

# TURBOVAC

TW 400, TW 400/300, TW 400/300/25 S  
Single, Dual & Triple Inlet  
Wide-range Turbomolecular Pumps

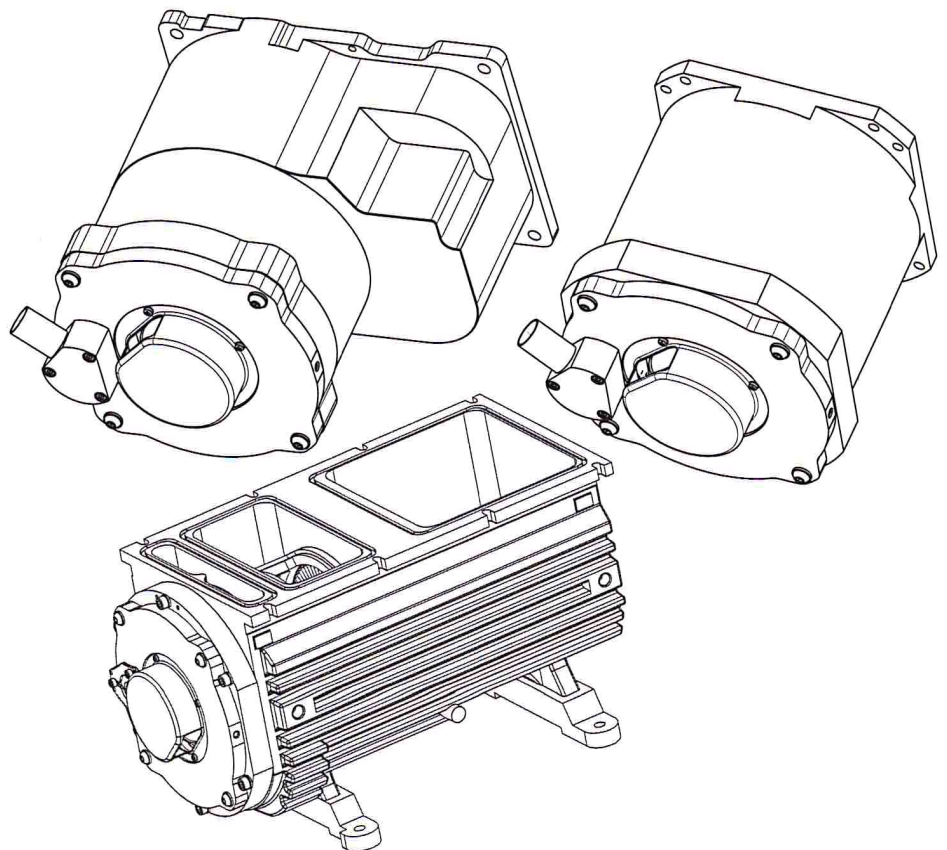
**Incorporation Declaration & Operating Instructions**  
**300353684\_002\_A4**

Part Nos.

800160V0032  
800160V0032V

800160V0027  
800160V0027V

800160V0029



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# Safety Information

## Obligation to Provide Information

Before installing and commissioning the pump, carefully read these Operating Instructions and follow the information so as to ensure optimum and safe working right from the start.

The Oerlikon Leybold Vacuum **TURBOVAC** 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 pump 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 our nearest office.

DANGER indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

WARNING indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION indicates a potentially hazardous situation which, if not avoided, could result in minor or moderate injury.

NOTICE is used to notify users of installation, operation, programming or maintenance information that is important, but not hazard related.

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.

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## NOTICE



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## DANGER



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## WARNING



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## CAUTION



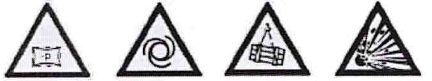
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## NOTICE



Original installation and operating instructions.

# Safety Information



## WARNING

### 0 Important Safety Information

#### 0.1 Mechanical hazards

- 1 Avoid exposing any part of the human body to the vacuum.
- 2 The pressure in the pump must not exceed 1.4 bar (absolute).
- 3 The pump is intended for generating a vacuum only. If there is a risk of an overpressure within the system and the pump, then the pump must be protected against this, by way of an overpressure safety valve, for example.
- 4 Vent the pump only up to atmospheric pressure.
- 5 The pump 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. Observe the information in Section 3.3.
- 6 We recommend to change the rotor after 80,000 hours of operation at the latest. Due to high-speed and temperature, the service life of the rotor is limited. If the rotor is changed too late, it may be destroyed. Thus in the flange mounts high forces and torque conditions can occur. The mounting screws for the pump may be torn off. When using clamped flange connections at the housing or with components above the housing, sudden twisting of the entire pump can be experienced.
- 7 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.
- 8 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.



## 0.2 Electrical hazards

- 1 The electrical connection must only be provided by a trained person. Please observe the national regulations in the country of use like EN 50110-1 for Europe, for example.
- 2 The frequency converter must only be connected to power supplies which meet the requirements for functional extra-low voltages with positive isolation in accordance with IEC 60364-4-41 (or local regulations) (PELV).
- 3 Lethal voltages are present at the mains connections. Before starting with any maintenance and service work, de-energise (lockout/tagout) the product first.
- 4 Unplug any connectors only when the mains voltage is switched off and the pump does no longer turn.
- 5 Unauthorized device conversion and modifications are prohibited for safety reasons.
- 6 Hazardous voltages are present within the frequency converter. When coming into contact with these, death or severe injury can result. After the pump has arrived at standstill, disconnect the frequency converter from the mains power and prevent it against being switched on inadvertently (lockout/tagout) before opening it. Basically there is no reason why the frequency converter should be opened. There are no user serviceable parts inside.
- 7 When the connector cable is attached, the outputs at the frequency converter are not free of voltage.
- 8 Lay connecting lines so that they cannot be damaged. Protect the lines against humidity and contact with water. Avoid any heat stress on the line due to unfavourable laying conditions.
- 9 Suitably support the connecting lines so that the pumps are not exposed to any major mechanical stress.
- 10 Do not expose pump, frequency converter and the connections to dripping water. Note the information on the IP type of protection.
- 11 When storing pump, frequency converter and connecting lines in a humid atmosphere, these can suffer corrosion. Corrosion gives rise to conductive deposits which in turn can cause short-circuits and reduce the insulation levels of electrical components
- 12 Transport pump, frequency converter and connecting cables only in their original packaging so as to avoid any mechanical damage which in turn may reduce air gaps and creepage distances.
- 13 When applying external voltages above 42 V to the connection terminals, observe the applicable VDE safety regulations!

