



RUVAC WH / WHU 2500 / 4400 / 7000

Roots Booster with Synthetic Oil or PFPE-Filling

Operating instructions 130001398_002_C7

Part Numbers

127440Vxx

127700Vxx

155 250V -

155 273V

155 280V -

155 290V



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You must use this product as described in this manual. Read the manual before you install, operate, or maintain the product. For manual enquiries, email documentation@leybold.com.

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Safety and compliance

1 Safety and compliance

For safe operation from the start, read these instructions carefully before you install or commission the equipment and keep them safe for future use. Read all the safety instructions in this section and the rest of this manual carefully and make sure that you obey these instructions.

The instruction manual is an important safety document that we often deliver digitally. It is your responsibility to keep the instruction manual available and visible while working with the equipment. Please download the digital version of the instruction manual for use on your device or print it if a device will not be available.

1.1 Definition of Warnings and Cautions

Important safety information is highlighted as warning and caution instructions which are defined as follows. Different symbols are used according to the type of hazard.

WARNING:

If you do not obey a warning, there is a risk of injury or death.

CAUTION:

If you do not obey a caution, there is a risk of minor injury, damage to equipment, related equipment or process.

NOTICE:

Information about properties or instructions for an action which, if ignored, will cause damage to the equipment.

We reserve the right to change the design and the stated data. The illustrations are not binding.

1.2 Trained personnel

For the operation of this equipment “trained personnel” are:

- skilled workers with knowledge in the fields of mechanics, electrical engineering, pollution abatement and vacuum technology and
- personnel specially trained for the operation of vacuum pumps

Safety and compliance

1.3 Safety symbols

The safety symbols on the products show the areas where care and attention is necessary.

The safety symbols that we use on the product or in the product documentation have the following meanings:

	Warning/Caution Risk of injury and/or damage to equipment. An appropriate safety instruction must be followed or a potential hazard exists.
	Warning - Automatic start up Risk of injury. The equipment can be started remotely and without warning.
	Warning - Corrosive substances Risk of injury or damage to equipment. Identifies the presence of corrosive gases, liquids or materials.
	Warning - Dangerous voltage Risk of injury. Identifies possible sources of hazardous electrical shock.
	Warning - Heavy object Risk of injury or damage to equipment. Identifies a possible hazard from a heavy object.
	Warning - Hot surfaces Risk of injury. Identifies a surface capable of inflicting burns through contact.
	Warning - Noise hazard Risk of injury. Identifies a possible source of noise above the recommended safe level.
	Warning - Overpressure Risk of increased pressure beyond permissible limit.
	Warning - Risk of explosion Risk of injury or damage to equipment. Identifies a situation that could result in an explosion.
	Warning - Toxic material Risk of injury or damage to the environment. Identifies a source of toxic gases, liquid or material.
	Warning - Wear hearing protection Risk of injury. Wear appropriate hearing protection when performing the task.

Safety and compliance

	Warning - Wear protective gloves Risk of injury. Wear appropriate protective gloves when performing the task.
	Warning - Protective earth (ground) Earth point for electrical equipment.

Important safety information

2 Important safety information

2.1 Mechanical hazards

1. In order to avoid the destruction of systems and injury to operating personnel we urgently recommend to observe the information and installation information provided in these Operating Instructions.
2. Avoid exposing any part of the human body to the vacuum.
3. Do not operate the pump with an opened intake port. There exists the risk of suffering injury. Even during standstill of the RUVAC it is dangerous to grasp into the pump casing. Fingers can easily be squeezed between impellers due to the high inertia of the parts. Please use caution when grasping into the pump and make sure that the pump is secured against unwanted rotation due to differential pressures.
4. The pump is intended for generating a vacuum only. If an overpressure can occur in the pump and the system then they must be protected against such an overpressure by an overpressure safety valve, for example.
5. When using purge gas, protect the purge gas supply so that in the event of a malfunction or power interruption no overpressure can occur within the pump system.
6. For transporting the pump use only suitable transport means. When selecting the lifting and transport means take note of the total weight before transporting the pump. As standard, the pump has been equipped with four crane eyes. When transporting the pump with a forklift or similar, ensure that the pump has been secured on the forks or on a suitable pallet. The lifting eye of the screw pump must never be used to lift any pump combinations (Roots pump and backing pump).
7. Select the location where the pump is installed so that all controls can be easily accessed. Place the pump only on a floor which is level. It can topple when it is tilted by more than 10° with respect to the vertical axis.
8. Before beginning with any maintenance and servicing work always ensure that no gas can flow backwards through the pump since then the rotors might turn against the normal direction of rotation. For this reason vent the vacuum chamber to the discharge pressure level or ensure through suitable valves that the vacuum chamber and the lines are reliably separated from the pump. When connecting several pump systems, pressure differences between intake and discharge can give rise to uncontrolled turning of the pump's shafts.
9. During operation, the cooling water circuit must not be shut off. A cooling water discharge which has been blocked can cause the formation of gas bubbles and result in excessively high pressures.
10. Lay electric feed and cooling water lines so that there is no risk of tripping over these.
11. When changing the oil remove any escaped oil as otherwise there is the risk of slipping.
12. Before doing installation work on the pump system make sure that no vacuum is present in the pump and that all media connections have been depressurised.
13. Before disassembling any cooling water lines, leave the pump to cool down, shut off the feed line.

Important safety information

14. The pumps must only be operated at the permitted speeds. When using frequency converters which have not been specifically approved by us, make sure that effective protection against overspeeding is observed.
15. Should malfunctions affect the pump, seized impellers in particular owing to hard deposits or foreign objects, the occurrence of leaks affecting the housing cannot be ruled out. When pumping hazardous gases the operator must ensure that the possibility of such an incident is excluded, respectively that leaks at the pump casing will not pose a hazard.

2.2 Electrical hazards



WARNING: DANGEROUS VOLTAGES

Risk of electric shock. Potentially lethal voltages are present at the mains connections. Before you begin any maintenance or service work on the pump, disconnect the pump from all power supplies (lockout/tagout). In addition, there is the danger of residual voltage for up to 5 minutes after disconnection. When touching parts at high electric voltages, there is the risk of suffering severe injuries by an electric shock. Covers marked with this symbol must only be opened by trained electricians after having reliably de-energised (lockout/tagout) the equipment.

1. The electrical connection must only be provided by a trained person. Please observe the national regulations in the country of use like EN 50110-1 for Europe, for example.
2. Install a device for a safe disconnection from the power supply.
3. Note the information on the IP type of protection.
4. Always operate the pump with a properly connected protective earth conductor and make sure that the motor casing is closed.
5. Observe the manufacturer's information and operating instructions for the respective frequency converter.
6. The pump must only be operated at the frequency specified for the motor. For the WH 2500 use only our frequency converter.
7. For pumps with an external frequency converter after having connected the motor and each time after having made changes to the wiring, check the motor's direction of rotation.
A wrong direction of rotation can cause a pressure buildup on the intake side. Moreover, the pump may suffer severe damage.
8. Install a suitable motor protection for the electric motor before starting up for the first time. Note the information in these operating instructions and on the nameplate.
The motor protection switch must be suitable for IE3. To handle high current factors >9 during initial pump start a class 30 motor protection is recommended.
9. Before starting, check to ensure that the junction box is undamaged, run a visual inspection on the seals.
10. Install add-on parts (pressure switches, for example) without any mechanical tensions and protect these against being damaged by impacts, for example.
11. Lay the connecting lines so that these cannot be damaged. Protect the lines against humidity and contact with water. Avoid thermally stressing the lines by unfavourable laying. Comply with the required standards when designing and laying the electrical connections.

Important safety information

12. Provide strain relief for the connecting lines so that the plugs and the line connectors are not subjected to excessively high mechanical stresses.
13. Lay electric lines so that there is no risk of tripping over these.
14. For models with external frequency converter only:
Consider the following precautions for the output circuit wiring.
Do not connect any other load than a 3 phase motor to the frequency converters output. Never connect a power source to the frequency converters output. Never short or ground the output terminals. Do not use phase correction capacitors.
15. The pump must be integrated in the system control arrangement so that it can not run-up automatically after it has been shut down due to overtemperature. This applies equally to emergency shut-down arrangements. After having determined the fault cause, the pump should be switched on manually again.
16. Work on the frequency converter within the motor casing must always be left to suitably instructed personnel only.

2.3 Thermal hazards



WARNING: HOT SURFACE

Risk of burns. During operation the pump is hot and some surfaces can reach a temperature higher than 80 °C. Note the danger symbols on the pump and in the case of a hot pump wear the appropriate Personal Protection Equipment (PPE). If there is the risk of touching hot surfaces inadvertently, install corresponding protection. This protection must be constructed in such a way that it can only be removed with tools. When working on a pump which is still warm from operation, always wear protective gloves.

-
1. Handle the pump only while vented and after having let it cool down.
 2. Before disassembling any cooling water lines, leave the pump to cool down first, then shut off the feed line.
 3. When uninstalling the cooling water lines, take note of splashing water. Heated water can cause burns.
 4. Never remove the oil-fill or oil-drain plugs while the pump is running. There exists the risk of suffering burns. Always wear protective gloves and protective goggles also for protection against the oil.
 5. Operating the pump with less than the specified amount of cooling water will result in excessively high surface temperatures which can damage the pump. Moreover, there exists the risk of suffering burns.

2.4 Hazards caused by materials and substances



WARNING: HAZARDOUS GASES

Risk of injury or damage to the equipment. The vacuum line and the exhaust line must be leak tight. Hazardous process gases may escape or the pumped gases can react with air or atmospheric humidity. After installation of the pump and after servicing work on the vacuum system, a leak search will always be necessary. When pumping hazardous gases we recommend a leak search on a regular basis. Leaks in the pump cannot be ruled out under all circumstances. When pumping hazardous gases, the operator must make sure that leaks at the pump will not be a hazard.

Important safety information



WARNING: CONTAMINATION HAZARD

Risk of exposure. Contaminated parts can be detrimental to health and the environment. Before beginning with any repair and maintenance work inform yourself about any possible contamination. When handling contaminated parts observe the pertinent regulations and comply with the necessary protection measures. If the pump has been contaminated by the process or through environmental influences, it must be decontaminated professionally. When shipping contaminated pumps which require approval by the authorities, note the applicable regulations regarding packaging and shipping.

The cooling water from the return is not of drinking water quality and should not be used for this purpose. After having operated the pump, the cooling water lines may suffer from microbiological contamination. Take appropriate safety precautions.

1. Since not all application related hazards for vacuum systems can be described in detail in these Operating Instructions, We have made available a separate document (safety booklet) in which the hazards and general safety concepts for design, operation and maintenance of vacuum systems are explained.
When planning to pump hazardous substances with this pump, read the related chapters in the Safety Booklet and in these Operating Instructions first. You can download the Safety Booklet from our homepage.
2. Before commissioning the pump, make sure that the media which are to be pumped are compatible with each other so as to avoid hazardous situations.
3. If required additional monitoring of the purge gas quantities is necessary from the side of the operator when a well-defined and ensured dilution is necessary from the side of the process.
The type of protection depends on the specific process and needs to be assessed by of the customer.
4. When the pump has been used to pump hazardous gases before, introduce appropriate safety precautions before opening the intake or the discharge connections. Before opening the pump, purge it for a longer period of time with an inert gas. If necessary, wear suitable personal protection equipment like gloves, breathing protection and protection clothing, for example (see material safety data sheets for the substances in use, the chemical reactions and the by-products). Firmly seal off the pump. When shipping the contaminated pump for servicing, indicate the type of hazard. For this refer to [Service](#) on page 81.
5. We are not in a position to perform servicing (repairs) and waste disposal of radioactively contaminated pumps. Both needs to be ensured from the side of the user.
6. When disposing of the pump, used lubricants and used oil filters, observe the applicable environment regulations.
7. When pumping hazardous gases you must assume the presence of hazardous residues in the pump.

Important safety information

8. Some pumps use perfluoropolyether (PFPE) as lubricant. When handling **(PFPE)** you should observe the following. During thermal decomposition at temperatures over 290 °C toxic and corrosive gases are released. When handling PFPE keep it away from open fires. Do **not smoke** with PFPE on your fingers.

Touch the inner sections of the pumps only while wearing clean gloves, and use clean tools;

do the necessary work in clean and dry rooms;

after having removed the pump from its packaging, start it up as quickly as possible;

as cleaning agents, solvents, based on hydrofluorether compounds may be used.

9. Fluoropolymers are used as sealants (FKM) and as lubricants (PFPE) in the pumps. In case the pump suffers a severe mechanical failure, the possibility of hazardous substances being released owing to their thermal decomposition cannot be excluded. The hazards caused by such decomposition are described in the Material Safety Data Sheets for the materials, for example.

2.5 Ignition risk

1. The standard version of the pump is not suited for operation in explosion hazard areas. Contact us before planning to use the pump under such circumstances.
2. Before pumping oxygen (or other highly reactive gases) at concentrations exceeding the concentration in the atmosphere (> 21 % for oxygen) it will be necessary to use a special pump. Such a pump will have to be modified and degreased, and an inert special lubricant (like PFPE) must be used.

2.6 Noise hazard

1. The noise level produced by the RUVAC is between 63 and 75 dB(A). When operating the pump temporarily at pressures above 100 mbar the noise level can be much higher. Make sure that suitable protection measures are taken to protect your hearing.
2. When the pump is being started with open flanges, a noise level which is detrimental to health will be produced. If such operation is unavoidable, then it is mandatory to wear hearing protectors (ear muffs).

2.7 Dangers in connection with safety-related measures and precautions



WARNING: AUTOMATIC RESTART

Risk of injury and damage to the equipment. For the pumps being operated with a frequency converter, after a mains power failure the pump will automatically start up again once the power returns.

1. The pump is not equipped with an emergency shutdown facility.
2. Take note of the warning information on the casing surface. If this warning information was removed, covered or obstructed, then provide corresponding additional warning information.

Important safety information

2.8 Danger of pump damage

1. Select an installation site for the pump so that all controls are easily accessible.
2. With the pump filled with oil it must be placed such that it will deviate by no more than 2° from the vertical axis as otherwise oil can enter into the sealing system.

WH/WHU 4400 and 7000: Before filling the pump with oil, align it. Transporting the pump filled with oil is not permissible.

WH/WHU 2500: The pumps are supplied filled with oil. For this reason they should, while being transported or shipped, not be subjected to much tilting.

3. Do not allow the ingestion of any objects (screws, welding beads, nuts, washers, pieces of wire, etc.) through the intake port of the pump.

Use the intake screen which has been fitted as standard to prevent ingestion of objects during commissioning, after this it must be removed. This will allow full vacuum performance to be achieved and will eliminate the risk that a damaged intake screen could enter the pump inlet.

Objects falling into the pump can cause severe damage to the pump including leaks to atmosphere; therefore the design of the pipework and vacuum chamber should prevent this possibility. For more detail consult our Safety Booklet.

The intake screen does not replace a filter. Prevent the intake of particles by fitting suitable filters or traps.

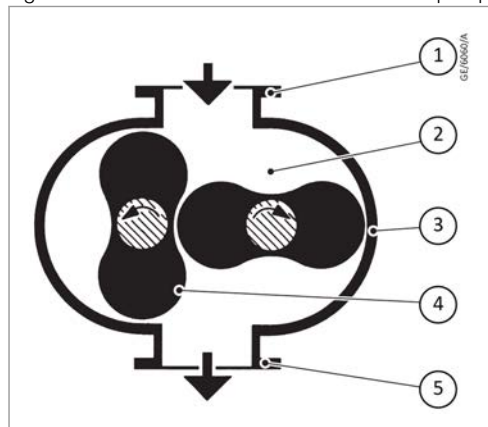
4. When pumping dust containing media, install a dust filter in the process gas flow upstream with respect to the pump.
5. When connecting the pump, provide a suitable valve on the intake side for the purpose of shutting off the intake line so as to prevent the pump from turning backwards in the event of a power failure. Otherwise the pump may suffer damage or oil may contaminate the pump chamber.
6. Lines and other vacuum connections should be clean and free of oil. Special attention must be paid here when oil-sealed pumps have been used on the vacuum side. Check the conditions before initial commissioning. In the case of deviations, the pump can suffer contamination with oil residues.
7. The discharge line should be laid so that it slopes down and away from the pump so as to prevent condensed vapours from backstreaming into the pump.
8. In the case of wet processes we recommend the installation of liquid separators, upstream and downstream of the pump so as to avoid the influx of liquid into the pump. During installation work on the intake and discharge lines do not subject flanges to any stresses. Check the rubber elements of the pump's feet as to any deformation.
9. Before pumping condensable vapours the pump should be at operating temperature. If a gas ballast is present, then it should be opened. The pump will attain its operating temperature approximately 30 minutes after having started the pump. During this warm-up phase, the pump should be left separated from the process by a valve in the intake line, for example.
10. With the pump warm from operation do not clean it from the outside with water. There is the risk of a rotor crash due to shock cooling.

Important safety information

11. If condensable vapours have been pumped, the pump should before switching off be purged for about 15 minutes with an inert gas or air (depending on the specific application). This process should also be run before cleaning the pump chamber.
12. For shutting down the pump let the pump operate idle for at least 30 minutes. Disconnect the pump from the mains power. Place desiccant into the intake flange and into the discharge flange and blank off the flanges with a piece of foil.
When storing the pump for a longer period of time, drain out the oil first. Package the pump airtight in polyethylene foil.
13. Improper maintenance or repair work can have an influence on the service life and the performance of the pump and will void any warranty claims.
14. Maximum cooling water pressure 6 bar. When exceeded, there is the risk of leaks.
15. The pump must only be operated at ambient temperatures between 10 and 40 or 50 °C. The thermal radiation produced by the pump must be removed to a sufficient extent. If for whatever reason the pump needs to be operated at higher ambient temperatures, then reduced maximum pressure differences apply (derating). For operation under such conditions consult us.
16. In order to prevent the transfer of vibrations from the RUVAC to other system components which have been connected, we recommend fitting of corrugated hoses respectively compensators on the intake and the discharge side.
17. Do not operate the RUVAC WH/WHU in connection with backing pumps where an ultimate pressure exceeding 10 mbar is specified. This will prevent excessively high temperatures when the RUVAC is running idle.
18. The ingress of particles and liquids must be avoided under all circumstances.

Pressures stated in bar or mbar are absolute pressures, except something else is expressly mentioned (for example, bar(g))

Figure 1. Schematic cross-section of a Roots pump (vertical flow)



- | | |
|---------------------|--------------------|
| 1. Intake flange | 2. Pumping chamber |
| 3. Casing | 4. Impeller |
| 5. Discharge flange | |

3 Description

3.1 Design and function

The RUVAC WH and RUVAC WHU are Roots boosters driven by water cooled hermetically sealed motors.

The WHU types have a pressure balance line between the discharge and intake flanges.

The RUVAC WH and WHU are lubricated with synthetic oil or perfluorized polyether (PFPE).

Only specially prepared RUVAC WH/WHU PFPE pumps can be used for pumping oxygen greater than atmospheric concentration.

Only RUVAC WH/WHU PFPE pumps can be used for pumping very aggressive or hazardous gases. In these cases it is imperative that you consult our local office.

The RUVAC WH/WHU 2500 can pump gas in the vertical direction, the RUVAC WH/WHU 4400 und 7000 in the vertical or horizontal direction.

Although the pumping chamber of Roots pumps is in principle free of sealing agents and lubricants, the two gearwheels of the synchromesh gearing and the bearings are lubricated with synthetic oil or with PFPE. The two bearing chambers are separated from the pumping chamber by the impeller seals.

The RUVACs are driven by a water cooled hermetically sealed motor. The hermetically sealed motor runs completely under vacuum and is sealed against atmosphere. Thus a shaft feedthrough to the atmosphere is not needed.

With the standard motors, the RUVAC WH/WHU 4400/7000 can run on either 50 Hz or 60 Hz power supplies or with an appropriate frequency converter. The RUVAC WH/WHU 2500 are available with motors for 50 Hz or 60 Hz power supplies or with internal or external frequency converter.

