



OPERATING INSTRUCTIONS

EN

Translation of the Original

HIPACE 1200

Turbopump

Dear Customer,

Thank you for choosing a Pfeiffer Vacuum product. Your new turbopump is designed to support you by its performance, its perfect operation and without interfering your individual application. The name Pfeiffer Vacuum stands for high-quality vacuum technology, a comprehensive and complete range of top-quality products and first-class service. With this expertise, we have acquired a multitude of skills contributing to an efficient and secure implementation of our product.

Knowing that our product must not interfere with your actual work, we are convinced that our product offers you the solution that supports you in the effective and trouble-free execution of your individual application.

Please read these operating instructions before putting your product into operation for the first time. If you have any questions or suggestions, please feel free to contact info@pfeiffer-vacuum.de.

Further operating instructions from Pfeiffer Vacuum can be found in the [Download Center](#) on our website.

Disclaimer of liability

These operating instructions describe all models and variants of your product. Note that your product may not be equipped with all features described in this document. Pfeiffer Vacuum constantly adapts its products to the latest state of the art without prior notice. Please take into account that online operating instructions can deviate from the printed operating instructions supplied with your product.

Furthermore, Pfeiffer Vacuum assumes no responsibility or liability for damage resulting from the use of the product that contradicts its proper use or is explicitly defined as foreseeable misuse.

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1 About this manual



IMPORTANT

Read carefully before use.

Keep the manual for future consultation.

1.1 Validity

This operating instructions is a customer document of Pfeiffer Vacuum. The operating instructions describe the functions of the named product and provide the most important information for the safe use of the device. The description is written in accordance with the valid directives. The information in this operating instructions refers to the product's current development status. The document shall remain valid provided that the customer does not make any changes to the product.

1.1.1 Applicable documents

Document	Number
Operating instructions, Electronic drive unit TC 1200, standard	PT 0239 BN
Operating instructions, Electronic drive unit TC 1200 PB, Profibus	PT 0269 BN
Operating instructions, Electronic drive unit TC 1200 E74, according to Semi E74	PT 0303 BN
Operating instructions, Electronic drive unit TC 1200 DN, DeviceNet	PT 0353 BN
Operating instructions, Electronic drive unit TC 1200 EC, EtherCat	PT 0455 BN
Declaration of conformity	A component of these instructions

You can find these documents in the [Pfeiffer Vacuum Download Center](#).

1.1.2 Variants

- HiPace 1200, DN 200 ISO-K
- HiPace 1200, DN 200 ISO-F
- HiPace 1200, DN 200 CF-F
- HiPace 1200 C, DN 200 ISO-K
- HiPace 1200 C, DN 200 ISO-F
- HiPace 1200 C, DN 200 CF-F
- HiPace 1200 U, DN 200 ISO-K
- HiPace 1200 U, DN 200 ISO-F
- HiPace 1200 U, DN 200 CF-F
- HiPace 1200 U C, DN 200 ISO-K
- HiPace 1200 U C, DN 200 ISO-F
- HiPace 1200 U C, DN 200 CF-F

1.2 Target group

These operating instructions are aimed at all persons performing the following activities on the product:

- Transportation
- Setup (Installation)
- Usage and operation
- Decommissioning
- Maintenance and cleaning
- Storage or disposal

The work described in this document is only permitted to be performed by persons with the appropriate technical qualifications (expert personnel) or who have received the relevant training from Pfeiffer Vacuum.

1.3 Conventions

1.3.1 Instructions in the text

Usage instructions in the document follow a general structure that is complete in itself. The required action is indicated by an individual step or multi-part action steps.

Individual action step

A horizontal, solid triangle indicates the only step in an action.

- This is an individual action step.

Sequence of multi-part action steps

The numerical list indicates an action with multiple necessary steps.

1. Step 1
2. Step 2
3. ...

1.3.2 Pictographs

Pictographs used in the document indicate useful information.



Note

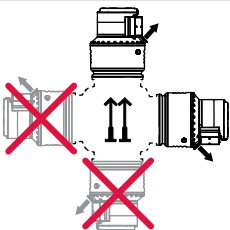


Tip

1.3.3 Stickers on the product

This section describes all the stickers on the product along with their meaning.

	Rating plate (example) Rating plates of individual assemblies are located on the lower part of the turbopump or on the relevant attachments.
	Operating manual note This sticker indicates that this operating manual must be read before performing any tasks.
	Operating fluids note This sticker emphasizes the necessity to fill the turbopump with operating fluid before commissioning.
	Mounting orientation upright note This sticker depends on the variant. The sticker shows the valid spatial positions for the installation and operation of the turbopump.

	Overhead mounting orientation note This sticker depends on the variant. The sticker shows the valid spatial positions for the installation and operation of the turbopump.
ACHTUNG! Wird F3-Öl über 300 °C erwärmt, entstehen giftige Dämpfe, die den Atemwegen schaden! F3-Öl nicht mit Tabakwaren in Berührung bringen! Die üblichen Vorsichtsmaßnahmen im Umgang mit Chemikalien beachten! ATTENTION! If oil F3 will be heated to more than 300 °C poisonous vapours come out which are noxious for the respiratory organs! Do not bring oil F3 in contact with tobacco! Care for the usual precautions for treating chemicals! ATTENTION ! Quand on chauffe l'huile F3 à une température supérieure à 300 °C, il se forment des vapeurs toxiques, nuisibles pour les organes de la respiration! Le contact de l'huile F3 avec des produits en tabac doit être évité! Il faut faire attention aux précautions usuelles pour le traitement des substances chimiques!	F3 operating fluid note This sticker provides information on the safe handling of hazardous substances.
Öleinfüll- und Ablassschraube nur dann öffnen wenn Pumpe auf Atmosphärendruck gelutet Do not open oil-filling or oil-drain flange unless interior of the pump is under atmospheric pressure Ne pas ouvrir les brides d'entrée d'huile et de vidange si l'intérieur de la pompe ne se trouve pas sous pression atmosphérique	Operating fluid filler screws note This sticker provides information on the safe handling of the screws on the operating fluid pump.
	Operating fluid filler screw This sticker describes the position of the respective filler screw for operating fluid.
	Protection class This sticker describes protection class 1 for the product. The positioning indicates the position for the ground connection.
COOLING WATER IN max. 6 bar (90 psi)	Cooling water connection This sticker indicates the position and conditions for the cooling water supply of the turbopump.
COOLING WATER OUT	Cooling water connection This sticker indicates the position for the cooling water discharge of the turbopump.
warranty seal PFEIFFER VACUUM	Closure seal The product is sealed ex-factory. Damaging or removing a closure seal results in loss of the warranty.
PURGE	Sealing gas connection note This sticker indicates the position for the exclusive sealing gas connection.

1.3.4 Abbreviations

Abbreviation	Meaning in this document
AC	Alternating current (AC)
C	Corrosive gas version
d	Diameter value (in mm)
DCU	Display Control Unit (Pfeiffer Vacuum display and control unit).
DN	Nominal diameter as size description
EMS	Emergency Stop
f	Rotation speed value of a vacuum pump (frequency, in rpm or Hz)
HPU	Handheld Programming Unit. Aid for control and monitoring pump parameters
HV	High vacuum flange, high vacuum side
ISO	Flange: Connector in accordance with ISO 1609 and ISO 2861

Abbreviation	Meaning in this document
LED	Light emitting diode
PE	Earthed conductor (protective earth)
[P:xxx]	Electronic drive unit control parameters. Printed in bold as a three-digit number in square brackets. Frequently displayed in conjunction with a short description. Example: [P:312] software version
remote	26-pole D-Sub connecting socket on the turbopump electronic drive unit
WAF	width across flats
T	Temperature (in °C)
TC	Turbo Controller
U	Upside-down version
VV	Fore-vacuum flange, fore-vacuum connection

Tbl. 1: **Abbreviations used in this document**

2 Safety

2.1 General safety information

The following 4 risk levels and 1 information level are taken into account in this document.

DANGER

Immediately pending danger

Indicates an immediately pending danger that will result in death or serious injury if not observed.

- Instructions to avoid the danger situation

WARNING

Potential pending danger

Indicates a pending danger that could result in death or serious injury if not observed.

- Instructions to avoid the danger situation

CAUTION

Potential pending danger

Indicates a pending danger that could result in minor injuries if not observed.

- Instructions to avoid the danger situation

NOTICE

Danger of damage to property

Is used to highlight actions that are not associated with personal injury.

- Instructions to avoid damage to property



Notes, tips or examples indicate important information about the product or about this document.

2.2 Safety instructions

All safety instructions in this document are based on the results of the risk assessment carried out in accordance with Machinery Directive 2006/42/EC Annex I and EN ISO 12100 Section 5. Where applicable, all life cycle phases of the product were taken into account.

Risks during transport

WARNING

Risk of serious injury from swinging, toppling or falling objects

During transport, there is a risk of crushing and impact on swinging, toppling or falling objects. There is a risk of injuries to limbs, up to and including bone fractures and head injuries.

- Secure the danger zone if necessary.
- Pay attention to the center of gravity of the load during transport.
- Ensure even movements and moderate speeds.
- Observe safe handling of the transport devices.
- Avoid sloping attachment aids.
- Never stack products.
- Wear protective equipment, e.g. safety shoes.

Risks during installation

DANGER

Danger to life from electric shock

Touching exposed and voltage-bearing elements causes an electric shock. Improper connection of the mains supply leads to the risk of touchable live housing parts. There is a risk to life.

- ▶ Before the installation, check that the connection leads are voltage-free.
- ▶ Make sure that electrical installations are only carried out by qualified electricians.
- ▶ Provide adequate grounding for the device.
- ▶ After connection work, carry out an earthed conductor check.

WARNING

Risk of fatal injury due to electric shock on account of incorrect installation

The device's power supply uses life-threatening voltages. Unsafe or improper installation can lead to life-threatening situations from electric shocks obtained from working with or on the unit.

- ▶ Ensure safe integration into an emergency off safety circuit.
- ▶ Do not carry out your own conversions or modifications on the unit.

WARNING

Risk of danger to life through missing mains disconnection device

The vacuum pump and electronic drive unit are **not** equipped with a mains disconnection device (mains switch).

- ▶ Install a mains disconnection device according to SEMI-S2.
- ▶ Install a circuit breaker with an interruption rating of at least 10,000 A.

WARNING

Risk of cuts on moving, sharp-edged parts when reaching into the open high vacuum flange

With the high vacuum flange open, access to sharp-edged parts is possible. A manual rotation of the rotor increases the danger situation. There is the risk of cuts, up to the separation of body parts (e.g. fingertips). There is a risk of hair and loose clothing being drawn in. Objects falling in destroy the turbopump during subsequent operation.

- ▶ Only remove the original protective covers immediately prior to connecting the high vacuum flange.
- ▶ Do not reach into the high vacuum connection.
- ▶ Wear protective gloves during installation.
- ▶ Do not start the turbopump with open vacuum connections.
- ▶ Always carry out the mechanical installation before electrical connection.
- ▶ Prevent access to the high vacuum connection of the turbopump from the operator side (e.g. open vacuum chamber).

WARNING

Danger of cut injuries from unexpected start up.

The use of mating plugs of the electronic drive unit (accessories) enables the automatic run-up of the vacuum pump as soon the power is turned on. Attaching mating plugs before or during the installation leads to the movement of parts hence the risk of cut injuries by sharp-edged in the exposed high vacuum flange.

- ▶ Only connect mating plugs after the mechanical installation.
- ▶ Only switch on the vacuum pump immediately prior to operation.

⚠ WARNING**Risk of serious injury from oscillating, toppling or falling objects**

Incorrect handling during the mechanical installation leads to a risk of oscillating, toppling or falling heavy loads. There is a risk of crushing and impacts (e.g. on colliding flange connections). There is a risk of injuries to limbs, up to and including bone fractures and head injuries.

- ▶ Use the intended eye bolts during the installation.
- ▶ When approaching the vacuum pump, be particularly careful at the counter flange.
- ▶ Note the center of gravity of the load.

⚠ WARNING**Danger of poisoning from toxic vapors**

Igniting and heating synthetic operating fluid generates toxic vapors. Danger of poisoning if inhaled.

- ▶ Observe the application instructions and precautions.
- ▶ Do not allow tobacco products to come into contact with the operating fluid.

⚠ WARNING**Risk of scalding from suddenly escaping hot cooling water**

The turbopump water connections are open to both sides. When connecting the cooling water supply, there is a risk of scalding from suddenly escaping, hot cooling water at over pressure.

- ▶ Prior to installation, ensure that pressure is discharged from the cooling water system, and that it is cooled down.
- ▶ Wear protective equipment, e.g., safety goggles and gloves.

Risks during operation**⚠ WARNING****Risk of burns on hot surfaces when using additional equipment for heating during operation**

The use of additional equipment for heating the vacuum pump or for optimizing the process generates very high temperatures on surfaces that can be touched. There is a risk of burning.

- ▶ If necessary, set up a contact guard.
- ▶ If necessary, apply the warning stickers provided for this at the danger points.
- ▶ Ensure adequate cooling down before working on the vacuum pump or in its vicinity.
- ▶ Wear protective equipment, e.g., gloves.

⚠ WARNING**Risk of serious injury in the event of vacuum pump destruction due to over pressure**

Gas entry with very high over pressure results in destruction of the vacuum pump. There is a risk of serious injury due to ejected objects.

- ▶ Never exceed the permissible 1500 hPa (absolute) inlet pressure on the suction side or the venting and sealing gas connection.
- ▶ Make sure that high, process-related over pressures cannot directly enter the vacuum pump.

⚠ CAUTION**Risk of injuries due to contact with vacuum when venting**

While venting the vacuum pump there is a risk of minor injuries due to the direct contact of body parts with the vacuum, e.g. hematomas.

- ▶ Do not fully unscrew the venting screw out of the housing during venting.
- ▶ Keep a distance from automatic venting device, such as venting valves.

Risks during maintenance, decommissioning and disposal

WARNING

Danger to life from electric shock during maintenance and service work

The device is only completely de-energized when the mains plug has been disconnected and the turbopump is at a standstill. There is a danger to life from electric shock when making contact with live components.

- ▶ Before performing all work, switch off the main switch.
- ▶ Wait until the turbopump comes to a standstill (rotation speed =0).
- ▶ Remove the mains plug from the device.
- ▶ Secure the device against unintentional restarting.

WARNING

Danger of poisoning from toxic vapors

Igniting and heating synthetic operating fluid generates toxic vapors. Danger of poisoning if inhaled.

- ▶ Observe the application instructions and precautions.
- ▶ Do not allow tobacco products to come into contact with the operating fluid.

WARNING

Health hazard through poisoning from toxic contaminated components or devices

Toxic process media result in contamination of devices or parts of them. During maintenance work, there is a risk to health from contact with these poisonous substances. Illegal disposal of toxic substances causes environmental damage.

- ▶ Take suitable safety precautions and prevent health hazards or environmental pollution by toxic process media.
- ▶ Decontaminate affected parts before carrying out maintenance work.
- ▶ Wear protective equipment.

WARNING

Risk of burns on hot surfaces when using additional equipment for heating during operation

The use of additional equipment for heating the vacuum pump or for optimizing the process generates very high temperatures on surfaces that can be touched. There is a risk of burning.

- ▶ If necessary, set up a contact guard.
- ▶ If necessary, apply the warning stickers provided for this at the danger points.
- ▶ Ensure adequate cooling down before working on the vacuum pump or in its vicinity.
- ▶ Wear protective equipment, e.g., gloves.

WARNING

Risk of cuts on moving, sharp-edged parts when reaching into the open high vacuum connection

Incorrect handling of the turbopump before maintenance work results in hazardous situations with risk of injury. There is a risk of cuts from accessing sharp-edged, rotating parts when removing the turbopump.

- ▶ Wait until the turbopump comes to a standstill (rotation speed $f=0$).
- ▶ Switch the turbopump off properly.
- ▶ Secure the turbopump against re-start.
- ▶ Seal open connections immediately following removal, using the original protective cover.

⚠ WARNING**Risk of scalding from suddenly escaping hot cooling water**

The turbopump water connections are open to both sides. When connecting the cooling water supply, there is a risk of scalding from suddenly escaping, hot cooling water at over pressure.

- ▶ Prior to installation, ensure that pressure is discharged from the cooling water system, and that it is cooled down.
- ▶ Wear protective equipment, e.g., safety goggles and gloves.

⚠ CAUTION**Risk of injuries due to contact with vacuum when venting**

While venting the vacuum pump there is a risk of minor injuries due to the direct contact of body parts with the vacuum, e.g. hematomas.

- ▶ Do not fully unscrew the venting screw out of the housing during venting.
- ▶ Keep a distance from automatic venting device, such as venting valves.

⚠ CAUTION**Electric shock and damage to the vacuum pump and electronic drive unit due to improper disconnection of components**

Even after the mains power is switched off, the turbopump continues to deliver electrical energy during its run-down period. If the turbopump and electronic drive unit are disconnected prematurely, there is the risk of electric shock from contact with live components. There is a risk of electric body contact and, as a result, the destruction of electronic components.

- ▶ Never disconnect the turbopump and electronic drive unit from each other if power is still connected or if the rotor is running.
- ▶ Monitor the turbopump rotation via the parameters available in the electronic drive unit (e.g., [P:398]).
- ▶ Wait until the turbopump comes to a standstill (rotation speed $f=0$).

Risks in the event of malfunctions**⚠ DANGER****Risk of fatal injury from electric shock in case of a leak in the cooling water system**

Escaping cooling water which penetrates the heater will energize external parts of the heating jacket. The insulation material absorbs moisture and is therefore potentially hazardous, even after the fault has been rectified. There is a risk of fatalities from electric shock upon contact.

- ▶ Perform an overpressure test of the cooling water system at least once a year.
- ▶ In the event of a fault, always replace the heating jacket completely.
- ▶ Ensure installation of an RCCB on site.

⚠ WARNING**Danger to life from electric shock in the event of a fault**

In the event of a fault, devices connected to the mains may be live. There is a danger to life from electric shock when making contact with live components.

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

WARNING

Danger to life from the turbopump breaking away in the event of a fault

Sudden jamming of the rotor generates high destructive torques in accordance with ISO 27892. If the turbopump is **not** properly secured, it can shear off. The energy that this would release could throw the entire turbopump or shattered pieces from its interior through the surrounding space. Potentially dangerous gases can escape. There is a risk of very serious injuries, including death, and extensive property damage.

- ▶ Follow the installation instructions for this turbopump.
- ▶ Observe the requirements regarding stability and design of the counter flange.
- ▶ Use only original accessories or fixing material approved by Pfeiffer Vacuum for the installation.

WARNING

Risk of injury caused by the turbopump breaking away with the vibration compensator in the event of a malfunction

Sudden jamming of the rotor generates high destructive torques in accordance with ISO 27892. When using a vibration compensator, this will probably lead to the turbopump being sheared off in use. The energy that this would release could throw the entire turbopump or shattered pieces from its interior through the surrounding space. Potentially dangerous gases can escape. There is a risk of very serious injuries, including death, and extensive property damage.

- ▶ Take suitable safety precautions on-site for the compensation of the occurring torques.
- ▶ Before installing a vibration compensator, you must first of all contact Pfeiffer Vacuum.

WARNING

Danger to life from poisoning where toxic process media leak from damaged connections

Sudden twisting of the turbopump in the event of a fault causes fittings to accelerate. There is the risk of damaging on-site connections (e.g., fore-vacuum line) and resulting leaks. This results in leakage of process media. In processes involving toxic media, there is a risk of injury and danger to life due to poisoning.

