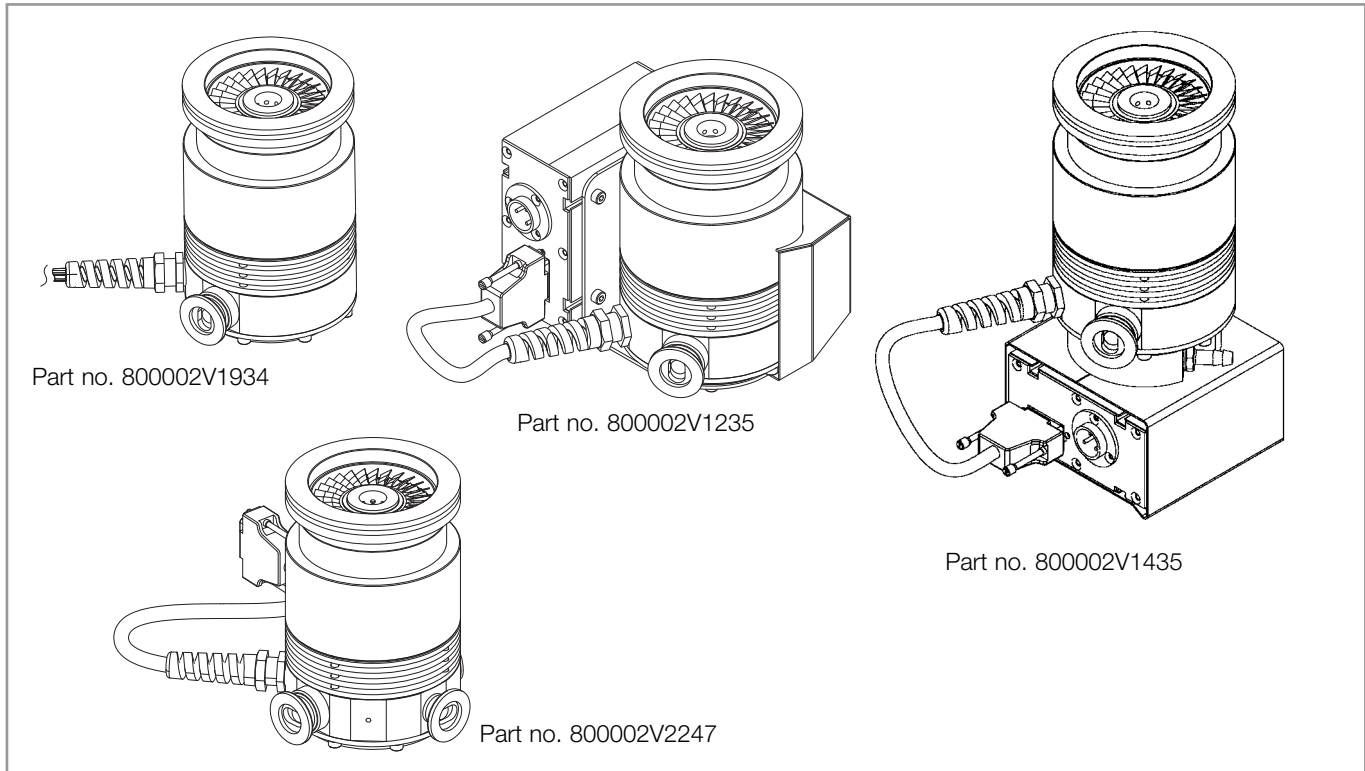
Part no. 800002V1435

Part no. 800002V2247

Fig. 2 Examples of TW 70 H

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 400 frequency converter.

1.2   Standard equipment

The components of the pump are given in the ordering matrix in Section 1.4 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 Technical data

TURBOVAC	**TW 70 H**
High-vacuum connection	DN 63 ISO-K / DN 63 CF

Pumping speed (without splinter guard) for
N_2	60 $l \cdot s^{-1}$
Ar	56 $l \cdot s^{-1}$
He	52 $l \cdot s^{-1}$
H_2	40 $l \cdot s^{-1}$

Ultimate pressure
with two-stage, oil-sealed
rotary vane pump	$< 2 \cdot 10^{-10}$ mbar
with ECODRY M 15	$< 4 \cdot 10^{-10}$ mbar
with diaphragm pump	$< 5 \cdot 10^{-9}$ mbar

Max. permissible forevacuum pressure with N_2
without purge gas	20 mbar
with 0.4 $mbar \cdot l \cdot s^{-1}$ (24 sccm) purge gas	8 mbar

Max. gas throughput with water cooling
N_2	1.9 $mbar \cdot l \cdot s^{-1}$
Ar	2.4 $mbar \cdot l \cdot s^{-1}$
H_2	1.3 $mbar \cdot l \cdot s^{-1}$
He	1.9 $mbar \cdot l \cdot s^{-1}$

Weight
Pump	2.3 kg
Pump with TURBO.DRIVE 400	3.0 kg
Pump with TURBO.DRIVE 400 and air cooler	3.2 kg
Pump with TURBO.DRIVE 400 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)

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

Description

Option pump with water cooling

Cooling water connections	G 1/8"
Cooling water data	see Section 2.5

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 TW 70 H	
Nominal voltage	24 V---
Max. power consumption	140 W
Max. peak current, input side	6 A DC
Required power output from the power supply	≥ 150 W
Max. length of the DC cable (shielded)	
at 3 x 1.5 mm2	5 m
at 3 x 2.5 mm2	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.	0.7 kg

Purge gas and venting valve

Part No.	800152V0013	800152V0014
Gas flow rate at 1 bar	0.4 mbar·l·s^{-1} (24 sccm)	
Solenoid valves	2, normally closed	
Mains supply	24 V DC	230 V AC
Power consumption	4 W	6 W
Connection to pump	DN 10 KF	
Gas connection	G 1/4"	
Dimensions	60 x 65 x 45 mm	61 x 65 x 45 mm

Description
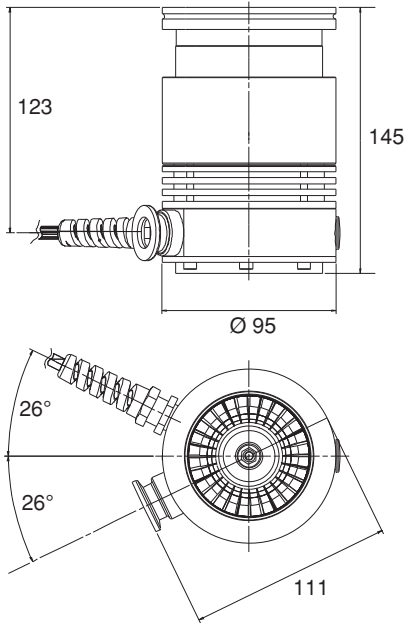
Part no. 800002V1934
TW 70 H
with DN 63 ISO-K flange,
no forced cooling,
DN 16 KF forevacuum connection,
without frequency converter
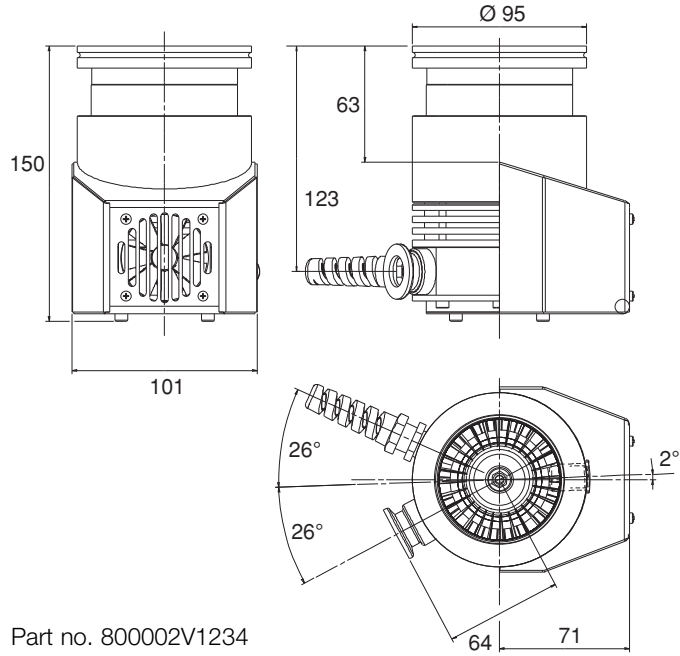
Part no. 800002V1234
TW 70 H
with DN 63 ISO-K flange,
air cooling,
DN 16 KF forevacuum connection,
without frequency converter
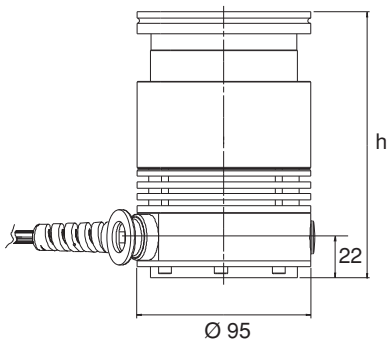
**Height for different
high-vacuum flanges**

High-vacuum flange DN	h
63 ISO-K	145
63 CF	166

Purge gas connection

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

DN 63 ISO-K

Ø 95

123

148

Part no. 800002V1235
TW 70 H
with DN 63 ISO-K flange,
air cooling,
DN 16 KF forevacuum connection,
with frequency converter

155.5

50.5

71

64

106

2°

26°

Ø 95

123

147

152.5

2°

100

64

156

26°   26°

Part no. 800002V1915
TW 70 H
with DN 63 ISO-K flange,
no forced cooling,
Camozzi forevacuum connection,
with frequency converter

