Vacuum Solutions | Application Support | Service

LEYBOLD VACUUM

GA 05.140/1.02

TURBOVAC
TW 220/170 S
TW 220/150/15 S

TURBO.DRIVE S

Dual & Triple Inlet Hybrid
Turbomolecular Pumps
and Frequency Converter

Ref.Nos
114 39
114 30
113 53

Preliminary Operating Instructions

Contents

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

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

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

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

1 Description

The TURBOVAC TW 220/170 S is a dual-inlet hybrid type turbomolecular pump designed to evacuate both high vacuum chambers of mass spectrometers.

The TURBOVAC TW 220/150/15 S is a triple-inlet hybrid type turbomolecular pump without housing designed to be integrated into a system.

They are suitable for pumping air and clean gases.

Required for their operation are

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

The pumps are **not suitable** for

- pumping liquids or gases containing dust or particulates
- pumping corrosive or reactive gasses
- operation without a forevacuum pump.

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

During operation the pressure inside the pump is so low that there is no danger of ignition (at pressures below about 100 mbar). A hazardous condition will be created if flammable mixtures enter the hot pump at pressures above 100 mbar. During operation the pump can reach temperatures as high as 110°C (230 °F). Ignition sparks could occur in case of damage to the pump and these could ignite explosive mixtures.

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

Warning

Never expose any parts of the body to the vacuum.

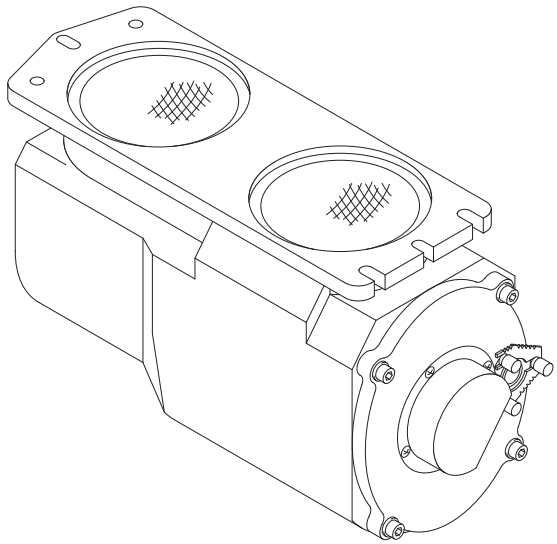


Fig.1 TW 220/170 S

TW 220/170 S

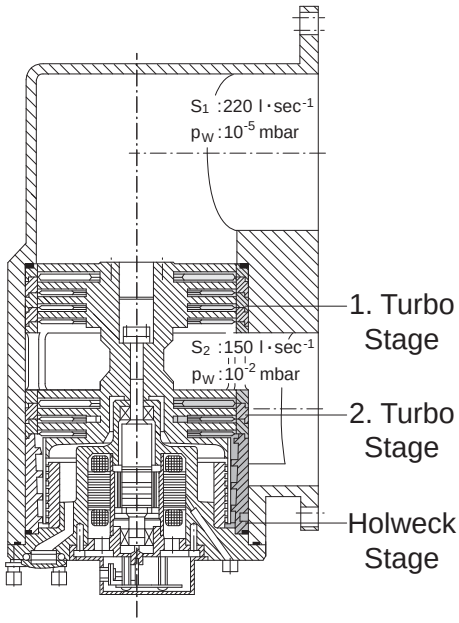


Fig. 2 Section through the TW 220/170 S

1.1 Design

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

The TW 220/170 S has a pump housing (see Fig. 1), the TW 220/150/15 S housing has to be provided by the customer (Cartridge Version).

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

Both pumps have gas inlets into the turbo stages, the TW 220/150/15 S has a third gas inlet into the Holweck stage.

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

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

A circuit board is installed in the pump. It is equipped with a temperature sensor and a memory in which the critical operating data for the pump are stored.

The pump is convection cooled and normally needs no separate cooling.

