



OPERATING INSTRUCTIONS

EN

Translation of the original instructions

DUO 1.6 / DUO 1.6 M / DUO 1.6 MC

Rotary Vane Pump

PFEIFFER  **VACUUM**

Table of contents

1	About this manual	3
1.1	Validity	3
1.2	Conventions	3
2	Safety	5
2.1	Safety precautions	5
2.2	Protective equipment	5
2.3	Proper use	6
2.4	Improper use	6
3	Transport and storage	7
3.1	Transport	7
3.2	Storage	7
4	Product description	8
4.1	Product identification	8
4.2	Function	9
5	Installation	9
5.1	Set-up	9
5.2	Connecting the vacuum side	10
5.3	Connecting the exhaust side	10
5.4	Connecting to the mains power supply	13
5.5	Filling up the operating fluid	16
6	Operation	17
6.1	Before switching on the pump	17
6.2	Switching on	17
6.3	Pumping condensable vapours	17
6.4	Topping up the operating fluid	20
6.5	Switching off the pump	21
7	Maintenance	22
7.1	Precautions	22
7.2	Changing the operating fluid	24
7.3	Changing the kind of operating fluid	26
7.4	Cleaning the gas ballast valve	27
8	Decommissioning	28
8.1	Shutting down for longer periods	28
8.2	Re-starting	28
8.3	Disposal	28
9	Malfunctions	29
9.1	Rectifying malfunctions	29
10	Service	31
11	Spare parts	32
11.1	Spare parts packages	32
12	Accessories	34
13	Technical data and dimensions	34
13.1	General	34
13.2	Technical data	35
13.3	Dimensions	35
	Declaration of conformity	37

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.

Applicable documents

Duo 1.6 / Duo 1.6 M / Duo 1.6 MC	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

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

- 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:

DANGER
<p>Imminent danger Indicates an imminent hazardous situation that will result in death or serious injury.</p>
WARNING
<p>Possibly imminent danger Indicates an imminent hazardous situation that can result in death or serious injury.</p>
CAUTION
<p>Possibly imminent danger Indicates an imminent hazardous situation that can result in minor or moderate injury.</p>
NOTICE
<p>Command or note 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

M version: Version with magnetic coupling

MC version: C-Version with magnetic coupling

RSSR: Radial Shaft Seal Ring

OME: Oil mist eliminator

ODK: Oil drain kit with return unit

Symbols used

The following symbols are used consistently throughout in all illustrations:

- Ⓥ 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.
 - **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
<p>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.</p>



CAUTION
<p>Increased noise emission! Increased noise emission can occur within a limited area surrounding the vacuum pump. → Provide noise protection or → wear hearing protection.</p>

2.3 Proper use



NOTICE
<p>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.</p>

- 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.

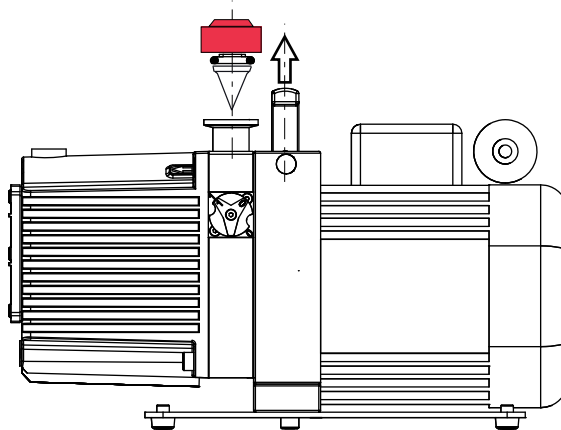


Fig. 1: Transporting the pump

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.

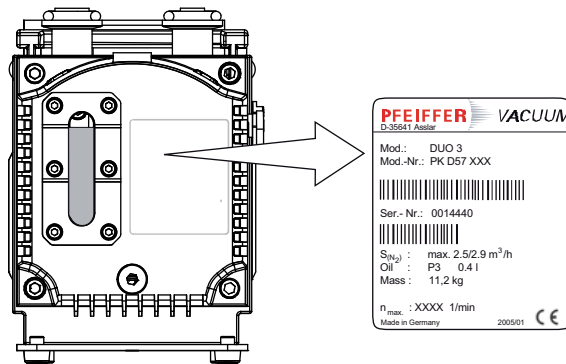


Fig. 2: Product identification on the rating plate

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

Variants

Pump type	Pump versions
Duo 1.6	Standard version of pump
Duo 1.6 M	M version of pump; differences from the standard version: <ul style="list-style-type: none"> • Magnetic coupling
Duo 1.6 MC	C version of pump; differences from the standard version: <ul style="list-style-type: none"> • Operating fluid F4 • Magnetic coupling capsulated on pump side • Vane material changed • Hose connection at the gas ballast valve • Leak rate $\leq 1 \cdot 10^{-8}$ Pa m³/s

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.

The version with magnetic coupling has as an alternative to conventional shaft feedthrough a static and maintenance-free seal towards the outside.

