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1 About this manual

1.1 Validity

This operating manual is for customers of Pfeiffer Vacuum. It describes the functioning of the designated product and provides the most important information for safe use of the unit. The description follows applicable EU guidelines. All information provided in this operating manual refers to the current state of the product's development. The documentation remains valid as long as the customer does not make any changes to the product. Up-to-date operating instructions can also be downloaded from www.pfeiffer-vacuum.com.

1.1.1 Applicable documents

<table>
<thead>
<tr>
<th>HiPace 1500, depending on the model</th>
<th>Operating instructions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating instructions “Electronic drive unit TC 1200”, standard</td>
<td>PT 0239 BN*</td>
</tr>
<tr>
<td>Operating instructions “Electronic drive unit TC 1200 PB”, Profinet</td>
<td>PT 0269 BN*</td>
</tr>
<tr>
<td>Operating instructions “Electronic drive unit TC 1200 E74”, acc. Semi E74</td>
<td>PT 0303 BN*</td>
</tr>
<tr>
<td>Operating instructions “Electronic drive unit TC 1200 DN”, DeviceNet</td>
<td>PT 0353 BN*</td>
</tr>
<tr>
<td>Operating instructions “Electronic drive unit TC 1200 EC”, EtherCAT</td>
<td>PT 0455 BN*</td>
</tr>
<tr>
<td>Declaration of conformity</td>
<td>Part of this document</td>
</tr>
</tbody>
</table>

*also available via www.pfeiffer-vacuum.com

1.2 Conventions

1.2.1 Safety instructions

The safety instructions in Pfeiffer Vacuum operating instructions are the result of risk evaluations and hazard analyses and are oriented on international certification standards as specified by UL, CSA, ANSI Z-535, SEMI S1, ISO 3864 and DIN 4844. In this document, the following hazard levels and information are considered:

<table>
<thead>
<tr>
<th>DANGER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Imminent danger</td>
</tr>
<tr>
<td>Indicates an imminent hazardous situation that will result in death or serious injury.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>WARNING</th>
</tr>
</thead>
<tbody>
<tr>
<td>Possibly imminent danger</td>
</tr>
<tr>
<td>Indicates an imminent hazardous situation that can result in death or serious injury.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CAUTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Possibly imminent danger</td>
</tr>
<tr>
<td>Indicates an imminent hazardous situation that can result in minor or moderate injury.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>NOTICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Command or note</td>
</tr>
<tr>
<td>Command to perform an action or information about properties, the disregarding of which may result in damage to the product.</td>
</tr>
</tbody>
</table>
1.2.2 Pictographs

Prohibition of an action to avoid any risk of accidents, the disregarding of which may result in serious accidents

Warning of a displayed source of danger in connection with operation of the unit or equipment

Command to perform an action or task associated with a source of danger, the disregarding of which may result in serious accidents

Important information about the product or this document

1.2.3 Instructions in the text

→ Work instruction: here you have to do something.

1.2.4 Abbreviations

DCU: Display Control Unit
HPU: Handheld Programming Unit
TC: Electronic drive unit for turbopump
PB: Profibus version
DN: DeviceNet version

1.2.5 Symbols used

The following symbols are used consistently throughout the diagrams:

- High vacuum flange
- Fore-vacuum flange
- Vacuum flange of the backing pump
- Exhaust flange of the backing pump
- Electrical connection
- Sealing gas connection
- Venting connection
- Cooling water connection
2 Safety

2.1 Safety precautions

Duty to inform
Each person involved in the installation, operation or maintenance of the vacuum pump must read and observe the safety-related parts of these operating instructions.

- The operator is obligated to make operating personnel aware of dangers originating from the vacuum pump, the pumped medium and the entire system.

Installation and operation of accessories
Pfeiffer Vacuum pumps can be equipped with a series of adapted accessories. The installation, operation and maintenance of connected devices are described in detail in the operating instructions of the individual components.

- For information on order numbers of components, see "Accessories".
- Use original accessory parts only.

NOTICE
Checking the safety system against excess rotation speed
To provide the functioning of the integrated safety system for avoiding excess rotation speed, the pump must run-up from the standstill at least once a year.

- Switch off the pump and await the complete standstill (rotation speed = 0 Hz).
- Run-up the pump according to this operating instructions.

WARNING
Danger of unsafe electrical installation
Safe operation after installation is the responsibility of the operator.

- Do not independently modify or change the pump and electrical equipment.
- Make sure that the system is integrated in an emergency off safety circuit.
- Consult Pfeiffer Vacuum for special requirements.

WARNING
Danger due to lack of power disconnection device
Pump and electronic drive unit are not equipped with a power disconnection device. Installation of a user-supplied power disconnection device in accordance with SEMI-S2.

- Fit a circuit breaker with an interruption rating of min. 10,000 A.

WARNING
Danger of electric shock
In case of defect, the parts connected to the mains supply are under voltage.

- Always keep the mains connection freely accessible so you can disconnect it at any time.

- Do not expose any body parts to the vacuum.
- Observe all safety and accident prevention regulations.
- Regularly check the proper observance of all safety measures.
- Always ensure a safe connection to the protective earthing conductor (PE, protection class I).
- Do not loosen any plug connection during operations.
- Wait for the rotor to reach standstill before performing work on the high vacuum flange.
- Keep leads and cables well away from hot surfaces (> 70 °C).
- Never fill or operate turbopump with cleaning agent.
- Do not operate the turbopump with open high vacuum flange.
2.2 Protective equipment

Determined situations concerning the handling of vacuum pumps require wearing of personal protective equipment. The owner, respectively the employer are obligated to provide an adequate equipment to any operating persons.

<table>
<thead>
<tr>
<th>DANGER</th>
<th>Danger to health by hazardous substances during maintenance or installation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wear adequate protective equipment during maintenance and repairs or in case of reinstallation.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>WARNING</th>
<th>Risk of injury through falling objects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carry small and mid-size vacuum pumps two-handed.</td>
<td></td>
</tr>
<tr>
<td>Carry vacuum pumps &gt; 20 kg by a suitable lifting device.</td>
<td></td>
</tr>
<tr>
<td>Wear safety shoes with steel toe cap according to directive EN 347.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CAUTION</th>
<th>Risk of injury through hot surfaces</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allow the pump to cool before maintenance and repairs.</td>
<td></td>
</tr>
<tr>
<td>If necessary wear protective gloves according to EN 420.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CAUTION</th>
<th>Risk of injury through sharp edges</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before any working wait for the complete standstill of the pump.</td>
<td></td>
</tr>
<tr>
<td>Do not reach in the high vacuum flange.</td>
<td></td>
</tr>
<tr>
<td>If necessary wear protective gloves according to EN 420.</td>
<td></td>
</tr>
</tbody>
</table>
2.3 Proper use

The vacuum pump may only be used to generate a vacuum.

Only operate the turbopump with an approved backing pump.

2.4 Improper use

Improper use will cause all claims for liability and warranties to be forfeited. Improper use is defined as usage for purposes deviating from those mentioned above, especially:

- transport, installation or operation of the pump in invalid orientation
- installation of the pump with unspecified mounting material
- pumping of corrosive gases (exception: pumps in C version)
- pumping of corrosive gases without sealing gas (only pumps in C version)
- pumping of explosive media
- pumping of condensing vapors
- operation with improper high gas throughput
- operation with improper high fore-vacuum pressures
- operation with improper high levels of insulated heat input
- operation in improper high magnetic fields
- operation with improper gas mode
- venting with improper high venting rates
- operation of the devices in areas with ionizing radiation
- operation in potentially explosive areas
- use of the devices in systems in which impact-like stress and vibrations or periodic forces affect the devices
- use of accessories or spare parts, which are not named in this manual
- fixing the pump at its bottom part

Closure seal

The product is sealed at the factory. Damaging or removal of a closure seal leads to the loss of liability and warranty entitlements.

¬ Do not open the product within its warranty period!
¬ For process-related shorter maintenance intervals please contact the Pfeiffer Vacuum Service.
3 Transport and storage

3.1 Transport

Two pieces of eye bolts are screwed with the pump on delivery.

**NOTICE**

Observe type-specific mounting orientations!
Incorrect mounting orientations result in contamination of the process vacuum or damage to the pump.

- Pay attention to the properties after the model designation on the name plate!
- Observe the pictographs on the pump housing!
- Do not transport or tilt the pump filled with operating fluid!

![Fig. 1: Transport of HiPace 1500](image1)  
![Fig. 2: Transport of HiPace 1500 U](image2)

**WARNING**

Danger from falling and swinging loads!
When lifting the pump there is a danger of falling parts.

- Make sure that there are no persons under the suspended load.
- Close off and supervise the area under the pump.

- Only transport the turbopump in the valid orientation and with vertical rotor axis.
- Fix a suitable lifting device on both eye bolts.
  - Observe the approved fixing (e.g. maximum opening angle towards the longitudinal axis of the pump).
  - Do not lift any additional weights (e.g. vacuum chamber).
- Lift the pump perpendicularly out of the packing.
- Reuse the transport container of the vacuum pump.
  - Transport or ship vacuum pumps in the original packing preferably.
- Only remove the protective covers from the high vacuum and the fore-vacuum side immediately before connection.
- Keep the original protective covers.
- After the transport the eye bolts can be removed.

3.2 Storage

- Close the flange openings by using the original protective covers.
- Close further connection ports by using the corresponding protective covers.
- Store the pump only indoors at temperatures between -25 °C and +55 °C.
- In rooms with moist or aggressive atmospheres, the pump must be airproof shrink-wrapped in a plastic bag together with a bag of desiccant.
4 Product description

4.1 Product identification

4.1.1 Pump types

The product designation consists of a family designation (1), the size (2), which is oriented on the pumping speed, and if applicable the additional properties (3) of the pump.

<table>
<thead>
<tr>
<th>HiPace</th>
<th>1500</th>
<th>U</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Family designation</td>
<td>1500</td>
<td>Model designation</td>
<td>Property designation</td>
</tr>
<tr>
<td>HiPace</td>
<td>1500</td>
<td>Model designation</td>
<td>none</td>
</tr>
<tr>
<td></td>
<td></td>
<td>of the pump</td>
<td>U</td>
</tr>
<tr>
<td></td>
<td></td>
<td>related to its pumping speed class</td>
<td>C</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>P</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>M</td>
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<tr>
<td></td>
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<td>T</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>E</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>H</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>I</td>
</tr>
</tbody>
</table>

4.1.2 Pump features

This product has been tested to the requirements of CAN/CSA-C22.2 No. 61010-1, second edition, including Amendment 1, or a later version of the same standard incorporating the same level of testing requirements.

For information about other certifications, if applicable, please see the signet on the product or:

- www.tuvdotcom.com
- TUVdotCOM-ID 0000021320

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>HiPace 1500</th>
</tr>
</thead>
<tbody>
<tr>
<td>HV flange</td>
<td>DN 250 ISO-K</td>
</tr>
<tr>
<td>Flange material</td>
<td>Aluminium</td>
</tr>
</tbody>
</table>

To correctly identify the product when communicating with Pfeiffer Vacuum, always have the information from the rating plate available.

4.1.3 Variants

- HiPace 1500
- HiPace 1500 C, corrosive gas version
- HiPace 1500 U, for upside-down installation orientation
- HiPace 1500 U C, for upside-down installation orientation and corrosive gases

4.1.4 Scope of delivery

- Turbopump with electronic drive unit and integrated power supply
- Protective cover for the high vacuum flange and the fore-vacuum flange
- Mating plug for the connection “remote” on the TC 1200 (type dependent)
- Mating plug for the connection “E74” on the TC 1200 (type dependent)
4.2 Function

The turbopumps HiPace 1500 form a complete unit together with the electronic drive unit. The voltage is supplied via the integrated power supply pack.

4.2.1 Cooling

- Water cooling

In the case of excess temperature the electronic drive unit reduces the drive power automatically.

