OPERATING INSTRUCTIONS

EN

Translation of the original instructions

UNIDRY^{TM} 50

Rotary Piston Pump

PP 0938 BEN/O (1604)

PFEIFFER VACUUM

Table of contents

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

UniDry^{IM} 50	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

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

Imminent danger

Indicates an imminent hazardous situation that will result in death or serious injury.

WARNING

Possibly imminent danger

Indicates an imminent hazardous situation that can result in death or serious injury.

CAUTION

Possibly imminent danger

Indicates an imminent hazardous situation that can result in minor or moderate injury.

NOTICE

Command or note

Command to perform an action or information about properties, the disregarding of which may result in damage to the product.

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

DM version: Pressure surge protected version

RSSR: Radial shaft seal ring

Symbols used

The following symbols are used consistently throughout in all illustrations:

- Vacuum flange
- Exhaust flange
- Gas ballast connection
- Sealing gas connection
- 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 80 °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.
- Use sealing gas, depending on the process.
- 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
- operation of the pump with open vacuum or fore-vacuum flange open to the atmosphere
- use of the vacuum pump to generate pressure
- 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
- the evacuation of gases that may form adherent deposits or condensate in the suction chamber

3 Transport and storage

3.1 Transport

The vacuum pumps are checked for functioning in the factory and packed properly on pallets. In the packaged condition, the vacuum pump can be moved with a pallet truck.

WARNING

Danger from falling and swinging loads!

When lifting the pump there is a danger of falling parts.

➔ Make sure that there are no persons under the suspended load.

➔ Close off and supervise the area under the pump.

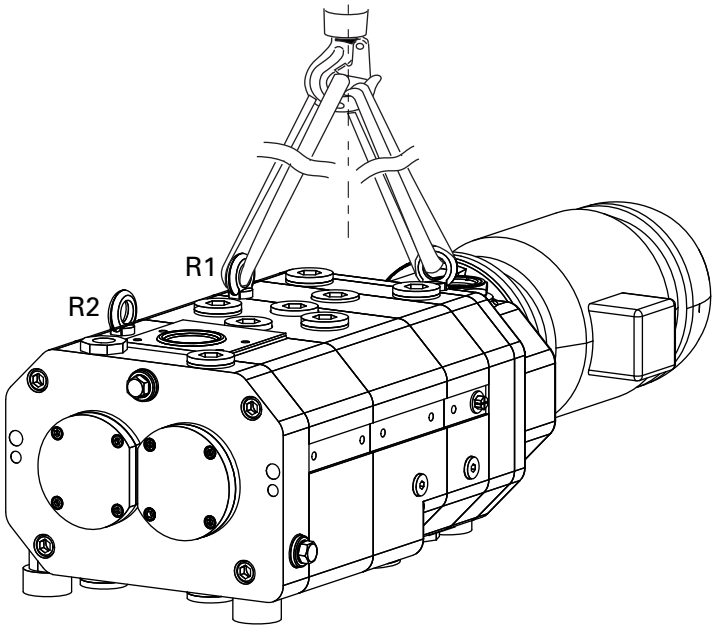


Fig. 1: Transporting the pump

➔ Look for transportation damage when receiving the pump.

➔ Lift the pump using lifting devices, and use only the eye bolts provided for that purpose on the top side of the pump.

➔ When lifting without motor, move eye bolt from position R1 to R2.

➔ Reuse the transport container of the vacuum pump.

– Transport or ship vacuum pumps in the original packing preferably.

➔ Remove the locking cap from the vacuum and fore-vacuum flange immediately before connecting!

3.2 Storage

The pumps of standard design are not provided with a corrosion protection. Therefore a special corrosion protection should be provided by the customer and agreed with the manufacturer for longer storage. Otherwise should be proceeded as follows.

➔ Check that all the openings on the pump are securely closed.

➔ Store the pump only indoors, preferably at temperatures between -10 °C and +40 °C.

- 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 lubricant 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.

- Serial number
- Pump model and model number
- Type and amount of lubricant

For motor-specific data, please see the separately installed motor rating plate.

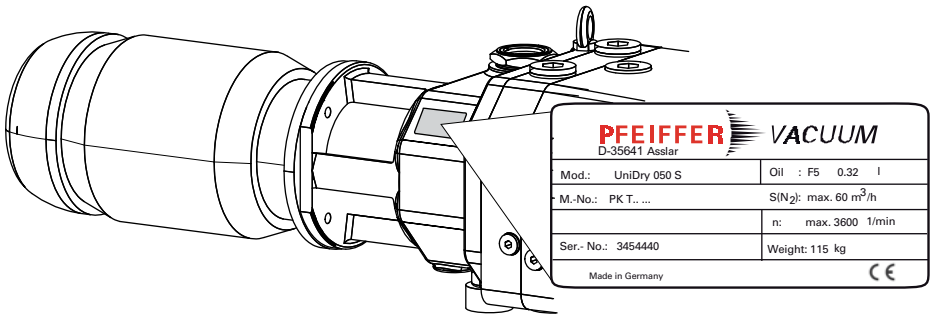


Fig. 2: Product identification on the rating plate (example)

Scope of delivery

- Pump with drive unit
- Lubricant (only for standard pump)
- Operating instructions

Variants

Pump type	Pump designs
UniDry™ 50 SM	Version with magnetic coupling ● Vacuum flange (option): DN 40 ISO-KF, DN 63 ISO-F, DN 100 ISO-F ● Exhaust flange: DN 25 ISO-KF ● Ultimate pressure at 50 Hz: 5 • 10^{-2} hPa ● Ultimate pressure at 60 Hz: 5 • 10^{-2} hPa
UniDry™ 50 SDM	Pressure surge protected version with magnetic coupling ● Vacuum flange (option): DN 40 ISO-KF, DN 63 ISO-F, DN 100 ISO-F ● Exhaust flange: DN 25 ISO-KF ● Ultimate pressure at 50 Hz: 5 • 10^{-2} hPa ● Ultimate pressure at 60 Hz: 5 • 10^{-2} hPa

4.2 Function

The UniDry^{TM} 50 is a three/four stage, valveless dry pump with a nominal pumping speed of 50 m^3/h. Higher pumping speeds can be achieved easily in combination with Roots pumps. The pump can be used in most chemical, semiconductor and standard applications. The use of accessories permits the pump to be adapted to specific process conditions.

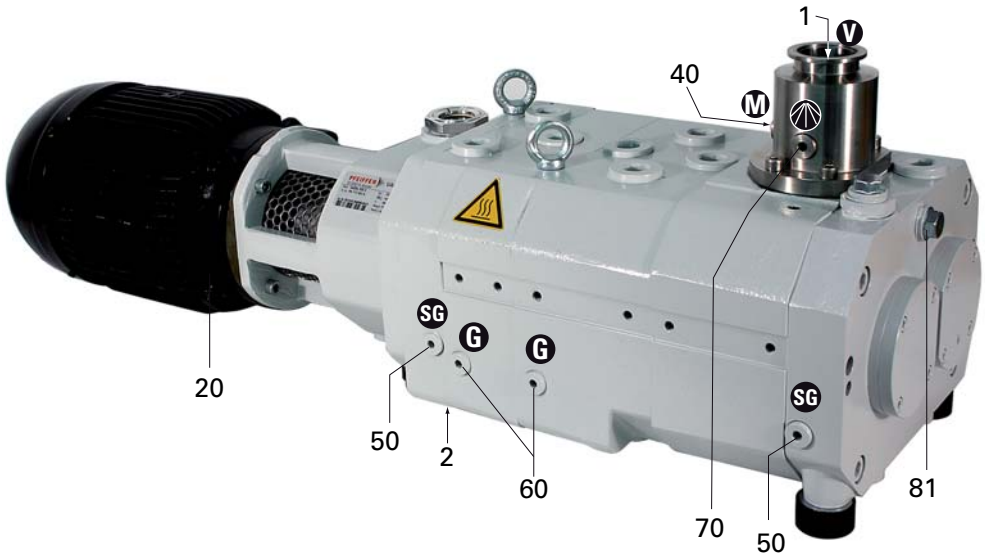
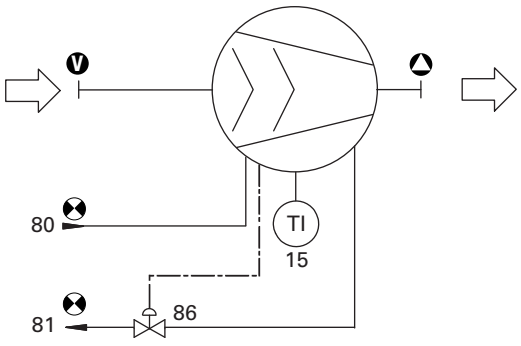


