



OPERATING INSTRUCTIONS

EN

Translation of the Original

OKTA 300 | 300 M | 600 | 600 M

Roots pump

PFEIFFER  **VACUUM**

Dear Customer,

Thank you for choosing a Pfeiffer Vacuum product. Your new roots pump should support you in your individual application with full performance and without malfunctions. The name Pfeiffer Vacuum stands for high-quality vacuum technology, a comprehensive and complete range of top-quality products and first-class service. From this extensive, practical experience we have gained a large volume of information that can contribute to efficient deployment and to your personal safety.

In the knowledge that our product must avoid consuming work output, we trust that our product can offer you a solution that supports you in the effective and trouble-free implementation of your individual application.

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

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

Disclaimer of liability

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

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

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1 About this manual



IMPORTANT

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

1.1 Validity

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

1.1.1 Applicable documents

Document	Number
Additional information for "M Version"	PW 0142
Spray lance operating instructions	PW 0332
Declaration of conformity	A component of these instructions

You can find these documents in the [Pfeiffer Vacuum Download Center](#).

1.1.2 Variants

These instructions apply for roots pumps of the following versions:

Pump type	Pump designs
Standard version	Standard version: <ul style="list-style-type: none"> • Standard motor • Housing and all parts forming the suction chamber are made of GGG • Connection flanges are designed as ISO flanges
M version	Changes to the standard design: <ul style="list-style-type: none"> • Version with magnetic coupling
Special versions	<ul style="list-style-type: none"> • Special sealing materials resistant to aggressive media • Special coatings for corrosion protection or anti-stick properties • Version with PN flanges • Special, process-specific lubricants

1.2 Target group

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

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

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

1.3 Conventions

1.3.1 Instructions in the text

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

Individual action step

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

- ▶ This is an individual action step.

Sequence of multi-part action steps

The numerical list indicates an action with multiple necessary steps.

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

1.3.2 Pictographs

Pictographs used in the document indicate useful information.



Note



Tip

1.3.3 Stickers on the product

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

<p>PFEIFFER VACUUM D-35641 Asslar</p> <p>Mod.: Okta 600 Mod.-No.: PP W34 ... Ser. -No.: 183.....</p> <p>n: max. 4500 1/min Oil: P3 1,5 l S(N): max. 840 m³/h Weight: 140 kg</p> <p>Made in Germany 04/2021 CE</p>	<p>Rating plate (example) The rating plate is located on the front side above the sight glass</p> <p>Motor rating plate (not shown)</p>
<p>Vor Inbetriebnahme Pumpe mit Öl füllen Fill the pump with oil before putting into operation Remplir la pompe d'huile avant la mise en route</p>	<p>Sticker (red) Before commissioning, fill the gear and bearing chambers with lubricant</p>
<p>Achtung! nur mit D1 befüllen Attention! only D1 to be used</p>	<p>Sticker (blue) – special lubricant only Caution: fill with D1 only</p>
<p>Achtung! nur mit F5 befüllen Attention! only F5 to be used</p>	<p>Sticker (orange) – only in case of special lubricants Caution: fill with F5 only</p>

	<p>Warning hot surface</p> <p>This sticker warns of injuries caused by high temperatures as a result of contact without protection during operation.</p>
	<p>Warning of magnetic field</p> <p>This sticker warns of injuries to people with pacemakers.</p>

Tbl. 1: Stickers on the product

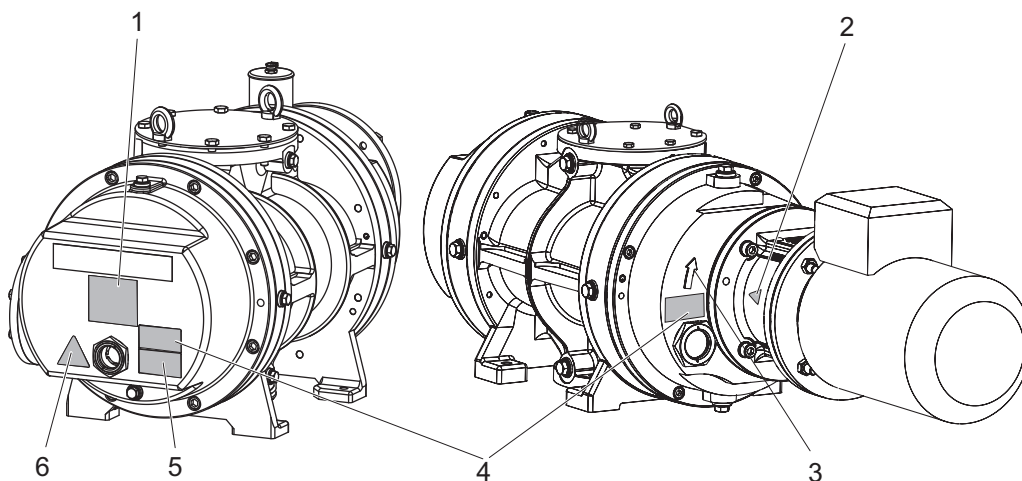


Fig. 1: Position of the stickers on the product

- | | |
|---|-----------------------------|
| 1 Rating plate | 4 Filling up lubricant note |
| 2 Magnetic field warning sign for M version | 5 Note D1/F5 lubricant |
| 3 Direction of rotation arrow (cast in the cover) | 6 Hot surface warning sign |

1.3.4 Abbreviations


Abbreviation	Explanation
OI	Operating instructions
DIN	German Institute for Standardization (Deutsches Institut für Normung)
E	Clearance between both coupling halves
f	Rotation speed value of a vacuum pump (frequency, in rpm or Hz)
FPM	Fluoropolymer rubber
FC	Frequency converter
GG	Cast iron with lamellar graphite
GGG	Spheroidal graphite cast iron
ISO	International Organization for Standardization
M version	Roots pumps with magnetic coupling
p	Intake pressure or general pressure in [hPa]
PN	Nominal pressure stage (pressure nominal)
PTC	Temperature-dependent resistor (Positive Temperature Coefficient)
RSSR	Radial shaft seal ring
SI	Service instructions
WAF	Width Across Flats

Tbl. 2: Abbreviations used

2 Safety

2.1 General safety information

The following 4 risk levels and 1 information level are taken into account in this document.

⚠ DANGER	
<p>Immediately pending danger Indicates an immediately pending danger that will result in death or serious injury if not observed.</p> <ul style="list-style-type: none"> ▶ Instructions to avoid the danger situation 	
⚠ WARNING	
<p>Potential pending danger Indicates a pending danger that could result in death or serious injury if not observed.</p> <ul style="list-style-type: none"> ▶ Instructions to avoid the danger situation 	
⚠ CAUTION	
<p>Potential pending danger Indicates a pending danger that could result in minor injuries if not observed.</p> <ul style="list-style-type: none"> ▶ Instructions to avoid the danger situation 	
NOTICE	
<p>Danger of damage to property Is used to highlight actions that are not associated with personal injury.</p> <ul style="list-style-type: none"> ▶ Instructions to avoid damage to property 	
<div style="border: 1px solid black; padding: 5px; display: inline-block;">  </div>	Notes, tips or examples indicate important information about the product or about this document.

2.2 Safety instructions

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

Risks during transport

⚠ WARNING
<p>Risk of serious injury from swinging, toppling or falling objects During transport, there is a risk of crushing and impact on swinging, toppling or falling objects. There is a risk of injuries to limbs, up to and including bone fractures and head injuries.</p> <ul style="list-style-type: none"> ▶ Secure the danger zone if necessary. ▶ Pay attention to the center of gravity of the load during transport. ▶ Ensure even movements and moderate speeds. ▶ Observe safe handling of the transport devices. ▶ Avoid sloping attachment aids. ▶ Never stack products. ▶ Wear protective equipment, e.g. safety shoes.

Risks during installation

⚠ DANGER**Danger to life from electric shock**

Touching exposed and voltage-bearing elements causes an electric shock. Improper connection of the mains supply leads to the risk of touchable live housing parts. There is a risk to life.

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

⚠ WARNING**Risk of crushing from rotating parts**

Fingers and hands may be caught by rotating pistons within the connection flange. This results in severe injuries.

- ▶ Keep limbs out of the reach of the roots pump.

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

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

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

⚠ CAUTION**Risk of injury from loss of stability**

During setup, there is a risk of injury from tipping, if the vacuum pump is not anchored on the standing surface.

- ▶ Secure the vacuum pump using suitable lifting gear.
- ▶ Wear personal protective equipment.

⚠ CAUTION**Danger of injury from moving parts**

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

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

Risks during operation

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

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

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

⚠ WARNING

Risk of crushing on rotating parts when reaching into the open flange

The pistons continue to run in the vacuum after switching off the motor, and can trap fingers and hands within their reach.

- ▶ Wait until the vacuum pump comes to a complete standstill.
- ▶ Secure the vacuum pump against re-start.

⚠ CAUTION

Danger of burns on hot surfaces

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

- ▶ Provide suitable touch protection.

⚠ CAUTION

Health hazard from increased noise emission

Remaining in the close proximity of the vacuum pump for a sustained period of time may cause hearing damage.

- ▶ Ensure adequate sound insulation.
- ▶ Wear hearing protection.

Risks during maintenance, decommissioning and malfunctions

⚠ WARNING

Danger of injury from strong magnetic field

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

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

⚠ WARNING

Health hazard through poisoning from toxic contaminated components or devices

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

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

⚠ WARNING

Risk of crushing from rotating parts

Fingers and hands may be caught by rotating pistons within the connection flange. This results in severe injuries.

- ▶ Keep limbs out of the reach of the roots pump.

⚠ WARNING**Health hazard and environmental damage from toxic contaminated lubricant**

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

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

⚠ WARNING**Danger of injury due to exposed rotating parts**

In the operating range of the motor coupling, there is a danger of clothing being caught and wound up.

- ▶ When assembling the motor and coupling, make sure that the coupling protection is seated correctly.
- ▶ Wear correct clothing.

⚠ CAUTION**Scalding from hot lubricant**

Danger of scalding when draining lubricant if it comes into contact with the skin.

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

2.3 Safety precautions

**Duty to provide information on potential dangers**

The product holder or user is obliged to make all operating personnel aware of dangers posed by this product.

Every person who is involved in the installation, operation or maintenance of the product must read, understand and adhere to the safety-related parts of this document.