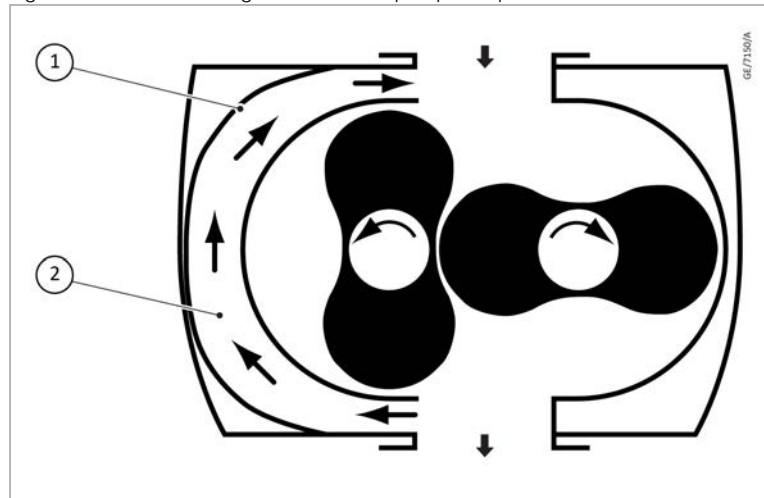
RUVAC WH/WHU pumps are water cooled by cooling water tubes integrated into the motor casing and the gearbox cover. A connection tube allows the cooling water to flow through both housing parts.

Built into the stator coil of the motor is a temperature switch (PTO) and a PTC that have to be analysed when the motor is not operated in connection with a frequency converter so as to shut down the pump should the motor overheat.

In the case of RUVAC WH pumps equipped with a frequency converter from us, the frequency converter has been set up through pre-defined parameters for the purpose of protecting the pump. The built-in pump temperature sensor can be connected providing additional protection against thermally overloading the pump.

Description

Figure 2. Schematic diagram of a Roots pump with pressure balance line



1. Pressure balance valve

2. Pressure balance line (bypass line)

Pressure balance line (bypass line)

The RUVAC WHU has an integrated pressure balance line. It links the discharge and intake flanges via a pressure balance valve. The valve is spring loaded. It works with both vertical and horizontal flow of the pump.

If the differential pressure between the flanges is too large, the valve opens. Some of the gas which has already been pumped flows back through the line to the intake flange.

The RUVAC WHU pumps are optimised for fast atmospheric cycling. They should be used in combination with a suitable roughing pump to achieve short pumpdown times for example in load lock applications. The RUVAC WHU pumps can be switched on together with a backing pump at atmospheric pressure. Thus the pumping speed of the pump combination is increased also at high intake pressures.

Note:

The pressure balance valve will not protect the pump from thermal overload if opened continuously.

3.1.1 Lubricants

RUVAC WH/WHU pumps described here are, as standard, prepared either for operation with synthetic oil or the special lubricant perfluoropolyether (PFPE). Other types of oil (white oil, for example) upon request.

Note:

If synthetic oil and PFPE come into contact with each other they will emulsify. That's why the pumps must only be run with the type of lubricant specified for the pump. If you want to change the type of lubricant contact us.

3.2 Standard specification

RUVAC WH/WHU are supplied for vertical flow.

WH/WHU 4400 and 7000: Before delivery the oil has been drained out. The quantity of synthetic oil or PFPE which is required for operation, is supplied separately with the pump.

WH/WHU 2500: The pumps are filled with synthetic oil or PFPE.

All pumps are equipped with an intake screen in their intake flange and have been vented with nitrogen to protect the pump against corrosion. The flanges have been sealed off with adhesive foil.

The RUVAC WH 2500 pumps with an internal frequency converter are supplied together with the frequency converter. RUVAC 2500 pumps intended for operation with an external frequency converter are supplied without the frequency converter but with a 30 m long connecting cable for the built-in Pt 1000 temperature sensor.

3.3 Conforming utilisation

The pumps are vacuum pumps which in connection with suitable backing pumps are capable of pumping gases and vapours.

They are used to increase the pumping speed of backing pumps below 10-100 mbar by a very significant factor or for the purpose of attaining a lower ultimate pressure.

Alternatively the RUVAC vacuum pumps may be used to pump gases in closed circuits provided the permissible pressure differences are not exceeded and provided the absolute pressure within the circuit does not exceed 1.2 bar.

Accessories which have not been specified by us should only be used after approval by us.

3.3.1 Non-conforming utilisation



WARNING: NON-CONFORMING UTILISATION OF PUMP

Risk of injury and damage to equipment. Any non-conforming utilisation of pump, frequency converter and accessories can result in severe injury or death and cause damage to components.

Non-conforming utilisations for the pump are among others:

- Pumping of gases and vapours for which the materials of the pump are not suited.
- Pumping of condensable vapours without adequately controlling the temperature of the pump. Upon compression in the pump, these vapours may condense or form deposits.
- Pumping of dusts and solids without suitable traps and filters.
- Pumping of liquids.
- Pumping of ignitable gas mixtures.
- Operation at an impermissibly high differential pressures.
- Pumping of process gases which form hard or sticky deposits which may cause the pump to seize.
- The use of pump and frequency converter in the explosion hazard areas.
- Non-compliance with the described maintenance and service intervals.
- Use in systems and pump systems in which the exhaust pressure may increase over 1.2 bar(a).
- Operation with an inadequately affixed pump.
- Operation without suitable backing pump.
- Operation at impermissibly high gas temperatures.
- Use in systems where pump, frequency converter and cables are subjected to impact stresses.

Description

- Operation on movable systems or system components (locks or mobile pump systems).
- Use of pump, fitted ad-on components, drive electronics, flanges and cables to climb onto the system.
- Removing, covering or obstructing warning notices.
- Standstill or storing of pump and drive electronics without suitable sealing and drying. When stored in a humid atmosphere corrosion can occur.
- Conversions, manipulations and maintenance work by persons not authorised by us.

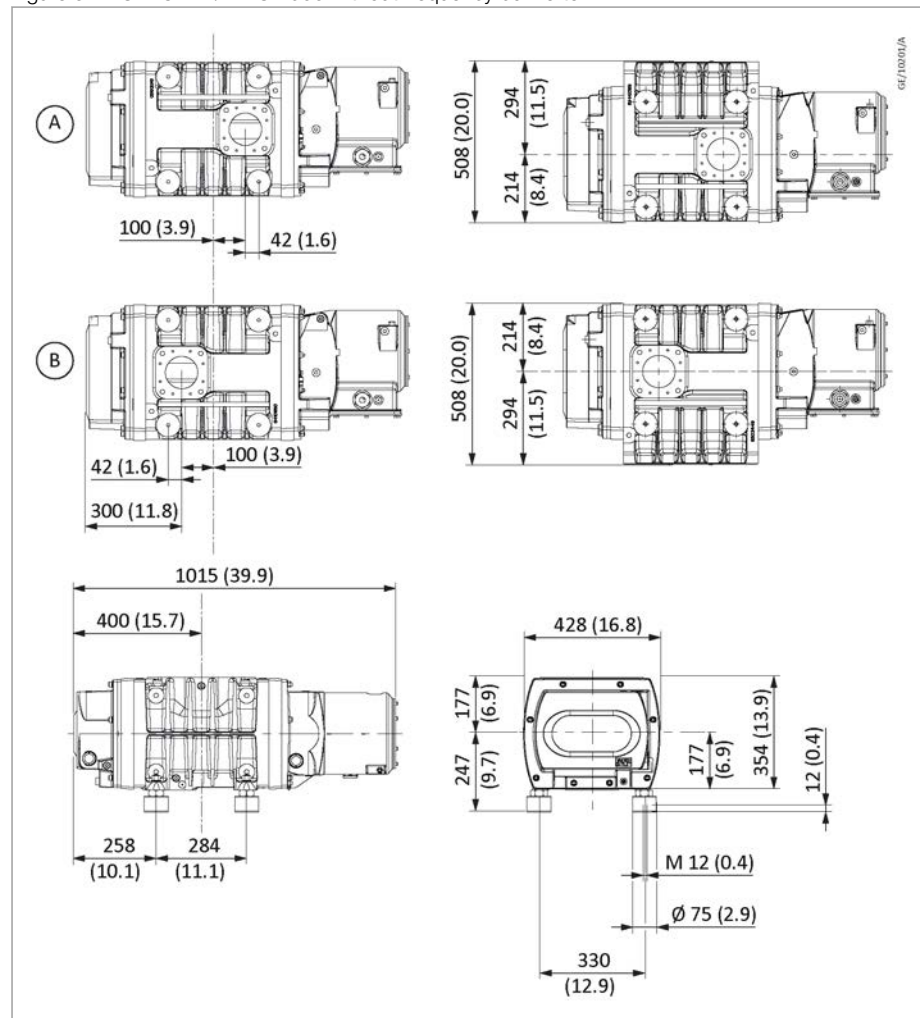
3.4 Dimension drawings



Note:

All dimensions given are in mm (inch).

Figure 3. RUVAC WH/WHU 2500 without frequency converter

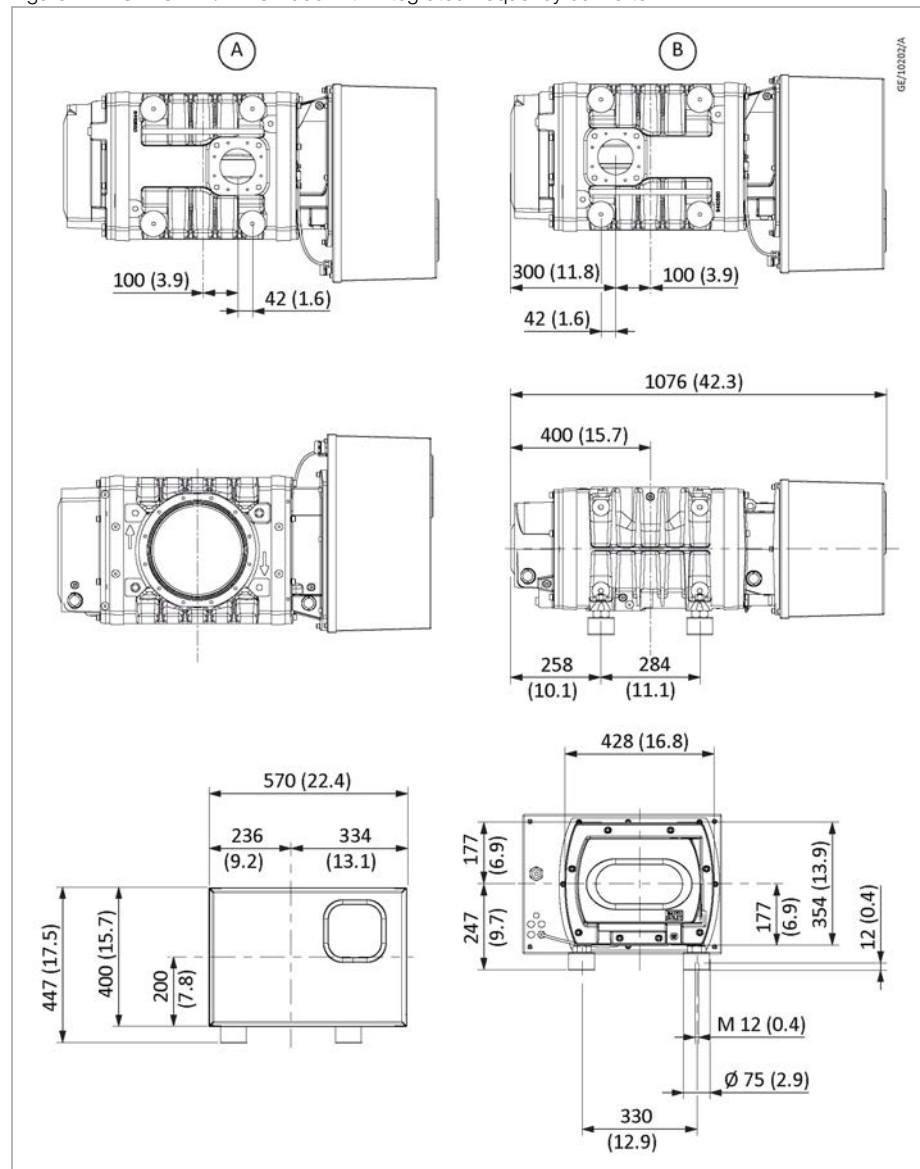


A. Version with discharge flange on the motor side

B. Version with discharge flange on the gear side

Description

Figure 4. RUVAC WH/WHU 2500 with integrated frequency converter

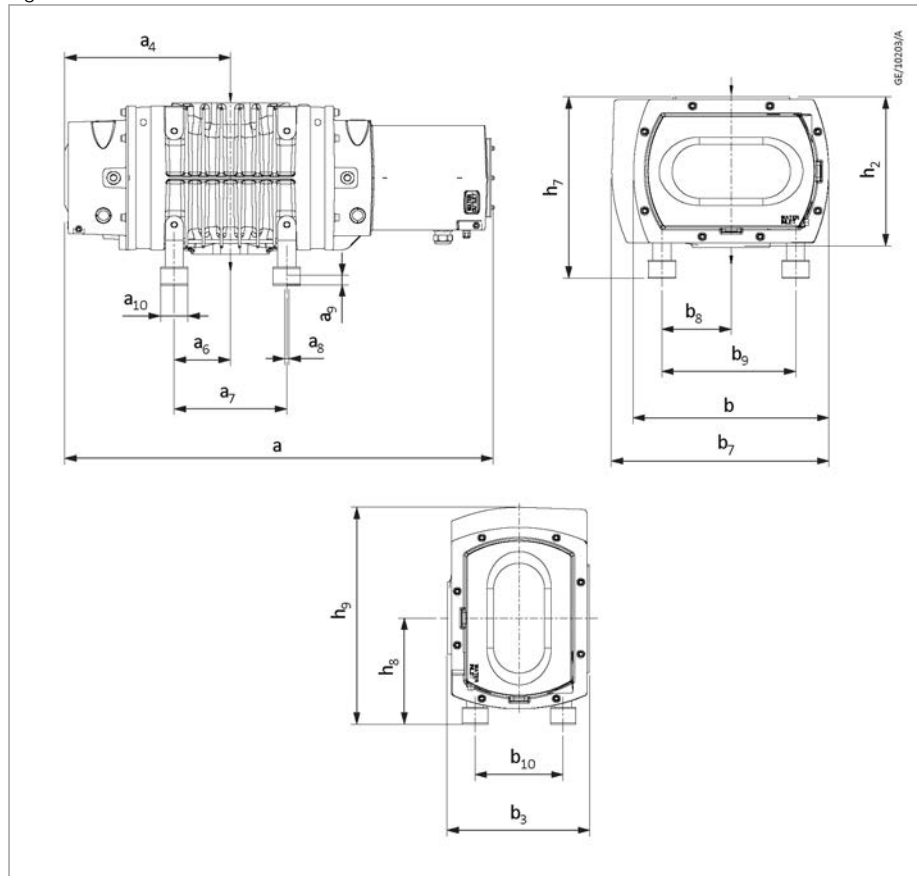


A. Version with discharge flange on the motor side

B. Version with discharge flange on the gear side

Description

Figure 5. RUVAC WH/WHU 4400 and 7000

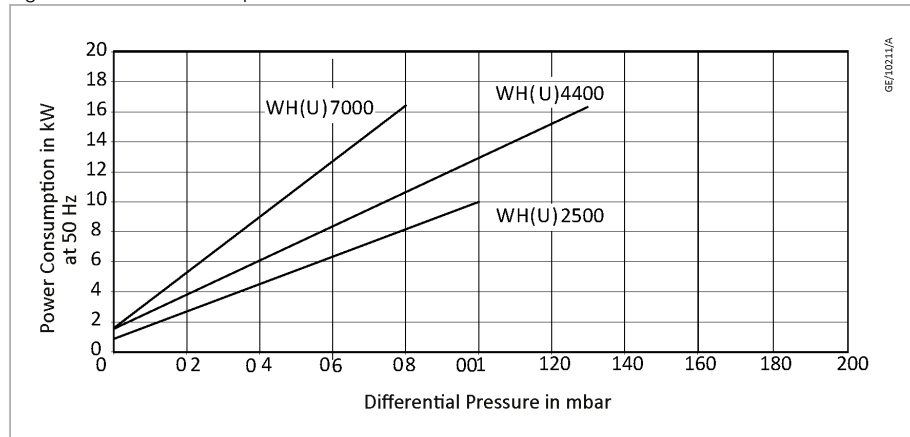


Pump	Unit	Intake flange	Discharge flange	a	a ₄	a ₆	a ₇	a ₈	a ₉	a ₁₀
WH 4400	mm	DN 250 ISO-K	DN 160 ISO-K	1183	457	155	310	M12	12	Ø 75
WHU 4400	mm	DN 250 ISO-K	DN 160 ISO-K	1183	457	155	310	M12	12	Ø 75
WH 7000	mm	DN 320 ISO-K	DN 160 ISO-K	1433	582	280	560	M12	12	Ø 75
WHU 7000	mm	DN 320 ISO-K	DN 160 ISO-K	1433	582	280	560	M12	12	Ø 75

Pump	Unit	b	b ₃	b ₇	b ₈	b ₉	b ₁₀	h ₂	h ₇	h ₈	h ₉
WH 4400	mm	540	419	-	155	310	260	414	505	315	645
WHU 4400	mm	540	419	600	238	393	260	416	505	315	645
WH 7000	mm	540	419	-	155	310	260	414	505	315	645
WHU 7000	mm	540	419	600	238	393	260	416	505	315	645

Description

Figure 6. Power consumption of the RUVAC WH/WHU



Technical data

4 Technical data

Table 1 Technical data for RUVAC WH/WHU 2500

RUVAC WH/WHU 2500	Unit	50 Hz	60 Hz	80 Hz	100 Hz	Tolerance
Nominal pumping speed according to DIN 28426	m ³ h ⁻¹	2500	3000	4000	5000	
Maximum. effective pumping speed with SP 630 backing pump	m ³ h ⁻¹	2200	2500	3200	3900	± 5 %
Maximum permissible pressure difference WH for continuous operation ¹⁾ WHU for short cycle operation < 2 minutes	mbar mbar	50-75 90	40-60 90	30-40	20	
Leak rate	mbar. l. s ⁻¹	1x10 ⁻⁵				
Permissible ambient temperature ²⁾	°C	10 - 50				
Storage temperature	°C	-10 to + 60				
Pollution degree		2				
Overvoltage category		III				
Nominal voltage						
WH with frequency converter	V	380 - 460	380 - 460			± 10%
	V	200 - 240	200 - 240			
WH/WHU with direct mains power connection	V	400	400 - 460			± 10%
		200	210			
Nominal power rating						
WH with frequency converter	kW	11	11	11	11	± 0.8 kW
WH/WHU with direct mains power connection	kW	6.2	7.4	-	-	
Power consumption at operation with frequency converter	kW	< 6				
Nominal current for 400/460 V						
WH with frequency converter	A	20	17	-		
WH/WHU with direct mains power connection	A	11.6	11.6			
Nominal current for 200/210 V						
WH with frequency converter	A	41	41	-		
WH/WHU with direct mains power connection	A	23.2	25			
Idle power consumption	kW	1.1	1.3	1.5	1.7	± 0.3 kW
Motor efficiency class Calculated and configured according to EN 60034-30		For 2500: IE2				
Mains fusing/characteristic ³⁾	A	32 /C (50 /C)	for 400/460 V (200/210 V)			

Technical data

RUVAC WH/WHU 2500	Unit	50 Hz	60 Hz	80 Hz	100 Hz	Tolerance
Short-circuit interrupting capacity	kA	< 10 for WH 2500 < 25 for WHU 2500				
Nominal speed	rpm	3000	3600	4800	6000	
Maximum permissible speed ⁴⁾						
WHU	rpm	3600				
WH without frequency converter	rpm	3600				
WH with frequency converter	rpm	6000				
Protection class according to EN 60529/ NEMA						
with internal frequency converter		IP 54/Type 1 (UL 50E)				
with external or no frequency converter		IP 55/Type 1 (UL 50E)				
Cooling water		Refer to Connect the cooling water on page 39				
Lubricant filling	l	1.2				
Connecting flange inlet/discharge	DN	250 ISO-K / 100 ISO-K				
Materials (components in contact with gas in the pump chamber)		Grey cast iron/graphite cast iron/FKM/steel/stainless steel/epoxy paint				
Weight						
WH without/with frequency converter	kg	390 / 430				
WHU without frequency converter	kg	410				
Noise level according to DIN EN ISO 2151	dB (A)	< 63 ⁵⁾				K _{pA} = 3 dB

1) The permissible pressure differences are dependent on various factors.

2) Higher ambient temperatures are possible with reduced operating limits (derating).
Consult us for details.

3) Circuit breaker capacity for operation with frequency converter.

4) Minimum permissible speed for operation over a period of over 1 h: 1200 rpm

5) Valid for 50 Hz operation under ultimate pressure conditions. Higher rotational speeds
and especially pressure levels above 10 mbar will result in higher noise levels.