- ▶ Keep masses connected to the turbopump as low as possible.
- ▶ Use flexible lines to connect to the turbopump where necessary.

2.3 Safety precautions



Duty to provide information on potential dangers

The product holder or user is obliged to make all operating personnel aware of dangers posed by this product.

Every person who is involved in the installation, operation or maintenance of the product must read, understand and adhere to the safety-related parts of this document.



Infringement of conformity due to modifications to the product

The Declaration of Conformity from the manufacturer is no longer valid if the operator changes the original product or installs additional equipment.

- Following the installation into a system, the operator is required to check and re-evaluate the conformity of the overall system in the context of the relevant European Directives, before commissioning that system.

General safety precautions when handling the product

- ▶ Observe all applicable safety and accident prevention regulations.
- ▶ Check that all safety measures are observed at regular intervals.
- ▶ Do not expose body parts to the vacuum.
- ▶ Always ensure a secure connection to the earthed conductor (PE).
- ▶ Never disconnect plug connections during operation.
- ▶ Observe the above shutdown procedures.
- ▶ Before working on the high vacuum connection, wait until the rotor has stopped completely (rotation speed $f = 0$).

- ▶ Never put the device into operation with the high vacuum connection open.
- ▶ Keep lines and cables away from hot surfaces ($> 70^{\circ}\text{C}$).
- ▶ Never fill or operate the unit with cleaning agents or cleaning agent residues.
- ▶ Do not carry out your own conversions or modifications on the unit.
- ▶ Observe the unit protection class prior to installation or operation in other environments.

2.4 Limits of use of the product

Installation location	weatherproof (internal space)
Air pressure	750 hPa to 1060 hPa
Installation altitude	max. 2000 m
Rel. air humidity	max. 80%, at $T < 31^{\circ}\text{C}$, up to max. 50% at $T < 40^{\circ}\text{C}$
IP degree of protection (according to IEC 61010)	I
Degree of pollution (according to IEC 61010)	2
Excess voltage category	II
Permissible protection degree	IP54
Ambient temperature	5°C to 40°C with water cooling
Permissible surrounding magnetic field	6 mT
Maximum irradiated thermal output	22.5 W
Maximum permissible rotor temperature of the turbopump	120°C
Maximum permissible bakeout temperature at the high vacuum flange	120°C

Tbl. 2: Permissible ambient conditions



Notes on ambient conditions

The specified permissible ambient temperatures apply to operation of the turbopump at maximum permissible backing pressure or at maximum gas throughput, depending on the cooling type. The turbopump is intrinsically safe thanks to redundant temperature monitoring.

- The reduction in backing pressure or gas throughput permits operation of the turbopump at higher ambient temperatures.
- If the maximum permissible operating temperature of the turbopump is exceeded, the electronic drive unit first reduces the drive output and then switches it off where necessary.

2.5 Proper use

- ▶ Use the turbopump only for generating vacuum.
- ▶ Use the turbopump only in combination with a suitable backing pump that can deliver up to the required maximum fore-vacuum pressure.
- ▶ Use the turbopump only in closed indoor areas.
- ▶ Use the turbopump only for the evacuation of dry and inert gases.
- ▶ Exclusively use C-version turbopumps with sealing gas supply for the pumping of corrosive media.

2.6 Foreseeable improper use

Improper use of the product invalidates all warranty and liability claims. Any use that is counter to the purpose of the product, whether intentional or unintentional, is regarded as misuse.

- Transport, installation or operation of the vacuum pump in an impermissible spatial position
- Establishing the voltage supply without correct installation
- Installing the pump with unspecified mounting material
- Pumping explosive media
- Pumps of corrosive media with turbopumps in the standard version

- Pumping of fluids
- Pumping of dust
- Operation with impermissible high gas throughput
- Operation with impermissible high fore-vacuum pressure
- Operation with excessively high irradiated heat output
- Operation in impermissible high magnetic fields
- Operation in an incorrect gas mode
- Venting with impermissible high venting rates
- Use for pressure generation
- Use in areas with ionizing radiation
- Operation in explosion-hazard areas
- Use in systems in which sporadic loads and vibrations or periodic forces act on the device
- The causing of hazardous operating conditions by a presetting on the electronic drive unit that is contrary to the process
- Use of accessories or spare parts that are not listed in these instructions

2.7 Personnel qualification

The work described in this document may only be carried out by persons who have appropriate professional qualifications and the necessary experience or who have completed the necessary training as provided by Pfeiffer Vacuum.

Training people

1. Train the technical personnel on the product.
2. Only let personnel to be trained work with and on the product when under the supervision of trained personnel.
3. Only allow trained technical personnel to work with the product.
4. Before starting work, make sure that the commissioned personnel have read and understood these operating instructions and all applicable documents, in particular the safety, maintenance and repair information.

2.7.1 Ensuring personnel qualification

Specialist for mechanical work

Only a trained specialist may carry out mechanical work. Within the meaning of this document, specialists are people responsible for construction, mechanical installation, troubleshooting and maintenance of the product, and who have the following qualifications:

- Qualification in the mechanical field in accordance with nationally applicable regulations
- Knowledge of this documentation

Specialist for electrotechnical work

Only a trained electrician may carry out electrical engineering work. Within the meaning of this document, electricians are people responsible for electrical installation, commissioning, troubleshooting, and maintenance of the product, and who have the following qualifications:

- Qualification in the electrical engineering field in accordance with nationally applicable regulations
- Knowledge of this documentation

In addition, these individuals must be familiar with applicable safety regulations and laws, as well as the other standards, guidelines, and laws referred to in this documentation. The above individuals must have an explicitly granted operational authorization to commission, program, configure, mark, and earth devices, systems, and circuits in accordance with safety technology standards.

Trained individuals

Only adequately trained individuals may carry out all works in other transport, storage, operation and disposal fields. Such training must ensure that individuals are capable of carrying out the required activities and work steps safely and properly.

2.7.2 Personnel qualification for maintenance and repair



Advanced training courses

Pfeiffer Vacuum offers advanced training courses to maintenance levels 2 and 3.

Adequately trained individuals are:

- **Maintenance level 1**
 - Customer (trained specialist)
- **Maintenance level 2**
 - Customer with technical education
 - Pfeiffer Vacuum service technician
- **Maintenance level 3**
 - Customer with Pfeiffer Vacuum service training
 - Pfeiffer Vacuum service technician

2.7.3 Advanced training with Pfeiffer Vacuum

For optimal and trouble-free use of this product, Pfeiffer Vacuum offers a comprehensive range of courses and technical trainings.

For more information, please contact [Pfeiffer Vacuum technical training](#).

3 Product description

3.1 Identifying the product

- ▶ To ensure clear identification of the product when communicating with Pfeiffer Vacuum, always keep all of the information on the rating plate to hand.
- ▶ Learn about certifications through test seals on the product or at www.certipedia.com with company ID no. 000021320.

3.1.1 Product types

The product designation of Pfeiffer Vacuum turbopumps from the HiPace series is composed of the family name, the size (which is based on the pumping speed of the vacuum pump) and, if required, an additional feature description.

Family	Size/model	Property, attribute, feature
HiPace	10 to 2800	none = Standard version
		mini = Compact version
		U = Overhead version
		C = Corrosive gas version
		P = Process
		M = Active magnetic bearing
		T = Temperature management
		Plus = Low vibration, low magnetic field
		E = High efficiency
		H = High compression
		I = Ion implantation

Tbl. 3: Product designation of Pfeiffer Vacuum HiPace turbopumps

3.1.2 Product features

Feature	Version		
HV flange	DN 200 ISO-K	DN 200 ISO-F	DN 200 CF-F
Flange material	Aluminium	Aluminium	Stainless steel

Tbl. 4: Turbopump features

Mains voltage $\pm 10\%$	Motor input power of the electronic drive unit
100 to 120 V AC	700 to 930 W
200 to 240 V AC	1200 W

Tbl. 5: Delivered drive power depending on the supplied mains voltage

3.2 Functional properties

The turbopump forms a compact unit with the electronic drive unit. The integrated power supply pack acts as a voltage supply.

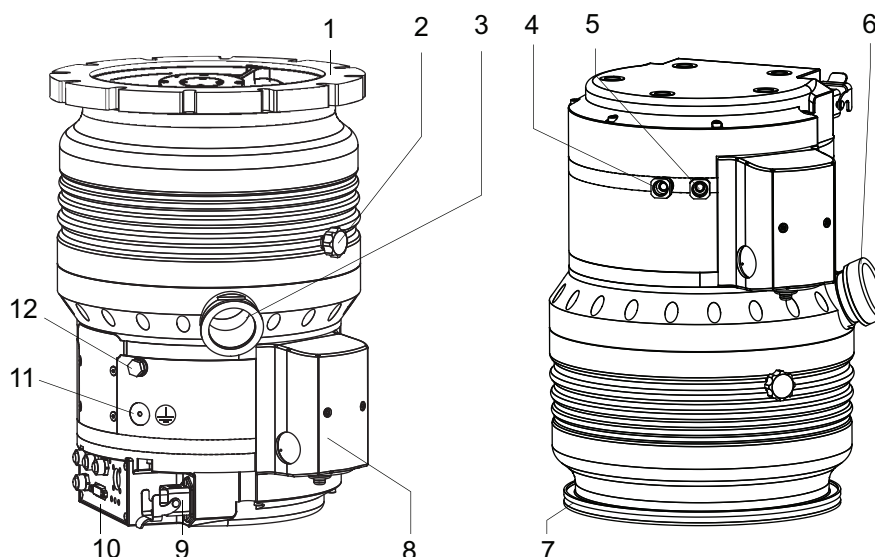


Fig. 1: HiPace 1200 design (example: standard version, DN 200 ISO-F | U-version DN 200 ISO-K)

- | | |
|---|---|
| 1 High vacuum connection | 7 Protective cover for the high vacuum flange |
| 2 Venting connection, venting screw | 8 Protective cap of operating fluid pump |
| 3 Fore-vacuum connection, DN 40 ISO-KF | 9 Mains connection "AC in" |
| 4 Cooling water connection, outlet | 10 Electronic drive unit TC 1200 |
| 5 Cooling water connection, inlet | 11 Ground terminal |
| 6 Protective cover for the fore-vacuum flange | 12 Sealing gas connection |

3.2.1 Cooling

- Water cooling

The electronic drive unit automatically regulates the drive power down in the event of excessive temperatures.

3.2.2 Rotor bearing

Hybrid-bearing turbopump

- High vacuum side: wear-free permanent magnetic bearing
- Fore-vacuum side: ball bearing with ceramic balls

Turbopumps from the hybrid bearing HiPace series use ceramic ball bearings for the rotor bearing on the fore-vacuum side. The operating fluid pump provides a defined lubrication and continuous functioning of the ball bearings.

3.2.3 Drive

- Electronic drive unit TC 1200

3.3 Shipment

- Turbopump with electronic drive unit and integrated power supply pack
- Protective cover for the high vacuum connection
- Protective cover for the fore-vacuum connection
- Mating plug for the "remote" connection on the TC 1200 (type-dependent)
- Mating plug for the "E74" connection on the TC 1200 (type-dependent)
- Mains power socket HAN 3A for mains connection of the turbopump
- Sealing gas valve (already fitted)
- Operating fluid F3 (50 ml) with syringe
- 2 eye bolts for transport
- 2 threaded hose nozzles with sealing ring for cooling water connection, G 1/4"
- Operating instructions

4 Transportation and Storage

4.1 Transport

WARNING

Risk of serious injury from swinging, toppling or falling objects

During transport, there is a risk of crushing and impact on swinging, toppling or falling objects. There is a risk of injuries to limbs, up to and including bone fractures and head injuries.

- ▶ Secure the danger zone if necessary.
- ▶ Pay attention to the center of gravity of the load during transport.
- ▶ Ensure even movements and moderate speeds.
- ▶ Observe safe handling of the transport devices.
- ▶ Avoid sloping attachment aids.
- ▶ Never stack products.
- ▶ Wear protective equipment, e.g. safety shoes.

NOTICE

Destruction of the vacuum pump due to failure to observe the type-specific spatial position

Impermissible spatial positions lead to pollution of the vacuum pump by operating fluid. There is a risk of pollution of the process vacuum and damage to the vacuum pump up to and including its destruction.

- ▶ Observe the labels relating to the valid spatial position of the vacuum pump.
- ▶ Observe the property labels on the type plate.
- ▶ Drain off the operating fluid before moving or transporting the vacuum pump.
- ▶ Only fill the vacuum pump with operating fluid after mechanical installation.



Pfeiffer Vacuum recommends keeping the transport packaging and original protective cover.

General information regarding safe transport

1. Observe weight specified on the rating plate.
2. Where possible, always transport or ship the turbopump in its original packaging.
3. Remove the protective cover only immediately prior to installation.

Information regarding transport of the turbopump in its packaging

1. Use a pallet truck to transport the turbopump when still in its packaging.
2. Note the center of gravity of the load.
3. Observe safe handling of manually operated transport devices.
4. Only transport the turbopump in its valid spatial position and with the rotor axis vertically aligned.
5. Ensure harmonious movements and moderate speeds.
6. Ensure a flat substrate.
7. Wear protective equipment, e.g. safety shoes.

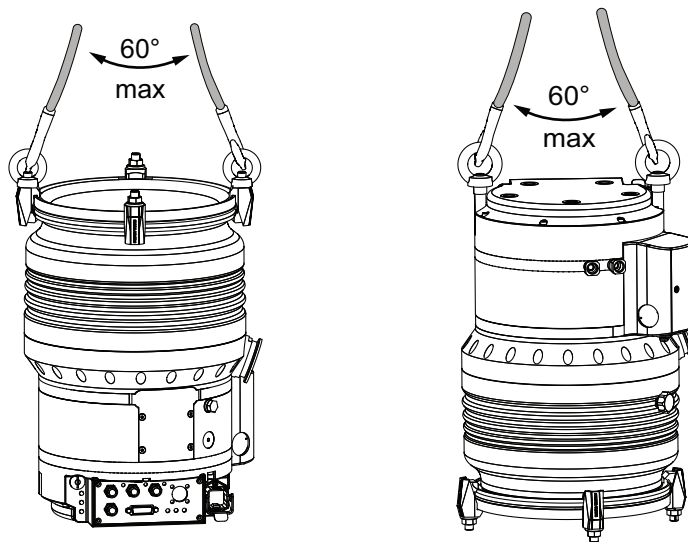


Fig. 2: Slinging points for transport of the turbopump in the standard and U versions

Information regarding transport of the turbopump without packaging

2 eye bolts are included in the shipment and are firmly bolted to the turbopump ex works.

1. Attach suitable lifting tools to both eye bolts.
2. Pay attention to the correct use and fastening of the lifting equipment.
3. Lift the turbopump vertically (e.g. out of the packaging).
4. Only transport the turbopump in its valid spatial position and with the rotor axis vertically aligned.
5. If necessary, remove the eye bolts after transport and installation.
 - Keep the eye bolts for future use.

4.2 Storage



We recommend

Pfeiffer Vacuum recommends storing the products in their original transport packaging.

Storing the turbopump

1. Seal all flange openings with the original protective caps.
2. Seal all other connections (e.g. venting connection) with the corresponding original parts.
3. Store the turbopump only indoors within the permissible temperature limits.
4. In rooms with humid or aggressive atmospheres: Hermetically seal the turbopump together with a drying agent in a plastic bag.

5 Installation

The installation of the turbopump and its fastening is of outstanding importance. The rotor of the turbopump revolves at very high speed. In practice it is not possible to exclude the risk of the rotor touching the stator (e.g. due to the penetration of foreign bodies into the high vacuum connection). The kinetic energy released acts on the housing and on the anchoring of the turbopump within fractions of a second.

Comprehensive tests and calculations conforming to ISO 27892 confirm the safety of the turbopump both against crashes (destruction of the rotor blade) and against bursting (breakage of the rotor shaft). The experimental and theoretical results are expressed in safety measures and recommendations for the correct and safe fastening of the turbopump.

5.1 Preparatory work

WARNING

Risk of cuts on moving, sharp-edged parts when reaching into the open high vacuum flange

With the high vacuum flange open, access to sharp-edged parts is possible. A manual rotation of the rotor increases the danger situation. There is the risk of cuts, up to the separation of body parts (e.g. fingertips). There is a risk of hair and loose clothing being drawn in. Objects falling in destroy the turbopump during subsequent operation.

- ▶ Only remove the original protective covers immediately prior to connecting the high vacuum flange.
- ▶ Do not reach into the high vacuum connection.
- ▶ Wear protective gloves during installation.
- ▶ Do not start the turbopump with open vacuum connections.
- ▶ Always carry out the mechanical installation before electrical connection.
- ▶ Prevent access to the high vacuum connection of the turbopump from the operator side (e.g. open vacuum chamber).

General notes for the installation of vacuum components

- ▶ Choose an installation location that permits access to the product and to supply lines at all times.
- ▶ Observe the ambient conditions given for the limits of use.
- ▶ Provide the highest possible level of cleanliness during assembly.
- ▶ Ensure that flange components during installation are grease-free, dust-free and dry.

Select the installation location

1. Observe the instructions for transport to the installation location.
2. Make sure that there are sufficient cooling options for the turbopump.
3. Install suitable shielding if the surrounding magnetic fields exceed the permissible levels.
4. Install suitable shielding so that the irradiated thermal output does not exceed the permissible values when high temperatures occur due to the process.
5. Observe the permissible temperatures for the vacuum connection.

5.2 Connecting the high vacuum side

5.2.1 Requirements for the dimensioning of a counter flange

NOTICE

Risk of damage due to incorrect counter flange design

Unevenness on the operator-side counter flange results in stresses in the vacuum pump housing, even when properly attached. This can produce leakage or negative changes in running characteristics.

- ▶ Adhere to the shape tolerances for the counter flange.
- ▶ Observe the maximum flatness deviations over the entire surface.



Superstructural parts and fittings on the high vacuum connection

Installing superstructural parts and fittings to the high vacuum connection is the responsibility of the operating company. The loading capacity of the high vacuum flange is specific for the turbopump used.

- The total weight of superstructural parts must not exceed the maximum axial values specified.
- Make sure that all the torques generated if the rotor blocks suddenly, are absorbed by the system on the operator side and the high vacuum connection.
- Only use the approved mounting kits of Pfeiffer Vacuum for the high vacuum connection of the turbopump.

Parameter	HiPace 1200
Maximum torque occurring in the event of a burst ¹⁾	9800 Nm
Maximum permissible axial load on the high vacuum flange ²⁾	2000 N (equivalent to 200 kg)
Flatness	± 0.05 mm
Minimum tensile strength of the flange material in all operating states in relation to the engagement depth of the fixing screws	170 N/mm ² at 2.5 x d 270 N/mm ² at 1.5 x d
Maximum permissible surrounding magnetic field	6.0 mT
Maximum permissible irradiated thermal output	22.5 W

Tbl. 6: Requirements for the dimensioning of customer-specific high vacuum connection

Important information for correct installation

- Only use the approved mounting kits of Pfeiffer Vacuum for the high vacuum connection of the turbopump.

5.2.2 Considering the earthquake protection

NOTICE

Vacuum pump damage caused by external vibrations

In the event of earthquakes or other external vibrations, there is the risk of the rotor coming into contact with the safety bearings, or the housing wall touching the turbopump. This can produce mechanical loads up to and including destruction of the turbopump.

- Make sure that all flange and safety connections absorb the resulting forces.
- Secure the vacuum chamber against displacement or tipping.

1) The theoretically calculated torque in the event of a burst (rotor shaft breakage) according to ISO 27892 was not reached in any experimental test.
2) A one-sided load is not permitted.