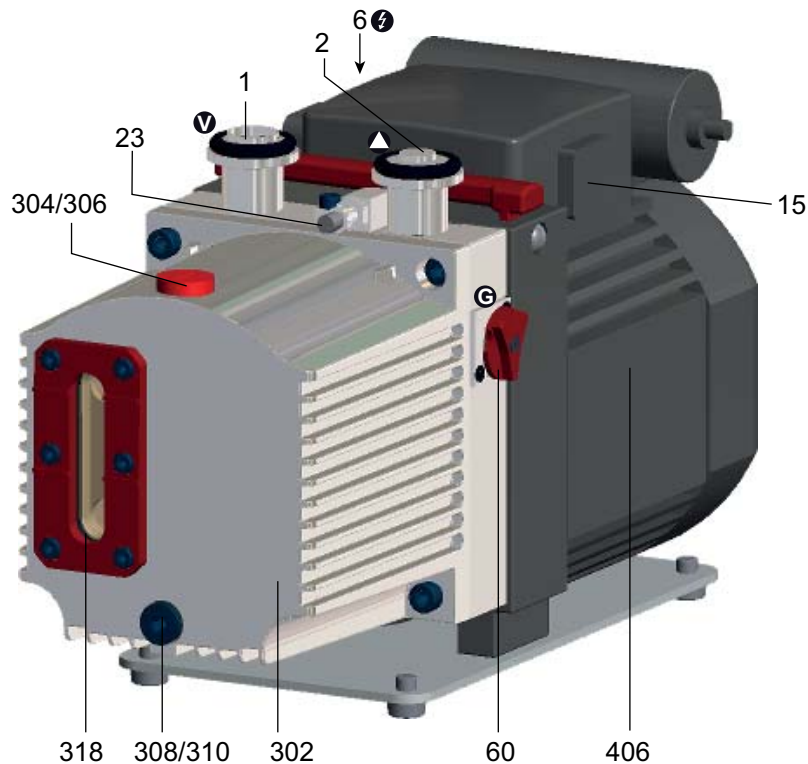


Fig. 3: Duo 1.6

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

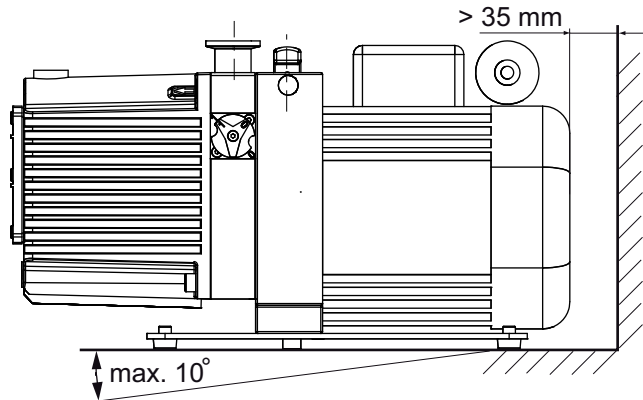


Fig. 4: Setting up the pump

- Fill up with operating fluid before operating the first time (see p. 16, chap. 5.5).
 - 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; if necessary, exchange the base for one with mounting holes (on request).
- 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



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.



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.

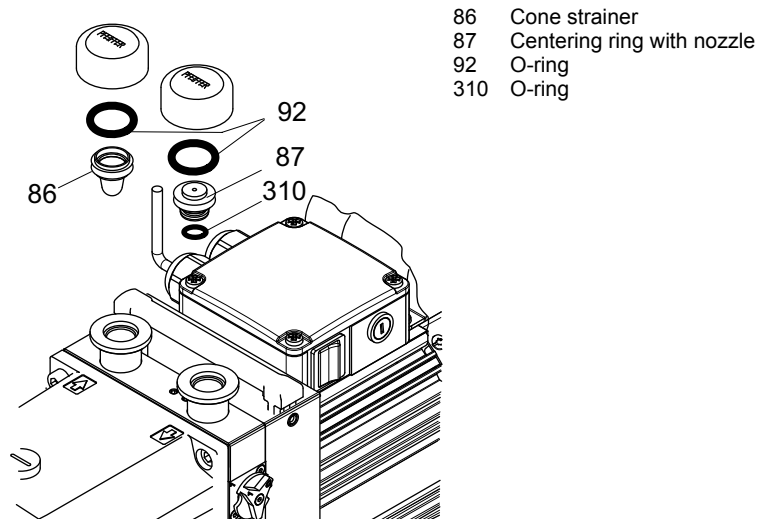


NOTICE

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.



- 86 Cone strainer
- 87 Centering ring with nozzle
- 92 O-ring
- 310 O-ring

- Before attaching the piping at the exhaust flange remove locking cap and insert centering ring/centering ring with nozzle with the respective O-rings.
- 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.

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

- Turn off the vacuum pump, vent to atmospheric pressure and allow to cool.
- Remove the protective cap from the connection flange.
- Zentrierring mit Düse 87 durch einen Standard-Zentrierring (DN 16 ISO-KF) ersetzen.
- Place OME on the exhaust side of the pump with flange pointing downwards and fit with clamping ring (accessories), pay attention to centering ring.

