OPERATING INSTRUCTIONS

EN

Translation of the Original

ACP 90

Multi-stage Roots pump, air cooled

PFEIFFER VACUUM

Scan the QR code or click here to access the “Quick start guide” of the product (English version only).

This guide describes the main points of:

- installation
- pump start and stop

This document does not replace the operating manual.

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.

Copyright

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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	Reference
EC Declaration of Conformity	included with these operating instructions
UK Declaration of Conformity	included with these operating instructions
UL/CSA compliance (ETL mark)	included with these operating instructions

1.1.2 Products concerned

This document applies to products with the following part numbers:

Part Number	Model	Description
V9SAbScZde01	ACP 90 SD	Models for standard applications
V9GAbScZde01	ACP 90 G	Models for applications with traces of corrosive gases

Option		a	b	S	c	Z	d	e	0	1
Pumping applications	Clean gases	V9SA								
	Trace of corrosive gas	V9GA								
Inlet tube	Without		A							
	With		B							
Power supply	Single-phase 230 V				A					
	Three-phase 230 V				B					
	Three-phase 440 V				C					
Gas ballast dilution	Closed with a plug						B			
	With permanent filter						F			
	ON/OFF manual						M			
Purge dilution	Inert gas purge connection (for ACP 90G only)						R			
Pump on feet								F		
Pump on casters								R		

Use the matrix to decode the product part numbers; not all combinations of options are available as products.

1.2 Target group

This user manual is intended for all persons in charge of transport, installation, commissioning/decommissioning, use, maintenance or storage of the product.

The work described in this document must only be carried out by persons with suitable technical training (specialized staff) or persons who have undergone Pfeiffer Vacuum training.

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

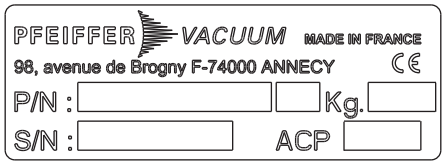
Pictographs used in the document indicate useful information.

Note

Tip

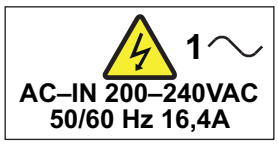
1.3.3 Labels

INLET	Pump inlet connection
PUMP EXHAUST	Pump exhaust
DILUTION	SD version: air or neutral gas injection G version: neutral gas injection
LIFTING EYE DIRECTION	Direction of the hoisting ring
MAINTENANCE	Lit indicator: maintenance threshold reached
REMOTE PORT	Remote control connector
RS PORT	Serial link connector
⏚	CPC Earth connection



Product rating plate (example).

This label indicates that the pump is compliant with UL/CSA tests.

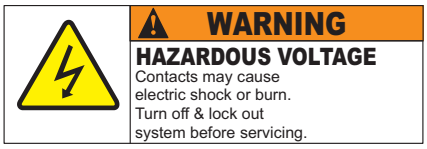


This label indicates the voltage of the equipment to which the pump is to be connected (example).

1

This label warns users about the risk of crushing or cutting due to moving parts: keep a safe distance and/or keep your hands away from the moving parts.

2

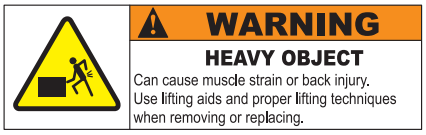


This label indicates that certain internal components carry an electric charge and can cause electric shock if touched: before working on the pump, always either disconnect it, or lock out/tag out the installation breaker in the appropriate manner.

3

This label warns users against the risk of injury if their hands come into contact with a hot surface: protective gloves must be worn when working on the pump.

4



This label indicates that the product should not be handled manually due to its weight and that appropriate handling devices should always be used.

5

This label indicates that the power supply must be switched off before connecting and/or disconnecting the pump. Any person responsible for installation or operation of the product must first refer to the operating manual.

The product comes with a sheet of labels including other language versions. The installer must stick these labels to the most appropriate and visible place on the pump to warn the operator about potential hazards.

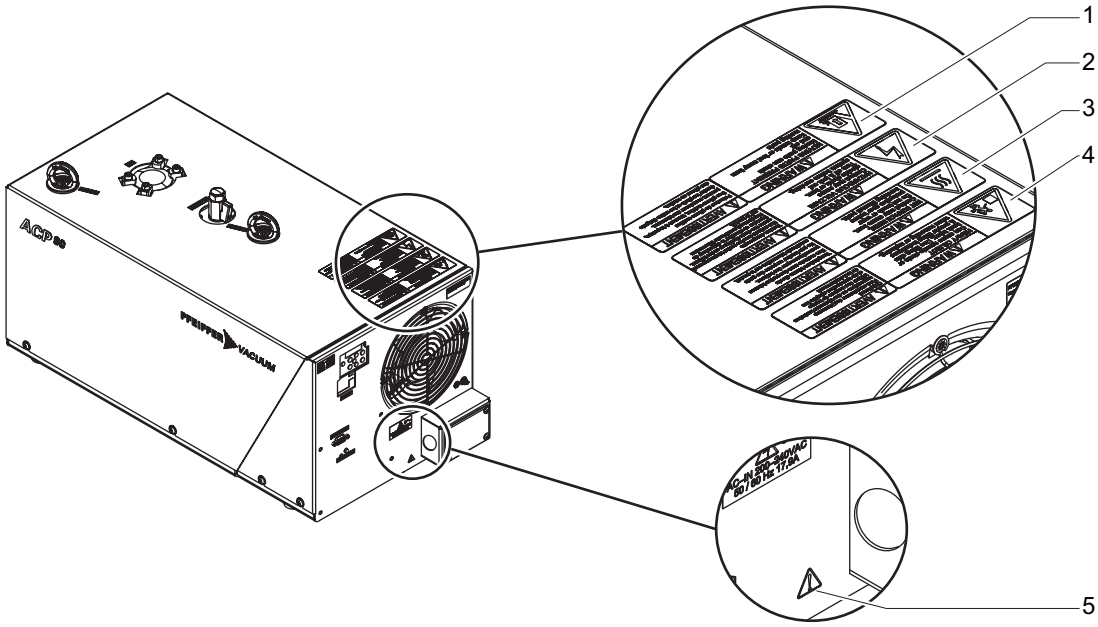


Fig. 1: Safety label locations

1 Moving parts
2 Electric shock hazard
3 Hot surface
4 Heavy object
5 Electrical safety

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.

⚠ WARNING

Risk of crushing when the product is slung

Given the heaviness of the product, there is a risk of crushing during handling operations involving lifting devices. Under no circumstances shall the manufacturer be liable if the following instructions are not followed:

► Only qualified staff trained in handling heavy objects are authorized to handle the product.
► The lifting devices provided **must be used** and the procedures set out in this document must be followed.

⚠ WARNING

Risk of electric shock due to non-compliant electrical installations

This product uses mains voltage for its electrical supply. Non-compliant electrical installations or installations not done to professional standards may endanger the user's life.

► Only qualified technicians trained in the relevant electrical safety and EMC regulations are authorized to work on the electrical installation.
► This product must not be modified or converted arbitrarily.

⚠ WARNING

Danger of electrocution by contact during maintenance or overhaul

There is an electric shock hazard in case of contact with a product powered on and not electrically isolated.

- ► Before carrying out any work, stop the pump.
- ► Disconnect the power cable from the mains.
- ► Secure the installation correctly by tagging and locking (LO/TO) the system to prevent unintentional re-engagement.

⚠ WARNING

Risk of poisoning when process gases are present in the atmosphere

The manufacturer has no control over the types of gases used with the pump. Process gases are often toxic, flammable, corrosive, explosive and/or otherwise reactive. There is a risk of serious or fatal injury if these gases are allowed to escape freely into the atmosphere.

- ► Apply the relevant safety instructions in accordance with local regulation. This information is available from the operator's safety department.
- ► **The pump exhaust must be connected** to the installation's dangerous gases extraction system.
- ► Regularly check that there are no leaks where the pump connects to the exhaust pipework.

⚠ WARNING

Risk of injury in case of contact with pressurized nitrogen

The product uses pressurized nitrogen as a flushing gas. Non-compliant installations or installations not done to professional standards may endanger the user's life.

- ► Install a manual valve on the circuit at a distance of 3 m from the product, so that the nitrogen supply can be locked out.
- ► Observe the recommended supply pressure.
- ► Always lock out and disconnect the nitrogen circuit before working on the product.
- ► When carrying out maintenance, secure the installation properly by locating and locking out the pressurized nitrogen circuit to prevent it from being re-engaged by accident (LO/TO Lock Out/Tag Out procedure).
- ► Regularly check the condition of the pipework and supply circuit connections.

⚠ WARNING

Risk of burns in case of contact with hot surfaces

Component temperature remains high, even after the pump has stopped. There is a risk of burns through contact with hot surfaces, especially at the pump exhaust.

- ► Wait for the product to fully cool down before working on it.
- ► Protective gloves must be worn in accordance with standard EN ISO 21420.

⚠ WARNING

Risk of crushing and/or cutting in case of contact with moving parts

The pump inlet flange is large enough for body part (finger or hand) to be inserted into it, presenting a risk of crushing due to contact with moving parts. The inlet and exhaust ports should be sealed with blanking plates before connection.

- ► Wait for the pumping line to be connected before removing the blanking plates.
- ► **Wait for the pump to be connected before powering on.**

2.3 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.

Only qualified personnel trained in safety regulations (EMC, electrical safety, chemical pollution) are authorized to carry out the installation and maintenance described in this manual. Our service centers can provide the necessary training.

- ► Do not expose any part of the human body to the vacuum.
- ► Comply with all safety and risk prevention instructions in accordance with local safety standards.
- ► Regularly check compliance with all precautionary measures.
- ► If the pump is used in a manner not specified in this manual, the protections provided by the pump are not guaranteed.
- ► Do not remove the blanking plates sealing the inlet and exhaust ports if the product is not connected to the pumping line.
- ► Do not operate the product unless the inlet and exhaust are connected to a vacuum and exhaust pumping line.

2.4 Intended use

- The vacuum pump should only be used to generate a vacuum while pumping gases.
- The vacuum pump is designed to operate in industrial environments.
- The vacuum pump G version is used to pump **traces of corrosive gases**.

2.5 Foreseeable misuse

Misuse of the product will render the warranty and any claims void. Any use, whether intended or not, that diverges from the uses already mentioned will be treated as non-compliant; this includes but is not limited to:

- Pumping of flammable and explosive mixtures
- Pumping of corrosive gases (exception: pumps in G version for traces of corrosive gases)
- Pumping liquids
- Pumping dust particles
- Using the vacuum pump to generate pressure
- Using the pump in potentially explosive areas
- Using accessories or spare parts not mentioned in these operating instructions

The product is not designed to carry people or loads and should not be used as a seat, stepladder or similar.

3 Transportation and Storage

3.1 Receipt of the product

Condition of the delivery

- Check that the product has not been damaged during transport.
- If the product is damaged, take the necessary measures with the carrier **and** notify the manufacturer.

► Keep the product in its original packaging so it stays as clean as it was when dispatched by us. Only unpack the product once it has arrived at the location where it will be used.
► Keep the blanking plates in place on the inlet, exhaust and purge ports while the product is not connected to the pumping line.

Keep the packaging (recyclable materials) in case the product needs to be transported or stored.