KF type components can be connected directly to the forevacuum flange using a clamping yoke.

The TURBO.DRIVE S frequency converter takes care of power supply and pump control. This frequency converter needs an additional power supply for 24 V DC.

1.2 Standard equipment

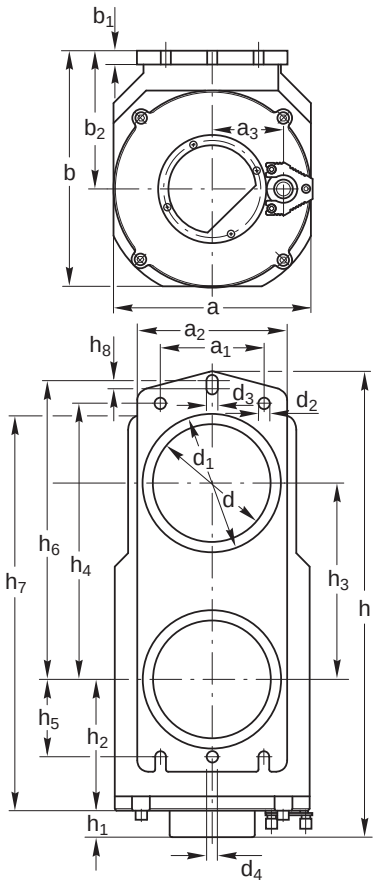
The pumps are shipped sealed in a PE bag with a desiccant to absorb moisture.The maximum useful life of the desiccant is one year.

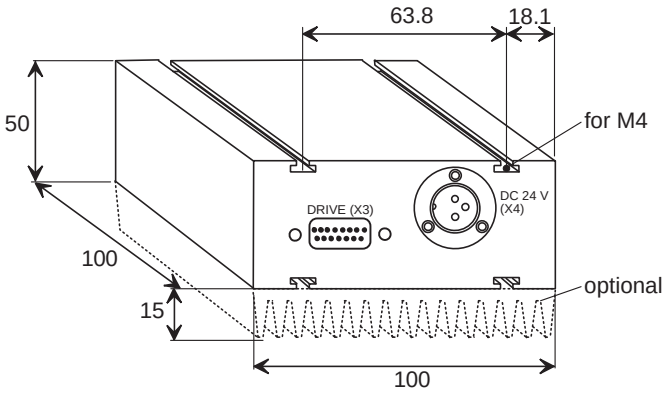
The flanges are equipped with blank covers for shipping.

The high-vacuum connection elements are **not** part of the standard equipment. For the forevacuum connection a centering ring with FPM sealing ring, and a clamping yoke is delivered.

The connector cable required for operation is not included with the pump.

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





a	a_1	a_2	a_3	b	b_1	b_2
170	90	130	61.5	205	12	120

d	d_1	d_2	d_3	d_4
102	120	9	8.5	8.5

h	h_1	h_2	h_3	h_4	h_5	h_6	h_7	h_8
386.5	22.5	98	170	238	69	258	326	8

Fig. 3 Dimensional drawing for TW 220/170 S and the frequency converter, dimensions in mm

1.3 Ordering data

TURBOVAC TW 220/170 S	114 39
TURBOVAC TW 220/150/15 S	114 30
TURBO.DRIVE S, frequency converter	113 53

Connector cable between pump and frequency converter, 3 m long	200 06 636
Power Supply 24 V DC	200 57 165

1.4 Technical data

TURBOVAC		***TW 220/170 S***	***TW 220/150/15 S***
High-vacuum connections	DN	2 x 100 ISO	—
Pumping speed for N_2			
HV flange	$l \cdot s^{-1}$	220	220
Interstage HV flange I	$l \cdot s^{-1}$	170	150
Interstage HV flange II	$l \cdot s^{-1}$	—	15
Operating pressure			
HV flange	mbar	10^{-5} - 10^{-7}	10^{-5} - 10^{-7}
Interstage HV flange I	mbar	10^{-2} - 10^{-4}	10^{-2} - 10^{-4}
Interstage HV flange II	mbar	—	2 - 10^{-1}
Max. permissible forevacuum pressure	mbar	8	
Recommended frequency converter		TURBO.DRIVE S	
Operating speed	r.p.m.	45,000	
Run-up time, approx.	min	8	
Forevacuum connection	DN	16 KF	
Weight, approx.	kg	12	
Type of protection	IP	20	