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**DANGER**



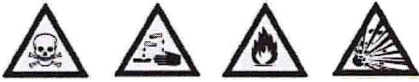
# Safety Information

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**CAUTION****0.3 Thermal hazards**

- 1 Handle the equipment only while vented and cooled down.
- 2 During operation of the pump certain areas can get so hot (80 °C max.) so that there is the risk of suffering burns. Protect hot parts against being touched.
- 3 Note the warning information on the housing surface. If these warning notices have been removed, covered or obstructed, include corresponding additional warning notices.

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**DANGER****0.4 Hazards caused by materials and substances**

- 1 The pump is not suited for pumping of reactive or corrosive media. If the rotor is attacked by process gases, it can suffer destruction. Thus in the flange mounts high forces and torque conditions can occur. The mounting screws for the pump may be torn off. When using clamped flange connections at the housing or with components above the housing, sudden twisting of the entire pump can be experienced.
- 2 Please consult us as to which types of pump are required for specific processes and applications.
- 3 The forevacuum line must be tight. Hazardous gases can escape at leaks or the gases being pumped can react with air or humidity. A leak search will always be required after having installed the pump and after service work on the vacuum. Upon delivery the pump has an integral leak rate of  $< 5 \cdot 10^{-7}$  mbar-l/s. When pumping toxic gases we recommend a leak search on a regular basis.
- 4 If the pump has previously handled hazardous gases, implement the proper precautionary measures before opening the intake or exhaust connection. Before opening the pump, purge it for a longer period of time with an inert gas. If necessary, use gloves, a respirator and/or protective clothing and work under an exhaust hood. Firmly seal off the pump. When shipping the contaminated pump for servicing, please also state the type of hazard. For this you must use a form which we have prepared for you.
- 5 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.

## 0.5 Danger of ignition

- 1 During operation the pressure inside the turbomolecular 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 120°C internally, and at parts of the outside surfaces 80 °C. Sparks could occur in case of damage to the pump and these could ignite explosive mixtures. Also note the safety information provided by the gas supplier.

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### CAUTION



## 0.6 Dangers in connection with safety-related measures and precautions

- 1 The frequency converter is not equipped with its own emergency shut down switch. Such a facility needs to be provided from the side of the system.

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### CAUTION



## 0.7 Risk of damaging the pump

- 1 Never touch the rotor. Touching the rotor may cause injury and damage the rotor bearing.
- 2 Foreign objects which enter the pump through the intake would cause serious damage to the rotor. That's why we recommend installing an inlet screen. Damages caused during operation without the inlet screen are excluded from warranty.
- 3 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 Oerlikon Leybold Vacuum Service.
- 4 The interface connectors have UNC 4-40 threads. Do not use connectors with M3 threads.
- 5 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.
- 6 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.

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### NOTICE





# Description

## 1 Description

The TURBOVACs are wide-range turbomolecular pumps designed to evacuate one, two or three vacuum chambers.

TW 400: single-inlet, TW 400/300: dual-inlet, TW 400/300/25 S: triple-inlet

The pumps are designed to be integrated into a system.

They are suitable for pumping air and clean gases.

Required for the operation are

- a TURBO.DRIVE 400 frequency converter
- a power supply for the TURBO.DRIVE and
- a forevacuum pump.

### 1.1 Design

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

The first section of the rotor are one or two turbomolecular pump stages while the second section represents a Holweck stage. The Holweck pumping stage increases the permissible forevacuum pressure level markedly when compared with the classical turbomolecular pump.

The pump has one or two gas inlets into the turbo stages, the triple-inlet pump has a third gas inlet into the Holweck stage.

**Bearings** The rotor shaft runs in two lifetime lubricated ceramic ball bearings.

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

A circuit board is installed in the pump. It is equipped with a temperature sensor and a code resistor for identification of the pump type.

**Cooling** Standard pumps rely on convection cooling, but require additional air or water cooling depending on the load, like increased gas throughput, high ambient temperatures or operation in a closed housing.

**Frequency converter** The pump is driven by an electronic frequency converter TURBO.DRIVE 400. All functions like, for example, speed control, pump sensing or temperature monitoring are monitored by the TURBO.DRIVE 400. This unit is powered by an external power supply.

### 1.2 Standard equipment

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

The flanges are equipped with blank covers for shipping.

For the TW 400 an O-ring 125x5 (part no. 23970419) is added.

For the TW 400/300/25 S a centering ring with FPM sealing ring, and a clamping yoke is delivered for the forevacuum connection (assembled at the forevacuum port).



## 1.3 Technical data

TURBOVAC TW	400	400/300	400/300/25 S
Pumping speed for N <sub>2</sub>			
HV flange	400 l·s <sup>-1</sup>	400 l·s <sup>-1</sup>	400 l·s <sup>-1</sup>
Interstage port I	—	300 l·s <sup>-1</sup>	300 l·s <sup>-1</sup>
Interstage port II	—	—	25 l·s <sup>-1</sup>
Operating pressure			
HV flange	10 <sup>-5</sup> - 10 <sup>-7</sup> mbar	10 <sup>-5</sup> - 10 <sup>-7</sup> mbar	10 <sup>-5</sup> - 10 <sup>-7</sup> mbar
Interstage port I	—	10 <sup>-2</sup> - 10 <sup>-4</sup> mbar	10 <sup>-2</sup> - 10 <sup>-4</sup> mbar
Interstage port II	—	—	10 <sup>-1</sup> mbar
Max. permissible forevacuum pressure for N <sub>2</sub>		8 mbar	
Recommended frequency converter		TURBO.DRIVE 400	
Operating speed		48,000 r.p.m.	
Run-up time, approx.		8 min	
Forevacuum connection	Hose connector 19 mm outer dia.	Hose connector 19 mm outer dia.	DN 16 KF
Weight, approx.		12 kg	
Type of protection		IP 20	
Ambient temperature			
during operation		+ 15 - + 40 °C	
storage		- 15 - + 70 °C	
Max. rel. air humidity		approx. 95% <sup>1)</sup> (non-condensing)	
(More details in Applied technical standard IEC 721-3-3 3K3/3Z1/3B1/3C1/3S2/3M1)			

# Description

## 1.4 Ordering data

Part number

### Turbomolecular pump TURBOVAC

TW 400	800160V0032
TW 400, TD 400 RS 485, cable 0.65 m	800160V0032V
TW 400/300	800160V0027
TW 400/300, TD 400 RS 485, cable 0.65 m	800160V0027V
TW 400/300/25 S (short stand)	800160V0029

