



# OPERATING INSTRUCTIONS

EN

Translation of the original instructions

## DUO 11 / DUO 11 M

Rotary Vane Pump

**PFEIFFER**  **VACUUM**

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# 1 About this manual

## 1.1 Validity

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

Up-to-date operating instructions can also be downloaded from [www.pfeiffer-vacuum.com](http://www.pfeiffer-vacuum.com).

### Applicable documents

Duo 11 / Duo 11 M	Operating instructions
Declaration of Conformity	Part of this document
Operating instructions for accessories (order-specifically)	see section "accessories"

\*also available via [www.pfeiffer-vacuum.com](http://www.pfeiffer-vacuum.com)

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

→ [www.tuvdotcom.com](http://www.tuvdotcom.com)

→ TUVdotCOM-ID 0000021320

## 1.2 Conventions

### Safety instructions

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

<b>DANGER</b>
<p><b>Imminent danger</b> Indicates an imminent hazardous situation that will result in death or serious injury.</p>
<b>WARNING</b>
<p><b>Possibly imminent danger</b> Indicates an imminent hazardous situation that can result in death or serious injury.</p>
<b>CAUTION</b>
<p><b>Possibly imminent danger</b> Indicates an imminent hazardous situation that can result in minor or moderate injury.</p>
<b>NOTICE</b>
<p><b>Command or note</b> Command to perform an action or information about properties, the disregarding of which may result in damage to the product.</p>

## Pictographs



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



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



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



Important information about the product or this document

## Instructions in the text

→ Work instruction: here you have to do something.

## Abbreviations

**C version:** Corrosive gas version

## Symbols used

The following symbols are used consistently throughout in all illustrations:

- ⓪ Vacuum flange
- Ⓛ Exhaust flange
- Ⓜ Gas ballast valve
- Ⓝ Power connection

## 2 Safety

### 2.1 Safety precautions



#### Duty to inform

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

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



#### Installation and operation of accessories

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

→ For information on order numbers of components, see "Accessories".

→ Use original accessory parts only.

- Do not expose any body parts to the vacuum.
- Observe the safety and accident prevention regulations.
- Check regularly that all safety precautions are being complied with.
- Do not carry out any unauthorised modifications or conversions to the pumps.
- Depending on the operating and ambient conditions, the surface temperature of the pumps may rise above 70 °C. Use suitable finger guards if necessary.
- When returning the pumps to us please note the instructions in the Service section.

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

- When disassembling the drive system from the pump housing, the strong magnetic field may influence the function and operational reliability of electrical and electronic devices.
- Persons with cardiac pacemakers must keep away from the magnetic coupling.

#### **Danger to life!**

– **Minimum distance: 2 m!**

- Disassembled magnetic couplings must be kept away from computers, data storage media and other electronic components.
- Keep the disassembled components of the magnetic coupling separate at all times. Danger of crushing!
- Do not allow any magnetised parts into the vicinity of the magnetic coupling. Danger of injury!

### 2.2 Protective equipment

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



#### **DANGER**

#### **Danger to health by hazardous substances during maintenance or installation**

Depending on the process vacuum pumps, components or operating fluids can be contaminated by toxic, reactive or radioactive substances.

→ Wear adequate protective equipment during maintenance and repairs or in case of reinstallation.



**CAUTION**

**Risk of injury through hot surfaces**

Vacuum pumps can become hot during operation.

- Allow the pump to cool before maintenance and repairs.
- If necessary wear protective gloves according to EN 420.

**WARNING**

**Increased noise emission!**

Increased noise emission can occur within a limited area surrounding the vacuum pump.

- Provide noise protection or
- wear hearing protection.

**2.3 Proper use**



**NOTICE**

**EC conformity**

The manufacturer's declaration of conformity becomes invalid if the operator modifies the original product or installs additional components.

- Following installation into a plant and before commissioning, the operator must check the entire system for compliance with the valid EU directives and reassess it accordingly.

- The vacuum pump may only be used to generate a vacuum.
- Only use the vacuum pump for applications with oxygen concentration  $\leq 21\%$ .
- Installation, operating and maintenance regulations must be complied with.
- Other accessories, than those described in this manual, must not be used without the agreement of Pfeiffer Vacuum.

**2.4 Improper use**

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

- pumping of corrosive gases
- pumping of explosive media
- operation in potentially explosive areas
- pumping of gases containing impurities such as particles, dusts and condensate; note the vapour compatibility levels of the pump
- pumping of substances that tend to sublime
- use of the vacuum pump to generate pressure
- pumping of liquids
- the use of operating fluids not specified by Pfeiffer Vacuum
- connection to pumps or units which are not suitable for this purpose according to their operating instructions
- connection to units which have exposed voltage-carrying parts

## 3 Transport and storage

### 3.1 Transport

#### Transport instructions

- Remove the locking cap from the vacuum and exhaust flange immediately before connecting!
  - Check the cone strainer, paying attention to the O-ring.
- Use only the handle on the top side of the pump to lift the pump.

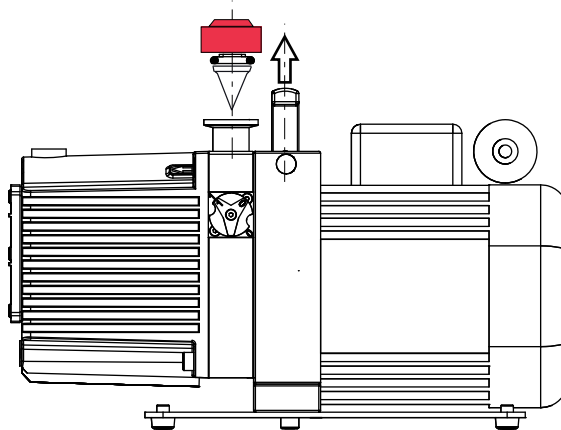


Fig. 1: Transporting the pump

### 3.2 Storage

- Check that all the openings on the pump are securely closed.
- Fill up the pump with new operating fluid to the top edge of the sight glass.
- Store the pump only dry and dust-free indoors within the specified environmental conditions.
  - In rooms with moist or aggressive atmospheres, the pump must be airproof shrink-wrapped in a plastic bag together with a bag of desiccant.
  - After storage periods longer than two years, it is recommended to carry out maintenance and change the operating fluid before using the pump.

## 4 Product description

### 4.1 Product identification

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

- Pump model and model number
- Type and amount of operating fluid
- Date of manufacture

Please find the voltage range and motor-related data on the separately attached motor rating plate.

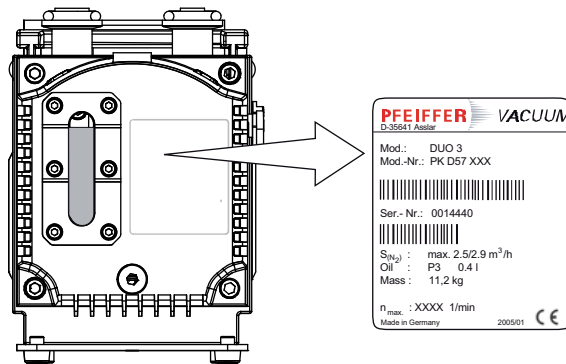


Fig. 2: Product identification on the rating plate

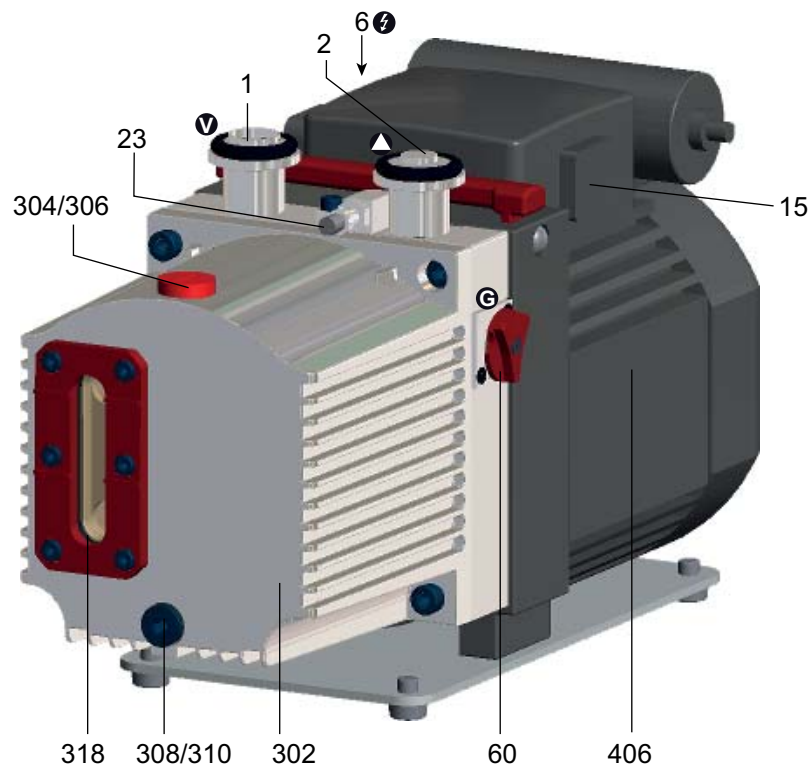
### Scope of delivery

- Pump with drive unit
- Operating fluid (except F4 and F5)
- Cone strainer and centering ring/centering ring with nozzle with O-rings
- Locking cap for vacuum and exhaust flange
- Operating instructions



## 4.2 Function

Vacuum pumps of the Duo series are oil-sealed, two-stage rotary vane vacuum pumps. The vacuum pumps are equipped with a safety valve which, when the pump is at a standstill, closes the vacuum chamber vacuum tight and at the same time vents the pump.



