

oerlikon
leybold vacuum

RUVAC WH / WHU 2500 / 4400 / 7000

Roots booster with synthetic oil or PFPE-filling

Installation and Operating Instructions 130001398_002_A8

Part Numbers

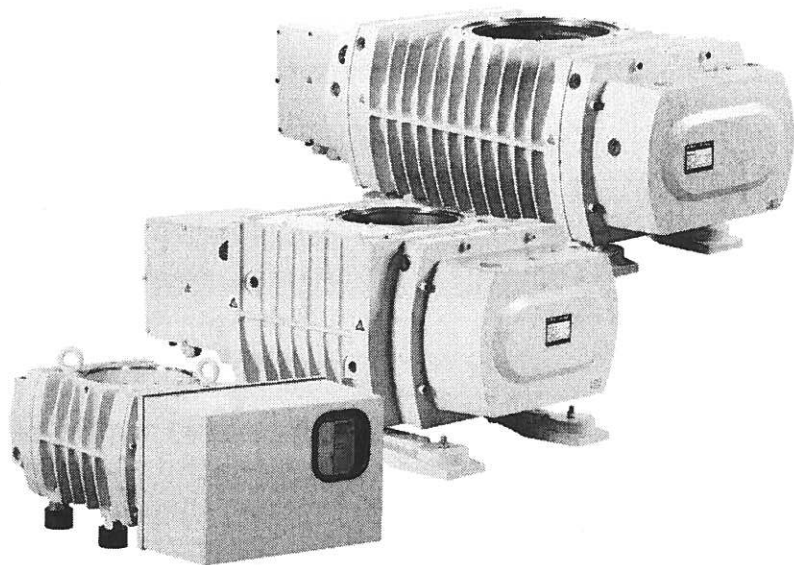
155 150 – 155 158V

7850012V – 7850017V

155 160 – 155 167

155 250V – 155 273V

155 280V – 155 283V



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These Installation and Operating Instructions are the original instructions.

Safety information

NOTICE



Obligation to Provide Information

Before installing and commissioning the pumps, carefully read these Operating Instructions and follow the information so as to ensure optimum and safe working right from the start

The Oerlikon Leybold Vacuum **RUVAC WH/WHU 2500/4400/7000** has been designed for safe and efficient operation when used properly and in accordance with these Operating Instructions. It is the responsibility of the user to carefully read and strictly observe all safety precautions described in this Section and throughout the Operating Instructions. **The pump must only be operated in the proper condition and under the conditions described in the Operating Instructions.** It must be operated and maintained by trained personnel only. Consult local, state, and national agencies regarding specific requirements and regulations. Address any further safety, operation and/or maintenance questions to our nearest office

DANGER



DANGER indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

WARNING



WARNING indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION



CAUTION indicates a potentially hazardous situation which, if not avoided, could result in minor or moderate injury.

NOTICE



NOTICE is used to notify users of installation, operation, programming or maintenance information that is important, but not hazard related.

Figures

The references to diagrams, e.g. (4.1/2) consist of Section No., consecutive fig. No. within the Section and the Item No. in the figure in that order.

We reserve the right to modify the design and the specified data. The illustrations are not binding.

Retain the Operating Instructions for further use.

Safety information

0 Important Safety Information

0.1 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 + 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.

WARNING



Safety information

- 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.
 - 14 The pumps must only be operated at the permitted speeds. Especially when using frequency converters which have not been specifically approved by Oerlikon Leybold Vacuum, you need to ensure an effective protection against overspeeding.
 - 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.
-

0.2 Electrical Hazards

- 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 Potentially lethal voltages are present at the mains connections. Before beginning with 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.
- 3 Install a device for a safe disconnection from the power supply.
- 4 High electric voltages! 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 deenergised (lockout/tagout) the equipment.
- 5 Note the information on the IP type of protection.
- 6 Always operate the pump with a properly connected protective earth conductor and make sure that the motor casing is closed.
- 7 Observe the manufacturer's information and operating instructions for the respective frequency converter.
- 8 The pump must only be operated at the frequency specified for the motor. For the WH 2500 use only the OLV frequency converter.
- 9 For pumps with 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.
- 10 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.
- 11 Before starting, check to ensure that the junction box is undamaged, run a visual inspection on the seals.
- 12 Install add-on parts (pressure switches, for example) without any mechanical tensions and protect these against being damaged by impacts, for example.
- 13 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.
- 14 Provide strain relief for the connecting lines so that the plugs and the line connectors are not subjected to excessively high mechanical stresses.
- 15 Lay electric lines so that there is no risk of tripping over these.

DANGER



Safety information

- 16 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.
- 17 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.
- 18 Work on the frequency converter within the motor casing must always be left to suitably instructed personnel only.

CAUTION



0.3 Thermal Hazards

- 1 Under certain ambient conditions the pump may attain temperatures over 80° C. There then exists the risk of suffering burns. Note the danger symbols on the pump and in the case of a hot pump wear the required protection equipment. All work on a pump which is "still warm from operation" should be done only whilst wearing protective gloves.
 - 2 Handle the pump only while vented and after having let it cool down.
 - 3 Before disassembling any cooling water lines, leave the pump to cool down first, then shut off the feed line.
 - 4 When uninstalling the cooling water lines, take note of splashing water. Heated water can cause burns.
 - 5 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.
 - 6 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.
-

0.4 Hazards Caused by Materials and Substances

- 1 The vacuum line must be leaktight. 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 test will always be necessary.

When pumping toxic, corrosive and reactive gases we recommend a leak test on a regular basis. Leaks in the pump cannot be ruled out under all circumstances. When pumping hazardous gases, the operator must ensure that leaks at the pump will not be a hazard.

- 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.

All relevant safety standards and regulations must be observed.

- 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 the customer.

- 4 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.

- 5 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 gloves, breathing protection or protection clothing and work under a fume hood. Firmly seal off the pump. When shipping the contaminated pump for servicing please also indicate the type of hazard. For this see Section 5.5 Service at Oerlikon Leybold Vacuum.

- 6 Oerlikon Leybold Vacuum is 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.

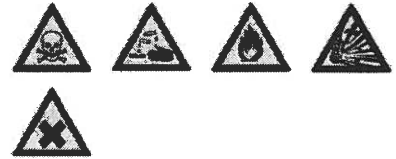
- 7 When disposing of the pump, used lubricants and used oil filters, observe the applicable environment regulations.

- 8 When pumping hazardous gases you must assume the presence of hazardous residues in the pump.

- 9 If the pump has been contaminated by the process or through environmental influences, it must be decontaminated professionally.

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.

DANGER



Safety information

When shipping contaminated pumps which require approval by the authorities, note the applicable regulations regarding packaging and shipping.



- 10 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.

DANGER



0.5 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.

CAUTION



0.6 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).

CAUTION



0.7 Dangers in Connection with Safety-related Measures and Precautions

- 1 The pump is not equipped with an emergency shutdown facility.
 - 2 The following applies to pumps being operated with a frequency converter: after a mains power failure the pump will automatically start up again once the power returns.
 - 3 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.
-

0.8 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 und 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.

If possible, use the intake screen which has been fitted as standard and clean it regularly.

In case the pump is operated without intake screen the operator has to make sure that no objects can enter the pump through the intake port. Objects falling into the pump can cause severe damage at the pump including leaks to atmosphere.

The intake screen does not replace a filter. Prevent the intake of particles from the side of the process by fitting suitable filters. Upstream filters protect the pump against damage to the pump chamber.
- 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.
- 9 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.

NOTICE



Safety information

- 10 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.
- 11 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.
- 12 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.
- 13 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.
- 14 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.
- 15 Maximum cooling water pressure: 6 bar. When exceeded, there is the risk of leaks.
- 16 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 please consult OLV.
- 17 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.
- 18 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.
- 19 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))

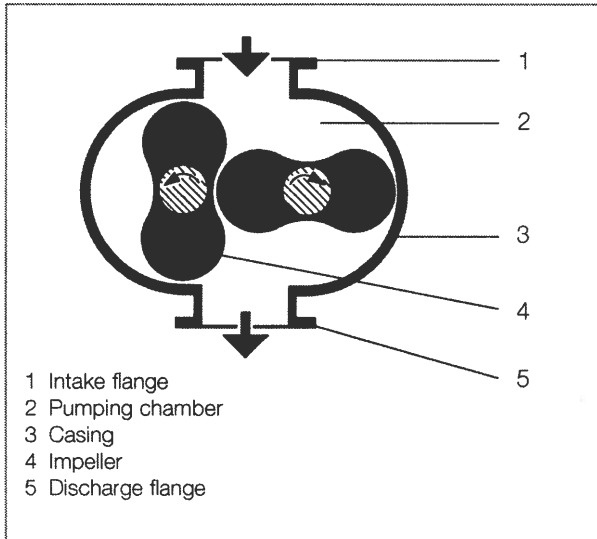


Fig. 1.1 Schematic cross-section of a Roots pump (vertical flow)

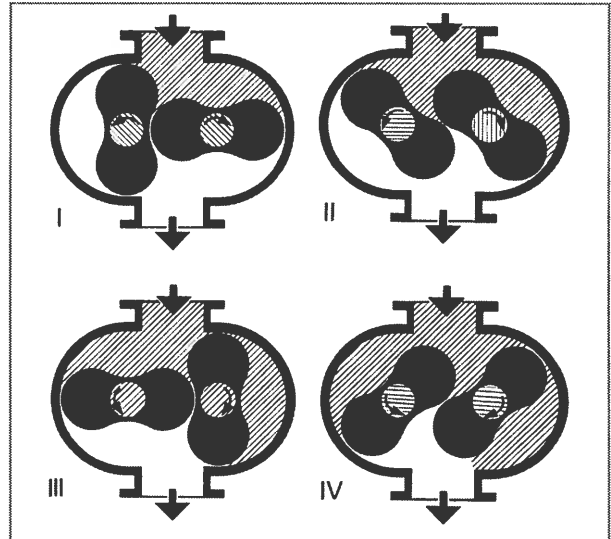


Fig. 1.2 Functional diagram of a Roots pump (vertical flow)

1 Description

1.1 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 mineral oil or perfluorized polyether (PFPE) or diester oil, depending on the customer requirements. Apart from the lubricant, the mineral oil and PFPE models are identical in type.

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 gasses. In these cases it is imperative that you consult your local Oerlikon Leybold office.

1.1.1 Principle of Operation

Roots boosters - also known as Roots pumps or Roots blowers - contain in their pump casing (1.1/3) two symmetrical impellers (1.1/4) rotating in opposite directions. The impellers have roughly the cross section of a figure "8" and are synchronised by a toothed gear so that they move past each other and the casing without contact but with a small clearance. The principle of operation is explained in fig. 1.2.

Description

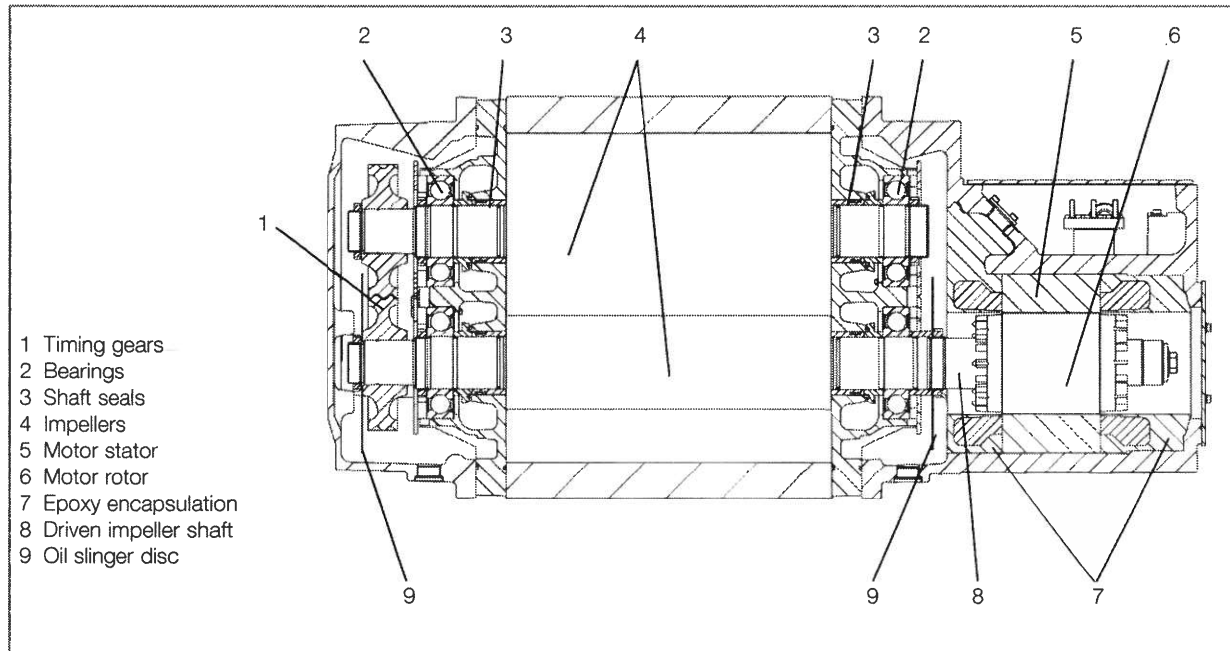


Fig. 1.3 Longitudinal section of a RUVAC WH 4400 (horizontal flow)

In impeller positions I and II, the volume in the intake flange is increased. When the impellers rotate further to position III, part of the volume is sealed off from the intake side.

In position IV, this volume is opened to the discharge side, and gas at backing pressure (higher than the intake pressure) flows in. The inflowing gas compresses the gas volume pumped from the intake side. As the impellers rotate further, the compressed gas is ejected via the discharge flange. This process occurs twice per complete revolution of each of the two impellers.

Due to the non-contacting rotation in the pumping chamber, Roots pumps can be operated at high speeds (standard $n = 3,000$ rpm at a mains frequency of 50 Hz). Thus a relatively high pumping speed is attained with small pumps.

Differential pressure and compression ratio between the intake and discharge sides are limited on Roots pumps. If the allowable differential pressure is exceeded, the pump overheats or the motor is overloaded.

In practice, the maximum attainable differential pressure is significant only in the rough vacuum range ($p > 10$ mbar), whereas for pressures in the medium vacuum range ($p < 1$ mbar) the attainable compression ratio is decisive.

RUVAC pumps from the WH/WHU range have been specifically designed for operation in the rough and medium vacuum ranges. They are thus either used in connection with backing pumps or in closed gas cycles.

Power consumption of the pump depends on

- the volume of the pump chamber
- the speed of the pump
- the working pressure range
- the pressure difference between intake and discharge flange
- and the type of gas to be pumped.

1.1.2 Design

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 gear-wheels and bearings of the RUVAC are located in two side chambers which also contain the oil supply (see fig. 1.3).

These two side chambers are separated from the pumping chamber by the impeller seals.

In both side chambers there are oil slinger discs to ensure that the bearings and gearwheels receive sufficient lubricant at all recommended speeds.

RUVAC WH/WHU pumps 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. The exposed motor material is very stable against chemicals.

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 Oerlikon Leybold Vacuum, 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

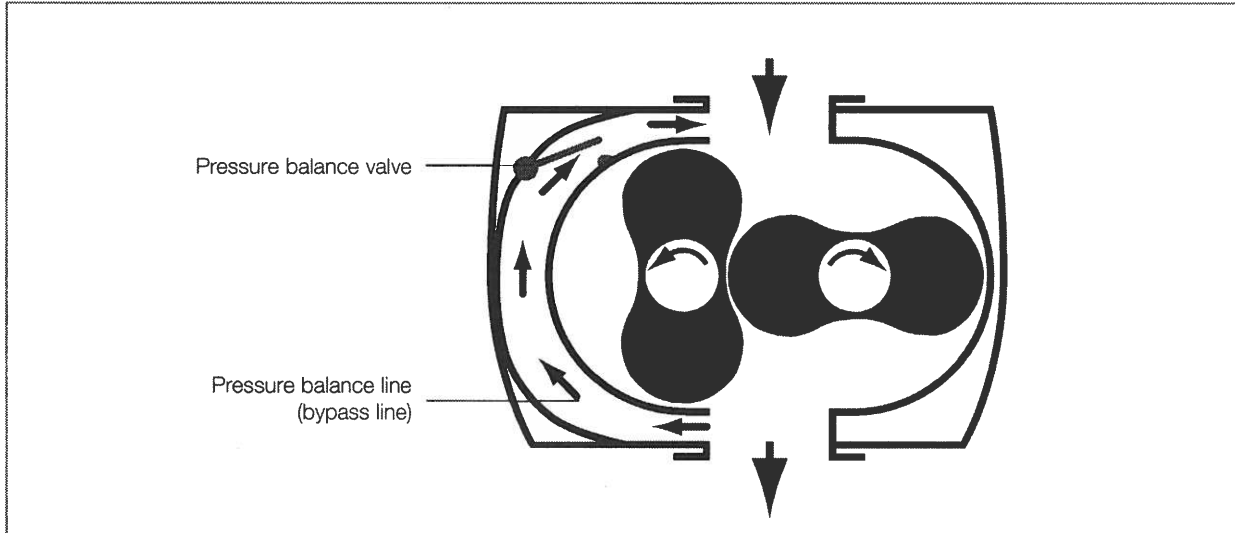


Fig. 1.4 Schematic diagram of a Roots pump with pressure balance line

1.1.3 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 optimized 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.

The pressure balance valve is therefore adjusted to generate a maximum differential pressure and will not protect the pump from thermal overload if opened continuously. If you want to protect the pump from overload over a longer period of time for example in process applications running close to or above the differential pressure limit of the pump, a frequency converter with a customized current limit will be the better choice. OLV offers suitable frequency converters and can assist you with adjusting the parameters.

1.1.4 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.

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 please contact Oerlikon Leybold Vacuum.

NOTICE



1.2 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.

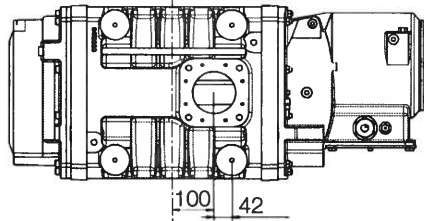
All pumps are equipped with an intake screen in their intake flange and have been vented with nitrogen to protect the pump against corrosion. The flanges have been sealed off with adhesive foil.

The RUVAC WH 2500 pumps with an internal frequency converter are supplied together with the frequency converter.

