

OPERATING INSTRUCTIONS

EN

Translation of the Original

DUO 6 | DUO 6 M | DUO 6 MC

Rotary vane pump

Dear Customer,

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

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

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

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

Disclaimer of liability

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

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

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We reserve the right to make changes to the technical data and information in this document.

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1 About this manual



IMPORTANT

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

1.1 Validity

These operating instructions are for customers of Pfeiffer Vacuum. They describe the function of the designated product and provide the most important information for safe usage of the product. The descriptions comply with applicable directives. All information provided in these operating instructions refer to the current development status of the product. The documentation remains valid as long as the customer does not modify the product in any way.

1.1.1 Applicable documents

Designation	Document
Declaration of conformity	A component of these operating instructions

1.1.2 Variants

These instructions apply to the DuoLine vacuum pumps.

Pump type	Pump version
Duo 6	Pump in standard version
Duo 6 M	M version; differs compared to the standard version by: <ul style="list-style-type: none"> • Magnetic coupling
Duo 6 MC	MC version; differs compared to the standard version by: <ul style="list-style-type: none"> • Operating fluid F4 • Magnetic coupling encapsulated on the pump side • Vane material changed • Hose connection on the gas ballast valve • Leakage rate $\leq 1 \times 10^{-8}$ Pa m³/s

1.2 Target group

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

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

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

1.3 Conventions

1.3.1 Instructions in the text

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

Individual action step

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

- ▶ This is an individual action step.

Sequence of multi-part action steps

The numerical list indicates an action with multiple necessary steps.

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

1.3.2 Pictographs

Pictographs used in the document indicate useful information.



Note




Tip

1.3.3 Stickers on the product

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

	<p>Rating plate (example) Rating plate of the rotary vane vacuum pump Motor rating plate (not shown)</p>
	<p>Sticker (yellow) – three phase motor only Attention! Check the direction of rotation of the pump before filling with oil</p>
	<p>Sticker (red) Fill pump with oil prior to commissioning</p>
	<p>Sticker (orange) – special operating fluid only Caution: fill with F4 only</p>
	<p>Sticker (blue) – special operating fluid only Caution: fill with D1 only</p>
	<p>Arrow indicating direction of rotation The direction of rotation arrow indicates the required motor rotation direction.</p>

	<p>Closure seal The product is sealed ex-factory. Damaging or removing a closure seal results in loss of the warranty.</p>
	<p>Warning hot surface This sticker warns of injuries caused by high temperatures in case of touching without protection during operation.</p>

Tbl. 1: Stickers on the product

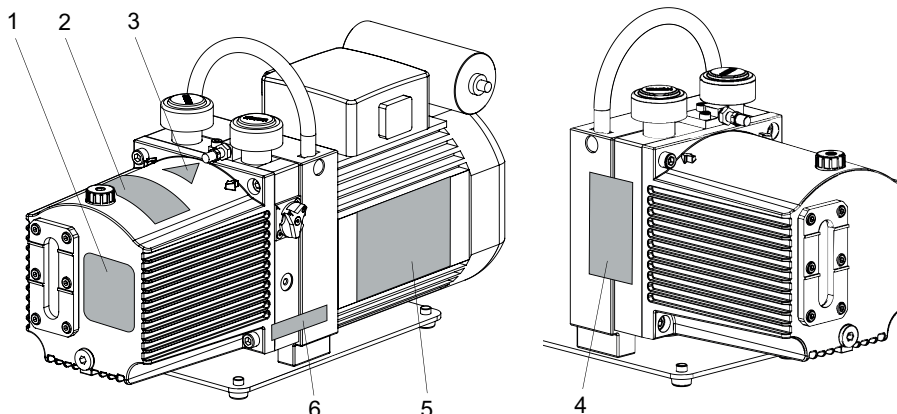


Fig. 1: Position of stickers on the product (single-phase motor)

- | | |
|--|---|
| <p>1 Rating plate of the rotary vane vacuum pump</p> <p>2 Operating fluid P3:
Fill rotary vane pump with operating fluid before commissioning
Operating fluid F4/D1 (alternative):
Attention! Fill the rotary vane pump with F4 or D1 only</p> <p>3 Hot surface warning sign</p> | <p>4 Operating fluid F4/D1, alternative to item 2:
Fill rotary vane pump with operating fluid before commissioning</p> <p>5 Motor rating plate</p> <p>6 Closure seal</p> |
|--|---|

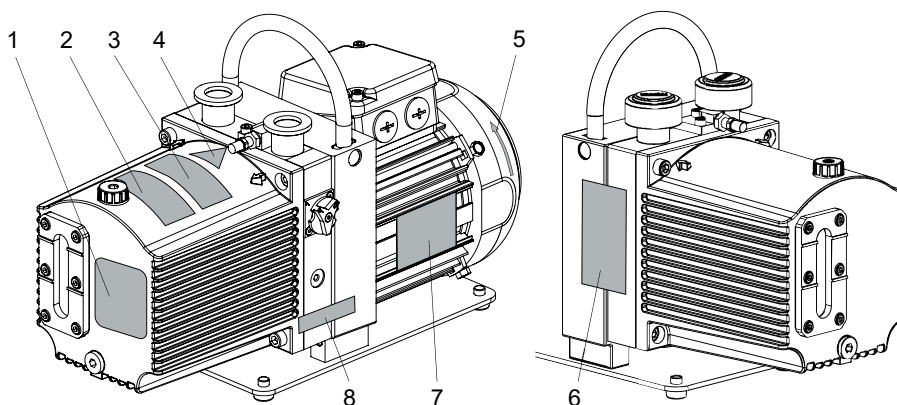


Fig. 2: Position of stickers on the product (three-phase motor)

- | | |
|--|---|
| <p>1 Rating plate of the rotary vane vacuum pump</p> <p>2 Attention! Check the direction of rotation of the rotary vane pump before filling with operating fluid</p> <p>3 Operating fluid P3:
Fill rotary vane pump with operating fluid before commissioning
Operating fluid F4/D1 (alternative):
Attention! Fill the rotary vane pump with F4 or D1 only</p> <p>4 Hot surface warning sign</p> | <p>5 Arrow indicating direction of rotation</p> <p>6 Operating fluid F4/D1, alternative to item 3:
Fill rotary vane pump with operating fluid before commissioning</p> <p>7 Motor rating plate</p> <p>8 Closure seal</p> |
|--|---|

1.3.4 Abbreviations

Abbreviation	Explanation
BA	Operating instructions
C version	Corrosive gas version
DN	Nominal diameter (Diamètre nominal)
FPM	Fluoropolymer rubber
FKM	Fluorinated rubber
I_N	Rated (nominal) current
I_{max}	Maximum current
ISO	Flange: Connector in accordance with ISO 1609 and ISO 2861
M version	Version with magnetic coupling
PE	Protective ground (protective earth)
ODK	Operating fluid return line (oil drain kit)
PTC	Temperature-dependent resistor (positive temperature coefficient)
M version	Version with magnetic coupling
MC version	Corrosive gas version with magnetic coupling
OME	Oil mist filter (oil mist eliminator)
RSSR	Radial shaft seal ring
WAF	width across flats
MM	Maintenance manual

Tbl. 2: Abbreviations used in this document

2 Safety

2.1 General safety instructions

This document includes the following 4 risk levels and 1 information level.

DANGER

Imminent danger

Indicates a hazardous situation which, if not avoided, will result in death or serious injury.

- ▶ Instructions on avoiding the hazardous situation

WARNING

Possibly imminent danger

Indicates a hazardous situation which, if not avoided, could result in death or serious injury.

- ▶ Instructions on avoiding the hazardous situation

CAUTION

Possibly imminent danger

Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

- ▶ Instructions on avoiding the hazardous situation

NOTICE

Danger of property damage

Notice is used to address practices not related to physical injury.

- ▶ Instructions on avoiding property damage



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

2.2 Safety instructions

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

Risks during transportation

WARNING

Danger of serious injury due to falling objects

Due to falling objects there is a risk of injuries to limbs through to broken bones.

- ▶ Take particular care and pay special attention when transporting products manually.
- ▶ Do not stack the products.
- ▶ Wear protective equipment, e.g. safety shoes.

Risks during installation

⚠ DANGER

Danger to life from electric shock

Contact with exposed and live elements generate an electric shock. Incorrect connection of the mains supply leads to the risk of live housing parts that can be touched. There is a risk to life.

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

⚠ WARNING

Danger of poisoning from toxic vapors

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

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

⚠ CAUTION

Risk of injury from suction of body parts

After a power failure or a standstill as a result of overheating, the motor restarts automatically.

There is a risk of minor injuries to fingers and hands (e.g. hematoma) from direct contact with the vacuum flange.

- ▶ Maintain sufficient distance to the vacuum flange during all work.
- ▶ Safely disconnect motor from the mains.
- ▶ Secure the motor against re-start.

Risks during operation

⚠ WARNING

Danger of poisoning due to toxic process media escaping from the exhaust pipe

During operation with no exhaust line, the vacuum pump allows exhaust gases and vapors to escape freely into the air. There is a risk of injury and fatality due to poisoning in processes with toxic process media.

- ▶ Observe the pertinent regulations for handling toxic process media.
- ▶ Safely purge toxic process media via an exhaust line.
- ▶ Use appropriate filter equipment to separate toxic process media.

⚠ WARNING

Danger of poisoning from toxic vapors

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

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

⚠ CAUTION

Risk of injury from suction of body parts

After a power failure or a standstill as a result of overheating, the motor restarts automatically.

There is a risk of minor injuries to fingers and hands (e.g. hematoma) from direct contact with the vacuum flange.

- ▶ Maintain sufficient distance to the vacuum flange during all work.
- ▶ Safely disconnect motor from the mains.
- ▶ Secure the motor against re-start.

⚠ CAUTION**Danger of injury from bursting as a result of high pressure in the exhaust line**

Faulty or inadequate exhaust pipes lead to dangerous situations, e.g. increased exhaust pressure. There is a danger of bursting. Injuries caused by flying fragments, the escaping of high pressure, and damage to the unit cannot be excluded.

- ▶ Route the exhaust line without shut-off units.
- ▶ Observe the permissible pressures and pressure differentials for the product.
- ▶ Check the function of the exhaust line on a regular basis.

⚠ CAUTION**Danger of burns on hot surfaces**

Depending on the operating and ambient conditions, the surface temperature of the vacuum pump can increase to above 70 °C.

- ▶ Provide suitable touch protection.

Risks during maintenance, decommissioning and malfunctions**⚠ WARNING****Health hazard through poisoning from toxic contaminated components or devices**

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

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

⚠ WARNING**Danger of injury from strong magnetic field**

There is a risk of injury for people with pacemakers and medical implants.

- ▶ Make sure that such individuals do not enter the sphere of influence (≤ 2 m) of the magnetic field.
- ▶ Identify rooms in which magnetic couplings are openly accessible with the symbol: **"No access for people with pacemakers"**.
- ▶ Always keep disassembled couplings away from computers, data carriers, and other electronic components.

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

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

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

⚠ WARNING**Health hazard and risk of environmental damage from toxic contaminated operating fluid**

Toxic process media can cause operating fluid contamination. When changing the operating fluid, there is a health hazard due to contact with poisonous substances. Illegal disposal of toxic substances causes environmental damage.

- ▶ Wear suitable personal protective equipment when handling these media.
- ▶ Dispose of the operating fluid according to locally applicable regulations.

⚠ WARNING

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

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

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

⚠ CAUTION

Scalding from hot operating fluid

Danger of burns when draining operating fluid if it comes into contact with the skin.

- ▶ Wear protective equipment.
- ▶ Use a suitable collection vessel.

⚠ CAUTION

Risk of injury from suction of body parts

After a power failure or a standstill as a result of overheating, the motor restarts automatically. There is a risk of minor injuries to fingers and hands (e.g. hematoma) from direct contact with the vacuum flange.

- ▶ Maintain sufficient distance to the vacuum flange during all work.
- ▶ Safely disconnect motor from the mains.
- ▶ Secure the motor against re-start.

⚠ CAUTION

Danger of burns on hot surfaces

In the event of a fault, the surface temperature of the vacuum pump can increase to above 105 °C.

- ▶ Allow the vacuum pump to cool down before carrying out any work.
- ▶ Wear personal protective equipment if necessary.

⚠ CAUTION

Danger of injury from moving parts

After a power failure or a standstill as a result of overheating, the motor restarts automatically. There is a risk of injury to fingers and hands if they enter the operating range of rotating parts.

- ▶ Safely disconnect motor from the mains.
- ▶ Secure the motor against reactivation.
- ▶ Dismantle the vacuum pump for inspection, away from the system if necessary.

2.3 Safety precautions

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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.

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Infringement of conformity due to modifications to the product

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

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

General safety precautions when handling the product

- ▶ Observe all applicable safety and accident prevention regulations.
- ▶ Check that all safety measures are observed at regular intervals.
- ▶ Do not expose body parts to the vacuum.
- ▶ Always ensure a secure connection to the earthed conductor (PE).
- ▶ Never disconnect plug connections during operation.
- ▶ Observe the above shutdown procedures.
- ▶ Keep lines and cables away from hot surfaces (> 70 °C).
- ▶ Never fill or operate the unit with cleaning agents or cleaning agent residues.
- ▶ Do not carry out your own conversions or modifications on the unit.
- ▶ Observe the unit protection class prior to installation or operation in other environments.
- ▶ Provide suitable touch protection, if the surface temperature exceeds 70 °C.

2.4 Safety precautions for vacuum pumps with magnetic coupling

The following safety instructions are only valid for the working with a drive system of a vacuum pump with a magnetic coupling:

Safety precautions

- ▶ Keep a magnetic coupling away from people with pacemakers.
 - Minimum distance: **2 m**
- ▶ Avoid convergence of magnetic coupling components.
- ▶ Keep magnetized parts away from the magnetic coupling.
- ▶ Always keep a disassembled magnetic coupling away from computers, data carriers and other electronic components.
 - The magnetic coupling can influence operational reliability of electrical and electronic devices.

2.5 Limits of use of the product

Installation location	<ul style="list-style-type: none"> • Indoors, protected from dust deposits • Outdoors, protected from direct weather influences
Installation altitude	max. 2000 m
Installation surface inclination	±10 %
Ambient temperature	+12 °C to +40 °C
Relative air humidity	max. 85 %
Pumped medium intake temperature, max.	+40 °C
Exhaust pressure of the vacuum pump	≤ 1500 hPa absolute
Exhaust pressure at OME	max. atmospheric pressure

Tbl. 3: Limits of use of the product

2.6 Proper use

- ▶ Use the vacuum pump for vacuum generation only.
- ▶ When pumping media with an oxygen concentration level of ≥ 21 %, only use perfluorinated, synthetic oils (F4, F5, A113) as operating fluid.
- ▶ Adhere to the installation, commissioning, operating, and maintenance instructions.
- ▶ Do not use any accessory parts other than those recommended by Pfeiffer Vacuum.

2.7 Foreseeable improper use

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

- Pumping of corrosive media (exception: C version of the rotary vane vacuum pumps)
- Pumping radioactive media
- Pumping of gases that introduce an ignition source to the suction chamber
- Pumping of gases that contain impurities such as particles, dust, or condensate
- Pumping explosive media

- Pumping of media with a propensity to sublimation
 - Pumping of fluids
 - Use of the vacuum pump in potentially explosive atmospheres
 - Use of the vacuum pump outside the specified area of application
 - Use for pressure generation
 - Use in strong electrical, magnetic, or electromagnetic fields
 - Connection to vacuum pumps or equipment which are not suitable for this purpose according to their operating instructions
 - Connection to devices with exposed live parts
 - Use of accessories or spare parts not listed in these instructions
 - Use of operating fluids other than those specified by Pfeiffer Vacuum
 - Use of D1 or mineral oil as operating fluid with an oxygen concentration level of > 21 %
- Mineral oils are combustible and ignite in high temperatures and when they come into contact with pure oxygen. This oils oxidize heavily and thus lose their lubricating capacity.

2.8 Responsibilities and warranty

Pfeiffer Vacuum shall assume no responsibilities and warranty if the operating company or a third party:

- disregards this document.
- does not use the product for its intended purpose.
- carries out any modifications to the product (conversions, changes, maintenance work, etc.) that are not listed in the corresponding operating instructions.
- operates the product with accessories that are not listed in the corresponding operating instructions.

The operator is responsible for the process media used.

2.9 Owner requirements

Safety-conscious working

1. Only operate the product in a technically flawless state.
2. Operate the product in line with its intended purpose, safety and hazard-conscious and only in compliance with these operating instructions.
3. Fulfill the following instructions and monitor the observation of the following instructions:
 - Proper use
 - Generally applicable safety instructions and accident prevention regulations
 - International, national and locally applicable standards and guidelines
 - Additional product-related guidelines and regulations
4. Only use original parts or parts approved by Pfeiffer Vacuum.
5. Keep the operating instructions available at the place of installation.
6. Ensure personnel qualification.

2.10 Personnel qualification

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

Training people

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

2.10.1 Ensuring personnel qualification

Specialist for mechanical work

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

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

Specialist for electrotechnical work

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

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

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

Trained individuals

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

2.10.2 Personnel qualification for maintenance and repair



Advanced training courses

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

Adequately trained individuals are:

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

2.10.3 Advanced training with Pfeiffer Vacuum

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

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

2.11 Operator requirements

Observing relevant documents and data

1. Read, observe and follow this operating instruction and the work instructions prepared by the operating company, in particular the safety and warning instructions.
2. Install, operate and maintain the product only in accordance with these operating instructions.
3. Carry out all work only on the basis of the complete operating instructions and applicable documents.
4. Comply with the application limits.
5. Observe the technical data.
6. Please contact the Pfeiffer Vacuum Service Center if your questions on operation or maintenance of the product are not answered by these operating instructions.
 - You can find information in the [Pfeiffer Vacuum service area](#).

3 Product description

3.1 Identifying the product

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

3.2 Scope of delivery

- Rotary vane vacuum pump with motor
- Operating fluid (other than F4, F5 and A113)
- Centering ring with cone sieve and O-ring for the connection flange
- Locking caps for both connection flanges
- Operating instructions

3.3 Function

DuoLine™ rotary vane vacuum pumps are two-stage, oil-sealed rotary positive displacement pumps for use in coarse and medium vacuum. The vacuum pumps are equipped with a safety valve that vacuum seals the vacuum chamber and simultaneously vents the vacuum pump when the pump is at a standstill. The rotary vane vacuum pump is available in the standard version with a conventional seal, or as an M version with non-contact and wear-proof drive with magnetic coupling. The pump housing is hermetically sealed.

