Leybold

RUVAC WS / WSU 251/501/1001/2001

Roots vacuum pump with mineral oil, synthetic oil or PFPE-filling

Installation and Operating Instructions GA 03108_002_C2

Part Numbers

11375
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Contents

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 Leybold **RUVAC WS/WSU** 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

WARNING

1 Avoid exposing any part of the human body to the vacuum.

2 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.

3 The crane eyes of the RUVAC pumps must not be used to lift any pump combinations (Roots + backing pump). Exceptions are allowed only with approval from Leybold. Secure the pump by the crane at the intended eyes until a firm connection has been established with the backing pump or a corresponding suspension has been installed.

4 Do not operate the pump with any of the covers removed. Serious injury may result.

5 Never operate the RUVAC without connected intake line or blank flange at the intake.

6 Make sure that the gas flow from the discharge port is not blocked or restricted in any way.

7 It is recommended to always only operate the RUVAC with a suitable discharge line which is properly connected.

8 If discharged gases must be collected or contained, do not allow the discharge line to become pressurized.

9 When moving the RUVAC always use the allowed means.
Two crane eyes are provided on this pump as standard.

10 Do not allow the ingestion of any objects (screws, nuts, washers, pieces of wire, etc.) through the intake port of the pump. The use of the intake screen is strongly recommended. 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 including leaks to atmosphere.

11 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.

12 In order to prevent the destruction of equipment and injuries to the operating personnel, we urgently recommend to follow the installation instructions given in these Operating Instructions.

13 First open the cooling water discharge and then the cooling water supply. Otherwise a water pressure can build up in the pump which is too high. When shutting off the cooling water supply proceed in the reverse order: first shut off the water supply and then shut off the drain.

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

0.2 Electrical Hazards

WARNING

1 Potentially lethal voltages are present at the mains connections. Before beginning with any maintenance or service work on the RUVAC, disconnect the pump from all power supplies (lockout/tagout).

2 The electrical connections must only be provided by a trained electrician as specified, for example, by the regulations EN 50110-1. Note the national regulations of the country in which the equipment is in being operated.

3 Before initial commissioning install a suitable motor protection switch for the electric motor. Please note the information given in these Operating Instructions and on the electric motor (terminal diagram).

4 Before commissioning, check the junction box to ensure that it is undamaged, perform a visual inspection on the seals.

5 Install add-on parts (pressure switches, for example) without any tensions and protect these against damage by impacts, for example.

6 Lay the connecting lines so that they cannot be damaged. Protect the lines against humidity and contact with water. Avoid thermally stressing the lines due to unfavourable laying. Observe the required standards when designing and laying the electrical connections.

7 Provide strain relief for the connecting lines so that the plugs and the line connectors are not exposed to excessively high mechanical stresses.

8 Lay the electric lines so that there is no risk of tripping over these.

9 The RUVAC must be integrated in the system control arrangement so that the pump can not run-up automatically after it has been shut down due to overtemperature of the motor. This applies equally to emergency shut-down arrangements. After having determined the fault cause, the pump should be switched on manually again.

10 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.

11 The temperature sensors (PTC, PTO) have basic insulation to the motor winding. The operator must guarantee protection in the case of indirect contact. For this purpose a monitoring device with galvanic isolation can be provided from the temperature sensor to the pump control, e.g. through thermistor machine protection devices by Eaton, type EMT6-DBK.

Safety Information

0.3 Thermal Hazards

CAUTION

1 Hot surfaces, risk of suffering burns.
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.
If there is the risk of touching hot surfaces inadvertently, install corresponding protection. When working on a pump which is still warm from operation, always wear protective gloves.

2 The pump must only be operated at ambient temperatures between 12 and 40 °C. It needs to be ensured that the thermal radiation produced by the pump can be dissipated sufficiently. If the pump has to be operated at higher ambient temperatures than 40 °C for any reason, reduced max. differential pressures apply (derating). Please consult Leybold for further details.

3 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.

4 Before disassembling the cooling water lines, let the pump cool down first and shut off the supply line.

5 Before any servicing and maintenance work always let the pump cool down first.

6 Note the warning information on the housing surface. If these warning notices have been removed, are covered or obstructed, include corresponding additional warning information.

0.4 Hazards Caused by Materials and Substances

DANGER

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 hazardous 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 Since not all application related hazards for vacuum systems can be described in detail in these Operating Instructions, Leybold has available a separate document (Safety Booklet) in which the hazards and general safety concepts for design, operation and maintenance of vacuum systems are explained.

When planning to pump hazardous substances with this pump, read the related chapters in the Safety Booklet and in these Operating Instructions first. You can download the Safety Booklet from our homepage.

Safety Information

3 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.

4 The user has to ensure that all appropriate safety codes and all safety procedures are applied in case of pumping toxic, chemically reactive, corrosive gases and/or pyrophoric substances. Before using the RUVAC pumps with toxic and/or aggressive gases, it is imperative that you consult your local Leybold office.

5 Leybold 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.

6 When pumping hazardous gases you must assume the presence of corresponding residues in the pump.

7 After having operated the pump, the cooling water lines may suffer from microbiological contamination. Introduce corresponding safety precautions.

8 The intake and the discharge lines should be checked regularly for leaks. There exists the danger of escaping gas.

9 The cooling water used must not attack stainless steel (note the cooling water quality).

10 When changing the oil, remove any escaped oil as otherwise there exists the risk of slipping.

11 After having completed the installation work we recommend running of a leak test on the complete installation at an absolute pressure of 1100 mbar. Otherwise the possibility of escaping of process gases cannot be completely ruled out.

12 Some Roots 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 way from open fires. Do not smoke in the work area.
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.

Safety Information

0.5 Ignition Risk

1 Basically the RUVAC pumps must not be used with flammable or explosive gases and vapors. In particular cases the composition of the substances may not be critical. In any case the user is obliged to analyse the situation carefully and to take appropriate precautions introduced by competent experts.

2 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.

3 3 Before commissioning the RUVAC, 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.

4 4 The standard version of the RUVAC is not suited for operation in explosion hazard areas. Contact us before planning to use the pump under such circumstances

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

NOTICE

0.7 Danger of Pump Damage

1 Do not use the pump for applications that produce abrasive or adhesive powders or condensable vapors that can leave adhesive or high viscosity deposits. Please contact Leybold Sales for selecting the right separator.

2 Vapors which condense upon being compressed within the pump to liquids must be avoided when their vapor pressure exceeds the vapor tolerance of the pump.

3 Before pumping vapors, the RUVAC should have attained its operating temperature. The pump will have attained its operating temperature about 1 hour after starting the pump. During this time the pump should be separated from the process by a valve in the intake line, for example.

4 In order to prevent the transfer of vibrations from the RUVAC to other parts of the system we recommend the use of corrugated hoses or compensators on both the intake and the discharge sides.

5 Do not use the RUVAC pumps in combination with backing pumps that have an ultimate pressure above 10 mbar. This prevents excessively high temperatures of the RUVAC in idle mode operation.

6 The maximum cooling water pressure must not exceed 6 bar. Otherwise there exists the risk of leaks.

7 In the case of wet processes we recommend the installation of liquid separators upstream and downstream of the pump so as to avoid a massive influx of liquid into the pump.

8 The discharge line should be laid so that it slopes down and away from the pump so as to prevent condensate from backstreaming into the pump.

9 The ingress of particles and liquids must be avoided under all circumstances.

10 Before installing, all flange covers must be removed.

11 The location where the RUVAC is installed must be selected such that all controls are easily accessible.

12 In order to ensure an adequate supply of oil, the location at which the RUVAC (including its accessories) is operated should be such that angles over > 1° from the vertical are avoided.

Description

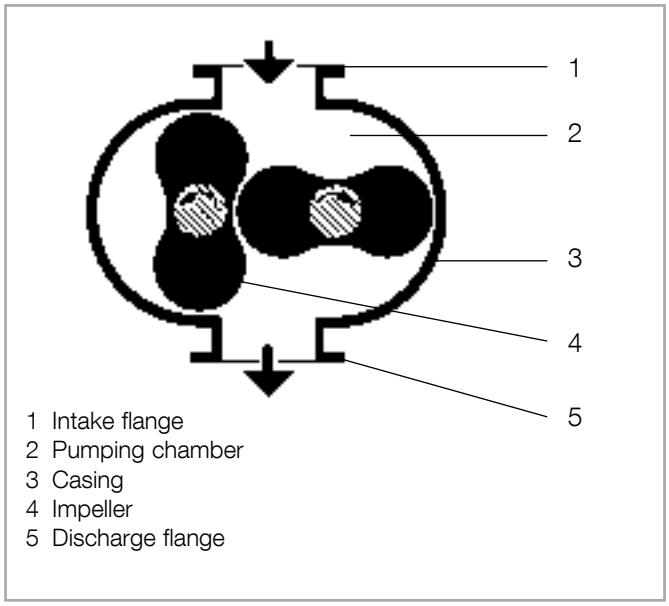


Fig. 1.1 Schematic cross-section of a Roots pump (vertical flow)