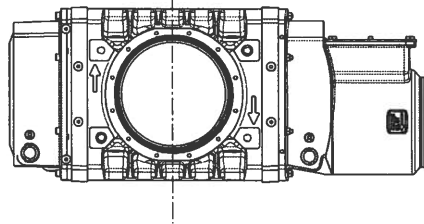
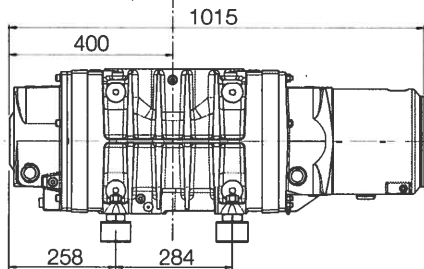
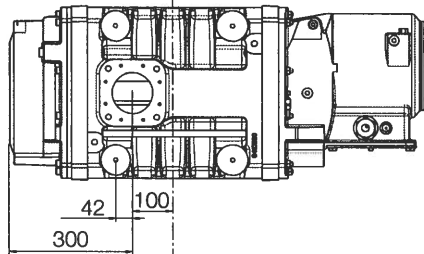
Description

RUVAC WH/WHU 2500 without frequency converter

Version with discharge flange on the motor side



Version with discharge flange on the gear side



Deviating dimensions for WHU 2500
(The bypass line changes the side together with the exhaust flange.)

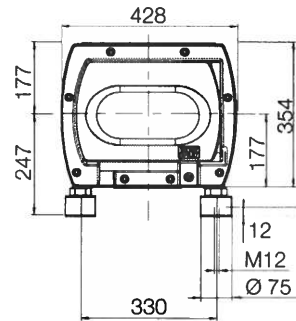
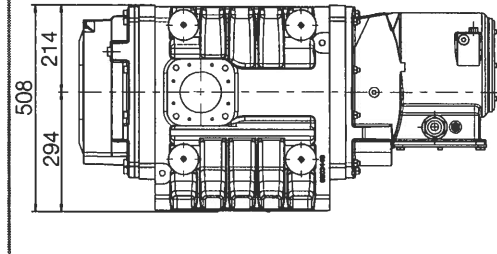
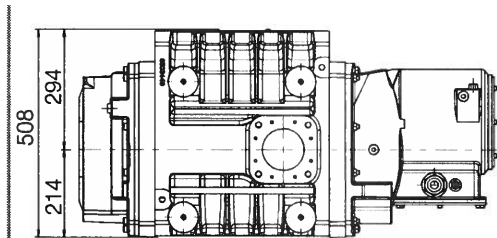


Fig. 1.5 Dimensional drawing for the RUVAC WH/WHU 2500 without frequency converter

Description

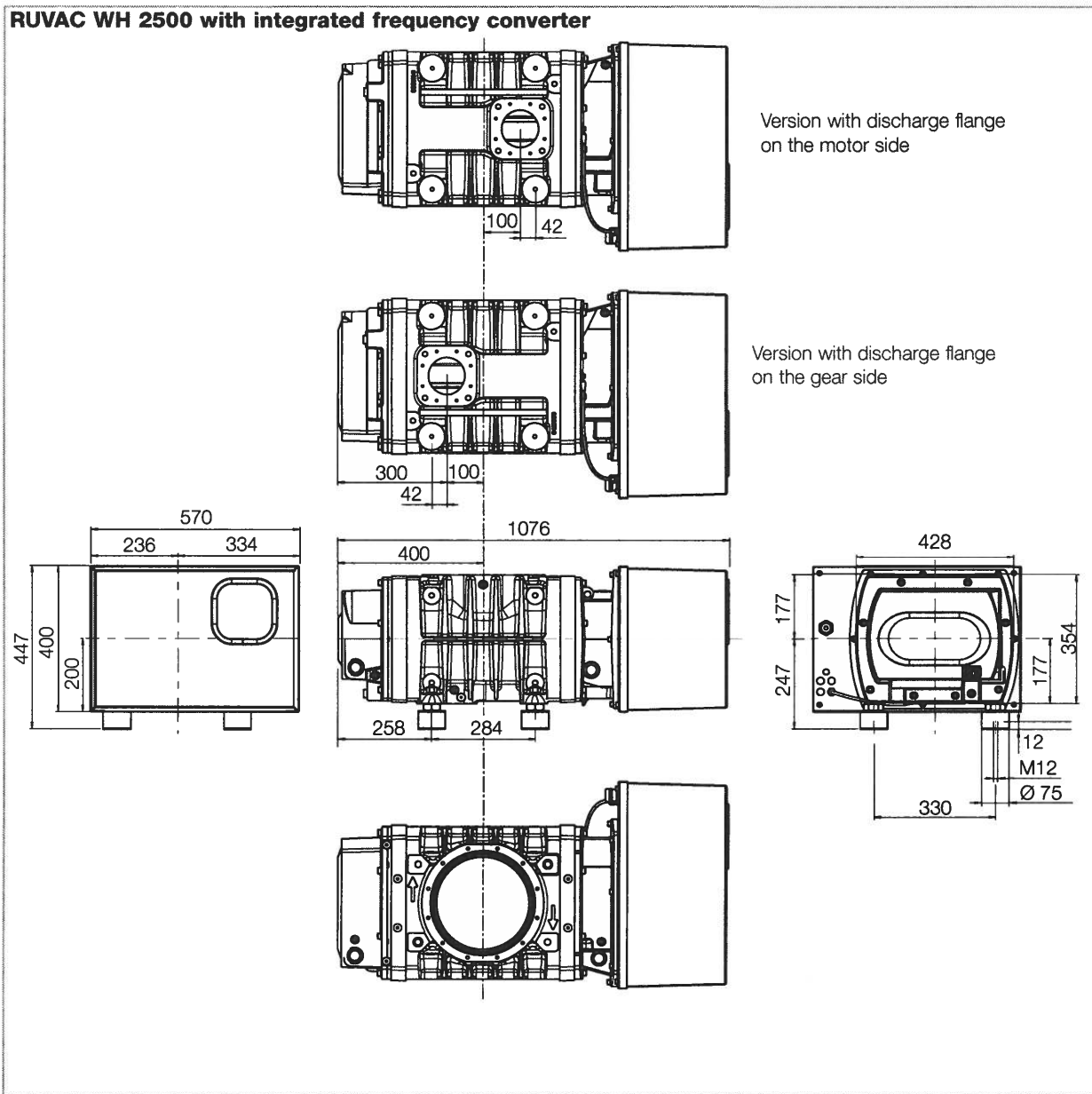
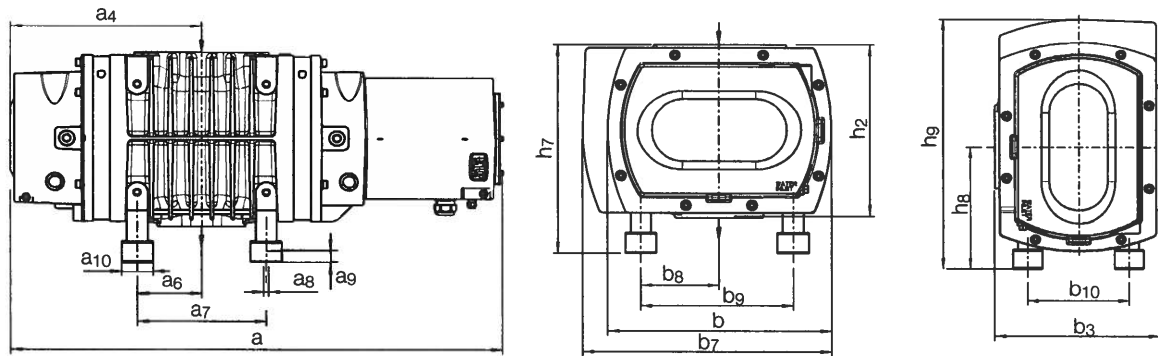


Fig. 1.6 Dimensional drawing RUVAC WH/WHU 2500 with integrated frequency converter

Description

RUVAC WH/WHU 4400/7000



Pump		ntake 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

Pumpe		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

Fig. 1.7 Dimensional drawing for the RUVAC WH/WHU 4400 and 7000

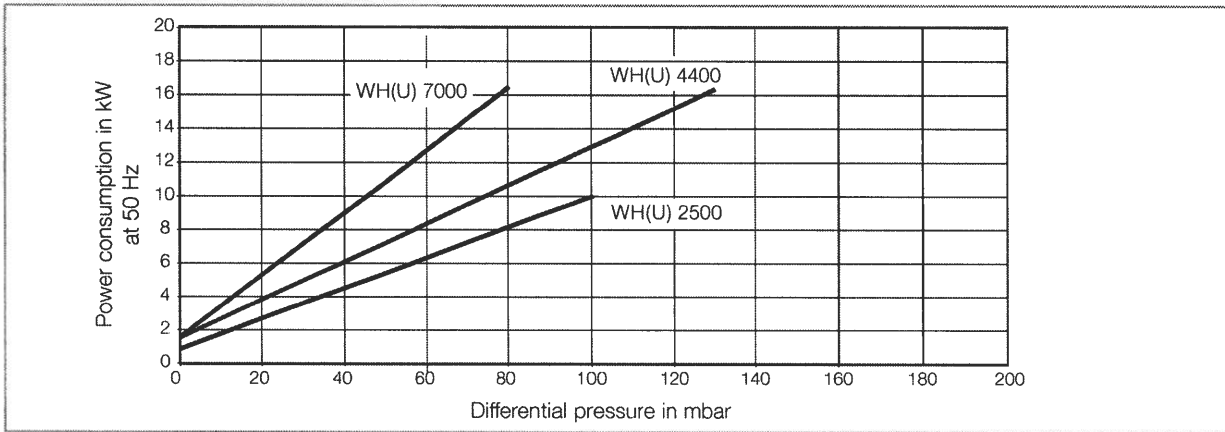


Fig. 1.8 Power consumption of the RUVAC WH/WHU

Description

1.3 Technical Data

RUVAC WH/WHU 2500		50 Hz	60 Hz	80 Hz	100 Hz	Tolerance
Nominal pumping speed acc. to DIN 28426	m ³ ·h ⁻¹	2500	3000	4000	5000	
Max. effective pumping speed with SP 630 backing pump	m ³ ·h ⁻¹	2200	2500	3200	3900	± 5 %
Max. permissible pressure difference WH for continuous operation ¹⁾	mbar	50-75	40-60	30-40	20	
WHU for short cycle operation < 2 minutes	mbar	150	150			
Leak rate, integral	mbar l·s ⁻¹			1x10 ⁻⁵		
Permissible ambient temperature ²⁾	°C		10 - 50			
Storage temperature	°C		-10 to + 60			
Contamination grade			2			
Overvoltage category			3			
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 (200)	460 (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	-	-	
Rated idle current	kW	0.9	1	1.3	1.5	± 0.8 kW
Motor efficiency class calculated and configured acc. to EN 60034-30				IE2		
Mains fusing/characteristic ³⁾	A		32 /C			
Short-circuit interrupting capacity	kA		< 25			
Nominal speed	rpm	3000	3600	4800	6000	
Max. permissible speed ⁴⁾	rpm		6000			
Protection class acc. to EN 60529 with internal frequency converter				IP 54		
with external or no frequency converter				IP 55		
Cooling water				see Section 3.3		
Lubricant filling	l		1.2			
Connecting flange inlet/discharge	DN		250 ISO-K / 100 ISO-K			
Painting			RAL 7011			
Weight						
WH without/with frequency converter	kg		390 / 430			
WHU without frequency converter	kg		410			
Noise level acc. to DIN EN ISO 2151	dB (A)		< 63 ⁵⁾			K _{PA} = 3 dB

1) The permissible pressure differences are dependent on various factors. Please see Section 1.3.2 for further details.

2) Higher ambient temperatures are possible with reduced operating limits (derating). Please consult Oerlikon Leybold Vacuum 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.

Description

RUVAC WH/WHU		4400	4400	4400	7000	7000	7000
		50 Hz	60 Hz	80 Hz	50 Hz	60 Hz	70 Hz
Nominal pumping speed acc. to DIN 28426	m ³ · h ⁻¹	4400	5280	7040	7000	8400	9800
Max. effective pumping speed with SP 630 backing pump (+ RUVAC WS 2001)	m ³ · h ⁻¹	3300 (3700)	3900 (4400)	4800 (5800)	4700 (5700)	5300 (6800)	5800 (7800)
Max. 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	120	120	-	70	70	-
Leak rate, integral	mbar l · s ⁻¹	1x10 ⁻⁵					
Permissible ambient temperature	°C	10 - 40 ⁴⁾					
Storage temperature	°C	-10 to + 60					
Mains voltage	V	400 (200) ²⁾	460 (210) ²⁾	FC	400 (200) ²⁾	460 (210) ²⁾	FC
Rated power consumption	kW	11 / 18.5					
Idle power consumption	kW	1.2	1.4	2	1.2	1.4	1.7
Nominal speed	rpm	3000	3600	4800	3000	3600	4200
Max. permissible speed ³⁾	rpm	4800	4800	4800	4200	4200	4200
Motor efficiency class calculated and configured acc. to EN 60034-30		IE2					
Protection class acc. to EN 60529		IP 55					
Cooling water		see Section 3.3					
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					
Painting	RAL	7011					
Weight WH / WHU	kg	590/620			650/700		
Noise level acc. to DIN EN ISO 2151	dB (A)	< 63 ⁵⁾					

1) The permissible pressure differences are dependent on various factors. Please see Section 1.3.2 for further details.

2) ± 10%, Low voltage 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 please consult Oerlikon Leybold Vacuum.

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.

1.3.1 Voltage Ranges for the Hermetically Sealed Motors

400 V motor

	Nominal power/current at:		Nominal power/current at:	
	50 Hz, 400 V		60 Hz, 460 V	
	kW	A	kW	A
RUVAC WH(U) 2500	6,2	11,6	7,4	11,6
RUVAC WH(U) 4400 11 kW	11	20	11	17
RUVAC WH(U) 4400 18 kW	18,5	35	18,5	29
RUVAC WH(U) 7000 11 kW	11	20	11	17
RUVAC WH(U) 7000 18 kW	18,5	35	18,5	29

200 V motor

	Nominal power/current at:		Nominal power/current at:	
	50 Hz, 200 V		60 Hz, 200/208 V	
	kW	A	kW	A
RUVAC WH(U) 2500	6,2	23,2	7,4	25
RUVAC WH 4400 11 kW	11	41	11	41
RUVAC WH 7000 11 kW	11	41	11	41

Under all circumstances the motor protection switch must be set to the nominal current listed in the table.

NOTICE



1.3.2 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.

Description

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 Section 4.1

In general 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.

Example Max. allowable differential pressure in duty cycle:

RUVAC WH 4400 at 50 Hz / SP 630

Operation: 10 minutes at high differential pressure

10 minutes at a discharge pressure of less than 1 mbar

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

Duty cycle is 50 %. The maximum allowable differential pressure resulting from the table above is $D_{pmax} = 63 \text{ mbar}$.

See also Section 4.1 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, see Section 1.5. The RUVAC WHU 2500 with PFPE is equipped with an integrated gear chamber evacuation facility.

Avoid oil spreading

If the pump is intended for more than 100,000 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.

Description

Maximum permissible differential pressures for the RUVAC WH in mbar

WH 2500												
Operation at	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	75/55*	60/55*	50	60/55*	50/55*	40/50*	40	35	30	20	20	20
Duty cycle 50% (max. 40 min)	75/55*	75/55*	70/55*	75/55*	70/55*	55	55	45	40	25	25	25
Pumpdown from atmosphere (< 2 min)	150	150	-	150	150	-	-	-	-	-	-	-

* Operation without frequency converter / with OLV frequency converter

WH 4400									
Operation at	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	45	38	30	30	25	20	12	10	8
Duty cycle 50% (max. 40 min)	75	63	50	57	47	38	18	15	12
Pumpdown from atmosphere (< 2 min)	120	120	-	120	120	-	-	-	-

WH 7000									
Operation at	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	30	25	20	21	17	14	14	12	11
Duty cycle 50% (max. 40 min)	45	37	30	31	25	21	21	18	16
Pumpdown from atmosphere (< 2 min)	70	70	-	70	70	-	-	-	-

Remarks

Cycle times exceeding 40 minutes are considered as continuous operation.

Short cycle operation below 2 minutes should 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.

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!