Fig. 3: UniDry^{TM} 50 S

1	Vacuum flange	40	Measuring connection	70	Flushing gas connection
2	Exhaust flange	50	Sealing gas connection	81	Cooling water connection, outlet
20	Motor	60	Gas ballast connection		

Water cooling

To dissipate the heat arising from compression of the gases, the cooling chambers of the pump must be connected to an external coolant suppy (e.g. water). The cooling water flows through the cooling chambers and absorbs the heat there. Connection of the flow-through cooling system is described under *(see p. 19, chap. 5.6)*.



80	Cooling water inlet
81	Cooling water outlet
15	Thermometer
86	Cooling water regulator

Fig. 4: Cooling water connection scheme

4.3 Range of application

The vacuum pumps are conceived for use in coarse and fine vacuum application. They can be used for pumping gases and gas mixtures. All corresponding product-specific safety requirements must be followed.

Make sure that no solids can enter the pump. We recommend installation of a suitable intake filter or protective strainer. The pump can transport a limited amount of surge fluid, which can enter the pump through process errors. If this happens, the pump must be run dry with flushing gas after the process end and the silencer completely emptied.

5 Installation

5.1 Setting up the pump

When installing the pump, observe the following conditions:

➔ Always place the pump on a firm, even surface.
- Check the load-bearing capacity of the floor at the installation location.
- The vacuum flange serves as the reference surface.
- Threaded holes in the anti-vibration buffers can be used for fastening.

➔ When installing the pump in a closed housing, ensure there is sufficient air circulation.
- Voltage and frequency information given on the motor rating plate must be visible.
- Keep the ventilation openings at the motor free, in order to provide sufficient cooling air.

➔ Fill up with lubricant before operating the first time *(see p. 14, chap.)*.
- Amount and type according to rating plate

Installation conditions

The vacuum pump must be installed and operated under the following ambient conditions:

Installation location	Inside; must however be protected against dust deposits Outside; must however be protected against direct weather influences
Permissible ambient temperature range	+5 °C ... +40 °C
Relative humidity	Max. 85 %
Installation altitude	Max. 2000 m above m.s.l., the rated power of the motor is reduced by approx. 10 % for installation altitudes > 1000 m and an ambient temperature of 40 °C
Power connections	according to voltage and frequency information given on the motor rating plate

5.2 Filling with lubricant

The type and amount of lubricant is visible on the pump's rating plate for each vacuum pump. Generally only the lubricant used during initial assembly can be used later on.

Permissible lubricants

- P3 (standard)
- F5
- Other lubricants 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 with lubricant

➔ Unscrew lubricant filler screws 31.

➔ Fill in lubricant.

➔ Check lubricant level when the pump is running at operating temperature in final vacuum:
- Fill level during operation: as per the sight glass image.
- Check fill level during continuous operation on a daily basis, otherwise each time the pump is switched on. To add lubricant, switch off the pump and vent it to atmospheric pressure.

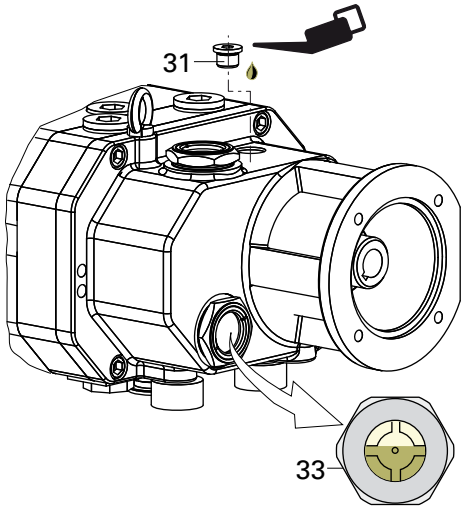


Fig. 5: Standard version

31 Lubricant filler screw
33 Sight glass

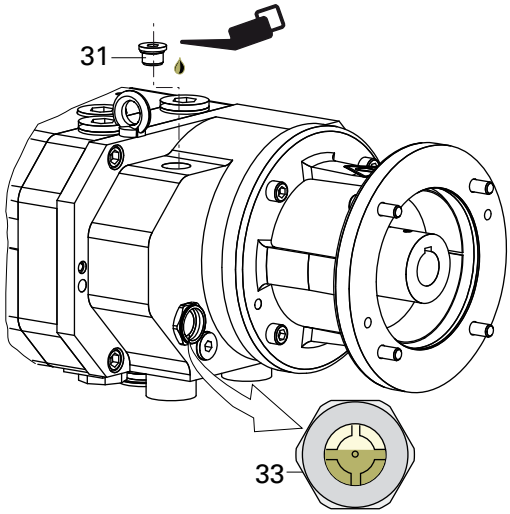


Fig. 6: Version with magnetic coupling

31 Lubricant filler screw
33 Sight glass

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.

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.

➔ Screw in lubricant filler screw 31.

➔ Close intake port valve (if present) or cover intake flange.

➔ Start pump and run it for max. 5 minutes.

➔ Switch off pump and check fill level; add lubricant if necessary.

➔ Open intake port valve.

5.3 Connecting the vacuum side

WARNING

Exposed, rotating rotors!

Fingers and hands can become crushed when the intake flange is open.

➔ Do not expose any body parts to the operating range of the rotors.

➔ Disconnect the motor from the power supply before performing work on the intake flange.

NOTICE

Danger of intake of solid particles!

Even in clean processes, fouling from the system must be anticipated during initial commissioning.

➔ Use a suitable start-up strainer at the intake connection (see accessories).
➔ Ensure that this strainer is only removed when the risk of solid particles entering the pump can be excluded.
➔ Note loss of pumping speed if necessary.

➔ The connection between the pump and the vacuum chamber should be kept as short as possible and should have at least the nominal diameter of the pump flange. Use a greater nominal diameter on line lengths > 5 m.
➔ Install shut-off valve in the intake line so that the process gas feed can be stopped.
➔ Piping to the pump must be suspended or supported.
  – Physical forces from the piping system must not be allowed to act on vacuum pumps.
➔ Clear welded lines of any welding scales, loose parts etc. before installation.

5.4 Connecting the exhaust side

CAUTION

High pressure in the exhaust line!

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

➔ Install the line without shut-off valves on the exhaust side.
➔ If there is danger of a build-up of excess pressure (> 1500 hPa abs.) in the lines, observe all official accident prevention safety regulations.
➔ If the exhaust gases are being extracted, the exhaust pressure must be at least 250 hPa greater than the pressure at the intake side.