**Infringement of conformity due to modifications to the product**

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

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

General safety precautions

- ▶ Do not expose body parts to the vacuum.
- ▶ Check all safety measures at regular intervals.
- ▶ Observe the safety and accident prevention regulations, if necessary wear personal protective equipment.
- ▶ Always ensure a secure connection to the earthed conductor (PE), protection class I.
- ▶ Never operate the vacuum pump with open vacuum flange.
- ▶ Provide suitable touch protection, if the surface temperature exceeds 70°C.
- ▶ Provide suitable noise protection measures as necessary.
- ▶ Before working on the vacuum connection, wait until the rotor is at a complete standstill (rotation speed $f = 0$ Hz).
- ▶ Never make your own conversions or modifications to the vacuum pump.
- ▶ Before returning the vacuum pump, observe the notes in the chapter Service.

2.4 Product usage limits

Parameter	Okta
Installation location	<ul style="list-style-type: none"> • Indoors, protected against: <ul style="list-style-type: none"> – dust deposits – falling objects – fire-fighting water • Outdoors, protected against: <ul style="list-style-type: none"> – falling objects – direct influence of weather such as rain, splash water, strong drafts and sunlight – fire-fighting water – lightning strike
Installation altitude	max. 2000 m above sea level ¹⁾
Ambient temperature	+5 °C – +40 °C
Relative humidity of air	max. 85 % (depending on the motor version)
Gas temperature, pressure side, max.	+200 °C
Permissible rotation speed range	1500 – 4500 rpm
Intake pressure, max.	< 1300 hPa (abs.)
Orientation	Horizontal

Tbl. 3: Usage limits of the vacuum pump

2.5 Proper use

- ▶ Use the vacuum pump for vacuum generation only.
- ▶ When pumping media with an oxygen concentration level of > 21 %, only use perfluorinated, synthetic oils (F5) as lubricant.
- ▶ Use sealing gas as appropriate for the process.
- ▶ Operate the vacuum pump within the application limits of the product (see chapter “Product usage limits”, page 14) and in compliance with the technical data.
- ▶ When operating the vacuum pump with frequency converter, make sure that the vacuum pump does not exceed the max. permissible rotation speed, even in the event of a frequency converter fault.
- ▶ When operating the vacuum pump with frequency converter, make sure that the vacuum pump never exceeds the max. permissible rotation speed, even in the event that the frequency converter malfunctions.
- ▶ Adhere to the installation, commissioning, operating, and maintenance instructions.
- ▶ Use only accessory parts recommended by Pfeiffer Vacuum.

Operation without frequency converter

- ▶ Avoid an impermissible pressure rise between the roots pump and the backing pump to prevent associated malfunctions.
- ▶ Only switch the roots pump on when the fore-vacuum pressure allows the backing pump to accommodate the amount of gas required.

2.6 Foreseeable improper use

Improper use of the product invalidates all warranty and liability claims. Improper use is any, even unintended, use, which is contrary to the product purpose; and in particular:

- Transport, installation or operation of the vacuum pump in an impermissible spatial position
- Pumping media which are corrosive to materials of the vacuum pump
- Pumping of explosive media
- Pumping radioactive media
- Pumping media prone to exothermic reactions
- Pumping media that introduce an ignition source to the suction chamber

1) at installation altitudes > 1,000m above m.s.l. and an ambient temperature of 40 °C the rated power of the motor reduces by around 10 %

- Pumping media that form adhesive deposits inside the suction chamber and cause the pistons to touch or jam
- Pumping fluids - flushing media for cleaning are permissible
- Using the vacuum pump to generate pressure
- Using the vacuum pump in systems in which sporadic loads and vibrations or periodic forces act on the unit
- Use of the vacuum pump in potentially explosive atmospheres
- Use of the vacuum pump in areas with strong electrical, magnetic or electromagnetic fields
- Use of the vacuum pump with open vacuum and/or fore-vacuum flange open to the atmosphere
- Using lubricants not specified by Pfeiffer Vacuum
- Lifting the vacuum pump without the prescribed eye bolts, for example on piping.
- Use of accessories or spare parts that are not listed in these instructions
- Using the vacuum pump as a climbing aid.

2.7 Personnel qualification

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

Training people

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

2.7.1 Ensuring personnel qualification

Specialist for mechanical work

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

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

Specialist for electrotechnical work

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

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

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

Trained individuals

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

2.7.2 Personnel qualification for maintenance and repair



Advanced training courses

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

Adequately trained individuals are:

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

2.7.3 Advanced training with Pfeiffer Vacuum

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

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

3 Product description

3.1 Functional description

The operating principle of the roots pump is based on 2 synchronous pistons that rotate in a housing without touching. The pumping effects arise as a result of the opposing rotation of the 2 figure-of-eight shaped rolling pistons. While suction chambers are formed between the rolling pistons and the housing, the rolling pistons continuously form a mutual seal without touching each other or the housing. This opposing yet synchronised movement of the rolling pistons is achieved by means of a pair of gears mounted on the extended shaft ends. Lubrication is limited to the two bearing and gear chambers which are arranged separately from the suction chambers. Operation with a backing pump connected upstream enables compressing against atmospheric pressure.

Roots pumps of the M series are equipped with a magnetic coupling.

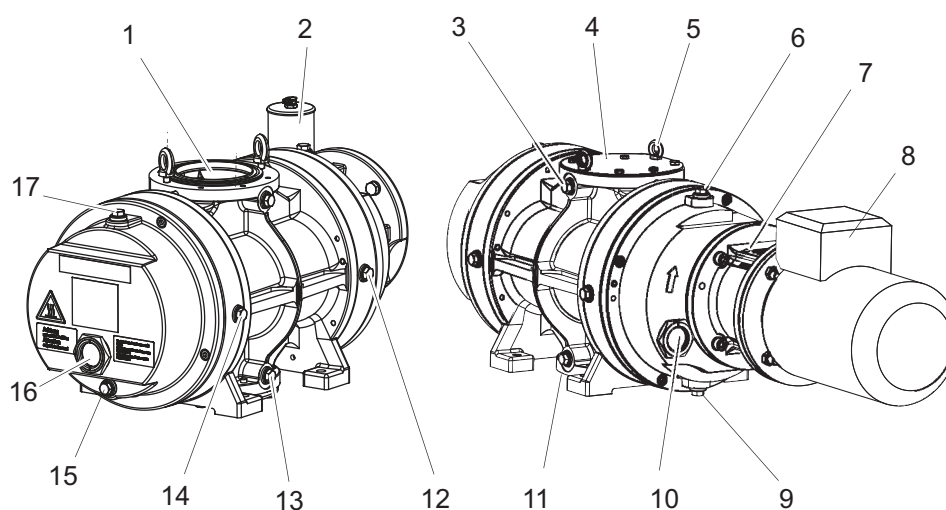


Fig. 2: Design of standard version and M version

- | | |
|---------------------------------------|---|
| 1 Vacuum flange | 10 Sight glass, motor side |
| 2 Oiler for version with RSSR | 11 Fore-vacuum flange |
| 3 Measurement connection, vacuum side | 12 Sealing gas connection, motor side |
| 4 Cardboard cover disk | 13 Measurement connection, fore-vacuum side |
| 5 Eye bolt | 14 Sealing gas connection, gearbox side |
| 6 Filler screw | 15 Drain screw, gearbox side |
| 7 Lantern, M version | 16 Sight glass, gearbox side |
| 8 Motor terminal box | 17 Filler screw, gearbox side |
| 9 Motor-side drain screw, M version | |

3.2 Identifying product

To ensure for a clear identification of the product when communicating with Pfeiffer Vacuum, always keep all of the information on the rating plate to hand.

The following information is shown on the rating plates:

- Pump model
- Model number
- Type and quantity of the lubricant
- Max. allowable pump rotation speed
- Date of manufacture
- Input voltage range (motor rating plate)

3.3 Product features

Flange types	Nominal pumping speed [m ³ /h]	Vacuum connection/ Fore-vacuum connection	Motor rotation speed [min ⁻¹ /h]	Operation with frequency converter
Okta 300	290/350	ISO-F	1500/1800	-
	290/350	PN-16	1500/1800	-
Okta 600	580/700	ISO-F	3000/3600	-
	580/700	PN-16	3000/3600	-
	290/870	ISO-F	1500 - 4500	X
	290/870	PN-16	1500 - 4500	X

Tbl. 4: Features of the roots pumps

3.4 Scope of delivery

- Roots pump
- Seals for the connection flanges; for ISO flanges, centering rings are included
- Cover disks for the connecting flanges
- Screw kit for the connection flange
- 2 eye bolts for lifting the roots pump
- Lubricant P3 (standard version)
- Motor-side coupling half for roots pumps without motor
- Operating instructions

4 Transportation and Storage

4.1 Transporting the vacuum pump

WARNING

Risk of serious injury from swinging, toppling or falling objects

During transport, there is a risk of crushing and impact on swinging, toppling or falling objects. There is a risk of injuries to limbs, up to and including bone fractures and head injuries.

- ▶ Secure the danger zone if necessary.
- ▶ Pay attention to the center of gravity of the load during transport.
- ▶ Ensure even movements and moderate speeds.
- ▶ Observe safe handling of the transport devices.
- ▶ Avoid sloping attachment aids.
- ▶ Never stack products.
- ▶ Wear protective equipment, e.g. safety shoes.



Instructions for safe transport

- Only remove the protective cover for the connection flange once the pipes have been mounted.
- Fill the gear and bearing chambers with lubricant only once the final installation position is reached.



Preparations for transport

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

General information regarding safe transport

1. Observe weight specified on the rating plate.
2. Where possible, always transport or ship the roots pump in its original packaging.
3. Remove the protective cover only immediately prior to installation.

Transporting the vacuum pump in its packaging

1. Use a pallet truck to transport the vacuum pump in its packaging.
2. Note the center of gravity of the load.
3. Observe safe handling of manually operated transport devices.
4. Ensure harmonious movements and moderate speeds.
5. Ensure a flat substrate.
6. Wear protective equipment, e.g. safety shoes.