4.2.2 Rotor bearing

Hybrid bearing turbopump

- High vacuum side: maintenance-free permanent magnetic bearing
- Fore-vacuum side: ceramic ball bearing

4.2.3 Drive

Electronic drive unit TC 1200
4.3 Range of application

The pump HiPace 1500 must be installed and operated under the following ambient conditions:

<table>
<thead>
<tr>
<th>Installation location</th>
<th>weather protected (indoors)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protection class</td>
<td>IP54</td>
</tr>
<tr>
<td>Temperature</td>
<td>+5 °C to +40 °C</td>
</tr>
<tr>
<td>Relative humidity</td>
<td>max. 80 %, at T ≤ 31 °C, to max. 50 % at T ≤ 40 °C</td>
</tr>
<tr>
<td>Atmospheric pressure</td>
<td>750 hPa - 1060 hPa</td>
</tr>
<tr>
<td>Installation altitude</td>
<td>2000 m max.</td>
</tr>
<tr>
<td>Degree of pollution</td>
<td>2</td>
</tr>
<tr>
<td>Permissible surrounding magnetic field</td>
<td>≤ 6 mT</td>
</tr>
<tr>
<td>Overvoltage category</td>
<td>II</td>
</tr>
<tr>
<td>Connection voltage</td>
<td>100-120/200-240 (± 10%) V AC</td>
</tr>
</tbody>
</table>

Remarks to ambient conditions

The specified permissible ambient temperatures apply to operation of the turbopump at maximum permissible fore-vacuum pressure or at maximum gas throughput depending on the cooling method. The turbopump is intrinsically safe by a redundant temperature monitoring.

- By reducing the fore-vacuum pressure or gas throughput, the turbopump can be operated at higher ambient temperatures.
- If the maximum permissible operating temperature of the turbopump is exceeded, the electronic drive unit reduces drive power first and switches off then, if necessary.
5 Installation

### Installation

#### WARNING

**Danger from the turbopump being ripped off**

If the rotor is suddenly blocked, torques of up to 9800 Nm could occur, which could cause the turbopump to be ripped off if it is not properly affixed. The energy that this would release could throw the entire pump or pieces from its interior through the room. That would cause severe, possibly fatal, injuries as well as serious property damage.

- Carefully follow the installation instructions in this handbook.
- Only use approved original parts from Pfeiffer Vacuum (Accessories) for the installation.

#### NOTICE

**Danger of destroying the pump through impermissible gas loads**

An inadmissibly high pressure increase in the pump during operation can result in the destruction of the rotor and the entire pump.

- Protect the high-vacuum side and fore-vacuum side against impermissible gas seepage.
- Protect the fore-vacuum lines against external mechanical influences.
- Protect the isolation devices on the high-vacuum side against accidental opening.
- Observe the permitted venting rates (max. 15 hPa/s).

#### Installation and operation of accessories

Pfeiffer Vacuum pumps can be equipped with a series of adapted accessories. The installation, operation and maintenance of connected devices are described in detail in the operating instructions of the individual components.

- For information on order numbers of components, see "Accessories".
- Use original accessory parts only.

#### Operating fluid filling

The pump is delivered without operating fluid filling. The operating fluid is part of the delivery consignment.

- Do not fill the pump with operating fluid until the installation is done on site!

5.1 Preparatory work

When installing the pump, observe the following conditions:

- the ambient conditions specified for the range of application
- The attachment of the pump at its bottom part is not permitted.
- It is not allowed to operate the device in systems where impact-like stresses and vibrations or periodically forces occur.

- Ensure sufficient cooling for the turbopump.
- Where magnetic fields > 6 mT are involved, a suitable shielding must be used. Check installation location and consult Pfeiffer Vacuum if needed!
- The maximum permissible rotor temperature for the turbopump is 120 °C. If high temperatures arise for process reasons, the radiated heat input must not exceed 22.5 W. Install suitable screening sheets, if necessary (design information on request).
5.2 Set-up

- Ensure the greatest possible cleanliness when installing any high vacuum parts. Unclean components prolong the pump-down time.
- All flange components must be grease-free, dust-free and dry at installation.

5.2.1 Earthquake safety

An earthquake can result in contact with the safety bearings. All forces occurring hereby are safely absorbed by the properly installed flange connections.

⇒ Secure the vacuum chamber against shifting and tipping on customers’ side.

5.2.2 Use of a splinter shield or protection screen

Pfeiffer Vacuum centering rings with splinter shield or protection screen in the high vacuum flange protect the turbopump against foreign bodies coming from the chamber. Thus, the pumping speed of the pump is reduced.

<table>
<thead>
<tr>
<th></th>
<th>Volume flow rate reduction in %</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>H₂</td>
<td>He</td>
<td>N₂</td>
<td>Ar</td>
</tr>
<tr>
<td>Splinter shield DN 250</td>
<td>5</td>
<td>7</td>
<td>18</td>
<td>21</td>
</tr>
<tr>
<td>Protection screen DN 250</td>
<td>1</td>
<td>2</td>
<td>5</td>
<td>6</td>
</tr>
</tbody>
</table>

5.2.3 Vibration damper

**WARNING**

Danger from the turbopump and vibration damper being torn-off

In case of sudden blocking of the rotor, an applied vibration damper cannot compensate any of the occurring forces. There is a danger of the turbopump being torn-off and thereby resulting severest injuries and property damages. Applicable safeguards must be taken to compensate possible occurring torques.

⇒ Definitely consult with Pfeiffer Vacuum.
⇒ Do not exceed the max. permissible temperature at the vibration damper (100 °C).
5.3 Mounting orientation

**NOTICE**

Observe type-specific mounting orientations!
Incorrect mounting orientations result in contamination of the process vacuum or damage to the pump.

- Pay attention to the properties after the model designation on the name plate!
- Observe the pictographs on the pump housing!
- Do not transport or tilt the pump filled with operating fluid!

---

**Fig. 6: Standard and C-versions**

**Fig. 7: U- and U C-versions**

**Simple recognition of the valid mounting orientation**

The valid mounting orientation of a turbopump can be deduced by the orientation of its operating fluid pump:

- Horizontal longitudinal axis of the operating fluid pump
- Vertical longitudinal axis with the sight glass 8.06 pointing downwards.

---

5.3.1 Horizontal mounting orientation

- For horizontal installation, the fore-vacuum flange must point vertically downward (± 25°), since otherwise the turbopump can be contaminated.
- Support pipes in front of the vacuum pump or remove them. No force from the pipe system may be exerted on the fixed pump.

The maximum axial loading capacity of the high vacuum flange is 2000 N (equals 200 kg). A one-sided load on the high vacuum flange is not permitted.
5.4 Connecting the high vacuum side

If the rotor is suddenly blocked, the torques arising from the system and the high vacuum flange must be absorbed. Only the components listed in the following can be used to fasten the turbopumps to the high vacuum flange. The installation elements for turbopumps are special designs by Pfeiffer Vacuum. In all operating conditions, the tensile strength of the flange material must be at least 170 N/mm².

→ Secure the vacuum chamber against shifting and tipping on customers side.

**DANGER**

**Danger to life - impermissible fastening**
Twisting or tearing-off is possible in case the rotor is suddenly blocked due to the fastening of pumps on a vacuum chamber with different flange variants.

→ Use only the correct mounting kit from Pfeiffer Vacuum.
→ Pfeiffer Vacuum will not accept any liability for all damages resulting from impermissible fastening.

**DANGER**

**Life-threatening hazard - incorrect mounting**
The use of clamps to mount pumps can result in life-threatening situations if the rotor suddenly blocks.

→ Never use claws to mount the pumps!
→ Use only the correct mounting kit from Pfeiffer Vacuum.

**NOTICE**

**Observe shape tolerances for the counter flange**
Unevennesses of the customer supplied counter flange can lead to warping of the pump casing despite proper fastening. Leakiness and negative running characteristics can be the result.

→ Do not exceed an evenness of max. 0.05 mm for the whole surface.

**Mounting of ISO flanges**
If the rotor suddenly blocks the connection of high vacuum flanges of types ISO-KF or ISO-K can lead to twisting despite proper installation.

→ The tightness of the high vacuum flange is not at risk thereby.

5.4.1 Installation of ISO-K flange with ISO-K flange

For the installation the following components are exclusively authorized:

- the valid mounting kit of the Pfeiffer Vacuum accessories programme
- mounting materials including protection screen or splinter shield are optionally available

→ Mind that the sealing surfaces are not damaged.

1) Connect the flanges according to the drawing and with the component parts of the mounting kit.
2) Use the required number of 14 claw clamps.
3) Tighten the claw clamps crosswise in three steps.
4) Tightening torque: 5, 15, 25 ± 2 Nm
5.4.2 Installation of ISO-K flange with ISO-F flange

The connection types for installation of ISO-K to ISO-F flange are "hex screw and threaded hole," "stud screw and threaded hole," and "stud screw and through hole." For the installation the following components are exclusively authorized:

- the valid mounting kit of the Pfeiffer Vacuum accessories programme
- mounting materials including protection screen or splinter shield are optionally available

**Hexagon screw and threaded hole**

> Mind that the sealing surfaces are not damaged.

1) Put the collar flange over the high vacuum flange of the turbopump.
2) Insert the retaining ring into the groove of the high vacuum flange.
3) Fasten the turbo pump with collar flange and centering ring to the counter flange as shown in the graphic.
4) Use the required number of 12 hex screws with washer.
5) Screw hex screws 1.5 x d into the threaded holes.
   - The tensile strength of the flange material must be at least 270 N/mm² in all operating conditions.
6) Tighten the hex screws crosswise in three steps.
7) Tightening torque DN 250: 5, 15, 25 ± 2 Nm

**Stud screw and threaded hole**

> Mind that the sealing surfaces are not damaged.

1) Use the required number of 12 stud screws and nuts.
2) Screw in the stud screws with the shorter threaded end 2.5 x d in the bore holes on the counter flange.
3) Put the collar flange over the high vacuum flange of the turbopump.
4) Insert the retaining ring into the groove of the high vacuum flange.
5) Fasten the turbo pump with collar flange and centering ring to the counter flange as shown in the graphic.
6) Tighten the nuts crosswise in three steps.
7) Tightening torque DN 250: 5, 15, 25 ± 2 Nm

**Stud screw and through hole**

> Mind that the sealing surfaces are not damaged.

1) Put the collar flange over the high vacuum flange of the turbopump.
2) Insert the retaining ring into the groove of the high vacuum flange.
3) Fasten the turbo pump with collar flange and centering ring to the counter flange as shown in the graphic.
4) Use the required number of 12 stud screws and nuts.
5) Tighten the nuts crosswise in three steps.
6) Tightening torque DN 250: 5, 15, 25 ± 2 Nm
5.4.3 Installation of ISO-F with ISO-F flange

The connection types for installation of ISO-F to ISO-F flange are "hex screw and threaded hole," "stud screw and threaded hole," and "stud screw and through hole".

For the installation the following components are exclusively authorized:

- the valid mounting kit of the Pfeiffer Vacuum accessories programme
- mounting materials including protection screen or splinter shield are optionally available

**Hexagon screw and threaded hole**

1. Connect the flanges according to the drawing and with the component parts of the mounting kit.
2. Use the required number of **12** hex screws with washer.
3. Screw hex screws 1.5 \( \times d \) into the threaded holes.
   - The tensile strength of the flange material must be at least 270 N/mm\(^2\) in all operating conditions.
4. Tighten the hex screws crosswise in three steps.
5. Tightening torque DN 250: 10, 20, 38 ± 3 Nm

**Stud screw and threaded hole**

1. Use the required number of **12** stud screws and nuts.
2. Screw in the stud screws with the shorter threaded end 2.5 \( \times d \) in the bore holes on the counter flange.
3. Connect the flanges according to the drawing and with the component parts of the mounting kit.
4. Tighten the nuts crosswise in three steps.
5. Tightening torque DN 250: 10, 20, 38 ± 3 Nm

**Stud screw and through hole**

1. Connect the flanges according to the drawing and with the component parts of the mounting kit.
2. Use the required number of **12** stud screws and nuts.
3. Tighten the nuts crosswise in three steps.
4. Tightening torque DN 250: 10, 20, 38 ± 3 Nm
5.4.4 Installation of CF- flanges

NOTICE

Assembly of CF flanges!
Loss of sealing capability due to a lack of cleanliness when handling the sealing and CF flange.
- Assemble the sealing dry and oil-free.
- Always wear gloves when handling the components.
- Do not damage the surfaces and cutting edges.