**Fig. 3: Duo 11**

1	Vacuum flange	60	Gas ballast valve	304	Operating fluid filler screw
2	Exhaust flange	302	Casing	306	O-ring
6	Connector IEC/C14	318	Sight glass	310	O-ring
23	Inlet port operating fluid return line	406	Motor		
		308	Operating fluid drain screw		

## 5 Installation

### 5.1 Set-up

#### Installation location

Observe the following requirements when setting up the pump:

- Consider the load-bearing capacity of the installation site.
- Maximum installation altitude 2000 m (above mean sea level)
- Permissible ambient temperature: +12 ... 40°C
- Maximum relative humidity 85%

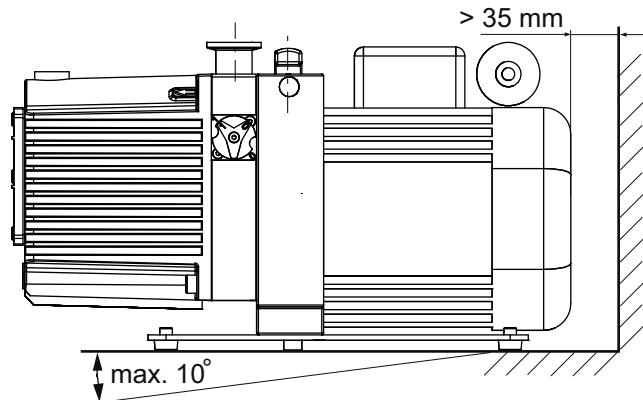


Fig. 4: Setting up the pump

- Fill up with operating fluid before operating the first time .
  - Amount and type according to rating plate
- Always place the pump on a firm, even surface.
- Where stationary installation is involved, anchor the pump on site.
- When installing the pump in a closed housing, ensure there is sufficient air circulation.
  - Sight glass and gas ballast valve must be visible and readily accessible.
  - Voltage and frequency information given on the motor rating plate must be visible.

### 5.2 Connecting the vacuum side

- Remove locking cap from the vacuum flange;
  - pay attention to the cone strainer and the respective O-ring in the intake port.
- The connection between the pump and the vacuum chamber should be kept as short as possible.
  - Depending on the pump type, use metallic hoses or PVC hoses with flange connections.
  - Separators, filters etc. may be installed upstream to protect the pump (see accessories). However, please observe the loss of pumping capacity due to the conductivity of the accessories.

### 5.3 Connecting the exhaust side



#### CAUTION

##### High pressure in the exhaust line!

Danger of damage to the seals and danger of the pump bursting.

- Observe the maximum permissible pressure of 1500 hPa (absolute), activate shut-off valves in such a way that they open before or at the same time as the pump is started.



#### NOTICE

##### Reduced pressure in the exhaust line!

Reduced pressure in the exhaust line can cause malfunctions and damage the pump. It is only allowed in pumps with magnetic coupling.

- Ensure that when discharging gases the exhaust pressure is at least 250 hPa higher than the suction pressure.

- Remove the protective cap from the connection flange.
- Choose the cross-section of the exhaust line to be at least the size of the nominal connection diameter of the vacuum pump's exhaust connection.
- Piping to the pump must be suspended or supported.
  - Physical forces from the piping system must not be allowed to act on vacuum pumps.
- Lay piping from the pump sloping downward so that no condensate can flow back into the pump; otherwise fit a condensate separator.
  - If an air trap is created in the system, then a device for draining condensation water must be provided at the lowest point.



#### WARNING

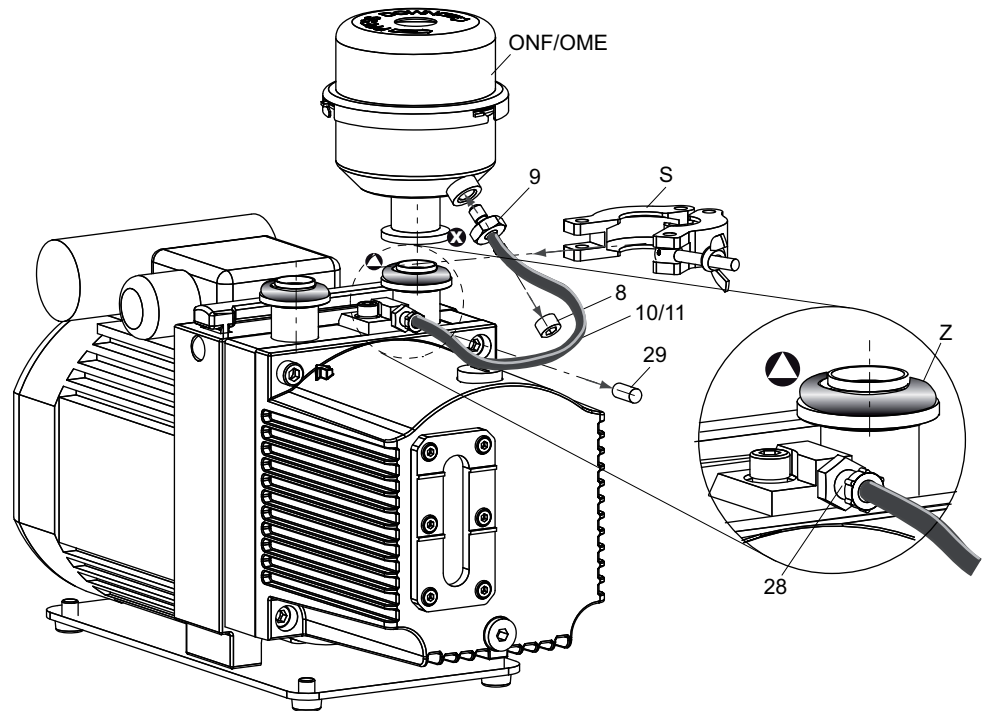
##### Emission of toxic substances from the exhaust!

Danger of poisoning from emitted gases or vapours, which can be detrimental to health and/or can pollute the environment, depending on the particular application.

- Comply with the applicable regulations when working with toxic substances.
- Only officially approved filter systems may be used to separate and remove these substances.

#### Fitting the OME and the oil return line (option)

- Turn off the vacuum pump, vent to atmospheric pressure and allow to cool.
- Remove the protective cap from the connection flange.
- Place OME on the exhaust side of the pump with flange pointing downwards and fit with clamping ring (accessories), pay attention to centering ring.



**Fig. 5: Duo 11 with operating fluid return line**

8	Locking screw	11	Spring (inside the hose)	S	Clamping ring
9	Fitting	28	Fitting cap	Z	Centering ring
10	Operating fluid return hose	29	Locking cap		

**Note:** As the hexagon socket of the **locking screw** is not metric, a **special spanner (3/16")** (provided as part of the scope of supply) is required.

- Unscrew locking screw 8.
- Drain off operating fluid if so and fill in the pump.
- Screw in fitting 9 in place of the locking screw 8; take care with seal ring.
- Loosen fitting 28 and remove cap 29.
- Insert spring 11 into hose 10 (anti-kink device).
- Fit operating fluid return hose 10 at both sides,
  - keep the hose as short as possible and protect it from bending.
- Tighten the union nuts of both screw fittings.