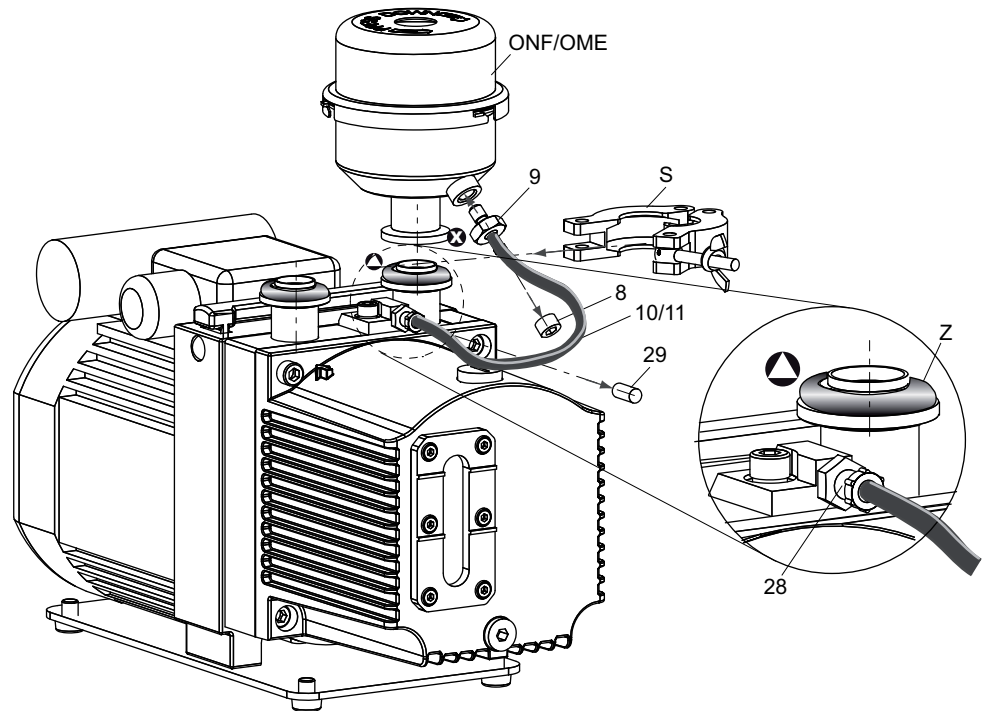


Fig. 5: Duo 1.6 with operating fluid return line

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.
- Unscrew and remove the union nut of the screw fitting 28 and remove the sealing plug 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)



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.

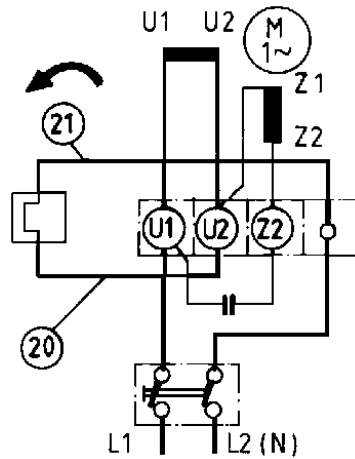


Fig. 6: Motor circuit diagram with switch

Fuse protection

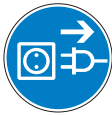


The transmission power of the pump’s magnetic coupling is so great that the coupling is no overload protection for the motor.

- 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], ± 10 %	Frequency [Hz]	Nominal current [A]	Recommended fuse, slow [A]	Cable/plug version
230 ... 240	50	1.15	2.5	Safety plug (C14) at terminal box
230 ... 240	60	1	2.5	
105	50	1.7	4	Safety plug (C14) at terminal box
115 ... 125	60	2.5	5	
100	50	1.8	4	Safety plug (C14) at terminal box
95 ... 105	60	2.6	5	

Changing the voltage range



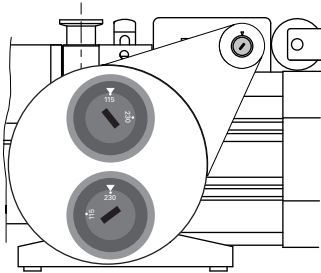
NOTICE

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.

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 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

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 fluids

- P3 (Standard operating fluid)
- F4 (Operating fluid for corrosive gas versions)



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

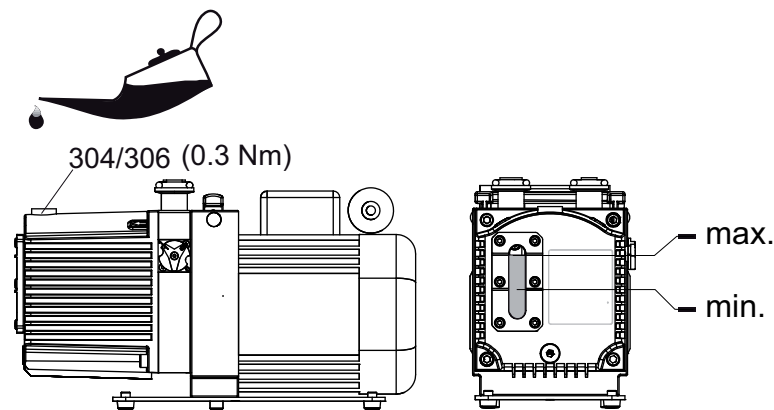


Fig. 7: Filling up the operating fluid

- 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.
- Screw in operating fluid filler screw 304; pay attention to O-ring 306.



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.

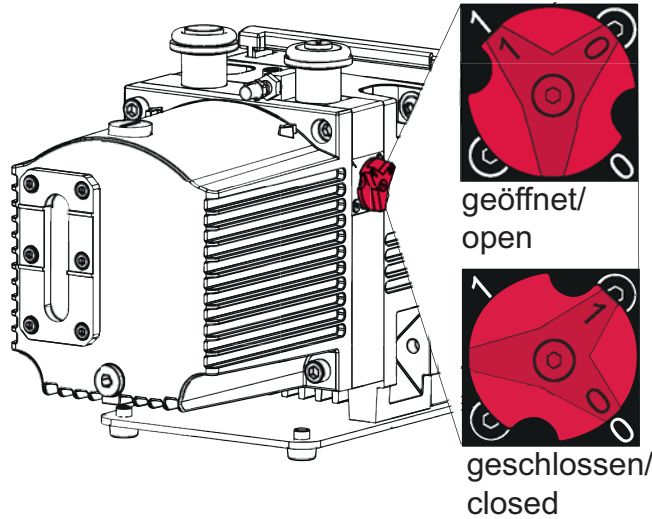


Fig. 8: Standard version 42 of gas ballast valve

Operation with accessories

Gas ballast valve with flushing gas connection

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



NOTICE

Flushing gas pressure higher than allowed endangers the operational reliability of the pump.

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!

