



# OPERATING INSTRUCTIONS

EN

Translation of the Original

## ATH 1603 M - ATH 2303 M

Magnetically levitated turbomolecular pump

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## Disclaimer of liability

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

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

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# Table of contents

|          |                                                                |           |
|----------|----------------------------------------------------------------|-----------|
| <b>1</b> | <b>About this manual</b>                                       | <b>7</b>  |
| 1.1      | Validity                                                       | 7         |
| 1.1.1    | Products concerned                                             | 7         |
| 1.1.2    | Applicable documents                                           | 7         |
| 1.2      | Conventions                                                    | 7         |
| 1.2.1    | Pictographs                                                    | 7         |
| 1.2.2    | Target group                                                   | 7         |
| 1.2.3    | Instructions in the text                                       | 8         |
| 1.2.4    | Labels                                                         | 8         |
| 1.2.5    | Abbreviations                                                  | 9         |
| <b>2</b> | <b>Safety</b>                                                  | <b>10</b> |
| 2.1      | General safety information                                     | 10        |
| 2.2      | Safety instructions                                            | 10        |
| 2.3      | Safety instructions relating to flammable/pyrophoric materials | 12        |
| 2.4      | Precautions                                                    | 13        |
| 2.5      | Intended use                                                   | 14        |
| 2.6      | Misuse                                                         | 14        |
| <b>3</b> | <b>Transportation and Storage</b>                              | <b>15</b> |
| 3.1      | Receipt of the product                                         | 15        |
| 3.2      | Handling the pump                                              | 15        |
| 3.3      | Storage                                                        | 16        |
| <b>4</b> | <b>Product description</b>                                     | <b>17</b> |
| 4.1      | Product identification                                         | 17        |
| 4.1.1    | Scope of delivery                                              | 17        |
| 4.1.2    | Product applications                                           | 17        |
| 4.2      | Man/machine interface                                          | 18        |
| <b>5</b> | <b>Installation</b>                                            | <b>19</b> |
| 5.1      | Equipment installation conditions                              | 19        |
| 5.1.1    | Installation specifications                                    | 19        |
| 5.1.2    | Securing the equipment and the frame                           | 21        |
| 5.2      | Positioning the pump                                           | 21        |
| 5.3      | Connecting to the pumping line                                 | 23        |
| 5.3.1    | Pump inlet connection                                          | 24        |
| 5.3.2    | Pump exhaust connection                                        | 24        |
| 5.4      | Connecting the water circuit                                   | 25        |
| 5.4.1    | Procedure for assembling connectors                            | 25        |
| 5.4.2    | Connecting the pump to the water circuit                       | 26        |
| 5.5      | Nitrogen circuit connection                                    | 27        |
| 5.6      | Connection of the air inlet solenoid valve                     | 28        |
| 5.7      | Check that the installation is leaktight                       | 29        |
| 5.8      | Electrical connection                                          | 29        |
| 5.8.1    | Customer electrical installation protection                    | 30        |
| <b>6</b> | <b>Operation</b>                                               | <b>32</b> |
| 6.1      | Preliminary precautions for use                                | 32        |
| 6.2      | Starting the pump                                              | 32        |
| 6.2.1    | Powering on                                                    | 32        |
| 6.2.2    | Pumping start-up                                               | 33        |
| 6.2.3    | Restarting the pump after an emergency equipment stop          | 33        |
| 6.3      | Shutting down the pump                                         | 34        |
| 6.3.1    | Pumping shutdown                                               | 34        |
| 6.3.2    | Powering off                                                   | 35        |
| 6.3.3    | Prolonged stoppage                                             | 35        |

|           |                                              |           |
|-----------|----------------------------------------------|-----------|
| 6.4       | Operation monitoring                         | 35        |
| <b>7</b>  | <b>Maintenance</b>                           | <b>36</b> |
| 7.1       | Maintenance safety instructions              | 36        |
| 7.2       | Maintenance frequency                        | 37        |
| 7.3       | On-site maintenance                          | 38        |
| 7.4       | Exchange procedure by a replacement product  | 39        |
| 7.4.1     | Disconnecting the pump from the installation | 39        |
| 7.4.2     | Draining the water circuit                   | 39        |
| 7.4.3     | Preparing the pump for shipping              | 40        |
| <b>8</b>  | <b>Decommissioning</b>                       | <b>42</b> |
| 8.1       | Shutting down for longer periods             | 42        |
| 8.2       | Recommissioning                              | 42        |
| 8.3       | Disposal                                     | 42        |
| <b>9</b>  | <b>Service solutions by Pfeiffer Vacuum</b>  | <b>43</b> |
| <b>10</b> | <b>Accessories</b>                           | <b>45</b> |
| <b>11</b> | <b>Spare parts</b>                           | <b>47</b> |
| <b>12</b> | <b>Technical data and dimensions</b>         | <b>48</b> |
| 12.1      | General                                      | 48        |
| 12.2      | Technical characteristics                    | 48        |
| 12.3      | Environmental characteristics                | 49        |
| 12.4      | Cooling water characteristics                | 50        |
| 12.5      | Nitrogen characteristics                     | 50        |
| 12.6      | Electrical characteristics                   | 50        |
| 12.7      | Dimensions and weight                        | 51        |
|           | <b>Declaration of conformity</b>             | <b>56</b> |

## List of tables

|         |                                                      |    |
|---------|------------------------------------------------------|----|
| Tbl. 1: | Loads exerted on the equipment                       | 21 |
| Tbl. 2: | Securing the high vacuum flange (inlet flange)       | 21 |
| Tbl. 3: | Conversion table: Pressure units                     | 48 |
| Tbl. 4: | Conversion table: Units for gas throughput           | 48 |
| Tbl. 5: | Environmental characteristics                        | 50 |
| Tbl. 6: | Cooling water characteristics                        | 50 |
| Tbl. 7: | Nitrogen characteristics                             | 50 |
| Tbl. 8: | Electrical characteristics of the pump               | 50 |
| Tbl. 9: | Electrical characteristics of the customer's network | 51 |

## List of figures

|          |                                                          |    |
|----------|----------------------------------------------------------|----|
| Fig. 1:  | Description of an ATH 1603 M pump                        | 18 |
| Fig. 2:  | Description of an ATH 2303 M pump                        | 18 |
| Fig. 3:  | Mechanical connection of the pump to the equipment       | 19 |
| Fig. 4:  | Graph of the loads exerted on the equipment - ATH 1603 M | 20 |
| Fig. 5:  | Graph of the loads exerted on the equipment - ATH 2303 M | 20 |
| Fig. 6:  | Operating positions                                      | 22 |
| Fig. 7:  | Installing the pump inlet facing up                      | 23 |
| Fig. 8:  | Purge flow diagram                                       | 27 |
| Fig. 9:  | ATH 1603 M dimensions                                    | 51 |
| Fig. 10: | Dimensions of ATH 1603 M with OBC                        | 52 |
| Fig. 11: | ATH 2303 M dimensions                                    | 53 |
| Fig. 12: | Dimensions of ATH 2303 M with OBC                        | 54 |
| Fig. 13: | Dimensions of Purge solenoid valve                       | 55 |
| Fig. 14: | Dimensions of Air inlet solenoid valve                   | 55 |

# 1 About this manual



## IMPORTANT

Read carefully before use.

Keep the manual for future consultation.

## 1.1 Validity

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

### 1.1.1 Products concerned

This document applies to products with the following part numbers:

| Part Number  | Description                             |
|--------------|-----------------------------------------|
| Yxxx2100     | ATH 1603 M pumps for clean applications |
| YNxx215A     |                                         |
| YLxx215A     |                                         |
| YJxx215A     |                                         |
| Xxxx2100     | ATH 2303 M pumps for clean applications |
| XNxx215A     |                                         |
| XLxx215A     |                                         |
| XJxx215A     |                                         |
| TMBxxxxxxxxx |                                         |

### 1.1.2 Applicable documents

| Document                        | Part Number                                |
|---------------------------------|--------------------------------------------|
| Magpower Operating instructions | 120932                                     |
| OBC V4 Operating instructions   | 124470                                     |
| Declaration of conformity       | included with these operating instructions |

## 1.2 Conventions

### 1.2.1 Pictographs

Pictographs used in the document indicate useful information.



Note



Tip

### 1.2.2 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.

### 1.2.3 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.

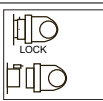
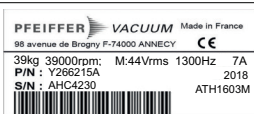
- This is an individual action step.

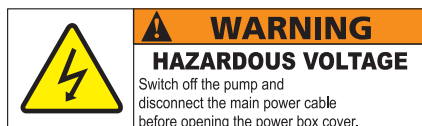
#### Sequence of multi-part action steps

The numerical list indicates an action with multiple necessary steps.

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

### 1.2.4 Labels

|                                                                                     |                                                                                            |
|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------|
| <b>PURGE</b>                                                                        | Purge circuit connection                                                                   |
| <b>PUMP EXHAUST</b>                                                                 | Pump exhaust                                                                               |
| <b>WATER MAX Pr 7 bar/101 psi</b>                                                   | Maximum water circuit pressure                                                             |
| <b>WATER</b>                                                                        | Water circuit connection                                                                   |
|    | Functional grounding connection                                                            |
|    | 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.



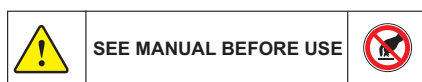
This label indicates that the product should not be handled manually due to its weight and that appropriate handling devices should always be used.



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.

## 1.2.5 Abbreviations

|                 |                                                                       |
|-----------------|-----------------------------------------------------------------------|
| <b>AMB</b>      | Active magnetic bearings                                              |
| <b>Exh.</b>     | Exhaust                                                               |
| <b>HHR</b>      | Hand Held Remote                                                      |
| <b>IN</b>       | Inlet flange                                                          |
| <b>LEL</b>      | Lower Explosive Limit                                                 |
| <b>M</b>        | Pump version without Temperature Management System (no TMS)           |
| <b>Magpower</b> | Electronic drive unit (box)                                           |
| <b>OBC</b>      | Electronic drive unit mounted to an active magnetic bearing turbopump |

## 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. <sup>1)</sup>
- Ensure that the oxidizing agent concentration does not exceed 60% of the maximum permissible concentration of the oxidizing agent gas (MOC) <sup>2)</sup>, 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 vacuum pump must be integrated into industrial equipment.
- The pump must operate with a Pfeiffer Vacuum OBC or Magpower electronic drive unit.