Table 2 Technical data for RUVAC WH/WHU

RUVAC WH/WHU	Unit	4400	4400	4400	7000	7000	7000
		50 Hz	60 Hz	80 Hz	50 Hz	60 Hz	70 Hz
Nominal pumping speed according. to DIN 28426	m ³ h ⁻¹	4400	5280	7040	7000	8400	9800
Maximum effective pumping speed with SP 630 backing pump (+ RUVAC WS 2001)	m ³ h ⁻¹	3300	3900	4800	4700	5300	5800
		(3700)	(4400)	(5800)	(5700)	(6800)	(7800)
Maximum permissible pressure difference WH for continuous operation ¹⁾	mbar	30 - 45	20 - 30	8 - 12	20 - 30	14 - 21	11 - 14
WHU for short cycle operation < 2 minutes	mbar	90	90	–	70	70	–

Technical data

RUVAC WH/WHU	Unit	4400	4400	4400	7000	7000	7000
		50 Hz	60 Hz	80 Hz	50 Hz	60 Hz	70 Hz
Leak rate	mbar. l. s ⁻¹	1x10 ⁻⁵					
Permissible ambient temperature	°C	10 - 40 ⁴⁾					
Storage temperature	°C	-10 to + 60					
Pollution degree		2					
Overvoltage category		III					
Mains voltage	V	400 (200) ²⁾	460 (230) ²⁾	-	400 (200) ²⁾	460 (230) ²⁾	-
Rated power consumption	kW	11 / 18.5					
Power consumption at operation with frequency converter	kW	< 6					
Nominal current for 400/460 V (200/230 V) with 11 kW motor	A	20 (41.3)	17.4 (36.4)		20 (41.3)	17.4 (36.4)	
with 18.5 kW motor	A	33.6	28.6		33.6	28.6	
Idle power consumption	kW	0.7	0.8	1.0	0.9	1.0	1.2
Nominal speed	rpm	3000	3600	4800	3000	3600	4200
Maximum permissible speed ³⁾	rpm	4800	4800	4800	4200	4200	4200
Motor efficiency class calculated and configured according to EN 60034-30		IE3 ⁶⁾					
Connecting cable cross-selection, maximum (drive) 400 V 11 kW 400 V 18 kW 200 V 11 kW	mm ²	10 16 (Input), 10 (Output) 25					
Protection class according to EN 60529/ NEMA		IP 55/Type 1 (UL 50E)					
Cooling water		Refer to Connect the cooling water on page 39					
Lubricant filling (vertical/horizontal)	L	4.75 / 1.8					
Connecting flange Intake	DN	250 ISO-K	250 ISO-K	250 ISO-K	320 ISO-K	320 ISO-K	320 ISO-K
Discharge	DN	160 ISO-K					
Materials (components in contact with gas in the pump chamber)		Grey cast iron/graphite cast iron/FKM/steel/stainless steel/epoxy paint					

Technical data

RUVAC WH/WHU	Unit	4400	4400	4400	7000	7000	7000
		50 Hz	60 Hz	80 Hz	50 Hz	60 Hz	70 Hz
Weight WH / WHU	kg	590/620			650/700		
Noise level according. to DIN EN ISO 2151	dB (A)	< 63 ⁵⁾					

1) The permissible pressure differences are dependent on various factors.

2) $\pm 10\%$, 200 V voltage range option available for the 11 kW motor.

3) Minimum permissible speed: 1200 rpm for operation over a period of over one hour

4) Higher ambient temperatures are permissible in consideration of reduced operating limits (derating). For details consult us.

5) Valid for 50 Hz operation under ultimate pressure conditions. Higher rotational speeds and especially pressure levels above 10 mbar will result in higher noise levels.

6) IE3 equivalent motors

4.1 Maximum pressure difference

The maximum differential pressure at which the RUVAC can be operated at is limited by two factors:

1. The installed motor power
2. The thermal limitations of the pump

The installed motor power must not be exceeded by more than a few minutes, which results in a fixed limit in differential pressure.

The thermal limits of the RUVAC can be exceeded for a limited time if this is followed by a period of time that allows it to recover at a rather low pressure.

The percentage of time within a repeating cycle for which the RUVAC is operated at high differential pressure is called the duty cycle.

If the duty cycle is for example 25%, the pump runs at high differential pressure for a time period of 1 minute followed by a time period 3 minutes at a discharge pressure of less than 1 mbar. If a cycle time of 40 minutes is exceeded, the pump has to be considered in continuous operation.

Further factors can influence the maximum differential pressure as for example the pump ratio, the rotational speed of the RUVAC, the gas intake temperature, the ambient temperature and the gas type.

The pump ratio is equal to the effective compression ratio described in refer to [Start-up](#) on page 56. It will a lower pump ratio result in a higher allowable differential pressure.

The tables above give the maximum allowable differential pressures for the RUVAC WH depending on pump ratio and duty cycle.

The given values are valid for air with a maximum intake temperature of 40 °C and an ambient temperature not exceeding 40 °C.

RUVAC WH 4400 at 50 Hz / SP 630

Operation: 10 minutes at high differential pressure

10 minutes at a discharge pressure of less then 1 mbar

Technical data

$$\text{Pump ratio*} = \frac{\text{Nominal pumping speed SP 630}}{\text{Nominal pumping speed RUVAC 4400}} = \frac{630 \text{ m}^3 \cdot \text{h}^{-1}}{4400 \text{ m}^3 \cdot \text{h}^{-1}} = 1:7$$

Duty cycle is 50 %. The maximum allowable differential pressure resulting from the table above is Dpmax = 63 mbar.

Refer to [Start-up](#) on page 56 for calculating the cut-in pressure.

In the case of short cycle operation we recommend the use of a gear chamber evacuation facility so as to avoid oil spreading, refer to [Accessories](#) on page 82. The RUVAC WHU 2500 with PFPE is equipped with an integrated gear chamber evacuation facility.

If the pump is intended for more than 100000 cycles, always use the gear chamber evacuation.

* Pump ratio is given by the nominal pumping speed of the backing pump relative to the nominal pumping speed of the Roots booster.

Table 3 Maximum permissible differential pressure for WH 2500

Operation	50 Hz			60 Hz			80 Hz			100 Hz		
Pump ratio	1:1 - 1:4	1:5 - 1:8	1:9 - 1:15	1:1 - 1:4	1:5 - 1:8	1:9 - 1:15	1:1 - 1:4	1:5 - 1:8	1:9 - 1:15	1:1 - 1:4	1:5 - 1:8	1:9 - 1:15
Continuous operation in mbar	75/55*	60/55*	50	60/55*	50/55*	40/50*	40	35	30	20	20	20
Duty cycle 50% in mbar	75/55*	75/55*	70/55*	75/55*	70/55*	55	55	45	40	25	25	25
Pumpdown from atmosphere (< 2 minimum) WHU in mbar	90	90	-	90	90	-	-	-	-	-	-	-

* Operation without frequency converter / with our frequency converter

Table 4 Maximum permissible differential pressure for WH 4400

Operation	50 Hz			60 Hz			80 Hz		
Pump ratio	1:1 - 1:4	1:5 - 1:8	1:9 - 1:15	1:1 - 1:4	1:5 - 1:8	1:9 - 1:15	1:1 - 1:4	1:5 - 1:8	1:9 - 1:15
Continuous operation in mbar	45	38	30	30	25	20	12	10	8
Duty cycle 50% in mbar	75	63	50	57	47	38	18	15	12
Pumpdown from atmosphere (< 2 minimum) WHU in mbar	90	90	-	90	90	-	-	-	-

Table 5 Maximum permissible differential pressure for WH 7000

Operation	50 Hz			60 Hz			70 Hz		
Pump ratio	1:1 - 1:4	1:5 - 1:8	1:9 - 1:15	1:1 - 1:4	1:5 - 1:8	1:9 - 1:15	1:1 - 1:4	1:5 - 1:8	1:9 - 1:15
Continuous operation in mbar	30	25	20	21	17	14	14	12	11
Duty cycle 50% in mbar	45	37	30	31	25	21	21	18	16
Pumpdown from atmosphere (< 2 minimum) WHU in mbar	70	70	-	70	70	-	-	-	-

Remarks

Cycle times exceeding 40 minutes are considered as continuous operation.

Short cycle operation below 2 minutes must only be implemented using a WHU pump; in the case of longer pumpdown times we recommend a WH pump in combination with a frequency converter.

For precise determination of the starting differential pressure in connection with frequency converter operation please consult us.



Note:

Do not allow the WHU pumps to operate for longer periods of time at high pressures. The bypass line has been optimised for rapid pumpdowns and has not been designed to protect the pump at higher pressures.

Transportation

5 Transportation



WARNING: SUSPENDED LOAD

Risk of injury. Do not stand below the pump while connecting or removing the pump.

The RUVAC WH pumps are heavy machines and thus should only be lifted using suitable lifting equipment tied to the eyes provided for this purpose. The correct lifting is described in refer to [Figure: Transportation](#). Serious injury can result if the pump is dropped or not handled properly. Never lift the RUVAC when connected to a forevacuum pump.

When the pump is removed from the shipping container it has to be secured with suitable lifting equipment until it is safely bolted on either a vacuum flange or a rack that is stable enough to support the weight of the pump. If bolted to a forevacuum pump or a rack, sufficient tilt resistance has to be ensured.



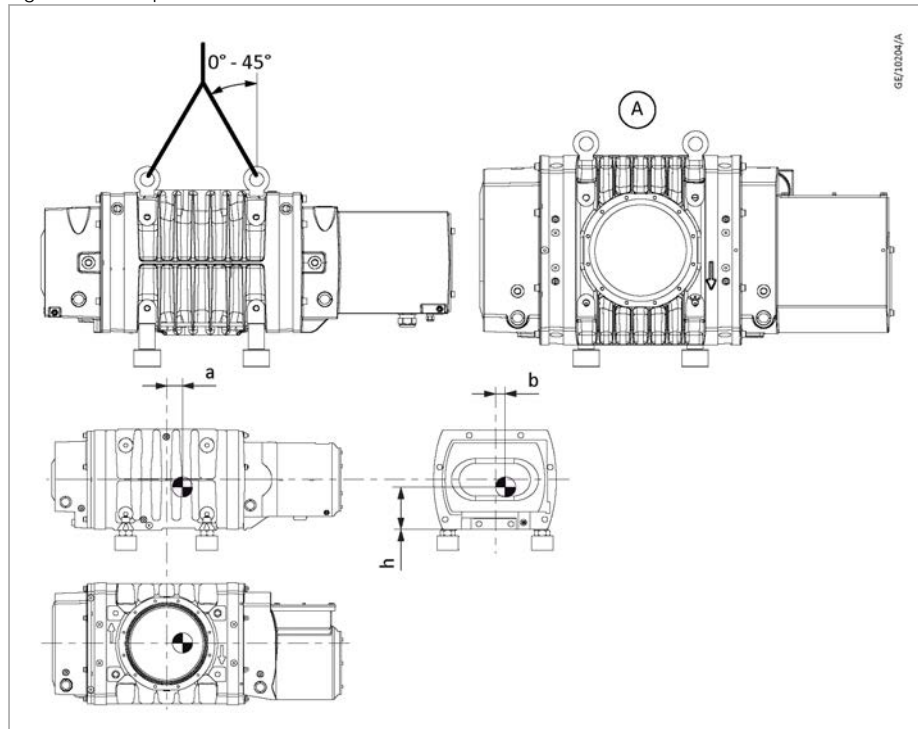
Note:

WH/WHU 4400 and 7000: Before transporting the pump always drain out the oil (refer to [Change the lubricant](#) on page 65). Screw the oil-drain plug with its gasket back in and wipe any oil droplets off from the casing.

The pump should be transported and stored in a horizontal position (10° maximum tilt). Otherwise there is the danger that oil from the side chambers may enter the pump chamber, even before the pump is filled with oil for the first time.

WH/WHU 2500: The pumps are supplied filled with oil or PFPE. For this reason they should, while being transported or shipped, not be subjected to much tilting. Store the pumps only horizontally standing on their feet.

Figure 7. Transportation



A. Eyebolt position in horizontal orientation WH 4400/7000

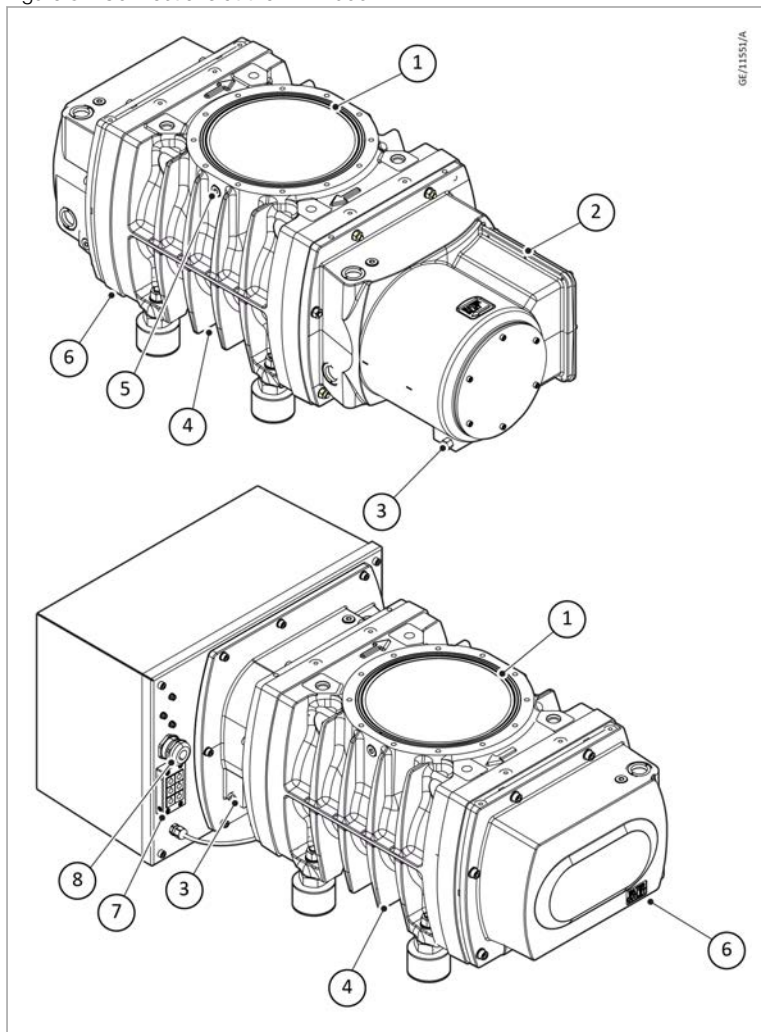
RUVAC	a	b	h
WH 2500	60 ± 10	39 ± 5	160 ± 5
WH 4400	82 ± 10	5 ± 5	186 ± 5
WH 7000	84 ± 10	9 ± 5	186 ± 5

The pump must be stored at the most for one year only. Longer storing without turning the rotors will damage the bearings. Connect the pump to operate it briefly and then decommission it as described in the following sections.

Refer to the frequency converter operating instructions when a frequency converter was longer than 2 years on stock.

Transportation

Figure 8. Connections at the WH 2500



- | | |
|---|-----------------------|
| 1. Intake flange | 2. Mains voltage |
| 3. Cooling water IN | 4. Discharge flange |
| 5. M16x1.5 thread with closure screw
for measurement connection (4x) | 6. Cooling water OUT |
| 7. Cable entry frame | 8. Mains power supply |

6 Installation

6.1 Placement



Note:

Install RUVAC WH/WHU pumps on a flat, horizontal surface (2° maximum tilt). If the pump is not levelled, lubricant may enter the pumping chamber from the gear chambers.

The pump's ambient temperature should be between 10 °C to 40 °C (WH 4400/7000) or 50 °C (WH 2500). Lower temperatures hamper run-up; higher ones shorten the lubricant change intervals and may lead to greater wear. Moreover, the pump attains its thermal operating limit faster.



Note:

In combination with the maximum allowable differential pressure higher temperatures can even damage the pump. Install the pumps only in indoor rooms. Sudden cooling of the pump casing during operation will damage the pump. The RUVAC pumps are designed to be functional at altitudes up to 1000 m above sea level. Operation at higher altitudes is permissible in consideration of reduced operating limits (derating). Consult us in this case.

Secure the pump.

Use the bores at the bottom of the rubber elements.



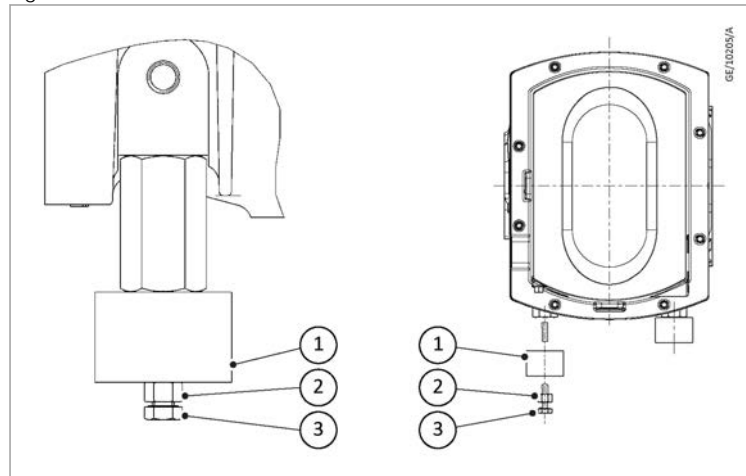
Note:

When bolting the feet down, make certain that there is no stress or twist on the pump casing. Stress on the pump can change the close tolerances between the impellers and the pump casing and may result in damage to the pump (use washers to equalise). Since compensation elements must be attached to the flanges on the intake and discharge sides, the screws for attachment of the feet must always be fitted and tightened. Refer to [Mechanical hazards](#) on page 12.

Use screws 4 x M 12.

Installation

Figure 9. Accessories



1. Metal cylinder
3. Hexagon screw

2. Lock nut

Note:

Use 3 metal cylinders for absorbing lateral forces in case of a horizontal flow for WH/WHU 4400/7000.

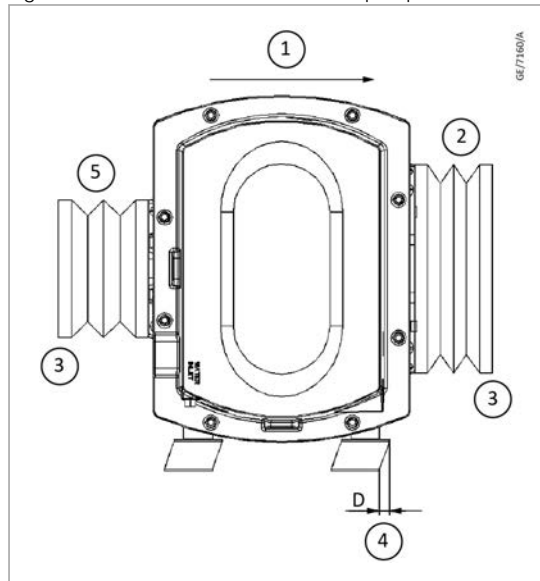
6.1.1 Pump feet (metal cylinder) for absorbing lateral forces

The metal cylinders shall absorb occurring lateral forces and keep the pump in its position.

For replacing, remove three of the four existing vibration absorbers from the pump and replace them by the metal cylinders. Before affixing the pump to the base frame, the metal cylinders must be tightened at a tightening torque 75 Nm. For this use one hexagon screw with lock nut. Remove the hexagon screw again.

The fourth vibration absorber remains in place so that any tensions which might occur during operation of the pump are avoided.

Figure 10. Outer forces on evacuated pumps for horizontal flow



- | | |
|--|--|
| 1. Resulting force F | 2. Compensation element at the intake (compressed) |
| 3. Fixed position | 4. Deformation of rubber elements $D < 5 \text{ mm}$ |
| 5. Compensation element at the outlet (expanded) | |

RUVAC	D
WH 4400*	3 kN
WH 7000*	6 kN

* Resulting force F when vacuum is present.

6.1.2 Outer forces on evacuated pumps

Due to the large flange area of the RUVAC WH pumps significant forces affect the pipework that is connected to the pump, shifting it if not properly affixed.

In the vertical pumping direction this is typically not a problem if the pump's feet are properly affixed to a stable surface.

