

OPERATING INSTRUCTIONS

EN

Translation of the Original

OKTA 8000 G ATEX

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

These operating instructions are 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 these 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
Declaration of conformity	Part of this document
Technical information on the thermometer	Supplier document
Installation instructions for axial face seal	Supplier document

1.1.2 Variants

According to identification of the motor:

- Okta 8000 G ATEX, 3/3G
- Okta 8000 G ATEX, 3/-G

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.



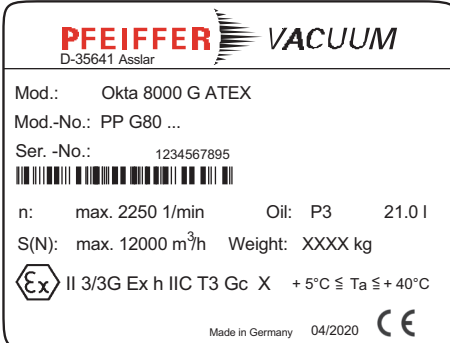

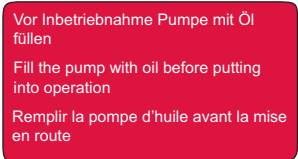
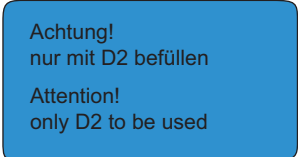
Note



Tip

1.3.3 Labels on product

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

 <p>Mod.: Okta 8000 G ATEX Mod.-No.: PP G80 ... Ser. -No.: 1234567895 n: max. 2250 1/min Oil: P3 21.0 l S(N): max. 12000 m³/h Weight: XXXX kg Ex II 3/G Ex h IIC T3 Gc X + 5°C ≤ Ta ≤ + 40°C Made in Germany 04/2020 CE</p>	<p>Rating plate (example) The rating plate is located on the front side above the sight glass</p>
	<p>Warning hot surface This label warns of injuries caused by high temperatures as a result of contact without protection during operation.</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>Label (red) Before commissioning, fill the gear and bearing chambers with lubricant</p>
 <p>Achtung! nur mit D2 befüllen Attention! only D2 to be used</p>	<p>Sticker (blue) – special lubricant only Caution: fill with D2 only</p>

Tbl. 1: Labels on product

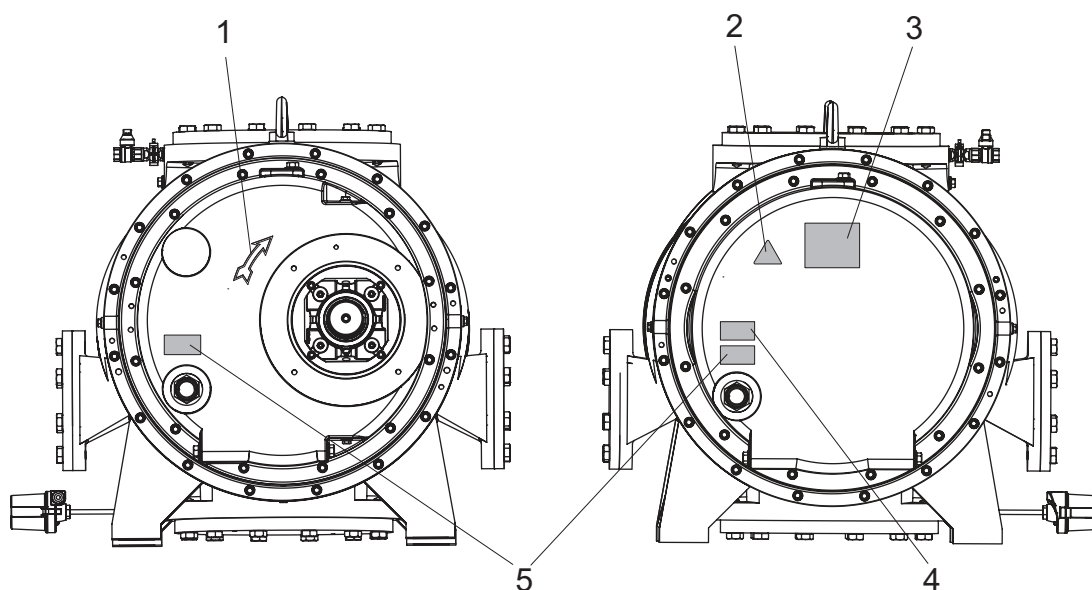


Fig. 1: Position of the labels on the product

- | | | | |
|---|--|---|------------------------------|
| 1 | Direction of rotation arrow (cast in pump housing) | 4 | D2 lubricant notice |
| 2 | Hot surface warning sign | 5 | Note on filling up lubricant |
| 3 | Rating plate | | |

1.3.4 Abbreviations

Abbreviation	Explanation
Okta "G"	Gas circulation cooled roots pump
SIL	Safety Integrity Level in accordance with safety standard DIN EN 61508
EPL	Equipment Protection Level
HART	Highway Addressable Remote Transducer
FKM	Fluorinated rubber
PTC	Temperature-dependent resistor (Positive Temperature Coefficient)
n	Rotation speed [Hz]
PE	Earthed conductor (protective earth)
PN	Nominal pressure stage (pressure nominal)
ISO	International Organization for Standardization
DIN	German Institute for Standardization (Deutsches Institut für Normung)
f	Rotation speed value of a vacuum pump (frequency, in rpm or Hz)
WAF	width across flats
OI	Operating instructions
SI	Service instructions

Tbl. 2: Abbreviations used

1.4 Trademark proof

- Loctite® is a registered trade mark of HENKEL IP & HOLDING GMBH.
- Anderol® is a registered trade mark of Royal Lubricants Inc., East Hanover N.J., US
- Shell Morlina® is a registered trade mark of SHELL BRANDS INTERNATIONAL AG, 6340, CH

2 Safety

2.1 General safety information

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

DANGER

Immediately pending danger

Indicates an immediately pending danger that will result in death or serious injury if not observed.

- Instructions to avoid the danger situation

WARNING

Potential pending danger

Indicates a pending danger that could result in death or serious injury if not observed.

- Instructions to avoid the danger situation

CAUTION

Potential pending danger

Indicates a pending danger that could result in minor injuries if not observed.

- Instructions to avoid the danger situation

NOTICE

Danger of damage to property

Is used to highlight actions that are not associated with personal injury.

- Instructions to avoid damage to property



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

DANGER

Risk of explosion from electrostatic charging during transport

There is a risk of fatalities when transporting packaging material (foil) and plastic containers in potentially explosive areas. Ignition can cause very serious injuries, and even fatalities.

- Only unpack the vacuum pump outside of potentially explosive areas.

DANGER

Risk of explosion when carrying out installation and maintenance work in potentially explosive areas

There is a risk of explosion if unsuitable tools are used in potentially explosive areas. Ignition can cause very serious injuries.

- Transport, installation and maintenance work may not be performed in potentially explosive atmospheres.
- Always shut down the vacuum pump before commencing any work.

⚠ 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.

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 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.

⚠ 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**Risk of scalding from suddenly escaping hot cooling water**

The cooling water connections are open to both sides. When connecting the cooling water supply, there is a risk of scalding from the sudden escape of overpressurized hot water.

- ▶ Prior to installation, ensure that pressure is discharged from the cooling water system, and that it is cooled down.
- ▶ Wear protective equipment, e.g., safety goggles and gloves.

⚠ 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.

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.

Risks during operation

WARNING

Risk of explosion when the ignition temperature of the pumped medium is reached

If the prescribed temperature monitoring is not in place, the gas temperature in the fore-vacuum flange can exceed the temperature class limit. In the worst case, it can result in ignition in the suction chamber.

- ▶ You must continually monitor the gas temperature in the fore-vacuum flange.
- ▶ Operate the roots pump only if the temperature measurement is functioning.
- ▶ When a gas temperature of 140 °C is reached, switch the roots pump off (zero potential).

WARNING

Risk of injury due to the bearing bursting after overheating

During longer operation with defective bearings, there is a risk of explosion due to hot surfaces if there is a potentially explosive atmosphere.

- ▶ Perform a vibration measurement at the defined measuring points at the prescribed time intervals.
- ▶ Switch the roots pump off if process-independent trend changes of characteristic variables occur.

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.

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.

⚠ 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, recycling and malfunctions**⚠ DANGER****Risk of explosion when carrying out installation and maintenance work in potentially explosive areas**

There is a risk of explosion if unsuitable tools are used in potentially explosive areas. Ignition can cause very serious injuries.

- ▶ Transport, installation and maintenance work may not be performed in potentially explosive atmospheres.
- ▶ Always shut down the vacuum pump before commencing any work.

⚠ DANGER**Risk of explosion from electrostatic charging during transport**

There is a risk of fatalities when transporting packaging material (foil) and plastic containers in potentially explosive areas. Ignition can cause very serious injuries, and even fatalities.

- ▶ Only unpack the vacuum pump outside of potentially explosive areas.

⚠ WARNING**Health hazard through poisoning from toxic contaminated components or devices**

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

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

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

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

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

⚠ 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.

CAUTION

Danger of burns on hot surfaces

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

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

CAUTION

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.
- ▶ Observe the safety and accident prevention regulations, if necessary wear personal protective equipment.
- ▶ Check all safety measures at regular intervals.
- ▶ Always ensure a secure connection to the earthed conductor (PE), protection class I.
- ▶ During operation, make sure that plug-and-socket connections are securely fitted.
- ▶ Never operate the vacuum pump with open vacuum flange.
- ▶ 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 ATEX classification and safety measures

Vacuum pumps of the ATEX series are specially designed and manufactured to comply with the requirements of Directive 2014/34/EU regarding the proper use of equipment and protective systems in potentially explosive areas.