### Spare parts

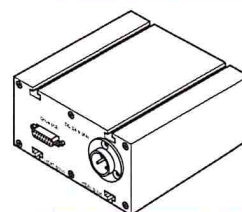
O-ring 125x5 for TW 400	E23970419
Replacement cartridge for TW 400/300/25 S	800160V0019C

## 1.5 Accessories

Part number

### Frequency converter

TURBO.DRIVE 400 with RS 485 C interface	800073V0003
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Connecting cable pump - frequency converter

0.26 m long	20012726
0.5 m long	800080V0050
0.65 m long	800080V0065
1.0 m long	152 47
2.5 m long	864 49
3.0 m long	864 40
5.0 m long	864 50

### Power Supply

Astec 24 V/250 W with air cooler	864 46
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OEM power supply (with screw terminals) SITOP 24 V / 10 A	152 50
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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

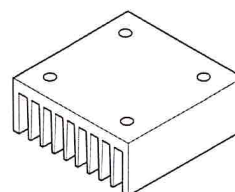


Mains cable for power supply, 2 m long

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

### Options

Heat sink for frequency converter	800110V0001
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# Description

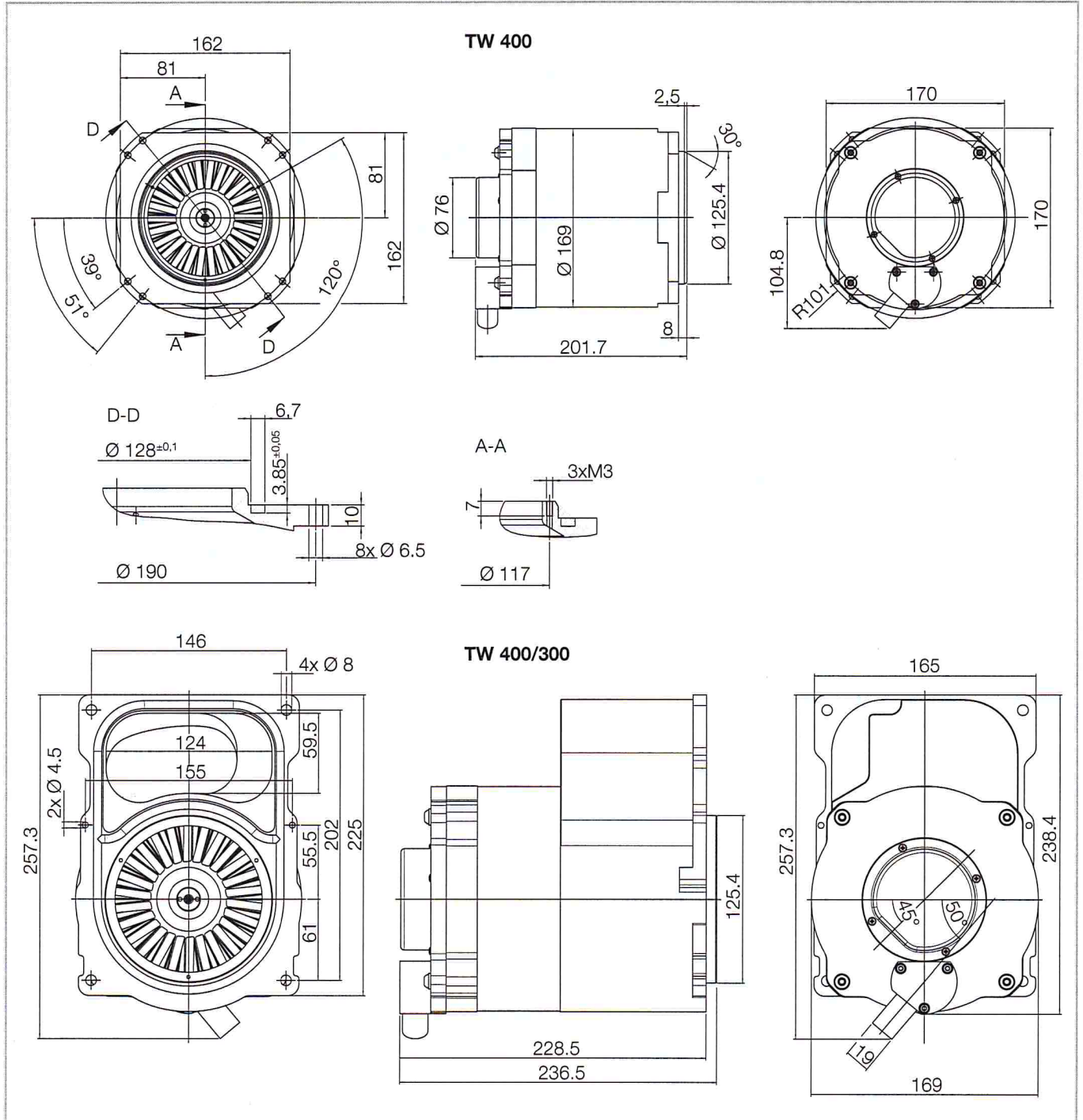


Fig. 1.1 Dimensional drawing, dimensions in mm

# Description

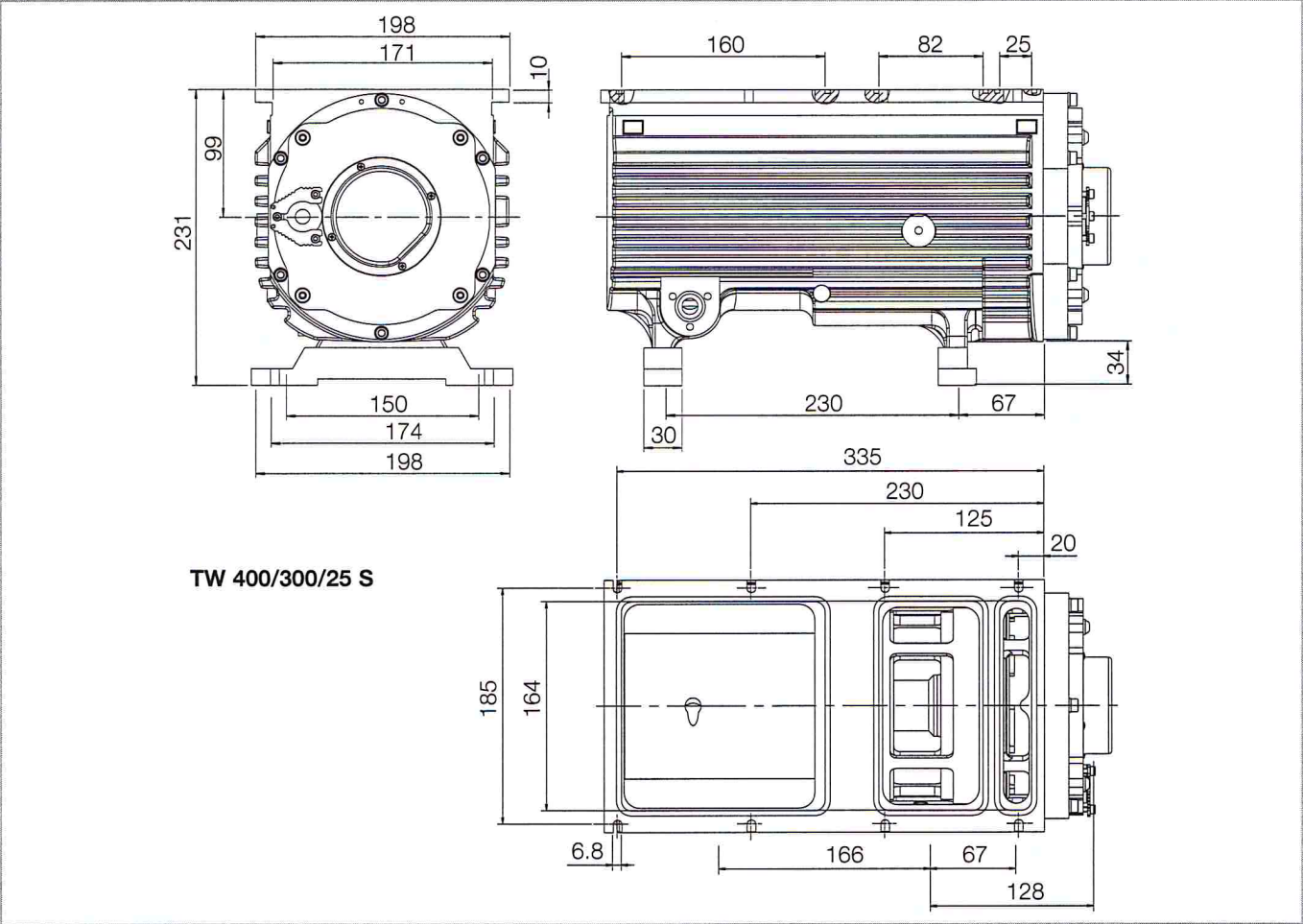


Fig. 1.2 Dimensional drawings , dimensions in mm



# Transport and storing

## 2 Transport and storing

Remove the equipment from the transportation box and keep the packaging. Make sure that the product has not been damaged during transportation. If this unit is damaged contact your carrier and inform Oerlikon Leybold Vacuum if necessary. For storage of the product, use the packaging provided.

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

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

The turbomolecular pump is shipped in a sealed PE bag with desiccant. Do not open the sealed package until immediately before installing.

Do not remove the covers and blanking flanges until you are ready to make the connections, to ensure that the turbomolecular pump is installed under the cleanest possible conditions.

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.

Do not store pump and accessories in a moist atmosphere so as to prevent these items from suffering corrosion.

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### NOTICE



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### WARNING



## 3 Installation

### 3.1 Conforming utilization

The turbomolecular pump is intended for generating a vacuum. It is suited for non-corrosive processes only.

The turbomolecular pump must be bolted to a rigid vacuum system and connected to a suitable backing pump.

The turbomolecular pump must only be operated with correspondingly specified frequency converters, the special connecting cables and mounting bolts.

Both pump and frequency converter are intended for being operated within closed rooms.

The use of any accessories which have not been specified by Oerlikon Leybold Vacuum is only allowed after approval by Oerlikon Leybold Vacuum.