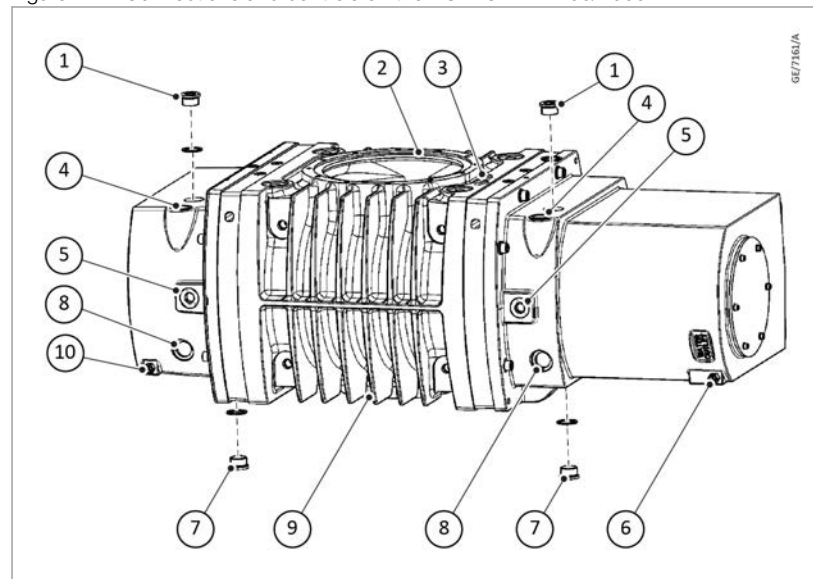
In the horizontal pumping direction the resulting force would overload the rubber elements of the pump feet if not compensated by the pipework thus displacing the pump. This would highly stress the piping.

In order to prevent any shifting, our specially manufactured pump feet must be used, refer to [Accessories](#) on page 82.

Make sure that the pump is connected using compensation elements so that the piping is not stressed too much.

Installation

Figure 11. Connections and controls on the RUVAC WH 4400/7000



- | | |
|--|---|
| 1. Oil inlet ports | 2. Intake flange |
| 3. Direction of rotation arrow | 4. Oil sight glasses (horizontal operation) |
| 5. Oil outlet ports (horizontal operation) | 6. Cooling water outlet port |
| 7. Oil outlet ports (vertical operation) | 8. Oil sight glasses (vertical operation) |
| 9. Discharge flange | 10. Cooling water intake port |

6.1.3 Fill the lubricants

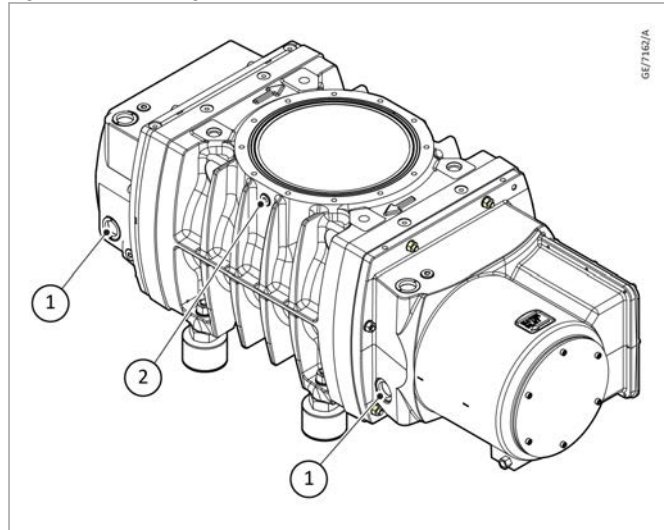
Not required for the WH/WHU 2500. The lubricant needed for running the pump is supplied in a separate container. Unscrew the oil-fill plugs and add lubricant. Please note that both oil reservoirs (gear and motor side) have to be filled separately. There is no connection between them. An oil without additives and of viscosity class ISO VG 100 (formerly SAE 30) must be used for the pump. We recommend the use of our special oil LVO 211. As PFPE we recommend LVO 400 or LVO 410 sold by us. Consult us if you intend to run the pump with other oils or special lubricants.



Note:

It is needed to make sure that the oil filling levels stated in [Figure: Oil level](#) which apply to switched off pumps (at standstill) are correctly maintained.

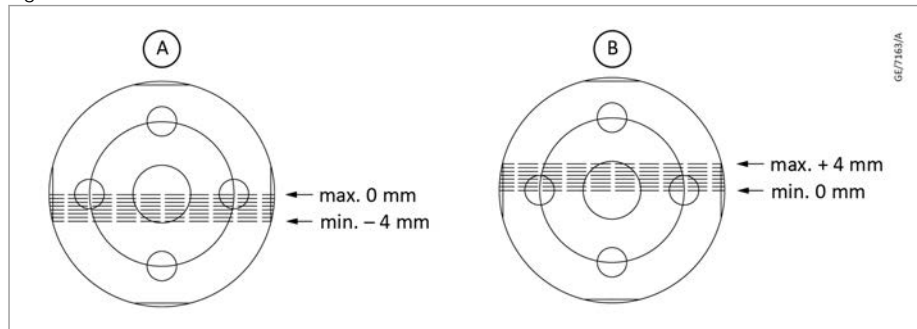
Figure 12. Checking the oil levels at the RUVAC



1. Oil sight glass 2. M16 connection

WH/WHU 2500: The pumps are supplied filled with oil or PFPE. Nothing will have to be refilled. Check the oil levels through both oil level glasses. If one of the oil levels is found to be incorrect, please contact us.

Figure 13. Oil level



A. RUVAC WH/WHU 2500 for vertical flow

B. RUVAC WH/WHU 4400/7000 for vertical and horizontal flow

Note:

If the oil level is too low, the bearings and gearwheels are not lubricated adequately; if it is too high oil may enter the pumping chamber and the pump could overheat. Clean the oil-fill port and screw the plug back in using a gasket which is in perfect condition. The oil-fill port must be sealed air-tight. Entry of air from the outside may cause oil-containing gas to enter the pumping chamber via the impellers seals.

6.2 Connect the cooling water



CAUTION: SAFETY INFORMATION

Observe all safety information provided in [Mechanical hazards](#) on page 12 and [Thermal hazards](#) on page 14.

Connect the cooling water. Make sure that an adequate cooling water flow. Secure the cooling water connections with Loctite 572.

Installation

6.2.1 Cooling water data

Table 6. Cooling water data

Parameter	Value
Cooling water connections	2 pcs. G 1/4, fem.
Fastening torque	10 ± 1 Nm
Water temperature	5 to 35 °C
Minimum/maximum supply pressure bar(g): bar (gauge) is overpressure, that is atmospheric pressure = 0 bar(g)	2 / 9 bar(g)

Type	Power loss to be dissipated by the cooling water	Cooling water demand at feed temperature (assuming a constant discharge temperature of 50 °C (1) or 40 °C (2))		
		25 °C - 30 °C	20 °C - 25 °C	<20 °C
	kW	l/min	l/min	l/min
WH(U) 2500 (1)	3	2.2	1.7	1.4
WH(U) 4400/7000 (2)	4	5.7	3.8	2.9

6.2.2 Water quality

In order to ensure long trouble-free operation the cooling water must not contain any oils, greases and suspended solids. Moreover, we recommend compliance with the following limit values:

Table 7. Water quality

Parameter	Value
Appearance	Clear, free of oils and greases
Suspended matter	< 250 mg/l
Particle size	< 150 µm
Electrical conductivity	< 700 µS/cm
pH value	7.0 to 9.0
Total hardness (total alkaline earths)	< 8 °dH
Aggressive carbon dioxide	None, not detectable
Chloride	< 100 mg/l
Sulphate	< 150 mg/l
Nitrate	≤ 50 mg/l
Iron	< 0.2 mg/l
Manganese	< 0.1 mg/l
Ammonium	< 1.0 mg/l
Free chlorine	< 0.2 mg/l
8 °dH (degrees German hardness) = 1.4 mmol/l = 10 °e (degrees English hardness) = 14 °f (degrees French hardness)	

Parameter	Value
If there is the danger of frost, you may use a water glycol mixture of up to 30 %.	
DS water (softened or fully desalinated water) can be used for cooling the system, if the pH value corresponds to the range indicated above.	

6.3 Electrical connection

Depending on the motor, the RUVACs can be operated as follows:

With a direct mains power connection. For these pumps ask us for a quotation when wanting to use a frequency converter.

- Within the scope of the technical data a freely selected frequency converter
For this you may use pumps for which we are offering the external frequency converter.
- With a specified internal frequency converter or
- With a specified external frequency converter

Pumps intended for operation with a frequency converter **must not be connected directly to the mains power.**

The external frequency converters supplied by us comply with EMC guidelines when the cable between pump and frequency converter does not exceed a length of 20 metres maximum. Longer cables are possible but at the risk of possibility exceeding EMC limits. 200V need external Filter. See addendum 301140450.

Compliance with the EMC emission levels in industrial environments is ensured when complying with the listed operating conditions. The maximum motor cable length must not be exceeded.

Note:

The frequency converter may, when deployed in residential areas, cause high-frequency interference. In such a case the operator of the unit will have to introduce additional measures for the purpose of suppressing high-frequency interference.

6.3.1 Direct mains power connection



WARNING: DANGEROUS VOLTAGE

Risk of injury. Unplug any connectors only when the mains voltage is switched off and the pump does no longer turn.

Observe safety information given in [Electrical hazards](#) on page 13.

Connect the pump to the correct mains voltage through the connections provided in the junction box (refer to [Figure: Electrical connections for WH\(U\) 4400, 7000 and WH\(U\) 2500 without frequency converter](#)).

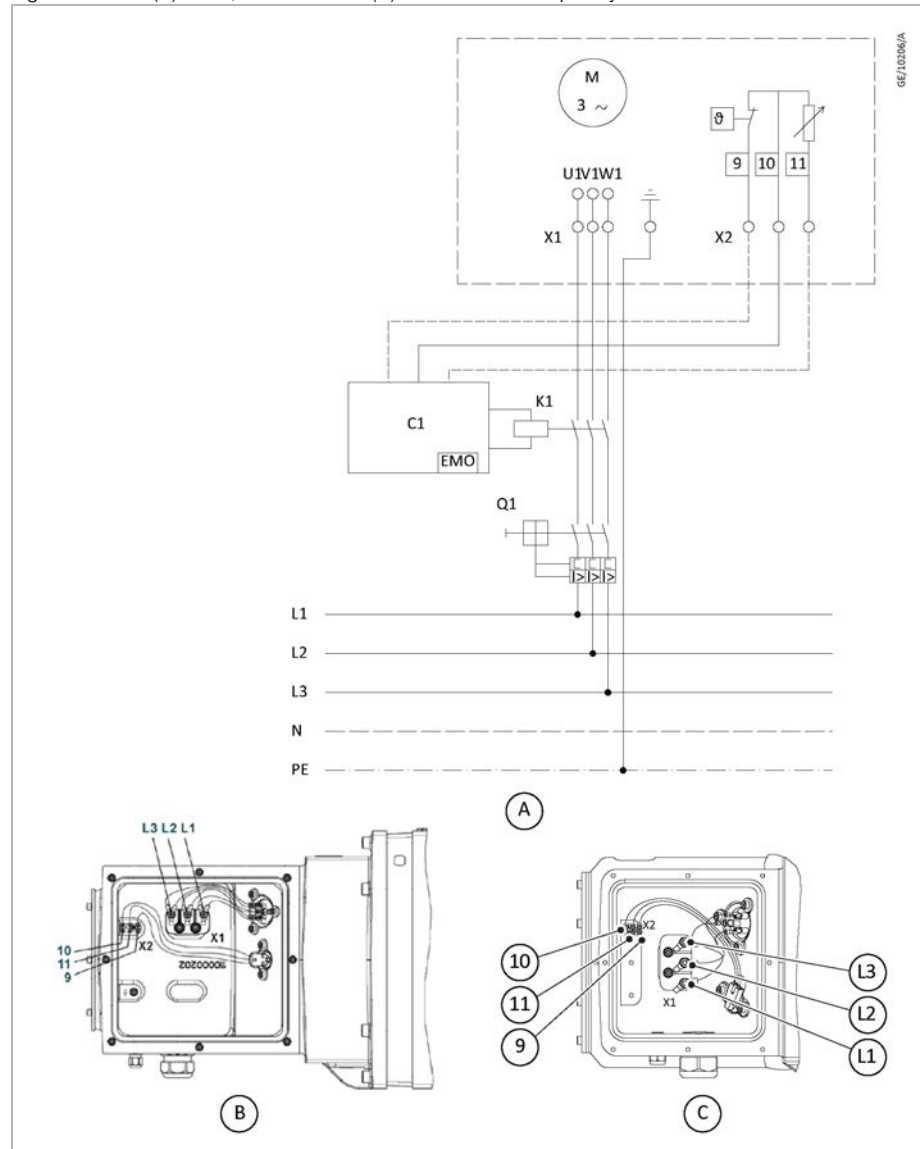
The motor of the RUVAC is equipped with:

- a temperature switch (PTO) and a temperature dependent resistor (PTC) (RUVAC 4400 to 7000)
- a temperature dependent resistor (PTC) (RUVAC 2500)

Connect the PTO or PTC so that the pump is reliably shutdown when being thermally overloaded.

Installation

Figure 14. WH(U) 4400, 7000 and WH(U) 2500 without frequency converter



- A. 3 phase 400 V, 50Hz / 460 V, 60 Hz (200 V, 50 Hz / 210 V, 50/60 Hz / 230 V, 60 Hz)
- B. Junction box WH(U) 4400, 7000
- C. Junction box WH(U) 2500

Q1 - Motor protection switch

C1 - Customer controller

K1 - Relay for Roots booster motor

9/10/11 - Connections for the temperature switch

L1/L2/L3 - Power connection

WH/WHU 2500: 100 °C

WH/WHU 4400/7000: 80 °C

6.3.2 Connection with a freely selected frequency converter

For selecting the right frequency converter for your specific application consult us first. We recommend a frequency converter similar to the one described in [Connection with internal frequency converter](#) on page 46 and [Connection with external frequency converter](#) on page 51. This

Installation

frequency converter perfectly matches the pump. A connection diagram is depicted in [Figure: Main and control circuit wiring RUVAC WH with PTC](#).

The WH 2500 DOL (direct online) can also be operated with a frequency converter, but only up to a maximum of 80 Hz. In addition, the power of the motor is significantly lower than that of the WH 2500-FC motor (prepared for frequency converter operation). We therefore recommend the combination of RUVAC WH 2500-FC and our frequency converter for the WH 2500 or the RUVAC WH 2500 with integrated frequency converter for frequency converter operation to increase the pumping speed.



Note:

Observe the information on the frequency converter provided in the enclosed Operating Instructions. Read these Operating Instructions and understand the information provided before installing, operating or doing maintenance work on the frequency converter. The frequency converter must be installed in agreement with the information provided in these Operating Instructions and in agreement with the locally applicable regulations. Non-compliance with the safety information can result in serious or even deadly injury, or may damage the products or facilities and systems connected to the product. If you select the frequency converter for your specific application which is not recommended by us, then it is your responsibility to make sure that the bearings are not damaged by bearing currents or discharges.

Connect the pump to the correct mains voltage through the connections in the junction box. Do not connect the electric control circuitry to the power circuitry of the frequency converter. During operation of the pump one of the motor's temperature sensors needs to be monitored to ensure that the pump is shut down as soon as one of the monitoring facilities responds. For the frequency converter recommended by us the PTC will be the connection at A1 and AC.

For the motor power supply line shielded types of cable must be used.

Setup data for our frequency converter

Setup data for our frequency converter is recommended or mandatory settings for freely selectable frequency converters

Table 8. Setup data for our frequency converter

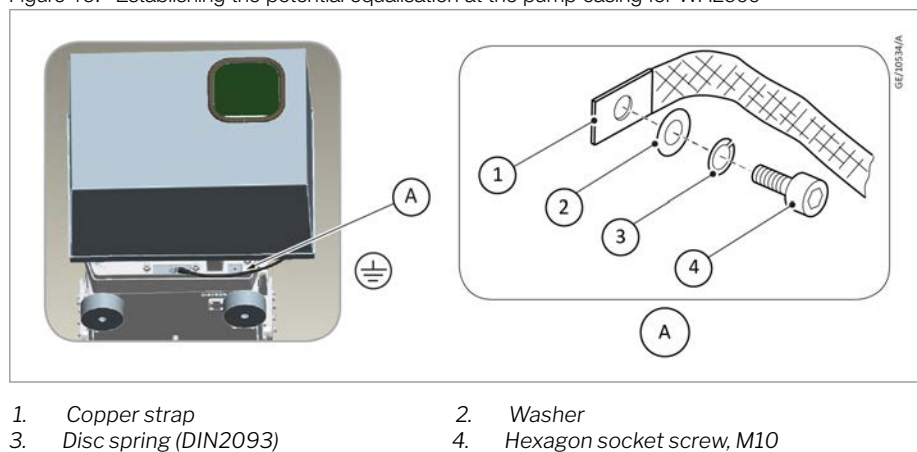
For RUVAC WH	2500 DOL 6.2/7.4 kW at 50/60 Hz	2500-FC 11 kW at 100 Hz	4400/7000 11 kW at 50 Hz	4400/7000 18.5 kW at 50 Hz
Maximum voltage	400 V, 50 Hz 480 V, 60 Hz	360 V	400 V	400 V
Base frequency (this is not the maximum frequency for the pump)	–	120 Hz	50 Hz	50 Hz
Base voltage	–	360 V	400 V	400 V
Nominal motor current	11.6 A	27 A	20 A	31 A
Number of motor poles	2	2	2	2
Motor outside conductor to outside conductor resistance	Approximate 0.9 Ohm	0.34 Ohm	0.72 Ohm	0.55 Ohm

Installation

For RUVAC WH	2500 DOL 6.2/7.4 kW at 50/60 Hz	2500-FC 11 kW at 100 Hz	4400/7000 11 kW at 50 Hz	4400/7000 18.5 kW at 50 Hz
Nominal motor output power	6.2 kW, 50 Hz	14.5 kW	11 kW	18.5 kW
	7.4 kW, 60 Hz			
Warning temperature Pt 1000	–	80 °C	–	–
Maximum pump temperature Pt 1000	–	90 °C	–	–
Maximum motor temperature PTC	110 °C	–	80 °C	80 °C
Permissible minimum frequency	20 Hz	20 Hz	20 Hz	20 Hz
Permissible maximum frequency	80 Hz	100 Hz	80 Hz	70 Hz

In the case of FC operation considerable electromagnetic interference occurs. Here the limits specified in the pertinent standards and guidelines need to be complied with under all circumstances by the installer. In order to reduce the level of electromagnetic interference, shielded motor cables, shielded cable feedthroughs, mains filters and EMC compliant ground connections are required between frequency converter and pump. In order to protect the pump, current limits in the frequency converter as a function of the frequency must be taken into account. Operation of the frequency converter requires the corresponding mains filter. Note for maximum speeds that in the case of increased speeds and the available maximum power, the maximum permissible pressure difference cannot be attained.

Figure 15. Establishing the potential equalisation at the pump casing for WH2500



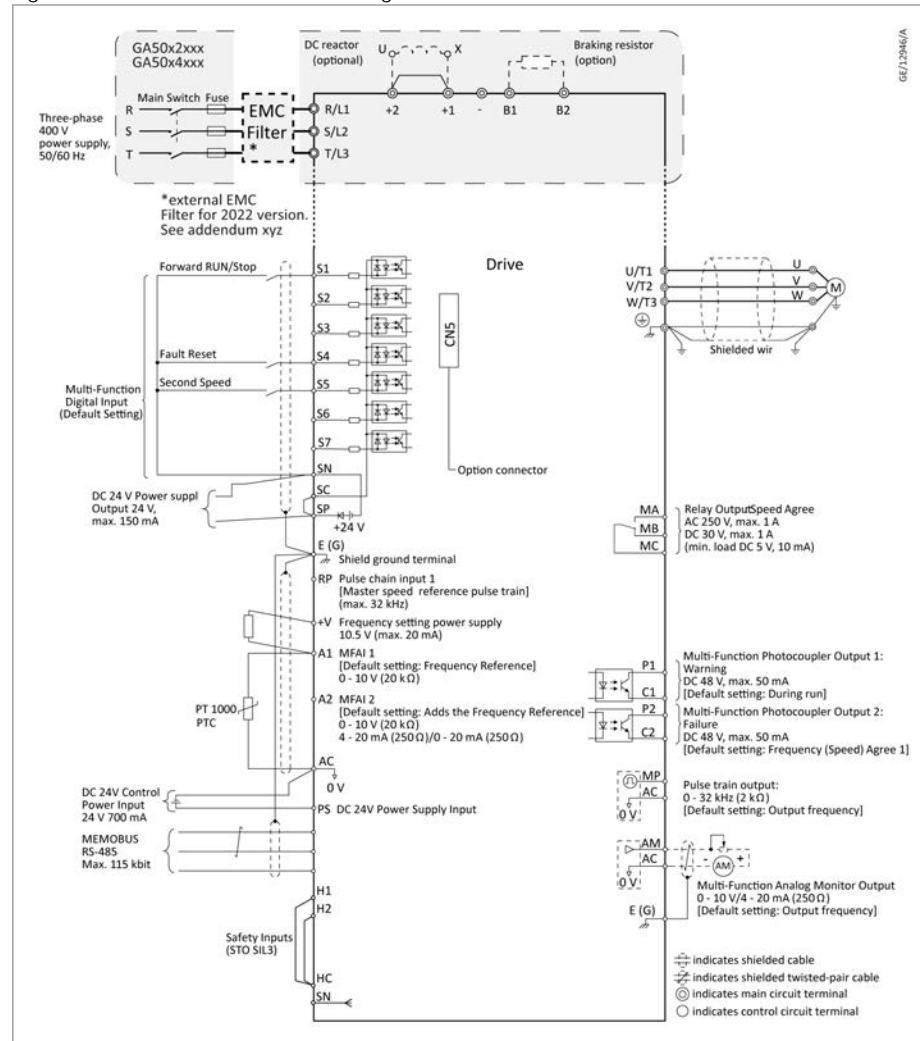
Establishing potential equalisation

Note:

In the case of operation with a frequency converter and ground leakage currents of over 3.5 mA, the protective ground conductor must have a cross-section of the least 10 mm². Or a further protective ground conductor having at least the same cross-section as the connection cable must be provided.

