OPERATING INSTRUCTIONS

EN

Translation of the Original

ATH 500 M - ATH 500 MT

Magnetically levitated turbopump

PFEIFFER VACUUM

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.

Copyright

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1 About this manual

IMPORTANT
Read carefully before use.
Keep the manual for future consultation.

1.1 Validity

These operating instructions are 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 these 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	Part number
Operating instructions for Profibus fieldbus	004432
Operating instructions for EtherCAT fieldbus	131580
48 VDC power supply operating instructions	127118
Declaration of conformity	included with these operating instructions

1.1.2 Products concerned

This document applies to products with the following part numbers:

Référence	Description
Vxxxxx00	ATH 500 M: pump models for light-duty applications
Vxxxxx05	ATH 500 M nickel plated model: pump models for heavy-duty applications
Vxxxxx03	ATH 500 MT: pump models for heavy-duty applications
Vxxxxx01	ATH 500 MT nickel plated model: pump models for heavy-duty applications

Option		V	x	x	x	x	x	x	x
Water valve in copper[1)]	MT					2		0	3
	MT nickel plated model					2		0	1
Water valve in inox[1)]	MT					3		0	3
	MT nickel plated model					3		0	1

1) see chapter « Spare parts »

Use the matrix to decode the product part numbers; not all combinations of options are available as products.

1.2 Target group

This user manual is intended for all persons in charge of transport, installation, commissioning/decommissioning, use, maintenance or storage of the product.

The work described in this document must only be carried out by persons with suitable technical training (specialized staff) or persons who have undergone Pfeiffer Vacuum training.

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. ...

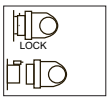
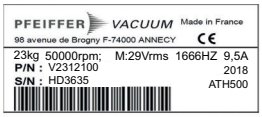
1.3.2 Pictographs

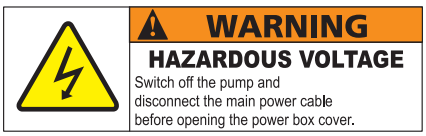
Pictographs used in the document indicate useful information.

Note

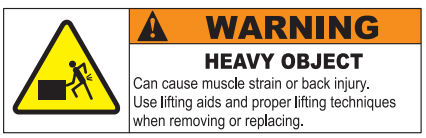
Tip

1.3.3 Labels

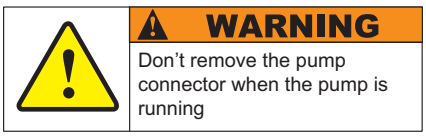
PURGE	Purge circuit connection
PUMP EXHAUST	Pump exhaust
WATER MAX Pr 7 bar/101 psi	Maximum water circuit pressure
WATER IN	Water circuit connection: inlet
WATER OUT	Water circuit connection: outlet
⏚	Functional grounding connection
48 V ⎓ 12 A	Power supply
	Locking the connector before using the pump. Do not disconnect before the pump has stopped
	Direction of rotation of the pump rotor
	Product rating plate (example)



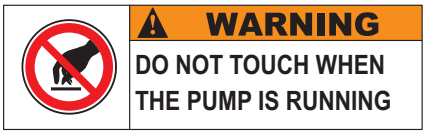
This label indicates that certain internal components carry an electric charge and can cause electric shock if touched: before working on the pump, always either disconnect it, or lock out/tag out the installation breaker in the appropriate manner.



This label indicates that the product should not be handled manually due to its weight and that appropriate handling devices should always be used.



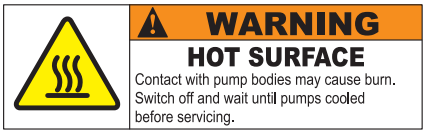
This label means that the user must lock the connector before using the pump. Do not disconnect before the pump has stopped.



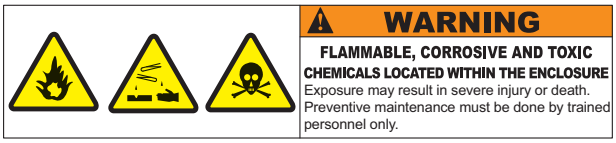
This label warns users about the risk of crushing or cutting due to moving parts: keep a safe distance and/or keep your hands away from the moving parts.

Any person responsible for installation or operation of the product must first refer to the operating manual.

The product comes with a sheet of labels including other language versions. The installer must stick these labels to the most appropriate and visible place on the pump to warn the operator about potential hazards:



This label warns users that they risk being injured if their hands come into contact with a hot surface: protective gloves must be worn at all times when working on the pump.



This label warns users about pumped process gases that can be dangerous or toxic and lead to severe injury or death. It specifies that only trained personnel should perform preventive maintenance operations.

1.3.4 Abbreviations

AMB	Active Magnetic Bearings
DC	Direct Current
Exh.	Exhaust
HHR	Hand Held Remote
IN	Inlet flange
LEL	Lower Explosive Limit
M	Pump version without temperature management system (no TMS)
MT	Pump version equipped with a temperature management system (TMS)
TMS	Temperature Management System
[XXXX]	The HHR remote control unit menus and settings are shown in bold between square brackets. For example: **[DEFINITION][LANGUAGE]** to select the message display language.

1.4 Trademark proof

- Profibus® is a trademark of PI (PROFIBUS & PROFINET International).
- EtherCAT® is a trademark and patented technology, licensed by Beckhoff Automation GmbH, Germany.

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.

⚠ WARNING

Risk of crushing when the product is slung

Given the heaviness of the product, there is a risk of crushing during handling operations involving lifting devices. Under no circumstances shall the manufacturer be liable if the following instructions are not followed:

► Only qualified staff trained in handling heavy objects are authorized to handle the product.
► The lifting devices provided **must be used** and the procedures set out in this document must be followed.

⚠ WARNING

Risk of electric shock due to non-compliant electrical installations

This product uses mains voltage for its power supply. Non-compliant electrical installations or installations not done to professional standards may endanger the user's life.

- ► Only qualified technicians trained in the relevant electrical safety and EMC regulations are authorized to work on the electrical installation.
- ► This product must not be modified or converted arbitrarily.
- ► Check that the product is properly connected to the equipment's or pumping installation's emergency stop circuit.

⚠ WARNING

Danger of electrocution by contact during maintenance or overhaul

There is an electric shock hazard in case of contact with a product powered on and not electrically isolated.

- ► Before carrying out any work, set the main switch to **O**.
- ► Disconnect the power cable from the mains.
- ► Secure the installation correctly by tagging and locking (LO/TO) the system to prevent unintentional re-engagement.

⚠ WARNING

Risk of serious injury caused by the separation of the pump when the rotor is blocked

If the pump is not secured properly and the rotor suddenly becomes blocked, the turbomolecular pump will detach from the equipment: the energy released could launch the entire pump or pieces of the pump across the room. This could cause severe, possibly fatal, injuries as well as serious property damage.

- ► Strictly comply with the installation instructions described in this manual. Pfeiffer Vacuum will be released from any warranty and liability for non-compliance with installation instructions.
- ► Only use approved original parts from Pfeiffer Vacuum for connection to the equipment (see accessories).

⚠ WARNING

Risk of poisoning when process gases are present in the atmosphere

The manufacturer has no control over the types of gases used with the pump. Process gases are often toxic, flammable, corrosive, explosive and/or otherwise reactive. There is a risk of serious or fatal injury if these gases are allowed to escape freely into the atmosphere.

- ► Apply the relevant safety instructions in accordance with local regulation. This information is available from the operator's safety department.
- ► **Always connect the turbomolecular pump's exhaust to a backing pump compatible with process gases**: the backing pump's exhaust is connected to the installation's dangerous gas extraction system
- ► Regularly check that there are no leaks where the pump connects to the exhaust pipework.

⚠ WARNING

Risk of injury in case of contact with pressurized nitrogen

The product uses pressurized nitrogen as a flushing gas. Non-compliant installations or installations not done to professional standards may endanger the user's life.

- ► Install a manual valve on the circuit at a distance of 3 m from the product, so that the nitrogen supply can be locked out.
- ► Observe the recommended supply pressure.
- ► Always lock out and disconnect the nitrogen circuit before working on the product.
- ► When carrying out maintenance, secure the installation properly by locating and locking out the pressurized nitrogen circuit to prevent it from being re-engaged by accident (LO/TO Lock Out/Tag Out procedure).
- ► Regularly check the condition of the pipework and supply circuit connections.

⚠ WARNING

Risk of injury in case of contact with pressurized water

The product uses pressurized water as a cooling fluid. Non-compliant installations or installations not done to professional standards may endanger the user's life.

- ► Install a manual valve on the circuit at a distance of 3 m from the product, so that the water supply can be locked out.
- ► Observe the recommended pressure and pressure differences.
- ► Always lock out and disconnect the water circuit before working on the product.
- ► When carrying out maintenance, secure the installation properly by locating and locking out the pressurized water circuit to prevent it from being re-engaged by accident (LO/TO Lock Out/Tag Out procedure).
- ► Regularly check the condition of the pipework and supply circuit connections.

⚠ 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

Risk of burns in case of contact with hot surfaces

For the operator's safety, the products are designed to avoid thermal risk. Depending on the application, the conditions of use generate high temperatures which require extra caution from users (surfaces > 65 °C).

- ► Pay attention to the marking of hot surfaces indicated by safety labels.
- ► Wait for the product to fully cool down before working on it.
- ► Protective gloves must be worn in accordance with standard EN ISO 21420.

2.3 Safety instructions relating to flammable/pyrophoric materials

It is the user and/or integrator who is/are solely responsible for the safety of the pump installation, the equipment and the gas exhaust extraction system. The user and/or the integrator is responsible for the application which uses the product.

Pumping pyrophoric or flammable gases may be hazardous. The user and/or integrator must comply with the safety instructions below and conduct a risk assessment.

⚠ DANGER

Danger of death by explosion or fire related to pyrophoric/flammable gases

Semiconductor, photovoltaic panel, flat panel display and industrial processes may use pyrophoric or flammable gases. When mixed with oxidizing agents, these gases can spontaneously combust (pyrophoric gases) or combust when ignited as a result of an unintended chemical reaction (flammable gases). In the worst case scenario, this could start a fire or set off an explosion causing metal parts to be ejected and serious injury to nearby persons.

- ► Conduct a risk assessment to assess the dangers before installing the pump.
- ► Install safety systems that comply with the requirements of the EN 50495 standard.

The risk assessment must take into account the pumped gases, by-products, and all components making up the installation. The following situations are hazardous and must be avoided at all cost:

- Flammable or pyrophoric gas concentrations in the flammable range.
- Flammable or pyrophoric gas concentrations above the flammable range (a leak could potentially cause the concentration to drop down into the flammable range).
- Insufficient dilution.
- An accumulation of reactive solids in the exhaust.
- Exposure of chemically-reduced species or reducing agents to oxidizing agents.

The following general safety recommendations must be applied:

- Ensure leak-tightness throughout system.
- Do not allow oxidizing agents (air, other gases, etc.) to mix with flammable/pyrophoric gases. [1)]
- Ensure that the oxidizing agent concentration does not exceed 60% of the maximum permissible concentration of the oxidizing agent gas (MOC) [2)], mainly when the dilution is not sufficiently high to reach 25% of the LEL.
- Perform a nitrogen gas purge prior to carrying out maintenance on the pumping line (inlet side, pump and exhaust lines).
- Regularly clean away reactive by-products such as silicon dust from the exhaust line to prevent clogging and/or explosion.

For further details on the safety instructions relating to flammable and pyrophoric gases, contact our service center.

Affix labels to the pump to identify the hazards inherent in all the above applications (flammability, explosion, toxicity, corrosion, etc.) and comply with the SEMI S1 requirements. This information must be added to the equipment operating instructions intended for end users.

2.4 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.

Only qualified personnel trained in safety regulations (EMC, electrical safety, chemical pollution) are authorized to carry out the installation and maintenance described in this manual. Our service centers can provide the necessary training.

- ► **Secure the pump in strict compliance with the installation requirements**.
- ► Do not expose any part of the human body to the vacuum.
- ► Follow the safety and accident prevention requirements.
- ► Regularly check compliance with all precautionary measures.
- ► Do not remove the blanking plates sealing the inlet and exhaust ports if the product is not connected to the pumping line.
- ► Do not operate the product unless the inlet and exhaust are connected to a vacuum and exhaust pumping line.
- ► Before working on the inlet flange, wait until the rotor is immobilized.
- ► Keep pipes and cables well away from hot surfaces (> 70°C).

1) Reference NFPA 69-2019, § 8.3.1 chap.8 Deflagration prevention by combustible concentration reduction.

2) Reference NFPA 69-2019, § 7.7.2.5 chap.7 Deflagration prevention by oxydant concentration reduction.

2.5 Intended use

- The vacuum pump should only be used to generate a vacuum while pumping gases.
- The turbomolecular pump must be combined with an appropriate backing pump.
- The MT Version pump can be used to pump condensable fluids as long as condensation does not occur in the pump.
- The vacuum pump must be integrated into industrial equipment.

When the pump is integrated into industrial equipment, it becomes a pumping component: the integrator of this component must provide the operator with all safety measures, notably for hot surface risks.

2.6 Misuse

Misuse of the product will render the warranty and any claims void. Any use, whether intended or not, that diverges from the uses already mentioned will be treated as non-compliant; this includes but is not limited to:

- Pumping reactive fluids
- Pumping of corrosive or explosive media
- Pumping liquids
- Pumping of solids
- Pumping dust particles
- Pumping of media with risk of condensables (M version)
- Operation with improper high gas throughput
- Operation with improper high fore-vacuum pressure
- Operation with improper high levels of radiated heat input
- Venting with improper high venting rates
- Using accessories or spare parts not mentioned in these operating instructions
- Using the pump in potentially explosive areas
- Using the vacuum pump to generate pressure
- Operation in areas with ionizing radiation
- Operation in improper high magnetic fields
- Use of the devices in systems in which impact-like stress and vibrations or periodic forces affect the devices

3 Transportation and Storage

3.1 Receipt of the product

Condition of the delivery

- Check that the product has not been damaged during transport.
- If the product is damaged, take the necessary measures with the carrier **and** notify the manufacturer.

► Keep the product in its original packaging so it stays as clean as it was when dispatched by us. Only unpack the product once it has arrived at the location where it will be used.
► Keep the blanking plates in place on the inlet, exhaust and purge ports while the product is not connected to the pumping line.

Keep the packaging (recyclable materials) in case the product needs to be transported or stored.

3.2 Handling the pump

⚠ WARNING

Risk of crushing when the product is slung

Given the weight of the product, there is a risk of crushing during handling operations. Under no circumstances shall the manufacturer be liable if the following instructions are not followed:

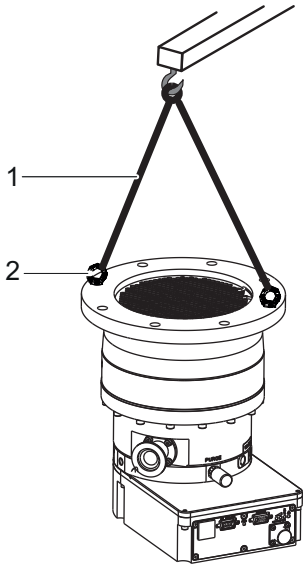
► Only qualified staff trained in handling heavy objects are authorized to handle the product.
  – Lift the pump manually: load < 20 kg.
  – Use appropriate lifting rings screwed into holes provided for this purpose.
► Wear safety shoes with steel toe in accordance with standard EN 347.

⚠ WARNING

Risk of crushing due to product tilting

Even though compliance with EU safety rules is guaranteed, all necessary precautions should be taken when handling and installing the product **until the pump has been integrated into the equipment**.

► Do not place the pump on an inclined plane.
► Do not push the pump sideways.
► Always secure the pump until it has been integrated into the equipment (mounting holes in the inlet flange).



1 Strap 2 Lifting ring M8

Handling the pump using a lifting device

When handling the pump, **a lifting device appropriate for the weight of the product must be used**. The weight and center of gravity vary depending on the model (see chapter “Dimensions”). Provide 2 approved M8 lifting rings (supplied by the customer).

1. Screw the lifting rings into 2 of the 3 M8 holes on the inlet housing.
2. Use a multi-strand strap with a minimum length of 230 mm
3. Secure the pump using lifting rings and hoist it.
4. **Always transport** the turbomolecular pump in an upright position.

3.3 Storage

Storing a new pump

- ► Keep the pump wrapped in its protective envelope.
- ► Always **leave** the inlet, the exhaust and purge blanking plates in place.
- ► Always **leave** plastic plugs in place on the electrical connectors.
- ► Store the pump in line with the permitted storage temperatures (see chapter "Environmental conditions").
- ► Store the pump in a clean, dry and non-contaminated area, **for a maximum period of 1 year**.

Storage after use

- ► To store a pump that has been used, see chapter "Shutting down for longer periods".

4 Product description

4.1 Product identification

To correctly identify the product when communicating with our service center, always have the information from the product rating plate available (see chapter "Labels").

4.1.1 Scope of delivery

- 1 magnetically levitated turbomolecular pump with integrated electronic drive unit
- 1 splinter shield (in the pump inlet flange)
- 1 water solenoid valve (MT version)
- 1 operating instructions and a sheet of safety labels

and, depending on the ordering guide, the following components are present:

- 1 copper gasket
- 1 set of screws and bolts
- 1 purge solenoid valve

Unless they have been ordered, the hand-held remote control (HHR) and 48 VDC power supply are not included in the order. To order, refer to the Accessories chapter.

4.1.2 Product applications

The pump manufacturer has developed a range of reliable, high performance magnetically levitated turbopumps with active magnetic bearings (AMB) and compression stages. They are specially adapted for coating and dry-etching plasma processes, for glass coating as well as for R&D applications. These pumps are equipped with an integrated electronic drive unit.

These pumps are characterized by their resistance to corrosion, robustness, high gas throughput at high operating pressure and lack of maintenance requirements.

For more detailed information on specific applications, please contact us.

Rotation speed

The magnetically levitated pump rotation speed can be selected and set between a minimum speed and the nominal speed. This makes it possible to optimize pumping characteristics according to each application (for example, high pressure pumping). A distinction is made between the following speeds:

- Selected rotation speed (= Stand-by speed) between minimum speed and the nominal rotation speed
- Nominal rotation speed set in the factory

M version pump

Standard version is suitable for the most of the clean applications. This pump version has no temperature management system (no TMS).

This pump version is available in an air- or water-cooled option.

MT version pump

This MT version is recommended for any application where high temperature for the pump and gases are demanded in order to minimize the condensation in the pump. This pump version is equipped with a temperature management system (TMS). The temperature management is controlled via the integrated electronic drive unit.