#### 3.1.1 Non-conforming utilization

Non-conforming utilizations for both pump and frequency converter are among others:

- Pumping of gases and vapours for which the materials of the pump are unsuitable.
- Operation in connection with processes in which GaAs (gallium arsenide) is being pumped.
- Pumping of gas mixtures with an oxygen content of > 21%.
- Pumping of corrosive gases and dust containing gases.
- Pumping of condensable vapours without suitably controlling the temperature of the pump. Upon compression within the pump, these vapours may condense or form deposits.
- Pumping of dusts and solids without the use of suitable screens and filters.
- Operation at an inadmissibly high forevacuum pressure.
- Operation at inadmissibly high gas loads.
- Utilization of both pump and frequency converter in explosion hazard areas.
- Non-compliance of the specified maintenance and servicing intervals for both pump and frequency converter.
- Operation of the pump and drive electronics in environments which demand protection type IP 20 or higher and where the installation site is over 1000 m above sea level.
- Utilization in systems and pump systems in which the pressure may exceed 1.4 bar abs.
- Operation with an inadequately mounted pump.

- Operation without having flanged the pump to the system or without having connected it to a suitable backing pump.
- Operation with additional heat sources involving thermal radiation, thermal conduction via the high vacuum or the forevacuum flange, strong magnetic fields or very hot process gases, for example.
- Use in systems in which impact stress and vibrations or periodically occurring forces affect pump, frequency converter and cables.
- Operation on moving system or system components (locks or movable pump systems, for example).
- Operation at vibration absorbers and vacuum components (gate valves, valves) which are not capable of sustaining the specified deceleration torque should the pump rotor seize.
- Stepping on pump, add-on parts, drive electronics, flanges and cables to climb onto the system.
- Fitting of add-on parts to the forevacuum flange which cause an inadmissible high load.
- Removing, covering or obstructing warning notices.
- Standstill or storing of pump and drive electronics without suitable sealing-off and drying. Storing in a humid atmosphere can cause corrosion.
- Conversions, manipulations and maintenance work by personnel not authorised by Oerlikon Leybold Vacuum.

Any non-conforming utilisation of pump, frequency converter and accessories can result in severe injury and cause damage to components.

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## WARNING



### 3.2 Operating environment

Permissible ambient temperature i	max. 45 °C no dripping or spraying water, no explosive gas atmospheres
Max. magnetic induction at the surface of the pump housing	B=5 mT if impinging radially B=15 mT if impinging axially
Max. radiation resistance	10 <sup>3</sup> Gy
Installation altitude	up to 1000 m At altitudes over 1000 m heat dissipation by the ambient air is impaired.