## 5.4 Connecting to the mains power supply

Depending on the pump type, different motor versions or mains voltages are possible:

- Single phase motor for fixed voltage with
  - built-in thermal protection switch,
  - mains switch and
  - mains connection socket (C14)
- Single phase motor with switchable voltage range,
  - thermal protection switch,
  - mains switch and
  - mains connection socket (C14)
- Three phase motor (without switch and mains cable).



**DANGER**

**Voltage-bearing elements**

Danger to life from electric shock.

- The electrical connection can be carried out only by trained and authorised electricians.
- Disconnect the power supply and secure it against being switched back on.
- Ensure the system is adequately earthed.



**NOTICE**

**Excess voltage!**

Danger of destroying the motor.

- Power connections must comply with local regulations. Voltage and frequency information given on the motor rating plate must correspond to the mains voltage and frequency values.
- To protect the motor and supply cable in case of malfunction, mains fuse protection must be implemented.



**WARNING**

**Danger of injury from moving parts!**

After power failure or motor shutdown due to overheating, the motor may restart automatically.

- Secure the motor so that it cannot be switched on while any work is being performed on the pump.
- If necessary, dismantle the pump from the installation for inspection.

**Single phase motors**

The vacuum pumps are equipped with single-phase motors with built-in thermal protection switch. This interrupts the motor current in case of overheating, but provides no permanent shutdown of the motor.

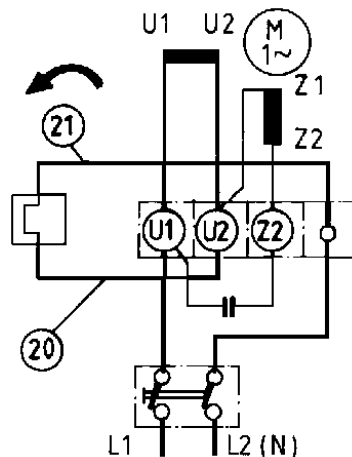


Fig. 6: Motor circuit diagram with switch

**Fuse protection**



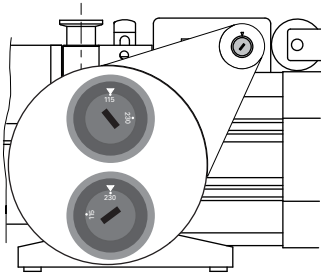
**The transmission power of the pump's magnetic coupling is so great that the coupling is no overload protection for the motor.**

- To protect the motor in case of malfunction, additionally provide a fuse protection in accordance with the regional regulations.
  - Select a fuse with slow characteristics according to the table below.

Motor voltage [V]	Frequency [Hz]	Nominal current [A]	Recommended fuse, slow [A]
100 ... 127	50	3.9	16
100 ... 127	60	4.2	16
115/230	50	3.8/1.9	16/6
115/230	60	5.2/2.6	16/6
208 ... 240	50	2.2	6
208 ... 240	60	2.5	6

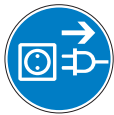
**Changing the voltage range**

Only valid for pumps with reversible motor:



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

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



**NOTICE**

**Overvoltage!**  
 An incorrect voltage range setting can damage the motor.

- Always check the set voltage range before switching on the pump.
- Only change the voltage range when the pump is disconnected from the power mains.

**Three-phase motor**

**The three-phase current motor circuit**

The connections U1 - L2, V1 - L1 and W1 - L3 result in a clockwise rotation of the motor shaft as seen looking towards the motor fan.

**Delta Connection**

The three coils are connected in series with the connection point connected to the mains. The voltage of each coil is the same as the mains voltage whereas the mains current is the cube root of the coil current. Delta connections are denoted by the symbol  $\Delta$ . The voltage between the mains supply lines is called mains voltage. The mains current is the current which flows in the supply lines.

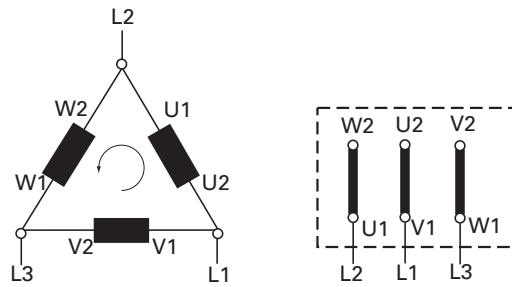


Fig. 7: Motor coil and connecting plate of Delta Connection (for low voltage)

**Star Connection**

The ends of the three coils are connected at the star center. The terminal voltage is the cube root of the coil voltage; the mains and the coil current are the same. Star connections are denoted by the symbol Y.

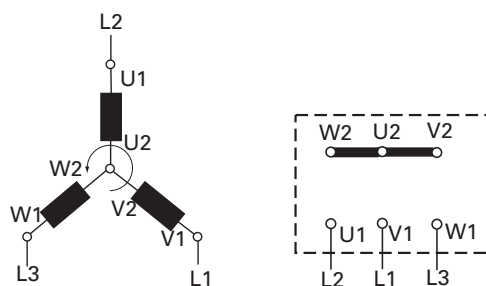


Fig. 8: Motor coil and connecting plate of Star Connection (for high voltage)



<b>NOTICE</b>
<p><b>Do not start with star/delta connection.</b></p> <p>→ Always start motor directly.</p>

**Inspection of the direction of rotation**

For pumps with three-phase motors, it is necessary to check the direction of rotation!



<b>CAUTION</b>
<p><b>Operating fluids may leak out!</b></p> <p>If the direction of rotation is incorrect, there is a danger that operating fluids may leak at the vacuum flange.</p> <p>→ Always check the direction of rotation before filling in operating fluid.</p>

- Remove the locking cap from the exhaust flange (if existing).
- Switch the pump on briefly (from 2 to 3 sec.).
  - The motor and motor fan must turn in a clockwise direction (see the arrow on the support stand).
- If the direction of rotation is incorrect: Swap two phase contacts at the connecting cable.
- Fill up the operating fluid.

**Motor protection**



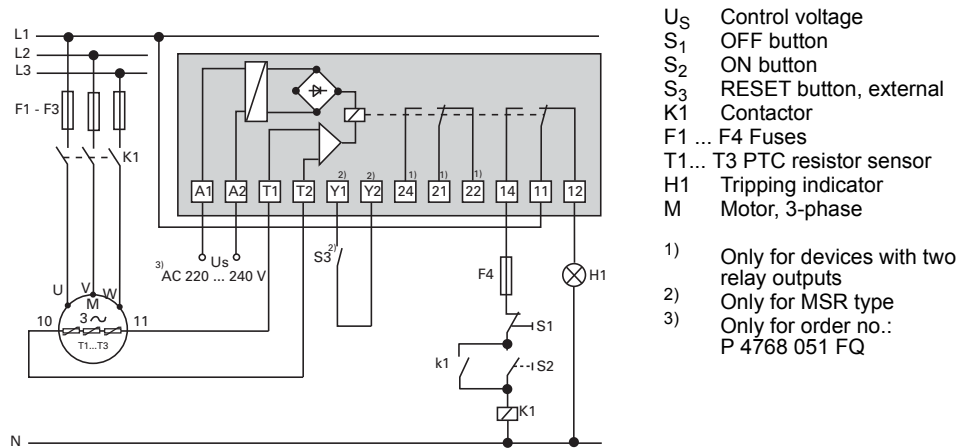
<p><b>The transmission power of the pump's magnetic coupling is so great that the coupling is no overload protection for the motor.</b></p>
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**With PTC temperature sensors (3PTC)**

Pump motors equipped with PTC temperature sensors (3PTC) in the stator windings can be connected to a PTC resistor tripping device for protection against overload. Other approved motor temperature monitoring can be used also by the operator.

Tripping devices store the shutdown event and need to be manually switched back on again via the integrated RESET button or via the external RESET S3. Mains-ON is detected as an automatic RESET.

➔ Set up the connections so that the directional rotation indicated on the pump is maintained, regardless of the representations in the current flow diagram.



**Fig. 9: Connection example for a three-phase AC motor with PTC resistor tripping device**

**With motor protection switch**

Suitable are protection switches with slow triggering characteristics. The drive motor can have a power consumption that is higher than the rated current  $I_N$ . According to DIN EN 60034-1 it is permissible to exceed the rated current  $I_N$  1.5 times for a period of 2 minutes. The setting must permit the overload ability of the motor and can be found in the following table.

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

**Motor control system**

**Frequency converter (valid for three phase motors)**

Operation of rotary vane pumps with variable rotation speeds is possible in the mains frequency range between 35 and 60 Hz. The start-up can use a ramp (run-up time: max. 30 s); the shutdown can occur directly.