The connection types for installation of CF to CF flange are "hexagon screw and through hole", "stud screw and threaded hole" as well as "stud screw and through hole".

- the valid mounting kit of the Pfeiffer Vacuum accessories programme
- A copper seal
- protection screen or splinter shield are optionally

Hexagon screw and through hole
1) If used: Insert protective screen or splinter shield with the clamping lugs downward into the high vacuum flange of the turbopump.
2) Place the seal exactly in the hollow.
3) Connect the flanges using 32 hexagon-head screws (M8) with washers and bolts.
4) Tighten the screw connections circularly.
5) Tightening torque: 22 ± 2 Nm
6) After this, check the torque, since flowing of the sealing material may make it necessary to tighten the screws again.

Stud screw and threaded hole
1) Screw in the stud screws (32 pieces, M8) with the shorter threaded end into the threaded holes of the counter flange.
2) If used: Insert protective screen or splinter shield with the clamping lugs downward into the high vacuum flange of the turbopump.
3) Place the seal exactly in the hollow.
4) Connect the flanges using washers and nuts.
5) Tighten the screw connections circularly.
6) Tightening torque: 22 ± 2 Nm
7) After this, check the torque, since flowing of the sealing material may make it necessary to tighten the screws again.

Stud screw and through hole
1) If used: Insert protective screen or splinter shield with the clamping lugs downward into the high vacuum flange of the turbopump.
2) Place the seal exactly in the hollow.
3) Connect the flanges using 32 hexagon-head screws (M8) with washers and bolts.
4) Tighten the screw connections circularly.
5) Tightening torque: 22 ± 2 Nm
6) After this, check the torque, since flowing of the sealing material may make it necessary to tighten the screws again.

NOTICE

Assembly of CF flanges!
Loss of sealing capability due to a lack of cleanliness when handling the sealing and CF flange.
- Assemble the sealing dry and oil-free.
- Always wear gloves when handling the components.
- Do not damage the surfaces and cutting edges.
5.5 Filling up the operating fluid

**WARNING**

Toxic vapours!
Danger of poisoning when igniting and heating synthetic operating fluids (e.g. F3) above 300 °C.
- Observe the application instructions.
- Do not allow operating fluid to make contact with tobacco products; observe safety precautions when handling chemicals.

**NOTICE**

Danger of the pump being destroyed
The pump can be destroyed by missing or deficient operating fluid supply.
- Fill the pump with the adequate amount of operating fluid, before starting up for the first time or after each transport.
- Do not mix-up filler and draining screws!
- For type and amount of the operating fluid please refer to the rating plate.

**NOTICE**

Danger of the pump being destroyed
The filling capacity of operating fluid depends on the orientation of the mounted vacuum pump.
- Only fill in the operating fluid, when the vacuum pump is mounted.
- The operating fluid capacity for a vertically mounted pump is 40 ml.
- The operating fluid capacity for a horizontally mounted pump must be 50 ml!

![Fig. 8: Removing the protective cover of the operating fluid pump at standard and U-versions](image)

8 Operating fluid pump 109 Protective cover 110 Allen head screw

- Turn off the vacuum pump, vent to atmospheric pressure and allow to cool.
- Screw out the allen head screws (2x) of the operating fluid pump and remove the protective cover.

**Design of the operating fluid pump**
The operating fluid pump is largely mirror symmetrical. The screws for filling the operating fluid are located at the sides of the operating fluid pump. The screws for draining the operating fluid are located at the front of the operating fluid pump.
- Always use the higher positioned screw for filling.
- Always use the lower positioned screw for draining.
- Never fill via the draining screws.
Unscrew the respectively higher positioned filler screw 8.23a of the operating fluid pump.

Fill in the operating fluid (max. 50 ml) into the operating fluid pump by using the filling syringe.

Lock the filler screw 8.23a again.

– Observe the O-ring 8.35!

**Fig. 9:** Filling the operating fluid with vertical and horizontal installation orientation

8.23a  Filler screw
8.23b  Drain screw (do not use for filling!)
8.35  O-ring
5.6 Connecting the fore-vacuum side

**Recommendation:** As backing pump, use a suitable vacuum pump from the Pfeiffer Vacuum programme.

**WARNING**

Damage to health due to poisonous gases
Process gases can damage health and contaminate the environment.

- Safely lead away the gas emission from the backing pump!
- Observe all safety recommendations of the gas producer.

---

**Fig. 10: Connecting the backing pump**

415 Fore-vacuum connection  
415.1 Centering ring  
415.2 Clamping ring  
415.3 Vacuum components  
415a Backing pump

**NOTICE**

Design of the fore-vacuum connection regarding sudden twisting of the pump
If the rotor suddenly blocks the connection of high vacuum flanges of types ISO-KF or ISO-K can lead to twisting despite proper installation.

- Keep masses small, which can be installed directly to the pump.
- Connect flexible line elements directly to the turbopump, if necessary.

- With rigid pipe connections: Install bellows for attenuation of vibrations in the connection line.
- Connect the fore-vacuum line with small-flange components or threaded hose couplings. Do not narrow the free cross section of the fore-vacuum flange!
- For connection and operation of the backing pump see its operating instructions.
5.7 Connections to the turbopump

5.7.1 Electronic drive unit

Turbopumps with integrated electronic drive unit are designed for various applications. Therefore different connection panels are available.

- TC 1200 in standard version
- TC 1200 PB for Profibus linking
- TC 1200 E74 in dependence on specification SEMI E74
- TC 1200 DN for DeviceNet linking
- TC 1200 EC for EtherCAT linking

Detailed description for function, configuration and operation with the respective connection panel are given in the specific operating instructions for the electronic drive unit.

5.7.2 Earthing

Connect appropriate earthing wire according to local regulations, to derive applicable interferences.

5.7.3 Power and electrical supply

**WARNING**

Danger of unsafe electrical installation
Safe operation after installation is the responsibility of the operator.

- Do not independently modify or change the pump and electrical equipment.
- Make sure that the system is integrated in an emergency off safety circuit.
- Consult Pfeiffer Vacuum for special requirements.

![Diagram of mains connection plug](image)

**Fig. 12: Pin assignment of the mains connection plug**

- Order the mains cable separately (see "accessories").
- Assemble mains cable for yourself using the supply socket (delivery) if necessary.
5.7.4 Remote plug

The shipment includes a mating plug for the 26-pin connection with the designation "remote" on the TC 1200. The mating plug bridges the following connections with the supply voltage (Pin 1), allowing the turbopump to operate without an additional operating unit or remote control:

- Pin 2, Enable venting "on"
- Pin 3, Motor pump "on"
- Pin 4, Pumping station "on"
- Pin 14, Remote access request

Place and fix the mating plug on the connection "remote" on the TC 1200.

---

**CAUTION**

**Automatic start**

After bridging the contacts Pin 1, 3, 4, 14 on the connection "remote" or using the mating plug supplied and setting up the supply voltage, the turbopump will run up immediately.

Switch on the mains supply on the turbopump immediately before operation.

5.8 Accessory connection

Up to 4 accessories can be connected to the electronic drive unit TC 1200. M12 sockets with the designation "accessory" are available for this purpose. The accessory connections have been preconfigured at the factory. If the units listed below are connected with the preconfigured connection, they are immediately ready for operation according to the factory settings. It is possible to connect other accessories; to do so, settings must be made on the electronic drive unit.

- To connect two units to one accessory connection, use the appropriate Y-Connector from the Pfeiffer Vacuum range of accessories.
- Connect the adapter to the appropriate red-coded connection on the TC 1200.
- Settings can be made via the interfaces of the TC 1200 (remote, RS-485, Profibus or DeviceNet).

<table>
<thead>
<tr>
<th>Accessory connection</th>
<th>Connection with Y-connector</th>
<th>Preset accessory unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accessory A1</td>
<td>Acc. A to Y-1</td>
<td>Sealing gas valve</td>
</tr>
<tr>
<td>Accessory A2</td>
<td>Acc. A to Y-2</td>
<td>Backing pump</td>
</tr>
<tr>
<td>Accessory B1</td>
<td>Acc. B to Y-1</td>
<td>Venting valve</td>
</tr>
<tr>
<td>Accessory B2</td>
<td>Acc. B to Y-2</td>
<td>Casing heating unit</td>
</tr>
</tbody>
</table>

Table 1: Overview of factory preset accessory connections on the TC 1200

5.8.1 Sealing gas connection

The turbopump must be operated with sealing gas to protect it, such as in the case of unclean processes or high gas throughput. The supply is made via a sealing gas valve or alternatively via a sealing gas throttle without control. The activation of the control valve for the sealing gas connection is pre-installed in the electronic drive unit. The sealing gas valve is already part of the delivery consignment.

The permissible connection pressure is max. 1500 hPa absolute.

- When operating the pump with more than 50 % of the maximum gas throughput, sealing gas must be used to ensure rotor cooling.
- The sealing gas flow rate amounts 17.5-20 sccm for the HiPace 1500.
Sealing gas supply with control valve

Unscrew the locking screw with seal ring out of the sealing gas connection.
Screw the sealing gas valve with seal ring into the sealing gas connection.
Plug in and fix the accessory’s control lead to the corresponding accessory connection port on the electronic drive unit.
Default for the sealing gas valve is "accessory A1".
Install the sealing gas supply (e.g. inert gas) via a connection adapter or on the inlet side (G 1/8") of the control valve.

Sealing gas supply without control valve

Unscrew the locking screw with seal ring out of the sealing gas connection.
Screw the sealing gas throttle with seal ring into the sealing gas connection.

5.8.2 Venting valve

The Pfeiffer Vacuum venting valve is used for automatic venting in case of shut-down or power failure.
The permissible connection pressure is max. 1500 hPa absolute.
Unscrew the venting screw with seal ring from the venting connection.
Screw in the venting valve with seal ring.
Plug in and fix the accessory’s control lead to the corresponding accessory connection port on the electronic drive unit.
Default for the venting valve is "accessory B1".
If necessary install a venting gas supply (e.g. inert gas) to the intake (G 1/8") of the solenoid valve.

5.8.3 Heating jacket

The turbopump and vacuum chamber can be heated to reach the ultimate pressure more quickly. Use of a heating jacket is only permissible for pumps with the high vacuum flange in stainless steel design. The heating duration depends on the degree of contamination as well as the ultimate pressure to be reached and should be at least 4 hours.

NOTICE

Dangerous excess temperatures
Process-related high temperatures can result in impermissible excess temperatures and thus damage to the turbopump.
Water cooling must be used when employing a casing heating or during operation with heated vacuum chambers.
Do not introduce any additional energy into the pump (see p. 28, chap. 6.1).
When using a casing heating and a water cooling unit the temperature of the connected flange of the vacuum chamber must not exceed 120 °C.

The maximum permissible rotor temperature for the turbopump is 120 °C. If high temperatures arise for process reasons, the radiated heat input must not exceed 22.5 W. Install suitable screening sheets, if necessary (design information on request).

Bend open the outer heating jacket on the tensioning strap and place it sidewards on to the cylindrical segment of the pump casing.

- Do not bend the heating straps!
- The heating jacket must seat completely on the casing segment.

Fix the heating jacket with the fixing screw on the casing.

- Observe the tightening torque for the fixing screw!

**CAUTION**

**Risk of burns**
High temperatures arise when the turbopump or vacuum chamber are baked out. As a result, there is a danger of burns from touching hot parts, even after the casing heating is switched off!