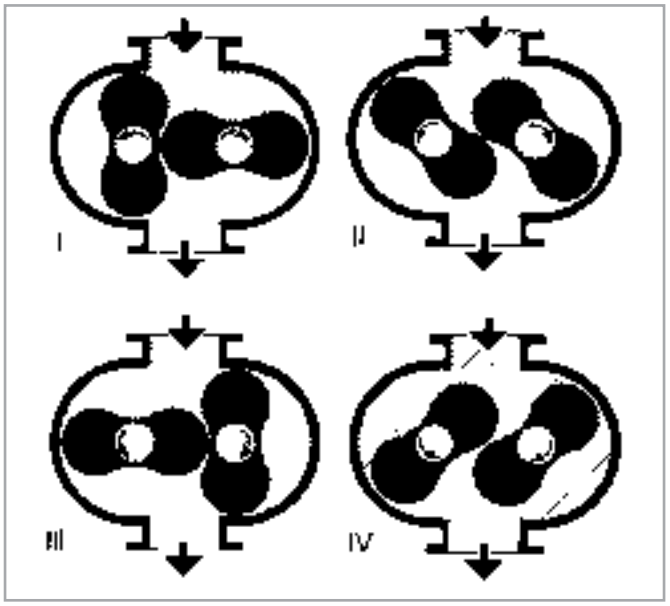


Fig. 1.2 Functional diagram of a Roots pump (vertical flow)

1 Description

1.1 Design and Function

The RUVAC WS and RUVAC WSU are Roots pumps driven by a canned motor.

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

The RUVAC WS and WSU are lubricated with mineral oil, synthetic oil or perfluorized polyether (PFPE) in the case of the PFPE models. Apart from the lubricant the mineral oil and PFPE models are identical in type.

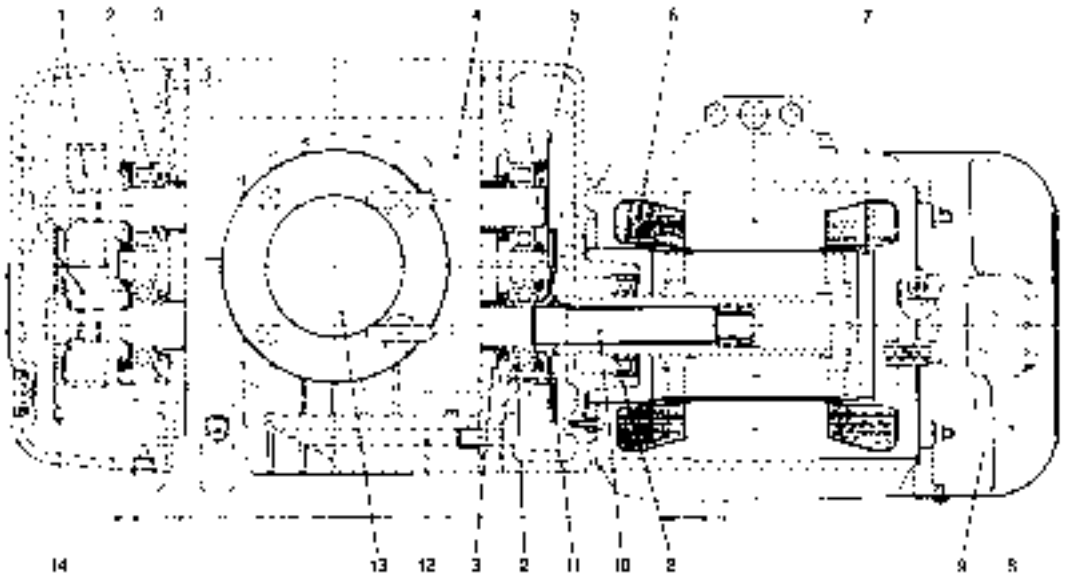
Only the RUVAC WS/WSU PFPE can be used for pumping greater than atmospheric concentrations of oxygen or very aggressive or hazardous gases.

1.1.1 Principle of Operation

Roots pumps - also known as 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



1	Gearwheels	8	Fan cowl
2	Bearings	9	Fan
3	Impeller seals	10	Drive shaft
4	Impellers	11	Centrifugal disc lubricator
5	Driven impeller shaft	12	Equalisation passage
6	Stator	13	Intake port
7	Can	14	Centrifugal disc lubricator

Fig. 1.3 Longitudinal section of a RUVAC WS 1001 (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.

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

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

RUVAC WS/WSU pumps have been specifically designed for operation in the rough and fine 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 existing pressure range
- the pressure difference between the inlet and the discharge flange (see fig. 1.7)
- and the type of gas to be pumped.

1.1.2 Design

RUVAC Roots pumps can pump gas in the vertical or horizontal direction.

Although the pumping chamber of Roots pumps is free of sealing agents and lubricants, the two gearwheels of the synchromesh gearing (1.3/1) and the bearings (1.3/2) are lubricated with mineral oil, synthetic oil or with PFPE. The gearwheels and bearings of the RUVAC are located in two side chambers which also contain the oil supply.

These two side chambers are separated from the pumping chamber by the impeller seals (1.3/3). During operation of the pump, the side chambers are evacuated via the impeller seals.

The side chambers are linked to each other by two passages (1.3/12). These passages are arranged so that for either horizontal or vertical flow the pressure will be equalised between the oil supplies.

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

RUVAC WS/WSUs are driven by an air or water cooled canned motor. In such a motor, the rotor and stator coils (1.3/6) are separated by a vacuum-tight can (1.3/7) made of non-magnetic material. The rotor runs in the vacuum on the pump's drive shaft (1.3/10); thus a shaft feedthrough to the atmosphere is not needed.

With the standard motors, the RUVAC WS/WSUs can run on either 50 Hz or 60 Hz power supplies.

When operating with frequency converters even higher speeds are possible.

Built into the stator coil of the motor is, depending on the version, a temperature switch, respectively three PTCs and a temperatures switch which will shut down the pump when the motor temperature gets too high.

The pump section of the RUVAC WS/WSU is air cooled. The air flow cooling the motor and the pump is produced by a fan (1.3/9) having its own drive motor under the fan cowl (1.3/8).

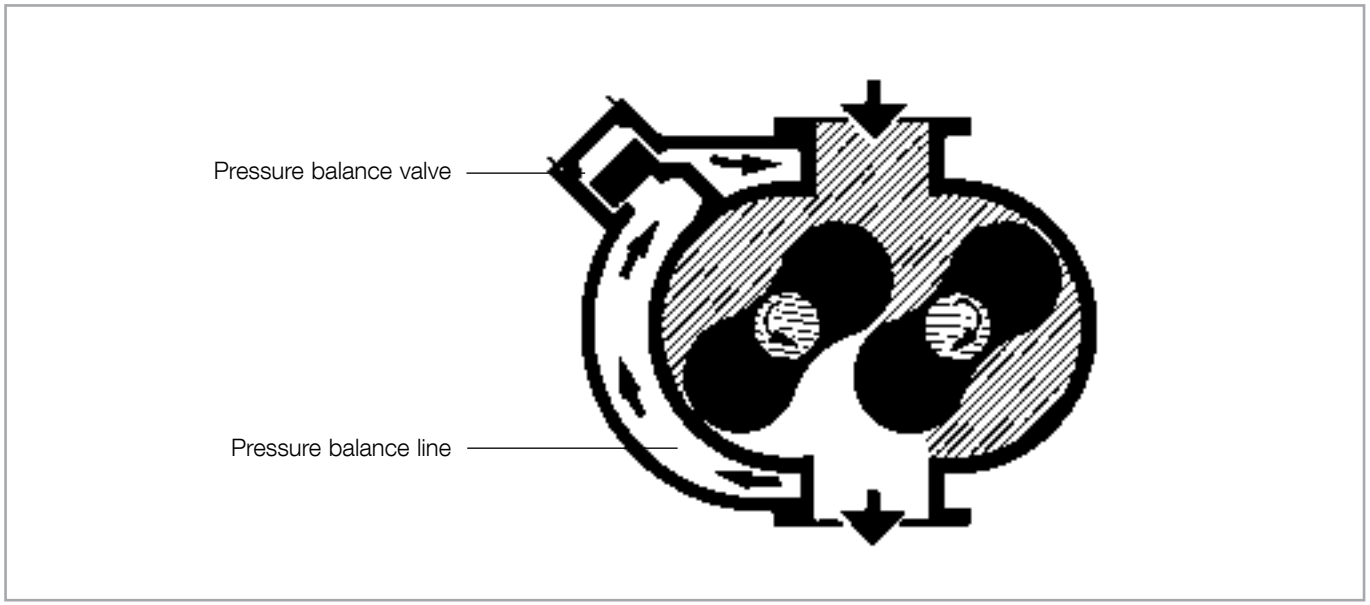


Fig. 1.4 Schematic diagram of a Roots pump with pressure balance line

When operating the pump with a frequency converter, then generally the drive motor of the fan must be operated at the normal mains frequency.

1.1.3 Pressure Balance Line

The RUVAC WSU has an integrated pressure balance line. It links the discharge and intake flanges via a pressure balance valve.

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

The valve is weight- and spring-loaded so that it works with both vertical and horizontal flow of the pump.