4.2 Human/Machine Interface

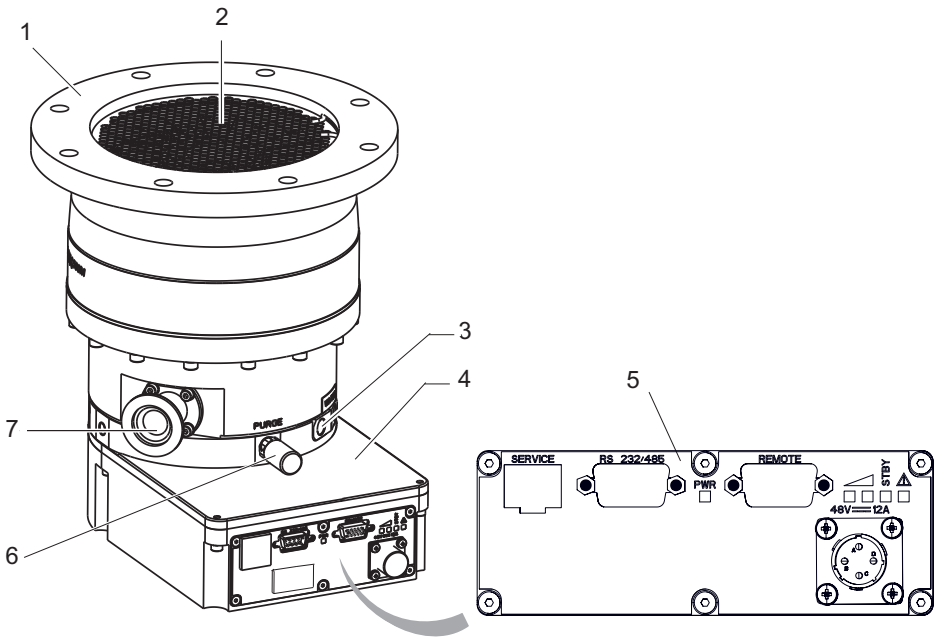


Fig. 1: Description of an M version ATH 500 pump

1 Inlet flange (high vacuum)
2 Splinter shield
3 WATER IN/WATER OUT connections (1/8 NPT female)
4 Electronic drive unit
5 Control interface
6 Neutral gas purge (50 sccm) (1/8 BSPP female equipped with a filter)
7 Exhaust flange (PUMP EXHAUST)

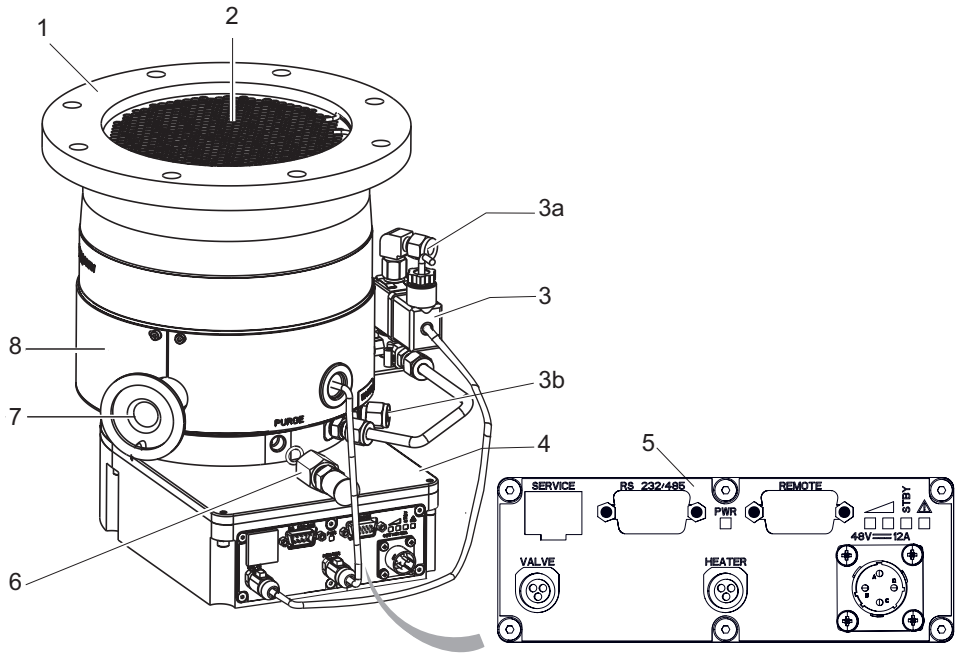


Fig. 2: Description of an MT version ATH 500 pump

1 Inlet flange (high vacuum)
2 Splinter shield
3 Water solenoid valve
3a WATER IN connection (1/4 double ring)
3b WATER OUT connection (1/4 double ring)
4 Electronic drive unit
5 Control interface
6 Neutral gas purge (50 sccm) (1/4 VCR)
7 Exhaust flange (PUMP EXHAUST)
8 Heater band

4.3 Electronic drive unit

The magnetically levitated pump with integrated electronic drive unit is intended to be installed into and controlled by the equipment.

As standard, the electronic drive unit is equipped with an **RS-232/RS-485** serial link interface and **REMOTE** connector. It can also be controlled with the hand-held remote **HHR** available as an accessory (see chapter "Accessories").

Depending on the ordering guide, the integrated electronic drive unit is equipped with an interface that allows control through **EtherCAT, Profibus** control networks.

In this document, only the operations with the **Remote, RS-232/RS-485** and **HHR** interfaces are described.

For the other interfaces, please refer to the operating manual of the control interface installed on the pump (see chapter “Applicable documents”).

The electronic drive unit does not power the pump. **Power supply comes from an external 48 VDC unit**.

Regardless of the product’s configuration, **the control interface** of the electronic drive unit enables a connection to the control network and display of the pump's operating status.

The integrated electronic drive unit makes it possible to:

- power the turbomolecular pump when it is connected to the external power supply
- power and control the water solenoid valve and heating (MT version pump)

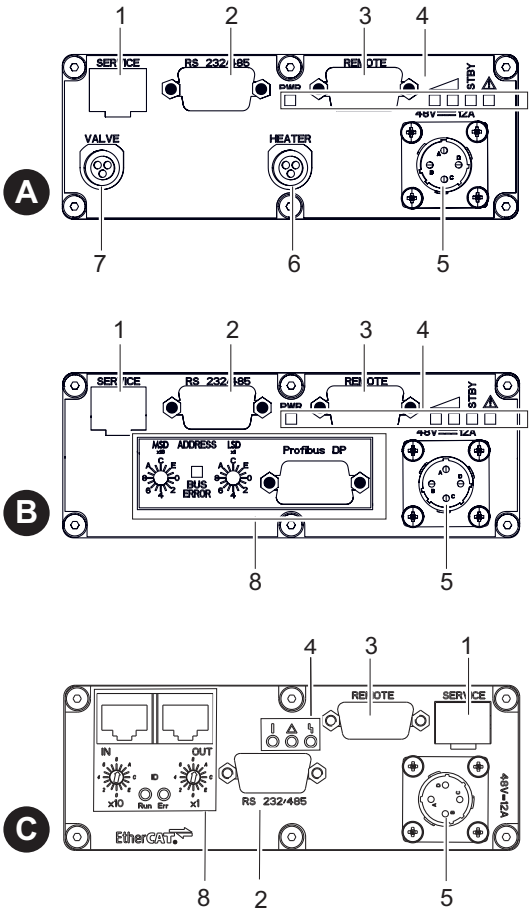


Fig. 3: Example of integrated electronic drive unit

A Remote / RS-232/RS-485 interface
B Profibus interface
C EtherCAT interface

1	Service	*Hand held remote control connector (HHR)*
2	RS-232/RS-485 serial link	*The RS-232/RS-485 serial link is used to drive and control the pump from a computer. The RS-485 serial link enables the installation and control of several pumps simultaneously.*

3	REMOTE connector	*The REMOTE connector is used to drive the* **START/STOP/ STANDBY***functions to enable the remote pump status via dry contacts.*
4	Pump status indicator lights	*Display of the pump operating status*
5	Power supply connector	*Used to connect a 48 VDC power supply*
6	Heater band electrical connector	*Heater band power supply*
7	Water solenoid valve electrical connector	*Water solenoid valve cable supply*
8	Fieldbus connection area	*See chapter "Applicable documents"*

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 blades) 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 Equipment installation conditions

⚠ WARNING

Risk of serious injury caused by the separation of the pump when the rotor is blocked

If the pump is not secured properly and the rotor suddenly becomes blocked, the turbomolecular pump will detach from the equipment: the energy released could launch the entire pump or pieces of the pump across the room. This could cause severe, possibly fatal, injuries as well as serious property damage.

- ► Strictly comply with the installation instructions described in this manual. Pfeiffer Vacuum will be released from any warranty and liability for non-compliance with installation instructions.
- ► Only use approved original parts from Pfeiffer Vacuum for connection to the equipment (see accessories).

The equipment frame on which the pump is installed must be sufficiently rigid to absorb the kinetic energy if the rotor blocks suddenly. For this, take into account:

- The maximum loads to calculate the attachment devices.
- The inlet flange dimensions.
- The quality and number of screws.
- The type of connection between the pump inlet and the chamber to be pumped.

When the pump is connected according to the manufacturer's recommendations, in case of overpressure resulting from an incident, the pump enclosure can withstand maximum static pressure of $11 \cdot 10^3$ hPa for 1 minute.

5.1.1 Installation specifications

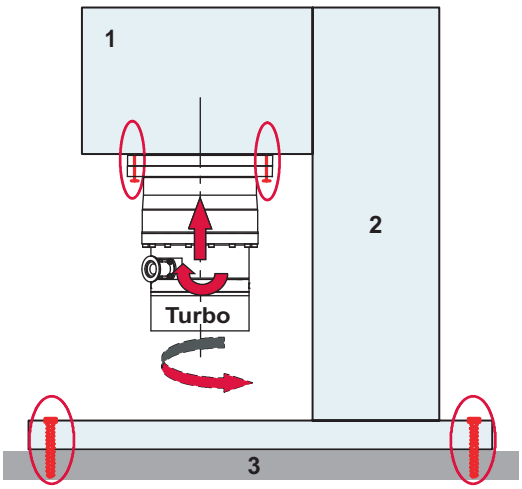


Fig. 4: Mechanical connection of the pump to the equipment

1 Vacuum chamber
2 Equipment
3 Frame
Secure anchor point

Description of a sudden blocking scenario

The kinetic energy of the rotor has to be absorbed by the installation if the pump blocks suddenly. The maximum resulting loads have been measured on a test bench by simulating the worst-case turbo pump blockage with a rotor split in two with the pump rotating at nominal speed. The impact on the rotor parts creates the following transient loads.

Axial force (A)

The rotor parts can be ejected out of the pump inlet flange and can hit the valve plate or any other part of the system. If this is placed close to the turbo pump and if it has high stiffness, the impact can create a high axial force on the installation. Such axial force has not been observed on a standard pendulum valve, or when there is a free space greater than 100 mm.

Bending moment (B)

The impact of the rotor parts on the housing will create a radial force on the housing. This radial force will create a bending moment on the system as a function of the distance to the pump. The deceleration of the rotor parts creates a torque value on the pump housing, which is transmitted to the equipment.

Torque (C)

The deceleration of the rotor parts creates a torque value on the pump housing, which is transmitted to the system. The maximum values of the axial force and the bending moment occur at approximately the same time. A delay of up to several ms has been observed for the maximum torque value.

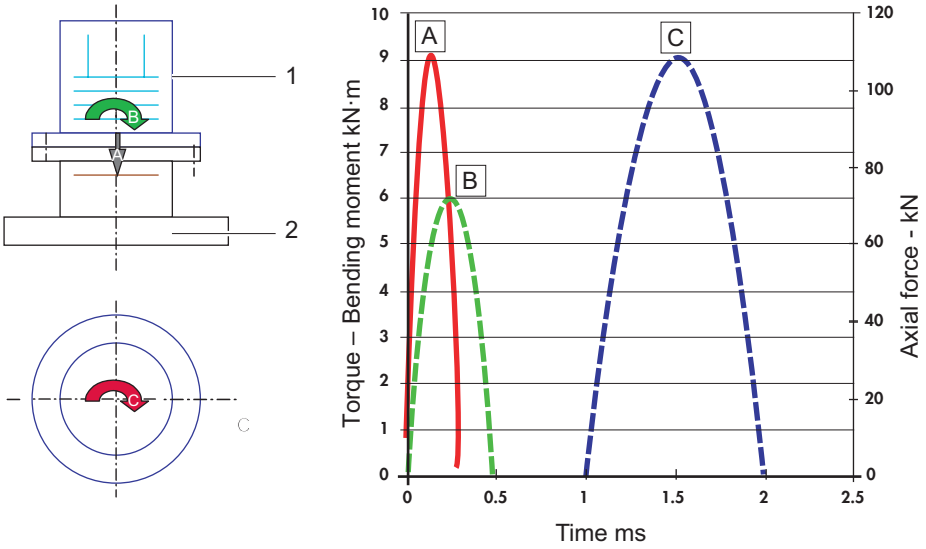


Fig. 5: Graph of the loads exerted on the equipment

1 Turbopump 2 Pendulum valve

Technical data	Unit	Set Point
Nominal speed	min^{-1}	50000
Energy	kJ	24
Torque **(C)**	Max. kN·m	9
	Duration ms	1
	Delay ms	1
Bending moment **(B)**	Max. kN·m	6
	Duration ms	0.5
	Delay ms	0
Axial force **(A)** [1)]	Max. kN	0 to 110
	Duration ms	0.3
	Delay ms	0

1) Maximum axial force occurs when pump inlet is blocked by the rigid parts. There is no load on the equipment in case of limited stiffness, e.g. with a valve.

Tbl. 1: Loads exerted on the equipment

5.1.2 Securing the equipment and the frame

Fastening the pump to the equipment

The maximum load caused by a sudden blockage must be absorbed by the pump's fastening elements.

- ► Design and secure the frame of the pump so that it can withstand the maximum load.
- ► The screws **must be** tightened with a torque wrench in accordance with the tightening torques in the following table:
  - – if the torque is low: risk of screws loosening.
  - – if the torque is high: risk of the screws deteriorating.

Type of inlet flange		DN160 ISO-F or ISO-K	DN100 ISO-F or ISO-K	DN160 CFF	DN100 CFF
Type of screw [1)]		M 10	M 8	M 8	M 8
Number of screw [1)]		8	8	20	16
Screw metric grade [1)]		12-9	12-9	12-9	12-9
Tightening torque per screw [1)]	N·m	30	20	20	20
Total clamping force	N	108000	88500	222000	177000
Length of screw	mm	≥ 35	-	≥ 40	≥ 35
1) The type, number, grade and tightening torque of the screw are **imposed** and **mandatory**.					

Tbl. 2: Securing the high vacuum flange (inlet flange)

The manufacturer recommends using set of screws designed for this purpose (accessories).

Specific use of ISO-K flanges

ISO-K flanges do not prevent the accidental rotation of the pump around the equipment flange in the event of the rupture of a rotating part. This rotation can damage roughing and purge lines and can pose a risk to the user.

- **Use only rotating flanges.**
- If claw clamps are used, **install the same number of claw clamps (made of stainless steel) as the recommended number of screws for fastening the ISO-F flange** (accessories).

Frame fastening

If the frame is not designed to withstand the maximum loads in case of sudden blockage, contact our service center who will help you design your installation.

5.2 Positioning the pump

NOTICE

Damage to pump caused by external vibrations

Vibrations from outside or impacts on the pump can overload the magnetic bearings resulting in stress on the landing bearings.

- ► Lateral and tilting movements of the pump must be avoided.
- ► External agitation must be compensated for by an appropriate system design.
- ► Secure the vacuum chamber provided by the customer against moving and tilting.

⚠ CAUTION

Risk of falling due to poorly-secured cables or pipework

The space around the pump must be kept clear of obstacles to prevent falls from potentially occurring.

- ► Route and secure electric cables and pipework in the appropriate pathways.

The manufacturer guarantees proper operation of the pump if it is used in a uniform magnetic field up to 0.5 mT. From 0.5 to 5 mT, proper operation depends on cooling and gas loads. A magnetic field exceeding 5 mT can cause excessive rotor heating. In this case, suitable shielding must be provided.

The standalone pump can withstand radiation levels of up to 10^3 Gy.

The turbomolecular pump cannot evacuate at atmospheric pressure; it must be connected to a backing pump. For a transient period, they can start to run at atmospheric pressure.

The turbomolecular pump can operate in any position.

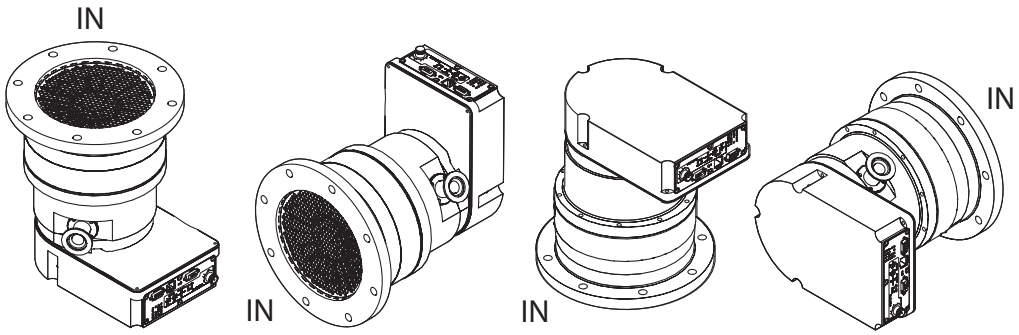


Fig. 6: Operating positions

Positioning the pump

1. Handling the pump, see chapter "Handling the pump".
2. Connect and secure the turbomolecular pump fastening to ensure operator safety and operational reliability (see chapter "Installation specifications").
3. Stick the safety labels in the operator's language to the most appropriate and visible place on the pump to warn the operator about potential hazards.

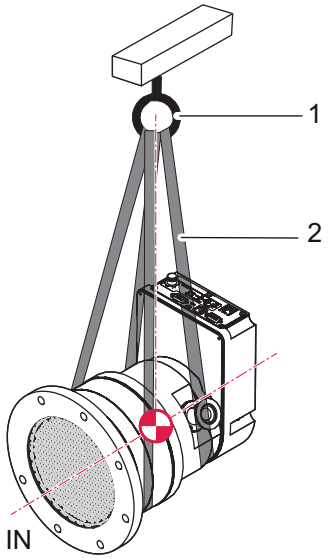


Fig. 7: Installating the pump horizontally

1 Strap (Qty2) 2 Safety hook

Installing the pump horizontally

When handling the pump, **a lifting device appropriate for the weight of the product must be used**. The weight and center of gravity vary depending on the model (see chapters “Technical data” and “Dimensions”).

1. Use 2 EN-1492-1 approved multi-strand straps that can support the weight of the pump.
2. Use approved accessories to attach the pump to the lifting device (e.g. hook with safety lock).
3. Position the straps securely around the pump.
4. **Position the lifting device hook vertically above the center of gravity.**
5. Hoist up the pump and move it to its location on the frame.
6. Keep the pump hanged all the installation time until the high vacuum flange is secured.

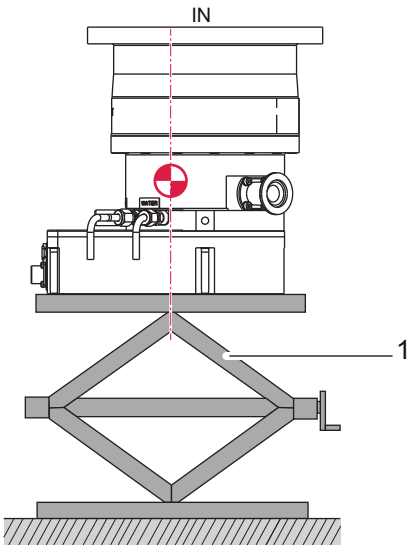


Fig. 8: Installing the pump inlet facing up

1 Lifting table (example)

Installing the pump inlet facing up

When handling the pump, **a lifting device appropriate for the weight of the product must be used**. The weight and center of gravity vary depending on the model (see chapters “Technical data” and “Dimensions”).