## 5.5 Filling up the operating fluid

The type and amount of operating fluid should be visible on the pump's rating plate for every rotary vane pump.

### Permissible operating fluid

- P3 (standard operating fluid)
- Operating fluid for special applications on request



### NOTICE

#### Use approved operating fluids only!

The use of operating fluids that have not been approved by Pfeiffer Vacuum shall result in a limited warranty. In such cases, it is not possible to guarantee that product-specific performance data will be achieved.

→ Prior consultation is required before using other application-specific operating fluids.

### Filling up the operating fluid

- Unscrew operating fluid filler screw 304.
- Fill up the operating fluid.
  - First fill when the pump is cold: Maximum 3/4 of the min./max. range.

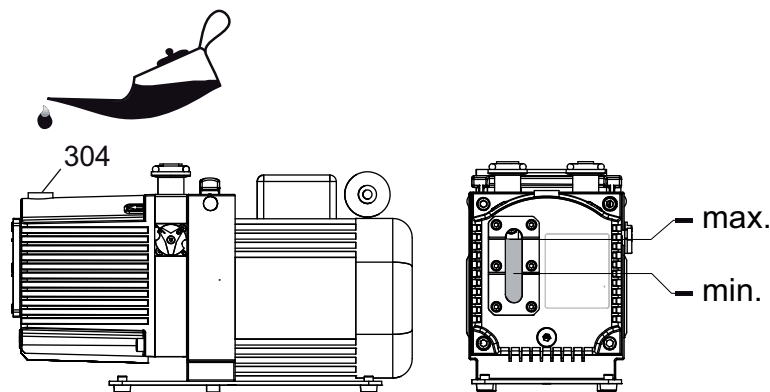


Fig. 10: Filling up the operating fluid

- Screw in operating fluid filler screw 304.



### WARNING

#### Toxic vapours!

Danger of poisoning when igniting and heating synthetic operating fluids (e.g. F4/F5) above 300 °C.

- Observe the application instructions.
- Do not allow operating fluid to make contact with tobacco products; observe safety precautions when handling chemicals.

## 6 Operation

### 6.1 Before switching on the pump

- Check the operating fluid level in the sight glass.
- Compare the voltage and frequency information on the rating plate with the mains voltage and frequency values.
- Check that the exhaust connection allows free flow (max. permissible pressure 1500 hPa absolute).
  - Activate the shut-off valves in such a way that they open before or at the same time as the pump is started.
- Protect the pump sufficiently from taking in contaminants by means of suitable precautions (e.g. dust filters); if necessary, check operating fluid regularly or replace at shorter intervals.

### 6.2 Switching on

The pump can be switched on in any pressure range between atmospheric and ultimate pressure.

The ideal operating condition of the pump is achieved during continuous operation. Cyclic operation is possible, but 10 cycles per hour should not be exceeded and the operating phase should always be longer than the downtime (non-operation time).

No special precautions are necessary when pumping dry gases. In order to attain the lowest possible ultimate pressures, the gas ballast valve should be closed.



#### CAUTION

##### Hot surface!

Danger of burns if hot parts are touched. Depending on the operating and ambient conditions, the surface temperature of the pump may rise above 70 °C.

→ In this case, use suitable finger guards.

- Switch on pump at main switch 15.
- Switch on the pump with the vacuum flange closed and allow to warm up for 30 minutes.
- Check operating fluid level only when the pump is warm and running; therefore
  - close vacuum flange and gas ballast valve,
  - correct filling level during operations: within the markings at the sight glass frame,
  - check operating fluid daily in non-stop operation, otherwise whenever the pump is switched on. Refilling is possible when the pump is in final vacuum operation.

### 6.3 Pumping condensable vapours

Should the process gases contain condensable gases, the rotary vane pump must be operated with gas ballast (i.e. with an open gas ballast valve).



#### NOTICE

##### Bad final vacuum and damage to the pump!

Danger of condensation and corrosion due to exceeding the water vapour compatibility during operation without gas ballast or in case of insufficient supply of flushing gas.

- Only pump vapours when the pump is warm and the gas ballast valve is open.
- When the process has been completed, allow the pump to continue running for about 30 minutes with the vacuum flange closed and the gas ballast open for operating fluid regeneration purposes.

### Gas ballast valve, standard version

To avoid condensation in the pump when pumping condensable vapours, air is periodically fed into the working chamber at the beginning of the compression phase via the gas ballast valve 42.

The gas ballast valve is closed when turning to the right to position 0 and open when turning to the left to position 1. Intermediate settings are not possible.

The gas ballast valve 42 will only be contaminated when airborne dust is in the intake air.

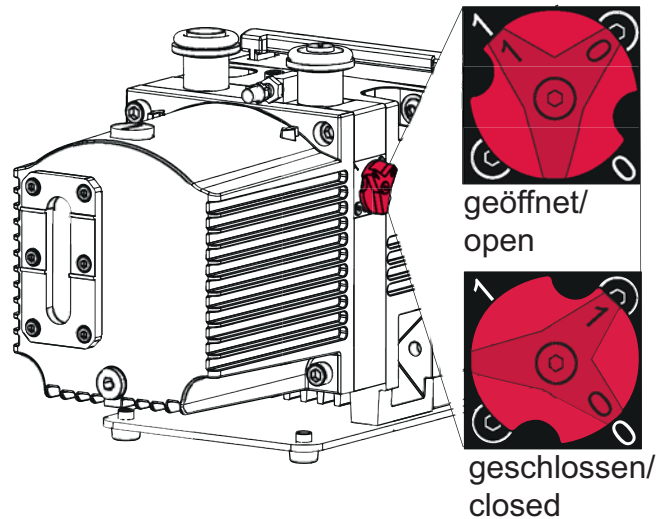


Fig. 11: Standard version 42 of gas ballast valve

### Operation with accessories

#### Gas ballast valve, corrosive gas version

If the pumping process requires the connection of flushing gas, the C version of the gas ballast valve with the flushing gas connection must be used.

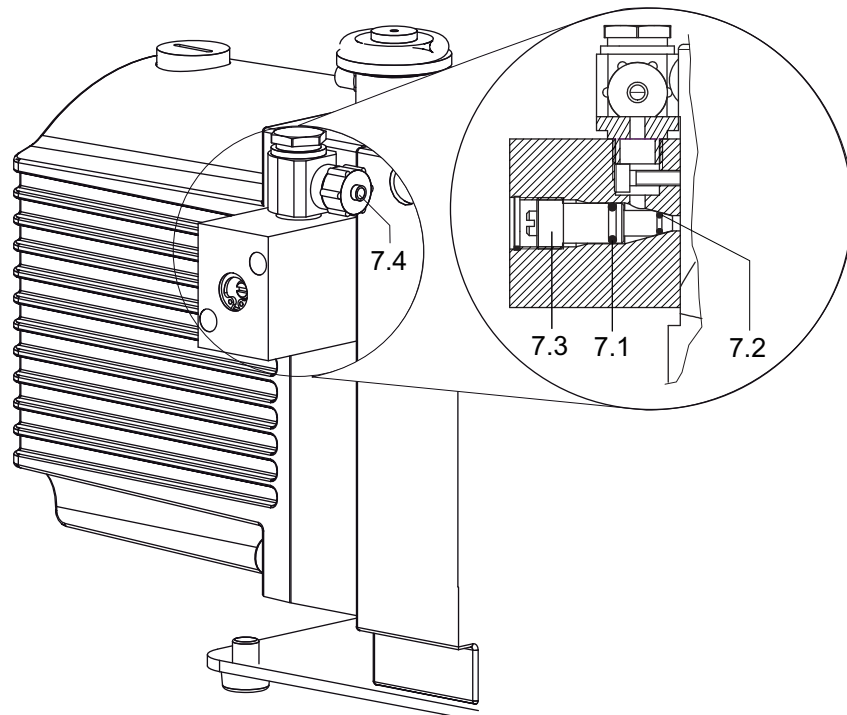


Fig. 12: Corrosive gas version of gas ballast valve

- |            |  |
|------------|--|
| 7.1 O-ring | 7.3 Proportioning screw                        |
| 7.2 O-ring | 7.4 Flushing gas connection (for DN 6 mm hose) |

- Connect flushing gas at the flushing gas connection 7.4.
- Set flushing gas pressure; maximum pressure 1500 hPa (absolute).