NOTICE



Description

1.4 Ordering Information

RUVAC WH(U) 2500

P/N	Type	Frequency converter	Mains voltage	Discharge flange	Type of oil	Motor power
155 250V	WH 2500	internal	400 V	GS	LVO 410 ¹⁾	11 kW
155 251V	WH 2500	internal	400 V	MS	LVO 410 ¹⁾	11 kW
155 252V	WH 2500	internal	400 V	GS	LVO 210	11 kW
155 253V	WH 2500	internal	400 V	MS	LVO 210	11 kW
155 260V	WH 2500	external	400 V	GS	LVO 410 ¹⁾	11 kW
155 261V	WH 2500	external	400 V	MS	LVO 410 ¹⁾	11 kW
155 262V	WH 2500	external	400 V	GS	LVO 210	11 kW
155 263V	WH 2500	external	400 V	MS	LVO 210	11 kW
155 264V	WH 2500	external	200 V	MS	LVO 410 ¹⁾	11 kW
155 265V	WH 2500	external	200 V	GS	LVO 410 ¹⁾	11 kW
155 270V	WH 2500	none	400 V	GS	LVO 410 ¹⁾	6.2/7.4 kW (50/60 Hz)
155 271V	WH 2500	none	400 V	MS	LVO 410 ¹⁾	6.2/7.4 kW (50/60 Hz)
155 272V	WH 2500	none	400 V	GS	LVO 210	6.2/7.4 kW (50/60 Hz)
155 273V	WH 2500	none	400 V	MS	LVO 210	6.2/7.4 kW (50/60 Hz)
7850016V*	WH 2500	external	200 V	MS	PFPE	
7850017V*	WH 2500	external	400 V	MS	PFPE	
155 280V	WHU 2500	none	400 V	GS	LVO 410 ¹⁾	6.2/7.4 kW (50/60 Hz)
155 281V	WHU 2500	none	400 V	MS	LVO 410 ¹⁾	6.2/7.4 kW (50/60 Hz)
155 282V	WHU 2500	none	200 V	GS	LVO 410 ¹⁾	6.2/7.4 kW (50/60 Hz)
155 283V	WHU 2500	none	200 V	MS	LVO 410 ¹⁾	6.2/7.4 kW (50/60 Hz)

GS: gear side, MS: motor side

LVO 210 is a synthetic type of oil (ester oil), **LVO 400** and **LVO 410** PFPE lubricants

1) LVO 400 has also been qualified

*special models for single customers, order only possible after consultation with OLV

Description

RUVAC WH(U) 4400

P/N	Type	Pressure balance valve	Motor power	Mains voltage		Type of oil
				50 Hz	60 Hz	
155 150	WH 4400	no	11 kW	400 V	460 V	LVO 210
155 151V	WH 4400	no	11 kW	200 V	210 V	LVO 210
155 153	WHU 4400 PFPE	yes	18.5 kW	400 V	460 V	PFPE LVO 400
155 154V	WH 4400	no	18.5 kW	400V	460 V	LVO 210 purge gas
155 155	WH 4400 PFPE	no	11 kW	400 V	460 V	PFPE LVO 400
155 156	WH 4400PFPE	no	11 kW	200 V	210 V	PFPE LVO 400
155 158V	WHU 4400	yes	18.5 kW	400 V	460 V	LVO 210
7850012V*	WH 4400	no	11 kW	200 V	210 V	PFPE LVO 400
7850013V*	WH 4400	no	11 kW	400 V	460 V	PFPE LVO 400

RUVAC WH(U) 7000

P/N	Type	Pressure balance valve	Motor power	Mains voltage		Type of oil
				50 Hz	60 Hz	
155 160	WH 7000	no	11 kW	400 V	460 V	LVO 210
155 161V	WH 7000	no	11 kW	200V	200 V	LVO 210
155 162	WHU 7000	yes	18.5 kW	400 V	460 V	LVO 210
155 163V	WH 7000	no	18.5 kW	400V	460 V	LVO 210 sealed pistons purge gas
155 164V	WH 7000 PFPE	no	11 kW	200 V	210 V	PFPE LVO 400
155 165	WH 7000 PFPE	no	11 kW	400 V	460 V	PFPE LVO 400
155 166	WHU 7000 PFPE	yes	18.5 kW	400 V	460 V	PFPE LVO 400
155 167	WH 7000	no	18.5 kW	400 V	460 V	LVO 210
7850014V*	WH 7000	no	11 kW	200V	210 V	PFPE LVO 400
7850015V*	WH 7000	no	11 kW	400 V	460 V	PFPE LVO 400

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

*special models for single customers, order only possible after consultation with OLV

Description

1.5 Accessories

Description
P/N

Frequency converter¹⁾ for

RUVAC WH 2500 11 kW (at 50 Hz), 400 V	155 230V
RUVAC WH 2500 11 kW (at 50 Hz), 200 V	155 231V
RUVAC WH 4400/7000 11 kW, 400 V	155 191V
RUVAC WH 4400/7000 18.5 kW, 400 V	155 192V
RUVAC WH 4400/7000 11 kW, 200 V	155 193V
Profibus board for frequency converter	155 212V
LCD operator front panel for frequency converter	155 213V
USB Copy Unit	155 214V
Relais board	112 005A01
Set pump feet for horizontal flow WH/WHU 4400/7000	155 181V
Gear chamber evacuation kit WH/WHU 4400/7000 (works also for WH/WHU 2500 with LVO 210)	155 183V

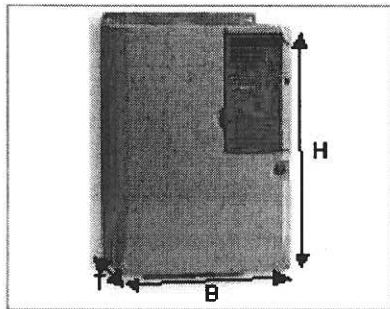
Adapters

RUVAC WH/WHU 2500 to DRYVAC DV 650 /1200	112 005A07
RUVAC WH/WHU 2500 to SOGEVAC SV 630 B	9714WH2500
RUVAC WH/WHU 2500 to SP 630	on request
RUVAC WH/WHU 2500 to SOGEVAC SV 1200	on request
RUVAC WH/WHU 4400 to SP 630	119 024V
RUVAC WH/WHU 4400 to SOGEVAC SV 630 B	97143WH4400
RUVAC WH/WHU 4400/7000 to SOGEVAC SV1200	9533WH

1) All frequency converters are equipped with an EMC filter.

Frequency converter dimensions incl. mains filter

P/N	for RUVAC	Description	W x H x D incl. mains filter
155 230V	WH 2500	400 V 11 kW	180 x 290 x 220
155 231V	WH 2500	200 V 11 kW	180 x 290 x 240
155 191V	WH 4400/7000	400 V 11 kW	180 x 290 x 243
155 192V	WH 4400/7000	400 V 18 kW	180 x 290 x 263
155 193V	WH 4400/7000	200 V 11 kW	180 x 290 x 263



Transportation and storage

2 Transportation and Storage

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 fig. 2.1. 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.

When connecting or removing the pump, do not step under hoisted loads. Notice safety information 0.1.

WH/WHU 4400 und 7000: Before transporting the pump always drain out the oil (see Section 5.2). 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° max. 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.

CAUTION



NOTICE



Transportation and storage

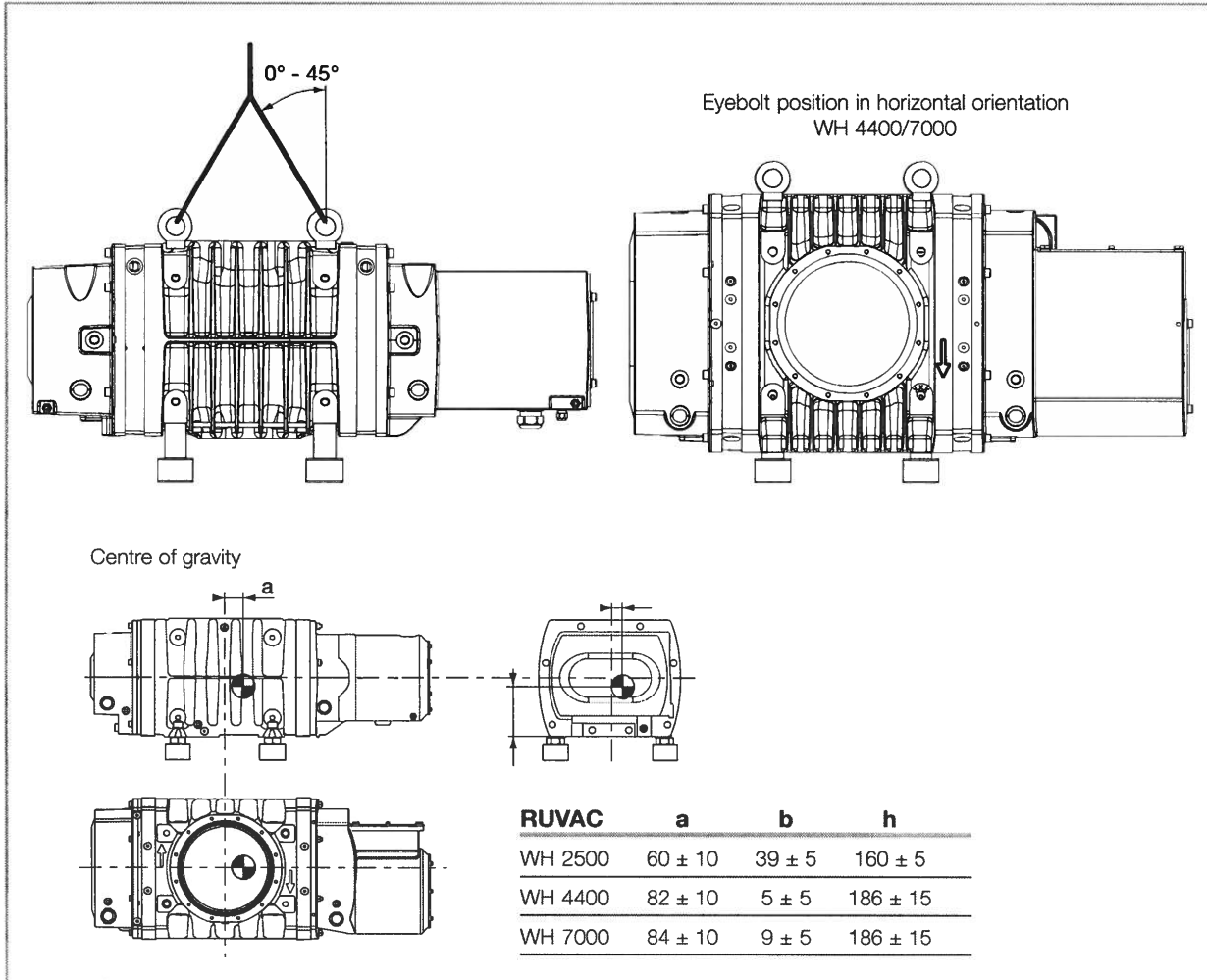


Fig. 2.1 Transporting

Transportation and storage

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.

If there is the danger of frost, the cooling water must be drained, see Section 4.3 Removing from Service.

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

Temperature (only for storage without cooling water!) -20 °C to +60 °C

Storage site dry

Maximum atmospheric humidity 95 %, non-condensing

NOTICE



Capacitor forming – What has to be observed when a frequency converter was longer than 2 years on stock?

If a frequency converter was on stock for a time longer than two years, it should not be connected directly to the power line. When doing so, the capacitors might be permanently damaged.

Instead the DC bus of the frequency converter should be connected to a DC power source including a current limiting resistor and the voltage should be raised slowly. This kind of process is called forming capacitors.

In case a DC power source is not available, the DC bus of a second frequency converter connected to a variable AC power supply could be used to supply the variable DC voltage.

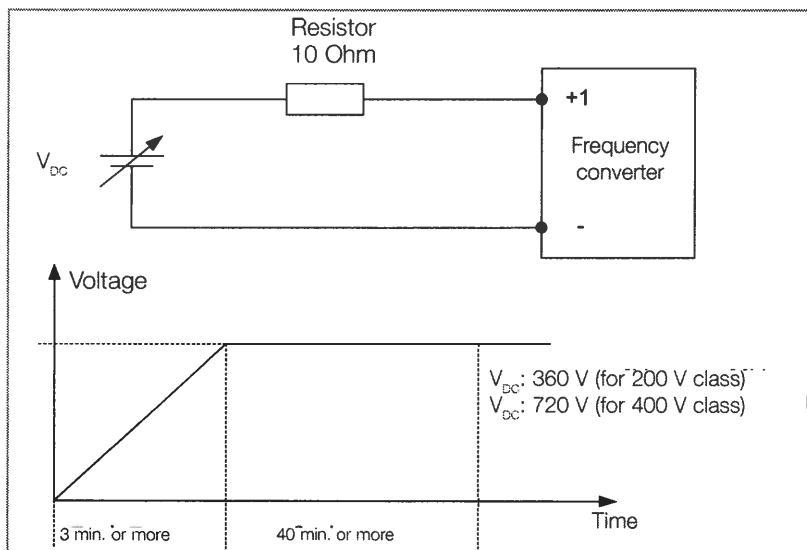


Fig. 2.2 Capacitor forming

Installation

RUVAC WH 2500

M16x1.5 thread with
closure screw for
measurement
connection (4x)

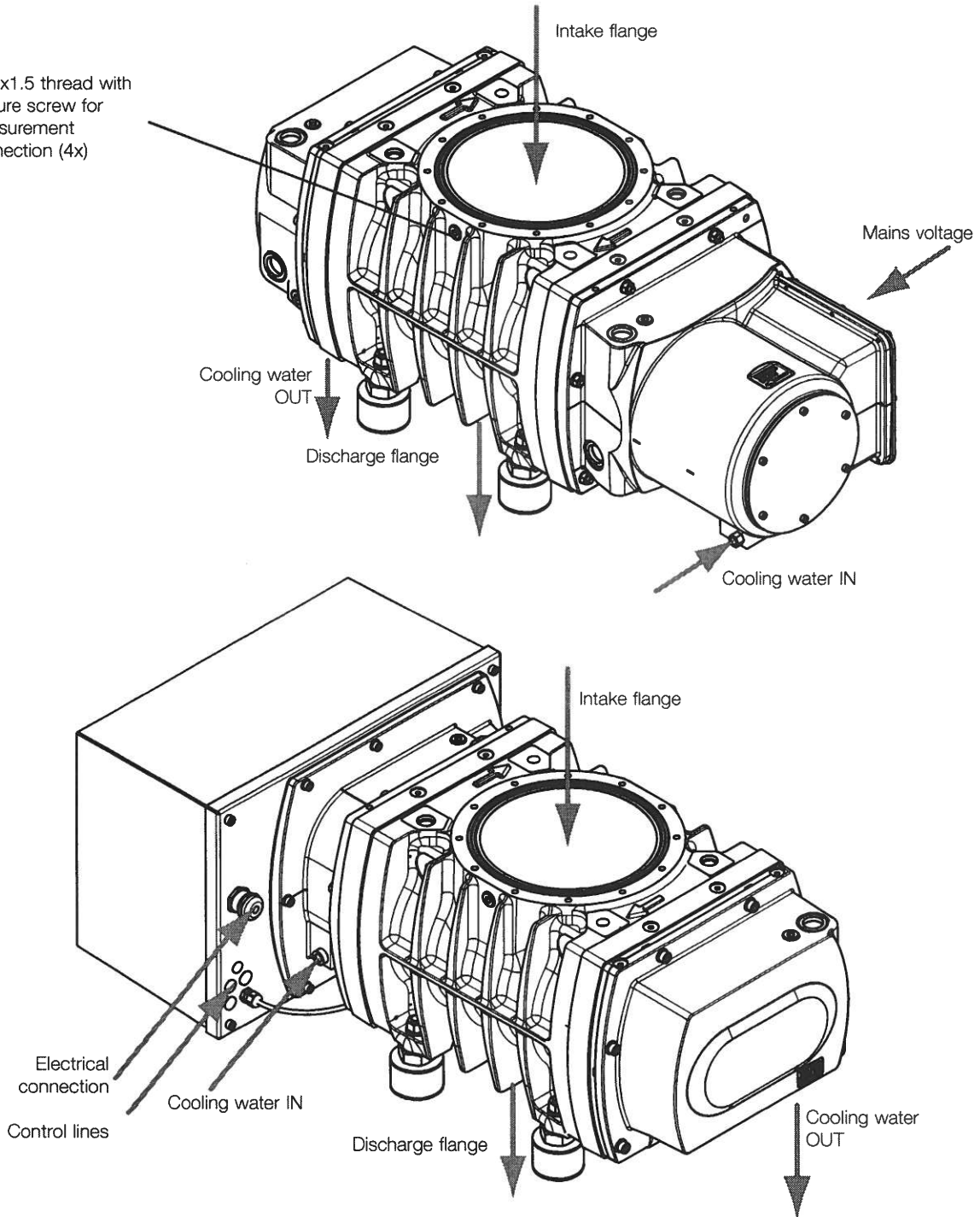


Fig. 3.1. Connections at the WH 2500

3 Installation

3.1 Placement

Install RUVAC WH/WHU pumps on a flat, horizontal surface (2° max. 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 und 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.

In combination with the maximum allowable differential pressure higher temperatures can even damage the pump.

Install the WH/WHU pumps only in indoor rooms. Sudden cooling of the pump casing during operation will damage the pump.

The RUVAC WH/WHU pumps are designed to be functional at altitudes up to 1000 m above sea level. If the pump is operated on higher altitudes, special precautions have to be taken. Please consult Oerlikon Leybold Vacuum in this case.

Secure the pump.

Use the bores at the bottom of the rubber elements.

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.

Notice safety information 0.1.

Use screws 4 x M 12.

NOTICE

NOTICE

NOTICE

Installation

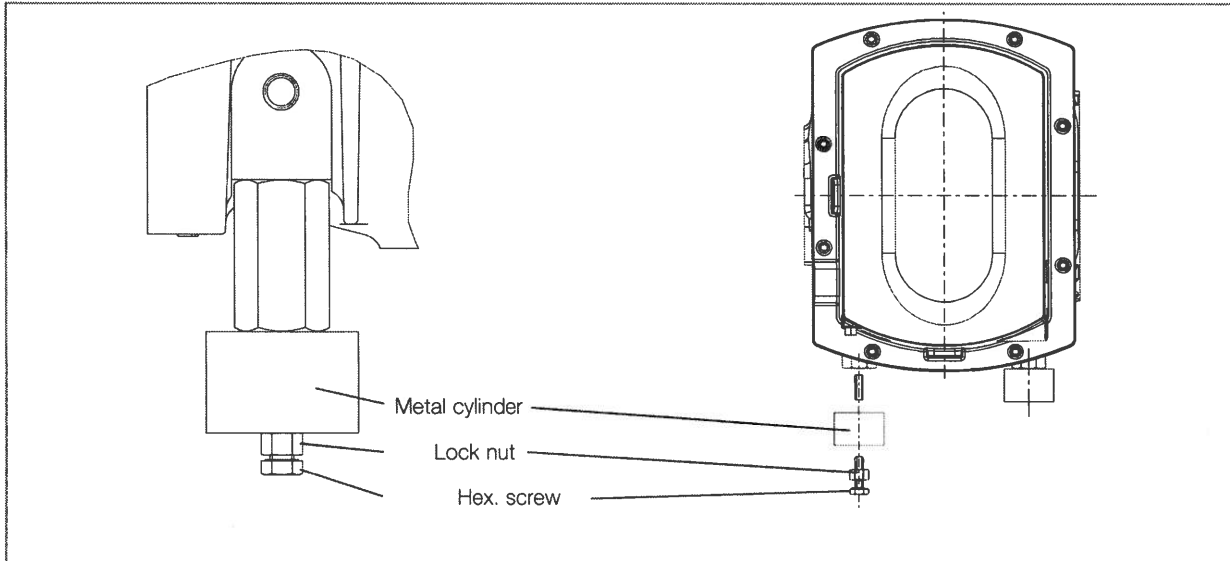


Fig. 3.2 Accessories / 3 metal cylinders for absorbing lateral forces in case of a horizontal flow (for WH/WHU 4400/7000)

3.1.1 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. Thereafter 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.