1. Affix the pump to the lifting device by using the holes designed and labelled for this purpose to avoid the tilting of the pump.
2. Keep the pump attached to the lifting device until the high vacuum flange is secured.

5.3 Connecting to the pumping line

The presence of pyrophoric, flammable or toxic materials in the pump can lead to additional risks, which the operator must assess and manage for the entire pumping installation.

The user and/or product OEM is ultimately responsible for the equipment and must apply the specific safety instructions, in accordance with local regulation.

⚠ DANGER

Danger of death by fire when pumping flammable gases

There is a fire risk caused by an unintended chemical reaction (ignition) between two pumped flammable materials.

► Provide an electromechanical LEL detection device in the extraction system (detection capability at 25% of the LEL) that will stop chemical supply to the pump when gas is detected over 25% of the LEL for that flammable material.

⚠ WARNING

Risk of crushing and/or cutting in case of contact with moving parts

The pump inlet flange is large enough for body part (finger or hand) to be inserted into it, presenting a risk of crushing due to contact with moving parts. The inlet and exhaust ports should be sealed with blanking plates before connection.

► Wait for the pumping line to be connected before removing the blanking plates.
► **Wait for the pump to be connected before powering on.**

General instructions for installing the pump in the pumping line in accordance with industry best practice

The inlet and exhaust connections must not put undue strain on the pumping line that could cause leakage.

1. Wear gloves to connect and remove the pump from the equipment.
2. Always complete the mechanical installation before the electrical connection.
3. **Avoid connecting a reducing flange to the pump inlet**. Contact us if necessary.
4. **Check that the splinter shield is installed in the inlet flange.**
5. Only use accessories on the pumping line, for the inlet and exhaust lines, with materials and sealing properties that are compatible with the gases being pumped. Refer to the connection accessories catalog available at the Pfeiffer-Vacuum website.
6. When assembling the pumping line, include accessories for isolating the pump from the pumping line and making maintenance easier to carry out (pump inlet and exhaust isolation valves, purge valves, etc.).
7. The O-rings located under the blanking plates are not compatible with all applications. **Product users or integrators are responsible for installing O-rings compatible with the application**.
8. Remove the blanking plates used to seal the inlet and exhaust ports.
9. Keep the blanking plates, screws and washers for reuse when transporting the pump.
10. Ensure that no screws, washers or other objects are dropped into the pump inlet.
11. Perform a leak test on the entire pumping line after installation.

5.3.1 Pump inlet connection

⚠ WARNING

Risk of cutting injuries due to contact with sharp edges via the 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).

- ► Wait for a complete standstill, before starting any work on the product.
- ► Keep the splinter shield in the inlet flange, as it limits the risk of injury.
- ► Wear protective gloves in accordance with standard EN ISO 21420.

NOTICE

Failure to meet cleanliness requirements poses a risk of process contamination

When parts in contact with high vacuum are dirty, pumping time increases and the process is contaminated.

- ► Use only dry parts and clean, grease-free, dust-free pipelines.
- ► Wear gloves when making connections, especially on the high vacuum side.

Make sure that the parts or chambers connected to the inlet of our products can withstand a negative pressure of $1 \cdot 10^{-3}$ hPa absolute.

5.3.2 Pump exhaust connection

⚠ WARNING

Risk of poisoning when process gases are present in the atmosphere

The manufacturer has no control over the types of gases used with the pump. Process gases are often toxic, flammable, corrosive, explosive and/or otherwise reactive. There is a risk of serious or fatal injury if these gases are allowed to escape freely into the atmosphere.

- ► Apply the relevant safety instructions in accordance with local regulation. This information is available from the operator's safety department.
- ► **Always connect the turbomolecular pump's exhaust to a backing pump compatible with process gases**: the backing pump's exhaust is connected to the installation's dangerous gas extraction system
- ► Regularly check that there are no leaks where the pump connects to the exhaust pipework.

- ► Connect the turbopump with an approved backing pump (see chapter "Technical data").
- ► Install an isolation valve (NC) between the turbomolecular pump and the backing pump.

5.4 Connecting the water circuit

To limit corrosion and **clogging of the water circuit**, we recommend using softened or non-aggressive water with the required characteristics (see chapter "Water characteristics"). If the solid pollution characteristics cannot be met, install a filter on the water inlet.

NOTICE

The water cooling circuit may be damaged if an unregulated mains supply is used

Using unregulated mains water can lead to water circuit clogging due to limescale deposition. This may necessitate complete cleaning and overhaul of the water cooling circuit.

Furthermore, **the presence of micro-organisms such as algae and biological substances such as bacteria** can lead to problems in the cooling circuit.

- ► Connect the water cooling circuit to a regulated water supply.
- ► Take appropriate measures to prevent the growth of such micro-organisms.

The effect of cooling continuity on the process

If an interruption to the water circuit represents a serious risk for the process, it is advisable to control the pump cooling with an external system capable of taking over if the water circuit fails.

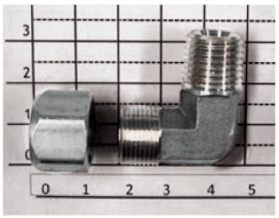
⚠ WARNING

Risk of injury in case of contact with pressurized water

The product uses pressurized water as a cooling fluid. Non-compliant installations or installations not done to professional standards may endanger the user's life.

- ► Install a manual valve on the circuit at a distance of 3 m from the product, so that the water supply can be locked out.
- ► Observe the recommended pressure and pressure differences.
- ► Always lock out and disconnect the water circuit before working on the product.
- ► When carrying out maintenance, secure the installation properly by locating and locking out the pressurized water circuit to prevent it from being re-engaged by accident (LO/TO Lock Out/Tag Out procedure).
- ► Regularly check the condition of the pipework and supply circuit connections.

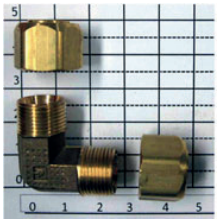
5.4.1 Procedure for assembly connectors

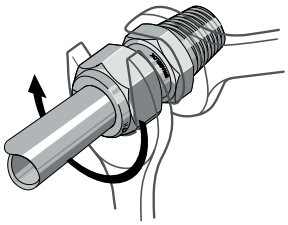


Threaded connector

Threaded connections bonding and tightening procedure

1. Use 1/8 NPT connectors (to be supplied by the customer).
2. Bond the connections using oleo-waterproof glue or put PTFE sealing tape on the threads.
3. Tighten the connection **while keeping the baseplate on the pump side**.



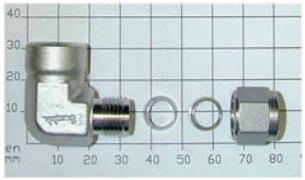


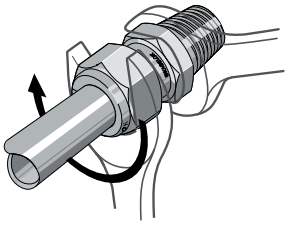
Single ferrule connector

Procedure for the assembly of single ferrule connectors

Connectors used to connect flexible pipes between the pump and electronic drive unit (for example).

1. Insert the pipe until it is affixed tightly to the connector.
2. Manually place the nut into contact.
3. Tighten the nut **1/2 turn using an open-ended spanner while holding the body of the connector still**.





Twin ferrule connector

Procedure for the assembly of twin ferrule connectors

Connectors used to connect rigid pipe (stainless steel, nickel plated copper, etc.).

1. Insert the pipe with the ferrules until it is affixed tightly to the connector.
2. Lock the fitting in position
3. Manually place the nut into contact.
4. Tighten the nut **3/4 turn using an open-ended spanner while holding the body of the connector still**.

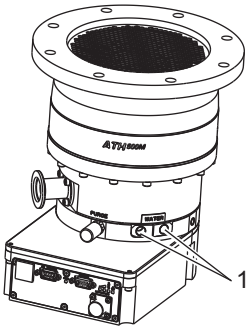
5.4.2 Connecting the pump to the water circuit

Tightening the connectors and direction of water circulation

Observe the connection/tightening procedure of the connectors to avoid any risk of leaks.

MT version pump: observe the direction of water circulation so as not to disrupt the operation of the solenoid valve.

Connection of the model ATH 500 M

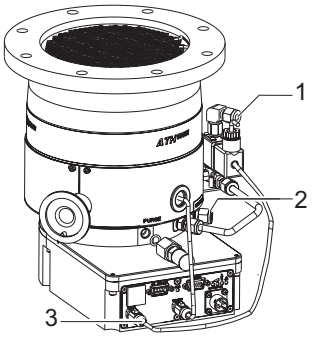


1 WATER IN / WATER OUT (direction does not matter)

Connection procedure of ATH 500 M pump model

1. Provide a water-cooling circuit and a water valve to adjust the flow.
2. Connect the water-cooling circuit to one of the connections and the other to the drainage circuit.
3. Check that there are no leaks in the water circuit or the water circuit connections.

Connection of the model ATH 500 MT



1 WATER IN
2 WATER OUT
3 Water solenoid valve power supply

Connection procedure of ATH 500 MT pump model

1. Provide a water-cooling circuit.
2. Connect the cooling circuit to the connectors provided while respecting the flow direction:
   – WATER IN = water inlet on the solenoid valve
   – WATER OUT = drainage circuit.
3. Check that there are no leaks in the water circuit or the water circuit connections.

5.5 Installation of the air cooling accessory

An air cooling accessory can be ordered separately (see chapter "Accessories"). The customer is responsible for installation.

Depending on ordering configuration (air cooled version), the pump is equipped with a fan as a factory setting. In this case, only the electrical wiring is the customer's responsibility.

With the air cooling, the maximum admissible gas flow is decreased!

User will have to check the maximum inlet flow and reduce the ambiant temperature to avoid any overheating of the pump.

In continuous use, the current consumption must be less than 3.8 A: this parameter can be monitored via the control interface.

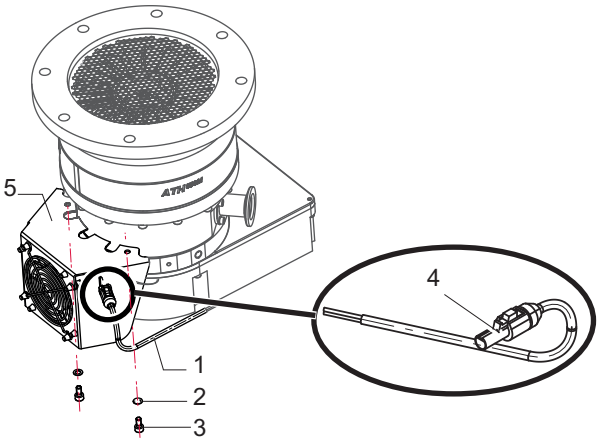


Fig. 9: Assembly of the air cooling accessory

1 Fan power cable (5 m long) - [1 or blue (-), 2 or brown (+)]
2 Wave spring washer Diam. 5
3 CHC M5x10 screws
4 Fan connector [1 (-), 2 (+), 3 (not connected)]
5 Holder

Assembling procedure

The air cooling set includes the screws for the mechanical installation on the pump and the power cable for electrical wiring.

The fan requires a 48 VDC external power supply.

The 48 VDC power supply proposed by the manufacturer supplies the pump and the fan.

- ► Tighten the 2 screws onto the fan holder.
- ► Wire up the fan in accordance with the marking of terminals and wires (see chapter “Connection to external supply”).

5.6 Nitrogen circuit connection

Depending on the application, the inert gas purge can consist of:

- Injecting ambient air, or
- Injecting an inert gas into the pump.

In this manual, the inert gas will be called 'nitrogen', as it is the most commonly used gas. For more information on the type of purge gas, contact our service center.

⚠ DANGER

Danger of death by explosion when pumping gases containing pyrophoric/flammable materials

There is a risk of explosion if pyrophoric materials above the LEL are sent to the pump.

- ► Ensure there is a sufficient flow of nitrogen to lower the concentration below the LEL.
- ► Provide an interlock to ensure that gas flow towards the pump is stopped if the nitrogen flow is interrupted.

⚠ WARNING

Risk of injury in case of contact with pressurized nitrogen

The product uses pressurized nitrogen as a flushing gas. Non-compliant installations or installations not done to professional standards may endanger the user’s life.

- ► Install a manual valve on the circuit at a distance of 3 m from the product, so that the nitrogen supply can be locked out.
- ► Observe the recommended supply pressure.
- ► Always lock out and disconnect the nitrogen circuit before working on the product.
- ► When carrying out maintenance, secure the installation properly by locating and locking out the pressurized nitrogen circuit to prevent it from being re-engaged by accident (LO/TO Lock Out/Tag Out procedure).
- ► Regularly check the condition of the pipework and supply circuit connections.

A filtered dry nitrogen supply with the given characteristics is required for optimum performance (see chapter "Nitrogen characteristics").

5.6.1 Inert gas purge

NOTICE

Inert gas purge function

When the inert gas purge is stopped, the pumped gases can pass from the fore vacuum side to the high vacuum side and damage the bearing housings.

- ► Maintain the inert gas purge flow as long as the rotor is running to prolong the flushing.
- ► The purge maximum pressure must not exceed $1 \cdot 10^3$ to $1.5 \cdot 10^3$ hPa (absolute).

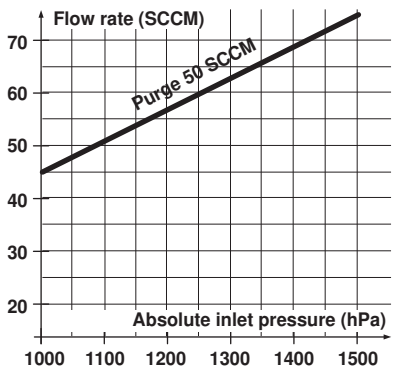


Fig. 10: Purge flow diagram

Purge device 50 sccm

The operation of this purge is continuous. The integrated flow reducer guarantees a 50 sccm flow for a pressure of $1.1 \cdot 10^3$ hPa.

1. Directly connect the inert gas supply to the **PURGE** port instead of the filter or plug (1/8 BSPP-ISO228 connection), or to the VCR connection*.
2. Adjust the inert gas pressure to obtain the desired flow (see Purge flow diagram).

* Other connections are possible depending on the ordering guide (see chapter “Product concerned”).

Solenoid valve equipped with a 50 sccm purge (for ATH 500 M only)

This option is available depending on the pump configuration.

This purge solenoid valve must be powered with 24 VDC: **the power supply and control of this solenoid valve are the customer's responsibility**.

1. Remove the plug or dust filter from the **PURGE** port.
2. Connect the solenoid valve to the **PURGE** port (1/8 BSPP connection).

The installation and connection of a ‘purge set’ accessory are described in the chapter “Installation of the purge accessory”.

5.6.2 Installation of the purge accessory

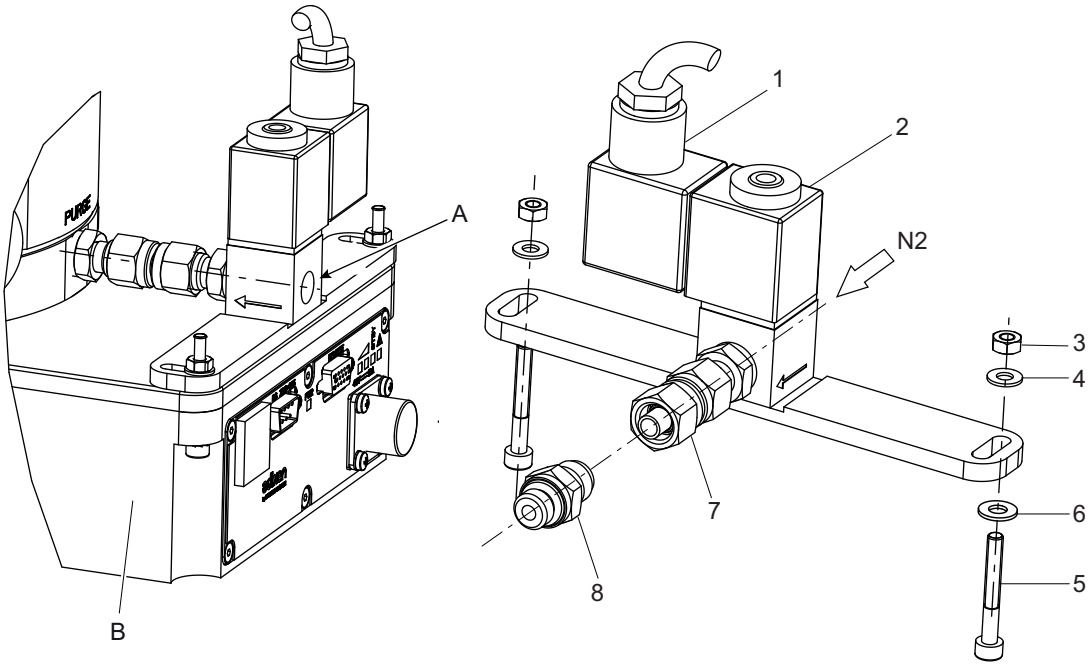


Fig. 11: Purge set

A	1/8" BSPP connection (ISO 228)	3	H M 4 nut (Qty: 2)
B	Electronic drive unit	4-6	Washer (Qty: 4)
1	Solenoid valve cable	5	CHC M4x30 screw (Qty: 2)
2	Solenoid valve coil	7-8	1/8" BSPP union fitting

Purge set installation

This accessory is available upon request.

1. Replace the M4x16 screws of the electronic drive unit with the CHC M4x30 screws and washers.
2. Remove the dust filter or plug from the purge.
3. Tighten the 1/8" BSPP UNION fitting to the purge port.
4. Place the assembly onto the electronic drive unit using the CHC M4x30 screws as guidance in the plate holes.
5. Align the 1/8" BSPP union fittings before tightening the nut.
6. Tighten the nuts with the washers.
7. Test vacuum tightness.

Connecting the purge accessory to an inert gas supply line

This solenoid valve can be connected to an inert gas line. The inert purge flow must be present when the pump is running.

When the pump is stopped, the solenoid valve can be closed to perform a tightness test on the equipment.

To connect the solenoid valve to an inert gas line, the nitrogen supply must be clean and filtered and must have the characteristics required (see chapter "Nitrogen characteristics").

1. Remove the plug from the solenoid valve connector.
2. Connect the inert gas line instead: 1/8 BSPP female connector.
3. Bond the connection using oleo-waterproof glue, or put PTFE sealing tape on the threads.
4. Tighten the connection, applying a maximum tightening torque of 10 N·m.
5. Adjust the inert gas pressure to obtain the desired flow (see Purge flow diagram).

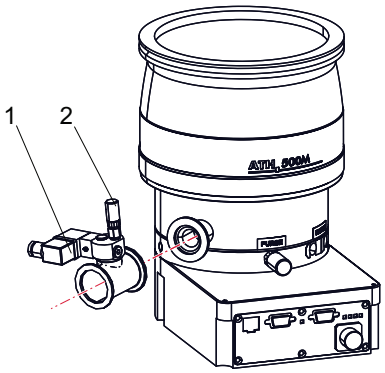
5.7 Connection of the air inlet solenoid valve

This accessory is available upon request (see chapter "Accessories").