➔ 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.

5.5 Connecting to the mains power supply

The pumps are supplied with three-phase motors for different voltages and frequencies. The applicable motor type is shown on its rating plate.

DANGER

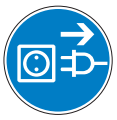
Voltage-bearing elements

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. Recommended: Type K slow blow circuit breaker.

NOTICE

Danger of overloading the magnetic coupling!

There is an increased starting torque, when using energy-efficient motors, which can lead to overrunning of the motor and to demagnetization of the magnetic coupling.

➔ Motor according to IE2: Soft start relay or frequency converter **recommended**.

➔ Motor according to IE3: Soft start relay or frequency converter **required**.

The three-phase current motor circuit

The direction of rotation must be checked on pumps with three-phase motors!

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 **Δ**. The voltage between the mains supply lines is called mains voltage. The mains current is the current which flows in the supply lines.

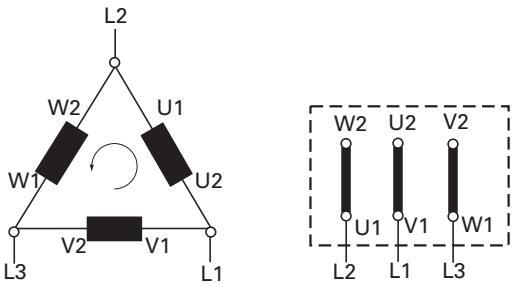


Fig. 7: Motor coil and connecting plate of Delta Connection (for low voltage)

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**.

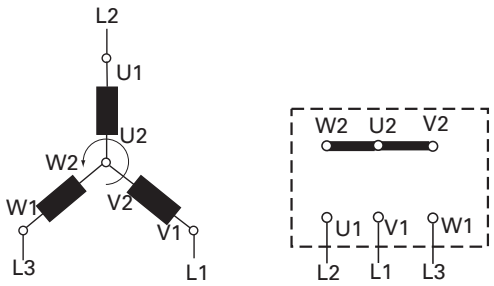


Fig. 8: Motor coil and connecting plate of Star Connection (for high voltage)

Visual inspection of the direction of rotation

➔ Check the direction of rotation of the pump after switching on for the first time:
  – To do this, switch the pump briefly ON and OFF again (for a max. of 5 seconds).

➔ Compare the direction rotation of the motor or the coupling with the directional arrow on the housing cover.
  – Looking from the motor side, the correct direction of rotation is in a clockwise direction.

➔ If the direction of rotation is incorrect: Swap two of the three phase contacts at the connecting cable.

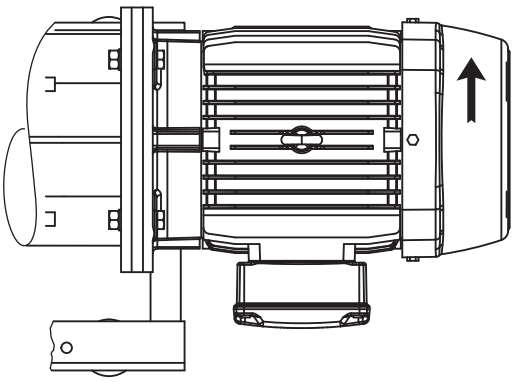


Fig. 9: Checking the direction of rotation (pump motor in top view)

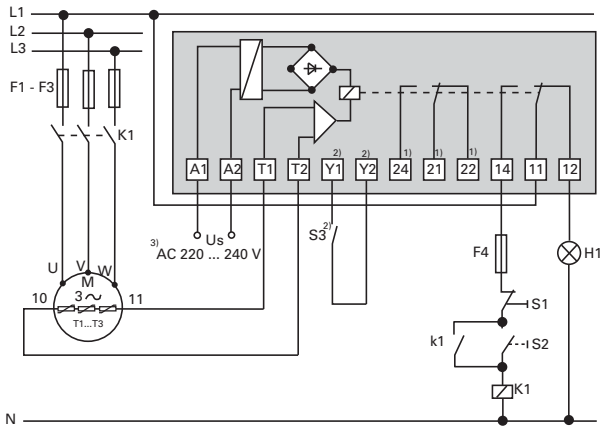
Motor protection

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.



U_S Control voltage
S_1 OFF button
S_2 ON button
S_3 RESET button, external
K1 Contactor
F1 ... F4 Fuses
T1... T3 PTC resistor sensor
H1 Tripping indicator
M Motor, 3-phase

1) Only for devices with two relay outputs
2) Only for MSR type
3) Only for order no.: P 4768 051 FQ

Fig. 10: Connection example for a three-phase AC motor with PTC resistor tripping device

5.6 Connecting accessories

Connecting the cooling water

The warming up of the UniDry™ 50 is dependent on various factors such as, for example, the intake pressure, operations with or without gas ballast, gas temperature at the inlet, the rotation speed (50/60 Hz or operations with frequency converter), type of gas, ambient temperature etc.).

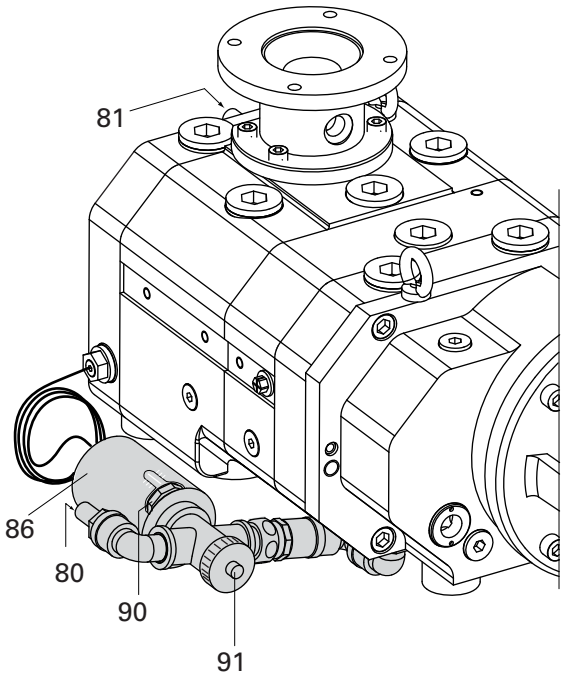
For detailed information about installation and operation, refer to the operating instructions for the cooling water unit CWK 50 (PP 0960 BN).

CAUTION

Overheating of the pump!

The value set on the cooling water controller corresponds to the temperature at the intake side of the pump. **The temperature is approximately 30 °C higher at the exhaust side** (motor side).

➔ Only adjust the cooling water controller within the permitted setting range of 40 ... 70 °C to adapt the operating temperature to the process conditions.



80 Cooling water inlet
81 Cooling water outlet
86 Cooling water regulator
90 Setting disk
91 Venting screw

Fig. 11: Cooling water regulator 86

➔ Connect the cooling water lines:
  – Cooling water inlet (80).
  – Cooling water outlet (81); must be pressure-free.

➔ With a screw driver set setting disk 90 of the cooling water regulator to the desired operating temperature.
  – Factory setting is 55 °C.

NOTICE

Damage to the pump rotor

For applications with short evacuating cycles or increased ambient temperature the rotor can get blocked after switching off and restarting the motor, because of different rates at which the pump housing and the rotor cool down.

➔ Switch off water cooling supply as well as a separately driven fan immediately when switching off the pump.

Silencer

The silencer reduces the pump noise and collects any condensates that may arise.

For detailed information about installation and operation, refer to the operating instructions for the exhaust silencer (PP 1001 BN).

Non-return valve

The non-return valve prevents backflow of exhausted gases.