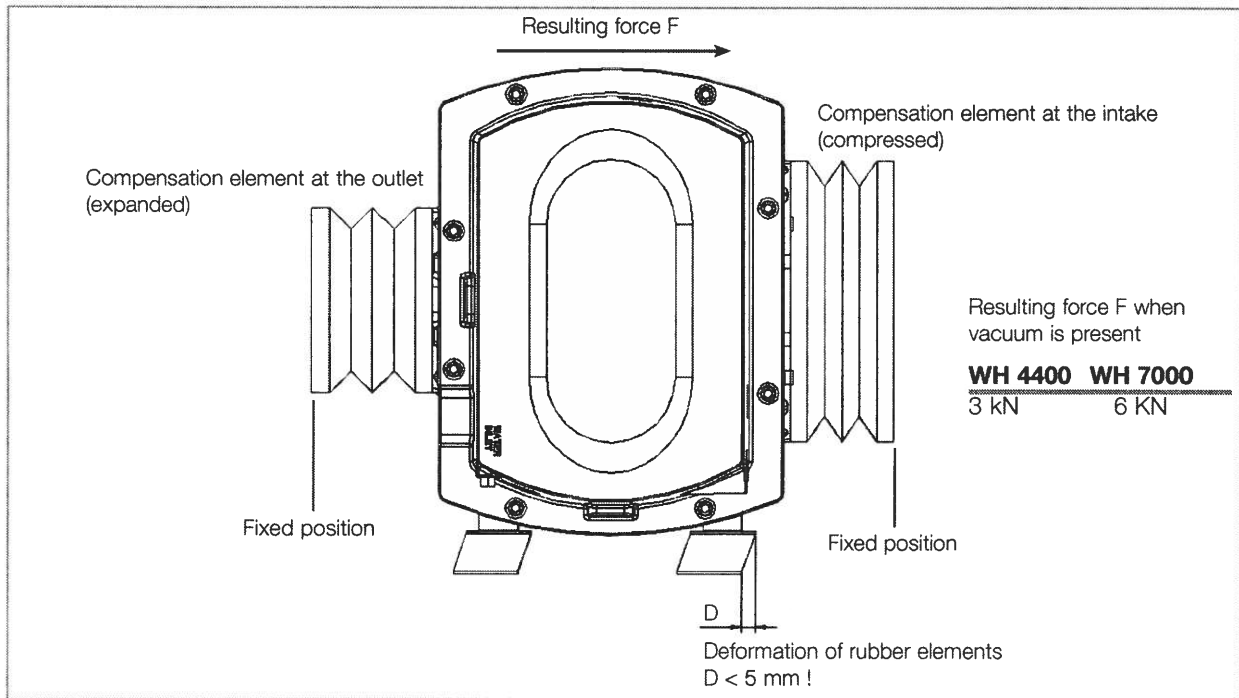


Fig. 3.3 Outer forces on evacuated pumps for horizontal flow

3.1.2 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, see Section 1.5 Accessories.

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

Installation

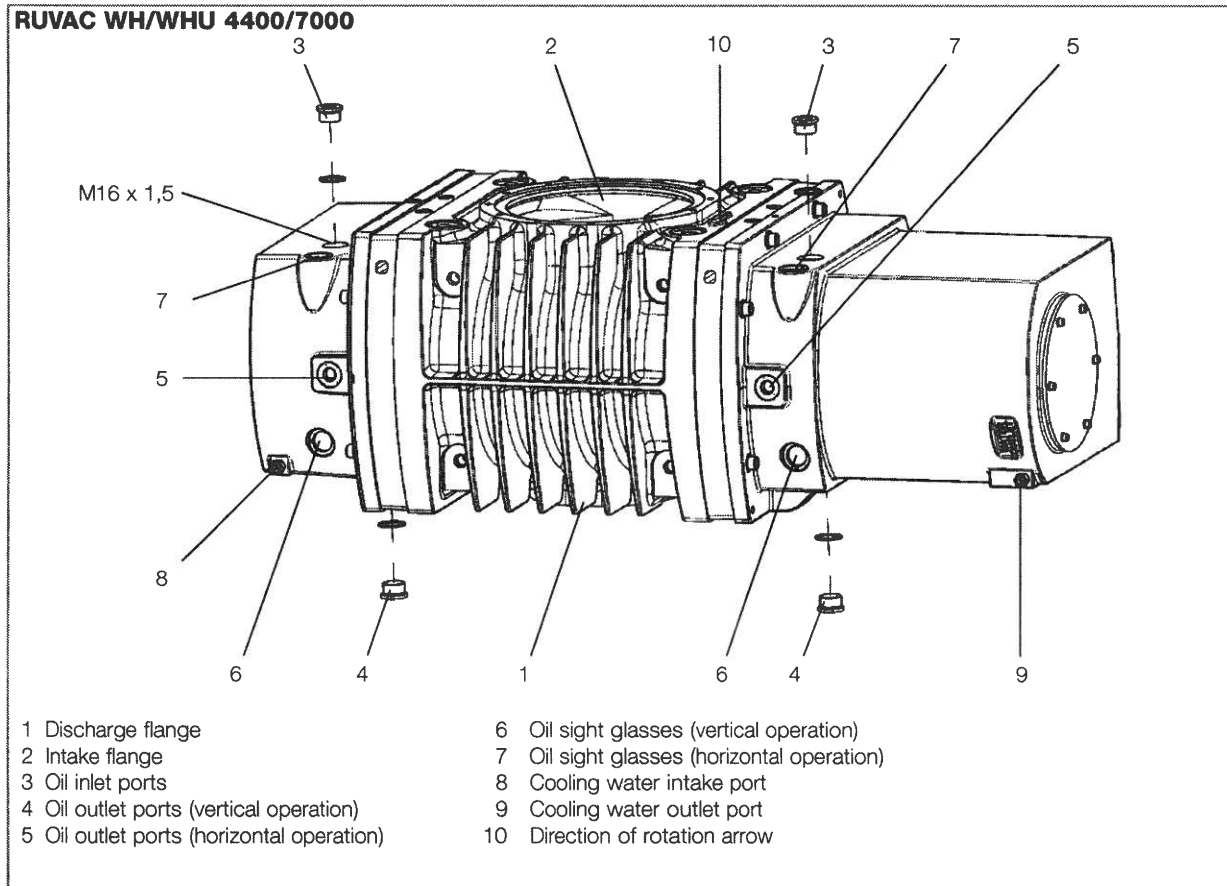


Fig. 3.4 Connections and controls on the RUVAC WH 4400/7000

3.1.3 Filling in of 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 210. As PFPE we recommend LVO 400 or LVO 410 sold by us. Please consult us if you intend to run the pump with other oils or special lubricants.

NOTICE



It needs to be ensured that the oil filling levels stated in fig. 3.6 which apply to switched off pumps (at standstill) are correctly maintained.

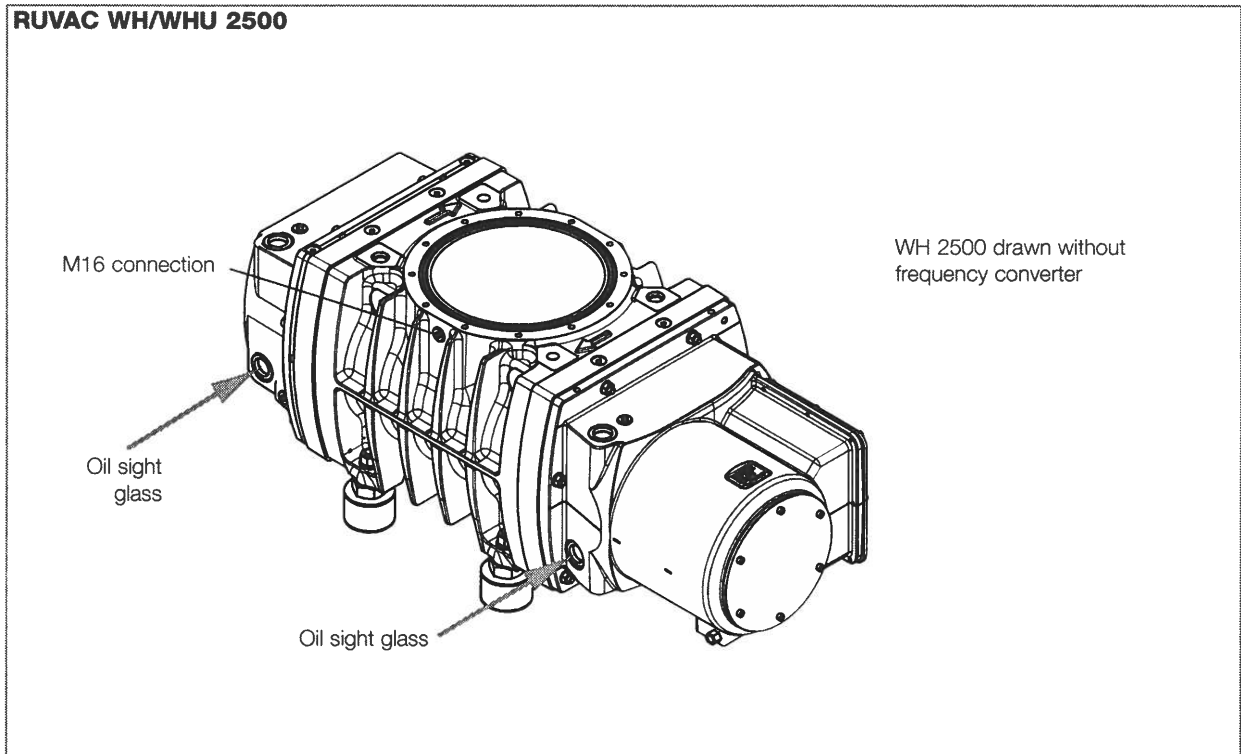


Fig. 3.5 Checking the oil levels at the RUVAC

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.

Installation

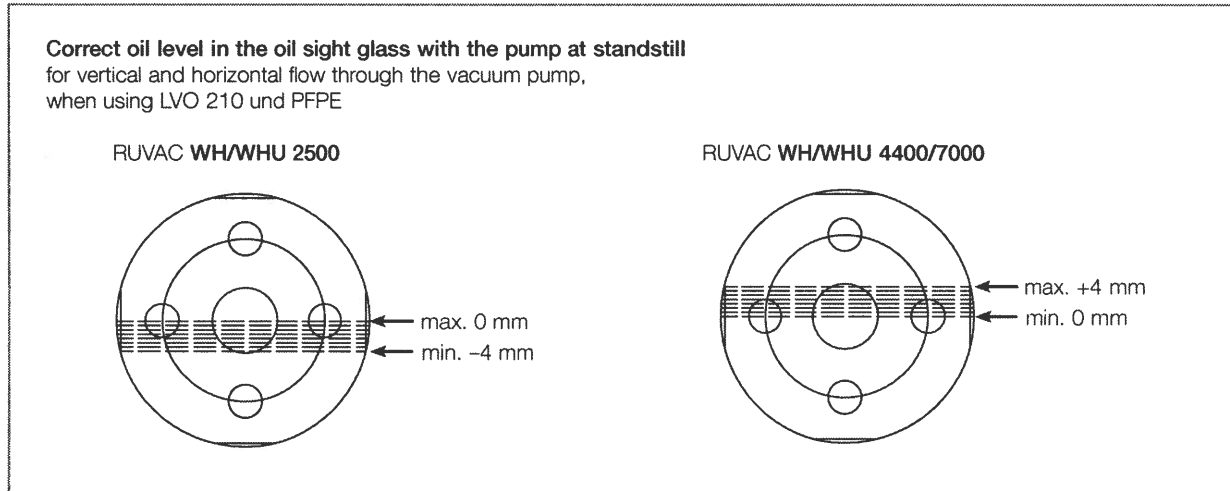


Fig. 3.6 Oil level

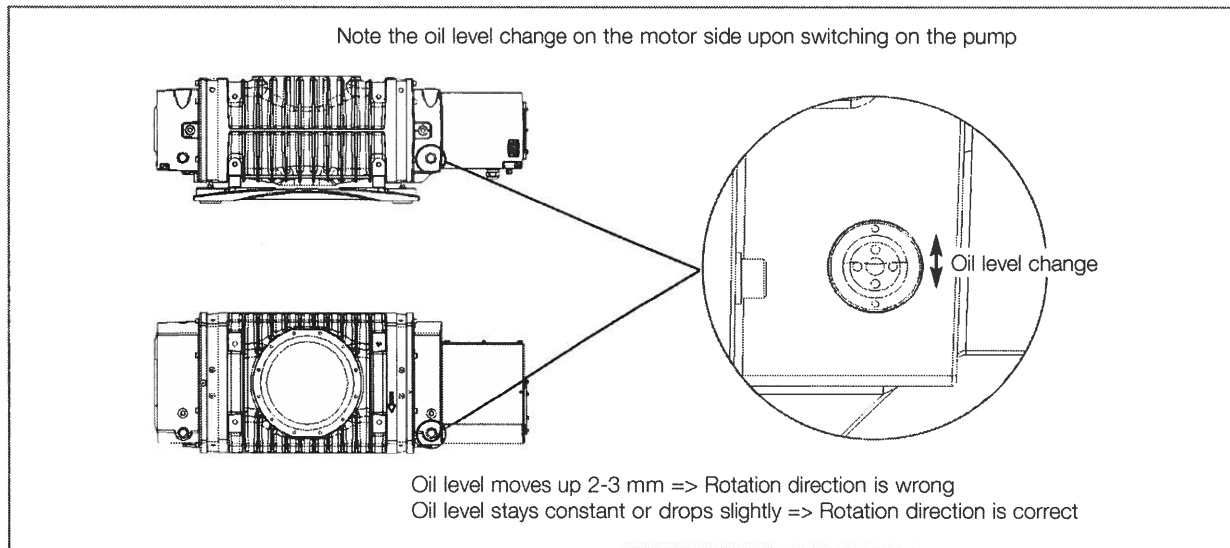


Fig. 3.7 Checking the direction of rotation

NOTICE



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.

3.2 Conforming Utilisation

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

They are employed 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.

Accessories which have not been specified by Oerlikon Leybold Vacuum may only be used after approval by Oerlikon Leybold Vacuum.

3.2.1 Non-conforming Utilisation

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 screens 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 pressure may increase over 1.2 bar abs.
- 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.
- 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 Oerlikon Leybold Vacuum.

Installation

WARNING

The non-conforming utilisation of pump and accessories may result in severe injury or damage to the components.

3.3 Connecting the Cooling Water

Connect the cooling water. Ensure an adequate cooling water flow.

Secure the cooling water connections with Loctite 572.

CAUTION

Notice safety information 0.1.9 and 0.3.

Cooling water data

Cooling water connections	2 pcs. G 1/4, fem.
Fastening torque	10 ±1 Nm
Cooling water quantity	min. 3 l/min
Water temperature	5 to 35 °C
Minimum/maximum supply pressure	2 / 6 bar(g)
bar(g): bar (gauge) is overpressure, i.e. atmospheric pressure = 0 bar(g)	

3.3.1 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:

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
Sulfate	< 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) = 1.4mmol/l
= 10 °e (degrees English hardness)
= 14 °f (degrees French hardness)

If there is the danger of frost, you may use a water glycol mixture of up to 30 %.

When using DS water/deionised water (softened or fully desalinated water) check whether cooling system, water and materials used are suitable. For this please consult us.

Installation

3.4 Electrical Connection

- Depending on the motor, the RUVACs can be operated as follows:
 - without frequency converter
 - within the scope of the technical data a freely selected frequency converter (here we recommend only one type)
 - with a specified internal frequency converter or
 - with a specified external frequency converter

RUVAC WH/WHU	2500	4400	7000	Description in Section	Direction of rota. check see Section 3.4.5
Connected directly to the mains power	Versions without frequency converter	All versions	All versions	3.4.1	Required
Connected with a freely selected frequency converter	Versions without frequency converter 50 - 80 Hz only!	All versions	All versions	3.4.2	Required
Connected with the internal frequency converter	Versions with internal frequency converter	Not possible	Not possible	3.4.3	Not required
Connected with a supplied external frequency converter	Versions with external frequency converter	All versions	All versions	3.4.4	Required

The external frequency converters supplied by Oerlikon Leybold Vacuum comply with EMC guidelines when the cable between pump and frequency converter does not exceed a length of 25 meters maximum. Longer cables are possible but at the risk of possibility exceeding EMC limits.

3.4.1 Direct Mains Power Connection

WARNING



Notice safety information 0.2.

Connect the pump to the correct mains voltage through the connections provided in the junction box (see fig. 3.8).

The motor of the RUVAC WH is equipped with a temperature switch (PTO) and a temperature dependent resistor (PTC). During operation of the pump one of these facilities needs to be monitored to ensure that the pump is shut down as soon as one of the monitoring facilities responds.

Installation

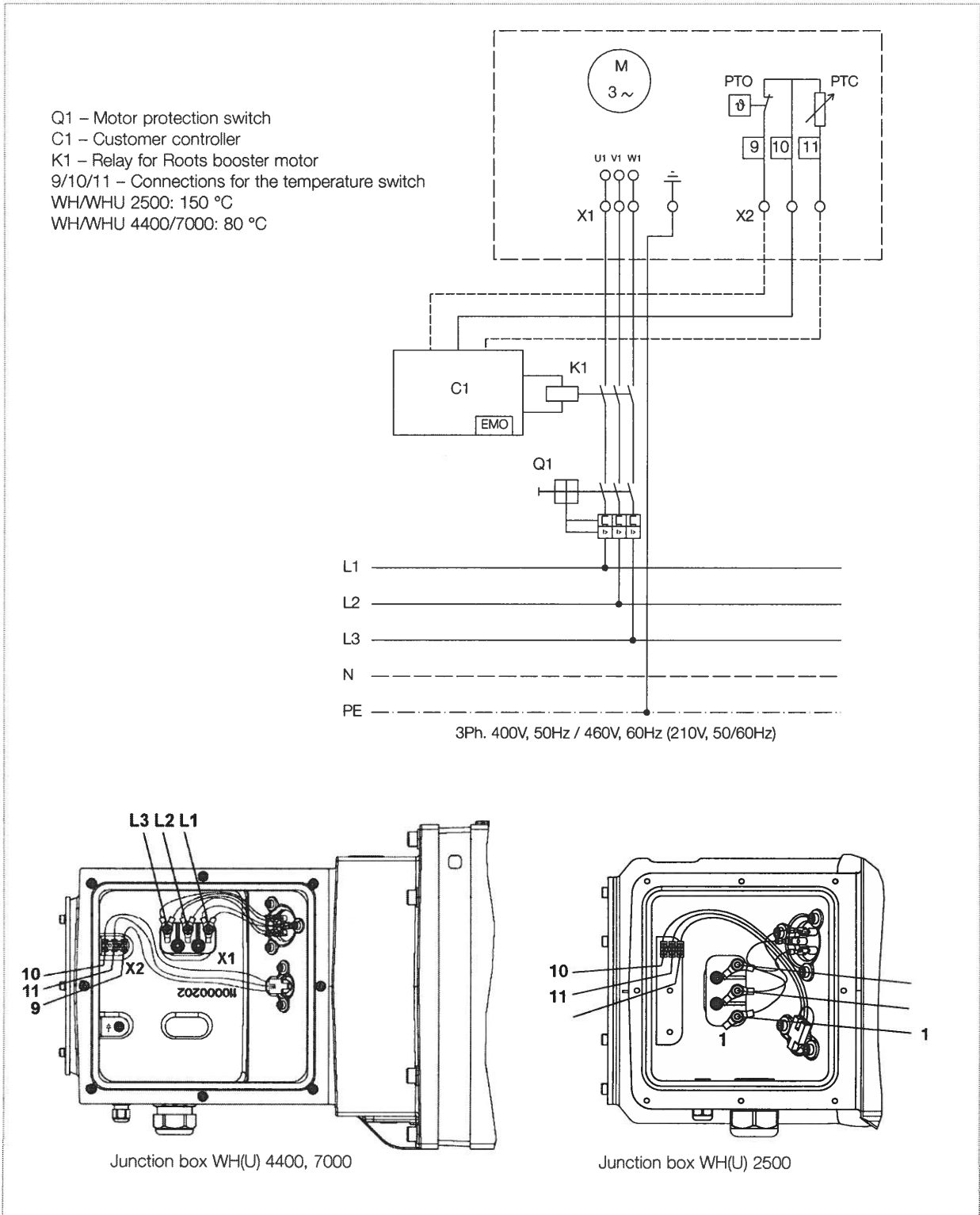


Fig. 3.8 Electrical connections for WH(U) 4400, 7000 and WH(U) 2500 without frequency converter

Installation

3.4.2 Connection with a Freely Selected Frequency Converter

WARNING



Notice safety information 0.2.