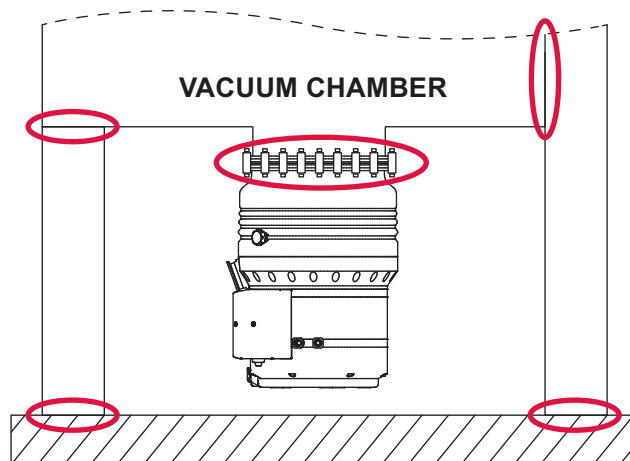


Fig. 3: Example: Secure against displacement and tipping caused by external vibrations

 Safety connection, customer-side

5.2.3 Using a splinter shield or protective screen

Pfeiffer Vacuum centering rings with splinter shield or protective screen in the high vacuum flange protect the Turbopump against foreign matter from the vacuum chamber. The pumping speed of the pump is reduced according to the passage guide values and the size of the high vacuum flange.

Flange size	Reduced pumping speed in % by gas type			
	H ₂	He	N ₂	Ar
Splinter shield DN 200	10	13	26	28
Protective screen DN 200	3	3	8	9

Tbl. 7: Behavior of pumping speed when using a splinter shield or protective screen

- ▶ Use centering rings with protective screen or splinter shield for ISO flanges.
- ▶ Use additional protective screen or splinter shield for CF flanges.

5.2.4 Using the vibration compensator

Pfeiffer Vacuum vibration compensators are suitable for use on vibration-sensitive systems.

WARNING

Risk of injury caused by the turbopump breaking away with the vibration compensator in the event of a malfunction

Sudden jamming of the rotor generates high destructive torques in accordance with ISO 27892. When using a vibration compensator, this will probably lead to the turbopump being sheared off in use. The energy that this would release could throw the entire turbopump or shattered pieces from its interior through the surrounding space. Potentially dangerous gases can escape. There is a risk of very serious injuries, including death, and extensive property damage.

- ▶ Take suitable safety precautions on-site for the compensation of the occurring torques.
- ▶ Before installing a vibration compensator, you must first of all contact Pfeiffer Vacuum.

Installing the vibration compensator

1. Install the vibration compensator only with vertical passage.
2. Consider the flow resistance.
3. Secure the turbopump additionally to the high vacuum flange.
4. Observe the fastening of the ISO flanges.

5.2.5 Mounting orientations

NOTICE

Destruction of the vacuum pump due to failure to observe the type-specific spatial position

Impermissible spatial positions lead to pollution of the vacuum pump by operating fluid. There is a risk of pollution of the process vacuum and damage to the vacuum pump up to and including its destruction.

- ▶ Observe the labels relating to the valid spatial position of the vacuum pump.
- ▶ Observe the property labels on the type plate.
- ▶ Drain off the operating fluid before moving or transporting the vacuum pump.
- ▶ Only fill the vacuum pump with operating fluid after mechanical installation.

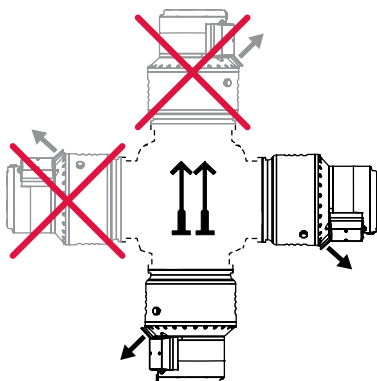


Fig. 4: Mounting orientations of the standard version, upright

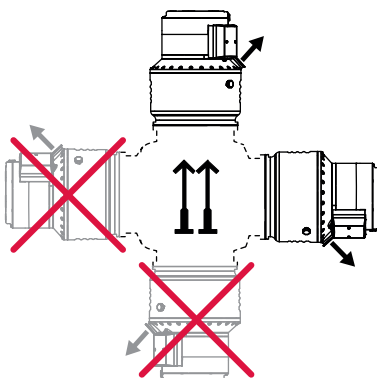


Fig. 5: Mounting orientations of the U version, overhead

- ▶ When using oil-sealed backing pumps, avoid backflow from the fore-vacuum range.

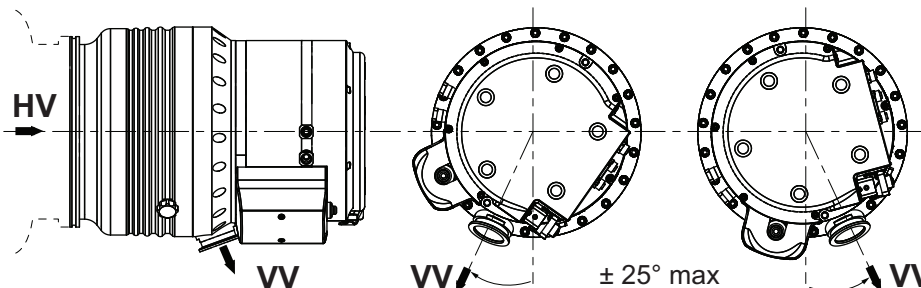


Fig. 6: Alignment of the fore-vacuum connection with horizontal mounting orientation

Determining the horizontal mounting orientation of the turbopump

1. Always align the fore-vacuum connection downwards vertically.
 - Permissible deviation $\pm 25^\circ$
2. Support the tube connections in front of the turbopump.

3. Do not allow any forces from the piping system to act on the turbopump.
4. Do not load the high vacuum flange of the turbopump on one side.

5.2.6 Attaching ISO-K flange onto ISO-K



ISO flange connections

For the connection of flanges in ISO-KF or ISO-K design, twisting may occur in the event of sudden blockage of the rotor, despite correct installation.

- Leak-tightness of the flange connection, however, is not jeopardized in this regard.

Required tools

- Wrench, WAF 15
- Calibrated torque wrench (Tightening factor ≤ 1.6)

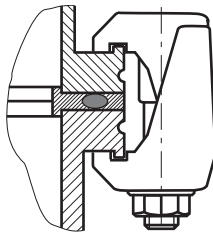


Fig. 7: Flange connection ISO-K to ISO-F, bracket screws

Connection with bracket screw

1. For the connection of the turbopump, use only the approved mounting kits from Pfeiffer Vacuum.
2. Connect the flange with the components of the mounting kit according to the figure.
3. Use for all prescribed components for the turbopump.
4. Tighten the bracket screws cross-wise in 3 steps.
 - Tightening torque: **5, 15, 25 $\pm$ 2 Nm**

5.2.7 Attaching ISO-K flange to ISO-F

The connection types for ISO-K flange installation with ISO-F flange are:

- "Hexagon head screw and tapped hole"
- "Stud screw with tapped hole"
- "Stud screw with through hole"



ISO flange connections

For the connection of flanges in ISO-KF or ISO-K design, twisting may occur in the event of sudden blockage of the rotor, despite correct installation.

- Leak-tightness of the flange connection, however, is not jeopardized in this regard.

Required tools

- Hexagon wrench (15 WAF)
- Calibrated torque wrench (tightening factor ≤ 1.6)

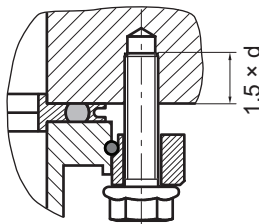


Fig. 8: Flange connection ISO-K to ISO-F, hexagon head screw and tapped hole

Connection of the hexagon head screw and tapped hole

1. For the connection of the turbopump, use only the approved mounting kits from Pfeiffer Vacuum.
2. Place the collar flange over the high vacuum flange of the turbopump.

3. Insert the snap ring in the side groove on the high vacuum flange of the turbopump.
4. Attach the turbopump with collar flange, snap ring and centering ring to the counter flange according to the figure.
5. Use all prescribed components for the turbopump.
6. Screw the hexagon head screws into the tapped holes.
 - Observe the minimum tensile strength of the flange material and the screw depth.
7. Fasten the hexagon head screws cross-wise in 3 steps.
 - Tightening torque: **5, 15, 25 ± 2 Nm**

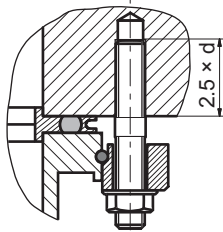


Fig. 9: Flange connection ISO-K to ISO-F, stud screw and tapped hole

Connection of the stud screw and tapped hole

1. For the connection of the turbopump, use only the approved mounting kits from Pfeiffer Vacuum.
2. Screw in the required number of stud screws with the shorter end in the holes on the counter flange.
 - Observe the minimum tensile strength of the flange material and the screw depth.
3. Place the collar flange over the high vacuum flange of the turbopump.
4. Insert the snap ring in the side groove on the high vacuum flange of the turbopump.
5. Attach the turbopump with collar flange, snap ring and centering ring to the counter flange according to the figure.
6. Use all prescribed components for the turbopump.
7. Secure the nuts cross-wise in 3 steps.
 - Tightening torque: **5, 15, 25 ± 2 Nm**

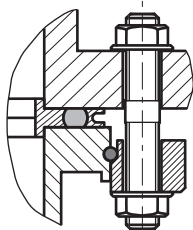


Fig. 10: Flange connection ISO-K to ISO-F, stud screw and through hole

Connection of the stud screw and through hole

1. For the connection of the turbopump, use only the approved mounting kits from Pfeiffer Vacuum.
2. Place the collar flange over the high vacuum flange of the turbopump.
3. Insert the snap ring in the side groove on the high vacuum flange of the turbopump.
4. Attach the turbopump with collar flange, snap ring and centering ring to the counter flange according to the figure.
5. Use all prescribed components for the turbopump.
6. Tighten the nuts cross-wise in 3 steps.
7. Tightening torque: **5, 15, 25 ± 2 Nm**

5.2.8 Attaching ISO-F flange to ISO-F

The connection types for ISO-F flange installation with ISO-F flange are:

- "Hexagon head screw and tapped hole"
- "Hexagon head screw and through hole"
- "Stud screw with tapped hole"
- "Stud screw with through hole"

Required tools

- Hexagon wrench (15 WAF)
- Calibrated torque wrench (tightening factor ≤ 1.6)

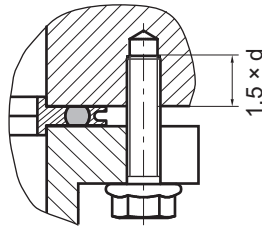


Fig. 11: Flange connection ISO-F, hexagon head screw and tapped hole

Connection of the hexagon head screw and tapped hole

1. For the connection of the turbopump, use only the approved mounting kits from Pfeiffer Vacuum.
2. Attach the turbopump with centering ring to the counter flange according to the figure.
3. Use all prescribed components for the turbopump.
4. Screw the required number of hexagon head screws into the tapped hole.
 - Observe the minimum tensile strength of the flange material and the screw depth.
5. Fasten the hexagon head screws cross-wise in 3 steps.
 - Tightening torque: **10, 20, 38 $\pm$ 3 Nm**

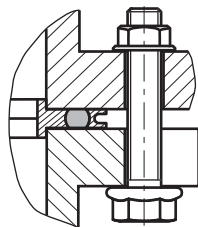


Fig. 12: Flange connection ISO-F, hexagon head screw and through hole

Connection of the hexagon head screw and through hole

1. For the connection of the turbopump, use only the approved mounting kits from Pfeiffer Vacuum.
2. Attach the turbopump with centering ring to the counter flange according to the figure.
3. Use all prescribed components for the turbopump.
4. Push the hexagon head screws through the holes of the turbopump and counter flange.
5. Secure the hexagon nuts.
6. Fasten the screw connections cross-wise in 3 steps.
 - Tightening torque: **10, 20, 38 $\pm$ 3 Nm**

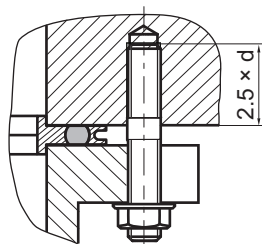


Fig. 13: Flange connection ISO-F, stud screw and tapped hole

Connection of the stud screw and tapped hole

1. For the connection of the turbopump, use only the approved mounting kits from Pfeiffer Vacuum.
2. Screw in the stud screws with the shorter end in the tapped holes on the counter flange.
 - Observe the minimum tensile strength of the flange material and the screw depth.
3. Attach the turbopump with centering ring to the counter flange according to the figure.
4. Use all prescribed components for the turbopump.
5. Secure the hexagon nuts.
6. Tighten the nuts cross-wise in 3 steps.
 - Tightening torque: **10, 20, 38 $\pm$ 3 Nm**

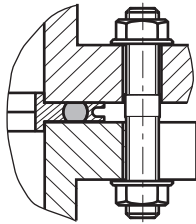


Fig. 14: Flange connection ISO-F, stud screw and through hole

Connection of the stud screw and through hole

1. For the connection of the turbopump, use only the approved mounting kits from Pfeiffer Vacuum.
2. Attach the turbopump with collar flange, snap ring and centering ring to the counter flange according to the figure.
3. Use all prescribed components for the turbopump.
4. Fasten the screw connections cross-wise in 3 steps.
 - Tightening torque: **10, 20, 38 ± 3 Nm**

5.2.9 Attaching CF flange to CF-F

The connection types for CF installation with CF flange are:

- "Hexagon head screw and through hole"
- "Stud screw with tapped hole"
- "Stud screw with through hole"

NOTICE

Leaks may occur due to the incorrect installation of CF flanges

Inadequate cleanliness when handling CF flanges and copper gaskets results in leaks and may cause process damage.

- ▶ Always wear suitable gloves before touching or fitting any components.
- ▶ Fit seals only if dry and free of grease.
- ▶ Take care of damaged surfaces and cut edges.
- ▶ Replace the damaged components.

Required tools

- Hexagonal wrench (13 WAF)
- Calibrated torque wrench (tightening factor ≤ 1.6)

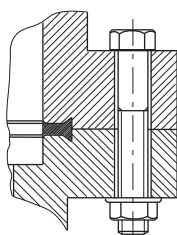


Fig. 15: Flange connection CF-F, hexagon head screw and through hole

Connection of the hexagon head screw and through holes

1. For the connection of the turbopump, use only the approved mounting kits from Pfeiffer Vacuum.
2. If used: Insert the protective screen or splinter shield with clamping lugs downwards in the turbopump high vacuum flange.
3. Place the seal exactly in the hollow.
4. Connect the flange with the components of the mounting kit according to the figure.
5. Tighten the screw couplings all the way around.
 - Tightening torque: **22 ± 2 Nm**
6. Then check the torque, since flowing of the sealing material may make it necessary to re-tighten the screws.

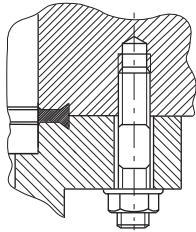


Fig. 16: Flange connection CF-F, stud screw and tapped hole

Connection of the stud screw and tapped hole

1. For the connection of the turbopump, use only the approved mounting kits from Pfeiffer Vacuum.
2. Screw in the required number of stud screws with the shorter end in the holes on the counter flange.
3. If used: Insert the protective screen or splinter shield with clamping lugs downwards in the turbopump high vacuum flange.
4. Place the seal exactly in the hollow.
5. Connect the flange with the components of the mounting kit according to the figure.
6. Tighten the screw couplings all the way around.
 - Tightening torque: **$22 \pm 2 \text{ Nm}$**
7. Then check the torque, since flowing of the sealing material may make it necessary to re-tighten the screws.

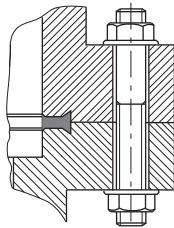


Fig. 17: Flange connection CF-F, stud screw and through hole

Connection of the stud screw and through hole

1. For the connection of the turbopump, use only the approved mounting kits from Pfeiffer Vacuum.
2. If used: Insert the protective screen or splinter shield with clamping lugs downwards in the turbopump high vacuum flange.
3. Place the seal exactly in the hollow.
4. Connect the flange with the components of the mounting kit according to the figure.
5. Tighten the screw couplings all the way around.
 - Tightening torque: **$22 \pm 2 \text{ Nm}$**
6. Then check the torque, since flowing of the sealing material may make it necessary to re-tighten the screws.

5.3 Filling the operating fluid

WARNING

Danger of poisoning from toxic vapors

Igniting and heating synthetic operating fluid generates toxic vapors. Danger of poisoning if inhaled.

- ▶ Observe the application instructions and precautions.
- ▶ Do not allow tobacco products to come into contact with the operating fluid.

NOTICE**Destruction of the turbopump due to incorrect operation when filling with operating fluid**

The operating fluid filling quantity depends on the selected spatial position of the turbopump. The filler screws are located at clearly marked positions on both sides of the operating fluid pump of the turbopump. Confusion with other screw plugs leads to impurities, damage to the turbopump, up to and including its destruction.

- ▶ Only fill the turbopump with operating fluid after mechanical installation.
- ▶ Fill the turbopump with operating fluid via one of the filler screws marked with an oil can symbol only.
- ▶ If in doubt, contact Pfeiffer Vacuum.

The operating fluid pump of the turbopump is situated beneath a protective cap. The screws for filling the operating fluid are identified with a respective symbol. The drain screws are located at the front of the operating fluid pump.

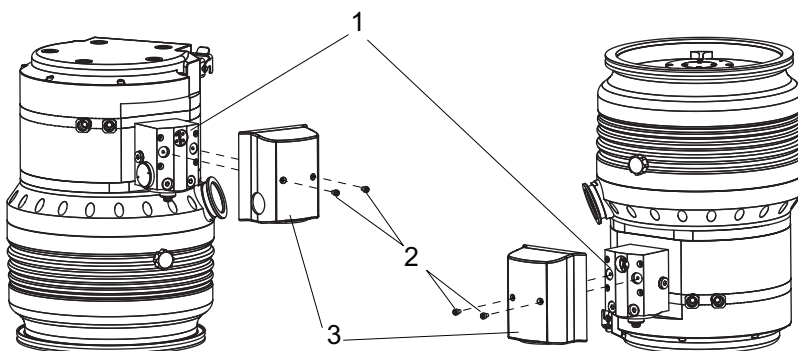


Fig. 18: Removing the protective cap on U- or standard versions

- | | |
|------------------------|------------------|
| 1 Operating fluid pump | 3 Protective cap |
| 2 Allen head screws | |

Required tools

- Allen key, size 3
- Allen key, size 5
- Calibrated torque wrench (tightening factor ≤ 1.6)

Permitted operating fluid

- F3 for vacuum pumps, 50 ml

Remove the protective cap from the operating fluid pump

- ▶ Unscrew the Allen head screws.
- ▶ Remove protective cap.