**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 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.

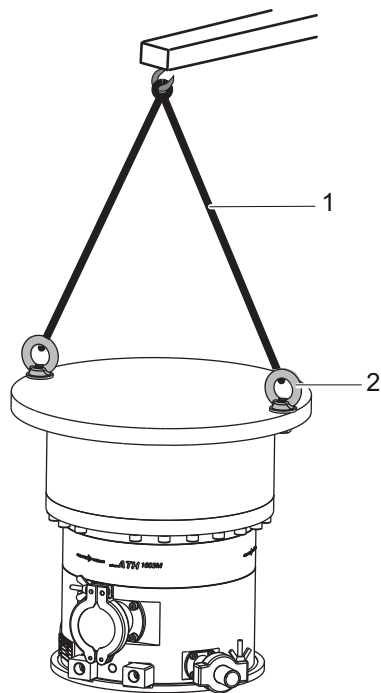
#### WARNING

##### Risk of crushing due to product tilting

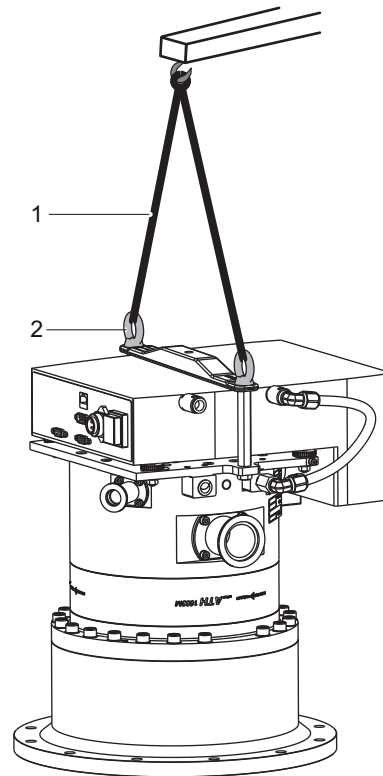
Even though compliance with EEC safety rules is guaranteed, all necessary precautions should be taken when handling and installing the product **until the pump has been integrated into the equipment**.

- ▶ 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).

Pump alone



Pump with OBC



1. Strap
2. Lifting ring

#### Handling the pump using a hoist

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").

1. Use the lifting rings installed on the product or electronic drive unit (where applicable).
2. Use a lifting sling with several arms with a minimum length of 500 mm
3. Secure the pump using lifting rings and hoist it.
4. **Always transport** the turbomolecular pump in an upright position.

#### Handle the pump with inlet facing up

When handling the pump "**inlet facing up**", an appropriate handling device as well as mounting accessories must be used.

1. Affix the pump to the handling device using the 2 M10 holes at the rear of the pump and hoist it.
2. **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.
- 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
- 1 splinter shield (in the pump inlet flange)
- 2 lifting rings installed on the product
- 1 label sheet
- 1 operating instructions

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

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



The hand-held remote control (HHR) is not included in the order. To order, see chapter "Accessories".

#### 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. These pumps are capable of pumping an inlet pressure on the order of 2 hPa or an inlet flow around 4000 sccm.

They are specially adapted for coating and dry-etching plasma processes for clean applications as well as for R&D applications. These pumps are controlled via an electronic drive unit installed on the pump or connected via a cable.

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

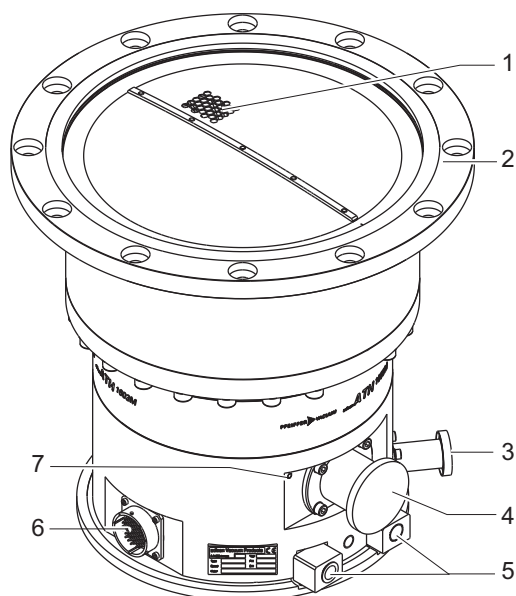
The magnetically levitated pump rotation speed can be selected and set between a minimum speed and the nominal speed. This makes it possible to optimize pumping characteristics according to each application (for example, high pressure pumping). A distinction is made between the following speeds:

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

##### M Version pump

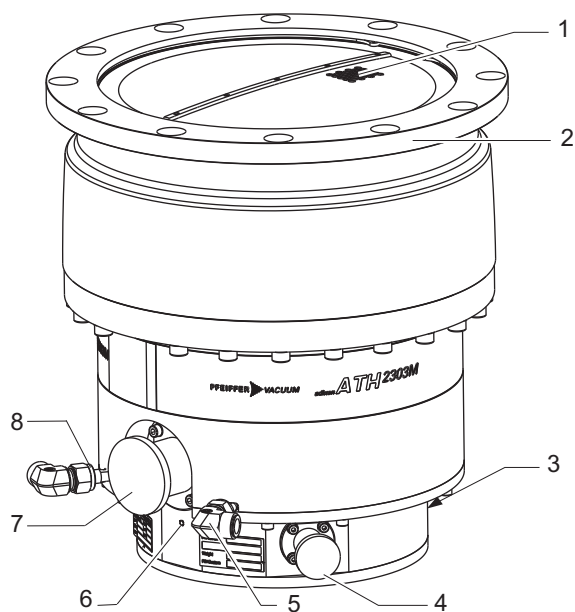
Standard version is suitable for most of the clean applications. This pump version has no temperature management system (no TMS).

## 4.2 Man/machine interface



**Fig. 1: Description of an ATH 1603 M pump**

- |                                     |                           |
|-------------------------------------|---------------------------|
| 1 Splinter shield                   | 5 IN/OUT water connection |
| 2 Inlet flange (high vacuum flange) | 6 Electrical connector    |
| 3 Neutral gas purge (Purge)         | 7 Functional grounding    |
| 4 Exhaust flange (Pump exhaust)     |                           |



**Fig. 2: Description of an ATH 2303 M pump**

- |                                     |                                 |
|-------------------------------------|---------------------------------|
| 1 Splinter shield                   | 5 Water connection (OUT)        |
| 2 Inlet flange (high vacuum flange) | 6 Functional grounding          |
| 3 Electrical connection             | 7 Exhaust flange (Pump exhaust) |
| 4 Neutral gas purge (Purge)         | 8 Water connection (IN)         |

## 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.

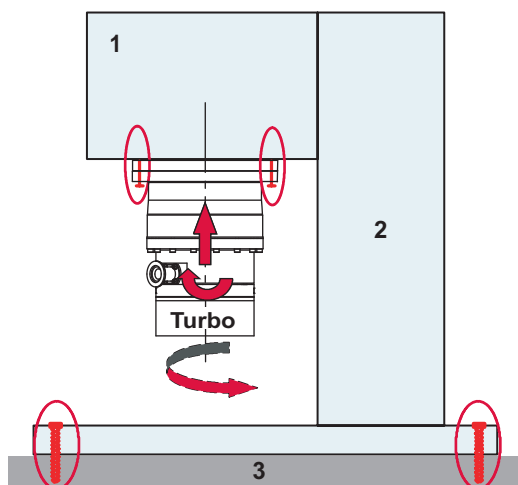
- ▶ Strictly comply with the installation instructions described in this manual. Pfeiffer Vacuum will be released from any warranty and liability for non-compliance with installation instructions.
- ▶ Only use approved original parts from Pfeiffer Vacuum for connection to the equipment (see accessories).

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. 3: 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 of 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.