123

228

105

48°   48°

2°

100   111

106

26°

26°

Ø95

155

Part no. 800002V1435
TW 70 H
with DN 63 ISO-K flange,
water cooling,
DN 16 KF forevacuum connection,
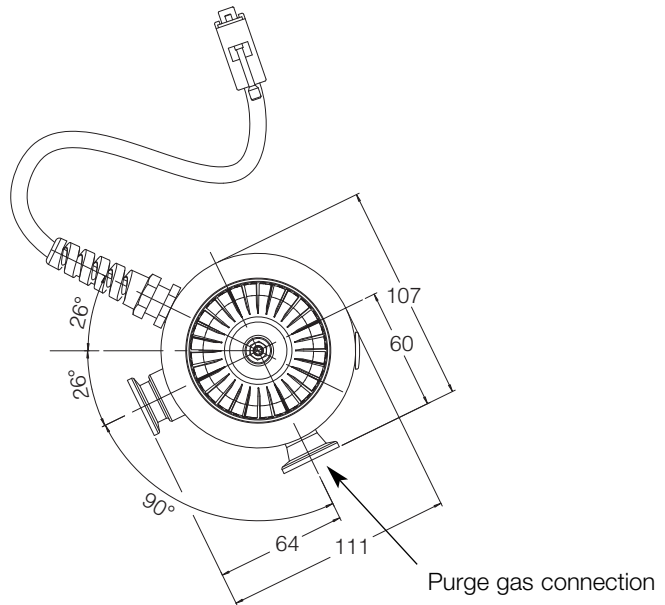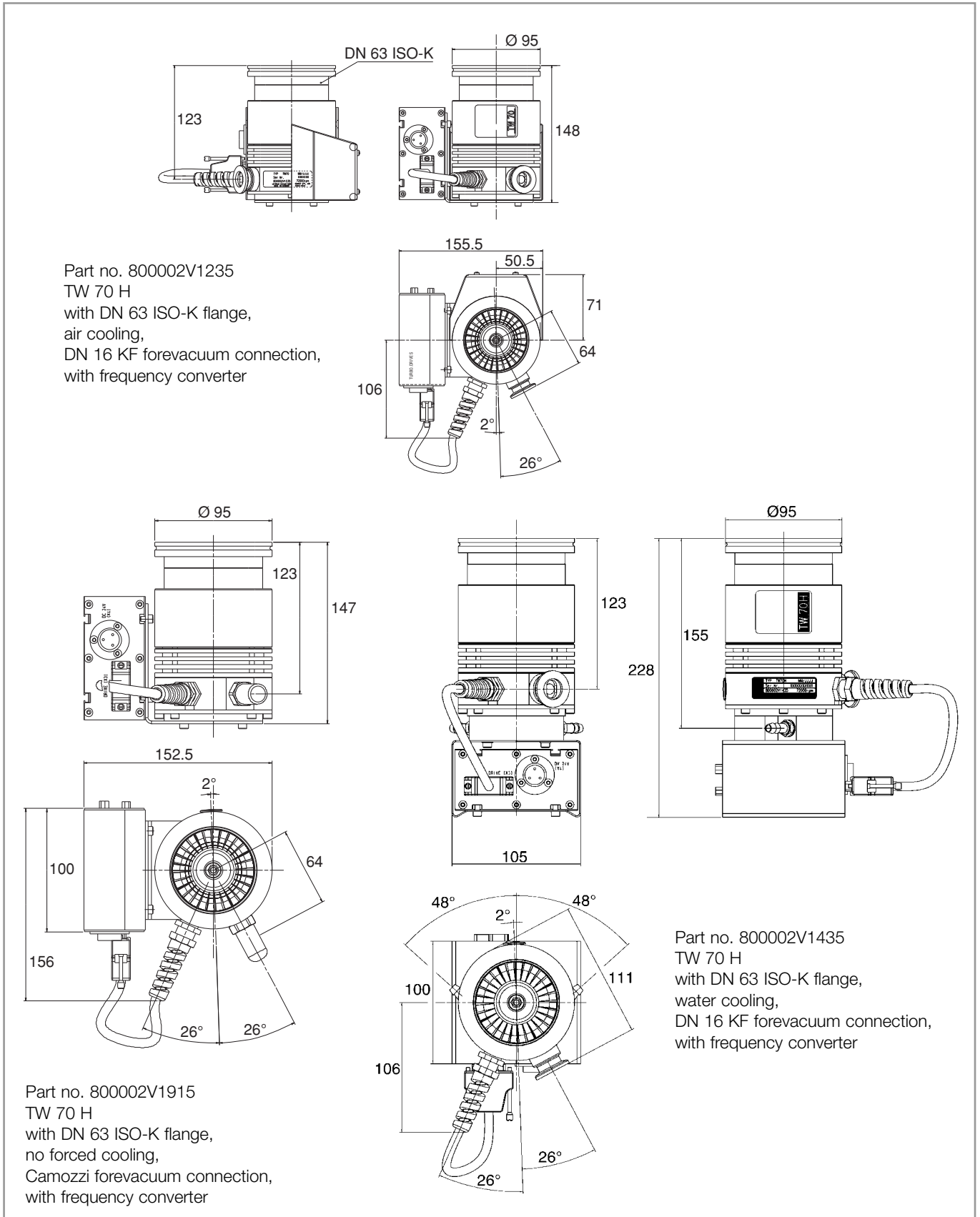with frequency converter

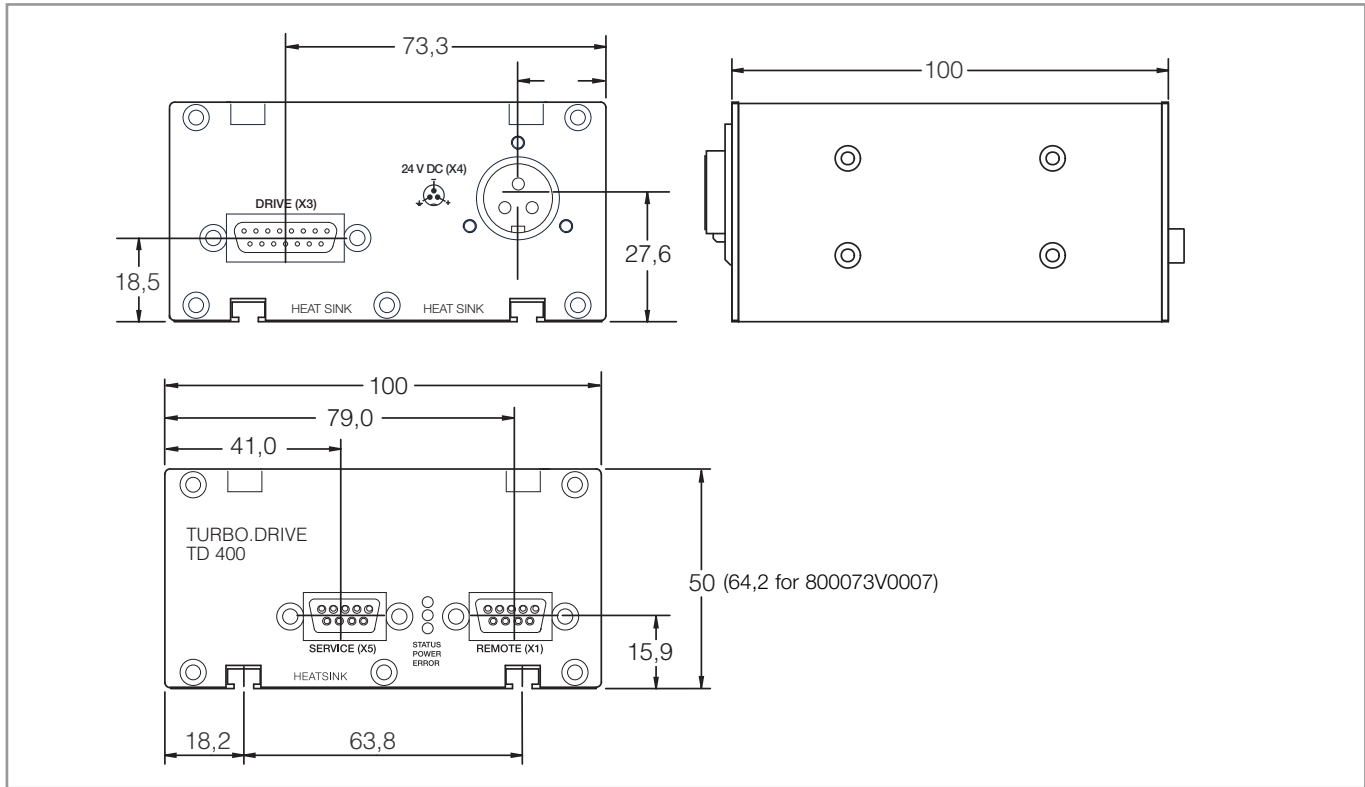Fig. 3b   Dimensional drawings for TW 70 H pumps; dimensions in mm

Description

Fig. 4 Dimensional drawing for the frequency converter; dimensions in mm

1.4 Ordering data

HV flange 63 ISO-K	HV flange 63 CF	Forevacuum flange DN 16 KF	Camozzi coupling	without frequency converter	with TURBO.DRIVE 400 with RS 232	with TURBO.DRIVE 400 with RS 485	no forced cooling	with water cooling	with air cooling	with purge gas conn. DN 16 KF	Part No.
■		■				■			■		800002V1235
■		■			■				■		800002V1236
■		■				■		■			800002V1435
■			■			■			■		800002V1215
■			■			■		■			800002V1415
	■	■			■				■		800002V2236
	■	■				■		■			800002V2435
■		■		■			■				800002V1934
■		■	■	■			■				800002V1914
	■	■		■			■				800002V2934
■		■		■			■				800003V1934 Stainless steel housing
	■	■		■			■			■	800002V2246
■		■		■			■			■	800002V2247

Description

1.5 Accessories

Frequency converter TURBO.DRIVE 400

with RS 232 C interface	800073V0001
with RS 485 C interface	800073V0003
with Profibus interface	800073V0004
with Ethernet /IP interface	800073V0007
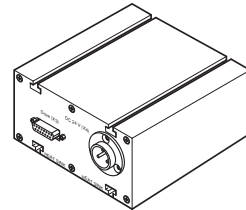
Connecting cable pump - frequency converter

1.0 m long	152 47
2.5 m long	864 49
3.0 m long	864 40
5.0 m long	864 50
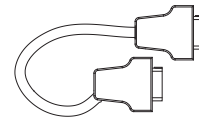
OEM power supply (with screw terminals)

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

Power supply unit - plug and play

TURBO.POWER 300	800100V0002

■ supplies the TURBO.DRIVE 400 with 24 V DC

■ plug & play cables

■ desktop unit or rack mountable
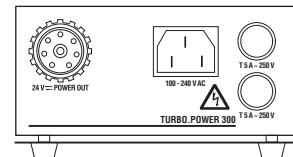
24V DC Power cable (TURBO.DRIVE 400 – TURBO.POWER 300)

1 m	800094V0100
3 m	800094V0300
5 m	800094V0500
10 m	800094V1000
20 m	800094V2000

Mains cable for TURBO.POWER 300, 3 m long

with EURO plug	800102V0002
with US plug 6-15P	800102V1002

Description

Power supply and control unit
TURBO.CONTROL 300   800100V0001
- supplies the TURBO.DRIVE 400 with 24 V DC
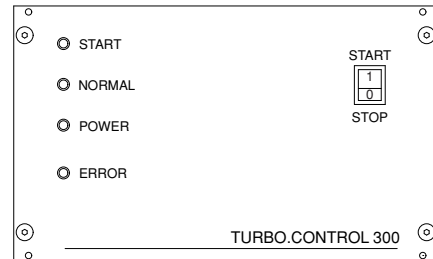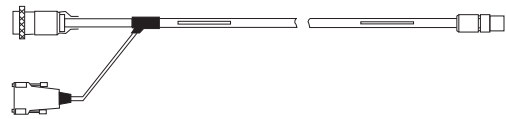- plug & play cables
- desktop unit or rack mountable
- with power switch
- with start/stop switch for the turbomolecular pump
- remote control
- status LEDs and status relays