3.2 Handling

⚠ WARNING

Risk of crushing when the product is slung

Given the heaviness of the product, there is a risk of crushing during handling operations involving lifting devices. Under no circumstances shall the manufacturer be liable if the following instructions are not followed:

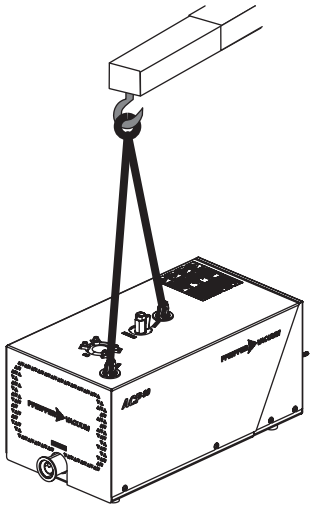
► Only qualified staff trained in handling heavy objects are authorized to handle the product.
► The lifting devices provided **must be used** and the procedures set out in this document must be followed.

⚠ WARNING

Risk of crushing related to product tilting

Although the product fully complies with the EEC safety regulations, there is a risk of tilting when it is moved over the floor or is not properly secured.

► Do not place the product on an inclined plane.
► Place it on a flat, hard floor.
► Do not push the product sideways.



Handling the pump using a hoist

1. Use a lifting device suitable for the product's weight.
2. Use a 2-strand strap with the following characteristics:
   – length for each strand **> 500 mm**
   – load per strand **> 90 kg**
3. Use the strap to lift the pump by its hoisting rings.

Using the casters

The casters (optional) are **only** intended for moving the pump over short distances so that its position on the installation can be adjusted.

1. Unlock the casters.
2. Move the pump to position it on the installation.
3. Lock the casters to immobilize the pump.

3.3 Storage

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

Storing a new pump

1. Keep the pump wrapped in its protective envelope.
2. **Always** leave inlet, exhaust and purge protections in place.
3. Store the pump in line with the permitted storage temperatures for a maximum period of **1 year**.

Storing a new pump for longer than 1 year

Run the pump regularly **at least once a year**: factors such as temperature, degree of humidity, salt air, etc. may cause the deterioration of the pump components.

1. Let the pump run for 30 minutes with gas ballast opened or while injecting a dry neutral gas into the pump (G version).
2. Let the pump run for 30 minutes at ultimate pressure (inlet, gas ballast and purge ports closed).
3. Stop the pump.
4. Seal the pump inlet, exhaust and purge ports with included accessories.
5. Repeat this **at least once a year**.

Beyond 4 years, the pump must be reviewed at our service centers before commissioning (see chapter “Service solutions by Pfeiffer Vacuum”, page 42).

For prolonged immobilization after use, see chapter “Extended Immobilization”.

4 Product description

4.1 Product identification

To correctly identify the product when communicating with our service center, always have the information from the product rating plate available (see chapter "Labels").

4.1.1 Scope of delivery

- 1 vacuum pump
- 1 cover plug for auto-start
- 1 feed through
- 1 operating instructions and a sheet of safety labels

4.1.2 Differences between the pump versions

The multi-stage Roots pump technology of **the ACP series** meets the requirements of applications where a clean and dry vacuum is needed.

By design, the pump provides ample pumping capacity up to atmospheric pressure and withstands volume cyclic pumping applications.

For energy efficiency, the pump is equipped with an IPM (Interior Permanent Magnet) synchronous motor with a high level of electrical efficiency.

The pump is equipped with a frequency converter compliant with EU standards allowing operation at different voltages depending on the selected model (see chapter “Electrical Characteristics”).

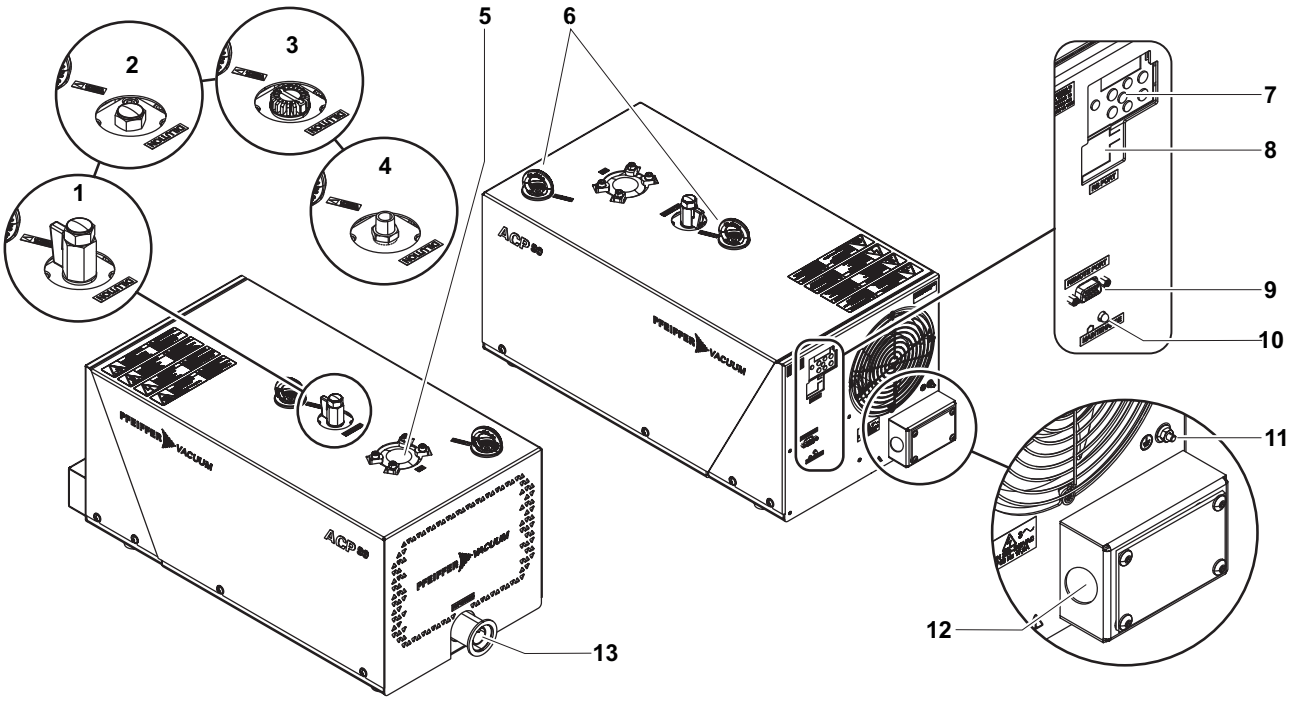
In order to satisfy most applications in the 90 m^3/h range, the ACP 90 is available in 2 versions.

Standard SD version
The pump is designed for clean (dust-free) and non-corrosive gas pumping applications. Standard pumps are equipped with a gas ballast device to improve pumping of light gases and avoid vapor condensation inside the pump.

G version
The pump is compatible with traces of corrosive gases. A purge gas stream protects low- and high-pressure ball bearings and dilutes trace amounts of corrosive gases.

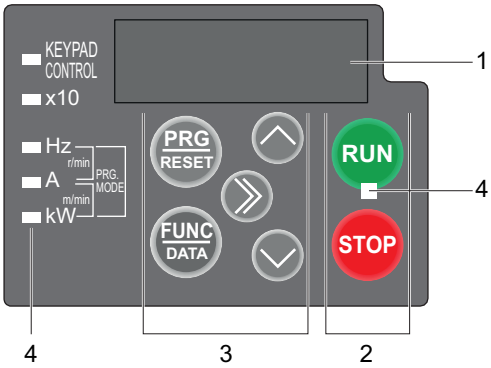
Please contact Pfeiffer Vacuum for more detailed information on specific applications.

4.2 Human/Machine Interface



1 ON/OFF manual gas ballast (SD version)
2 Continuous gas ballast (SD version)
3 Gas ballast closed with a plug (SD version)
4 Inert gas purge connection (G version)
5 Pump inlet
6 Hoisting ring
7 Frequency converter control pad
8 Serial link connector (**RS PORT**)
9 Remote control connector (**REMOTE PORT**)
10 Indicator light (**MAINTENANCE**)
11 CPC Earth
12 Power supply connection
13 Pump exhaust

4.3 Description of the frequency converter control pad



1 Display
2 Manual control keys
3 Parameter selection keys
4 Indicators

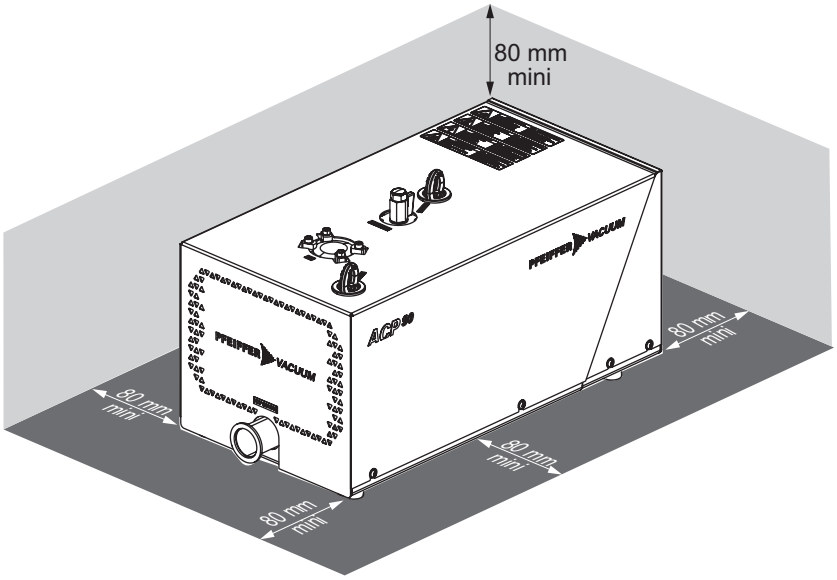
Description	Key	Functions
Display		A four-digit monitor displays the following, depending on the operating modes. **Running mode** ● Operating status information (for example: frequency, current or voltage) ● “L-AL” to signal an alert **Programming mode** ● Menus, function codes and their values **Alarm mode** ● Alarm code activated
Manual control keys		Used to start/stop the pump in LOCAL command mode.
Parameter selection keys	 UP / DOWN	● Access the next or previous menu. ● Access the next or previous parameter. ● Select or adjust the parameter.
	 SHIFT	Move the cursor to the right from one digit to another.
		**Running mode / Programming mode** ● Used to switch from one mode to another by pressing this key.
		Used to switch from operating mode to other information. **Running mode** ● Used to change the display: switch from the rotation frequency to the current, power, etc. ● When an alert (L-AL) is displayed, pressing and holding this key will acknowledge the alert. Return to operating mode. **Programming mode** ● Used to display the function code or adjust the parameters. **Alarm mode** ● Displays the details of the alarm.
Indicators	RUN	The indicator lights up when the pump receives a start-up command.
	KEYPAD CONTROL	The indicator lights up when the frequency converter is ready to receive a command in LOCAL mode if the frequency converter is in **Running** operating mode. **Running mode** ● The indicator lights up when the frequency converter is ready to receive a command in LOCAL mode.
	x10	The indicator lights up when the data to be displayed exceeds 9999: the displayed value x 10 is the real value. Example: If the monitor displays 1234 and the x10 indicator lights up, it means 1234 x 10 = 12,340.
	Hz - A - kW	**Running mode** ● The indicators indicate the unit of the displayed parameter: Hz, A, kW or combination of indicators: rpm and mpm. **Programming mode** ● The Hz and kW indicators are on.

5 Installation

5.1 Installation

The pump needs to operate in the horizontal position resting on its feet, the pumping axis must be vertical, and the pump inlet must be on top.

1. Determine where the pump will be located.
2. Handle the pump using a hoist.
3. Install the pump such that the frequency converter control pad is accessible to the operator.
4. Lock the casters of the pump (if present).



Ventilation

To guarantee the characteristics and performances of the pump within the boundaries of the operating conditions:

- ► Do not obstruct the ventilation grids.
- ► Keep the pump away from fixed walls, at a minimum using the value indicated on the diagram above.