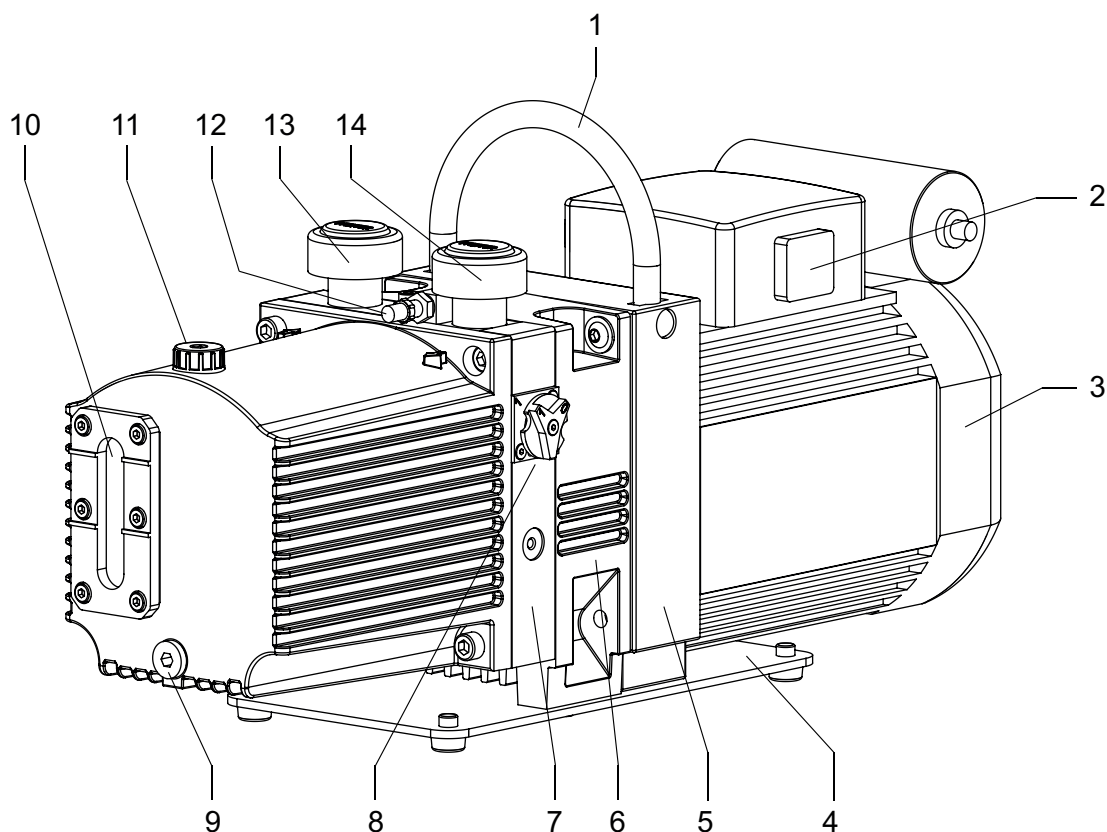


Fig. 3: Structure of the rotary vane pump

- | | |
|---|--|
| 1 Handle | 8 Gas ballast valve |
| 2 Mains switch | 9 Drain screw for operating fluid |
| 3 Motor | 10 Sight glass |
| 4 Base plate | 11 Filling screw for operating fluid |
| 5 Motor flange | 12 Connection for the operating fluid return |
| 6 Intermediate flange (only with M version) | 13 Vacuum flange with protective cap |
| 7 Stand | 14 Exhaust flange with protective cap |

3.4 Operating principle

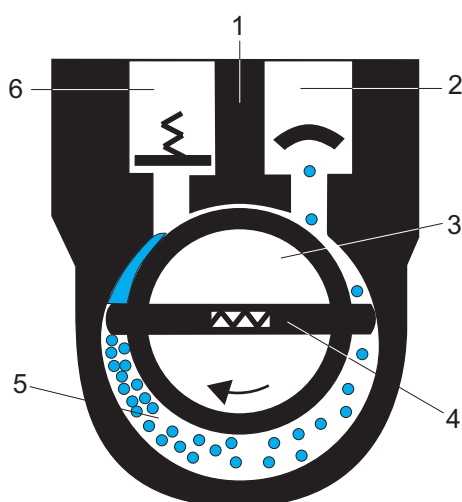


Fig. 4: Rotary vane vacuum pump functional principle

- | | |
|-------------------------|--------------------|
| 1 Housing | 4 Vane |
| 2 Vacuum flange (inlet) | 5 Suction chamber |
| 3 Rotor | 6 Exhaust (outlet) |

The rotary vane pump is an oil-sealed rotational displacement pump. The pumping system is made up of the housing, the eccentrically mounted rotor, and the centrifugally- and spring-loaded radially sliding vanes, which divide the suction chamber into multiple chambers. The volume of each chamber changes periodically as the rotor rotates. This causes the gas to be drawn in at the vacuum flange and compressed in the suction chamber by the rotation of the rotor, until the exhaust valve opens against the atmospheric pressure at the outlet and expels the gas. The exhaust valve is oil-sealed. When the valve opens, a small quantity of oil penetrates into the suction chamber. In addition to lubrication, this also causes the gaps between the rotor, stator and vanes to seal.

Vacuum safety valve

Depending on the pump type, rotary vane pumps are equipped with a vacuum safety valve. This separates the rotary vane pump from the vacuum chamber in the event of intentional or unintentional standstill, and vents the pumping system with the displaced gas so that oil does not rise into the vacuum chamber. After switching on, the valve opens after a delay.

Gas ballast valve

The gas ballast device is used to blend ambient air or inert gas with the process gas in the pumping system. The increase of air content compresses and expels a pumped gas-vapor-mixture within specific limits, without causing condensation in the suction chamber.

Operating fluid, oil

The pump oil, also known as operating fluid, fulfills various tasks in a rotary vane pump:

- lubrication of all moving parts
- filling part of the dead volume under the exhaust valve
- sealing the gap between the intake and exhaust channel, and between the vanes and the working chamber
- ensuring an optimal temperature balance through heat transfer

4 Transportation and Storage

4.1 Transporting the vacuum pump

⚠ WARNING

Danger of serious injury due to falling objects

Due to falling objects there is a risk of injuries to limbs through to broken bones.

- ▶ Take particular care and pay special attention when transporting products manually.
- ▶ Do not stack the products.
- ▶ Wear protective equipment, e.g. safety shoes.



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

General information regarding safe transport

1. Observe the weight specified on packaging.
2. Use a transport aid if necessary (trolley, lift truck).
3. Transport the product in its original packaging.
4. Always place the product on an adequately sized, level surface.

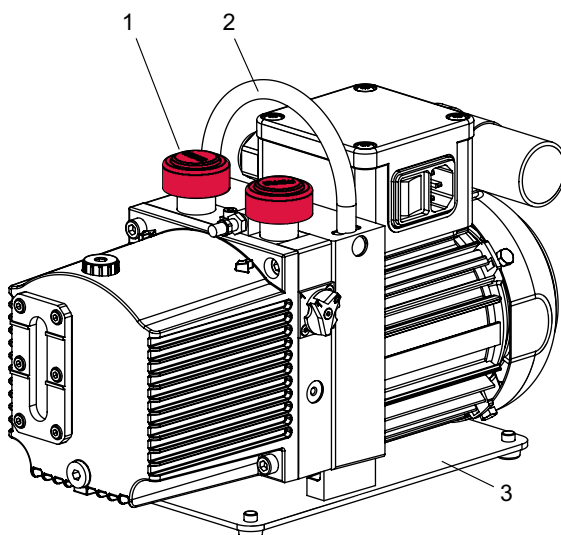


Fig. 5: Transporting the vacuum pump manually

- | | |
|------------------|--------------|
| 1 Protective cap | 3 Base plate |
| 2 Handle | |

Transporting the vacuum pump without its packaging

1. Unpack the vacuum pump.
2. To protect the inside of the pump, leave both protective caps on the connection flanges during transport.
3. For lifting, use the handle provided for this purpose, located on the top of the pump.
4. Lift the vacuum pump out of the transport packaging.
5. Always place the vacuum pump on an adequately sized, level surface.

4.2 Storing the vacuum pump



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

Procedure

1. Fill the vacuum pump with operating fluid up to the upper edge of the sight glass.
2. Close both connection flanges and all openings on the vacuum pump.
3. Make sure that the gas ballast valve is closed.
4. Store the vacuum pump only in dry, dust-free rooms, within the specified ambient conditions.
5. In rooms with humid or aggressive atmospheres: Hermetically seal the vacuum pump together with a drying agent in a plastic bag.
6. Change the operating fluid if the storage period is longer than 2 years.

5 Installation

5.1 Installing the vacuum pump

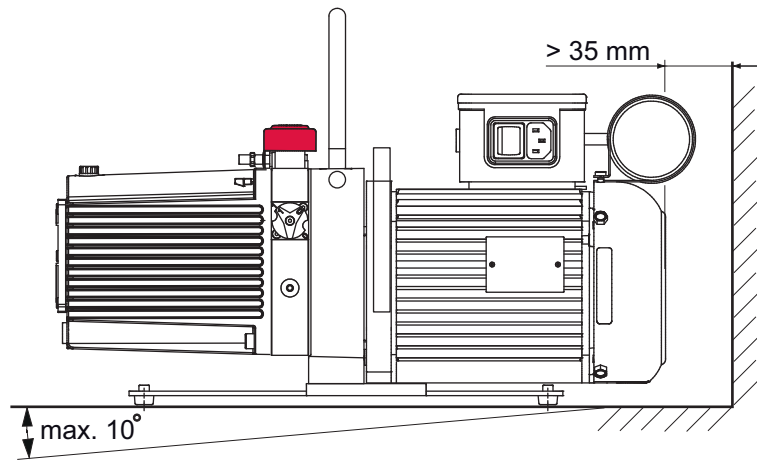


Fig. 6: Minimum distances and permissible inclination

Procedure

1. Place the vacuum pump on a flat, horizontal surface, to safeguard the operating fluid supply.
2. Observe the max. permissible angle of inclination of $\pm 10^\circ$.
3. Screw the base plate of the vacuum pump to the mounting surface if necessary.
4. When installing the pump in a closed housing, ensure adequate air circulation.
5. Keep the sight glass and gas ballast valve visible and freely accessible.
6. Keep the voltage and frequency specifications on the motor rating plate visible and freely accessible.
7. Fill with operating fluid prior to first commissioning.
 - You can find the quantity and type of the operating fluid on the rating plate.

5.2 Connecting the vacuum side

NOTICE

Property damage from contaminated gases

Pumping down gases that contain impurities (condensate, particles) damages the vacuum pump.

- ▶ Use suitable filters or separators from the Pfeiffer Vacuum range of accessories, to protect the vacuum pump.



Installation and operation of accessories

Pfeiffer Vacuum offers a series of special, compatible accessories for its rotary vane pumps.

- You can find information and ordering options for approved [accessories](#) online.
- Described accessories are not included in the shipment.

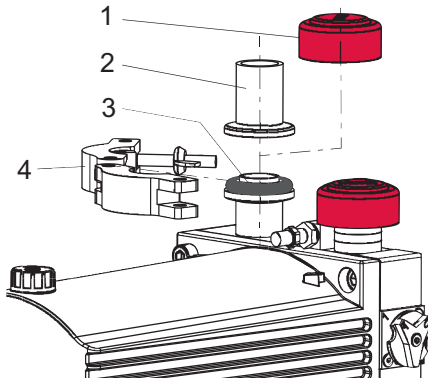


Fig. 7: Vacuum connection with flange connection

- | | |
|------------------|---|
| 1 Protective cap | 3 Centering ring with cone sieve and O-ring |
| 2 Intake line | 4 Circlip |

Procedure

1. Remove the protective cap from the vacuum flange.
2. Make sure that the centering ring with cone sieve and the O-ring are in the vacuum flange.
3. Establish the shortest possible connection between vacuum pump and vacuum chamber.
4. Choose a minimum vacuum line cross section equal to the nominal diameter of the connection flange.
5. Depending on the pump type, use PVC or metallic hoses with flange connections from the [Pfeiffer Vacuum component shop](#).
6. Support or suspend the piping to the vacuum pump so that no piping system forces act on the vacuum pump.
7. Connect both flanges with a circlip.
8. Use a separator or filter from the Pfeiffer Vacuum line of [accessories](#) if necessary.

5.3 Connecting the exhaust side

⚠ CAUTION

Danger of injury from bursting as a result of high pressure in the exhaust line

Faulty or short exhaust lines cause hazardous situations, e.g. exhaust pressure increase. There is a danger of bursting. Injuries caused by flying fragments, the escaping of high pressure, and damage to the unit cannot be excluded.


- ▶ Open shut-off units immediately before or at the same time as starting the pump.
- ▶ Observe the maximum permissible pressure of 1,500 hPa (absolute).
- ▶ Observe the permissible pressures and pressure differentials for the product.
- ▶ Check the function of the exhaust line on a regular basis.

NOTICE

Malfunction and damage to the vacuum pump from inadmissible exhaust line installation

Negative pressure in the exhaust line causes malfunctions and damage to the vacuum pump. Negative pressure is permitted only in rotary vane vacuum pumps with magnetic coupling.

- ▶ When dissipating gases, make sure that the exhaust pressure is at least 250 hPa higher than the intake pressure.

 **Condensate separator**

Pfeiffer Vacuum recommends installing a condensate separator, with condensate drain at the lowest point of the exhaust line.



Installation and operation of accessories

Pfeiffer Vacuum offers a series of special, compatible accessories for its rotary vane pumps.

- You can find information and ordering options for approved [accessories](#) online.
- Described accessories are not included in the shipment.

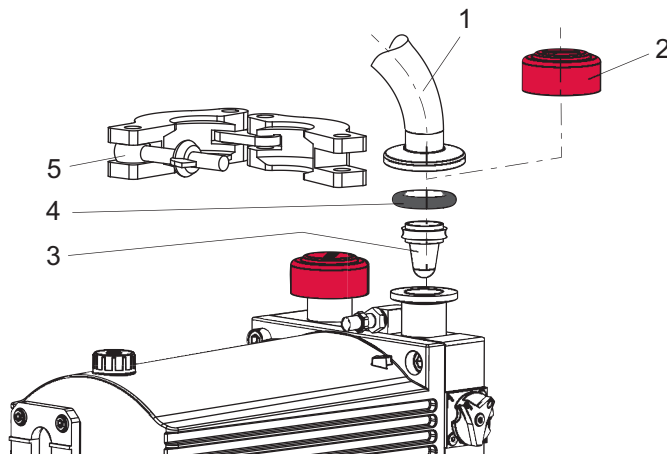


Fig. 8: Exhaust connection with flange connection

- | | |
|----------------------------------|-----------|
| 1 Exhaust line | 4 O-ring |
| 2 Protective cap | 5 Circlip |
| 3 Centering ring with cone sieve | |

Procedure

1. Remove the protective cap from the exhaust flange.
2. Ensure that the centering ring with cone sieve is fitted in the exhaust flange.
3. Choose a minimum exhaust line diameter equal to the nominal diameter of the connection flange.
4. Depending on the pump type, use PVC or metallic hoses with flange connections from the [Pfeiffer Vacuum component shop](#).
5. Route the piping downwards from the vacuum pump, to prevent condensate return.
6. Support or suspend the piping to the vacuum pump so that no piping system forces act on the vacuum pump.
7. Connect both flanges with a circlip.

5.4 Establishing mains connection

⚠ DANGER

Danger to life from electric shock

Contact with exposed and live elements generate an electric shock. Incorrect connection of the mains supply leads to the risk of live housing parts that can be touched. There is a risk to life.

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

NOTICE

Risk of property damage from excess voltage

Incorrect or excessive mains voltage will destroy the motor.

- ▶ Always observe the motor rating plate specifications.
- ▶ Route the mains connection in accordance with locally applicable provisions.
- ▶ Always provide a suitable mains fuse to protect the motor and supply cable in the event of a fault.

Depending on the pump type, different motor designs or mains voltages can be used:

- Single-phase motor for fixed voltage with
 - inbuilt thermal protection switch,
 - mains switch and
 - rubber connector
- Single-phase motor with reversible voltage range and
 - thermal protection switch,
 - mains switch and
 - rubber connector
- Three phase motor (without switch and mains cable)

5.4.1 Connecting single-phase motors

NOTICE

Property damage from the voltage range being set incorrectly

Recommissioning after longer downtimes of the vacuum pump or after changing the oil requires the current settings to be checked.

- ▶ Before switching the vacuum pump on each time, check the currently set voltage range.
- ▶ Make changes to the voltage range only after the vacuum pump has been disconnected from the mains.

Vacuum pumps with single-phase motors are equipped with an installed thermal protection switch. In event of excess temperature, the protection switch interrupts the motor current, but does not offer a permanent shut-down of the motor. Depending on the pump type, different motor versions with rubber connector are possible.

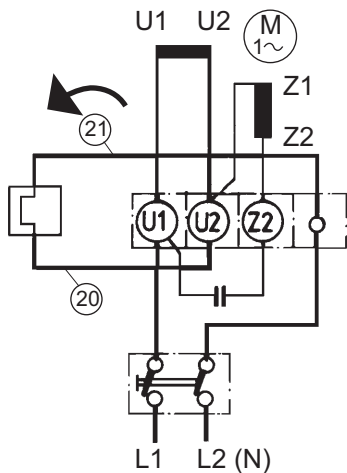


Fig. 9: Motor circuit diagram, single-phase motor with switch

i **The magnetic coupling does not offer an overload protection.**
 The magnetic coupling's torque is so strong that it does not provide any overload protection for the motor.

On-site protection

- ▶ For the protection of the motor in case of malfunction, always provide fuse protection according to the regulations applicable for the region.