24V DC Control cable
(TURBO.DRIVE 400 – TURBO.CONTROL 300)

1 m	800091V0100
3 m	800091V0300
5 m	800091V0500
10 m	800091V1000
20 m	800091V2000

Mains cable for TURBO.CONTROL 300, 3 m long
with EURO plug   800102V0002
with US plug 6-15P   800102V1002

Mechanical accessories

Plug for connector REMOTE with integrated
ON/OFF switch for the pump (Sub-D plug, 9 way)   152 48
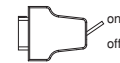
Heat sink for frequency converter   800110V0001
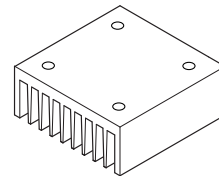
Top hat rail adaptor (mounting aid for
TURBO.DRIVE 400 and TURBO.POWER 300)   800110V0003
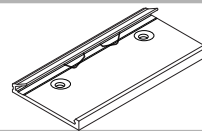
Purge gas and venting valve 0.4 mbar·l/s at 1 bar
24 V DC   800152V0013
230 V AC   800152V0014
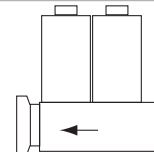
PC software "**Turbo.Drive Server**" for Windows 95
and higher, CD-ROM
- Display, change, save and compare parameter lists
- Integration of customer's software
- Record parameter data   800110V0102
The software can also be downloaded from
www.oerlikon.com in the menu Oerlikon Leybold Vacuum
→ Documentation → Download Software

Adaptor RS232/RS485 for 220 V/Euro plug   800110V0101
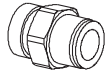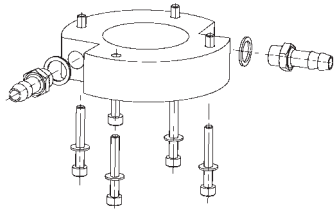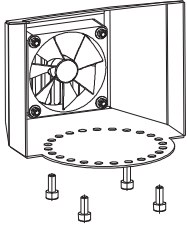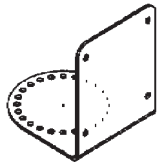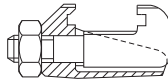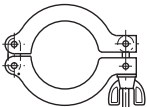
GSD file for Profibus DP
Can be downloaded from www.oerlikon.com
in the menu Oerlikon Leybold Vacuum
→ Documentation → Download Software

	Part No.
Splinter guard DN 63 ISO-K	200 17 170
Splinter guard DN 63 CF	200 17 171
Camozzi coupling	200 04 361
Water cooling unit with connection G 1/8" incl. 2 hose nipples G 1/8", outer dia. 8mm for water hose, 2 sealing rings approx. 10x4x1	800135V0001
Air cooling (for fitting to pumps without forced cooling)	800136V0001
Mounting kit for fixing the frequency converter to the pump	800 000 541

Flange heater (only for pumps with CF flange)
  DN 63 CF, 230 V
  DN 63 CF, 110 V
	
	854 04
	854 07

Copper gasket rings for CF flange (Set of 10 pieces) DN 63 CF	 839 44
Set of hex. screws with nuts, screws and washers for CF flange DN 63 CF	 838 81
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
	
	183 26
	182 06

Clamping ring (Al) DN 16 KF	183 41

Installation

2 Installation

2.1 Conforming Utilization

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 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 gasses
- operation without a forevacuum pump.

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

Install a micropore filter when pumping media which contains dust.

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

2.2 Operating environment

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

Magnetic field If the pump is used within a magnetic field, the magnetic induction at the surface of the pump housing may not exceed:
B = 5 mT if impinging radially and
B = 15 mT if impinging axially.

Install shielding equipment as appropriate if these values are exceeded.

Radiation The standard pump version without frequency converter is resistant to radiation up to 10^3 Gy.

Places of installation Places of installation up to 1000 m above sea level (3300 ft) are possible without restrictions. At altitudes over 1000 m heat dissipation by the ambient air is impaired. Please consult us.

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

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

High-vacuum flange

Connection cable
to TURBO.DRIVE

Forevacuum connection
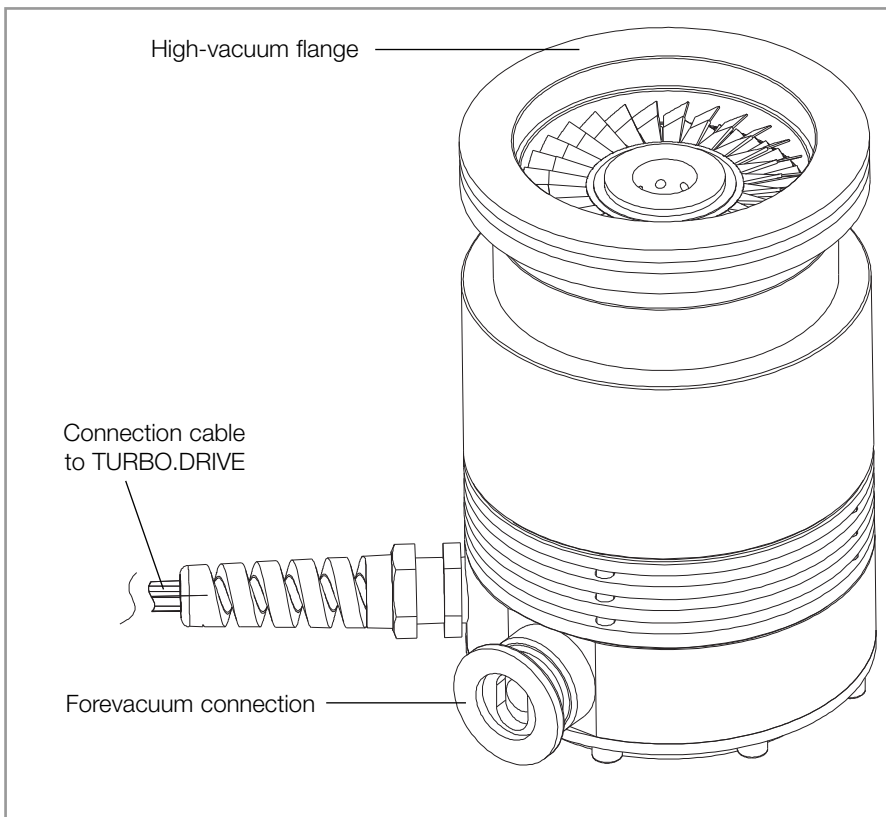
Fig. 5 Connection elements

2.3   Attach the pump to the vacuum chamber

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 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).
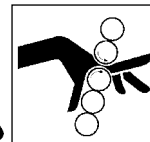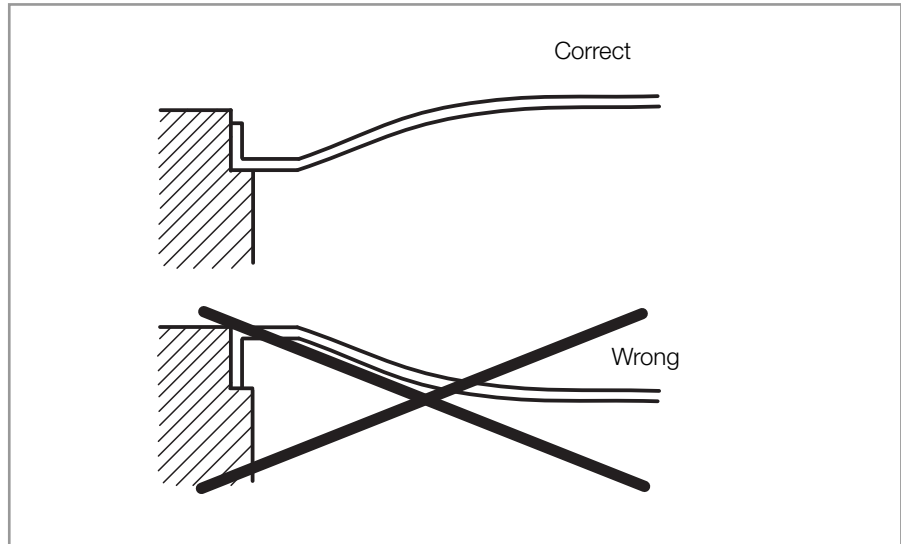
Installation

Fig. 6 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 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.

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.
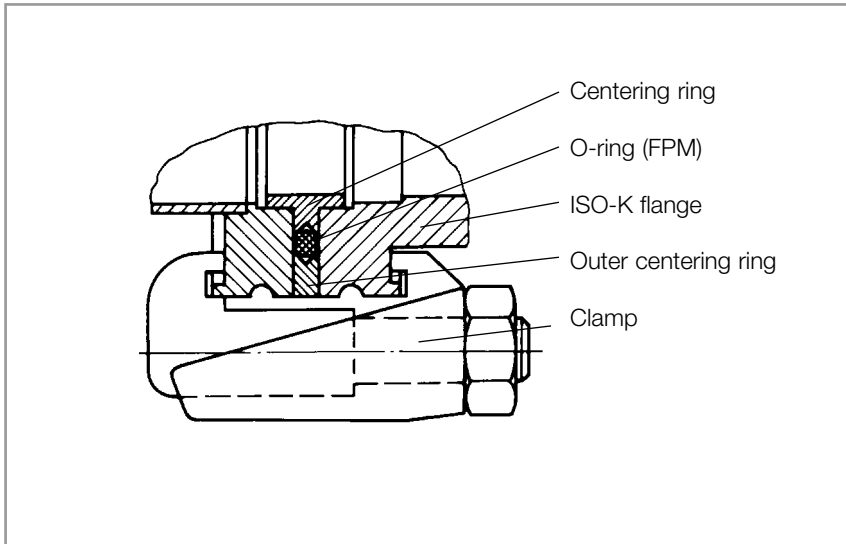
Fig. 7   Using type ISO-K flanges

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.