5.2 Connecting to the pumping line

The user and/or product integrator is ultimately responsible for the equipment and must apply the specific safety instructions, in accordance with local regulations.

⚠ WARNING

Risk of crushing and/or cutting in case of contact with moving parts

The pump inlet flange is large enough for body part (finger or hand) to be inserted into it, presenting a risk of crushing due to contact with moving parts. The inlet and exhaust ports should be sealed with blanking plates before connection.

- ► Wait for the pumping line to be connected before removing the blanking plates.
- ► **Wait for the pump to be connected before powering on.**

General instructions for installing the pump in the pumping line in accordance with industry best practices

The inlet and exhaust connections must not put undue strain on the pumping line that could cause leakage.

1. Only use accessories on the inlet and exhaust lines with materials and sealing properties that are compatible with the gases being pumped. Refer to the connection accessories catalog available at the Pfeiffer-Vacuum website.
2. When assembling the pumping line, include accessories for isolating the pump from the pumping line and making maintenance easier to carry out (pump inlet and exhaust isolation valves, purge valves, etc.).
3. The O-rings located under the blanking plates are not compatible with all applications. **Product users or integrators are responsible for installing O-rings that are compatible with their applications**.
4. Remove the blanking plates used to seal the inlet and exhaust ports.
5. Keep the blanking plates, screws and washers for reuse when transporting the pump.
6. Ensure that no screws, washers or other objects are dropped into the pump inlet.
7. Fit flexible tubes in the pumping line to reduce the transmission of vibration.
8. Perform a leak test on the entire pumping line after installation.

5.2.1 Connection on the pump inlet side

Make sure that the parts or chambers connected to the inlet of our products can withstand a negative pressure of $1 \cdot 10^{-3}$ hPa absolute.

To achieve the optimum pumping speed, make the pumping line **as short and straight as possible and ensure that its inside diameter is not narrower than the pump inlet flange inside diameter**.

The product is not designed to withstand loads on its inlet flange which may compromise stability.

- Mechanically attach the vacuum chamber separately from the pump.
- Use only dry parts and clean, grease-free, dust-free pipelines.
- It may be necessary to install an inlet filter (particle filter or condensable filter).
- If necessary, install an isolation valve on the inlet which closes when the pump stops.

5.2.2 Connection on the pump exhaust side

⚠ DANGER

Risk of poisoning in case of contact with toxic substances and by-products generated by the process

The vacuum pump, pumping line components and operating fluids **may potentially be contaminated** with toxic, corrosive, reactive and/or radioactive substances related to the process and harmful to health.

► Always connect the pump exhaust to an exhaust extraction system.

Ensure that all components in the exhaust line have a maximum pressure rating that exceeds the highest pressure the pump can generate.

5.2.3 Connection of the purge circuit

The purge consists of injecting an inert gas into the pump.

In this manual, the inert gas will be called 'nitrogen', as it is the most commonly used gas. For more information on the type of purge gas, contact our Pfeiffer Vacuum service center.

⚠ DANGER

Danger of death by explosion when pumping gases containing pyrophoric/flammable materials

There is a risk of explosion if pyrophoric materials above the LEL are sent to the pump.

- ► Ensure there is a sufficient flow of nitrogen to lower the concentration below the LEL.
- ► Provide an interlock to ensure that gas flow towards the pump is stopped if the nitrogen flow is interrupted.

The effect of nitrogen injection continuity on the process

If an interruption to the nitrogen flow represents a serious risk for the process, it is advisable to control the nitrogen supply with an external system capable of taking over if the nitrogen circuit fails.

G version

A purge gas flow protects the pump bearings.

The pump must be connected to a dry and filtered nitrogen supply with the required characteristics (see chapter “Nitrogen characteristics”).

1. Connect the inert gas pipe to the 1/4 BSPT connector provided for this purpose (flexible or rigid pipe supplied by the customer).
2. Install an isolation valve on the inert gas injection circuit, as close as possible to the pump. This enables the pump to recover its original pumping performance when gas injection is not in use.
3. Install a purge flow monitoring system if a variation of nitrogen flow can cause a risk for the process.
4. Perform the purge without exceeding a maximum relative pressure of 300 hPa at the purge circuit input.

5.3 Check that the installation is leak tight

When the product leaves the factory, product leak tightness under normal operating conditions is guaranteed. The operator must maintain this level of leak tightness, especially when pumping dangerous gases. For more information concerning leak tests, please contact our service center.

1. Perform a leak test on the entire pumping line after installation.
2. Carry out regular checks to ensure that there are no traces of the pumped gases in the surrounding environment and that no air is entering the pumping line during operation.

5.4 Electrical connection

⚠ WARNING

Risk of electric shock due to non-compliant electrical installations

The product is permanently connected to the mains voltage. Non-compliant electrical installations or installations not done to professional standards may endanger the user’s life.

- ► Only qualified technicians trained in the relevant electrical safety and EMC regulations are authorized to work on the electrical installation.
- ► This product must not be modified or converted arbitrarily.

⚠ WARNING

Danger of electrocution by contact during maintenance or overhaul

There is an electric shock hazard in case of contact with a product powered on and not electrically isolated.

- ► Before carrying out any work, stop the pump.
- ► Disconnect the power cable from the mains.
- ► Secure the installation correctly by tagging and locking (LO/TO) the system to prevent unintentional re-engagement.

NOTICE

Risk of electromagnetic disturbance

Voltages and currents can induce a multitude of electromagnetic fields and interference signals. Installations that do not comply with the EMC regulations can interfere with other equipment and the environment in general.

► Use shielded cables and connections for the interfaces in interference-prone environments.

Electromagnetic compatibility

The product complies with industrial environment immunity and emission standards.

This product is designed for professional use with a power greater than 1 kW.

In the case of use in a laboratory environment, contact us.

Safety features

The pump has thermal sensors that prevent start-up at certain temperatures (see chapter “Preliminary precautions for use”).

Fuses protect the pump’s electrical circuit.

5.4.1 Customer electrical installation protection measures

Circuit breaker protection

The user must supply the pump from facilities equipped with main circuit breaker, curve D (IEC 60947-2), in accordance with UL/CSA certifications and local regulations. The short-circuit cut-off capacity must be at least 10 kA. This protection device should be in close proximity to the pump (no further than 7 m away), easily accessible and identified as the product's cut-off device.

The customer must provide a correctly-rated main circuit breaker (see chapter “Electrical characteristics”).

Differential circuit breaker

To protect individuals against insulation faults, you must install a differential circuit breaker (see chapter “Electrical characteristics”). If needed, contact our service center. The applicable local regulations must be complied with at all times.

Earthing

When necessary, the installer must provide dual protection in addition to the existing one. It consists of an uninsulated braid or a separate green/yellow conductor with a minimum section equal or above the supply cable section. The impedance between the pump body and the ground connection point must be < 0.1 Ω at 25 A.

The IEC 60417 #5019 ⏚ symbol is marked on the rear panel to indicate where the CPC earth terminal is located.

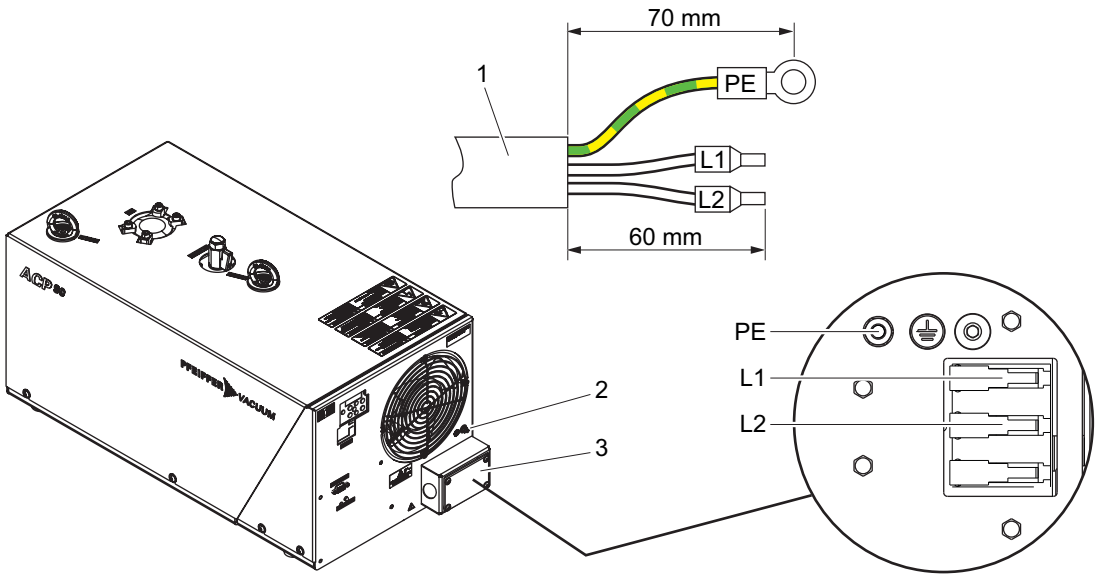
► Connect the earth stud to a suitable installation earthing point such as the host system frame.

Absence of emergency stop

The vacuum pump is not equipped with an emergency stop device (EMS) or a lock-out device. The vacuum pump is designed to be integrated into equipment fitted with an emergency stop device.

- When activated, the EMS of the equipment must switch off the vacuum pump.

5.4.2 Connecting the single-phase power supply



1	Power supply	3	Electrical cabinet
2	CPC Earth connection	PE	Earth stud

Preparation and connection

The power supply is the responsability of the customer. It shall have suitable protection against grounding faults and the earth wire is longer than the conductor wires (see chapter “Electrical Characteristics”).

A feed through is supplied with the pump.

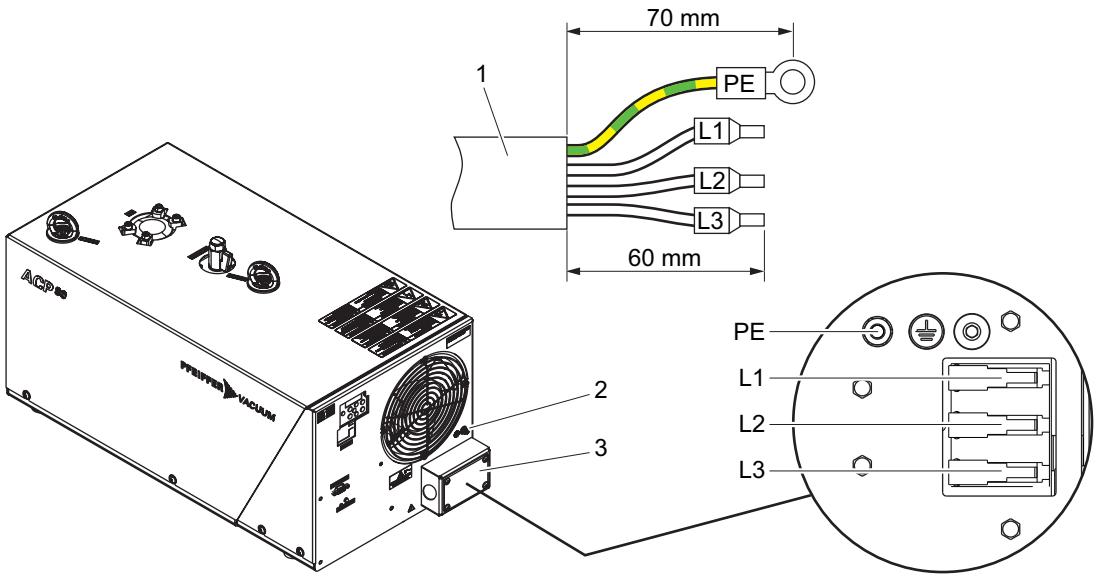
The CPC Earth is connected to a suitable installation earthing point (see chapter “Customer electrical installation protection measures”).