#### 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.

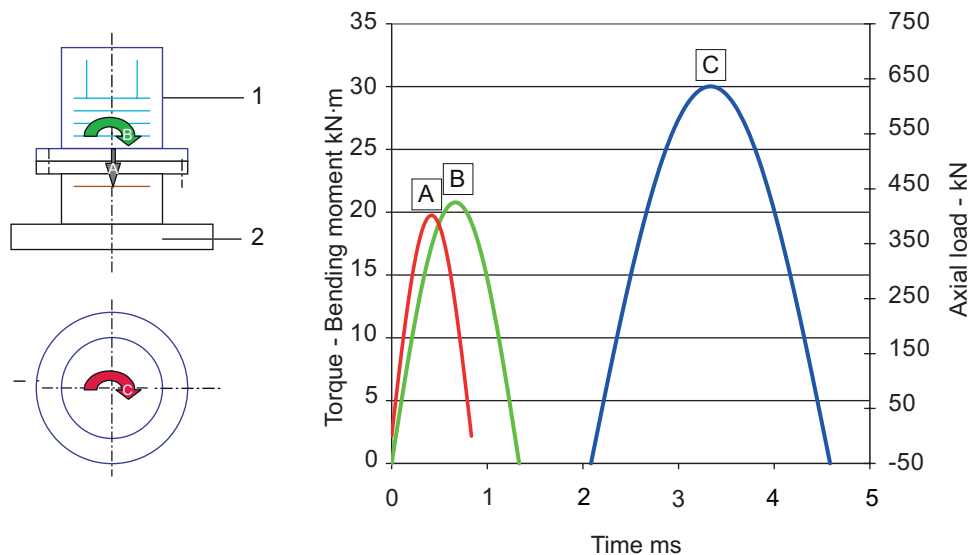


Fig. 4: Graph of the loads exerted on the equipment - ATH 1603 M

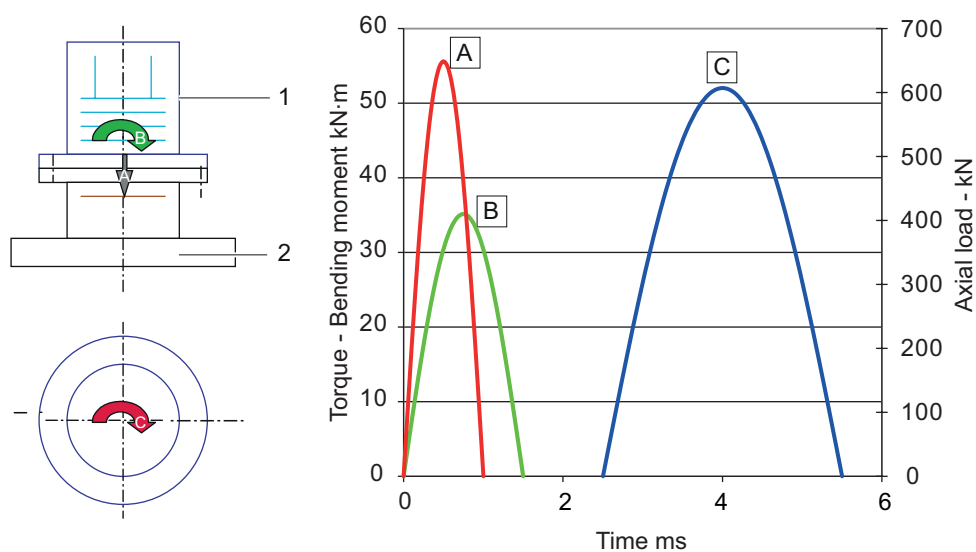


Fig. 5: Graph of the loads exerted on the equipment - ATH 2303 M

1 Turbopump      2 Pendulum valve

| Characteristics               | Unit              | ATH 1603 M | ATH 2303 M |
|-------------------------------|-------------------|------------|------------|
| Nominal speed                 | min <sup>-1</sup> | 39000      | 31000      |
| Energy                        | kN·m              | 76         | 124        |
| Torque (C)                    | Max. kN·m         | 30         | 52         |
|                               | Duration ms       | 2.5        | 3.00       |
|                               | Delay ms          | 2.1        | 2.5        |
| Bending moment (B)            | Max. kN·m         | 21         | 35         |
|                               | Duration ms       | 1.3        | 1.5        |
|                               | Delay ms          | 0          | 0          |
| Axial force (A) <sup>1)</sup> | Max. kN           | 0 <<398    | 0 <<650    |
|                               | Duration ms       | 0.8        | 1.0        |
|                               | Delay ms          | 0          | 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                      |     | DN200 ISO-F | DN250 ISO-F | DN200 CFF | DN250 CFF |
|-------------------------------------------|-----|-------------|-------------|-----------|-----------|
| Type of screw <sup>1)</sup>               |     | M 10        | M 10        | M 8       | M 8       |
| Number of screw <sup>1)</sup>             |     | 12          | 12          | 24        | 32        |
| Screw metric grade <sup>1)</sup>          |     | 12-9        | 12-9        | 12-9      | 12-9      |
| Tightening torque per screw <sup>1)</sup> | N·m | 30          | 30          | 20        | 20        |
| Total clamping force                      | N   | 161500      | 161500      | 266000    | 355000    |
| Length of screw                           | mm  | 35          | 35          | 65        | 65        |

1) The type, number, grade and tightening torque of the screws 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). Contact our service center.

### 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

#### Pump damage caused by external vibrations

External pump vibrations or shocks may cause magnet bearing overload and therefore landing bearing stress.

- ▶ Avoid lateral and tilting pump movements.
- ▶ Configure the equipment appropriately to compensate for external vibration.
- ▶ Secure the vacuum chamber on the equipment side 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.

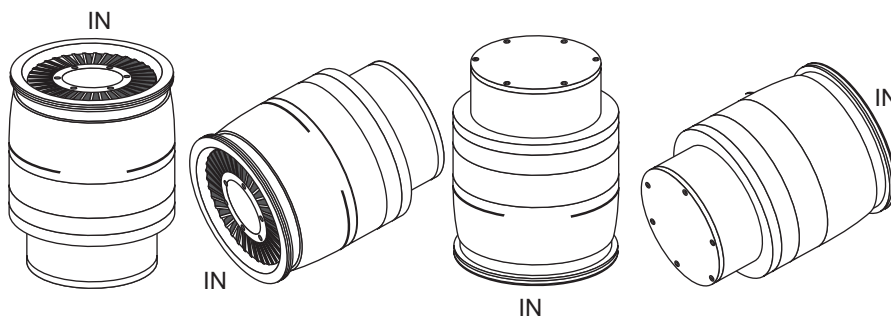
The manufacturer guarantees proper operation of the pump if it is used in a uniform magnetic field up to 0.5 mT. From 0.5 to 5 mT, proper operation depends on cooling and gas loads. A magnetic field exceeding 5 mT can cause excessive rotor heating. In this case, suitable shielding must be provided.

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.

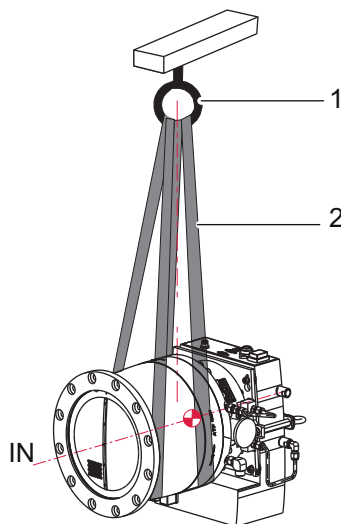
The turbomolecular pump can operate in any position.

**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.



1 Safety hook

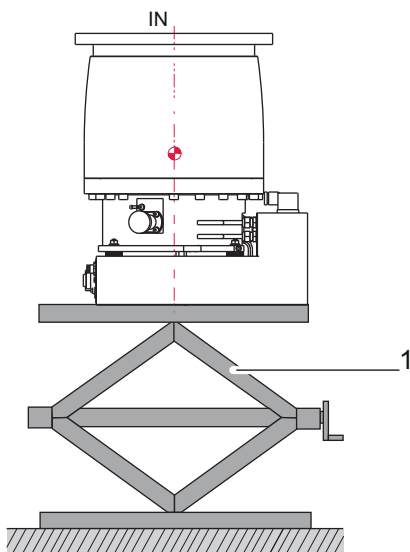
2 Strap (Qty2)

### 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 hung all the installation time until the high vacuum flange is secured.



**Fig. 7: 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](https://www.pfeiffer-vacuum.com) 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**

Sharp components can be accessed via the inlet flange. Rotor and stator blades on turbomolecular pumps have very sharp edges.

- ▶ Before starting any work on the product, wait for the pump to come to a complete standstill.
- ▶ Always keep the splinter shield in the inlet housing, as it limits the risk of injury.
- ▶ Always wear protective gloves in accordance with standard EN ISO 21420.
- ▶ **Never disconnect the high vacuum flange before the rotor is completely immobilized.**

#### **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 relative to atmospheric pressure.

### 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.

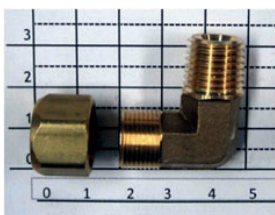
### ⚠ WARNING

#### 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.

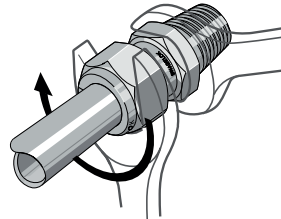
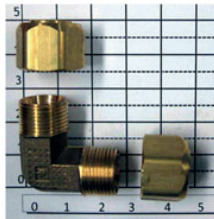
- ▶ Install a manual valve on the circuit at a distance of 3 m from the product, so that the water supply can be locked out.
- ▶ Observe the recommended pressure and pressure differences.
- ▶ Always lock out and disconnect the water circuit before working on the product.
- ▶ When carrying out maintenance, 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 assembling connectors



#### Threaded connections bonding and tightening procedure

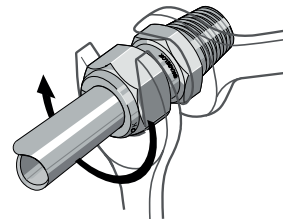
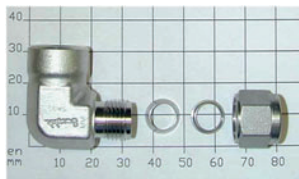
1. Use 1/4 NPT male connectors (to be supplied by the customer).
2. Bond the connections using oleo-waterproof glue or put PTFE sealing tape on the threads.
3. Tighten the connection **while keeping the baseplate on the pump side**.



#### 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.**



#### Procedure for the assembly of twin ferrule connectors

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

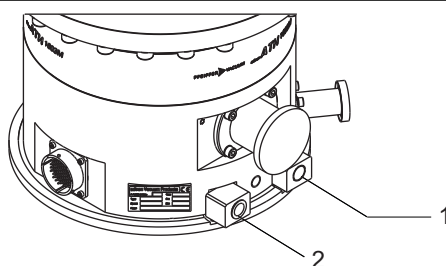
1. Insert the pipe with the ferrules until it is affixed tightly to the connector.
2. Lock the fitting in position
3. Manually place the nut into contact.
4. Tighten the nut **3/4 turn using an open-ended spanner while holding the body of the connector still.**

### 5.4.2 Connecting the pump to the water circuit

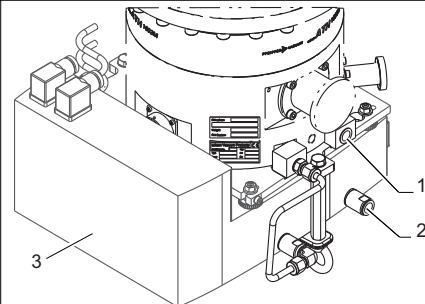


Follow the connector installation procedure to avoid any risk of leaks.