Installation
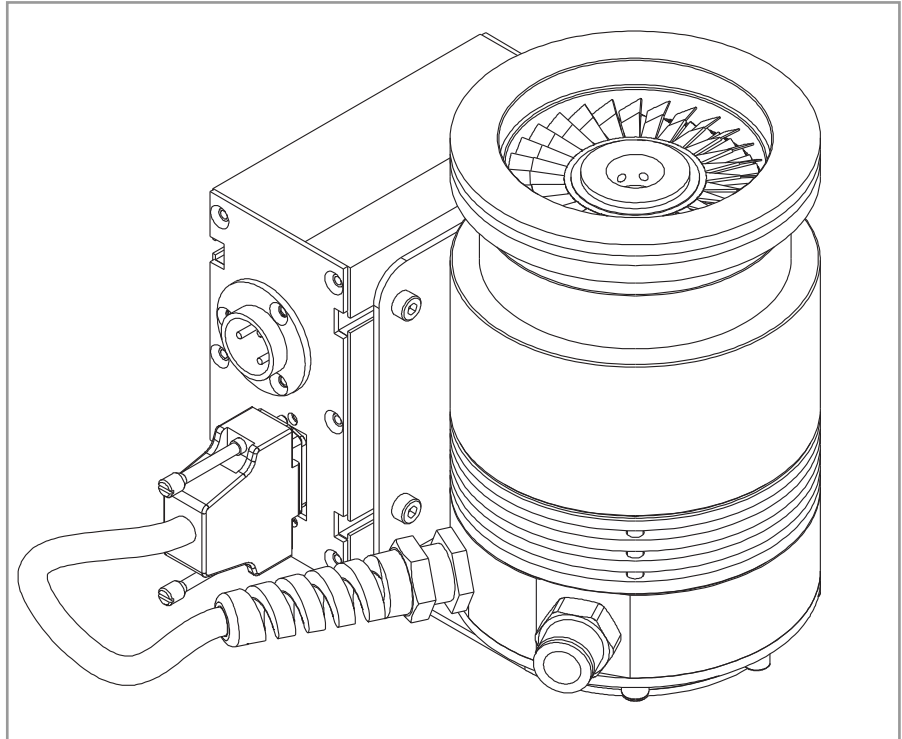
Fig. 8 Forevacuum connection with Camozzi coupling

2.4   Forevacuum connection

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

Forevacuum pump

We recommend using dry-running diaphragm vacuum pumps or TRIVAC rotary vane pump for this purpose.

For the forevacuum connection a vacuum hose Ø 10 x 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 turbo-molecular 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.

Safety valve

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.

Adsorption trap

Provide a roughing line to achieve the shortest cycle times.

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

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

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

Caution

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.

Installation

Cooling water connnections
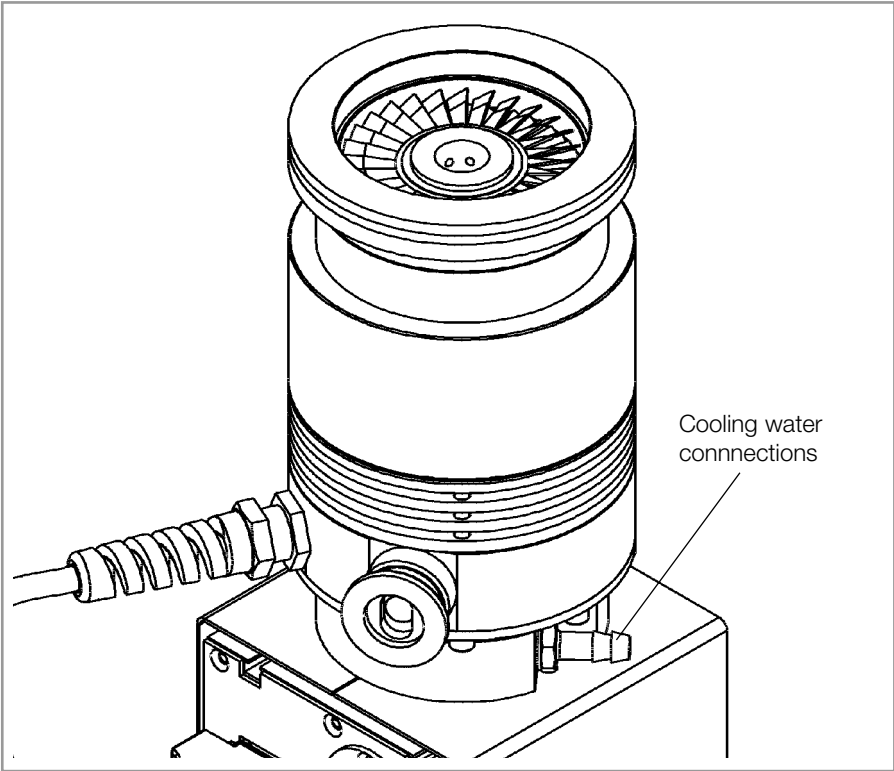
Fig. 9 Pump with water cooling
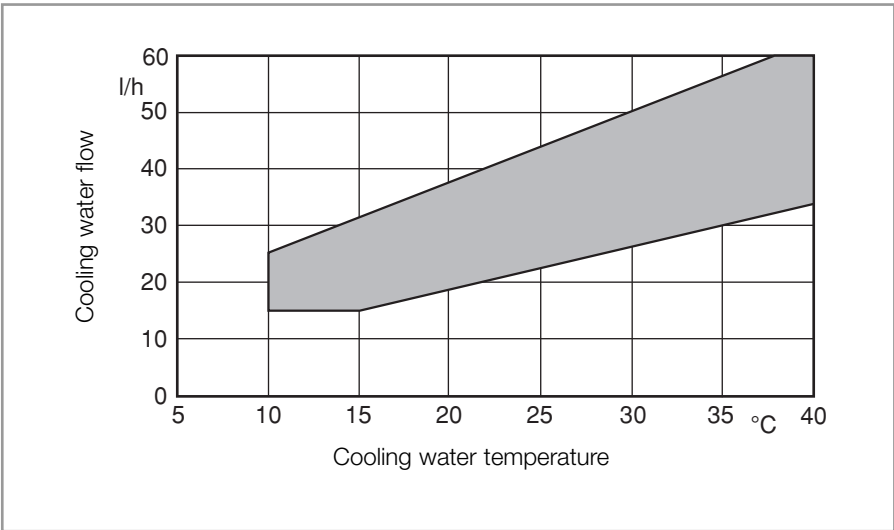
Fig. 10 Cooling water requirements
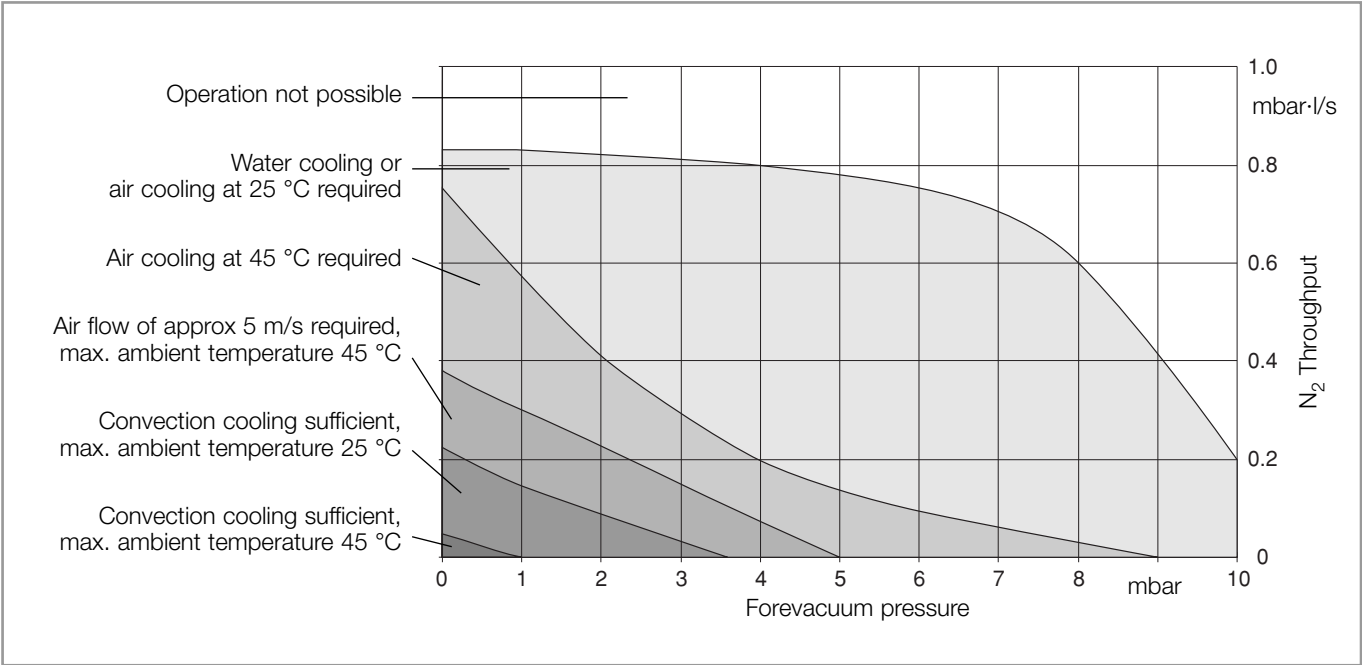
Fig. 11   TW 70 H cooling requirements when pumping Nitrogen or air