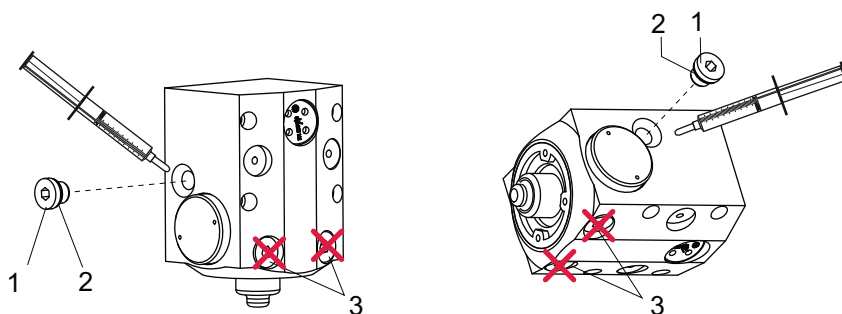


Fig. 19: Position of the operating fluid filler screws depending on orientation of the turbopump

- | | |
|----------------|---------------|
| 1 Filler screw | 3 Drain screw |
| 2 O-ring | |

Procedure

1. Unscrew and remove the higher filler screw from the operating fluid pump.
2. Use the syringe and the operating fluid from the turbopump shipment.
3. Place a container below the filling port.
4. Continue to fill in operating fluid until it overflows at the filling port
 - Maximum volume **50 ml**.
 - In vertical mounting orientation, the filling volume is a little lower.
5. Seal the filler screw.
 - Tightening torque: **3 Nm**

5.4 Connecting the fore-vacuum side

WARNING

Danger to life from poisoning where toxic process media leak from damaged connections

Sudden twisting of the turbopump in the event of a fault causes fittings to accelerate. There is the risk of damaging on-site connections (e.g., fore-vacuum line) and resulting leaks. This results in leakage of process media. In processes involving toxic media, there is a risk of injury and danger to life due to poisoning.

- ▶ Keep masses connected to the turbopump as low as possible.
- ▶ Use flexible lines to connect to the turbopump where necessary.



Suitable backing pump

Use the turbopump only in combination with a suitable backing pump that can deliver up to the required maximum fore-vacuum pressure. To achieve the fore-vacuum pressure, use a suitable vacuum pump or a pumping station from the Pfeiffer Vacuum range.

In this case, the backing pump is also controlled directly via the turbopump electronic drive unit interfaces (e.g., relay box or connection cable).

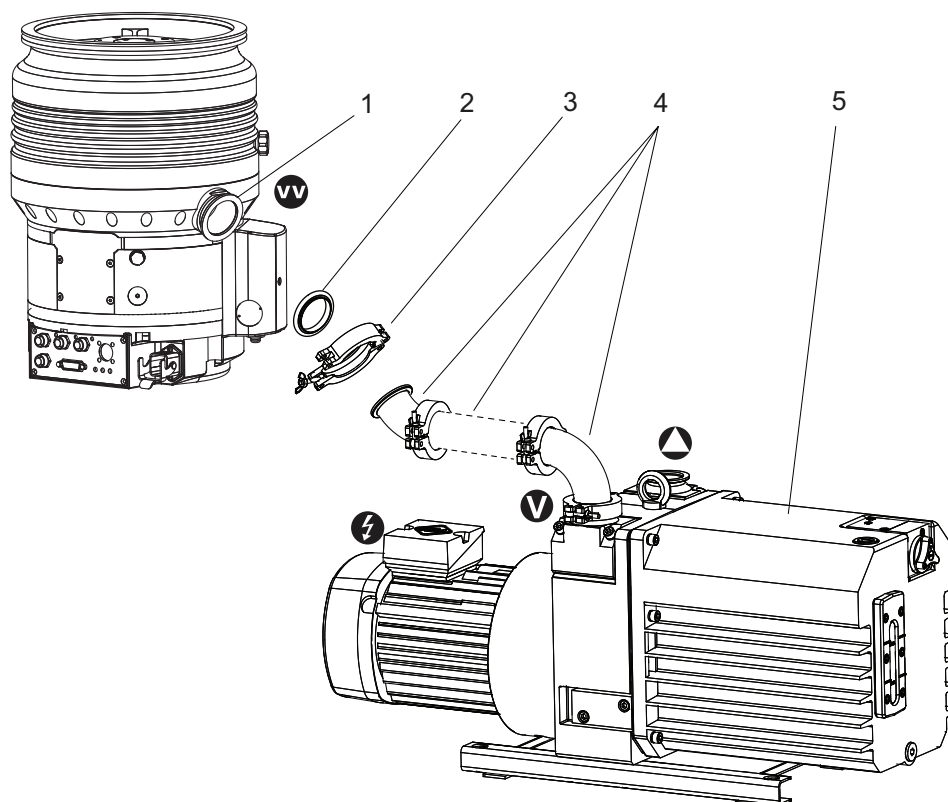


Fig. 20: Example of fore-vacuum connection

- | | |
|------------------------------------|---|
| 1 turbopump fore-vacuum connection | 4 Vacuum components DN 40 ISO-KF |
| 2 Centering ring | 5 Backing pump (e.g. two-stage vane pump) |
| 3 Circlip | |

Procedure

1. With rigid pipe connections, include bellows to attenuate external vibrations.
2. Install a fore-vacuum connection with small flange components, e.g. connection elements and pipe components DN 40 ISO-KF from the [Pfeiffer Vacuum Components Shop](#).
3. Implement measures to counteract the backflow of operating fluids or condensate from the fore-vacuum area.
4. Observe the information in the operating manual of the backup pump or pumping station when connecting and operating it.

5.5 Connecting the cooling water supply

⚠ WARNING

Risk of scalding from suddenly escaping hot cooling water

The turbopump water connections are open to both sides. When connecting the cooling water supply, there is a risk of scalding from suddenly escaping, hot cooling water at over pressure.

- ▶ Prior to installation, ensure that pressure is discharged from the cooling water system, and that it is cooled down.
- ▶ Wear protective equipment, e.g., safety goggles and gloves.

The HiPace 1200 turbopumps use water cooling as standard.

Parameter	Cooling water
Appearance	• filtered • mechanically clear • visually clear • no turbidity • no sediment • free from grease and oil
pH value	7 to 9
Carbonate hardness, max.	10 °dH 12.53 °e 17.8 °fH 178 ppm CaCO ₃
Chloride content, max.	100 mg/l
Sulfate content, max.	240 mg/l
Carbonic acid content, max.	not detectable
Ammonia content, max.	not detectable
Electrical conductivity, max.	500 µS/cm
Particle size, max.	150 µm
Cooling water temperature	see "Technical data"
Cooling water flow	see "Technical data"
Feed line overpressure, max.	6000 hPa

Tbl. 8: Requirements on the cooling water composition

Connection to the turbopump	External cooling water supply
Internal thread, G 1/4"	Hose cable
Hose nozzles (included with shipment)	Inner hose diameter 7 to 8 mm

Tbl. 9: Requirements on the cooling water connection

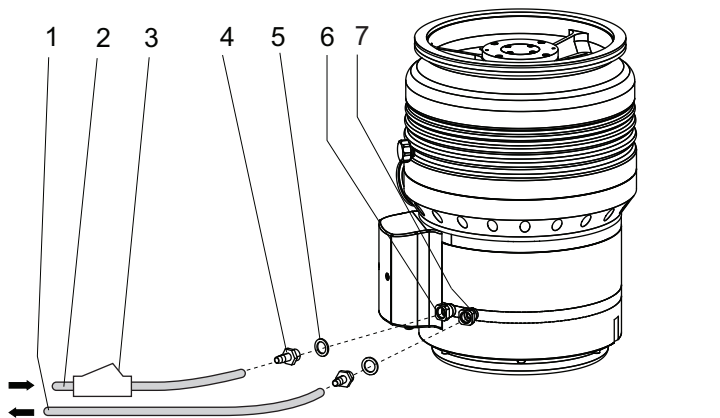


Fig. 21: Cooling water connection

- | | |
|------------------------|-------------------------------------|
| 1 Return line | 5 Sealing ring (2x) |
| 2 Feed line | 6 Cooling water inlet, 1/4" thread |
| 3 Dirt trap | 7 Cooling water outlet, 1/4" thread |
| 4 Threaded nozzle (2x) | |

Procedure

Pfeiffer Vacuum recommends the use of a dirt trap in the supply line.

- Screw one hose nozzle with sealing ring onto each of the turbopump's cooling water connections.
 - Tightening torque: max. **15 Nm**
- Connect the cooling water supply line to the hose nozzle at the designated cooling water inlet of the turbopump.

3. Connect the cooling water return line to the hose nozzle at the designated cooling water outlet of the turbopump.
4. Secure the hose lines on the turbopump with hose clamps.

5.6 Connecting accessories



Electronic drive unit TC 1200 accessory connection

The electronic drive unit of the turbopump offers space for the connection of maximum 4 accessory devices. M12 sockets with the designation "accessory" are available for this purpose.

- The accessory connections have been preconfigured at the factory.
- After connecting pre-configured accessory devices, these are immediately ready for operation according to the factory settings.
- The use of other accessories for turbopumps is possible and requires settings in the configuration of the electronic drive unit.
- The desired accessory output is configured via RS-485 using Pfeiffer Vacuum display and control units or a PC.
- You can find more detailed information in the "Electronic drive unit TC|1200" operating manual.

	Electronic drive unit connection	Accessory connection	Y-connector	Pre-set configuration
	Acc. A	A1	Y-1	Sealing gas valve
		A2	Y-2	Backing pump
	Acc. B	B1	Y-1	Venting valve
		B2	Y-2	Heating

Tbl. 10: Factory pre-set accessory connections on the electronic drive unit

Connecting accessory devices

1. Observe the installation instructions in the operating instructions for the relevant accessory.
2. Note the existing configuration of existing connections and control lines.
3. Connect only matching accessory devices to the electronic drive unit.
4. Use the Y-distributor from the Pfeiffer Vacuum range of accessories if you want to connect 3 or 4 devices.

Using additional accessories

1. Observe the installation instructions in the operating instructions for the relevant accessory.
2. Note the existing configuration of existing connections.
3. Use the Pfeiffer Vacuum display and control unit DCU 002, or a DCU with integrated power supply pack.

5.7 Connecting the electrical supply

DANGER

Danger to life from electric shock

Touching exposed and voltage-bearing elements causes an electric shock. Improper connection of the mains supply leads to the risk of touchable live housing parts. There is a risk to life.

- Before the installation, check that the connection leads are voltage-free.
- Make sure that electrical installations are only carried out by qualified electricians.
- Provide adequate grounding for the device.
- After connection work, carry out an earthed conductor check.

5.7.1 Grounding the vacuum pump

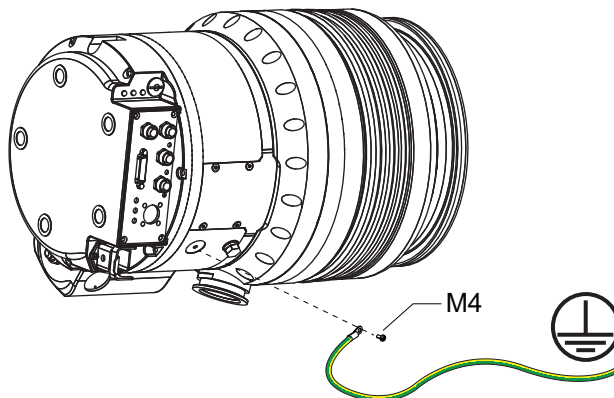


Fig. 22: Example: Connecting the grounding cable

Required aids

- Screw M4 × 8
- Shake proof washer M4, if required
- Suitable grounding cable with cable lug size M4

Procedure

1. Use a suitable grounding cable to divert applicative interferences.
2. Route the connection in accordance with locally applicable provisions.
3. Use the turbopump ground terminal (M4 female thread).

5.7.2 Establishing the electric connection

⚠ WARNING

Risk of fatal injury due to electric shock on account of incorrect installation

The device's power supply uses life-threatening voltages. Unsafe or improper installation can lead to life-threatening situations from electric shocks obtained from working with or on the unit.

- ▶ Ensure safe integration into an emergency off safety circuit.
- ▶ Do not carry out your own conversions or modifications on the unit.

⚠ WARNING

Danger of cut injuries from unexpected start up.

The use of mating plugs of the electronic drive unit (accessories) enables the automatic run-up of the vacuum pump as soon the power is turned on. Attaching mating plugs before or during the installation leads to the movement of parts hence the risk of cut injuries by sharp-edged in the exposed high vacuum flange.

- ▶ Only connect mating plugs after the mechanical installation.
- ▶ Only switch on the vacuum pump immediately prior to operation.

	Pin	Assignment
	1	Phase L
	2	Neutral conductor
	3	not connected
	PE	Earthed conductor

Tbl. 11: Terminal lay-out of the power supply connector

Preparing a supply cable for the turbopump

There are 2 options for configuring the mains connection for the turbopump.

- ▶ Make sure that you have the correct supply voltage.
- ▶ Order a corresponding mains connection cable from the Pfeiffer Vacuum accessories range.
- ▶ Assemble your own mains connection cable using the HAN 3A connecting socket from the shipment.

6 Operation

6.1 Commissioning

WARNING

Danger of cut injuries from unexpected start up.

The use of mating plugs of the electronic drive unit (accessories) enables the automatic run-up of the vacuum pump as soon the power is turned on. Attaching mating plugs before or during the installation leads to the movement of parts hence the risk of cut injuries by sharp-edged in the exposed high vacuum flange.

- ▶ Only connect mating plugs after the mechanical installation.
- ▶ Only switch on the vacuum pump immediately prior to operation.

NOTICE

Vacuum pump destruction due to excessive energy input during operation

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

- ▶ Consult Pfeiffer Vacuum before combining varying loads on the vacuum pump. Lower limit values apply.

NOTICE

Turbopump destruction due to gases with too high molecular masses

The pumping of gases with impermissible high molecular masses leads to the destruction of the turbopump.

- ▶ Make sure that the gas mode is set correctly by **[P:027]** in the electronic drive unit.
- ▶ Consult Pfeiffer Vacuum before you use gases with higher molecular masses (> 80).

Important settings and function-related variables are factory-programmed into the vacuum pump electronic drive unit as parameters. Each parameter has a three-digit number and a description. Parameter-driven operation and control is supported via Pfeiffer Vacuum displays and control units, or externally via RS-485 using Pfeiffer Vacuum protocol.

Parameter	Name	Designation	Adjustment, setting
[P:027]	GasMode	Gas mode	0 = heavy gases
[P:035]	CfgAccA1	Accessory connection A1	5 = Sealing gas
[P:036]	CfgAccB1	Accessory connection B1	1 = Venting valve
[P:037]	CfgAccA2	Accessory connection A2	3 = backing pump
[P:038]	CfgAccB2	Accessory connection B2	2 = heating
[P:700]	RUTimeSVal	Set value run-up time	8 min
[P:701]	SpdSwPt1	Speed-control switching point	80 %
[P:707]	SpdSVal	Speed-control operation specification	65 %
[P:708]	PwrSVal	Set value power consumption	100 %
[P:720]	VentSpd	Venting at rotation speed, delayed venting	50 %
[P:721]	VentTime	Venting time, delayed venting	3600 s

Tbl. 12: Preconfigured settings for turbopumps when delivered

Putting the turbopump into operation

1. When using water cooling, observe the cooling water flow and throughput.
2. When using sealing gas, observe the sealing gas flow and throughput.
3. Observe the reduction of the drive power depending on the mains connection voltage provided.
4. Provide the current supply for the product.

6.2 Operating modes

The turbopump can be operated in different modes.

- Operation without control unit
- Operation via connection "E74"
- Operation via "remote" connection
- Operation via interface RS-485 and Pfeiffer Vacuum display and control unit or PC
- Operation via field bus

6.2.1 Operation without operating unit



Automatic start

When using the supplied mating plug on the electronic drive unit or bridging contacts according to the terminal lay-out, the turbopump is ready for operation. Once the supply voltage is provided, the turbopump starts up immediately.

Instructions for operation without control panel

1. Use only the approved Pfeiffer Vacuum mating plug with bridges on the connection of the electronic drive unit.
2. Switch on the mains supply of the turbopump only immediately before operation.

After applying the operating voltage, the electronic drive unit carries out a self-test to check the supply voltage. After completing the self-test successfully, the turbopump starts and activates connected additional equipment according to the configuration.

6.2.2 Operation via connection "E74"

Operation is possible via the 15-pole D-sub connection with the "E74" designation on the electronic drive unit. Besides the signals defined in the Directive SEMI E74-0301, the connection is provided with an inverted alarm signal and an analog output.

Instructions for operation with E74

- See the operating instructions of the electronic drive unit with E74 version.

6.2.3 Operation via multi-function connection "remote"

Remote control is available via the 26-pole D-sub connector with the "remote" designation on the electronic drive unit. The accessible individual functions are mapped to "PLC levels".

Instructions for remote control operation

- See the operating instructions of the electronic drive unit for the standard version.

6.2.4 Operation via Pfeiffer Vacuum display and control unit

The connection of a Pfeiffer Vacuum display and control panel permits the controlling of the turbopump via the parameters fixed in the electronic drive unit.

Instructions for operation with display and control unit

1. When handling the Pfeiffer Vacuum display and control unit, observe the associated operating instructions:
 - "DCU" operating instructions available from the [Download Center](#).
 - "HPU" operating instructions available from the [Download Center](#).
2. Observe the electronic drive unit operating instructions included in the scope of delivery for the turbopump.
3. Connect the display and control unit to the connection "RS-485" on the electronic drive unit.

6.2.5 Operation via field bus

Integrating and operating Pfeiffer Vacuum turbopumps in the customer's field bus system is possible when using an electronic drive unit with a corresponding connection panel.

The following are available:

- Profibus
- EtherCAT
- DeviceNet

Instructions for field bus operation

- ▶ See the operating manual of the electronic drive unit with corresponding connection panel.

6.3 Switching on the turbopump

WARNING

Danger of cut injuries from unexpected start up.

The use of mating plugs of the electronic drive unit (accessories) enables the automatic run-up of the vacuum pump as soon the power is turned on. Attaching mating plugs before or during the installation leads to the movement of parts hence the risk of cut injuries by sharp-edged in the exposed high vacuum flange.

- ▶ Only connect mating plugs after the mechanical installation.
- ▶ Only switch on the vacuum pump immediately prior to operation.

WARNING

Risk of burns on hot surfaces when using additional equipment for heating during operation

The use of additional equipment for heating the vacuum pump or for optimizing the process generates very high temperatures on surfaces that can be touched. There is a risk of burning.

- ▶ If necessary, set up a contact guard.
- ▶ If necessary, apply the warning stickers provided for this at the danger points.
- ▶ Ensure adequate cooling down before working on the vacuum pump or in its vicinity.
- ▶ Wear protective equipment, e.g., gloves.

WARNING

Risk of serious injury in the event of vacuum pump destruction due to over pressure

Gas entry with very high over pressure results in destruction of the vacuum pump. There is a risk of serious injury due to ejected objects.

- ▶ Never exceed the permissible 1500 hPa (absolute) inlet pressure on the suction side or the venting and sealing gas connection.
- ▶ Make sure that high, process-related over pressures cannot directly enter the vacuum pump.

Establishing mains connection

1. Make sure that the connection to the operator's network is interrupted or switched off.
2. Plug the mains cable into the "AC in" connector on the turbopump's electronic drive unit.
3. Connect the mounting bracket of the connecting plug.

Switching on the turbopump

- ▶ Connect the mains cable to the operator's mains supply or switch it on.

6.4 Operation monitoring

6.4.1 Operating mode display via LED

LEDs on the electronic drive unit show the basic operating states of the vacuum pump. A differentiated error and warning display is only possible for operation with the Pfeiffer Vacuum display and control unit or a PC.