TURBO.DRIVE S	
Supply voltage	24 V DC ± 5%
Residual ripple	< 2%
Max. power consumption	150 W
Max. permanent current	6 A
Max. current	6.5 A
Max. length of the DC cable	
at 3 x 1.5 mm^2	5 m
at 3 x 2.5 mm^2	10 m
Load capability, relay output	48 V, 0,5 A
Ambient temperature	
during operation	10 - 55 °C
storage	-15 - + 60 °C
Relative air humidity acc. to DIN EN 60721	Class F
Type of protection	IP 20
Weight, approx.	0,7 kg

Legend for Fig. 4

1 HV flange
2 Interstage HV flange
3 Forevacuum connection
4 Connection for frequency converter

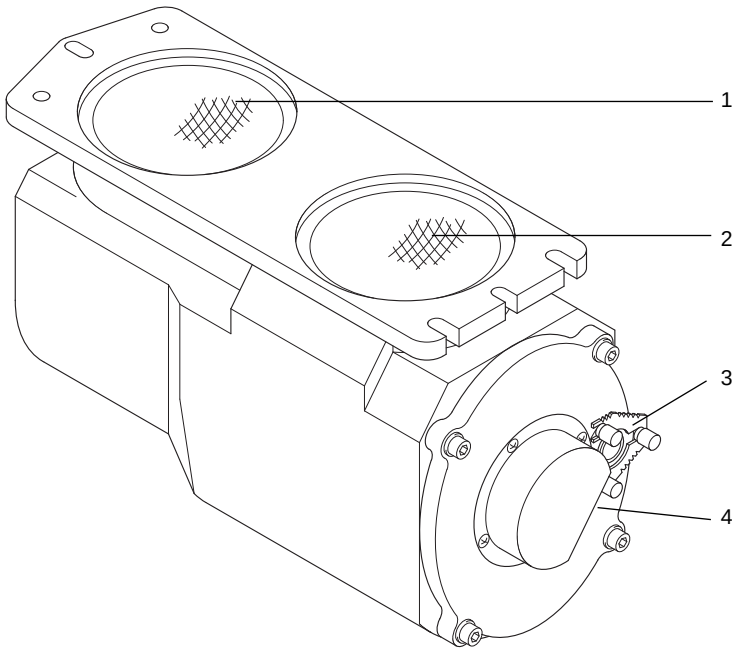


Fig. 4 Connection elements

2 Connections

Caution

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

Install a micropore filter when pumping media which contains dust.
Observe the information on media compatibility at the beginning of these operating instructions.

Do not open the packaging until immediately before installation.

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

The noise level when the pump is running is below 70 dB(A). No acoustic insulation is required.

Warning

During operation the pump can become so hot (> 80°C) that there is a danger of burns. Provide protection against contact with the hot components.

2.1 Operating environment

The maximum permissible ambient temperature is 40°C (104 °F). Do not expose the pump to dripping or spraying water

The pump is convection cooled and needs no additional cooling. When it is built in a closed housing install an external cooling if required.

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

B = 5 mT if impinging radially and

B = 15 mT if impinging axially.

Install shielding equipment as appropriate if these values are exceeded.