A M10 thread is provided at the motor casing for connecting the external potential equalisation cable. The potential equalisation conductor must be connected as depicted in [Figure: Establishing the potential equalisation at the pump casing](#).

Figure 16. Main and control circuit wiring RUVAC WH with PTC/Pt 1000



*External EMC filter for 200 V



Note:

Use external resistor between V+ and A1.

WH4000/7000: 12000 Ohm (PTC)

WH2500 External FC: 4020 Ohm (Pt 1000)

WH2500 Internal FC: Resistor is in Pt 1000 cable



Note:

< 1 > Connected using sequence input signal (S1 to S7) from NPN transistor.

Default: sink mode (0V com).

< 2 > Use only the +24 V internal power supply in sinking mode.

The source mode requires an external power supply.

Switch	Function	Input
DIP S1	I/V	Amper/Voltage
DIP S2	ON/OFF	Memobus
DIP S4	P/M	PTC/A2

DIP switch S4 changes the functionality of analog input A2. When DIP switch S4 is set to P the function is PTC input. When DIP switch S4 is set to M the function of analog input A2 is multi-function input.

Installation

6.3.3 Connection with internal frequency converter

For RUVAC WH 2500 only.



WARNING: ELECTRICAL HAZARD

Risk of injury or damage to equipment. Observe safety information given in [Electrical hazards](#) on page 13.

Wiring the main circuit input

Consider the following precautions for the main circuit input.

- Use fuses recommended in Main Circuit only, refer to [Technical data](#) on page 26.
- If using a ground fault circuit breaker, make sure that it can detect both DC and high frequency currents.
- The pump has no circuit breaker. Therefore install a circuit breaker in the system. Arrange the circuit breaker in such a way that it is easy for the operator to reach and mark it in such a way that it can be identified as a disconnecting device for the RUVAC's technical data.

Ground connection

Take the following precautions when grounding the frequency converter.

- Always connect the frequency converter to ground in accordance with the international and local regulations for equipment exhibiting an increased leakage current.
- Keep the ground wires as short as possible. The frequency converter produces leakage currents (typically less than 10 mA). In the case of unbalanced mains power supplies, the leakage current may exceed 10 mA. In this case the protective ground conductor must exhibit a cross-section of at least 10 mm². Or connect a further protective ground conductor having at least the same cross-section as the connection cable. A connection point is provided.
- When using more than one frequency converter, do not loop the ground wire.
- The screw connection must be secured against loosening.

Control circuit wiring

The control terminal board is equipped with screwless terminals. We recommend you to use flexible wires 0.5 mm² with ferrules.

Connect the mains power

Remove the cover from the frequency converter. The cover is connected to the PE terminals with a PE cable. Do not interrupt this cable.

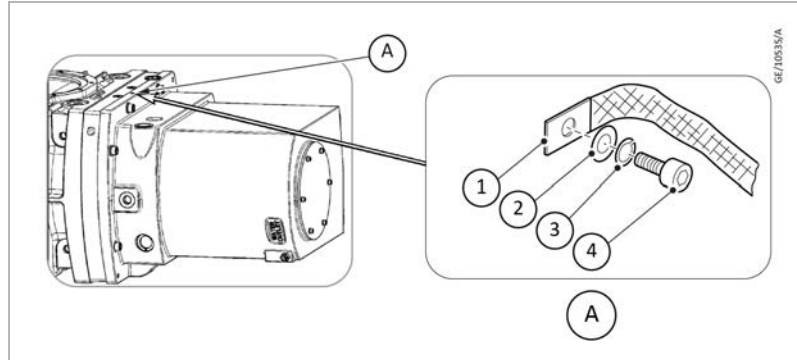
Connect the mains cable as shown refer to [Figure: Frequency converter without cover](#). Use the M32 cable fitting for that purpose. The terminals are designed for 10 mm² maximum cable diameter.

Establishing potential equalisation

An M6 thread is provided at the motor casing for connecting the external potential equalisation cable, for a functional ground connection.

Connect the potential equalisation conductor as depicted in refer to [Figure: Establishing the potential equalisation at the pump casing](#).

Figure 17. Establishing the potential equalisation at the pump casing for WH4400/7000



- | | |
|--------------------------|----------------------------|
| 1. Copper strap | 2. Washer |
| 3. Disc spring (DIN2093) | 4. Hexagon socket screw M6 |

Start/stop connection

Bridge SN and S1 to start the drive, open SN and S1 to stop the drive.

WH2500 with internal FC:

For the connection of the control cables, the multi cable feed through installed.

Sensors

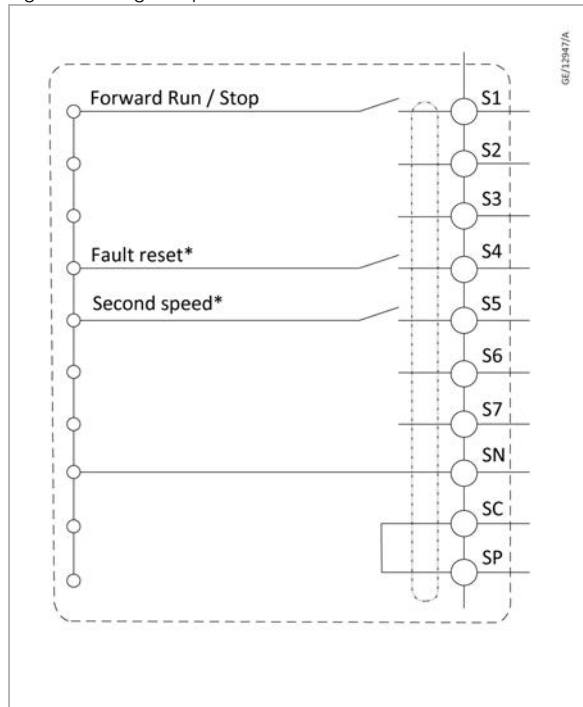
For pumps with external FC:

The pump's temperature sensor is connected to A1, AC and +V. You will find the conductor connector and the resistor in the PE bag of the operating instructions and the frequency converter.

Remount the cover on the frequency converter.

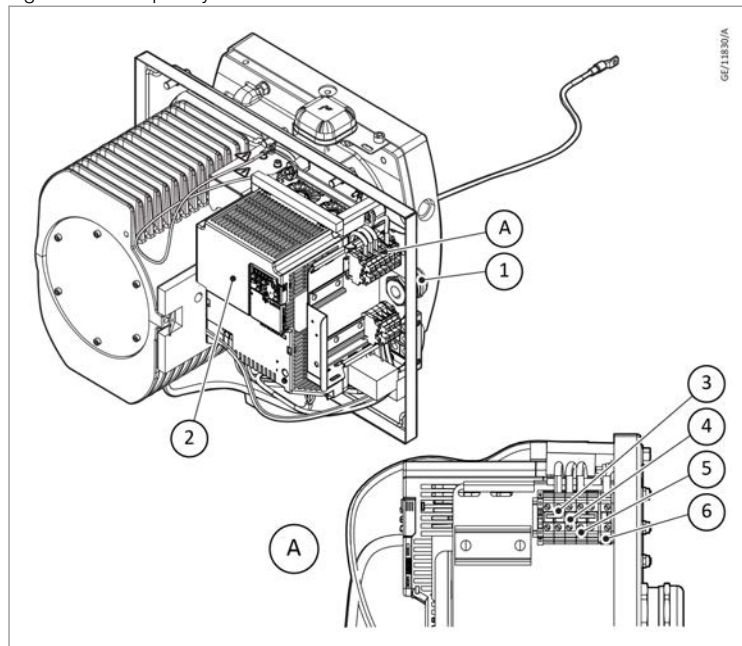
Installation

Figure 18. Digital inputs



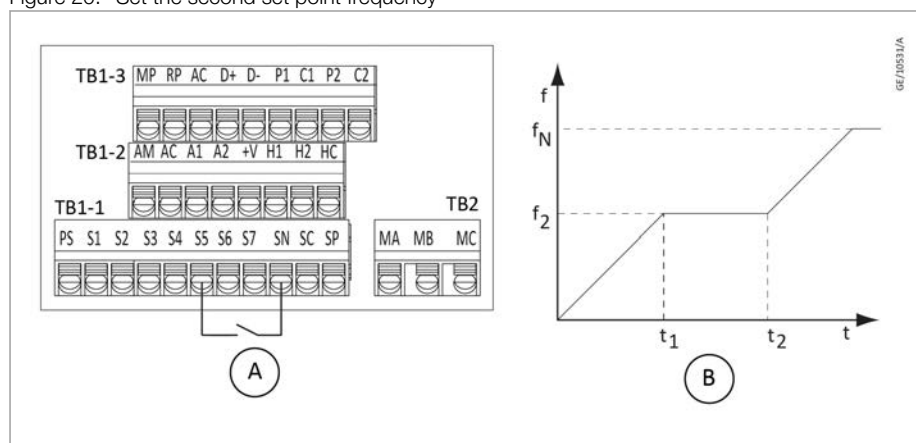
*For settings see parameters

Figure 19. Frequency converter without cover



- | | |
|-------------------------------------|------------------------|
| 1. Feedthrough for mains connection | 2. Frequency converter |
| 3. L1 | 4. L2 |
| 5. L3 | 6. PE |

Figure 20. Set the second set point frequency



A. Switch (normally open)

B. Pump run-up with two set up frequencies (schematic)

6.3.4 Option: changing the speed of the pump

The frequency converter permits the following:

- entering of a second setpoint frequency and selecting it as required. This allows gentle running up of the pump for a sensitive vacuum chamber.
- changing the speed of the pump through an input at the analogue input.

We recommend you to consult us first.



Note:

The pump must not be operated for more than one hour at frequencies below 20 Hz.

Setting up the second setpoint frequency

Enter the desired second frequency through the parameter d1-02 (default 0 Hz, allowed input range 0 Hz to 100 Hz). Closing of the switch between the digital input S5 and SN will enable the second frequency.

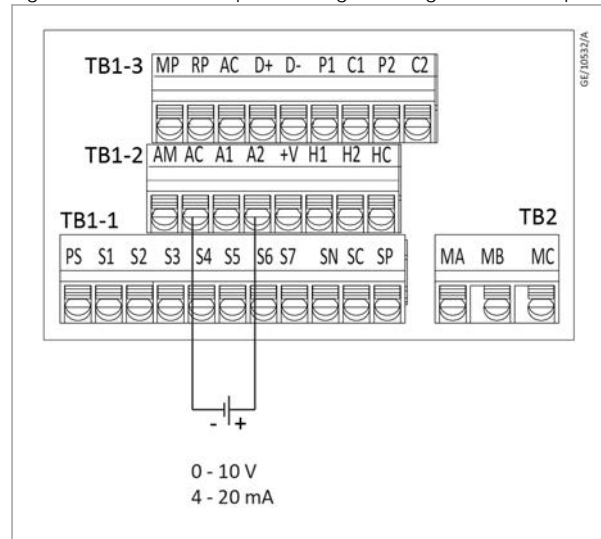
Controlling the speed through a voltage input

Set parameter b1-01 to 1 (0 default). Through this, the analogue input terminal A2 becomes the main frequency reference. Set DIP switch S1 to the bottom position V (voltage).

Set parameter H3-09 to 0. Through this, the input signal type is set to "0-10 V d.c. with lower limit". Make sure that parameter H3-10 has been set to the default value 0. Connect the control voltage to terminals A2 and AC. 0 to 10 V, 0 V corresponds to 0 Hz, 10 V corresponds to 100 Hz, linear increase.

Installation

Figure 21. Control the speed through a voltage or current input



Controlling the speed through a current Input

Set parameter b1-01 to 1 (0 default). Through this, the analogue input terminal A2 becomes the main frequency reference. DIP switch S1 must be at its default position: top, position I.

Parameter H3-09 must be at its default value 2, input signal type "4-20 mA"). Make sure that parameter H3-10 has been set to the default value 0.

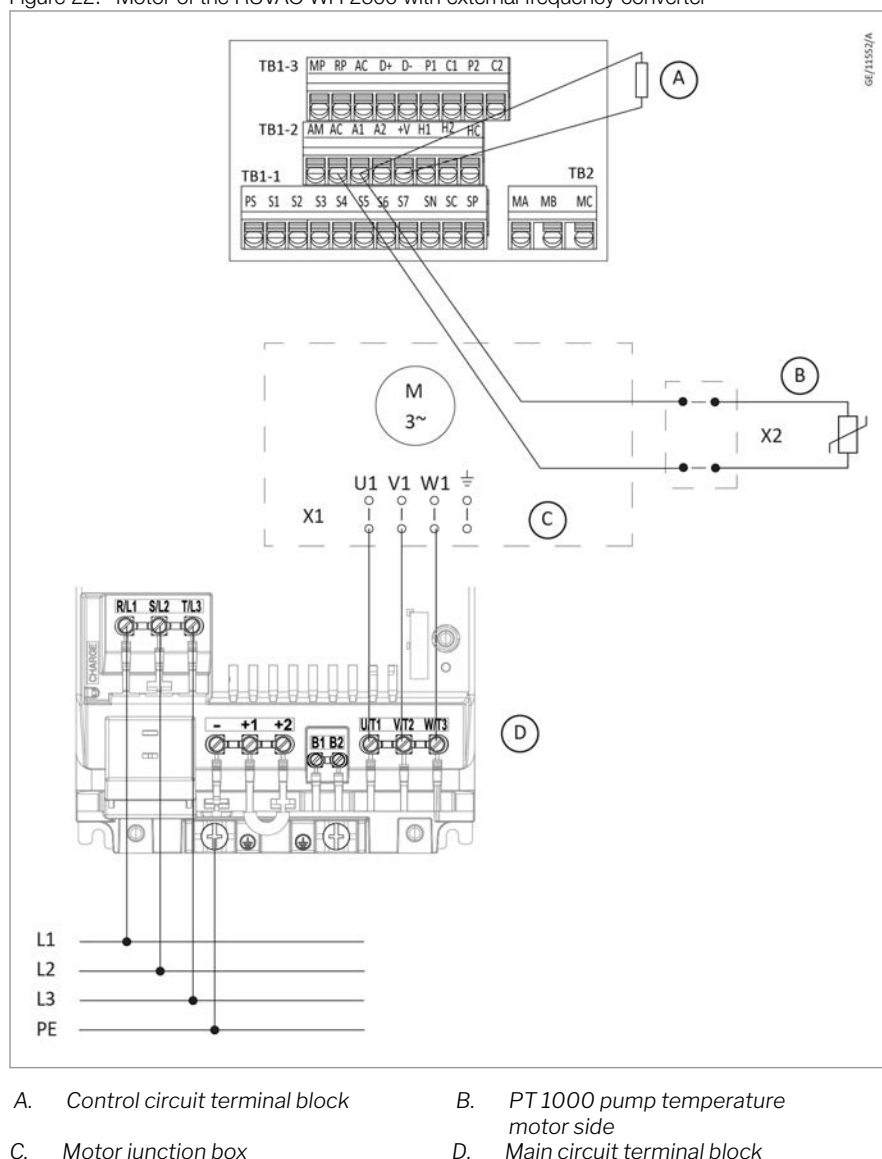
Connect the control current to terminals A2 and AC. 4 to 20 mA, 4 mA corresponds to 0 Hz, 20 mA corresponds to 100 Hz, linear increase.



Note:

Always operate the pump with its cover in place.

Figure 22. Motor of the RUVAC WH 2500 with external frequency converter



- A. Control circuit terminal block B. PT1000 pump temperature motor side
C. Motor junction box D. Main circuit terminal block

6.3.5 Connection with external frequency converter

[Connection with internal frequency converter](#) on page 46 applies also to the external frequency converter.

Connecting the cables

The maximum current load at the frequency converter output is 31 A. Connect the main and control circuits as shown in [Figure: Main and control circuit wiring for the RUVAC WH 2500 for external frequency converter](#).

When wiring the main electric circuit on the output side observe the following precautions:

- Do not connect to the output of the frequency converter other loads than the three-phase motor.
- Never connect a current source to the output of the frequency converter. Never short-circuit the output terminals.

Installation

- Do not use any capacitors for the purpose of phase correction.

Start/stop connection

Bridge SN and S1 to start the drive, open SN and S1 to stop the drive.

Sensors

Connect the Pt 1000 temperature sensor of the WH 2500 to A1 and AC. 30 m connection cable is delivered for the Pt 1000.

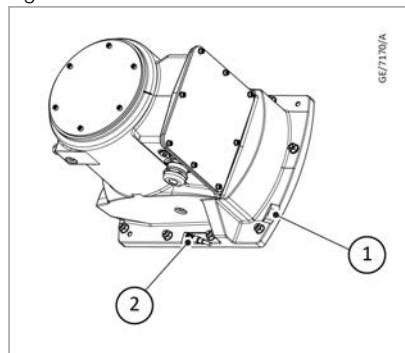
You will find the conductor connector and the 4020 Ohm resistor in the PE bag of the operating instructions.

Connect the pump's temperature sensor (Pt 1000) to A1 and AC. Lay the cable so that it does not touch any hot surfaces.

Connect the external resistor 4k02 to A1 and +V.

You will find the conductor connector and the resistor in the PE bag of the operating instructions.

Figure 23. Motor of the RUVAC WH 2500 with external frequency converter



1. Connection, Thread M6

2. Pt 1000

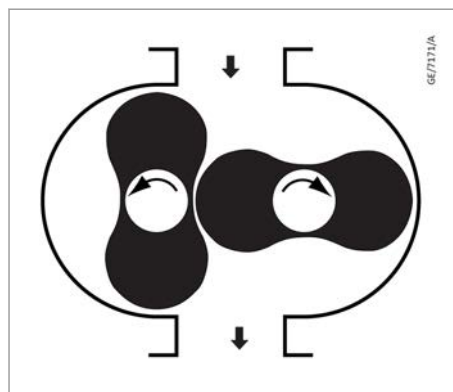
6.3.6 Check the direction of rotation

Not required with internal frequency converter. After connecting the motor and every time you alter the wiring, check the direction of rotation.



Note:

Never allow the pump to operate in the wrong direction or with open flanges for a longer period of time. Notice safety information refer to [Mechanical hazards](#) on page 12.



Installation

An arrow on the pump casing shows the correct direction of rotation for the impeller connected to the motor shaft.

The impellers should move up from the centre and drop down to the side.

Even if the pump has been already firmly connected to the piping, you may determine the direction of rotation. To do so note the oil level change on the **motor side** upon switching on the pump.

Oil level moves up 2-3 mm => Rotation direction is wrong

Oil level stays constant or drops slightly => Rotation direction is correct

In case of a wrong direction of rotation, disconnect the pump from the mains power and interchange two mains phases.

6.4 Connection of the flanges



Note:

Already small quantities of liquids (from the vacuum chamber or the piping) can lead to liquid damages within the pump. These may lead to a deformation of the impellers and may entirely destroy the pump. Suitable protective measures should be provided as required in the piping on the intake side (separator, T-piece).

The pumps are vented with nitrogen for protection during transport. Only remove the packing flanges before immediate connection.

If not already done, remove the protective shipping covers, foil or packing flanges from the flanges.

Clean the flanges and check that the sealing surfaces are in perfect condition.

Flange the pump to the vacuum system.



Note:

Don't place any stress on the pump casing when installing the intake and discharge lines. Fit compensation elements in order to avoid such stresses.

Inspect the rubber elements of the pump feet for excess deformation (refer to [Placement](#) on page 35).

When you install the pump directly (without bolting down the feet) to the forevacuum pump, a special adapter has to be used. Refer to [Accessories](#) on page 82.

You must also check whether the backing pump is rigid and stable enough to support the load of the RUVAC pump in each case. Notice safety information refer to [Mechanical hazards](#) on page 12.