LED	Symbol	LED status	Display	Meaning
Green 		Off		Currentless
		On, flashing		"pumping station OFF", rotation speed ≤ 60 rpm
		On, inverse flashing		"pumping station ON", set rotation speed not reached
		On, constant		"pumping station ON", set rotation speed reached
		On, flashing		"pumping station OFF", speed > 60 rpm
Yellow 		Off		No warning
		On, constant		Warning
Red 		Off		No error, no warning
		On, constant		Error, malfunction

Tbl. 13: Behavior and meaning of the LEDs on the electronic drive unit

6.4.2 Temperature monitoring

If threshold values are exceeded, output signals from temperature sensors bring the turbopump to a safe condition. Depending on the type, temperature thresholds for warning and error messages are immutably stored in the electronic drive unit. For information purposes, various status requests are set up in the parameter set.

- In order to avoid switching off the turbopump, the electronic drive unit already reduces the power consumption in case of exceeding the warning threshold for excess temperature.
 - Examples are an impermissible motor temperature, or impermissibly high housing temperature.
- Further reduction of drive power and thus decreasing speed can potentially lead to underrun the rotation speed switchpoint. The turbopump switches off.
- Exceeding the temperature threshold for error messages switches off the turbopump immediately.

6.5 Switching off and venting



We recommend

Vent the turbopump after shutdown. By doing so, you prevent particles flowing back into the vacuum system from the fore-vacuum area.

6.5.1 Switching off

Notes for switching off the turbopump

1. Shut down the turbopump via the control unit or remote control.
2. Close the fore-vacuum line.
3. Switch off the backing pump, if necessary.
4. Vent the turbopump (options see below).
5. Close the supply lines (e.g. for cooling water or sealing gas).

6.5.2 Venting

⚠ CAUTION

Risk of injuries due to contact with vacuum when venting

While venting the vacuum pump there is a risk of minor injuries due to the direct contact of body parts with the vacuum, e.g. hematomas.

- ▶ Do not fully unscrew the venting screw out of the housing during venting.
- ▶ Keep a distance from automatic venting device, such as venting valves.

NOTICE**Damage to the turbopump due to non-permissibly fast pressure rise during venting**

Non-permissibly high pressure rise rates place a significant load on the rotor and the magnetic bearing of the turbopump. During venting very small volumes in the vacuum chamber or the turbopump, there is a risk of uncontrollable pressure rises. This causes mechanical damage to the turbopump, including potential failure.

- ▶ Observe the prescribed maximum pressure rise speed of **15 hPa/s**.
- ▶ Avoid manual and uncontrolled venting of very low volumes.
- ▶ Where necessary, use a venting valve from the Pfeiffer Vacuum range of accessories.

Manual venting

Manual venting describes the standard process for venting the turbo pumping station.

1. Ensure that the vacuum system is shut down.
2. Open the black venting screw on the turbopump by one revolution maximum.
3. Wait for pressure equalization to atmospheric pressure in the vacuum system.
4. Close the venting screw again.

Use a Pfeiffer Vacuum venting valve

The Pfeiffer Vacuum venting valve is an optional accessory for installation on the turbopump.

The venting valve is normally closed. Control is via the turbopump electronic drive unit, and configuration of parameters **[P:012]** and **[P:030]**. In the event of a power failure, the turbopump continues to deliver sufficient energy during its run-down period to initiate a proper venting process. When power is restored, the venting process is interrupted.

- ▶ Switch off the turbopump.
 - The venting process starts automatically.

Venting speed [P:720]	Venting duration [P:721]	Venting duration in the event of a power failure
50 % of rated speed	3600 s	3600 s

Tbl. 14: Factory settings for delayed venting in turbopumps

General information for fast venting

We recommend fast venting of larger volumes in 4 steps.

1. Use a Pfeiffer Vacuum venting valve for the turbopump, or match the valve cross-section to the size of the recipient and maximum venting rate.
2. Vent the vacuum system with a maximum rate of pressure rise of **15 hPa/s** for a duration of 20 seconds.
3. Then vent the system with a second venting valve of any size; for example, directly at the vacuum chamber.
4. Wait for pressure equalization to atmospheric pressure in the vacuum system.

7 Maintenance

7.1 General maintenance information

WARNING

Danger to life from electric shock during maintenance and service work

The device is only completely de-energized when the mains plug has been disconnected and the turbopump is at a standstill. There is a danger to life from electric shock when making contact with live components.

- ▶ Before performing all work, switch off the main switch.
- ▶ Wait until the turbopump comes to a standstill (rotation speed = 0).
- ▶ Remove the mains plug from the device.
- ▶ Secure the device against unintentional restarting.

WARNING

Health hazard through poisoning from toxic contaminated components or devices

Toxic process media result in contamination of devices or parts of them. During maintenance work, there is a risk to health from contact with these poisonous substances. Illegal disposal of toxic substances causes environmental damage.

- ▶ Take suitable safety precautions and prevent health hazards or environmental pollution by toxic process media.
- ▶ Decontaminate affected parts before carrying out maintenance work.
- ▶ Wear protective equipment.

WARNING

Risk of cuts on moving, sharp-edged parts when reaching into the open high vacuum connection

Incorrect handling of the turbopump before maintenance work results in hazardous situations with risk of injury. There is a risk of cuts from accessing sharp-edged, rotating parts when removing the turbopump.

- ▶ Wait until the turbopump comes to a standstill (rotation speed $f=0$).
- ▶ Switch the turbopump off properly.
- ▶ Secure the turbopump against re-start.
- ▶ Seal open connections immediately following removal, using the original protective cover.

7.2 Maintenance intervals and responsibilities

Recommendations for performing maintenance measures

1. Clean the turbopump exterior with a lint-free cloth and a little isopropanol.
2. Replace the electronic drive unit in case of a defect.
3. Replace the operating fluid.
4. Pay attention to when the operating fluid must be changed.
5. Replace the operating fluid at least every 4 years.
6. Have Pfeiffer Vacuum Service replace the rotor bearing of the turbopump at least every 4 years.
7. Consult with Pfeiffer Vacuum Service about shorter maintenance intervals for extreme loads or impure processes.
8. For all other cleaning, maintenance or repair work, contact the responsible Pfeiffer Vacuum Service Center.

7.3 Changing the operating fluid

⚠ WARNING

Risk of poisoning from contact with harmful substances

The operating fluid and parts of the turbopump may contain toxic substances from pumped media.

- ▶ Decontaminate affected parts before carrying out maintenance work.
- ▶ Prevent health hazards or environmental impacts with adequate safety precautions.
- ▶ Observe the operating fluid safety data sheet.
- ▶ Dispose of the operating fluid according to locally applicable regulations.

⚠ WARNING

Danger of poisoning from toxic vapors

Igniting and heating synthetic operating fluid generates toxic vapors. Danger of poisoning if inhaled.

- ▶ Observe the application instructions and precautions.
- ▶ Do not allow tobacco products to come into contact with the operating fluid.

You can find the safety data sheet in the [Download Center](#).

Prerequisites

- Turbopump switched off
- Turbopump cooled down
- Vacuum system vented to atmospheric pressure
- Electric supply interrupted
- All cables removed from electronic drive unit
- All openings sealed with original protective covers and screw plugs, if needed

7.3.1 Draining the operating fluid

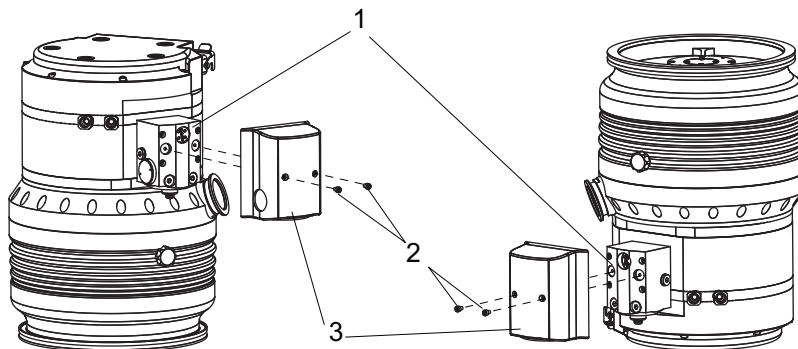


Fig. 23: Removing the protective cap on U- or standard versions

- | | |
|------------------------|------------------|
| 1 Operating fluid pump | 3 Protective cap |
| 2 Allen head screws | |

Required tools

- Allen key, size 3
- Allen key, size 5
- Calibrated torque wrench (tightening factor ≤ 1.6)

Required aids

- Suitable vessel for collecting the operating fluid

Remove the protective cap from the operating fluid pump

1. Unscrew the Allen head screws.
2. Remove protective cap.

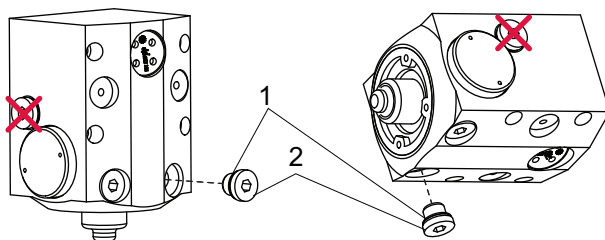


Fig. 24: Position of the operating fluid drain plugs depending on orientation of the turbopump

- 1 O-ring 2 Drain screw

Draining the operating fluid

1. Place the vessel under the operating fluid pump of the turbopump.
2. Unscrew the lower drain plug from the operating fluid pump.
3. Fully drain the operating fluid.
4. Screw the drain screw back in.
 - Tightening torque: **max. 3 Nm**

7.3.2 Filling the operating fluid

⚠ WARNING

Danger of poisoning from toxic vapors

Igniting and heating synthetic operating fluid generates toxic vapors. Danger of poisoning if inhaled.

- ▶ Observe the application instructions and precautions.
- ▶ Do not allow tobacco products to come into contact with the operating fluid.

NOTICE

Destruction of the turbopump due to incorrect operation when filling with operating fluid

The operating fluid filling quantity depends on the selected spatial position of the turbopump. The filler screws are located at clearly marked positions on both sides of the operating fluid pump of the turbopump. Confusion with other screw plugs leads to impurities, damage to the turbopump, up to and including its destruction.

- ▶ Only fill the turbopump with operating fluid after mechanical installation.
- ▶ Fill the turbopump with operating fluid via one of the filler screws marked with an oil can symbol only.
- ▶ If in doubt, contact Pfeiffer Vacuum.

Required tools

- Allen key, size 5
- Calibrated torque wrench (tightening factor ≤ 1.6)

Permitted operating fluid

- F3 for vacuum pumps, 50 ml

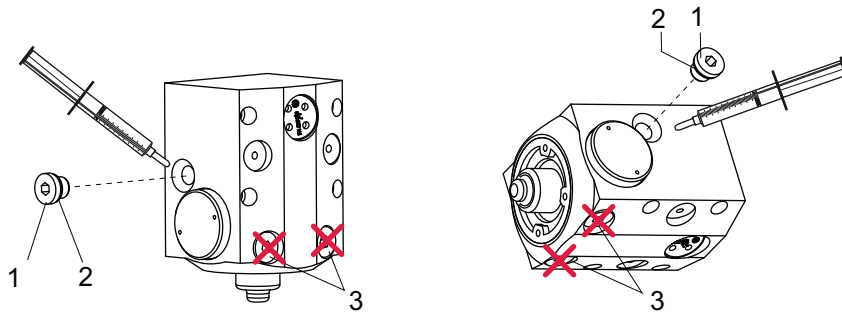


Fig. 25: Position of the operating fluid filler screws depending on orientation of the turbopump

- 1 Filler screw 3 Drain screw
2 O-ring

Procedure

1. Unscrew and remove the higher filler screw from the operating fluid pump.
2. Use the syringe and the operating fluid from the turbopump shipment.
3. Place a container below the filling port.
4. Continue to fill in operating fluid until it overflows at the filling port
 - Maximum volume **50 ml**.
 - In vertical mounting orientation, the filling volume is a little lower.
5. Seal the filler screw.
 - Tightening torque: **3 Nm**

7.4 Replacing the electronic drive unit

NOTICE

Damage to the turbopump and electronic drive unit due to improper disconnection of components

Even after the mains power is switched off, the turbopump continues to deliver electrical energy during its run-down period. If the turbopump and electronic drive unit are disconnected prematurely, there is the risk of a short-circuit to ground and consequently the destruction of electronic components.

- ▶ Never disconnect the turbopump and electronic drive unit from each other if power is still connected or if the rotor is running.
- ▶ Monitor the turbopump's rotation speed via the parameters available in the electronic drive unit (e.g. [P:398]).
- ▶ Wait until the turbopump comes to a standstill (rotation speed $f = 0$).

NOTICE

Property damage from electrostatic discharge

Neglecting the electrostatic hazard for electronic components results in their damage or destruction

- ▶ Implement ESD safety measures at the workstation.
- ▶ Observe EN 61340 "Protection of electronic devices from electrostatic phenomena".

The electronic drive unit of the turbopump cannot be repaired. In the event of a defect, replace the entire electronic drive unit with a replacement part.



Backing up settings made by the customer

The factory operating parameters are always preset in replacement units. All settings made by the customer to the original electronic drive unit are lost when it is replaced. To preserve your custom settings, you have the following options:

1. Back up all your settings as a parameter set in a HPU.
2. Load a backup parameter set by means of a HPU into the new electronic drive unit.
3. Program the individual settings into the new electronic drive unit by hand.
4. Observe the operating instructions of the electronic drive unit and the HPU.

Preparatory work

1. Do not apply any mechanical loads to the electronic drive unit.
2. Switch off the turbopump (see chapter "Switching off", page 43).
3. Vent the vacuum system to atmospheric pressure (see chapter "Venting", page 43).
4. Interrupt the electric supply.
5. Remove all cables from the electronic drive unit.
6. **If dismantling the turbopump from the system:** Seal all openings with the original protective covers and screw plugs.

Required tools

- Allen key, size 3
- Calibrated torque wrench (tightening factor ≤ 1.6)

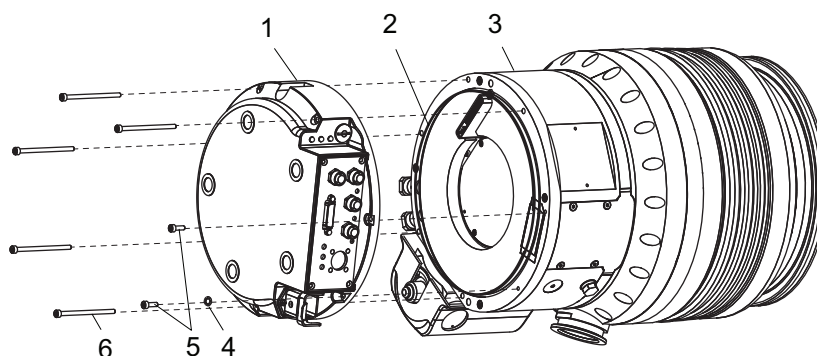


Fig. 26: Replacing the electronic drive unit – Removal

- | | |
|---------------------------------|----------------------------|
| 1 Electronic drive unit TC 1200 | 4 Shake proof washer |
| 2 O-ring | 5 Allen head screw M4 × 12 |
| 3 Pump lower part | 6 Allen head screw M4 × 65 |

Removing the electronic drive unit

1. Observe the valid spatial position after removing the turbopump.
2. Unscrew the M4 × 12 and M4 × 65 Allen head screws that secure the electronic drive unit on the turbopump.
3. Pay attention to the shake proof washer.
4. Store the screws and shake proof washer in a safe place.
5. Carefully remove the old electronic drive unit from the pump, making sure that you keep it straight.

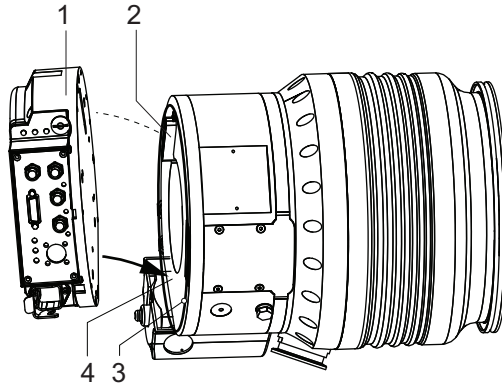


Fig. 27: Replacing the electronic drive unit – Installation

- | | |
|---------------------------------|-----------------|
| 1 Electronic drive unit TC 1200 | 3 O-ring |
| 2 Connecting plug | 4 Cooling plate |

Installing the electronic drive unit

1. If needed, secure the O-ring in the groove in the pump base.
2. Line up the new electronic drive unit with the straight edge on the cooling plate above the operating fluid pump.
3. Carefully place a new electronic drive unit on the connecting plug of the turbopump, making sure that it is straight.
4. Check that the electronic drive unit is correctly seated on the pump base and in relation to the screw connection bores.

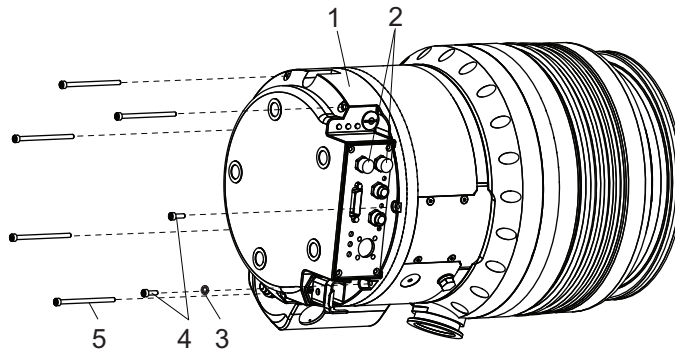


Fig. 28: Replacing the electronic drive unit – Fastening

- | | |
|---------------------------------|----------------------------|
| 1 Electronic drive unit TC 1200 | 4 Allen head screw M4 × 12 |
| 2 Screw plug | 5 Allen head screw M4 × 65 |
| 3 Shake proof washer | |

Fastening the electronic drive unit

1. Screw an M4 × 12 Allen head screw with shake proof washer into the bore in front of the power supply plug of the electronic drive unit.
2. Screw an M4 × 12 Allen head screw into the bore in front of the electronic drive unit connection panel.
3. Use all of the other M4 x 65 Allen head screws to fasten the electronic drive unit to the turbopump.
– Tightening torque: **2.5 Nm**
4. Remove the screw plugs from the electronic drive unit connections.
5. Keep them in a safe place.

7.5 Confirming the speed specification

The typical nominal rotation speed of a turbopump is preset at the factory 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 is cleared. The manual confirmation of the nominal rotation speed is part of a redundant safety system as a measure for preventing excess rotation speed.

HiPace	Confirmation of nominal rotation speed [P:777]
1200 / 1500	630 Hz
1800 / 2300	525 Hz
2800	455 Hz

Tbl. 15: Characteristic nominal rotation speeds of the turbopumps

Required aids

- A connected Pfeiffer Vacuum display and control unit.
- Knowledge of the configuration and setting of electronic drive unit operating parameters.

Adjusting the nominal rotation speed confirmation

1. Observe the display and control unit operating instructions.
2. See the electronic drive unit operating instructions.
3. Set the parameter **[P:794]** to "1" and activate the expanded parameter set.
4. Open and edit the parameter **[P:777]**.
5. Set the parameter **[P:777]** to the required value of the nominal rotation speed in Hertz.

8 Decommissioning

8.1 Stillsetzen für längere Zeit

WARNING

Health hazard through poisoning from toxic contaminated components or devices

Toxic process media result in contamination of devices or parts of them. During maintenance work, there is a risk to health from contact with these poisonous substances. Illegal disposal of toxic substances causes environmental damage.

- ▶ Take suitable safety precautions and prevent health hazards or environmental pollution by toxic process media.
- ▶ Decontaminate affected parts before carrying out maintenance work.
- ▶ Wear protective equipment.