Operation not possible

Water cooling or air cooling at 25 °C required

Air cooling at 45 °C required

Air flow of approx 5 m/s required, max. ambient temperature 45 °C

Convection cooling sufficient, max. ambient temperature 25 °C

Convection cooling sufficient, max. ambient temperature 45 °C

Forevacuum pressure

N_2 Throughput
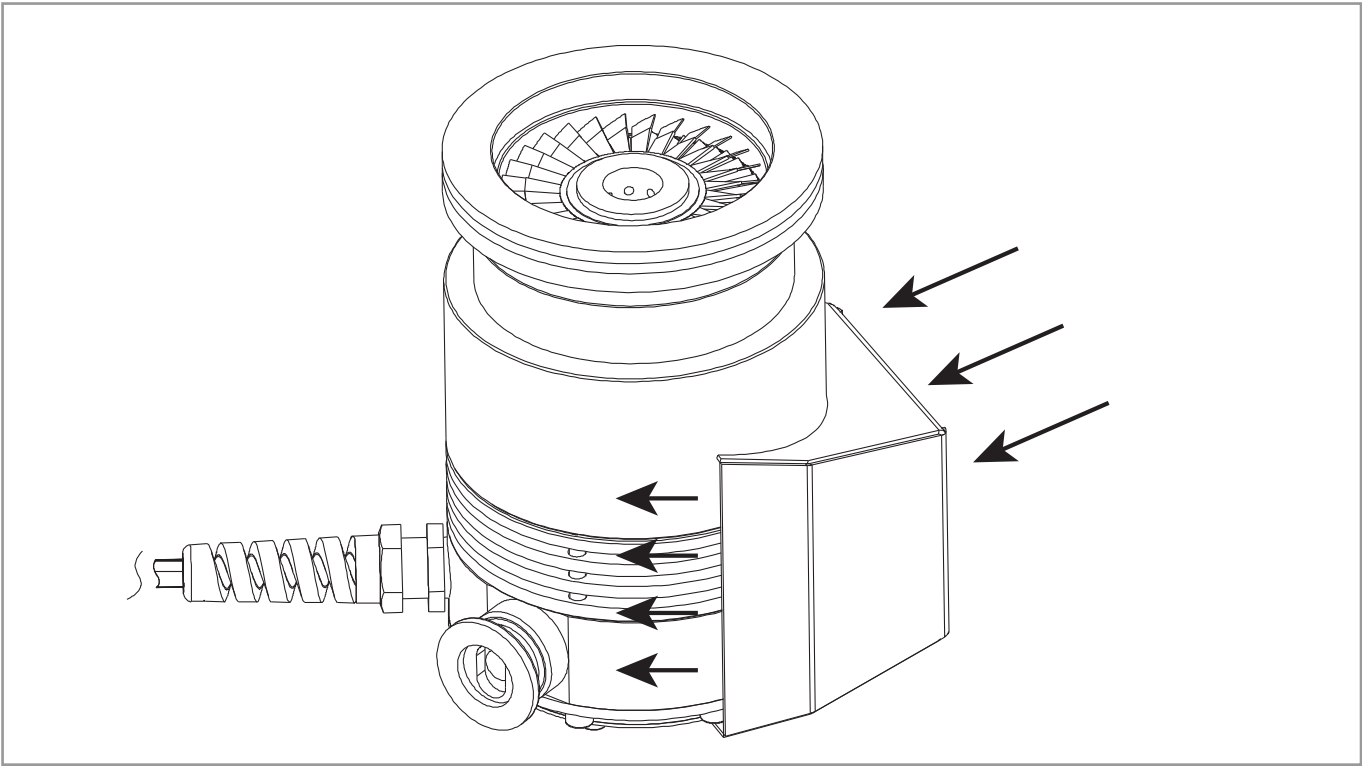
Fig.12   Pump with air cooling

Installation

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

— — — — Roughing line;
recommend to achieve the shortest
possible cycle times
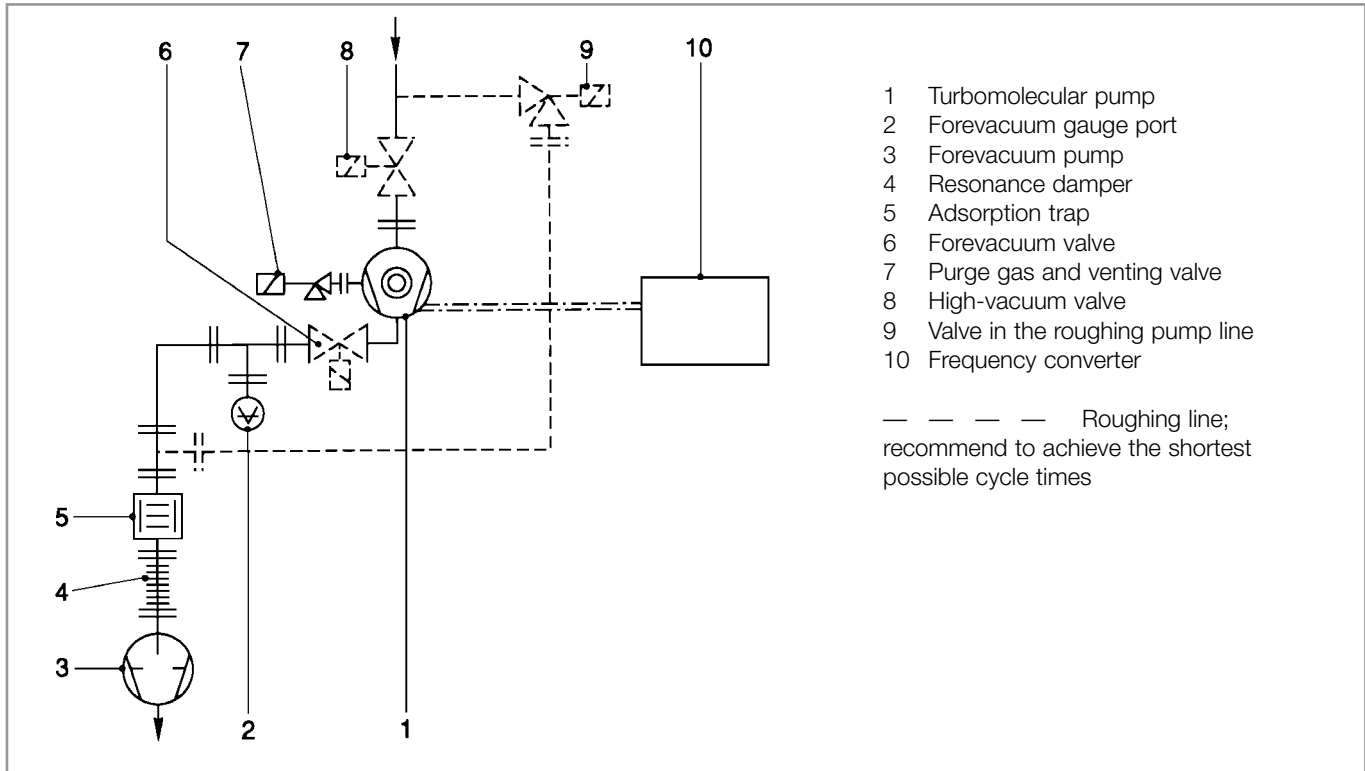
Fig.13   Schematic of a turbomolecular pump system

2.6   Connecting the purge gas

Only for pumps with purge gas flange.

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 0.4 mbar·l/s (24 sccm) with Nitrogen. The pressure in the pump must not exceed 1200 mbar (0.2 bar over-pressure).

Connect the purge gas and venting valve to the purge gas flange.

TURBOVAC **with** integrated frequency converter TURBO.DRIVE 400
without forced cooling

Mains

≈

| Power supply |

24 V DC cable,
max. 20 m

TURBOVAC **with** integrated frequency converter TURBO.DRIVE 400
with water cooling

24 V DC cable,
max. 20 m

Mains

≈

| Power supply |

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

Mains

≈

| Power supply |

DC cable,
with shielding,
max. 20 m

Frequency converter
TURBO.DRIVE 400
(Cooler optional)

24 V DC cable,
max. 20 m

Mains

≈

| Power supply |

DC cable,
with shielding,
max. 20 m

Frequency converter
TURBO.DRIVE 400
(Cooler optional)

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

24 V DC cable,
max. 20 m

Fig. 14 Examples for connection

Installation

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

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

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

Fig. 15 TURBO.DRIVE 400, front and rear side

2.7 Electrical connection

The TURBO.DRIVE 400 frequency converter needed to operate the TURBO-VAC TW 70 H has either been integrated in the pump or is a separate unit. For connection examples see Fig. 14.

Older pumps (date of manufacture before May 2008) are equipped with a different frequency converter, the TURBO.DRIVE S. This unit is connected and operated similarly, compared with the TURBO.DRIVE 400. Refer to Operating Instructions GA05223 for the TURBO.DRIVE S for details.

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.

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.
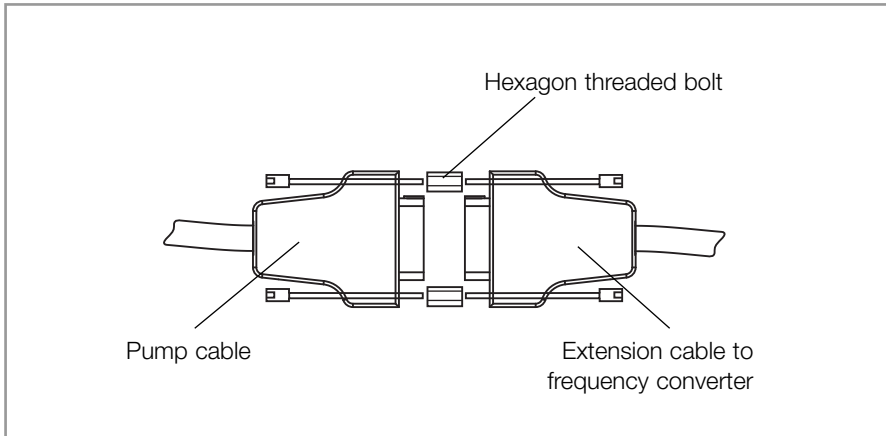
Fig. 16 Connect the extension cable
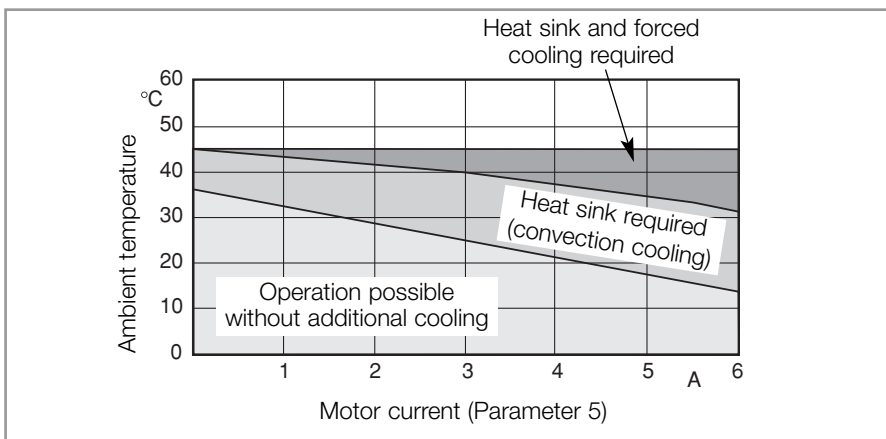
Fig. 17 Cooling requirements for the TURBO.DRIVE 400 when fitted separately

2.7.1 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 2.7.3 and also Fig. 17.

2.7.2 Connecting the power supply

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

Warning

The power supply must meet the requirements given in Section 1.5. Peak loads in the kHz range may be present on the DC side. The power supply should have a current limitation or control.