Temperature monitoring

The pump can be fitted with a PT 100 temperature resistor 15 for monitoring the temperature of the housing.

Observe the recommended temperature limits:

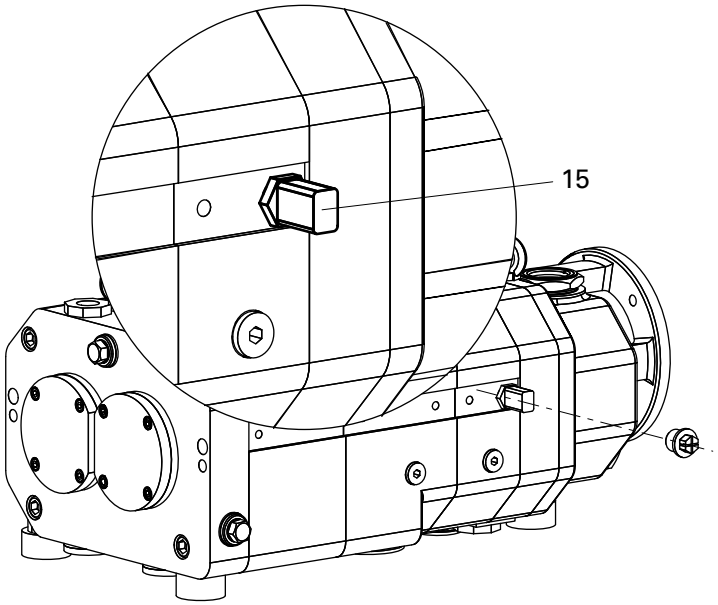
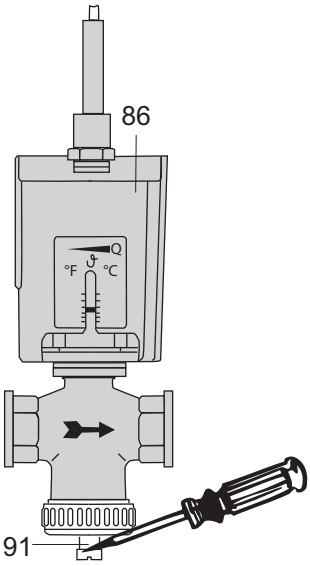


Fig. 12: Temperature resistor (PT 100)

– T1 = 110 °C Pre-alarm
– T2 = 135 °C Excess temperature

6 Operation

6.1 Before switching on



➔ Check lubricant levels at both sight glasses and at the oiler as well.

➔ Check process-specific and pump-specific media supplies.

➔ Operate shut-off units in the exhaust line in such a way that they open before or at the same time as starting the pump.

➔ 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. protective strainer); if necessary, check lubricant regularly or replace at shorter intervals.

➔ Open cooling water supply;

– lever down screw 91 at the cooling water controller 86 by using a screwdriver and vent the cooling chambers.

6.2 Switching on the pump

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

➔ Switch on vacuum pump via mains power supply;

– The pump achieves its operating temperature after approx. 30 minutes and thus the specified ultimate pressure.

➔ Check process-specific and pump-specific media supplies.

➔ Open shut-off valve in the intake line and switch the pump over to the process.

➔ Check the pump operation visually and acoustically. If malfunctions occur (noise, overheating, etc.), switch off the pump immediately.

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 80 °C.

➔ In this case, use suitable finger guards.

WARNING

Increased noise emission!

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

➔ Provide noise protection or

➔ wear hearing protection.

CAUTION

Thermal overload of the pump!

Evacuation at higher intake pressure during continuous operation may cause pump damage.

➔ The pump may only be operated at a maximum of 50 Hz where intake pressure of > 400 hPa in non-stop operations are involved.

NOTICE

Thermal motor overload!

Inadequate cooling at low motor speeds.

➔ When operating the pump with frequency converter, follow the rotation speed range, specified in the technical data.

Temperature monitoring

A temperature switch built into the pump cylinder is used to monitor the pump temperature.

The electrical connection must be made in such a way that an alarm is triggered when the trigger point (135°C) is exceeded. The pump must be switched off no more than 30 seconds afterward.

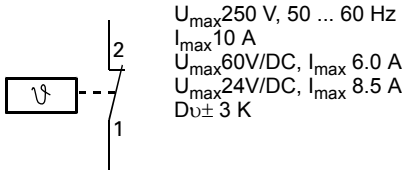


Fig. 13: Connecting the temperature switch

Inertization

Please refer to operating instructions of the inert gas panel (PP 1005 BN) for detailed instructions on installation and operation.

6.3 Switching off

In the case of clean processes that convey pure gases, the pump can be switched off in every pressure range and directly after the process end. When the evacuated medium in the suction chamber causes strong contamination or deposits, the vacuum pump should be flushed with air or nitrogen after the process end.

CAUTION

Danger of damage to the inside of the pump!

Danger of contamination of the pump interior when pumping out reactive gases.

➔ After pumping, flush the pump interior with nitrogen.

➔ Close shut-off valve in the intake line and separate the pump from the process.

➔ Switch off the pump.

➔ When inert gas is used: Stop inert gas supply.

➔ Stop cooling water supply.

Flush pump with flushing gas

➔ Close shut-off valve in the intake line and separate the pump from the process.

➔ Open flushing gas feed at the intake flange.

➔ Pump is operated for an additional 20 to 40 minutes while flushing gas is suctioned in.

➔ Switch off the pump.

➔ Stop flushing gas feed.

➔ Stop cooling water supply.

Flush pump with liquid

In the case of special applications in which process materials can stick inside the pump, the pump interior can be flushed with liquid.

If water is used as the flushing liquid, it must be demineralised (<5° dGH):

German GH	French GH	English GH	American GH
1° dGH	1.78°	1.25 e	17.9 mg/kg $CaCO_3$

Fig. 14: Hardness (GH) conversion table

➔ Close shut-off valve in the intake line and separate the pump from the process.
➔ Open flushing liquid feed at the intake flange.
➔ Supply flushing liquid in low doses, max. 0,1 l/min.
➔ Operate the pump (10 ... 15 minutes) with n < 30 Hz during the flushing process.
➔ After the flushing process, continue to operate the pump with mean gas throughput for another 20 minutes at 20 hPa intake pressure to remove liquid remnants completely.
➔ Stop flushing liquid feed.
➔ Switch off the pump.
➔ Stop cooling water supply.

6.4 Switching off and venting

In the case of clean processes that convey pure gases, the pump can be switched off in every pressure range and directly after the process end. When the evacuated medium in the suction chamber causes strong contamination or deposits, the vacuum pump should be flushed with air or nitrogen after the process end.

If venting of the vacuum chamber is not required, then the intake port valve must be closed before switching off the pump in order to prevent venting of the vacuum chamber.

WARNING

Exposed, rotating rotors!

Danger of crushing! The rotors will continue to run under vacuum after the motor has been switched off.

➔ Never disconnect any pipe connections at the vacuum flange or fore-vacuum flange or any sealing gas lines while the pump is running.

NOTICE

High pressure in the sealing gas line when the pump is switched off!

Risk of damage to the pump seals.

➔ Lower sealing gas pressure to < 1200 hPa or stop sealing gas feed immediately.

Flush pump with flushing gas

➔ Close shut-off valve in the intake line and separate the pump from the process.
➔ Open flushing gas feed at the intake flange.
➔ Pump is operated for an additional 20 to 40 minutes while flushing gas is suctioned in.
➔ Close sealing gas valve.
➔ Switch off the pump.
➔ Venting should be performed via the suction side, do not ventilate vacuum chambers through the pump.
➔ Stop flushing gas feed.