For selecting the right frequency converter for your specific application please consult OLV first. We recommend a frequency converter similar to the one described in Sections 3.4.3 and 3.4.4. This frequency converter perfectly matches the pump. A connection diagram is depicted in fig. 3.10.

NOTICE



Observe the information on the frequency converter provided in the enclosed Operating Instructions issued by the manufacturer. Please 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.

Enclosed with the frequency converters delivered by OLV is a copy of the instructions for the Yaskawa V1000.

OLV Part No.	for RUVAC	Yaskawa designation
155191V	WH 4400/7000 11 kW, 400 V	CIMR-VC 4A0031F
155192V	WH 4400/7000 15 kW, 400 V	CIMR-VC 4A0038F
155193V	WH 4400/7000 11 kW, 200 V	CIMR-VC 2A0056F

Connect the pump to the correct mains voltage through the connections in the junction box (see fig. 3.8).

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 this will be the connection at A2 and AC.

NOTICE



When using the connections A2 and AC to control the speed via the analogue input, connect the PTO and evaluate its signal or connect the PTC using a separate processing unit and evaluate its output signal. Note the setting of DIP switch S4.

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

**Setup data for OLV frequency converter =
recommended or mandatory settings for freely selectable frequency converters**

for RUVAC WH	2500	4400/7000 11 kW @ 50 Hz	4400/7000 18,5 kW @ 50 Hz
Maximum voltage	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	27 A	20 A	31 A
Number of motor poles	2	2	2
Motor outside conductor to outside conductor resistance	0.34 Ohm	0.72 Ohm	0.55 Ohm
Nominal motor output power	14.5 kW	11 kW	18.5 kW
Warning temperature Pt 1000	80 °C	–	–
Maximum pump temperature Pt 1000	90 °C	–	–
Maximum motor temperature PTC	110 °C (only for WH(U) 2500 with direct mains power connection)	80 °C	80 °C

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.

Permissible frequencies

RUVAC	WH 2500	WH 4400	WH 7000
Minimum frequency	20 Hz	20 Hz	20 Hz
Maximum frequency	100 Hz*	80 Hz	70 Hz

* only permissible using the internal or the external frequency converter supplied by OLV, otherwise max. 80 Hz

Installation

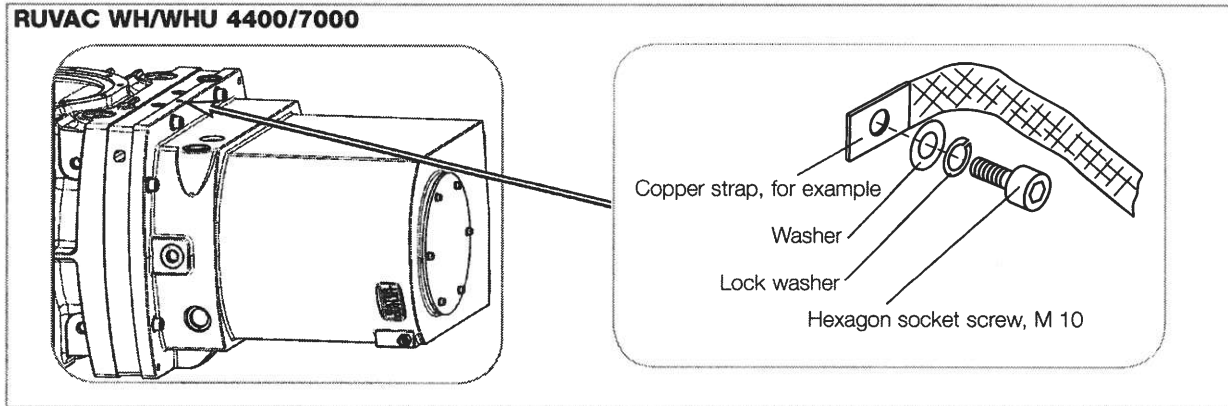


Fig. 3.9 Establishing the potential equalisation at the pump casing

Establishing Potential Equalisation

NOTICE



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 fig. 3.9.

Installation

Applies to the frequency converter recommended by Oerlikon Leybold Vacuum and to the RUVAC WH/WHU 4400/7000

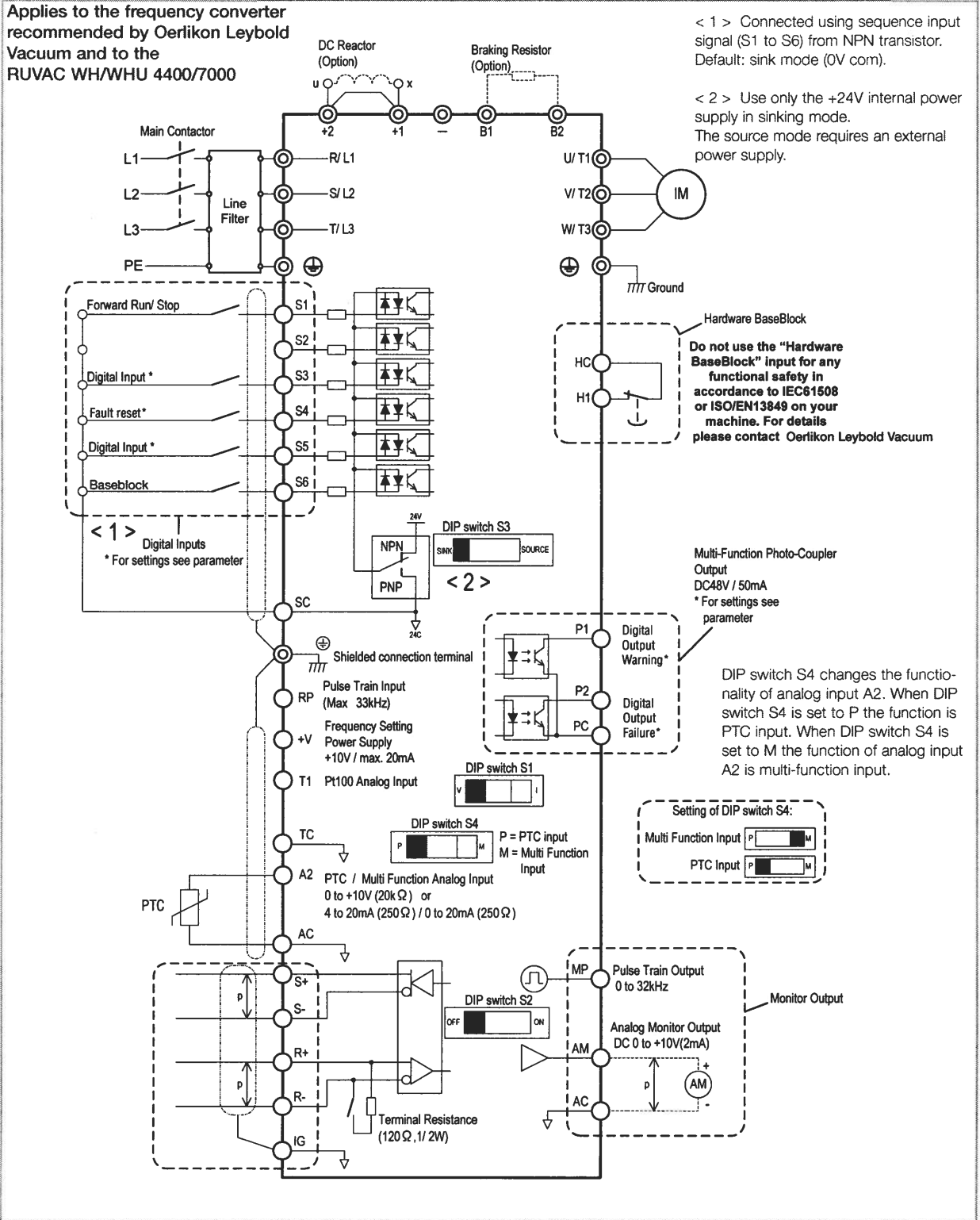


Fig. 3.10 Main and control circuit wiring RUVAC WH with PTC

Installation

3.4.3 Connection with Internal Frequency Converter

For RUVAC WH 2500 only.

DANGER



Notice safety information in Section 0.2.

Take note of the information provided in the Operating Instructions “Quick Start Guide” enclosed with the frequency converter. Read these Operating Instructions and make yourself comfortable with the contents before installing and operating the frequency converter or before doing maintenance work on it. The frequency converter must be installed in agreement with the information given in these Operating Instructions and in agreement with the locally applicable regulations. Non-compliance with the safety information can result in severe or even deadly injuries or may damage the products or facilities and systems operated in connection with the product.

Enclosed with the frequency converters delivered by OLV is a copy of the instructions for the Yaskawa V1000.

OLV Part No.	for RUVAC	Yaskawa designation
155230V	WH 2500 11 kW (at 50 Hz), 400 V	CIMR-VC 4A0031F
155231V	WH 2500 11 kW (at 50 Hz), 200 V	CIMR-VC 2A0056F

Wiring the Main Circuit Input

Consider the following precautions for the main circuit input.

- Use fuses recommended in Main Circuit only, see technical data.
- If using a ground fault circuit breaker, make sure that it can detect both DC and high frequency currents.

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.

Control Circuit Wiring

The control terminal board is equipped with screwless terminals. Always use wires within the specification listed below. For safe wiring it is recommended to use solid wires or flexible wires with ferrules. The stripping length respectively ferrule length should be 8 mm.


Wire type	Wire size (mm ²)
Solid	0.2 to 1.5
Flexible	0.2 to 1.0
Flexibele with ferrule	0.25 to 0.5

Control Circuit Wiring Precautions

Consider the following precautions for wiring the control circuits.

- Separate control circuit wiring from main circuit wiring and other high-power lines.
- For external control power supply use a UL Listed Class 2 power supply.
- Use twisted-pair or shielded twisted-pair cables for control circuits to prevent operating faults.
- Ground the cable shields with the maximum contact area of the shield and ground.
- Cable shields should be grounded on both cable ends.
- If flexible wires with ferrules are connected they might fit tightly into the terminals. To disconnect them, grasp the wire end with a pair of pliers, release the terminal using a straight-edge screw driver, turn the wire for about 45°, and pull it gently out of the terminal.

Main Circuit Terminals

Terminal	Type	Function
R/L1, S/L2, T/L3	Main circuit power supply input.	Connects line power to the frequency converter via line filter.
U/T1, V/T2, W/T3	Drive output.	Connects to the motor.
B1, B2	Braking resistor.	For connecting an optional braking resistor.
+1, +2	DC reactor connection.	Linked at shipment. Remove the link to install a DC choke.
+1, -	DC power supply input	For connecting a DC power supply.
 (2 terminals)	Ground terminal.	200 V class: ground with 100 Ω or less. 400 V class: ground with 10 Ω or less.

Installation

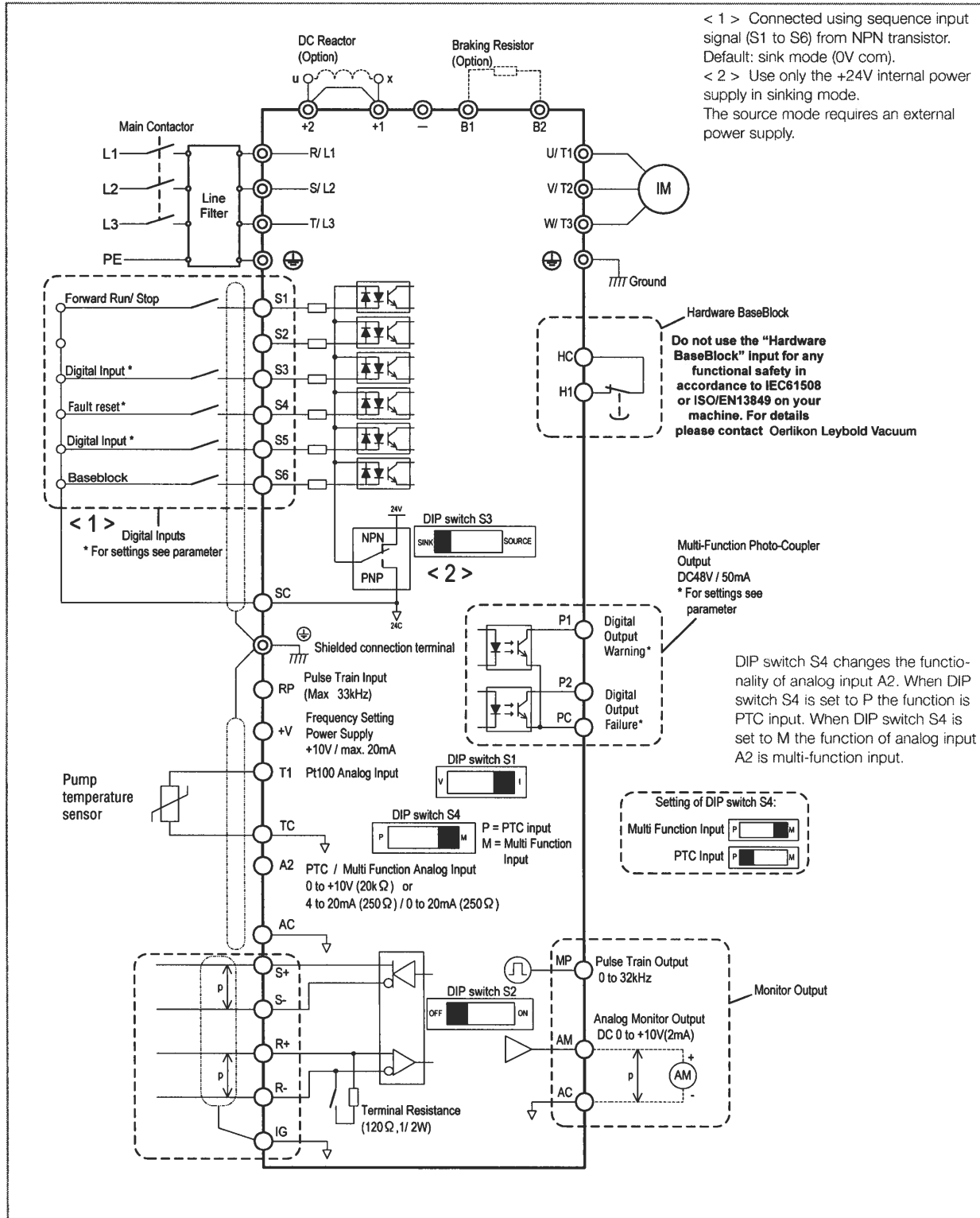


Fig. 3.11 Main and control circuit wiring RUVAC WH 2500 with internal or external frequency converter

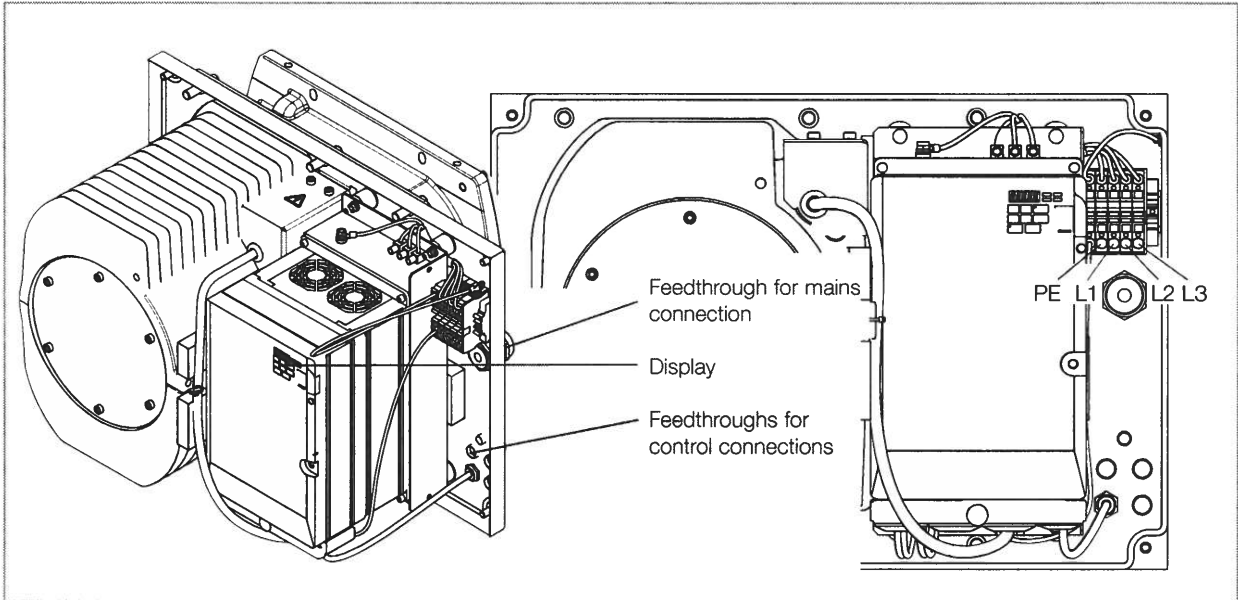


Fig. 3.12 Frequency converter without cover

Connecting 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 in Fig. 3.8. Use the M32 cable fitting for that purpose. The terminals are designed for 10 mm² max. cable diameter.

Establishing Potential Equalisation

An M 6 thread is provided at the motor casing for connecting the external potential equalisation cable, for a functional ground connection, for example.

Connect the potential equalisation conductor as depicted in fig. 3.13.