6.4.1 Flange bolts and tightening torque specifications

RUVAC WH/WHU	2500	4400	7000
Intake flange DN	250 ISO-K	250 ISO-K	320 ISO-K
Bolts	12x M10	12x M10	12x M12
Tightening torque	48 ^{±5} Nm	48 ^{±5} Nm	80 ^{±8} Nm
Discharge flange DN	100 ISO-K	160 ISO-K	160 ISO-K
Bolts	8x M8 or 4x M16	8x M10	8x M10
Tightening torque	25 ^{±2,5} Nm 100 ^{±10}	48 ^{±5} Nm	48 ^{±5} Nm

The specified torque levels apply to oiled bolts of a minimum strength class of 8.8 but are not for stainless steel bolts. These can also be used but with different tightening torque levels.

Always use the full set of bolts intended for the specific flange connection.

Installation

The supplied intake screen should always be fitted into the intake flange during commissioning when there is the possibility of contaminants entering the pump coming from the vacuum chamber or the piping. Even with clean vacuum processes, contaminants from the system may enter upon initial startup. Depending on the operating conditions, the intake screen may reduce the pumping speed of the pump. The intake screen does not replace the need for inlet filters or traps on dusty applications.

6.4.2 Atmospheric shock and intake screen

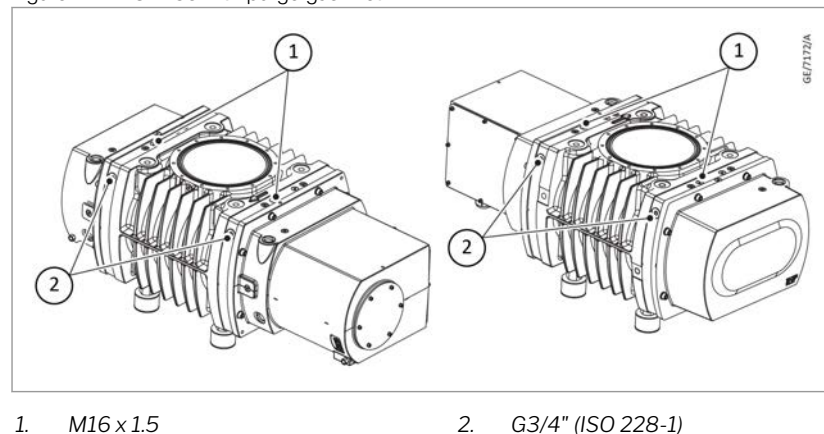
When a pump is used to pump down a chamber from atmosphere it is common for it to be connected to the vacuum chamber by a long fore line pipe with a vacuum isolation valve located next to the chamber. The foreline and pump can be at full vacuum when the vacuum isolation valve is opened, the resulting gas shock condition is able to stress the intake screen to such an extent that over time the metal-mesh can rupture and fall into the pump resulting in seizure, possible rupture of the pump casing and possible ejection of particles from the pump.

In order to avoid the above possibility we recommend that on fast cycle applications where there is the possibility of an atmospheric shock, the intake screen supplied with the RUVAC vacuum pump should be installed only during the commissioning process in order to prevent large objects left over from the construction (for example nuts, bolts, welding slag etc.) falling into the pump.

It is recommended that on this type of application the intake screen is removed after commissioning. For all applications other than atmospheric shock there is no issue.

Where there is the possibility of large particle ingestion into the vacuum pump it is recommended that a risk assessment is undertaken and where necessary suitable traps or filters should be installed into the vacuum pipework.

Figure 24. RUVACs with purge gas inlet



6.5 Purge gas connection (optional)

Some RUVAC pumps have been prepared for purge gas operation. The purge gas prevents dust from entering through the piston rings into the bearings mainly when venting the pump. Moreover, these pumps are equipped with sealed pistons.

Installation

The admission of purge gas impairs the attainable ultimate pressure and the pumping speed of the pump and for this reason the purge gas flow may be reduced or shut down completely during ultimate pressure operation.

Connect the purge gas separately to the motor side and to the gear side. Which of the 4 connections on each side is selected is irrelevant.

The pump must only be vented such that **atmospheric pressure is never exceeded**.

Depending on the type of process, connect nitrogen or another suitable dry gas. Check process compatibility.

Make sure that the purge gas flow is not obstructed in any way.

The supply with nitrogen should be ensured at all times during operation of the pump system, in particular when switching off and venting

7 Operation

7.1 Start-up

Check the pump motor's direction of rotation (refer to [Check the direction of rotation](#) on page 52).

RUVAC WHU

The RUVAC WHU can be started together with the backing pump at atmospheric pressure.

It is protected against excessively high differential pressures by a pressure balance line.



Note:

The opening pressure of the pressure balance valve is designed only for 50 or 60 Hz operation of the pumps.

RUVAC WH

The RUVAC pumps with our frequency converter are so controlled that overloading is avoided. RUVAC pumps without our frequency converter need to be interlocked by means of a pressure switch so that compliance with the values stated in the table of maximum pressure difference for RUVAC WH. Refer to [Maximum pressure difference](#) on page 29.

Do not switch on the RUVAC WH until the backing pump has evacuated the vacuum vessel down to the cut-in pressure.

For processes in which condensable vapors are pumped, it is advisable to evacuate the vacuum vessel via a roughing line to the cut-in pressure.

Electrically switch on the Roots pump together with the backing pump and cut it in upon reaching the cut-in pressure. The initial bypassing of the Roots pump serves to prevent condensation of vapors in the cold pump.

Avoid flushing back of condensate because of wrong piping installation. We strongly recommend a vertical flow direction.

The permissible cut-in pressure depends on the ratio between the Roots pump and the backing pump.

$$p_E = \frac{\Delta p_{\max}}{k_{\text{eff}} - 1}$$

Since k_{eff} is not known in all cases, the following equation may be used for a first approximation:

$$p_E \sim \frac{\Delta p_{\max}}{k_{\text{th}} - 1}$$

p_E = Cut-in pressure

$\Delta p_{\max}$ = Maximum permissible pressure difference
(see Technical Data)

k_{th} = Theoretical compression ratio = $\frac{\text{Nominal pumping speed}^{1)} \text{ RUVAC}}{\text{Nominal pumping speed of the backing pump}}$

k_{eff} = Effective compression ratio = $\frac{\text{Effective pumping speed RUVAC}}{\text{Effective pumping speed of the backing pump}}$

1) the corresponding operating frequency

RUVAC WH 4400 at 50 Hz / SP 630

$$k_{th} = \frac{4400 \text{ m}^3 \cdot \text{h}^{-1}}{630 \text{ m}^3 \cdot \text{h}^{-1}} \sim 7$$
$$p_e \sim \frac{40 \text{ mbar}}{7 - 1} \sim 6.5 \text{ mbar}$$

With small vacuum vessels, the maximum permissible differential pressure can be briefly exceeded (maximum 3 minutes) upon start-up. If a pressure switch has been installed, do not set it to this higher pressure because it will fail to protect the pump against overload in the event of a greater gas quantity.

 Note:

It is advisable to switch the RUVAC WH on and off through a pressure switch to make sure that it runs only in the permissible pressure range.

7.2 Field-bus interface

(Option for frequency converters delivered by us)

For operating with a Field-bus interface refer to the YASKAWA AC Drive-GA500 Option Technical Manual and Bus Interface manual (Publication number - 301076031).

The files and the manual can be downloaded from www.Leybold.com in the menu -> Documentation -> Download Software.

7.3 MEMOBUS/Modbus

The frequency converter is equipped with a serial RS 485 interface with MEMOBUS/Modbus (RTU) protocol. For more information, refer to Bus Interface manual (Publication number - 301076031).

7.4 Operation

CAUTION: ELECTRICAL HAZARD



Risk of injury. Do not operate the pump without having connected the flanges to a vacuum system. Observe safety information given in [Electrical hazards](#) on page 13.

The screws of the flanges on the intake and the discharge side must not be loosened in the presence of a vacuum or while the pump is still running.

During operation of the RUVAC, check the lubricant level from time to time and also the condition of the lubricant. Correct as required (refer to [Change the lubricant](#) on page 65). Normally, the oil LVO 211 is light-brown. If it turns dark, this is a sign of ageing. When using PFPE as intended, PFPE will not be subject to ageing.

7.4.1 Dirt ingress into the oil via the piston rings

In the case of dusty processes which are frequently vented with atmospheric air, there is the risk of dust being forced into the oil chambers. This can be prevented by a pressure equalisation between the oil chamber and the pump chamber. For this, install a valve at the oil inlet which during operation is opened simultaneously with the venting valve.

Operation



Note:

Run the Roots pump exclusively under the operating conditions for which it has been designed. Any modification of the operating parameters (for example, intake pressure, intake temperature, ratio between Roots pump and backing pump) for a longer period may place an inadmissible thermal load on the pump. Increases in temperature which are not compensated by taking suitable measures may damage the Roots pump and/or the backing pump.



WARNING: HOT SURFACE

Risk of burn. Observe safety information give in [Thermal hazards](#) on page 14.

Do not open the oil-fill or oil-drain plugs in the presence of a vacuum or while the pump is running. There is the danger that oil may squirt out.

7.5 Switch off and shutdown

For shutdown, close the valve between the Roots pump and the vacuum system. First switch off the Roots pump, then the backing pump.

After working with corrosive gases, the system should 30 to 60 minutes running without process gas be vented with dry protective gas (e.g. N₂) to prevent corrosion during standstill.

When shutting down the pump and removing it from the system, it is advisable to seal the connecting flanges tightly.



WARNING: ELECTRICAL SAFETY

Risk of injury or damage to the equipment. Before removing pump from the vacuum system, disconnect it from the mains supply. Note any contamination affecting the pump. Comply with all safety regulations. Observe safety information given in [Electrical hazards](#) on page 13.

RUVAC pumps with a PFPE filling **must** upon removal from the system be flooded with nitrogen and sealed off in a gas-tight manner because PFPE does not have a conserving effect. For RUVAC pumps with synthetic oil we recommend this protection measure.

Blow out the cooling water lines with compressed air. Avoid splashing water.

For transportation and storage of the pump, observe the information provided in refer to [Transportation](#) on page 32 and [Storage](#) on page 79.

7.6 Changing from vertical to horizontal flow

The RUVAC WH/WHU pumps are supplied as standard for vertical flow. The WH/WHU 2500 can only be operated for vertical flow.

Moreover, the WH/WHU 4400 and 7000 may be converted from one flow direction to the other. For this proceed as follows:

1. Unscrew the oil drain plugs and drain out the lubricant.
2. Seal off the bottom opening with the oil drain plug using a gasket which is in perfect condition so that a vacuum tight seal is attained again.
3. Remove the feet, turn the pump by 90° as shown in the dimensional drawings and mount the feet for the new direction of flow, refer to [Outer forces on evacuated pumps](#) on page 37 and [Accessories](#) on page 82.

4. Always make sure that proper lifting equipment is used and step back from the pump when turning it. Getting hit by a tilting pump might result in serious injury.
5. It is recommendable to tilt the pump on a soft surface to avoid damage to the painting.



Note:

The longitudinal axis of the pump must remain horizontal so that no residual lubricant can flow from the side chambers into the pumping chamber.

6. Fill in lubricant.
7. The valve in the pressure balance line of the RUVAC WHU is designed to work with both vertical and horizontal flow of the pump.

7.7 Operation with the frequency converter supplied by us

After turning the power on, the frequency converter mode display should appear and no fault or alarm should be displayed.

After switching on, the display indicates the monitoring parameters U1-02 (output frequency). The units of measurement are not displayed.

- Connect S4 to SN to reset fault messages.
- Connect S1 to SN for start.

The frequency converter is programmed for this pump. The parameter access is limited. The default output frequency can be changed in the programming mode. For the parameter list refer to the Yaskawa manual.



CAUTION: OPERATION SAFETY

Risk of damage to the equipment. The pre-set limiting parameters, in particular the maximum speed, must not be changed. Observe safety information given in [Electrical hazards](#) on page 13.



Note:

Do not run any auto-tuning on the frequency converter, since the pre-set motor parameters are then lost.

7.7.1 Frequency converter outputs

The frequency converter outputs have been assigned as follows:

P1-C1	Digital output multifunction opto-coupler 48 V d.c. maximum 50 mA maximum	Contact closed during Warning (general message)
P2-C2	Digital output multifunction opto-coupler 48 V d.c. maximum 50 mA maximum	Contact closed during Error (general message)
MA/MB/MC	Relay output, maximum AC 250 V 1A, DC 30 V 1A minimum DC 5 V 10 mA	MA/MC is closed when pump on target speed

Operation

Figure 25. LED operator

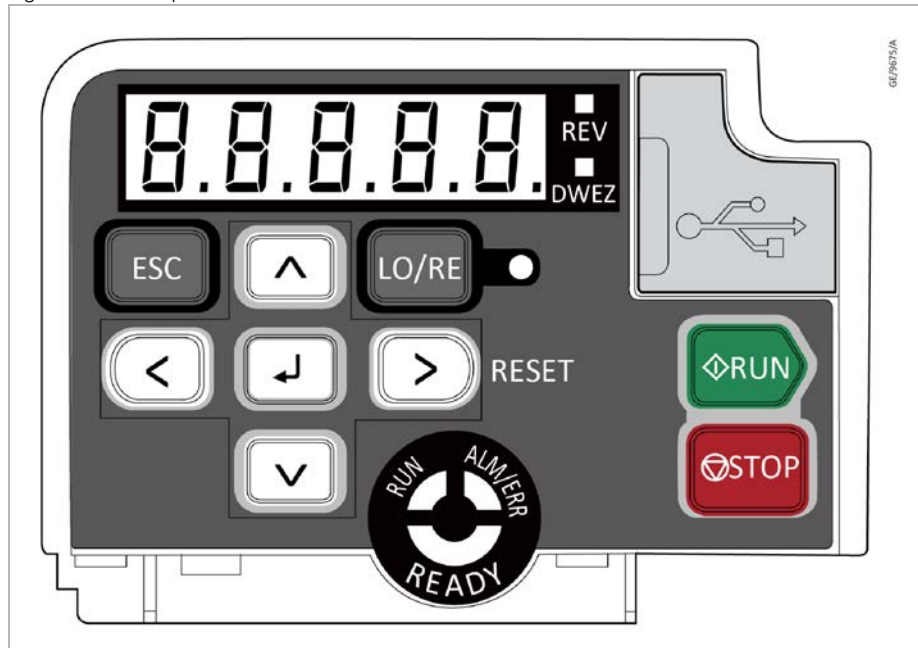


Table 9 Keys and functions

Display	Name	Function
	Data display area	Displays the parameter, errors and other data
	RUN key	Starts the drive in the LOCAL* mode, if control is set to LOCAL.
	STOP key	Stops drive. Uses a stop-priority circuit. This will also apply when a Run command (REMOTE Mode) is active at an external Run command source.
	LO/RE selection key	Switches drive control between the operator (LOCAL) and the control circuit terminals (REMOTE) *. The LED is on when the drive is in LOCAL mode (operation from keypad).
	ALM LED light	Flashing: The drive is in the alarm state. On: The drive is in a fault state and the output is stopped.
	DRV LED light	On: The drive is ready to operate the motor. Off: The drive is in the Verify, Setup, Parameter Setting or Auto tuning mode.

Display	Name	Function
	RUN LED light	Illuminated: The drive is in normal operation. OFF: The drive is stopped. Flashing: The drive is decelerating to stop. The drive received a Run command, but the frequency reference is 0 Hz. Flashing quickly: - When the drive is in LOCAL Mode, the drive received a Run command from the MFDI terminals and is switched to REMOTE Mode. - The drive received a Run command from the MFDI terminals when the drive is not in Drive Mode. - The drive received a Fast Stop command. - The safety function shut off the drive output. - The user pushed STOP on the keypad while the drive is operating in REMOTE Mode. - The drive is energised with an active Run command and b1-17 = 0 [Run Command at Power Up = Disregard Existing RUN Command].
	ESC key	Returns to the previous menu. Push and hold to go back to the frequency reference screen (the initial screen).
	Left arrow key	Moves the cursor to the left.
	Up/Down arrow key	Scrolls up/down to select parameter numbers, setting values, etc.
	Right arrow key (RESET)	Moves the cursor to the right. Resets a fault.
	ENTER key	Selects modes, parameters and is used to store settings.
	REV LED	On: The motor rotation direction is reverse Off: The motor rotation direction is forward
	DWEZ LED	On: The drive is In DriveWorksEZ operation.

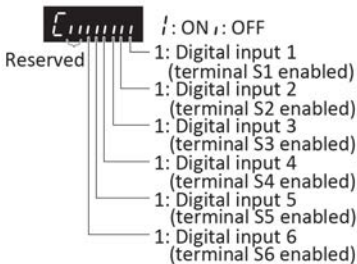
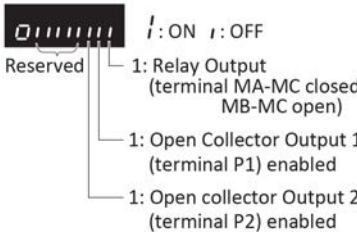
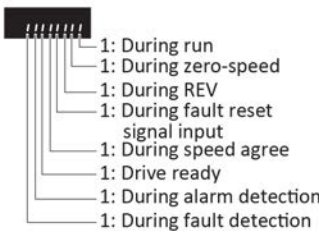
* The pump is not intended for LOCAL mode. Default mode is REMOTE

Monitor parameter

The [Table: Monitor parameter](#) shows the most important monitoring parameters about the frequency converter status and faults (monitoring mode).

Operation

Table 10. Monitor parameter

Monitor	Description
U1-01	Frequency reference (Hz)
U1-02	Output frequency (Hz)
U1-03	Output current (A)
U1-05	Motor speed (Hz)
U1-06	Output voltage reference (V a.c.)
U1-07	DC bus voltage (V d.c.)
U1-08	Output power (kW)
U1-09	Torque reference (% of motor rated torque)
U1-10	Input terminal status 
U1-11	Output terminal status 
U1-12	Drive status 
U1-13	Terminal A1 input level
U1-14	Terminal A2 input level
U1-16	Soft starter output (frequency after acceleration/deceleration ramps)
U1-18	OPE fault parameter
U1-24	Pulse input frequency
U7-03	Pump temperature
U7-04	Actual current limit
U7-05	Base block counter
Fault trace	

Operation

Monitor	Description
U2-01	Current fault
U2-02	Previous fault
U2-03	Frequency reference at previous fault
U2-04	Output frequency at previous fault
U2-05	Output current at previous fault
U2-06	Motor speed at previous fault
U2-07	Output voltage at previous fault
U2-08	DC bus voltage at previous fault
U2-09	Output power at previous fault
U2-10	Torque reference at previous fault
U2-11	Input terminal status at previous fault
U2-12	Output terminal status at previous fault
U2-13	Drive operation status at previous fault
U2-14	Cumulative operation time at previous fault
U2-15	Soft starter speed reference at previous fault
U2-16	Motor q-axis current at previous fault
U2-17	Motor d-axis current at previous fault
Fault history	
U3-01 to U3-10	Lists the 10 most recent faults
U3-11 to U3-20	Operation times that belong to the tenth most recent faults

* The faults CPF00, 01, 02, 03, UV1, and UV2 are not recorded in the error log.