Installation
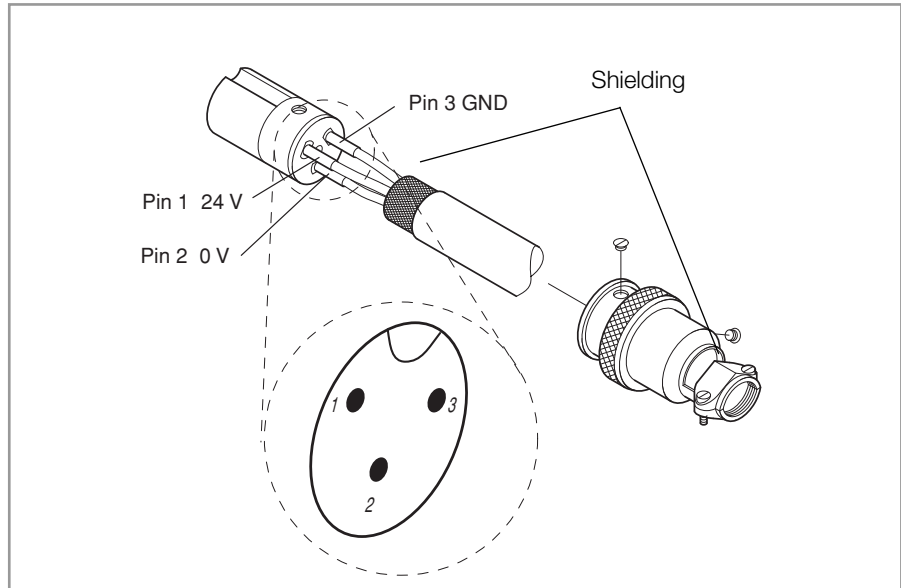
Fig. 18   Pin assignment of the DC connector (X4) Model Hirose HS16P-3

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

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 shutdown: 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"

2.7.3 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.

For special requirements please contact Oerlikon Leybold Vacuum.
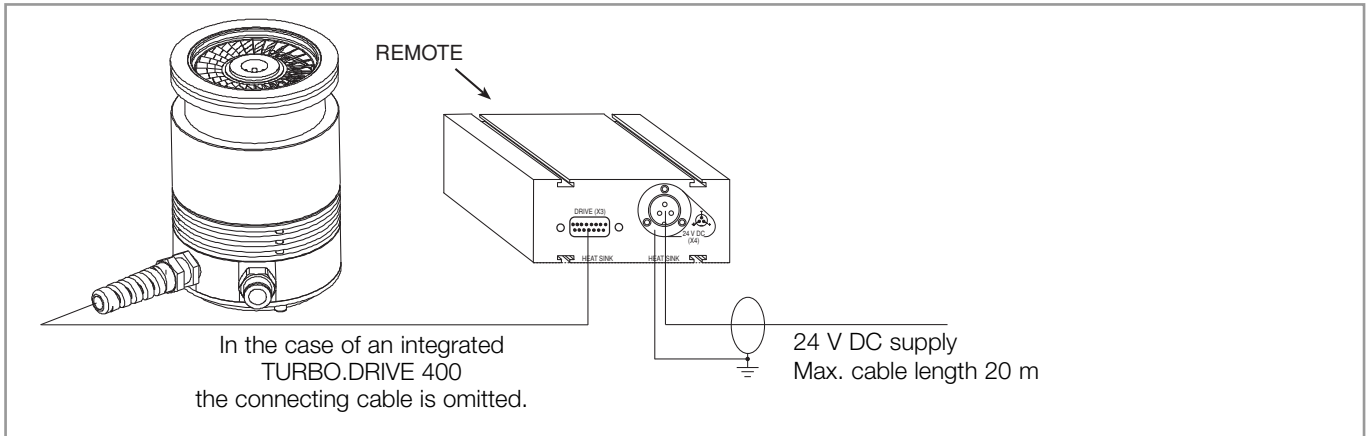
Fig. 19   Connection of the power supply and the TURBO.DRIVE 400

In the case of an integrated
TURBO.DRIVE 400
the connecting cable is omitted.

REMOTE

24 V DC supply
Max. cable length 20 m

Relay functions

Pin assignment of the connector

5 4 3 2 1

9 8 7 6

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)

Relay output rating: 42 V, 0.5 A

n. c. 5
n. o. 3
com.   4

n. c. 2
n. o. 9
com.   1

TURBO.DRIVE 400

Pin assignment for the Start/Stop input

7   7.2 kΩ   24 V   5 V

8   2.6 kΩ   6.2 V

6   3.6 kΩ

TURBO.DRIVE 400

Switching threshold for
the Start/Stop control
input:
Low-Level: < 9 V
High-Level: > 10.5 V

**Caution: No power feed
is allowed at pin 7**

Start/Stop operation
Example 1: Operation via a PLC

0 V = STOP   7   24 V
24 V = START   8
                 6
                 TURBO.DRIVE 400

Example 2: Operation via contacts

Contact open = STOP
Contact closed = START   7   24 V
                           8
                           6
                           TURBO.DRIVE 400

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

Installation

2.7.4 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
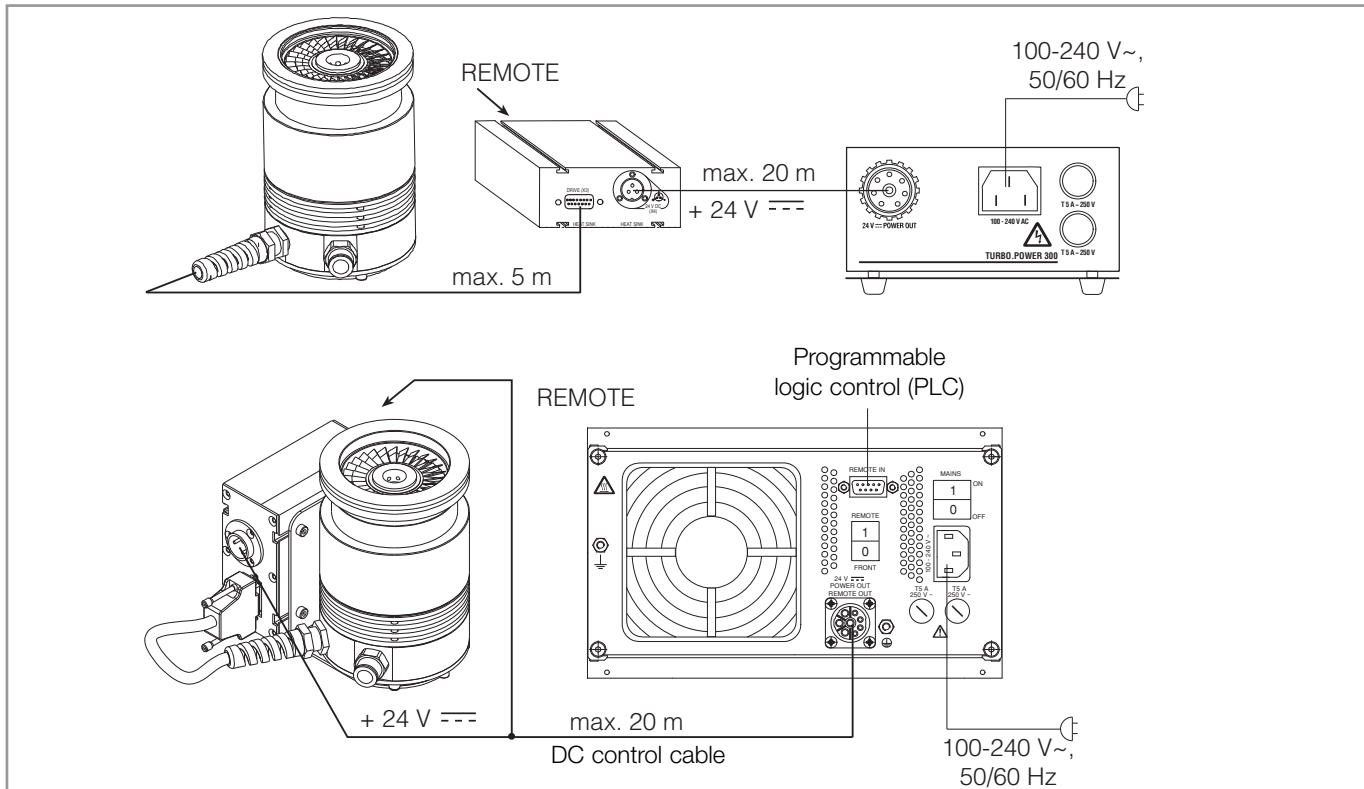
Fig. 21 Examples for connection
top: TURBOVAC with separate frequency converter to TURBO.POWER 300,
bottom: TURBOVAC with integrated frequency converter to TURBO.CONTROL 300

3   Operation

3.1   Media compatibility / purge gas

The TURBOVAC TW 70 H 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 gasses

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

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.

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	■ Precise planning for maintenance ■ Improved reliability of sensitive production processes in a vacuum	Monitoring of: ■ Motor current P5 ■ Ball bearing temperature P125 or P127 ■ Motor temperature P7 ■ Frequency converter temperature P11
Standby operation	■ Extending the service life for the ball bearings ■ Cutting energy consumption	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
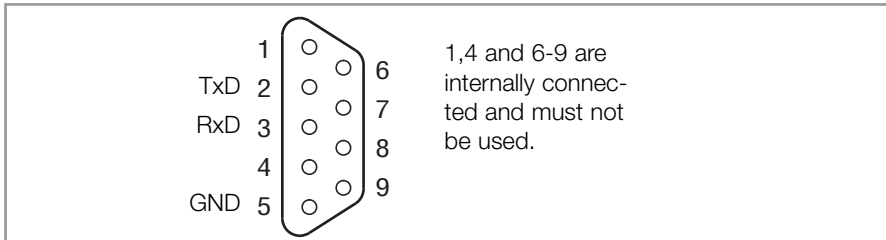
Fig. 22 Pin assignment for the socket at the frequency converter (female) SERVICE X5
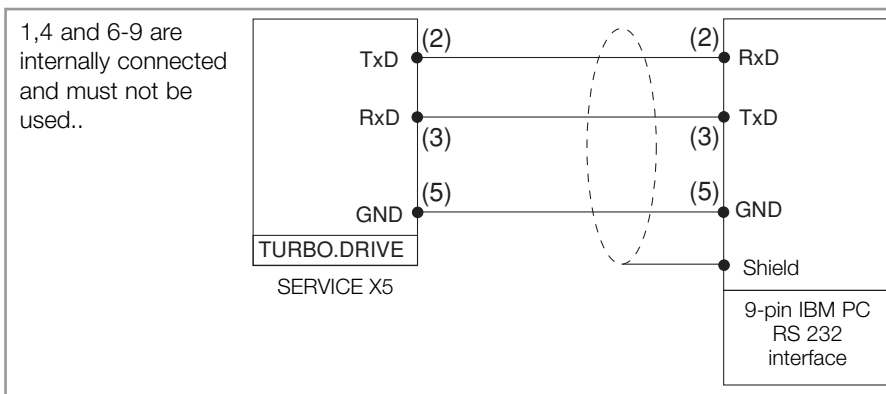
Fig. 23 Providing a RS 232 connection

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. 23 may be used.