- With ATEX-certified motor:

 II 3/3G Ex h IIC T3 Gc X +5 °C ≤ Ta ≤ +40 °C

- A part of the product does not comply with the ATEX Directive, and cannot therefore be used in potentially explosive areas (e.g. roots pump without ATEX-certified motor):

 II 3/-G Ex h IIC T3 Gc X +5 °C ≤ Ta ≤ +40 °C

2.4.1 Labeling of the vacuum pump

Classification	Description
Device group	<p>Devices which can be used for applications in potentially explosive atmospheres are divided into two groups:</p> <p>Device group I: Devices for mines susceptible to firedamp (will not be discussed in any more detail here)</p> <p>Device group II: Devices for all other potentially explosive areas with the exception of underground operations in mines and their surface installations which are susceptible to hazardous firedamp and / or combustible dust.</p>
Device category	<p>Device group II is divided into three categories which vary in their respective degree of safety.</p> <p>Devices of Device category 1 are designed to guarantee an extremely high degree of safety. They must guarantee the necessary degree of safety even if malfunctions occur only rarely on the device.</p> <p>Devices of Device category 2 are designed to guarantee a high degree of safety. They must guarantee the necessary degree of safety even with regular occurrences of malfunctions or fault conditions which are generally to be expected.</p> <p>Devices of Device category 3 are designed to guarantee a normal degree of safety. They guarantee the necessary degree of safety for normal operation.</p>
Combustible materials	<p>G: Gases or vapors</p> <p>D: Dust (will not be discussed in any more detail here)</p> <p>Note: The device may only be used in atmospheres susceptible to explosion due to gases or vapors. Operation in dust-charged, potentially explosive atmospheres is not permitted.</p>
Type of protection	<p>Identification code “Ex h” designated in the standard DIN EN ISO 80079-36 for non-electrical equipment. A protection type established for electrical equipment is not used.</p>
Explosion groups	<p>Gases and vapors are divided into three Explosion groups based on their particular ignition capability (IIA, IIB and IIC). The ignition power in this regard decreases from Explosion group IIA to IIC. (The higher Explosion group, e.g. IIC incorporates the respectively lower IIB and IIA).</p>
Temperature class	<p>Classification of equipment depending on their maximum surface temperature, in accordance with assignment as follows:</p> <p>Temperature class --> Maximum surface temperature/gas temperature:</p> <ul style="list-style-type: none"> • T1 --> +450 °C • T2 --> +300 °C • T3 --> +200 °C • T4 --> +135 °C • T5 --> +100 °C • T6 --> +85 °C <p>The temperature class and the actual maximum surface temperature of the units includes a safety margin to the minimum ignition temperature of a potentially explosive atmosphere, as stipulated in DIN EN ISO 80079-36.</p>
EPL according to DIN EN 60079	<p>Equipment protection level</p> <p>EPL Ga: Equipment with “extremely high” protection level for use in potentially explosive gas atmospheres in which no risk of ignition exists during normal operation, with foreseeable or infrequent faults/malfunctions.</p> <p>EPL Gb: Equipment with “high” protection level for use in potentially explosive gas atmospheres in which no risk of ignition exists during normal operation, with foreseeable faults/malfunctions.</p> <p>EPL Gc: Equipment with “extended” protection level for use in potentially explosive gas atmospheres in which no risk of ignition exists during normal operation.</p>

Classification	Description
X	Special operating conditions must be observed! Special conditions and notes in the operating instructions apply.
Ta	Permissible ambient temperature for operation of the vacuum pump prescribed on the rating plate.

TbI. 3: ATEX designations

2.4.2 Potential hazards

The ignition hazard assessment for the roots pumps in the ATEX series was performed in accordance with the harmonized standard ISO 80079-36 (Non-electrical equipment for explosive atmospheres - Basic method and requirements). This assessment includes the identification of hazards described as follows which will not occur if the system is operated properly with the respective safety measures.

Potential hazard	Occurrence due to	Safety measures
Hot surfaces	Heating up of components due to compression work and friction	When used as intended, all surface temperatures are below the measuring gas temperature in the exhaust channel.
Hot gases	Compression of the required gases	<ul style="list-style-type: none"> Measure the gas temperature in the exhaust channel using the supplied thermometer and evaluate the temperatures. Note the information in the operating instructions of the thermometer.
Mechanical sparks	Contact of the pistons in the suction chamber	The air gaps for the maximum gas temperature are designed taking into account a safety factor.
Electrical sparks (depending on the respective outer zone)	Electric motor	Use of an explosion protected electric motor is prescribed for potentially explosive atmospheres on the outside. <ul style="list-style-type: none"> Observe the marking on the motor rating plate.
Static electricity	Vacuum pump not earthed	<ul style="list-style-type: none"> Integrate the vacuum pump in the equipotential bonding at the installation location.
Chemical reaction	Between the process gas and lubricant or between the process gas and components that are part of the housing	<ul style="list-style-type: none"> Evaluate the process and avoid hazardous process conditions.
Zone entrainment	due to leaky vacuum pump	The vacuum pump underwent a final inspection with leak test within the framework of a production control.

TbI. 4: Potential hazards

2.4.3 Safety measures

- Observe and implement the following safety measures for safe operation of the roots pump in accordance with the respective device category:

Place	Measures/safety equipment	Category 3	
		Specification	recommended
Piston bearing	Regular vibration measurement at the defined measuring points and required time intervals		x
Gas outlet temperature	Monitor the gas outlet temperature with the supplied thermometer (see chapter "Setting and checking the temperature monitoring", page 32).	x	

TbI. 5: Measures and safety equipment

2.5 Limits of use of product

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	according to the motor used. Observe the operating instructions of the motor manufacturer!
Ambient temperature	+5°C to +40°C
Relative air humidity	Max. 85% (depending on the motor version)
Orientation	Horizontal
Pumped medium intake temperature, max.	≤ 40°C
Permanent intake pressure in circulation mode	< 1300 hPa (abs.)
Max. speed in circulation mode	1000 – 2250 rpm
Permanent intake pressure in vacuum mode	depending on max. pressure differential
Max. gas temperature, pressure side	140°C

Tbl. 6: Permissible ambient conditions

2.6 Proper use

- ▶ Only use the vacuum pump to create a vacuum in connection with a suitable backing pump.
- ▶ To protect the lubricant, use sealing gas if media with a high boiling point or corrosive media (e.g. solvents) are being pumped.
- ▶ Adhere to the installation, commissioning, operating, and maintenance instructions.
- ▶ Use only accessory parts recommended by Pfeiffer Vacuum.
- ▶ Use the vacuum pump to convey potentially explosive atmospheres in accordance with the labeling.
- ▶ Observe the corresponding safety measures ([see chapter "Safety measures", page 16](#)).
- ▶ Operate the vacuum pump within the application limits of the product ([see chapter "Limits of use of product", page 17](#)) and in compliance with the technical data.
 - 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. Increased bearing wear is therefore avoided.
 - When operating the pump with frequency converter, the vacuum pump must be operated at minimum speed. This will prevent increased wear of the axial face seal as a result of a lack of lubrication.

2.7 Foreseeable improper use

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

- Pumping media which are corrosive to materials of the vacuum pump
- Pumping media that introduce an ignition source to the suction chamber
- Pumping media that form adhesive deposits inside the suction chamber and cause the pistons to touch or jam
- Pumping pressurized media (> atmospheric pressure)
- Pumping fluids – the use of fluids is permitted for cleaning purposes
- Pumping radioactive media
- Pumping media prone to spontaneous, specific exothermic reactions
- Use of the vacuum pump for cyclic pumping processes above atmospheric pressure (load lock)

- Using the vacuum pump in systems in which sporadic loads and vibrations or periodic forces act on the unit
 - Using the vacuum pump in 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
 - Using pipes to lift the vacuum pump
 - Use of accessories or spare parts that are not listed in these instructions
 - Using lubricants not specified by Pfeiffer Vacuum
 - Using the vacuum pump as a climbing aid
 - Overcoating the vacuum pump whereby the permissible layer thicknesses in accordance with DIN EN ISO 80079-36 are exceeded
 - Use of mineral-based operating fluids, such as P3, with an oxygen concentration > 21 %
- Mineral-based operating fluids are combustible and ignite at high temperatures, and when they come into contact with pure oxygen. These operating fluids oxidize heavily and thus lose their lubricating capacity.

2.8 Personnel qualification

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

Training people

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

2.8.1 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.

2.8.2 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

2.8.3 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 Function

The **gas circulation-cooled** roots pumps of the OktaLine "G" series can be used for high differential pressures and compression ratios. Operation with a backing pump connected upstream enables compressing against atmospheric pressure.

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. A pair of gears positioned on the extended shaft ends, causes the opposing, synchronous running of the roots pistons. Lubrication is limited to the two bearing and gear chambers which are arranged separately from the suction chambers.

Roots pumps of the ATEX series are equipped with a thermometer.

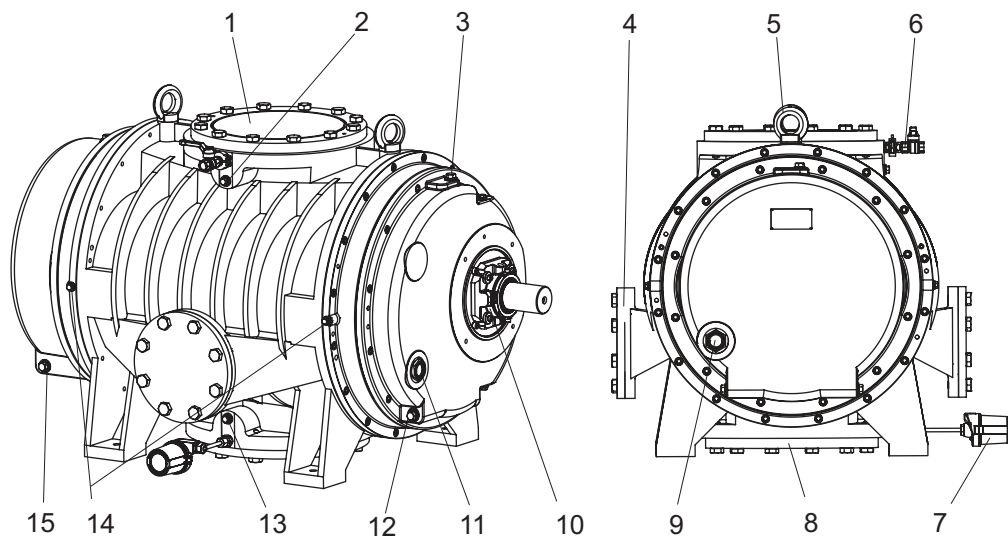


Fig. 2: Assembly of Okta 8000 G ATEX

- | | |
|---|---|
| 1 Vacuum flange | 9 Sight glass (2×) |
| 2 Measurement connection, vacuum flange | 10 Axial face seal |
| 3 Lubricant filling plug (2×) | 11 Sight glass |
| 4 Cooling gas connection (2×) | 12 Lubricant drain plug |
| 5 Eye bolt (2×) | 13 Measurement connection, fore-vacuum flange |
| 6 Ball valve for filling with nitrogen during transport and storage | 14 Sealing gas connection (4×) |
| 7 Thermometer | 15 Lubricant drain plug |
| 8 Fore-vacuum flange | |