- Thermally insulate heating jacket, pump housing and vacuum chamber, if possible during installation.
- Do not touch heating jacket, pump casing and vacuum chamber during bake out.

- When using a casing heating and a water cooling unit the temperature of the connected flange of the vacuum chamber must not exceed 120 °C.
- The maximum permissible rotor temperature for the turbopump is 120 °C. If high temperatures arise for process reasons, the radiated heat input must not exceed 22.5 W.

**Table 2: Tightening torques for fixing screws of heating jackets**

<table>
<thead>
<tr>
<th>Fixing screw</th>
<th>Tightening torque in cold condition</th>
<th>Tightening torque during the heating-up</th>
<th>Singular retightening after the cooling down</th>
</tr>
</thead>
<tbody>
<tr>
<td>M5</td>
<td>6 Nm</td>
<td>7 Nm</td>
<td>7 Nm</td>
</tr>
<tr>
<td>M6</td>
<td>11 Nm</td>
<td>12 Nm</td>
<td>12 Nm</td>
</tr>
</tbody>
</table>

Plug in and fix the accessory’s control lead to the corresponding accessory connection port on the electronic drive unit.

Default for the casing heating is "accessory B2”.

Establish the mains supply for the relay box according to the accessory operating instructions.
5.8.4 Water cooling

The turbopumps HiPace 1500 with TC 1200 have water cooling as standard equipment.

Cooling water requirements

<table>
<thead>
<tr>
<th>Cooling water quality</th>
<th>filtrated, mechanically clean, optically clear, no turbidity, no sediments, chemically neutral</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oxygen content max.</td>
<td>4 mg/kg</td>
</tr>
<tr>
<td>Chloride content max.</td>
<td>100 mg/kg</td>
</tr>
<tr>
<td>Water hardness max.</td>
<td>10 °dH, 12.53 °e, 17.8 °fH, 178 ppm CaCO₃</td>
</tr>
<tr>
<td>Consumption of potassium permanganate max.</td>
<td>10 mg/kg</td>
</tr>
<tr>
<td>Carbon dioxide content max.</td>
<td>undetectable</td>
</tr>
<tr>
<td>Ammonia content max.</td>
<td>undetectable</td>
</tr>
<tr>
<td>pH-value</td>
<td>7 - 9</td>
</tr>
<tr>
<td>Fore-line overpressure max.</td>
<td>6000 hPa</td>
</tr>
<tr>
<td>Cooling water temperature</td>
<td>refer to &quot;Technical Data&quot;</td>
</tr>
<tr>
<td>Cooling water consumption at max. gas throughput</td>
<td>refer to &quot;Technical Data&quot;</td>
</tr>
</tbody>
</table>

Connecting to a cooling water system

[Diagram showing connections and components]

Fig. 15: Connecting the cooling water
150 Screw-in nozzle  403 Cooling water connection  403b Return-line
155 Seal ring      403a Fore-line

→ Connect the cooling water connection alternatively:
  - Direct connection on the pump with G1/4” internal thread.
  - Using screw-in nozzles with seal ring (2 pcs. each in the scope of delivery) for hose internal diameters of 7 - 8 mm.
  - Tightening torque: max. 15 Nm.
→ Recommendation: install dirt trap in the fore-line.
→ Connect the cooling water fore-line to the designated connector.
→ Connect the cooling water return-line to the designated connector.
6 Operation

6.1 Commissioning

The following important settings are programmed in the electronic drive unit ex factory.

- **Parameter [P:027]** Gas mode: 0 = heavy gases
- **Parameter [P:700]** Set value max. run-up time monitoring: 8 min
- **Parameter [P:701]** Rotation speed switchpoint: 80% of the nominal rotation speed
- **Parameter [P:707]** Set value in rotation speed setting mode: 65% of the nominal rotation speed
- **Parameter [P:708]** Set value power consumption: 100%
- **Parameter [P:720]** Venting rotation speed at delayed venting: 50% of the nominal rotation speed
- **Parameter [P:721]** Venting time: 3600 s

- When water cooling is used: Open cooling water supply and check the flow.
- When sealing gas is used: Open the sealing gas supply and check the flow.
- Switch on the pump by connecting the mains cable with the mains supply.

---

### NOTICE

**Risk of destroying the pump by inputting too much energy**

Simultaneous loading by means of high drive power (gas flow rate, fore-vacuum pressure), high heat radiation, or strong magnetic fields results in uncontrolled heating of the rotor and may destroy the pump.

- Reduced limit values apply when combining these loads.
- If necessary consult with Pfeiffer Vacuum.

---

### NOTICE

**Danger of the pump being destroyed**

Pumping of gases with a higher molecular mass in the wrong gas mode can lead to destruction of the pump.

- Ensure the gas mode is correctly set.
- Contact Pfeiffer Vacuum before using gases with a greater molecular mass (> 80).

---

6.1.1 Connecting to the mains power supply

---

### CAUTION

**Automatic start**

After bridging the contacts Pin 1, 3, 4, 14 on the connection "remote" or using the mating plug supplied and setting up the supply voltage, the turbopump will run up immediately.

- Switch on the mains supply on the turbopump immediately before operation.

---

### WARNING

**Danger of electric shock**

In case of defect, the parts connected to the mains supply are under voltage.

- Always keep the mains connection freely accessible so you can disconnect it at any time.

- Insert the mains cable into the mains connection AC in.
- Lock the mains cable with the mounting bracket.
- Connect the mains cable to the mains.
- Always ensure a safe connection to the protective earthing conductor (PE, protection class I).
After the mains voltage is applied, the electronic drive unit performs a self-test to check the supply voltage. The turbopump is set into operation.

**Drive power reduction depending on the mains connection voltage**

<table>
<thead>
<tr>
<th>Mains connection voltage</th>
<th>Drive power</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 - 120 V AC</td>
<td>700 - 930 W</td>
</tr>
<tr>
<td>200 - 240 V AC</td>
<td>1200 W</td>
</tr>
</tbody>
</table>

The power of the electronic drive unit depends on the provided mains voltage.

### 6.2 Operation modes

The following operation modes are available:

- Operation without operating unit
- Operation via "remote" connection
- Operation via RS-485 and Pfeiffer Vacuum display and control units or PC
- Operation via field bus

### 6.3 Function description

#### 6.3.1 Operation without operating unit

For operation without the control unit, the 26-pole D-Sub plug must be in the "remote" connection on the TC 1200.

After operating voltage is applied, the TC 1200 performs a self-test to check the supply voltage. Once the self-test has been successfully completed on the TC 1200, the turbopump and the backing pump - if connected - begin to operate.

#### 6.3.2 Operation via "remote" connection

Remote control is possible via the 26-pin D-sub connector labelled "remote" on the electronic drive unit. The accessible individual functions are mapped to "PLC levels".

Consider the following manuals for the operation via remote control:

- Operating instructions "Electronic drive unit TC 1200"

#### 6.3.3 Operation with DCU or HPU

Consider the following manuals for the operation via Pfeiffer Vacuum display and control units:

- Operating instructions "DCU"
- Operating instructions "HPU"
- Operating instructions "Electronic drive unit TC 1200"

Switch on the pump by connecting the mains cable with the mains supply.

Settings are possible via interface RS-485 by using DCU, HPU or PC.

#### 6.3.4 Operation via fieldbus

Integrating and operating Pfeiffer Vacuum turbopumps in the customer's field bus system is possible for electronic drive units with a corresponding field bus panel.
Consider the following manuals for the operation via field bus:

- Operating instructions for the electronic drive unit with the respective connection panel
6.4 Monitoring of the operation conditions

6.4.1 Operation display via LED

LEDs in the front panel of the electronic drive unit show basic operating conditions of the turbopump. A differentiated malfunction and warning display is possible only for operation with DCU or HPU.

<table>
<thead>
<tr>
<th>LED</th>
<th>Symbol</th>
<th>LED status</th>
<th>Display</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green</td>
<td></td>
<td>Off</td>
<td>currentless</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>On, flashing</td>
<td>&quot;Pumping Station OFF&quot;, rotation speed ≤ 60 min⁻¹</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>On, invers flashing</td>
<td>&quot;Pumping Station ON&quot;, set rotation speed not attained</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>On, constantly</td>
<td>&quot;Pumping Station ON&quot;, set rotation speed attained</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>On, blinking</td>
<td>&quot;Pumping Station OFF&quot;, rotation speed &gt; 60 min⁻¹</td>
<td></td>
</tr>
<tr>
<td>Yellow</td>
<td></td>
<td>Off</td>
<td>no warning</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>On, constantly</td>
<td>Warning</td>
<td></td>
</tr>
<tr>
<td>Red</td>
<td></td>
<td>Off</td>
<td>no malfunction</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>On, constantly</td>
<td>Malfunction</td>
<td></td>
</tr>
</tbody>
</table>

Fig. 16: Behaviour and meaning of LEDs on the electronic drive unit

6.4.2 Temperature monitoring

The drive power is reduced in case of impermissible motor temperature or impermissibly high housing temperature. This can cause falling below the rotation speed switchpoint and so result in turning off the turbopump.

6.5 Switching off and venting

6.5.1 Switching off

After the turbopump is switched off, it must be vented to avoid contamination due to particles streaming back from the fore-vacuum area.

- Close the fore-vacuum: Switch off the backing pump or close a fore-vacuum valve.
- Switch off the turbopump on the control unit or via remote control.
- Venting (possibilities see below)
- Leave open the cooling water supply until the halt of the rotor (rotation speed < 1 Hz).

6.5.2 Venting

Manually venting

- Open the venting screw (included) in the venting connection of the turbopump about one turn.

Venting with Pfeiffer Vacuum Venting Valve

- Enable venting via the functions of the electronic drive unit.
- Settings are possible via interface RS-485 by using DCU, HPU or PC.

<table>
<thead>
<tr>
<th>Venting rotation speed</th>
<th>Switch off the pumping station</th>
<th>Mains power failure¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>50 % of the nominal rotation speed</td>
<td>Venting valve opens for 3600 s (1 h, works setting)</td>
<td>Venting valve opens for 3600 s (1 h, works setting)</td>
</tr>
</tbody>
</table>

¹When mains power is restored the venting procedure is aborted.
Basic information for the rapid venting
Venting of the vacuum chamber in two steps. Ask for details on individual solutions from Pfeiffer Vacuum.

➔ Vent for 20 seconds at a rate of pressure rise of max. 15 hPa/s.
  – The valve cross section for the venting rate of 15 hPa/s must be adapted to the size of the vacuum chamber.
  – For small vacuum chambers, use the Pfeiffer Vacuum venting valve.
➔ Then vent with an additional venting valve of any desired size.

7 Maintenance / replacement

WARNING
Contamination of parts and operating fluid by pumped media is possible.
Poisoning hazard through contact with materials that damage health.
➔ In the case of contamination, carry out appropriate safety precautions in order to prevent danger to health through dangerous substances.
➔ Decontaminate affected parts before carrying out maintenance work.

WARNING
Toxic vapours!
Danger of poisoning when igniting and heating synthetic operating fluids (e.g. F3) above 300 °C.
➔ Observe the application instructions.
➔ Do not allow operating fluid to make contact with tobacco products; observe safety precautions when handling chemicals.

NOTICE
Disclaimer of liability
Pfeiffer Vacuum accepts no liability for personal injury or material damage, losses or operating malfunctions due to improperly performed maintenance. The liability and warranty entitlement expires.

7.1 Maintenance intervals and responsibilities

● Clean the turbopump externally with a lint-free cloth and little industrial alcohol.
● Change the operating fluid yourself.
● Change the operating fluid at least every 4 years.
● Change the turbopump bearing at least every 4 years.
  – Contact Pfeiffer Vacuum Service.
● Clarify shorter maintenance intervals for extreme loads or impure processes with Pfeiffer Vacuum Service.
● For all other cleaning, maintenance or repair work, please contact your Pfeiffer Vacuum service location.
7.2 Changing the operating fluid

**WARNING**

Poisoning hazard through contact with materials that damage health. Operating fluid and parts of the pump may contain toxic substances from the pumped media.