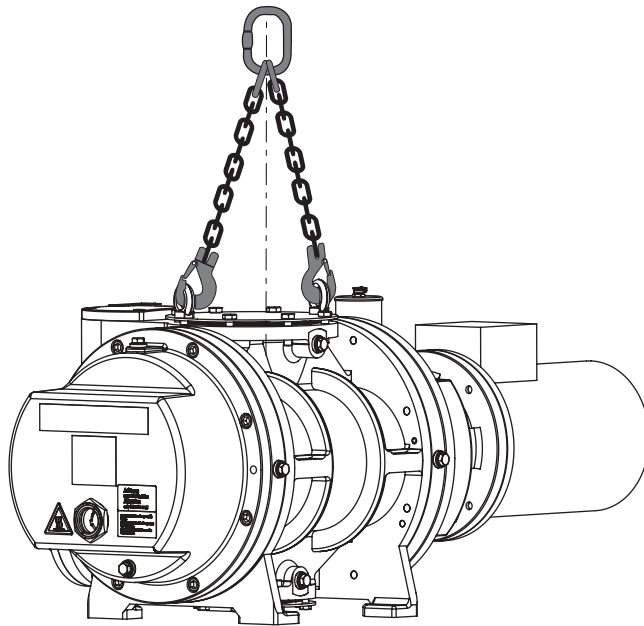


Fig. 3: Transporting the vacuum pump

Transporting the vacuum pump without its packaging

2 eye bolts are included in the shipment, which are firmly bolted to the vacuum pump ex-factory.

1. Unpack the vacuum pump.
2. Attach suitable lifting tools to both eye bolts.
3. Pay attention to the correct use and fastening of the lifting equipment.
4. Lift the vacuum pump out of the transport packaging vertically.
5. If necessary, remove the eye bolts after transport and installation.
 - Keep the eye bolts for future use.

4.2 Storing vacuum pump

Neither the suction chamber nor the pistons in the roots pump in the roots pump interior are provided with **corrosion protection**.



Storage

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

Procedure

1. Vacuum-seal both connection flanges.
2. Store the roots pump only in dry, dust-free rooms, within the specified ambient conditions.
3. Evacuate and then fill the suction chamber with nitrogen to achieve the best corrosion protection for the roots pump.
4. In rooms with humid or aggressive atmospheres, seal the roots pump airtight in a plastic bag, together with a drying agent.
5. Change the lubricant after a storage period of more than 2 years.
6. If you intend to store the roots pump for longer periods, we recommend that you use a special corrosion protection agreed with Pfeiffer Vacuum.

5 Installation

5.1 Setting up vacuum pump

⚠ CAUTION

Risk of injury from loss of stability

During setup, there is a risk of injury from tipping, if the vacuum pump is not anchored on the standing surface.

- ▶ Secure the vacuum pump using suitable lifting gear.
- ▶ Wear personal protective equipment.

General notes for the installation of vacuum components

- ▶ Choose an installation location that permits access to the product and to supply lines at all times.
- ▶ Observe the ambient conditions given for the limits of use.
- ▶ Provide the highest possible level of cleanliness during assembly.
- ▶ Ensure that flange components during installation are grease-free, dust-free and dry.

Procedure

1. Check the carrying capacity of the floor at the installation location.
2. Place the vacuum pump on a flat, horizontal and fixed surface, to safeguard the lubricant supply.
 - Reference surface is the vacuum flange.
3. Evenly screw the 4 feet of the vacuum pump onto the base without distorting the pump housing.
4. Use adjustment elements from the Pfeiffer Vacuum [range of accessories for roots pumps](#) to mount the feet horizontally.
5. When installing the pump in a closed housing, ensure adequate air circulation.
6. Keep both sight glasses freely accessible for checks and maintenance.
7. Keep the filling/drain holes freely accessible.
8. Ensure that the motor rating plate remains accessible at all times for a clear view of the voltage and frequency specifications.
9. Maintain the minimum distances to bordering surfaces to guarantee sufficient air circulation.
10. Fill with lubricant prior to first commissioning.

5.2 Filling up lubricant

⚠ WARNING

Danger of poisoning from toxic vapors

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

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

NOTICE

Property damage from using non-approved lubricant

Attainment of product-specific performance data is not ensured. If non-approved lubricants are used, all liability and warranty claims against Pfeiffer Vacuum are excluded.

- ▶ Use only lubricants approved by Pfeiffer Vacuum.
- ▶ Use alternative, application-specific lubricants only following consultation with Pfeiffer Vacuum.

The type of lubricant specified for the gear and bearing chambers, and the fill quantity for the entire roots pump are shown on the rating plate. Only the lubricant used during initial installation is permissible. Subsequent change is possible only after consultation with Pfeiffer Vacuum.

Permissible lubricants

- P3 for standard version
- D1 for special applications (such as higher operating temperatures)
- F5 for corrosive gas model
- Other lubricants on request

Required tools

- Open-end wrench, 17 mm WAF
- Calibrated torque wrench (tightening factor ≤ 2.5)

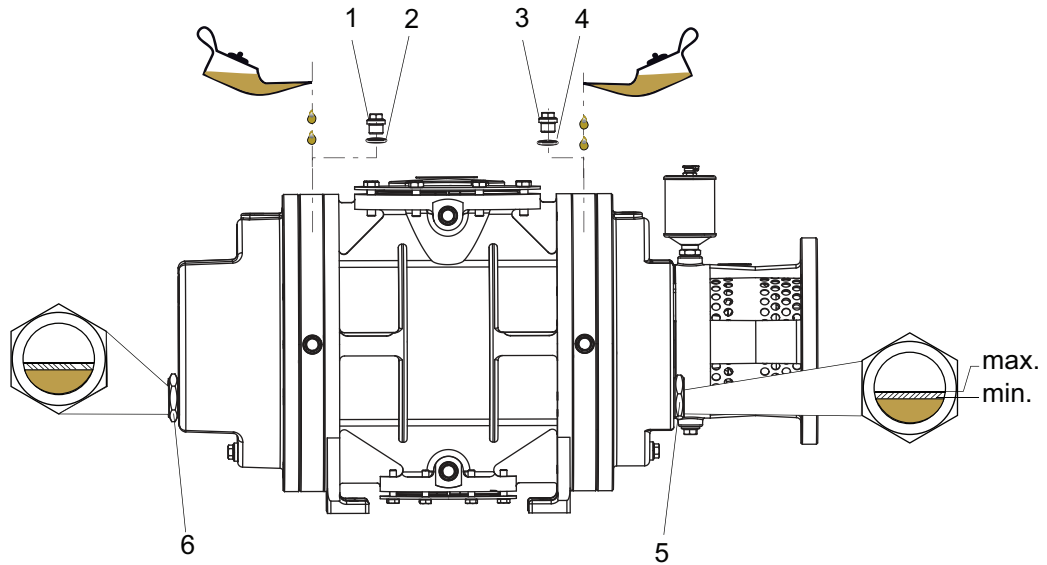


Fig. 4: Filling up lubricant

- | | |
|--------------------------|-----------------------------|
| 1 Lubricant filling plug | 4 O-ring |
| 2 O-ring | 5 Sight glass, motor side |
| 3 Lubricant filling plug | 6 Sight glass, gearbox side |

Procedure

1. Unscrew and remove the lubricant filler screws.
2. Fill the lubricant on both sides while observing the sight glass.
 - Fill levels for the first fill: approx. 5 mm above the sight glass middle.
3. Seal the filler screws.
 - Tightening torque: **32 Nm**
4. Check the fill level during operation in the final vacuum.
5. If necessary, top up the lubricant only when the roots pump is switched off and flooded.

5.3 Filling with sealing oil

NOTICE

Damage to the vacuum pump due to incorrect procedure when filling sealing oil

Disassembly of the lubricator causes leakage in the system. The lubricant expands when the roots pump heats up, which could cause lubricant to leak if overfilled.

- ▶ Use only the lubricator's filler flap to fill up.
- ▶ While the roots pump is cold, fill the lubricator **no more than halfway**.



Versions with RSSR

This section is only valid for roots pumps with radial shaft seal rings. The version with magnetic coupling "M" does not have a lubricator.

The shaft feedthrough of the drive shaft is sealed with sealing oil-covered radial shaft seals. The corresponding oiler on the seal casing cools and lubricates the radial shaft seal rings. The sealing oil type is the same as the lubricant.

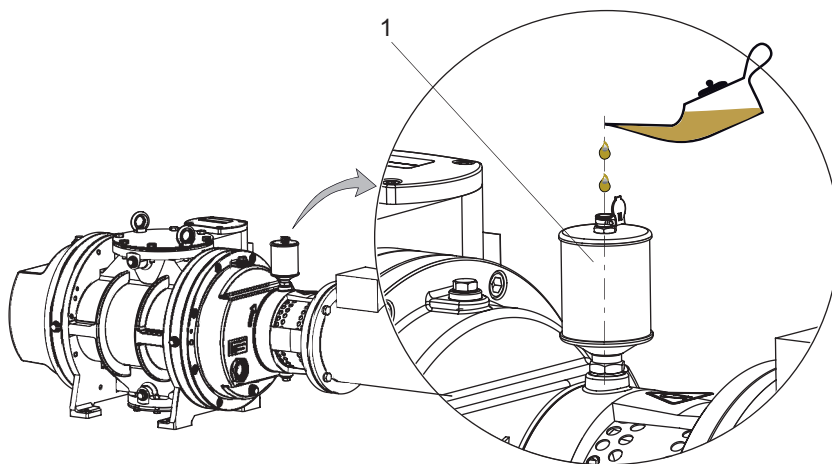


Fig. 5: Filling sealing oil for radial shaft seal rings

1 Oiler

Procedure

1. Open the filler flap on the oiler.
2. Fill the oiler with lubricant to max. halfway.
3. Close the filler flap.
4. Always make sure that the lubricator is screwed tightly to the vacuum pump.

5.4 Connecting vacuum side

⚠ WARNING

Risk of crushing from rotating parts

Fingers and hands may be caught by rotating pistons within the connection flange. This results in severe injuries.

- ▶ Keep limbs out of the reach of the roots pump.

NOTICE

Property damage from intake of solid particles

During commissioning, there is a risk of damage to the suction chamber from dirt from the system or the pipes.

- ▶ Use a suitable protective strainer ("start-up strainer") in the intake flange.
- ▶ Ensure that this strainer is only removed when the risk of solid particles entering the vacuum pump can be excluded.
 - Observe any pumping speed decrease.

Required tools

- Ring spanner, **WAF 13** with flange DN 100 ISO-F
- Ring spanner, **WAF 24** with flange DN 100 PN16

Procedure

1. Degrease the connection flange.
2. Clear welded lines of any tinder, loose parts or similar before installation.
3. Route the piping between the vacuum pump and vacuum chamber so that it remains as short as possible; at a minimum, the nominal diameter of the pump flange.
4. Select a larger nominal diameter for pipe lengths > 5 m.
5. Support or suspend the piping to the vacuum pump so that no piping system forces act on the vacuum pump.
 - Install a bellows in the piping if necessary.
6. Always use **all** prescribed screws to fasten the flange.