1. Prepare the power supply by crimping the ferrules and terminal on the wires, making sure to follow the wire dimensions.
   - Conductor wires have crimp ferrules.
   - The earth wire has a ring terminal.
2. Check that the power supply corresponds to the electrical voltage label on the product.
3. Open the electrical cabinet.
4. Connect the conductor wires to the connector as shown in the below diagram.
5. Connect the earth wire to the earth stud and tighten to a 3 N·m torque.
6. Close the electrical cabinet.

Permanent connection in US and Canada

► Connect the pump to a wiring system in accordance with ANSI/NFPA 70, NEC, and with CSA C22.1, CEC, Part I (see chapter “Electrical Characteristics”).

5.4.3 Connecting the three-phase power supply



1 Power supply
2 CPC Earth connection
3 Electrical cabinet
PE Earth stud

Preparation and connection

The power supply is the responsability of the customer. It shall have suitable protection against grounding faults and the earth wire is longer than the conductor wires (see chapter “Electrical Characteristics”).

A feed through is supplied with the pump.

The CPC Earth is connected to a suitable installation earthing point (see chapter “Customer electrical installation protection measures”).

1. Prepare the power supply by crimping the ferrules and terminal on the wires, making sure to follow the wire dimensions.
   - Conductor wires have crimp ferrules.
   - The earth wire has a ring terminal.
2. Check that the power supply corresponds to the electrical voltage label on the product.
3. Open the electrical cabinet.
4. Connect the conductor wires to the connector as shown in the below diagram.
5. Connect the earth wire to the earth stud and tighten to a 3 N·m torque.
6. Close the electrical cabinet.

Permanent connection in US and Canada

► Connect the pump to a wiring system in accordance with ANSI/NFPA 70, NEC, and with CSA C22.1, CEC, Part I (see chapter “Electrical Characteristics”).

5.5 Connecting the remote control connector

NOTICE

Safety Extra-Low Voltage circuits

The remote control circuits are equipped with dry contact outputs (30 V - 1 A max). Overvoltages and overcurrents can result in internal electrical damage. Users must observe the following wiring conditions:

► Connect these outputs in accordance with the rules and protection of Safety Extra-Low Voltage (SELV) circuits.
► The voltage applied to these contacts should be less than 30 V and the current less than 1 A.

Description

The connection made via the **REMOTE PORT** (15-pin Male D-Sub HD) connector is used to:

- remote control of following functions: start, stop of the pump,
- set the rotation speed,
- remote pump status through auxiliary dry contacts.

The remote control connector wiring is the customer's responsibility.

5.5.1 Cover plug wiring

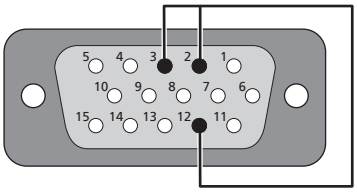


Fig. 2: Cover plug wiring

The cover plug, supplied with the pump, allows automatic starting of the pump in LOCAL mode (see chapter “LOCAL mode operation with auto-start”).

The cover plug is connected to the remote control connector.

5.5.2 Logic input wiring

There are dry contact inputs.

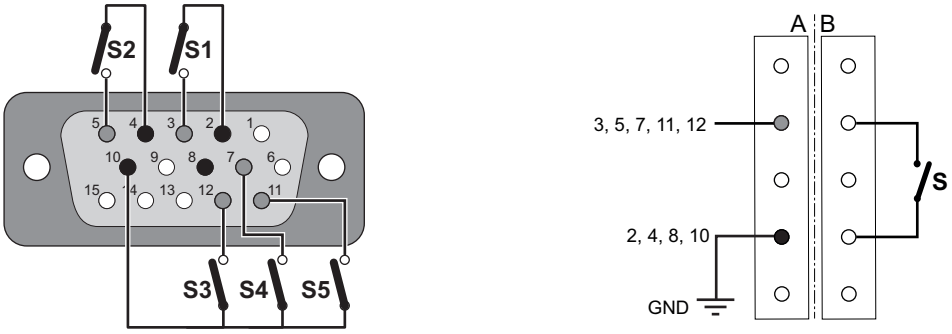


Fig. 3: Logic input wiring

A Internal wiring B Wiring from customer’s side

Contact	Function	
S1 (2-3)	Pump Start/Stop	Contact open, S1=0: pump stops Contact closed, S1=1: pump starts
S2 (4-5)	SERIAL LINK mode	Contact open, S2=0: SERIAL LINK mode disabled Contact closed, S2=1: SERIAL LINK mode enabled This function is enabled when REMOTE mode is selected: S3 contact closed.
S3 (10-12)	LOCAL or REMOTE mode	Contact open, S3=0: LOCAL mode enabled Contact closed, S3=1: REMOTE mode enabled
S4 (7-10) S5 (10-11)	Rotation speed setting	Depending on the contact status (open or closed), the rotation speed changes.

5.5.3 Setting of the rotation speed

Contact		Rotation speed	
S4	**S5**	**Hz**	**min^{-1}**
0	0	112	6720
0	1	80	4800

Contact		Rotation speed	
S4	**S5**	**Hz**	**min^{-1}**
1	0	60	3600
1	1	40	2400

Tbl. 1: Setting of the rotation speed

5.5.4 Logic output wiring

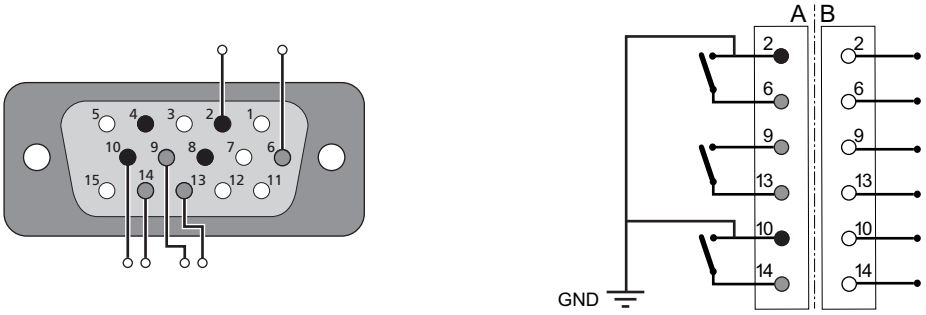


Fig. 4: Logic output wiring

A Internal wiring B Wiring from customer's side

Contact	Function	
(2-6)	Isolation valve control	Contact opened as soon as a **'STOP'** order is sent to the pump. Contact closed 2 seconds after sending a **'RUN'** order to the pump.
(9-13)	Pump operating status	Contact closed: pump is running
(10-14)	Maintenance alert	Contact closed: maintenance threshold is reached

5.6 Connecting the serial link connector

NOTICE

Risk of electromagnetic disturbance

Voltages and currents can induce a multitude of electromagnetic fields and interference signals. Installations that do not comply with the EMC regulations can interfere with other equipment and the environment in general.

► Use shielded cables and connections for the interfaces in interference-prone environments.

Description

Information from the frequency converter can be managed and collected via the Modbus RS-485 serial link.

The connection made via the **RS PORT** (RJ45) connector is used to:

- control remotely the following functions: start, stop of the pump,
- set the rotation speed between 2400 and 6720 min^{-1},
- read the frequency converter's parameters (power, current, voltage, frequency, etc.).

The connector wiring is the customer's responsibility.

As the network output cannot be shielded (plastic cover of the frequency converter), using a ferrite is recommended (reference example: Wurth 74271112).

5.6.1 Wiring the serial link

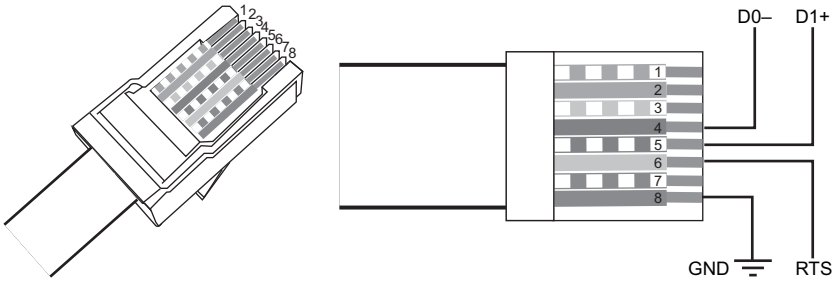


Fig. 5: Wiring the serial link on RJ45 connector

1	-	Not connected
2	-	Not connected
3	-	Not connected
4	D0-	Differential data (RS-485)
5	D1+	Differential data (RS-485)
6	RTS	Ready to send
7	-	Not connected
8	GND	Signal ground

Tbl. 2: Wiring the serial link on RJ45 connector

Transmission speed	9600 Bauds
Parity	None
Stop bit	1
Data word length	8 bits

Tbl. 3: Serial link connection settings

5.6.2 Description command syntax

Pump address	Number given to the pump. The default address is 1. It can be changed.
Function code	To read a variable: 03 To write a variable: 10
Variable address	(see chapter “List of variables”)
Number of words	Number of read or written variables.
Number of bytes	Number of read or written bytes. Number of bytes = 2 x Number of words If Number of words = 00 01 then Number of bytes = 02
Variable value	Variable value is read or written in hexadecimal code.
CRC16	Polynomial control parameter CRC (cyclical redundancy check). To calculate it, download an application from the Internet: hexadecimal CRC16 modbus https://crccalc.com

Pump address	Function code	Variable address	Number of words	CRC16
XX	03	AA AA	BB BB	CC CC

Tbl. 4: Variable reading

Pump address	Function code	Number of bytes	Variable address	CRC16
XX	03	CC	EE EE	CC CC

Tbl. 5: Response to the variable reading

Pump address	Function code	Variable address	Number of words	Number of bytes	Value to enter	CRC16
XX	10	AA AA	BB BB	CC	ZZ ZZ	CC CC

Tbl. 6: Variable writing

Pump address	Function code	Variable address	Number of words	CRC16
XX	10	AA AA	BB BB	CC CC

Tbl. 7: Response to the variable writing

5.6.3 List of variables

All the information available on the front panel of the frequency converter are available with the serial link.

Description	Choice	Modbus address	Read/Write
Start/Stop pump	Start = 01 Stop = 00	07 06	W
Rotation speed adjustment (300 x Hz)	Value	07 05	W
Reading the frequency (300 x Hz)	-	08 09	R
Reading the power (0.1 x W)	-	0F 15	R
Reading the running time (0.1 x h)	-	04 5E	R

Tbl. 8: List of the most common Modbus commands

Rotation speed adjustment: to reach the maximum rotation speed of 6720 min^{-1} (112 Hz), the value “83 40” must be sent.

Rotation speeds between 4800 min^{-1} (80 Hz) and 6540 min^{-1} (109 Hz) are prohibited speeds.

The pump does not operate in this speed range.

Example of power reading: the reading of 49 corresponds to a power of 490 W.

6 Operation

6.1 Preliminary precautions for use

⚠ WARNING

Risk of poisoning when process gases are present in the atmosphere

The manufacturer has no control over the types of gases used with the pump. Process gases are often toxic, flammable, corrosive, explosive and/or otherwise reactive. There is a risk of serious or fatal injury if these gases are allowed to escape freely into the atmosphere.

- ► Apply the relevant safety instructions in accordance with local regulation. This information is available from the operator's safety department.
- ► **The pump exhaust must be connected** to the installation's dangerous gases extraction system.
- ► Regularly check that there are no leaks where the pump connects to the exhaust pipework.

⚠ WARNING

Risk of electric shock in case of contact with the mains connector at power-off

Certain components use capacitors that are charged up to over 60 VDC and that hold their electrical charge **at power-off**: residual voltages due to filter capacitance can cause electric shock, up to and including mains voltage levels.