Motor voltage [V], ±10 %	Mains frequency [Hz]	Rated (nominal) current [A]	Recommended fuse, slow-blow [A]
100 – 110	50	4.8	16
100 – 120	60	5.2	16
100/200	50	4.3/2.3	16/6
100/200	60	5.7/3.2	16/6

Motor voltage [V], ±10 %	Mains frequency [Hz]	Rated (nominal) current [A]	Recommended fuse, slow-blow [A]
115/230	50	2.9/1.45	16/6
115/230	60	3.9/1.95	16/6
115/230	50	3.8/1.9	16/6
115/230	60	5.2/2.6	16/6
230 – 240	50	2.0	6
230 – 240	60	2.2	6
200 – 240	50	2.5	6
200 – 240	60	3.0	6

Tbl. 4: Recommended fuse values for on-site protection

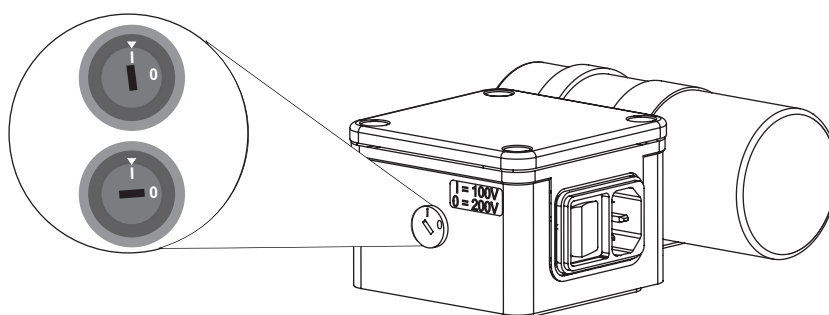


Fig. 10: Voltage selector switch on the terminal box (example)

Switch position:	"115"	"1"	"230"	"2"
Voltage range Motor 115/230 V	115 V ±10 %, 50/60 Hz		230 V ±10 %, 50/60 Hz	
Voltage range Motor 100/200 V		100 V ±10 %, 50/60 Hz		200 V ±10 %, 50/60 Hz

Tbl. 5: Permissible voltage range for reversible single-phase motor

Required tool

- Screwdriver

Change over of the voltage range for vacuum pumps with reversible motor

1. The mains voltage must be determined on-site each time before the vacuum pump is installed or moved to a different location.
2. Disconnect the vacuum pump from the mains.
3. Set the required voltage range on the voltage selector switch using a suitable screwdriver.

5.4.2 Connect three phase motor with 6-pin terminal board

NOTICE
<p>Property damage from high starting torque</p> <p>The specific load behavior of the vacuum pump requires direct on-line starting at full motor power. Engine damage occurs if a different starting circuit is used.</p> <ul style="list-style-type: none"> ▶ Always start the motor directly. ▶ Never use a star-delta start-up circuit.

Ports U1 – L2, V1 – L1 and W1 – L3 rotate the motor shaft clockwise when looking at the motor fan.

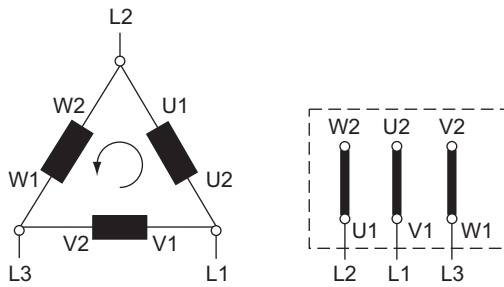


Fig. 11: Delta connection for low voltage

The 3 phases are connected in series, and their connection points connected to the mains. The voltage per phase is equal to the mains voltage, while the mains current is $\sqrt{3}$ times the phase current. The delta connection is marked with the Δ symbol. The voltage between the incoming mains supply lines is called mains voltage. The mains current is the current flowing in the incoming supply lines.

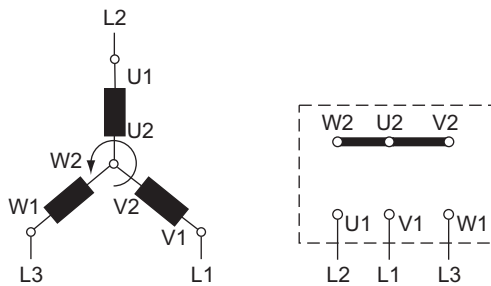


Fig. 12: Star circuit for high voltage

The ends of the 3 phases are connected in the star point. The terminal voltage is $\sqrt{3}$ times the phase voltage, the mains current is equal to the phase current. The star circuit is marked with the Y symbol.

5.4.3 Frequency inverter for vacuum pumps with 3-phase motor

Rotary vane pumps with variable rotation speed can be operated within a mains frequency range of 35 to 60 Hz. Start-up is ramped (maximum run-up time: 30 s). Shutdown can take place immediately.

5.4.4 Checking the direction of rotation



Operating fluid leaks out

The direction of rotation must be checked on vacuum pumps with three phase motors. If the direction of rotation for the vacuum pump is incorrect, there is a risk of operating fluid escaping at the vacuum flange.

- Check the direction of rotation before refilling operating fluid.

Procedure

1. Switch on the rotary vane pump briefly (2 to 3 seconds.)
 - The motor and motor fan must rotate clockwise (see the arrow on the fan cover).
2. If the direction of rotation is incorrect, exchange the 2 phases on the connection cable.
3. Refill the operating fluid.

5.4.5 Setting the motor protection switch



The magnetic coupling does not offer an overload protection.

The magnetic coupling's torque is so strong that it does not provide any overload protection for the motor.

Motor protection switches are current-dependent protective devices for the drive motors. Protection switches with slow tripping characteristics are suitable.

An increase of 1.5 times the rated current over a 2 minute period is permissible for the drive motors (in accordance with EN 60034-1), without tripping the motor protection switch.

Procedure

1. Take the settings for the motor protection switch from the following table.
2. Take into consideration that certain operating conditions (for example, cold vacuum pump start) can cause short-term increases in power input.
3. Set the desired value on the contactor.

Voltage [V]	Frequency [Hz]	Motor rating [kW]	I_N [A]	I_{max} [A]
230	50	0.15	1.0	4.3
400	50	0.15	0.6	2.6
265	60	0.18	1.0	4.5
460	60	0.18	0.6	2.7

Tbl. 6: Motor protection switch settings

5.4.6 Thermal winding protection



The magnetic coupling does not offer an overload protection.
 The magnetic coupling's torque is so strong that it does not provide any overload protection for the motor.

The three phase motor is equipped with a bi-metallic contact in the stator winding. The contact is routed to the terminal box for on-site use.

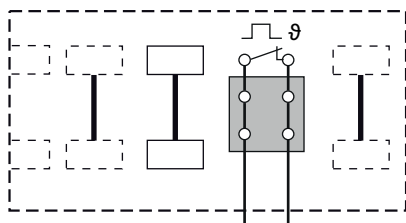


Fig. 13: Thermal winding protection with three-phase motor

Connecting the thermal winding protection

- ▶ Use the signal for temperature monitoring and, if necessary, for switching off the motor.

5.5 Filling the operating fluid

⚠ WARNING

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

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

NOTICE

Risk of damage due to the use of non-approved operating fluid
 Product-specific performance data are not achieved. All liability and warranty claims against Pfeiffer Vacuum are also excluded.

- ▶ Only use approved operating fluids.
- ▶ Only use other application-specific operating fluids after consultation with Pfeiffer Vacuum.

The type of operating fluid specified, as well as the filling quantity for the entire rotary vane vacuum pump, are shown on the rating plate. Only the operating fluid used during initial installation is permissible. Subsequent change is possible only after consultation with Pfeiffer Vacuum.

Approved operating fluids

- P3 (standard design)
- F4 (operating fluid for corrosive gas version)
- D1 for special applications (such as higher operating temperatures)

Read the operating fluid type on the rating plate

- ▶ Refer to the rating plate of the vacuum pump for type and quantity of intended operating fluid.

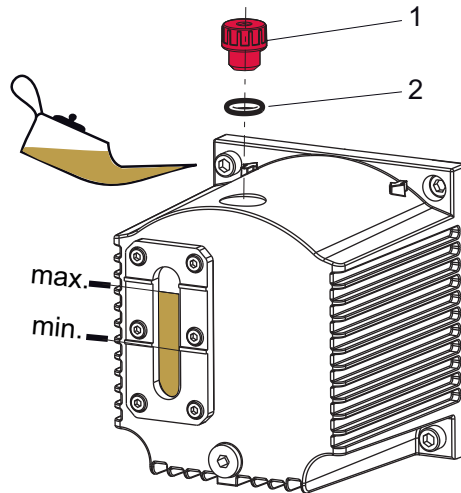


Fig. 14: Filling the operating fluid

- 1 Filler screw
- 2 O-ring

Required consumables

- Operating fluid of the vacuum pump

Required tools

- Allen key, **WAF 5**
- Calibrated torque wrench (tightening factor ≤ 2.5)

Filling the operating fluid

1. Unscrew the filler screw.
2. Fill the operating fluid according to the sight glass:
 - Fill level of the initial filling when the vacuum pump is cold: A maximum of 3/4 of the min./max. range.
3. Screw in the filler screw again.
 - Be careful with the O-ring.
 - Tightening torque: **max. 0.3 Nm**

6 Operation

6.1 Putting the vacuum pump into operation

WARNING

Danger of poisoning due to toxic process media escaping from the exhaust pipe

During operation with no exhaust line, the vacuum pump allows exhaust gases and vapors to escape freely into the air. There is a risk of injury and fatality due to poisoning in processes with toxic process media.

- ▶ Observe the pertinent regulations for handling toxic process media.
- ▶ Safely purge toxic process media via an exhaust line.
- ▶ Use appropriate filter equipment to separate toxic process media.

CAUTION

Danger of injury from bursting as a result of high pressure in the exhaust line

Faulty or inadequate exhaust pipes lead to dangerous situations, e.g. increased exhaust pressure. There is a danger of bursting. Injuries caused by flying fragments, the escaping of high pressure, and damage to the unit cannot be excluded.

- ▶ Route the exhaust line without shut-off units.
- ▶ Observe the permissible pressures and pressure differentials for the product.
- ▶ Check the function of the exhaust line on a regular basis.

Before switching on

1. Check the operating fluid in the sight glass.
2. Compare the voltage and frequency specifications on the motor rating plate with the available mains voltage and frequency.
3. Protect the vacuum pump from sucking in contaminants using suitable measures.
4. Check the operating fluid at regular intervals.
5. Check the exhaust connection for free passage (max. permissible pressure: 1500 hPa absolute).
6. Actuate the shut-off units so that the shut-off units open before or at the same time as the pump starts up.

6.2 Switching on the vacuum pump

CAUTION

Risk of injury from suction of body parts

After a power failure or a standstill as a result of overheating, the motor restarts automatically. There is a risk of minor injuries to fingers and hands (e.g. hematoma) from direct contact with the vacuum flange.

- ▶ Maintain sufficient distance to the vacuum flange during all work.
- ▶ Safely disconnect motor from the mains.
- ▶ Secure the motor against re-start.

CAUTION

Danger of burns on hot surfaces

Depending on the operating and ambient conditions, the surface temperature of the vacuum pump can increase to above 70 °C.

- ▶ Provide suitable touch protection.

NOTICE

Risk of damage to the drive from increased motor current consumption

At an intake pressure of approximately 300 hPa and under unfavorable operating conditions (such as for example exhaust side counterpressure), the power input exceeds the rated current.

- ▶ Limit the maximum power input of 1.5 times the rated current to max. 2 minutes (in accordance with EN 60034-1).



Cycle operation

Cycle operation with maximum 10 cycles per hour is possible.

Longer operating phases and short downtimes permit a functionally safe operating condition of the vacuum pump.

Operating Conditions

- The optimal operating condition of the vacuum pump is continuous operation.
- When pumping down dry gases, no special precautions are required.
- The lowest possible ultimate pressures can be achieved with the gas ballast valve closed.

Switching on the vacuum pump

1. If required, switch the vacuum pump on in each pressure range.
2. Switch the vacuum pump on at the mains switch, or, in the case of three phase motors, on site via a protective circuit.
3. Allow the vacuum pump to warm up prior to process start, with the vacuum flange closed, for approximately 30 minutes.

Check the operating fluid level

1. Regularly check the operating fluid level while the vacuum pump is running and at operating temperature.
2. Make sure that the level is in the area at the center of the sight glass.
3. Check the operating fluid fill level daily during continuous operation, and every time the vacuum pump is switched on.

6.3 Operating the rotary vane pump with gas ballast

NOTICE

Risk of damage from condensation in vacuum pump

During operation without gas ballast, condensation may form as a result of the vapor compatibility of the vacuum pump being exceeded.

- ▶ Pump condensable vapors only when the vacuum pump is warm and the gas ballast valve open.
- ▶ Allow the vacuum pump to run on after process end for another 30 minutes with the gas ballast valve open.
 - This cleans the operating fluid and protects the vacuum pump against corrosion.



No intermediate setting possible

An intermediate setting between open and closed is not possible.

The gas ballast valve periodically supplies air to the working chamber of the vacuum pump at the beginning of the compression phase. When pumping down vapors, this air prevents condensation within certain limits in the vacuum pump.

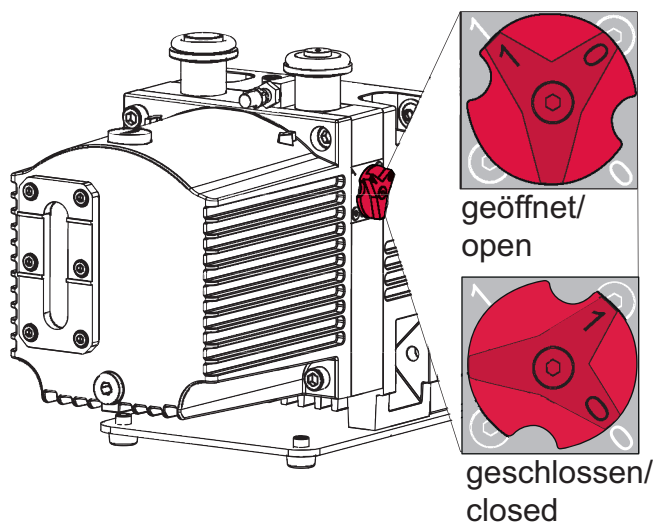


Fig. 15: Gas ballast valve

Behavior with process gases with condensable vapors

- ▶ Operate the vacuum pump with gas ballast, i.e. with the gas ballast valve open.

Open gas ballast valve

- ▶ Rotate knob on the gas ballast valve to the left to open, into position "1".

Close gas ballast valve

- ▶ Rotate the knob on the gas ballast valve to the right to close, into position "0".

6.4 Refilling operating fluid

⚠ WARNING

Danger of poisoning from toxic vapors

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

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

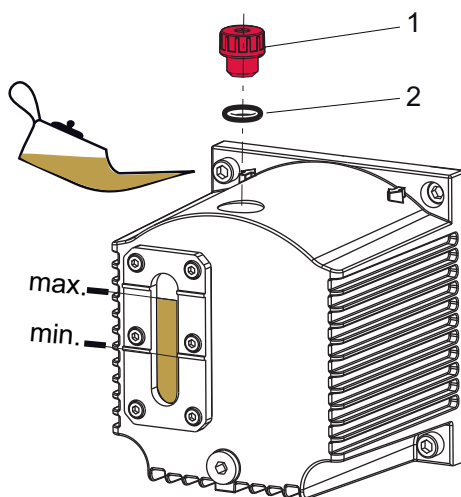


Fig. 16: Refilling operating fluid

- 1 Filler screw
- 2 O-ring

Required consumables

- Operating fluid of the vacuum pump

Required tools

- Allen key, **WAF 5**
- Calibrated torque wrench (tightening factor ≤ 2.5)



Refill during operation

Operating fluid can be refilled during operation in the final vacuum.

Procedure

1. Unscrew the filler screw.
2. Refill with operating fluid up to the top marking before the minimum fill level is reached.
3. Screw in the filler screw again.
 - Be careful with the O-ring.
 - Tightening torque: **0.3 Nm**

6.5 Switching off the vacuum pump

NOTICE

Contamination from operating fluid backflow

After the vacuum pump is switched off, there is a risk that the connected vacuum system can become contaminated by backflow. The safety valve on the vacuum pump is not suitable for longer-term sealing.

- ▶ Install an additional shut-off valve in the intake line.
- ▶ Shut off the intake line immediately after switching off the vacuum pump.

NOTICE

Contamination from operating fluid backflow

After the vacuum pump is switched off, there is a risk that the connected vacuum system can become contaminated by backflow.

- ▶ Vent the vacuum chamber, regardless of its size, within 30 seconds.
- ▶ Shut off the intake line with an additional shut-off valve, after the vacuum pump is switched off during longer venting operations.

Pfeiffer Vacuum rotary vane pumps have an integral vacuum safety valve on the intake side. The vacuum safety valve automatically closes from a differential pressure of ≥ 250 hPa between the exhaust and intake sides, when the vacuum pump is switched off, and vents the vacuum pump.

Procedure

1. If required, switch the vacuum pump off in each pressure range.
2. Switch the mains switch off or securely disconnect the drive motor from the mains.
3. Install an additional shut-off valve in the intake line to ensure that the vacuum is maintained in the vacuum chamber.

7 Maintenance

7.1 Maintenance instructions

WARNING

Health hazard through poisoning from toxic contaminated components or devices

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

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

CAUTION

Danger of injury from moving parts

After a power failure or a standstill as a result of overheating, the motor restarts automatically. There is a risk of injury to fingers and hands if they enter the operating range of rotating parts.

- ▶ Safely disconnect motor from the mains.
- ▶ Secure the motor against reactivation.
- ▶ Dismantle the vacuum pump for inspection, away from the system if necessary.

NOTICE

Danger of property damage from improper maintenance

Unprofessional work on the vacuum pump will lead to damage for which Pfeiffer Vacuum accepts no liability.

- ▶ We recommend taking advantage of our service training offering.
- ▶ When ordering spare parts, specify the information on the nameplate.

The following section describes the tasks for cleaning and maintaining the vacuum pump. More advanced works are described in the service instructions.

Prerequisites

- Vacuum pump switched off
- Vacuum pump vented to atmospheric pressure
- Vacuum pump cooled

Preparing maintenance

- ▶ Safely disconnect the drive motor from the mains.
- ▶ Secure the motor against switching back on.
- ▶ For maintenance work, only dismantle the vacuum pump to the extent needed.
- ▶ Dispose of used operating fluid according to applicable regulations in each case.
- ▶ When using synthetic operating fluid, please observe the associated application instructions.
- ▶ Only clean the pump parts using industrial alcohol, isopropanol or similar media.

7.2 Maintenance instructions for M or MC version magnetic coupling

WARNING

Danger of injury from strong magnetic field

There is a risk of injury for people with pacemakers and medical implants.

- ▶ Make sure that such individuals do not enter the sphere of influence (≤ 2 m) of the magnetic field.
- ▶ Identify rooms in which magnetic couplings are openly accessible with the symbol: **"No access for people with pacemakers"**.
- ▶ Always keep disassembled couplings away from computers, data carriers, and other electronic components.

This safety note applies to **drive system disassembly** in pump versions with magnetic coupling.

7.3 Checklist for inspection and maintenance



Notes on maintenance intervals

Depending on the process, the required maintenance intervals may be shorter than the reference values specified in the table.

- Consult with Pfeiffer Vacuum Service about shorter maintenance intervals for extreme loads or for specific processes.