5.5 Connecting the fore-vacuum side

WARNING

Risk of crushing from rotating parts

Fingers and hands may be caught by rotating pistons within the connection flange. This results in severe injuries.

- ▶ Keep limbs out of the reach of the roots pump.

CAUTION

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

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

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

Procedure

1. Choose a minimum pipe cross section equal to the nominal diameter of the pressure flange.
2. Clear welded lines of any tinder, loose parts or similar before installation.
3. Route the pipes so that no mechanical tension can act on the roots pump or the backing pump.
4. Install a bellows in the piping if necessary.
5. Ensure that mating flanges are in a parallel position.
6. Install the pipes downward from the roots pump, so that condensate does not flow back into the roots pump.
7. Install a condensate separator if necessary.
8. If an air trap is created in the system, then install a condensate drain facility at the lowest point.

5.6 Connect to mains power supply

DANGER

Danger to life from electric shock

Touching exposed and voltage-bearing elements causes an electric shock. Improper connection of the mains supply leads to the risk of touchable live housing parts. There is a risk to life.

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

WARNING

Risk of fatal injury due to electric shock on account of incorrect installation

The device's power supply uses life-threatening voltages. Unsafe or improper installation can lead to life-threatening situations from electric shocks obtained from working with or on the unit.

- ▶ Ensure safe integration into an emergency off safety circuit.
- ▶ Do not carry out your own conversions or modifications on the unit.

CAUTION

Danger of injury from moving parts

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

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

NOTICE

Risk of damage from excess voltage

Incorrect or excessive mains voltage will destroy the motor.

- ▶ Always observe the motor rating plate specifications.
- ▶ Route the mains connection in accordance with locally applicable provisions.
- ▶ Always provide a suitable mains fuse to protect the motor and supply cable in the event of a fault.
 - Pfeiffer Vacuum recommends the circuit breaker type "K" with slow tripping characteristic.

NOTICE

Motor damage from overheating

Limited motor fan cooling capacity, caused by low speeds, causes the motor to overheat.

- ▶ During operation with frequency converter, observe the rotation speed range specified in the technical data.

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

Standard versions

- Three phase motor with PTC, without switch and mains cable

5.6.1 Connecting three phase motor with 6-pin terminal board

NOTICE

Property damage from high starting torque

The specific load behavior of the vacuum pump requires direct on-line starting at full motor power. Engine damage occurs if a different starting circuit is used.

- ▶ Always start the motor directly.
- ▶ **Never** use a star-delta start-up circuit.

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

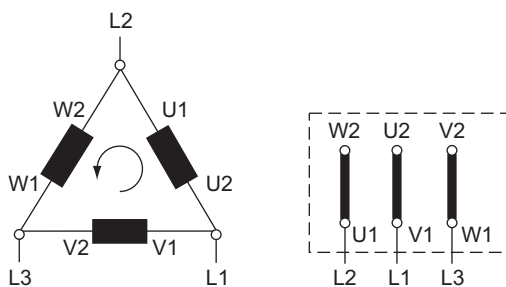


Fig. 6: Delta connection for low voltage

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

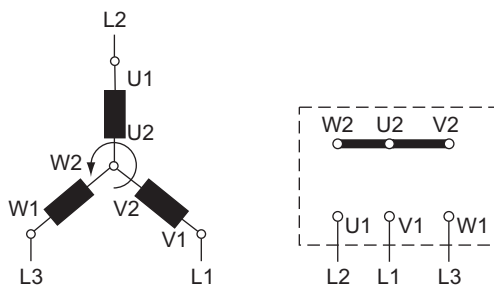


Fig. 7: Star circuit for high voltage

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

5.6.2 Checking the direction of rotation

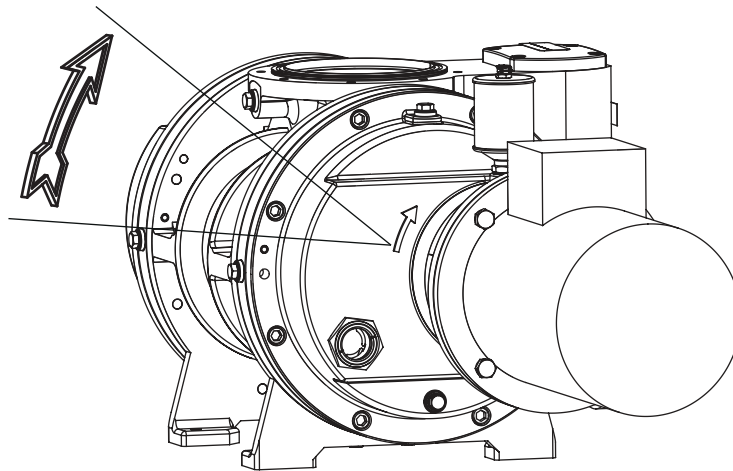


Fig. 8: Check of direction of rotation

Procedure

When switching on for the first time, check the roots pump direction of rotation.

1. Switch the vacuum pump on briefly (2 to 3 seconds)
 - The motor and coupling must rotate clockwise (see directional arrow on housing cover).
2. If the direction of rotation is incorrect, exchange the 2 phases on the connection cable.

5.6.3 Connecting the PTC thermistor tripping unit



Tripping units store the shut-down

Pfeiffer Vacuum recommends connecting motors with PTC in the stator winding to a PTC resistor tripping device for protection against overload.

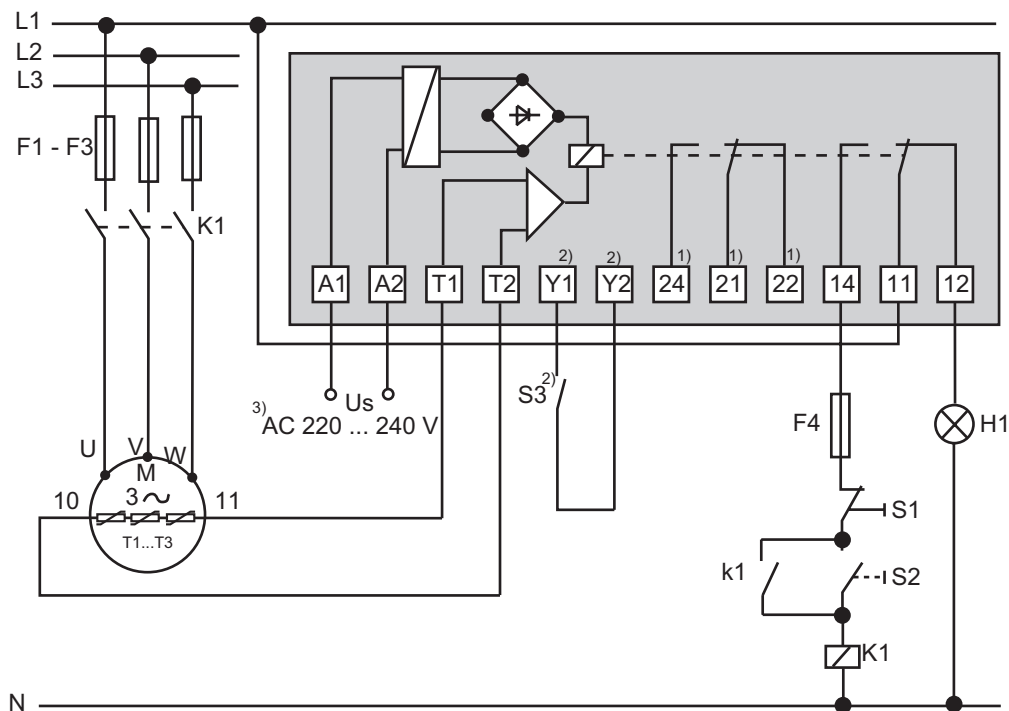


Fig. 9: Connection example with PTC thermistor tripping unit

U _s	Control voltage	T1 – T3	PTC resistor sensor
S ₁	OFF button	H1	Tripping indicator
S ₂	ON button	M	Motor, 3-phase
S ₃	RESET button	1)	For devices with two relay outputs only
K1	Contactor	2)	For MSR type (model) only
F1 – F4	Fuses	3)	Only for order no.: P 4768 052 FQ and P 4768 052 FE

Procedure

- ▶ After shut-down, switch the tripping unit back on manually via the installed RESET button or via the external RESET S3.
 - Switching on mains detected as automatic RESET.

6 Operation

6.1 Putting the vacuum pump into operation

Before switching on

1. Check the lubricant levels on both sight glasses.
2. Compare the specifications on the motor rating plate with the available mains voltage and frequency.
3. Make sure that the suction chamber is free from all foreign matters.
4. Check the vacuum pump for visible damage and put the vacuum pump into operation only in a correct state.
5. Protect the vacuum pump from sucking in contamination using suitable measures (e.g. dust filter).
6. Make sure that the shut-off units on the pressure side open before starting the pump.

6.2 Switching on vacuum pump

WARNING

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

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

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

CAUTION

Danger of burns on hot surfaces

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

- ▶ Provide suitable touch protection.

Procedure for operation without FC

1. Allow the vacuum pump to warm up with the vacuum flange closed, for approx. 30 minutes prior to the process start.
2. Do not switch on the roots pump until the fore-vacuum pressure allows the backing pump to accommodate the amount of gas required.
3. Switch off the roots pump immediately if the backing pump fails.

Procedure for operation with FC

1. Allow the vacuum pump to warm up with the vacuum flange closed, for approx. 30 minutes prior to the process start.
2. If you wish to switch on the roots pump simultaneously with the backing pump, use a frequency converter to limit the torque in the event of an overload to 28 Nm.

6.3 Check the lubricant level

Check the lubricant level

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

6.4 Adjusting sealing gas amount

⚠ WARNING

Risk of injury from reactive, potentially explosive or other hazardous gas/air mixtures

Uncontrolled gas inlet of air or gases containing oxygen provides ideal conditions for the formation of unexpected explosive gas/air mixtures in the vacuum system. This results in severe injuries.

- ▶ Use only inert gases for supplying the sealing gas supply in order to avoid a potential ignition.

NOTICE

Property damage from impermissibly high sealing gas pressure

Excessive sealing gas pressure leads to damage to the seals after switching on the vacuum pump.