#### Connection to the water-cooling circuit, pump alone



#### Connection to the water-cooling circuit, pump with OBC



1. WATER OUT
2. WATER IN
3. Electronic drive unit (OBC)

1. Provide a water-cooling circuit and a tap to adjust the flow.
2. Connect the water inlet circuit to the **WATER IN** and the water outlet to the **WATER OUT** of the pump drainage circuit.
3. Check that there are no leaks in the water circuit or the water circuit connections.

## 5.5 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").

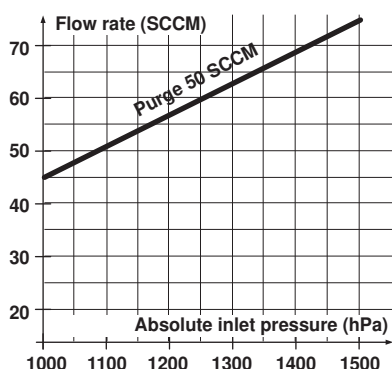
**Inert gas purge**

### **NOTICE**

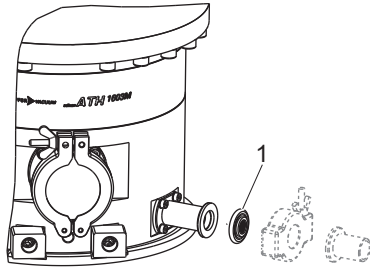
**Inert gas purge function**

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. 8: Purge flow diagram**



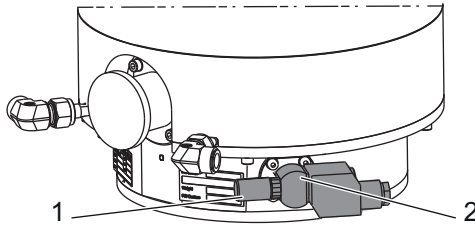
1 Flow reduction - 50 sccm

#### Purge device 50 sccm

The operation of this purge is continuous. The flow reducer guarantees a 50 sccm flow for a pressure of  $1.1 \cdot 10^3$  hPa. When the inert gas line is equipped with a mass flowmeter, do not install the flow reduction device.

1. Directly connect the inert gas supply to the **PURGE** port equipped with the flow reduction device (see chapter "Accessories").
2. Adjust the inert gas pressure to obtain the desired flow (see Purge flow diagram).

#### Solenoid valve equipped with 50 sccm purge



1 Dust filter      2 Purge solenoid valve

#### Solenoid valve equipped with 50 sccm purge

This option is available depending on the pump configuration.

The solenoid valve installed on the pump is supplied and controlled by the electronic drive unit connected to the pump.

1. Connect the solenoid valve to the **PURGE** port (affixed using 4 supplied screws).
2. Control the solenoid valve via the **REMOTE** connector or via the serial link from the electronic drive unit.

#### Connection of the purge solenoid valve to an inert gas line

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

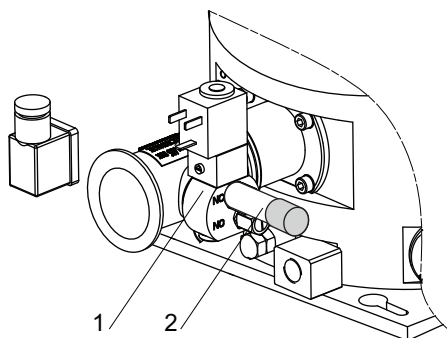
When the pump is stopped, the solenoid valve can be closed to perform a tightness test on the equipment.

1. Remove the dust filter from the solenoid valve.
2. Connect the inert gas line instead.
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).

## 5.6 Connection of the air inlet solenoid valve

This option is available depending on the pump configuration.

The air inlet solenoid valve (flow  $11 \cdot 10^3$  sccm), makes it possible to reduce the braking time required for the pump to get up to atmospheric pressure. When isolation valves are installed on the pump inlet and exhaust, the rotor slow-down efficiency is improved. This solenoid valve is supplied and controlled by the electronic drive unit.



1 Air inlet solenoid valve      2 Dust filter

1. Connect the solenoid valve to the **PUMP EXHAUST** port of the pump (use connecting accessories of product catalog).
2. Connect the solenoid valve to the connector of the electronic drive unit (see electronic drive unit operating instructions).
3. Send a control order via the control panel (remote control, the serial link or the fieldbus connection).

#### Connection of the air inlet solenoid valve 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 defined (see chapter "Nitrogen characteristics").

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

## 5.7 Check that the installation is leaktight

When the product leaves the factory, product leaktightness under normal operating conditions is guaranteed. The operator must maintain this level of leaktightness, 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.

## 5.8 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.
  - Mains switch of the electronic drive unit to **O**.
- ▶ Wait approximately 15 seconds.
- ▶ Correct the cause of the fault.
- ▶ Restore power supply.
  - Mains switch of the electronic drive unit to **I**.

## **5.8.1 Customer electrical installation protection**

#### **Circuit breaker protection**

The power circuit used to supply the pump 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”.

#### **Differential circuit breaker**

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

The pump 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.

### 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<sup>2</sup> (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.

## 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**

Sharp components can be accessed via the inlet flange. Rotor and stator blades on turbomolecular pumps have very sharp edges.

- ▶ Before starting any work on the product, wait for the pump to come to a complete standstill.
- ▶ Always keep the splinter shield in the inlet housing, as it limits the risk of injury.
- ▶ Always wear protective gloves in accordance with standard EN ISO 21420.
- ▶ **Never disconnect the high vacuum flange before the rotor is completely immobilized.**

Pumping pyrophoric or flammable gases may be hazardous. The user and/or integrator 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 are connected and supplied, including the purge valve (where applicable).



The turbomolecular pump operates with an OBC or Magpower electronic drive unit. Please refer to the associated electronic drive unit instructions.

### 6.2 Starting the pump

#### 6.2.1 Powering on

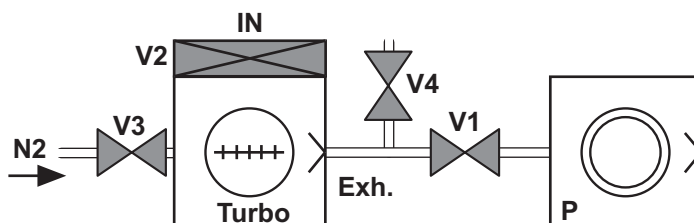
- ▶ Set the mains switch of the electronic drive unit to I: the electronic drive unit boots up.

## 6.2.2 Pumping start-up

The following steps describe the use of the pump regardless of the control interface:

- Use via **HHR**.
- Use via **REMOTE** control.
- Use via **RS-232/RS-485** Serial link.
- Use via **FIELDBUS**.

### Pumping installation diagram



|                  |                                      |                 |                                            |
|------------------|--------------------------------------|-----------------|--------------------------------------------|
| V1 <sup>1)</sup> | Fore-vacuum isolation valve          | N2              | Inert gas purge inlet                      |
| V2 <sup>1)</sup> | High vacuum isolation valve          | Turbo           | Magnetically levitated turbomolecular pump |
| V3 <sup>2)</sup> | Purge solenoid valve (option)        | P <sup>1)</sup> | Backing pump                               |
| V4 <sup>2)</sup> | Air inlet solenoid valve (accessory) |                 |                                            |

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

2) These solenoid valves are controlled via the electronic drive unit.

### Pumping start-up procedure

#### Initial conditions:

Valves V1, V2, V3, V4 are connected and controlled by the equipment or electronic drive unit.

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 water-cooling circuit.
2. Send the order to **'Start'** the pump via the control interface
  - 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.

## 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.

#### Pumping interruption procedure

**Initial conditions:** valves V1, V2, V3, V4 are connected and controlled by the equipment or electronic drive unit, 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 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).
  - The air inlet solenoid opens when the speed is less than 10000 min<sup>-1</sup>.
4. Close the V1 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.

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 mains switch of the drive unit to **O**:
  - All LED on the electronic drive unit are off.
  - Wait for the rotor **to completely stop rotating**.
2. Disconnect the 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

Fault messages are listed in the electronic drive unit instructions associated with the "Malfunctions" chapter.

## 7 Maintenance

### 7.1 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**

Sharp components can be accessed via the inlet flange. Rotor and stator blades on turbomolecular pumps have very sharp edges.

- ▶ Before starting any work on the product, wait for the pump to come to a complete standstill.
- ▶ Always keep the splinter shield in the inlet housing, as it limits the risk of injury.
- ▶ Always wear protective gloves in accordance with standard EN ISO 21420.
- ▶ **Never disconnect the high vacuum flange before the rotor is completely immobilized.**

#### 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 leaktightness 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.

## 7.2 Maintenance frequency

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 power failure have to be changed when indicated by the electronic drive unit: the percentage of landing time to be 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**

Landing bearings are designed to withstand many accidental landings of the rotor at full speed. 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%. **These landing bearings must be replaced by a Pfeiffer Vacuum service center.**

#### **Rotor of the pump**

The life of the pump rotor changes with the operating conditions and applications. To ensure the best performance, **after 5 years of operation, check the condition of the rotor.** Consult us.



#### **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: [Pfeiffer Vacuum Service Support](mailto:Pfeiffer Vacuum Service Support).

## 7.3 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.

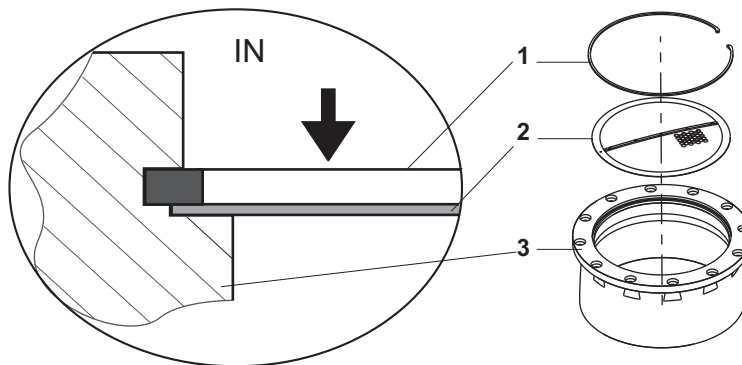
### Splinter shield replacement

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.