Switching back on

After switching off the pump it can be switched back on again within 5 minutes. If you wait any longer then leave the pump to cool to ambient temperature before switching back on again.

NOTICE

Roots pump damage due to the rotors starting up!

Differences in the rate of cooling of the pump housing and rotors can cause damage to the pump.

➔ If the pump / pumping station is switched off and at a standstill for > 5 minutes, then only switch it on again after ventilation and a waiting period of at least 120 minutes to allow a balanced temperature of rotors and housing.

7 Maintenance

7.1 Precautions

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 (≤ 2m) 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.

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.

➔ Remove the vacuum pump from the system, if necessary.

➔ Allow the lubricant to drain off.

➔ Stop cooling water feed and remove cooling water intake and output lines.

➔ Blow compressed air through the cooling water system and completely empty cooling water channels to avoid rust and frost damage.

➔ 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.

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.

Maintenance intervals depend very greatly on individual operating conditions. The following values should be considered typical values that may be shortened or lengthened. For operation under difficult conditions, such as high dust in the environment or in the gases to be pumped, a considerable shortening of the maintenance interval can occur.

Service work	2000 h	8000 h	16000 h
Clean ventilator cowl of the drive motor	X		Pump undergoes general overhaul (PV) But not later than every 4 years
Clean exhaust silencers	X		
Check non-return valve for dirt; clean, if necessary	X		
Check air filter at the flushing device for dirt; clean or replace, if necessary	X		
Greasing the loose bearings	X		
Replacement of the loose bearings		X	
Change lubricant		X	
Check cooling water connection lines for dirt; clean, if necessary		X	
Check intake and exhaust lines; clean or replace, if necessary		X	
Replacement of all wearing parts such as radial shaft seals, protective bushing and all gaskets (including between the housing and end plate)			X (PV)
Replacement of the fixed bearings			
Depending on the process, the required replacement intervals for lubricants and the intervals for inspection, maintenance and overhaul may be shorter than the guide values specified in the table. Consult with Pfeiffer Vacuum Service, if necessary.			

7.2 Changing the lubricant

WARNING

Hot operating fluid!

Danger of burns when draining due to contact with skin.

➔ Wear suitable protective clothing.

➔ Use a suitable collecting vessel.

Changing the lubricant

The intervals for replacing lubricant in the gear and bearing chambers are heavily dependent upon the operating conditions.

➔ Change the lubricant at least once every year.

➔ Turn off the vacuum pump, vent to atmospheric pressure and allow to cool.

➔ Unscrew lubricant filler screws 31.

➔ Unscrew the lubricant drain screw 32 and drain the lubricant; pay attention to the O-ring!

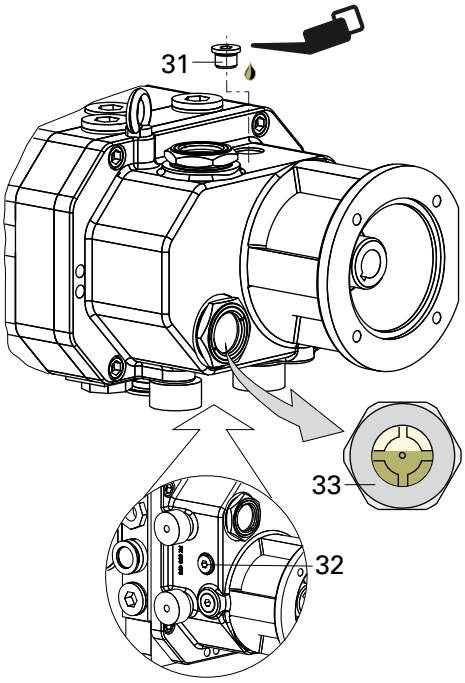


Fig. 15: Standard version

31 Lubricant filler screw
32 Lubricant drain screw
33 Sight glass

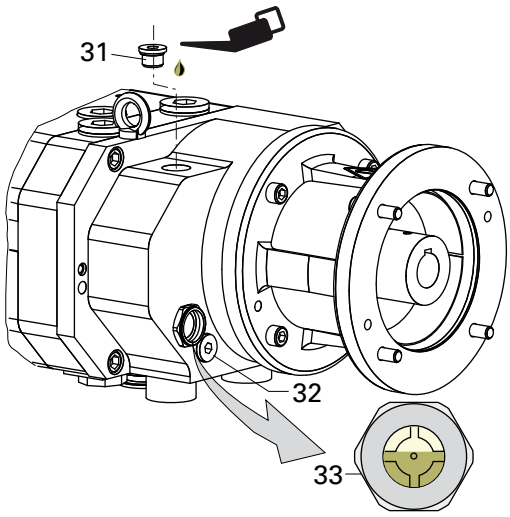


Fig. 16: Version with magnetic coupling

31 Lubricant filler screw
32 Lubricant drain screw
33 Sight glass

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

➔ Screw in lubricant drain screw 32 with O-ring.

➔ Fill with new lubricant and check fill level.

➔ Screw in lubricant filler screw 31.

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.

7.3 Greasing the loose bearings

NOTICE

Greasing the loose bearings at the vacuum side
Usual re-lubrication intervals: **2000 operating hours** or one year at the latest.
➔ Only use vacuum grease which is specified by Pfeiffer Vacuum.
➔ Change the bearings every two years.

➔ Dismantle both bearing covers 35.
➔ Remove old grease using a clean synthetic spatula.
➔ Using a syringe **apply 5.0 ml** of vacuum grease between the bearing outer and inner rings **of each bearing**.
– The grease must be distributed (injected) evenly in the spaces between the bearing balls and complete to the front edge of the washer.
➔ Re-fit the two bearing covers; take care with the O-rings.

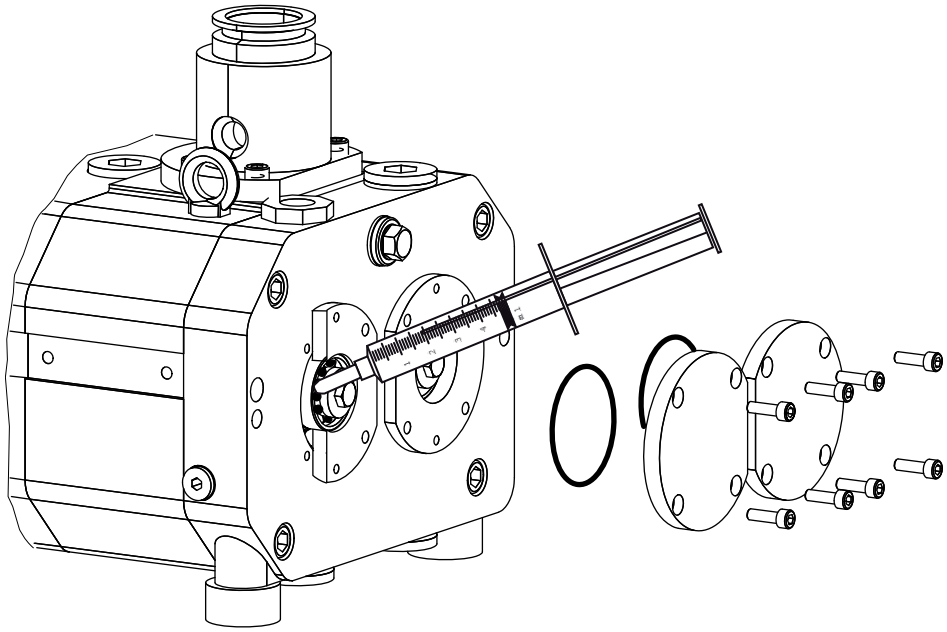


Fig. 17: Greasing the loose bearings

7.4 Assembling the motor and coupling

WARNING

Exposed, rotating coupling!