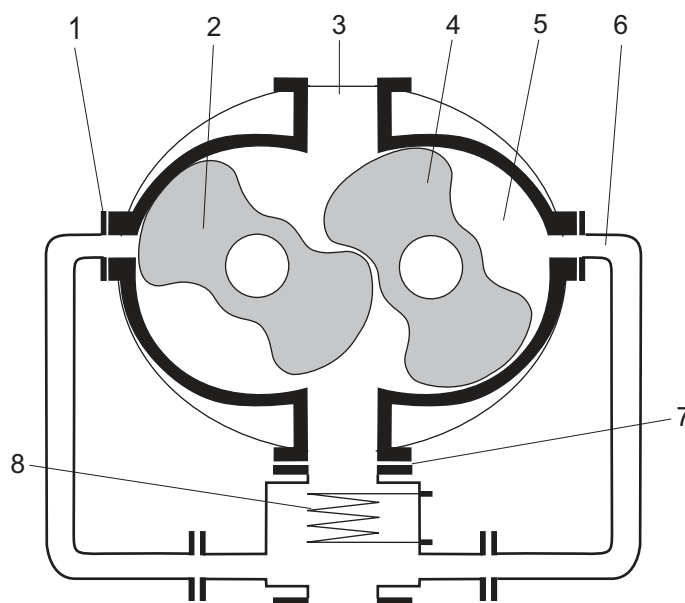


Fig. 3: Functional diagram Okta G

- | | |
|----------------------------|---|
| 1 Cooling gas connection I | 5 Suction chamber |
| 2 Secondary rotor | 6 Cooling gas connection II |
| 3 Vacuum connection | 7 Fore-vacuum connection (fore-vacuum flange) |
| 4 Main rotor | 8 Gas cooler |

Cooling

Forced gas recirculation dissipates the heat of the gas, after it has undergone the compression and discharge phases, via a gas cooler on the fore-vacuum connection. This allows process conditions to be achieved which are not possible with normal roots pumps.

3.2 Identifying product

To ensure unambiguous identification of the product when communicating with Pfeiffer Vacuum, always keep all of the information on the rating plate at 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 Scope of delivery

- Roots pump with axial face seal, without motor and coupling
- Connection flanges produced in accordance with PN 16
- Seal for the connection flange
- Blank flange
- Screw kit for the connection flange
- 2 eye bolts for lifting the Roots pump
- Lubricant P3 (for standard pump)
- Thermometer
- Ball valve
- Locking screw
- Operating instructions of the roots pump
- Additional documents for the thermometer
- Additional documents for the axial face seal

4 Transportation and Storage

4.1 Transporting vacuum pump

DANGER

Risk of explosion from electrostatic charging during transport

There is a risk of fatalities when transporting packaging material (foil) and plastic containers in potentially explosive areas. Ignition can cause very serious injuries, and even fatalities.

- ▶ Only unpack the vacuum pump outside of potentially explosive areas.

DANGER

Risk of explosion when carrying out installation and maintenance work in potentially explosive areas

There is a risk of explosion if unsuitable tools are used in potentially explosive areas. Ignition can cause very serious injuries.

- ▶ Transport, installation and maintenance work may not be performed in potentially explosive atmospheres.
- ▶ Always shut down the vacuum pump before commencing any work.

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. If possible, transport or ship the roots pump in its original packaging.
3. Remove the protective cap only immediately prior to installation.

Instructions for transport when packaged

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.

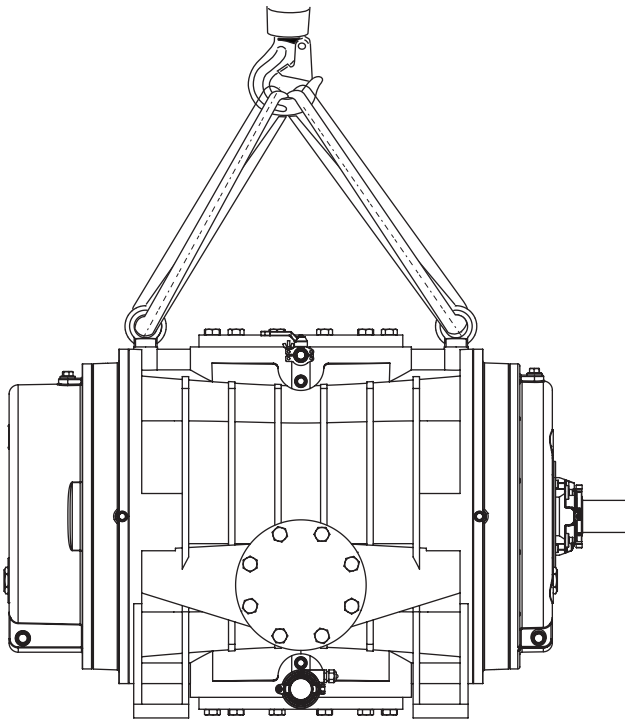


Fig. 4: Transporting the vacuum pump using a belt

Information for transport of the vacuum pump without 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. 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 Preparatory work

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.



Filling the nitrogen

The vacuum pump is filled with nitrogen to protect against corrosion, therefore the suction chamber has a slight over pressure (200 hPa) upon delivery

- Prior to installation, you must dismantle the fittings required for nitrogen filling.

Required consumables

- Seal screw included in scope of delivery

Required tools

- Hexagon wrench **SW 19**
- Hexagon wrench **SW 22**
- Calibrated torque wrench (tightening factor ≤ 2.5)

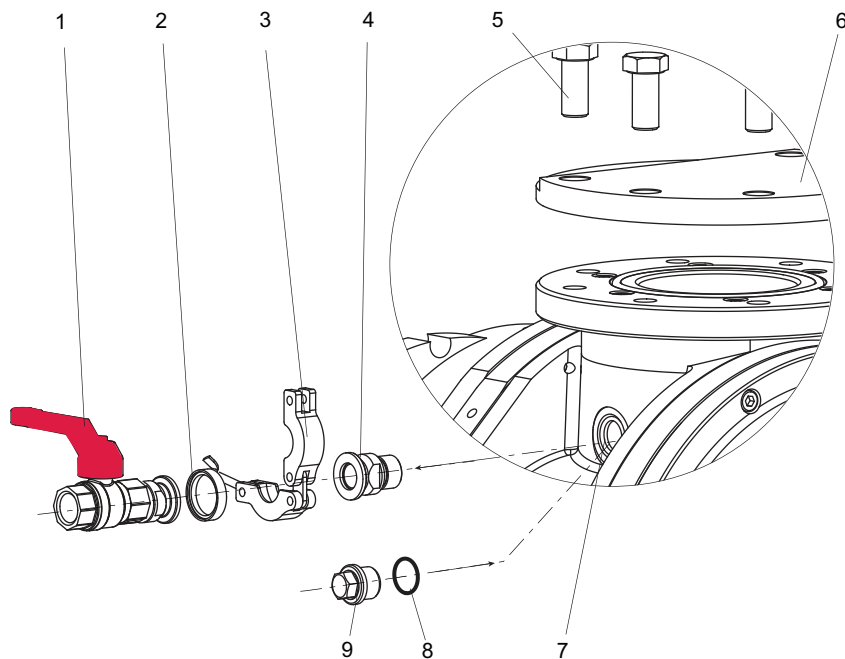


Fig. 5: Dismantle the fittings to vent the vacuum pump

- | | |
|-------------------------|--------------------------|
| 1 Ball valve | 6 Blank flange |
| 2 Centering ring | 7 Measurement connection |
| 3 Circlip | 8 Seal |
| 4 Small screw-in flange | 9 Locking screw |
| 5 Screws | |

Dismantling the ball valve from the measurement connection

1. Open the ball valve until the pressure equalization is created.
2. Undo the circlip and at the same time remove the ball valve.
3. Unscrew the small flange on the measurement connection.

4. Lock the measurement connection using the locking screw.
 - Tightening torque: **32 Nm**
5. Dismantle the blank flange from the inlet flange and exhaust flange.

5.2 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.

5.3 Filling with 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.

Permissible lubricants

- P3 for standard version
- D2 for special applications (such as higher operating temperatures)
- Other lubricants on request

The lubricant type is specified on the rating plate

- ▶ Please refer to rating plate of the vacuum pump for type and quantity of intended lubricant.
 - Only the lubricant used during initial installation is permissible.
 - D2 is permitted as a replacement for D1.
- ▶ Contact Pfeiffer Vacuum if you want to use another type of lubricant.

Required consumables

- Lubricant of the vacuum pump

Required tools

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

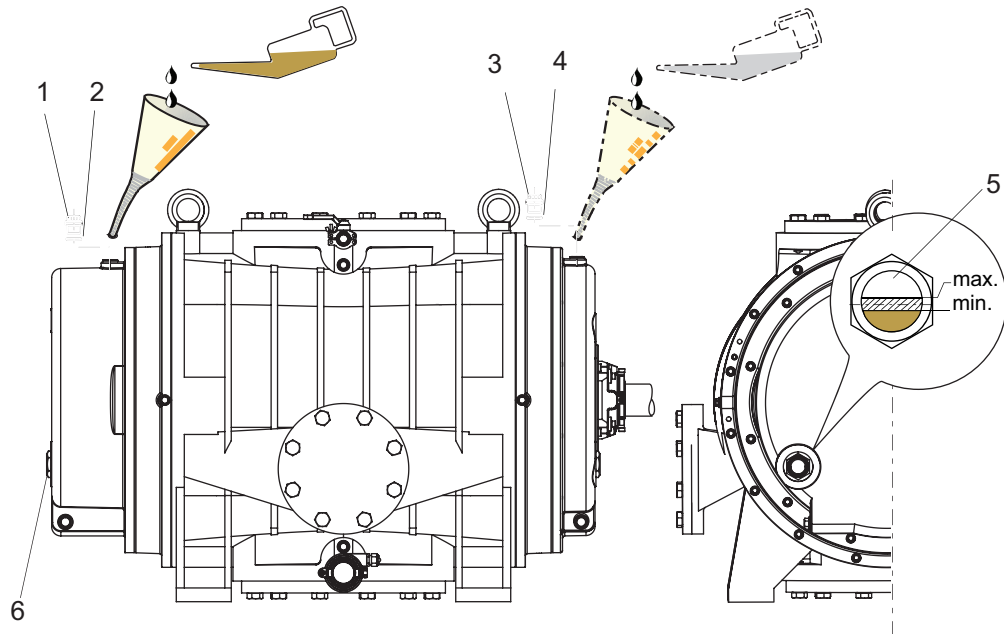


Fig. 6: Filling with lubricant

- | | |
|----------------------------|--------------------------------|
| 1 Filler screw, gear side | 4 O-ring |
| 2 O-ring | 5 Sight glass, gear side |
| 3 Filler screw, motor side | 6 Sight glass, bearing chamber |

Procedure

1. Unscrew both filler screws.
2. Fill the lubricant on both sides according to the sight glass.
 - Fill levels for first filling: approx. 5 mm above the middle of the inspection glass.
3. Seal the filler screws.
 - Tightening torque: **32 Nm**
4. Be careful with the O-rings.
5. Check the fill level during operation in the final vacuum:
 - Middle of the inspection glass ± 3 mm.
6. If necessary, top up the lubricant only when the roots pump is switched off and vented.