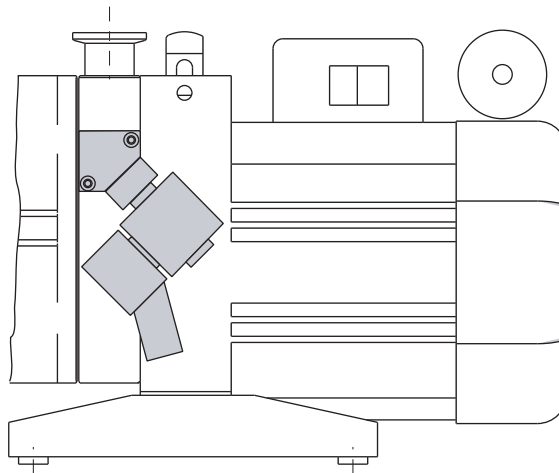
- Select the type and amount of flushing gas depending on the process; consult Pfeiffer Vacuum if necessary.
- Use the proportioning screw 7.3 to set the desired amount of gas.
  - Closed when fully turned to the right; open when fully turned to the left.

**Gas ballast valve with solenoid valve**

To control the flow of the flushing gas externally, an electromagnetic valve can also be used as an alternative to the versions described above. The valve makes it easier to operate the gas ballast and allows clean air or other gas to be let in in a process-controlled manner.



<b>NOTICE</b>	
<b>Flushing gas pressure higher than allowed endangers the operational reliability of the pump.</b>	
The power input of the pump, the temperature and the ejection of operating fluid will increase.	
→ Observe the maximum permissible flushing gas pressure of 1500 hPa (absolute).	
→ Set the amount of flushing gas on site; dosing is not possible when using a solenoid valve!	



**Fig. 13: Assembling the solenoid valve at the gas ballast inlet**

<b>Performance data of the solenoid valve</b>	
2/2 way valve	closed when disconnected
Supply voltage	24 V DC, +/- 10 %
Power input	4 W
Socket	Type 2506
Threaded connection of flushing gas	1/8" inside
Flushing gas pressure	max. 1500 hPa (absolute)
Amount of flushing gas	max. 180 l/h

## 6.4 Topping up the operating fluid

If the operating fluid has reached its minimum filling level, the operating fluid must be topped up. The fluid can be topped up during operation in the final vacuum.

### Filling up the operating fluid

- Unscrew operating fluid filler screw 304.
- When the pump is at operation temperature, top up the operating fluid up to the "max." marking.

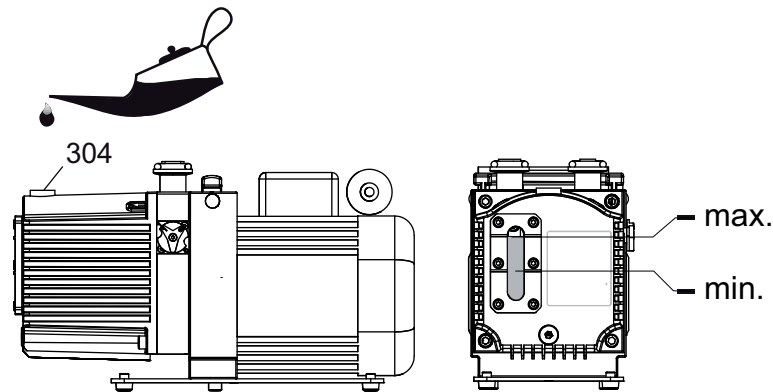


Fig. 14: Filling up the operating fluid

- Screw in operating fluid filler screw 304.

## 6.5 Switching off the pump

The pump can be switched off in any pressure range.

Rotary vane pumps have an integrated safety valve on the intake side. If the differential pressure between the exhaust side and the intake side is  $\geq 250$  hPa, then the valve closes automatically and vents the pump when the pump is switched off.

→ Switch the pump off at the mains switch or disconnect from the mains in a secure manner.

### Venting the vacuum chamber



#### NOTICE

**Danger of backflow of operating fluid into the intake line!**

Contamination of the connected vacuum system!

- Vent the vacuum chamber within 30 s, regardless of the chamber size.
- For a longer venting process, use an additional shut-off valve and shut off the intake line after switching off the pump.

### Maintaining the vacuum in the chamber



#### NOTICE

**Danger of backflow of operating fluid into the intake line!**

Contamination of the connected vacuum system!

- Because the safety valve of the 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 pump.

## 7 Maintenance

### 7.1 Precautions



#### WARNING

##### **Danger of injury from moving parts!**

After power failure or motor shutdown due to overheating, the motor may restart automatically.

- Secure the motor so that it cannot be switched on while any work is being performed on the pump.
- If necessary, dismantle the pump from the installation for inspection.



#### WARNING

##### **Pump parts may be contaminated from pumped media!**

Danger of poisoning due to contact with harmful substances.

- Decontaminate the pump before carrying out any maintenance work.
- In the event of contamination, take suitable safety precautions to prevent your health from being harmed by any dangerous substances.
- Turn off the vacuum pump, vent to atmospheric pressure and allow to cool.
- Disconnect the drive motor from the mains and secure it so that it cannot be switched on.
- Only dismantle the pump as far as necessary to carry out maintenance.
- Dispose of used operating fluid in compliance with local regulations.
- When using synthetic operating fluids or working with toxic substances or substances contaminated with corrosive gases, the relevant instructions governing their use must be observed.
- Use only alcohol or similar agents for cleaning pump parts.

### Magnetic coupling

The following safety instructions are only valid for the **disassembly** of the drive system for vacuum pumps with **magnetic coupling!**



#### DANGER

##### **Strong magnetic field in the vicinity of the drive system!**

Danger to life for persons with cardiac pacemakers when the drive system is disassembled.

- Persons with cardiac pacemakers must not enter the area ( $\leq 2\text{m}$ ) of the magnetic field.
- Rooms in which open couplings are accessible must be identified: "No trespassing for persons with heart pacemaker"!
- Disassembled magnetic couplings must be kept away from computers, data storage media and other electronic components.

**Checklist for inspection, maintenance and overhaul**

Certain maintenance and overhaul work should only be performed by Pfeiffer Vacuum Service (PV). Pfeiffer Vacuum will be released from all warranty and liability claims if the required, below listed, intervals are exceeded or maintenance or overhaul procedures are not performed properly. This also applies if replacement parts other than Pfeiffer Vacuum OEM replacement parts are used.

Activity	K/I/W/R <sup>1</sup>	daily	as required; at least annually	as required; at least every 2 years	as required; at least every 4 years
Check operating fluid level	K	X			
Visual inspection (leak-tightness/oil leaks)	K	X			
Check filter insert of external oil mist filter (if existent)	K	X			
Change operating fluid	I		X		
Disassemble casing, sight glass and pumping system and clean casing outside (without cleaning agent)	I		X		
Clean gas ballast valve and silencer	I		X		
Clean the motor fan cap	I		X		
Disassemble the pump, clean and exchange seals and wearing parts: ⇒ Radial shaft seal ring ⇒ Coupling half at motor side ⇒ Hydraulic valve ⇒ Exhaust valve tongue ⇒ Valve flap of the gas ballast valve ⇒ Vane springs	W			X (PV)	
Carry out work in accordance the maintenance and additionally: ⇒ Change vanes ⇒ Change valves, springs and sight glass ⇒ Change silencer nozzle ⇒ Check coupling and exchange if necessary	R				X (PV)

Depending on the process, the required replacement intervals for the operating fluid and the intervals for inspection, maintenance and overhaul may be shorter than the guide values specified in the table. Consult Pfeiffer Vacuum Service, if necessary.

1. K: Checking, I: Inspection, W: Maintenance, R: Overhaul



## 7.2 Changing the operating fluid

The service life of the operating fluid is dependent on the application area for the pump. It must be changed if:

- The specified ultimate pressure is no longer reached
- The operating fluid in the sight glass is visibly contaminated, milky, or cloudy
- The operating fluid is thermally aged, identifiable by its color ID value (applies to mineral oils only).



**Depending on the applications, Pfeiffer Vacuum recommends determining the exact service life of the operating fluid during the first year of operation.**

The replacement interval may vary from the guide value specified by Pfeiffer Vacuum depending on the thermal and chemical loads, and the accumulation of suspended particles and condensation in the operating fluid.



### WARNING

#### Hot operating fluid!

Danger of burns when draining due to contact with skin.

- Wear suitable protective clothing.
- Use a suitable collecting vessel.



### WARNING

#### Operating fluid may contain toxic substances from the pumped media!

Danger of poisoning from the emission of harmful substances from the operating fluid.

- Wear suitable protective clothing and respirators.
- Dispose of operating fluid according to the local regulations



#### Request safety data sheets for operating fluids and lubricants

from Pfeiffer Vacuum or download at [www.pfeiffer-vacuum.com](http://www.pfeiffer-vacuum.com).