#### Pumps with clipped splinter shield

Products with part numbers as follows :

ATH1603M : type Yxxxxxxx / ATH2303M : type Xxxxxxxx / ATH2303M : type TMBxxxxxxx



- |                   |                 |
|-------------------|-----------------|
| 1 Clips           | 3 Inlet housing |
| 2 Splinter shield |                 |

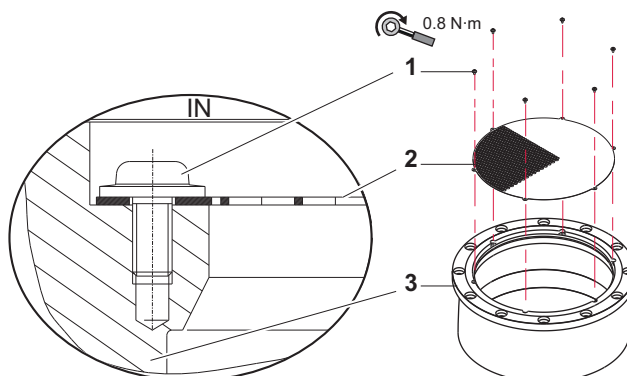
For reassembly, respect the following instructions:

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**.

#### Pumps with screwed splinter shield

Products with part number as follows :

ATH2303M : type TMBBxxx4xxx



- |                   |                 |
|-------------------|-----------------|
| 1 Screw           | 3 Inlet housing |
| 2 Splinter shield |                 |

For reassembly, respect the following instructions:

1. Install the splinter shield in the inlet housing groove.
2. Position the 6 fastening screws and tighten them at **the tightening torque**.

## 7.4 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 43](#)).

### 7.4.1 Disconnecting the pump from the installation



#### Reminder of the risks and safety measures

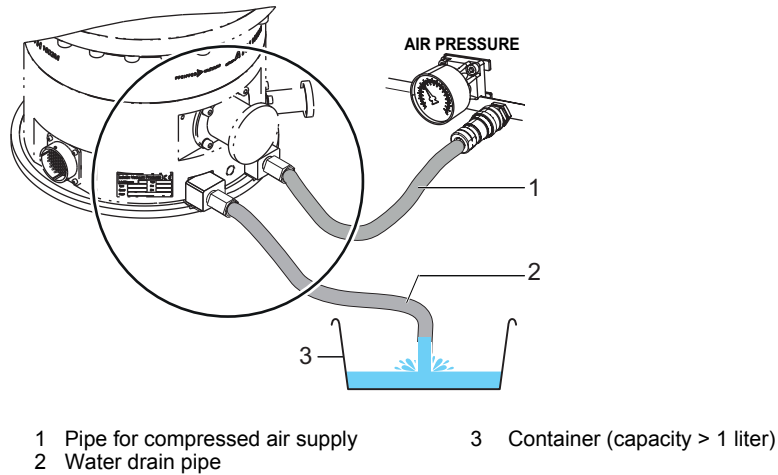
- Follow the maintenance safety instructions.
- Apply the specific safety instructions in accordance with local laws; this information is available from the customer's health and safety department.

#### Disconnection procedure

1. Stop the pump by sending a **Stop** order (see chapter "Pumping shutdown").
2. Switch off the pump by setting the mains switch of the electronic drive unit to **O**.
3. Switch off the circuit breaker of the customer's installation.
4. Disconnect the power cable at the electrical connector.
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 (available as accessories).
9. Disconnect the pump from the exhaust and blank off the exhaust port with the airtight connection accessories (available as accessories).
10. Install the handling devices (see chapter "Handling the pump").
11. Disconnect the pump from the installation.

### 7.4.2 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 · 10<sup>3</sup> hPa).



#### 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.

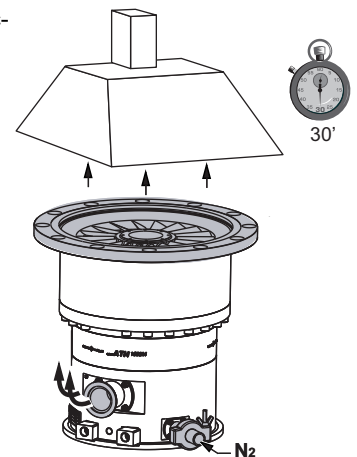
### 7.4.3 Preparing the pump for shipping

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).

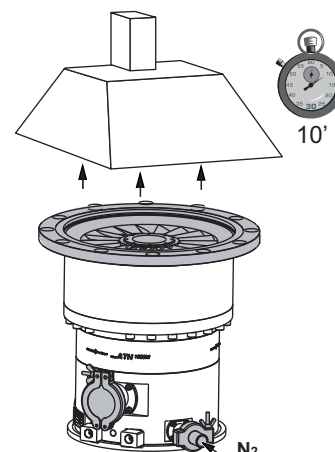
#### Complete flushing

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

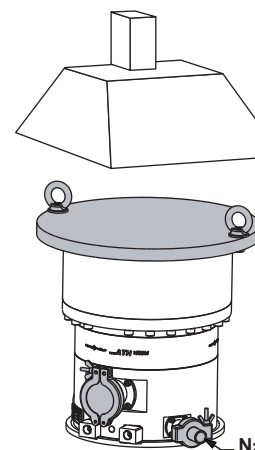


**Purge/inlet flushing**

1. Install the blanking plate on the exhaust port **Pump exhaust** and seal.
2. Flush with nitrogen by injecting a relative pressure of 120 to 150 hPa for 10 minutes.
3. Stop the nitrogen flow.

**Pressurizing the pump**

1. Seal the pump inlet with airtight connection 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 declaration of contamination and attach it to the product (see chapter "Service solutions").



## 8 Decommissioning

### 8.1 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.

##### 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 43](#)).

### 8.2 Recommissioning

To restart the pump after prolonged storage, refer to the installation instructions ([see chapter "Installation", page 19](#)).

### 8.3 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 43](#)).



#### 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.

## 9 Service solutions by Pfeiffer Vacuum

### We offer first-class service

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

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

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

### Make use of Pfeiffer Vacuum service

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

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

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



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



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



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

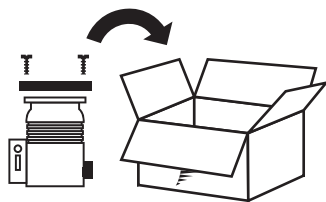


4. You will receive an acknowledgment from Pfeiffer Vacuum.

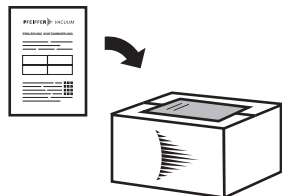
PFEIFFER VACUUM

### Submission of contaminated products

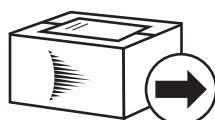
No microbiological, explosive, or radiologically contaminated products will be accepted. Where products are contaminated, or the contamination declaration is missing, Pfeiffer Vacuum will contact you before starting service work. Depending on the product and degree of pollution, **additional decontamination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



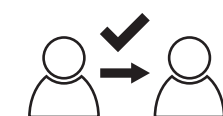
5. Prepare the product for transport in accordance with the provisions in the contamination declaration.
  - a) Neutralize the product with nitrogen or dry air.
  - b) Seal all openings with blind flanges, so that they are airtight.
  - c) Shrink-wrap the product in suitable protective foil.
  - d) Package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



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



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



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

PFEIFFER VACUUM

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

## 10 Accessories

| Accessory                           | Function                                                                                                                                                                                      | Description                                                 | 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   |                               |
| Copper seal for CF-F inlet flange   |                                                                                                                                                                                               |                                                             | DN 200 CF-F                  | 303293<br>(Qty 5)             |
|                                     |                                                                                                                                                                                               |                                                             | DN 250 CF-F                  | 303294<br>(Qty 5)             |
| Splinter shield                     | This splinter shield protects the pump from solid particles. It is installed in the pump inlet housing.                                                                                       | Stainless steel bent screen + bored clip (mesh size 4.5 mm) | DN 200 ISO-F                 | 108872                        |
|                                     |                                                                                                                                                                                               | Stainless steel bent screen + bored clip (mesh size 5 mm)   | DN 250 ISO-F                 | 119591<br>108762 for XxxxxxA4 |
|                                     |                                                                                                                                                                                               | Stainless steel bent screen + bored clip (mesh size 8 mm)   | DN 250 ISO-F                 | 121607 for TMBxxxxxxx70       |
| 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 CHc M10 x 35 screws<br>(ATH1603M/<br>ATH2303M)    | DN 200 ISO-F<br>DN 250 ISO-F | 110676S                       |
|                                     |                                                                                                                                                                                               | Set of 24 CHc M8 x 65 screws<br>(ATH1603M)                  | DN 200 CF-F                  | 111664                        |
|                                     |                                                                                                                                                                                               | Set of 32 CHc M8 x 65 screws<br>(ATH1603M/<br>ATH2303M)     | DN 250 CF-F                  | 111665                        |
| Set of claw clamps for loose flange |                                                                                                                                                                                               | Stainless steel                                             | ISO-K                        | 123898S<br>(Qty 24)           |
| Set for pump pressurization         | This set includes: <ul style="list-style-type: none"><li>the set purge pressurization</li><li>the closing set for inlet port</li><li>the closing accessories for pump exhaust port</li></ul>  |                                                             | DN 250 ISO-F/<br>VG250       | 108498                        |
|                                     |                                                                                                                                                                                               |                                                             | DN 200 ISO-F/<br>VG200       | 108499                        |
| Set purge pressurization            | For purge port, blanking plate equipped with 1/8" BSPT gas connection and Injector 4x6 mm.                                                                                                    |                                                             | DN 16-ISO-KF                 | A458805                       |
|                                     |                                                                                                                                                                                               | Injector 4x6 mm                                             | DN 16-ISO-KF                 | 106859                        |
|                                     |                                                                                                                                                                                               | Blanking plate                                              | DN 16-ISO-KF<br>1/8 BSPT     | A458808                       |
|                                     |                                                                                                                                                                                               | Nipple MF                                                   | 1/8" BSPT                    | 082981                        |
| Closing set for inlet port          | This set includes: <ul style="list-style-type: none"><li>the transport blanking plate, an O-ring, screws to fix the blanking plate to the pump inlet flange</li><li>2 lifting rings</li></ul> |                                                             | DN 200 ISO-F/<br>VG200       | 108496                        |
|                                     |                                                                                                                                                                                               |                                                             | DN 250 ISO-F/<br>VG250       | 108497                        |
| Closing accessories                 | For pump exhaust port                                                                                                                                                                         | Centering ring with O-ring                                  | DN 40 ISO-KF                 | 122ZRG040                     |
|                                     |                                                                                                                                                                                               | Quick-connect clamp                                         | DN 40 ISO-KF                 | 120BSR040                     |
|                                     |                                                                                                                                                                                               | Blanking plate                                              | DN 40 ISO-KF                 | 120FBL040                     |
|                                     | For the purge.                                                                                                                                                                                | Centering ring with O-ring                                  | DN 16 ISO-KF                 | 122ZRG016                     |
|                                     |                                                                                                                                                                                               | Quick-connect clamp                                         | DN 16 ISO-KF                 | 120BSR016                     |
|                                     |                                                                                                                                                                                               | Connection                                                  | 1/4<br>VCR 1/8 NPT           | 108500                        |
| Purge flow reduction device         | This device is used to reduce the purge gas flow rate to 50 sccm in some applications.                                                                                                        | Reductor                                                    | DN16 ISO-KF                  | 066752S                       |