In the case of 50/60 Hz operation and due to the pressure balance line, no additional controlling equipment will be needed to protect the pump against pressure differences which are too high. The RUVAC WSU pumps can then 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.

Some models are equipped with an ACE shock absorber in the pressure balance line. In the case of pressure bursts this prevents the valve from making contact at the cover. This reduces valve noise and increases its durability.

NOTICE

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

1.1.4 Lubricants

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

NOTICE

If mineral oil and PFPE come into contact 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 Leybold should do the change.

In case of operation with mineral oil we recommend our vacuum pump oil LVO 130.

When the RUVAC is operated at a pressure difference of Dp > 10 mbar or at > 60 Hz.then LVO 211 should be used.

In case of operation with PFPE we recommend our LVO 400. PFPE pumps are marked by an additional red label at the oil-fill screw.

1.2 Standard Specification

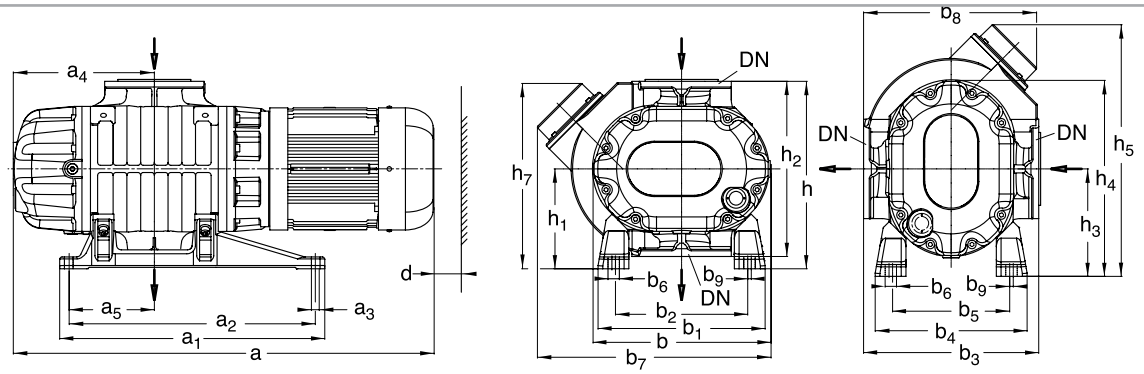
RUVAC WS/WSU are supplied for vertical flow.

Before delivery the oil has been drained out. The quantity of mineral oil, synthetic oil or PFPE which is required for operation, is supplied separately with the pump.

All pumps are equipped in their intake flange with an intake screen and have been vented with nitrogen so as to protect the pump against corrosion. The flanges are sealed by a zinc coated metal cover plate with polymer seal.

All pumps are equipped with a standard motor in accordance with the IEC standard.

Description



DN_1 = ND 6 pump flange in accordance with DIN 2501

DN_1 = Collar flange with gasket for connecting ISO-K standard components

Type		DN/DN1	DN_1	a	a_1	a_2	a_3	a_4	a_5
WS/WSU 251	mm	65	63 ISO-K	694	405	365	14	212	120
WS/WSU 501	mm	65	63 ISO-K	752	486	450	14	237	155
WS/WSU 501H	mm	65	63 ISO-K	752	486	450	14	237	155
WS/WSU 1001	mm	100	100 ISO-K	885	560	520	16.5	298	180
WS/WSU 1001H	mm	100	100 ISO-K	885	560	520	16.5	298	180
WS/WSU 2001	mm	150	160 ISO-K	1042	800	740	18	367	220
WS/WSU 2001H	mm	150	160 ISO-K	1042	800	740	18	367	220
WS 2001 FC	mm	150	160 ISO-K	1042	800	740	18	367	220

		b	b_1	b_2	b_3	b_4	b_5	b_6	b_7 1)	b_8	b_9
WS/WSU 251	mm	250	270	210	280	230	170	24	305	285	7.5
WS/WSU 501	mm	310	299	229	320	271	201	24	390	313	7.5
WS/WSU 501H	mm	310	299	229	320	271	201	24	414	330	7.5
WS/WSU 1001	mm	376	352	278	370	320	246	24	494	366	7.5
WS/WSU 1001H	mm	376	352	278	370	320	246	24	524	398	7.5
WS/WSU 2001	mm	463	518	388	460	422	292	24	638	456	7.5
WS/WSU 2001H	mm	463	518	388	460	422	292	24	642	460	7.5
WS 2001 FC	mm	463	518	388	460	422	292	24	–	–	7.5

		d	h	h_1	h_2	h_3	h_4	h_5 1)	h_6
WS/WSU 251	mm	50	300	160	280	180	306	360	307
WS/WSU 501	mm	50	340	180	320	194	348	430	332
WS/WSU 501H	mm	50	340	180	320	194	348	450	350
WS/WSU 1001	mm	50	396	211	370	227	414	532	392
WS/WSU 1001H	mm	50	396	211	370	227	414	564	424
WS/WSU 2001	mm	50	530	300	460	351	578	760	523
WS/WSU 2001H	mm	50	530	300	460	351	578	753	530
WS 2001 FC	mm	50	530	300	460	351	578	–	–

1) RUVAC WSU only

Outside dimensions ± 3mm

Fig. 1.5 Dimensional drawing for the RUVAC WS/WSU

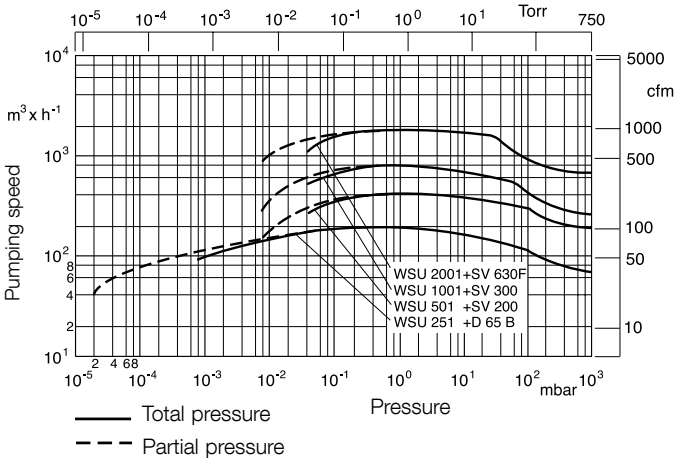


Fig. 1.6 Pumping speed characteristics for operation at 50 Hz
The ultimate pressure ($P_{ult.}$) depends on the backing pump used.

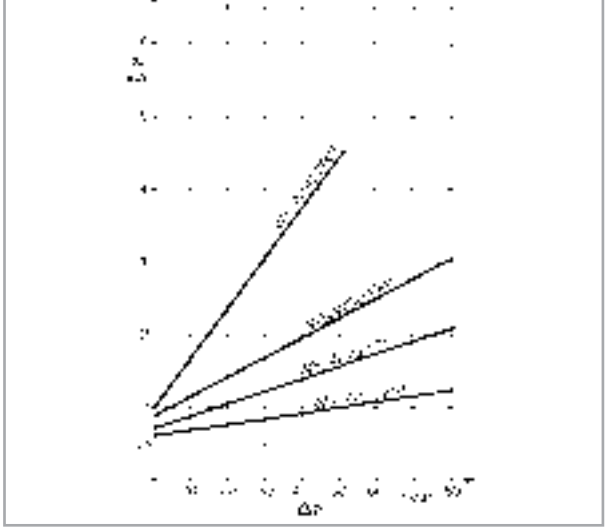


Fig. 1.7 Power consumption of the RUVAC WS/WSU

Description

1.3 Technical Data

RUVAC WS/WSU		251 50 Hz 60 Hz	501 50 Hz 60 Hz	1001 50 Hz 60 Hz	2001 50 Hz 60 Hz
Nominal pumping speed [1) 2)]	$m^3 . h^{-1}$	253 304	505 606	1000 1200	2050 2460
Max. pumping speed	$m^3 . h^{-1}$	210 251	410 530	800 1000	1850 2100
n with backing pump TRIVAC		D 65 B	-	-	-
n with backing pump SOGEVAC		-	SV 200	SV 300	SV 630 F
Ultimate partial pressure [3)]	mbar	$< 2 \times 10^{-5}$	$< 8 \times 10^{-3}$	$< 8 \times 10^{-3}$	$< 8 \times 10^{-3}$
Ultimate total pressure [3)]	mbar	$< 8 \times 10^{-4}$	$< 4 \times 10^{-2}$	$< 4 \times 10^{-2}$	$< 4 \times 10^{-2}$
Possible cut-in pressure – RUVAC WS		see Section 4.1			
Maximum allowable pressure differential in continuous operation[4)]	mbar	80	80	80	50
Leaktightness	$mbar \cdot l \cdot s^{-1}$	$\leq 1 . 10^{-4}$			
Permissible ambient temperatures	°C	12 - 40			
Permissible voltage at the motor's fan	AC	230 V / 50/60 Hz and 265 V / 50 (60) Hz			
Mains voltage at the Motor, 50 Hz	D/Y V D/Y V	200/- 230/400			
Mains voltage at the Motor, 60 Hz	D/Y V D/Y V	200-208/- 265/460			
Temperature class		F	F	F	F
Motor power, 50/60 Hz	kW	1.1/1.4	2.2/2.4	4.0/4.4	7.5/8.5
Nominal speed, 50/60 Hz	min^{-1}	3000/3600	3000/3600	3000/3600	3000/3600
Max. permissible speed	min^{-1}	6000	6000	6000	4200 [5)]
Min. permissible speed[9)]	min^{-1}	1200	1200	1200	1200
Motor protection category	IP	20	20	20	20
Lubricant filling 6)		1. Filling[7)] / 2. Filling	1. Filling[7)] / 2. Filling	1. Filling[7)] / 2. Filling	1. Filling[7)] / 2. Filling
n PFPE - vertical flow	l	0.6 / 0.55	0.85 / 0.75	1.85 / 1.65	3.0 / 2.7
- horizontal flow	l	0.5 / 0.45	0.75 / 0.7	1.1 / 1.0	2.1 / 1.9
n other types of oil - vertical flow	l	0.65 / 0.6	0.9 / 0.8	2.0 / 1.8	3.85 / 3.6
- horizontal flow	l	0.5 / 0.45	0.75 / 0.7	1.2 / 1.1	2.6 / 2.4
Weight WS / WSU	kg	90 / 95	130 / 135	228 / 233	458 / 465
Connection flanges	DN	63 ISO - K	63 ISO - K	100 ISO - K	160 ISO - K
Noise level [8)]	dB (A)	< 63	< 63	< 68	< 72

