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
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 gases
- 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.
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)
### 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

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

<table>
<thead>
<tr>
<th>TURBOVAC</th>
<th>TW 220/170 S</th>
<th>TW 220/150/15 S</th>
</tr>
</thead>
<tbody>
<tr>
<td>High-vacuum connections DN</td>
<td>2 x 100 ISO</td>
<td>—</td>
</tr>
<tr>
<td>Pumping speed for N₂ l·s⁻¹</td>
<td>220</td>
<td>220</td>
</tr>
<tr>
<td>Interstage HV flange I l·s⁻¹</td>
<td>170</td>
<td>150</td>
</tr>
<tr>
<td>Interstage HV flange II l·s⁻¹</td>
<td>—</td>
<td>15</td>
</tr>
<tr>
<td>Operating pressure mbar</td>
<td>10⁻⁵ - 10⁻⁷</td>
<td>10⁻⁵ - 10⁻⁷</td>
</tr>
<tr>
<td>Interstage HV flange I mbar</td>
<td>10⁻² - 10⁻⁴</td>
<td>10⁻² - 10⁻⁴</td>
</tr>
<tr>
<td>Interstage HV flange II mbar</td>
<td>—</td>
<td>2 - 10⁻¹</td>
</tr>
<tr>
<td>Max. permissible forevacuum pressure mbar</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Recommended frequency converter TURBO.DRIVE S</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operating speed r.p.m.</td>
<td>45,000</td>
<td></td>
</tr>
<tr>
<td>Run-up time, approx. min</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Forevacuum connection DN</td>
<td>16 KF</td>
<td></td>
</tr>
<tr>
<td>Weight, approx. kg</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>Type of protection IP</td>
<td>20</td>
<td></td>
</tr>
</tbody>
</table>

**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 mm² | 5 m |
| at 3 x 2.5 mm² | 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 |
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:

\[ B = 5 \text{ mT} \text{ if impinging radially and} \]
\[ B = 15 \text{ mT} \text{ if impinging axially.} \]

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-Tesla) = 10 G (Gauss)
1 Gy (Gray) = 100 rad
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.
Ensure that the pump is sufficiently isolated against resonances (vibrations) generated by the forevacuum pump.

### 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.

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).

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.
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

- **Optional**
- **Pump connection**
- **Supply voltage connection 24 V DC**
- **(Cooling fins)**
- **(Connector for RS 485 interface)**
- **LEDs**
- **REMOTE connector** (Switch for bus address, 0-15)

- **red LED:** Failure
- **yellow LED:** Voltage applied
- **green LED** flashes: Run-up or Run-down
  lights up: Normal operation

**STOP** = open  **START** = closed

**external connection**

**internal relays**

- Relay normal operation
- Closed during stop, acceleration, deceleration
- Closed during normal operation ($f > 0.9 \cdot f_{set}$)
- Closed in case of no failure
- Closed in case of failure