## Accessories

| Accessory                | Function                                                                                                                  | Description  | Dimension | P/N         |
|--------------------------|---------------------------------------------------------------------------------------------------------------------------|--------------|-----------|-------------|
| Air inlet solenoid valve | Air inlet solenoid valve is used to slow down the pump. It only opens for a rotation speed < at 10000 min <sup>-1</sup> . | 24 V DC (NC) | 11 slm    | 114280      |
| Purge solenoid valve     | Purge solenoid valve is used to protect the spindle from back-scattering of the customer's process gases.                 | 24 V DC (NC) | 50 sccm   | 111921S     |
| Cable                    | Air inlet valve cable and purge valve cable for pump controlled by <b>electronic drive unit (type Magpower)</b> .         |              | 1 m       | A462403-010 |
|                          |                                                                                                                           |              | 3.5 m     | A462403-035 |
|                          |                                                                                                                           |              | 5 m       | A462403-050 |
|                          |                                                                                                                           |              | 10 m      | A462403-100 |
|                          |                                                                                                                           |              | 20 m      | A462403-200 |

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

## 11 Spare parts

| Description  | P/N    | Comments                            |
|--------------|--------|-------------------------------------|
| 24 V DC coil | 038066 | for purge valve and air inlet valve |
| Dust filter  | 106229 | on air inlet solenoid valve         |

## 12 Technical data and dimensions

### 12.1 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                   |

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

**Tbl. 3: Conversion table: Pressure units**

|           | mbar l/s             | Pa m³/s              | sccm | Torr l/s             | atm cm³/s            |
|-----------|----------------------|----------------------|------|----------------------|----------------------|
| mbar l/s  | 1                    | 0.1                  | 59.2 | 0.75                 | 0.987                |
| Pa m³/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 cm³/s | 1.01                 | 0.101                | 59.8 | 0.76                 | 1                    |

**Tbl. 4: Conversion table: Units for gas throughput**

### 12.2 Technical characteristics

| Technical data               |    | Units  | ATH 1603 M       |                  | ATH 2303 M       |                  |
|------------------------------|----|--------|------------------|------------------|------------------|------------------|
| Inlet flange                 |    | ISO-F  | DN 200           | DN 250           | DN 200           | DN 250           |
| Exhaust flange <sup>1)</sup> |    | ISO-KF | DN 40            | DN 40            | DN 40            | DN 40            |
| Purge flange <sup>1)</sup>   |    | ISO-KF | DN 16            | DN 16            | DN 16            | DN 16            |
| Pumping speed                | N2 | l/s    | 1360             | 1400             | 1550             | 2150             |
|                              | Ar | l/s    | 1280             | 1350             | 1450             | 2000             |
|                              | He | l/s    | 940              | 970              | 1650             | 1800             |
|                              | H2 | l/s    | 540              | 540              | 1100             | 1100             |
| Compression ratio            | N2 |        | $5 \cdot 10^7$   | $5 \cdot 10^7$   | $> 1 \cdot 10^8$ | $> 1 \cdot 10^8$ |
|                              | Ar |        | $1.7 \cdot 10^8$ | $1.7 \cdot 10^8$ | $> 1 \cdot 10^8$ | $> 1 \cdot 10^8$ |
|                              | He |        | $4 \cdot 10^3$   | $4 \cdot 10^3$   | $> 3 \cdot 10^4$ | $> 3 \cdot 10^4$ |
|                              | H2 |        | $5 \cdot 10^2$   | $5 \cdot 10^2$   | $> 1 \cdot 10^3$ | $> 1 \cdot 10^3$ |

| Technical data                                    |    | Units                     | ATH 1603 M               |                          | ATH 2303 M               |                          |
|---------------------------------------------------|----|---------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| Maximum flow with water flow 60 l/h <sup>2)</sup> | N2 | sccm                      | 4000                     | 4000                     | 4000                     | 4000                     |
|                                                   | Ar | sccm                      | 1200                     | 1200                     | 1500                     | 1500                     |
|                                                   | He | sccm                      | > 4000                   | > 4000                   | > 4000                   | > 4000                   |
|                                                   | H2 | sccm                      | > 4000                   | > 4000                   | > 4000                   | > 4000                   |
| Maximum pressure at inlet <sup>2)</sup>           | N2 | hPa                       | 0.6                      | 0.6                      | 0.25                     | 0.25                     |
|                                                   | Ar | hPa                       | 0.026                    | 0.026                    | 0.025                    | 0.025                    |
|                                                   | He | hPa                       | > 0.6                    | > 0.6                    | -                        | -                        |
|                                                   | H2 | hPa                       | > 0.6                    | > 0.6                    | -                        | -                        |
| Maximum pressure at exhaust <sup>3)</sup>         | N2 | hPa                       | 1.7                      | 1.7                      | 2.9                      | 2.9                      |
|                                                   | Ar | hPa                       | 2.5                      | 2.5                      | 3.5                      | 3.5                      |
|                                                   | He | hPa                       | 1.2                      | 1.2                      | 2                        | 2                        |
|                                                   | H2 | hPa                       | 0.3                      | 0.3                      | 0.75                     | 0.75                     |
| Ultimate pressure <sup>4)</sup>                   |    | hPa                       | $6 \cdot 10^{-9}$        | $6 \cdot 10^{-9}$        | $6 \cdot 10^{-9}$        | $6 \cdot 10^{-9}$        |
| Nominal rotation speed                            |    | min <sup>-1</sup><br>(Hz) | 39000<br>(650)           | 39000<br>(650)           | 31000<br>(516)           | 31000<br>(516)           |
| Stand-by speed                                    |    | min <sup>-1</sup><br>(Hz) | 15000–39000<br>(250–650) | 15000–39000<br>(250–650) | 15000–31000<br>(250–516) | 15000–31000<br>(250–516) |
| Maxi. bake-out temperature                        |    | °C                        | 120                      | 120                      | 120                      | 120                      |
| Leak rate                                         |    | hPa·l/s                   | $< 5 \cdot 10^{-8}$      | $< 5 \cdot 10^{-8}$      | $< 5 \cdot 10^{-8}$      | $< 5 \cdot 10^{-8}$      |
| Purge flow rate                                   |    | hPa·l/s                   | 0.845 mini               | 0.845 mini               | 0.845 mini               | 0.845 mini               |
| Supply voltage <sup>5)</sup>                      |    |                           | 200-240 V AC 50/60 Hz    |                          |                          |                          |
| Maximum current leakage <sup>6)</sup>             |    | mA                        | < 12                     | < 12                     | < 12                     | < 12                     |
| Max. apparent start up power <sup>7)</sup>        |    | VA                        | 1500                     | 1500                     | 2100                     | 2100                     |
| Start-up time <sup>7)</sup>                       |    | mn                        | < 6                      | < 6                      | < 8                      | < 8                      |
| Start up power                                    |    | W                         | 850                      | 850                      | < 1200                   | < 1200                   |
| Power consumed at ultimate pressure               |    | W                         | < 200                    | < 200                    | < 200                    | < 200                    |
| Power at minimum stand-by speed                   |    | W                         | 100                      | 100                      | 100                      | 100                      |
| Vibration level (at nominal speed)                |    | µm                        | < 0.01                   | < 0.01                   | < 0.01                   | < 0.01                   |
| Sound level                                       |    | dB (A)                    | < 48                     | < 48                     | < 47                     | < 47                     |
| Electronic drive unit                             |    |                           | OBC / Magpower           |                          |                          |                          |

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

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

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

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

5) In accordance with EC regulations, the pumps can withstand a voltage variation of ± 10 %.

6) Value for the pump and electronic drive unit installed to the pump. All the current leakage may not pass through the earth wire, this depends on the way the pump is connected to the earth via the equipment in which it is integrated.

7) The value depend on the electronic drive unit type.