1) To DIN 28 400 and subsequent numbers
2) In the case of deviating frequencies, please contact us
3) With double-stage rotary vane vacuum pump TRIVAC, resp. single-stage rotary vane vacuum pump SOGEVAC (Type of backing pump look at max. pumping speed). When using 2-stage backing pumps the ultimate pressures will be correspondingly lower
4) Applicable for ratio up to 1 : 4 between backing pump and Roots vacuum pump at 3000 rpm
5) Upon request also available with a max. speed of 6000 rpm (see table "differential pressures" in Section 1.3.2 and part nos. for 100 Hz versions of the WS(U) 2001
6) Authoritative, however, is the oil level at the oil-level glass, see Fig. 3.2 to 3.5
7) After a complete disassembly
8) At an operating pressure below $< 10^{-1}$ mbar and 50/60 Hz operation
9) The minimum permissible speed is relevant for the oil lubrication system of bearings and gears and has to be considered if the speed is constant for more than 1 hour. Running the pump at less than the minimum speed for more than 1 hour can cause damage to the pump due to a lack of lubrication.

1.3.1 Voltage ranges for the canned motors

Pump model	Nominal power / Nominal current at 50 Hz						Nominal power / Nominal current at 60 Hz					
	200 V		230 V		400 V		200-208 V		265 V		460 V	
	kW	A	kW	A	kW	A	kW	A	kW	A	kW	A
WS/WSU 251	0.9	4.8	1.1	5.5	1.1	3.2	0.9	4.8	1,4	5,5	1.4	3.2
WS/WSU 501	1.6	7.8	2.2	9	2.2	5.2	1.6	7.8	2.4	10	2.4	5.8
WS/WSU 1001	3	13	4	15.7	4	9.1	3	13	4.4	14.7	4.4	8,5
WS/WSU 2001	5	21	7.5	26	7.5	15	5	21	8.5	26	8.5	15

NOTICE

The motor overload protection switch must be set to the nominal current stated in the table in each case. The separate fan current may only be operated within the permissible voltage range (230 V, 50 Hz and 265 V, 60 Hz) as otherwise the fan will be damaged, especially so when using a frequency converter. In the case of deviating voltages you must use a transformer.

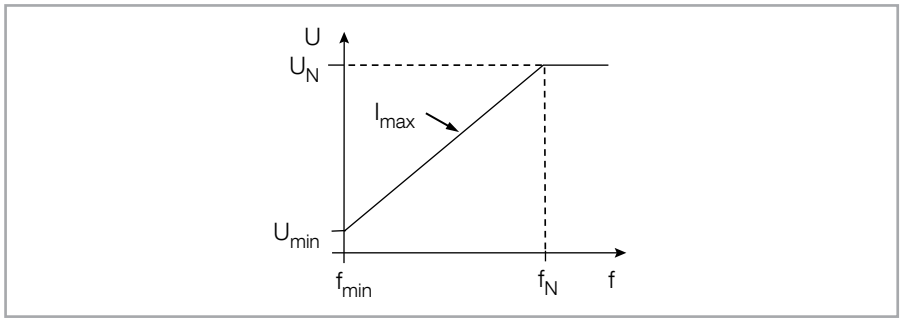


Fig. 1.8 U/f profile

1.3.2 Limitations of use for frequency converter operation

When using a frequency converter, we recommend setting a U/f profile. For a guide to settings please refer to the following table. The specified current limits should not be exceeded even for a short time by ensuring suitable settings in the frequency converter. Regardless of these current limits, the maximum pressure differentials listed in Section 1.3.3 must be observed.

Voltage range		~3 Δ 200-265 V	~3 Y 400-480 V
Rated voltage U_N		265 V	460 V
Minimum voltage U_{min}		10 V	18 V
Rated frequency f_N		60 Hz	
Minimum frequency f_{min}		0-5 Hz	
I_{max}	WS(U) 251	5.5 A	3.2 A
	WS(U) 501	10 A	5.8 A
	WS(U) 1001	14.7 A	8.5 A
	WS(U) 2001	26 A	15 A

1.3.3 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 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 cool down 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 20 minutes is exceeded, the pump has to be considered in continuous operation.

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

The given values are valid for air with a maximum intake temperature of 40 °C and a maximum ambient temperature of 40 °C.

With the evacuation of vented vacuum chambers in short cycle or load lock applications the RUVAC must only be operated at max. 60 Hz (air inrush).

Example

Max. allowable differential pressure in duty cycle:
RUVAC WS 2001 at 50 Hz / DV 650

Operation: 10 minutes at high differential pressure
10 minutes at a discharge pressure of less then 1 mbar

$$\text{Pumpe ratio} = \frac{\text{Nominal pumping speed DV 650}}{\text{Nominal pumping speed WS 2001}} = \frac{650\ m^3 \cdot h^{-1}}{2050\ m^3 \cdot h^{-1}} = 1{:}3$$

Duty cycle is 50 %. The maximum allowable differential pressure resulting from the table above is Δp_{max} = 75 mbar.

See also Section 4.1 for calculating the cut-in pressure.

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

Do not allow the WSU 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!

Description

Maximum permissible differential pressures for the RUVAC WS in mbar

WS 251 & WS 501

Operation at	50 Hz			60 Hz			80 Hz			100 Hz		
Pump ratio	1:1 - 1:4	1:5 - 1:7	1:8 - 1:15	1:1 - 1:4	1:5 - 1:7	1:8 - 1:15	1:1 - 1:4	1:5 - 1:7	1:8 - 1:15	1:1 - 1:4	1:5 - 1:7	1:8 - 1:15
Continuous operation	80	63	53	57	46	38	34	28	23	28	23	19
Duty cycle 50%	103	93	79	81	67	57	50	40	34	43	34	28
Duty cycle 25%	103	103	103	84	84	84	58	58	53	47	47	43
Pumpdown from atmosphere (< 2 min)	103	103	103	84	84	84	58	58	58	47	47	47

WS 1001

Operation at	50 Hz			60 Hz			80 Hz			100 Hz		
Pump ratio	1:1 - 1:4	1:5 - 1:7	1:8 - 1:15	1:1 - 1:4	1:5 - 1:7	1:8 - 1:15	1:1 - 1:4	1:5 - 1:7	1:8 - 1:15	1:1 - 1:4	1:5 - 1:7	1:8 - 1:15
Continuous operation	80	62	50	44	34	27	17	13	11	7	5	4
Duty cycle 50%	94	92	75	63	48	40	25	20	16	10	8	6
Duty cycle 25%	94	94	94	78	74	62	37	30	25	16	13	11
Pumpdown from atmosphere (< 2 min)	94	94	94	78	78	78	48	48	48	32	32	32

WS 2001

Operation at	50 Hz			60 Hz			80 Hz			100 Hz		
Pump ratio	1:1 - 1:4	1:5 - 1:7	1:8 - 1:15	1:1 - 1:4	1:5 - 1:7	1:8 - 1:15	1:1 - 1:4	1:5 - 1:7	1:8 - 1:15	1:1 - 1:4	1:5 - 1:7	1:8 - 1:15
Continuous operation	50	37	30	34	26	21	16	12	10	4	3	2
Duty cycle 50%	75	56	45	50	39	32	20	15	13	5	4	4
Duty cycle 25%	80	80	69	67	60	48	28	22	18	6	5	4
Pumpdown from atmosphere (< 2 min)	80	80	80	67	67	67	50	50	50	40	40	40