# Installation

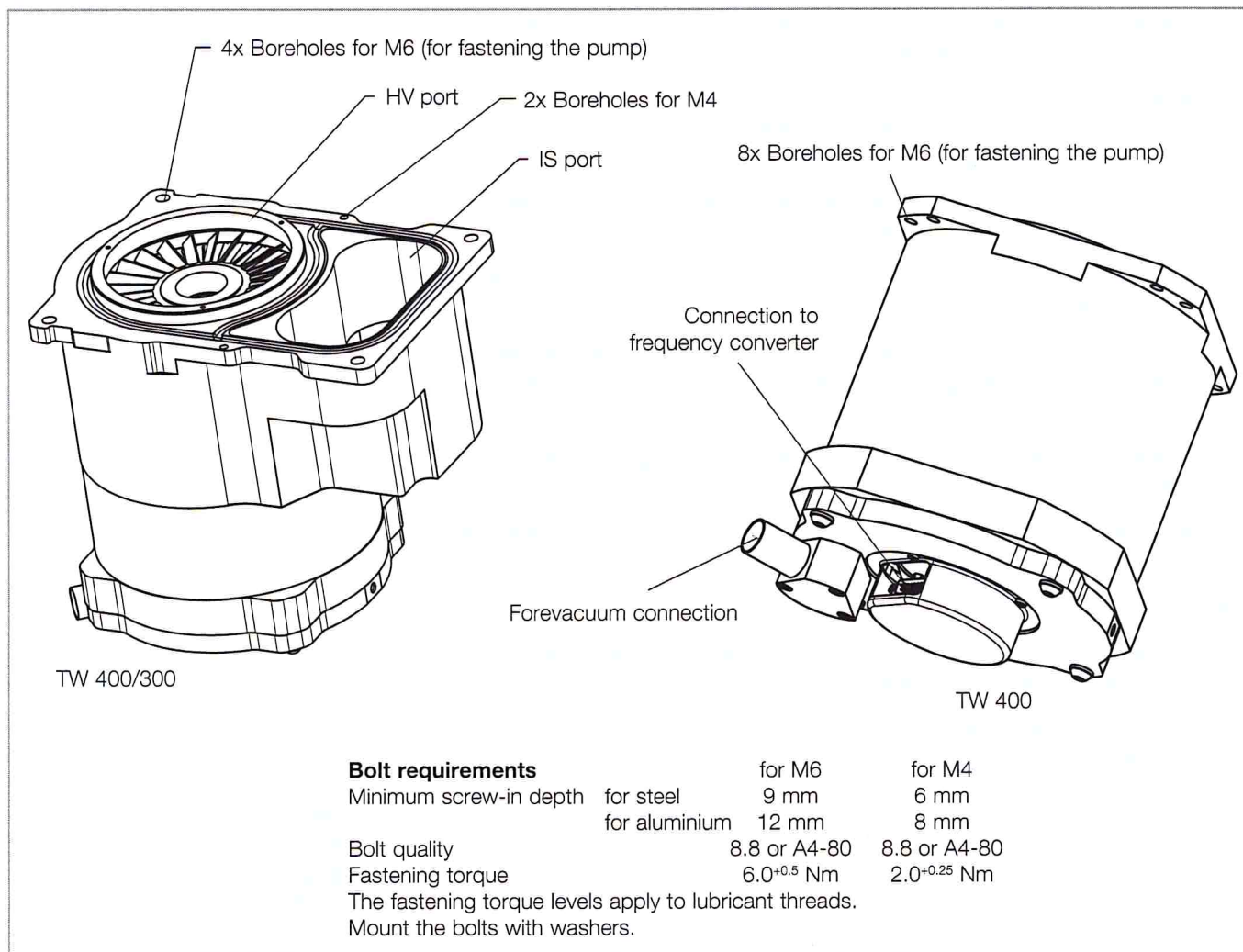


Fig. 3.1 Connection elements

### 3.3 Attach the pump to the vacuum chamber

#### NOTICE



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. Observe Safety Information 0.1.5.

Remove the transport seal from the intake flange and remove the desiccant. Pay attention to maximum cleanliness when connecting.

#### Torque when the rotor seizes

If the pump should suddenly seize, an ensuing deceleration torque of up to 3200 Nm will have to be absorbed by the system.

For this purpose there are mounting points at the high-vacuum flange.

Mount the pump to the system.



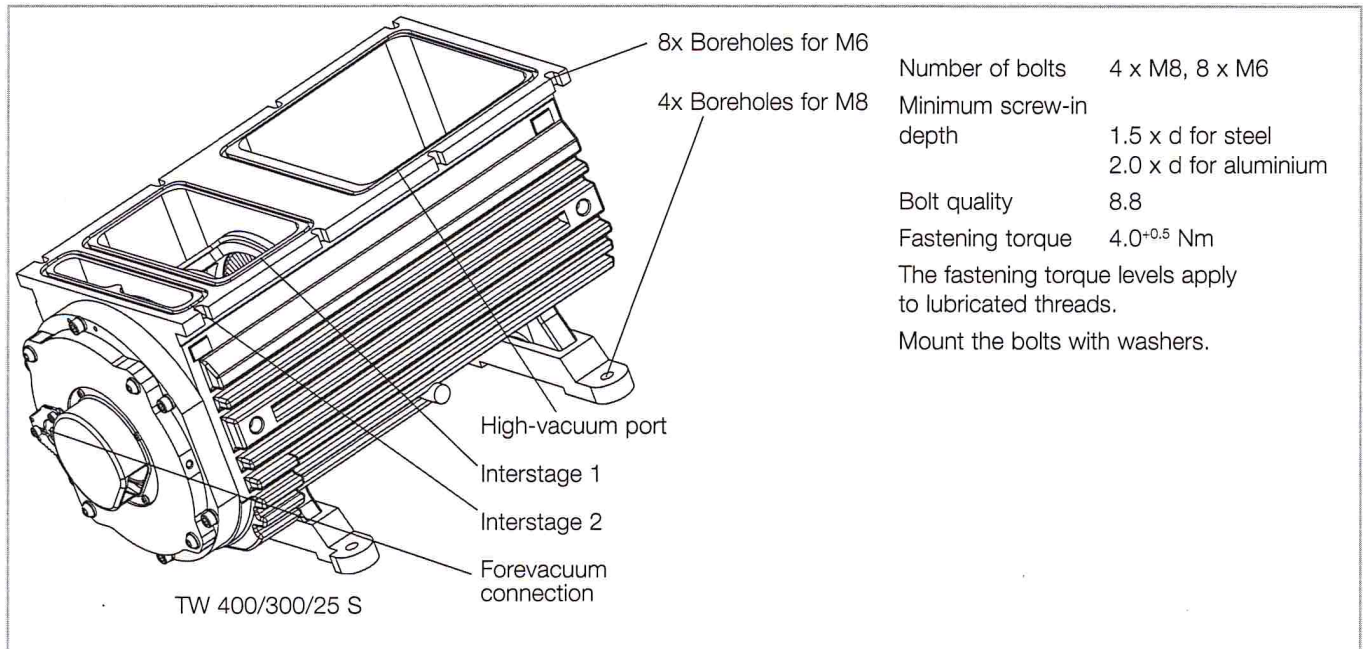


Fig. 3.2 Connection elements

The flange or housing material to which the pump is bolted, must have at operating temperature a minimum yield strength of 150 N/mm<sup>2</sup>. It is necessary to use thread inserts.