Procedure for a longer downtime of the turbopump (> 1 year)

1. Remove the turbopump from the vacuum system if necessary.
2. Drain the operating fluid from the turbopump.
3. Drain and dry the cooling water system of the turbopump.
4. Close the high vacuum flange of the turbopump.
5. Evacuate the turbopump via the fore-vacuum connection.
6. Vent the turbopump via the venting connection with dry, oil-free air or inert gas.
7. Close all flange openings with the original protective caps.
8. Store the turbopump with the vertical rotary axis in its permissible spatial position.
9. Store the turbopump indoors only, within the specified temperature range.
10. In rooms with humid or aggressive atmospheres: Hermetically seal the turbopump together with a drying agent in a plastic bag.

Vorgehensweise für ein längeres Stillsetzen der Turbopumpe (> 1 Jahr)

1. Bauen Sie die Turbopumpe ggf. aus dem Vakuumsystem aus.
2. Lassen Sie das Betriebsmittel der Turbopumpe ab.
3. Entleeren und trocknen Sie das Kühlwassersystem der Turbopumpe.
4. Verschließen Sie den Hochvakuumflansch der Turbopumpe.
5. Evakuieren Sie die Turbopumpe über den Vorvakuumanschluss.
6. Belüften Sie die Turbopumpe über den Flutanschluss mit trockener, ölfreier Luft oder Inertgas.
7. Verschließen Sie die Flanschöffnungen mit den Original-Schutzdeckeln.
8. Lagern Sie die Turbopumpe mit senkrecht stehender Rotorachse in ihrer zulässigen Raumlage.
9. Lagern Sie die Turbopumpe nur in Innenräumen im angegebenen Temperaturbereich.
10. In Räumen mit feuchter oder aggressiver Atmosphäre: Schweißen Sie die Turbopumpe zusammen mit einem Trockenmittel in einen Kunststoffbeutel luftdicht ein.

8.2 Recommissioning

NOTICE

Risk of damage to the turbopump as a result of operating fluid aging after recommissioning

The shelf life of the operating fluid of the turbopump is limited. Aging of the operating fluid may lead to the failure of the ball bearing and cause damage to the turbopump.

- ▶ Pay attention to when the operating fluid must be changed:
 - after maximum 2 years without operation,
 - after maximum 4 years combined operation and downtimes.
- ▶ Observe the maintenance instructions and inform Pfeiffer Vacuum Service.

Procedures for recommissioning the turbopump

1. Check the turbopump for pollution and moisture.
2. Clean the turbopump exterior with a lint-free cloth and a little isopropanol.
3. If necessary, arrange for Pfeiffer Vacuum Service to completely clean the turbopump.

4. Observe the total running time of the turbopump and if necessary, arrange for Pfeiffer Vacuum Service to replace the bearing.
5. Change the turbopump's operating fluid.
6. Install the turbopump according to these instructions ([see chapter "Installation", page 24](#)).
7. Recommission the turbopump according to these instructions .

9 Recycling and disposal

WARNING

Health hazard through poisoning from toxic contaminated components or devices

Toxic process media result in contamination of devices or parts of them. During maintenance work, there is a risk to health from contact with these poisonous substances. Illegal disposal of toxic substances causes environmental damage.

- ▶ Take suitable safety precautions and prevent health hazards or environmental pollution by toxic process media.
- ▶ Decontaminate affected parts before carrying out maintenance work.
- ▶ Wear protective equipment.



Environmental protection

You **must** dispose of the product and its components in accordance with all applicable regulations for protecting people, the environment and nature.

- Help to reduce the wastage of natural resources.
- Prevent contamination.



Environmental protection

The product and its components **must be disposed of in accordance with the applicable regulations relating to environmental protection and human health**, with a view to reducing natural resource wastage and preventing pollution.

9.1 General disposal information

Pfeiffer Vacuum products contain materials that you must recycle.

- ▶ Dispose of our products according to the following:
 - Iron
 - Aluminium
 - Copper
 - Synthetic
 - Electronic components
 - Oil and fat, solvent-free
- ▶ Observe the special precautionary measures when disposing of:
 - Fluoroelastomers (FKM)
 - Potentially contaminated components that come into contact with media

9.2 Dispose of turbopumps

Pfeiffer Vacuum turbopumps contain materials that you must recycle.

1. Remove the complete operating fluid reservoir.
2. Remove the electronic drive unit.
3. Decontaminate components that come into contact with process gases.
4. Separate the components into recyclable materials.
5. Recycle the non-contaminated components.
6. Dispose of the product or components in a safe manner according to locally applicable regulations.

10 Malfunctions

WARNING

Danger to life from electric shock in the event of a fault

In the event of a fault, devices connected to the mains may be live. There is a danger to life from electric shock when making contact with live components.

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

WARNING

Danger to life from the turbopump breaking away in the event of a fault

Sudden jamming of the rotor generates high destructive torques in accordance with ISO 27892. If the turbopump is **not** properly secured, it can shear off. The energy that this would release could throw the entire turbopump or shattered pieces from its interior through the surrounding space. Potentially dangerous gases can escape. There is a risk of very serious injuries, including death, and extensive property damage.

- ▶ Follow the installation instructions for this turbopump.
- ▶ Observe the requirements regarding stability and design of the counter flange.
- ▶ Use only original accessories or fixing material approved by Pfeiffer Vacuum for the installation.

WARNING

Risk of injury caused by the turbopump breaking away with the vibration compensator in the event of a malfunction

Sudden jamming of the rotor generates high destructive torques in accordance with ISO 27892. When using a vibration compensator, this will probably lead to the turbopump being sheared off in use. The energy that this would release could throw the entire turbopump or shattered pieces from its interior through the surrounding space. Potentially dangerous gases can escape. There is a risk of very serious injuries, including death, and extensive property damage.

- ▶ Take suitable safety precautions on-site for the compensation of the occurring torques.
- ▶ Before installing a vibration compensator, you must first of all contact Pfeiffer Vacuum.

WARNING

Danger to life from poisoning where toxic process media leak from damaged connections

Sudden twisting of the turbopump in the event of a fault causes fittings to accelerate. There is the risk of damaging on-site connections (e.g., fore-vacuum line) and resulting leaks. This results in leakage of process media. In processes involving toxic media, there is a risk of injury and danger to life due to poisoning.

- ▶ Keep masses connected to the turbopump as low as possible.
- ▶ Use flexible lines to connect to the turbopump where necessary.

Should malfunctions occur, you can find information about potential causes and how to fix them here. The operating manual of the associated electronic drive unit contains more detailed error descriptions.

Problem	Possible causes	Remedy
Turbopump will not start up; none of the built-in LEDs on the electronic drive unit light up	• Current supply interrupted	• Check the plug contacts on the power supply pack. • Check the current supply lines.
	• Incorrect operating voltage	• Observe the electronic drive unit rating plate. • Supply the correct operating voltage.
	• No operating voltage present	• Supply the correct operating voltage.
	• Electronic drive unit defective	• Replace the electronic drive unit. • Contact Pfeiffer Vacuum Service.

Turbopump will not start up; green LED on the electronic drive unit is flashing	• For operation without control unit: Pins 1-3, 1-4 and 1-14 on the "remote" connection are not connected	• Connect the connections according to the electronic drive unit connection diagram. • Install the mating plug from the shipment.
	• For operation via RS-485: The bridge between pins 1 and 14 inhibits control commands	• Remove the bridge at the "remote" connection. • Remove the mating plug from the electronic drive unit.
	• For operation via RS-485: Parameters not set in the electronic drive unit	• Set the parameters [P: 010] and [P: 023] via the interface RS-485 to 1 = "ON".
	• Voltage drop in the cable is too high	• Check the connection cable. • Use a suitable connection cable.
Turbopump fails to reach the nominal rotation speed within the set run-up time	• fore-vacuum pressure too high	• Check backup pump compatibility (see technical data). • Check that the backup pump is working.
	• Leakage on the turbopump	• Carry out leak detection. • Check seals and flange connections. • Eliminate leaks.
	• Gas throughput too high	• Reduce the process gas load.
	• Rotor not running smoothly, defective bearing	• Check the turbopump for noise development • Contact Pfeiffer Vacuum Service.
	• Run-up time setpoint adjusted too low	• Extend the run-up time setpoint [P:700] via a display and control unit.
	Thermal load due to: • lack of ventilation • water flow too low • fore-vacuum pressure too high • ambient temperature too high	• Reduce the thermal load. — Ensure adequate air supply. — Adjust the cooling water flow. — Reduce the fore-vacuum pressure. — Adapt the ambient conditions.
Turbopump not achieving the ultimate pressure	• Turbopump is polluted	• Heat the turbopump if required. • Have it cleaned. • Contact Pfeiffer Vacuum Service.
	• Vacuum chamber, pipes or turbopump leaking	• Carry out leak detection starting from the vacuum chamber. • Check seals and flange connections. • Eliminate leaks in the vacuum system.
Unusual noises during operation	• Rotor bearing damaged	• Contact Pfeiffer Vacuum Service.
	• Rotor damaged	• Contact Pfeiffer Vacuum Service.
	• Splinter shield or protective screen loose	• Check and correct the seat of the splinter shield or protective screen in the high vacuum flange. • Follow the installation instructions.
Red LED on the electronic drive unit illuminates	• Group error	• Reset the malfunction by switching the current supply off and on. • Reset the malfunction with V+ on pin 13 on the "remote" connection. • Set the parameter [P: 009] via the interface RS-485 to 1 = Malfunction acknowledgment. • Set the parameter [P: 010] via the interface RS-485 to 0 = off and then 1 = On and Malfunction acknowledgment. • Carry out a differentiated malfunction analysis with a display and control unit. • Contact Pfeiffer Vacuum Service.

TbL 16: Troubleshooting turbopumps

11 Service solutions by Pfeiffer Vacuum

We offer first-class service

High vacuum component service life, in combination with low downtime, are clear expectations that you place on us. We meet your needs with efficient products and outstanding service.

We are always focused on perfecting our core competence – servicing of vacuum components. Once you have purchased a product from Pfeiffer Vacuum, our service is far from over. This is often exactly where service begins. Obviously, in proven Pfeiffer Vacuum quality.

Our professional sales and service employees are available to provide you with reliable assistance, worldwide. Pfeiffer Vacuum offers an entire range of services, from original replacement parts to service contracts.

Make use of Pfeiffer Vacuum service

Whether preventive, on-site service carried out by our field service, fast replacement with mint condition replacement products, or repair carried out in a Service Center near you – you have various options for maintaining your equipment availability. You can find more detailed information and addresses on our homepage, in the Pfeiffer Vacuum Service section.

You can obtain advice on the optimal solution for you, from your Pfeiffer Vacuum representative.

For fast and smooth service process handling, we recommend the following:



1. Download the up-to-date form templates.
 - Explanations of service requests
 - Service requests
 - Contamination declaration



- a) Remove and store all accessories (all external parts, such as valves, protective screens, etc.).
- b) If necessary, drain operating fluid/lubricant.
- c) If necessary, drain coolant.
2. Complete the service request and contamination declaration.



3. Send the forms by email, fax, or post to your local Service Center.

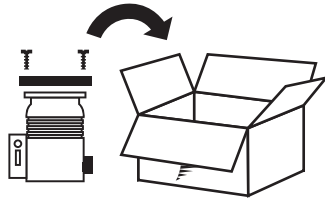


4. You will receive an acknowledgment from Pfeiffer Vacuum.

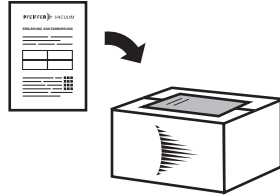
PFEIFFER VACUUM

Submission of contaminated products

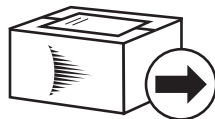
No microbiological, explosive, or radiologically contaminated products will be accepted. Where products are contaminated, or the contamination declaration is missing, Pfeiffer Vacuum will contact you before starting service work. Depending on the product and degree of pollution, **additional decontamination costs** may be incurred.



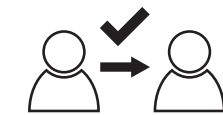
5. Prepare the product for transport in accordance with the provisions in the contamination declaration.
 - a) Neutralize the product with nitrogen or dry air.
 - b) Seal all openings with blind flanges, so that they are airtight.
 - c) Shrink-wrap the product in suitable protective foil.
 - d) Package the product in suitable, stable transport containers only.
 - e) Maintain applicable transport conditions.



6. Attach the contamination declaration to the **outside** of the packaging.



7. Now send your product to your local Service Center.



8. You will receive an acknowledgment/quotation, from Pfeiffer Vacuum.

PFEIFFER VACUUM

Our sales and delivery conditions and repair and maintenance conditions for vacuum devices and components apply to all service orders.

12 Spare parts

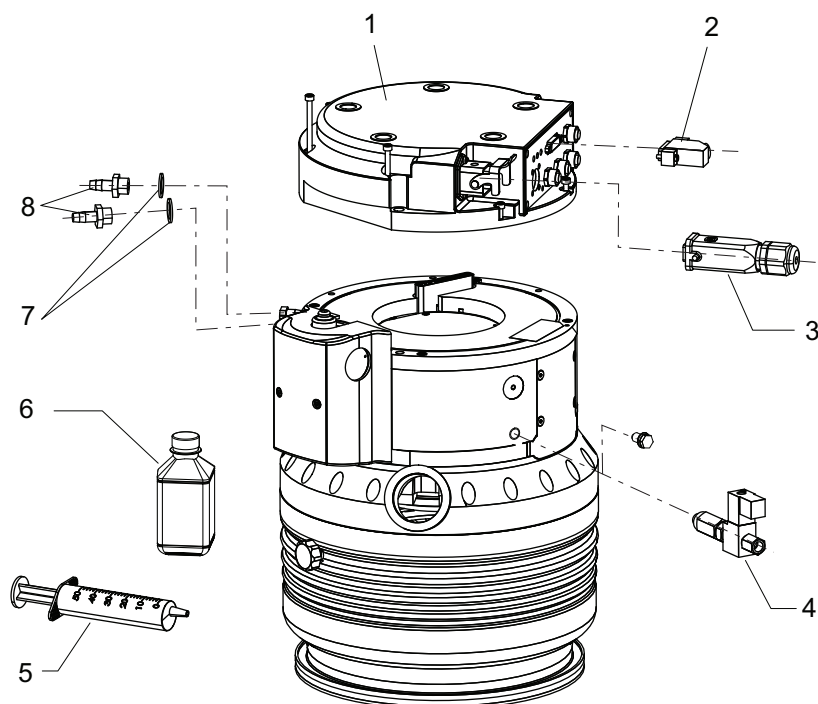


Fig. 29: Spare parts HiPace 1200

Position	Designation	Size	order number	Note	Pieces	Quantity
1	Electronic drive unit TC 1200		refer to the rating plate	depending on the connection panel	1	
2	"remote" mating plug		PM 061 378 -X	with solder tags	1	
3	Supply socket	HAN 3	PM 061 200 -T		1	
4	Sealing gas valve	17.5 – 20 sccm	PM Z01 313		1	
5	Syringe	50 ml	PM 006 915 -U		1	
6	Operating fluid F3	50 ml	PM 006 336 -T	Other lengths on request	1	
7	Sealing ring		P 3529 145 -A	for threaded nozzle	2	
8	Threaded nozzle	1/4" thread	P 0998 067	for inner hose diameter 7 to 8 mm	2	

Tbl. 17: Available spare parts

13 Accessories



View the [range of accessories for hybrid bearing turbopumps](#) on our website.

13.1 Accessory information

Fixing materials

Type-specific assembled packages, with centering ring and seal, ensure the secure fastening of the vacuum pump. Optionally with splinter shield or protective screen.

Power supply packs and display units

Power supply packs for optimal voltage supply of Pfeiffer Vacuum products are characterized by their compact size and adapted power supply with maximum reliability. Display and operating units are used to check and adjust operating parameters.

Cable and adapter

Mains, interface, connection, and extension cables provide a secure and suitable connection. Different lengths on request.

Venting accessories

A Pfeiffer Vacuum venting valve offers maximum operating and process security. Automatic control through the integrated electronic drive unit of the turbopump.

Sealing gas supply

Sealing gas is used to protect the vacuum pump from dusty and corrosive processes, or excessive gas throughputs. Sealing gas prevents the ingress of damaging substances into the motor and bearing area. The supply is carried out either via a sealing gas valve or a sealing gas throttle without control.

Air cooling

For processes with low gas throughputs and good fore-vacuum pressure, air cooling can be used independently of a water supply. Automatic control through the integrated electronic drive unit of the turbopump.

Heating

Heating jackets enable the ultimate pressure to be reached more quickly during process cleaning. Automatic control through the integrated electronic drive unit of the turbopump.

Backing pump control

The electronic drive unit of the turbopump enables useful control of backing pumps. Depending on the backing pump used, different operating modes are available.

Integrated pressure measurement

Evaluation and control by the integrated electronic drive unit, independently of an additional power supply.