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

1 mT (milli-Telsa) = 10 G (Gauss)
1 Gy (Gray) = 100 rad

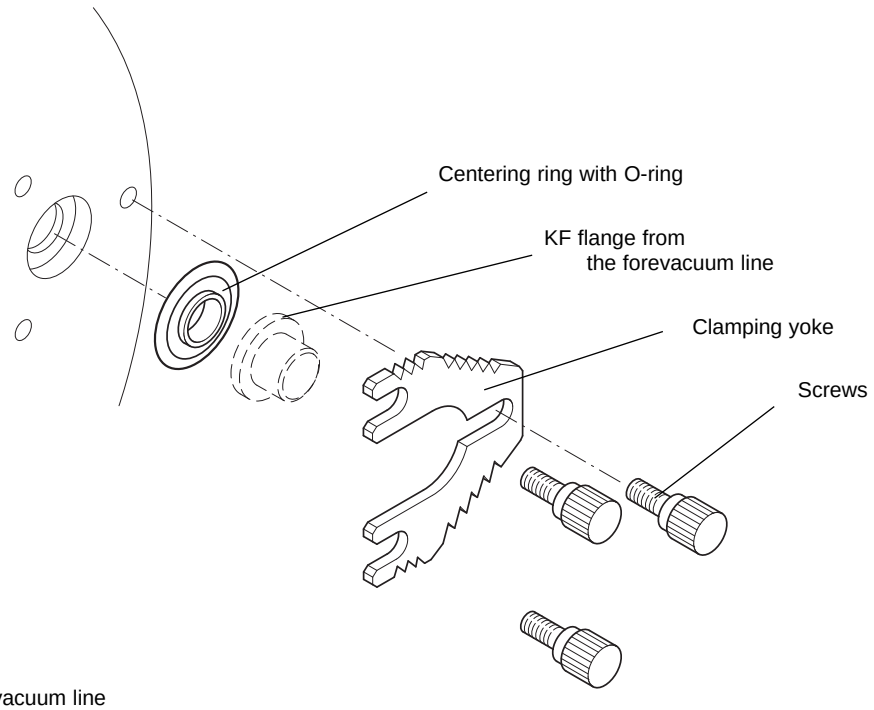


Fig. 5 Connecting the forevacuum line

2.2 Attach the pump to the vacuum chamber

Warning

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

If the pump should suddenly seize, an ensuing deceleration torque of up to 2200 Nm will have to be absorbed by the system. To accomplish this, 4 screws M8 (quality 12.9) are required.

The pump can be mounted and operated in any desired attitude. No support is required.

The pump is precision balanced and is generally operated without a resonance damper.

Unpack the pump and remove the desiccant. Pay attention to scrupulous cleanliness when making the connection.

2.3 Forevacuum connection

Connect the forevacuum line; refer to Figure 5.

To do so, remove the three screws and the clamping yoke. Remove the shipping plug.

Slide the KF flange from the forevacuum line onto the centering ring, slide the clamping yoke over the flange, insert and tighten the three screws down by hand.

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 6 is a schematic diagram of a pump system incorporating a (hybrid) turbomolecular pump and a TRIVAC forevacuum pump.

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 (hybrid) turbomolecular pump when the system is not running.

To ensure that the forevacuum space at the (hybrid) turbomolecular pump is kept largely free of oil vapors during operation, as well, we recommend installing an adsorption trap in the forevacuum line.

Legend for Fig. 6
1 Mass spectrometer
2 Dual inlet hybrid turbomolecular pump
3 Stainless steel or PVC hose
4 Adsorption trap (Option)
5 Forevacuum pump