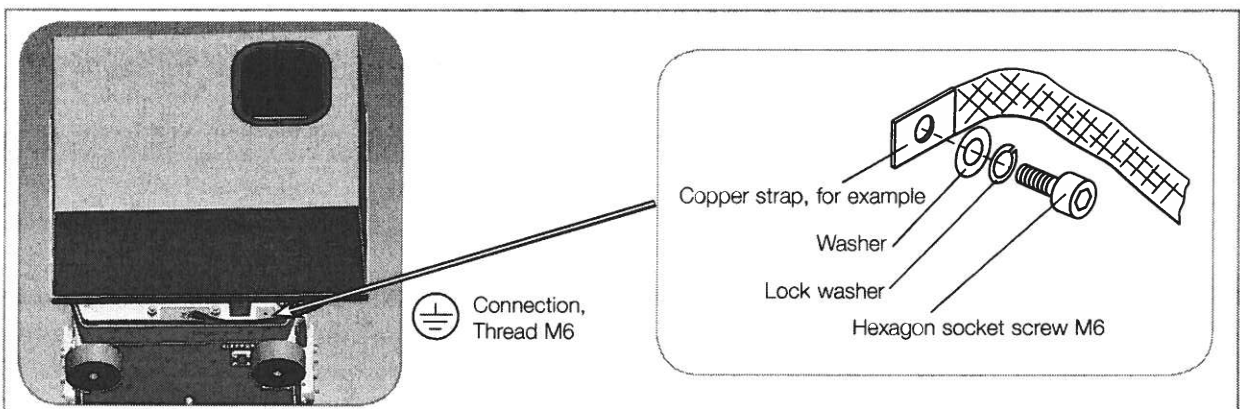


Fig. 3.13 Establishing the potential equalisation at the pump casing

Installation

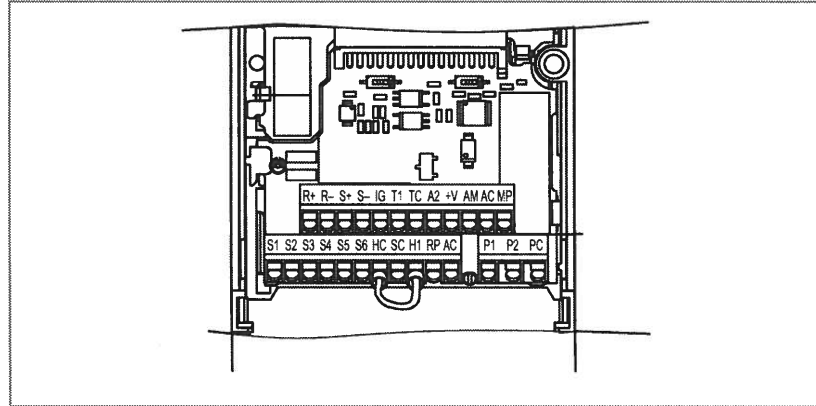


Fig. 3.14 Control circuit terminals

Start/stop Connection

Bridge SC and S6 to enable the drive.

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

For the connection of the control cables install a cable fitting M16x1.5 in a bore hole at the terminal box. Use EMC cable fittings if required.

Sensors

The pump's temperature sensor is connected to T1 and TC.

Remount the cover on the frequency converter.

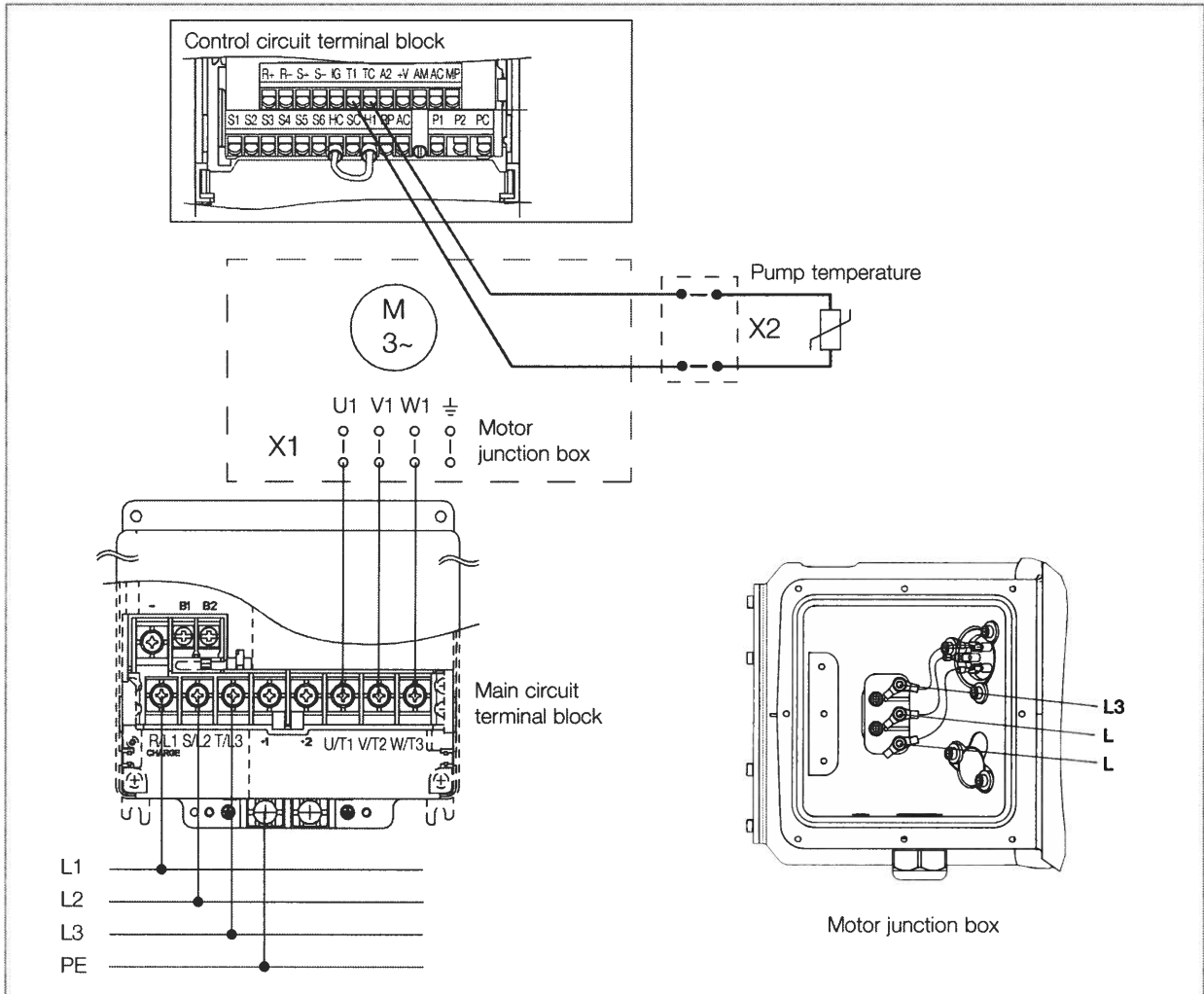


Fig. 3.15 Main and control circuit wiring for the RUVAC WH 2500 for external frequency converter

3.4.4 Connection with External Frequency Converter

Pages 48 to 50 of Section 3.4.3 apply also to the external frequency converter.

Connecting the Cables

The max. length for the cable between external frequency converter and motor is 30 m.

The max. current load at the frequency converter output is 31 A.

Connect the main and control circuits as shown in fig. 3.15.

Installation

CAUTION



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.

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

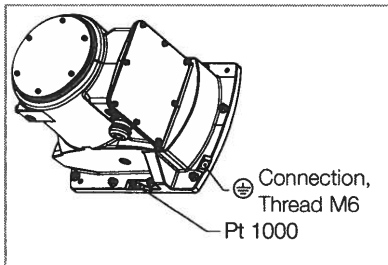


Fig. 3.15 Motor of the RUVAC WH 2500 with external frequency converter

Start/stop Connection

Bridge SC and S6 to enable the drive.

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

Sensors

Connect the Pt 1000 temperature sensor of the WH 2500 to T1 and TC. 30 m connection cable is delivered for the Pt 1000.

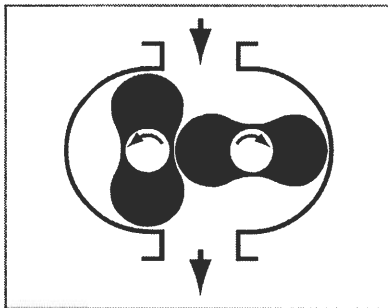
Connect the motor temperature sensor (PTC) of the WH 4400/7000 to A2 and AC. The terminals at the pump can be found in the motor junction box.

3.4.5 Check the Direction of Rotation

After connecting the motor and every time you alter the wiring, check the direction of rotation.

Never allow the pump to run in the wrong direction or with open flanges for a longer period of time. Notice safety information 0.1.

NOTICE



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 center 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 (see fig. 3.7).

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

3.5 Connection of the Flanges

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.

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 (see Section 3.1).

When attaching the pump directly (without bolting down the feet) to the forevacuum pump, a special adapter has to be used. Please consult OLV in this case.

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 0.1.

NOTICE



NOTICE



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	16x M12
Tightening torque	48 ⁺⁵ Nm	48 ⁺⁵ Nm	80 ⁺⁵ Nm
Discharge flange DN	100 ISO-K	160 ISO-K	160 ISO-K
Bolts	8x M8 or 4x M16	12x M10	12x M10
Tightening torque	25 ^{+2.5} Nm 100 ⁺¹⁰ Nm	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.

The supplied intake screen should always be fitted into the intake flange 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 start-up. Depending on the operating conditions, the intake screen may reduce the pumping speed of the pump

Installation

3.6 Connecting Purge Gas (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.

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. Connecting thread G ¼-in..

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.

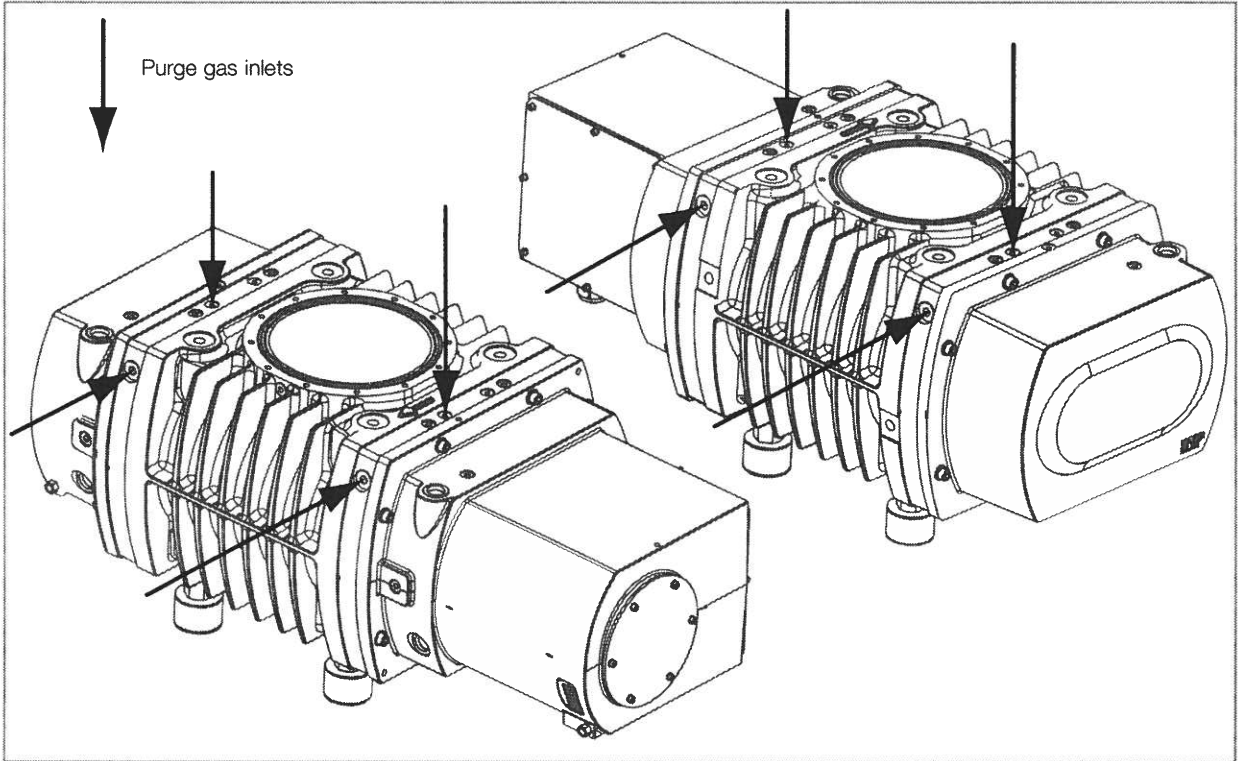


Fig. 3.17 RUVACs with purge gas inlet

Operation

4 Operation

4.1 Start-up

Check the pump motor's direction of rotation (see Section 3.4.5).

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.

NOTICE



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

RUVAC WH

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

Δp_{\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) at the corresponding operating frequency

Example - Pump combination:

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 (max. 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.

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

If the RUVAC WH is operated via a frequency converter, it can be treated like a RUVAC WHU. However it is not recommended to repeatedly do shock venting with frequency converter driven pumps because the mechanical forces on bearings and gears may lead to a reduced lifetime.

NOTICE



4.2 Profibus Interface

(Option for frequency converters delivered by OLV)

For operating the Profibus interface refer to the YASKAWA AC Drive-V1000 Option PROFIBUS-DP Technical Manual Type SI-P3/V.

The manual information is valid except from the following:

GSD file

The GSD file and the manual can be downloaded from www.oerlikon.com in the menu Oerlikon Leybold Vacuum -> Documentation -> Download Software.

Operation

Parameter Settings

No.	Name	Description	OLV Setting
b1-01	Frequency Reference Selection *1 *2	Selects the frequency reference input source 0: Operator - Digital preset speed d1-01 to d1-17 1: Terminals - Analog input terminal A1 or A2 2: MEMOBUS/Modbus communications 3: Option PCB 4: Pulse Input (Terminal RP)	3
b1-02	Run Command Selection *1 *2	Selects the run command input source 0: Digital Operator - RUN and STOP keys 1: Digital input terminals S1 to S7 2: MEMOBUS/Modbus communications 3: Option PCB	3
F6-01	Operation Selection after Communications Error	Determines drive response when a bUS error is detected during communications with the PROFIBUS-DP Option 0: Ramp to Stop 1: Coast to Stop 2: Fast-Stop 3: Alarm Only	1
F6-02	External Fault Detection Conditions (EFO)	Sets the condition for external fault detection (EFO) 0: Always detected 1: Detected only during operation	0
F6-03	Stopping Method for External Fault from Communication Option Board	Determines drive response for external fault input (EFO) detection during PROFIBUS communication 0: Ramp to Stop 1: Coast to Stop 2: Fast-Stop 3: Alarm Only *3	1
F6-04	BUS Error Detection Delay Time	Set the maximum time the drive should wait for a communication error to occur (bUS) Range 0.00 to 5.00 s	0.05
F6-30	Node Address *4	0 to 125	6
F6-31	Clear Mode Selection	Selects the action to take when a „Clear Mode“ command is received 0: Resets back to 0 1: Maintains the previous value	0
F6-32	PROFIBUS Map Selection	0: PPO Type 1: Conventional	1

* 1. To start and stop the drive through the PROFIBUS-DP network, set b1-02 to "3". To control the frequency reference of the drive via the PROFIBUS-DP network, set b1-01 to "3".

* 2. When b1-01 = 3 and/or b1-02 = 3 are selected and the communication option is not installed, V1000 detects oPE07 instead of oPE05 with software version 1010.

* 3. If F6-03 is set to 3, then the drive will continue to operate when an EFO fault is detected. Take proper safety measures, such as installing an emergency stop switch.

* 4. All node addresses must be unique. Node addresses 0, 1, and 2 are typically reserved for control, maintenance, and diagnostic equipment. The ERR light will illuminate when 0 or greater than 125 is entered.

MEMOBUS/Modbus Message

MEMOBUS/Modbus Message is not active.

Basic Data Register Map Detail

Output		Input	
Byte	Description	Byte	Description
0	Operation Command High Byte	0	Drive Status High Byte
1	Operation Command Low Byte	1	Drive Status Low Byte
2	Frequency setpoint High Byte*1	2	Motor Speed High Byte*1
3	Frequency setpoint Low Byte*1	3	Motor Speed Low Byte*1
4	Reserved	4	Output Current High Byte*2
5	Reserved	5	Output Current Low Byte*2

* 1. The unit is 0.01 Hz

* 2. The unit is 0.01 A for drives set up to 11 kW in Heavy Duty or Normal Duty and 0.1 A for drives set up for 15 kW and above.

Extended Data 1 Register Map

Output		Input	
Byte	Description	Byte	Description
0	Operation Command High Byte	0	Drive Status High Byte
1	Operation Command Low Byte	1	Drive Status Low Byte
2	Frequency setpoint High Byte*3	2	Motor Speed High Byte*3
3	Frequency setpoint Low Byte*3	3	Motor Speed Low Byte *3
4	Reserved	4	Torque Reference Monitor High Byte *4
5	Reserved	5	Torque Reference Monitor Low Byte *4
6, 7	Reserved	6, 7	Reserved
8	Reserved	8	Frequency setpoint High Byte
9	Reserved	9	Frequency setpoint Low Byte
10	Analog Output Channel 1 High Byte *1	10	Output Frequency High Byte
11	Analog Output Channel 1 Low Byte *1	11	Output Frequency Low Byte
12	Reserved	12	Output Current High Byte *5
13	Reserved	13	Output Current Low Byte *5
14	Digital Output High Byte *2	14	Reserved
15	Digital Output Low Byte *2	15	Reserved
16 to 31	Reserved	16 to 31	Reserved

* 1. To select drive analog output channel for communications, set H4-01 (Multi-Function Analog Output Terminal AM) to 31 (Not used)

* 2. Drive digital output ON/OFF during communications, set H2-01 (Terminal MA, MB and MC Function Selection (relay)), H2-02 (Terminal P1 Function Selection (opencollector)), and H2-03 (Terminal P2 Function Selection (open-collector)) to F.

* 3. The unit is 0.01 Hz

* 4. Cannot be used when setting A1-02 (Control Method Selection) to 0 (V/f Control without PG).

* 5. The unit is 0.01 A for drives set up to 11 kW in Heavy Duty or Normal Duty and 0.1 A for drives set up for 15 kW and above.

Operation

Extended Data 2 Register Map

Output		Input	
Byte	Description	Byte	Description
0	Operation Command High Byte	0	Drive Status High Byte
1	Operation Command Low Byte	1	Drive Status Low Byte
2	Frequency setpoint High Byte*1	2	Motor Speed High Byte *1
3	Frequency setpoint Low Byte*1	3	Motor Speed Low Byte *1
4 to 11	Reserved	4 to 11	Reserved

* 1. The unit is 0.01 Hz

Table 13 Operation Command

Byte	Command Bits	Description
Byte 1	0	Start / Stop (1 = Start, 0 = Stop)
Byte 1	1 to 7	Reserved
Byte 0	8	Reserved
Byte 0	9	Reset
Byte 0	A to F	Reserved

Basically set reserved bits to 0!