- Dispose of operating fluid in accordance with the applicable regulations. Safety data sheet on request or under www.pfeiffer-vacuum.com
- Prevent health hazards or environmental damage due to contamination by means of appropriate safety precautions.
- Decontaminate affected parts before carrying out maintenance work.

---

**Design of the operating fluid pump**

The operating fluid pump is largely mirror symmetrical. The screws for filling the operating fluid are located at the sides of the operating fluid pump. The screws for draining the operating fluid are located at the front of the operating fluid pump.

- Always use the higher positioned screw for filling.
- Always use the lower positioned screw for draining.
- Never fill via the draining screws.

---

**Fig. 17: Removing the protective cover of the operating fluid pump at standard and U-versions**

- Turn off the vacuum pump, vent to atmospheric pressure and allow to cool.
- Screw out the allen head screws (2x) of the operating fluid pump and remove the protective cover.

---

**Fig. 18: Draining the operating fluid with vertical and horizontal installation orientation**

- Unscrew the respectively lower positioned drain screw 8.23b of the operating fluid pump.
  - Observe the O-ring 8.35!
- Drain the operating fluid in a suitable tank.
- Lock the drain screw 8.23b again.
  - Observe the O-ring 8.35!
7.3 Replacing the electronic drive unit

**NOTICE**

Observe mounting orientations when replacing the electronic drive unit!

Electronic drive unit replacement can be carried out at the installed pump. When dismounting the pump from the system, observe:

- Unscrew the respectively higher positioned filler screw 8.23a of the operating fluid pump.
- Fill in the operating fluid (max. 50 ml) into the operating fluid pump by using the filling syringe.
- Lock the filler screw 8.23a again.

– Observe the O-ring 8.35!

**NOTICE**

Damages to the pump and drive

Even after the mains power is switched off, the subsequently running pump delivers electric power to the electronic drive unit. There is a danger of electric body contact by premature separating the pump from the electronic drive unit.

- Never separate the electronic drive unit from the pump when the mains power is connected or the rotor is running.

**NOTICE**

Operating parameters of the electronic drive unit

The factory operating parameters are always preset with replacement shipments.

- The use of a HPU enables the storing and the reuse of an existing parameter record.
- Reset any individually changed application parameters.
- Refer to the manual "Electronic drive unit".

- Do not exercise any mechanical load on the electronic drive unit.
- Turn off the vacuum pump, vent to atmospheric pressure and allow to cool.
- Only separate the pump and the electronic drive unit from each other after disconnecting the supply voltage and the complete standstill of the pump.
- Remove the vacuum pump from the system, if necessary.
Unscrew Allen head screws (3x) from the electronic drive unit.

Pull the electronic drive unit straight off the pump.
- Observe the plug connection!
- Observe O-ring 87!

Don’t touch any electrostatic sensitive devices.

Fix the O-ring 87 in the groove of the pump bottom part, if necessary. Ensure correct seating!

Set the new electronic drive unit 13 with the straight edge at the height of the operating fluid pump and fold carefully to the pump bottom part.
- Observe the plug connection!

Tighten the electronic drive unit 13 with allen head screws 94 (5x) and 96 (2x).
- Tightening torque 2.5 Nm.

**NOTICE**

Visual inspection - avoid malfunction!
Incorrect assembling of the electronic drive unit may lead to malfunctions!

- The base plate of the electronic drive unit must be seated planar on the cooling plate of the pump.
- If necessary loosen and reassemble the electronic drive unit. Observe the O-ring!
7.3.1 Rotation speed set value

The typical nominal rotation speed of a turbopump is factory-set in the electronic drive unit. If the electronic drive unit is replaced or a different pump type is used, the reference set value of the nominal rotation speed must be confirmed. This procedure is part of a redundant safety system for avoiding excess rotation speeds.

<table>
<thead>
<tr>
<th>HiPace</th>
<th>Nominal rotation speed confirmation [P:777]</th>
</tr>
</thead>
<tbody>
<tr>
<td>T200 / 1500</td>
<td>630 Hz</td>
</tr>
<tr>
<td>T800 / 2300</td>
<td>525 Hz</td>
</tr>
</tbody>
</table>

⇒ Adjust the parameter [P:777] according to the pump type.
⇒ Alternatively: If no display and control unit is available, please use the "SpeedConfigurator" of the spare parts delivery.
8 Decommissioning

8.1 Shutting down for longer periods

**WARNING**

Contamination of parts and operating fluid by pumped media is possible. Poisoning hazard through contact with materials that damage health.

- In the case of contamination, carry out appropriate safety precautions in order to prevent danger to health through dangerous substances.
- Decontaminate affected parts before carrying out maintenance work.

If the turbopump should be shut down for longer than a year:

- Remove the vacuum pump from the system, if necessary.
- Drain the operating fluid.
- Close the high vacuum flange of the turbopump.
- Evacuate turbopump via the fore-vacuum flange.
- Vent turbopump via the venting connection with oil-free, dry air or inert gas.
- Close the flange openings by using the original protective covers.
- Close further connection ports by using the corresponding protective covers.
- Store the pump only indoors at temperatures between -25 °C and +55 °C.
- In rooms with moist or aggressive atmospheres, the pump must be airproof shrink-wrapped in a plastic bag together with a bag of desiccant.

8.2 Re-starting

**NOTICE**

Risk of damage to the pump following recommissioning

The operating fluid in the turbo pump has a limited shelf life. The length of its shelf life is as follows:

- max. 2 years without operation or
- a total of max. 4 years following periods of operation and nonoperation.

Follow the maintenance instructions and inform Pfeiffer Vacuum.

- Check turbopump for contamination and moisture.
- Clean the turbopump externally with a lint-free cloth and little industrial alcohol.
- If necessary, have Pfeiffer Vacuum Service clean the turbopump completely.
- If necessary, have the bearings replaced. Take into account the total running time.
- Installation and commissioning in accordance with the operating instructions.

8.3 Disposal

Products or parts thereof (mechanical and electrical components, operating fluids, etc.) may cause environmental burden.

- Safely dispose of the materials according to the locally applicable regulations.
# 9 Malfunctions

If malfunctions on the pump occur, you will find possible causes and instructions for repair in the following table.

## 9.1 Rectifying malfunctions

<table>
<thead>
<tr>
<th>Problem</th>
<th>Possible causes</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pump will not start; none of the built-in LEDs on the TC 1200 lights up</td>
<td></td>
<td></td>
</tr>
<tr>
<td>● Electrical supply interrupted</td>
<td><a href="#">Check plug contacts on the power supply</a></td>
<td><a href="#">Check supply lines on the power supply</a></td>
</tr>
<tr>
<td>● Operating voltage incorrect</td>
<td><a href="#">Apply correct operating voltage</a></td>
<td><a href="#">Observe the rating plate</a></td>
</tr>
<tr>
<td>● No operating voltage applied</td>
<td><a href="#">Apply operating voltage</a></td>
<td></td>
</tr>
<tr>
<td>● TC 1200 defective</td>
<td><a href="#">Request an exchange of the TC 1200</a></td>
<td><a href="#">Contact the Pfeiffer Vacuum Service</a></td>
</tr>
<tr>
<td>Pump will not start; green LED on the TC 1200 is flashing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>● At operation without control panel: Pins 1-3, 1-4 or 1-14 are not connected on the &quot;remote&quot; connection</td>
<td><a href="#">Connect the pins 1-3, 1-4 or 1-14 on the &quot;remote&quot; connection</a></td>
<td><a href="#">Install the mating plug (scope of delivery) to the &quot;remote&quot; connection</a></td>
</tr>
<tr>
<td>● At operation via RS-485: Bridge at Pin 1-14 prevents control commands</td>
<td><a href="#">Remove the bridge at the &quot;remote&quot; connection</a></td>
<td><a href="#">Remove the mating plug from the &quot;remote&quot; connection</a></td>
</tr>
<tr>
<td>● At operation via RS-485 (without counter plug): Parameters of the electronic drive unit not set</td>
<td><a href="#">Set parameters [P: 010] and [P: 023] &quot;ON&quot; via interface RS-485</a></td>
<td><a href="#">Please refer to operating instructions of the electronic drive unit</a></td>
</tr>
<tr>
<td>Pump does not attain the final rotational speed within the specified run-up time</td>
<td></td>
<td></td>
</tr>
<tr>
<td>● Fore-vacuum pressure too high</td>
<td><a href="#">Ensure function and suitability of the backing pump</a></td>
<td></td>
</tr>
<tr>
<td>● Leak</td>
<td><a href="#">Perform leak detection</a></td>
<td><a href="#">Check sealings and flange fastenings</a></td>
</tr>
<tr>
<td></td>
<td><a href="#">Eliminate leaks</a></td>
<td></td>
</tr>
<tr>
<td>● Gas load too high</td>
<td><a href="#">Reduce process gas supply</a></td>
<td></td>
</tr>
<tr>
<td>● Rotor runs hard, bearing defective</td>
<td><a href="#">Check the bearing for noises</a></td>
<td><a href="#">Contact the Pfeiffer Vacuum Service</a></td>
</tr>
<tr>
<td>● Setpoint for run-up time to low</td>
<td><a href="#">Extend the run-up time via DCU, HPU or PC</a></td>
<td></td>
</tr>
<tr>
<td>● Thermal overload:</td>
<td><a href="#">Reduce thermal loads</a></td>
<td></td>
</tr>
<tr>
<td>- Lack of air ventilation</td>
<td>- Ensure adequate cooling</td>
<td></td>
</tr>
<tr>
<td>- Water flow too low</td>
<td>- Ensure the cooling water flow</td>
<td></td>
</tr>
<tr>
<td>- Fore-vacuum pressure too high</td>
<td>- Lower the fore-vacuum pressure</td>
<td></td>
</tr>
<tr>
<td>- Ambient temperature too high</td>
<td>- Adjust ambient conditions</td>
<td></td>
</tr>
<tr>
<td>Pump does not attain the ultimate pressure</td>
<td></td>
<td></td>
</tr>
<tr>
<td>● Pump is dirty</td>
<td><a href="#">Bake out the pump</a></td>
<td><a href="#">Cleaning in case of heavy contamination</a></td>
</tr>
<tr>
<td></td>
<td>- Contact the Pfeiffer Vacuum Service</td>
<td>- Contact the Pfeiffer Vacuum Service</td>
</tr>
<tr>
<td>● Vacuum chamber, pipes or pump are leaky</td>
<td><a href="#">Leak detection starting from the vacuum chamber</a></td>
<td><a href="#">Eliminate leaks</a></td>
</tr>
<tr>
<td>Unusual noises during operation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>● Bearing damage</td>
<td><a href="#">Contact the Pfeiffer Vacuum Service</a></td>
<td></td>
</tr>
<tr>
<td>● Rotor damage</td>
<td><a href="#">Contact the Pfeiffer Vacuum Service</a></td>
<td></td>
</tr>
<tr>
<td>● Splinter shield or protective screen are loose</td>
<td><a href="#">Correct the seat of the splinter shield or the protective screen</a></td>
<td><a href="#">Observe the installation notes</a></td>
</tr>
<tr>
<td>Red LED on the TC 1200 is on</td>
<td></td>
<td></td>
</tr>
<tr>
<td>● Collective fault</td>
<td><a href="#">Reset by switching the mains OFF/ON</a></td>
<td><a href="#">Reset via pin 13 on the &quot;REMOTE&quot; connection</a></td>
</tr>
<tr>
<td></td>
<td><a href="#">Differentiated malfunction display is possible via &quot;RS 485&quot;</a></td>
<td><a href="#">Contact the Pfeiffer Vacuum Service</a></td>
</tr>
</tbody>
</table>

1) If no Pfeiffer Vacuum display and control unit is available, please contact the Pfeiffer Vacuum Service.
10 Service

Pfeiffer Vacuum offers first-class service!
- Operating fluid and bearing change on the spot by Pfeiffer Vacuum FieldService
- Maintenance / repair in the nearby ServiceCenter or ServicePoint
- Fast replacement with exchange products in mint condition
- Advice on the most cost-efficient and quickest solution

Detailed information, addresses and forms at: www.pfeiffer-vacuum.com (Service).