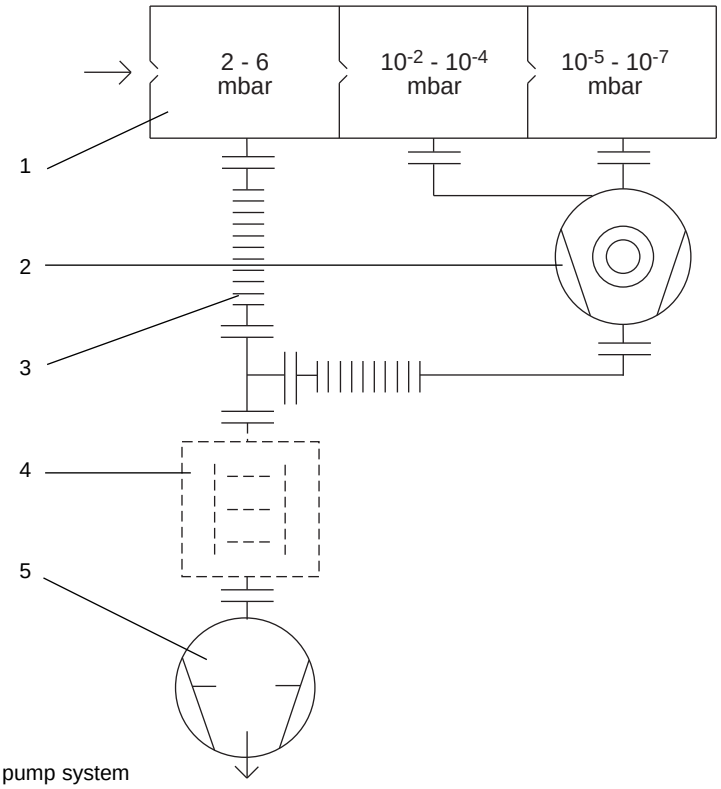


Fig. 6 Schematic of a dual inlet hybrid turbomolecular pump system

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

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

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

2.4 Connect the frequency converter

Warning

The frequency converter must only be connected to power supplies which meet the requirements for functional extra low voltage with positive isolation in accordance with VDE 0100 or local regulations.

Use the cable to connect the frequency converter and the pump.

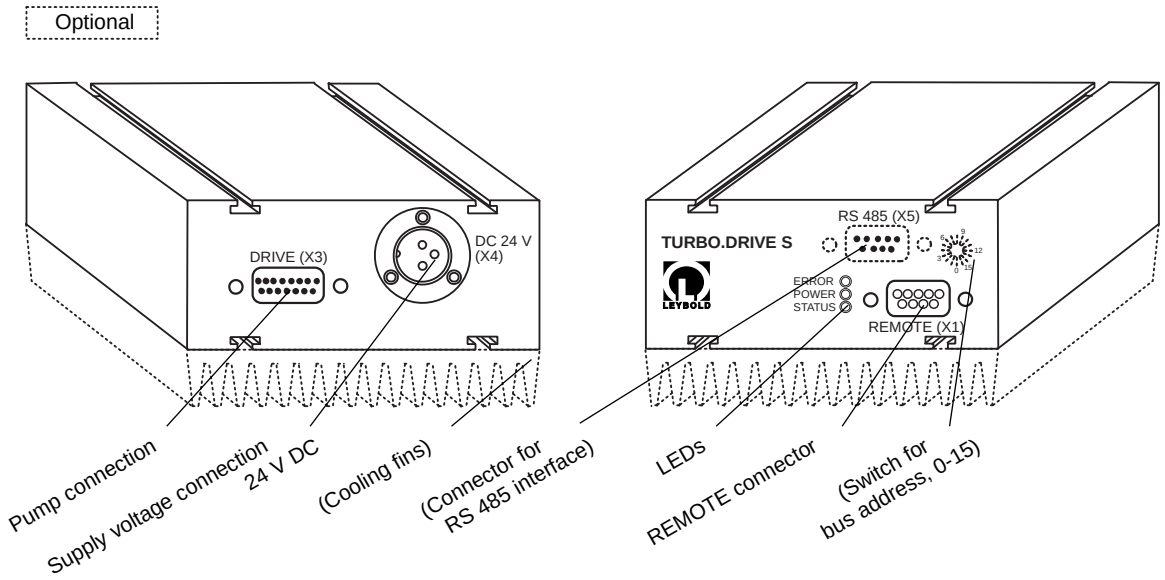
Warning

The pump may be operated only with the matching frequency converter and a suitable connector cable.
Peak voltages of up to 50 V may be present in the connector line between the frequency converter and the pump.
Route all cables so as to protect them from damage.