## 12.3 Environmental characteristics

|                               |                                                          |
|-------------------------------|----------------------------------------------------------|
| Use                           | indoor use                                               |
| Installation altitude         | up to 2000 m                                             |
| Pump protection rating        | IP 42                                                    |
| Ambient operating temperature | 5 – 45 °C                                                |
| Storage temperature           | -5 – +50 °C                                              |
| Maximum relative humidity     | 80 % max. with T ≤ 31 °C, up to 50 % max. with T ≤ 40 °C |

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

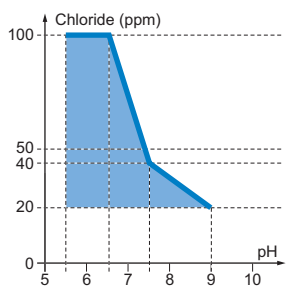
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|----------------------------------------------------------------------------------------------------------------------|-------------|
| Pollution degree                                                                                                     | 2           |
| Transient overvoltage protection <sup>1)</sup>                                                                       | Category II |
| 1) Transient overvoltages up to overvoltage category II levels. Temporary overvoltages that affect the mains supply. |             |

**Tbl. 5: Environmental characteristics**

## 12.4 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 <sup>1)</sup>                     | 100 to 20 ppm depending on the pH                                                                        |
|                                                                                    | Hardness                                    | < 35 °fH (French degree)<br>< 7 milliequivalent/L<br>< 350 mg/L of CaCO <sub>3</sub> (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 <sup>2)</sup>             | 15-35 °C (M version)<br>15-25 °C (MT version)                                                            |
|                                                                                    | Relative inlet pressure                     | < 6 · 10 <sup>3</sup> 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. 6: Cooling water characteristics**

## 12.5 Nitrogen characteristics

|                                |                                                  |
|--------------------------------|--------------------------------------------------|
| H <sub>2</sub> O concentration | < 10 ppm v                                       |
| O <sub>2</sub> concentration   | < 5 ppm v                                        |
| Dust                           | < 1 μm                                           |
| Oil                            | < 0.1 ppm v                                      |
| Absolut pressure               | 1 · 10 <sup>3</sup> to 1.5 · 10 <sup>3</sup> hPa |

**Tbl. 7: Nitrogen characteristics**

## 12.6 Electrical characteristics

| Characteristics of the three-phase motor | ATH 1603 M | ATH 2303 M |
|------------------------------------------|------------|------------|
| Voltage between phases                   | 44 Vrms    | 40 Vrms    |
| Power frequency                          | 1300 Hz    | 1033 Hz    |
| Phase current                            | 7A         | 12A        |

**Tbl. 8: Electrical characteristics of the pump**

|                                                                                                       |                                         |
|-------------------------------------------------------------------------------------------------------|-----------------------------------------|
| Main switch short circuit cut-off capacity                                                            | 10 kA                                   |
| Main circuit breaker rating                                                                           | 16 A (for 200-240 V - 50/60 Hz voltage) |
| GFI (or RCD) type B differential circuit breaker compatible with TT <sup>1)</sup> electrical networks | 30 mA                                   |
| 1) for TN and IT networks, use appropriate protection measures                                        |                                         |

Tbl. 9: Electrical characteristics of the customer's network

## 12.7 Dimensions and weight

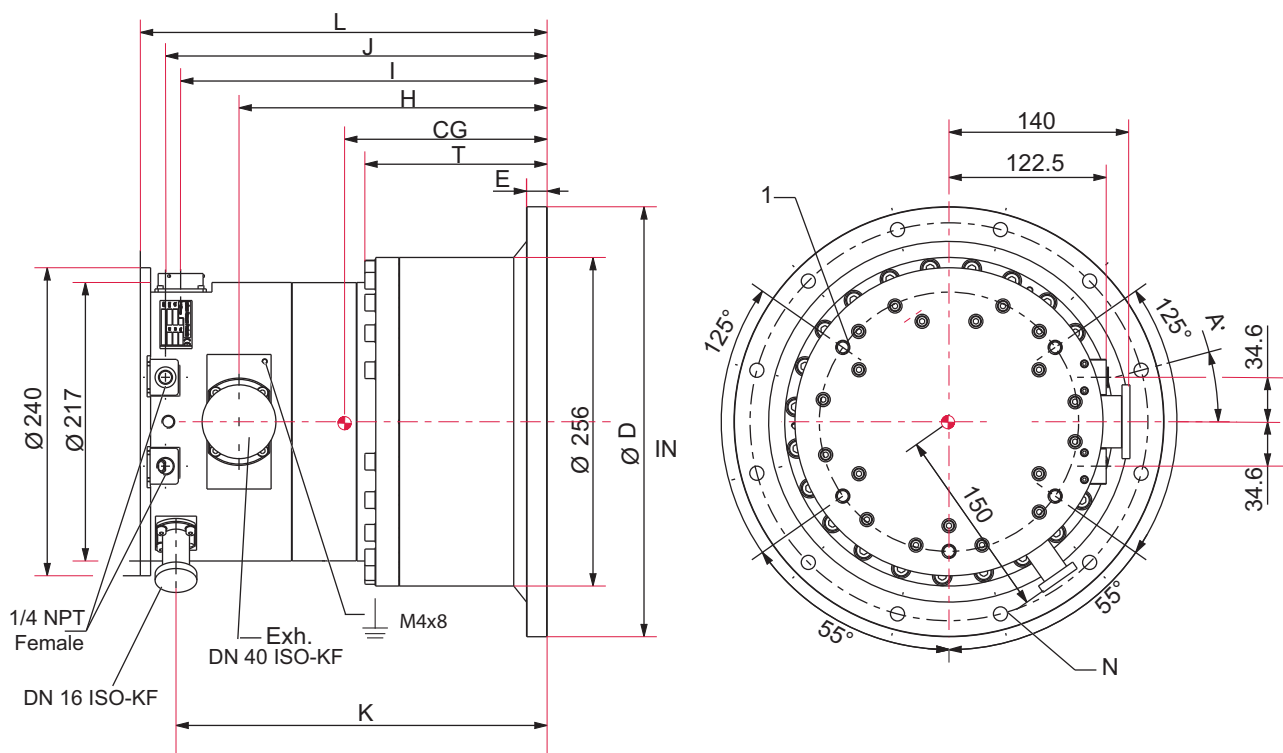
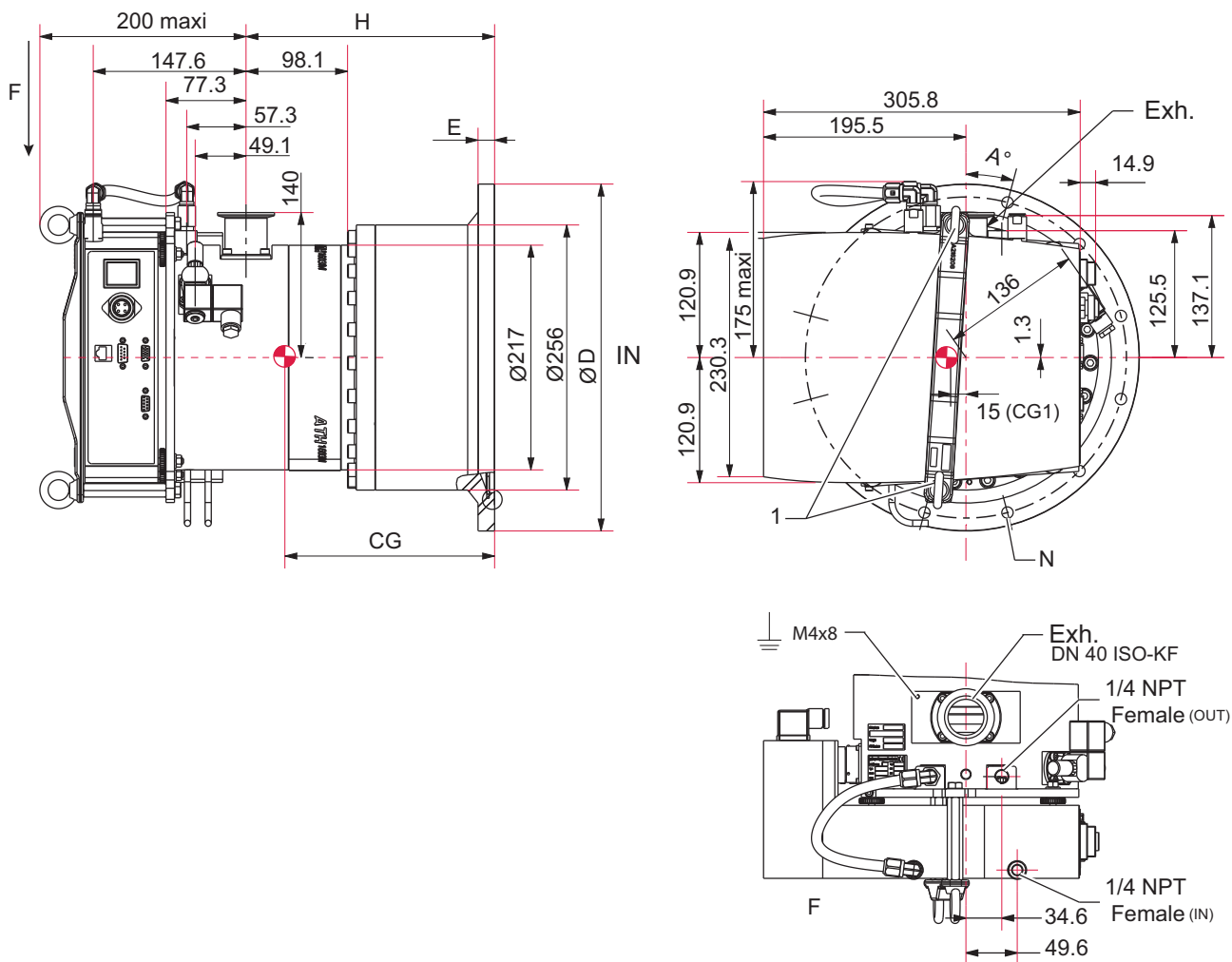