1.4 Ordering Information

1.4.1 Pumps

Model	for lubricant	Part No.	special feature
RUVAC WS/WSU 251			
WS 251	LVO 130	11722	–
WS 251	PFPE	11727	–
WSU 251	LVO 130	11723	–
WSU 251	PFPE	11728	–
WSU 251	LVO 130	155009	integral leak tightness < $1x10^{-5}$ mbarl/s
RUVAC WS/WSU 501			
WS 501	LVO 130	11732	–
WS 501	PFPE	11737	–
WS 501	PFPE	155110*	
WS 501-SEMI W	PFPE	12860*	water cooled motor
WSU 501	LVO 130	11733	–
WSU 501 H	LVO 130	11833	ACE shock absorber
WSU 501 H	PFPE	11375	ACE shock absorber
WSU 501	PFPE	11738	–
RUVAC WS/WSU 1001			
WS 1001	LVO 130	11742	–
WS 1001	PFPE	11747	–
WS 1001	PFPE	155111*	
WS 1001 W	PFPE	155042*	water cooled motor, special intake screen
WSU 1001	LVO 130	11743	–
WSU 1001 H	LVO 130	11843	ACE shock absorber
WSU 1001 H	LVO 211	167097	ACE shock absorber
WSU 1001 H	PFPE	15047	ACE shock absorber
WSU 1001 H	PFPE	155112*	ACE shock absorber
WSU 1001 W	PFPE	155043*	water cooled motor, special intake screen
WSU 1001 H	LVO 211	167043	ACE shock absorber, horizontal flow, supplied without oil

Description

Model	for lubricant	Part No.	special feature
RUVAC WS/WSU 2001			
WS 2001	LVO 130	11752	–
WS 2001	PFPE	11757	–
WS 2001	PFPE	15095	100 Hz operation possible
WS 2001	PFPE	155113*	100 Hz operation possible
WS 2001	PFPE	155114*	100 Hz operation possible, horizontal flow
WS 2001	LVO 211	167007	100 Hz operation possible
WS 2001	LVO 211	155007	100 Hz operation possible, reversed flow
WS 2001	LVO 130	167173V	special paint RAL 9002
WS 2001	special oil HCF12	167175V	
WS 2001	special oil Breox B75	167187V	
WS 2001	LVO 211	167190V	
WS 2001 W	PFPE	7850010*	100 Hz operation possible, water cooled motor, special intake screen
WS 2001 W	PFPE	155054*	100 Hz operation possible, water cooled motor, special intake screen
WSU 2001	LVO 130	11753	–
WSU 2001	PFPE	7850009*	–
WSU 2001	PFPE	20003123*	–
WSU 2001	LVO 211	15096	100 Hz operation possible
WSU 2001 H	LVO 211	167044	ACE shock absorber
WSU 2001 H	LVO 130	11853	ACE shock absorber
WSU 2001 H	LVO 211	167056	ACE shock absorber, 100 Hz operation possible, horizontal flow
WSU 2001 W	PFPE	155053*	water cooled motor, special intake screen
WSU 2001	LVO 211	167026	100 Hz operation possible, horizontal flow
WSU 2001 H	LVO 211	167042	ACE shock absorber, horizontal flow, supplied without oil
WSU 2001 W	PFPE	7850011V*	100 Hz operation possible, water cooled motor,
WSU 2001 H	PFPE	155066	100 Hz operation possible
WSU 2001 H	PFPE	167129V	ACE shock absorber

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

The RUVAC WS/WSU 251, 501, 1001 can all be operated with 100 Hz

1.4.2 Accessories

Roots pump	WS/WSU 251	WS/WSU(H) 501	WS/WSU(H) 1001	WS/WSU(H) 2001
Mandatory Accessories				
Collar flange with retaining ring, DIN 2501 For connection to flange system DN ...ISO-K				
DN 63 ISO-K	267 47	267 47	–	–
DN 100 ISO-K	–	–	267 50	–
DN 160 ISO-K	–	–	–	267 51
Accessories				
Flange adapter set, consisting of Flange adapter with screws, bolts, washers and nuts for ANSI flange	(3" ANSI)	(3" ANSI)	(4" ANSI)	(6" ANSI)
WA/WS pump	200 03 179	200 03 179	200 03 180	200 03 181
WAU/WSU pump	200 03 179	200 03 179	200 03 180	200 03 182
Frequency converter RUVATRONIC	RT 5/251 500 001 381	RT 5/501 500 001 382	RT 5/1001 500 001 383	RT 5/2001 500 001 384
Oil pressure switches (for WS-PFPE-models only)	194 82			
Oil drain facility (M 16 x 1.5) with right-angled drain coupling	200 14 271			
Pressure switch PS 115 (stainless steel), adjustable	160 04			
Pressure switch adjustment	160 05			
Accessories for mounting PS 115				
Adapter	168 40			
Right-angle bend DN 16 KF	184 36			
Centering ring DN 16 KF, 2 x	183 26			
Clamping ring DN 16 KF, 2 x	183 41			
Contact amplifier SV 110, 230 V	160 78			
Mineral oil LVO 130, 1 l	L13001			
5 l	L13005			
20 l	L13020			
208 l	L13099			
Ester oil LVO 211, 1 l	L21101			
5 l	L21105			
20 l	L21120			
208 l	L21199			
PFPE LVO 400, 0.75 l	L40000			
1 l	L40001			
Spare parts				
Major maintenance kit				
WS	EK 110 002 671	EK 110 002 672	EK 110 002 673	EK 110 002 674
WSU	EK 110 002 675	EK 110 002 676	EK 110 002 677	EK 110 002 678
RUVAC WS/WSU(H) Seal kit	194 62	194 66	194 70	194 74

Transport and Storage

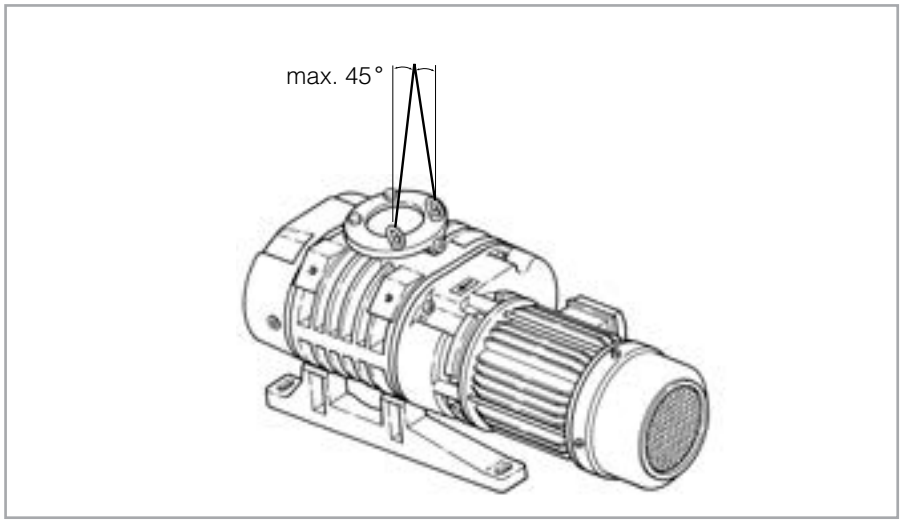


Fig. 2.1 Transport

2 Transport and Storage

Roots pumps are heavy machines made of cast iron and thus should only be lifted using suitable lifting equipment tied to the eyes provided for this purpose.

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.

CAUTION

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

NOTICE

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 (5° 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.

Transport and Storage

Storing

When shelving the pump for a longer period of time (> 2 weeks) you should seal off the flanges of the pump 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.

NOTICE

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

1 Discharge flange
2 Oil-level glass
3 Eyes
4 Oil-fill port
5 Intake flange
6 Connection for pressure switch
7 Direction-of-rotation arrow
8 Pressure switch
9 Centering and clamping ring
10 Right-angle bend
11 Adapter
12 Junction box

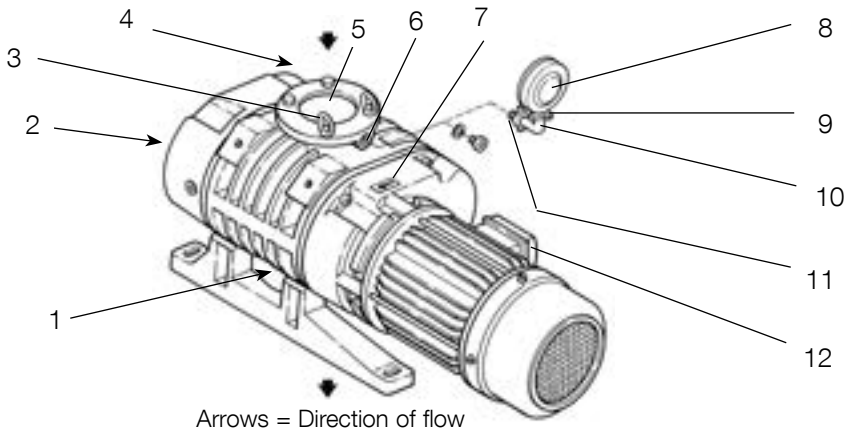


Fig. 3.1 Connections and controls

3 Installation

Only fill in the oil after having installed the pump.

NOTICE

3.1 Installation

Install RUVAC WS/WSU pumps on a flat, horizontal surface (1° max. tilt).

If the pump is not level, lubricant may enter the pumping chamber from the gear chambers.