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

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

The cooling surface of the frequency converter must not warm up to more than 45 °C (113 °F). When mounting the frequency converter on existing cooling surfaces use heat conducting foil or paste.



red LED: Failure

yellow LED: Voltage applied

green LED
flashes: Run-up or Run-down
lights up: Normal operation

Fig. 7 TURBO.DRIVE S

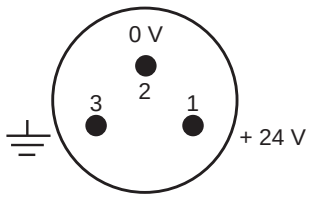


Fig. 8 Pin assignment of the DC connector (X4)
model Hirose HS16P-3

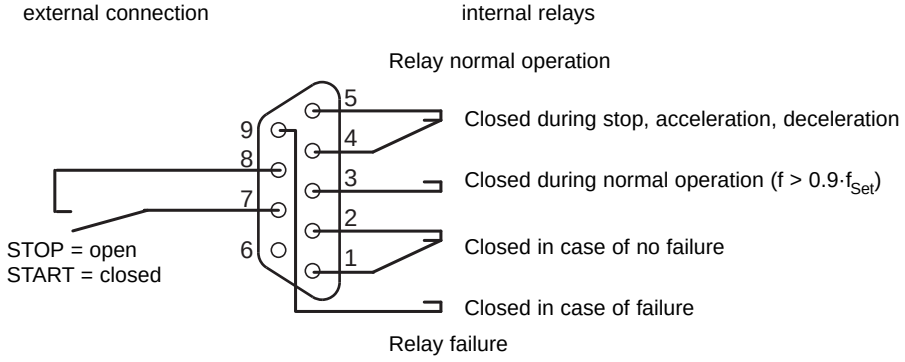
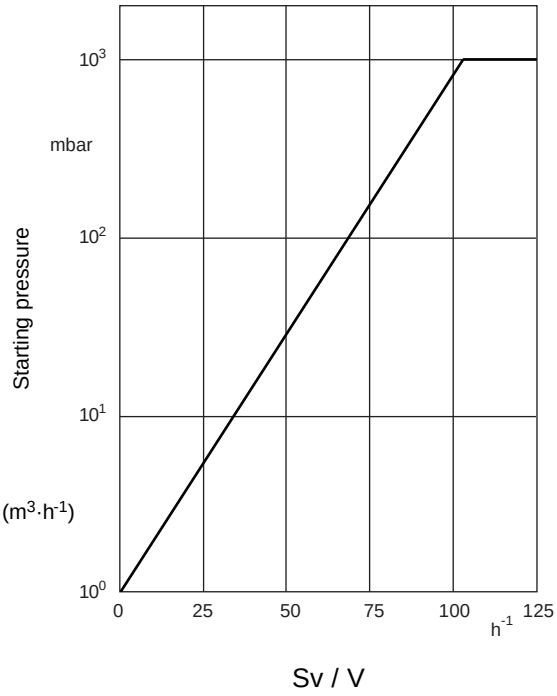