- ► Wait 5 minutes after power-off before commencing work on the product.

⚠ CAUTION

Auditory risk due to exposure to high noise emissions

When the chamber is in the fore pumping phase and the pressure is high, the pump noise level may exceed 70 dB (A).

- ► Connect the exhaust port to a chimney or to an exhaust pipe.
- ► Wear hearing protection.

Oil capacity

The pump is delivered with filled oil charge.

- Do not modify the oil level.
- Do not drain the pump: this operation is carried out during pump overhaul by our service centers.

Safety data sheets

You can obtain the safety data sheets for operating fluids from Pfeiffer Vacuum on request, or from the Pfeiffer Vacuum Download Center.

Thermal safety

The pump is fitted with a temperature sensors which prevents operation or start-up when the temperature of the pump body is **> 40°C**.

In order for the pump to operate:

- Operate the pump within the required temperature range.
- Avoid sudden changes of ambient temperature when the pump is running.

The pump automatically restarts when the thermal safety fault disappears.

Before the pump is switched on each time:

1. Check that the pump inlet is properly connected to the pumping line.
2. Check that exhaust pipe line is not clogged and that all the valves in the exhaust system are open.
3. Connect the pump to the mains supply.
4. Check that the inlet pressure is not higher than atmospheric pressure. If the pressure is too high, it can damage the product.

5. Check that the ambient temperature is well within the permitted operating range.
6. Check the exhaust line during pumping to prevent the risks related to excess overpressure.

6.2 Matrix gas/applications

You are advised to use the appropriate pump version according to the applications and the nature of the gases pumped and apply the usual precautions to guarantee the reliability and safety of the procedure.

► Ensure that the gases pumped are compatible with the various materials (see chapter “Environmental conditions”).

Type of gas or vapor pumped		Recommended equipment	Actions/Monitoring to be done	Minimum ACP configuration according to versions	
				SD	G
Neutral or inert gas	Air, nitrogen, CO2, noble gas or permanently non-reactive gas	None	• See use of gas ballast for purging.	Gas ballast closed	-
Gas containing condensable vapor	• Cyclic pumping of volume • Pumping large volumes • Presence of degassing material: plastic, elastomer, polymer, etc. • Drying	Avoid condensation which reduces the performance and reliability of the pump	• Before and after pumping on the installation, allow the pump to run for 1 hour at ultimate pressure with the gas ballast open (inlet closed).	Gas ballast open	-
Reactive and/or corrosive gas excluding halogens (F_2, CL_2, Br_2, I_2)	Pumping reactive gas: • Oxidizing • Base • Acid	Dilute the corrosive gas to reduce its activity. Connect the gas ballast to a neutral gas source.	• Dilute the gas to lower its concentration and avoid any condensation. • Use the purge. • Avoid excess pressure at the exhaust. • Check that the pump materials and their sealing are compatible with the pumped vapors.	-	Purge open
Inflammable or explosive gas		Work outside the flammability range of the product (ideal = 25 to 50 % of the LEL [1] **and/or** below the MOC [2]) Connect the gas ballast to a neutral gas source.	• Dilute the pumped gas upstream or in the pump to lower its concentration below the lower flammability limit via purges and/or the neutral gas ballast. • Dilute the gas discharged by the pump to lower its concentration to 25 % of the LEL via purge and/or the inert gas ballast. • Avoid any build-up of gas in the pumping line. • Avoid air or humidity backstreaming by maintaining a gas speed > 0.1 m/s in the exhaust line. • Check the sealing of the installation.	-	Purge open

1) Reference NFPA 69-2019, § 7.7.2.5 chap.7 “Deflagration prevention by oxidant concentration reduction”. LEL = Lower Explosive Limit.

2) MOC = Maximum Oxygen Concentration.

6.3 The control modes

This chapter describes the connections and protocols associated with each control mode. There are 3 control modes:

- **LOCAL**
  - **With automatic start-up**: the pump starts automatically when it is switched on.
  - **No automatic start-up**: the pump is managed by the **RUN/STOP** keys on the frequency converter control pad. The pump runs independently of the equipment onto which it has been integrated.
- **REMOTE**

  The pump is controlled by opening and closing different dry contacts on the **REMOTE PORT**connector.
- **SERIAL LINK**

  The pump is controlled by commands sent via the **RS PORT** serial link.

6.3.1 LOCAL mode operation with auto-start

⚠ DANGER

Risk of injury if the pump is configured to restart automatically

In local mode, the cover plug installed on the remote control connector initiates an auto-start as soon as the pump regains power.

► Take all the measures required to prevent risks resulting from this type of operation.

In **LOCAL** mode **with automatic start-up**: the pump starts automatically when it is switched on.

- The manual control keys **STOP** and **RUN** of the frequency converter control pad are not active.
- The pump rotation speed cannot be changed.

Starting the pump

The cover plug (see chapter “Cover plug wiring”) is connected to the remote control connector.

1. Power on the pump.
   - The fan starts.
   - The pump starts: the RUN indicator lights up.
   - The **Hz** and **A** indicators light up.
   - The display shows the pump rotation speed (6720 min^{-1}).
2. **G version:** operate the purge.

Shutting down the pump

1. Isolate the pump in the pumping line (isolation valve at pump inlet closed) and let the pump **run for 1 hour with gas ballast or purge open** (G version).
2. Power off the pump by switching off the power supply.
   - The pump stops.

Prolonged stoppage

If the pump is subject to a prolonged stop:

► Apply the **Decommissioning** procedure.

Restart after emergency stop (using the equipment)

The emergency stop is managed by the equipment in which the pump is integrated. To restart the pump after an emergency stop, you must:

1. Correct the problem,
2. Unlock the equipment's emergency stop button.
   - The pump restarts automatically.

Auto-restarting after a power failure

► After a power failure, the pumps restarts automatically when the power comes back on.

6.3.2 LOCAL mode operation without auto-start

Starting the pump

The cover plug is not on the remote control connector.

1. Power on the pump.
   – The fan starts.
   – The frequency converter display shows 0.00, the **KEYPAD CONTROL**, **Hz** and **A** indicators are on.
2. Press the **RUN** key.
   – The pump starts: the RUN indicator lights up.
   – The display indicates the minimum authorized speed: 2400 min^{-1} (default speed).
3. **G version:** operate the purge.

Modifying the rotation speed

Rotation speeds between 4800 min^{-1} and 6540 min^{-1} are prohibited speeds.

The pump does not operate in this speed range.

1. Press the **UP** key once.
2. Press the **SHIFT** key once to select the highest number.
3. Keeping the **UP** key pressed to increase the rotation speed to 6720 min^{-1}.

Shutting down the pump

1. Isolate the pump in the pumping line (isolation valve at pump inlet closed) and let the pump **run for 1 hour with gas ballast or purge open** (G version).
2. Press **STOP**.
   – The pump stops.
   – The speed setpoint is retained as long as the pump is not switched off.

Prolonged stoppage

If the pump is subject to a prolonged stop:

► Apply the **Decommissioning** procedure.

Restart after emergency stop (using the equipment)

The emergency stop is managed by the equipment in which the pump is integrated. To restart the pump after an emergency stop, you must:

1. Correct the problem,
2. Unlock the equipment's emergency stop button.
   – The pump does not start automatically and the speed setpoint is lost.
3. Press the **RUN** key.
   – The pump starts.
   – The display indicates a speed of 2400 min^{-1}.
4. Adjust the rotation speed if necessary.

Restarting after a power failure

The pump does not restart automatically when the power supply returns and the speed setpoint that was initially set is lost.

► Press the **RUN** key.
   – The pump starts.
   – The display indicates a speed of 2400 min^{-1}.
► Adjust the rotation speed if necessary.

6.3.3 REMOTE mode operation

The remote control mode is active when the S3 contact is closed.

1. Prepare the cable (see chapter “Connecting the remote control connector”).
2. Connect the cable to the **REMOTE PORT** connector.

Starting the pump

1. Power on the pump.
2. Send a **’RUN’** pump order via the S1 contact.
   – The pump starts and runs at the speed set on the S4 and S5 contacts.
3. **G version:** operate the purge.

Influence of rotation speed on pump performances

Pump performances are guaranteed for a nominal speed of **112 Hz**. Changing the rotation speed affects the pumping speed and the ultimate pressure of the pump. At low speed, it is the customer's responsibility to find the correct settings according to the pump and the process.

- Do not exceed the maximum frequency of **112 Hz**.
- Do not run the pump continuously at speeds **≤ 40 Hz**.

Shutting down the pump

1. Isolate the pump in the pumping line (isolation valve at pump inlet, closed) and let it **to run for 1 hour with gas ballast or purge open**
2. Send a **'STOP'** pump order via the S1 contact.
   – The pump stops after 5 seconds.

Prolonged stoppage

If the pump is subject to a prolonged stop:

► Apply the **Decommissioning** procedure.

Restart after emergency stop (using the equipment)

The emergency stop is managed by the equipment in which the pump is integrated. To restart the pump after an emergency stop, you must:

1. Correct the problem,
2. Unlock the equipment's emergency stop button.
   – The pump restarts automatically.

Restart after power failure

After a power failure, the pumps restarts automatically when the power comes back on.

⚠ DANGER

Risk of injury if the pump is configured to restart automatically

In remote control mode, the closed S1 contact causes automatic start-up as soon as the pump is powered up: the S1 contact wiring is the responsibility of the customer.

► Provide adequate wiring to authorize or prevent automatic restart.
► Take all the measures required to prevent risks resulting from this type of operation.

6.3.4 Operation in SERIAL LINK mode

Serial link mode is activated when the S2 and S3 contacts are closed.

1. Prepare the cable (see chapter “Connecting the serial link connector”).
2. Connect the cable to the **RS PORT** connector.

Starting the pump

1. Power on the pump.
2. Send a **'RUN'** pump order via the serial link.
   – The pump starts and runs at the speed set on the serial link parameter.
3. **G version:** operate the purge.

Influence of rotation speed on pump performances

Pump performances are guaranteed for a nominal speed of **112 Hz**. Changing the rotation speed affects the pumping speed and the ultimate pressure of the pump. At low speed, it is the customer's responsibility to find the correct settings according to the pump and the process.

- Do not exceed the maximum frequency of **112 Hz**.
- Do not run the pump continuously at speeds **≤ 40 Hz**.

Shutting down the pump

1. Isolate the pump in the pumping line (isolation valve at pump inlet, closed) and let it **to run for 1 hour with gas ballast or purge open**
2. Send a **'STOP'** pump order via the serial link.
   – The pump stops.

Prolonged stoppage

If the pump is subject to a prolonged stop:

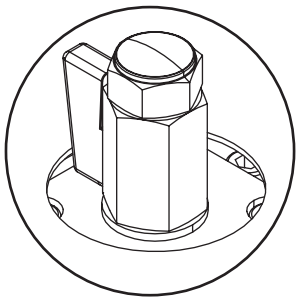
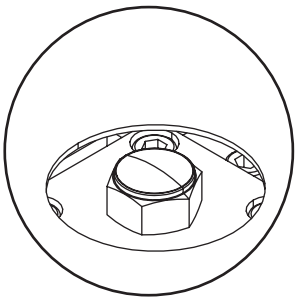
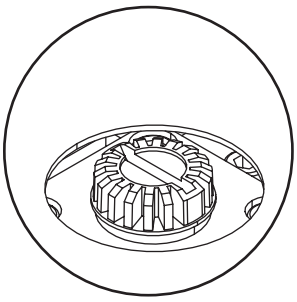
► Apply the **Decommissioning** procedure.