The standard mounting arrangement for the pump is adequate to ensure earthquake protection. If required mount the system to the floor or the walls.

During operation the pump can get so hot that there is the risk of suffering burns (up to approximately 80 °C). Protect the hot parts against being touched.

## Earthquake protection

### CAUTION



# Installation

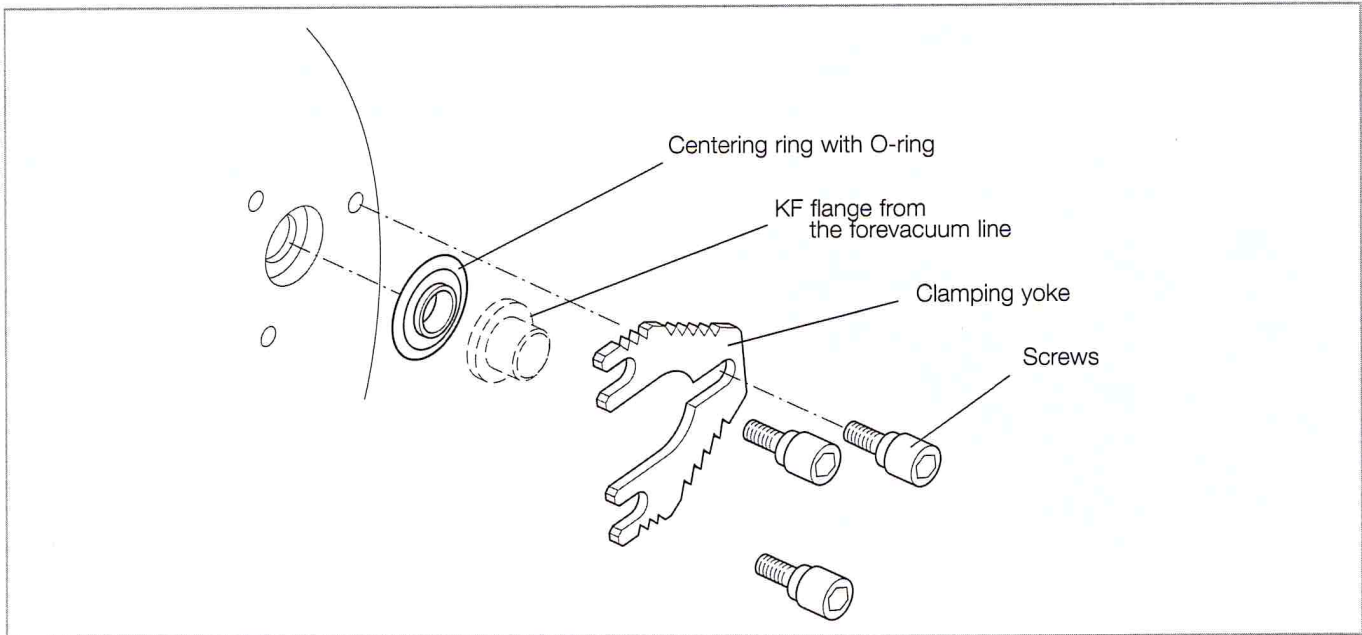


Fig. 3.3 Connecting the DN 16 KF forevacuum line

## 3.4 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.

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

The forevacuum line must be tight. Hazardous gases can escape at leaks or the gases being pumped can react with air or humidity. Observe Safety Information 0.4.4.

Fig. 3.4 is a schematic diagram of a pump system incorporating a turbomolecular pump and a TRIVAC forevacuum pump with an anti-suckback valve.

### Safety valve

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

### Adsorption trap

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

Provide a roughing line to achieve the shortest cycle times.

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

No forces from the piping system may be allowed to affect the turbomolecular pump. Support the piping correspondingly or decouple through flexible joints.



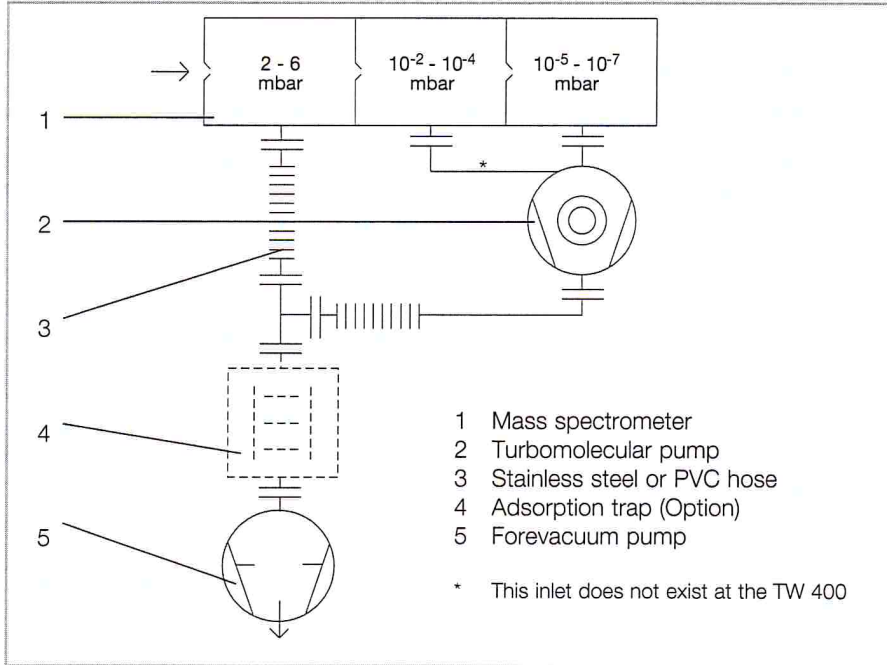


Fig. 3.4 Schematic of a dual inlet turbomolecular pump system

### 3.5 Connect the frequency converter

Refer to the Operating Instructions for the TURBO. DRIVE 400 and, if required, for the serial interfaces.