Fig. 9 Pin assignment of the REMOTE (X1) connector

Parameter list

No.	Designation	Range	Dimension	Default	Format	r/w	Description
2	Software version	1.04.1			U16	r	
7	Temp. motor	0 ... 150	° C		U16	r	actual motor temperature
8	EEPROM programming				U16	r	write command delivers data storage in the EEPROM. The parameter value is not evaluated or stored.
11	Temp. heatsink	0 ... 150	° C		U16	r	actual heatsink temperature in the converter
14	kp factor	0 ... 16		8	U16	r/w	control parameter (p)
15	ki factor	0 ... 16		8	U16	r/w	control parameter
17	Nominal motor current I_{Soll}	5 ... 50	0,1 A	50	U16	r/w	Max. motor current during normal operation
18	Max. nominal frequency $f_{Overspeed}$	500 ... 1600	Hz	900	U16	r/w	Max. frequency limit; Failure shutting down at $F_{pump} > F_{Overspeed}$ (failure code 1)
19	Lower critical frequency	10 ... 2550	Hz	60	U16	r/w	
20	Upper critical frequency	10 ... 2550	Hz	450	U16	r/w	
22	Max. passing time from Par19 to Par20	10 ... 2000	s	500	U16	r/w	Max. time for passing the frequency range from parameter 19 to parameter 20 (failure code 2)
23	Pump type				U16	r	0 = P70 1 = P200, 2 = TW 250 S (P200) 3 = TW 700 4 = TW 220/150, TW 220/170 S, TW 220/150/15 S
24	Nominal frequencyf_{soll}	40 ... 1500	Hz	860	U16	r/w	Max. nominal frequency
27	Current limit for relay „normal“	5 ... 50	0,1 A	20	U16	r/w	Current limit for relay „normal“ in relay mode TV = 1
29	Mode of relay „normal“	0/1	BLI/TV	0	U16	r/w	BLI (0): Relay switches as function of frequency TV (1): Relay switches as function of motor current
32	Max. acceleration time	30 ... 2000	s	720	U16	r/w	adjustable limit of acceleration time to f_{soll} (failure code 6)
127	Actual bearing temperature	0 ... 150	° C		U16	r	
132	Max. bearing temperature	30 ... 150	° C	80	U16	r/w	max. permissible bearing temperature (failure code 3)
133	Max. motor temperature	30 ... 150	° C	100	U16	r/w	max. permissible motor temperature (failure code 7)

No.	Designation	Range	Dimension	Default	Format	r/w	Description
171	Failure storage	0 ... 7			U16	r	Register for the last failure code 0 = no failure 1 = Overspeed 2 = max. passing time 3 = bearing temperature 4 = short circuit 5 = heat sink temperature 6 = max. acceleration time 7 = max. motor temp.
180	response delay time	2 ... 19	msec	10	U16	r/w	delay time after which the converter will send the answer to the master



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

Fig. 10 Determining the starting pressure of a (hybrid) turbomolecular pump when evacuating large volumes

3 Operation

Warning

The pump may only be operated in accordance with the Operating Instructions.

Warning

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

3.1 Switching on

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

The starting pressure for the (hybrid) turbomolecular pump can be read from the graph in Figure 10.

Switch on the (hybrid) turbomolecular pump at the frequency converter. If the contacts 7 and 8 at the REMOTE (X1) connector are closed the pump starts automatically when the DC voltage is switched on.

The (hybrid) turbomolecular pump runs up. The green LED at the frequency converter 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.

3.2 Shutting down

Switch off the pump at the frequency converter. Disconnect contacts 7 and 8 at the REMOTE (X1) connector or switch off the DC voltage.

Switch off the forevacuum pump.

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

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

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

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

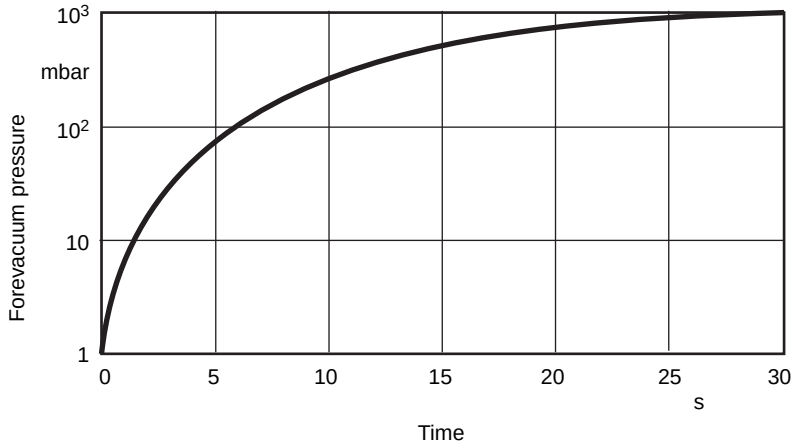


Fig. 11 Rise in pressure

3.3 Venting

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

Use dry nitrogen, for example, for venting purposes.