You can carry out maintenance work at **Maintenance Level 1** yourself.

We recommend Pfeiffer Vacuum Service for carrying out maintenance work of **Maintenance Level 2** and **Maintenance Level 3** (revision). If the required intervals listed below are exceeded, or if maintenance work is carried out improperly, no warranty or liability claims are accepted on the part of Pfeiffer Vacuum. This also applies if original spare parts are not used.

Action	Inspection	Maintenance level 1	Maintenance level 2	Maintenance level 3	Required materials
Described in document	OI	OI	MM	MM	
Interval	daily	≤ yearly	≤ 2 years	≤ 4 years	
Inspection					
Visual and acoustic pump check Check operating fluid: <ul style="list-style-type: none"> • Check fill level • Check color (contamination) • Check vacuum pump for leaks 	■				
Check accessories (in accordance with respective operating instructions)	■				
Maintenance level 1 – operating fluid replacement					
Clean the outside of the vacuum pump: <ul style="list-style-type: none"> • Pump housing • Clean motor fan cap Changing the operating fluid		■			Operating fluid Maintenance kit 1
Additional activities: <ul style="list-style-type: none"> • Remove cap • Clean inside of cap and outside of pumping system (without cleaning agent) • Remove and clean gas ballast valve, replace wearing parts 		■ as required			
Replace filter in external accessory (where present), in accordance with the respective operating instructions		■ as required			
Maintenance level 2 – RSSR change					
<ul style="list-style-type: none"> • Partially dismantle the vacuum pump • Replace RSSR and coupling half Not applicable for vacuum pumps with magnetic coupling			■		Operating fluid RSSR set

Action	Inspection	Maintenance level 1	Maintenance level 2	Maintenance level 3	Required materials
Described in document	OI	OI	MM	MM	
Interval	daily	≤ yearly	≤ 2 years	≤ 4 years	
Additional activities: Dismantle and clean vacuum pump, replace seals and the following wear parts: <ul style="list-style-type: none"> • Wear parts, vacuum safety valve (hydraulic piston) • Wear parts, exhaust valve (valve flap) • Wear parts, gas ballast valve (valve flap) • Vane springs 			■ as required		Operating fluid Maintenance kit 2
Maintenance level 3 – overhaul					
Dismantle and clean vacuum pump, replace seals and all wear parts: <ul style="list-style-type: none"> • Vane • Valves, springs, and sight glass • Silencer nozzle 				■	Operating fluid Overhaul kit

Tbl. 7: Maintenance intervals

7.4 Changing the operating fluid

WARNING

Health hazard and risk of environmental damage from toxic contaminated operating fluid

Toxic process media can cause operating fluid contamination. When changing the operating fluid, there is a health hazard due to contact with poisonous substances. Illegal disposal of toxic substances causes environmental damage.

- ▶ Wear suitable personal protective equipment when handling these media.
- ▶ Dispose of the operating fluid according to locally applicable regulations.

CAUTION

Scalding from hot operating fluid

Danger of burns when draining operating fluid if it comes into contact with the skin.

- ▶ Wear protective equipment.
- ▶ Use a suitable collection vessel.



Pfeiffer Vacuum recommends determining the precise service life of the operating fluid in the first operating year.

The service life may deviate from the reference value specified depending on thermic and chemical loads, and the accumulation of suspended particles and condensate in the operating fluid.



Operating fluid type

Fundamentally, when filling, refilling, or changing operating fluid, you must always use the operating fluid type specified on the rating plate. Should process conditions change, you can convert to a different operating fluid type.



Safety data sheets

You can obtain the safety data sheets for operating fluids from Pfeiffer Vacuum on request, or from the [Pfeiffer Vacuum Download Center](#).

The service life of operating fluid is dependent on the area of application of the rotary vane vacuum pumps.

Instructions for when operating fluid should be changed

- The vacuum pump does not reach the specified ultimate pressure.
- Operating fluid is perceptibly polluted, milky, or cloudy when viewed through the sight glass.
- It is possible to detect thermal aging of the operating fluid from its color number (applies to mineral oils only).

7.4.1 Determine the degree of aging of P3 operating fluid

WARNING

Health hazard and risk of environmental damage from toxic contaminated operating fluid

Toxic process media can cause operating fluid contamination. When changing the operating fluid, there is a health hazard due to contact with poisonous substances. Illegal disposal of toxic substances causes environmental damage.

- ▶ Wear suitable personal protective equipment when handling these media.
- ▶ Dispose of the operating fluid according to locally applicable regulations.

You can determine the degree of aging of P3 operating fluid in clean processes using the color chart (in accordance with DIN 51578). The supplementary sheet with the document number PK0219 can be obtained from the [Pfeiffer Vacuum Download Center](#).

Prerequisites

- Vacuum pump switched off
- Vacuum pump is vented to atmospheric pressure on the suction side
- Vacuum pump cooled

Required aids

- Test tube
- Pipette with flexible hose
- Allen key, **WAF 8**
- Calibrated torque wrench (tightening factor ≤ 2.5)

Determine degree of aging of P3 operating fluid

1. Unscrew the filler screw.
 - Be careful with the O-ring.
2. Use the pipette to extract a sample of the operating fluid from the filling port.
3. Pour the sample into a test tube.
4. Check the sample in bright light.
5. If it is a reddish-brown color at the latest (corresponding with color identification number 5), change the operating fluid.
6. Screw in the filler screw.
 - Be careful with the O-ring.
 - Tightening torque: **6 Nm**

7.4.2 Changing the operating fluid

WARNING

Health hazard and risk of environmental damage from toxic contaminated operating fluid

Toxic process media can cause operating fluid contamination. When changing the operating fluid, there is a health hazard due to contact with poisonous substances. Illegal disposal of toxic substances causes environmental damage.

- ▶ Wear suitable personal protective equipment when handling these media.
- ▶ Dispose of the operating fluid according to locally applicable regulations.

⚠ CAUTION**Scalding from hot operating fluid**

Danger of burns when draining operating fluid if it comes into contact with the skin.

- ▶ Wear protective equipment.
- ▶ Use a suitable collection vessel.

**Cleaning by changing the operating fluid**

Pfeiffer Vacuum recommends, in cases of heavy contamination with process residues, cleaning the inside of the vacuum pump with several operating fluid changes.

Prerequisites

- Vacuum pump switched off
- Vacuum pump vented to atmospheric pressure
- Vacuum pump has cooled so that it can be touched
- Operating fluid still warm

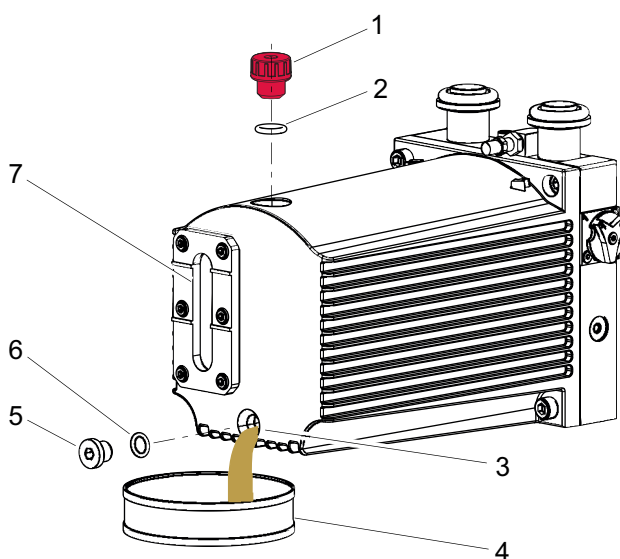


Fig. 17: Draining the operating fluid

- | | |
|---------------------|---------------|
| 1 Filler screw | 5 Drain screw |
| 2 O-ring | 6 O-ring |
| 3 Drain hole | 7 Sight glass |
| 4 Collection vessel | |

Required consumables

- Operating fluid of the vacuum pump

Required tools

- Allen key, **WAF 5**
- Calibrated torque wrench (tightening factor ≤ 2.5)

Required aids

- Collection vessel (> 0.5 l)

Draining the operating fluid

1. Unscrew the filler screw.
 - Be careful with the O-ring.
2. Place a collection vessel below the drain hole.
3. Unscrew the drain screw.
 - Be careful with the O-ring.
4. Allow operating fluid to drain into collection vessel.

Agitate remaining operating fluid

1. Screw in the filler screw.
 - Be careful with the O-ring.
2. Screw in the drain screw.
 - Be careful with the O-ring.
3. Switch on the vacuum pump with the vacuum flange open for a maximum of 5 seconds.

Drain remaining operating fluid

1. Unscrew the drain screw.
 - Be careful with the O-ring.
2. Gently tilt the vacuum pump.
3. Drain remaining operating fluid.
4. Screw in the drain screw.
 - Replace the O-ring.
 - Tightening torque: **6 Nm**
5. Dispose of old operating fluid according to applicable regulations.

Filling fresh operating fluid

1. Screw the drain screw in up to the stop.
 - Be careful with the O-ring.
 - Tightening torque: **6.0 Nm**
2. Fill new operating fluid.
3. Check level.
4. Screw the drain screw in completely.
 - Be careful with the O-ring.
 - Tightening torque: **0.3 Nm**

7.4.3 Rinsing and cleaning the rotary vane vacuum pump



Cleaning by changing the operating fluid

Pfeiffer Vacuum recommends, in cases of heavy contamination with process residues, cleaning the inside of the vacuum pump with several operating fluid changes.

Prerequisites

- Fresh operating fluid filled

Required tools

- Allen key, **WAF 5**
- Calibrated torque wrench (tightening factor ≤ 2.5)

Required aids

- Collection vessel (> 0.5 l)

Change operating fluid for cleaning

1. Operate the vacuum pump with the gas ballast open, until it is warm.
2. Perform an operating fluid change.
3. Check the pollution level and repeat the changing of the operating fluid if necessary.
4. Replace the corresponding filter elements wherever the accessory is installed.

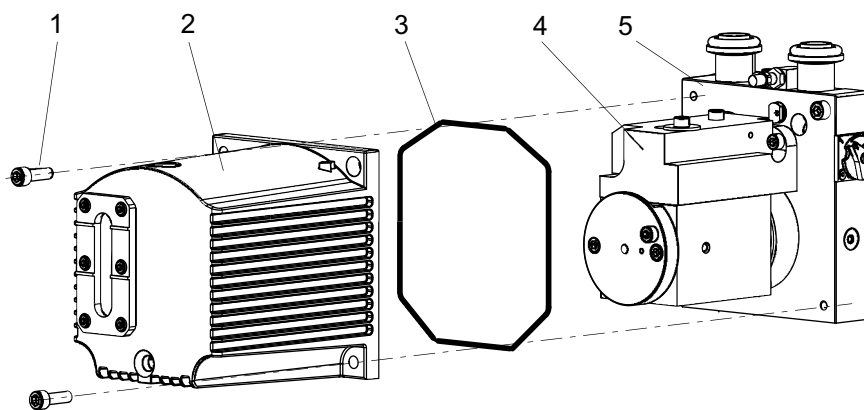


Fig. 18: Remove/fit rotary vane vacuum pump cap

- | | |
|-------------------------|------------------|
| 1 Allen head screw (2×) | 4 Pumping system |
| 2 Cap | 5 Stand |
| 3 O-ring | |

Remove the cap

1. Drain the operating fluid.
2. Unscrew both Allen head screws from the cap.
3. Remove the cap from the stand in axial direction.
 - Take care with the O-ring between cap and stand.
4. Collect any leaking operating fluid.
5. Dispose of operating fluid according to applicable regulations.

Cleaning the pumping system and cap

1. Clean the pumping system from the outside without cleaning agent.
2. Clean the cap from the inside without cleaning agent.

Install the cap

1. Insert the O-ring in the groove in the cap.
2. Install cap on stand.
3. Tighten both Allen head screws.
 - Tightening torque: **6.0 Nm**.
4. Screw in the operating fluid drain screw.
 - Be careful with the O-ring.
 - Tightening torque: **6.0 Nm**
5. Fill with operating fluid and check the fill level.
6. Screw in the operating fluid filler screw.
 - Be careful with the O-ring.
 - Tightening torque: **0.3 Nm**

7.5 Cleaning the gas ballast valve

The gas ballast valve is contaminated if the vacuum pump takes in ambient air containing dust.

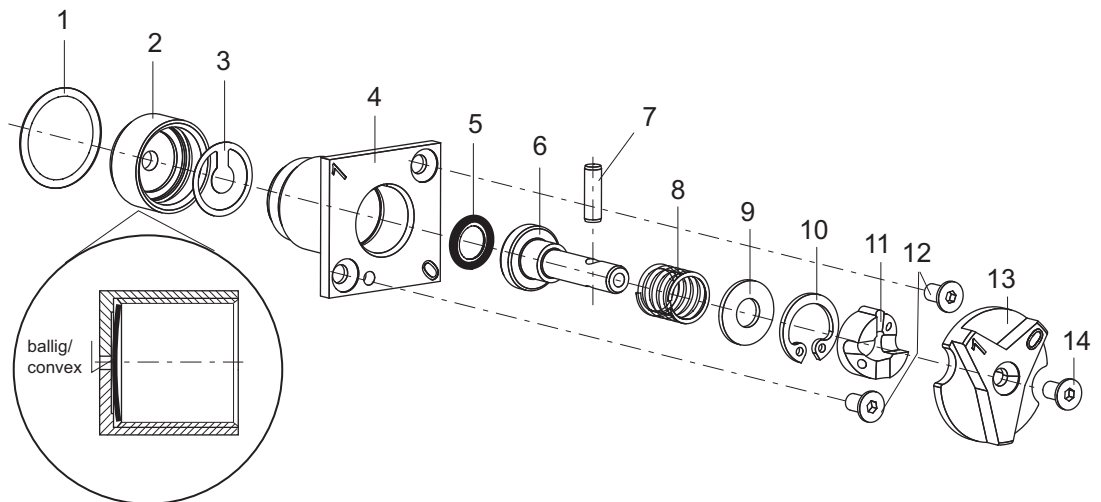


Fig. 19: Gas ballast valve

1 O-ring	8 Compression spring
2 Screw cap	9 Washer
3 Valve flap	10 Circlip
4 Valve housing	11 Cam plate
5 O-ring	12 Countersink screw (2x)
6 Tappet	13 Head
7 Cylinder bolt	14 Countersink screw

Required tools

- Allen key, **WAF 2**
- Circlip pliers, **J0**
- Calibrated torque wrench (tightening factor ≤ 2.5)

Dismantle gas ballast valve

1. Unscrew the countersink screws (2x).
2. Pull the valve housing out of the vacuum pump stand.
 - Be careful with the O-ring.
3. Unscrew the countersink screw the from the head.
4. Remove the head.
5. Unscrew the screw cap from the valve housing.
6. Watch out for the valve flap in the valve housing.
7. Pull the tappet far enough out of the valve housing so that you can pull out the cylinder bolt.
8. Using circlip pliers, remove the cam plate and the circlip.
9. Take care of the washer and the compression spring.
10. Remove tappet from valve housing.
 - Be careful with the O-ring.
11. Clean all parts and check the parts for wear.
12. Replace wear parts according to the maintenance set.

Assemble gas ballast valve

1. Determine the curve of the valve flap and place the valve flap in the screw cap with the curved side facing downwards.
2. Screw the screw cap and the valve housing hand tight.
3. Insert the O-ring in the groove in the tappet.
4. Insert the tappet in the valve housing.
5. Install the compression spring and the washer.
6. Install the circlip in the recess in the valve housing.
7. Slide cam plate onto tappet.
 - Take care with the longitudinal groove in the flange housing.
8. Pull out the tappet against the force of the spring and place the cylinder bolt in the bore.
9. Rotate the cam plate to move the tappet to the "1" position (open).
10. Install knob to tappet.
11. Tighten the countersunk head screw.
 - Tightening torque: **1.0 Nm**.

12. Install the complete valve with O-ring in the vacuum pump.
13. Tighten the countersunk head screws (2x).
 - Tightening torque: **1.0 Nm**.

7.6 Clean the gas ballast valve, corrosive gas version

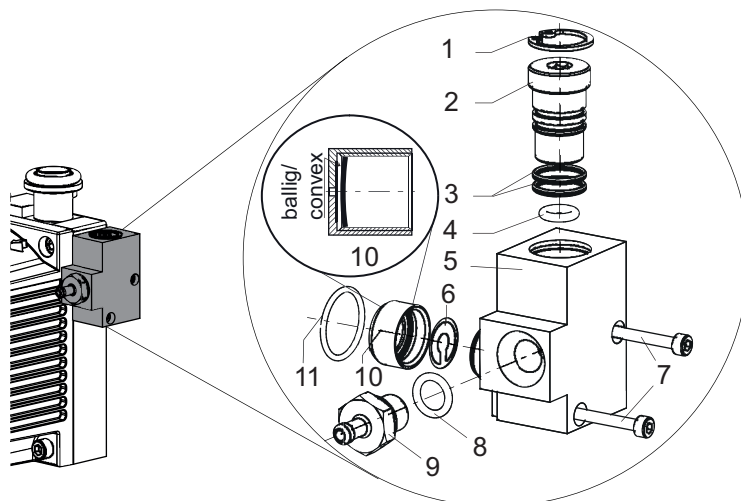


Fig. 20: Gas ballast valve with flushing gas connection

- | | |
|-----------------|-------------------|
| 1 Circlip | 7 Screw (2×) |
| 2 Spindle | 8 O-ring |
| 3 O-ring (2x) | 9 Hose connection |
| 4 O-ring | 10 Screw cap |
| 5 Valve housing | 11 O-ring |
| 6 Valve flap | |

Required tools

- Allen key, **WAF 2.5**
- Allen key, **WAF 5**
- Open-end wrench, **WAF 14**
- Circlip pliers, **J1**
- Calibrated torque wrench (tightening factor ≤ 2.5)

Remove the gas ballast valve with flushing gas connection

1. Dismantle the hose from the flushing gas supply line.
2. Disconnect the valve housing from the vacuum pump.
 - Be careful with the O-ring.
3. Unscrew the hose connection the from valve housing.
4. Unscrew the screw cap from the valve housing.
5. Remove the valve flap.
6. Dismantle the circlip using the circlip pliers.
7. Screw the spindle out of the valve housing.
 - Be careful with the O-rings.
8. Clean all parts.
 - Clean especially the bores in the valve housing.
9. Replace the parts according to the spare parts pack.