The air inlet solenoid valve (flow 11 · 10^3 sccm), is calibrated to restore the atmospheric pressure in the pump internal volume. When isolation valves are installed on the pump inlet and exhaust, the rotor slow-down efficiency is improved.

The air inlet solenoid valve is installed on the pump exhaust.

24 VDC power supply and air inlet valve control are the customer's responsibility.



1 Air inlet solenoid valve 2 Dust filter

Control of the air inlet solenoid valve

The pump is reset to atmospheric pressure when the pump stops or in the event of a default stop. The air inlet valve must be powered when the rotation speed of the pump is less than 10,000 min^{-1} and an opening command is sent to the solenoid valve.

The NO (normally open) air inlet valve must be closed to restart the pump.

1. Connect the solenoid valve to the **PUMP EXHAUST** port of the pump (use connecting accessories of product catalog).
2. Power the solenoid valve.
3. Wire the solenoid valve control.

Connecting the air inlet solenoid valve to an inert gas line

This solenoid valve can be connected to an inert gas line.

To connect the solenoid valve to an inert gas line, the nitrogen supply must be clean and filtered and must have the characteristics required (see chapter "Nitrogen characteristics").

1. Remove the dust filter from the solenoid valve.
2. Connect the inert gas line instead: 1/8'' NPT female connector.
3. Bond the connection using oleo-waterproof glue, or put PTFE sealing on the threads.
4. Tighten the connection, applying a maximum tightening torque of 10 N·m.

5.8 Check that the installation is leak tight

When the product leaves the factory, product leak tightness under normal operating conditions is guaranteed. The operator must maintain this level of leak tightness, especially when pumping dangerous gases. For more information concerning leak tests, please contact our service center.

1. Perform a leak test on the entire pumping line after installation.
2. Carry out regular checks to ensure that there are no traces of the pumped gases in the surrounding environment and that no air is entering the pumping line during operation.

5.9 Electrical connection

⚠ WARNING

Risk of electric shock due to non-compliant electrical installations

This product uses mains voltage for its power supply. Non-compliant electrical installations or installations not done to professional standards may endanger the user's life.

- ► Only qualified technicians trained in the relevant electrical safety and EMC regulations are authorized to work on the electrical installation.
- ► This product must not be modified or converted arbitrarily.
- ► Check that the product is properly connected to the equipment's or pumping installation's emergency stop circuit.

⚠ WARNING

Danger of electrocution by contact during maintenance or overhaul

There is an electric shock hazard in case of contact with a product powered on and not electrically isolated.

- ► Before carrying out any work, set the main switch to **O**.
- ► Disconnect the power cable from the mains.
- ► Secure the installation correctly by tagging and locking (LO/TO) the system to prevent unintentional re-engagement.

⚠ WARNING

Risk of electric shock in case of contact with the mains connector at power-off

Certain components use capacitors that are charged up to over 60 VDC and that hold their electrical charge **at power-off**: residual voltages due to filter capacitance can cause electric shock, up to and including mains voltage levels.

- ► Wait 5 minutes after power-off before commencing work on the product.

NOTICE

Risk of electromagnetic disturbance

Voltages and currents can induce a multitude of electromagnetic fields and interference signals. Installations that do not comply with the EMC regulations can interfere with other equipment and the environment in general.

- ► Use shielded cables and connections for the interfaces in interference-prone environments.

The pump is a class A product.In a domestic environment, this product can cause radio interference. In this case, users must take appropriate measures.

Electrical safety

The pump motor is protected against overload by the current limitation of the variable speed drive in electronic drive unit (in case of overload, the speed decreases automatically).

When there is a hazard due to accidental contact with liquids, gases or solids, you must install a hard-wired emergency stop circuit to cut the power supply.

► **Never override these interlocks during installation, use, or maintenance**.

During the pump stop following a fault, the variable speed drive is switched off and the pump is put in a safe condition. To restart the pump, you must:

► **Wait until all moving parts have stopped** before switching the power off.
  – Set the switch on the 48 VDC external power supply to **O**.
► Wait approximately 15 seconds.
► Correct the cause of the fault.
► Restore power supply.
  – Set the switch on the 48 VDC external power supply to **I**.

5.9.1 Customer electrical installation protection

Differential circuit breaker at the AC/DC power supply input

In the event of an insulation defect, you must install a differential circuit breaker to protect personnel (see chapter "Electrical characteristics").

The power circuit used to supply the installation must be fitted with a breaker complying with the IEC 60947-2 curve D standard whose short circuit cut-off capacity is at least 10 kA. This protection device should be in close proximity to the pump (no further than 7 m away) and in line of sight of the product.

The customer must provide a correctly-rated main circuit breaker: see chapter "Electrical characteristics".

This AC/DC power supply is Class 1 equipment and therefore must be grounded. The user must make sure the installation has an earth wire properly connected to the ground.

Power supply via a 48 VDC network

To supply the pump using a 48 VDC network, see chapter "Electrical characteristics".

Grounding

When necessary, the installer must provide dual protection in addition to the existing one. It consists of an uninsulated braid or a separate green/yellow conductor with a minimum section 3 mm^2 (9AWG). The impedance between the pump body and the ground connection point must be < 0.1 Ohm at 25 A.

► Use an M4 x 8 screw and a locking washer fitted to the hole on the pump (mark ⏚) to secure the conductor to the pump and to the installation's ground connection point.

Absence of emergency stop

The vacuum pump is not equipped with an emergency stop device (EMS) or a lock-out device. The vacuum pump is designed to be integrated into equipment fitted with an emergency stop device.

- When activated, the EMS of the equipment must switch off the vacuum pump.

Operation in local mode

There is no device to warn that the pump is operating in local mode.

- Provide a means to warn about local mode operation when the pump is not integrated neither controlled by the equipment.

5.9.2 Connection to external power supply

⚠ 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.

The pump operates with a 48 VDC external power supply. The power supply and cable are available as accessories (see chapter "Accessories").

It can also operate with an external power supply and a cable supplied by the customer with the required characteristics (see chapter “Electrical characteristics”, page 75).

If the pump is connected to a main 48 VDC network (as defined by standard EN 61000-6), add a filter and an overvoltage clipping system on the power line at the pump inlet: contact our service center. The “-” pole of the 48 VDC is grounded internally.

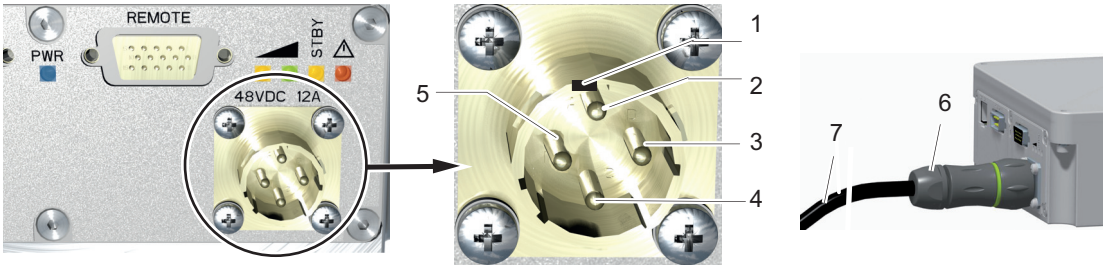


Fig. 12: 48 VDC power supply male connector

1 Index
2 Polarity + 48 VDC
3 Polarity - 48 VDC
4 Ground potential
5 Not connected
6 Pump power cable plug (Ref.: UTS6JC104S supplier: Souriau France)
7 Power cable

Pump power supply

1. Mark the main index on the pump’s male electrical connector.
2. Mark the main index on the female connector of the corresponding supply cable.
3. Insert the female connector in compliance with the indexes **and turn until you reach the locking position**.

Air cooled version

► If the pump is equipped with a fan, connect it via the connector to the front panel of the external power supply.

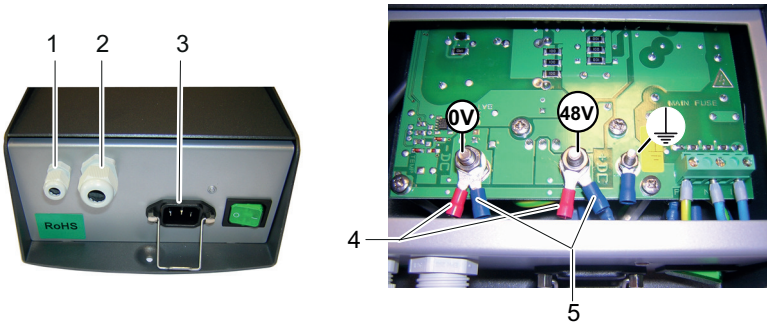


Fig. 13: Fan wiring to 48 VDC external power supply (accessory)

1 Connector for fan power supply (air cooled version)
2 Connector for pump power supply
3 Mains connector
4 Pump power cables: +++ (48 V), --- (0 V)
5 Fan power cables [1 or blue (-) (0 V), 2 or brown (+) (48 VDC)]

ATH 500 M version (only)

► Power the purge solenoid valve with 24 VDC (power supplied by the customer).

ATH 500 MT version (only)

► Power the heater band and the water valve.
  – the **HEATER** and **VALVE** connectors on the front panel of the electronic drive unit are connected.

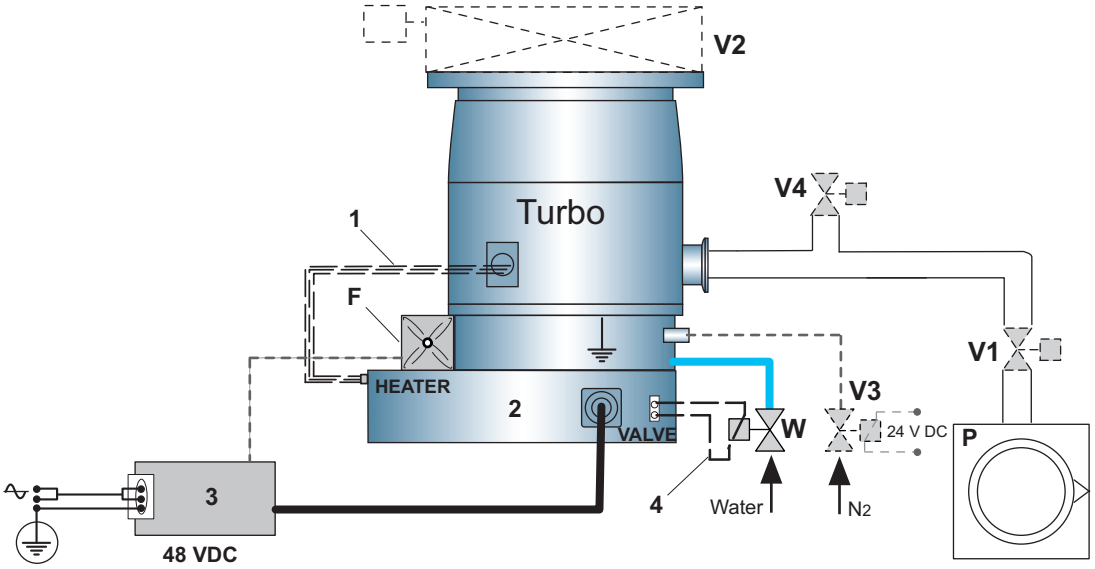


Fig. 14: Typical electrical wiring diagram

1	Heater band power supply (MT version pump)
2	Integrated electronics
3	External power supply
4	Water valve power supply (MT version pump)
P	Backing pump
Turbo	Magnetically levitated turbomolecular pump
F	Fan (air cooled version)
N2	Inert gas input
V1	Fore-vacuum isolation valve
V2	High vacuum isolation valve
V3	Purge solenoid valve (option)
V4	Air inlet solenoid valve (accessory)
W	Cooling circuit solenoid valve (MT version pump)
⏚	Functional grounding connection [1)]
⏚	CPC ground connection

1) Recommended for connecting the pump to the ground electrode in an environment affected by electromagnetic waves.

6 Operation

6.1 Preliminary precautions for use

⚠ WARNING

Risk of poisoning when process gases are present in the atmosphere

The manufacturer has no control over the types of gases used with the pump. Process gases are often toxic, flammable, corrosive, explosive and/or otherwise reactive. There is a risk of serious or fatal injury if these gases are allowed to escape freely into the atmosphere.

- ► Apply the relevant safety instructions in accordance with local regulation. This information is available from the operator's safety department.
- ► **Always connect the turbomolecular pump's exhaust to a backing pump compatible with process gases**: the backing pump's exhaust is connected to the installation's dangerous gas extraction system
- ► Regularly check that there are no leaks where the pump connects to the exhaust pipework.

⚠ WARNING

Risk of electric shock in the event of electrical disconnection while the pump is running

The turbomolecular pump and its electronic drive unit cannot be disconnected from the electrical network before the rotor completely stops rotating: the pump/electronic drive unit must be isolated from the electrical network to prevent electric shock!

1. Stop the pump from rotating by sending a **'Stop'** order on the control interface.
2. Wait for the rotor to completely stop rotating (several minutes).
3. Switch off customer power supply from the equipment.
4. Unplug the mains cable.

⚠ WARNING

Risk of cutting injuries due to contact with sharp edges via the 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).

- ► Wait for a complete standstill, before starting any work on the product.
- ► Keep the splinter shield in the inlet flange, as it limits the risk of injury.
- ► Wear protective gloves in accordance with standard EN ISO 21420.

Pumping pyrophoric or flammable gases may be hazardous. Product users and/or integrators must comply with the safety instructions (see chapter "Safety instructions relating to flammable/pyrophoric materials"). Every time the pump is commissioned:

1. Check that the pump has been correctly secured in accordance with safety instructions (see chapter "Equipment installation conditions").
2. Check that the pump inlet is properly connected to the pumping line.
3. Start the water and nitrogen circuits.
4. Check that the exhaust pipework is not clogged and that all the extraction system valves are open.
5. Check that the valves supplied by the customer are connected and supplied, including the purge valve (where applicable).
6. Check that the heater band and the water solenoid valve are connected to the electronic drive unit (MT Version pump).
7. Check that the fan is powered (where applicable).

6.2 Starting the pump

6.2.1 Powering on

► Set the 48 VDC power supply switch to **I**: the electronic drive unit boots up.
  – At the end of initialization, the yellow LED turns off and the green LED turns on.

6.2.2 Pumping start-up

The following steps describe the use of the pump regardless of the control panel. Refer to the "Control Panel" chapter for the wiring and configuration of the different interfaces, as well as the following chapters:

- Use via **HHR** (see chapter “Control via the HHR”)
- Use via **Remote** control (see chapter “Control via the Remote connector”)
- Use via **RS-232/RS-485** serial link (see chapter “Command via the RS-232/RS-485 serial link”)
- Use via **Fieldbus** (see chapter “Operation via fieldbus”)

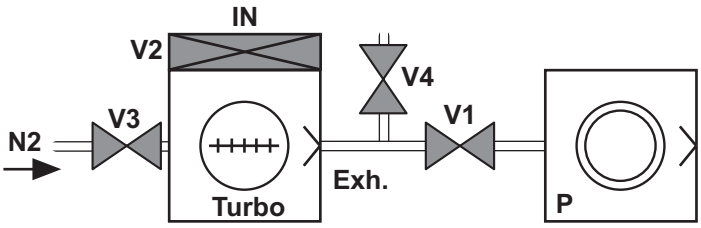


Fig. 15: Pumping installation diagram

Components in the pumping installation			
V1 [1)]	Fore-vacuum isolation valve	N2	Inert gas purge inlet
V2 [1)]	High vacuum isolation valve	Turbo	Magnetically levitated turbomolecular pump
V3 [1)]	Purge solenoid valve (option)	P [1)]	Backing pump
V4 [1)]	Air inlet solenoid valve (accessory)		

1) The supply, power supply and control of these components are the customer's responsibility.

Pumping start-up procedure

Initial conditions:

Valves V1, V2, V3, V4 are connected and controlled by the equipment (customer’s installation).

The vacuum chamber and the pumping lines are at atmospheric pressure, the backing pump is stopped and the valves are closed.

1. Start up the cooling circuit.
2. Send a pump **‘Start’** order via the HHR, Remote, serial link or fieldbus control panel:
   – The backing pump starts up and valves V1 and V2 open.
   – The turbomolecular pump starts to **reach the selected speed**.
3. Depending on the application, open the V3 purge solenoid valve (if installed and wired).

The pumping operation is performed until the operating pressure for the customer’s application is reached.

Stand-by speed

The Stand-by speed is selected when the pump is stopped or rotating.

► Send a **‘Stand-by’** order via Remote, serial link or fieldbus control panel or press the **STD-BY** key of the HHR interface.

Temperature management (MT pump version)

► Select the temperature setpoint via the the HHR, serial link or fieldbus control panel.

For more information about temperature management, see chapter “Pump Temperature management system”.

6.2.3 Restarting the pump after an emergency equipment stop

The equipment emergency stop manages the pump stop. To restart the pump after an emergency stop, it is necessary to:

1. Make sure the pump has stopped (all LED are off).
2. Wait until pump rotor has stopped.
3. Correct the problem.
4. Unlock the emergency stop button on the equipment,
5. Start the pump by sending a **'Start'** pump order via the control panel: the pump starts at the selected speed.

6.3 Shutting down the pump

6.3.1 Pumping shutdown

NOTICE

Risk of damaging the pump by generating an electric arc

The pump and its electronic drive unit must not be disconnected from the electrical network before the rotor completely stops rotating and the unit is isolated from the electrical network: an electric arc is created when the circuit is interrupted, which damages internal components.

1. Stop the pump from rotating by sending a **'Stop'** order on the control interface.
2. Wait for the rotor to completely stop rotating (several minutes).
3. Switch off customer power supply from the equipment.
4. Unplug the mains cable.

Shutdown procedure

Valves V1, V2, V3, V4 are connected and controlled by the equipment (customer's installation). The vacuum chamber and the pumping lines are under vacuum, the backing pump is on, and the V3 purge valve is open.

1. Close the V2 isolation valve to isolate the pump from the vacuum chamber.
2. Send a pump **'Stop'** order via the HHR, Remote, serial link, or fieldbus control panel.
   – The pump slows down.
3. Activate the V4 air inlet solenoid valve (accessory).
4. Close the V1 isolation valve and the backing pump stops.
5. Stop the water-cooling circuit when the pump is **stopped** (the rotor has stopped rotating).
6. Stop the inert gas purge flow.

NOTICE

Inert gas purge function

When the inert gas purge is stopped, the pumped gases can pass from the fore vacuum side to the high vacuum side and damage the bearing housings.

- ► Maintain the inert gas purge flow as long as the rotor is running to prolong the flushing.
- ► The purge maximum pressure must not exceed $1 \cdot 10^3$ to $1.5 \cdot 10^3$ hPa (absolute).

NOTICE

Air inlet solenoid valve function

The air inlet solenoid valve reduces the braking time required for the pump to get up to the atmospheric pressure. When isolation valves are installed on the pump inlet and exhaust, the rotor slow-down efficiency is improved.

- ► If the pump has been stopped by a sudden air inlet, **limit the number of restarts to 2 per hour**.
- ► if the pump has been stopped without air inlet, the number of restarts is not limited.
- ► Please contact us for advice on the air inlet solenoid valve.

Pump stop due to power failure

Stopping the pump by disconnecting the mains power supply is not a normal way to stop the pump:

- Always send a **'Stop'** order via the control panel and wait for the pump to stop rotating before starting work on the product.