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

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

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

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

Caution

The values shown along the curve for pressure rise in Figure 11 must be maintained in all cases.

3.4 Removing the pump from the system

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

Warning

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

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

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

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

To avoid health hazards and corrosion damage when the pumps are detached from the system, store the pump, with a desiccant, in an air-tight PE bag.

Corrosion damage due to faulty packing will nullify the guarantee.

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

Observe the instructions in Section 4.1 if you forward the pump to Leybold.

4 Maintenance

The (hybrid) turbomolecular pump requires no routine maintenance.

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

4.1 Service by LEYBOLD

Whenever you send a pump to Leybold, indicate whether the pump is contaminated or is free of substances which could pose a health hazard. If it is contaminated, specify exactly which substances are involved. You must use the form we have prepared for this purpose; we will forward the form on request.

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

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

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

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

5 Troubleshooting

Warning

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

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

Is the (hybrid) turbomolecular pump connected to the electrical power supply?

Are the connections in good working order?

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

Is the forevacuum pressure sufficient?

Malfunction	Possible cause	Corrective action
Hybrid turbomolecular pump does not start.	Plug or connector line not properly attached, loose or defective.	Attach the cable and cord correctly; replace if necessary.
	Pump has seized.	Replace the pump.
	REMOTE operation not set.	Change parameters.
Hybrid turbomolecular pump produces loud running noises and vibrations.	Rotor out of balance.	Have the rotor balanced (may be done only by a Leybold service technician).
	Bearing defective.	Have the bearing replaced (may be done only by a Leybold service technician).
Hybrid turbomolecular pump does not reach ultimate pressure.	Measurement instrument defective.	Inspect the measurement sensor.
	Measurement sensors soiled.	Clean or replace the measurement sensor.
	Leaks at the equipment, lines or the pump.	Check for leaks.
	Pump soiled.	Have the pump cleaned (may be done only by a Leybold service technician).
	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.
Hybrid turbomolecular pump runs too hot.	Forevacuum pressure too high.	Check the forevacuum pump and use a different forevacuum pump if necessary.
	Gas volume too great or leak in the system.	Seal leak; install a higher-capacity vacuum pump if necessary.
	Ambient temperature too high.	Feed cooler air to the pump.
	Bearing defective.	Have the pump repaired (may be done only by a Leybold service technician).
Frequency converter runs too hot.	Ambient temperature too high.	Feed cooler air to the frequency converter.
	Bad thermal coupling.	Mount cooling fins or improve thermal coupling.

EEC Manufacturer's Declaration

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

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

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

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

Designation: (Hybrid) Turbomolecular pump

Models: TW 220/150/15 S
TW 220/170 S

Catalogue number: 114 39/30

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	April 1983
• DIN ISO 1940	Dec. 1993

Cologne, April 12, 1999

Dr. Mattern-Klosson, Business Area Manager
Turbomolecular pumps

Cologne, April 12, 1999

Schütz, Design Department Manager
Turbomolecular pumps

LEYBOLD

VDMA

Declaration of Contamination of Vacuum Equipment and Components

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

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

1. Description of Vacuum Equipment and Components

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

2. Reason for Return

_____
_____
_____
_____
_____
_____

3. Condition of the Vacuum Equipment and Components

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

4. Process related Contamination of Vacuum Equipment and Components:

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

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

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

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

5. Legally Binding Declaration

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

Name of organisation or company: _____

Address: _____ Post code: _____

Tel.: _____

Fax: _____ Telex: _____

Name: _____

Job title: _____

Date: _____ Company stamp:

Legally binding signature: _____

 Order No.: 2121

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