Restart after emergency stop (using the equipment)

The emergency stop is managed by the equipment in which the pump is integrated. To restart the pump after an emergency stop, you must:

1. Correct the problem,
2. Unlock the equipment's emergency stop button.
3. Send a **'RUN'** pump order via the serial link.
   – The pump starts.

6.4 Gas ballast operation

ON/OFF manual gas ballast	Gas ballast with permanent filter	Gas ballast closed with a plug
		

Tbl. 9: Various gas ballast models

The user must take the appropriate measures when pumping condensable vapors or when use of the gas ballast is required. When condensable vapors or moist air are being pumped, gas is compressed beyond its saturated vapor pressure in the compression phase. It can condense, impairing pump performance. The gas ballast can be used to inject a certain quantity of air (neutral or dry gas) into the pump during the 'compression' phase so that the partial pressure of the pumped gas is less than its saturated vapor pressure at the pump's operating temperature. Condensation is therefore impossible if this limit is not reached. The saturated vapor pressure of a body is higher when the system is hot than when it is cold; therefore, the pump must reach operating temperature before pumping condensable vapors. **Using the gas ballast increases the ultimate pressure of the pump as well as the temperature.**

Commissioning

To better pump condensable vapours or moist air, it is necessary to operate with a hot pump. Proceed as follows:

1. Isolate the pump from the system (inlet isolation valve closed) and **allow it to operate for 1 hour with the gas ballast open**.
2. Then, open the isolation valve: the pump operates under the best conditions by reducing the risk of condensation inside the pump.

6.5 Purge operation

A gas purge circuit protects the low- and high-pressure ball bearings.

Commissioning

To operate the purge, there must be a neutral gas supply with the required characteristics (see chapter "Nitrogen characteristics").

When the neutral gas supply is connected to a purge connection:

1. Start the purge according to the recommended flow rate value (see chapter “Technical characteristics”).

Recommendations
See chapter “Matrix gas/applications”.

7 Maintenance

7.1 Maintenance safety instructions

⚠ DANGER

Risk to health posed by residual traces of process gases inside the pump

Process gases are toxic and hazardous to health. They can cause poisoning and be fatal. Before disconnecting the pump, any remaining traces of process gases must be eliminated.

- ► **The equipment (pumping installation) must be purged with a stream of nitrogen for 30 minutes** at the same pressure and flow as that used for the process itself.

⚠ DANGER

Risk of poisoning in case of contact with toxic substances and by-products generated by the process

The vacuum pump, pumping line components and operating fluids **will potentially be contaminated** with toxic, corrosive, reactive and/or radioactive materials related to the process. Any contact with the contaminated parts or by-products generated by the process may be injurious to health and could cause poisoning.

- ► Appropriate protective equipments must be worn when disconnecting the pump for maintenance, filling it with operating fluid, or draining it.
- ► Ventilate the area thoroughly or carry out the maintenance under an extraction hood.
- ► Do not eliminate the by-products/residue via as common waste; have them destroyed by a qualified company where necessary.
- ► **Close off all the ports with airtight blanking plates** (the product comes with blanking plates that are also available for sale as accessories).

⚠ WARNING

Danger of electrocution by contact during maintenance or overhaul

There is an electric shock hazard in case of contact with a product powered on and not electrically isolated.

- ► Before carrying out any work, stop the pump.
- ► Disconnect the power cable from the mains.
- ► Secure the installation correctly by tagging and locking (LO/TO) the system to prevent unintentional re-engagement.

⚠ WARNING

Risk of burns in case of contact with hot surfaces

Component temperature remains high, even after the pump has stopped. There is a risk of burns through contact with hot surfaces, especially at the pump exhaust.

- ► Wait for the product to fully cool down before working on it.
- ► Protective gloves must be worn in accordance with standard EN ISO 21420.

⚠ WARNING

Poisoning risk in case of process gas leakage

When connecting/disconnecting components to/from the pumping line (pump, pipework, valves, etc.) for maintenance, the leak tightness of the installation is broken, potentially causing hazardous process gas leakage.

- ► Always protect the inlet and exhaust surfaces during dismantling.
- ► Perform a leak test on the pumping line after reassembly.

General maintenance recommendations

- Ensure that the maintenance technician is trained in the safety regulations that cover the pumped gases.
- Disconnect the power cable from all sources of power before working on the product.
- Wait 5 minutes after powering off before working on the electrical components.
- Pressurized circuits – nitrogen and water – pose potential energy risks: always lock out these circuits using the LO/TO (Lock Out/Tag Out) procedure before working on the product.
- Route and secure cables, hoses and pipework to guard against falls.
- Collect the residues from the processes and call in a competent organization to dispose of them.
- Always protect the inlet and exhaust flange surfaces.

7.2 Operating time

The pump's operating time is stored by the time counter. The time counter triggers a maintenance alert when the threshold has been reached.

The operating time can be read on the frequency converter display or via the serial link.

Reading on display

The frequency converter displays the operating time in hours. If the value of the hour counter has more digits than is possible to display, then this value is displayed in two stages, alternating between the digits of the thousands and the unit digits (identifiable with the display of the character H).

1. Power on the pump.
   – The frequency converter is in Running mode.
2. Press the **PRG/RESET** key to switch to Programming mode.
   – The functions selection menu appears.
3. Use the **UP** or **DOWN** keys to display *S.CHE* (Maintenance Information).
4. Press the **FUNCT/DATA** key to switch to the maintenance components list.
5. Use the **UP** or **DOWN** keys to display *5_23* (time counter).
   – Display of the cumulative power-up time of the frequency converter (Counter range: 0 to 65,535 hours).
   – When the number of hours exceeds 65,535, the counter resets to zero.
6. Press the **PRG/RESET** key to return to the maintenance components list. Press the key again to return to the menu.

Reading by serial link

► (see chapter "List of variables", page 27)

7.3 Maintenance frequency

Operation	Frequency
Pump overhaul by the Pfeiffer Vacuum service center	24,000 hours or 4 years

The MAINTENANCE indicator, at the rear of the pump, lights up when the 24,000 hours threshold is reached.

Maintenance frequencies are typical values for non corrosive applications. For applications using G version pump, these values can be reduced. Contact our service center (see chapter "Service solutions by Pfeiffer Vacuum", page 42).

No maintenance is generally required before product overhaul in a service center.

How to contact us

Product overhauls must be carried out by personnel with manufacturer training. Contact our nearest service center at the following e-mail address: service.fr@pfeiffer-vacuum.com.

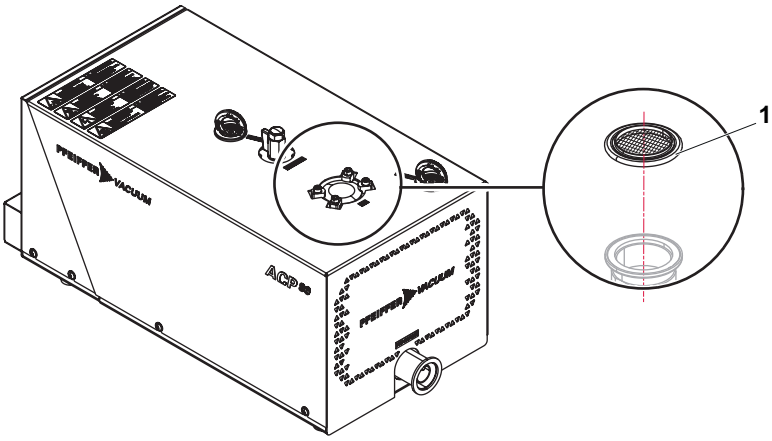
Life-time

Under normal operating conditions (at ambient temperature, low humidity and neutral pumped gas), in a non-polluted environment, a new pump which is regularly maintained according to the instructions in this manual (subject to the components becoming obsolete) **has a life-time greater than 10 years**

7.4 On-site maintenance

The pump does not require any maintenance on the customer's premises other than the day-to-day servicing described in this manual. Any other maintenance operation must be carried out by our service center (see chapter "Service solutions by Pfeiffer Vacuum", page 42).

- ► Clean the outer surfaces of the product using a clean, lint-free cloth and a product that will not damage the screen-printed surfaces and adhesive labels. Do not use organic material.
- ► Remove dust from the air ventilation grids with a cloth. Do not use a compressed air blower.



1 Filter

Cleaning the inlet filter

The pumps are fitted with a filter in the inlet flange. Check the cleanliness of this filter regularly.

1. Disconnect the pump inlet from the pumping line and remove the conical filter.
2. Wash the filter with industrial solvent.
3. Dry it before refitting.

7.5 Exchange procedure for replacement products

To proceed with a standard exchange, key steps must be followed in sequential order:

1. Disconnecting the pump from the installation.
2. Preparing the pump for shipping.
3. Complete the declaration of contamination.
4. Handling the new pump (see chapter "Handling").
5. Installing the new pump (see chapter "Installation").

Familiarize yourself with the service request procedure and fill in the declaration of contamination when returning products to our service centers (see chapter "Service solutions by Pfeiffer Vacuum", page 42).

7.5.1 Disconnecting the pump from the installation

Reminder of the risks and safety measures

- Follow the maintenance safety instructions.
- Apply the specific safety instructions in accordance with local laws; this information is available from the customer's health and safety department.

Procedure

1. Power off the pump by switching off the power supply.
2. Disconnect the power cable at the electrical connector.
3. Disconnect the nitrogen supply and protect the purge port with the plug.
4. Disconnect the pump from the pumping line and blank off the inlet port with the airtight connection accessories.

5. Disconnect the pump from the exhaust and blank off the exhaust port with the airtight connection accessories.
6. Remove the pump from the installation.

7.5.2 Preparing the pump for shipping

After use in clean applications

- Install the connecting accessories provided with the pump on delivery. Contact the service center to order accessories if necessary.
- Connect the cover plug (delivered with the pump) to the remote connector.

After use with traces of corrosive gases

- Respect safety instructions before working on the product.
- Install the connecting accessories to make the pump airtight.
- Connect the cover plug (delivered with the pump) to the remote connector.

Product transport and shipping

For product transport and shipping, pack it in the original packaging and follow the instructions from the Service procedure (see chapter “Service solutions by Pfeiffer Vacuum”, page 42).

8 Decommissioning

8.1 Extended Immobilization

Storage after use

1. Stop the pump.
2. Disconnect the pump from the installation.
3. Seal the pump inlet, exhaust and purge ports with included accessories.
4. Store the pump in a clean, dry, non-polluted area for a maximum of **6 mois** according to the storage temperatures.

Extended storage beyond 6 months after use

Run the pump regularly because factors such as temperature, degree of humidity, salt air, etc. may cause the deterioration of the pump components.

1. Let the pump run for 30 minutes with gas ballast opened or while injecting a dry neutral gas into the pump (G version).
2. Let the pump run for 30 minutes at ultimate pressure (inlet, gas ballast and purge ports closed).
3. Stop the pump.
4. Seal the pump inlet, exhaust and purge ports with included accessories.
5. Repeat this at least **every 6 months**.

Beyond 2 years, the pump must be revised before commissioning.

Return the pump to the service center (see chapter “Service solutions by Pfeiffer Vacuum”, page 42).

8.2 Recommissioning

To restart the pump after a prolonged stop, refer to the installation instructions (see chapter “Installation ”, page 18).

8.3 Disposal

In accordance with directives on the treatment of waste electrical and electronic equipment (WEEE), and concerning the restriction of hazardous substances (RoHS), end-of-life products can be returned to the manufacturer for decontamination and recycling.

The manufacturer shall only be required to take back equipment that is complete and unmodified, using Pfeiffer Vacuum SAS original spare parts, sold by Pfeiffer Vacuum and including all assemblies and sub-assemblies.

This obligation does not cover the shipping cost to a reclamation facility or services provided, for which the customer will be invoiced.