Operation

7.7.2 Relay option board

Figure 26. Relay option board - Connections

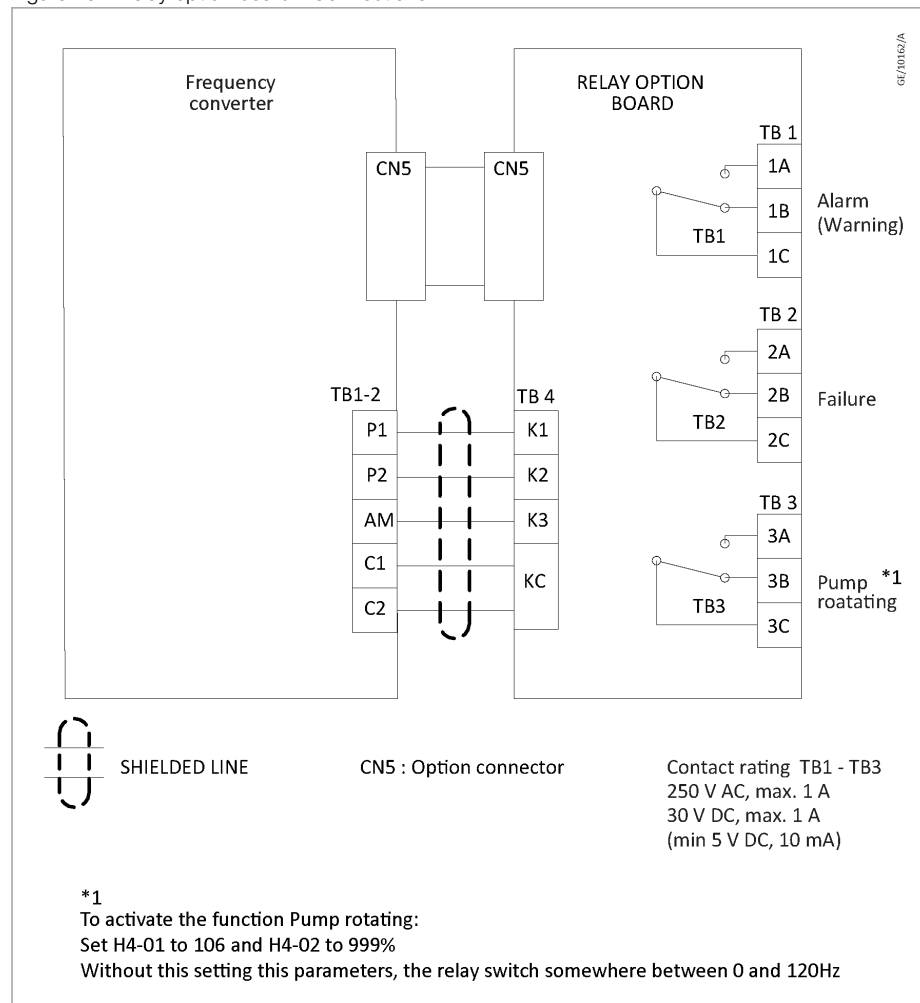


Table 11. Terminal block

Symbol	PIN No.	Function
TB1	1A	K1 Output, Normally Open (NO) contact
	1B	K1 Output, Normally Closed (NC) contact
	1C	K1 Output, Common
TB2	2A	K2 Output, Normally Open (NO) contact
	2B	K2 Output, Normally Closed (NC) contact
	2C	K2 Output, Common
TB3	3A	K3 Output, Normally Open (NO) contact
	3B	K3 Output, Normally Closed (NC) contact
	3C	K3 Output, Common
TB4	K1	K1 control signal
	K2	K2 control signal
	K3	K3 control signal
	KC	Common for K1, K2 and K3

8 Maintenance

8.1 Safety information

The safety information given in the following applies to all maintenance work:

- Disconnect the electrical power before disassembling the pump. Make absolutely sure that the pump cannot be accidentally started (logout / tagout).
- If the pump has been pumping harmful substances, determine the nature of hazard and introduce suitable safety measures.
- Improper maintenance or repairs may affect the service life and performance of the pump, and cause problems when filing warranty claims.
- Advanced repair work not described here should be left to the our service.

We would like to point out that we offers training courses on the maintenance, repair, and troubleshooting of RUVAC pumps. Further details are available on request.

8.2 Change the lubricant

WARNING: HOT SURFACE



Risk of injury or damage to the equipment. Before you remove the oil-drain or oil-fill plug must switch off the pump first and vent to atmospheric pressure. If the pump is still warm, the casing and the oil temperature may exceed 80 °C. Leave the pump to cool down. Please wear proper personnel protection equipment when you work with the aggressive residues in the pump or oil.



WARNING: MAINTENANCE SAFETY

Observe all safety information given in [Thermal hazards](#) on page 14 and [Ignition risk](#).

The oil-fill ports must be sealed air-tight. In the presence of a vacuum, the entry of air may cause oil-containing gas to enter the pumping chamber via the impeller seals.

When using PFPE as intended, PFPE is not subject to ageing. It must only be changed if it is contaminated by the process gas. It can only be determined for each individual case when the PFPE is so contaminated that it must be changed.

In case the pump suffers a severe mechanical failure, the possibility of hazardous substances being released owing to their thermal decomposition cannot be excluded. When opening the pump wear suitable personal protection equipment.

For recycling contaminated PFPE we ask you to consult us. As PFPE we recommend our LVO 400 or LVO 410.

Change the synthetic oil more frequently when pumping corrosive vapours or large amounts of dust or when cycling frequently from atmospheric to working pressure.

Maintenance

To simplify the process and also for safety reasons we recommend to use our oil-drain facility.

- Unscrew the oil-drain plugs the oil-fill plugs and drain the oil (refer to [Figure: Changing the lubricant \(shown for the RUVAC 7000, other models similar\)](#)).
- Clean the sealing surface and firmly reinstall the oil-drain plugs using a gasket which is in perfect condition. Wipe off any oil residues from the casing.
- Fill in new oil. For this use a clean funnel.
- For oil quantities and ordering data refer to [Technical data](#) on page 26.
- Make sure to use the right kind of oil. PFPE pumps are marked with a red label.
- Only use specified oil.
- Consult us if you intend to run the pump with other oils or special lubricants.
- The oil filling levels stated which apply to the shutdown (standing still) pump must be maintained correctly (refer to [Figure: Oil level](#)).

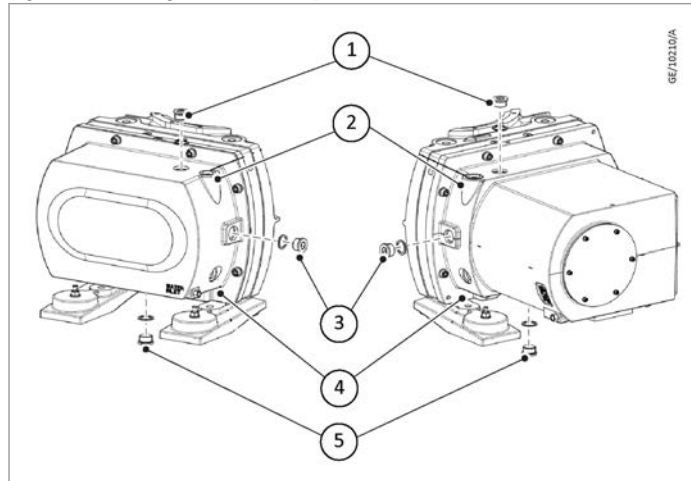


Note:

*If the oil level is too low, the bearings and gearwheels are not lubricated adequately; if it is too high, oil may enter the pumping chamber.
Mineral oils, synthetic oils and PFPE do not mix.*

Clean the oil-fill port and reinstall the plugs using a gasket which is in perfect condition. Wipe off any oil residues from the casing.

Figure 27. Change the lubricant (shown for the RUVAC 7000, other models similar)



- | | |
|---------------------------------------|--------------------------------------|
| 1. Oil filling plug | 2. Oil sight glasses horizontal flow |
| 3. Oil drain plug for horizontal flow | 4. Oil sight glasses vertical flow |
| 5. Oil drain plug for vertical flow | |

8.3 Clean the intake screen



Note:

Observe all safety information provided in refer to [Mechanical hazards](#) on page 12 to [Hazards caused by materials and substances](#) on page 14 and [Safety information](#) on page 65.

An intake screen is located in the intake port to collect foreign objects. It should be kept clean in order to avoid a reduction of the pumping speed.

To do so, take off the intake line. Remove the intake screen from the intake flange and rinse it using a suitable solvent. Then thoroughly dry it with compressed air. If the intake screen is damaged, replace it.

8.4 Clean the pumping chamber



WARNING: ROTATING PARTS

Risk of injury. During cleaning, the rotors must be turned only by hand. Please make sure that the rotors are turned in a way that fingers or hands can not be trapped between the rotors or between rotors and housing. Due to the high mass and inertia of the rotors serious injuries can occur even if the rotors are turned by hand only.



CAUTION: SAFETY INFORMATION

Observe all safety information give in [Mechanical hazards](#) on page 12 to [Hazards caused by materials and substances](#) on page 14 and [Safety information](#) on page 65.

Under dirty operating conditions, contaminants may be deposited in the pumping chamber or on the impellers. After removing the two connecting lines, the contaminants can be blown out with dry compressed air or flushed out with a suitable solvent.

Contaminants that cannot be blown or flushed out, can be removed completely from the pumping chamber with a wire brush, metallic sponge or scraper.

Then change the lubricant.



Note:

The loosened deposits must not remain in the pump. After cleaning, check the pump by slowly turning the impellers by hand. They should move freely and without any resistance.

Generally, the Roots pump does not need to be disassembled. If necessary, this should only be done by our after-sales service.

8.5 Maintenance intervals

Table 12 Maintenance intervals

Service work	Interval
Check the oil level	Before switching on and monthly
Oil change for LVO 211	1 year
Oil change for PFPE	Not required
Check oil quality visually	As required In the normal state PFPE is light, clear and transparent. LVO 211 is yellow, clear and transparent. In the case of black oil an oil change is necessary,
Complete overhaul in the service centre	Depending on the specific operating conditions
Leak search	After all maintenance and assembly work and upon request

Maintenance

Service work	Interval
RUVAC WHU: Replace bypass valve (Our Field Service)	After 1 Mio pump down cycles
Bearing exchange	40,000h for synthetic oil or 25,000h for PFPE fluid. Depending on application impacts, running conditions, cooling and maintenance these intervals might vary.

9 Fault finding

Table 13. Fault finding

Symptoms
<i>Pump does not start</i> on page 69
<i>Pump gets too hot</i> on page 69
<i>Motor power consumption is too high</i> on page 70
<i>Pump is too loud</i> on page 70
<i>Pump is losing lubricant (Lubricant leak is apparent)</i> on page 71
<i>Pump is losing lubricant (Lubricant leak is not apparent)</i> on page 71
<i>Oil gets too dark</i> on page 71
<i>Lubricant in the pump chamber</i> on page 71
<i>Pump does not attain its pumping speed</i> on page 72

Fault	Pump does not start
Cause	Motor is incorrectly connected.
Remedy	Connect motor correctly.
Cause	Over temperature switch or motor stator is defective.
Remedy	Contact us.
Cause	Lubricant is too thick.
Remedy	Exchange the lubricant or warm up lubricant and the pump.
Cause	Pump has seized: defective impellers, bearings or toothed gears
Remedy	Contact us.

Fault	Pump gets too hot
Cause	Cooling water supply is not sufficient.
Remedy	Make sure sufficient cooling water is supplied.
Cause	Cooling water lines are clogged.
Remedy	Decalcify cooling water lines.
Cause	Filter insert in the pressure reducer is clogged.
Remedy	Clean the filter insert.
Cause	Ambient temperature is too high or cooling air flow is obstructed.
Remedy	Install the pump at a suitable place or make sure that there is sufficient flow of cooling air.
Cause	Pump is operating in the wrong pressure range.
Remedy	Check the pressure levels within the system.

Fault finding

Cause	Gas temperature is too high.
Remedy	Check the system.
Cause	Clearance between housing and rotors are too small due to contamination or distortion of the pump.
Remedy	Clean pumping chamber. Affix and connect the pump free of tension.
Cause	Friction resistance is too high due to contaminated bearings and/or contaminated lubricant.
Remedy	Clean pump, respectively perform maintenance.
Cause	Lubricant level is too high.
Remedy	Drain lubricant down to the correct level.
Cause	Lubricant level is too low.
Remedy	Top up lubricant to the correct level.
Cause	Wrong lubricant is filled in.
Remedy	Contact us.
Cause	Bearing is defective.
Remedy	Contact us.

Fault	Motor power consumption is too high
Cause	Pump gets too hot
Remedy	Refer remedy in Pump gets too hot on page 69.
Cause	Incorrect mains voltage for the motor
Remedy	Connect the motor to the correct mains voltage.

Fault	Pump is too loud
Cause	Motor stator is defective.
Remedy	Contact us.
Cause	Oil level is too low.
Remedy	Top up oil to the correct level.
Cause	Distances between housing and rotors is too small due to contamination or distortion of the pump.
Remedy	Clean pumping chamber. Affix and connect the pump free of tensions.
Cause	Bearing or gear is damaged.
Remedy	Shutdown pump immediately. Contact us.
Cause	Pistons make contact with the housing.
Remedy	Shutdown pump immediately. Contact us.

Fault finding

Cause	Rotor is running untrue.
Remedy	Shutdown pump immediately. Contact us.

Fault	Pump is losing lubricant (Lubricant leak is apparent)
--------------	--

Cause	Oil drain plug leaks
Remedy	Drain lubricant, firmly screw in a new oil drain plug with the gasket, fill in correct lubricant quantity.

Cause	Oil level glass leaks
Remedy	Contact us.

Cause	Gear cover leaks
Remedy	Replace the O-ring of the gear cover.

Cause	Puddle under the motor, leak in the seal
Remedy	Shutdown pump immediately. Contact us.

Fault	Pump is losing lubricant (Lubricant leak is not apparent)
--------------	--

Cause	Lubricant in the pump chamber.
Remedy	For remedy, refer Lubricant in the pump chamber on page 71.

Fault	Oil gets too dark
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Cause	Oil has been used up.
Remedy	Exchange the oil.

Cause	Pump gets too hot.
Remedy	Refer Pump gets too hot on page 69. After the corrective action is taken for the malfunction, exchange the oil.

Fault	Lubricant in the pump chamber
--------------	--------------------------------------

Cause	Lubricant level is too high.
Remedy	Drain the lubricant down to the correct level.

Cause	Lubricant is ejected from the system.
Remedy	Check the system.

Cause	Pump is not standing horizontally.
Remedy	Place the pump correctly.

Cause	Pump has a gas leak towards outside.
Remedy	Run a leak search and pinpoint leaks. If the leak is not at the oil-fill or oil-drain plugs, return the pump to the manufacturer. Contact us.

Fault finding

Cause	Pump has an internal leak.
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Remedy	Contact us.
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Cause	Piston rings are defective.
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Remedy	Contact us.
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Fault	Pump does not attain its pumping speed
--------------	---

Cause	Intake screen is clogged.
--------------	----------------------------------

Remedy	Clean intake screen.
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Cause	Motor is incorrectly connected.
--------------	--

Remedy	Connect the motor correctly.
--------	------------------------------

Cause	Speed is too low.
--------------	--------------------------

Remedy	Set up the correct speed.
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Cause	Vacuum pump system has a gas leak.
--------------	---

Remedy	Detect leak and seal it.
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Cause	Valve of the pressure balance line does not close (WHU only)
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Remedy	Clean the valve or have it repaired.
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9.10 Fault and alarms displayed at the frequency converter

Faults and alarms indicate problems in the frequency converter or in the pump.

An alarm (warning) is indicated by a code on the data display and the flashing ALM LED. The frequency converter output is not necessarily switched. off.

A fault is indicated by a code on the data display and the ALM LED is on. The frequency converter output is always switched off immediately and the motor coasts to stop.

To remove an alarm or reset a fault, trace the cause, remove it and reset the frequency converter by pushing the Reset key on the operator or by cycling the power supply.

This list includes the more important alarms and faults only.

Fault finding

Table 14 Fault and alarms displayed at the frequency converter

Error message	Brief description	AL	FLT	Possible cause	Corrective action
CF	Control Fault			The torque limit was reached during deceleration for longer than 3 second when in Open Loop Vector control • The load inertia is too big. • The torque limit is too low. • The motor parameters are wrong.	Check the load. Set the torque limit to the most appropriate setting (L7-01 through L7-04). Check the motor parameters.
CPFD2 to CPFD4	Control Circuit Fault		■	There is a problem in the control circuit of the frequency converter.	Cycle the frequency converter power supply. Initialise the frequency converter. Replace the frequency converter if the fault occurs again.
CPFD5	Control Circuit Fault		■	There is no terminal board connected to the control board.	Check if the terminal board is installed properly. Uninstall and re-apply the terminal board. Change the frequency converter.
CRSR	Cannot Reset	■		Fault reset was input when a Run command was active.	Turn off the Run command and reset the frequency converter.
EFO	Option External Fault	■	■	An external fault was tripped by the upper controller via an option card.	Remove the fault cause, reset the fault and restart the frequency converter. Check the upper controller programme.
EF	External Fault	■		A forward and reverse command were input simultaneously for longer than 500 ms. This alarm stops a running motor.	Check the sequence and make sure that the forward and reverse input are not set at the same time.
EF1 to EF7	External Faults	■	■	An external fault was triggered by an external device via one of the digital inputs S1 to S7. EF2: Pressure sensor exceeds fault threshold. EF3: Temperature limiter exceeds fault threshold. The digital inputs are set up incorrectly. EF7: If purge sensor is connected, the pressure is not enough. If purge sensor is not connected then bridge between wago clamp and S7 is missing.	Find out why the device tripped the EF. Remove the cause and reset the fault. Check the functions assigned to the digital inputs. EF2: Check exhaust line. EF3: Check motor load, reduce if required, improve cooling.

Fault finding

Error message	Brief description	AL	FLT	Possible cause	Corrective action
GF	Ground Fault		■	Ground leakage current has exceeded 50% of the frequency converters rated output current. Cable or motor insulation is broken. Excessive stray capacitance at frequency converter output.	Check the output wiring and the motor for short circuits or broken insulation. Replace the broken parts. Reduce the carrier frequency.
LF	Output Phase Loss		■	Output cable is disconnected or the motor winding is damaged. Loose wires at the frequency converter output. Motor is too small (less than 5% of frequency converter current).	Check the motor wiring. Make sure all terminal screws in the frequency converter and motor are properly tightened. Check the motor and frequency converter capacity.
oL	Overcurrent		■	Short circuit or ground fault on the frequency converter output side The load is too heavy. The acceleration/deceleration times are too short. Wrong motor data or V/f pattern settings. A magnetic contactor was switched at the output.	Check the output wiring and the motor for short circuits or broken insulation. Replace the broken parts. Check the machine for damages (gears, etc.) and repair any broken parts. Check the frequency converter parameter settings. Check the output contactor sequence.
oH or oH 1	Heatsink Overheat	■	■	Surrounding temperature is too high. The cooling fan has stopped. The heatsink is dirty. The airflow to the heatsink is restricted.	Check the surrounding temperature and install cooling devices if necessary. Check the frequency converter cooling fan. Clean the heatsink. Check the airflow around the heatsink.
oL 1	Motor Overload		■	The motor load is too heavy. The motor is operated at low speed with heavy load. Cycle times of acceleration/ deceleration are too short. Incorrect motor rated current has been set.	Reduce the motor load. Use a motor with external cooling and set the correct motor in parameter L1-01 Check the sequence. Check the rated current setting.
oL 2	Drive Overload		■	The load is too heavy. Too much torque at low speed.	Check the load. The overload capability is reduced at low speeds. Reduce the load or increase the frequency converter size.

Fault finding

Error message	Brief description	AL	FLT	Possible cause	Corrective action
OU	DC Overvoltage	■	■	DC bus voltage is too high. The deceleration time is too short. Stall prevention is disabled1. Unstable motor control. Too high input voltage.	Increase the deceleration time. Enable stall prevention by parameter L3-04. Check motor parameter settings and adjust torque and slip compensation, AFR and hunting prevention as needed. Make sure that the power supply voltage meets the frequency converters specifications.
PF	Input Phase Loss		■	Input voltage drop or phase imbalance. One of the input phase is lost. Loose wires at the frequency converter input.	Check the power supply. Make sure that all cables are properly fixed to the correct terminals.
Uu1	DC Under-voltage	■	■	The voltage in the DC bus fell for longer than 2 second below the under-voltage detection level (L2-05). The power supply failed or one input phase has been lost. The power supply is too weak.	Check the power supply. Make sure, that the power supply is strong enough.
Uu2	Controller Undervoltage		■	The power supply voltage of the controller (of frequency converter) is too low.	Cycle power to the frequency converter. Check if the fault reoccurs. Replace the frequency converter if the fault continues to occur.
Uu3	DC Charge Circuit Fault		■	The charge circuit for the DC bus is broken.	Cycle power to the frequency converter. Check if the fault reoccurs. Replace the frequency converter if the fault reoccurs.
PTA1 / A2	Pt 1000 Alarm A1/2	■		Is true, when Pt 1000 measures temperatures of >50 °C (LVO 211) or >45 °C (LVO 410).	Check and improve cooling.
PTCA1 / A2	PTC and Pt 1000 Alarm A1/2	■		Is true, when PTC and Pt 1000 measures temperatures of >50 °C (LVO 211) or >45 °C (LVO 410).	Check and improve cooling.
PrECE	Pre CE alarm	■		Alarm is active for the time P5-01 before H5-09 elapsed during Memobus Communication error.	
EAL02	External Alarm during delay of MFDI set in S2	■		External alarm during delay of MFDI settings for S2 (H1-02). Pressure sensor exceeds alarm/(warning)	

Fault finding

Error message	Brief description	AL	FLT	Possible cause	Corrective action
EAL03	External Alarm during delay of MFDI set in S3	■		External alarm during delay of MFDI settings for S3 (H1-03).	
C-LiM	C-Lim Alarm	■		Drive was running at or above the Final Current Limit for the time P5-04 – P5-03	
L_SPd	Low Speed Detected		■	The output frequency is below the frequency set in P3-01 for the time set in P3-02.	
PTFT			■	Open circuit is detected. Note "Wait" fault.	Check Pt 1000 and connection cable, replace if required.
				Short circuit is detected.	Check Pt 1000 and connection cable, replace if required.
				Is true, when Pt 1000 measures temperatures of >60 °C (LVO 211) or >50 °C (LVO 410). Note "Wait" fault.	Check and improve cooling.
CMPFT	Compensation Fault		■	Contact us.	
C-LiM	C-Lim Fault		■	Drive was running at or above the Final Current Limit for the time set by parameter P5-04.	
_AiT	Wait		■	Condition for Pt 1000 Fault is reached. If the "Pt 1000 Open" threshold is reached within 10 seconds, then "Wait" changes to "Pt 1000 open", else it changes to "Pt 1000 fault". The fault is different to standard faults. There is no error code available and also no entry in the fault history. This ensures that only the faults "Pt 1000 open" and "Pt 1000 fault" can be seen or traced. As soon "Wait" is occurring the frequency converter stops with RUN to coast.	