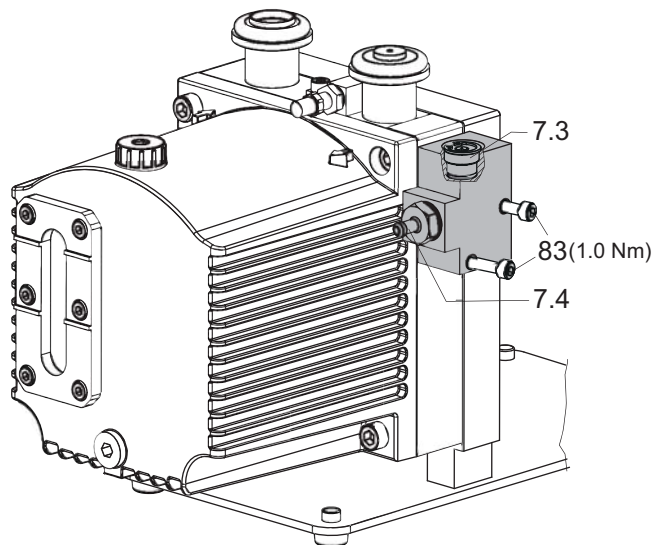


Fig. 9: Gas ballast valve with flushing gas connection

- 7.3 Proportioning screw 83 Schrauben
- 7.4 Flushing gas connection (for DN 5 mm hose)

- Tighten screws 83, **torque of 1 Nm.**
- 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.
 - Amount of flushing gas max. 180 l/h.

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.



NOTICE

Flushing gas pressure higher than allowed endangers the operational reliability of the pump.

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!

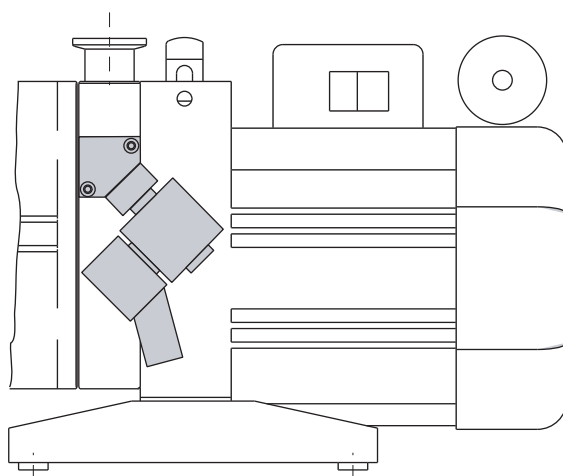


Fig. 10: Assembling the solenoid valve at the gas ballast inlet

Performance data of the solenoid valve	
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

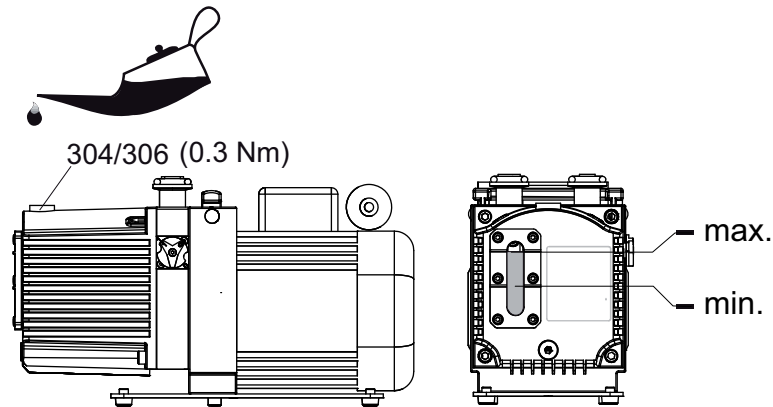


Fig. 11: Filling up the operating fluid

- Unscrew operating fluid filler screw 304.
- When the pump is at operation temperature, top up the operating fluid up to the "max." marking.
- Screw in operating fluid filler screw 304; pay attention to O-ring 306.

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 ≥ 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
<p>Danger of injury from moving parts! After power failure or motor shutdown due to overheating, the motor may restart automatically.</p> <ul style="list-style-type: none"> → 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
<p>Pump parts may be contaminated from pumped media! Danger of poisoning due to contact with harmful substances.</p> <ul style="list-style-type: none"> → 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.



NOTICE
<p>Service work should be carried out by a qualified person only! Pfeiffer Vacuum is not liable for any damage to the pump resulting from work carried out improperly.</p> <ul style="list-style-type: none"> → Take advantage of our service training programs; additional information at www.pfeiffer-vacuum.com. → Please state all the information on the pump rating plate when ordering spare parts.

- 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
<p>Strong magnetic field in the vicinity of the drive system! Danger to life for persons with cardiac pacemakers when the drive system is disassembled.</p> <ul style="list-style-type: none"> → 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

Pfeiffer Vacuum recommends to have maintenance carried out by the manufacturer's service. In the event of a breach of the required intervals set out below or in case of improperly completed maintenance work, any warranty and liability claims with respect to Pfeiffer Vacuum shall be rendered void. This also applies if Pfeiffer Vacuum original spare parts are not used.