5.4 Fill the sealing medium for the axial face seal

NOTICE

Damage to the axial face seal due to aging of the sealing medium

Sustained exceeding of the max. permissible sealing oil temperature damages the axial face seal.

- Observe the maximum permissible sealing oil temperature of 70°C at the outlet of the axial face seal.
- If necessary, provide temperature monitoring for the event that the temperature exceeds the permissible value.
- Also use water cooling at the sealing medium container, for the event that the cooling is insufficient due to the thermal radiation at the sealing medium container.

When using an axial face seal, the sealing surfaces must be cooled using a sealing medium. The piping and the sealing medium container are not included in the scope of delivery for the vacuum pump.

Sealing medium	Viscosity [mm ² /s]	Pump lubricant
Shell Morlina S2 B 32	32 at T = 40°C	P3
Anderol 495	28 at T = 40°C	D2

Tbl. 7: Permissible sealing media

Required consumables

- Sealing medium container including fittings
- Sealing medium

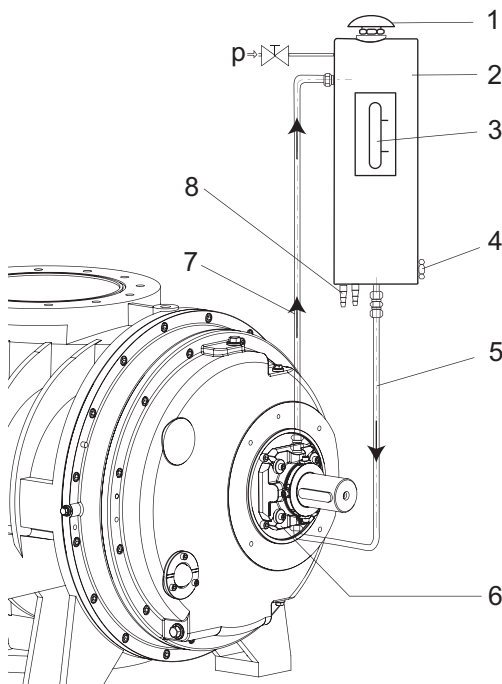


Fig. 7: Sealing agent container for axial face seal

- | | |
|---------------|-----------------------------|
| 1 Filler neck | 6 Sealing ring housing |
| 2 Container | 7 Return line |
| 3 Sight glass | 8 Cooling water connection |
| 4 Drainage | p Compressed air connection |
| 5 Feed line | |

Procedure

1. Fasten the container for the sealing medium onto the base frame above the shaft feedthrough, or as the respective conditions allow.
2. Observe the installation instructions of the manufacturer when mounting the container.
3. Mount the container at a height between 500 mm and max. 800 mm above the axial face seal.
4. Use approved sealing media only.

The axial face seal may bridge a certain pipe resistance through its own pumping effect. If the supply with sealing medium is no longer ensured, an additional circulation is necessary.

5.5 Connecting the 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 30** with flange DN 300 PN10

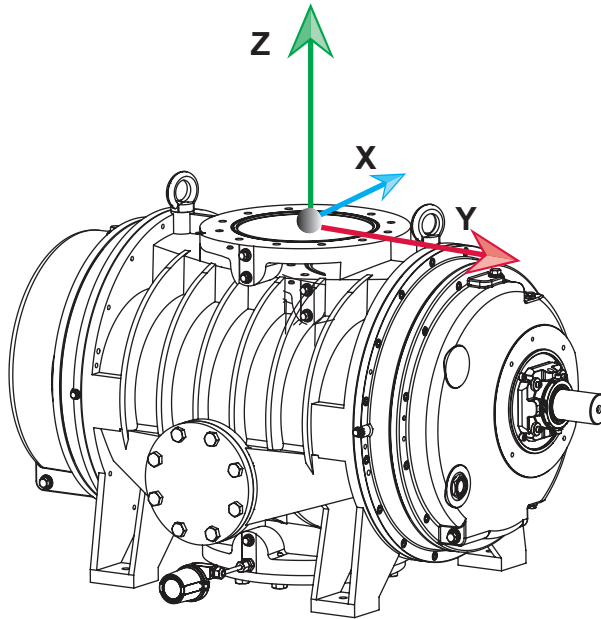


Fig. 8: Loading capacity of the connection flange

Connecting the vacuum side

1. Degrease the connection flange.
2. Clear welded lines of any scaling, loose particles etc. prior to 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.
6. Always use **all** prescribed screws for fastening the flanges and consider the prescribed pressure stage for PN 10.

**Note regarding loading capacity of the connection flange**

Installation of superstructural parts on the connection flange is the responsibility of the operating company. The loading capacity is specific for the roots pump used. The total weight of superstructural parts must not exceed the maximum values specified.

Maximum permissible forces	[N]	Maximum permissible torques	[Nm]
F_x	4000	M_x	3300
F_y	2000	M_y	800
F_z	-7000	M_z	3100

Tbl. 8: Maximum permissible forces and torques on the connection flange

5.6 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.

5.7 Connecting the gas cooler

Depending on the area of application and requirements of the process, Pfeiffer Vacuum recommends the use of a gas cooler (optional).

The dimensioning of the gas cooler and the cold gas circulation pipe is the responsibility of the operating company. As an alternative, Pfeiffer Vacuum can assist you with the authorization of the dimensioning.

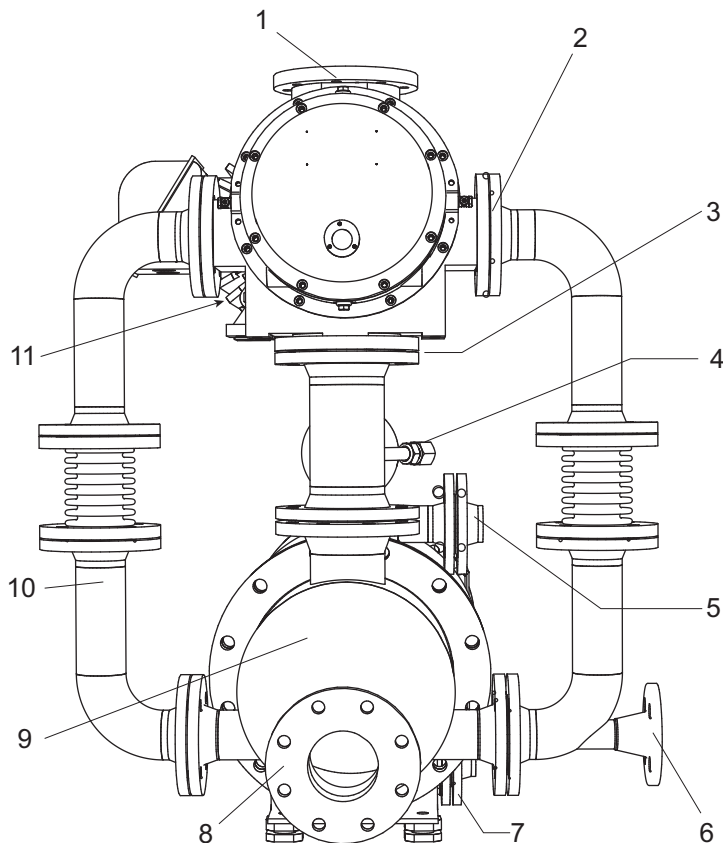


Fig. 9: Roots pump with tubular gas cooler

- | | |
|------------------------------------|-----------------------------------|
| 1 Vacuum flange | 7 Cooling water connection, inlet |
| 2 Cooling gas connection | 8 Fore-vacuum connection |
| 3 Fore-vacuum flange | 9 Gas cooler |
| 4 Measurement connection | 10 Cold gas circulation pipe |
| 5 Cooling water connection, outlet | 11 Temperature monitoring |
| 6 Measurement connection | |

Procedure

1. Design the gas cooler in mild steel or stainless steel, according to the media being conveyed.
2. Establish the pipe connections according to the respective design drawing.
3. Choose a minimum fore-vacuum line cross section equal to the size of the connection nominal diameter of the fore-vacuum flange.
4. When connecting the flanges, observe the correct position of the seals.
5. Maintain a tension-free connection.

5.8 Connecting cooling water supply

⚠ WARNING

Risk of scalding from suddenly escaping hot cooling water

The cooling water connections are open to both sides. When connecting the cooling water supply, there is a risk of scalding from the sudden escape of overpressurized hot water.

- ▶ Prior to installation, ensure that pressure is discharged from the cooling water system, and that it is cooled down.
- ▶ Wear protective equipment, e.g., safety goggles and gloves.

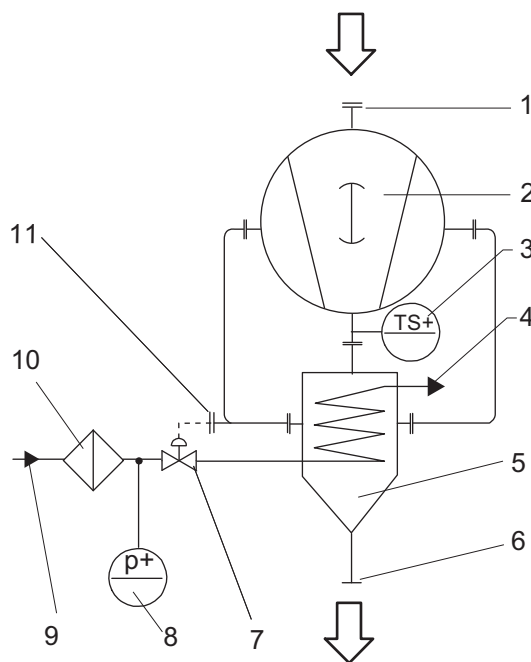
Using a cooling water control valve

- ▶ Install a cooling water control valve at the cooling water inlet of the gas cooler.
 - Using this regulator will reduce the consumption of cooling water, and keep the roots pump at the required operating temperature.