Maintenance and repair in the Pfeiffer Vacuum ServiceCenter
The following steps are necessary to ensure a fast, smooth servicing process:
- Download the forms "Service Request" and "Declaration on Contamination". ¹)
- Fill out the "Service Request" form and send it by fax or e-mail to your Pfeiffer Vacuum service address.
- Include the confirmation on the service request from Pfeiffer Vacuum with your shipment.
- Fill out the declaration on contamination and include it in the shipment (required!).
- Dismantle all accessories.
- Drain the operating fluid (applies for turbopumps with pumping speed > 700 l/s).
- Leave electronic drive on the pump.
- Close the flange openings by using the original protective covers.
- If possible, send pump or unit in the original packaging.

Sending of contaminated pumps or devices
No units will be accepted if they are contaminated with micro-biological, explosive or radioactive substances. "Hazardous substances" are substances and compounds in accordance with the hazardous goods directive (current version). If pumps are contaminated or the declaration on contamination is missing, Pfeiffer Vacuum performs decontamination at the shipper's expense.
- Neutralise the pump by flushing it with nitrogen or dry air.
- Close all openings airtight.
- Seal the pump or unit in suitable protective film.
- Return the pump/unit only in a suitable and sturdy transport container and send it in while following applicable transport conditions.

Exchange unit
The factory operating parameters are always preset with exchange units. If you use changed parameters for your application, you have to set these again.

Service orders
All service orders are carried out exclusively according to our repair conditions for vacuum units and components.

¹) Forms under www.pfeiffer-vacuum.com
### 11 Spare parts HiPace 1500

<table>
<thead>
<tr>
<th>Item</th>
<th>Designation</th>
<th>Size</th>
<th>Order number</th>
<th>Notes</th>
<th>Pieces</th>
<th>Order qty.</th>
</tr>
</thead>
<tbody>
<tr>
<td>13</td>
<td>Electronic drive unit TC 1200</td>
<td>according to the rating plate</td>
<td></td>
<td>depends on the connection panel</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>142</td>
<td>Syringe</td>
<td>50 ml</td>
<td>PM 006 915 -U</td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>143</td>
<td>Operating fluid F3</td>
<td>50 ml</td>
<td>PM 006 336 -T</td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mating plug &quot;remote&quot;</td>
<td></td>
<td>PM 061 378 -X</td>
<td>with bridges</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>145</td>
<td>Sealing gas valve</td>
<td>17.5 - 20 scm</td>
<td>PM Z01 313</td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>146</td>
<td>Mains connection socket</td>
<td>HAN 3</td>
<td>PM 061 200 -T</td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>150</td>
<td>Screw-in nozzle</td>
<td>G 1/4&quot;</td>
<td>P 0998 067</td>
<td>for hose internal Ø of 7-8 mm</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>155</td>
<td>Seal ring</td>
<td></td>
<td>P 3529 145 -A</td>
<td>for screw-in nozzle</td>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>

Please also specify model number of the the rating plate when ordering accessories or spare parts.
## 12 Accessories

<table>
<thead>
<tr>
<th>Designation</th>
<th>HiPace® 1500, DN 250 ISO-K</th>
<th>HiPace® 1500, DN 250 ISO-F</th>
<th>HiPace® 1500, DN 250 CF-F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mounting kit for HiPace 1500, DN 250 ISO-K, including coated centering ring, bracket screws</td>
<td>PM 016 395 -T</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mounting kit for HiPace 1500, DN 250 ISO-K, including coated centering ring, protection screen, bracket screws</td>
<td>PM 016 397 -T</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mounting kit for HiPace 1500, DN 250 ISO-K, including coated centering ring, splinter shield, bracket screws</td>
<td>PM 016 396 -T</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mounting kit for DN 250 ISO-K to ISO-F, with collar flange, coated centering ring</td>
<td>PM 016 970 -T</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mounting kit for DN 250 ISO-K to ISO-F, with collar flange, coated centering ring with splinter shield, hexagon bolts</td>
<td>PM 016 971 -T</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mounting kit for DN 250 ISO-K to ISO-F, with collar flange, coated centering ring with protection screen, hexagon bolts</td>
<td>PM 016 972 -T</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mounting kit for DN 250 ISO-K to ISO-F, with collar flange, coated centering ring with splinter shield, stud screws</td>
<td>PM 016 975 -T</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mounting kit for DN 250 ISO-K to ISO-F, with collar flange, coated centering ring with protection screen, stud screws</td>
<td>PM 016 976 -T</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mounting kit for DN 250 ISO-K to ISO-F, with coated centering ring, hexagon screws</td>
<td>PM 016 480 -T</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mounting kit for DN 250 ISO-K to ISO-F, including coated centering ring, protective screen, hexagon screws</td>
<td>PM 016 482 -T</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mounting kit for DN 250 ISO-K to ISO-F, including coated centering ring, splinter shield, hexagon screws</td>
<td>PM 016 481 -T</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mounting kit for DN 250 ISO-K to ISO-F, including coated centering ring, stud screws</td>
<td>PM 016 485 -T</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mounting kit for DN 250 ISO-K to ISO-F, including coated centering ring, protective screen, stud screws</td>
<td>PM 016 487 -T</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mounting kit for DN 250 ISO-K to ISO-F, including coated centering ring, splinter shield, stud screws</td>
<td>PM 016 486 -T</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Set of stud screws for threaded hole, DN 250 CF-F</td>
<td>PM 016 695 -T</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Set of stud screws for trough hole, DN 250 CF-F</td>
<td>PM 016 737 -T</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Set of hexagon screws for trough hole, DN 250 CF-F</td>
<td>PM 016 694 -T</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Centering ring with multifunction coating, DN 250 ISO-K/F</td>
<td>PM 016 225 -U</td>
<td>PM 016 225 -U</td>
<td></td>
</tr>
<tr>
<td>Centering ring with multifunction coating and integrated protection screen, DN 250 ISO-K/F</td>
<td>PM 016 227 -U</td>
<td>PM 016 227 -U</td>
<td></td>
</tr>
<tr>
<td>Centering ring with multifunction coating and integrated splinter shield, DN 250 ISO-K/F</td>
<td>PM 016 226 -U</td>
<td>PM 016 226 -U</td>
<td></td>
</tr>
<tr>
<td>Vibration damper for HiPace 1500/2300, DN 250 ISO-K/F</td>
<td>PM 006 670 -X</td>
<td>PM 006 670 -X</td>
<td></td>
</tr>
<tr>
<td>Protection screen for DN 250 CF-F</td>
<td></td>
<td></td>
<td>PM 016 345</td>
</tr>
<tr>
<td>Splinter shield for turbopumps, DN 250 CF-F</td>
<td></td>
<td></td>
<td>PM 016 324</td>
</tr>
<tr>
<td>Vibration damper for HiPace 1500/2300, DN 250 CF-F</td>
<td>PM 006 671 -X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mains cable 230 V AC, CEE 7/7 to HAN 3A, 3 m</td>
<td>P 4564 309 HA</td>
<td>P 4564 309 HA</td>
<td>P 4564 309 HA</td>
</tr>
<tr>
<td>Mains cable 208 V AC, NEMA 6-15 to HAN 3A, 3 m</td>
<td>P 4564 309 HB</td>
<td>P 4564 309 HB</td>
<td>P 4564 309 HB</td>
</tr>
<tr>
<td>Mains cable 115 V AC, NEMA 5-15 to HAN 3A, 3 m</td>
<td>PM 061 187 -X</td>
<td>PM 061 187 -X</td>
<td>PM 061 187 -X</td>
</tr>
<tr>
<td>DCU 002, Display Control Unit</td>
<td>PM 061 348 -T</td>
<td>PM 061 348 -T</td>
<td>PM 061 348 -T</td>
</tr>
<tr>
<td>HPU 001, Handheld Programming Unit</td>
<td>PM 051 510 -T</td>
<td>PM 051 510 -T</td>
<td>PM 051 510 -T</td>
</tr>
<tr>
<td>Accessories package for HPU 001/PC</td>
<td>PM 061 005 -T</td>
<td>PM 061 005 -T</td>
<td>PM 061 005 -T</td>
</tr>
<tr>
<td>Relay box, shielded, for backing pumps, 1-phase 7 A for TC 400/1200, TM 700 and TCP 350, M12</td>
<td>PM 071 284 -X</td>
<td>PM 071 284 -X</td>
<td>PM 071 284 -X</td>
</tr>
<tr>
<td>Relay box, shielded, for backing pumps, 1-phase 20 A for TC 400/1200, TM 700 and TCP 350, M12</td>
<td>PM 071 285 -X</td>
<td>PM 071 285 -X</td>
<td>PM 071 285 -X</td>
</tr>
<tr>
<td>TVV 001 fore-vacuum safety valve, 230 V AC</td>
<td>PM 201 205</td>
<td>PM 201 205</td>
<td>PM 201 205</td>
</tr>
<tr>
<td>TVV 001 fore-vacuum safety valve, 115 V AC</td>
<td>PM 201 206</td>
<td>PM 201 206</td>
<td>PM 201 206</td>
</tr>
<tr>
<td>Heating jacket, shielded, for HiPace 1200/1500 with TC 1200, 208 V AC, UL plug</td>
<td>PM 071 273 -T</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heating jacket, shielded, for HiPace 1200/1500 with TC 1200, 115 V AC, UL plug</td>
<td>PM 071 274 -T</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heating jacket, shielded, for HiPace 1200/1500 with TC 1200, 230 V AC, safety plug</td>
<td>PM 071 272 -T</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Designation</td>
<td>HiPace® 1500, DN 250 ISO-K</td>
<td>HiPace® 1500, DN 250 ISO-F</td>
<td>HiPace® 1500, DN 250 CF-F</td>
</tr>
<tr>
<td>----------------------------------------------------------------------------</td>
<td>---------------------------</td>
<td>---------------------------</td>
<td>--------------------------</td>
</tr>
<tr>
<td>Venting valve, shielded, 24 V DC, G 1/8&quot;, for connection to TC 400/1200 and TM 700</td>
<td>PM Z01 291</td>
<td>PM Z01 291</td>
<td>PM Z01 291</td>
</tr>
<tr>
<td>TTV 001, dryer for venting turbopumps</td>
<td>PM Z00 121</td>
<td>PM Z00 121</td>
<td>PM Z00 121</td>
</tr>
<tr>
<td>Sealing gas valve, shielded, HiPace 400/700/800 P with TC 400 and HiPace 1200 - 2300</td>
<td>PM Z01 313</td>
<td>PM Z01 313</td>
<td>PM Z01 313</td>
</tr>
<tr>
<td>Sealing gas throttle for HiPace 400/700/800 P version and HiPace 1200 - 2300</td>
<td>PM Z01 318</td>
<td>PM Z01 318</td>
<td>PM Z01 318</td>
</tr>
<tr>
<td>Sealing gas throttle for HiPace 1200 - 2300</td>
<td>PM Z01 319</td>
<td>PM Z01 319</td>
<td>PM Z01 319</td>
</tr>
<tr>
<td>Sealing gas throttle for 1200 - 2300, 52.5 ± 7.5 sccm</td>
<td>PM Z01 325</td>
<td>PM Z01 325</td>
<td>PM Z01 325</td>
</tr>
<tr>
<td>Interface cable, M12 m straight/M12 m straight, 3 m</td>
<td>PM 061 283 -T</td>
<td>PM 061 283 -T</td>
<td>PM 061 283 -T</td>
</tr>
<tr>
<td>HiPace - ACP connection cable</td>
<td>PM 071 142 -X</td>
<td>PM 071 142 -X</td>
<td>PM 071 142 -X</td>
</tr>
<tr>
<td>Control cable for pumping stations 0.7 m</td>
<td>PM 061 675 AT</td>
<td>PM 061 675 AT</td>
<td>PM 061 675 AT</td>
</tr>
<tr>
<td>USB converter to RS-485 interface</td>
<td>PM 061 207 -T</td>
<td>PM 061 207 -T</td>
<td>PM 061 207 -T</td>
</tr>
<tr>
<td>Y-Connector M12 to RS-485</td>
<td>P 4723 010</td>
<td>P 4723 010</td>
<td>P 4723 010</td>
</tr>
<tr>
<td>Connector M12 to RS-485</td>
<td>PM 061 270 -X</td>
<td>PM 061 270 -X</td>
<td>PM 061 270 -X</td>
</tr>
<tr>
<td>Termination resistor for RS-485</td>
<td>PT 348 105 -T</td>
<td>PT 348 105 -T</td>
<td>PT 348 105 -T</td>
</tr>
<tr>
<td>Power separator for RS-485</td>
<td>PT 348 132 -T</td>
<td>PT 348 132 -T</td>
<td>PT 348 132 -T</td>
</tr>
<tr>
<td>Y-connector, shielded, M12 for accessories</td>
<td>P 4723 013</td>
<td>P 4723 013</td>
<td>P 4723 013</td>
</tr>
<tr>
<td>RPT 010, Digital Piezo/Pirani Sensor</td>
<td>PT R71 100</td>
<td>PT R71 100</td>
<td>PT R71 100</td>
</tr>
<tr>
<td>IKT 010, Digital Cold Cathode Sensor</td>
<td>PTR 72 100</td>
<td>PTR 72 100</td>
<td>PTR 72 100</td>
</tr>
<tr>
<td>IKT 011, Digital Cold Cathode Sensor</td>
<td>PT R73 100</td>
<td>PT R73 100</td>
<td>PT R73 100</td>
</tr>
<tr>
<td>TIC 010, Adapter for two sensors</td>
<td>PT R70 000</td>
<td>PT R70 000</td>
<td>PT R70 000</td>
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</table>