- Dispose of operating fluid according to the local regulations.

### Draining the operating fluid

- Turn off the vacuum pump, vent to atmospheric pressure and allow to cool.
- Unscrew operating fluid filler screw 304.
- Unscrew operating fluid drain screw 308.
- Drain the operating fluid while still quite hot;
  - to empty the pump fully, tip it forward slightly.

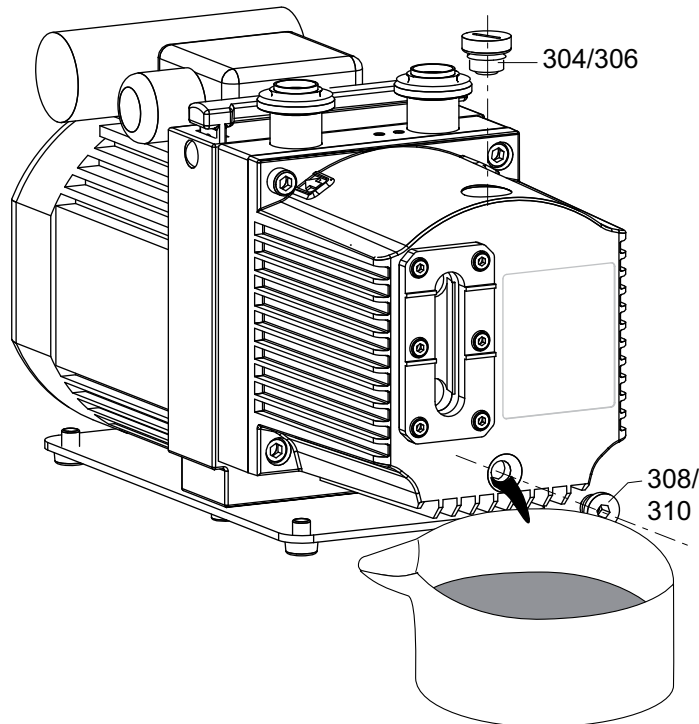


Fig. 15: Draining the operating fluid

- Screw in operating fluid drain screw 308; pay attention to O-ring.
- Screw in operating fluid filler screw 304.
- Allow pump to run for a maximum of 5 seconds with the vacuum flange open.
- Drain off remaining operating fluid.
  - In case of serious contamination, the operating fluid will have to be changed several times (flushing):
- Fill up with operating fluid and check the filling level .

**Determining the level of deterioration**

- The level of deterioration of operating fluid P3 can be determined for clean processes with the colour scale (in accordance with DIN 51578); supplementary sheet PK 0219 BN on request or at [www.pfeiffer-vacuum.com](http://www.pfeiffer-vacuum.com).
- Suck off operating fluid from the pump through the operating fluid filler opening.
- Fill the specimen in a test tube or some similar vessel and test by holding against the light.
- Where discolouration is red brown (equivalent to 5 on the scale) change operating fluid at the latest.

**Flushing and cleaning**

- If the interior of the pump is heavily contaminated with process residues, we recommend performing several changes of operating fluid to flush away the contamination:
- Operate the pump with the gas ballast open until the pump has warmed up.
  - Drain the operating fluid again and check for contamination, flush again if necessary.
  - Take off the cap and clean the sight glass and pump system externally (without cleaning agent).
  - Replace the filter elements in the accessories.
  - Screw the operating fluid drain screw back in.
  - Fill up with operating fluid and check the filling level .
  - Screw in operating fluid filler screw 304.

## 7.3 Changing the kind of operating fluid

When filling up, topping up or changing the operating fluid, always use the type of operating fluid indicated on the pump type plate. If, for example, amended process conditions require the use of a different operating fluid, the fluid can be changed as follows:



### NOTICE

#### Changing the type of operating fluid.

A change of operating fluid type can be only be made between mineral (P3) and synthetic operating fluid (D1). It is not possible to change from these two types to F4/F5 or the other way round!

→ For the two flushing processes and final fill, the pump needs to be filled up three times with fresh operating fluid, and this is the amount of operating fluid required.

- Perform two flushing processes with the new operating fluid.
- Clean any accessories present such as the ONF/OME or ORF/ODK and replace their filter elements; pay attention to whether more operating fluid is required.
- Fill the pump for the final time with the third filling.
- Note down the current type of operating fluid in an appropriate place on the pump (preferably on the type plate).

## 8 Decommissioning

### 8.1 Shutting down for longer periods

Before shutting down the pump, observe the following procedure and adequately protect the pump system against corrosion:

- Switch off pump.
- Change operating fluid.
- Start the pump and allow the pump to warm up.
- Switch off the pump.
- Fill up the pump with new operating fluid to the top edge of the sight glass.
- Close vacuum flange and exhaust flange with locking caps.
- Store the pump only dry and dust-free indoors within the specified environmental conditions.
  - In rooms with moist or aggressive atmospheres, the pump must be airproof shrink-wrapped in a plastic bag together with a bag of desiccant.
  - After storage periods longer than two years, it is recommended to carry out maintenance and change the operating fluid before using the pump.
- Do not store pump in the vicinity of machines, lanes, etc., because strong vibrations can damage the rotor bearings.

### 8.2 Re-starting



#### Emission of operating fluid!

Danger of the operating fluid being emitted at the exhaust flange if overfilled.

- Drain the operating fluid to the normal level before restarting the pump.



#### NOTICE

#### Re-starting

The serviceability of the operating fluid without operation is a maximum of 2 years. Before restarting after a shut-down of **2 years or longer**, carry out the following work.

- Replace the operating fluid.
- Replace the radial shaft sealing rings and further elastomer parts.
- Replace bearings at pumps with anti-friction bearings.
- Follow the maintenance instructions and inform Pfeiffer Vacuum.

### 8.3 Disposal

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

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

## 9 Malfunctions

Please note the following instructions should the pump malfunction:



### CAUTION

#### Hot surface!

Danger of burns if hot parts are touched. The surface temperature of the pump may rise above 105 °C in case of malfunction.

→ Carry out work on the pump only after it has cooled to a safe temperature.



### NOTICE

#### Motor overload!

Depending on the malfunction (e.g. blocking during cold start), the motor may not be sufficiently protected by the built-in thermal protection switch from damage through overheating.

→ Implement an additional network safety device.

### 9.1 Rectifying malfunctions

Problem	Possible causes	Remedy
Pump will not start up	No mains voltage or voltage does not correspond to the motor data	Check mains voltage and mains fuse protection; check motor switch
	Pump temperature too low	Warm up pump to > 12 °C
	Thermal protection switch has responded	Detect and fix cause of overheating; allow pump to cool off if necessary.
	Pump system dirty	Clean pump; contact Pfeiffer Vacuum Service if necessary.
	Pump system damaged	Clean and overhaul pump; contact Pfeiffer Vacuum Service if necessary.
	Motor defective	Replace motor
Pump switches off after a while after being started	Thermal protection switch of the motor has responded	Detect and fix cause of overheating; allow motor to cool off if necessary.
	Mains fuse protection triggered due to overload (e.g. cold start)	Warm up pump
	Exhaust pressure too high	Check opening of exhaust line and exhaust accessories
Pump does not attain ultimate pressure	Measurement reading is false	Check gauge, check ultimate pressure without installation connected.
	Pump or connected accessories are dirty	Clean pump and check components for contamination.
	Operating fluid dirty	Operate pump for a longer period with gas ballast valve open or change operating fluid
	Leak in system	Repair leak
	Operating fluid filling level too low	Top off operating fluid
	Pump damaged	Contact Pfeiffer Vacuum Service.
Pumping speed of pump too low	Intake line not well-dimensioned	Keep connections as short as possible and ensure that cross-sections are sufficiently dimensioned
	Exhaust pressure too high	Check opening of exhaust line and exhaust accessories
Loss of operating fluid	Swivel gasket leaky	Check tightness; replace gasket if necessary
	Radial shaft seal ring leaky	Replace seal ring and check bushing
	Operational loss of operating fluid, without ONF/OME	Install oil mist filter and oil return unit
	Operational loss of operating fluid, with ONF/OME	Clean oil mist filter and oil return unit, change filter respectively

Problem	Possible causes	Remedy
Unusual operating noises	Silencer dirty	Clean or replace the silencer.
	Damage to the pump system	Clean and overhaul pump; contact Pfeiffer Vacuum Service if necessary.
	Motor bearing defective	Replace motor; contact Pfeiffer Vacuum Service if necessary



<b>NOTICE</b>
<p><b>Service work should be carried out by a qualified person only!</b></p> <p>Pfeiffer Vacuum is not liable for any damage to the pump resulting from work carried out improperly.</p> <p>→ Take advantage of our service training programs; additional information at <a href="http://www.pfeiffer-vacuum.com">www.pfeiffer-vacuum.com</a>.</p> <p>→ Please state all the information on the pump rating plate when ordering spare parts.</p>

## 10 Service

### **Pfeiffer Vacuum offers first-class service!**

- Maintenance/repairs on site by Pfeiffer Vacuum field service
- Maintenance/repairs in a nearby service center or service point
- Fast replacement with exchange products in mint condition
- Advice on the most cost-efficient and quickest solution

Detailed information and addresses at: [www.pfeiffer-vacuum.com](http://www.pfeiffer-vacuum.com) (Service).