Activity	Inspection	Maintenance, level 1	Maintenance, level 2	Maintenance, level 3	Required equipment
specified in the document	BA	BA	WA	WA	
Interval	daily	≤ annually	≤ 2 years	≤ 4 years	
Inspection					
Visual, audible pump inspection Check operating fluid: ⇒ Check fill level ⇒ Check colour (dirt accumulation) ⇒ Check pump for leaks	■				
Check accessories (according to respective operating instructions)	■				
Maintenance Level 1 – Change of operating fluid					
Clean pump exterior ⇒ Pump housing ⇒ Clean engine fan cover Change operating fluid		■			Operating fluid Maintenance kit 1
Extended activities: ⇒ Disassemble cover ⇒ Clean cover internally and pump system externally (without cleaning agent) ⇒ Disassemble and clean gas ballast valve Replace parts subject to wear		■ as required			
Replace filter in the external accessories – if present (according to respective operating instructions)		■ as required			
Maintenance Level 2 – Change of shaft seal					
⇒ Partially disassemble pump ⇒ Replace RWDR and coupling half Does not apply in respect of pumps with magnetic coupling			■		Radial shaft seal kit
Extended activities: Disassemble and clean pump, replace seals and the following parts subject to wear: ⇒ Vacuum safety valve parts subject to wear (hydraulic piston) ⇒ Exhaust valve parts subject to wear (exhaust valve flap) ⇒ Gas ballast valve parts subject to wear (valve flap) ⇒ Vane springs			■ as required		Maintenance kit 2
Maintenance Level 3 – Overhaul					
Disassemble and clean pump, replace seals and all parts subject to wear: ⇒ vane ⇒ valves, springs and sight glass ⇒ silencer nozzle				■	Overhaul kit

BA: Operating instructions, **WA:** Maintenance instructions

Depending on operating conditions, the required maintenance intervals, which stay within the reference values specified in the table. Where applicable, consult with Pfeiffer Vacuum.

You can find the corresponding spare parts in the Spare parts pack chapter (see p. 32, chap. 11.1).

1. Operating fluid are required for all activities and must in each case be ordered separately.

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.

- 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.
- Place a collecting vessel under the drain hole.
- Unscrew operating fluid drain screw 308.
- Drain the operating fluid while still quite hot;
 - to empty the pump fully, tip it forward slightly.

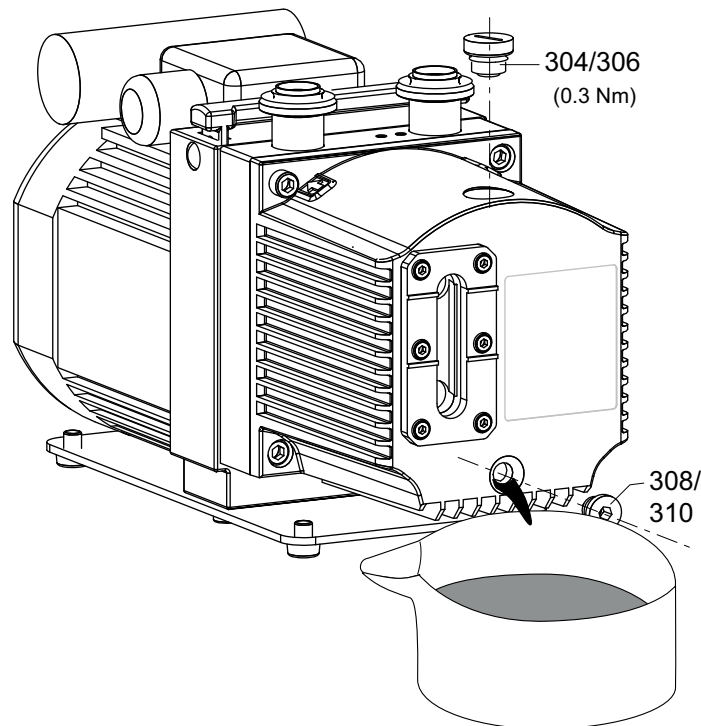


Fig. 12: Draining the operating fluid

- Screw in operating fluid drain screw 308; pay attention to O-ring.
- Screw in operating fluid filler screw 304; pay attention to O-ring 306.
- 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):
- Screw in operating fluid drain screw 308; pay attention to O-ring 310.
- Fill up with operating fluid and check the filling level (see p. 16, chap. 5.5).
- Screw in operating fluid filler screw 304; pay attention to O-ring 306.

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.
- 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 casing, clean casing inside 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 (see p. 16, chap. 5.5).
- 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).

7.4 Cleaning the gas ballast valve

Gas ballast valve, standard version

Dismantling

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

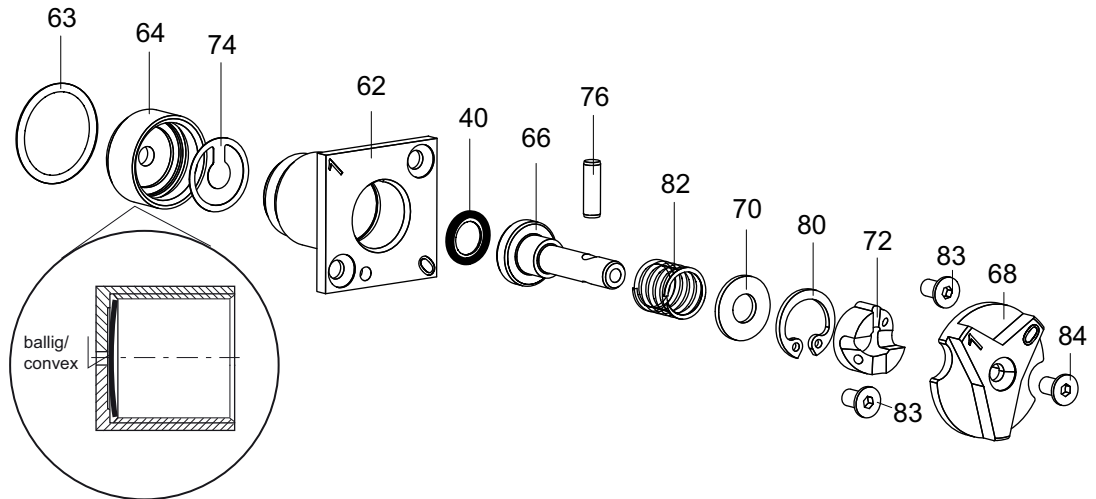


Fig. 13: Standard version 42 of gas ballast valve

62	Flange housing	70	Washer	82	Compression spring
63	O-ring	72	Cam plate	83	Countersunk screw
64	Screw cap	74	Valve tongue	84	Countersunk screw
66	Tappet	76	Cylinder pin	78	O-ring
68	Knob	80	Circlip		