Refer also to Operating Instructions GA 05.281

Interfaces
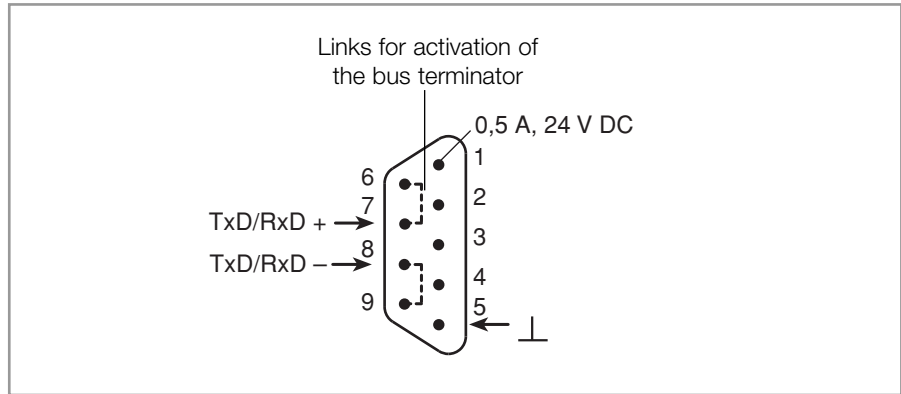
Fig. 24 Pin assignment for the socket at the frequency converter for RS 485 interface (male)

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
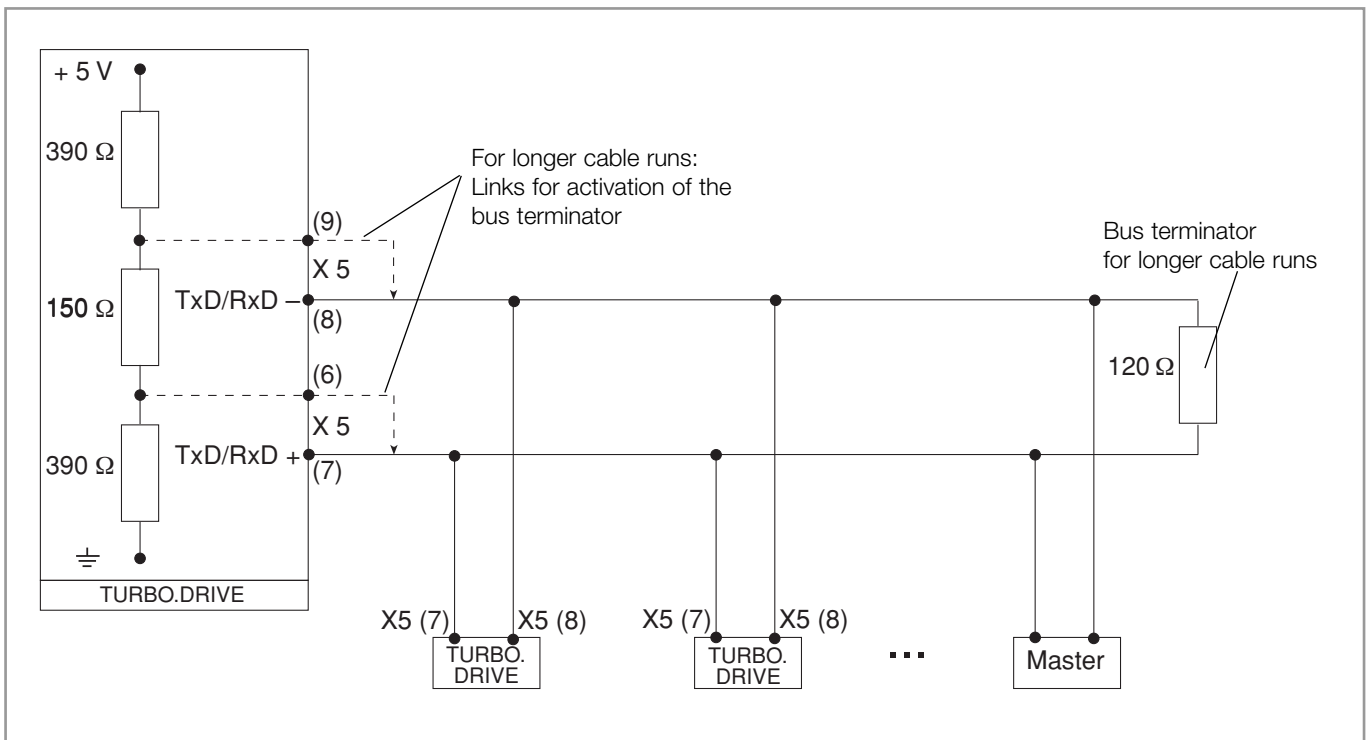
Fig. 25 Connection of the RS 485 bus

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

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	85	°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	1200	Hz	r	u16	Highest permissible frequency
19	Minimum frequency	0	1200	625	Hz	r	u16	Lowest permissible frequency
20	Critical frequency	0	1200	600	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	3= TW 70 H
24	Setpoint frequency	0	1200	1200	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.

No.	Designation	Min.	Max.	Default	Unit	r/w	Format	Description
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]
180	3600	350	5400	600	5400

No.	Designation	Min.	Max.	Default	Unit	r/w	Format	Description
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	Bearing temperature	-10	150	0	°C	r	i16	Actual value of the bearing temperature
126	Bearing temperature warning threshold	-10	150	60	°C	r	i16	Exceeding the bearing temperature warning threshold results in a warning
127	Bearing temperature	-10	150	0	°C	r	i16	Actual value of the bearing temperature
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	Exceeding the bearing temperature error threshold causes the pump to be switched off.
133	Motor temperature error threshold	-10	150	90	°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	30	100	100	%	r/w	u16	Is used for the reduction of the maximum consumption current,

e.g. for adaptation of low performance power supplies. Note: values < 100 reduce the pump performance and increase the run-up time.

No.	Designation	Min.	Max.	Default	Unit	r/w	Format	Description
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.

No.	Designation	Min.	Max.	Default	Unit	r/w	Format	Description
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.

No.	Designation	Min.	Max.	Default	Unit	r/w	Format	Description
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).

No.	Designation	Min.	Max.	Default	Unit	r/w	Format	Description
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.

No.	Designation	Min.	Max.	Default	Unit	r/w	Format	Description
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
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 [8000xxV000x]	:CHAR		r	u16	Catalogue number of the converter. One ASCII char per index.
313	Product name (Index 0...10 usable)	0 0	127 [TD_400] 127	: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 [xxxxxxxxxx]	:CHAR		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.	Check the ultimate pressure of the backing pump and install a bigger backing pump if req.
			Gas flow too high	Seal leak, check process
			Fan defective	Replace fan
			Water cooling switched off	Switch on water cooling
1	Converter temperature warning	Overtemperature at the power output stage or within the frequency converter	Ambient temperature too high	Ensure max. ambient temperature of 45°C
			Poor cooling	Improve cooling
2	Bearing overtemperature warning	The permissible warning threshold for the bearing temperature was exceeded.	Forevacuum pressure too high.	Check the ultimate pressure of the backing pump and install a bigger backing pump if req.
			Gas flow too high	Seal leak, check process
			Fan defective	Replace fan
			Water cooling switched off	Switch on water cooling
3	Motor under-temperature warning	The minimum permissible motor temperature (warning threshold) is not reached.	Ambient temperature too low	Ensure min. ambient temperature of 0°C
			Pump cooling too high	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.	Check the ultimate pressure of the backing pump and install a bigger backing pump if req.
			Gas flow too high	Seal leak, check process
12, 13	not used			
14	Power supply voltage warning	Supply voltage failure during active operation of the pump $P4 > Umax$ or $P4 < Umin$	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			
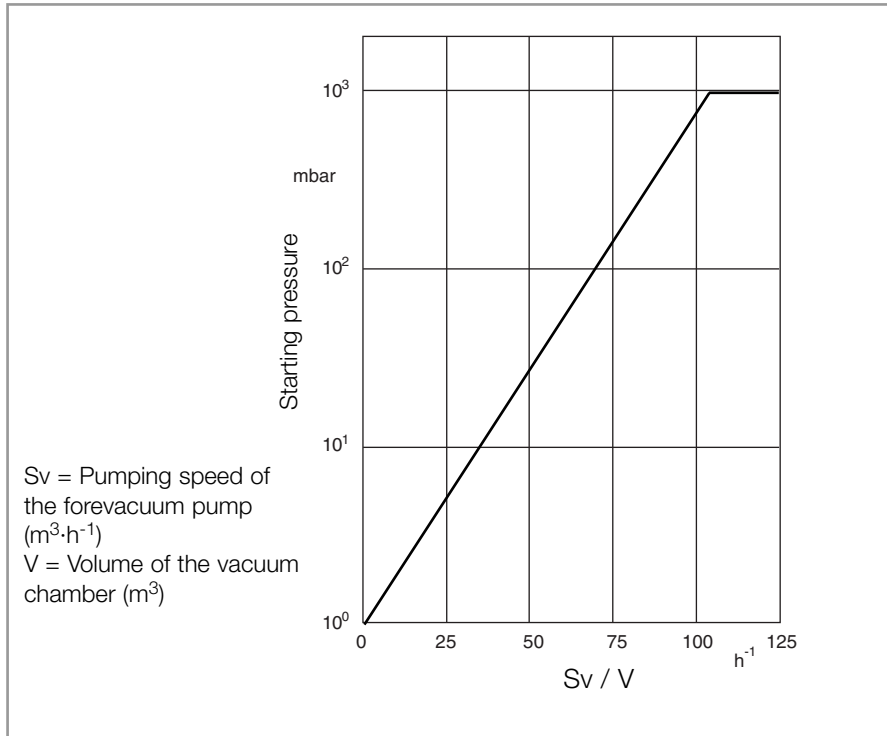
Fig. 26 Determining the starting pressure of a turbomolecular pump when evacuating large volumes

The graph axes labels: vertical axis "Starting pressure" in "mbar" with markings 10^0, 10^1, 10^2, 10^3. Horizontal axis "Sv / V" in "h^{-1}" with markings 0, 25, 50, 75, 100, 125.

Sv = Pumping speed of the forevacuum pump ($m^3 \cdot h^{-1}$)
V = Volume of the vacuum chamber (m^3)

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 Figure 26.

Starting pressure

Switch on the turbomolecular pump at the frequency converter

■ via pins 7 and 8 of the socket REMOTE (X1) (see Fig. 20) (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.

Caution

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

Operation

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 turbo-molecular 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.

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

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

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.

Speed
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.

Particles

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.