Additional monitoring devices to be provided on site:

- Cooling water control valve
- Flow indicator, optional
- Cooling water pressure monitor, optional

Parameter	Cooling water
Appearance	<ul style="list-style-type: none"> • filtered • mechanically clear • visually clear • no turbidity • no sediment • free from grease and oil
pH value	7 to 9
Carbonate hardness, max.	10 °dH 12.53 °e 17.8 °fH 178 ppm CaCO ₃
Chloride content, max.	100 mg/l
Sulfate content, max.	240 mg/l
Carbonic acid content, max.	not detectable
Ammonia content, max.	not detectable
Electrical conductivity, max.	500 µS/cm
Particle size, max.	150 µm

Tbl. 9: Requirements on the cooling water composition**Fig. 10: Cooling water connection at the gas cooler**

- | | |
|---------------------------------------|--|
| 1 Vacuum flange | 7 Cooling water control valve |
| 2 Roots pump Okta G | 8 Pressure monitor |
| 3 Measurement connection, temperature | 9 Cooling water connection, inlet |
| 4 Cooling water connection, outlet | 10 Dirt trap |
| 5 Gas cooler | 11 Cooling water control valve temperature sensor (measurement connection) |
| 6 Fore-vacuum connection | |

Connecting cooling water supply

1. Make sure that the outlet is unpressurized and that a visual check can be made of the flow rate.
 - The best method is the free outflow of cooling water via a funnel.
2. Alternatively, use a flow indicator in the cooling water line directly at the pump connection.

3. Connect the cooling water lines according to the connection diagram.
4. Open the supply provided on site.
5. Open the bypass valve and at the same time fill the cooling system until cooling water is emitted at the outlet.
6. Close the bypass valve.

Installing a pressure monitor

The installation of a cooling water pressure monitor protects the roots pump effectively against cooling water failure. Depending on the pump identification, approved flow rate monitors or flow indicators are required.

1. If necessary, close the pressure monitor and solenoid valve for monitoring and control of the cooling water flow according to the installation instructions of the manufacturer.
2. Set the required switching pressures:
 - minimum: 300 hPa
 - maximum: 10000 hPa

5.9 Setting and checking the temperature monitoring

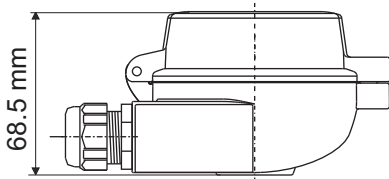
⚠ WARNING

Risk of explosion when the ignition temperature of the pumped medium is reached

If the prescribed temperature monitoring is not in place, when the ignition temperature is reached in the suction chamber this results in ignition.

- ▶ Always monitor the gas temperature in the fore-vacuum flange in order to safely comply with temperature class T3.
- ▶ When a gas temperature of 180 °C is reached, switch the roots pump off (zero potential).

Due to the compression work, the highest temperatures are generated in the exhaust channel of the roots pump. In order to avoid effective sources of ignition due to prevailing gas temperatures, the roots pump is equipped with a thermometer that measures the gas temperature in the exhaust channel.

Thermometer	Characteristics
Thermometer with flat TA30A connection head 	<ul style="list-style-type: none"> • 2 thermocouples in the protective pipe • 1 TMT82 type head transmitter in the connection head of the thermometer • The head transmitter has two input channels for both thermocouples • The device transmits the signals as an analog output signal. The prescribed SIL must be adhered to.

Tbl. 10: Thermometer type

5.9.1 Check thermometer installation dimension



Faulty temperature measurement

Faulty temperature measurement due to deviating installation dimension. The thermometer cannot detect any maximum values in this case.

Required tools

- Open-end wrench, **SW 17**

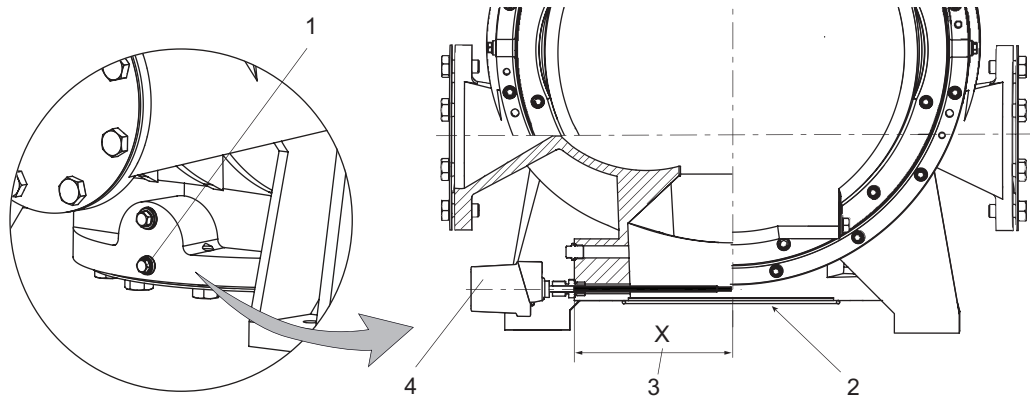


Fig. 11: Temperature monitoring

- | | |
|---|----------------------------|
| 1 Locking screw of the measurement connection | 3 Installation dimension X |
| 2 Fore-vacuum flange | 4 Thermometer |

Checking the installation of the thermometer

- ▶ Check the installation dimension "X" and tighten the clamping screw if necessary.
 - X = 239.3 mm

5.9.2 Setting up thermometer signal evaluation



A restart following "zero potential" without resetting the interlock of the ignition system is not permissible.

Device category	EPL	Result of the ignition hazard evaluation for the existing device	Ex "b" ignition protection system necessary	Ignition system
3	Gc	No effective ignition sources are to be expected during normal operation	The signal must be evaluated without the use of an ignition protection system	
2	Gb	No effective ignition sources are to be expected during normal operation	An individual system in order to avoid ignition sources where expected malfunctions are expected	b1

In accordance with DIN EN ISO 80079-37, the b1 ignition protection system complies with safety requirement level SIL1 and the IEC 61508 series of standards, and a "performance level" PL c in accordance with the ISO 13849 series of standards

Tbl. 11: EPL (Equipment protection level)

Procedure

- ▶ Set up the ignition protection system on the operator side in accordance with the requirements for the device category or EPL.
- ▶ Observe the necessary ignition protection system type.

Regular check

- ▶ Check the thermometer regularly and compare the temperature with other process temperatures.
- ▶ Information on calibration can be obtained directly from the manufacturer.

5.10 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 property damage from excess voltage

Incorrect or excessive mains voltage will destroy the motor.

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

NOTICE

Motor damage from overheating

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

- ▶ During operation with a frequency converter, observe the rotational 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

5.10.1 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.

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

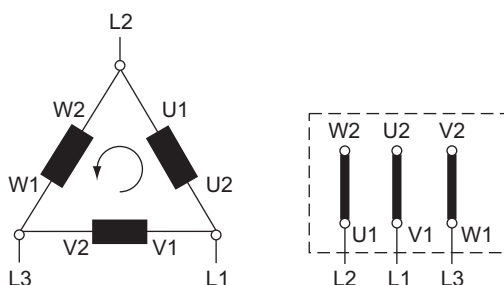


Fig. 12: Delta connection for low voltage

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.

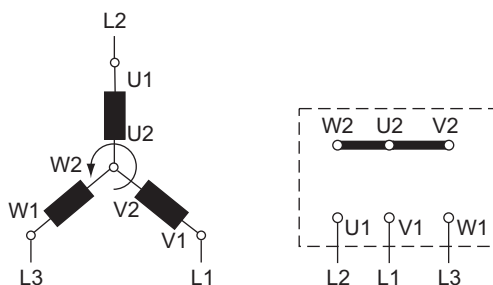


Fig. 13: Star circuit for high voltage

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.

5.10.2 Checking the direction of rotation

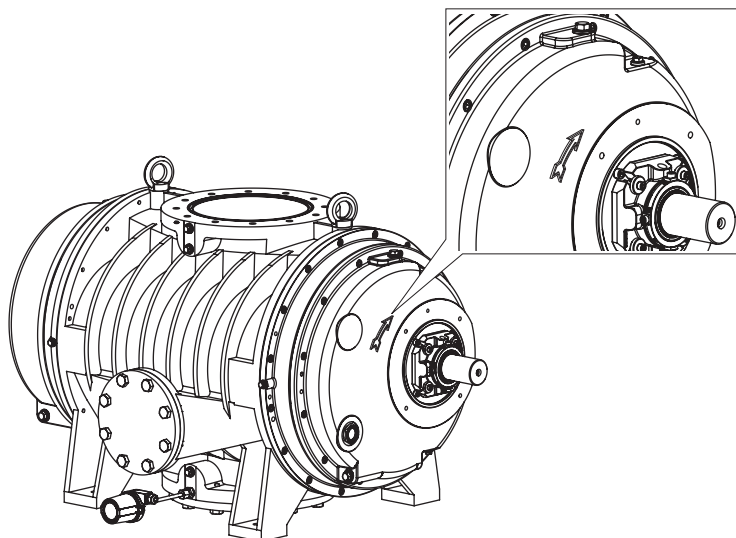


Fig. 14: Check of direction of rotation

Procedure

1. When switching on for the first time, check the roots pump direction of rotation.
2. Switch the vacuum pump on briefly (2 to 3 seconds)
 - The motor and coupling must rotate clockwise (see directional arrow on housing cover).
3. If the direction of rotation is incorrect, swap the 2 phases of the connection cable in the terminal box.

5.10.3 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.