Items of clothing could be trapped and wound up.

➔ When mounting the motor, always ensure a correct seating of the coupling protection.

➔ Wear close-fitting clothing.

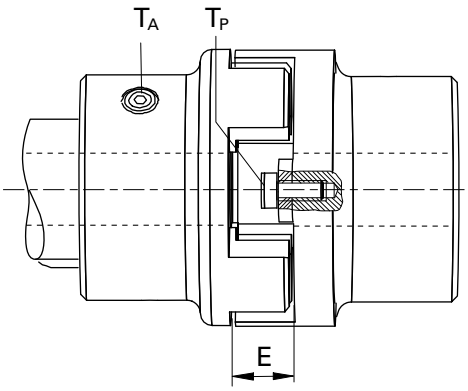
Crown gear coupling

When performing installation work on the coupling, it is important to observe the installation instructions of the coupling manufacturer:

www.ktr.com/de/tools-downloads/montageanleitungen/

➔ The shaft of the drive motor must be aligned with the pump shaft:
- Observe the permissible angular and radial displacements.
- Maintain clearance E so that the crown gear can still move axially.

➔ Tighten the screws in the coupling half with the prescribed torque and secure the stud bolt with Loctite 243.



E:20 mm
T_A: 10 Nm
T_P: 32 Nm

Fig. 18: Assembling the crown gear coupling at pump with standard coupling

Magnetic coupling

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

➔ Before working on the motor, it is essential to read and observe the Supplementary Information PW 0142 BN.

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 (≤ 2m) 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.

NOTICE

Danger of bursting when the motor is removed!

The separating can of the magnetic coupling is made of plastic or ceramics, and can be destroyed when the motor is pulled off.

➔ Suspend the motor at the eyebolt to the lifting device and pull it off horizontally.

➔ Use jack screws and guide pins.

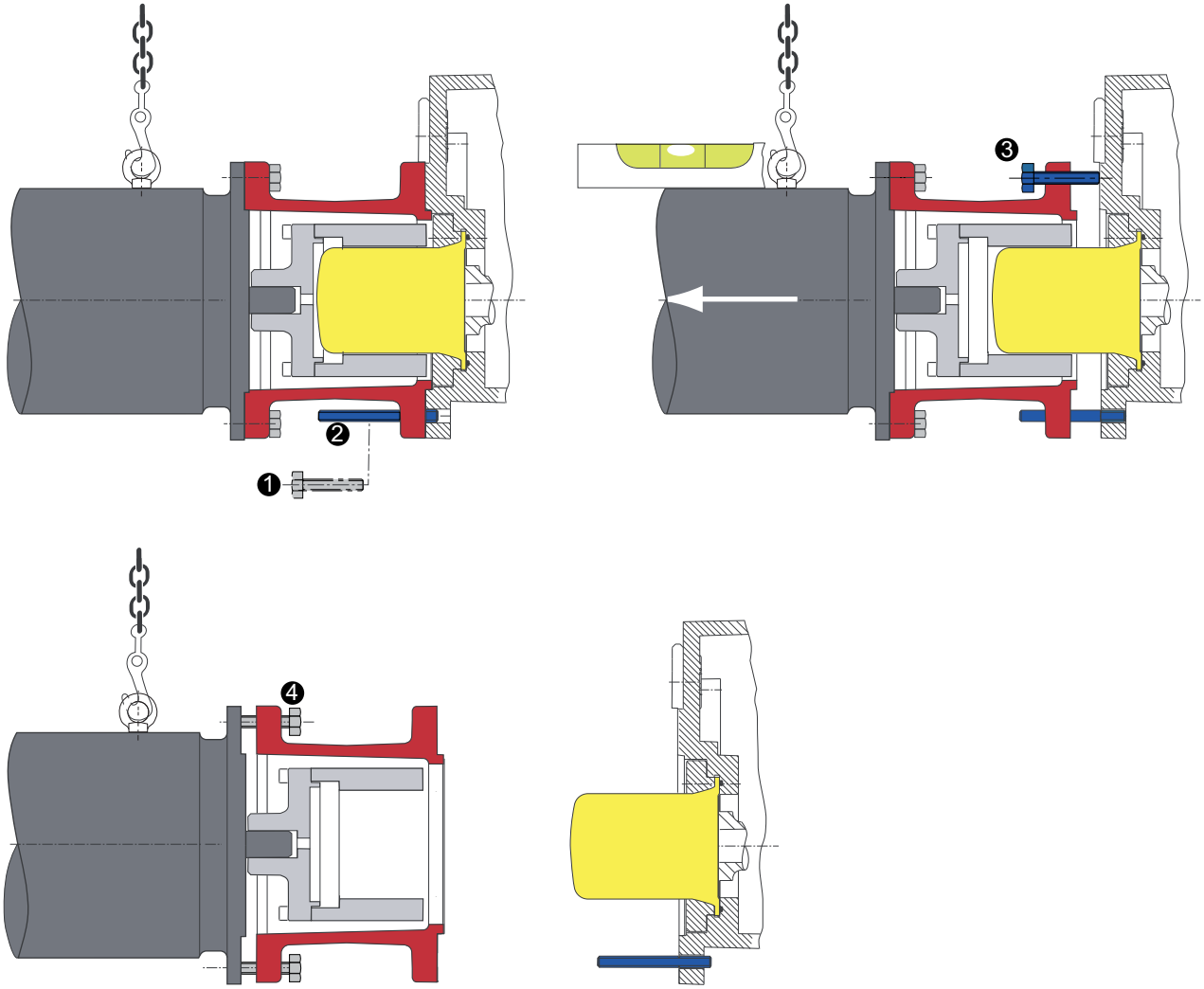


Fig. 19: Removing the motor – pump with magnetic coupling

7.5 Drain condensate in the silencer

DANGER

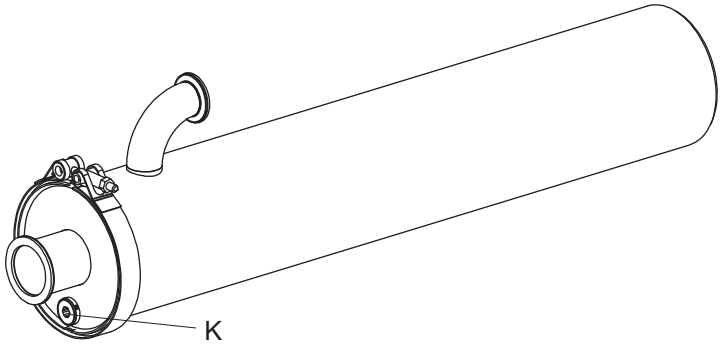
Release of toxic materials

Danger to health through contact with toxic substances during operation, service and maintenance work.

➔ The operator must provide suitable protective clothing for all work on open chambers and vacuum components.

➔ Drain condensate regularly via the drain hole K of the silencer and collect in a vessel;
– define adequate, process-specific drain intervals.

➔ Dispose of condensate according to the respectively valid legal requirements.



Clean silencer

➔ Clean silencer approx. every 1000 h, depending on the process.

➔ Remove silencer from the pump.

➔ Clean with suitable cleaning agent.

➔ Dry silencer sufficiently and install it again.

Clean non-return valve

➔ Clean non-return valve approx. every 1000 h, depending on the process.

➔ Check function of the non-return valve; if necessary, clean it with suitable cleaning agent and make it mobile.

➔ Dry non-return valve sufficiently and install it again.