Operator Programming Errors

An Operator Programming Error (OPE) occurs when an inapplicable parameter is set or an individual parameter setting is inappropriate. When an OPE error is displayed, press the ENTER button to display U1-18 (OPE fault constant). This monitor will display the parameter that is causing the OPE error.

Table 15 Operating programming errors

Error message	Possible cause	Corrective action
oPE01	Drive capacity and value set to 02-04 do not match.	Correct the value set to 02-04.
oPE02	Parameters were set outside the allowable setting range.	Set the parameters to the proper values.
oPE03	A contradictory setting is assigned to multi-function contact inputs H1-01 through to H1-07. The same function is assigned to two inputs. (this excludes "External fault" and "Not used") Input functions which require the setting of other input functions were set alone. Input functions that are not allowed to be used simultaneously have been set.	Fix any incorrect settings.
oPE05	The run command source (b1-02) or frequency reference source (b1-01) is set to 3 but no option board is installed. The frequency reference source is set to pulse input but H6-01 is not 0.	Install the required option board. Correct the values set to b1-01 and b1-02.
oPE07	Settings to multi-function analog inputs H3-02 and H3-10 and PID functions conflict. H3-02 and H3-10 are set to the same value. (this excludes settings "0" and "F") PID functions have been assigned to both analog inputs and the pulse input at the same time.	Fix any incorrect settings.
oPE08	A function has been set that cannot be used in the control mode selected.(might appear after control mode change)	Fix any incorrect settings.
oPE10	The V/f pattern setting is incorrect.	Check the V/f pattern settings.
oPE12	Occurs if b1-01 (Frequency Reference) = 3 or b1-02 (Sequence Reference) =3 and Parameters Lower Level is set and option card is connected. Occurs if following condition is not given: P2-02 < P2-04 < P2-06 < P2-08 < P2-10 < P2-12 < P2-14 < P2-16 < P2-18 < P2-20 < P2-22. Occurs if following condition is not given: P4-01 < P4-02 < P4-03 Occurs if MFDI setting in H1-02 is not an external fault setting and P1-05 is unequal to 0. ((H1-02 < 20h) OR (H1-02 > 2Fh)) AND (P1-05 NOT 0) Occurs if MFDI setting in H1-03 is not an external fault setting and P1-06 is unequal to 0. ((H1-03 < 20h) OR (H1-03 > 2Fh)) AND (P1-06 NOT 0)	

Wearing and original spare parts

10 Wearing and original spare parts

Original spare parts are available from our service facilities.

11 Storage

When storing the pump for a longer period of time (> 2 weeks) the flanges should be sealed off with a piece of foil. Place a bag with desiccant in the pump chamber, if required. Before operating the pump once more do not forget to remove this bag first.

Pumps having a filling of PFPE should be sealed off in a gas-tight manner and vented with nitrogen.



Note:

If there is the danger of frost, the cooling water must be drained, refer to [Operation](#) on page 57 Removing from Service.

You may use a water glycol mixture of up to 30 %.

Parameter	Values
Temperature (only for storage without cooling water)	-20 °C to +60 °C
Storage site	Dry
Maximum atmospheric humidity	95 %, non-condensing

12 Disposal

The pump may have been contaminated by the process or by environmental influences. In this case the equipment must be decontaminated in accordance with the relevant regulations. We offer this service at fixed prices. Further details are available on request.



WARNING: CONTAMINATION HAZARD

Risk of contamination. Contaminated parts can be detrimental to health and environment. Before beginning with any work, first find out whether any parts are contaminated. Adhere to the relevant regulations and take the necessary precautions when handling contaminated parts.

Separate clean pumps according to their materials, and dispose of these accordingly. We offer this service. Further details are available on request.

When sending us a pump, observe the regulations given in [Service](#) on page 81.

Disposal of waste oil

Owners of waste oil are entirely self-responsible for proper disposal of this waste.

Waste oil from vacuum pumps must not be mixed with other substances or materials.

Waste oil from vacuum pumps (oils which are based on mineral oils) which are subject to normal wear and which are contaminated due to the influence of oxygen in the air, high temperatures or mechanical wear must be disposed of through the locally available waste oil disposal system.

Waste oil from vacuum pumps which is contaminated with other substances must be marked and stored in such a way that the type of contamination is apparent. This waste must be disposed of as special waste.

European, national and regional regulations concerning waste disposal need to be observed. Waste must only be transported and disposed of by an approved waste disposal vendor.

PFPE from vacuum pumps may be regenerated, if required, and provided the quantities are large enough. For this, contact us for assistance.

13 Service

13.1 Return the equipment or components for service

Before you send your equipment to us for service or for any other reason, you must complete a Declaration of Contamination Form. The form tells us if any substances found in the equipment are hazardous, which is important for the safety of our employees and all other people involved in the service of your equipment. The hazard information also lets us select the correct procedures to service your equipment.

If you are returning equipment note the following:

- If the equipment is configured to suit the application, make a record of the configuration before returning it. All replacement equipment will be supplied with default factory settings.
- Do not return equipment with accessories fitted. Remove all accessories and retain them for future use.
- The instruction in the returns procedure to drain all fluids does not apply to the lubricant in pump oil reservoirs.

Download the latest documents from leybold.com/en/downloads/download-documents/declaration-of-contamination/, follow the procedure in HS1, fill in the electronic HS2 form, print it, sign it, and return the signed copy to us.



NOTICE:

If we do not receive a completed form, your equipment cannot be serviced.

Accessories

14 Accessories

Table 16 RUVAC WH/WHU

RUVAC WH/WHU	2500	4400	7000
	Part no.	Part no.	Part no.
Frequency converter, inclusive mains filter - GA500*			
11 kW / 200 V	127250A19	127700A19	127700A14
11 kW / 400 V	127250A14	127700A14	127700A14
18 kW / 400 V	–	127700A10	127700A10
200V filter	E6503086	E6503086	E6503086
200V filter IT grid	112005A25	112005A25	112005A25
LCD display	112005A80	112005A80	112005A80
Profibus DP module - GA500	112005A78	112005A78	112005A78
ProfiNet module - GA500	112005A75	112005A75	112005A75
EtherCAT module - GA500	112005A76	112005A76	112005A76
Relay module (digital output) - GA500	112005A70	112005A70	112005A70
Ethernet interface board - GA500	112005A72	112005A72	112005A72
Pump feet set for horizontal operation	-	155 181V	155 181V
Gear chamber evacuation kit for WHU pumps	-	-	155 183V
Spare parts			
Major maintenance kit	EK 110 003 000	EK 110 002 828	EK 110 002 828
Spare motor, 400 V			
11.0 kW	-	E6550282	E6550282
15.0 kW	Upon request	-	-
18.5 kW	-	E6550284	E6550284

*200V with C3 Filter. C2 Filter is available externally.

Table 17 Frequency converter dimensions including mains filter

Part no.	Yaskawa Designation	For RUVAC	Description	W x H x D inclusive mains filter
127250A14	GA500	WH 2500	400 V 11 kW	180 x 295 x 200
127250A19	GA500	WH 2500	200 V 11 kW	180 x 295 x 200
127700A14	GA500	WH 4400/7000	400 V 11 kW	180 x 295 x 200
127700A10	GA500	WH 4400/7000	400 V 18 kW	180 x 295x 200
127700A19	GA500	WH 4400/7000	200 V 11 kW	180 x 295 x 200
155187IE3	V1000	WH 4400/7000	400 V 11 kW	345 x 500 x 274

Accessories

Part no.	Yaskawa Designation	For RUVAC	Description	W x H x D inclusive mains filter
			IP 66 (dust and water proof)	
155188IE3	V1000	WH 4400/7000	400 V 15 kW IP 66 (dust and water proof)	345 x 500 x 274

Figure 28. Frequency converter GA500



14.1 Ordering information

Table 18 RUVAC WH(U) 2500

Part no.	Type	Frequency converter	Mains voltage	Discharge flange	Type of oil	Motor power
155 250V	WH 2500	Internal	400 V	GS	LVO 410	11 kW (100 Hz)
155 251V	WH 2500	Internal	400 V	MS	LVO 410	11 kW (100 Hz)
155 252V	WH 2500	Internal	400 V	GS	LVO 211	11 kW (100 Hz)
155 253V	WH 2500	Internal	400 V	MS	LVO 211	11 kW (100 Hz)
155 254V	WH 2500	Internal	200 V	GS	LVO 410	11 kW (100 Hz)
155 260V	WH 2500	External	400 V	GS	LVO 410	11 kW (100 Hz)
155 261V	WH 2500	External	400 V	MS	LVO 410	11 kW (100 Hz)

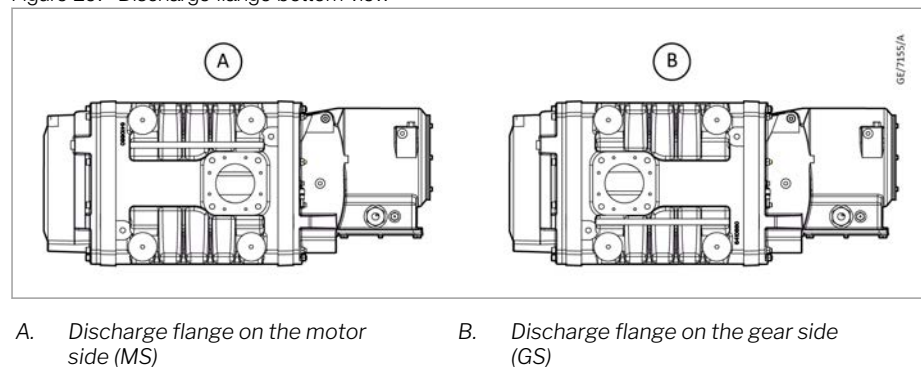
Accessories

Part no.	Type	Frequency converter	Mains voltage	Discharge flange	Type of oil	Motor power
155 262V	WH 2500	External	400 V	GS	LVO 211	11 kW (100 Hz)
155 263V	WH 2500	External	400 V	MS	LVO 211	11 kW (100 Hz)
155 264V	WH 2500	External	200 V	MS	LVO 410	11 kW (100 Hz)
155 265V	WH 2500	External	200 V	GS	LVO 410	11 kW (100 Hz)
155 267V	WH 2500	External	200 V	GS	LVO 211	11 kW (100 Hz)
155 270V	WH 2500	None (Dol)	400 V	GS	LVO 410	6.2/7.4 kW (50/60 Hz)
155 271V	WH 2500	None (Dol)	400 V	MS	LVO 410	6.2/7.4 kW (50/60 Hz)
155 272V	WH 2500	None (Dol)	400 V	GS	LVO 211	6.2/7.4 kW (50/60 Hz)
155 273V	WH 2500	None (Dol)	400 V	MS	LVO 211	6.2/7.4 kW (50/60 Hz)
155 280V	WHU 2500	None (Dol)	400 V	GS	LVO 410	6.2/7.4 kW (50/60 Hz)
155 281V	WHU 2500	None (Dol)	400 V	MS	LVO 410	6.2/7.4 kW (50/60 Hz)
155 284V	WHU 2500	None (Dol)	200 V	GS	LVO 410	6.2/7.4 kW (50/60 Hz)
155 285V	WHU 2500	None (Dol)	200 V	MS	LVO 410	6.2/7.4 kW (50/60 Hz)
155 288V	WHU 2500	None (Dol)	400 V	GS	LVO 211	6.2/7.4 kW (50/60 Hz)

LVO 211 is a synthetic type of oil (ester oil), **LVO 410** a PFPE lubricant

**Special models for single customers, order only possible after consultation with us.*

Figure 29. Discharge flange bottom view



Accessories

Table 19 RUVAC WH(U) 4400

Part no.	Type	Pressure balance valve	Motor power	Mains voltage		Type of oil	Special feature
				50 Hz	60 Hz		
127440V01	WHU 4400	Yes	18.5 kW	400 V	460 V	LVO 211	Washable
127440V14	WH 4400	No	11 kW	400 V	460 V	LVO 211	
127440V19	WH 4400	No	11 kW	200 V	230 V	LVO 211	
127440V25	WHU 4400 PFPE	Yes	18.5 kW	400 V	460 V	PFPE LVO 400	
127440V10	WH 4400	No	18.5 kW	400 V	460 V	LVO 211	Purge gas
127440V24	WH 4400 PFPE	No	11 kW	400 V	460 V	PFPE LVO 400	
127440V29	WH 4400 PFPE	No	11 kW	200 V	230 V	PFPE LVO 400	
127440V15	WHU 4400	Yes	18.5 kW	400 V	460 V	LVO 211	

Table 20 RUVAC WH(U) 7000

Part no.	Type	Pressure balance valve	Motor power	Mains voltage		Type of oil	Special feature
				50 Hz	60 Hz		
127700V14	WH 7000	No	11 kW	400 V	460 V	LVO 211	
127700V19	WH 7000	No	11 kW	200 V	200 V	LVO 211	
127700V15	WHU 7000	Yes	18.5 kW	400 V	460 V	LVO 211	
127700V10	WH 7000	No	18.5 kW	400 V	460 V	LVO 211	Sealed pistons purge gas
127700V29	WH 7000 PFPE	No	11 kW	200 V	230 V	PFPE LVO 400	
127700V24	WH 7000 PFPE	No	11 kW	400 V	460 V	PFPE LVO 400	
127700V13	WH 7000	No	18.5 kW	400 V	460 V	LVO 211	
127700V20	WH 7000	No	18.5 kW	400 V	460 V	PFPE LVO 400	Sealed pistons purge gas

All WH(U) 4400/7000 pump versions can be operated with a frequency converter.

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EU Declaration of Conformity

**Leybold GmbH**

Bonner Strasse 498
D-50968 Köln
Germany

Documentation Officer

T: +49(0) 221 347 0
documentation@leybold.com

The product specified and listed below

- *Product:* Roots Booster RUVAC with motor
- *Models:* WH(U) 4400, WH(U) 7000
- *Product family codes:* 127440Vxx "x" can be 1 - 9
127700Vxx
7850014V - 7850017V

Is in conformity with the relevant requirements of European CE legislation:

2006/42/EC Machinery directive

Note: The safety objectives of the Low Voltage Directive 2014/35/EU were complied with in accordance with Annex 1 No. 1.5.1 of this directive.

2014/30/EU Electromagnetic compatibility (EMC) directive
Class A Emissions, Industrial Immunity

2011/65/EU Restriction of certain hazardous substances (RoHS) directive
as amended by Delegated Directive (EU) 2015/863

Based on the relevant requirements of harmonised standards:

EN 1012-2:1996 +A1:2009 Compressors and vacuum pumps. Safety requirements. Vacuum pumps

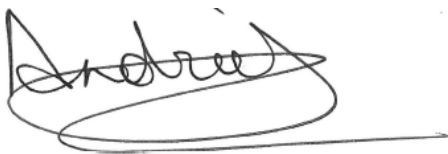
EN 61010-1:2010 Safety requirements for electrical equipment for measurement, control and laboratory use. General requirements

EN 61326-1:2013 Electrical equipment for measurement, control and laboratory use. EMC requirements. General requirements

This declaration, based on the requirements of the listed Directives and EN ISO/IEC 17050-1, covers all product serial numbers from this date on: 2022-02-04

You must retain the signed legal declaration for future reference

This declaration becomes invalid if modifications are made to the product without prior agreement.



Andries de Bock – VP Engineering
Industrial Vacuum Division
Cologne



Axel Guddas – General Manager
Product Company Cologne

Declaration of Conformity

Leybold GmbH

Bonner Strasse 498
D-50968 Köln
Germany

Documentation Officer

Innovation Drive
Burgess Hill
West Sussex
RH15 9TW
documentation@leybold.com

This declaration of conformity is issued under the sole responsibility of the manufacturer.

- *Product:* Roots Booster RUVAC with motor
- *Models:* WH(U) 4400, WH(U) 7000
- *Product family codes:* 127440Vxx "x" can be 1 - 9
 127700Vxx
 7850014V - 7850017V

The object of the declaration described above is in conformity with relevant statutory requirements:

Supply of Machinery (Safety) Regulations 2008

The objectives of the Electrical Equipment (Safety) Regulations 2016 are governed by Annex 1 1.5.1 of this regulation.

Electromagnetic Compatibility Regulations 2016

Class A Emissions, Industrial Immunity

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

Relevant designated standards or technical specifications are as follows:

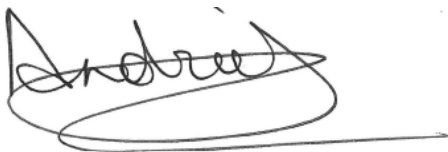
EN 1012-2:1996 +A1:2009	Compressors and vacuum pumps. Safety requirements. Vacuum pumps
EN 61010-1:2010	Safety requirements for electrical equipment for measurement, control and laboratory use. General requirements
EN 61326-1:2013	Electrical equipment for measurement, control and laboratory use. EMC requirements. General requirements

This declaration, based on the requirements of the listed Statutory Instruments and EN ISO/IEC 17050-1, covers all product serial numbers from this date on: 2022-02-04

You must retain the signed legal declaration for future reference

This declaration becomes invalid if modifications are made to the product without prior agreement.

Signed for and on behalf of Leybold GmbH



Andries de Bock – VP Engineering
Industrial Vacuum Division
Cologne



Axel Guddas – General Manager
Product Company Cologne

ADDITIONAL LEGISLATION AND COMPLIANCE INFORMATION

EMC (EU, UK): Class A/B Industrial equipment Caution: This equipment is not intended for use in residential environments and may not provide adequate protection to radio reception in such environments.

RoHS (EU, UK): Material Exemption Information This product is compliant with the following Exemptions Annex III:

- 6(a) Lead as an alloying element in steel for machining purposes and in galvanised steel containing up to 0.35 % lead by weight

REACH (EU, UK) This product is a complex article which is not designed for intentional substance release. To the best of our knowledge the materials used comply with the requirements of REACH. The product manual provides information and instruction to ensure the safe storage, use, maintenance and disposal of the product including any substance-based requirements.

Article 33.1 Declaration (EU, UK) This product contains Candidate List Substances of Very High Concern above 0.1%ww by article as clarified under the 2015 European Court of Justice ruling in case C-106/14.

- Lead (Pb) This substance is present in certain steel components.

Additional Applicable Requirements -

The product is in scope for and complies with the requirements of the following:
2012/19/EU Directive on waste electrical and electronic equipment (WEEE)
Product is certified to CSA-C22.2 No.61010-1-12 Safety requirements for electrical equipment for measurement, control and laboratory use – Part 1: General requirements
Product is certified to UL61010-1 3rd Edition Safety requirements for electrical equipment for measurement, control and laboratory use – Part 1: General requirements
cTUVus Certificate No. CU 72171635 01
The product is certified by TÜV Rheinland of North America which is a “Nationally Recognized Testing Laboratory” (NRTL) for USA and Canada.

材料成分声明

China Material Content Declaration

	有害物质 Hazardous Substances					
部件名称 Part name 	铅 Lead (Pb)	汞 Mercury (Hg)	镉 Cadmium (Cd)	六价铬 Hexavalent Chromium (Cr VI)	多溴联苯 Polybrominated biphenyls (PBB)	多溴二苯醚 Polybrominated diphenyl ethers (PBDE)
钢合金制品 Steel alloys	X	O	O	O	O	O
O: 表示该有害物质在该部件的所有均质材料中的含量低于 GB/T 26572 标准规定的限量要求。 O: Indicates that the hazardous substance contained in all of the homogeneous materials for this part is below the limit requirement in GB/T 26572. X: 表示该有害物质在该部件的至少一种均质材料中的含量超出 GB/T26572 标准规定的限量要求。 X: Indicates that the hazardous substance contained in at least one of the homogeneous materials used for this part is above the limit requirement of GB/T26572.						

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Pioneering products. Passionately applied.

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