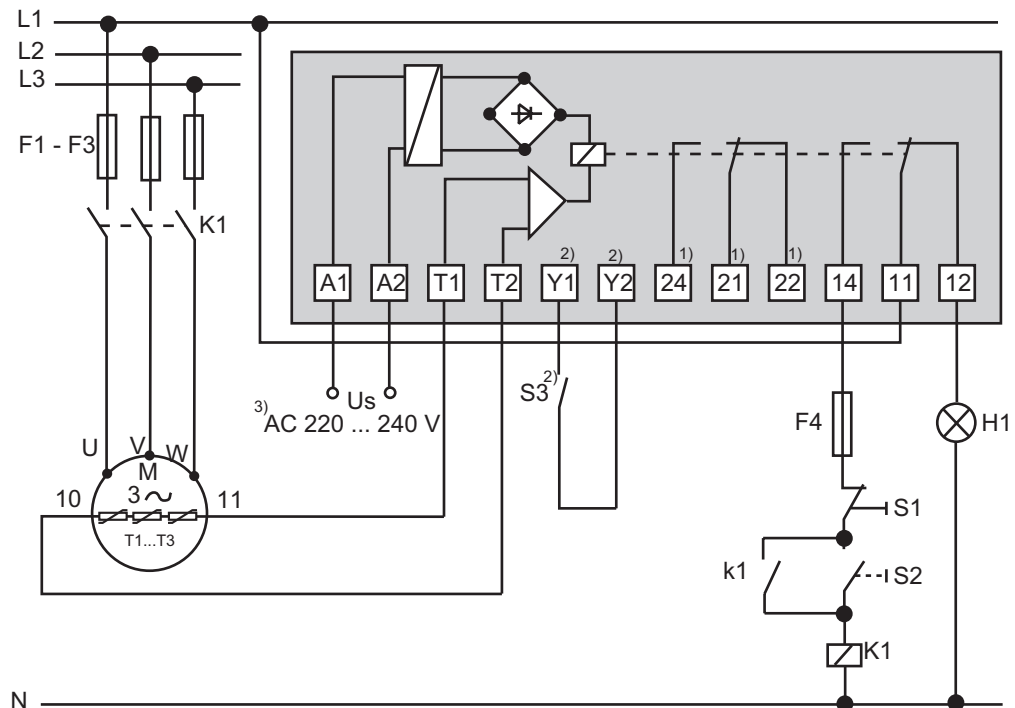


Fig. 15: Connection example with PTC thermistor tripping unit

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.

5.11 Assembling the motor and 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.



Assembly instructions

Observe the manufacturer's installation instructions when carrying out assembly work on the coupling.



Minimum requirements

Motor and coupling to be selected in accordance with the scope of validity prescribed by European Directive 2014/34/EU.

The roots pump meets the requirements of ATEX Category 3/3G (inside/outside).

- In the event of potentially explosive atmospheres outside, ensure when selecting the motor and coupling that their identification conforms at least with the identification of the roots pump.
- If the motor does not conform with the pump identification, the identification is only valid for inside use.

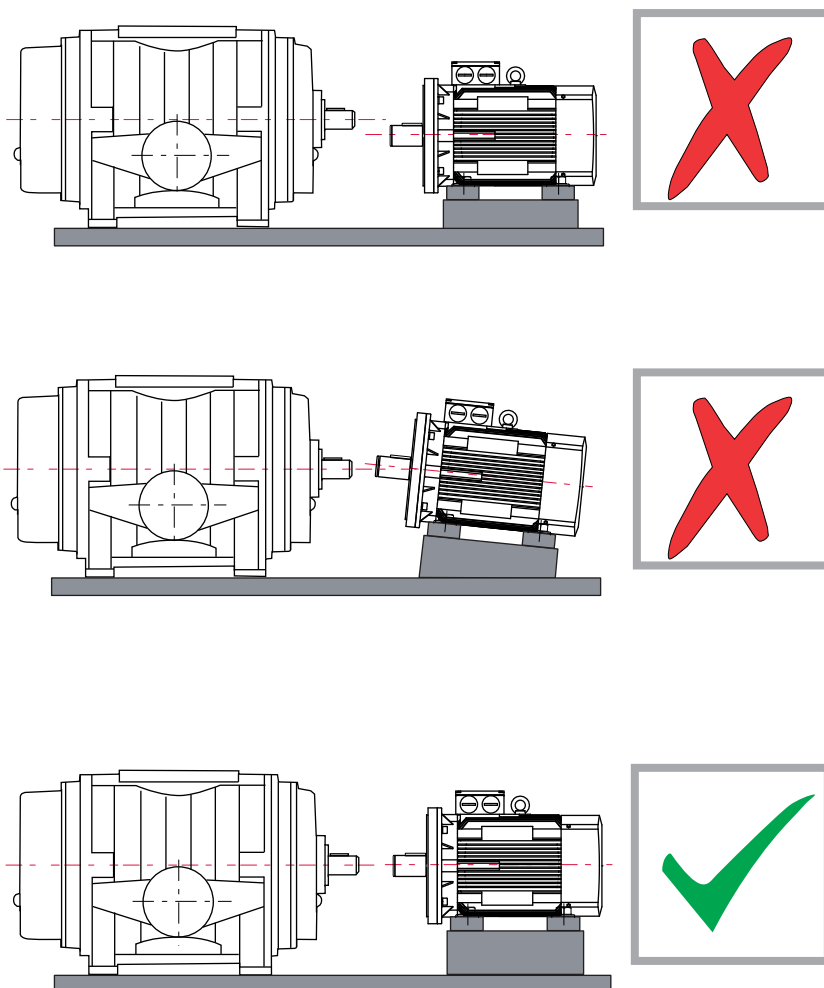


Fig. 16: Shaft alignment for roots pumps with conventional motor

Speed range [min ⁻¹]	Parallel offset [mm]	Angle error [mm/100]
0 – 1000	0.07 – 0.13	0.06 – 0.1
1000 – 2000	0.05 – 0.1	0.05 – 0.08
2000 – 3000	0.03 – 0.07	0.04 – 0.07

Tbl. 12: Permissible deviation between motor shaft and pump shaft

Procedure for alignment of the shafts

- Observe the permissible angular and radial displacement.
 - The shaft of the drive motor must be aligned with the vacuum pumps' axis.

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 voltage and frequency 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.
7. Open the cooling water flow and ensure the flow rate.
8. If necessary, vent the cooling chambers.

6.2 Operating with frequency converter

6.2.1 Observe the voltage slew rate

NOTICE

Damage to motor components when operating with frequency converter

Operation of the motors with standard insulation resistance on a frequency converter may lead to potential damage of the motor insulation from an output voltage of $> 480 \text{ V}$.

- ▶ Use a suitable filter to smooth voltage peaks as output switching of the frequency converter, e.g. sinus filter.
- ▶ Observe the permissible voltage slew rate.
 - $\text{SR max } (\Delta u / \Delta t) = 1.5 \text{ kV}/\mu\text{s}$
- ▶ Observe the permissible impulse voltage at the motor terminals.
 - $V \text{ max.} = 1.35 \text{ kV}$

Frequency converters generate a pulse width modulated (PWM) motor voltage that comprises voltage blocks with a relatively steep rise and fall speed. The steepness of the flanks of the voltage blocks define the voltage slew rate ($\text{SR} = \Delta u / \Delta t$). Factors which influence the voltage slew rate are the line length, line cross-section and shielding. Information is provided by the motor manufacturer in accordance with IEC60034 and IEC61800-2.

Configuring the frequency converter

- ▶ Observe the instructions of the manufacturer regarding installation and operation.
- ▶ Observe the maximum permissible torque of the motor.
- ▶ Set the current limit according to the rated motor current.
- ▶ Observe the permissible speed range of the vacuum pump.

6.2.2 Observe the mechanical resonance

NOTICE

Damage from mechanical resonance when operating with frequency converter

The use of a frequency converter allows operation of the vacuum pump with variable speed ranges. Potentially critical speed ranges lead to increased frequencies and vibrations. Permanent operation in critical speed ranges impairs running behavior of the vacuum pump. Damage is caused to the housing, gear, bearings, seals and motor.

- ▶ Decouple the vacuum pump mechanically by means of an anti-vibration buffer on the pump feet.
- ▶ Install the compensators at the inlet and outlet flange.
- ▶ When installing the vacuum pump, always ensure a new vibration-capable arrangement with specific structure resonance frequencies.

6.3 Switching on the 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.

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.

NOTICE

Property damage from impermissibly high pressure in the vacuum system

Excessive pressure following the failure of the backing pump may damage the motor, pump seals, and cooling system.

- ▶ Where possible, switch off the roots pump immediately if the backing pump fails.

Depending on the application, the roots pump can discharge directly to the atmosphere as single pump or be operated together with a backing pump in a roots pumping station.

Procedure with independent operation of the roots pump

You can switch on the vacuum pump in every pressure range, between atmospheric pressure and ultimate pressure.

1. Switch the vacuum pump on the on-site side via respective start-up switching (e.g. contactor circuit).
2. Allow the vacuum pump to warm up prior to process start, with the vacuum flange closed, for approx. 30 minutes.

Procedure when operating the roots pump in a roots pumping station

The roots pump compresses against one or more backing pumps (e.g. liquid ring pumps).

1. Switch the backing pump on at the mains switch, or on-site, via a contactor circuit.
2. Only switch the roots pump on when the fore-vacuum pressure allows the backing pump to accommodate the amount of gas required.

6.4 Adjusting the 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.

Equation 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]

Procedure

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. The set quantity of sealing gas influences effective pumping speed and achievable ultimate pressure.

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 inferential meter.

Example for Okta 8000 G with e.g. 50 hPa intake pressure and 8 % sealing gas content

$$Q_S = (8000 \times 50 \times 0.08) / 1013 =$$

$$Q_S = 31.6 \text{ Nm}^3/\text{h}$$

At discharge pressures > 100 mbar:

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

6.5 Vibration monitoring

⚠ WARNING**Risk of injury due to the bearing bursting after overheating**

During longer operation with defective bearings, there is a risk of explosion due to hot surfaces if there is a potentially explosive atmosphere.

- ▶ Perform a vibration measurement at the defined measuring points at the prescribed time intervals.
- ▶ Switch the roots pump off if process-independent trend changes of characteristic variables occur.

**Boundary conditions of the vibration measurement**

The boundary conditions of the vibration measurement (including the operating conditions, measurement parameters, etc.) and the equipment for vibration measurement (including the vibration sensors) must comply with the requirements of the following directives and standards.