8 Decommissioning

8.1 Shutting down for longer periods

Perform the following procedure:

➔ Turn off the vacuum pump, vent to atmospheric pressure and allow to cool.

➔ Stop cooling water feed and remove cooling water intake and output lines.

➔ Blow compressed air through the cooling water system and completely empty cooling water channels to avoid rust and frost damage.

➔ Store the pump only indoors, preferably at temperatures between -10 °C and +40 °C.

– 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 lubricant before using the pump.

➔ Do not store pump in the vicinity of machines, lanes, etc., because strong vibrations can damage the rotor bearings.

Connecting the inert gas

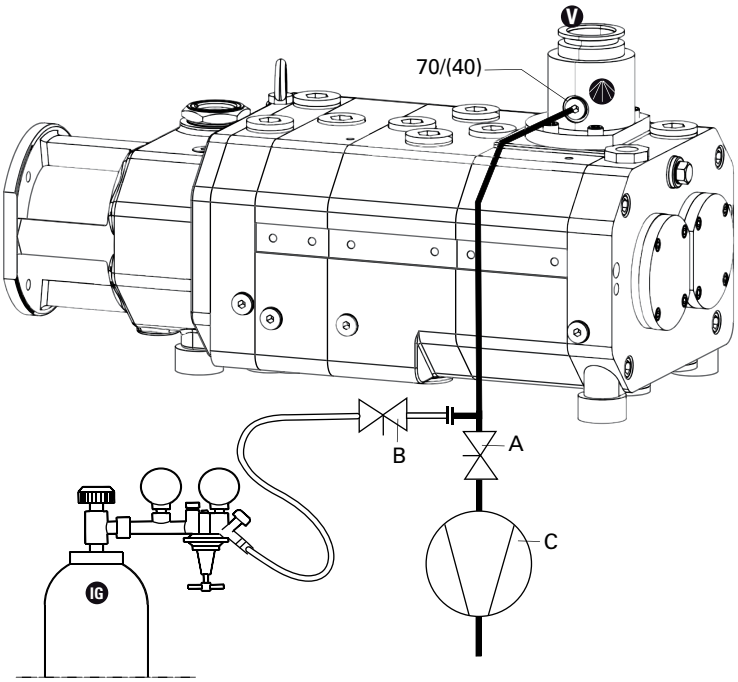


Fig. 20: Flushing the suction chamber with inert gas

➔ Fit evacuation and flushing device as shown in the diagram.

– The following does not apply where inert gas units with flushing components are involved.

➔ Close vacuum flange of the pump with a blank flange.

➔ Switch pump on and bring to operating temperature.

➔ Open dosing valve B. Flushing durations and rates are dependent on the level of contamination:

– Flushing duration: 5 ... 20 min.

– Rate: 500 ... 2500 sl/h

Venting

➔ Turn off the vacuum pump, vent to atmospheric pressure and allow to cool.

➔ Close the flange openings by using the original protective covers.

➔ Evacuate suction chamber to p <1 hPa at the measuring connection 40.

➔ Close valve A.

➔ Open dosing valve B and vent pump with inert gas (max. 1200 hPa abs.).
➔ Close dosing valve B.
➔ Wait 15 minutes.
➔ Dismantle evacuation and flushing device.
➔ Lock measuring connection 40 with locking screw; observe the seal ring.

8.2 Re-starting

Visually inspect the inner of the pump before taking it into operation. If there is evidence of rust on the parts of the pump which form the housing, then do not take it into operation and contact Pfeiffer Vacuum Service.

Depending on how long the pump is taken out of operation, it may be necessary to replace the elastomer parts. In accordance with DIN 7716 and the manufacturer's specifications we recommend replacing the installed elastomer parts after 2 years.

NOTICE

Re-starting

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

➔ Replace the lubricant.
➔ Replace bearings.
➔ Follow the maintenance instructions and inform Pfeiffer Vacuum.

➔ If drying pearls were inserted then they should be removed now. Improper handling can cause failure of the pump.

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:

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 (≤ 2m) 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.

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

NOTICE

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.

➔ 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.

Problem	Possible causes	Remedy
Pump will not start up	Motor voltage is incorrect	Apply correct motor voltage.
	Motor protection switch is too small or set to a trigger value that is too small.	Correct trigger value; set to a value of approx. 5% above the rated motor current.
	A fuse is defective	Check the fuses.
	Voltage drop in the connection cable is too high	Dimension the connection cable adequately.
	Pump or drive motor is blocked	Ensure that the drive motor has been separated from the power supply: – Remove ventilator cover. – Try to rotate the motor by hand If this is not possible: – Remove motor and check motor and pump separately If the pump is blocked, inform PV Service
	Drive motor defective	Replace drive motor.

Problem	Possible causes	Remedy
Vacuum pump is blocked	Foreign bodies entered the pump	If the pump is blocked, inform PV Service. Install filter or strainer in intake line
	Pump system etched inside or condensate has collected	Inform PV Service. Check process and pump medium; plan for condensate siphon.
	Incorrect direction of rotation	Inform PV Service. Check direction of rotation; if necessary, exchange two phases of the electrical connection.
	Circulation pump is blocked	Remove and clean circulation pump
Pump not achieving the ultimate pressure	Intake line plugged	Clean line
	Leak in the system	Check line.
	Pump interior plugged with process residue	Remove pump.
Long pumping-out times	Long intake line or cross section of the exhaust line is too small.	Shorten intake lines and increase cross section of the exhaust line.
Increased current input	Counter-pressure too high	Check exhaust line, clean if necessary
	Pump plugged with process residue	Remove pump.
	Cooling liquid or cooling water lacking	Check cooling liquid or cooling water.
	Lubricant contaminated	Change lubricant.
Unusual noises during operation	Loose cable connection; motor runs only with 2 phases	Check lines.
	Direction of rotation false	Check direction of rotation; if necessary, exchange two phases of the electrical connection.
	Longer pump standstill time	Allow the pump to warm up with closed intake flange.
	Bearing damage	Inform PV Service.
	Coupling defective	Remove motor and coupling; replace coupling, if necessary.
	Motor runs - pump doesn't:only valid for pumps with magnetic coupling system (AM/ADM series)	Magnetic coupling system defective or magnetic field "broken away", contact Pfeiffer Vacuum Service if necessary. **Attention! Magnetic field**: If the magnetic field has "broken away", the orientation of the magnets with respect to each other can only be re-established at standstill. If the pump is left to operate with a "broken away" magnetic field, demagnetisation will take place and the coupling is destroyed.
Overpressure at the exhaust	Exhaust line plugged	Check exhaust line, clean if necessary.
	Pressure switch at the exhaust (option) defective	Check pressure switch at the exhaust (option).
Pump pressure too high	Ambient temperature too high	Maintain permissible ambient temperature.
	Gas temperature too high	Maintain permissible intake temperature.
	When coolant is used: Check fill level	Fill with coolant, if necessary.
	Cooling water feed lacking or cooling water pressure too low	Check feed and flow; increase cooling water pressure, if necessary.
	Counter-pressure too high	Check exhaust line, clean if necessary.
	Increased gas temperature due to special process gases	After sufficient cooling, switch pump back on.
	Intake or exhaust line partially clogged	Check line cross-sections; clean if necessary
	Pump interior plugged with process residue	Remove pump.
	Lubricant level too low	Refill with lubricant; check the shaft sealings.
Low lubricant level	Loss of oil to the outside or inside	Check tightness of the oil chambers (cover, seals).
		Check the shaft sealings.

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

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.