When a power failure occurs, the rotor remains suspended by the energy emitted by the motor's counter-electromotive force, until the rotor rotation speed is low enough that it can rest on the landing bearings without being damaged.

If the power is restored before the minimum speed is reached, the pump recovers its initial speed without any disturbance. The landing bearing counter does not decrease.

Otherwise, if the minimum speed is reached before the power supply has been restored:

- The pump lands on its landing bearings.
- The electronic drive unit is powered off; no indicator light is on.
- The landing bearings' counter decreases (see chapter "Maintenance frequency").

Start up the pump according to the standard start-up procedure when the mains supply has been restored.

6.3.2 Powering off

1. Switch off the pump by setting the main 48 VDC switch to **O**:
   – All LEDs on the electronic drive unit are off.
   – Wait for the rotor **to completely stop rotating**.
2. Disconnect the pump supply cable from the electronic drive unit.

6.3.3 Prolonged stoppage

If the pump has to be stopped for a prolonged period, follow the shutting down procedure (see chapter "Shutting down for longer periods").

6.4 Operation monitoring

When a problem occurs, the user is warned by:

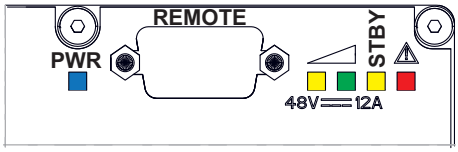
- Activation of the fault/warning LED
- Audible warning of the HHR (if enabled)
- Activation of the fault contacts on the **Remote** connector
- Pumping interruption when the **'Stop'** order has not been activated
- Fault/warning message displayed on the HHR
- A message via the RS-232 or RS-485 serial link
- A message via the fieldbus

Fault messages are listed in chapter "Malfunctions".

LED	Symbol	LED status	Display	Meaning
Green		off		Switched off
		on, flashing 10%		Power supplied. Pump stopped or rotation speed < 60 min^{-1}.
		on, flashing 90%		The pump has not reached the selected speed.
		on, constant light		The pump has reached the selected speed.
		on, flashing 50%		The pump speed decreases, speed > 60 min^{-1}.
Yellow		off		No warning
		on, constant light		Electronic drive unit initialized or warning signaled

LED	Sym-bol	LED status	Display	Meaning
Red		off		No fault
		on, constant light		Pump is faulty.

Tbl. 3: Meaning of LED on the EherCAT interface



LED status		Meaning
	Blue on	The pump is supplied with power.
	Yellow on	The pump has not reached the selected speed.
	Flashing yellow	The pump speed decreases, speed > 60 min^{-1}.
	Yellow STBY on	Stand-by mode selected
	Green on	The pump has reached the selected speed.
	Flashing green	The rotation speed exceeds the selected speed.
	Red on	Pump is faulty.
	Flashing red	Warning signaled

Tbl. 4: Meaning of LED on the Remote/RS232-RS485/Profibus interface

7 Advanced settings

This chapter describes the available functions and how they work. This chapter helps the user and/or the integrator to configure the pump parameters according to the requirements during the process.

7.1 Pump temperature management system

The temperature management system (TMS) fitted on the **MT version** pump consists on a heater band and a water solenoid valve.

The integrated heater band heats the pump to an adjustable temperature (refered to as temperature setpoint) to prevent the effects of condensation. The temperature setpoint depends on the application the pump is to be used for. Contact Pfeiffer Vacuum's applications department for advice in choosing the correct temperature setpoint.

The heater band and the water solenoid valve allow to manage the pump temperature up to the temperature setpoint. The electronic drive unit controls this temperature setpoint. The temperature setpoint is selected via the HHR control panel or via the serial link or fieldbus (see chapter "Control modes").

Depending on the temperature setpoint chosen to heat the pump and the temperature of the cooling water circuit, the pump can take a certain amount of time to reach the specified temperature.

7.2 Pump braking

Braking with air inlet solenoid valve

Braking with air inlet solenoid valve reduces the time required to stop the pump when electrical braking is not sufficient.

The air inlet solenoid valve is installed on the pump exhaust. The air inlet solenoid valve (flow $11 \cdot 10^3$ sccm), is calibrated to restore the atmospheric pressure in the pump internal volume. When isolation valves are installed on the pump inlet and exhaust, the rotor slow-down efficiency is improved.

24 VDC power supply and air inlet valve control are the customer's responsibility "Connection of the air inlet solenoid valve".

Electric braking

Electric braking is available on ATH 500 MT models.

Electric braking makes it possible to slow the pump by sending a **'Stop'** order to the pump, or in the event of a default stop, after a delay of 15 minutes during which time the pump can be kept under vacuum.

8 Interfaces for control

8.1 Control modes

This chapter describes the connections and protocols associated with each control mode. There are 4 control modes:

- **HHR**

  The pump is controlled **locally** from a Hand-Held Remote control (HHR), connected on the **SERVICE** connector.
- **REMOTE**

  The pump is controlled **remotely** by opening and closing different dry contacts or applying voltage to the **REMOTE** connector.
- **SERIAL LINK**

  The pump is controlled remotely by the commands transmitted via serial link **RS-232/RS-485**.
- **FIELDBUS CONNECTION**

  The pump is controlled with a remote-control system (automation, control, supervision) that communicates with the pump according to the fieldbus communication protocol.

  Different control interfaces for communication with fieldbuses (Profibus, EtherCAT, ...) are available in the ordering guide.

Choice of control mode

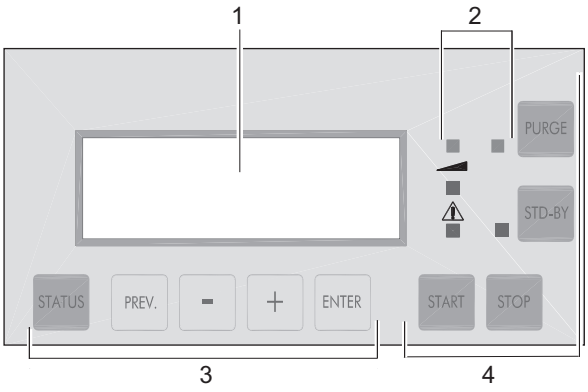
The selected mode controls the pump. The control mode can be selected:

- via the HHR **unit**
- via serial link **RS-232/RS-485**

8.2 Control via the HHR

Description of the HHR

Connected to the electronic drive unit, the HHR allows to display and configure the pump parameters.



1 Display
2 LED
3 Parameter selection and configuration keys
4 Manual control keys

Key	Functions	Key	Functions
STATUS	• To access the parameter display mode. • To exit the menus and return to parameter display.	ENTER	• To validate the selection of a menu, parameter, or value. • To confirm the answer to a question.
PREV.	• To access the configuration mode. • To exit the various menus without validating the functions.	STD-BY	• To allow pump operation at reduced speed via HHR when the **[SET UP][REMOTE CONTROL]** menu is set to **[KEYBOARD]** (see chapter 'Menu SETUP'). LED is lit when the pump rotates at Stand-by speed.

Key	Functions	Key	Functions
+ / −	• To move to the next or previous menu, next or previous parameter in the displayed menu. • To select or adjust the parameter value.	START	• To start the pump in local mode via HHR when the **[SET UP][REMOTE CONTROL]** menu is **[KEYBOARD]** (see chapter 'Menu SETUP').
PURGE	• To allow purge operation via HHR when the **[SET UP][REMOTE CONTROL]** menu is set to **[KEYBOARD]** (see chapter 'Menu SETUP'). LED is lit when the purge is activated.	STOP	• To stop the pump in local mode via HHR when the **[SET UP][REMOTE CONTROL]** menu is **[KEYBOARD]** (see chapter 'Menu SETUP').

Tbl. 5: Description of the HHR's keys

NOTICE

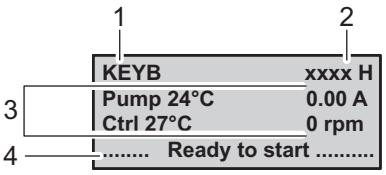
Risk of damage to the keypad

The keys are protected by a membrane. Using hard, pointed objects like pens and screwdrivers can damage the keys.

► Always use your hands to operate the keypad.

Description of the display

The display shows the status of the pump and the monitored parameters. Use the **+/-** keys to scroll through the monitored parameters.



1 Control mode
2 Running time
3 Operating parameters/fault messages
4 Pump operating status messages

8.2.1 Powering on

► Check that the electrical connections have been made before using the HHR.
► Connect the hand held remote to the **SERVICE** connector.
► Set the main switch to **I**: the HHR unit boots up.

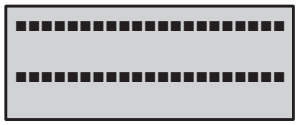
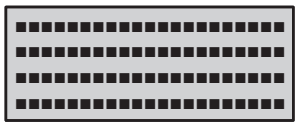
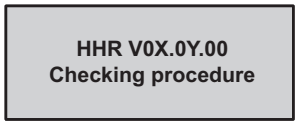
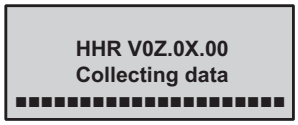
The HHR unit can be connected when the pump is switched on and/or when the rotor is rotating.

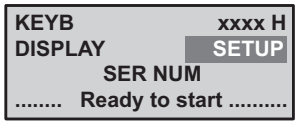
The factory settings

When the pump is run for the first time, it uses the default settings set at the factory to reflect the settings in the ordering guide. The factory settings are protected by an access code (initially 0) that can be changed.

- The user or the integrator is responsible for changing the pump parameters according to the requirements of the application.

HHR mode is active when the ‘Keyboard’ control mode is configured by the HHR or the RS-232/RS-485 serial link.

	Display initialization	
1 .	The electronic drive unit performs a self-test and identifies the connected pump. Boot-up time is approximately 15 seconds.	 
2 .	The equipment is identified, the software release is displayed, and communication with the pump is tested.	
3 .	In the meantime, the indicator lights are tested, they light up sequentially.	
4 .	At the end of the test, the type of connected pump and the message 'Ready to start....' are displayed.	

	Access to menus	
1 .	Access to the settings mode by pressing **PREV.** key. Access to the menu **[DISPLAY]** by pressing **ENTER** key.	
2.	Set the display parameters. Access from one menu to another by pressing **+/-** keys. Return to the previous menu using **PREV.** key.	
3 .	Access to the menu **[SETUP]** using **+/-** keys. Access the menu using **ENTER** key.	
3 .	Enter the access code to modify the setting and valid the new code by pressing **ENTER**. Return to the previous menu using **PREV.** key.	

8.2.2 DISPLAY menu

Selection	Description
STATUS	Display of the electronic drive unit and pump status: ● Pump temperature ● Pump motor current ● Electronic drive unit temperature ● Pump rotation speed
VERSION	Display of the electronic drive unit version (depends on the connected pump model): ● HHR version ● HHR front panel version ● Frequency converter version ● Turbomolecular pump magnetic spindle version
FAULT	Successive display of the last 10 defaults with their titles.
WARNING	Successive display of the last 10 warnings with their titles.
BEARING	Display of the landing bearing lifetime (in %) and the warning setpoint (in %).

8.2.3 SETUP menu

Selection	Choice	Description	Initial setting [1]
ACCESS CODE	0 to 65535		0
REMOTE CONTROL	Keyboard Remote hard Serial link Profibus EtherCAT	Choose the interface control mode.	According to ordering guide.
STAND-BY SPEED	from 15000 rpm to pump nominal speed	Activate pump Stand-by speed (selected speed) between minimum speed and nominal speed (= speed set at factory).	15000
BUZZER	ON OFF	Activate the acoustic signal in case of default. To stop the signal, press **OFF**.	OFF
THERMOSTAT	ON = 30 to 65 °C OFF	Activate the pump **temperature set-point**.	OFF (M version) ON = 65 °C (MT version)
RELAY AT SPEED	-3 to 50 % of the nominal speed	Modify the speed contact setpoint.	- 3 %
FIELDBUS PROFILE [2]	0 1	Reserved for service	0
FIELDBUS ADDRESS [2]			
RS-232 SPEED	9K6 19K2 38K4 57K6	Choose the RS-232 serial link transmission speed.	9K6
RS-232 ECHO	ON OFF	Activate all received characters to be echoed over the RS-232 serial link.	OFF
RS SEPARATOR	0 to 255	Enter the separator character in ASCII: e.g. “044” for “,”.	44
RS ADDRESS	0 to 255	Number given to the pump in the serial link.	0
BEARING LIVE Warning limit	0 to 99 %	Modify the landing bearing warning threshold.	20
NEW CODING	0 to 65535	Modify the access code.	0

1) For client's specification product, inital settings could be different (see chapter “Product concerned”).

2) Refer to the operating manual of the fieldbus interface that controls the pump.

8.2.4 SER NUM menu

Selection	Display	Initial settings
HHR	Display the HHR serial number.	XXXXXXXXXX
CONTROLLER	Display the control interface serial number of the electronic drive unit.	YYYYYYYYYY
CARTRIDGE [1]	Display the moving part serial number.	ZZZZZZZZZZ
MMCC06 [1]	Display the electronic board serial number.	AAAAAAAA

1) Only if HRR connected to an ATH 500 pump.

8.3 Control via the REMOTE connector

NOTICE

Safety of Extra-Low Voltage circuits

Remote control circuits are equipped with dry contact outputs (24 V - 1 A max). Overvoltages and overcurrents can result in internal electrical damage. Users must observe the following wiring conditions:

- ► Connect these outputs in accordance with the rules and protection of Safety Extra-Low Voltage (SELV) circuits.
- ► The voltage applied to these contacts should be less than 24 VDC and the current less than 1 A.

Description

Connection via the **REMOTE** connector (HD, 15-pin D-Sub female) can be used for:

- remote control of following functions: start, stop
- remote pump status through auxiliary dry contacts

The remote control mode is active when the 'Remote hardware' control mode is set on the RS-232/RS-485 serial link or via the HHR unit.

When the 'Remote hardware' control mode is set, the Stand-by speed and temperature setpoint can be set via the RS-232/RS-485 serial link or the HHR unit.

- ► Use shielded cable and connect both sides to the ground.

8.3.1 Logic input wiring

Control by direct voltage

The inputs are active when a DC voltage between 10 and 24 VDC is applied between their pins (wiring customer supplied).

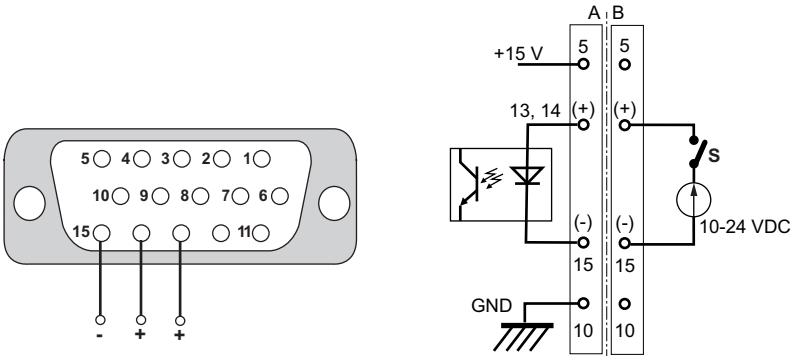


Fig. 16: Remote connector: control by direct voltage

A Internal wiring B Wiring from customer's side

Voltage 10-24 VDC	Function	
S3 (13-15)	Stand-by [1)]	Contact closed: Stand-by speed is selected. Contact open: pump rotation speed is the nominal speed.
S4 (14-15)	Start/Stop pump [1)]	Contact closed: the pump starts. Contact open: the pump stops.

1) This function runs when the control mode is set to 'Remote hard' via the RS-232/RS-485 serial link (see chapter "List of commands") or via HHR (see chapter "SETUP menu").

Control by dry contacts

To control these inputs by external contacts of the host equipment, connect pins 10 with 15 and wire the used contacts (wiring customer supplied). Pins 13, 14 are connected to + 15 V (pin 5) to be active.

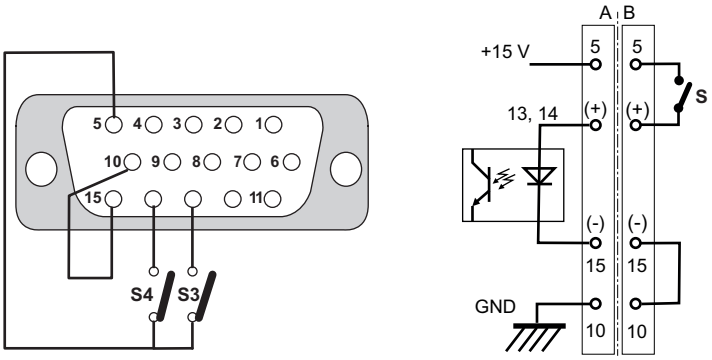


Fig. 17: Remote connector: control by dry contacts

A Internal wiring B Wiring from customer's side

Contact	Function	
S3 (13-5)	Stand-by [1]	Contact closed: Stand-by speed is selected. Contact open: pump rotation speed is the nominal speed.
S4 (14-5)	Start/Stop pump [1]	Contact closed: the pump starts. Contact open: the pump stops.

1) This function runs when the control mode is set to 'Remote hard' via the RS-232/RS-485 serial link (see chapter "List of commands") or via HHR (see chapter "SETUP menu").

8.3.2 Logic output wiring

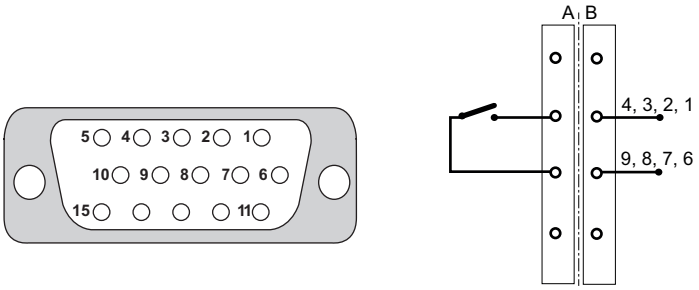


Fig. 18: Remote connector: logic outputs

A Internal wiring B Wiring from customer's side

Contact	Function	
1-6	Relay At Speed	Contact closed: OK for Process (at speed) • **M version** : speed ≥ nominal speed (set by 'Relay At Speed' parameter) (see chapter "SETUP menu") or (see chapter "List of commands"). • **MT version** : speed ≥ nominal speed (set by 'Relay At Speed' parameter, (see chapter "SETUP menu") or (see chapter "List of commands"), and if the temperature is ≥ the setpoint temperature - 3 °C.
2-7	Rotation	**Rotating mode OPT33 = 0** • The contact closes when the speed > 120 min^{-1}. • The contact opens when the speed < 100 min^{-1}. **Accelerating mode OPT33 = 1** • The contact closes when the motor is in acceleration phase. It remains closed until the nominal speed has been reached. • The contact opens when a STOP or INHIBIT command is taken into account or if the nominal speed has been reached.

To avoid misinterpreting the status of the contacts, we recommend a one-second filter on the reading of At Speed, Rotation, Fault and Stand-by contacts.

Contact	Function	
3-8	Fault	• The 'fault' contact closes when a fault appears (external, temperature, motor chassis, etc.). • The contact is open in the absence of faults.
4-9	Stand-by	• The 'stand-by' contact is closed when the stand-by mode is activated.
To avoid misinterpreting the status of the contacts, we recommend a one-second filter on the reading of At Speed, Rotation, Fault and Stand-by contacts.		