Table 14 Drive Status

Byte	Command Bits	Description
Byte 1	0	Pump rotating
Byte 1	1	Pump stands still
Byte 1	2, 3	Reserved
Byte 1	4	Normal operation (frequency setpoint reached)
Byte 1	5	Drive ready (ready to start, no fault)
Byte 1	6	Alarm
Byte 1	7	Fault
Byte 0	8 to F	Reserved

Example for control data in the "Basic data" format:

Byte 5	Byte 4	Byte 3	Byte 2	Byte 1	Byte 0
0000 0000	0000 0000	1101 1000	0010 1110	0000 000 1	0000 00 00
Reserved	Reserved	Frequency setpoint low byte	Frequency setpoint high byte	Start	Reset

Explanation: In addition to the start bit, a speed in the range of 10 to 120 Hz must be set. (2E D8hex = 119.92Hz)

Example for status data in the "Basic data" format:

Byte 5	Byte 4	Byte 3	Byte 2	Byte 1	Byte 0
0111 0110	0000 0111	1101 1000	0010 1110	0011 0001	0000 0000
Actual motor current low byte (07 76hex = 19.10 A)	Actual motor current high byte	Actual frequency low byte	Actual frequency high byte	0 Fault, 0 Alarm, 1 Pump ready, 1 Normal operation, 0 Reserved, 0 Reserved, 0 Pump stands still, 1 Pump rotating.	Reserved

Example for reading out the pump temperature via the Profibus

Applies to control data in the "Extended Data 1" format only:

Byte 32	Byte 20	Byte 19	Byte 18	Byte 17	Byte 16
1000 0000	0000 0000	0000 0010	0 110 0010	0000 0 110	0000 00 11
Bit for data updating	Reserved	Number of 2 bytes	662 hex parameter	Number	Read parameter
Byte 4	Byte 3	Byte 2	Byte 1	Byte 0	
0000 0000	1101 1000	0010 1110	0000 00 00	0000 00 00	
Reserved	Frequency setpoint low byte	Frequency setpoint high byte	Start	Reset	

Explanation: through a parameter channel it is possible to query in the control word the parameter X662 hex which represents the pump temperature and read out in the bytes 20/21 the status data. By activating, respectively deactivating the seventh bit in the last byte of the control data, the temperature value in the status data is updated.

Operation

Example for status data in the "Extended Data 1" format:

Byte 21	Byte 20	Byte 19	Byte 18	Byte 17	Byte 16
0001 1010	0000 0000	0000 0010	0110 0010	0000 0110	0000 0011
Temperature low byte 1A = 26°C	Temperature high byte	Number of 2 bytes	662 hex parameter	Number	Read parameter

Byte 4	Byte 3	Byte 2	Byte 1	Byte 0
0000 0000	1101 1000	0010 1110	0000 0000	0000 0000
Actual motor current high byte	Actual frequency low byte	Actual frequency high byte	0 Error, 0 Warning, 1 Pump ready, 1 Normal operation, 0 Reserved, 0 Reserved, 0 Pump at a standstill, 1 Pump is running.	Reserved

MEMOBUS/Modbus Message Area

MEMOBUS/Modbus Message Area is not active.

Handshaking Register

Handshaking Register is not active.

4.3 Operation

Do not operate the pump without having connected the flanges to a vacuum system. Notice safety information 0.2.

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 (see Section 5.2). Normally, the oil LVO 210 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.

Run the Roots pump exclusively under the operating conditions for which it has been designed. Any modification of the operating parameters (e. g. 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.

Notice safety information 0.3.

Never 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.

CAUTION



NOTICE



CAUTION



Operation

NOTICE

4.4 Switch off and Shutdown

We recommend to keep the RUVAC WH with a PFPE filling running even during prolonged intervals (e. g. over night) with the intake line closed. This can help to avoid corrosion during standstill.

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

When the pumps are being operated with purge gas, they must only be vented with the purge gas flow running. Otherwise there is a risk of dust being stirred up so that it may then enter into the piston rings and into the bearings.

After working with corrosive gases, the system should after 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

Before removing pump from the vacuum system, disconnect it from the mains supply. Note any contamination affecting the pump. Comply with all safety regulations. Notice safety information 0.2.

Before removing the RUVAC WH PFPE from the system it must be purged with nitrogen and sealed in a gas-tight manner.

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

For transportation and storing of the pump, observe the information provided in Section 2.

4.5 Changing from Vertical to Horizontal Flow

The RUVAC WH/WHU pumps are supplied as standard 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:

Unscrew the oil drain plugs and drain out the lubricant.

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.

Remove the feet, turn the pump by 90° as shown in the dimensional drawings and mount the feet for the new direction of flow, see Sections 3.1.2 and 1.5.

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.

It is recommendable to tilt the pump on a soft surface to avoid damage to the painting.

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

Fill in lubricant.

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

NOTICE



Operation

4.6 Operation with the Frequency Converter Supplied by OLV

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

- Connect S6 to SC (base block) for enable, see Section 3.4.
- Connect S1 to SC 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.

Permissible frequencies

RUVAC	WH 2500	WH 4400	WH 7000
Minimum frequency	20 Hz	20 Hz	20 Hz
Maximum frequency	100 Hz*	80 Hz	70 Hz

* only permissible using the internal or the external frequency converter supplied by OLV, otherwise max. 80 Hz

Description	Parameter in programming mode	OLV Setting
Standard output frequency reference	d1-01	50 Hz

CAUTION



The pre-set limiting parameters, in particular the maximum speed, must not be changed. Note Safety Information 0.2.

NOTICE



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

4.6.1 Frequency Converter Outputs

The frequency converter outputs have been assigned as follows:

P1-PC	Digital output Multifunction opto-coupler 48 V DC max. 50 mA max.	Contact closed during Warning (general message)
P2-PC	Digital output Multifunction opto-coupler 48 V DC max. 50 mA max.	Contact closed during Error (general message)
AM-AC	Analog output 0 to +10 V DC (2 mA)	Analog monitor output 10 V when the pump is running

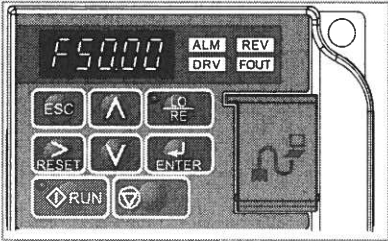


Fig. 4.1 LED operator

4.6.2 LED Operator and Keys

The LED operator is used to program the frequency converter and to display fault information. The LEDs indicate the frequency converter status.

Keys and Functions		
Display	Name	Function
	Data Display Area	Displays the frequency reference, parameter number, etc
	ESC Key	Returns to the previous menu.
	RESET Key	Moves the cursor to the right. Resets a fault.
	RUN Key	Starts the drive in the LOCAL* mode. The Run LED - is on, when the drive is operating the motor. - flashes during deceleration to stop or when the frequency reference is 0. - flashes quickly the drive is disabled by a DI, the drive was stopped using a fast stop DI or a run command was active during power up.
	Pfeil auf Taste	Scrolls up to select parameter numbers, setting values, etc.
	Pfeil ab Taste	Scrolls down to select parameter numbers, setting values, etc.
	STOP Key	Stops the drive.
	ENTER Key	Selects modes, parameters and is used to store settings.
	LO/RE Selecting Key	Switches drive control between the operator (LOCAL) and the control circuit terminals (REMOTE)*. The LED is on when the drive is in the 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
	REV LED Light	On: The motor rotation direction is reverse. Off: The motor rotation direction is forward
	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
	FOUT LED Light	On: The output frequency is displayed on the data screen Off: Anything else then the output frequency is displayed on the data screen
* The pump is not intended for LOCAL mode. Default is REMOTE		

Fig. 4.2 Keys and functions

Operation

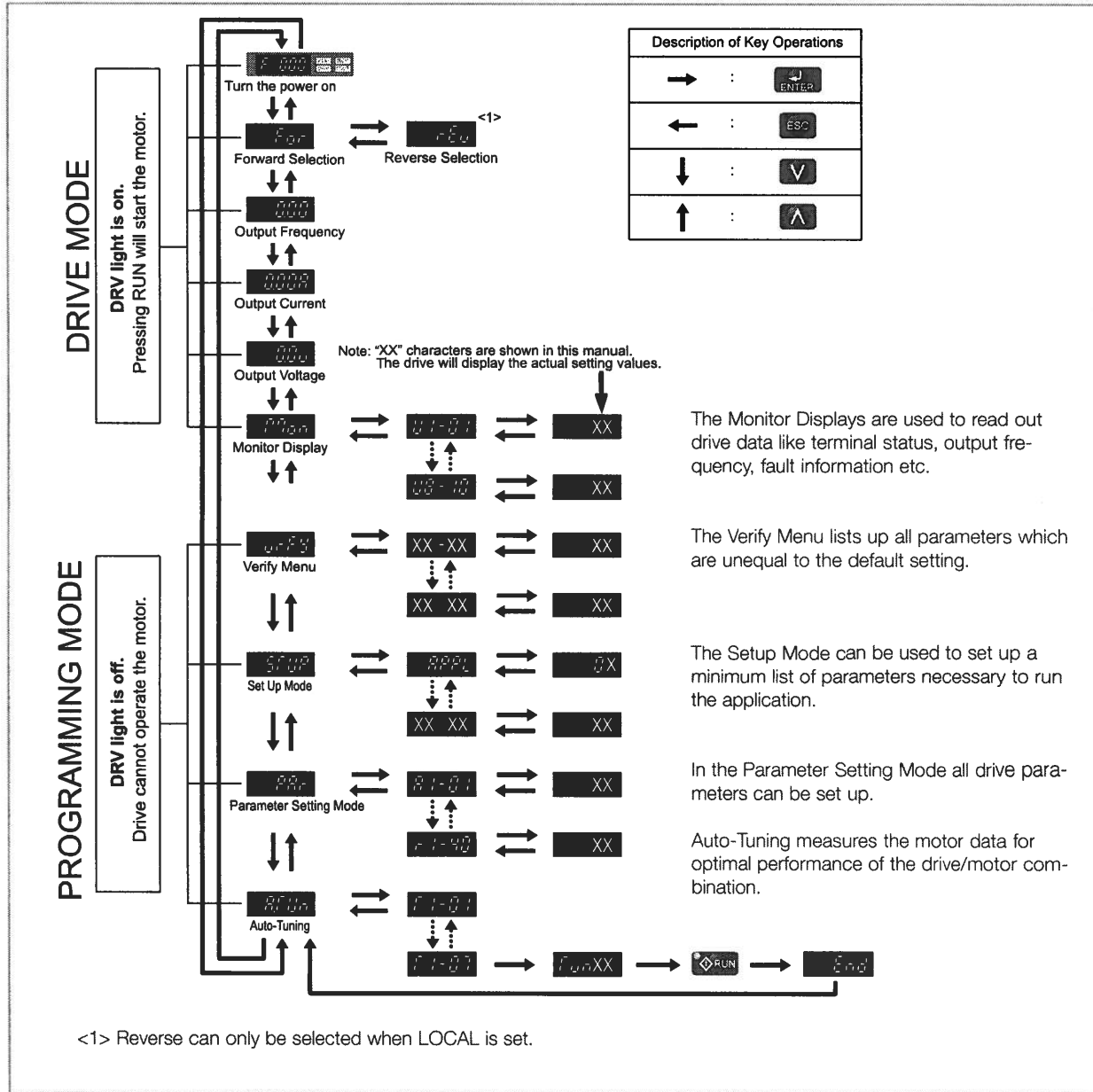


Fig. 4.3 Menu structure

4.6.3 Relay Option Board

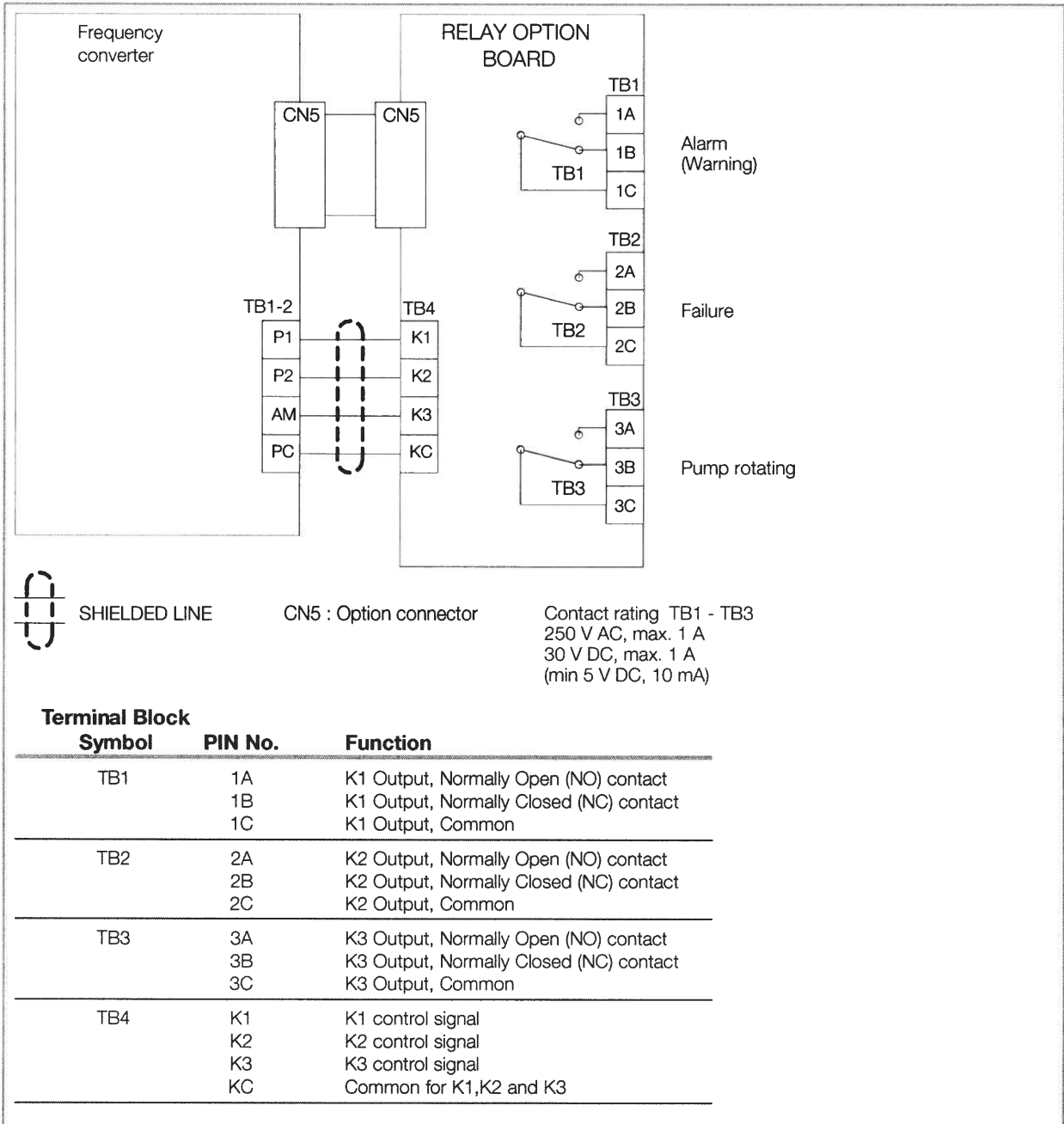


Fig. 4.3 Relay option board: Connections

Maintenance

5 Maintenance

5.1 Safety Information

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



Notice safety information 0.1 to 0.4.

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 Oerlikon Leybold Vacuum service.

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

5.2 Exchanging the Lubricant

CAUTION



Notice safety information 0.3 to 0.5.

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.

In the case of clean operating conditions, the lubricant is only consumed due to wear in the bearings and within the gear.

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. To be sure, we recommend changing the PFPE once a year.

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

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

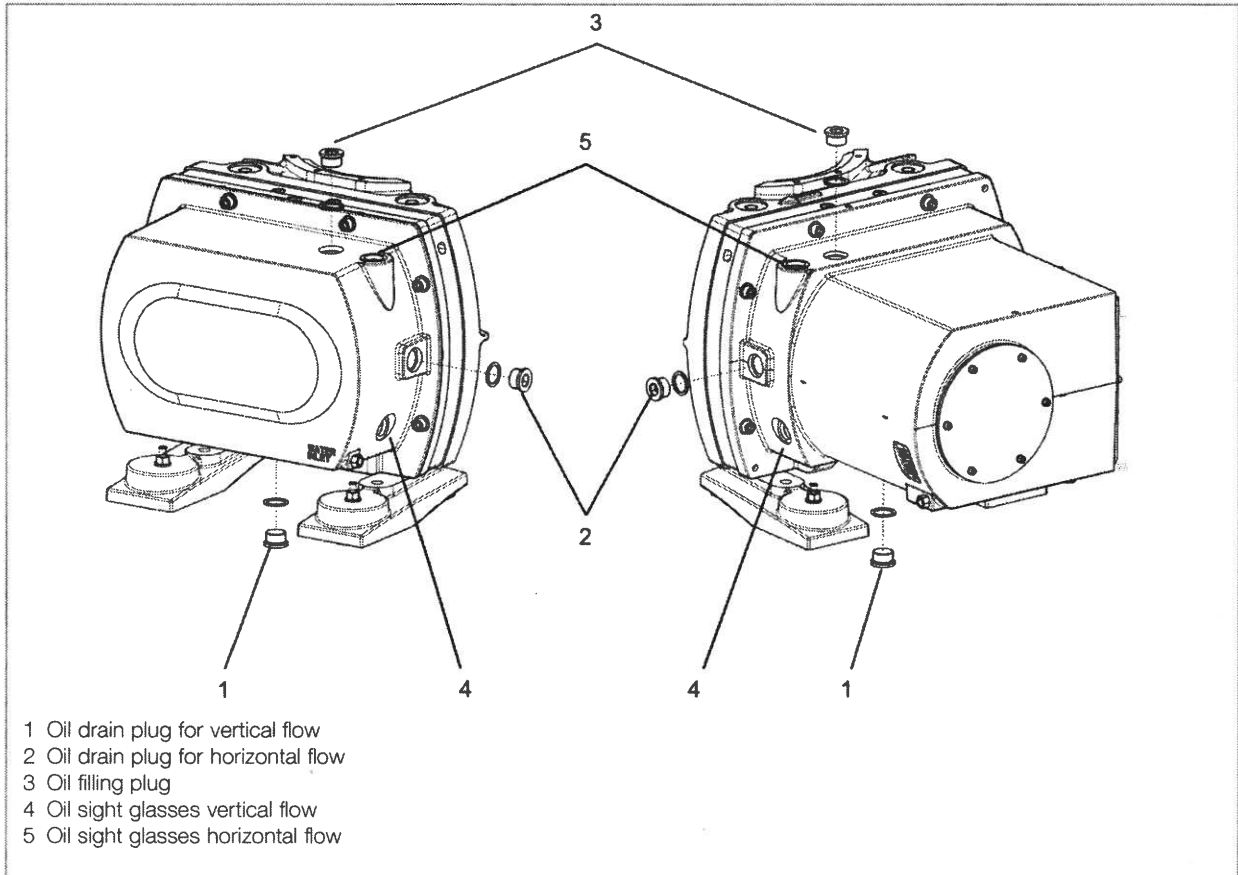


Fig. 5.1 Changing the lubricant (shown for the RUVAC 7000, other models similar)

Before removing the oil-drain or oil-fill plug always switch off the pump first and vent to atmospheric pressure.