- Unscrew the screws 83.
- Pull flange housing 62 from the support stand 12; watch O-ring 63.
- Unscrew screw 84 and dismantle knob 68
- Unscrew screw cap 64; watch valve tongue 74.
- Pull valve tappet 66 from valve housing 62 until cylinder pin 76 can be removed.
- Use an appropriate plier to remove cam plate 72 and circlip 80; watch washer 70 and compression spring 82.
- Remove valve tappet 66 from flange housing 62; watch O-ring 78.
- Clean all parts and examine for wear.
- Replace wear parts in accordance with service kit.

Assembling

- Place valve tongue 74 precisely in screw cap 64; convex side facing down.
 - First place valve flap on a level surface to determine convex side.
- Hand tighten flange housing 62 with screw cap 64.
- Position O-ring 78 level into the groove of valve tappet 66.
- Insert valve tappet 66 into flange housing.
- Assemble compression spring 82 and washer 70.
- Engage circlip 80 into groove in the flange housing.
- Push cam plate 72 on valve tappet 66; watch length groove on the flange housing.
- Pull valve tappet 66 and insert cylinder pin in the valve tappet bore; allow valve tappet 66 to retract.
- Bring valve tappet 66 into position "1" (open) by rotating cam plate 72 with cylinder pin 76.
- Assemble knob 68 on valve tappet and secure with counter-sunk screw 84 (torque: **2 Nm**).
- Insert complete valve with O-ring 63 into the support stand 12 and tighten with screws 83 (torque: **1 Nm**).

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



NOTICE
<p>Service work should be carried out by a qualified person only!</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 www.pfeiffer-vacuum.com.</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 (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".¹⁾
- 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.

¹⁾ Forms under www.pfeiffer-vacuum.com

11 Spare parts

11.1 Spare parts packages

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.

Spare parts package	Version	Order no.
Maintenance kit 1 – Maintenance Level 1	standard, M version	PK E01 050 CT
Radial shaft seal ring kit – Maintenance Level 2	standard	PK E06 100 CT
Maintenance kit 2 – Maintenance Level 2, extended ¹	standard	PK E01 040 CT
Maintenance kit 2 – Maintenance Level 2, extended ²	M/MC version	PK E01 041 CT
Overhaul kit – Maintenance Level 3	standard	PK E02 070 CT
	M version	PK E02 071 CT
Set of vanes	standard, M version	PK E08 030 -T
Set of vanes	MC version	PK E08 034 -T
Coupling set	M version	PK E06 013 -T
Coupling set	MC version	PK E06 010 -T

1. incl. radial shaft seal ring
2. without radial shaft seal ring

Maintenance kit 1, PK E01 050 CT

Maintenance kit 1 – Maintenance Level 1

The level 1 maintenance kit includes the seals for filler and drain screw for a change of the operating fluid and the seal for the cover for cleaning the oil chamber. Furthermore the seals and parts subject to wear are included for cleaning the gas ballast valve.

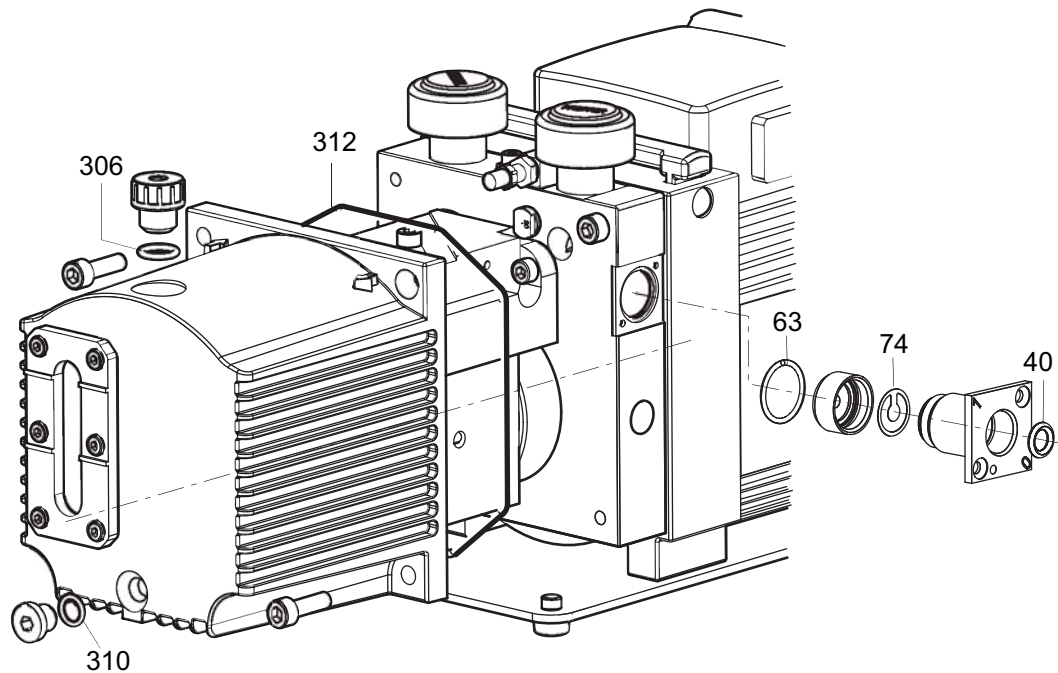


Fig. 14: Standard pump model

Item no.	Description	Size	Quantity
40	O-ring, FPM	6 x 2,2	1
63	O-ring, FPM	16,5 x 1,5	1
74	Valve tongue		1
306	O-ring, FPM	10 x 2,5	1
310	O-ring, FPM	8 x 2	1
312	O-ring, FPM	123 x 2,5	1