- **VDI 3836:** Measurement and evaluation of mechanical vibrations of screw compressors and roots blowers
- **VDI 3832:** Measurement of structure-borne sound of rolling element bearings in machines and plant for evaluation of condition
- **DIN ISO 10816-1:** Mechanical vibrations – Evaluation of machine vibration by measurements on non-rotating parts – Part 1
- **DIN ISO 10816-3:** Mechanical vibrations – Evaluation of machine vibration by measurements on non-rotating parts – Part 3

Assess the condition of pump, motor and bearing over the service life of the roots pump using changes in the trend of characteristic variables, compared with a defined reference value from the start-up phase. Due to the different set-up and process conditions, Pfeiffer Vacuum will not specify any binding, generally-applicable limit values. The alarm, warning and shutdown limits for the oscillation variables specified in the guidelines and standards are not adequate assessment criteria.

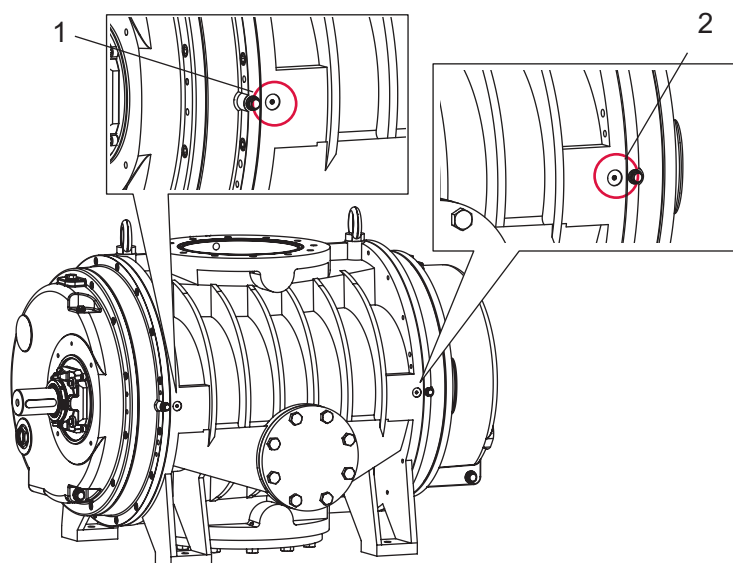


Fig. 17: Position of the vibration sensors

- 1 Position of vibration sensor 1 (pump housing on fixed bearing side)
- 2 Position of vibration sensor 2 (pump housing on loose bearing side)

without
fig. Vibration sensor 3 on the motor
connection flange (mounted hori-
zontally)

Installing the vibration sensors

You must install the vibration sensors using the designated M8 threads at the designated positions:

- Position 1 and 2: Condition monitoring of the vacuum pump and the pump bearing
- Vibration sensor 3: Condition monitoring of the motor

1. Screw the sensors in at the designated positions.
2. Use suitable adapters for sensors with a different thread.
3. As an alternative, fix the sensors to the intended positions using magnets (recessed areas).

Evaluating the measurements

Regular measurements are necessary in order to ensure the safe evaluation of the pump, motor and bearing condition.

1. Perform vibration measurements every two weeks and evaluate the results.
2. Shorten the interval to weekly and daily measurements if there are anomalies in the trend.

Carrying out a bearing replacement

1. Carry out a bearing replacement (in accordance with Maintenance Level 3) if significant changes occur in the trend (significant rise or drop) in accordance with the guidelines VDI 3836 or VDI 3832 during condition monitoring of the vacuum pump or the pump bearing.
2. In accordance with your own experience of condition monitoring, define limit values that result in Maintenance Level 3 for the vacuum pump in the event of a change in trend.

Carrying out an motor replacement

1. Carry out a motor replacement if significant changes occur in the trend for vibrations (significant rise or drop) in accordance with standards DIN ISO 10816-1 or DIN ISO 10816-3 during condition monitoring of the motor.
2. In accordance with your own experience of condition monitoring, define limit values that result in a motor replacement in the event of a change in trend.

6.5.1 Monitoring operating condition

Procedure

- During the vibration measurement, determine and evaluate a broadband root-mean-square value for the vibration velocity (v_{rms}) of both frequency ranges.

Frequency	Frequency limits (rotation speed)	Description
Frequency range A	10 Hz – 1000 Hz	Frequency range A incorporates the significant mechanical and aerodynamic vibration stimulations of the roots pump. Due to the permissible rotation speeds, only the range between 10 and 1000 Hz is relevant
Frequency range B	10 Hz – $(2 \times n)$ Hz	Frequency range B takes into account the vibration stimulations through imbalance of the rotating components. Deviating from VDI 3836, the upper limit is derived from twice the rotation frequency.

Tbl. 13: Evaluated frequency ranges using broadband method

6.5.2 Monitoring the bearing condition

Evaluation of the pump bearing oscillations is based on the frequency-selective method (narrow band method).

- A performance spectrum or envelope curve spectrum extracts the anti-friction bearing-specific or characteristic frequencies (rollover frequencies, bearing damage frequencies).
- Evaluation of the amplitudes as characteristic values.
- Concentrating multiple lines of a characteristic frequency to a narrow band.
- Assessment of the root-mean-square-value of the vibration acceleration and / or the maximum value amount of the vibration acceleration in a band.



Evaluating the vibration spectrum

Due to the early and clearer diagnosis for bearing damage, Pfeiffer Vacuum recommends using the envelope curve spectrum.

Bearing	Bearing damage frequency	Okta 8000 G ATEX
Fixed bearing	Cage rotation frequency	$(0.43 \times n) \text{ Hz}^{1)}$
	Rollover frequency of an irregularity on the outer ring	$(9.04 \times n) \text{ Hz}$
	Rollover frequency of an irregularity on the inner ring	$(11.96 \times n) \text{ Hz}$
	Rolling element rotation frequency	$(3.52 \times n) \text{ Hz}$
	Rollover frequency of an irregularity on both rolling tracks	$(7.03 \times n) \text{ Hz}$
Loose bearing	Cage rotation frequency	$(0.43 \times n) \text{ Hz}$
	Rollover frequency of an irregularity on the outer ring	$(7.70 \times n) \text{ Hz}$
	Rollover frequency of an irregularity on the inner ring	$(10.30 \times n) \text{ Hz}$
	Rolling element rotation frequency	$(3.38 \times n) \text{ Hz}$
	Rollover frequency of an irregularity on both rolling tracks	$(6.76 \times n) \text{ Hz}$

Harmonic (integral numbers of multiples) of these frequencies can also be of relevance for the diagnosis.

Tbl. 14: Characteristic bearing damage frequencies of the roots pump

1) n: Rotation speed in Hz

Frequency	Okta 8000 G ATEX
Rotation frequency	(n) Hz
Output frequency	(4 × n) Hz
Tooth engagement frequency	(64 × n) Hz
Harmonic (integral numbers of multiples) of these frequencies can also be of relevance for the diagnosis	

Tbl. 15: Characteristic frequencies of the roots pump

Optional method for the entire roots pump

- ▶ The characteristic frequencies of the roots pump can also be evaluated using the frequency-selective method (narrow band method).
 - The evaluation is not relevant for the ignition protection concept.

6.5.3 Monitoring the motor condition

The frequency range to be evaluated incorporates the significant mechanical vibration stimulations of the motor.

Frequency range of the motor	10 Hz – 1000 Hz
------------------------------	-----------------

Tbl. 16: Relevant frequency range of the motor

1. Evaluate the vibrations in a relevant frequency range using the broadband method.
2. Determine and evaluate the broadband root-mean-square-value for the vibration speed (v_{eff}) within the relevant frequency range.

6.6 Switching off and venting the vacuum pump

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

DANGER

Risk of explosion when carrying out installation and maintenance work in potentially explosive areas

There is a risk of explosion if unsuitable tools are used in potentially explosive areas. Ignition can cause very serious injuries.

- ▶ Transport, installation and maintenance work may not be performed in potentially explosive atmospheres.
- ▶ Always shut down the vacuum pump before commencing any work.

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.

NOTICE

Damage from incorrect maintenance work

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

- ▶ Ensure that only the following categories of persons are authorized to perform servicing tasks:
 - Pfeiffer Vacuum employees with corresponding qualifications.
 - Persons who have undergone training from Pfeiffer Vacuum and have subsequently taken part in refresher courses at intervals of no more than every two years.
 - Persons who have been awarded official certification in accordance with Article 14 (6) BetrSichV (Ordinance on Industrial Safety and Health).
- ▶ We recommend taking advantage of our service training offering.

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 intake side.
3. Safely disconnect the drive motor from the mains.
4. Secure the motor against switching back on.
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 extent needed.
8. Only use alcohol or similar media to clean the pump parts.
9. Avoid residues of cleaning agents inside the vacuum pump.

7.2 Checklist for inspection and maintenance

You can carry out maintenance work of **Maintenance Level 1** by 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.



Maintenance frequency and service lives

Maintenance frequency and service lives are process-dependent. Chemical and thermic loads or contamination reduce the recommended reference values.

- Determine the specific service lives during the first operating interval.
- Consult with Pfeiffer Vacuum Service if you wish to reduce the maintenance frequency.