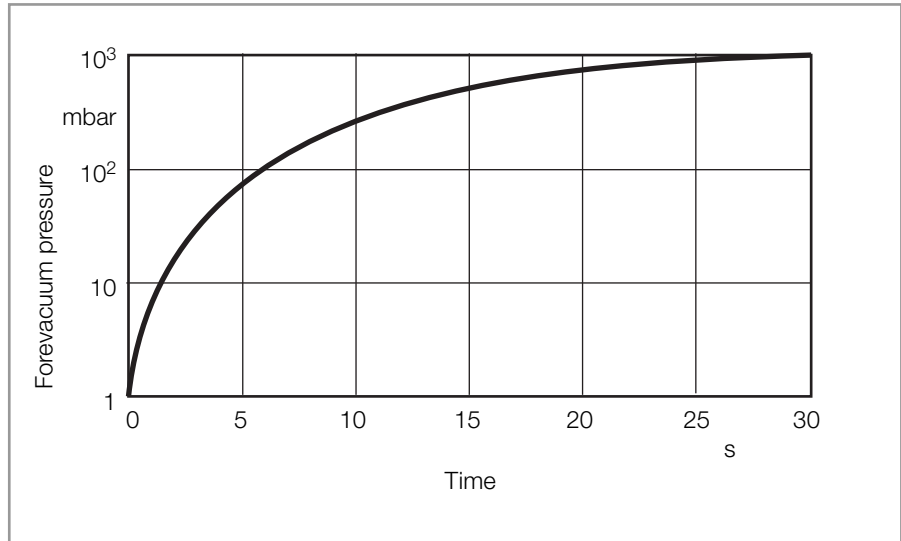The pump must not be vented to pressures above atmospheric pressure.

Operation

Fig. 27 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.

Warning

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.

Hazardous gases

Deposits

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.

Desiccant

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.

Maintenance

4 Maintenance

We recommend a standard bearing change after 20,000 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.

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 (at the latest after 15,000 and 40,000 hours respectively).

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 → 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.
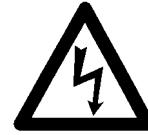
5 Troubleshooting

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.	Check the ultimate pressure of the backing pump and install a bigger backing pump if req.	yes
			Gas flow too high	Seal leak, check process	
			Rotor blocked	Check if the rotor turns freely. Contact Oerlikon Leybold Vacuum Service if the rotor is damaged or blocked.	
3	Bearing temperature error	The maximum permissible bearing temperature was exceeded.	Forevacuum pressure too high.	Check the ultimate pressure of the backing pump and install a bigger backing pump if req.	yes
			Gas flow too high	Seal leak, check process	
			Fan defective	Replace fan	
			Water cooling switched off	Switch on water cooling	
4	Short circuit error				yes
5	Converter temperature error	Overtempera-ture at the power output stage or within the frequency converter	Ambient temperature too high	Ensure max. ambient temperature of 45°C	yes
			Poor cooling	Improve cooling	
6	Run-up time error	The pump has not reached the normal operating frequency after the maximum run-up time.	Forevacuum pressure too high.	Check the ultimate pressure of the backing pump and install a bigger backing pump if req.	yes
			Gas flow too high	Seal leak, check process	
7	Motor temperature error	The motor temperature has exceeded the shutdown threshold.	Forevacuum pressure too high.	Check the ultimate pressure of the backing pump and install a bigger backing pump if req.	yes
				Seal leak, check process	
			Gas flow too high	Replace fan	
			Fan defective	Switch on water cooling	
			Water cooling switched off		
8	Pump error	Pump couldn't be identified or no pump is connected	Pump not connected correctly to frequency converter	Check connection between pump and frequency converter	yes
			Hardware defective	Contact Oerlikon Leybold Vacuum Service	

Error code	Designation	Meaning	Possible Cause	Remedy	Shut-down
61	Bearing temperature warning, top				no
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.	Check the ultimate pressure of the backing pump and install a bigger backing pump if req.	no
			Gas flow too high	Seal leak, check process	
103	Supply voltage warning	Intermediate circuit voltage too low or maximum time for generator operation was exceeded.	DC supply voltage below 24V	Check the voltage at the power supply and if required set up correctly	no
			Mains voltage has failed	Remedy the cause for the mains power failure	
106	overload error	The pump speed has dropped under the minimum speed	Forevacuum pressure too high.	Check the ultimate pressure of the backing pump and install a bigger backing pump if req.	yes
			Gas flow too high	Seal leak, check process	
111	Motor undertemperature error	The minimum permissible motor temperature is not attained.	Ambient temperature too low	Ensure min. ambient temperature of 0°C	yes
			Pump cooling too high	Reduce water cooing	
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.	Check the ultimate pressure of the backing pump and install a bigger backing pump if req.	yes
			Gas flow too high	Seal leak, check process	
117	Motor current error	Motor current less than nominal current	Cable fault	Contact Oerlikon Leybold Vacuum Service	yes
			Faulty connector		
126	Bearing temperature sensor error top	Bearing temperature sensor defective	Sensor defective, short circuit or broken cable	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	Check cables and power supply	–
		DC power miswired	Ensure correct polarity of the DC cable.	
		Frequency converter defective	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	Use USS protocol.	–
		No communication via the serial interface.	Connect bus as shown in Section 3.3.	
		REMOTE connector (X1) connected wrongly.	Connect as shown in Fig. 20	
		REMOTE and SERVICE connectors mixed up.	Connect correctly.	
		Wrong Profibus address set.	Set address between 0 and 126.	
–	Turbomolecular pump produces loud running noises and vibrations.	Rotor out of balance	Balance the rotor	no
		Bearing defective	Replace the bearing	
–	Turbomolecular pump does not reach ultimate pressure.	Measurement instrument defective	Inspect the measurement sensor	no
		Measurement sensors soiled	Clean or replace the sensors	
		Leaks at the equipment, lines or the pump	Check for leaks	
		Pump soiled	Clean the pump	
		Forevacuum pump provides insufficient pumping speed or ultimate pressure which is too high.	Check the ultimate pressure of the forevacuum pump and install a higher-capacity vacuum pump if necessary	
		Frequency parameters programmed wrongly	Check parameters.	
–	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.

Contamination

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

Warning

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

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

EC Manufacturer's Declaration

in the spirit of Appendix IIb to the 89/392/EWG Machinery Guidelines

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/EWG.

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
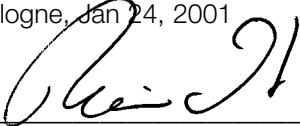
Applied harmonized standards:

■ 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:
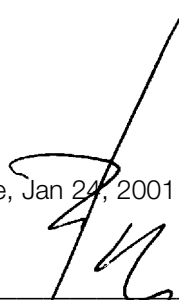
■ DIN 31 001   Nov. 1984

■ DIN ISO 1940   Dec. 1993

Cologne, Jan 24, 2001

Dr. Reinelt, Business Area Manager
Turbomolecular pumps

Cologne, Jan 24, 2001

Dr. Beyer, Design Department Manager
Turbomolecular pumps

Leybold
vacuum

œrlikon
leybold vacuum

$C\epsilon$ 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.

Designation of the products:	Frequency converter
Models:	**TURBO.DRIVE 400**
Part Nos.	800073V0002 /03 /04 /05 /07

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

    ■ EN 55011: 1998 class A   ■ EN 61000-4-4: 1995
    ■ EN 61000-4-6: 2001   ■ EN 61000-4-5: 1995
    ■ EN 61000-4-3: 1999   ■ EN 61000-4-2: 2001

Cologne, 24.10.2007

Dr. Ulrich Jung
Vice-President
Head of Product Development

Cologne, 24. 10. 2007

i.V.

Harald Udelhoven
Head of Quality Management

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

œrlikon leybold vacuum

Declaration of Contamination of Compressors, Vacuum Pumps and Components

The repair and / or servicing of compressors, vacuum pumps and components will be carried out only if a correctly completed declaration has been submitted. **Non-completion will result in delay**. The manufacturer can refuse to accept any equipment without a declaration.
A separate declaration has to be completed for each single component.
This declaration may be completed and signed only by authorised and qualified staff.

Customer/Dep./Institute: _____

_____

Address _____

_____

Person to contact: _____

Phone: _____ Fax: _____

End user: _____

Reason for return   ☒ **applicable please mark**

❏ **Repair** ❏ chargeable ❏ warranty

❏ **Exchange** ❏ chargeable ❏ warranty

❏ exchange already arranged / received

Return only: ❏ rent ❏ loan ❏ for credit

Calibration: ❏ DKD ❏ Factory calibration

❏ Quality test certificate DIN 55350-18-4.2.1

A. Description of the Leybold product

Material description: _____

Catalog number: _____

Serial number: _____

Type of oil (Forevacuum pumps): _____

Failure description: _____

_____

Additional parts: _____

Application Tool: _____

Application Process: _____

B. Condition of the equipment

	No[1]	Yes	No	**Contamination:**	No[1]	Yes
1. Has the equipment been used[1]	❏	❏	→	toxic	❏	❏
2. Drained (Product/service fluid)		❏	❏	corrosive	❏	❏
3. All openings sealed airtight		❏		flammable	❏	❏
4. Purged		❏	❏	explosive[2]	❏	❏
If yes which cleaning agent: _____				radioactive[2]	❏	❏
and which method of cleaning: _____				microbiological[2]	❏	❏
[1] if answered with "No" go to **D**.				other harmful substances	❏	❏

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

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

Tradename: Chemical name:

a) _____

b) _____

c) _____

d) _____

	No	Yes	
2. Are these substances harmful?	❏	❏	←
3. Dangerous decomposition products when heated?	❏	❏	
If yes, which? _____			

---

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

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

Name of authorised person (block letters): _____

Date _____ Signatur of authorised person _____

firm stamp

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Sales and Service

Germany

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

Oerlikon
Leybold Vacuum GmbH
Sales Area North/Northeast
Branch Office Berlin
Buschkrugallee 33
1. Obergeschoss
D-12359 Berlin
Phone: +49-(0)30-435 609 0
Fax: +49-(0)30-435 609 10
sales.vacuum.bn@oerlikon.com

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

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

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

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

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

Europe

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

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

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

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

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

Oerlikon
Leybold Vacuum Italia S.p.A.
Field Service Base
Z.I. Le Capanne
I-05021 Acquasparta (TR)
Phone: +39-0744-93 03 93
Fax: +39-0744-94 42 87
service.vacuum.mi@oerlikon.com

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

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

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

Switzerland
Oerlikon
Leybold Vacuum Schweiz AG
Leutschenbachstrasse 55
CH-8050 Zürich
Sales:
Phone: +41-044-308 40 50
Fax: +41-044-302 43 73
sales.vacuum.zh@oerlikon.com
Service:
Phone: +41-044-308 40 62
Fax: +41-044-308 40 60
service.vacuum.zh@oerlikon.com

America

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

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

Asia

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

oerlikon
leybold vacuum

w w w . o e r l i k o n . c o m