NOTICE

Keep the air intake and exhaust ducts for cooling the motor unobstructed (for minimum clearance with respect to the fan cowl, see Fig. 1.5).

The pump's ambient temperature should be between 12 °C and 40 °C . Lower temperatures hamper run-up; higher ones shorten the lubricant change intervals and may lead to greater wear.

Special oil for operation at temperatures below 12 °C is available upon request.

Install the pumps only in rooms with a roof. Motor and fan cowl are rated as IP 20 and are thus not protected against drip water and condensing water.

NOTICE

Secure the pump. Four bores in the feet are provided for this purpose.

NOTICE

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 suction and pressure sides, the screws for attachment of the feet must always be fitted and tightened.

Use the following screws:

RUVAC 251/501	:	4 x M 12
RUVAC 1001/2001	:	4 x M 16

3.1.1 Filling in of the Lubricants

The lubricant needed for running the pump is supplied in a separate container.

Unscrew the oil-fill plug (5.1/4) and add lubricant.

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 oils LVO 130 or LVO 211. As PFPE we recommend our LVO 400. 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. 3.2 to 3.5 which apply to switched off pumps (at standstill) are correctly maintained.

The filling level in the oil level viewing glass is dependent on the size of the pump and type of oil used.

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 or the pump may 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.

Installation

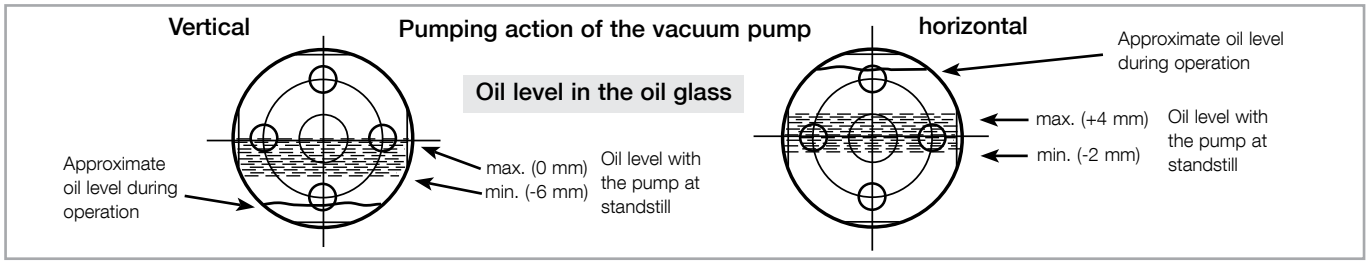


Abb. 3.2 **WSU 251-1001 LVO 211; WS/WSU 251-2001 LVO 130**

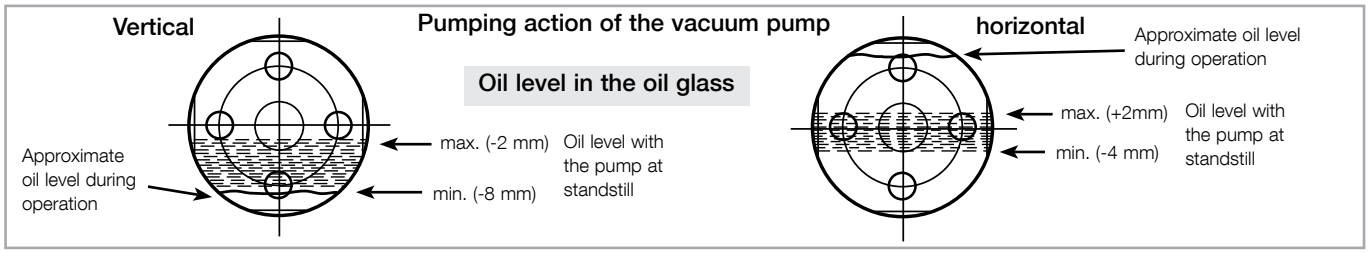


Abb. 3.3 **WS/U 251-501 PFPE**

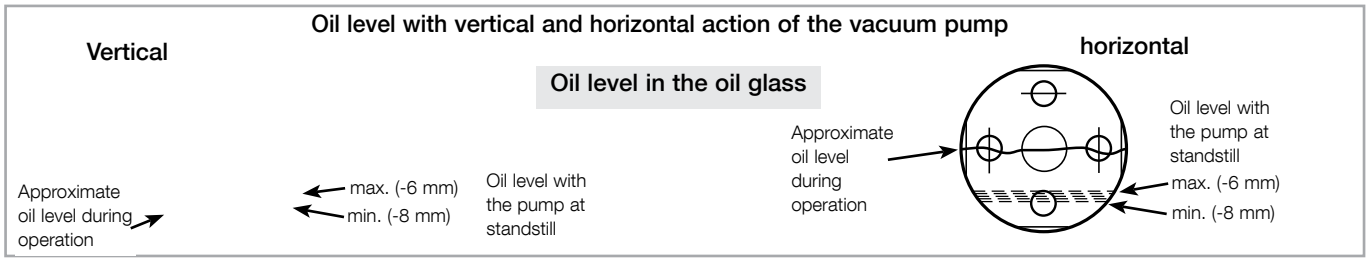


Abb. 3.4 **WSU 2001 LVO 211; WS/WSU 1001 PFPE**

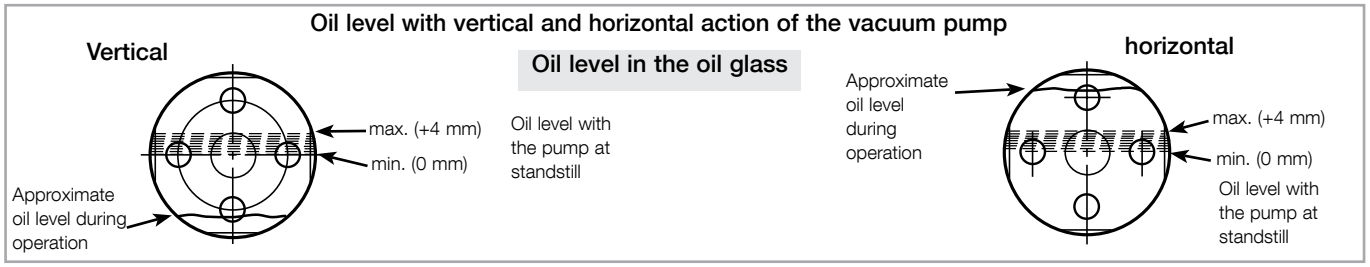


Fig. 3.5 **WS/U 2001 PFPE**

Fig. 3.2 - 3.5 Oil level in the oil level viewing glass depending on the size of the pump and type of oil.

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 Leybold may only be used after approval by Leybold.

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 Leybold.

Installation

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

WARNING

3.3 Connecting the Cooling Water

(for some motor versions)

Connect the cooling water. Ensure an adequate cooling water flow, see Technical Data.

Secure the cooling water connections with Loctite 572.

CAUTION

First open the cooling water discharge and then the cooling water supply. Otherwise a water pressure can build up in the pump which is too high. When shutting off the cooling water supply proceed in the reverse order: first shut off the supply and then open the drain.
Notice safety information 0.3.3.

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 %.	
DS water (softened or fully desalinated water) can be used for cooling the pump, if the pH value corresponds to the range indicated above.	

3.4 Electrical Connection

Notice safety information 0.2.

WARNING

NOTICE

Especially when operating the pump using a frequency converter you must ensure by means of a separate mains connection for the fan's motor that is connected to the right supply voltage and frequency. Otherwise the fan will be damaged.

Always provide an uninterrupted connection for the protective ground conductor ⏚ connecting it in a professional manner. Never leave the protective ground conductor for the pump unconnected.

Do not link control circuits to the power circuit of the motor. Observe the wiring diagrams.

When connecting the motor you must also connect the thermal switch of the pump motor (ensure protection in case of indirect contact, see Section 0.2.11) and the fan motor (for recommendations, see Fig. 3.6).

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

Connect the pump to the correct mains voltage through the terminals provided in the junction box (see Fig. 3.6).

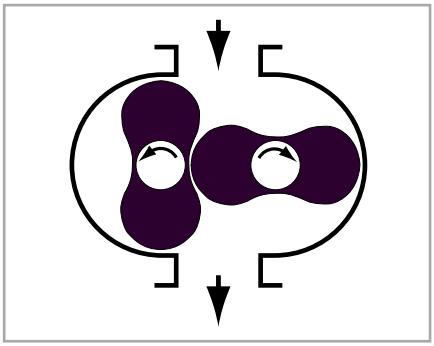
After connecting the motor and every time you alter the wiring, check the direction of rotation.

CAUTION

Wear protective goggles for protection against particles which may be forced out of the flange opening. Keep your hands away from the flange opening.

An arrow (3.1/7) on the motor flange shows the correct direction of rotation for the impeller connected to the motor shaft. To check rotation, switch on the motor briefly and observe the direction of impeller rotation through the pump's intake and then immediately switch off again.

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



If this is not the case, disconnect the pump from the mains and interchange two mains phases.

Even if the pump has been already firmly connected to the piping, you may determine the direction of rotation.