- ▶ Make sure that the sealing gas pressure inside the pump does not exceed 1200 hPa.
- ▶ Stop the sealing gas supply immediately after switching off the vacuum pump.

The set quantity of sealing gas influences effective pumping speed and achievable ultimate pressure. Depending on the operating pressure, the empirical value for the supplied sealing gas amount is between 1 % (for a high operating pressure) and 8 % (for a lower operating pressure) of the effective suction capacity.

Required consumables

- Inert gas, e.g. nitrogen (N₂)

Procedure

1. Open the sealing gas supply on the gas cylinder.
2. Set a max. pressure of 2500 hPa on the pressure reducer.
3. Set the desired quantity of sealing gas on the dosing valve of the flow meter.

Formula for calculating the sealing gas flow:

$$Q_S = (S_{th} \times p \times A_S) / p_0$$

- Q_S = Sealing gas flow under standard conditions [Nm³/h]
- p = Intake pressure [hPa]
- p_0 = Ambient pressure under standard conditions [hPa]
- Δp = Differential pressure max. [hPa]
- p_V = Fore-vacuum pressure [hPa]
- A_S = Sealing gas content at the operating gas flow ($0.01 \leq A_S \leq 0.08$)
- S_{th} = Rated volume flow rate of the roots pump [m³/h]

Example for Okta 600 G with 50 hPa intake pressure and 8 % sealing gas content

$$Q_S = (580 \times 50 \times 0.08) / 1013$$

$$Q_S = 2.29 \text{ Nm}^3/\text{h}$$

At discharge pressures > 100 mbar:

$$Q_S = (S_{th} \times (p_V - \Delta p) \times A_S) / p_0$$

6.5 Flushing suction chamber

NOTICE

Property damage from impermissibly high pressure build-up in the suction chamber

Exceeding the specified flushing quantities damages the vacuum pump.

- ▶ Observe the maximum permissible flushing quantities at max. 3000 hPa.
- ▶ Fully purge all supplied fluid.
- ▶ Observe the vapor compatibility of the downstream vacuum pumps.

NOTICE

Property damage from incorrect cleaning procedure

Flushing fluid and process media that enters the bearing and oil chambers will stick.

- ▶ During the cleaning processes, always protect all bearings with sealing gas in order to prevent a contamination of the lubricant and bearing chambers.

If the extracted medium polymerizes or becomes deposited in the suction chamber, a continuous or discontinuous flushing of the suction chamber can be performed during operation.

Procedure

- ▶ Choose a suitable spray lance from the Pfeiffer Vacuum accessories range and follow the recommended cleaning procedure, as specified in the lance's operating instructions.

You can find this document in the [Pfeiffer Vacuum Download Center](#).

6.6 Switching off and venting

⚠ WARNING

Risk of crushing on rotating parts when reaching into the open flange

The pistons continue to run in the vacuum after switching off the motor, and can trap fingers and hands within their reach.

- ▶ Wait until the vacuum pump comes to a complete standstill.
- ▶ Secure the vacuum pump against re-start.

NOTICE

Property damage from impermissibly high sealing gas pressure

Excessive sealing gas pressure leads to damage to the seals after switching on the vacuum pump.

- ▶ Make sure that the sealing gas pressure inside the pump does not exceed 1200 hPa.
- ▶ Stop the sealing gas supply immediately after switching off the vacuum pump.

Procedure with clean processes

You can switch off the vacuum pump in every pressure range, between atmospheric pressure and ultimate pressure directly after the process end.

1. Close the shut-off valve in the vacuum line and disconnect the vacuum pump from the process.
2. Switch off the vacuum pump.
3. Vent the vacuum pump via the intake side.
4. Make sure that you do not vent the vacuum chambers through the vacuum pump.
5. Switch off the process- and pump-specific media supply (e.g. the sealing gas supply).

Procedure with contaminated medium

With media that heavily contaminate the suction chamber, flush the suction chamber with air, nitrogen or any other suitable flushing medium at the end of the process.

1. Close the shut-off valve in the vacuum line and disconnect the vacuum pump from the process.
2. At the end of the process, continue to operate the vacuum pump with flushing gas supply at the vacuum flange for another approx. 20 to 40 minutes.
3. Then stop the flushing gas supply.
4. Switch off the vacuum pump.
5. Vent the vacuum pump via the intake side.
6. Make sure that you do not vent the vacuum chambers through the vacuum pump.
7. Switch off the process- and pump-specific media supply (e.g. the sealing gas supply).

6.7 Restarting

NOTICE

Damage to the roots pump from significant temperature fluctuation

If the housing cools down too quickly due to external influences, there is a risk of contact being made between the rotor at warm operating temperature, and the colder pump housing. This will result in irreversible pump damage.

- ▶ Avoid uneven cooling, if you are going to switch the roots pump back on after a short period.
- ▶ Vent the roots pump in order to achieve a temperature compensation between the housing and rotor as quickly as possible.

7 Maintenance

7.1 Maintenance information

WARNING

Health hazard through poisoning from toxic contaminated components or devices

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

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

WARNING

Risk of crushing from rotating parts

Fingers and hands may be caught by rotating pistons within the connection flange. This results in severe injuries.

- ▶ Keep limbs out of the reach of the roots pump.

Maintenance instructions

1. Shut down the vacuum pump and allow it to cool if necessary.
2. Vent the vacuum pump to atmospheric pressure via the vacuum side.
3. Safely disconnect the drive motor from the mains.
4. Secure the motor against unintentional reactivation.
5. Remove the vacuum pump from the system if necessary.
6. Dispose of used lubricant according to applicable regulations in each case.
7. For maintenance work, only dismantle the vacuum pump to the extend needed.
8. Only clean the pump parts using industrial alcohol, isopropanol or similar media.
9. Avoid residues of cleaning agent inside the vacuum pump.

7.2 Checklist for inspection and maintenance



Notes on maintenance intervals

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

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

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

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

Action	Inspection	Maintenance level 1	Maintenance level 2	Maintenance level 3	Required material
described in document	OI	OI	SI	SI	
Interval	daily	≤ 1 year	≤ 1.5 years	≤ 3 years	
Inspection					
Visual and acoustic pump check <ul style="list-style-type: none"> • Checking lubricant level and color of the lubricant • Checking lubricant level of the sealing oil 	■				
<ul style="list-style-type: none"> • Checking vacuum pump for leaks • Checking vacuum pump for running noises 	■				
Maintenance level 1					
Clean the vacuum pump <ul style="list-style-type: none"> • Pump housing from outside • Flushing suction chamber with a suitable cleaning agent adapted to the process 		■ as required			Lubricant Suitable cleaning agent, compatible with the process
<ul style="list-style-type: none"> • Changing lubricant and sealing oil 		■			
Maintenance level 2					
<ul style="list-style-type: none"> • Checking coupling for damage, replacing toothed ring if necessary • Changing radial shaft seal rings and protective sleeves • Clean the gear chambers and replace the seals 			■		Maintenance kit with wearing parts of the coupling and the radial shaft seal rings
Maintenance level 3					
Dismantling and cleaning vacuum pump <ul style="list-style-type: none"> • Replace the seals and all wearing parts • Replace 4 piston bearings (ball bearings/roller bearings) 				■	Overhaul kit Lubricant Option <ul style="list-style-type: none"> • Magnetic coupling set • Set of gear wheels
Checking critical components and replacing if necessary: <ul style="list-style-type: none"> • Checking magnetic coupling for damage • Calibrate the temperature sensor with the reference temperature • Checking gear wheels for breaks 				■	

Tbl. 5: Maintenance intervals

7.3 Changing lubricant

⚠ WARNING

Health hazard and environmental damage from toxic contaminated lubricant

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

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

⚠ CAUTION

Scalding from hot lubricant

Danger of scalding when draining lubricant if it comes into contact with the skin.

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



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

The usable life may deviate from the reference value specified depending on thermic and chemical loads, or due to penetrating process media in gear and bearing chambers.



Safety data sheets

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

7.3.1 Draining lubricant

Required tools

- Ring spanner, WAF 17 mm

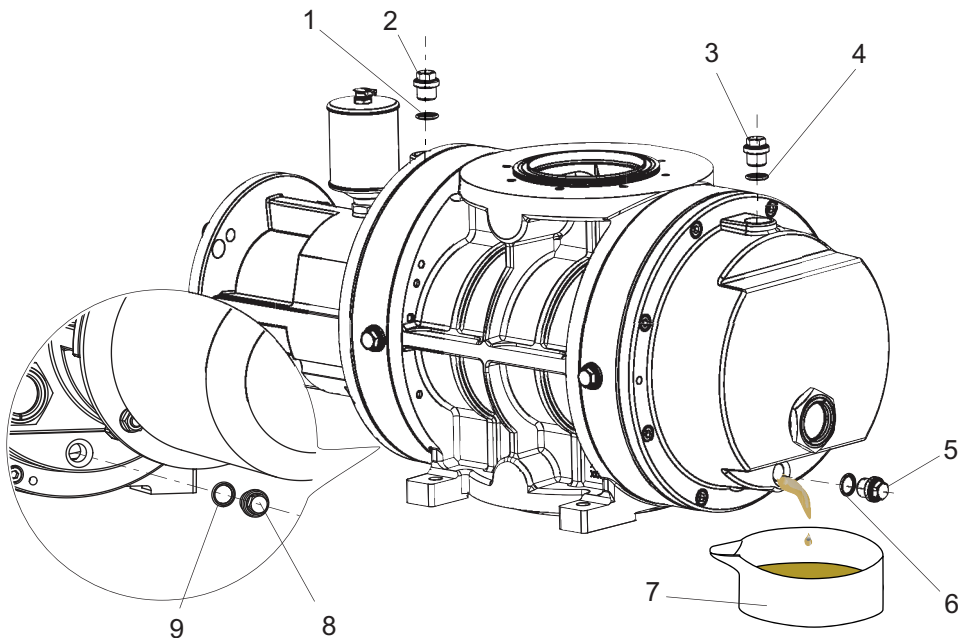


Fig. 10: Draining lubricant

- | | |
|----------------|-------------------------|
| 1 O-ring | 6 O-ring |
| 2 Filler screw | 7 Collection receptacle |
| 3 Filler screw | 8 Drain screw |
| 4 O-ring | 9 O-ring |
| 5 Drain screw | |

Draining lubricant

1. Shut down the vacuum pump and allow it to cool if necessary.
2. Vent the vacuum pump to atmospheric pressure via the intake side.
3. Unscrew the filler screws.
4. Place the collection receptacle underneath.
5. Unscrew both drain screws.
6. Fully drain the lubricant.
7. Screw the drain screws back in.
 - Tightening torque: **max. 32 Nm**

7.3.2 Filling up lubricant

Consumable

- Lubricant

Required tools

- Ring spanner, WAF 17 mm
- Calibrated torque wrench (tightening factor ≤ 2.5)

Required aids

- Funnel (optional)

Procedure

1. Pour in lubricant on both sides.
 - Fill level: approx. 5 mm below the middle of the inspection glass.
2. Screw in the filler screws again.
 - Tightening torque: **max. 32 Nm**

7.4 Changing sealing oil

NOTICE

Damage to the vacuum pump due to incorrect procedure when filling sealing oil

Disassembly of the lubricator causes leakage in the system. The lubricant expands when the roots pump heats up, which could cause lubricant to leak if overfilled.