Spare parts package	Pump type	No.	Consisting of
Set of seals	UniDry^{TM} 50 P	PU E00 001 -T	on request
	UniDry^{TM} 50 PM	PU E00 011 -T	
	UniDry^{TM} 50 S	PU E00 006 -T	
	UniDry^{TM} 50 SM	PU E00 010 -T	
Maintenance kit I	UniDry^{TM} 50 P	PU E01 001 -T	Greasing unit loose bearing, O-ring 66
	UniDry^{TM} 50 PM	PU E01 001 -T	
	UniDry^{TM} 50 S	PU E01 001 -T	
	UniDry^{TM} 50 SM	PU E01 001 -T	
Maintenance kit II	UniDry^{TM} 50 P	PU E01 002 -T	Loose bearing unit, O-ring 66
	UniDry^{TM} 50 PM	PU E01 002 -T	
	UniDry^{TM} 50 S	PU E01 002 -T	
	UniDry^{TM} 50 SM	PU E01 002 -T	
Overhaul kit	UniDry^{TM} 50 P	PU E02 001 -T	on request
	UniDry^{TM} 50 PM	PU E02 012 -T	
	UniDry^{TM} 50 S	PU E02 007 -T	
	UniDry^{TM} 50 SM	PU E02 011 -T	
Gear wheels	UniDry^{TM} 50 P	PU E03 001 -T	on request
	UniDry^{TM} 50 PM		
	UniDry^{TM} 50 S		
	UniDry^{TM} 50 SM		
Magnetic coupling	UniDry^{TM} 50 PM	PU E04 001 -T	on request
	UniDry^{TM} 50 SM		
Magnetic coupling	UniDry^{TM} 50 PDM	PU E04 002 -T	on request
	UniDry^{TM} 50 SDM		

12 Accessories

Designation	UniDry^{TM} 50 SDM	UniDry^{TM} 50 SM
Intake flange, DN 100 ISO-F	PK 055 473 -T	PK 055 473 -T
Intake flange, DN 63 ISO-F	PK 055 214 -T	PK 055 214 -T
Intake flange, DN 40 ISO-KF	PK 055 185 -T	PK 055 185 -T
CWK 50, Cooling water unit for UniDry^{TM}	PP Z10 300	PP Z10 300
PTC-resistor tripping device	P 4768 051 FQ	P 4768 051 FQ
PT 100, Temperature sensor	P 0992 605	P 0992 605
Non- return valve, DN 40 ISO-KF	PK 004 499 -U	PK 004 499 -U
Silencer, DN 25/40 ISO-KF	PK 055 190 -U	PK 055 190 -U
F5, Perfluorpolyether, 0.5 l	PK 001 851 -T	PK 001 851 -T
P3, mineral oil, 1 l	PK 001 106 -T	PK 001 106 -T
Regreasing kit, with two grease cartridges of 5 ml	PK 055 706-T	PK 055 706-T

Further detailed accessories are contained in the Pfeiffer Vacuum printed or Online Catalogue.

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^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	UniDry^{TM} 50 SDM	UniDry^{TM} 50 SM
Pumping speed at 50 Hz	50 m^3/h	50 m^3/h
Pumping speed at 60 Hz	60 m^3/h	60 m^3/h
Ultimate pressure without inert gas at 50 Hz	$5 \cdot 10^{-2}$ hPa	$5 \cdot 10^{-2}$ hPa
Ultimate pressure without inert gas at 60 Hz	$5 \cdot 10^{-2}$ hPa	$5 \cdot 10^{-2}$ hPa
Intake pressure at continuous operation max.	500 hPa	500 hPa
Exhaust pressure, min.	500 hPa	500 hPa
Exhaust pressure, max.	1500 hPa	1500 hPa
Rotation speed at 50 Hz	3000 min^{-1}	3000 min^{-1}
Rotation speed at 60 Hz	3600 min^{-1}	3600 min^{-1}
Leak rate	$1 \cdot 10^{-6}$ Pa m^3/s	$1 \cdot 10^{-4}$ Pa m^3/s
Ambient temperature	5-40 °C	5-40 °C
Number of pumping stages	4	4
Operating fluid	F5	F5
Operating fluid filling	0.32 l	0.32 l
Frequency range	40-60 Hz	40-60 Hz
Weight: with motor	145 kg	130 kg
Inert gas unit	Optional	Optional
Cooling method, optional	Water	Water
Cooling water pressure	2000-10000 hPa	2000-10000 hPa
Cooling water temperature	5-35 °C	5-35 °C

13.3 Dimensions

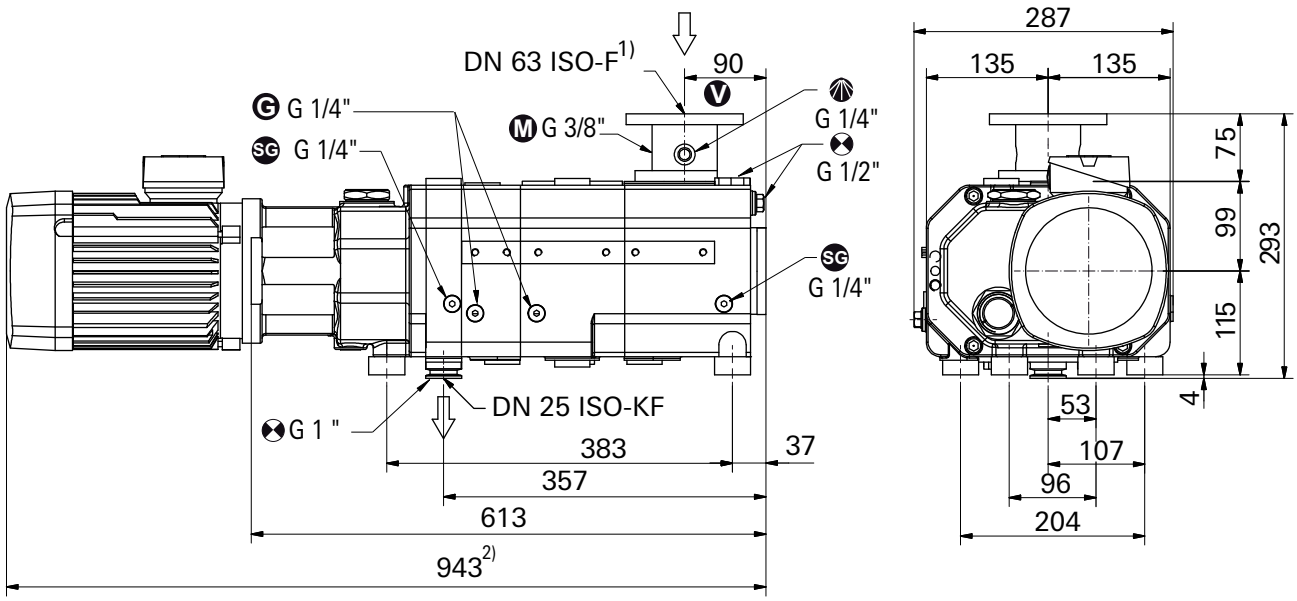


Fig. 21: UniDry^{TM} 50 SM / UniDry^{TM} 50 SDM

1) other intake flanges possible

2) dimensions depend on the motor supplier

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**

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UniDry^{TM} 50

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

DIN EN ISO 12100 : 2010	ISO 21360-1, 2 : 2012	DIN EN 61000-6-3 : 2007
DIN EN 1012-2 : 2011-12	DIN EN 61000-6-1 : 2007	DIN EN 61000-6-4 : 2007
DIN EN ISO 13857 : 2008	DIN EN 61000-6-2 : 2006	DIN EN ISO 2151 : 2009

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2016-04-28

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