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"> • Check the lubricant level and color of the lubricant • Check the lubricant level of the sealing oil 	■				
<ul style="list-style-type: none"> • Check the roots pump for leaks • Check the roots pump for running noises 	■				
Maintenance level 1					
Clean the roots pump <ul style="list-style-type: none"> • Pump housing from outside • Flushing the suction chamber 		■ as required			Lubricant Suitable cleaning agent, compatible with the process
• Change the lubricant and sealing oil		■			
• Check the thermometer (if installed)		■			
• Replace the axial face seal		■ as required			The wearing parts are not included in the maintenance kit. Pfeiffer Vacuum recommends that a spare axial face seal be kept in stock at all times as an intermediate repair measure for the faulty axial face seal.
Maintenance level 2					
<ul style="list-style-type: none"> • Check the coupling for damage, replace the toothed ring if necessary • Clean the gear chambers and replace the seals 			■		Maintenance kit with coupling wear parts
Maintenance level 3					

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	
Remove and clean roots pump <ul style="list-style-type: none"> Replace the seals and all wearing parts 				■	Overhaul kit Lubricant Option <ul style="list-style-type: none"> Set of seals Set of gear wheels
Check critical components and replace if necessary: <ul style="list-style-type: none"> Thermometer (calibrate the sensor with the reference temperature) Gear wheels (check the teeth for breaks) 				■	

Tbl. 17: Maintenance intervals

7.3 Changing the 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](#).

Consumable

- Lubricant

Required tools

- Ring spanner, **WAF 24**
- Calibrated torque wrench (tightening factor ≤ 2.5)

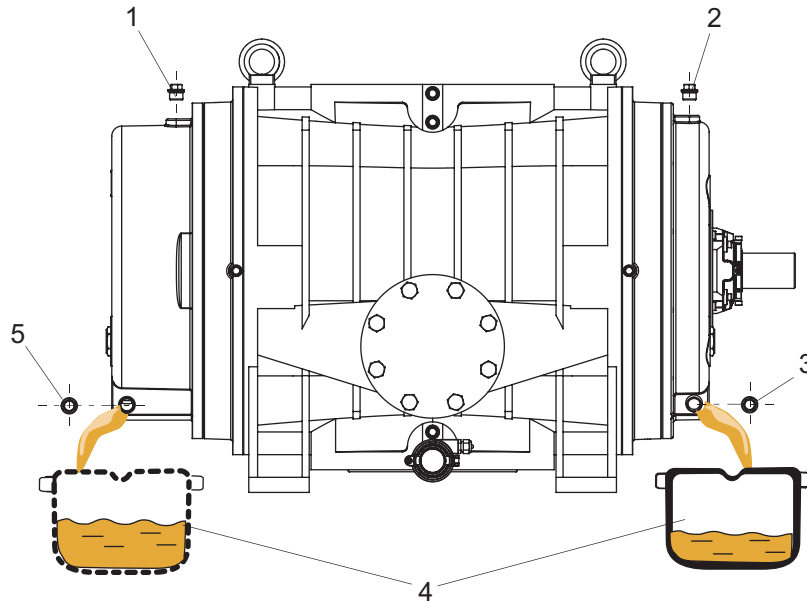


Fig. 18: Changing the lubricant

- | | |
|----------------------------|-------------------------|
| 1 Filler screw, gear side | 4 Collection receptacle |
| 2 Filler screw, motor side | 5 Drain screw |
| 3 Drain screw | |

Draining the lubricant

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

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. 50 Nm**

Filling with lubricant

1. Fill new lubricant on both sides until the max. fill level is reached .
2. Screw in the filler screws.
 - Tightening torque: **max. 50 Nm**

7.4 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

Procedure

1. Dismantle the pipes from the vacuum and fore-vacuum connections.
2. Clean the suction chamber using 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.

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:

Procedure for a longer downtime of the vacuum pump (> 1 year)

1. Allow the vacuum pump to cool down.
2. Clean suction chamber.
3. Change the lubricant.
4. Seal the vacuum flange and fore-vacuum flange and any other openings with screw caps.
5. Evacuate the pump interior via the measurement connection on the vacuum side, to $p < 1 \text{ hPa}$.
6. Vent the suction chamber of the vacuum pump through the measurement connection using dry air or nitrogen.
7. Store the vacuum pump in dry, dust-free rooms, within the specified ambient conditions.
8. In rooms with humid or aggressive atmospheres: Hermetically seal the vacuum pump together with a drying agent in a plastic bag.
9. For storage durations of more than 2 years, we recommend you carry out maintenance and a lubricant change prior to recommissioning.
10. 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

DANGER

Risk of explosion from electrostatic charging during transport

There is a risk of fatalities when transporting packaging material (foil) and plastic containers in potentially explosive areas. Ignition can cause very serious injuries, and even fatalities.

- ▶ Only unpack the vacuum pump outside of potentially explosive areas.

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.

Control work before re-commissioning

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 and notify [Pfeiffer Vacuum Service](#) in the event of housing parts exhibiting signs of rust.
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.

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

⚠ WARNING

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

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

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

⚠ CAUTION

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"> • 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 	<ul style="list-style-type: none"> • Determine the cause of the overheating and eliminate the fault. • Allow the motor to cool if necessary
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.
	<ul style="list-style-type: none"> • Escaping lubricant at the radial shaft seal rings or on the axial face seal 	<ul style="list-style-type: none"> • Check the radial shaft seal rings or the axial face seal. • Have the seals affected replaced, if necessary. • If necessary, contact Pfeiffer Vacuum Service.

Problem	Possible causes	Remedy
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.

TbI. 18: 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 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](#).

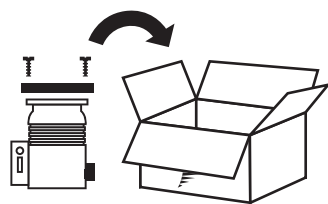


4. You will receive an acknowledgment from Pfeiffer Vacuum.

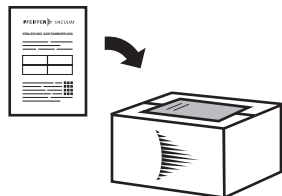
PFEIFFER VACUUM

Submission of contaminated products

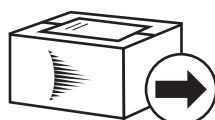
No microbiological, explosive, or radiologically contaminated products will be accepted. Where products are contaminated, or the contamination declaration is missing, Pfeiffer Vacuum will contact you before starting service work. Depending on the product and degree of pollution, **additional decontamination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

12.1 Ordering spare parts packs

Observe the following instructions when ordering spare parts:

- ▶ Have the vacuum pump part number, and any other necessary details from the rating plate, to hand when ordering spare parts.
- ▶ Install original spare parts only.

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.

13.2 Ordering accessories

Description	Order number
Set of blank flanges for Okta 8000 G, DN PN10, stainless steel	PP 001 828 -T
Set of seals (FKM) for Okta 8000 G, DN PN10	PP 001 829 -T
Screw set for Okta 4000 G Okta 8000 G, DN PN10, galvanized steel	PP 015 086 -T
Spray lance G1/2"	PP 046 146 -U
Foot mounting adjusting elements for Okta 8000 Okta 8000 G, 45 mm	PP 047 451 -T

Tbl. 19: Accessories

Description	Order number
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
P3, mineral oil, 200 l	PK 001 110 -T
D2, synthetic diester based oil, 1 l	PK 005 875 AT
D2, synthetic diester based oil, 5 l	PK 005 876 AT
D2, synthetic diester based oil, 20 l	PK 005 877 AT

Tbl. 20: 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. 21: Conversion table: Pressure units

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

Tbl. 22: 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 Substances in contact with the media

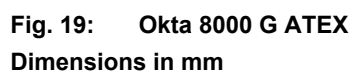
Pump parts	Substances in contact with the media
Pump housing	Cast iron (nodular graphite cast iron)
Rotor	Cast iron (nodular graphite cast iron)
Seals	FKM

Tbl. 23: Materials that make contact with the process media

14.3 Technical data

Type designation	Okta 8000 G ATEX
Type designation extended	Okta 8000 G ATEX, gas-cooled Roots pump
ATEX-certification	II 3/3G Ex h IIC T3 Gc X
Connection flange (in)	DN 300 PN 10
Connection flange (out)	DN 300 PN 10
Nominal pumping speed	5 300 – 12 000 m ³ /h
Nominal pumping speed at 50 Hz	8000 m ³ /h
Nominal pumping speed at 60 Hz	9600 m ³ /h
Nominal pumping speed min.	5300 m ³ /h
Nominal pumping speed max.	12000 m ³ /h
Nominal rotation speed at 50 Hz	1500 rpm
Nominal rotation speed at 60 Hz	1800 rpm
Rotation speed	1 000 – 2 250 rpm
Integral leak rate	1 · 10 ⁻³ Pa m ³ /s
Emission sound pressure level (EN ISO 2151) with connected exhaust line	75 – 105 dB(A)
Protection degree	IP55
Sealing gas	Yes
Cooling method	Gas
Ambient temperature	5 – 40 °C
Temperature: Shipping	-10 – 40 °C
Temperature: Storage	-10 – 40 °C
Operating fluid amount	21 l
Weight: without motor	–

Tbl. 24: Technical data for category 3G



EC Declaration of Conformity

Declaration for product(s) of the type:

Roots pump

Okta 8000 G ATEX

Ex II 3/3G Ex h IIC T3 Gc X +5°C ≤ Ta ≤ +40°C

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**
- **Explosion protection 2014/34/EU according to article 13 (1) c)**
- **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

ISO 21360-2: 2012

DIN EN 1012-2: 2011-12

DIN EN ISO 13732-1: 2008

DIN EN ISO 2151: 2009

DIN EN ISO 13857: 2008

DIN EN 1127-1: 2019

DIN EN 61000-6-2: 2006

DIN EN ISO 80079-36: 2016-12

DIN EN 61000-6-4: 2011

DIN EN ISO 80079-37: 2016-12

DIN EN IEC 63000: 2019

DIN ISO 21360-1: 2016

The authorized representative for the compilation of technical documents is
Dr. Adrian Wirth, Pfeiffer Vacuum GmbH, Berliner Straße 43, 35614 Asslar, Germany.

Signature:



(Daniel Sälzer)
Managing Director

Pfeiffer Vacuum GmbH
Berliner Straße 43
35614 Asslar
Germany

Asslar, 2024-05-07

UK Declaration of Conformity

This declaration of conformity has been issued under the sole responsibility of the manufacturer.

Declaration for product(s) of the type:

Roots pump

Okta 8000 G ATEX

Ex II 3/3G Ex h IIC T3 Gc X +5°C ≤ Ta ≤ +40°C

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

Supply of Machinery (Safety) Regulations 2008

Electrical Equipment (Safety) Regulations 2016

Equipment and Protective Systems Intended for Use in Potentially Explosive Atmospheres Regulations 2016

Electromagnetic Compatibility Regulations 2016

The Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations 2012

Applied standards and specifications:

ISO 12100: 2010

ISO 21360-2: 2020

EN 1012-2+A1: 1996

EN ISO 13732-1: 2008

EN ISO 2151: 2008

ISO 13857: 2019

EN 1127-1: 2019

EN IEC 61000-6-2: 2019

EN ISO 80079-36: 2016

EN IEC 61000-6-4: 2019

EN ISO 80079-37: 2016

EN IEC 63000: 2018

ISO 21360-1: 2020

The manufacturer's authorized representative in the United Kingdom and the authorized agent for compiling the technical documentation is Pfeiffer Vacuum Ltd, 16 Plover Close, Interchange Park, MK169PS Newport Pagnell.

Signature:



(Daniel Sälzer)
Managing Director

Pfeiffer Vacuum GmbH
Berliner Straße 43
35614 Asslar
Germany

Asslar, 2024-05-06

**UK
CA**



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