## 4 Operation

### 4.1 Media compatibility / purge gas

The TURBOVAC is suitable for pumping air and clean gases.

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

Suited for venting are all gases,

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

For venting 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.

### 4.2 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.



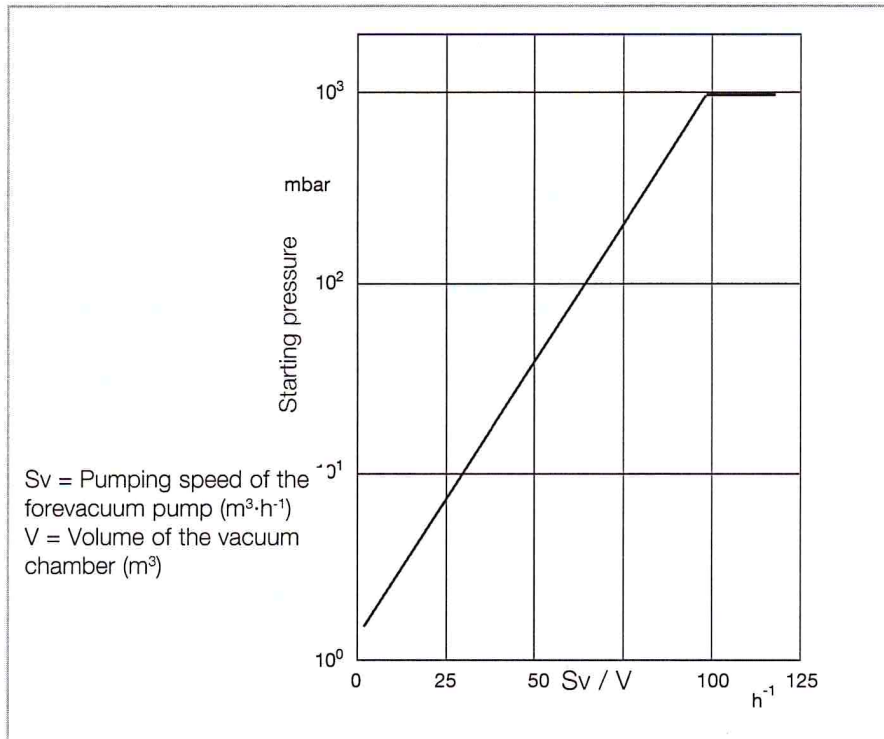


Fig. 4.1 Determining the starting pressure of a turbomolecular pump when evacuating large volumes

### 4.3 Switching on

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

The maximum starting pressure for the turbomolecular pump can be read from the graph in Fig. 4.1.

Switch on the turbomolecular pump at the frequency converter

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

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

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

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

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

### Starting pressure

#### NOTICE



## 4.4 Shutting down

Switch off the pump at the frequency converter.

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

### Generator operation

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

Switch off the forevacuum pump.

### Venting

When using oil-sealed forevacuum pumps, vent the turbomolecular pump before it comes to a stop; refer to Section 4.5.

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

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

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

### Emergency shut down

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

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

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

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### CAUTION



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

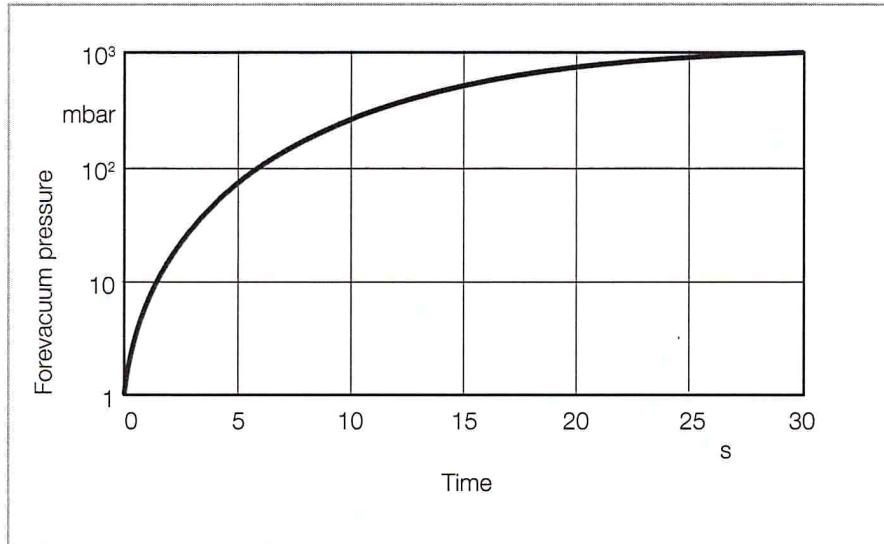


Fig. 4.2 Maximum rise in pressure

## 4.5 Venting

Refer to Section 4.1 for suited gases.

### Venting Methods

There are two different methods of venting the turbomolecular pump.

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

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

### Speed of the Pressure Rise

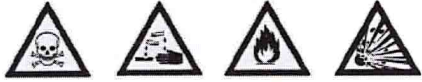
All turbomolecular pumps may be vented at full speed. However, the pressure must not increase faster than specified through the pressure rise curve.

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

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

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

**Particles**



## 4.6 Removing the pump from the system

Shut down the pump and vent as described in Sections 4.4 and 4.5.

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

Observe Safety Informations 0.4.5.

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

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

### **Hazardous gases**

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.

### **Deposits**

### **Desiccant**

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

Corrosion damage due to faulty packing will nullify the guarantee.

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

Observe the instructions in Section 5.2 if you forward the pump to Oerlikon Leybold Vacuum.



## 5 Maintenance

We recommend an exchange of the rotor unit after 80,000 operating hours at the latest.

### Rotor exchange

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

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

Observe Safety information 0.1.6.

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

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### WARNING



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### Adsorption trap

### 5.1 Cleaning

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

#### Cleaning the frequency converter internally

The converter essentially requires no servicing since it contains no components which could be adjusted.

Depending on the installation particulars and the ambient conditions, the converter may collect grime (dust, moisture) on the inside. Such contamination can lead to malfunctions, overheating or short circuits and will have to be avoided to the maximum extent possible. The Oerlikon Leybold Vacuum Service Department can clean the converter. We recommend adhering to a cleaning interval of about five years.