8.4 Command via the RS-232/RS-485 serial link

NOTICE

Risk of electromagnetic disturbance

Voltages and currents can induce a multitude of electromagnetic fields and interference signals. Installations that do not comply with the EMC regulations can interfere with other equipment and the environment in general.

► Use shielded cables and connections for the interfaces in interference-prone environments.

⚠ WARNING

Risk of electric shock in case of contact with a non-electrically insulated product

When powering off _mains switch to **O**_, certain components located between the mains connection and the circuit breaker will still contain an electric charge (live). There is a risk of electric shock in case of contact.

► Make sure that the mains connection is always visible and accessible so that it can be unplugged at any time.

► Disconnect the power cable from the mains supply before working on the product.

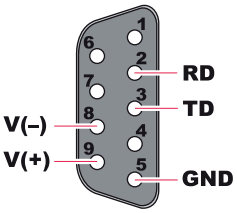
8.4.1 Connections

The 9-pin D-Sub male connector marked **RS-232/RS-485** is used to control and monitor the pump connected to an external computer. It allows also the installation of several pumps in a network. The connected computer allows the modification of the default serial link setting, according to the command list (see chapter “Command list”).

Initial serial link configuration

Description	Value
Serial link	RS-232
Transmission speed	9600 bauds
Data word length	8 bits
Parity	none (no parity)
Stop bit	1
Echo	no

RS-232/RS-485 connector

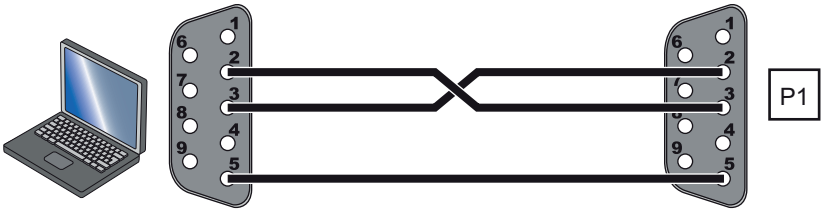


Pin	Assignment
2	Data reception (RS-232)
3	Data transmission (RS-232)

Pin	Assignment
5	GND
8	RS-485: V-
9	RS-485: V+

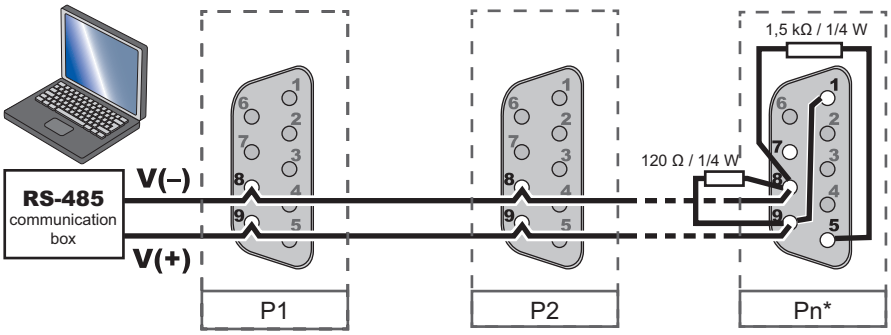
The user must use shielded links and connections in compliance with EMC and electrical safety standards.

RS-232 connection
A computer manages a single pump (P1) using the RS-232 link via the **RS-232/RS-485** connector.



RS-485 connection
A computer manages several pumps (P1, P2, Pn, etc.) using a RS-485 serial link via the **RS-232/ RS-485** connector. This parallel wiring allows communication between the pumps even if a pump is disconnected.

The wiring of the product at the end of line Pn* and the wiring of a single product on the network is specific.



Setting
The serial link control mode is active when the wiring is done and when the ‘Serial link’ control mode is configured by the HHR (see chapter “SETUP” menu) or on the RS-232/RS-485 serial link (see chapter “Command list”).

- ► Set the 48 VDC power supply switch to **I**.
- ► Send an order via the serial link.

8.4.2 Communication protocol

Control commands	
Header character	The default setting is the decimal code 035 of the character #
Address	Number given to the pump, 3 characters
Order	Command sent on serial link, 3 characters
Order	The number of characters depends on the command
End parameter	This is the message end character. The setting is ASCII 13 code **<CR>** *The <LF> character is not taken into account.*

Example:

Header character	Pump address	Order	Parameter	End character
#	ADR	ODR	XXXX	<CR>

Responses			
Header character	**Pump address**	**Response**	**End character**
#	ADR	yyyxxxabc	<CR>

OK	If everything is OK, or specific response to the order sent
ERR0	Setting fault
ERR1	Order fault
ERR2	Parameter fault
ERR3	Context fault
ERR4	Checksum fault

Example of dialog

Order	#005ECHON<CR>
Response	#005OK<CR>

8.4.3 Command list

Order	Parameter	Description	Functions	Min	Max	Default setting
ADR	xxx	Assignement an address to a pump in the network.	Example: *#adrADR,xxx<CR>* (only for RS-232) • adr = pump address before order • xxx = new address	000	255	0
DEF	none	Display of warnings/ faults history	List of the last 10 warnings/faults stamped on the electronic drive unit running time, followed by the name of the fault. The arrow->indicates the ongoing warning/fault *Example:* **00000:02:20 / Default list* *->00000:01:37 / Default in current Yh* *->00000:01:37 / PM Default* **00000:02:20 / Warning list* *->00000:02:37 / Holweck Temp. sensor* *00000:01:30 / Speed controller Hall sensor* *00000:00:50 / Holweck Temp. sensor*			
DLI	xxx	Data logger read interval	Defines the automatic read interval of pump status (STA) in seconds	0	255s	1s
DLR	none	Automatic read activated	Authorizes automatic reading of pump status (STA) according to the DLI interval (RS-232 only)			OFF
ECH	ON or OFF	Return character received on the serial link	Activated if ECHON (RS-232 only) Deactivated if ECHOFF (RS-232 only)			OFF
IDN	none	Identification of the product connected with the computer	Returns the type of pump connected with the computer, the software version (x, yy) followed by the release (zz) *Example: #adr,Pump_name Vx.y.zz,<CR>*			

Order	Parameter	Description	Functions	Min	Max	Default setting

LEV10	none	Returns the status of the operating parameters defined by SET	*Example: #adr,nnnnn,sssss,00000,0,ccccc,eeeee,00000,0000,0000,jj,kk,ll,mmm<CR>*
			nnnnn = nominal speed (min^{-1})
			sssss = standby speed (min^{-1})
			00000 = not used
			0 = not used
			ccccc = running time of the pump (hours)
			eeeee = running time of the electronic drive
			00000 = not used
			0000 = not used
			jj = 'At speed' relay setpoint (3 to 50%)
			kk = temperature setpoint (30 to 65°C)
			ll = landing bearing warning threshold (0 to 99%)
			mmm = landing bearing counter (0 to 100%)			

NSP	none	Switches from Stand-by speed to nominal speed	The speed is set to the nominal speed (default setting)			
OPT	XX	Setting of user's options/ orders	*Example: #adrOPTXX,n<CR>*			
			• XX = 14 control mode n = 0 HHR control mode (keyboard) n = 1 Remote control mode (hardware)* n = 2 RS-232/RS-485 control mode n = 5 Profibus fieldbus control mode n = 8 EtherCAT fieldbus control mode * not possible with EtherCAT			
			• XX = 25 Braking control n = 1 no motor braking n = 0 motor braking	0	1	0
			• XX = 29 Temperature management system ON/OFF (MT pump version) n = 0 temperature management disabled n = 1 temperature management enabled	0	1	0
			• XX = 33 contact mode n = 0 Rotating (contact closed if speed > 120 min^{-1}) n = 1 accelerating (contact closed during acceleration phase)	0	1	0
RDI	none	Serial number of the electronic drive unit	Serial number, coded with 10 digits and stored in EEPROM, of the pump, equipped spindle and control interface serial numbers.			

RPM	none	Stand-by speed setting	*Example: #adr,nnnnn<CR>*
			nnnnn = stand-by speed
				15000	50000	15000

SBY	none	Switches from the selected rotation speed to the Stand-by speed	The pump runs at the last Stand-by speed stored value. This last can be modified with RPM order.			

Order	Parameter	Description	Functions		Min	Max	Default setting
SEL10	none	Status of the options/ orders set with OPT order	*Example: #adr,0,0,1,0,r<CR>*				
			0 = not used				
			1 = not used				
			r = returns the remote control choice r = 0 Hand Held Remote (keyboard) r = 1 Remote control r = 2 Serial link r = 5 Profibus r = 8 EtherCAT	by default, the value depends on the pump configuration			
SEL20	none	Status of the parameters set with OPTXX	Returns the status of parameters set with OPTXX: S_{25}, S_{29}, S_{33} *Example : #000,S_{25},S_{29},S_{33}<CR>*				
SEP	none	Separator character	Valid for parameters returned on DLR, STA and LEV. ASCII input value of the character code 044 corresponds with comma “,”		000	255	044
SET	XX	Setting pump operating parameters	*Example: # adrSETXX,ccccc<CR>*				
			XX = 10 pump running time (in hours)				
			XX = 30 ‘at speed’ relay setpoint (%)		- 3	- 50	- 3
			XX = 31 temperature control (°C) (MT pump version)		30	65	30
			XX = 32 landing bearing threshold (%)		0	99	20
			ccccc = value				
TMP	ON or OFF	Start/Stop the pump	The pump rotation starts with TMPON The pump stops with TMPOFF				
VER	none	Display of software versions	*#adr,INTERFACE Vx.yy.zz,CARTRIDGE Vx.yy,TYPE zzzz,FIRMWARE Vx.yy.zz*<CR> INTERFACE: vx.yy.zz = control interface software version CARTRIDGE vx.y = variable speed drive software version Type zzzz = type of connected pump FIRMWARE Vx.yy.zz = software version				

Order	Parameter	Description	Functions	
STA	none	Pump status	*Example : #adr,$s_1s_2s_3$, rrrrr,vvv, www, xxx, yyy, zzz, aa, bbbbb, ccc, ddd, gggggggggggggggggggggggg<CR>*	
			rrrrr = pump rotation speed (min^{-1}) aa = motor voltage (V) bbbbb = motor current (mA) ccc = pump temperature (° C) ddd = electronic drive unit temperature (° C) $s_1s_2s_3$ = requires to convert ASCII to binary	vvv = Radial Xh www = Radial Yh xxx = Radial Xb yyy = Radial Yb zzz = Axial Z g_0 *to* g_{24} = warning and default bytes

Order	Parameter	Description	Functions								
STA	none	**s_1: order status**	**Bit**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
					INH	Local	Fault	Serial Fieldbus	REM	STBY	START
			0	-	0	OFF	OK	0	OFF	OFF	OFF
			1	1	ON	ON if HHR has control	Fault if status Fault activated	ON if fieldbus mode is activated	ON if Remote hard mode is activated	ON if Standby mode is activated	ON when starting, at speed, or overspeed
STA	none	**s_2: pump status**	**Bit**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
					Fault	Warning Temp.	Braking	(Free)	Accelerating	Rotating	Power (init).
			0	-	OFF	OFF	OFF	0	OFF	OFF	-
			1	1	- if fault is activated	ON if pump temp. is too high	ON	-	ON if starting mode is activated	ON when starting, at speed or overspeed	ON
STA	none	**s_3: solenoid valve status**	**Bit**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
					Speed	(Free)	(Free)	Water valve	TMS	(Free)	(Free)
			0	-	OFF	-	-	OFF	OFF	0	0
			1	1	ON if At speed activated	-	-	ON if water valve powered (MT)	ON if TMS activated (MT)	-	-

Order	Parameter	Description	Functions			
STA	none	**g_0 to g_{24}: warnings and defaults bit**	**g**	**0 = ok**	**1 = warning**	**2 = fault**
			0		Seized pump	Not accelerating
			1			Fault (any)
			2			
			3			
			4			
			5			Drive fault
			6			
			7			Mag. suspens.
			8		Power voltage	
			9			
			10			Upper radial bearing Yh
			11			Upper radial bearing Xh
			12			Lower radial bearing Yb
			13			Lower radial bearing Xb
			14			Axial bearing Z
			15		Bearing	Bearing change
			16		Electronic temperature	Electronic temperature
			17		Pump temperature, pump sensor	Pump temperature
			18			
			19			
			20			Self check
			21			
			22			
			23			
			24		Internal communication	

8.5 Operation via fieldbus

Connecting and using Pfeiffer Vacuum turbomolecular pumps with a fieldbus system is possible when the corresponding control interface is installed on the pump (depends on the ordering guide).

► Refer to the operating instructions of the corresponding control interface (see chapter “Applicable documents”).

9 Maintenance

9.1 Maintenance safety instructions

⚠ DANGER

Risk to health posed by residual traces of process gases inside the pump

Process gases are toxic and hazardous to health. They can cause poisoning and be fatal. Before disconnecting the pump, any remaining traces of process gases must be eliminated.

- ► **The equipment (pumping installation) must be purged with a stream of nitrogen for 30 minutes** at the same pressure and flow as that used for the process itself.

⚠ DANGER

Risk of poisoning in case of contact with toxic substances and by-products generated by the process

The vacuum pump, pumping line components and operating fluids **will potentially be contaminated** with toxic, corrosive, reactive and/or radioactive materials related to the process. Any contact with the contaminated parts or by-products generated by the process may be injurious to health and could cause poisoning.

- ► Appropriate protective equipments must be worn when disconnecting the pump for maintenance, filling it with operating fluid, or draining it.
- ► Ventilate the area thoroughly or carry out the maintenance under an extraction hood.
- ► Do not eliminate the by-products/residue via as common waste; have them destroyed by a qualified company where necessary.
- ► **Close off all the ports with airtight blanking plates** (the product comes with blanking plates that are also available for sale as accessories).

⚠ WARNING

Risk of cutting injuries due to contact with sharp edges via the 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).

- ► Wait for a complete standstill, before starting any work on the product.
- ► Keep the splinter shield in the inlet flange, as it limits the risk of injury.
- ► Wear protective gloves in accordance with standard EN ISO 21420.

⚠ WARNING

Danger of electrocution by contact during maintenance or overhaul

There is an electric shock hazard in case of contact with a product powered on and not electrically isolated.

- ► Before carrying out any work, set the main switch to **O**.
- ► Disconnect the power cable from the mains.
- ► Secure the installation correctly by tagging and locking (LO/TO) the system to prevent unintentional re-engagement.

⚠ WARNING

Risk of burns in case of contact with hot surfaces

Component temperature remains high, even after the pump has stopped. There is a risk of burns through contact with hot surfaces, especially at the pump exhaust.

- ► Wait for the product to fully cool down before working on it.
- ► Protective gloves must be worn in accordance with standard EN ISO 21420.

⚠ WARNING

Poisoning risk in case of process gas leakage

When connecting/disconnecting components to/from the pumping line (pump, pipework, valves, etc.) for maintenance, the leak tightness of the installation is broken, potentially causing hazardous process gas leakage.

- ► Always protect the inlet and exhaust surfaces during dismantling.
- ► Perform a leak test on the pumping line after reassembly.

NOTICE

Risk of damaging the pump by generating an electric arc

The pump and its electronic drive unit must not be disconnected from the electrical network before the rotor completely stops rotating and the unit is isolated from the electrical network: an electric arc is created when the circuit is interrupted, which damages internal components.

1. Stop the pump from rotating by sending a **'Stop'** order on the control interface.
2. Wait for the rotor to completely stop rotating (several minutes).
3. Switch off customer power supply from the equipment.
4. Unplug the mains cable.

General maintenance recommendations

- Ensure that the maintenance technician is trained in the safety regulations that cover the pumped gases.
- Disconnect the mains cable from all sources of power before working on the product.
- Wait 5 minutes after powering off before working on the electrical components.
- Wait for the product to cool down completely before working on it.
- Pressurized circuits – nitrogen and water – pose potential energy risks: always lock out these circuits using the LO/TO (Lock Out/Tag Out) procedure before working on the product.
- Route and secure cables, hoses and pipework to guard against falls.
- Collect the residues from the processes and call in a competent organization to dispose of them.
- Always protect the inlet and exhaust flange surfaces.

9.2 Maintenance frequency

The ATH magnetically levitated turbomolecular pumps require periodic maintenance to prevent failures. The maintenance frequency depends on customer processes. Some Process details informations are needed to determine the maintenance frequency, please consult Pfeiffer Vacuum.

Process dependent recommendations are as below:

Process	Maintenance frequency [1)]	Process example / Remarks
Metal and conductor etch process with corrosions and/or condensables	12 months	Maintenance frequency to be determined with process information. Please consult Pfeiffer Vacuum with process details.
Deposition processes with condensables		Condensable gas usage and/or powder production.
Light etch process	24 months	Oxide etch, Silicon etch, with little deposition processes.
Deposition processes without condensables		
Clean applications	60 months	Vacuum generation without any reactive gas.

1) Consult Pfeiffer Vacuum for more details.

Maintenance of landing bearings

By design, the pump does not include parts liable to wear and does not need preventive maintenance. However, **the landing bearings** used to protect the pump against accidental air in-rushes, accidental shocks or accidental disconnection of the electronic control unit, have to be changed when indicated by the electronic drive unit: the percentage of roll counter landing time deducted depends on the number and type of incidents.

The warning threshold informing the operator of the need for landing bearing maintenance is configured via the control mode which controls the pump (HHR, serial link or fieldbus). A counter displays the bearing wear level when landing bearing maintenance should be performed.

Landing bearings are designed to withstand landings caused by improper use. The wear of landing bearings is monitored by the electronic drive unit, based on the rotation speed and landing duration. The initial percentage is set at 100%. When this value reaches the warning threshold, a warning is triggered: the landing bearings must be replaced. If other landings occur, the counter continues to decrease to 0% **Theses landing bearings must be replaced by a Pfeiffer Vacuum service center.**

Maintenance of pump rotor

The life of the pump rotor changes with the operating conditions and applications. To ensure the best performance, **after 5 years of operation, have the condition of the rotor checked by a Pfeiffer Vacuum service center.**

How to contact us

Product overhauls must be carried out by personnel with manufacturer training. Contact our nearest service center at the following e-mail address: service.fr@pfeiffer-vacuum.com.

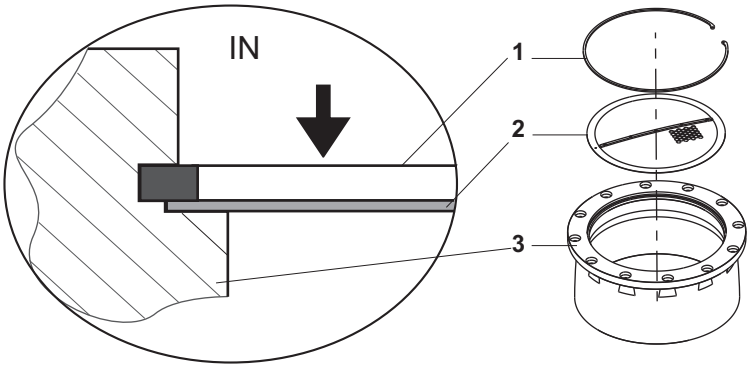
9.3 On-site maintenance

The pump does not require any maintenance on the customer's premises other than the day-to-day servicing described in this manual. All other maintenance operations must be carried out by our service center.