### **Maintenance and repairs in Pfeiffer Vacuum ServiceCenter**

The following steps are necessary to ensure a fast, smooth servicing process:

- ➔ Download the forms "Service Request" and "Declaration on Contamination".<sup>1)</sup>
- ➔ Fill out the "Service Request" form and send it by fax or e-mail to your Pfeiffer Vacuum service address.
- ➔ Include the confirmation on the service request from Pfeiffer Vacuum with your shipment.
- ➔ Fill in the contamination declaration and enclose it in the shipment (required!).
- ➔ Dismantle all accessories.
- ➔ Drain operating fluid/lubricant.
- ➔ Drain cooling medium, if used.
- ➔ Send the pump or unit in its original packaging if possible.

### **Sending of contaminated pumps or devices**

No units will be accepted if they are contaminated with micro-biological, explosive or radioactive substances. "Hazardous substances" are substances and compounds in accordance with the hazardous goods directive (current version). If pumps are contaminated or the declaration on contamination is missing, Pfeiffer Vacuum performs decontamination at the shipper's expense.

- ➔ Neutralise the pump by flushing it with nitrogen or dry air.
- ➔ Close all openings airtight.
- ➔ Seal the pump or unit in suitable protective film.
- ➔ Return the pump/unit only in a suitable and sturdy transport container and send it in while following applicable transport conditions.

### **Service orders**

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

<sup>1)</sup> Forms under [www.pfeiffer-vacuum.com](http://www.pfeiffer-vacuum.com)

# 11 Spare parts

## 11.1 Spare parts packages

The spare parts packages listed here are only applicable for standard models.

Please state all information on the rating plate when ordering spare parts. Other spare parts than those described in this manual must not be used without the agreement of Pfeiffer Vacuum.

### Set of radial shaft seal ring (RSSR)

- RSSR and felt ring
- Coupling, motor side

### Set of coupling for pump with magnetic coupling

- Can
- Coupling half, drive side
- Coupling half, pump side

### Maintenance kit and set of seals

The kit contains all the **critical wearing parts** that should be replaced after disassembly and cleaning the pump.

- Set of seals with all seals (O-rings) of the assembly groups and the subassemblies
- Radial shaft seal ring, coupling and felt ring
- Wearing parts pumping system
- Wearing parts vacuum safety valve

### Set of vanes

- Vanes
- Vane springs

### Overhaul kit and set of seals

The kit contains all the wearing parts that should be replaced after disassembly and cleaning the pump:

- Set of seals with all seals (O-rings) of the assembly groups and the subassemblies
- Wearing parts of the pumping system (incl. vanes and springs)
- Wearing parts of the valves
- Coupling spider.

Spare parts package	No.
Radial shaft ring kit incl. motor coupling	PK E06 100 -T
Coupling kit, M version	PK E06 011 -T
Maintenance kit+ set of seals, standard	PK E01 042 CT
Maintenance kit+ set of seals, M version	PK E01 043 CT
Set of vanes	PK E08 032 -T
Overhaul kit+set of seals, standard	PK E02 044 CT
Overhaul kit+set of seals, M version	PK E02 045 CT



## 12 Accessories

Designation	Duo 11	Duo 11 M
SAS 16, dust separator, DN 16 ISO-KF, polyester filter	PK Z60 506	PK Z60 506
KAS 16, condensate separator for pumping speeds from 1.6 to 12 m <sup>3</sup> /h	PK Z10 003	PK Z10 003
ONF 16 S, oil mist filter for pumping speeds up to 12 m <sup>3</sup> /h	PK Z40 001	PK Z40 001
OME 16 M, oil mist filter for pumping speeds of up to 12 m <sup>3</sup> /h	PK Z40 003	PK Z40 003
ZFO 16, zeolite trap	PK Z70 003	PK Z70 003
Operations monitoring unit 3 for Duo 1.6/3/6/11 and Duo 5/10/20 M	PK 196 141 -T	PK 196 141 -T
Operations monitoring unit 2 for Duo 1.6/3/6/11 and Duo 5/10/20 M	PK 196 142 -T	PK 196 142 -T
Operations monitoring unit 1 for Duo 1.6/3/6/11 and Duo 5/10/20 M	PK 196 157 -T	PK 196 157 -T
Mains cable 230 V with safety plug CEE 7, right angle IEC 320/C13 socket, 2 m	PK 050 109	PK 050 109
Mains cable 115 V with NEMA-plug, right angle IEC 320/C13 socket, 2 m	PK 050 110	PK 050 110
Mains cable 115 / 230 V without plug, right angle IEC 320/C13 socket, 3 m	PK 050 111	PK 050 111
Oil return unit from OME 16 S to Duo 1.6 / Duo 3	PK 005 986 -T	PK 005 986 -T
Oil return unit from OME 16 M to Duo 1.6, 3, 6, 11	PK 006 080 -T	PK 006 080 -T
Gas ballast valve - corrosive gas version	PK 194 144 -U	PK 194 144 -U
Gas ballast valve with magnet valve, 24 V DC	PK 194 343 -U	PK 194 343 -U

## 13 Technical data and dimensions

### 13.1 General

Conversion table: pressure units

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

1 Pa = 1 N/m<sup>2</sup>

Conversion table: gas throughput units

	mbar·l/s	Pa·m <sup>3</sup> /s	sccm	Torr·l/s	atm·cm <sup>3</sup> /s
mbar·l/s	1	0.1	59.2	0.75	0.987
Pa·m <sup>3</sup> /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 <sup>3</sup> /s	1.01	0.101	59.8	0.76	1

## 13.2 Technical data

Parameter	Duo 11
Flange (in)	DN 16 ISO-KF
Flange (out)	DN 16 ISO-KF
Pumping speed at 50 Hz	9.0 m <sup>3</sup> /h
Pumping speed at 60 Hz	10.5 m <sup>3</sup> /h
Ultimate pressure with gas ballast	3 · 10 <sup>-3</sup> hPa
Ultimate pressure without gas ballast	3 · 10 <sup>-3</sup> hPa
Exhaust pressure, min.	250 hPa
Exhaust pressure, max.	1500 hPa
Rotation speed at 50 Hz	3000 min <sup>-1</sup>
Rotation speed at 60 Hz	3600 min <sup>-1</sup>
Leak rate safety valve	≤ 1 · 10 <sup>-5</sup> Pa m <sup>3</sup> /s
Emission sound pressure level without gas ballast at 50 Hz	≤ 55 dB (A)
Ambient temperature	12-40 °C
Protection category	IP 40
Rated power 50 Hz	0.25 kW
Rated power 60 Hz	0.30 kW
Switch	Yes
Mains cable	No
Shipping and storage temperature	-25-+55 °C
Operating fluid filling	0.6 l
Weight	17 kg
Cooling method, standard	Air

Typical ultimate pressure according to PNEUROP

Parameter	Duo 11 M
Flange (in)	DN 16 ISO-KF
Flange (out)	DN 16 ISO-KF
Pumping speed at 50 Hz	9.0 m <sup>3</sup> /h
Pumping speed at 60 Hz	10.5 m <sup>3</sup> /h
Ultimate pressure with gas ballast	3 · 10 <sup>-3</sup> hPa
Ultimate pressure without gas ballast	3 · 10 <sup>-3</sup> hPa
Exhaust pressure, min.	250 hPa
Exhaust pressure, max.	1500 hPa
Rotation speed at 50 Hz	3000 min <sup>-1</sup>
Rotation speed at 60 Hz	3600 min <sup>-1</sup>
Leak rate safety valve	≤ 1 · 10 <sup>-5</sup> Pa m <sup>3</sup> /s
Emission sound pressure level without gas ballast at 50 Hz	≤ 55 dB (A)
Ambient temperature	12-40 °C
Protection category	IP 40
Rated power 50 Hz	0.25 kW
Rated power 60 Hz	0.30 kW
Switch	Yes
Mains cable	No
Shipping and storage temperature	-25-+55 °C
Operating fluid filling	0.6 l
Weight	19 kg
Cooling method, standard	Air