Assembly sequence

Observe the assembly sequence in order to prevent the Allen head screw from shearing:

1. Hose connection G 1/8" on the valve housing
2. Valve housing on the vacuum pump

Assemble the gas ballast valve with flushing gas connection

1. Determine the curve of the valve flap and place the valve flap in the screw cap with the curved side facing downwards.
2. Screw the screw cap and the valve housing hand tight.
3. Fit the G 1/8" hose connection onto the valve housing.
 - Tightening torque: **3.0 Nm**.
4. Slide the O-ring over the screw cap up to the stop.
5. Screw the valve housing to the vacuum pump.
6. Tighten the screws.
 - Tightening torque: **1.0 Nm**.
7. Fit the spindle in the valve housing.
8. Insert the circlip.

7.7 Changing the operating fluid type



Possibilities for changing the operating fluid type

The operating fluid type can be changed between mineral operating fluid – **P3** – and synthetic operating fluid – **D1** – only.

It is not possible to change from **P3/D1** to **F4/F5** or vice versa.

Required consumables

- 3 times the filling quantity of the new operating fluid

Changing the operating fluid type

1. Change the operating fluid with the new operating fluid **twice** in order to rinse the vacuum pump.
2. Clean any accessories if necessary, such as oil mist filter or oil return, and replace their filter elements.
3. Fill the vacuum pump with operating fluid to one third full.
4. Note the currently used operating fluid type at a suitable location on the vacuum pump, e.g. on the rating plate.

8 Decommissioning

8.1 Shutting down for longer periods

Before shutting down the vacuum pump, observe the following instructions to adequately protect the interior of the vacuum pump (suction chamber) from corrosion:

1. Switch off the vacuum pump.
2. Vent the vacuum pump.
3. Allow the vacuum pump to cool down.
4. Clean suction chamber.
5. Change the operating fluid.
6. Start the vacuum pump and take it up to operating temperature in order to wet the inside of the pumping system with fresh operating fluid.
7. Fill the vacuum pump to above the “**max.**” mark with operating fluid, up to the upper edge of the sight glass.
8. Seal the vacuum and fore-vacuum flanges as well as any other openings with blind flanges from the Pfeiffer Vacuum [accessories range](#).
9. Store the vacuum pump in dry, dust-free rooms, within the specified ambient conditions.
10. Pack the vacuum pump together with a drying agent in a plastic bag, and seal the vacuum pump airtight if it is to be stored in rooms with damp or aggressive atmospheres.
11. For longer storage periods (> 2 years), Pfeiffer Vacuum recommends changing the operating fluid again prior to recommissioning.

8.2 Recommissioning

NOTICE

Risk of damage to vacuum pump as a result of operating fluid aging

The operating fluid usability is limited (max. 2 years). Prior to recommissioning, following a shutdown of **2 years or more**, carry out the following work.

- ▶ Change the operating fluid.
- ▶ Change the radial shaft seal rings and other elastomer parts if required.
- ▶ Observe the maintenance instructions – consult Pfeiffer Vacuum if necessary.



Ejection of operating fluid

Overfilled operating fluid will be ejected at the exhaust connection when starting up the vacuum pump.

- Reduce the operating fluid level to the normal level before recommissioning.

8.3 Disposing of the vacuum pump

⚠ WARNING

Health hazard through poisoning from toxic contaminated components or devices

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

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

Procedure

- ▶ Dispose safely of all substances according to local regulations.

9 Malfunctions

⚠ CAUTION

Risk of injury from suction of body parts

After a power failure or a standstill as a result of overheating, the motor restarts automatically. There is a risk of minor injuries to fingers and hands (e.g. hematoma) from direct contact with the vacuum flange.

- ▶ Maintain sufficient distance to the vacuum flange during all work.
- ▶ Safely disconnect motor from the mains.
- ▶ Secure the motor against re-start.

⚠ CAUTION

Danger of burns on hot surfaces

In the event of a fault, the surface temperature of the vacuum pump can increase to above 105 °C.

- ▶ Allow the vacuum pump to cool down before carrying out any work.
- ▶ Wear personal protective equipment if necessary.

⚠ CAUTION

Danger of injury from moving parts

After a power failure or a standstill as a result of overheating, the motor restarts automatically. There is a risk of injury to fingers and hands if they enter the operating range of rotating parts.

- ▶ Safely disconnect motor from the mains.
- ▶ Secure the motor against reactivation.
- ▶ Dismantle the vacuum pump for inspection, away from the system if necessary.

NOTICE

Danger of property damage from improper maintenance

Unprofessional work on the vacuum pump will lead to damage for which Pfeiffer Vacuum accepts no liability.

- ▶ We recommend taking advantage of our service training offering.
- ▶ When ordering spare parts, specify the information on the nameplate.

Should malfunctions occur, you can find information about potential causes and how to fix them here:

Problem	Possible causes	Remedy
Vacuum pump will not start up	<ul style="list-style-type: none"> ● No mains voltage or voltage does not correspond to the motor data 	<ul style="list-style-type: none"> ● Check the mains voltage and mains fuse. ● Check the motor switch.
	<ul style="list-style-type: none"> ● Pump temperature too low 	<ul style="list-style-type: none"> ● Check the mains voltage and mains fuse. ● Check the motor switch.
	<ul style="list-style-type: none"> ● Thermal protection switch has triggered 	<ul style="list-style-type: none"> ● Determine and eliminate the cause. ● Allow the vacuum pump to cool down.
	<ul style="list-style-type: none"> ● Pumping system contaminated 	<ul style="list-style-type: none"> ● Clean the vacuum pump. ● Contact Pfeiffer Vacuum Service.
	<ul style="list-style-type: none"> ● Pumping system damaged 	<ul style="list-style-type: none"> ● Clean and maintain the vacuum pump. ● Contact Pfeiffer Vacuum Service.
	<ul style="list-style-type: none"> ● Motor faulty 	<ul style="list-style-type: none"> ● Replace the motor.

Problem	Possible causes	Remedy
Vacuum pump switches off after a while after being started	<ul style="list-style-type: none"> Thermal protection switch of the motor has triggered 	<ul style="list-style-type: none"> Determine and eliminate the cause of overheating. Allow the motor to cool down.
	<ul style="list-style-type: none"> Mains fuse triggered due to overload (e.g. cold start) 	<ul style="list-style-type: none"> Bring vacuum pump to permissible ambient temperature range.
	<ul style="list-style-type: none"> Exhaust pressure too high 	<ul style="list-style-type: none"> Check exhaust line outlet opening and exhaust side accessories.
Vacuum pump does not reach the specified ultimate pressure	<ul style="list-style-type: none"> Measurement result distorted 	<ul style="list-style-type: none"> Check the measurement instrument. Check the ultimate pressure without system connected.
	<ul style="list-style-type: none"> Vacuum pump or connected accessory contaminated 	<ul style="list-style-type: none"> Clean the vacuum pump. Check the components for contamination.
	<ul style="list-style-type: none"> Operating fluid contaminated 	<ul style="list-style-type: none"> Operate the vacuum pump for an extended period of time with gas ballast valve open, or change the operating fluid.
	<ul style="list-style-type: none"> Operating fluid level too low 	<ul style="list-style-type: none"> Top up the operating fluid.
	<ul style="list-style-type: none"> Leak in system 	<ul style="list-style-type: none"> Locate and eliminate the leak.
	<ul style="list-style-type: none"> Vacuum pump is damaged 	<ul style="list-style-type: none"> Contact Pfeiffer Vacuum Service.
Pumping speed of vacuum pump too low	<ul style="list-style-type: none"> The intake line is not suitably dimensioned 	<ul style="list-style-type: none"> Make sure that connections are short and cross sections adequately dimensioned.
	<ul style="list-style-type: none"> Exhaust pressure too high 	<ul style="list-style-type: none"> Check exhaust line outlet opening and exhaust side accessories.
Loss of operating fluid	<ul style="list-style-type: none"> Casing seal is leaking 	<ul style="list-style-type: none"> Check and replace the seal.
	<ul style="list-style-type: none"> Radial shaft seal ring (RSSR) leaking – not applicable to vacuum pumps with magnetic coupling 	<ul style="list-style-type: none"> Check and replace the RSSR. Check and replace the associated bushing as well.
	<ul style="list-style-type: none"> Operational operating fluid loss – no oil mist filter 	<ul style="list-style-type: none"> Install ONF/OME.
Unusual noises during operation	<ul style="list-style-type: none"> Noise reduction is contaminated 	<ul style="list-style-type: none"> Clean the noise reduction or replace it.
	<ul style="list-style-type: none"> Pumping system is contaminated or damaged 	<ul style="list-style-type: none"> Clean and maintain the vacuum pump. Contact Pfeiffer Vacuum Service.
	<ul style="list-style-type: none"> Motor bearing is faulty 	<ul style="list-style-type: none"> Change the motor. Contact Pfeiffer Vacuum Service.

Tbl. 8: Troubleshooting for rotary vane pumps

10 Service solutions from Pfeiffer Vacuum

We offer first class service

Long vacuum component service life, coupled with low downtimes, are clear expectations that you have of us. We satisfy your needs with capable products and outstanding service.

We are consistently striving to perfect our core competence, service for vacuum components. And our service is far from over once you've purchased a product from Pfeiffer Vacuum. It often enough really just begins then. In proven Pfeiffer Vacuum quality, of course.

Our professional sales engineers and service technicians stand ready to provide hands-on support to you worldwide. Pfeiffer Vacuum offers a complete portfolio of service offerings, ranging from genuine spare parts right through to service agreements.

Take advantage of Pfeiffer Vacuum Service

Whether for preventative on-site service from our field service, fast replacement with as-new replacement products or repair in a Service Center close to you; you have various options for upholding your equipment availability. Detailed information and addresses can be found on our website in the Pfeiffer Vacuum Service section.

Advice on the optimum solution is available from your Pfeiffer Vacuum contact partner. For quick and smooth handling of the service process, we recommend the following steps:



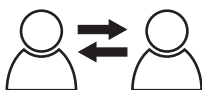
1. Download the current form templates.
 - Declaration of Service Request
 - Service Request
 - Declaration of Contamination



- a) Dismantle all accessories and keep them (all external mounted parts as valve, inlet screen, etc.).
 - b) Drain the operating fluid/lubricant as necessary.
 - c) Drain the cooling medium as necessary.
2. Fill out the service request and the declaration of contamination.



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

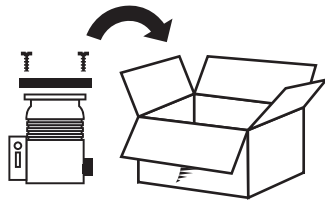


4. You will receive a response from Pfeiffer Vacuum.

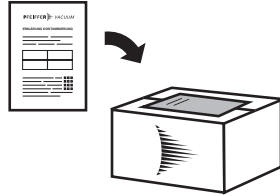
PFEIFFER VACUUM

Sending of contaminated products

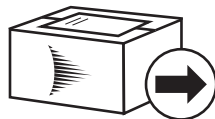
No units will be accepted if they are contaminated with micro-biological, explosive or radioactive substances. If products are contaminated or if the declaration of contamination is missing, Pfeiffer Vacuum will contact the customer before starting maintenance. In addition, depending on the product and the level of contamination **additional decontamination costs** may be required.



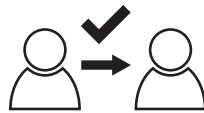
5. Prepare the product for transport in accordance with the details in the declaration of contamination.
 - a) Neutralize the product with nitrogen or dry air.
 - b) Close all openings with airtight blank flanges.
 - c) Seal the product in appropriate protective film.
 - d) Only pack the product in suitable, stable transport containers.
 - e) Observe the applicable transport conditions.



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



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



8. You will receive a confirmation message/a quotation from Pfeiffer Vacuum.

PFEIFFER VACUUM

For all service orders, our General Terms and Conditions of Sales and Supply and General Terms and Conditions of Repair and Maintenance apply to vacuum equipment and components.

11 Spare parts

11.1 Ordering spare parts packs

Procedure

1. Have the vacuum pump part number to hand, along with other details from the rating plate if necessary.
2. Install original spare parts only.

Spare parts pack	Pump version	Article no.:
Maintenance kit 1 – maintenance level 1	Standard, M/MC version	PK E01 050 CT
Radial shaft seal ring set – maintenance level 2	Standard	PK E06 100 CT
Maintenance kit 2 – maintenance level 2, extended ¹⁾	Standard	PK E01 042 CT
Maintenance kit 2 – maintenance level 2, extended ²⁾	M/MC version	PK E01 043 CT
Overhaul kit – maintenance level 3	Standard	PK E02 042 CT
	M version	PK E02 043 CT
	MC version	PK E02 055 -T
Set of vanes	Standard, M version	PK E08 031 -T
	MC version	PK E08 035 -T
Coupling set	M version	PK E06 011 -T
	MC version	PK E06 012 -T

Tbl. 9: Spare parts packs

11.2 Maintenance kit 1 – maintenance level 1

Maintenance kit 1 contains:

- Filler and drain screw seals for one operating fluid change
- Cap seal for cleaning oil chamber
- Seals and consumables for cleaning gas ballast valve

11.3 Radial shaft seal ring set – Maintenance level 2

The radial shaft seal ring set contains all parts for changing the seal ring and operating fluid:

- RSSR, coupling and felt ring
- Seals for changing the operating fluid
- Wear parts of the gas ballast valve

11.4 Maintenance kit 2 – Maintenance level 2, extended

Maintenance kit 2 contains all **relevant wear parts**, that have to be replaced after dismantling and cleaning the vacuum pump:

- Set of seals
- Wear parts of the gas ballast valve
- RSSR, coupling and felt ring
- Valves and vane springs

11.5 Overhaul kit – Maintenance level 3

The overhaul kit contains all the **wear parts** of the vacuum pump, which must be replaced after the vacuum pump has been dismantled and cleaned:

-
- 1) including radial shaft seal ring
 - 2) without radial shaft seal ring

- Set of seals
- Wear parts of the pumping system (including vane and springs)
- Wear parts of the vacuum safety valve
- Wear parts of the gas ballast valve

11.6 Set of vanes

The set of vanes contains:

- Vane
- Vane springs

11.7 Coupling set for versions with magnetic coupling

The coupling set contains:

- Both coupling halves
- Containment shell with O-ring

12 Accessories



View the [range of accessories for rotary vane pumps](#) on our website.

12.1 Accessory information

Condensate separator

Protects the pump from liquids from inlet line or backflow from exhaust line

Oil mist filter

Prevents emission of oil mist

Oil return

Transports separated operating fluid back from OME to rotary vane pump

Dust separator

Protects the pump from particles out of processes

Zeolite trap

Prevents operating fluid backflow on the intake side

Process monitoring unit

Monitors operating fluid level/temperature and exhaust pressure

Gas ballast valve - conversion kit with hose nozzle

Enables connection of inert gas

Gas ballast valve with solenoid valve

To replace a standard gas ballast valve

12.2 Ordering accessories

Description	Order no.	
	Standard M version	MC version
KAS 16, Condensate Separator	PK Z10 003	-
OME 16 S, Oil Mist Separator	PK Z40 000	-
OME 16 M, Oil Mist Separator	PK Z40 003	-
OME 16 C, Oil Mist Separator	-	PK Z40 400
Oil Return Unit from OME 16 S/16 C	PK 005 986 -T	PK 005 986 -T
Oil Return Unit from OME 16 M	PK 006 080 -T	-
ZFO 16, Zeolite Trap	PK Z70 003	-
SAS 16, DN 16 ISO-KF	PK Z60 506	-
Operations Monitoring Unit 1	PK 196 148 -T	PK 196 148 -T
Operations Monitoring Unit 2	PK 196 147 -T	PK 196 147 -T
Operations Monitoring Unit 3	PK 196 146 -T	PK 196 146 -T
Mains Cable, 230 V, with Safety Plug, Right Angle, Euro C13 Socket	PK 050 109	PK 050 109
Mains Cable, 115 V, with NEMA Plug, right angle Euro C13 Socket	PK 050 110	PK 050 110
Mains Cable, 115/230 V, without Plug, IEC 320/C13 Socket (Right Angle)	PK 050 111	PK 050 111
Gas ballast Valve with Dosing Spindle and Inert Gas Connection	PK 195 666 -U	-

Description	Order no.	
	Standard M version	MC version
Gas Ballast Valve with Solenoid Valve	PK 194 343 -U	PK 194 343 -U
Blank Flange, Gas Ballast Valve	PK 007 002 -T	PK 007 002 -T

Tbl. 10: Accessories

Consumables for Duo 11, Duo 11 M and Duo 11 MC	Order no.
P3, mineral oil, 0.5 l	PK 001 136 -T
P3, mineral oil, 1 l	PK 001 106 -T
F4, perfluoropolyether, 0.25 l	PK 005 885 -T
F4, perfluoropolyether, 0.5 l	PK 005 886 -T

Tbl. 11: Consumables

13 Technical data and dimensions

13.1 General

Basis for the technical data of Pfeiffer Vacuum rotary vane pumps:

- Specifications according to PNEUROP committee PN5
- ISO 21360-1: 2016: "Vacuum technology - Standard methods for measuring vacuum-pump performance - Part 1: General description"
- Leak test to ascertain the integral leakage rate according to EN 1779: 1999 technique A1; with 20 % helium concentration, 10 s measurement duration
- Sound pressure level according to ISO 3744, class 2

	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. 12: Conversion table: Pressure units

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

Tbl. 13: Conversion table: Units for gas throughput

13.2 Substances in contact with the media

Pump parts	Substances in contact with the media	Standard	M version	MC version
Housing	Aluminum	X	X	X
Inlet/exhaust flange	Stainless steel	X	X	X
Sight glass	Float glass	X	X	X
Stator/stator flange	Cast iron	X	X	X
Rotor	Cast iron (nodular graphite cast iron)	X	X	X
Coupling system	Steel	X	-	-
Magnetic coupling	Steel, nickel-coated magnets	-	X	X
Vane	Artificial resin compound, polymer	X	X	-
	Composite material, polymer	-	-	X
Exhaust valve	Stainless steel	X	X	X
Vacuum safety valve	Aluminum, FKM, steel	X	X	X
Screws	Galvanized steel, stainless steel	X	X	X
Seals	FPM	X	X	X

Pump parts	Substances in contact with the media	Standard	M version	MC version
Radial shaft seal ring (RSSR)	FPM	X	-	-
Containment shell	Synthetic	-	X	X