- ► Clean the outer surfaces of the product using a clean, lint-free cloth and a product that will not damage the screen-printed surfaces or adhesive labels.
- ► Check the exhaust line for clogging.
- ► Check that the splinter shield is not clogged; clean it or replace it.
- ► Replace the dust filter on the purge solenoid valve if it is obstructed (if valve present).
- ► Replace the solenoid valve coils if they are defective.
- ► Replace the water solenoid valve if it is defective (if valve present).

Splinter shield replacement

Pump is delivered with splinter shield installed in the pump inlet housing. This splinter shield protects the pump against solid particles coming from vacuum chamber. When it is polluted or damaged, it must be replaced.



1 Ring
2 Splinter shield
3 Inlet housing

For reassembly, respect the following instructions:

1. Install the splinter shield in the inlet housing groove, **bent side facing the vacuum chamber**.
2. Position the ring and **manually press it down on the groove bottom all around its circumference**.

9.4 Exchange procedure by a replacement product

To proceed with a standard exchange, key steps must be followed in sequential order:

1. Disconnecting the pump from the installation.
2. Draining the water circuit.
3. Preparing the pump for shipping.
4. Completing the declaration of contamination.
5. Handling the new pump (see chapter "Handling the pump").
6. Installing a new pump (see chapter "Installation").

Familiarize yourself with the service request procedure and fill in the declaration of contamination when returning products to our service centers (see chapter “Service solutions by Pfeiffer Vacuum”, page 67).

9.4.1 Disconnecting the pump from the installation

Reminder of the risks and safety measures

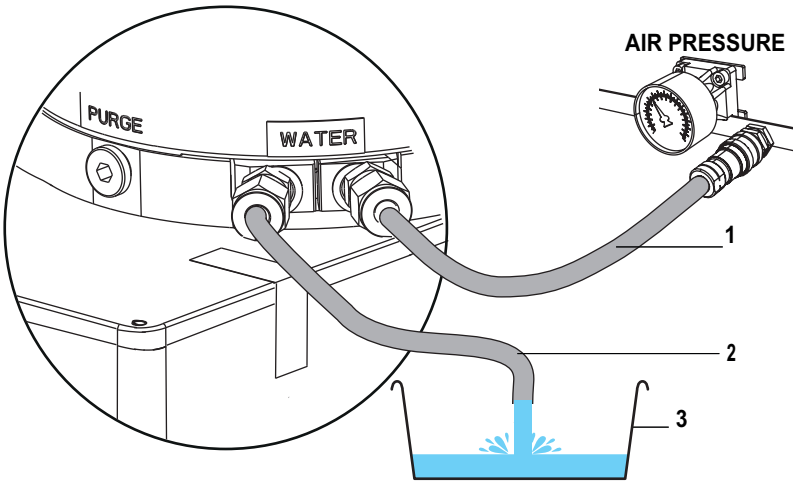
- Follow the maintenance safety instructions.
- Apply the specific safety instructions in accordance with local laws; this information is available from the customer’s health and safety department.

Disconnection procedure

1. Stop the pump by sending a **'Stop'** order.
2. Switch off the pump by setting the power supply main switch to **O**.
3. Switch off the network circuit breaker of the customer's installation.
4. Disconnect the mains plug.
5. Disconnect all the connectors on the control interface.
6. Disconnect the nitrogen supply.
7. Disconnect the **WATER IN** connector followed by the **WATER OUT** connector.
8. Disconnect the pump from the high vacuum flange and blank off the inlet port with the airtight connection accessories.
9. Disconnect the pump from the exhaust and blank off the exhaust port with the airtight connection accessories.
10. Install the handling devices (see chapter "Handling the pump").
11. Disconnect the pump from the installation.

9.4.2 Draining the water circuit

Any water that has accumulated must be drained to prevent the pipework from freezing during transport. To do this, users will need to provide flexible tubes and connections as well as a compressed air circuit (pressure 2 to 5 $\cdot 10^3$ hPa).



1 Pipe for compressed air supply
2 Water drain pipe
3 Container (capacity > 1 liter)

Water circuit draining procedure

1. Place a container below the pump water connectors.
2. Disconnect the water circuit from the **WATER IN** and **WATER OUT** connections.

3. Connect the drain pipe to a pump water connector.
4. Connect the other connector to a compressed air circuit.
5. Inject compressed air into the pump until the water has been completely evacuated.

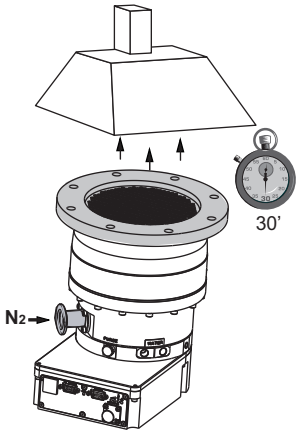
9.4.3 Preparing the pump for shipping

Pumps due to be shipped must first be roughly decontaminated then pressurized with nitrogen.

To decontaminate and pressurize the pump, you must have a nitrogen supply with the required characteristics (see chapter “Nitrogen characteristics”). Similarly, you should have connection accessories so that the pump can be tightly sealed (see accessories).

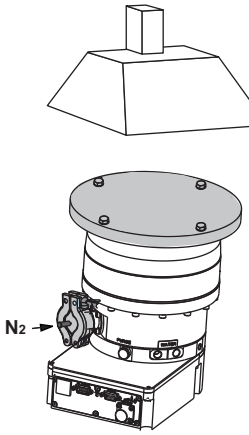
Exhaust/inlet flushing

1. Close the purge connector with a plug.
2. Install the blanking plate equipped with the injector on the exhaust flange.
3. Connect the nitrogen to the gas connector provided for this purpose.
4. Flush with nitrogen by injecting a relative pressure of 120 to 150 hPa for 30 minutes.
5. Stop the nitrogen flow.



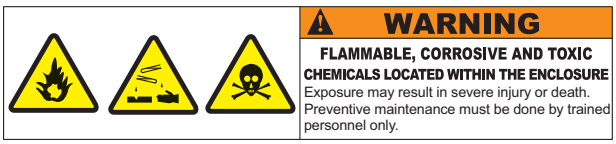
Pressurizing the pump

1. Seal the pump inlet with airtight connecting accessories.
2. Pressurize the pump with nitrogen to a relative pressure of 120 hPa.
3. Stop the nitrogen flow.



Labeling the pump

1. Affix this label to the product to warn users that the pump has been in contact with unsafe products.
2. Fill in the contamination declaration and attach it to the product.



10 Decommissioning

10.1 Shutting down for longer periods

NOTICE

Process gas accumulation in stopped equipment

All process pumps are designed for continuous operation in process gas pumping applications and should not be stopped. Pfeiffer Vacuum declines any liability for process pumps that have been stopped for a prolonged period of time leading to by-product condensation, powder build-up or corrosion inside the pump, nor does its warranty cover such items.

► **Carry out a product overhaul before putting it back into service. Contact Pfeiffer Vacuum.**

After use in clean applications

1. Continue nitrogen flow from the process tool for **30 minutes**. Nitrogen pressure and flow rate should be identical to the programmed values during process.
2. Drain the water circuit.
3. Disconnect the pump from the installation.
4. Seal the pump inlet, exhaust and purge ports with included accessories.
5. Store the pump in a clean and dry area, for a maximum period of **6 months** in accordance with storage temperatures.
6. Close the electrical connectors with plastic covers included with the pump.

After use in aggressive applications

► **Never store a pump which has been used in aggressive applications!!**.

Proceed with a standard exchange (see chapter “Exchange procedure for replacement products”) and return the product to the service center (see chapter “Service solutions by Pfeiffer Vacuum”, page 67).

10.2 Recommissioning

To restart the pump after prolonged storage, refer to the installation instructions (see chapter “Installation”, page 22).

10.3 Disposal

In accordance with directives on the treatment of waste electrical and electronic equipment (WEEE), and concerning the restriction of hazardous substances (RoHS), end-of-life products can be returned to the manufacturer for decontamination and recycling.

The manufacturer shall only be required to take back equipment that is complete and unmodified, using Pfeiffer Vacuum SAS original spare parts, sold by Pfeiffer Vacuum and including all assemblies and sub-assemblies.

This obligation does not cover the shipping cost to a reclamation facility or services provided, for which the customer will be invoiced.

Familiarize yourself with the service request procedure and fill in the declaration of contamination when returning products to our service centers (see chapter “Service solutions by Pfeiffer Vacuum”, page 67).

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.

Our products contain various materials which can be recycled: steel, stainless steel, brass, aluminum, nickel, copper, fluoroelastomers, PTFE, FEP and electronic boards. Take special precautions for:

- fluoroelastomers which may break down if they are exposed to high temperatures,
- components in contact with products resulting from processes which may have been contaminated.

11 Malfunctions

11.1 Malfunction and fault indication

Read the safety instructions for maintenance (see chapter "Maintenance safety instructions").

When a problem occurs, the user is warned by:

- Activation of the fault/warning LED
- Audible warning of the HHR (if enabled)
- Activation of the fault contacts on the **REMOTE** connector
- Pumping interruption when the **'Stop'** order has not been activated
- Fault/warning message displayed on the HHR
- A message via the RS-232/RS-485 serial link
- A message via the fieldbus.

Meaning of the LED

The LED configuration varies depending on the type of electronic interface.

- Yellow LED on/red LED flashing = warning
- Red LED on = presence of a fault, pump stops

For monitoring operation (see chapter "Operation monitoring", page 41).

Recommissioning after a stop due to a fault

During the pump stop following a fault, the speed variator is switched off and the pump is put in a safe condition. To restart the pump, you must:

1. Switch the power off and **wait until the rotor has stopped**.
   – Set the switch on the 48 VDC external power supply to **O**.
2. Wait approximately 15 seconds.
3. Correct the cause of the fault.
4. Restore power supply.
   – Set the switch on the 48 VDC external power supply to **I**.

11.2 Malfunction

Start-up problem and incorrect operation		
Symptom	**Cause**	**Remedy**
When the device is powered on, nothing happens and no indicator light is on.	No power supply	• Check that the external power supply 48 VDC is correctly powered. • Check that the pump is powered with 48 VDC. • Check the chaser when powering on the device. • Contact our service center.
The pump vibrates as its speed increases.	Mechanical problem	• Check that the pump is securely fastened to the frame (see chapter "Installation specifications"). • Check that the installation does not cause vibrations. • Check that the installation is correctly fastened to the floor (this problem may result from an anti-vibration flagstone). • If the fault occurs again, contact our service center.
The red LED of the electronic drive unit is on.	Pump is faulty.	• Connect the serial link. • Display the fault list via RS-232/RS-485 serial link (enter the command: #DEF).

Pump is running and a fault message is displayed			
Message	**Symptom**	**Cause**	**Remedy**
Unbalance fault Bearing overload Displacement fault Lower Radial Bearing Upper Radial Bearing Axial position Lower Radial current Upper Radial current Axial current No recovery	Electronic drive unit stops the motor. The air inlet solenoid valve is opened. The pump cannot restart.	Electronic drive unit cannot position the rotor.	• Check that the pump is correctly fastened to the frame (see chapter “Installation specifications”). • Turn off the mains power, wait for 15 s and restore power supply. • If the message disappears, restart the pump. • If the fault occurs again, contact our service center.
Not Ecc Correct	The Ecc self-inspection test is not complete.	The electronic drive unit stops the motor. The “START” contact opens. The pump cannot restart.	• Check that there are not vibrations on the frame. • Check that the pump is securely fastened. • Turn off the mains power, wait for 15 s and restore power supply. • if the message disappears, try to restart the pump • If the fault occurs again, contact our service center. For processes generating dust or condensable vapors, the rotor may be blocked by process by-products.
Safety shutdown	Mechanical or electrical problem	The electronic drive unit stops the motor. The “START” contact opens. The pump cannot restart.	• Contact our service center.
Drive fault	Motor overcurrent or fault on Hall sensors	The electronic drive unit stops the motor.	• Reduce the flow. • Turn off the mains power, wait for 15 s and restore power supply. • If the message disappears, try to restart the pump • If the fault occurs again, contact our service center.
Hardware fault	The safety contact appears when an pump/electronic drive unit assembly fault is detected.	No magnetic levitation. The pump cannot restart.	• Contact our service center.
Selfcheck failed	Mechanical or electrical problem	No magnetic levitation. The pump cannot restart.	• Turn off the mains power, wait for 15 s and restore power supply. • If the fault occurs again, contact our service center.
Electr.Temperature	The temperature of the electronic drive unit exceeds the authorized limit > 75–80 °C	The pump cannot start.	• Check the water cooling circuit (see chapter “Connecting the pump to the water circuit”).
Rotate during Powerup	The pump is powered, the rotor is still running.	The pump cannot start.	• Wait for pump rotor has stopped before switching the power off. • Disconnect and reconnect the mains power. • If the fault occurs again, contact our service center.

Pump is running and a fault message is displayed			
Message	**Symptom**	**Cause**	**Remedy**
Magnetic bearing	Electronic drive unit stops the motor. The air inlet solenoid valve is opened.	Rotor levitation fault	• Wait for pump rotor to stop completely. • Turn off the mains power, wait for 15 s and restore power supply. • If the message disappears, restart the pump. • If the fault occurs again, contact our service center.
Pump Temperature	The pump temperature exceeds the authorized limit: > 105 °C (Pump MT version) > 110 °C (Pump M version)	The electronic drive unit stops the motor until the temperature drops to 105 or 110 °C, after which the motor restarts.	• Check the water cooling circuit (see chapter “Connecting the pump to the water circuit”).
Bearing	The landing bearings must be replaced: landing bearing counter reaches the warning threshold.	The authorized limit for the number of landings on landing bearings is reached.	• Contact our service center.
Seized Pump	Electronic drive unit stops the motor.	Rotor is blocked.	• Turn off the mains power, wait for 15 s and restore power supply. • If the message disappears, restart the pump • If the fault occurs again, contact our service center.
Not Accelerating	Electronic drive unit stops the motor.	The pump cannot accelerate.	• Check if the backing pump is running (level of fore vacuum).
Internal communication	The pump cannot start.	Internal communication fault	• Turn off the mains power, wait for 15 s and restore power supply. • If the message disappears, restart the pump. • If the fault occurs again, contact our service center.

12 Service solutions by Pfeiffer Vacuum

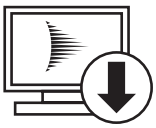
We offer first-class service
High vacuum component service life, in combination with low downtime, are clear expectations that you place on us. We meet your needs with efficient products and outstanding service.

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 section.

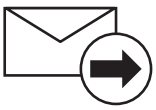
You can obtain advice on the optimal solution for you, from your Pfeiffer Vacuum representative.
For fast and smooth service process handling, we recommend the following:



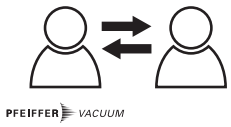
1. Download the up-to-date form templates.
   - Explanations of service requests
   - Service requests
   - Contamination declaration

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.

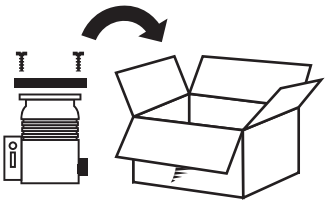


3. Send the forms by email, fax, or post to your local Service Center.

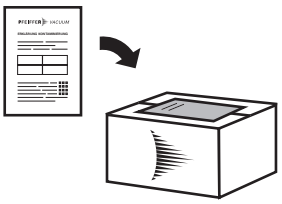


4. You will receive an acknowledgment from Pfeiffer Vacuum.

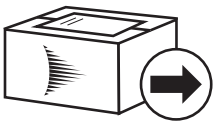
Submission of contaminated products
No microbiological, explosive, or radiologically contaminated products will be accepted. Where products are contaminated, or the contamination declaration is missing, Pfeiffer Vacuum will contact you before starting service work. Depending on the product and degree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



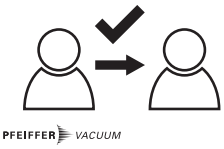
5. Prepare the product for transport in accordance with the provisions in the contamination declaration.
a) Neutralize the product with nitrogen or dry air.
b) Seal all openings with blind flanges, so that they are airtight.
c) Shrink-wrap the product in suitable protective foil.
d) Package the product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

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

13 Accessories

Accessory	Function	Type	Dimension	P/N
Isolation valve	This isolation valve is used to maintain vacuum in the pump by isolating it in the pumping line.	Manual valve	see manufacturer's catalog	
Hand-held remote control	This accessory allows remote man/machine interface for controlling the pump in local mode.	Control box with cable		114461
Centering ring for ISO-F inlet flange			100 ISO-F	115940
			160 ISO-F	115797
Copper seal for CF-F inlet flange			100 CF-F	303291 (Qty 1)
			160 CF-F	303292 (Qty 1)
Splinter shield	This splinter shield protects the pump from solid particles. It is installed in the pump inlet housing.	Bent screen + bored clips	DN 100 ISO-F	118001
			DN 160 ISO-F	118002
Set of screws for pump installation	This set includes connecting accessories to fasten the pump to the equipment via the inlet pump housing.	Set of 12 screws CHc M10 x 35	DN 160 ISO-F	110676S
		Set of 12 studs CHc M8 x 35	DN 100/160 CF-F	118690
Claw clamp for loose flange		Stainless steel	ISO-K	PF 300 110 - T (Qty 1)
Plug for purge port	A plug can be installed instead of the dust filter.	Plug + o-ring and washer		115298S
Power supply (external)	Input: 230V (±15%) 50-60Hz Output: 48 VDC 600 W			114866
Main power cable	This cable allows the connection of the external power supply to the mains (length 2 m).		Europe standard: 200-240V AC 48 VDC	103566
			US standard: 200-240V AC 48 VDC	103898
Power cable	The cable connects the pump to the 48 VDC power supply.		3.5 m	A331328-035
			5 m	A331328-050
			10 m	A331328-100
Air inlet solenoid valve	The air inlet solenoid valve is calibrated to return the internal volume of the pump to atmospheric pressure.	24 VDC	DN 25 ISO-KF (M version) DN 40 ISO-KF (MT version)	200043 see manufacturer
Purge solenoid valve set (without cable)	The purge solenoid valve is used to control inert gas injection while the pump is in operation. (M version pump only).		24 VDC - 5W	115303S
Purge solenoid valve cable			1 m	A462403-010
			3.5 m	A462403-035
			5 m	A462403-050
			10 m	A462403-100
			20 m	A462403-200
Closing kit for inlet port (polluted pump)	This sealing kit includes a blanking plate, seal ring and set of screws to seal the pump.		DN 160 ISO-F	114501
			DN 160 ISO-K	114502

For blanking plates, claw clamps and quick connect clamps, please refer to the connecting accessories catalog on the pfeiffer-vacuum.com site. Select material properties compatible with the application.

Accessory	Function	Type	Dimension	P/N
Connecting accessories	For exhaust (pressurization)	Blank-off flange with injector connector	DN 25 ISO-KF (M version)	114419
			DN 40 ISO-KF (MT version)	065053
		Injector		106859
For blanking plates, claw clamps and quick connect clamps, please refer to the connecting accessories catalog on the pfeiffer-vacuum.com site. Select material properties compatible with the application.				