Radial shaft seal ring kit – Maintenance Level 2

The kit contains all the parts that should be replaced when changing the operating fluid and the RSSR:

- RSSR, coupling and felt ring
- O-rings for changing the operating fluid
- Wearing parts of the gas ballast valve

Maintenance kit 2 – Maintenance Level 2, extended

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

- Set of seals
- Wearing parts gas ballast valve
- Radial shaft seal ring, coupling and felt ring
- Valves and vane springs

Overhaul kit 1 – Maintenance Level 3

The overhaul kit includes all **parts subject to wear** for the pump, which should be replaced after disassembly and cleaning of the pump:

- Set of seals
- Wearing parts pump system (including vane and springs)
- Wearing parts vacuum safety valve
- Wearing parts gas ballast valve

Set of vanes

- Vanes
- Vane springs

Set of coupling for pump with magnetic coupling

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

12 Accessories

Designation	Duo 1.6	Duo 1.6 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 ³ /h	PK Z10 003	PK Z10 003
ONF 16 S, oil mist filter for pumping speeds up to 12 m ³ /h	PK Z40 001	PK Z40 001
Ölrückführung aus ONF 16 S in Duo 1.6 / Duo 3	PK 005 986 -T	PK 005 986 -T
OME 16 M, oil mist filter for pumping speeds of up to 12 m ³ /h	PK Z40 003	PK Z40 003
Ölrückführung aus ONF 16 M in Duo 1.6, 3, 6, 11	PK 006 080 -T	PK 006 080 -T
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
P3, mineral oil, 1 l	PK 001 106 -T	PK 001 106 -T
P3, mineral oil, 5 l	PK 001 107 -T	PK 001 107 -T
P3, mineral oil, 20 l	PK 001 108 -T	PK 001 108 -T

13 Technical data and dimensions

13.1 General

- Recommendations of PNEUROP committee PN5
- ISO 21360; 2007: "Vacuum technology - Standard methods for measuring vacuum-pump performance - General description"

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

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

Conversion table: gas throughput 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

13.2 Technical data

Parameter	Duo 1.6	Duo 1.6 M
Flange (in)	DN 16 ISO-KF	DN 16 ISO-KF
Flange (out)	DN 16 ISO-KF	DN 16 ISO-KF
Pumping speed at 50 Hz	1.25 m ³ /h	1.25 m ³ /h
Pumping speed at 60 Hz	1.50 m ³ /h	1.50 m ³ /h
Ultimate pressure with gas ballast	$3 \cdot 10^{-3}$ hPa	$3 \cdot 10^{-3}$ hPa
Ultimate pressure without gas ballast	$3 \cdot 10^{-3}$ hPa	$3 \cdot 10^{-3}$ hPa
Exhaust pressure, min.	Atmospheric pressure	250 hPa
Exhaust pressure, max.	1500 hPa	1500 hPa
Rotation speed at 50 Hz	1500 min ⁻¹	1500 min ⁻¹
Rotation speed at 60 Hz	1800 min ⁻¹	1800 min ⁻¹
Leak rate safety valve	$\leq 1 \cdot 10^{-5}$ Pa m ³ /s	$\leq 1 \cdot 10^{-5}$ Pa m ³ /s
Emission sound pressure level without gas ballast at 50 Hz	≤ 48 dB (A)	≤ 48 dB (A)
Ambient temperature	12-40 °C	12-40 °C
Protection category	IP 40	IP40
Rated power 50 Hz	0.075 kW	0.075 kW
Rated power 60 Hz	0.090 kW	0.090 kW
Switch	Yes	Yes
Mains cable	No	No
Shipping and storage temperature	-25-+55 °C	-25-+55 °C
Operating fluid filling	0.4 l	0.4 l
Weight	9.6 kg	10.5 kg
Cooling method, standard	Air	Air