For this, evacuate the vacuum system down to a pressure below 20 mbar with the aid of the backing pump. Then switch on the RUVAC briefly; now the pressure must drop. If the pressure increases or remains constant, the RUVAC is turning in the wrong direction.

Then rewire as described above.

The built-in fan is driven by a separate single-phase motor and may thus not be used to determine the direction of rotation of the pump.

Its direction of rotation is independent of the pump and doesn't change when you interchange the phases.

NOTICE

Connecting the fan to the terminals for the motor is not allowed. The fan should be connected via a separate cable to 230 V, 50/60 Hz or 265 V/60 Hz. A voltage of 265 V/60 Hz must not be exceeded.

When operating the pumps in short cycles (WSU...H with ACE vibration absorbers) the fan needs to be connected separately so that it will be running constantly. The fan itself should not be switched on and off in short cycles.

The RUVAC can be automatically switched on and off via a contactor using a pressure switch and the contact amplifier SV 110.

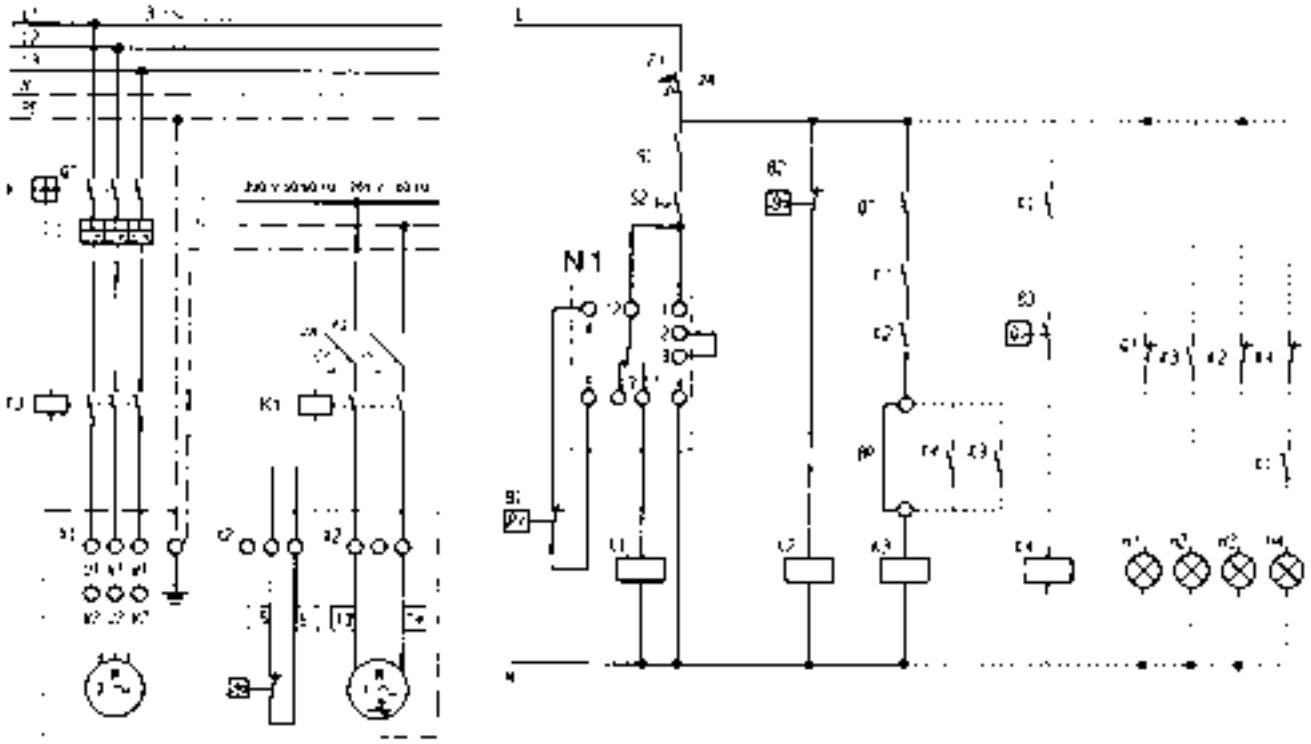
The pressure switch PS 115 is set by Leybold to a fixed value. Upon ordering the pressure switch please state the desired switch-on pressure.

After removing a screw plug, the pressure switch (3.1/8) together with an adapter (3.1/11) and a right-angle bend (3.1/10) can be mounted on the bore (3.1/6).

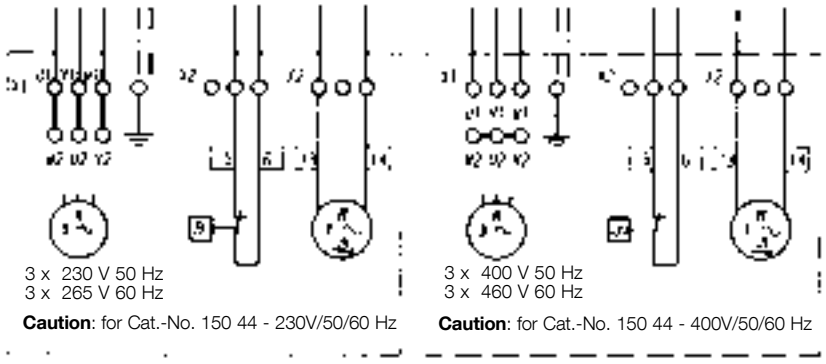
When doing so, ensure proper sealing and air-tight installation.

It is advisable to mount the switch vertically to reduce the entry of contaminants.

Installation



Various connection options for different mains power supplies.



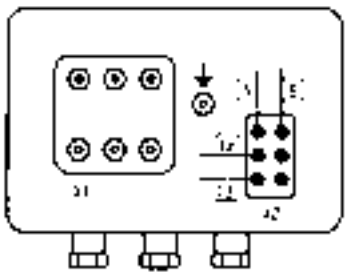
3 x 230 V 50 Hz
3 x 265 V 60 Hz

Caution: for Cat.-No. 150 44 - 230V/50/60 Hz

3 x 400 V 50 Hz
3 x 460 V 60 Hz

Caution: for Cat.-No. 150 44 - 400V/50/60 Hz

Motor junction box



B1 Pressure switch PS 115
B2 Limit switch, coil temperature
B3 Flow monitor (fan)
K1 Relay for fan motor
K2 Relay for temperature monitor, pump's motor
K3 Relay for Roots pump motor
K4 Relay for fan monitor
N1 Contact amplifier SV 110 (220 V - 240 V, 50/60 Hz, 110 - 130 V, 50/60 Hz)
S1 External switch contact
S2 Switch contact
F1 Fuse, control circuit
Q1 Motor protection switch

Signal lamps
H1 Motor protection switch: OFF
H2 Roots pump: ON
H3 Coil temperature: TOO HIGH
H4 Cooling air: BELOW MINIMUM

Links
BR on extension : - - remove link

Note
The above control circuit is designed so that the Roots pump cuts in only if the pressure drops below the set pressure level (B1).

5 Connections for the
6 temperature switch

13 Connections for
14 the fan

Fig. 3.6 Electrical connection

3.5 Connecting the Flanges

NOTICE

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 suction side (separator, T-piece).

The pumps are vented with nitrogen. Only remove the packing flanges before immediate connection.

If not already done, remove the protective shipping covers, plastic pieces, foil or packing flanges from the flanges (3.1/5) and (3.1/1).

We recommend that you retain the transport flanges in case you want to store the pump at a later date.

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

Flange the pump to the vacuum system.

NOTICE

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

When attaching the pump directly (without bolting down the feet) to the forevacuum pump, you must always use on the pressure side the full number of screws defined by the flange standard (ISO-K, DIN or ASA) whereby these must comply with the demanded property class rating.

You must also check whether the backing pump is rigid and stable enough to support the load of the RUVAC pump in each case.

The intake screen which is supplied with the pump 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.

4 Operation

4.1 Start-up

Check the pump motor's direction of rotation (see Section 3.4)

NOTICE

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

It is protected against excessively high pressure differentials by a bypass line.

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

NOTICE

RUVAC WS
Do not switch on the RUVAC WS until the backing pump has evacuated the vacuum vessel 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.

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

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

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

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

p_E =Switch-on 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 = $\frac{\text{Effective pumping speed RUVAC}}{\text{Effective pumping speed of the backing pump}}$

Example - Pump combination:
RUVAC WS 501[2)] / Sogevac SV 100

$$k_{th} = \frac{505\ m^3 \cdot h^{-1}}{100\ m^3 \cdot h^{-1}} \sim 5 \qquad p_E \sim \frac{80\ mbar}{5 - 1} \sim 20\ mbar$$

[1)] at the corresponding operating frequency
[2)] at 50 Hz operation

With small vacuum vessels, the maximum permissible pressure differential can be briefly exceeded (max. 3 min) 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.

NOTICE

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

4.2 Operation

When the RUVAC is operated at a pressure difference of Δp > 10 mbar or at > 60 Hz.then LVO 211 should be used.

CAUTION

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

The screws of the flanges on the suction and the pressure 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 130 is light-brown. If it turns dark, this is a sign of early ageing due to excessively high temperatures. When using PFPE as intended, PFPE will not be subject to ageing.