Designation HiPace®, HiPace® 1500,
### 13 Technical data and dimensions

#### 13.1 General

Basic principles for the Technical Data of Pfeiffer Vacuum Turbopumps:

<table>
<thead>
<tr>
<th>Recommendations of PNEUROP committee PN5</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISO 5302; 2003: &quot;Vacuum technology - Turbomolecular pumps - Measurement of performance characteristics&quot;</td>
</tr>
<tr>
<td>Ultimate pressure: using a test dome and a 48 hrs. period of baking out</td>
</tr>
<tr>
<td>Gas throughput: water cooling; backing pump = rotary vane pump (60 m³/h)</td>
</tr>
<tr>
<td>Cooling water consumption: at max. gas throughput, cooling water temp. 25 °C</td>
</tr>
<tr>
<td>Integral leak rate: using a Helium concentration of 100 %, period 10 s</td>
</tr>
<tr>
<td>Sound pressure level: Distance 1 m to the pump</td>
</tr>
</tbody>
</table>

#### Conversion table: pressure units

<table>
<thead>
<tr>
<th>mbar</th>
<th>bar</th>
<th>Pa</th>
<th>hPa</th>
<th>kPa</th>
<th>Torr mm Hg</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>100</td>
<td>1</td>
<td>0.1</td>
<td>0.75</td>
</tr>
<tr>
<td>1000</td>
<td>1</td>
<td>100</td>
<td>1000</td>
<td>100</td>
<td>750</td>
</tr>
<tr>
<td>0.01</td>
<td>1·10⁻³</td>
<td>1</td>
<td>0.01</td>
<td>1·10⁻³</td>
<td>7.5·10⁻³</td>
</tr>
<tr>
<td>1</td>
<td>1·10⁻³</td>
<td>100</td>
<td>1</td>
<td>0.1</td>
<td>0.75</td>
</tr>
<tr>
<td>10</td>
<td>0.01</td>
<td>1000</td>
<td>10</td>
<td>1</td>
<td>7.5</td>
</tr>
<tr>
<td>1.33</td>
<td>1.33·10⁻³</td>
<td>133.32</td>
<td>1.33</td>
<td>0.133</td>
<td>1</td>
</tr>
</tbody>
</table>

1 Pa = 1 N/m²

#### Conversion table: gas throughput units

<table>
<thead>
<tr>
<th>mbar l/s</th>
<th>Pa m⁻³/s</th>
<th>sccm</th>
<th>Torr l/s</th>
<th>atm·cm³/s</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.1</td>
<td>59.2</td>
<td>0.75</td>
<td>0.987</td>
</tr>
<tr>
<td>10</td>
<td>1</td>
<td>592</td>
<td>7.5</td>
<td>9.87</td>
</tr>
<tr>
<td>1.69·10⁻²</td>
<td>1.69·10⁻³</td>
<td>1</td>
<td>1.27·10⁻²</td>
<td>1.67·10⁻²</td>
</tr>
<tr>
<td>1.33</td>
<td>0.133</td>
<td>78.9</td>
<td>1</td>
<td>1.32</td>
</tr>
<tr>
<td>1.01</td>
<td>0.101</td>
<td>59.8</td>
<td>0.76</td>
<td>1</td>
</tr>
</tbody>
</table>
### 13.2 HiPace 1500 / HiPace 1500 U

<table>
<thead>
<tr>
<th>Parameter</th>
<th>HiPace® 1500</th>
<th>HiPace® 1500</th>
<th>HiPace® 1500</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flange (in)</td>
<td>DN 250 ISO-K</td>
<td>DN 250 CF-F</td>
<td>DN 250 ISO-F</td>
</tr>
<tr>
<td>Flange (out)</td>
<td>DN 40 ISO-KF</td>
<td>DN 40 ISO-KF</td>
<td>DN 40 ISO-KF</td>
</tr>
<tr>
<td>Pumping speed for Ar</td>
<td>1350 l/s</td>
<td>1350 l/s</td>
<td>1350 l/s</td>
</tr>
<tr>
<td>Pumping speed for H₂</td>
<td>1150 l/s</td>
<td>1150 l/s</td>
<td>1150 l/s</td>
</tr>
<tr>
<td>Pumping speed for He</td>
<td>1350 l/s</td>
<td>1350 l/s</td>
<td>1350 l/s</td>
</tr>
<tr>
<td>Pumping speed for N₂</td>
<td>1400 l/s</td>
<td>1400 l/s</td>
<td>1400 l/s</td>
</tr>
<tr>
<td>Compression ratio for Ar</td>
<td>&gt; 1 · 10⁸</td>
<td>&gt; 1 · 10⁸</td>
<td>&gt; 1 · 10⁸</td>
</tr>
<tr>
<td>Compression ratio for H₂</td>
<td>6 · 10³</td>
<td>6 · 10³</td>
<td>6 · 10³</td>
</tr>
<tr>
<td>Compression ratio for He</td>
<td>2 · 10⁵</td>
<td>2 · 10⁵</td>
<td>2 · 10⁵</td>
</tr>
<tr>
<td>Compression ratio for N₂</td>
<td>&gt; 1 · 10⁸</td>
<td>&gt; 1 · 10⁸</td>
<td>&gt; 1 · 10⁸</td>
</tr>
<tr>
<td>Gas throughput at full rotational speed for Ar</td>
<td>11 hPa l/s</td>
<td>6 hPa l/s</td>
<td>11 hPa l/s</td>
</tr>
<tr>
<td>Gas throughput at full rotational speed for H₂</td>
<td>&gt; 30 hPa l/s</td>
<td>&gt; 30 hPa l/s</td>
<td>&gt; 30 hPa l/s</td>
</tr>
<tr>
<td>Gas throughput at full rotational speed for N₂</td>
<td>&gt; 30 hPa l/s</td>
<td>&gt; 30 hPa l/s</td>
<td>&gt; 30 hPa l/s</td>
</tr>
<tr>
<td>Gas throughput at full rotational speed for Ar</td>
<td>16 hPa l/s</td>
<td>16 hPa l/s</td>
<td>16 hPa l/s</td>
</tr>
<tr>
<td>Gas throughput at full rotational speed for H₂</td>
<td>&gt; 30 hPa l/s</td>
<td>&gt; 30 hPa l/s</td>
<td>&gt; 30 hPa l/s</td>
</tr>
<tr>
<td>Gas throughput at full rotational speed for N₂</td>
<td>20 hPa l/s</td>
<td>20 hPa l/s</td>
<td>20 hPa l/s</td>
</tr>
<tr>
<td>Fore-vacuum max. for Ar</td>
<td>2.5 hPa</td>
<td>2.5 hPa</td>
<td>2.5 hPa</td>
</tr>
<tr>
<td>Fore-vacuum max. for H₂</td>
<td>0.25 hPa</td>
<td>0.25 hPa</td>
<td>0.25 hPa</td>
</tr>
<tr>
<td>Fore-vacuum max. for He</td>
<td>0.9 hPa</td>
<td>0.9 hPa</td>
<td>0.9 hPa</td>
</tr>
<tr>
<td>Fore-vacuum max. for N₂</td>
<td>2 hPa</td>
<td>2 hPa</td>
<td>2 hPa</td>
</tr>
<tr>
<td>Run-up time</td>
<td>2.5 min</td>
<td>2.5 min</td>
<td>2.5 min</td>
</tr>
<tr>
<td>Ultimate pressure according to PNEUROP</td>
<td>&lt; 1 · 10⁻⁷ hPa</td>
<td>&lt; 5 · 10⁻¹⁰ hPa</td>
<td>&lt; 1 · 10⁻⁷ hPa</td>
</tr>
<tr>
<td>Rotation speed ± 2 %</td>
<td>37800 min⁻¹</td>
<td>37800 min⁻¹</td>
<td>37800 min⁻¹</td>
</tr>
<tr>
<td>Rotation speed variable</td>
<td>50-100 %</td>
<td>50-100 %</td>
<td>50-100 %</td>
</tr>
<tr>
<td>Power characteristic line in gas mode 1, vertex A</td>
<td>710/37800 W/min⁻¹</td>
<td>540/37800 W/min⁻¹</td>
<td>710/37800 W/min⁻¹</td>
</tr>
<tr>
<td>Power characteristic line in gas mode 1, vertex B</td>
<td>750/35400 W/min⁻¹</td>
<td>756/14400 W/min⁻¹</td>
<td>750/35400 W/min⁻¹</td>
</tr>
<tr>
<td>Power characteristic line in gas mode 0, vertex C</td>
<td>578/37800 W/min⁻¹</td>
<td>406/37800 W/min⁻¹</td>
<td>578/37800 W/min⁻¹</td>
</tr>
<tr>
<td>Power characteristic line in gas mode 0, vertex D</td>
<td>717/29400 W/min⁻¹</td>
<td>616/11280 W/min⁻¹</td>
<td>717/29400 W/min⁻¹</td>
</tr>
<tr>
<td>Sound pressure level</td>
<td>≤ 50 dB (A)</td>
<td>≤ 50 dB (A)</td>
<td>≤ 50 dB (A)</td>
</tr>
<tr>
<td>Relative humidity of air</td>
<td>5-85, non-condensing %</td>
<td>5-85, non-condensing %</td>
<td>5-85, non-condensing %</td>
</tr>
<tr>
<td>Protection category</td>
<td>IP54</td>
<td>IP54</td>
<td>IP54</td>
</tr>
<tr>
<td>Connection pressure max. for venting/sealing gas valve</td>
<td>1500 hPa</td>
<td>1500 hPa</td>
<td>1500 hPa</td>
</tr>
<tr>
<td>Integral leak rate</td>
<td>&lt; 1 · 10⁻⁸ Pa m³/s</td>
<td>&lt; 1 · 10⁻⁸ Pa m³/s</td>
<td>&lt; 1 · 10⁻⁸ Pa m³/s</td>
</tr>
<tr>
<td>Power consumption max.</td>
<td>1350 VA</td>
<td>1350 VA</td>
<td>1350 VA</td>
</tr>
<tr>
<td>Mains requirement: frequency (range)</td>
<td>50/60 Hz</td>
<td>50/60 Hz</td>
<td>50/60 Hz</td>
</tr>
<tr>
<td>Mains requirement: voltage (range)</td>
<td>100-120/200-240 V AC</td>
<td>100-120/200-240 V AC</td>
<td>100-120/200-240 V AC</td>
</tr>
<tr>
<td>Current consumption max.</td>
<td>10 A</td>
<td>10 A</td>
<td>10 A</td>
</tr>
<tr>
<td>Mounting orientation</td>
<td>Standard (0°-90°)</td>
<td>Standard (0°-90°)</td>
<td>Standard (0°-90°)</td>
</tr>
<tr>
<td>Venting connection</td>
<td>G 1/8°</td>
<td>G 1/8°</td>
<td>G 1/8°</td>
</tr>
<tr>
<td>Weight</td>
<td>29 kg</td>
<td>41 kg</td>
<td>30 kg</td>
</tr>
<tr>
<td>Cooling method, standard</td>
<td>Water</td>
<td>Water</td>
<td>Water</td>
</tr>
<tr>
<td>Cooling water temperature</td>
<td>15-35 °C</td>
<td>15-35 °C</td>
<td>15-35 °C</td>
</tr>
<tr>
<td>Cooling water consumption</td>
<td>100 l/h</td>
<td>100 l/h</td>
<td>100 l/h</td>
</tr>
<tr>
<td>Permissible irradiated thermal power max.</td>
<td>22.5 W</td>
<td>22.5 W</td>
<td>22.5 W</td>
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<tr>
<td>Permissible magnetic field max.</td>
<td>6 mT</td>
<td>6 mT</td>
<td>6 mT</td>
</tr>
<tr>
<td>Interfaces</td>
<td>RS-485, Remote</td>
<td>RS-485, Remote</td>
<td>RS-485, Remote</td>
</tr>
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</table>
### 13.3 HiPace 1500 C / HiPace 1500 U C