Typical ultimate pressure according to PNEUROP

13.3 Dimensions

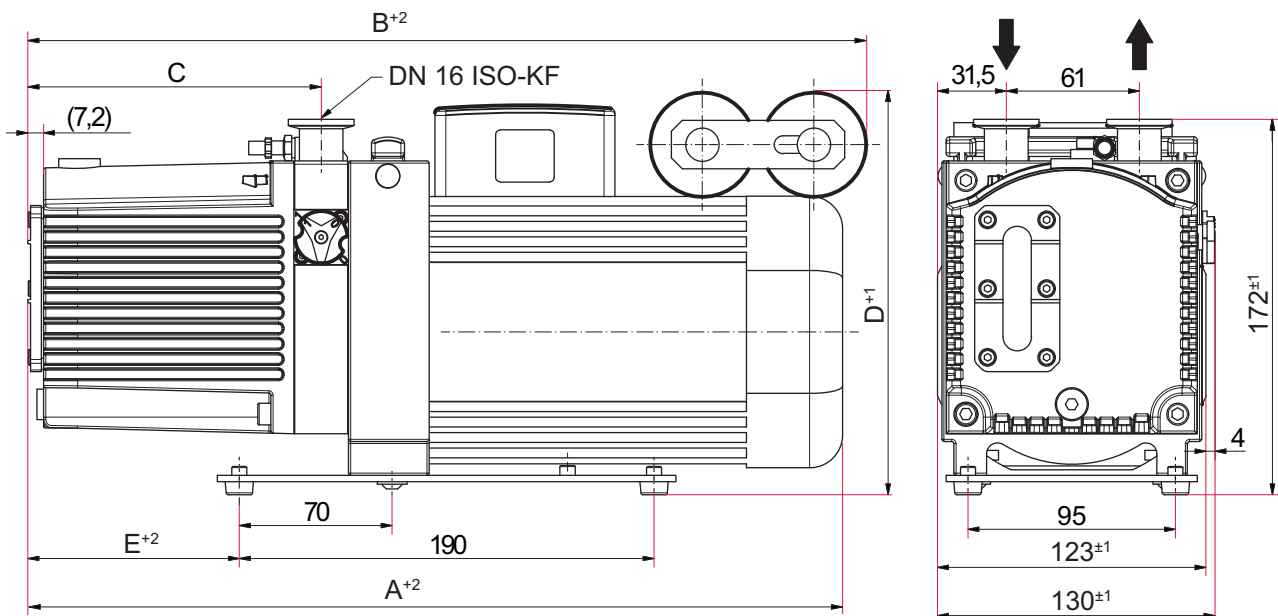


Fig. 15: Duo 1.6

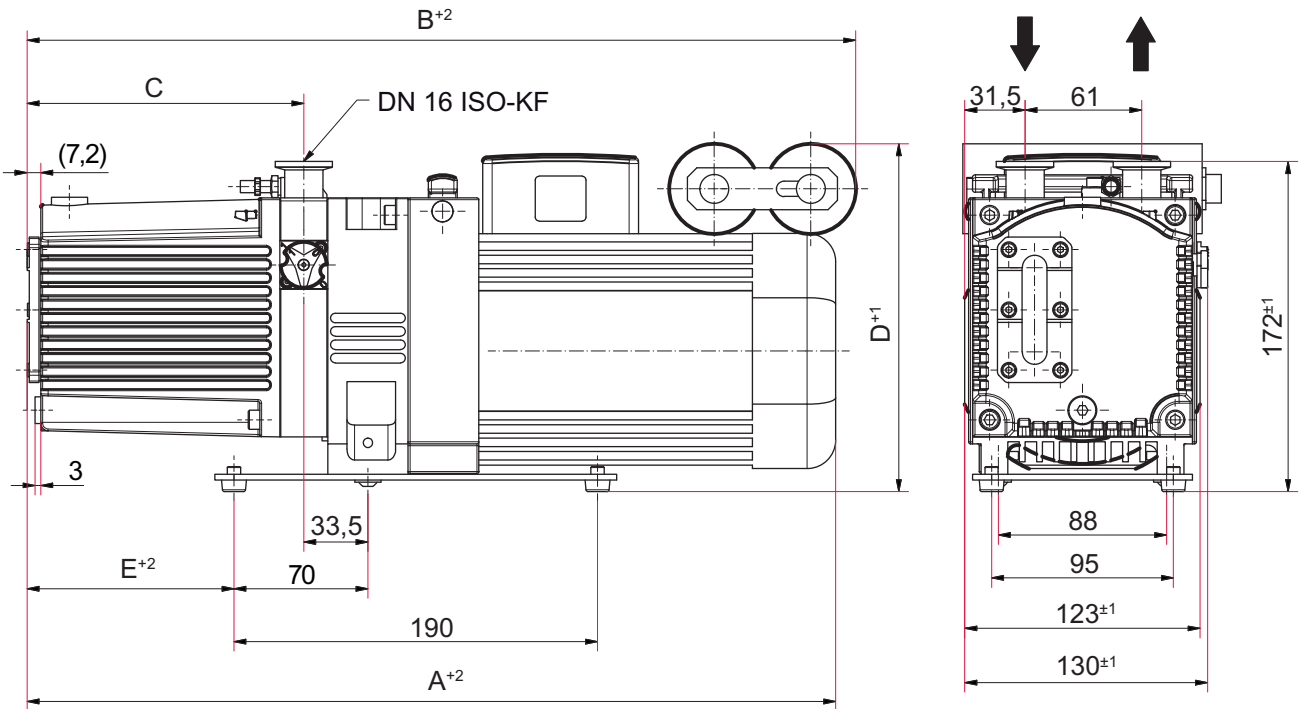


Fig. 16: Duo 1.6 M

Di- men- sions	Duo 1.6 M	Duo 1.6 M	Duo 1.6	Duo 1.6
	Duo 1.6 M, 1-phase motor, 105 V, 50 Hz; 115-125 V, 60 Hz	Duo 1.6 M, 1-phase motor, 230-240 V, 50/60 Hz	Duo 1.6, 1-phase motor, 105 V, 50 Hz; 115-125 V, 60 Hz	Duo 1.6, 1-phase motor, 230-240 V, 50/60 Hz
A	357 mm	357 mm	315 mm	315 mm
B	376 mm	357 mm	335 mm	315 mm
C	123 mm	123 mm	123 mm	123 mm
D	192 mm	189 mm	192 mm	189 mm
E	85.5 mm	85.5 mm	85.5 mm	85.5 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 1.6 / Duo 1.6 M / Duo 1.6 MC

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

(Dr. Ulrich von Hülsen)
Managing Director

2017-08-15

VACUUM SOLUTIONS FROM A SINGLE SOURCE

Pfeiffer Vacuum stands for innovative and custom vacuum solutions worldwide, technological perfection, competent advice and reliable service.

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