13.2 Ordering accessories

Benennung	Bestellnummer
Mounting kit for HiPace 1200, DN 200 ISO-K, including coated centering ring, bracket screws	PM 016 390 -T
Mounting kit for HiPace 1200, DN 200 ISO-K, including coated centering ring, splinter shield, bracket screws	PM 016 391 -T
Mounting kit for HiPace 1200, DN 200 ISO-K, including coated centering ring, protection screen, bracket screws	PM 016 392 -T
Mounting kit for DN 200 ISO-K to ISO-F, with collar flange, coated centering ring, hexagon bolts	PM 016 960 -T
Mounting kit for DN 200 ISO-K to ISO-F, with collar flange, coated centering ring with splinter shield, hexagon bolts	PM 016 961 -T

Benennung	Bestellnummer
Mounting kit for DN 200 ISO-K to ISO-F, with collar flange, coated centering ring with protection screen, hexagon bolts	PM 016 962 -T
Mounting kit for DN 200 ISO-K to ISO-F, with collar flange, coated centering ring, stud screws	PM 016 965 -T
Mounting kit for DN 200 ISO-K to ISO-F, with collar flange, coated centering ring with splinter shield, stud screws	PM 016 966 -T
Mounting kit for DN 200 ISO-K to ISO-F, with collar flange, coated centering ring with protection screen, stud screws	PM 016 967 -T
Mounting kit for HiPace DN 200 ISO-F, including coated centering ring, hexagon screws	PM 016 470 -T
Mounting kit for DN 200 ISO-F, including coated centering ring, splinter shield, hexagon screws	PM 016 471 -T
Mounting kit for DN 200 ISO-F, including coated centering ring, protective screen, hexagon screws	PM 016 472 -T
Mounting kit for DN 200 ISO-F, including coated centering ring, stud screws	PM 016 475 -T
Mounting kit for DN 200 ISO-F, including coated centering ring, splinter shield, stud screws	PM 016 476 -T
Mounting kit for DN 200 ISO-F, including coated centering ring, protective screen, stud screws	PM 016 477 -T
Hexagon Screw Set for Flanges with Through-Holes, DN 200 CF-F	PM 016 687 -T
Set of stud screws for flanges with a threaded hole, DN 200 CF-F	PM 016 688 -T
Set of stud screws for flanges with through-hole, DN 200 CF-F	PM 016 736 -T
Centering ring with multifunction coating, DN 200 ISO-K/-F	PM 016 220 -U
Centering ring with multifunction coating and integrated splinter shield, DN 200 ISO-K/-F	PM 016 221 AU
Centering ring with multifunction coating and integrated protection screen, DN 200 ISO-K/-F	PM 016 222 AU
Elastomer seal, FKM, DN 200 CF	402DFL200-S2
Elastomer seal, FKM, DN 200 CF	402DFL200-Z
Copper Gasket, Vacuum-annealed, DN 200 CF	490DFL200-G-S5
Copper Gasket, OFHC-copper, DN 200 CF	490DFL200-S5
Copper Gasket, Silver-plated, Vacuum-Annealed, DN 200 CF	490DFL200-S-G-S5
Copper Gasket, Silver-Plated, DN 200 CF	490DFL200-S-S5
Vibration damper for HiPace 800/1200/1800, DN 200 ISO-K/F	PM 006 668 -X
Vibration damper for HiPace 800/1200, DN 200 CF-F	PM 006 669 -X
Splinter shield for turbopumps, DN 200 CF-F	PM 016 321
Protection screen for DN 200 CF-F	PM 016 342
Mains cable 230 V AC, CEE 7/7 to HAN 3A, 3 m	P 4564 309 HA
Mains cable 208 V AC, NEMA 6-15 to HAN 3A, 3 m	P 4564 309 HB
Mains cable 115 V AC, NEMA 5-15 to HAN 3A, 3 m	PM 061 187 -X
RJ 45 interface cable on M12 for HiPace	PM 051 726 -T
HPU 001, Handheld Programming Unit	PM 051 510 -T
DCU 002, Display Control Unit	PM 061 348 AT
Y-distributor M12 to RS-485	P 4723 010
Y-Connector, shielded, M12 for accessories	P 4723 013
USB RS-485 converter	PM 061 207 -T
Interface cable, M12 m straight/M12 m straight, 3 m	PM 061 283 -T
Venting valve, shielded, 24 V DC, G 1/8", for connection to TC 400/1200 and TM 700	PM Z01 291
Sealing gas monitoring unit G 1/8"	PM 016 911 -U
Sealing gas valve, shielded, HiPace 400/700/800 P with TC 400 and HiPace 1200–2300 with TC 1200	PM Z01 313
Sealing gas throttle for HiPace 400/700/800 P version and HiPace 1200–2300	PM Z01 318
Sealing gas throttle for HiPace 1200–2300	PM Z01 319

Benennung	Bestellnummer
Sealing gas throttle for HiPace 1200–2300, 52.5 ± 7.5 sccm	PM Z01 325
Relay box, shielded, for backing pumps, 1-phase 7 A for TC 400/1200, TM 700 and TCP 350, M12	PM 071 284 -X
Relay box, shielded, for backing pumps, 1-phase 20 A for TC 400/1200, TM 700 and TCP 350, M12	PM 071 285 -X
TIC 010, adapter for two sensors	PT R70 000
RPT 010, digital Piezo/Pirani sensor	PT R71 100
IKT 010, digital cold cathode sensor, low current	PT R72 100
IKT 011, digital cold cathode sensor, high current	PT R73 100

Tbl. 18: Accessories

14 Technical data and dimensions

14.1 General

This section describes the basis for the technical data of Pfeiffer Vacuum turbopumps.



Technical data

Maximum values refer exclusively to the input as a single load.

- Specifications according to PNEUROP committee PN5
- ISO 27892 2010: "Vacuum technology - Turbomolecular pumps - Measurement of rapid shutdown torque"
- ISO 21360 2012: "Vacuum technology - Standard methods for measuring vacuum-pump performance - Part 1: General description"
- ISO 21360 2018: "Vacuum technology - Standard methods for measuring vacuum-pump performance - Part 4: Turbomolecular vacuum pumps"
- Ultimate pressure with test dome after 48 h bake out duration
- Gas throughput with water cooling; backing pump = rotary vane pump (10 m³/h)
- Cooling water consumption at maximum gas throughput, cooling water temperature 25 °C
- Integral leakage rate with 100 % helium concentration, 10 s measurement duration
- Sound pressure level at distance to vacuum pump = 1 m

	mbar	bar	Pa	hPa	kPa	Torr mm Hg
mbar	1	$1 \cdot 10^{-3}$	100	1	0.1	0.75
bar	1000	1	$1 \cdot 10^5$	1000	100	750
Pa	0.01	$1 \cdot 10^{-5}$	1	0.01	$1 \cdot 10^{-3}$	$7.5 \cdot 10^{-3}$
hPa	1	$1 \cdot 10^{-3}$	100	1	0.1	0.75
kPa	10	0.01	1000	10	1	7.5
Torr mm Hg	1.33	$1.33 \cdot 10^{-3}$	133.32	1.33	0.133	1

$$1 \text{ Pa} = 1 \text{ N/m}^2$$

Tbl. 19: Conversion table: Pressure units

	mbar l/s	Pa m ³ /s	sccm	Torr l/s	atm cm ³ /s
mbar l/s	1	0.1	59.2	0.75	0.987
Pa m ³ /s	10	1	592	7.5	9.87
sccm	$1.69 \cdot 10^{-2}$	$1.69 \cdot 10^{-3}$	1	$1.27 \cdot 10^{-2}$	$1.67 \cdot 10^{-2}$
Torr l/s	1.33	0.133	78.9	1	1.32
atm cm ³ /s	1.01	0.101	59.8	0.76	1

Tbl. 20: Conversion table: Units for gas throughput

14.2 Technical data

Selection field	HiPace® 1200 with TC 1200, DN 200 ISO-K	HiPace® 1200 with TC 1200, DN 200 ISO-F	HiPace® 1200 with TC 1200, DN 200 CF-F
Part number	PM P03 910	PM P03 911	PM P03 912
Connection flange (in)	DN 200 ISO-K	DN 200 ISO-F	DN 200 CF-F
Connection flange (out)	DN 40 ISO-KF	DN 40 ISO-KF	DN 40 ISO-KF
Final pressure according to PNEUROP	$< 1 \cdot 10^{-7}$ hPa	$< 1 \cdot 10^{-7}$ hPa	$< 5 \cdot 10^{-10}$ hPa
Pumping speed for Ar	1200 l/s	1200 l/s	1200 l/s
Pumping speed for H ₂	1100 l/s	1100 l/s	1100 l/s
Pumping speed for He	1300 l/s	1300 l/s	1300 l/s

Selection field	HiPace® 1200 with TC 1200, DN 200 ISO-K	HiPace® 1200 with TC 1200, DN 200 ISO-F	HiPace® 1200 with TC 1200, DN 200 CF-F
Pumping speed for N ₂	1250 l/s	1250 l/s	1250 l/s
Gas throughput at final rotation speed for Ar	11 hPa·l/s	11 hPa·l/s	6 hPa·l/s
Gas throughput at final rotation speed for H ₂	> 30 hPa·l/s	> 30 hPa·l/s	> 30 hPa·l/s
Gas throughput at final rotation speed for He	> 30 hPa·l/s	> 30 hPa·l/s	16 hPa·l/s
Gas throughput at final rotation speed for N ₂	20 hPa·l/s	20 hPa·l/s	16 hPa·l/s
Fore-vacuum max. for N ₂	2 hPa	2 hPa	2 hPa
Fore-vacuum max. for Ar	2.5 hPa	2.5 hPa	2.5 hPa
Fore-vacuum max. for H ₂	0.25 hPa	0.25 hPa	0.25 hPa
Fore-vacuum max. for He	0.9 hPa	0.9 hPa	0.9 hPa
Compression ratio for Ar	> 1 · 10 ⁸	> 1 · 10 ⁸	> 1 · 10 ⁸
Compression ratio for H ₂	6 · 10 ³	6 · 10 ³	6 · 10 ³
Compression ratio for He	2 · 10 ⁵	2 · 10 ⁵	2 · 10 ⁵
Compression ratio for N ₂	> 1 · 10 ⁸	> 1 · 10 ⁸	> 1 · 10 ⁸
Performance curve in gas mode 0, vertex C	578/37800 W/min ⁻¹	578/37800 W/min ⁻¹	406/37800 W/min ⁻¹
Performance curve in gas mode 0, vertex D	717/29400 W/min ⁻¹	717/29400 W/min ⁻¹	616/11280 W/min ⁻¹
Performance curve in gas mode 1, vertex A	710/37800 W/min ⁻¹	710/37800 W/min ⁻¹	540/37800 W/min ⁻¹
Performance curve in gas mode 1, vertex B	750/35400 W/min ⁻¹	750/35400 W/min ⁻¹	756/14400 W/min ⁻¹
Rotation speed ± 2 %	37800 rpm	37800 rpm	37800 rpm
Rotation speed variable	50 – 100 %	50 – 100 %	50 – 100 %
Run-up time	2.5 min	2.5 min	2.5 min
Sound pressure level	≤50 dB(A)	≤50 dB(A)	≤50 dB(A)
Integral leakage rate	< 1 · 10 ⁻⁸ Pa m ³ /s	< 1 · 10 ⁻⁸ Pa m ³ /s	< 1 · 10 ⁻⁸ Pa m ³ /s
Venting connection	G 1/8"	G 1/8"	G 1/8"
Max. connection pressure (abs.) for venting/sealing gas valve	1500 hPa	1500 hPa	1500 hPa
Electronic drive unit	TC 1200	TC 1200	TC 1200
Mains connection: voltage (range)	100 – 120/200 – 240 V AC	100 – 120/200 – 240 V AC	100 – 120/200 – 240 V AC
Mains connection: frequency (range)	50/60 Hz	50/60 Hz	50/60 Hz
Power consumption max.	1350 VA	1350 VA	1350 VA
Current, max.	10 A	10 A	10 A
Cooling water connection	G 1/4"	G 1/4"	G 1/4"
Cooling method	Water	Water	Water
Cooling water temperature	15 – 35 °C	15 – 35 °C	15 – 35 °C
Cooling water flow	100 l/h	100 l/h	100 l/h
Permissible radial magnetic field max.	6 mT	6 mT	6 mT
Protection degree	IP54	IP54	IP54
Relative humidity of air	5 – 85 %, non-condensing	5 – 85 %, non-condensing	5 – 85 %, non-condensing
Mounting orientation	0° (HV flange top) – 90°	0° (HV flange top) – 90°	0° (HV flange top) – 90°
Weight	30 kg	31.9 kg	41 kg

TbI. 21: Technical data for HiPace 1200 Standard

Selection field	HiPace® 1200 U with TC 1200, DN 200 ISO-K	HiPace® 1200 U with TC 1200, DN 200 ISO-F	HiPace® 1200 U with TC 1200, DN 200 CF-F
Part number	PM P03 913	PM P03 914	PM P03 915
Connection flange (in)	DN 200 ISO-K	DN 200 ISO-F	DN 200 CF-F
Connection flange (out)	DN 40 ISO-KF	DN 40 ISO-KF	DN 40 ISO-KF
Final pressure according to PNEUROP	$< 1 \cdot 10^{-7}$ hPa	$< 1 \cdot 10^{-7}$ hPa	$< 5 \cdot 10^{-10}$ hPa
Pumping speed for Ar	1200 l/s	1200 l/s	1200 l/s
Pumping speed for H ₂	1100 l/s	1100 l/s	1100 l/s
Pumping speed for He	1300 l/s	1300 l/s	1300 l/s
Pumping speed for N ₂	1250 l/s	1250 l/s	1250 l/s
Gas throughput at final rotation speed for Ar	11 hPa·l/s	11 hPa·l/s	6 hPa·l/s
Gas throughput at final rotation speed for H ₂	> 30 hPa·l/s	> 30 hPa·l/s	> 30 hPa·l/s
Gas throughput at final rotation speed for He	> 30 hPa·l/s	> 30 hPa·l/s	16 hPa·l/s
Gas throughput at final rotation speed for N ₂	20 hPa·l/s	20 hPa·l/s	16 hPa·l/s
Fore-vacuum max. for N ₂	2 hPa	2 hPa	2 hPa
Fore-vacuum max. for Ar	2.5 hPa	2.5 hPa	2.5 hPa
Fore-vacuum max. for H ₂	0.25 hPa	0.25 hPa	0.25 hPa
Fore-vacuum max. for He	0.9 hPa	0.9 hPa	0.9 hPa
Compression ratio for Ar	$> 1 \cdot 10^8$	$> 1 \cdot 10^8$	$> 1 \cdot 10^8$
Compression ratio for H ₂	$6 \cdot 10^3$	$6 \cdot 10^3$	$6 \cdot 10^3$
Compression ratio for He	$2 \cdot 10^5$	$2 \cdot 10^5$	$2 \cdot 10^5$
Compression ratio for N ₂	$> 1 \cdot 10^8$	$> 1 \cdot 10^8$	$> 1 \cdot 10^8$
Performance curve in gas mode 0, vertex C	578/37800 W/min ⁻¹	578/37800 W/min ⁻¹	406/37800 W/min ⁻¹
Performance curve in gas mode 0, vertex D	717/29400 W/min ⁻¹	717/29400 W/min ⁻¹	616/11280 W/min ⁻¹
Performance curve in gas mode 1, vertex A	710/37800 W/min ⁻¹	710/37800 W/min ⁻¹	540/37800 W/min ⁻¹
Performance curve in gas mode 1, vertex B	750/35400 W/min ⁻¹	750/35400 W/min ⁻¹	756/14400 W/min ⁻¹
Rotation speed ± 2 %	37800 rpm	37800 rpm	37800 rpm
Rotation speed variable	50 – 100 %	50 – 100 %	50 – 100 %
Run-up time	2.5 min	2.5 min	2.5 min
Sound pressure level	≤ 50 dB(A)	≤ 50 dB(A)	≤ 50 dB(A)
Integral leakage rate	$< 1 \cdot 10^{-8}$ Pa m ³ /s	$< 1 \cdot 10^{-8}$ Pa m ³ /s	$< 1 \cdot 10^{-8}$ Pa m ³ /s
Venting connection	G 1/8"	G 1/8"	G 1/8"
Max. connection pressure (abs.) for venting/sealing gas valve	1500 hPa	1500 hPa	1500 hPa
Electronic drive unit	TC 1200	TC 1200	TC 1200
Mains connection: voltage (range)	100 – 120/200 – 240 V AC	100 – 120/200 – 240 V AC	100 – 120/200 – 240 V AC
Mains connection: frequency (range)	50/60 Hz	50/60 Hz	50/60 Hz
Power consumption max.	1350 VA	1350 VA	1350 VA
Current, max.	10 A	10 A	10 A
Cooling water connection	G 1/4"	G 1/4"	G 1/4"
Cooling method	Water	Water	Water
Cooling water temperature	15 – 35 °C	15 – 35 °C	15 – 35 °C
Cooling water flow	100 l/h	100 l/h	100 l/h
Permissible radial magnetic field max.	6 mT	6 mT	6 mT

Selection field	HiPace® 1200 U with TC 1200, DN 200 ISO-K	HiPace® 1200 U with TC 1200, DN 200 ISO-F	HiPace® 1200 U with TC 1200, DN 200 CF-F
Protection degree	IP54	IP54	IP54
Relative humidity of air	5 – 85 %, non-condensing	5 – 85 %, non-condensing	5 – 85 %, non-condensing
Mounting orientation	90° – 180° (HV flange bottom)	90° – 180° (HV flange bottom)	90° – 180° (HV flange bottom)
Weight	30 kg	31.9 kg	41 kg

Tbl. 22: Technical data for HiPace 1200 U

Selection field	HiPace® 1200 C with TC 1200, DN 200 ISO-K, corrosive	HiPace® 1200 C with TC 1200, DN 200 ISO-F, corrosive	HiPace® 1200 C with TC 1200, DN 200 CF-F, corrosive
Part number	PM P03 916	PM P03 917	PM P04 190
Connection flange (in)	DN 200 ISO-K	DN 200 ISO-F	DN 200 CF-F
Connection flange (out)	DN 40 ISO-KF	DN 40 ISO-KF	DN 40 ISO-KF
Final pressure according to PNEUROP	$< 1 \cdot 10^{-7}$ hPa	$< 1 \cdot 10^{-7}$ hPa	$< 5 \cdot 10^{-10}$ hPa
Pumping speed for Ar	1200 l/s	1200 l/s	1200 l/s
Pumping speed for H ₂	1100 l/s	1100 l/s	1100 l/s
Pumping speed for He	1300 l/s	1300 l/s	1300 l/s
Pumping speed for N ₂	1250 l/s	1250 l/s	1250 l/s
Gas throughput at final rotation speed for Ar	11 hPa·l/s	11 hPa·l/s	6 hPa·l/s
Gas throughput at final rotation speed for H ₂	> 30 hPa·l/s	> 30 hPa·l/s	> 30 hPa·l/s
Gas throughput at final rotation speed for He	> 30 hPa·l/s	> 30 hPa·l/s	16 hPa·l/s
Gas throughput at final rotation speed for N ₂	20 hPa·l/s	20 hPa·l/s	16 hPa·l/s
Fore-vacuum max. for N ₂	2 hPa	2 hPa	2 hPa
Fore-vacuum max. for Ar	2.5 hPa	2.5 hPa	2.5 hPa
Fore-vacuum max. for H ₂	0.25 hPa	0.25 hPa	0.25 hPa
Fore-vacuum max. for He	0.9 hPa	0.9 hPa	0.9 hPa
Compression ratio for Ar	$> 1 \cdot 10^8$	$> 1 \cdot 10^8$	$> 1 \cdot 10^8$
Compression ratio for H ₂	$6 \cdot 10^3$	$6 \cdot 10^3$	$6 \cdot 10^3$
Compression ratio for He	$2 \cdot 10^5$	$2 \cdot 10^5$	$2 \cdot 10^5$
Compression ratio for N ₂	$> 1 \cdot 10^8$	$> 1 \cdot 10^8$	$> 1 \cdot 10^8$
Performance curve in gas mode 0, vertex C	578/37800 W/min ⁻¹	578/37800 W/min ⁻¹	406/37800 W/min ⁻¹
Performance curve in gas mode 0, vertex D	717/29400 W/min ⁻¹	717/29400 W/min ⁻¹	616/11280 W/min ⁻¹
Performance curve in gas mode 1, vertex A	710/37800 W/min ⁻¹	710/37800 W/min ⁻¹	540/37800 W/min ⁻¹
Performance curve in gas mode 1, vertex B	750/35400 W/min ⁻¹	750/35400 W/min ⁻¹	756/14400 W/min ⁻¹
Rotation speed ± 2 %	37800 rpm	37800 rpm	37800 rpm
Rotation speed variable	50 – 100 %	50 – 100 %	50 – 100 %
Run-up time	2.5 min	2.5 min	2.5 min
Sound pressure level	≤ 50 dB(A)	≤ 50 dB(A)	≤ 50 dB(A)
Integral leakage rate	$< 1 \cdot 10^{-8}$ Pa m ³ /s	$< 1 \cdot 10^{-8}$ Pa m ³ /s	$< 1 \cdot 10^{-8}$ Pa m ³ /s
Venting connection	G 1/8"	G 1/8"	G 1/8"
Max. connection pressure (abs.) for venting/sealing gas valve	1500 hPa	1500 hPa	1500 hPa

Selection field	HiPace® 1200 C with TC 1200, DN 200 ISO-K, corrosive	HiPace® 1200 C with TC 1200, DN 200 ISO-F, corrosive	HiPace® 1200 C with TC 1200, DN 200 CF-F, corrosive
Electronic drive unit	TC 1200	TC 1200	TC 1200
Mains connection: voltage (range)	100 – 120/200 – 240 V AC	100 – 120/200 – 240 V AC	100 – 120/200 – 240 V AC
Mains connection: frequency (range)	50/60 Hz	50/60 Hz	50/60 Hz
Power consumption max.	1350 VA	1350 VA	1350 VA
Current consumption max.	10 A	10 A	10 A
Cooling water connection	G 1/4"	G 1/4"	G 1/4"
Cooling method, standard	Water	Water	Water
Cooling water temperature	15 – 35 °C	15 – 35 °C	15 – 35 °C
Cooling water flow	100 l/h	100 l/h	100 l/h
Permissible radial magnetic field max.	6 mT	6 mT	6 mT
Protection degree	IP54	IP54	IP54
Relative humidity of air	5 – 85 %, non-condensing	5 – 85 %, non-condensing	5 – 85 %, non-condensing
Mounting orientation	0° (HV flange top) – 90°	0° (HV flange top) – 90°	0° (HV flange top) – 90°
Weight	30 kg	31.9 kg	41 kg