Familiarize yourself with the service request procedure and fill in the declaration of contamination when returning products to our service centers (see chapter “Service solutions by Pfeiffer Vacuum”, page 42).

Environmental protection

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

Our products contain different materials which must be recycled (see chapter “Environmental conditions”). Take particular precautions for:

- fluoroelastomers which may break down if they are exposed to high temperatures,
- potentially contaminated components that have been in contact with products resulting from the processes,

9 Malfunctions

9.1 Faults history

For a fault diagnosis, it is necessary to know the last faults that occurred on the pump. The last 4 alarms are recorded. This history is not cleared when the power is turned off.

It is possible to read the alarms on the frequency converter display or via the serial link.

Reading on display

The frequency converter displays the last 4 alarms. For each fault, the latest information from the frequency converter is recorded (frequency, power, etc.).

1. Power on the pump.
   – The frequency converter is in Running mode.
2. Press the **PRG/RESET** key to switch to Programming mode.
   – The functions selection menu appears.
3. Use the **UP** or **DOWN** keys to display *6AL* (Alarm Information).
4. Press the **FUNCT/DATA** key to switch to the alarm codes list.
5. Use the **UP** or **DOWN** keys to switch from one alarm to the other. They are listed starting with the most recent in the following order 1, 2, 3 and 4.
6. Press the **FUNCT/DATA** key to see the details of the alarm selected.
   – The fault code (for example 6_00) and the information on the frequency converter status (for example the output frequency) at the time of the alarm occurrence alternately appear at approximately 1 second intervals .
   – Use the **UP** or **DOWN** keys to see the details for the next alarm.
7. Press the **PRG/RESET** key to return to the list of alarm codes. Press the key again to return to the menu.

Reading by serial link

Modbus code	Description of the command
0810	M16 Details of the last alarm recorded
0811	M17 Details of the previous M16 alarm
0812	M18 Details of the previous M17 alarm
0813	M19 Details of the previous M18 alarm

► Send the selected hexadecimal command.
   – The response provides the alarm details.

9.2 The pump runs incorrectly

Read the safety instructions for maintenance.

Symptom	Cause	Remedy
Pump runs intermittently	Temperature	• Check the pump ventilation conditions. • Check the ambient temperature.
	The pump supply voltage is not compatible with the equipment's power configuration	• Check that the voltage corresponds to required power voltage.
	Other problem	• **Contact our service center.**
Pump noisy	Gas ballast	• Check if the gas ballast is open. Warning: if the application requires it, the gas ballast must remain open despite the noise!
	The pressure does not go down - leak in the installation	• Check the pressure at the pump inlet.
	Vibration	• Check that the pump is properly attached to the frame.
	Other problem	• **Contact our service center.**

Symptom	Cause	Remedy
Bad ultimate pressure	Gas ballast	• Check if the gas ballast is open. Warning: if the application requires it, the gas ballast must remain open at the expense of the limit pressure!
	Purge (if present)	• Check the purge connection between pump and installation (if the purge is used). • Check the purge input pressure. • Check the tightness of the plug installed on the purge port (if the purge is not used).
	Rotation speed	• Check the setpoint speed.
	Pumping of condensable vapors	• If the application allows it, let the pump run for 30 minutes to 1 hour with the gas ballast open; this removes the condensable vapors. • Check that exhaust pipe line is not clogged.
	Defective measurement gauge	• Check the accuracy of the measurement means.
	Leak in the installation	• Perform a leak test on the pumping line.
	Other problem	• **Contact our service center.**

9.3 The pump does not work

Read the safety instructions for maintenance.

Symptom	Message	Cause	Remedy
The pump does not start and the fan does not run	ECF	The pump supply voltage is not compatible with the equipment's power configuration.	• Check the equipment's voltage corresponds to required power supply. • Stop the pump until the message disappeared. Then, Restart the pump.
		Power failure	• Check the electrical installation and supply voltage. • Stop the pump until the message disappeared. Then, Restart the pump.
		Main cable not correctly connected or damaged	• Check / replace the main power cable. • Stop the pump until the message disappeared. Then, Restart the pump.
		Other problem	• Stop the pump until the message disappeared. Then, Restart the pump. • If the fault persists: **contact our service center.**
The pump does not start but the fan runs	ECF	Temperature	• Check the pump ventilation conditions. • Wait for 1 hour at ambient temperature between 12 °C and 40 °C. The pump must start automatically. • Stop the pump until the message disappeared. Then, Restart the pump. • If the fault persists: **contact our service center.**
		Other problem	• Fan rotation fault: **contact our service center.**
	ERD / OC1 / OC2 / OC3	Other problem	• Stop the pump until the message disappeared. Then, Restart the pump. • If the fault persists: **contact our service center.**

10 Service solutions by Pfeiffer Vacuum

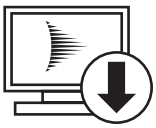
We offer first-class service
High vacuum component service life, in combination with low downtime, are clear expectations that you place on us. We meet your needs with efficient products and outstanding service.

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.

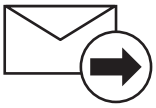
You can obtain advice on the optimal solution for you, from your Pfeiffer Vacuum representative.
For fast and smooth service process handling, we recommend the following:



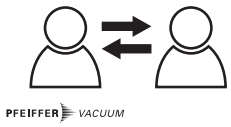
1. Download the up-to-date form templates.
   - Explanations of service requests
   - Service requests
   - Contamination declaration

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.

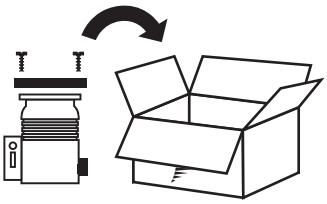


3. Send the forms by email, fax, or post to your local Service Center.

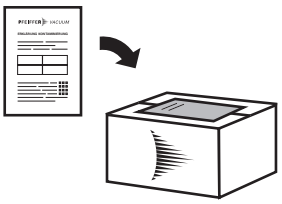


4. You will receive an acknowledgment from Pfeiffer Vacuum.

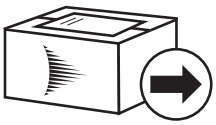
Submission of contaminated products
No microbiological, explosive, or radiologically contaminated products will be accepted. Where products are contaminated, or the contamination declaration is missing, Pfeiffer Vacuum will contact you before starting service work. Depending on the product and degree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



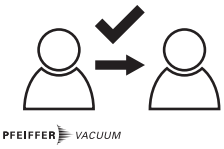
5. Prepare the product for transport in accordance with the provisions in the contamination declaration.
a) Neutralize the product with nitrogen or dry air.
b) Seal all openings with blind flanges, so that they are airtight.
c) Shrink-wrap the product in suitable protective foil.
d) Package the product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

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

11 Technical data and dimensions

11.1 General

Basic principles for the Technical Data of Pfeiffer Vacuum dry compact multi-stage Roots pumps:

- ISO 21360; 2007: “Vacuum technology - Standard methods for measuring vacuum-pump performance - General description”
- Sound pressure level at ultimate pressure according to EN ISO 2151

	mbar	bar	Pa	hPa	kPa	Torr | mm Hg
mbar	1	$1 \cdot 10^{-3}$	100	1	0.1	0.75
bar	1000	1	$1 \cdot 10^{5}$	1000	100	750
Pa	0.01	$1 \cdot 10^{-5}$	1	0.01	$1 \cdot 10^{-3}$	$7.5 \cdot 10^{-3}$
hPa	1	$1 \cdot 10^{-3}$	100	1	0.1	0.75
kPa	10	0.01	1000	10	1	7.5
Torr | mm Hg	1.33	$1.33 \cdot 10^{-3}$	133.32	1.33	0.133	1
1 Pa = 1 N/m^2						

Tbl. 10: 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. 11: Conversion table: Units for gas throughput

11.2 Technical characteristics

Characteristics	ACP 90 SD	ACP 90 G
Inlet flange	DN 40 ISO-KF	
Exhaust flange	DN 40 ISO-KF	
Pumping speed max.	88 m^3/h	
Maximum ultimate pressure: without purge or gas ballast	$3 \cdot 10^{-2}$ hPa	
Maximum ultimate pressure: with gas ballast open	$1.6 \cdot 10^{-1}$ hPa	-
Maximum ultimate pressure: with purge [3]	-	$9 \cdot 10^{-2}$ hPa
Maximum ultimate pressure: with purge [3] and gas ballast open	-	-
Max. pumping capacity of pure water vapor at 20 °C, gas ballast open [2]	2.4 kg/h	2.4 kg/h
Continuous inlet pressure	1013 hPa	
Maximum exhaust pressure	1200 hPa	
N_2 purge flow [3]	-	30 slpm
Gas ballast flow at atmospheric pressure	70 slpm	-
Sound level (gas ballast and purge closed)	< 65 dB(A)	
Max. Helium leak rate [4] [5]	$5 \cdot 10^{-6}$ hPa l/s	
Power supply [1] (according to ordering guide)	200-240 V 1-phase 200-240 V 3-phase 380-480 V 3-phase	
Power consumption at ultimate pressure	1280 W	
Power consumption at atmospheric pressure	1800 – 2000 W	

Characteristics	ACP 90 SD	ACP 90 G
Full load current (200-240 V 1-phase)	16.4 A	
Full load current (200-240 V 3-phase)	13.2 A	
Full load current (380-480 V 3-phase)	8.2 A	
Fan flow	430 m^3/h	
Weight	75 kg	

1) In accordance with IEC/UL/CSA regulations, the pumps can withstand a voltage variation of ± 10 %.
2) At ambient temperature: 20 °C.
3) Inert gas flushing 300 hPa relative pressure.
4) Test by Helium spray.
5) Overall leak test.

11.3 Environmental characteristics

Use	indoor use
Installation altitude	up to 2000 m
Protection rating	IP 20
Ambient operating temperature	12 – 40 °C
Storage temperature	-10 – +60 °C
Maximum relative humidity	max. 80 % with T ≤ 31 °C, up to max. 50 % with T ≤ 40 °C
Transient overvoltage protection	Category II
Pollution degree	2

The materials
Our products contain different materials which must be recycled:

Description	Version SD	Version G
Jet	-	Brass
Purge line	-	Stainless steel
Valves	FPM	
O-rings, lip seals	FPM / NBR / PTFE	
Shaft, spring, inlet filter	Stainless steel	
Stators	Aluminum, aluminum alloy + Al_2O_3 coating	
Screws, worked pins, deflectors	Stainless steel	
Ball bearings	Steel, PFPE grease, oil	
Inlet and exhaust flanges	Aluminum, Stainless steel	

11.4 Nitrogen characteristics

H_2O concentration	< 10 ppm v
O_2 concentration	< 5 ppm v
Dust	< 1 µm
Oil	< 0.1 ppm v
Relative pressure	$2 \cdot 10^3$ to $6 \cdot 10^3$ hPa

Tbl. 12: Nitrogen characteristics

Nitrogen inlet	1/4 BSPT male connector	Stainless steel

Tbl. 13: Nitrogen connector type

11.5 Electrical characteristics

Circuit breaker short circuit cut-off capacity	10 kA
GFI (or RCD) type B, differential circuit breaker compatible with TT electrical networks	30 mA [1)]
1) for TN and IT networks, use appropriate protection measures	

Tbl. 14: Electrical network protection

Mains power supply	**Single-Phase**	**Three-Phase**	
	200-240 V	**200-240 V**	**380-480 V**
Main circuit breaker rating (minimum value)	16 A	13 A	8 A