Tbl. 14: Materials that make contact with the process media

13.3 Technical data

Classification	Duo 6	Duo 6	Duo 6
Order number	PK D58 602	PK D58 707	PK D58 709
Flange (in)	DN 16 ISO-KF	DN 16 ISO-KF	DN 16 ISO-KF
Flange (out)	DN 16 ISO-KF	DN 16 ISO-KF	DN 16 ISO-KF
Pumping speed at 50 Hz	5 m ³ /h	5 m ³ /h	5 m ³ /h
Pumping speed at 60 Hz	6 m ³ /h	6 m ³ /h	6 m ³ /h
Ultimate pressure with gas ballast	3 · 10 ⁻² hPa	3 · 10 ⁻² hPa	3 · 10 ⁻² hPa
Ultimate pressure without gas ballast	3 · 10 ⁻³ hPa	3 · 10 ⁻³ hPa	3 · 10 ⁻³ hPa
Gas ballast pressure	≤ 1500 hPa	≤ 1500 hPa	≤ 1500 hPa
Gas ballast flow	540 l/h	540 l/h	540 l/h
Exhaust pressure, min.	Atmospheric pressure	Atmospheric pressure	Atmospheric pressure
Exhaust pressure, max.	1500 hPa	1500 hPa	1500 hPa
Leak rate safety valve	≤ 1 · 10 ⁻⁵ Pa m ³ /s	≤ 1 · 10 ⁻⁵ Pa m ³ /s	≤ 1 · 10 ⁻⁵ Pa m ³ /s
Water vapor capacity 50 Hz	110 g/h	110 g/h	110 g/h
Water vapor capacity 60 Hz	170 g/h	170 g/h	170 g/h
Water vapor tolerance at 50 Hz	30 hPa	30 hPa	30 hPa
Water vapor tolerance at 60 Hz	40 hPa	40 hPa	40 hPa
Emission sound pressure level without gas ballast at 50 Hz	51 dB(A)	51 dB(A)	51 dB(A)
Emission sound pressure level without gas ballast at 60 Hz	54 dB(A)	54 dB(A)	54 dB(A)
Motor protection	Bimetal	Bimetal	Bimetal
Motor version	3-ph motor	1-ph motor	1-ph motor
Input voltage 50 Hz	230 / 400 V	100 – 110 V	200 – 240 V
Input voltage 60 Hz	265 / 460 V	100 – 120 V	200 – 240 V
Mains requirement: voltage (range)	±5 %	±10 %	±10 %
Rotation speed at 50 Hz	3000 rpm	3000 rpm	3000 rpm
Rotation speed at 60 Hz	3600 rpm	3600 rpm	3600 rpm
Rated power 50 Hz	0.15 kW	0.2 kW	0.25 kW
Rated power 60 Hz	0.18 kW	0.24 kW	0.3 kW
Recommended mains fuse capacity	–	16 A	6 A
Mains cable	No	No, C14-plug inside the terminal box	No, C14-plug inside the terminal box
Cooling method, standard	Air	Air	Air
Continuous gas temperature, max.	40 °C	40 °C	40 °C
Ambient temperature	12 – 40 °C	12 – 40 °C	12 – 40 °C
Transport and storage temperature	-25 – 55 °C	-25 – 55 °C	-25 – 55 °C
Protection category	IP55	IP40	IP 40

Classification	Duo 6	Duo 6	Duo 6
Operating fluid	P3	P3	P3
Operating fluid filling	0.5 l	0.5 l	0.5 l
Weight	9.8 kg	15.3 kg	13 kg

Tbl. 15: Technical data, Duo 6

Classification	Duo 6	Duo 6	Duo 6
Order number	PK D58 710	PK D58 711	PK D58 712
Flange (in)	DN 16 ISO-KF	DN 16 ISO-KF	DN 16 ISO-KF
Flange (out)	DN 16 ISO-KF	DN 16 ISO-KF	DN 16 ISO-KF
Pumping speed at 50 Hz	5 m ³ /h	5 m ³ /h	5 m ³ /h
Pumping speed at 60 Hz	6 m ³ /h	6 m ³ /h	6 m ³ /h
Ultimate pressure with gas ballast	3 · 10 ⁻² hPa	3 · 10 ⁻² hPa	3 · 10 ⁻² hPa
Ultimate pressure without gas ballast	3 · 10 ⁻³ hPa	3 · 10 ⁻³ hPa	3 · 10 ⁻³ hPa
Gas ballast pressure	≤ 1500 hPa	≤ 1500 hPa	≤ 1500 hPa
Gas ballast flow	540 l/h	540 l/h	540 l/h
Exhaust pressure, min.	Atmospheric pressure	Atmospheric pressure	Atmospheric pressure
Exhaust pressure, max.	1500 hPa	1500 hPa	1500 hPa
Leak rate safety valve	≤ 1 · 10 ⁻⁵ Pa m ³ /s	≤ 1 · 10 ⁻⁵ Pa m ³ /s	≤ 1 · 10 ⁻⁵ Pa m ³ /s
Water vapor capacity 50 Hz	110 g/h	110 g/h	110 g/h
Water vapor capacity 60 Hz	170 g/h	170 g/h	170 g/h
Water vapor tolerance at 50 Hz	30 hPa	30 hPa	30 hPa
Water vapor tolerance at 60 Hz	40 hPa	40 hPa	40 hPa
Emission sound pressure level without gas ballast at 50 Hz	51 dB(A)	51 dB(A)	51 dB(A)
Emission sound pressure level without gas ballast at 60 Hz	54 dB(A)	54 dB(A)	54 dB(A)
Motor protection	Bimetal	Bimetal	Bimetal
Motor version	1-ph motor	1-ph motor	1-ph motor
Input voltage 50 Hz	100 / 200 V	115 / 230 V	230 – 240 V
Input voltage 60 Hz	100 / 200 V	115 / 230 V	230 – 240 V
Mains requirement: voltage (range)	±10 %	±10 %	±10 %
Rotation speed at 50 Hz	3000 rpm	3000 rpm	3000 rpm
Rotation speed at 60 Hz	3600 rpm	3600 rpm	3600 rpm
Rated power 50 Hz	0.25 kW	0.25 kW	0.2 kW
Rated power 60 Hz	0.3 kW	0.3 kW	0.24 kW
Recommended mains fuse capacity	16 / 6 A	16 / 6 A	6 A
Mains cable	No, C14-plug inside the terminal box	No, C14-plug inside the terminal box	No, C14-plug inside the terminal box
Cooling method, standard	Air	Air	Air
Continuous gas temperature, max.	40 °C	40 °C	40 °C
Ambient temperature	12 – 40 °C	12 – 40 °C	12 – 40 °C
Transport and storage temperature	-25 – 55 °C	-25 – 55 °C	-25 – 55 °C
Protection category	IP 40	IP40	IP40
Operating fluid	P3	P3	P3

Classification	Duo 6	Duo 6	Duo 6
Operating fluid filling	0.5 l	0.5 l	0.5 l
Weight	15.2 kg	15.2 kg	14.8 kg

Tbl. 16: Technical data, Duo 6

Classification	Duo 6 M	Duo 6 M	Duo 6 M
Order number	PK D58 107	PK D58 109	PK D58 110
Flange (in)	DN 16 ISO-KF	DN 16 ISO-KF	DN 16 ISO-KF
Flange (out)	DN 16 ISO-KF	DN 16 ISO-KF	DN 16 ISO-KF
Pumping speed at 50 Hz	5 m ³ /h	5 m ³ /h	5 m ³ /h
Pumping speed at 60 Hz	6 m ³ /h	6 m ³ /h	6 m ³ /h
Ultimate pressure with gas ballast	$3 \cdot 10^{-2}$ hPa	$3 \cdot 10^{-2}$ hPa	$3 \cdot 10^{-2}$ hPa
Ultimate pressure without gas ballast	$3 \cdot 10^{-3}$ hPa	$3 \cdot 10^{-3}$ hPa	$3 \cdot 10^{-3}$ hPa
Gas ballast pressure	≤ 1500 hPa	≤ 1500 hPa	≤ 1500 hPa
Gas ballast flow	540 l/h	540 l/h	540 l/h
Exhaust pressure, min.	250 hPa	250 hPa	250 hPa
Exhaust pressure, max.	1500 hPa	1500 hPa	1500 hPa
Leak rate safety valve	≤ $1 \cdot 10^{-5}$ Pa m ³ /s	≤ $1 \cdot 10^{-5}$ Pa m ³ /s	≤ $1 \cdot 10^{-5}$ Pa m ³ /s
Water vapor capacity 50 Hz	110 g/h	110 g/h	110 g/h
Water vapor capacity 60 Hz	170 g/h	170 g/h	170 g/h
Water vapor tolerance at 50 Hz	30 hPa	30 hPa	30 hPa
Water vapor tolerance at 60 Hz	40 hPa	40 hPa	40 hPa
Emission sound pressure level without gas ballast at 50 Hz	51 dB(A)	± 51 dB(A)	± 51 dB(A)
Emission sound pressure level without gas ballast at 60 Hz	54 dB(A)	54 dB(A)	54 dB(A)
Motor protection	Bimetal	Bimetal	Bimetal
Motor version	1-ph motor	1-ph motor	1-ph motor
Input voltage 50 Hz	100 – 110 V	200 – 240 V	100 / 200 V
Input voltage 60 Hz	100 – 120 V	200 – 240 V	100 / 200 V
Mains requirement: voltage (range)	±10 %	±10 %	±10 %
Rotation speed at 50 Hz	3000 rpm	3000 rpm	3000 rpm
Rotation speed at 60 Hz	3600 rpm	3600 rpm	3600 rpm
Rated power 50 Hz	0.2 kW	0.25 kW	0.25 kW
Rated power 60 Hz	0.24 kW	0.3 kW	0.3 kW
Recommended mains fuse capacity	16 A	6 A	16 / 6 A
Mains cable	No, C14-plug inside the terminal box	No, C14-plug inside the terminal box	No, C14-plug inside the terminal box
Cooling method, standard	Air	Air	Air
Continuous gas temperature, max.	40 °C	40 °C	40 °C
Ambient temperature	12 – 40 °C	12 – 40 °C	12 – 40 °C
Transport and storage temperature	-25 – 55 °C	-25 – 55 °C	-25 – 55 °C
Protection category	IP40	IP 40	IP 40
Operating fluid	P3	P3	P3

Classification	Duo 6 M	Duo 6 M	Duo 6 M
Operating fluid filling	0.5 l	0.5 l	0.5 l
Weight	16.5 kg	14.2 kg	16.4 kg

Tbl. 17: Technical data, Duo 6 M

Classification	Duo 6 M	Duo 6 M	Duo 6 M
Order number	PK D58 111	PK D58 112	PK D58 152
Flange (in)	DN 16 ISO-KF	DN 16 ISO-KF	DN 16 ISO-KF
Flange (out)	DN 16 ISO-KF	DN 16 ISO-KF	DN 16 ISO-KF
Pumping speed at 50 Hz	5 m ³ /h	5 m ³ /h	5 m ³ /h
Pumping speed at 60 Hz	6 m ³ /h	6 m ³ /h	6 m ³ /h
Ultimate pressure with gas ballast	3 · 10 ⁻² hPa	3 · 10 ⁻² hPa	3 · 10 ⁻² hPa
Ultimate pressure without gas ballast	3 · 10 ⁻³ hPa	3 · 10 ⁻³ hPa	3 · 10 ⁻³ hPa
Gas ballast pressure	≤ 1500 hPa	≤ 1500 hPa	≤ 1500 hPa
Gas ballast flow	540 l/h	540 l/h	540 l/h
Exhaust pressure, min.	250 hPa	250 hPa	250 hPa
Exhaust pressure, max.	1500 hPa	1500 hPa	1500 hPa
Leak rate safety valve	≤ 1 · 10 ⁻⁵ Pa m ³ /s	≤ 1 · 10 ⁻⁵ Pa m ³ /s	≤ 1 · 10 ⁻⁵ Pa m ³ /s
Water vapor capacity 50 Hz	110 g/h	110 g/h	110 g/h
Water vapor capacity 60 Hz	170 g/h	170 g/h	170 g/h
Water vapor tolerance at 50 Hz	30 hPa	30 hPa	30 hPa
Water vapor tolerance at 60 Hz	40 hPa	40 hPa	40 hPa
Emission sound pressure level without gas ballast at 50 Hz	51 dB(A)	51 dB(A)	51 dB(A)
Emission sound pressure level without gas ballast at 60 Hz	54 dB(A)	54 dB(A)	54 dB(A)
Motor protection	Bimetal	Bimetal	Bimetal
Motor version	1-ph motor	1-ph motor	3-ph motor
Input voltage 50 Hz	115 / 230 V	230 – 240 V	230 / 400 V
Input voltage 60 Hz	115 / 230 V	230 – 240 V	265 / 460 V
Mains requirement: voltage (range)	±10 %	±10 %	±5 %
Rotation speed at 50 Hz	3000 rpm	3000 rpm	3000 rpm
Rotation speed at 60 Hz	3600 rpm	3600 rpm	3600 rpm
Rated power 50 Hz	0.25 kW	0.2 kW	0.15 kW
Rated power 60 Hz	0.3 kW	0.24 kW	0.18 kW
Recommended mains fuse capacity	16 / 6 A	6 A	–
Mains cable	No, C14-plug inside the terminal box	No, C14-plug inside the terminal box	No
Cooling method, standard	Air	Air	Air
Continuous gas temperature, max.	40 °C	40 °C	40 °C
Ambient temperature	12 – 40 °C	12 – 40 °C	12 – 40 °C
Transport and storage temperature	-25 – 55 °C	-25 – 55 °C	-25 – 55 °C
Protection category	IP40	IP40	IP55
Operating fluid	P3	P3	P3
Operating fluid filling	0.5 l	0.5 l	0.5 l
Weight	16.4 kg	16 kg	11 kg

Tbl. 18: Technical data, Duo 6 M

Classification	Duo 6 MC
Order number	PK D58 211
Flange (in)	DN 16 ISO-KF
Flange (out)	DN 16 ISO-KF
Pumping speed at 50 Hz	5 m ³ /h
Pumping speed at 60 Hz	6 m ³ /h
Ultimate pressure with gas ballast	$\leq 5 \cdot 10^{-2}$ hPa
Ultimate pressure without gas ballast	$\leq 6 \cdot 10^{-3}$ hPa
Gas ballast pressure	≤ 1500 hPa
Gas ballast flow	540 l/h
Exhaust pressure, min.	250 hPa
Exhaust pressure, max.	1500 hPa
Leak rate safety valve	$\leq 1 \cdot 10^{-5}$ Pa m ³ /s
Emission sound pressure level without gas ballast at 50 Hz	51 dB(A)
Emission sound pressure level without gas ballast at 60 Hz	54 dB(A)
Motor protection	Bimetal
Motor version	1-ph motor
Input voltage 50 Hz	115 / 230 V
Input voltage 60 Hz	115 / 230 V
Mains requirement: voltage (range)	± 10 %
Rotation speed at 50 Hz	3000 rpm
Rotation speed at 60 Hz	3600 rpm
Rated power 50 Hz	0.25 kW
Rated power 60 Hz	0.3 kW
Recommended mains fuse capacity	16 / 6 A
Mains cable	No, C14-plug inside the terminal box
Cooling method, standard	Air
Continuous gas temperature, max.	40 °C
Ambient temperature	12 – 40 °C
Transport and storage temperature	-25 – 55 °C
Protection category	IP40
Operating fluid	F4
Operating fluid filling	0.5 l
Weight	16.4 kg