- ▶ Use only the lubricator's filler flap to fill up.
- ▶ While the roots pump is cold, fill the lubricator **no more than halfway**.

Consumable

- Lubricant

Required tools

- Open-end wrench, WAF 17
- Calibrated torque wrench (tightening factor ≤ 2.5)

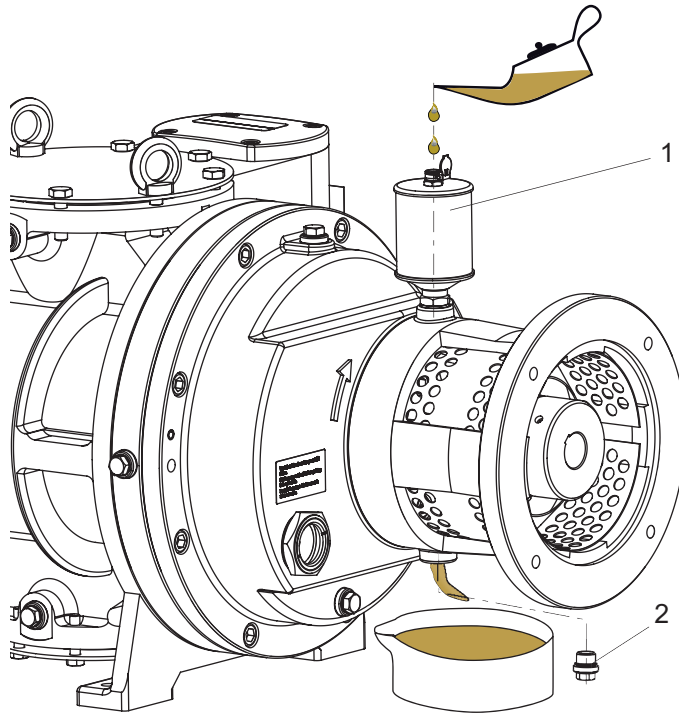


Fig. 11: Replacing sealing oil for radial shaft seal rings

- 1 Oiler 2 Sealing oil drain screw

Procedure in the event of minor oil loss

A decreasing oil level in the oiler and an oil leak below the lantern indicate a defective **external** radial shaft seal ring.

- ▶ Check the level at shorter intervals and top up regularly as required.
 - With this type of damage, the roots pump can continue to be operated for a time.

Procedure in the event of significant oil loss

A decreasing oil level, with no leaked oil visible below the roots pump, is due to a worn **inner** radial shaft seal ring.

- ▶ Should this occur, arrange for maintenance to be carried out by Pfeiffer Vacuum Service, during which all 3 radial shaft seal rings and the protective sleeve are replaced.
 - This damage leads to an inadmissibly high oil level in the bearing chamber.

Changing sealing oil

1. In general, carry out a sealing oil change once a year.
2. Open the filler flap on the oiler.
3. Place the collection receptacle underneath.
4. Unscrew the sealing oil drain screw.
5. Fully drain the lubricant.
6. Screw the drain screw back in.
 - Tightening torque: **32 Nm**
7. Fill the oiler with lubricant to max. halfway.
8. Close the filler flap.

7.5 Cleaning the suction chamber

⚠ WARNING

Risk of crushing from rotating parts

Fingers and hands may be caught by rotating pistons within the connection flange. This results in severe injuries.

- ▶ Keep limbs out of the reach of the roots pump.

NOTICE**Property damage from incorrect cleaning procedure**

Flushing fluid and process media that enters the bearing and oil chambers will stick.

- ▶ During the cleaning processes, always protect all bearings with sealing gas in order to prevent a contamination of the lubricant and bearing chambers.

The clearance between pistons and housing are within a tenth of a centimeter range. Sustained, accumulating contamination has the following effect:

- the friction heat inside the roots pump increases
- the power consumption of the roots pump increases
- the pistons jam

Required aids

- Brushes and cleaning agents
- Suitable vessel for collecting the cleaning fluid
- Absorbent materials for absorbing the cleaning fluid

Procedure

1. Dismantle the pipes from the vacuum and fore-vacuum connections.
2. Clean the suction chamber and the overflow channel with suitable brushes and cleaning agents.
3. After cleaning, completely remove remaining fluids using absorbent materials, and dry the suction chamber.
4. After cleaning, mount all pipes.
5. Screw in the drain screws.

7.6 Installing coupling

⚠ WARNING**Danger of injury due to exposed rotating parts**

In the operating range of the motor coupling, there is a danger of clothing being caught and wound up.

- ▶ When assembling the motor and coupling, make sure that the coupling protection is seated correctly.
- ▶ Wear correct clothing.

**Coupling assembly**

Observe the installation instructions of the coupling manufacturer.

Required tools

- Allen key, WAF 2.5 mm
- Allen key, WAF 6 mm
- Calibrated torque wrench (tightening factor ≤ 2.5)

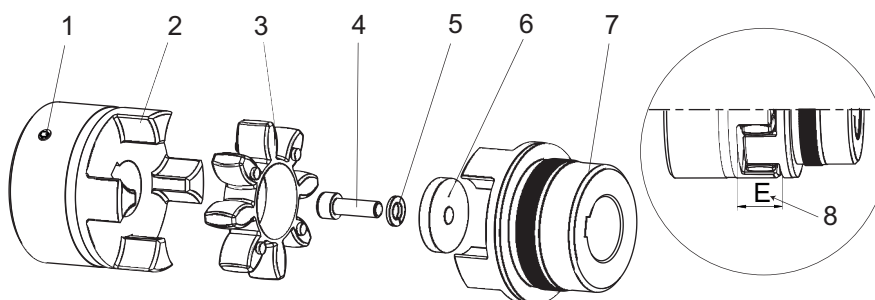


Fig. 12: Installation instructions gear rim coupling

- | | |
|-----------------------------|---------------------------|
| 1 Stud screw (T_A) | 5 Lock washer |
| 2 Coupling half motor | 6 Washer |
| 3 Toothed ring coupling hub | 7 Coupling half pump side |
| 4 Cylinder screw (T_P) | 8 Clearance E |

Procedure

1. Precisely adhere to the prescribed installation dimensions.
 - Angular and radial displacement of the shafts.
 - Clearance E: **18 mm**.
2. Lock the thread on the stud screw with **Loctite 243**.
3. Tighten the stud screw in the motor side coupling half.
 - Tightening torque T_A : **2 Nm**
4. Install the pump side coupling half.
5. Lock the thread on the cylinder screw with **Loctite 243**.
6. Install the cylinder screw with washer and spring washer.
 - Tightening torque T_P : **32 Nm**

7.7 Installing the coupling for versions with magnetic coupling

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

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

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

NOTICE**Damage to the magnetic coupling due to incorrect installation and removal**

The isolating shroud on the magnetic coupling is made of impact-sensitive material (synthetic or ceramic).

If the motor is installed or removed incorrectly, there is a risk of damage.

- ▶ Attach the motor to the lifting gear with the eye bolt and pull the motor horizontally away from the vacuum pump.
- ▶ Use jacking bolts and guide pins.

**Supplementary information for work on the magnetic couplings of Roots pumps**

Upon request, you can obtain supplementary information **PW0142** from [Pfeiffer Vacuum Download Center](#).

8 Decommissioning

8.1 Shutting down for longer periods

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

Shutting down the vacuum pump

1. Switch off the vacuum pump.
2. Vent the vacuum pump.
3. Allow the vacuum pump to cool down.
4. Clean suction chamber.
5. Change the lubricant.
6. Seal the vacuum and fore-vacuum flanges as well as any other openings with blind flanges from the Pfeiffer Vacuum [accessories range](#).
7. Evacuate the pump interior via the measurement connection on the vacuum side to $p < 1$ hPa.
8. Fill the suction chamber with nitrogen.
9. Store the vacuum pump in dry, dust-free rooms, within the specified ambient conditions.
10. In rooms with damp or aggressive atmospheres, you should package the vacuum pump in a plastic bag together with a drying agent, and seal it so that it is airtight.
11. For storage durations longer than 2 years, we recommend you carry out maintenance and a lubricant change prior to recommissioning.
12. Please note, the vacuum pump may not be stored in the vicinity of machines, traffic routes, etc., as strong vibrations may damage the bearing.

8.2 Recommissioning

NOTICE

Damage to the roots pump due to aging of the lubricant

The useful life of the lubricant is limited (max. 2 years). Prior to recommissioning, carry out the following operations following inactivity of **2 years or more**:

- ▶ Observe the maintenance instructions – consult Pfeiffer Vacuum where necessary.
- ▶ Change the lubricant.
- ▶ Check the bearings and replace any aged elastomer parts.

Procedure when recommissioning the vacuum pump

1. Check the roots pump for visible damage and operate the roots pump only in an appropriate operating status.
2. Check the interior of the pump for contaminants.
3. Remove any drying pearls from the suction chamber.
4. Do not operate the vacuum pump if there is evidence of rust on the parts which form the housing. Contact [Pfeiffer Vacuum Service](#).
5. Perform a leak test prior to recommissioning the vacuum pump as required.

9 Recycling and disposal

WARNING

Health hazard through poisoning from toxic contaminated components or devices

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

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



Environmental protection

You **must** dispose of the product and its components in accordance with all applicable regulations for protecting people, the environment and nature.

- Help to reduce the wastage of natural resources.
- Prevent contamination.



Environmental protection

The product and its components **must be disposed of in accordance with the applicable regulations relating to environmental protection and human health**, with a view to reducing natural resource wastage and preventing pollution.