Tbl. 15: Main circuit breaker rating

Characteristic of the single-phase power supply	
2-phase + earth cable	Cable through hole: ø 22.2 mm Ambient temperature range > 40°C EEC cable compatible with IEC 60227 and IEC 60245 standards.
Supply cable phase wires	AWG14 (2.08 mm^2) with crimp ferrule
Example wire crimp ferrule for phase wire	TYCO - Part number: 1-966067-6 LAPP - Part number: 61801750
Earth wire	≥ AWG14 (2.08 mm^2) with ring terminal for M4 stud
Example of a ring crimp terminal for earth wire	TE connectivity - Part number: 320560 Molex - Part number: 19324-0008

Tbl. 16: Characteristic of the single-phase power supply

Characteristic of the three-phase power supply	
3-phase + earth cable	Cable through hole: ø 22.2 mm Ambient temperature range > 40°C EEC cable compatible with IEC 60227 and IEC 60245 standards.
Supply cable phase wires	AWG14 (2.08 mm^2) with crimp ferrule
Example wire crimp ferrule for phase wire	TYCO - Part number: 1-966067-6 LAPP - Part number: 61801750
Earth wire	≥ AWG14 (2.08 mm^2) with ring terminal for M4 stud
Example of a ring crimp terminal for earth wire	TE connectivity - Part number: 320560 Molex - Part number: 19324-0008

Tbl. 17: Characteristic of the three-phase power supply

11.6 Dimensions

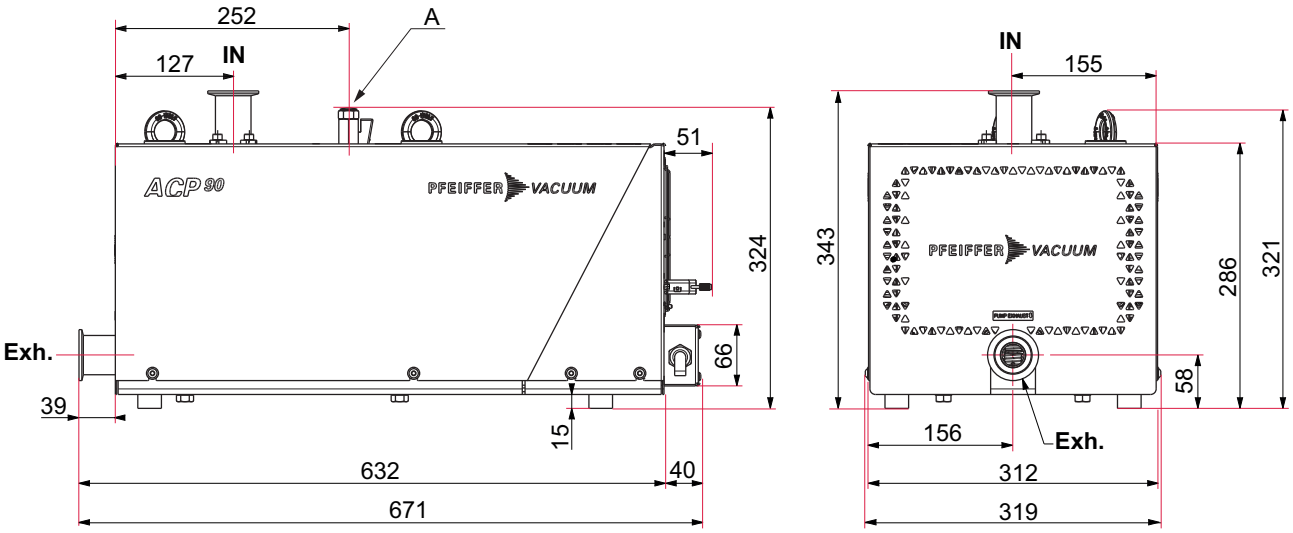


Fig. 6: Dimensions (mm) ACP 90 (version SD / version G)

A 1/4 BSPP purge connection for G version

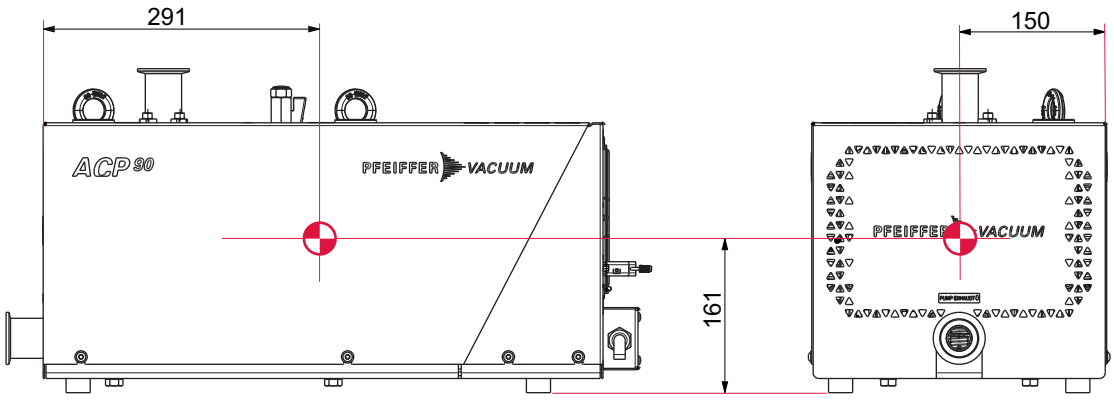


Fig. 7: Position of center of gravity (mm)

Center of gravity

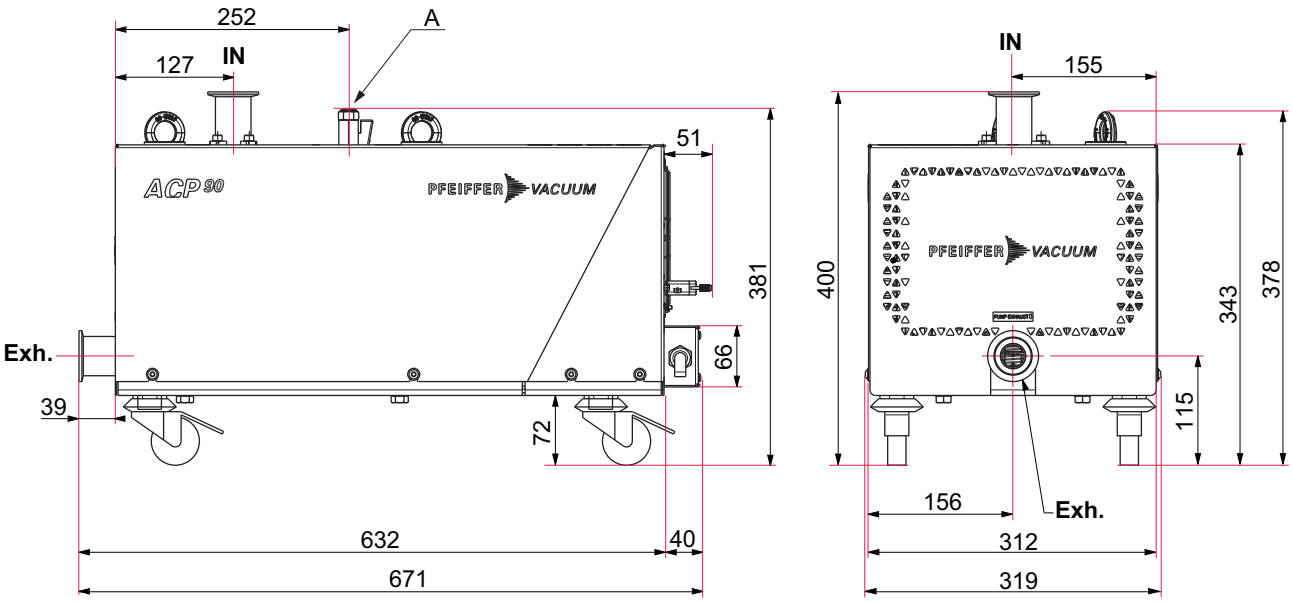


Fig. 8: Dimensions (mm) ACP 90 with casters option

A 1/4 BSPP purge connection for G version

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Total Quality. Assured.

AUTHORIZATION TO MARK

This authorizes the application of the Certification Mark(s) shown below to the models described in the Product(s) Covered section when made in accordance with the conditions set forth in the Certification Agreement and Listing Report. This authorization also applies to multiple listee model(s) identified on the correlation page of the Listing Report.

This document is the property of Intertek Testing Services and is not transferable. The certification mark(s) may be applied only at the location of the Party Authorized To Apply Mark.

Applicant:	Pfeiffer Vacuum SAS	**Manufacturer:**	Pfeiffer Vacuum SAS
Address:	98, avenue de Brogny 74000 Annecy	**Address:**	98, avenue de Brogny 74000 Annecy
Country:	France	**Country:**	France

Party Authorized To Apply Mark: Same as Manufacturer
Report Issuing Office: Intertek Italia SpA

Control Number: *3026716* **Authorized by:** Helen Gustafson

for L. Matthew Snyder, Certification Manager

C ETL LISTED US
Intertek

This document supersedes all previous Authorizations to Mark for the noted Report Number.

Intertek Testing Services NA Inc.
545 East Algonquin Road, Arlington Heights, IL 60005
Telephone 800-345-3851 or 847-439-5667 Fax 312-283-1672

Standard(s):	Electrical Equipment for Measurement, Control, and Laboratory Use; Part 1: General Requirements [UL 61010-1:2012 Ed.3+R:19Jul2019] Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use Part 1: General Requirements [CSA C22.2#61010-1-12:2012 Ed.3+U1;U2;A1]
Product:	Multi-stage Roots pump
Brand Name:	PFEIFFER VACUUM
Models:	ACP 90 followed by SD or G

PFEIFFER VACUUM

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:

Multi-stage Roots Pump, air cooled

ACP 90 SD - ACP 90 G

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

Supply of Machinery (Safety) Regulations 2008

Electromagnetic Compatibility Regulations 2016

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

Applied standards and specifications:

EN 1012-2 + A1: 2009

EN 61010-1: 2011

EN IEC 61000-6-2: 2019

EN IEC 61000-6-4: 2019

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:

Pfeiffer Vacuum SAS
98, avenue de Brogny
74009 Annecy cedex
France
B.P. 2069

(Guillaume Kreziak)
Managing Director

Annecy, 2023/02/20

UK CA

PFEIFFER VACUUM

EC Declaration of Conformity

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

Declaration for product(s) of the type:

Multi-stage Roots Pump, air cooled

ACP 90 SD - ACP 90 G

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

Machinery 2006/42/EC (Annex II, no. 1 A)

Electromagnetic compatibility 2014/30/EU

Restriction of the use of certain hazardous substances 2011/65/EU

Restriction of the use of certain hazardous substances, delegated directive 2015/863/EU

Harmonized standards and national standards and specifications applied:

EN 1012-2 + A1: 2009

EN 61010-1: 2011

EN IEC 61000-6-2: 2019

EN IEC 61000-6-4: 2019

The person authorized to compile the technical file is Mr. Mandallaz Eric, Pfeiffer Vacuum SAS (Simplified joint stock company), 98, avenue de Brogny B.P. 2069, 74009 Annecy cedex.

Signature:

Pfeiffer Vacuum SAS
98, avenue de Brogny
74009 Annecy cedex
France
B.P. 2069

(Guillaume Kreziak)
Managing Director

Annecy, 2023/02/20

CE

PFEIFFER VACUUM

VACUUM SOLUTIONS FROM A SINGLE SOURCE

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

COMPLETE RANGE OF PRODUCTS

From a single component to complex systems:
We are the only supplier of vacuum technology that provides a complete product portfolio.

COMPETENCE IN THEORY AND PRACTICE

Benefit from our know-how and our portfolio of training opportunities!
We support you with your plant layout and provide first-class on-site service worldwide.

Ed 04 - Date 2024/06 - P/N:129048OEN

Are you looking for a perfect vacuum solution? Please contact us

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