When the pump has become warm during operation the casing and the oil temperature may exceed 80 °C.

Leave the pump to cool down. Always wear protective gloves also to protect yourself against aggressive residues in the oil.

Unscrew the oil-drain plugs the oil-fill plugs and drain the oil (see fig. 5.1).

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 at a pump temperature of 15 °C to 25 °C.

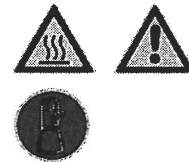
For oil quantities and ordering data see Section 1.3.

Make sure to use the right kind of oil. PFPE pumps are marked with a red label.

Only use Oerlikon Leybold Vacuum oil.

Please consult us if you intend to run the pump with other oils or special lubricants.

WARNING



Maintenance

It must be observed under all circumstances that the oil filling levels stated which apply to the shutdown (standing still) pump - are maintained correctly (see fig. 3.6).

NOTICE

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.

5.3 Cleaning the Intake Screen

NOTICE

Observe all safety information provided in Sections 0.1 to 0.4 and 5.1.

A wire-mesh sieve 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.

5.4 Cleaning the Pumping Chamber

Observe all safety information provided in Sections 0.1 to 0.4 and 5.1.

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.

During cleaning, the blower must be turned only by hand.

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

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.

CAUTION



CAUTION



NOTICE



Maintenance

5.5 Service at Oerlikon Leybold Vacuum

If you send a pump to Oerlikon Leybold Vacuum indicate whether the pump is free of substances damaging to health or whether it is contaminated.

If it is contaminated also indicate the nature of the hazard. To do so, you must use a preprinted form which we shall send to you upon request.

A copy of this form is reproduced at the end of these Operating Instructions: "Declaration of Contamination of Compressors, Vacuum Pumps and Components". Moreover, you may download a suitable form from the Internet:

www.oerlikon.com -> Oerlikon Leybold Vacuum -> Documentation -> Download Documents.

Please attach this form to the pump or enclose it with the pump.

This "Declaration of Contamination" is required to meet the requirements of German Law and to protect our personnel.

Oerlikon Leybold Vacuum must return any pumps without a "Declaration of Contamination" to the sender's address.

Before packaging (respectively shipping) the pump it should, if possible, be purged with inert gas, but as a minimum requirement it should be completely emptied of all pumped substances.

CAUTION



The pump must be packed in such a way, that it will not be damaged during shipping and so that any contaminants are not released from the package.

Oerlikon Leybold Vacuum is 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.

5.6 Maintenance Intervals

Service work	Interval
Check the oil level	Before switching on and monthly
Oil change for LVO 210	1 year
Oil change for PFPE	4 years
Check oil quality visually	as required
	In the normal state PFPE is light, clear and transparent. LVO 210 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

Troubleshooting

6 Troubleshooting

Malfunction	Possible cause	Remedy	Repair
Pump does not start up.	Motor/frequency converter incorrectly connected.	Connect motor/frequency converter correctly.	3.4
	Overtemperature switch or motor stator defective.	OLV Service.	-
	Lubricant is too thick.	Exchange the lubricant or warm up lubricant and pump.	5.2
	Pump has seized: defective impellers, bearings or toothed gears.	OLV Service	-
Pump gets too hot.	Cooling water supply is not sufficient. Cooling water lines are clogged.	Ensure sufficient cooling water supply.	3.3
	Cooling water temperature is too high.	Ensure sufficient cooling water supply acc. to Technical Data	
	Ambient temperature is too high.	Install the pump at a suitable place	3.1
	Pressure differences too high.	Check pressure conditions in the system	-
	Gas temperature is too high.	Check the system	-
	Clearances between housing and rotors are too small due to - contamination - distortion of the pump.	Clean pump chamber Affix and connect the pump free of tension	5.4 3.1/3.5
	Friction resistance is too high due to contaminated bearings and/or contaminated lubricant.		
	Wrong lubricant was filled in.	Drain lubricant, fill in correct lubricant. When changing between mineral oil, ester oil or PFPE the pump will have to be cleaned first by the OLV service.	5.2
	Defective bearings.	OLV Service.	
Power consumption of the motor is too high.	Like malfunction "Pump gets too hot".	Like malfunction "Pump gets too hot".	-
	Incorrect mains voltage for the motor.	Connect the motor to the correct mains voltage.	1.3/3.4
Pump is too loud.	Motor stator defective.	OLV Service.	-
	Oil level is too low	Top up oil	3.1.3
	Distances between housing and rotors is too small due to - contamination - distortion of the pump	Clean pump chamber Fix and connect pump free of tension	5.4 3.1/3.5
	Bearing or gear damage.	OLV Service, shutdown pump immediately.	-
	Pistons make contact with the housing.	OLV Service, shutdown pump immediately.	-
	Rotor is running untrue.	OLV Service, shutdown pump immediately.	-

Troubleshooting

Malfunction	Possible cause	Remedy	Repair	
Pump is losing lubricant	Lubricant leak is apparent:			
	Oil drain plug is leaky.	Drain lubricant, firmly screw in a new oil drain plug with the gasket, fill in correct lubricant quantity		
	Oil sight glasses leaky.	OLV Service.	5.2	
	Gear cover is leaky.	Replace the O-ring of the gear cover.		
	Puddle under the motor, leak in the seal.	OLV Service, shutdown pump immediately.	-	
Oil gets too dark.	No lubricant leak is apparent: See malfunction "Lubricant in the pump chamber".	See malfunction "lubricant in the pump chamber".	-	
	Oil has been used up.	Exchange the oil.	5.2	
	Pump gets too hot.	See malfunction "Pump gets too hot"; after remedy of the malfunction, exchange the oil.	-	
	Lubricant in the pump chamber.	Lubricant level is too high.	Drain the lubricant down to the correct level.	5.2
		Lubricant is ejected from the system.	Check system.	-
Pump is not standing horizontally.		Place the pump correctly.	-	
Pump has a gas leak towards the outside.		Check to ensure that the oil-fill and oil drain plugs are correctly seated. If required replace the gaskets. Replace the O-ring of the gearbox cover.	3.1 5.2	
Pump has an internal leak.		OLV Service.	-	
Pump does not attain its pumping speed.	Piston rings are defective.	OLV Service.	-	
	Intake screen is clogged.	Clean intake screen.	5.3	
	Motor incorrectly connected.	Connect motor correctly.	3.4	
	Speed is too low.	Set up the correct speed.	-	
	Pump system has a gas leak.	Detect leak and seal it off.	-	
Valve of the pressure balance line does not close (WHU only).	Clean the valve or have it repaired.	-		

6.1 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.

Troubleshooting

Error message	Brief Description	AL	FLT	Possible cause	Corrective Action
<i>bb</i>	Base Block	■		The software base block function is assigned to one of the digital inputs and the input is off. The frequency converter does not accept Run commands.	Check the digital inputs function selection. Provide link between SC and S6.
<i>CF</i>	Control Fault		■	The torque limit was reached during deceleration for longer than 3 sec. when in Open Loop Vector control <ul style="list-style-type: none"> • 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.
<i>CPF02 to CPF24</i>	Control Circuit Fault		■	There is a problem in the frequency converter's control circuit.	Cycle the frequency converter power supply. Initialize the frequency converter. Replace the frequency converter if the fault occurs again.
<i>CPF25</i>	Control Circuit Fault		■	There is no terminal board connected to the control board	Check if the terminal board is installed properly. Uninstall and reapply the terminal board. Change the frequency converter.
<i>CFR</i>	Cannot Reset	■		Fault reset was input when a Run command was active.	Turn off the Run command and reset the frequency converter.
<i>EF</i>	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 program.
<i>EF</i>	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.
<i>EF1 to EF6</i>	External Faults	■	■	An external fault was triggered by an external device via one of the digital inputs S1 to S6. EF 3: Temperature switch (PTO or PTC) has tripped. The digital inputs are set up incorrectly	Find out why the device tripped the EF. Remove the cause and reset the fault. Check and improve cooling or reduce pump load. Check the functions assigned to the digital inputs.
<i>GF</i>	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 any broken parts. Reduce the carrier frequency.

Troubleshooting

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

Troubleshooting

Error message	Brief Description	AL	FLT	Possible cause	Corrective Action
<i>ou</i>	DC Overvoltage	■	■	DC bus voltage rose too high. The deceleration time is too short. Stall prevention is disabled. 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.
<i>LF</i>	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
<i>uu1</i>	DC Under-voltage	■	■	The voltage in the DC bus fell below the undervoltage 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.
<i>uu2</i>	Controller Under-voltage		■	The frequency converters controller power supply voltage is too low.	Cycle power to the frequency converter. Check if the fault reoccurs. Replace the frequency converter if the fault continues to occur.
<i>uu3</i>	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.

Troubleshooting

Error message	Brief Description	AL	FLT	Possible cause	Corrective Action
100A1	Pt 1000 Alarm 1	■		Occurs when Pt 1000 temperature is > 90 °C.	Check and improve cooling.
100A2	Pt 1000 Alarm 2	■		Occurs when Pt 1000 temperature is > 90 °C.	Check and improve cooling.
OH3	Pre CE alarm	■		Motor too warm. Occurs when PTC temperature is between PTC -5°C and PTC +5°C and Pt100Alm1/ Pt100Alm2 conditions are not reached. OH3 condition: Threshold value of PTC – 5°C Motor PTC not connected.	Check and improve cooling or reduce pump load. Connect motor PTC
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). Delay time set in P1-05 Pressure sensor exceeds alarm/(warning	
EAL03	External Alarm during delay of MFDI set in S3	■		External alarm during delay of MFDI settings for S3 (H1-03). Delay time set in P1-06	
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.	

Troubleshooting

Error message	Brief Description	AL	FLT	Possible cause	Corrective Action
oPEn	Pt 1000 open		■	Open circuit is detected. Note "Wait" fault.	Check Pt 1000 and connection cable, replace if required.
SHorT	Pt 1000 short circuit		■	Short circuit is detected.	Check Pt 1000 and connection cable, replace if required.
100FT	Pt 1000 fault		■	Temperature measured with the Pt 1000 reaches > 100 °C. Note "Wait" fault.	Check and improve cooling.
CMPFT	Compensation Fault		■	Contact Oerlikon Leybold Vacuum	
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		■	<p>Condition for PT 100 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".</p> <p>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.</p> <p>As soon "Wait" is occurring the frequency converter stops with RUN to coast.</p>	

Troubleshooting

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.

Error message	Possible cause	Corrective action
oPE01	Drive capacity and value set to o2-04 do not match.	Correct the value set to o2-04.
oPE02	Parameters were set outside the allowable setting range.	Set parameters to the proper values.
oPE03	A contradictory setting is assigned to multi-function contact inputs H1-01 through to H1-06. 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 setting.
oPE08	A function has been set that cannot be used in the control mode selected.(might appear after control mode change)	Fix any incorrect setting.
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 Leybold 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 parts

7 Wearing and Original Spare Parts

Original spare parts are available from the Oerlikon Leybold Vacuum Service facilities.

8 Waste 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.

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 Section "5.5 Oerlikon Leybold Vacuum Service".

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 (Oerlikon Leybold Vacuum 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, please contact us for assistance.

WARNING





EC Declaration of Conformity

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D-50968 Köln
Tel.: +49(0)221 347-0
info.vacuum@oerlikon.com

herewith declares that the products specified and listed below, which we have placed on the market, comply with the applicable EC Council Directives. This declaration becomes invalid if modifications are made to the product without agreement of Oerlikon Leybold Vacuum GmbH. Compliance with the EMC Directives requires that the components are installed within a system or machine in a manner adapted to EMC requirements.

Product designation: **Roots Booster**

Type designation: **RUVAC WH, RUVAC WHU**

Catalogue No.:

155100, 155105, 155150, 155153, 155155, 155156, 155160, 155162, 155165, 155167, 155200, 155201, 155202, 155203, 155150A, 155151V, 155158V, 155158VA, 155160A, 155161V, 155162A, 155163V, 155164V, 155204V, 155205V, 167113V, 167114V, 167124V, 7850012V, 7850013V, 7850014V, 7850015V, 7850016V, 7850017V, 155250V to 155280V

The product complies to the following European Council Directives:

- EC-low-voltage directive (2006/95/EC)
- EC-Directive relating to electromagnetic compatibility (2004/108/EC)

The following harmonised standards have been applied:

- EN 60034 - 1, 2004
Rotating electrical machines, Part 1: Rating and performance
- EN 60204 - 1, 2006
Safety of machinery - Electrical equipment of machines, Part 1: General requirements

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300302764-001-A2 - 04/2011

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Product designation: **Roots Booster**

Type designation: **RUVAC WH, RUVAC WHU**

Catalogue No.:

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155201, 155202, 155203, 155150A, 155151V, 155158V, 155158VA, 155160A, 155161V, 155162A,
155163V, 155164V, 155204V, 155205V, 167113V, 167114V, 167124V, 7850012V, 7850013V,
7850014V, 7850015V, 7850016V, 7850017V
155250V to 155280V

complies with the following fundamental requirements of the **EC Machinery Directive (2006/42/EG)**:
Annex I, Paragraph 1.1.2, 1.1.3, 1.1.5, 1.3.1, 1.3.2, 1.3.3, 1.3.4, 1.3.7, 1.5.1, 1.5.2, 1.5.4, 1.5.5, 1.5.8,
1.5.9, 1.5.11, 1.5.13, 1.6.1, 1.6.2, 1.7.1, 1.7.3, 1.7.4, 1.7.4.1 and 1.7.4.2

The following harmonised standards have been applied:

- EN 1012-2: 1996 +A1: 2009
Safety requirements for compressors and vacuum pumps, Part 2: Vacuum pumps

The incomplete machine may only be put into operation after it has been determined that the machine into which the incomplete machine shall be installed complies with the regulations laid down in the EC Machinery Directive (2006/42/EG).

The manufacturer commits himself to make the special documentation on the incomplete machine electronically available to national authorities upon request.

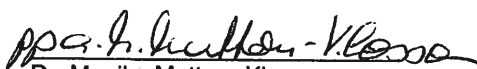
The special engineering documentation belonging to the machine was compiled in accordance with Annex VII Part B.

Documentation Officer:

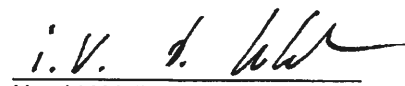
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Head of Research & Development



Harald Udelhoven
Head of Quality Management

300302764-001-A2 - 04/2011

Safety information on contamination of compressors, vacuum pumps and components.

Scope

Every employer (user) is held responsible for the health and safety of his employees. This also applies to service personnel performing maintenance work either at the premises of the user or the service company in charge.

By means of the declaration attached the contractor is to be informed about any possible contamination of the compressor, vacuum pump or component sent in for servicing. Based on this information the contractor will be able to take the necessary safety precautions.

Notice: The same conditions apply to on-site repairs.

Preparation before dispatch

Before shipping any parts, the user must complete the following declaration and add it to the dispatch papers. All dispatch instructions laid down in the manual must be followed e.g.:

- Drain all service fluids
- Remove filter elements
- Seal all openings airtight
- Pack / handle appropriately
- Attach the declaration of contamination **outside** of the packaging

Declaration of Contamination of Compressors, Vacuum Pumps and Components

The repair and / or servicing of compressors, vacuum pumps and components will be carried out only if a correctly completed declaration has been submitted. Non-completion will result in delay. The manufacturer can refuse to accept any equipment without a declaration.

A separate declaration has to be completed for each single component.

This declaration may be completed and signed only by authorized and qualified staff.

Customer/Dep./Institute : _____ Address : _____ _____ Person to contact: _____ Phone : _____ Fax: _____ End user : _____	Reason for return: <input checked="" type="checkbox"/> applicable please mark Repair: <input type="checkbox"/> chargeable <input type="checkbox"/> warranty Exchange: <input type="checkbox"/> chargeable <input type="checkbox"/> warranty <input type="checkbox"/> Exchange already arranged / received Return only: <input type="checkbox"/> rent <input type="checkbox"/> loan <input type="checkbox"/> for credit Calibration: <input type="checkbox"/> DKD <input type="checkbox"/> Factory-calibr. <input type="checkbox"/> Quality test certificate DIN 55350-18-4.2.1
---	--

A. Description of the product: Material description : _____ Catalog number: _____ Serial number: _____ Type of oil (ForeVacuum-Pumps) : _____	Failure description: _____ Additional parts: _____ Application-Tool: _____ Application- Process: _____
--	---

B. Condition of the equipment	No ¹⁾	Yes	No		Contamination :	No ¹⁾	Yes
1. Has the equipment been used	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	→	toxic	<input type="checkbox"/>	<input type="checkbox"/>
2. Drained (Product/service fluid)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	→	corrosive	<input type="checkbox"/>	<input type="checkbox"/>
3. All openings sealed airtight	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	→	flammable	<input type="checkbox"/>	<input type="checkbox"/>
4. Purged	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	→	explosive ²⁾	<input type="checkbox"/>	<input type="checkbox"/>
If yes, which cleaning agent _____					radioactive ²⁾	<input type="checkbox"/>	<input type="checkbox"/>
and which method of cleaning _____					microbiological ²⁾	<input type="checkbox"/>	<input type="checkbox"/>
¹⁾ If answered with "No", go to D. ←					other harmful substances	<input type="checkbox"/>	<input type="checkbox"/>

C. Description of processed substances (Please fill in absolutely)

1. What substances have come into contact with the equipment ?
 Trade name and / or chemical term of service fluids and substances processed, properties of the substances
 According to safety data sheet (e.g. toxic, inflammable, corrosive, radioactive)

X	Tradename:	Chemical name:
	a)	
	b)	
	c)	
	d)	

2. Are these substances harmful ? No Yes ←

3. Dangerous decomposition products when heated ? No Yes

If yes, which ? _____

²⁾ Components contaminated by microbiological, explosive or radioactive products/substances will not be accepted without written evidence of decontamination.

D. Legally binding declaration

I / we hereby declare that the information supplied on this form is accurate and sufficient to judge any contamination level.

Name of authorized person (block letters) : _____

→ _____

Date signature of authorized person firm stamp

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