**Relay failure**
## Parameter list

<table>
<thead>
<tr>
<th>No.</th>
<th>Designation</th>
<th>Range</th>
<th>Dimension</th>
<th>Default</th>
<th>Format</th>
<th>r/w</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Software version</td>
<td>1.04.1</td>
<td></td>
<td></td>
<td>U16</td>
<td>r</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Temp. motor</td>
<td>0 ... 150</td>
<td>°C</td>
<td></td>
<td>U16</td>
<td>r</td>
<td>actual motor temperature</td>
</tr>
<tr>
<td>8</td>
<td>EEPROM programming</td>
<td></td>
<td></td>
<td></td>
<td>U16</td>
<td>r</td>
<td>write command delivers data storage in the EEPROM. The parameter value is not evaluated or stored.</td>
</tr>
<tr>
<td>11</td>
<td>Temp. heatsink</td>
<td>0 ... 150</td>
<td>°C</td>
<td></td>
<td>U16</td>
<td>r</td>
<td>actual heatsink temperature in the converter</td>
</tr>
<tr>
<td>14</td>
<td>kp factor</td>
<td>0 ... 16</td>
<td>8</td>
<td></td>
<td>U16</td>
<td>r/w</td>
<td>control parameter (p)</td>
</tr>
<tr>
<td>15</td>
<td>ki factor</td>
<td>0 ... 16</td>
<td>8</td>
<td></td>
<td>U16</td>
<td>r/w</td>
<td>control parameter</td>
</tr>
<tr>
<td>17</td>
<td>Nominal motor current $I_{\text{Soll}}$</td>
<td>5 ... 50</td>
<td>0,1 A</td>
<td>50</td>
<td>U16</td>
<td>r/w</td>
<td>Max. motor current during normal operation</td>
</tr>
<tr>
<td>18</td>
<td>Max. nominal frequency $f_{\text{Overspeed}}$</td>
<td>500 ... 1600</td>
<td>Hz</td>
<td>900</td>
<td>U16</td>
<td>r/w</td>
<td>Max. frequency limit; Failure shutting down at $f_{\text{pump}} &gt; f_{\text{Overspeed}}$ (failure code 1)</td>
</tr>
<tr>
<td>19</td>
<td>Lower critical frequency</td>
<td>10 ... 2550</td>
<td>Hz</td>
<td>60</td>
<td>U16</td>
<td>r/w</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>Upper critical frequency</td>
<td>10 ... 2550</td>
<td>Hz</td>
<td>450</td>
<td>U16</td>
<td>r/w</td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>Max. passing time from Par19 to Par20</td>
<td>10 ... 2000</td>
<td>s</td>
<td>500</td>
<td>U16</td>
<td>r/w</td>
<td>Max. time for passing the frequency range from parameter 19 to parameter 20 (failure code 2)</td>
</tr>
<tr>
<td>23</td>
<td>Pump type</td>
<td></td>
<td></td>
<td></td>
<td>U16</td>
<td>r</td>
<td>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</td>
</tr>
<tr>
<td>24</td>
<td>Nominal frequency $f_{\text{Soll}}$</td>
<td>40 ... 1500</td>
<td>Hz</td>
<td>860</td>
<td>U16</td>
<td>r/w</td>
<td>Max. nominal frequency</td>
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<tr>
<td>27</td>
<td>Current limit for relay „normal“</td>
<td>5 ... 50</td>
<td>0,1 A</td>
<td>20</td>
<td>U16</td>
<td>r/w</td>
<td>Current limit for relay „normal“ in relay mode TV = 1</td>
</tr>
<tr>
<td>29</td>
<td>Mode of relay „normal“</td>
<td>0/1</td>
<td>BLI/TV</td>
<td>0</td>
<td>U16</td>
<td>r/w</td>
<td>BLI (0): Relay switches as function of frequency TV (1): Relay switches as function of motor current</td>
</tr>
<tr>
<td>32</td>
<td>Max. acceleration time</td>
<td>30 ... 2000</td>
<td>s</td>
<td>720</td>
<td>U16</td>
<td>r/w</td>
<td>adjustable limit of acceleration time to $I_{\text{Soll}}$ (failure code 6)</td>
</tr>
<tr>
<td>127</td>
<td>Actual bearing temperature</td>
<td>0 ... 150</td>
<td>°C</td>
<td></td>
<td>U16</td>
<td>r</td>
<td></td>
</tr>
<tr>
<td>132</td>
<td>Max. bearing temperature</td>
<td>30 ... 150</td>
<td>°C</td>
<td>80</td>
<td>U16</td>
<td>r/w</td>
<td>max. permissible bearing temperature (failure code 3)</td>
</tr>
<tr>
<td>133</td>
<td>Max. motor temperature</td>
<td>30 ... 150</td>
<td>°C</td>
<td>100</td>
<td>U16</td>
<td>r/w</td>
<td>max. permissible motor temperature (failure code 7)</td>
</tr>
<tr>
<td>No.</td>
<td>Designation</td>
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<td>Dimension</td>
<td>Default</td>
<td>Format</td>
<td>r/w</td>
<td>Description</td>
</tr>
<tr>
<td>-----</td>
<td>---------------------</td>
<td>-------</td>
<td>-----------</td>
<td>---------</td>
<td>--------</td>
<td>-----</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>171</td>
<td>Failure storage</td>
<td>0 ... 7</td>
<td></td>
<td>U16</td>
<td>r</td>
<td></td>
<td>Register for the last failure code</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0 = no failure</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1 = Overspeed</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2 = max. passing time</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3 = bearing temperature</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4 = short circuit</td>
</tr>
<tr>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>5 = heat sink temperature</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>6 = max. acceleration time</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>7 = max. motor temp.</td>
</tr>
<tr>
<td>180</td>
<td>response delay time</td>
<td>2 ... 19</td>
<td>msec</td>
<td>10</td>
<td>U16</td>
<td>r/w</td>
<td>delay time after which the converter will send the answer to the master</td>
</tr>
</tbody>
</table>
3 Operation

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

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.

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

\[
\text{Sv} = \text{Pumping speed of the forevacuum pump (m}^3\text{·h}^{-1}) \\
V = \text{Volume of the vacuum chamber (m}^3\text{)} \\
\text{Sv} / V \]

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

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

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?
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

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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

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Cologne, April 12, 1999

Dr. Mattern-Klosson, Business Area Manager
Turbomolecular pumps

Cologne, April 12, 1999

Schütz, Design Department Manager
Turbomolecular pumps
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 ☐ no ☐ (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:

<table>
<thead>
<tr>
<th>Trade name</th>
<th>Product name</th>
<th>Chemical name (or Symbol)</th>
<th>Dangerous material class</th>
<th>Measures if spillage</th>
<th>First aid in case of human contact</th>
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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: _________________________________________________________________
Tel.: ________________________________________________________________ Post code:______________
Fax: ________________________________________________________________ Telex: __________________
Name: ________________________________________________________________
Job title: ________________________________________________________________
Date: ________________________________________________________________ Company stamp: __________________
Legally binding signature:__________________________________________________

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