9.1 General disposal information

Pfeiffer Vacuum products contain materials that you must recycle.

- ▶ Dispose of our products according to the following:
 - Iron
 - Aluminium
 - Copper
 - Synthetic
 - Electronic components
 - Oil and fat, solvent-free
- ▶ Observe the special precautionary measures when disposing of:
 - Fluoroelastomers (FKM)
 - Potentially contaminated components that come into contact with media

9.2 Dispose of Okta roots pumps

Pfeiffer Vacuum roots pumps from the Okta series contain materials that you must recycle.

1. Fully drain the lubricant.
2. Dismantle the motor.
3. Decontaminate the components that come into contact with process gases.
4. Separate the components into recyclable materials.
5. Recycle the non-contaminated components.
6. Dispose of the product or components in a safe manner according to locally applicable regulations.

10 Malfunctions

⚠ CAUTION

Danger of burns on hot surfaces

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

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

NOTICE

Danger of property damage from improper maintenance

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

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

Problem	Possible causes	Remedy
Vacuum pump will not start up	<ul style="list-style-type: none"> • Mains voltage is missing or the incorrect operating voltage is present 	<ul style="list-style-type: none"> • Check the mains voltage. • Check the mains fuse. • Check the motor switch.
	<ul style="list-style-type: none"> • The circuit breaker trips; the circuit breaker may be of the wrong type 	<ul style="list-style-type: none"> • Check the terminal connection in the motor terminal box • Check the circuit breaker type; use type "K" with slower tripping characteristic
	<ul style="list-style-type: none"> • Thermal protection switch has triggered 	<ul style="list-style-type: none"> • Determine the cause and eliminate the fault. • Allow the vacuum pump to cool if needed.
	<ul style="list-style-type: none"> • Suction chamber contaminated 	<ul style="list-style-type: none"> • Clean suction chamber. • If necessary, contact Pfeiffer Vacuum Service.
	<ul style="list-style-type: none"> • Gear (gear wheels) damaged 	<ul style="list-style-type: none"> • Switch off the vacuum pump immediately. • If necessary, contact Pfeiffer Vacuum Service.
	<ul style="list-style-type: none"> • Bearing damage present 	<ul style="list-style-type: none"> • Have the bearing changed. • Contact Pfeiffer Vacuum Service.
	<ul style="list-style-type: none"> • Motor faulty 	<ul style="list-style-type: none"> • Change the motor.
Vacuum pump switches off after a while after being started	<ul style="list-style-type: none"> • Thermal protection switch of the motor has triggered • Fore-vacuum pressure possibly too high 	<ul style="list-style-type: none"> • Determine the cause of the overheating and eliminate the fault. • Check the fore-vacuum pressure • Allow the motor to cool if necessary
	<p>Operation without frequency converter:</p> <ul style="list-style-type: none"> • Thermal protection switch of the motor has triggered • Backing pump is overloaded • Magnetic coupling slips and magnetic field is interrupted 	<ul style="list-style-type: none"> • Determine the cause of the overheating and eliminate the fault. • Switch off the vacuum pump immediately. <p>While the vacuum pump is at a standstill, the magnets can realign with each other.</p> <ul style="list-style-type: none"> • Allow the motor to cool if necessary • When restarting, do not switch the roots pump on until the fore-vacuum pressure allows the backing pump to accommodate the amount of gas required.

Problem	Possible causes	Remedy
Vacuum pump/ pumping station does not reach ultimate pressure	<ul style="list-style-type: none"> • Suction chamber dirty 	<ul style="list-style-type: none"> • Clean suction chamber
	<ul style="list-style-type: none"> • Lubricant soiled 	<ul style="list-style-type: none"> • Change the lubricant
	<ul style="list-style-type: none"> • Backing pump operates incorrectly 	<ul style="list-style-type: none"> • Check the backing pump
	<ul style="list-style-type: none"> • Leak in system 	<ul style="list-style-type: none"> • Examine the system for leaks and, if necessary, carry out a leak test. • Eliminate leaks.
Unusual noises during operation	<ul style="list-style-type: none"> • Suction chamber dirty 	<ul style="list-style-type: none"> • Switch off the vacuum pump immediately. • Clean suction chamber.
	<ul style="list-style-type: none"> • Damage to the bearing or gear wheels 	<ul style="list-style-type: none"> • Switch off the vacuum pump immediately. • Contact Pfeiffer Vacuum Service.
	<ul style="list-style-type: none"> • Damage to motor bearing 	<ul style="list-style-type: none"> • Switch off the vacuum pump immediately. • Change the motor. • If necessary, contact Pfeiffer Vacuum Service.
	<p>Only applies to vacuum pumps with magnetic coupling</p> <ul style="list-style-type: none"> • Motor is running – vacuum pump is not working, i.e., the magnetic coupling is defective or the magnetic field has broken down. <p>If the vacuum pump continues to run with a "broken down" magnetic field, the magnetic coupling is destroyed by demagnetization.</p>	<ul style="list-style-type: none"> • Switch off the vacuum pump immediately. <p>While the vacuum pump is at a standstill, the magnets can realign with each other.</p> <ul style="list-style-type: none"> • Slowly restart the vacuum pump and check the power transmission and vacuum pressure.
Vacuum pump losing oil	<ul style="list-style-type: none"> • A decreasing oil level in the oiler and an oil leak below the lantern indicate a defective external radial shaft seal ring. 	<ul style="list-style-type: none"> • Check the level at shorter intervals and top up regularly as required. • You can continue to operate the roots pump for a time.
	<ul style="list-style-type: none"> • A decreasing oil level, with no leaked oil visible below the roots pump, is due to a worn inner radial shaft seal ring. 	<ul style="list-style-type: none"> • Should this occur, arrange for maintenance to be carried out by Pfeiffer Vacuum Service, during which all 3 radial shaft seal rings and the protective sleeve are replaced. This damage leads to an inadmissibly high oil level in the bearing chamber.

Tbl. 6: Troubleshooting

11 Service solutions by Pfeiffer Vacuum

We offer first-class service

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

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

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

Make use of Pfeiffer Vacuum service

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

You can obtain advice on the optimal solution for you, from your [Pfeiffer Vacuum representative](#).

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



1. Download the up-to-date form templates.
 - [Explanations of service requests](#)
 - [Service requests](#)
 - [Contamination declaration](#)



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



3. Send the forms by email, fax, or post to your local [Service Center](#).

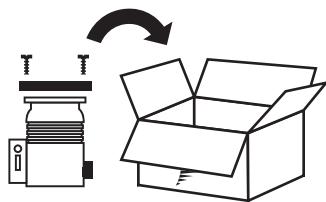


4. You will receive an acknowledgment from Pfeiffer Vacuum.

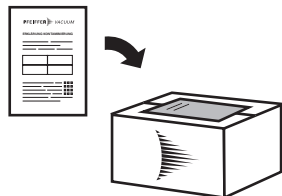
PFEIFFER VACUUM

Submission of contaminated products

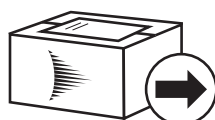
No microbiological, explosive, or radiologically contaminated products will be accepted. Where products are contaminated, or the contamination declaration is missing, Pfeiffer Vacuum will contact you before starting service work. Depending on the product and degree of pollution, **additional decontamination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



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



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



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



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

PFEIFFER VACUUM

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

12 Spare parts



Ordering and using spare parts

Spare parts for service work are grouped into packs. These vary according to pump version.

- You can ask Pfeiffer Vacuum Service for spare parts pack order numbers.
- Have the full vacuum pump article number (with index where applicable) to hand. You can find it on the rating plate.
- Replace all parts contained in the pack.

12.1 Set of seals for version with RSSR

The set of seals contains:

- all sealing parts such as O-rings, radial shaft seal rings and supporting rings
- flat seals, square washers and annular profile seals

The protective sleeve and centering rings for connecting the roots pump to the suction and pressure sides are not included.

12.2 Set of seals for version with magnetic coupling

The set of seals contains:

- all sealing parts such as O-rings
- flat seals, square washers and annular profile seals

Centering rings for connecting the suction and pressure sides are not included.

12.3 Maintenance kit for version with RSSR

The maintenance kit contains:

- all sealing parts in the area of the radial shaft seal ring including the protective sleeve
- all sealing rings of the filling and drain screws and both O-rings for the device cover and cap
- the coupling buffer (toothed ring)

12.4 Maintenance kit for version with magnetic coupling

The maintenance kit contains:

- all sealing rings of the filling and drain screws and both O-rings for the device cover and cap
- the O-ring for the isolation shroud

13 Accessories



View the line of accessories for Pfeiffer Vacuum roots pumps online at pfeiffer-vacuum.de.

13.1 Accessory information

Sealing gas device

The use of sealing gas at the bearing points protects the lubricant from contamination by the ingress of process media and flushing fluid into the bearing and oil chambers.

Flushing device

The flushing device is used to clean the materials in contact with the medium if the extracted medium polymerizes or deposits in the suction chamber.

Gear space extraction

The gear chamber extractor serves to evacuate the gear and bearing chambers in order to shorten pump-down time.

Protective strainer

The protective strainer on the vacuum connection prevents solids from penetrating into the suction chamber of the vacuum pump.