Tbl. 23: Technical data for HiPace 1200 C

Selection field	HiPace® 1200 UC with TC 1200, DN 200 ISO-K, corrosive	HiPace® 1200 UC with TC 1200, DN 200 ISO-F, corrosive	HiPace® 1200 UC with TC 1200, DN 200 CF-F, corrosive
Part number	PM P03 918	PM P03 919	PM P04 191
Connection flange (in)	DN 200 ISO-K	DN 200 ISO-F	DN 200 CF-F
Connection flange (out)	DN 40 ISO-KF	DN 40 ISO-KF	DN 40 ISO-KF
Final pressure according to PNEUROP	$< 1 \cdot 10^{-7}$ hPa	$< 1 \cdot 10^{-7}$ hPa	$< 5 \cdot 10^{-10}$ hPa
Pumping speed for Ar	1200 l/s	1200 l/s	1200 l/s
Pumping speed for H ₂	1100 l/s	1100 l/s	1100 l/s
Pumping speed for He	1300 l/s	1300 l/s	1300 l/s
Pumping speed for N ₂	1250 l/s	1250 l/s	1250 l/s
Gas throughput at final rotation speed for Ar	11 hPa·l/s	11 hPa·l/s	6 hPa·l/s
Gas throughput at final rotation speed for H ₂	> 30 hPa·l/s	> 30 hPa·l/s	> 30 hPa·l/s
Gas throughput at final rotation speed for He	> 30 hPa·l/s	> 30 hPa·l/s	16 hPa·l/s
Gas throughput at final rotation speed for N ₂	20 hPa·l/s	20 hPa·l/s	16 hPa·l/s
Fore-vacuum max. for N ₂	2 hPa	2 hPa	2 hPa
Fore-vacuum max. for Ar	2.5 hPa	2.5 hPa	2.5 hPa
Fore-vacuum max. for H ₂	0.25 hPa	0.25 hPa	0.25 hPa
Fore-vacuum max. for He	0.9 hPa	0.9 hPa	0.9 hPa
Compression ratio for Ar	$> 1 \cdot 10^8$	$> 1 \cdot 10^8$	$> 1 \cdot 10^8$
Compression ratio for H ₂	$6 \cdot 10^3$	$6 \cdot 10^3$	$6 \cdot 10^3$
Compression ratio for He	$2 \cdot 10^5$	$2 \cdot 10^5$	$2 \cdot 10^5$
Compression ratio for N ₂	$> 1 \cdot 10^8$	$> 1 \cdot 10^8$	$> 1 \cdot 10^8$
Performance curve in gas mode 0, vertex C	578/37800 W/min ⁻¹	578/37800 W/min ⁻¹	406/37800 W/min ⁻¹
Performance curve in gas mode 0, vertex D	717/29400 W/min ⁻¹	717/29400 W/min ⁻¹	616/11280 W/min ⁻¹

Selection field	HiPace® 1200 UC with TC 1200, DN 200 ISO-K, corrosive	HiPace® 1200 UC with TC 1200, DN 200 ISO-F, corrosive	HiPace® 1200 UC with TC 1200, DN 200 CF-F, corrosive
Performance curve in gas mode 1, vertex A	710/37800 W/min ⁻¹	710/37800 W/min ⁻¹	540/37800 W/min ⁻¹
Performance curve in gas mode 1, vertex B	750/35400 W/min ⁻¹	750/35400 W/min ⁻¹	756/14400 W/min ⁻¹
Rotation speed ± 2 %	37800 rpm	37800 rpm	37800 rpm
Rotation speed variable	50 – 100 %	50 – 100 %	50 – 100 %
Run-up time	2.5 min	2.5 min	2.5 min
Sound pressure level	≤50 dB(A)	≤50 dB(A)	≤50 dB(A)
Integral leakage rate	< 1 · 10 ⁻⁸ Pa m ³ /s	< 1 · 10 ⁻⁸ Pa m ³ /s	< 1 · 10 ⁻⁸ Pa m ³ /s
Venting connection	G 1/8"	G 1/8"	G 1/8"
Max. connection pressure (abs.) for venting/sealing gas valve	1500 hPa	1500 hPa	1500 hPa
Electronic drive unit	TC 1200	TC 1200	TC 1200
Mains connection: voltage (range)	100 – 120/200 – 240 V AC	100 – 120/200 – 240 V AC	100 – 120/200 – 240 V AC
Mains connection: frequency (range)	50/60 Hz	50/60 Hz	50/60 Hz
Power consumption max.	1350 VA	1350 VA	1350 VA
Current consumption max.	10 A	10 A	10 A
Cooling water connection	G 1/4"	G 1/4"	G 1/4"
Cooling method, standard	Water	Water	Water
Cooling water temperature	15 – 35 °C	15 – 35 °C	15 – 35 °C
Cooling water flow	100 l/h	100 l/h	100 l/h
Permissible radial magnetic field max.	6 mT	6 mT	6 mT
Protection degree	IP54	IP54	IP54
Relative humidity of air	5 – 85 %, non-condensing	5 – 85 %, non-condensing	5 – 85 %, non-condensing
Mounting orientation	90° – 180° (HV flange bottom)	90° – 180° (HV flange bottom)	90° – 180° (HV flange bottom)
Weight	30 kg	31.9 kg	41 kg

Tbl. 24: Technical data for HiPace 1200 UC

14.3 Dimensions

Dimensions in mm

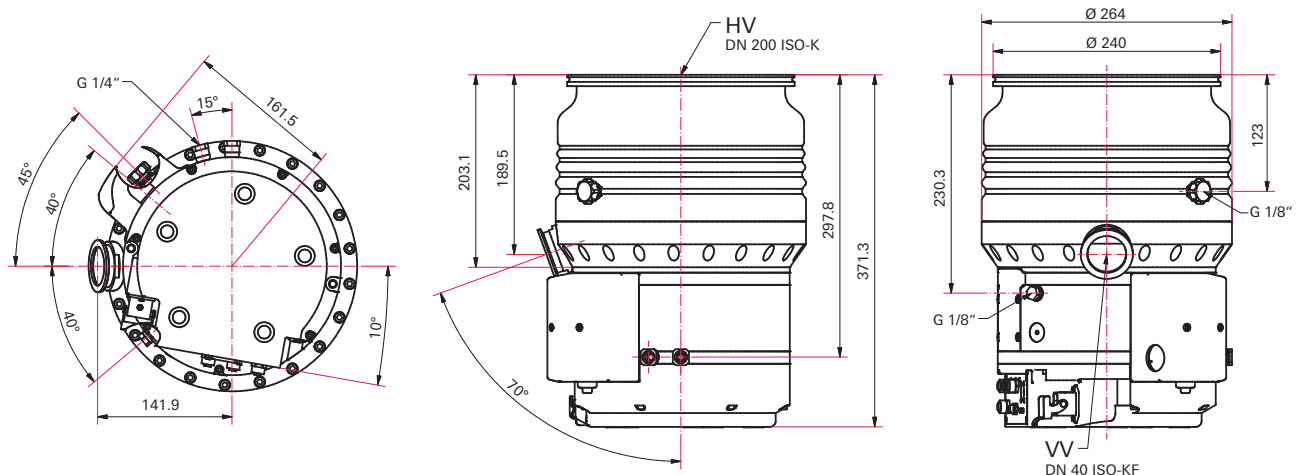
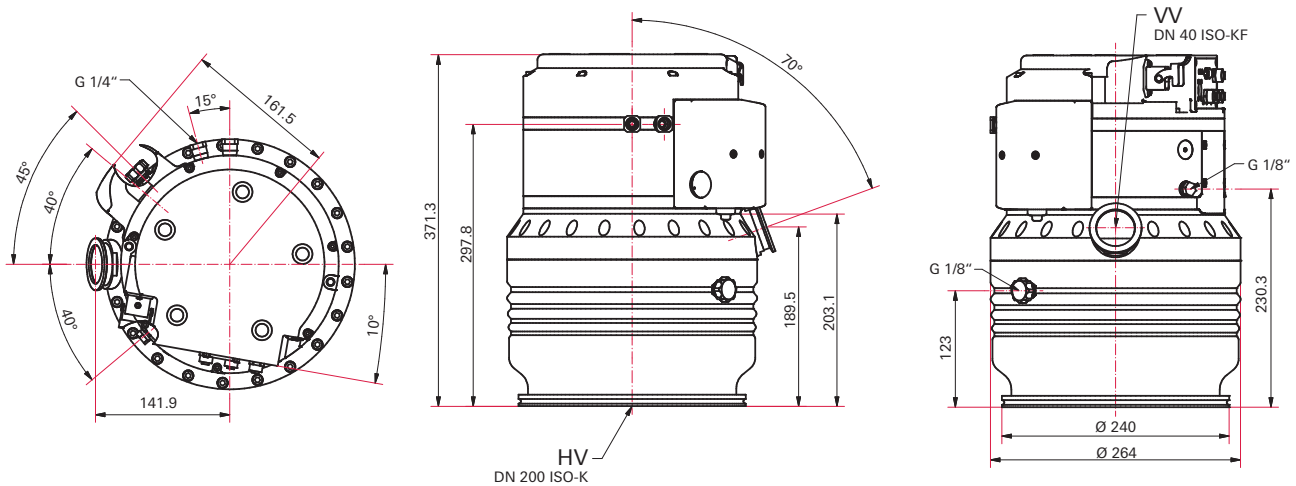
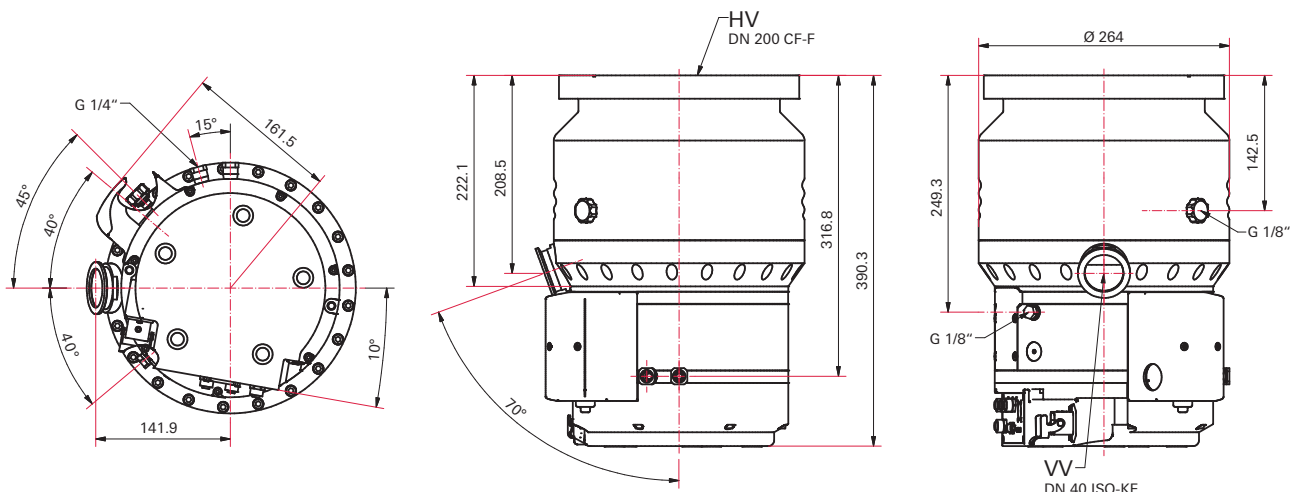
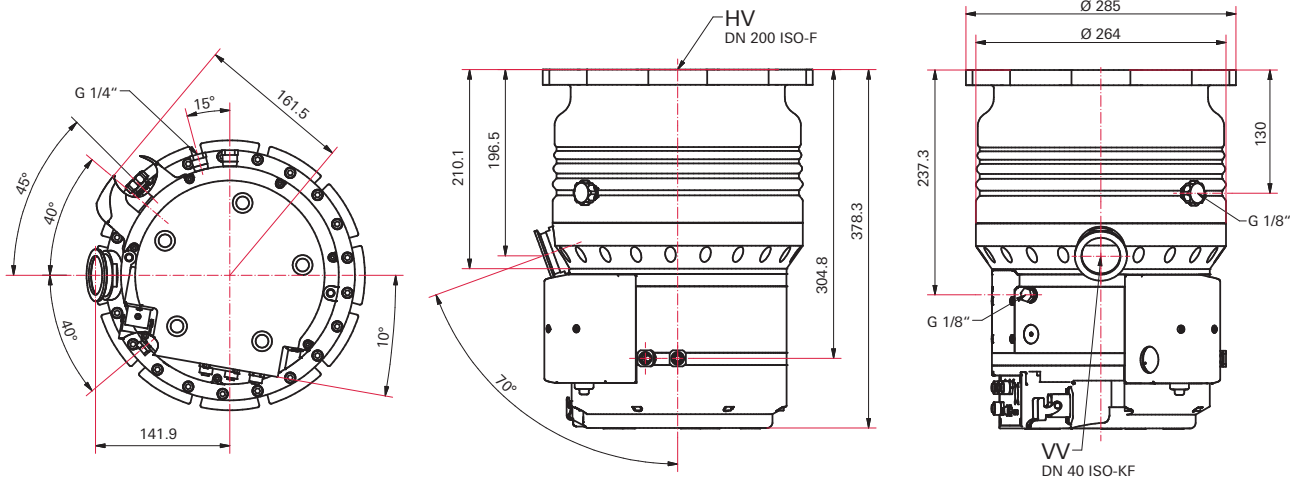


Fig. 30: HiPace 1200 | DN 200 ISO-K



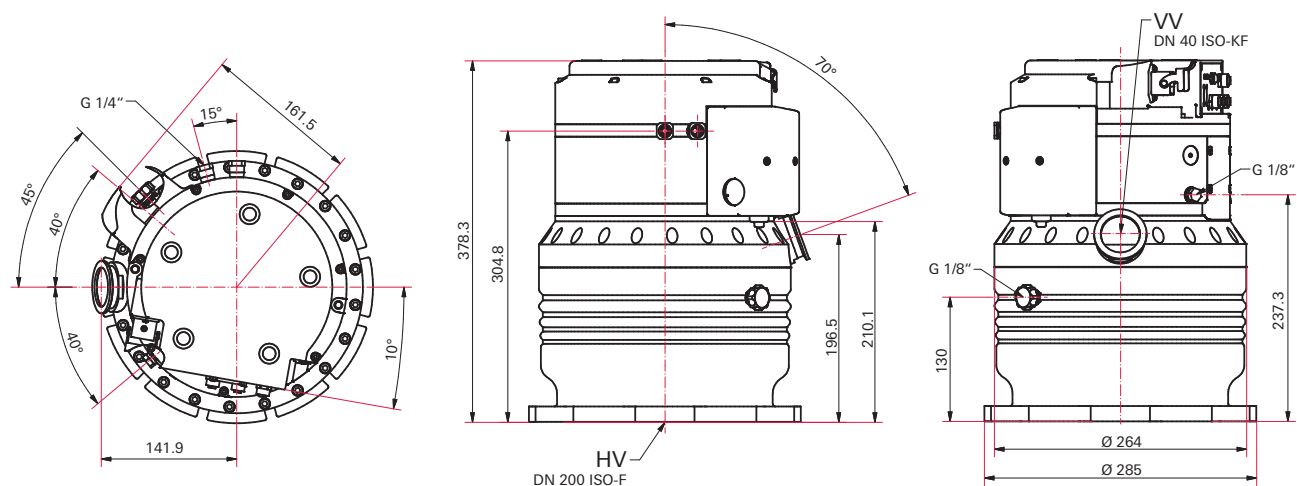


Fig. 34: HiPace 1200 U | DN 200 ISO-F

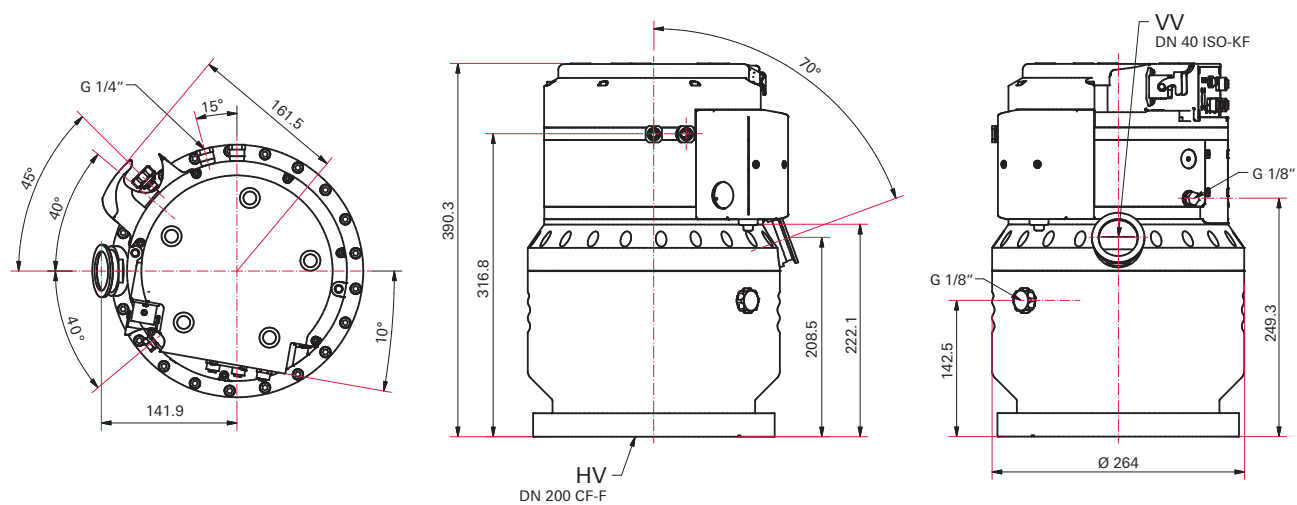


Fig. 35: HiPace 1200 U | DN 200 CF-F

Declaration of conformity

Declaration for product(s) of the type:

Turbopump

HiPace 1200

HiPace 1200 C

HiPace 1200 U

HiPace 1200 UC

We hereby declare that the listed product satisfies all relevant provisions of the following **European Directives**.

Machinery 2006/42/EC (Annex II, no. 1 A)

Electromagnetic compatibility 2014/30/EU

Restriction of the use of certain hazardous substances 2011/65/EU

Restriction of the use of certain hazardous substances, delegated directive 2015/863/EU

Harmonized standards and applied national standards and specifications:

DIN EN ISO 12100: 2011

ISO 21360-1: 2016

DIN EN 1012-2: 2011

ISO 21360-4: 2018

DIN EN 61000-3-2: 2015

DIN EN IEC 63000: 2019

DIN EN 61000-3-3: 2014

DIN EN 61010-1: 2011

DIN EN 61326-1: 2013

DIN EN 62061: 2013

The authorized representative for the compilation of technical documents is Mr. Tobias Stoll, Pfeiffer Vacuum GmbH, Berliner Straße 43, 35614 Asslar, Germany.

Signature:



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Asslar, 2020-02-24



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