Tbl. 19: Technical data, Duo 6 MC

13.4 Dimensions

Dimensions in mm

13.4.1 Standard version

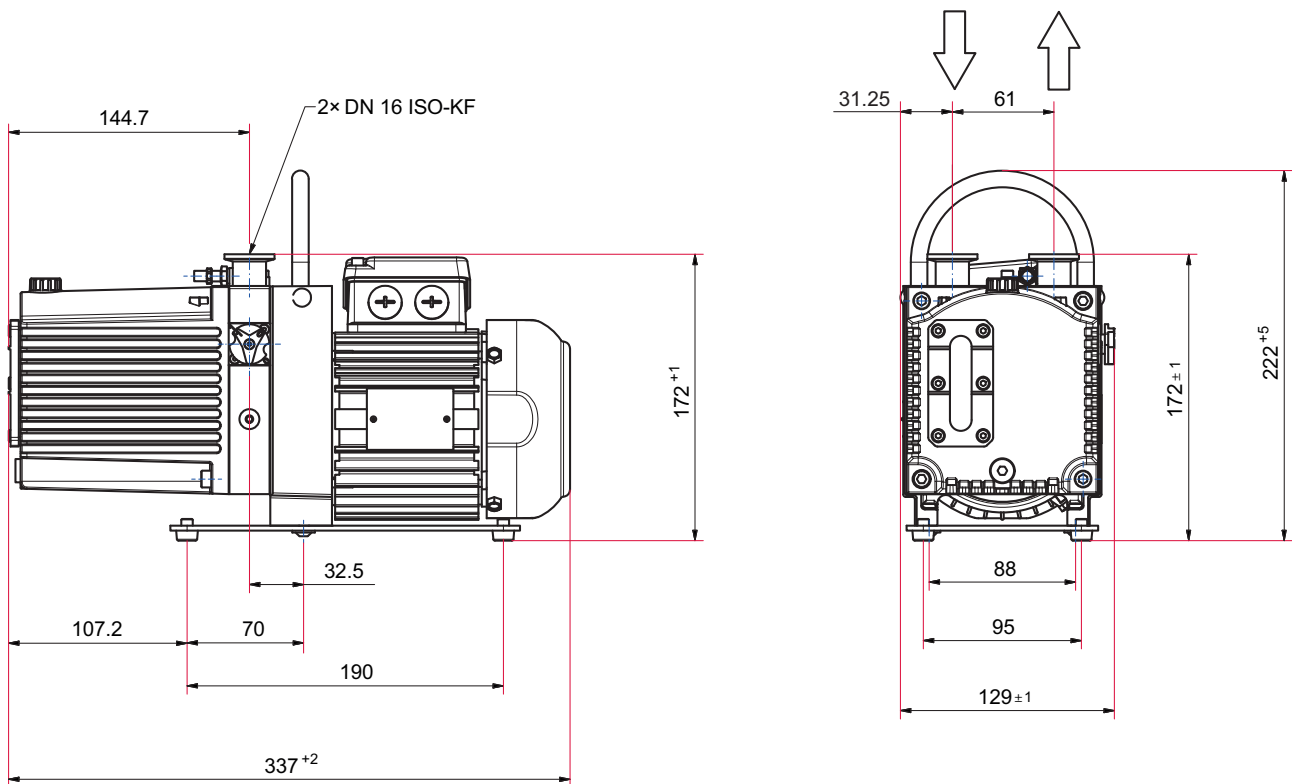


Fig. 21: Dimensions Duo 6, 230/400 V, 50 Hz | 265/460 V, 60 Hz, 1TF

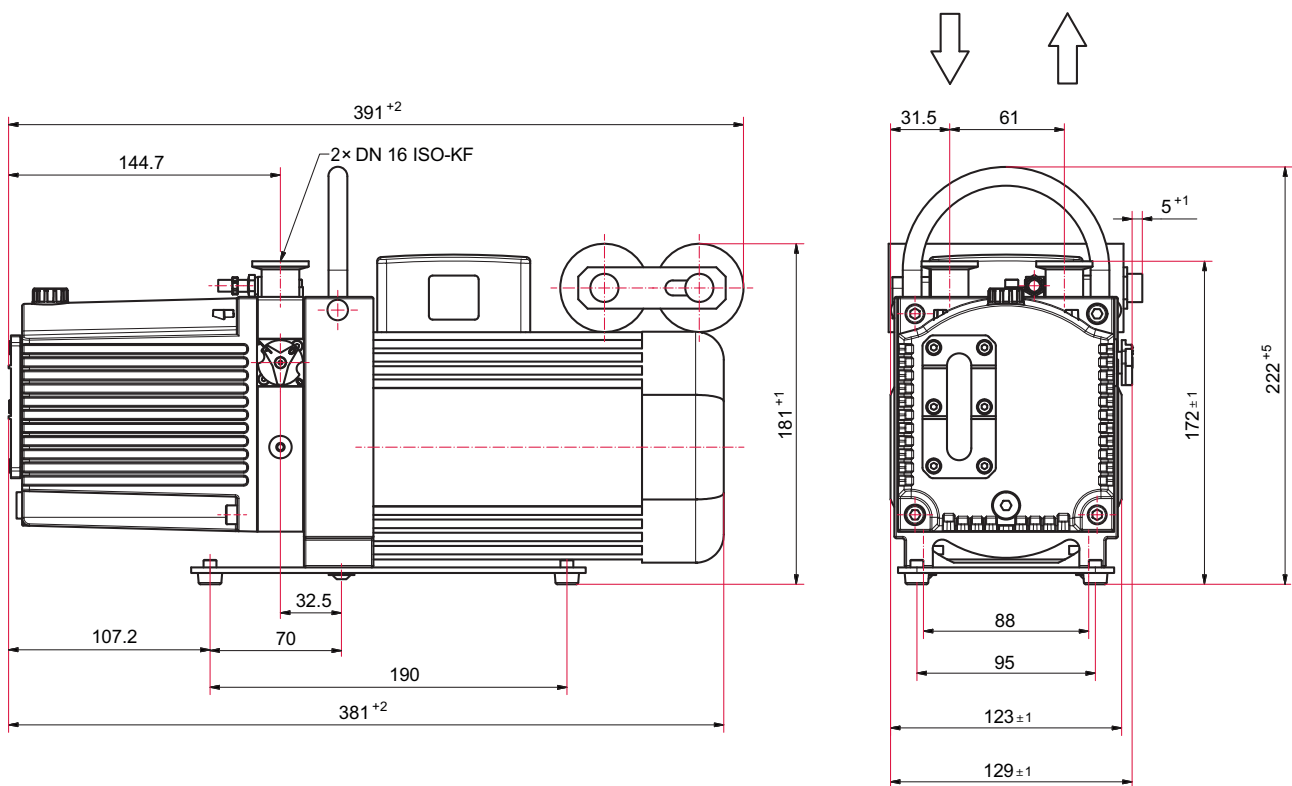


Fig. 22: Dimensions Duo 6, single-phase motor, 100–110 V, 50 Hz | 100–120 V, 60 Hz

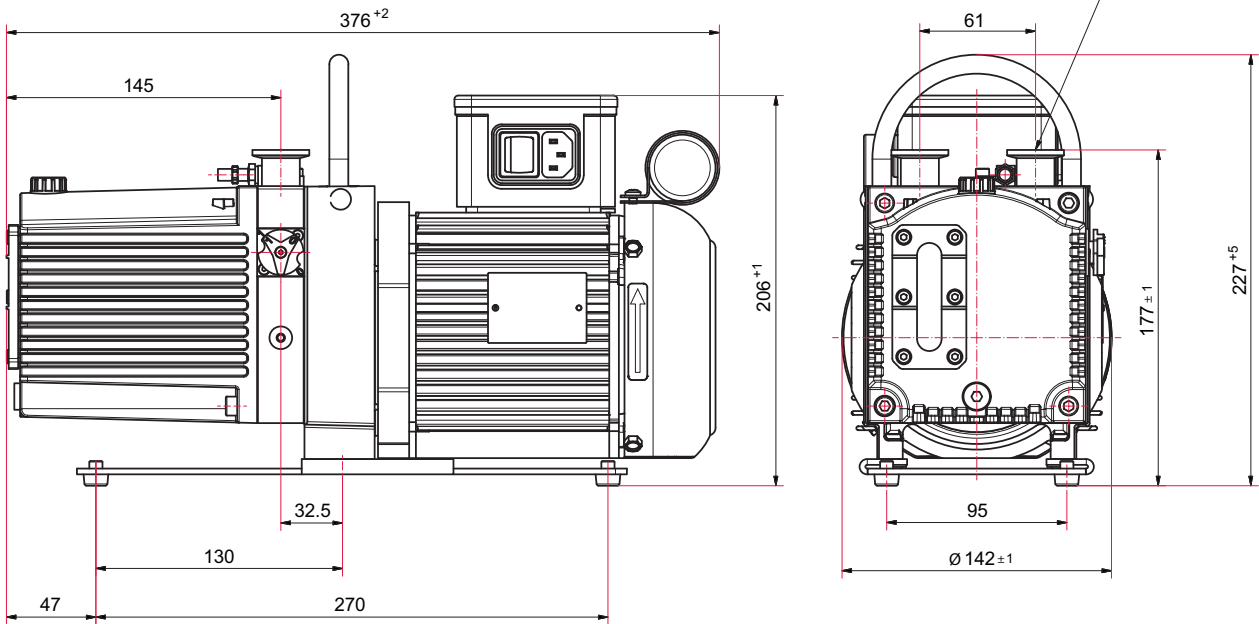


Fig. 23: Dimensions Duo 6, single-phase motor, 200-240 V, 50/60 Hz

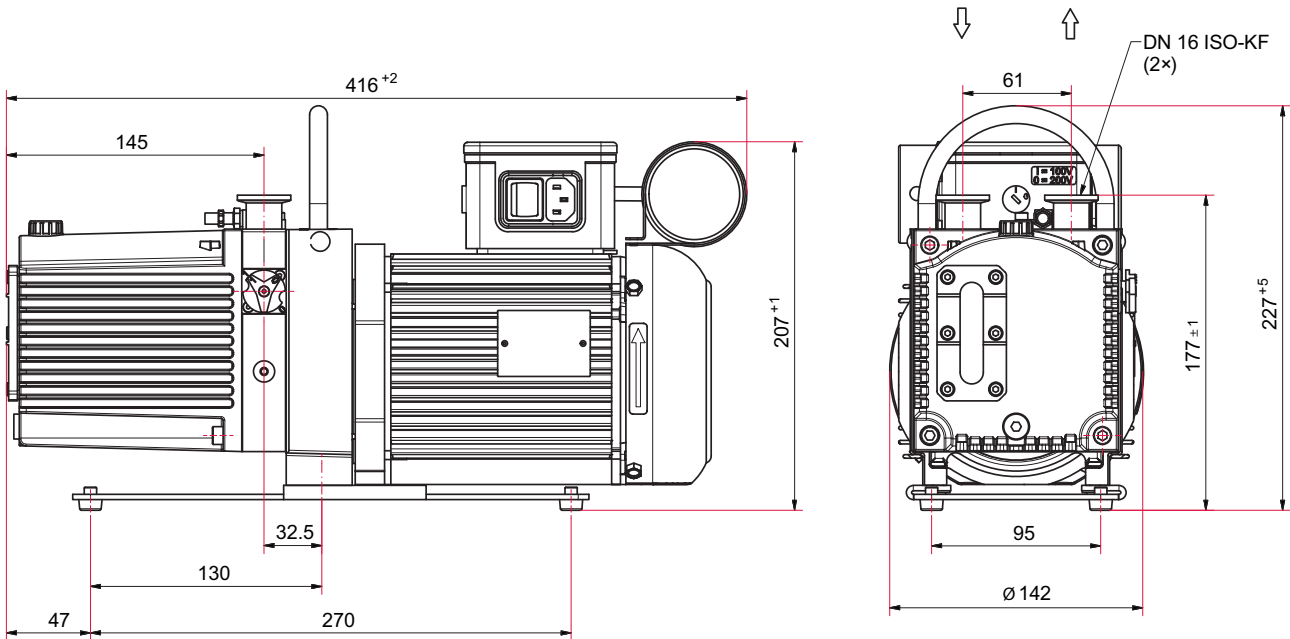


Fig. 24: Dimensions Duo 6, single-phase motor, 100/200 V, 50/60 Hz

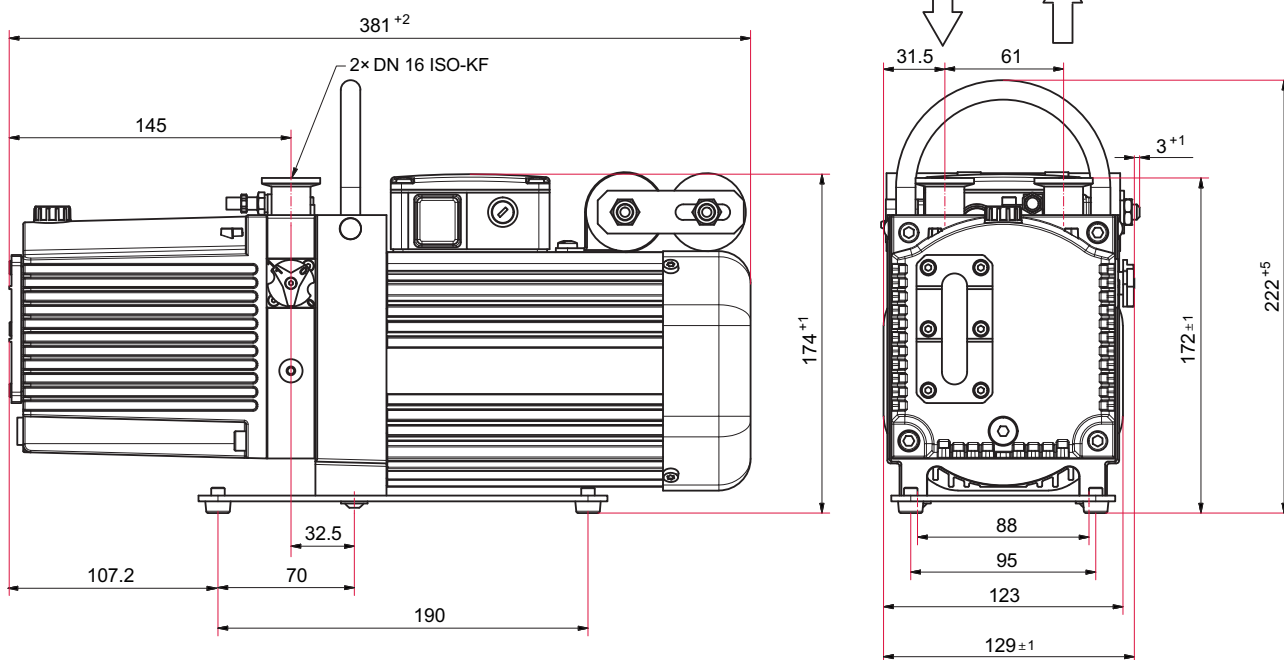


Fig. 25: Dimensions Duo 6, single-phase motor, 115/230 V, 50/60 Hz

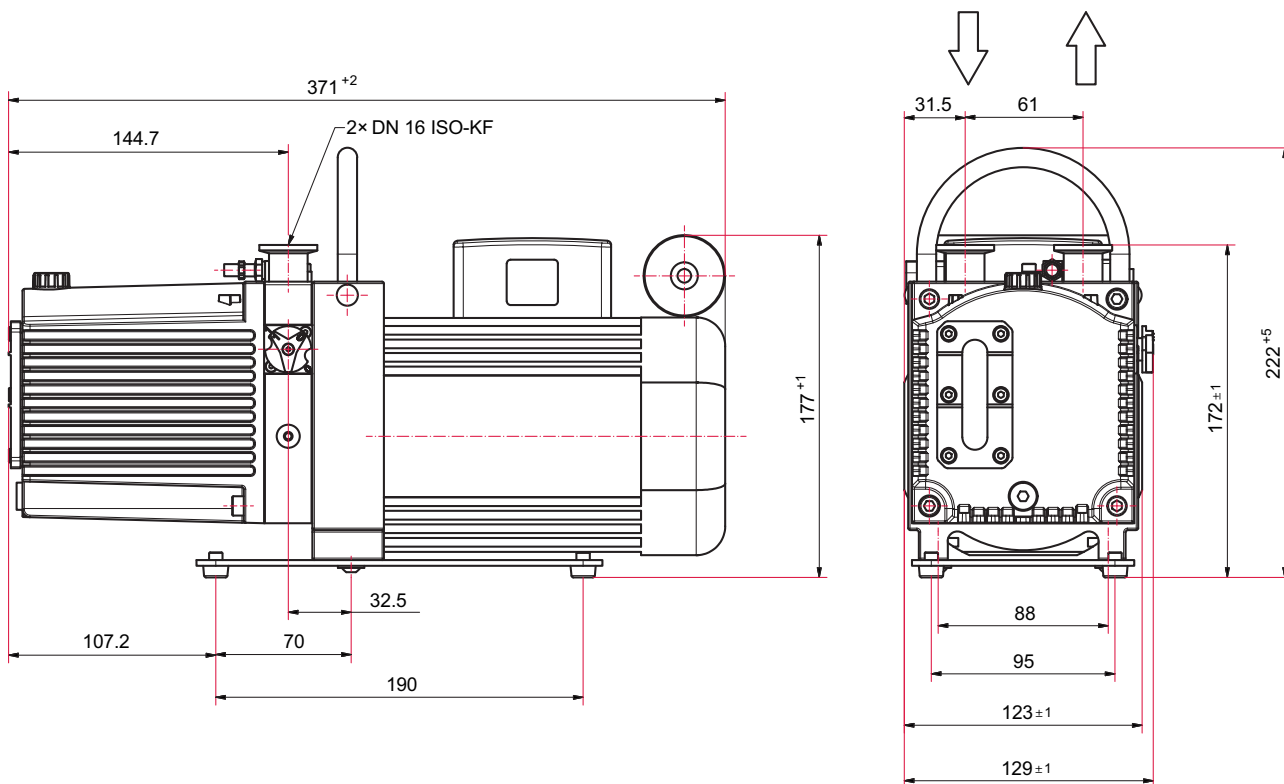


Fig. 26: Dimensions Duo 6, single-phase motor, 230-240 V, 50/60 Hz

13.4.2 M version

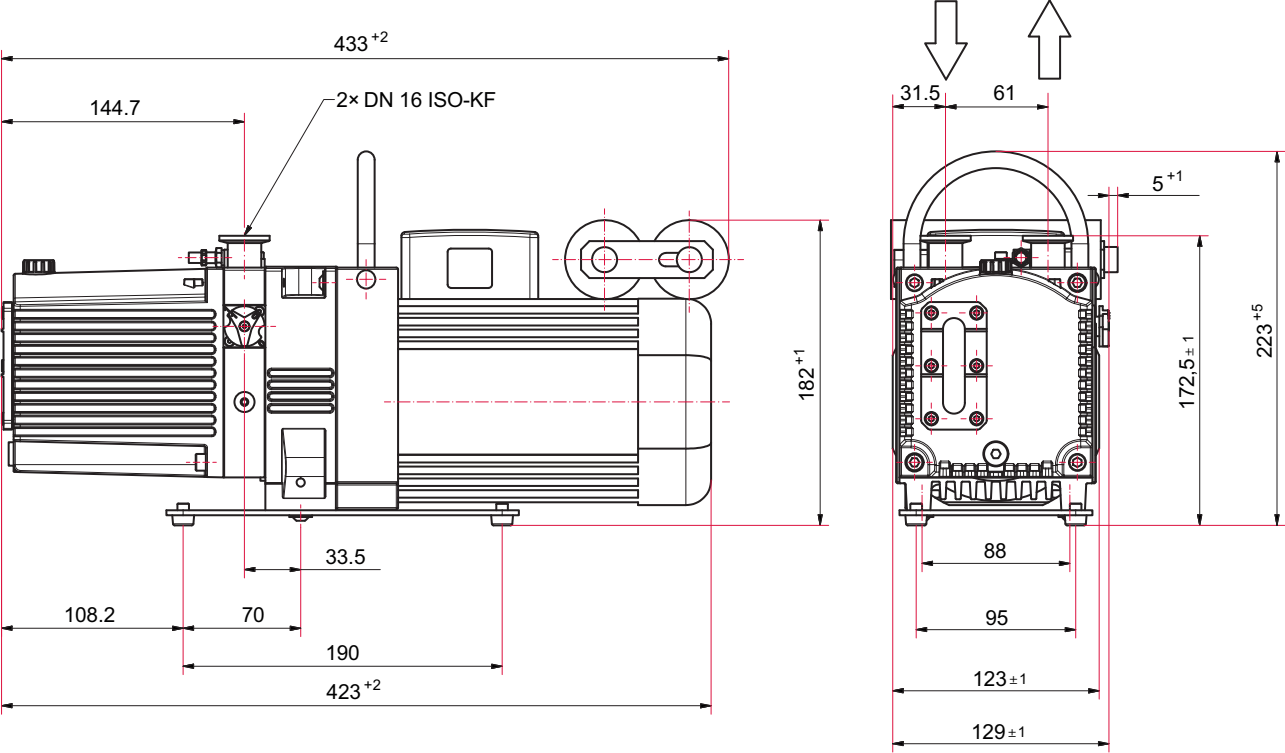


Fig. 27: Dimensions Duo 6 M, single-phase motor, 100–110 V, 50 Hz | 100–120 V, 60 Hz