<table>
<thead>
<tr>
<th>Parameter</th>
<th>HiPace® 1500 C</th>
<th>HiPace® 1500 C</th>
<th>HiPace® 1500 C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flange (in)</td>
<td>DN 250 ISO-K</td>
<td>DN 250 CF-F</td>
<td>DN 250 ISO-F</td>
</tr>
<tr>
<td>Flange (out)</td>
<td>DN 40 ISO-KF</td>
<td>DN 40 ISO-KF</td>
<td>DN 40 ISO-KF</td>
</tr>
<tr>
<td>Pumping speed for Ar</td>
<td>1350 l/s</td>
<td>1350 l/s</td>
<td>1350 l/s</td>
</tr>
<tr>
<td>Pumping speed for CF₄</td>
<td>1100 l/s</td>
<td>1100 l/s</td>
<td>1100 l/s</td>
</tr>
<tr>
<td>Pumping speed for H₂</td>
<td>1150 l/s</td>
<td>1150 l/s</td>
<td>1150 l/s</td>
</tr>
<tr>
<td>Pumping speed for He</td>
<td>1350 l/s</td>
<td>1350 l/s</td>
<td>1350 l/s</td>
</tr>
<tr>
<td>Pumping speed for N₂</td>
<td>1400 l/s</td>
<td>1400 l/s</td>
<td>1400 l/s</td>
</tr>
<tr>
<td>Compression ratio for Ar</td>
<td>&gt; 1 · 10⁸</td>
<td>&gt; 1 · 10⁸</td>
<td>&gt; 1 · 10⁸</td>
</tr>
<tr>
<td>Compression ratio for CF₄</td>
<td>&gt; 1 · 10⁸</td>
<td>&gt; 1 · 10⁸</td>
<td>&gt; 1 · 10⁸</td>
</tr>
<tr>
<td>Compression ratio for H₂</td>
<td>6 · 10³</td>
<td>6 · 10³</td>
<td>6 · 10³</td>
</tr>
<tr>
<td>Compression ratio for He</td>
<td>2 · 10⁵</td>
<td>2 · 10⁵</td>
<td>2 · 10⁵</td>
</tr>
<tr>
<td>Compression ratio for N₂</td>
<td>&gt; 1 · 10⁸</td>
<td>&gt; 1 · 10⁸</td>
<td>&gt; 1 · 10⁸</td>
</tr>
<tr>
<td>Gas throughput at full rotational speed for Ar</td>
<td>11 hPa l/s</td>
<td>6 hPa l/s</td>
<td>11 hPa l/s</td>
</tr>
<tr>
<td>Gas throughput at full rotational speed for CF₄</td>
<td>12 hPa l/s</td>
<td>6 hPa l/s</td>
<td>12 hPa l/s</td>
</tr>
<tr>
<td>Gas throughput at full rotational speed for He</td>
<td>&gt; 30 hPa l/s</td>
<td>16 hPa l/s</td>
<td>&gt; 30 hPa l/s</td>
</tr>
<tr>
<td>Gas throughput at full rotational speed for H₂</td>
<td>&gt; 30 hPa l/s</td>
<td>&gt; 30 hPa l/s</td>
<td>&gt; 30 hPa l/s</td>
</tr>
<tr>
<td>Gas throughput at full rotational speed for N₂</td>
<td>20 hPa l/s</td>
<td>16 hPa l/s</td>
<td>20 hPa l/s</td>
</tr>
<tr>
<td>Fore-vacuum max. for Ar</td>
<td>2.5 hPa</td>
<td>2.5 hPa</td>
<td>2.5 hPa</td>
</tr>
<tr>
<td>Fore-vacuum max. for CF₄</td>
<td>0.25 hPa</td>
<td>0.25 hPa</td>
<td>0.25 hPa</td>
</tr>
<tr>
<td>Fore-vacuum max. for He</td>
<td>0.9 hPa</td>
<td>0.9 hPa</td>
<td>0.9 hPa</td>
</tr>
<tr>
<td>Fore-vacuum max. for N₂</td>
<td>2 hPa</td>
<td>2 hPa</td>
<td>2 hPa</td>
</tr>
<tr>
<td>Run-up time</td>
<td>2.5 min</td>
<td>2.5 min</td>
<td>2.5 min</td>
</tr>
<tr>
<td>Ultimate pressure according to PNEUROP</td>
<td>&lt; 1 · 10⁻⁷ hPa</td>
<td>&lt; 1 · 10⁻⁷ hPa</td>
<td>&lt; 1 · 10⁻⁷ hPa</td>
</tr>
<tr>
<td>Rotation speed ≥ 2 %</td>
<td>37800 min⁻¹</td>
<td>37800 min⁻¹</td>
<td>37800 min⁻¹</td>
</tr>
<tr>
<td>Power characteristic line in gas mode 1, vertex A</td>
<td>710/37800 W/min⁻¹</td>
<td>540/37800 W/min⁻¹</td>
<td>710/37800 W/min⁻¹</td>
</tr>
<tr>
<td>Power characteristic line in gas mode 1, vertex B</td>
<td>750/35400 W/min⁻¹</td>
<td>750/35400 W/min⁻¹</td>
<td>750/35400 W/min⁻¹</td>
</tr>
<tr>
<td>Power characteristic line in gas mode 0, vertex C</td>
<td>578/37800 W/min⁻¹</td>
<td>578/37800 W/min⁻¹</td>
<td>578/37800 W/min⁻¹</td>
</tr>
<tr>
<td>Power characteristic line in gas mode 0, vertex D</td>
<td>717/29400 W/min⁻¹</td>
<td>717/29400 W/min⁻¹</td>
<td>717/29400 W/min⁻¹</td>
</tr>
<tr>
<td>Sound pressure level</td>
<td>≤ 50 dB (A)</td>
<td>≤ 50 dB (A)</td>
<td>≤ 50 dB (A)</td>
</tr>
<tr>
<td>Relative humidity of air</td>
<td>5-85, non-condensing %</td>
<td>5-85, non-condensing %</td>
<td>5-85, non-condensing %</td>
</tr>
<tr>
<td>Protection category</td>
<td>IP54</td>
<td>IP54</td>
<td>IP54</td>
</tr>
<tr>
<td>Connection pressure max. for venting/sealing gas valve</td>
<td>1500 hPa</td>
<td>1500 hPa</td>
<td>1500 hPa</td>
</tr>
<tr>
<td>Integral leak rate</td>
<td>&lt; 1 · 10⁻⁶ Pa m³/s</td>
<td>&lt; 1 · 10⁻⁶ Pa m³/s</td>
<td>&lt; 1 · 10⁻⁶ Pa m³/s</td>
</tr>
<tr>
<td>Power consumption max.</td>
<td>1350 VA</td>
<td>1350 VA</td>
<td>1350 VA</td>
</tr>
<tr>
<td>Mains requirement: frequency (range)</td>
<td>50/60 Hz</td>
<td>50/60 Hz</td>
<td>50/60 Hz</td>
</tr>
<tr>
<td>Mains requirement: voltage (range)</td>
<td>100-120/200-240 V AC</td>
<td>100-120/200-240 V AC</td>
<td>100-120/200-240 V AC</td>
</tr>
<tr>
<td>Current consumption max.</td>
<td>10 A</td>
<td>10 A</td>
<td>10 A</td>
</tr>
<tr>
<td>Mounting orientation</td>
<td>Standard (0°-90°)</td>
<td>Standard (0°-90°)</td>
<td>Standard (0°-90°)</td>
</tr>
<tr>
<td>Venting connection</td>
<td>G 1/8&quot;</td>
<td>G 1/8&quot;</td>
<td>G 1/8&quot;</td>
</tr>
<tr>
<td>Weight</td>
<td>29 kg</td>
<td>41 kg</td>
<td>30 kg</td>
</tr>
<tr>
<td>Cooling method, standard</td>
<td>Water</td>
<td>Water</td>
<td>Water</td>
</tr>
<tr>
<td>Cooling water temperature</td>
<td>15-35 °C</td>
<td>15-35 °C</td>
<td>15-35 °C</td>
</tr>
<tr>
<td>Cooling water consumption</td>
<td>100 l/h</td>
<td>100 l/h</td>
<td>100 l/h</td>
</tr>
<tr>
<td>Permissible irradiated thermal power max.</td>
<td>22.5 W</td>
<td>22.5 W</td>
<td>22.5 W</td>
</tr>
<tr>
<td>Permissible magnetic field max.</td>
<td>6 mT</td>
<td>6 mT</td>
<td>6 mT</td>
</tr>
<tr>
<td>Interfaces</td>
<td>RS-485, Remote</td>
<td>RS-485, Remote</td>
<td>RS-485, Remote</td>
</tr>
</tbody>
</table>
13.4 Dimensions

Fig. 21: HiPace 1500 / C, DN 250 ISO-K

Fig. 22: HiPace 1500 / C, DN 250 ISO-F

Fig. 23: HiPace 1500 / C, DN 250 CF-F
Fig. 24: HiPace 1500 U / U C, DN 250 ISO-K

Fig. 25: HiPace 1500 U / U C, DN 250 ISO-F

Fig. 26: HiPace 1500 U / U C, DN 250 CF-F
Declaration of conformity

We hereby declare that the product cited below satisfies all relevant provisions according to the following EC directives:

- Machinery 2006/42/EC (Annex II, no. 1 A)
- Electromagnetic Compatibility 2014/30/EU

The agent responsible for compiling the technical documentation is Mr. Helmut Bernhardt, Pfeiffer Vacuum GmbH, Berliner Straße 43, 35614 Aßlar.

HiPace 1500

Harmonised standards and national standards and specifications which have been applied:

DIN EN ISO 12100 : 2011-03
DIN EN 1012-2 : 1996
DIN EN 61000-3-2 : 2010
DIN EN 61000-3-3 : 2009
DIN EN 61010-1 : 2010
DIN EN 61326-1 : 2013
DIN EN 62061 : 2013

Signature:

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(Dr. Ulrich von Hülsen) 2016-03-30
Managing Director
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