Typical ultimate pressure according to PNEUROP

### 13.3 Dimensions

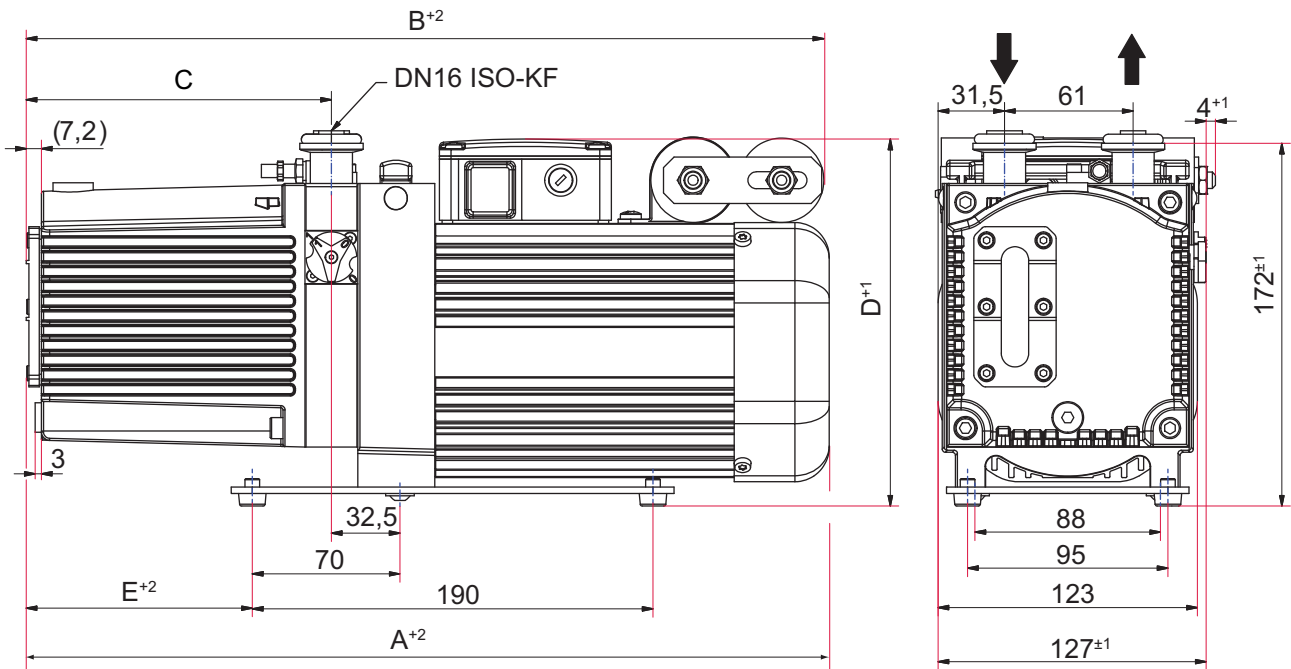


Fig. 16: Duo 11

Dimensions	Duo 11, 1-phase motor, 100-127 V, 50/60 Hz	Duo 11, 1-phase motor, 115/230 V, 50/60 Hz	Duo 11, 1-phase motor, 208-240 V, 50/60 Hz
A	411 mm	421 mm	411 mm
B	429 mm	418 mm	409 mm
C	185 mm	185 mm	185 mm
D	197 mm	191 mm	191 mm
E	147.5 mm	147 mm	147.5 mm

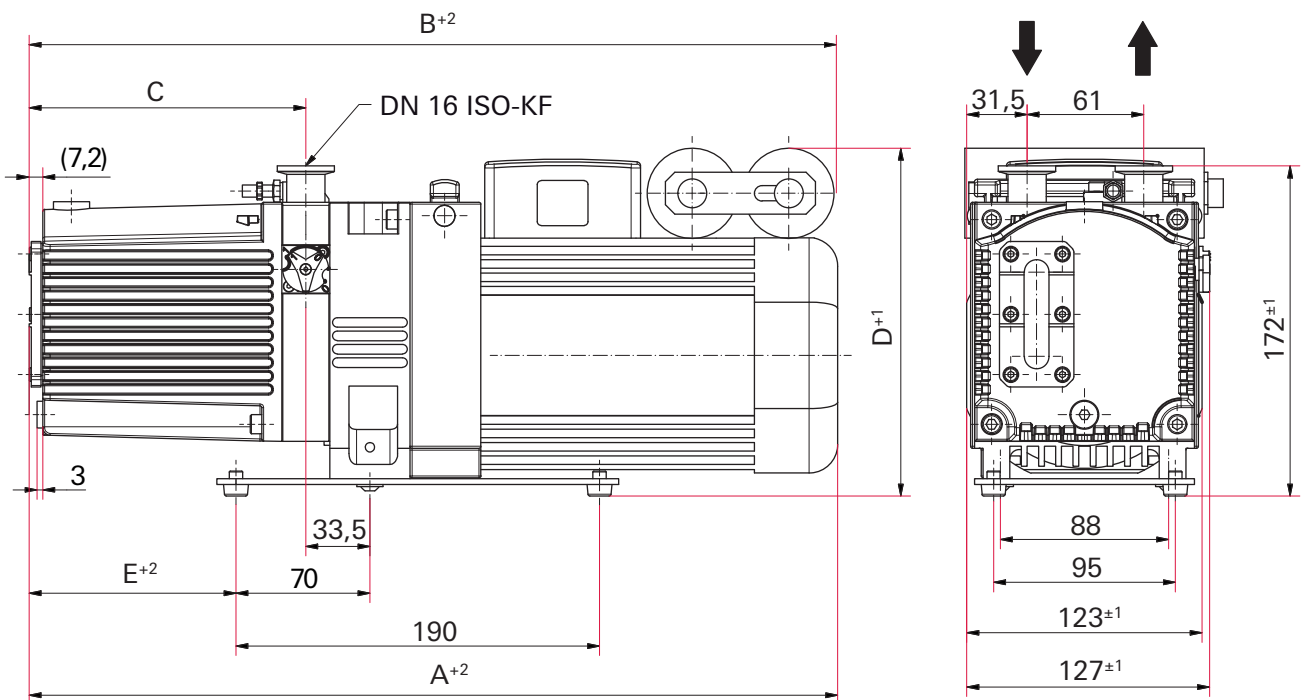


Fig. 17: Duo 11 M

<b>Dimen- sions</b>	<b>Duo 11 M, 1-phase mo- tor, 100-127 V, 50/60 Hz</b>	<b>Duo 11 M, 1-phase mo- tor, 115/230 V, 50/60 Hz</b>	<b>Duo 11 M, 1-phase motor, 208-240 V, 50/ 60 Hz</b>
A	463 mm	463 mm	463 mm
B	481 mm	460 mm	460 mm
C	185 mm	185 mm	185 mm
D	154 mm	192 mm	154 mm
E	197 mm	148 mm	192 mm



# Declaration of conformity

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

- **Machinery 2006/42/EC (Annex II, no. 1 A)**
- **Electromagnetic Compatibility 2014/30/EU**
- **Restriction of the use of certain Hazardous Substances 2011/65/EU**

The agent responsible for compiling the technical documentation is Mr. Sebastian Oberbeck, Pfeiffer Vacuum GmbH, Berliner Straße 43, 35614 Asslar.

## DuoLine

### Duo 11 / Duo 11 M

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

DIN EN ISO 12100 : 2010	DIN EN 61010-1 : 2010	DIN EN 61000-6-3 : 2007 + A1: 2011
DIN EN 1012-2 : 2011-12	DIN EN 61000-6-1 : 2007	DIN EN 61000-6-4 : 2007 + A1: 2011
DIN EN ISO 13857 : 2008	DIN EN 61000-6-2 : 2006	DIN EN ISO 2151 : 2: 2008
ISO 21360-1, 2 : 2012		

Signature:

Pfeiffer Vacuum GmbH  
Berliner Straße 43  
35614 Asslar  
Germany

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(Dr. Ulrich von Hülsen)  
Managing Director

2016-08-05

## **VACUUM SOLUTIONS FROM A SINGLE SOURCE**

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