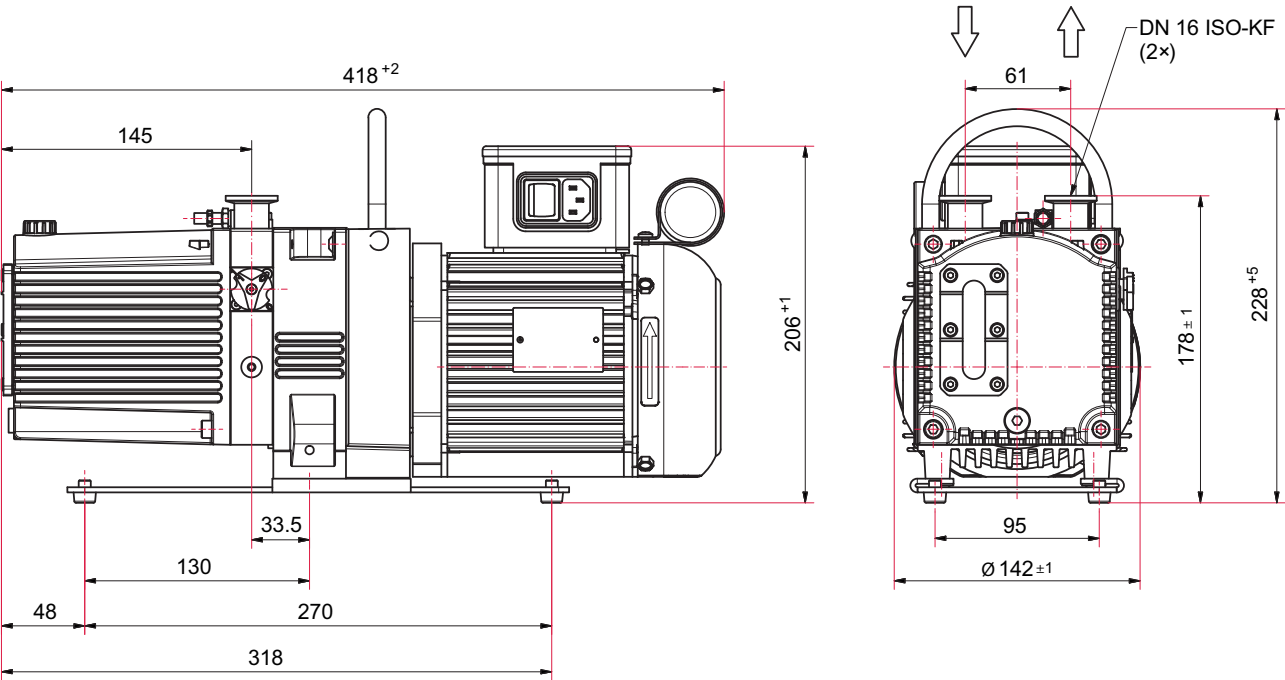


Fig. 28: Dimensions Duo 6 M, single-phase motor, 200–240 V, 50/60 Hz

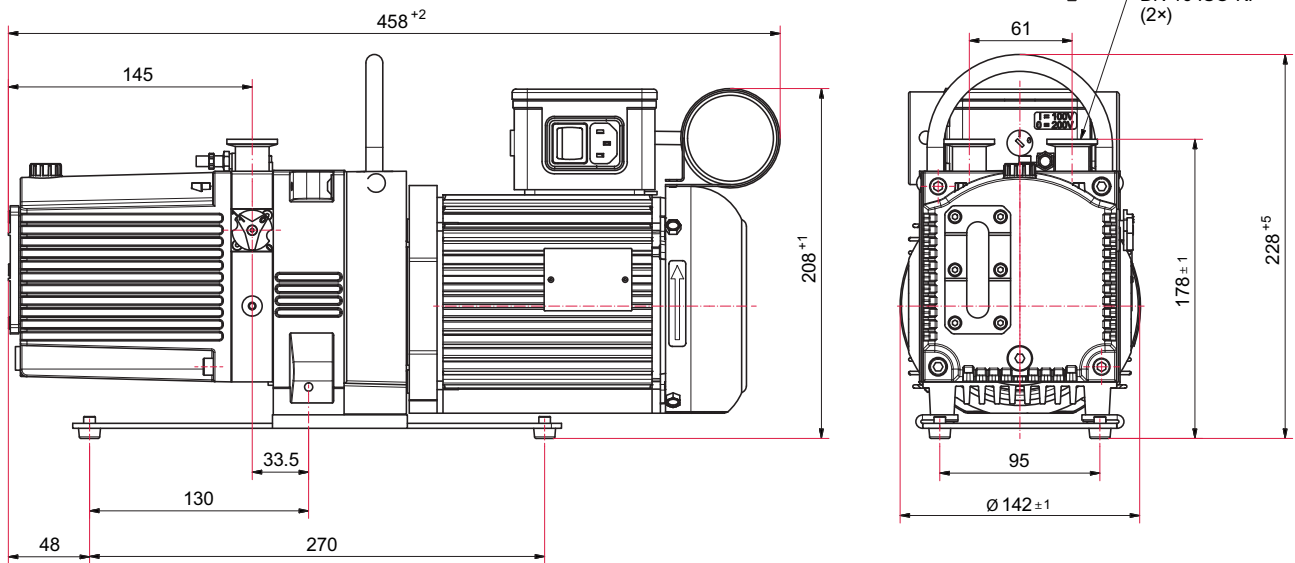


Fig. 29: Dimensions Duo 6 M, single-phase motor, 100/200 V, 50/60 Hz

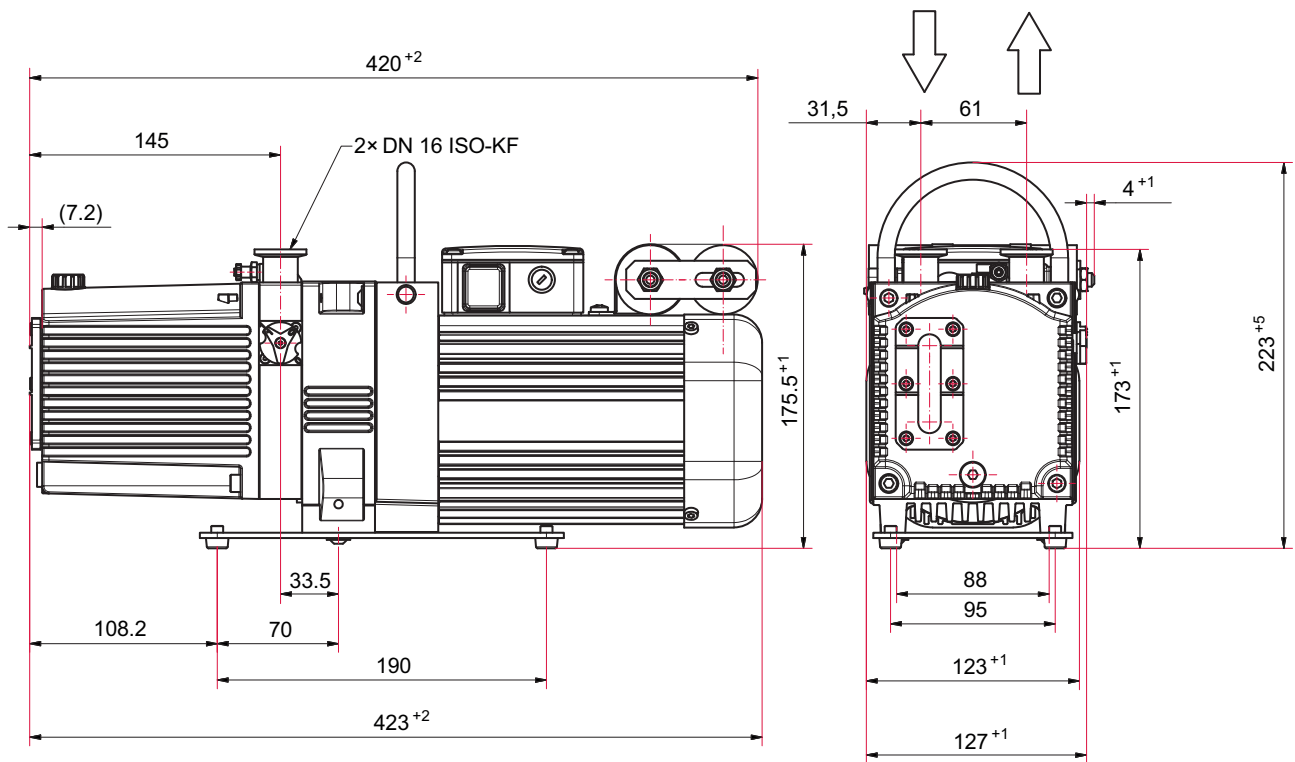


Fig. 30: Dimensions Duo 6 M, single-phase motor, 115/230 V, 50/60 Hz

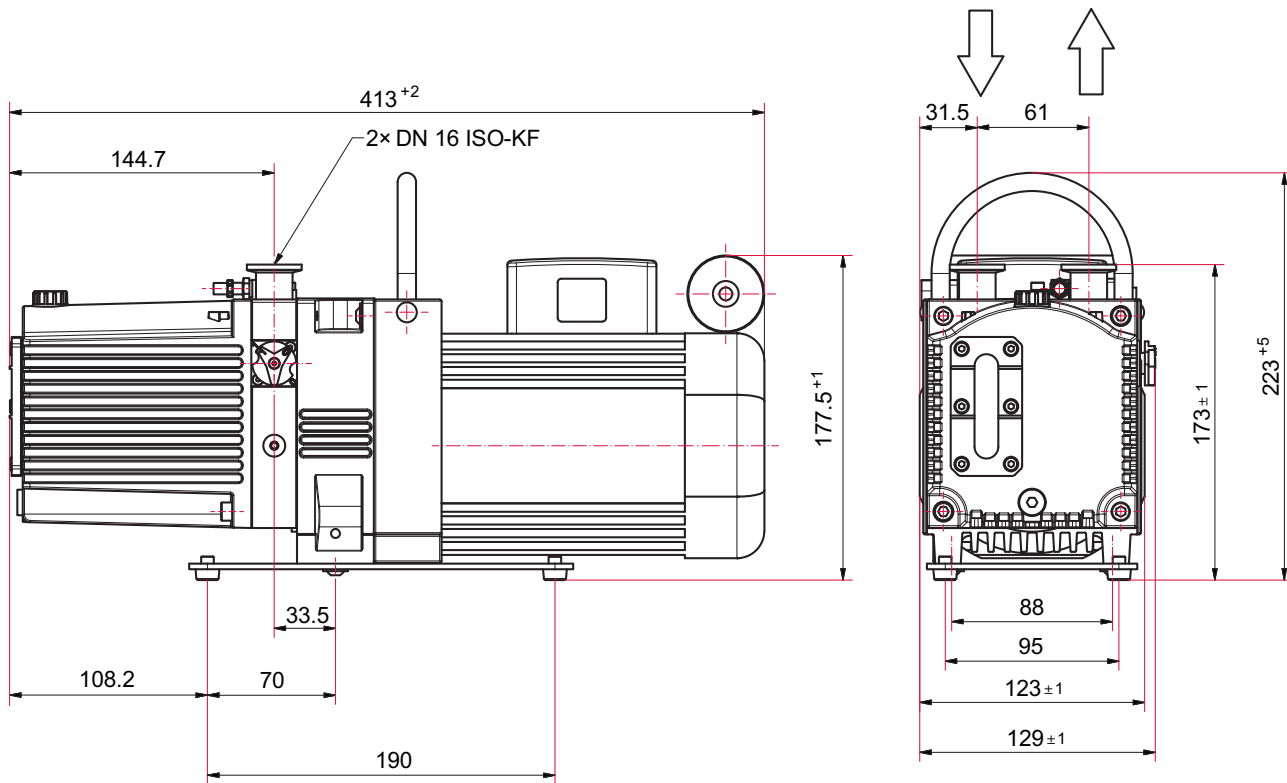


Fig. 31: Dimensions Duo 6 M, single-phase motor, 230–240 V, 50/60 Hz

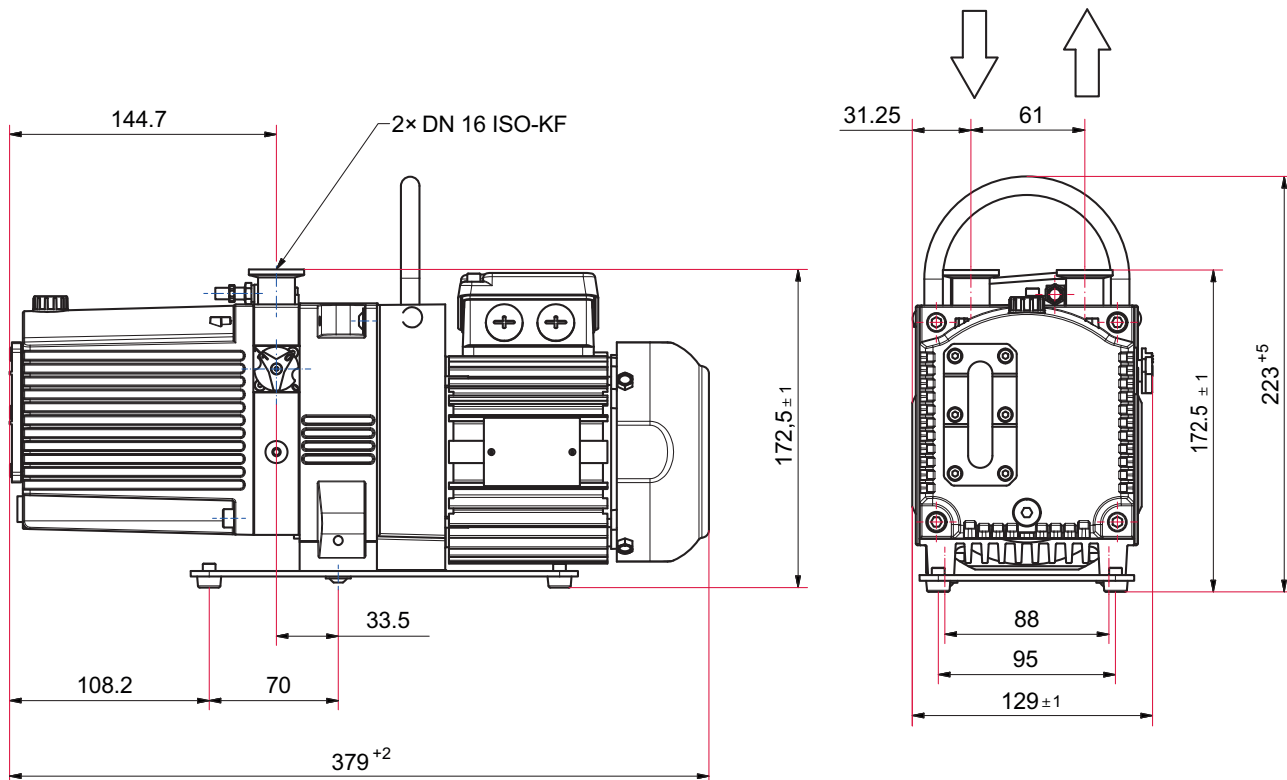


Fig. 32: Dimensions Duo 6 M, 230/400 V, 50 Hz | 265/460 V, 60 Hz, 1TF

13.4.3 MC version

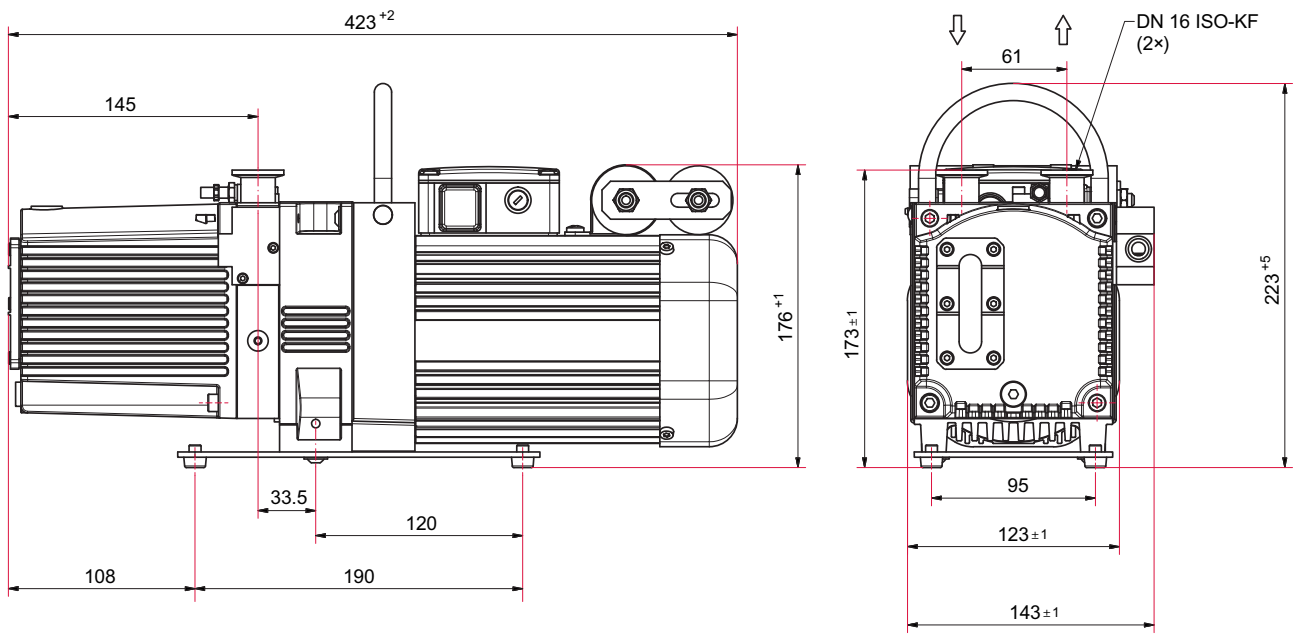


Fig. 33: Dimensions Duo 6 MC, single-phase motor, 115/230 V, 50/60 Hz

Declaration of conformity

We hereby declare that the below product satisfies all relevant provisions of the following **European Directives**:

- **Machinery 2006/42/EC (Annex II, no. 1 A)**
- **Electromagnetic compatibility 2014/30/EU**
- **Restriction of the use of certain hazardous substances 2011/65/EU**
- **Restriction of the use of certain hazardous substances, delegated directive 2015/863/EU**

The authorized representative for the compilation of technical documents is Mr. Sebastian Oberbeck, Pfeiffer Vacuum GmbH, Berliner Strasse 43, 35614 Asslar, Germany.

Rotary vane pump

Duo 6

Duo 6 M

Duo 6 MC

Harmonized standards and applied national standards and specifications:

DIN EN ISO 12100: 2011

DIN EN 61010-1: 2011

DIN EN 1012-2: 2011-12

DIN EN 61000-6-2: 2006

DIN EN ISO 13857: 2008

DIN EN 61000-6-4: 2011

DIN ISO 21360-1 : 2016

DIN EN ISO 2151: 2009

ISO 21360-2: 2012

DIN EN IEC 63000:2019

Signature:



(Dr. Ulrich von Hülsen)

Managing Director

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