13.2 Ordering accessories

Description	Order number
Centering Ring with Outer Ring	PF 303 110 -T
Oil Level Monitoring 20–250 V AC	PK 004 930 -U
Oil Level Monitoring 24 V DC	PK 005 639 -U
Sealing gas kit	PP 027 401 -T
Splinter Shield	PP 030 149 AX
Setting Elements for Foot Mounting	PP 041 454 -T
Splinter Shield	PP 042 350 -X
Screw Set, Zinc-Plated Steel	PP 042 645 -T
Spray lance G1/2"	PP 042 765 -U
Screw Set, Stainless Steel	PP 042 655 -T
Claw Set (Stainless Steel)	PP 042 660 -T
Blank flange set for Okta 300/M Okta 500/M Okta 600/M Okta 800/M, Stainless steel	PP 042 664 -T
Blank flange set for Okta 300/M Okta 500/M Okta 600/M Okta 800/M, DN ISO-K (stainless steel)	PP 042 665 -T
Frequency Converter	PP 078 296 -T

Tbl. 7: Accessories for Okta 300 | Okta 600

Description	Order no.
P3, mineral oil, 1 l	PK 001 106 -T
P3, mineral oil, 5 l	PK 001 107 -T
P3, mineral oil, 20 l	PK 001 108 -T
D1, synthetic diester based oil, 1 l	PK 005 875 -T
D1, synthetic diester based oil, 5 l	PK 005 876 -T
D1, synthetic diester based oil, 20 l	PK 005 877 -T
F5, perfluoropolyether, 0.5 l	PK 001 851 -T

Description	Order no.
F5, perfluoropolyether, 1 l	PK 001 852 -T
F5, perfluoropolyether, 5 l	PK 001 853 -T

Tbl. 8: Consumables

14 Technical data and dimensions

14.1 General

Basis for the technical data of Pfeiffer Vacuum roots pumps

- Specifications according to PNEUROP committee PN5
- ISO 21360-1: 2016 “Vacuum technology - Standard methods for measuring vacuum-pump performance - General description”
- Leak test to ascertain the integral leakage rate according to EN 1779: 1999 technique A1; with 100 % helium concentration, 10 s measurement duration
- Sound pressure level: distance to vacuum pump 1 m

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

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

Tbl. 9: Conversion table: Pressure units

	mbar l/s	Pa m³/s	sccm	Torr l/s	atm cm³/s
mbar l/s	1	0.1	59.2	0.75	0.987
Pa m³/s	10	1	592	7.5	9.87
sccm	$1.69 \cdot 10^{-2}$	$1.69 \cdot 10^{-3}$	1	$1.27 \cdot 10^{-2}$	$1.67 \cdot 10^{-2}$
Torr l/s	1.33	0.133	78.9	1	1.32
atm cm³/s	1.01	0.101	59.8	0.76	1

Tbl. 10: Conversion table: Units for gas throughput



Special versions

The technical data and dimensions for the vacuum pump refer to the specified standard version.

- For deviations in special versions, please refer to the rating plates or the enclosed information.

14.2 Technical data

Type designation	Okta 300	Okta 600
Version	Standard with motor	Standard with motor
Connection flange (in)	DN 100 ISO-F	DN 100 ISO-F
Connection flange (out)	DN 100 ISO-F	DN 100 ISO-F
Nominal pumping speed	290 – 350 m³/h	290 – 870 m³/h
Nominal pumping speed at 50 Hz	290 m³/h	580 m³/h
Nominal pumping speed at 60 Hz	350 m³/h	700 m³/h
Input voltage 50 Hz	230 / 400 V	230 / 400 V
Input voltage 60 Hz	265 / 460 V	265 / 460 V
Input voltage: tolerance	±5 %	±5 %
Rated power 50 Hz	1.1 kW	1.5 kW
Rated power 60 Hz	1.3 kW	1.8 kW

Type designation	Okta 300	Okta 600
Nominal rotation speed at 50 Hz	1500 rpm	3000 rpm
Nominal rotation speed at 60 Hz	1800 rpm	3600 rpm
Rotation speed	1 500 – 3 000 rpm	1 500 – 4 500 rpm
Integral leakage rate	$1 \cdot 10^{-3} \text{ Pa m}^3/\text{s}$	$1 \cdot 10^{-3} \text{ Pa m}^3/\text{s}$
Emission sound pressure level (EN ISO 2151) at intake pressure 10 hPa	75 dB(A)	75 dB(A)
Emission sound pressure level (EN ISO 2151) at intake pressure 1 hPa	70 dB(A)	70 dB(A)
Protection degree	IP55	IP55
Cooling method, standard	Air	Air
Motor protection	3TF	3TF
Pumping speed category	300 m ³ /h	600 m ³ /h
Operating fluid amount	1.5 l	1.5 l
DN 1	DN 100 ISO-F	DN 100 ISO-F
DN 2	DN 100 ISO-F	DN 100 ISO-F
Ambient temperature	5 – 40 °C	5 – 40 °C
Shipping and storage temperature	-10 – 40 °C	-10 – 40 °C
Weight: with motor	130 kg	140 kg

Tbl. 11: Technical data of Okta 300 | Okta 600

14.3 Characteristics

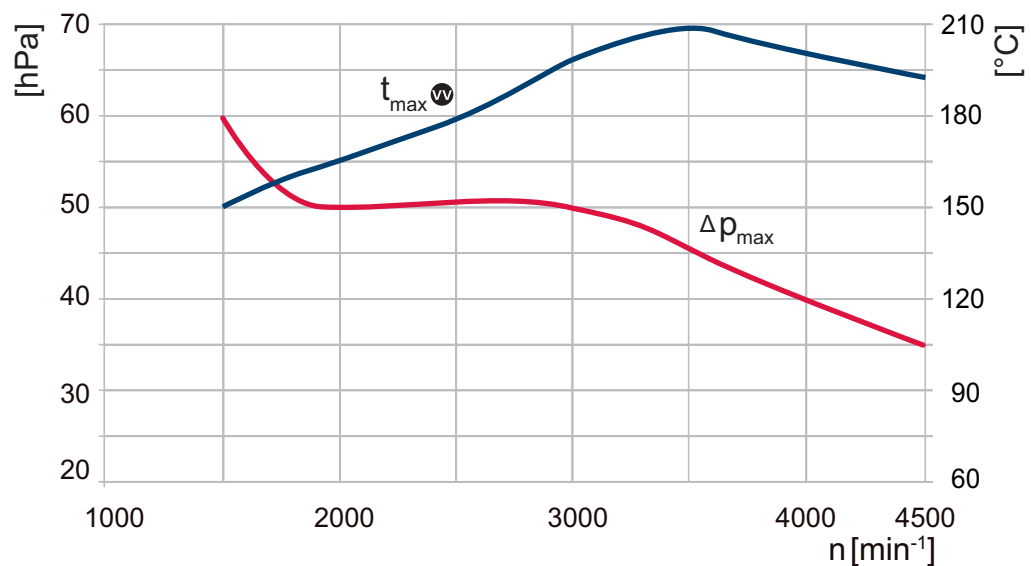


Fig. 13: Operating limits for differential pressure and discharge side gas temperature

14.4 Dimensions

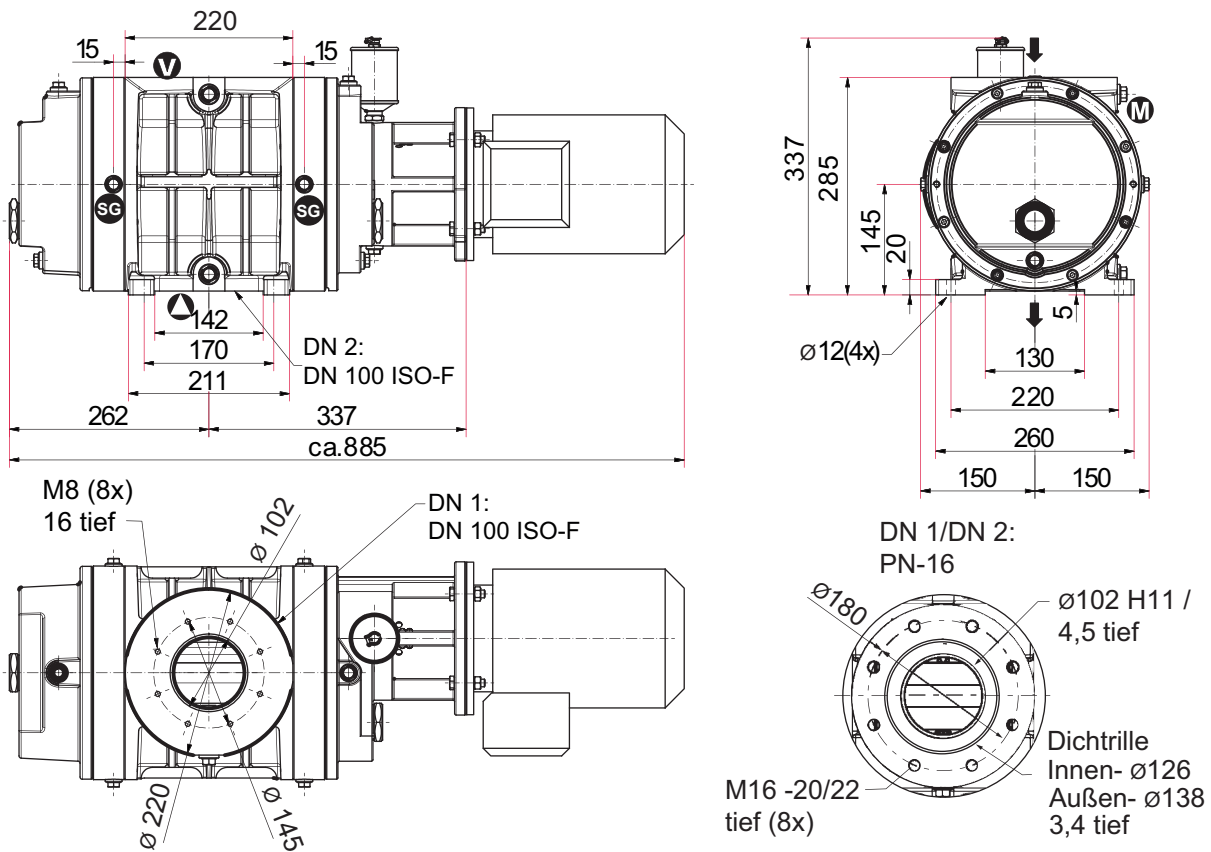


Fig. 14: Okta 300 | Okta 600 dimensions
Dimensions in mm

Declaration of conformity

Declaration for product(s) of the type:

Roots pump

Okta 300
Okta 300 M
Okta 600
Okta 600 M

We hereby declare that the listed product satisfies all relevant provisions of the following **European Directives**.

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

Harmonized standards and applied national standards and specifications:

DIN EN ISO 12100: 2011	DIN EN ISO 2151: 2009
DIN EN 1012-2: 2011-12	DIN EN 61000-6-2: 2006
DIN EN ISO 13857: 2008	DIN EN 61000-6-4: 2011
ISO 21360-1: 2016	
ISO 21360-2: 2012	

The authorized representative for the compilation of technical documents is Mr. Wolfgang Bremer, Pfeiffer Vacuum GmbH, Berliner Straße 43, 35614 Asslar, Germany.

Signature:



(Daniel Sälzer)
Managing Director

Pfeiffer Vacuum GmbH
Berliner Straße 43
35614 Asslar
Germany

Asslar, 2021-06-01



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