Fig. 9: ATH 1603 M dimensions

-  Center of gravity
- N Equidistant holes Ø d2 on Ø d1

- 1 5 M10 holes for handling



**Fig. 10: Dimensions of ATH 1603 M with OBC**



Center of gravity  
Equidistant holes Ø d2 on Ø d1

F View according to F  
1 Lifting rings (Qty: 2)

| ATH 1603 M dimensions (mm) |    |        |        |       |       |       |       |       |       |     |    |     | Pump<br>alone | Pump<br>+ OBC |     |
|----------------------------|----|--------|--------|-------|-------|-------|-------|-------|-------|-----|----|-----|---------------|---------------|-----|
| Inlet<br>flange            | E  | H      | I      | J     | k     | L     | T     | D     | d1    | d2  | N  | A*  | CG            | CG            | CG1 |
| DN 250<br>ISO-F            | 16 | 240.1  | 285.6  | 297.4 | 289.2 | 317.2 | 142   | 335   | 310   | 11  | 12 | 15  | 163           | 202           | 15  |
| DN 250<br>ISO-K            | 12 | 240.1  | 285.6  | 297.4 | 289.2 | 317.2 | 142   | 290   | -     | -   | -  | -   | 144           | 183           | 15  |
| DN 250<br>CF-F             | 26 | 240.1  | 258.60 | 297.4 | 289.2 | 317.2 | 142   | 304.8 | 284   | 8.5 | 4  | 7.5 | 139           | 178           | 15  |
| DN 200<br>ISO-F            | 16 | 243.41 | 288.6  | 300.4 | 292.2 | 320.2 | 145   | 285   | 260   | 11  | 12 | 15  | 146           | 185           | 15  |
| DN 200<br>ISO-K            | 12 | 243.41 | 288.6  | 300.4 | 292.2 | 320.2 | 145   | 240   | -     | -   | -  | -   | 149           | 188           | 15  |
| DN 200<br>CF-F             | 20 | 250.4  | 295.9  | 307.7 | 299.5 | 327.5 | 152.3 | 256   | 231.9 | 8.5 | 24 | 7.5 | 154           | 193           | 15  |
| * in degrees               |    |        |        |       |       |       |       |       |       |     |    |     |               |               |     |

\* in degrees

| Inlet flange | ATH 1603 M alone<br>Pump weight (kg) | ATH 1603 M with OBC<br>Pump weight (kg) |
|--------------|--------------------------------------|-----------------------------------------|
| DN 250 ISO-F | 32                                   | 39                                      |
| DN 250 ISO-K | 39                                   | 46                                      |
| DN 250CF-F   | 41                                   | 48                                      |
| DN 200 ISO-F | 37                                   | 44                                      |
| DN 200 ISO-K | 35                                   | 42                                      |
| DN 200 CF-F  | 36                                   | 43                                      |

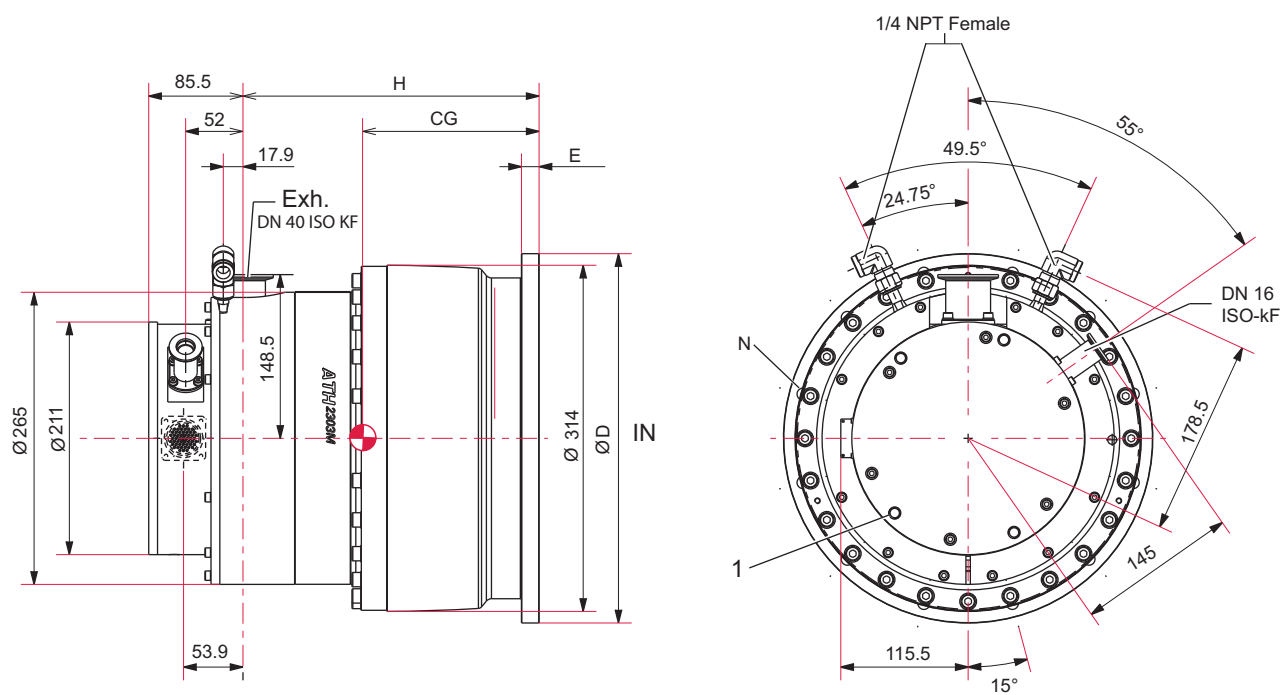


Fig. 11: ATH 2303 M dimensions

-  Center of gravity
- N 12 equidistant holes Ø d2 on Ø d1

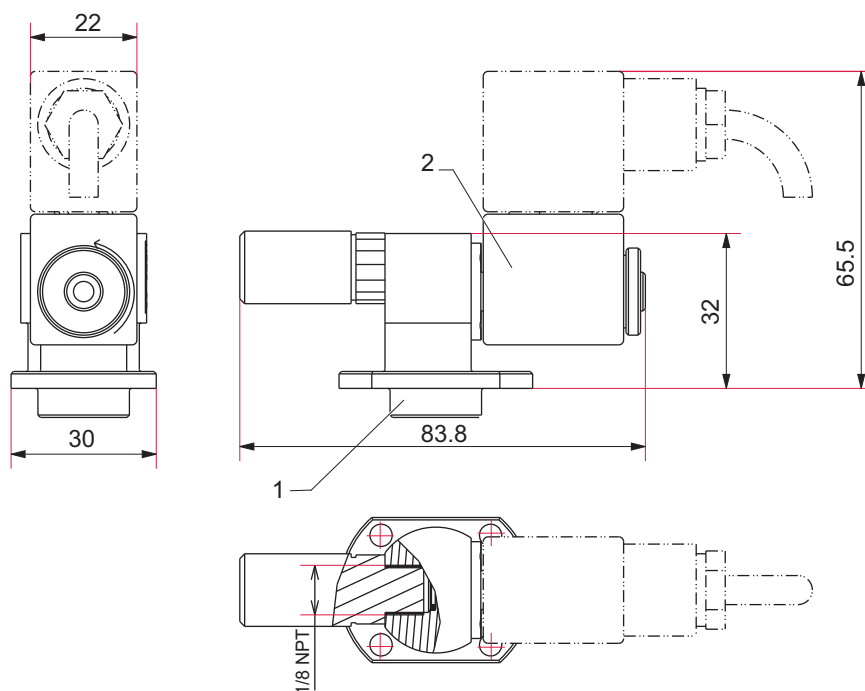
- 1 4 M10 holes for handling



N Equidistant holes  $\varnothing d_2$  on  $\varnothing d_1$

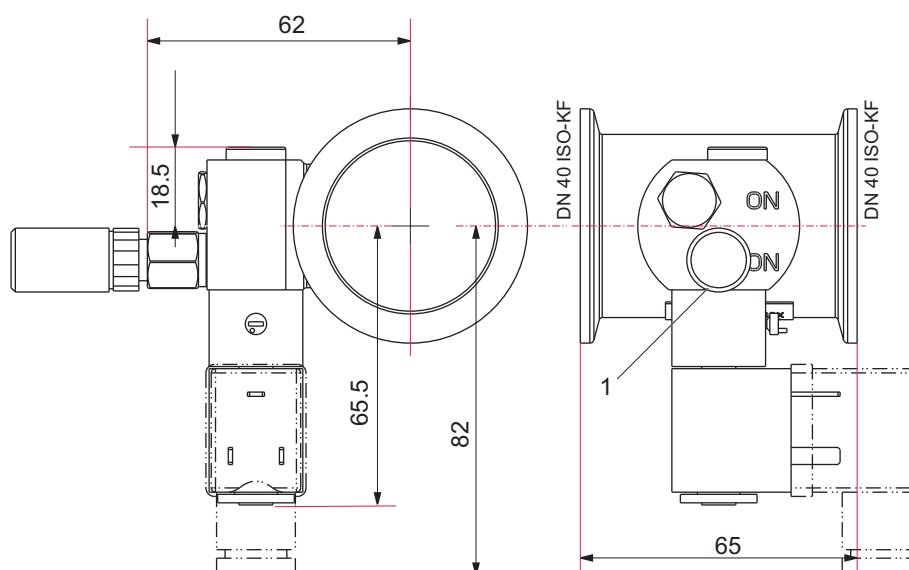
\* in degrees

**ATH 2303 M with OBC**  
**Pump weight (kg)**



**Fig. 13: Dimensions of Purge solenoid valve**

- 1 Connection to pump      2 Possible rotation



**Fig. 14: Dimensions of Air inlet solenoid valve**

- 1 1/8" NPT female connector

# Declaration of conformity

We hereby declare that the product mentioned below complies with all the applicable provisions of the following **EU 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

The person responsible for compiling the technical file is Mr. Nicolas Varennes, Pfeiffer Vacuum SAS, 98, avenue de Brogny B.P. 2069, 74009 Annecy cedex, France.

## **Magnetically levitated turbomolecular pumps**

**ATH 1603 M** <sup>1)</sup>

**ATH 2303 M** <sup>1)</sup>

<sup>1)</sup> Pump connected to an electronic drive unit OBC V4 or Magpower type.

## **Harmonized standards and national standards and specifications which have been applied:**

NF EN 1012-2 +A1: 2009

NF EN 61010-1 : 2011

NF EN 61000-6-2 : 2005

NF EN 61000-6-4 : 2011

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Signature:



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Bertrand Seigeot  
Pumps Product Group Director

2019/11/01





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