### 5.2 Oerlikon Leybold Vacuum Service

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

### Contamination

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

### Form

Attach the form to each pump.

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.

# Troubleshooting

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**CAUTION**

## 6 Troubleshooting

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

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

Are the connections in good working order?

- Mains connection,
- 24 V DC cable to the frequency converter,
- Connector cable between the frequency converter and the pump

Is the forevacuum pressure sufficient?

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

- In case of error code 8 by switching the mains power off.
- In case of all other error codes by applying a STOP signal via the socket REMOTE (X1) or the serial interface or by switching the mains power off.

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

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

# Troubleshooting

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

# Troubleshooting

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



# Troubleshooting

Error code	Error	Possible Cause	Remedy	Shut-down
—	Yellow power LED is not on	No DC power DC power miswired Frequency converter defective	Check cables and power supply Ensure correct polarity of the DC cable. Replace frequency converter. The following may damage the freq. converter: - Disconnection of the DC cable while the pump was still rotating - Non-compliance with the note related to connecting several pump to a single power supply.	—
div.	Red LED flashes	Warning message. See Operating Instructions of the frequency converter for the possible reasons of the warning.	The pump can continue to run, as long as operation limits are only exceeded for a short time. In case of longer exceeding send pump and frequency converter to the OLV service.	no
—	Turbomolecular pump does not start, ERROR LED does not light.	Interface protocol error No communication via the serial interface. REMOTE connector (X1) connected wrongly. REMOTE and SERVICE connectors mixed up. Wrong Profibus address set.	Use USS protocol. Connect bus as shown in the Operating Instructions of the frequency converter. Connect as shown in the Operating Instructions of the frequency converter. Connect correctly. Set address between 0 and 126.	—
—	Turbomolecular pump produces loud running noises and vibrations.	Rotor out of balance Bearing defective	Balance the rotor Replace the bearing	no
—	Turbomolecular pump does not reach ultimate pressure.	Measurement instrument defective Measurement sensors soiled Leaks at the equipment, lines or the pump Pump soiled Forevacuum pump provides insufficient pumping speed or ultimate pressure which is too high. Frequency parameters programmed wrongly	Inspect the measurement sensor Clean or replace the sensors Check for leaks Clean the pump Check the ultimate pressure of the forevacuum pump and install a higher-capacity vacuum pump if necessary Check parameters.	no
—	Running pump can not be stopped via X1	Pump has been started via the serial interface, the interface controls the pump	Disconnect the DC supply or connect serial interface and stop via bus	no

## Contamination

### WARNING



## 7 Waste Disposal

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

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

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

When sending us any equipment, observe the regulations given in Section "5.2 Oerlikon Leybold Vacuum service".

This product complies with with the European Community Regulation 2002/95 (**RoHS** Restriction of Hazardous Substances).

## Certificates

The turbomolecular pumps have been tested by the TÜV Rheinland of North America according to the requirements of:

- UL 61010-1: 2004 R07.05
- CAN/CSA-C22.2 No.61010-1: 2004

The components are in compliance to the tested standards.

cTUVus File Nos. 30882228 002 & 004

cTUVus Certificate No. CU 72081867 02 & 04



c U S

## EC Incorporation Declaration

The manufacturer: Oerlikon Leybold Vacuum GmbH  
Bonner Straße 498  
D-50968 Cologne  
Germany  
Tel.: +49(0)221 347-0  
info.vacuum@oerlikon.com

herewith declares that the following product:

Product designation: **Turbomolecular pump**

Type designation:

TW 220/xxx  
TW 250/xxx  
TW 400/xxx

Kat.Nr. 11430, 800160Vxxxx x= 0 bis 9

complies with the following fundamental requirements of the **EC Machinery Directive (2006/42/EG)**:  
Annex I, Paragraph 1.1.2, 1.1.3, 1.1.5, 1.2.1, 1.2.3, 1.2.4.1, 1.2.4.2, 1.2.6, 1.3.1, 1.3.2, 1.3.3, 1.3.4,  
1.3.7, 1.5.1, 1.5.2, 1.5.4, 1.5.5, 1.5.13, 1.6.1 and 1.7.1

The following harmonised standard has been applied:

EN 1012-2:1996+A1:2009 Compressors and vacuum pumps - Safety requirements - Part 2:  
Vacuum pumps

The incomplete machine may only be put into operation after it has been determined that the machine into which the incomplete machine shall be installed complies with the regulations laid down in the EC Machinery Directive (2006/42/EG).

The manufacturer commits himself to make the special documentation on the incomplete machine electronically available to national authorities upon request.

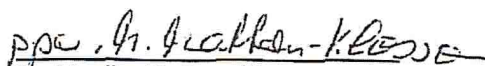
The special engineering documentation belonging to the machine was compiled in accordance with Annex VII Part B.

Documentation Officer

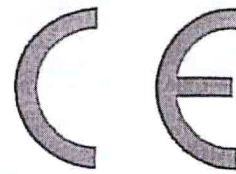
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Oerlikon Leybold Vacuum GmbH  
Bonner Straße 498 , D-50968 Cologne  
Germany

Cologne, dated 18-7-2011

Cologne, dated 18-7-2011

  
Dr. Monika Mattern-Klosson  
Head of Research & Development

  
Harald Udelhoven  
Head of Quality Management



## EC Declaration of Conformity

The manufacturer: Oerlikon Leybold Vacuum GmbH  
Bonner Straße 498  
D-50968 Cologne  
Germany  
Tel.: +49(0)221 347-0  
info.vacuum@oerlikon.com

herewith declares that the products specified and listed below which we have placed on the market, comply with the applicable EC Council Directives.

This declaration becomes invalid if modifications are made to the product without agreement of Oerlikon Leybold Vacuum GmbH.

Compliance with the EMC Directives requires that the components are installed within a system or machine in a manner adapted to EMC requirements.

Product designation: **Turbomolecular pump**

Type designation:

TW 220/xxx  
TW 250/xxx  
TW 400/xxx

Kat.Nr. 11430, 800160Vxxxx x= 0 bis 9

The product complies to the following European Council Directives:

EC-Directive relating to electromagnetic compatibility (2004/108/EG),

EC-Directive relating to Low Voltage Directive (LVD) (2006/95/EG).

The following harmonised standards have been applied:

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 - Part 1: General requirements

Cologne, dated 18-7-2011

Cologne, dated 18-7-2011

Dr. Monika Mattern-Klosson  
Head of Research & Development

Harald Udelhoven  
Head of Quality Management

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