14 Spare parts

Replacement of defective parts

The initial safety conditions of the product call into question if non-original parts are used.

- Use only spare parts available for order from Pfeiffer Vacuum Service.
- To identify the product and communicate with Pfeiffer Vacuum look at the product's rating plate.

Description	Version of pump	Part Number	Comments
24 VDC coil	Vxxxxx00 (M) Vxxxxx03 (MT)	038066	for purge valve and air inlet valve
Dust filter	Vxxxxx00 (M) Vxxxxx03 (MT)	106229	on air inlet solenoid valve
48 VDC fan cable	Vxxxxx00 (M) Vxxxxx03 (MT)	A464597	
Copper water solenoid valve set 48 VDC (NO) • Valve body • 48 VDC coil • 1/8 BSPP straight connector • 1/8 NPT straight connector • 1/8 NPT elbow connector	Vxxx2x03 (MT)	119110S • 115062 • 119079 • 115304 • 105559 • 119077	
Inox water solenoid valve set 48 VDC (NO) • Valve body • 48 VDC coil • 1/8 BSPP straight connector • 1/8 NPT straight connector • 1/8 NPT elbow connector	Vxxx3x03 (MT)	126753S • 123192 • 119079 • 115304 • 105559 • 119077	

Tbl. 6: Spare parts - ATH500

15 Technical data and dimensions

15.1 General

Basic principles for the Technical Data of Pfeiffer Vacuum turbomolecular pumps:

- Recommendations from PNEUROP committee PN5.
- ISO 21360; 2007: “Vacuum technology - Standard methods for measuring vacuum-pump performance - General description”
- Ultimate pressure: using a test dome and after 48 hours of baking out.
- Gas throughput: with water cooling.
- Cooling water consumption: at max gas throughput, water temperature 20 °C.
- Sound pressure level: distance of 1 m to the pump.
- Technical data measured without splinter shield at pump inlet.

	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 Pa = 1 N/m^2						

Tbl. 7: 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. 8: Conversion table: Units for gas throughput

15.2 Technical data

Technical data	Units		ATH 500 M	ATH 500 M	ATH 500 MT
Inlet flange (High vacuum flange)		ISO-F	DN 100	DN 160	DN 160
Exhaust flange		ISO-KF	DN 25	DN 25	DN 40
Purge flange [1)]			1/8 BSPP (ISO228)	1/8 BSPP (ISO228)	1/4 VCR

1) The products that have customer specificities may have different characteristics.

2) Standard reference conditions: T0 = 273,15 K - P0 = 1013.25 hPa.

3) At nominal speed with 25 °C water cooling temperature.

4) With an exhaust pressure < 0.4 hPa, depends on external conditions (temperature, water flow rate, ambient temperature). For other conditions, contact us

5) Reduced maximum flow rate, ultimate pressure at exhaust without loss of flow rate speed. Depends on environmental conditions.

6) With ISO-F flange (best with CF-F flange). Contact us.

7) This maximum temperature influences the maximum flow, contact us.

8) Up to 90 % of full rotation speed, with exhaust pressure < 0.1 hPa.

Technical data	Units		ATH 500 M	ATH 500 M	ATH 500 MT
Pumping speed	N2	l/s	350	550	550
	Ar	l/s	320	530	530
	He	l/s	310	390	390
	H2	l/s	170	190	190
Compression ratio	N2		$> 2 \cdot 10^7$	$> 2 \cdot 10^7$	$> 2 \cdot 10^7$
	Ar		$> 8 \cdot 10^6$	$> 8 \cdot 10^6$	$> 8 \cdot 10^6$
	He		$> 1 \cdot 10^4$	$> 1 \cdot 10^4$	$> 1 \cdot 10^4$
	H2		$> 2 \cdot 10^2$	$> 2 \cdot 10^2$	$> 2 \cdot 10^2$
Maximum flow [2) 3) 4)]	N2	hPa l/s	67.6	67.6	8.5
	Ar	hPa l/s	42.2	42.2	5
	He	hPa l/s	> 169	> 169	> 16.9
	H2	hPa l/s	> 169	> 169	> 16.9
Maximum pressure at inlet [4)]	N2	hPa	1	1	0.04
	Ar	hPa	1	1	0.02
	He	hPa	10	10	> 0.1
	H2	hPa	10	10	> 0.1
Maximum pressure at exhaust [5)]	N2	hPa	2.6	2.6	2.6
	Ar	hPa	3.3	3.3	3.3
	He	hPa	1	1	1
	H2	hPa	0.25	0,25	0.25
Ultimate pressure [6)]		hPa	$< 1 \cdot 10^{-8}$	$< 1 \cdot 10^{-8}$	$< 1 \cdot 10^{-8}$
Nominal rotation speed		min^{-1} (Hz)	50 000 (833)	50 000 (833)	50 000 (833)
Stand-by speed		min^{-1} (Hz)	15 000 (250) to 50 000 (833)	15 000 (250) to 50 000 (833)	15 000 (250) to 50 000 (833)
Maxi. bake-out temperature		°C	120	120	-
Maxi. regulation temperature [7)]		°C	-	-	65
Leak rate		hPa l/s	$< 5 \cdot 10^{-8}$	$< 5 \cdot 10^{-8}$	$< 5 \cdot 10^{-8}$
Purge flow rate [2)]		sccm	50	50	50
Supply voltage		VDC	48	48	48
Start-up time [8)]		mn	< 2	< 2	< 2
Start up power		Watt	< 560	< 560	< 560
Power consumed at ultimate pressure		Watt	< 100	< 100	< 100
Power at minimum stand-by speed		Watt	< 50	< 50	< 50
Vibration level (at nominal speed)		µm	< 0.01	< 0.01	< 0.01
Sound level		dB(A)	< 42	< 42	< 42
Water cooling flow		l/mn	1	1	1

1) The products that have customer specificities may have different characteristics.

2) Standard reference conditions: T0 = 273,15 K - P0 = 1013.25 hPa.

3) At nominal speed with 25 °C water cooling temperature.

4) With an exhaust pressure < 0.4 hPa, depends on external conditions (temperature, water flow rate, ambient temperature). For other conditions, contact us

5) Reduced maximum flow rate, ultimate pressure at exhaust without loss of flow rate speed. Depends on environmental conditions.

6) With ISO-F flange (best with CF-F flange). Contact us.

7) This maximum temperature influences the maximum flow, contact us.

8) Up to 90 % of full rotation speed, with exhaust pressure < 0.1 hPa.

Technical data	Units		ATH 500 M	ATH 500 M	ATH 500 MT
Cooling type (accessory)			water/(air)	water/(air)	water
Weight (Air cooling) Weight (Water cooling)		kg	19 15	19 15	19 15
Backing pump recommended		m^3/h	15 mini.	15 mini.	15 mini.

1) The products that have customer specificities may have different characteristics.

2) Standard reference conditions: T0 = 273,15 K - P0 = 1013.25 hPa.

3) At nominal speed with 25 °C water cooling temperature.

4) With an exhaust pressure < 0.4 hPa, depends on external conditions (temperature, water flow rate, ambient temperature). For other conditions, contact us

5) Reduced maximum flow rate, ultimate pressure at exhaust without loss of flow rate speed. Depends on environmental conditions.

6) With ISO-F flange (best with CF-F flange). Contact us.

7) This maximum temperature influences the maximum flow, contact us.

8) Up to 90 % of full rotation speed, with exhaust pressure < 0.1 hPa.

Tbl. 9: Technical characteristics

15.2.1 Environmental characteristics

Use	indoor use
Installation altitude	up to 2,000 m
Protection rating (air cooled pump) Protection rating (water cooled pump)	IP 20 IP 40
Ambient operating temperature (water cooled pump)	Model M: 5 – 45 °C Model MT: 5 – 25 °C
Ambient operating temperature (air cooled pump)	Model M: 5 – 30 °C
Storage temperature	-5 – +50 °C
Maximum relative humidity	80 % max. with T ≤ 31°C, up to 50 % max. with T ≤ 40°C
Pollution degree	2
Transient overvoltage protection [1)]	Category II

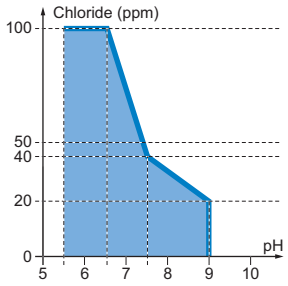
1) Transient overvoltages up to overvoltage category II levels. Temporary overvoltages that affect the mains supply.

Tbl. 10: Environmental characteristics

15.2.2 Cooling water characteristics

The characteristics below concern only the turbomolecular pump with magnetic ball bearings. This pump is associated with a backing pump. To ensure the effective operation of the application:

- ► Comply with the most restrictive characteristics for the installation.
- ► Make sure the water coming from the equipment does not freeze.



pH	5.5 to 9
Chlorides [1]	100 to 20 ppm depending on the pH
Hardness	< 35 °fH (French degree) < 7 milliequivalent/L < 350 mg/L of $CaCO_3$ (calcium carbonate)
Total dissolved solids	< 100 mg/L
LSI (Langelier saturation Index) = pH - pHs	< 0 to 20 °C
Particle size	< 0.2 mm
Resistivity	R > 1 500 Ω cm
Inlet temperature [2]	15-35 °C (M version) 15-25 °C (MT version)
Relative inlet pressure	< $6 \cdot 10^3$ hPa
Input/output pressure difference	depends on flow
Flow	> 60 l/h

1) The oxidizing action of the chlorine depends on the pH (aggressiveness of the water). The chloride content must be within the colored area on the graph.

2) According to the conditions of use, please contact us.

Tbl. 11: Cooling water characteristics

15.2.3 Nitrogen characteristics

H_2O concentration	< 10 ppm v
O_2 concentration	< 5 ppm v
Dust	< 1 µm
Oil	< 0.1 ppm v
Absolute pressure	$1 \cdot 10^3$ to $1.5 \cdot 10^3$ hPa

Tbl. 12: Nitrogen characteristics

15.2.4 Electrical characteristics

Characteristics of the motor	
Voltage between phases	29 Vrms
Power frequency	1666 Hz
Phase current	9.5 A
Internal protection fuse	
Fuse soldered to PCBoard	
Time-Lag T, L	16 A

Tbl. 13: Electrical characteristics of the pump

Main circuit breaker short circuit cut-off capacity	10 kA
Main circuit breaker rating	6 A (for 200-240 V - 50/60 Hz voltage)
GFI (or RCD) type B, differential circuit breaker compatible with TT [1] electrical networks	30 mA

1) for TN and IT networks, use appropriate protection measures

Tbl. 14: Electrical characteristics of the customer's network

Rated voltage	48 VDC ± 5%
Minimum rated power	550 W
Current limitation	15 A max
Transient network overvoltage [1)]	Category II min
Cut-off capacity	125 A [2)] 300 ms

Depending on the peak power which can be delivered by the 48 V power supply; add an extra protection system on the 48 VDC pump power line.

1) must accept the temporary overvoltages that affect the mains supply.

2) if current value is higher, add a protection system.

Tbl. 15: Characteristics of the 48 VDC external power supply

The supply cable used with this power supply must be compatible with the pump supply voltage and current (48 VDC, 12 A).

15.3 Dimensions

Dimensions (mm)

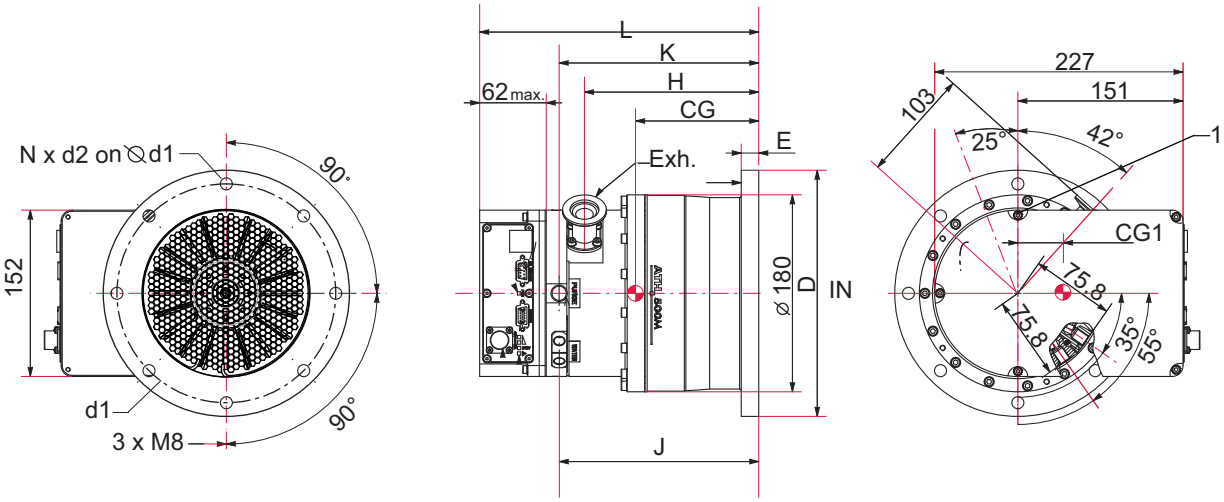


Fig. 19: ATH 500 M dimensions

1 M4 holes for ground connection

Center of gravity

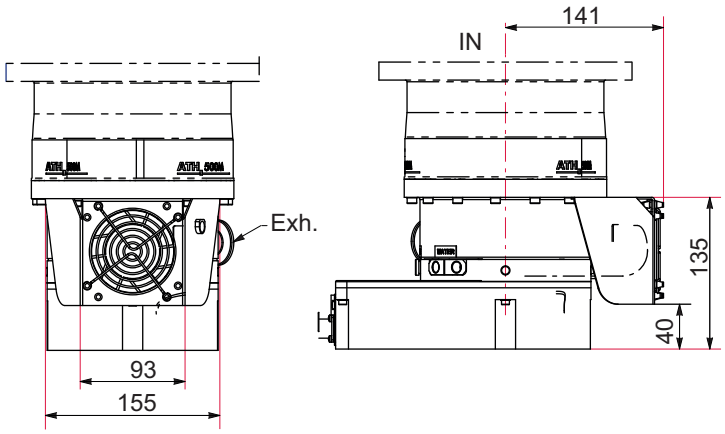


Fig. 20: Air cooled ATH 500 M dimensions

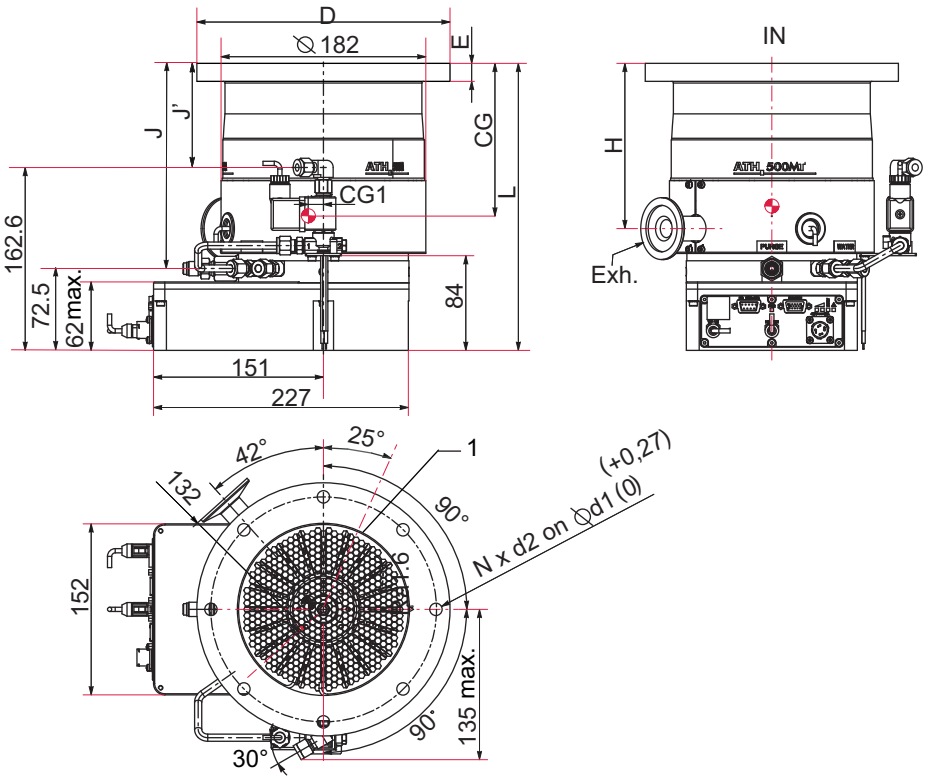


Fig. 21: ATH 500 MT dimensions

1 M4 holes for ground connection

Center of gravity

Inlet flange		E	H	J	K	L	D	d1	d2	N	CG	CG1
DN 160 ISO-F	mm	16	159.3	182.5	182.2	254.9	225	200	11	8	112.6	9.7
DN 160 ISO-K	mm	12	159.3	182.5	182.2	254.9	180	-	-	-	128.6	11.3
DN 160 CF-F	mm	20	180.3	203.5	203.2	275.9	198	181.1	8.6	20	114.1	10.1
DN 100 ISO-K	mm	12	199.3	222.5	222.2	294.5	130	-	-	-	116.1	10.2
DN 100 CF-F	mm	16	209.3	232.5	232.2	304.9	148.5	130.2	8.6	16	109.5	9.8

EC Declaration of Conformity

This declaration of conformity has been issued under the sole responsibility of the manufacturer.

Declaration for product(s) of the type:

Magnetically levitated turbomolecular pumps and integrated electronic drive unit
ATH 500 M
ATH 500 MT

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

The objectives of the Low Voltage Directive 2014/35/EU are complied with in accordance with Annex I, No. 1.5.1 of the Machinery 2006/42/EC.

Applied standards and specifications:

EN 1012-2/A1 : 2009
EN 61010-1/A1 : 2019
EN IEC 61000-6-2 : 2019
EN IEC 61000-3-2 : 2019
EN 61000-3-3/A1 : 2019
EN IEC 61000-6-4 : 2019

The person authorized to compile the technical file is Mr. Varennes Nicolas, Pfeiffer Vacuum SAS (Simplified joint stock company), 98, avenue de Brogny B.P. 2069, 74009 Annecy cedex.

Signature:

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France
B.P. 2069

(Guillaume Kreziak)
Managing Director

Annecy, 2023/01/31

CE

PFEIFFER VACUUM

UK Declaration of Conformity

This declaration of conformity has been issued under the sole responsibility of the manufacturer.

Declaration for product(s) of the type:

Magnetically levitated turbomolecular pump with embedded electronics

ATH 500 M

ATH 500 MT

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

Supply of Machinery (Safety) Regulations 2008

Electrical Equipment (Safety) Regulations 2016

Electromagnetic Compatibility Regulations 2016

The Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations 2012

Applied standards and specifications:

EN 1012-2/A1 : 2009

EN 61010-1/A1 : 2019

EN IEC 61000-6-2 : 2019

EN IEC 61000-3-2 : 2019

EN 61000-3-3/A1 : 2019

EN IEC 61000-6-4 : 2019

The manufacturer's authorized representative in the United Kingdom and the authorized agent for compiling the technical documentation is Pfeiffer Vacuum Ltd, 16 Plover Close, Interchange Park, MK169PS Newport Pagnell.

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Annecy, 2023/01/31

UK CA

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