Dirt Ingress into the Oil via the Piston Rings

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

CAUTION

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.

Hot surfaces, risk of suffering burns.
Notice safety information 0.3.

Note the labels on the pump.

Never open the oil-fill or oil-drain screw in the presence of a vacuum or while the pump is running. There is the danger that oil may squirt out.

4.3 Shutdown and Storage

NOTICE

We recommend to keep the RUVAC WS 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.

Close the valve between the Roots pump and the vacuum system. First switch off the Roots pump, then the backing pump.

After working with corrosive gases, the system should 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. Observe safety informations 0.2.

Before removing the RUVAC WS 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.

4.4 Changing from Vertical to Horizontal Flow

The RUVAC WS/WSUs are supplied as standard for vertical flow unless you specifically request horizontal flow. Moreover, the pump may be converted from one flow direction to the other.

For this proceed as follows:

Unscrew the oil drain plugs (5.1/2 and 5.1/4) 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 Fig. 1.5 (dimensional drawing) and mount the feet for the new direction of flow.

NOTICE

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 (5.1/4); (see Section 3.1.1).

If a pressure switch has been installed, turn it so that it again points vertically upwards.

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

1 Oil-drain plug **for horizontal flow**
2 Oil-drain plug **for vertical flow**
3 Oil-level glass
4 Oil-fill plug

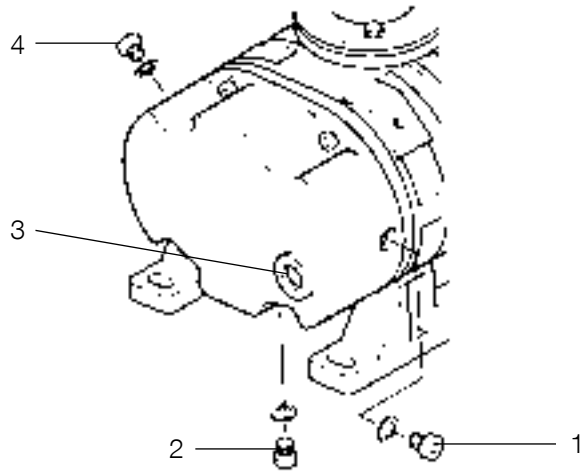


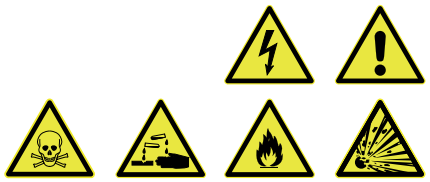
Fig. 5.1 Changing the lubricant

5 Maintenance

5.1 Safety Information

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

WARNING



Notice safety information 0.1 to 0.3.

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. Observe all safety regulations !

When shipping contaminated pumps which require approval by the authorities, you must observe the applicable packaging and shipping regulations.

All maintenance and cleaning work described in this section must be carried out only by suitably trained personnel.

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 Leybold service.

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

5.2 Exchanging the Lubricant

CAUTION

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 de-greased, and an inert special lubricant (like PFPE) must be used.

Observe safety informations 0.3 to 0.5.

The oil-fill port 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.

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

Under such operating conditions it is recommended to regularly check the neutralisation value (to DIN 51 558) based on a sample of oil. If the neutralisation value of LVO 130 exceeds 2, an oil exchange will be required.

WARNING

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.

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

Unscrew the oil-drain plugs (5.1/2) and the oil-fill plug (5.1/3) and drain the oil.

Clean the sealing surface and firmly reinstall the oil-drain plug (5.1/2) or (5.1/4) 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 this use a clean funnel.

For oil quantities and ordering data see Sections 3.1.1 and 1.4.

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

Only use Leybold oil.

NOTICE

Mineral oils, synthetic oils and PFPE do not mix.

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

The oil filling levels stated in Fig. 3.2 to 3.5 - which apply to the shutdown (standing still) pump - must be observed.

The filling level visible in the oil-sight glass depends on the size of the pump and the type of oil used.

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 or the pump may overheat.

Clean the oil-fill port and reinstall the plug (5.1/3) using a gasket which is in perfect condition. Wipe off any oil residues from the casing.

5.3 Cleaning the Fan Cowl and the Cooling Fins

CAUTION

Observe all safety information provided in Sections 0.3 to 0.5 and 5.1.

The slits in the fan cowl as well as the fins on the motor and on the pump may be contaminated depending on humidity conditions and the degree of contamination in the ambient air.

In order to ensure a sufficient air flow for the motor and the pump's casing, the grid of the fan cowl must be cleaned with a clean brush when contaminated.

Any coarse dirt must be removed from the fins on the motor and the pump.

5.4 Cleaning the Intake Screen

Observe all safety information provided in Sections 0.3 to 0.5 and 5.1.

CAUTION

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

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

5.5 Cleaning the Pumping Chamber

Observe all safety information provided in Sections 0.1 to 0.3 and 5.1.

CAUTION

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.

CAUTION

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.

NOTICE

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

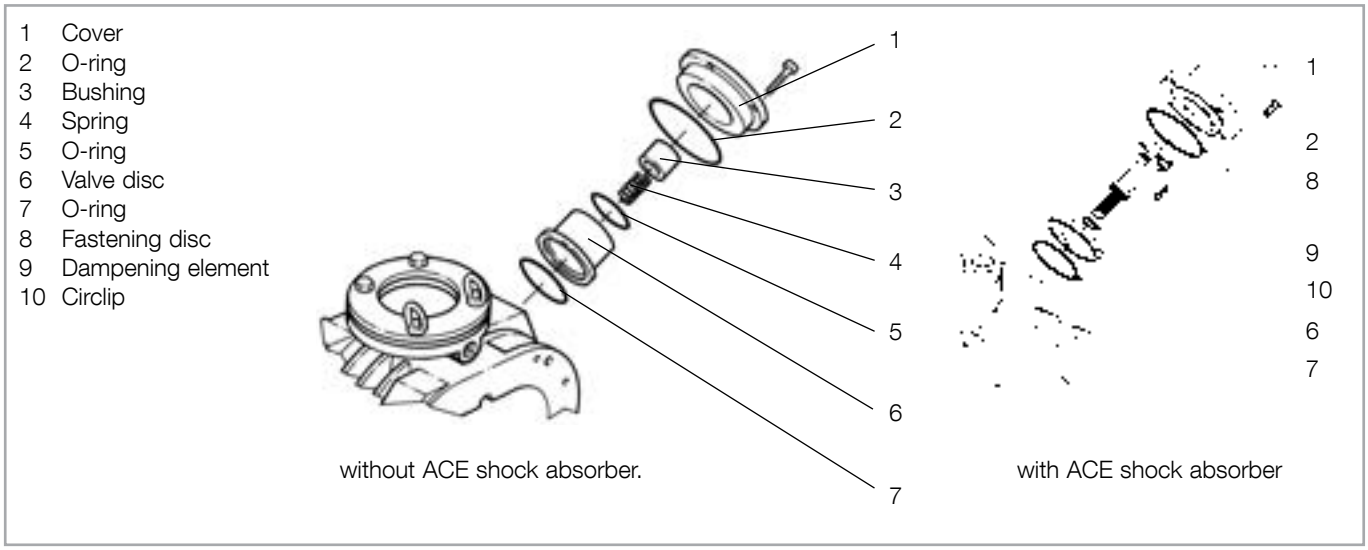


Fig. 5.2 Valve of the pressure balance line

5.6 Cleaning the Valve of the Pressure Balance Line

CAUTION

Observe all safety information provided in Sections 0.1 to 0.3 and 5.1.

Remove the screws and take off the cover (5.2/1) with O-ring (5.2/2).

Take out the spring (5.2/4).

Remove the valve disk (5.2/6) with O-rings (5.2/5) and (5.2/7).

If the bushing (5.2/3) is damaged, pull it out of the valve disk and replace it.

Clean all parts or replace them if necessary. Reassemble in the reverse sequence. When doing so, check the O-rings for leak-tightness and replace if found faulty.

5.7 Service at Leybold

If you send a pump to Leybold 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 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.leybold.com → Downloads → 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.

Leybold 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.

Leybold 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.

5.8 Maintenance Schedule

Process	Meas./test quantity	Maintenance intervall	Remark
Check oil level	Min./max. oil level in oil level glass	Before switching on and daily	Check oil level with the pump at standstill, see Section 3.1.1
Check oil quality	Visual	Weekly	In the normal state LVO 130 and PFPE are light, clear and transparent. LVO 211 is yellow, clear and transparent. In the case of black oil an oil change is necessary, see Section 5.2.
Check oil quality	Neutralisation value (DIN 51 558)	For normal operating conditions annually When pumping corrosive vapours, in the case of much dust and cyclic operation weekly to quarter yearly	If the neutralisation value of LVO 130 is > 2, then an oil change will be required, see Section 5.2.
Oil change		For normal operating conditions annually When pumping corrosive vapours, in the case of much dust and cyclic operation weekly to quarter yearly	See Section 5.2.
Check leak tightness of the cooling water connections		Quarter yearly	
Clean motor fan and cooling fins		The cleaning intervals will depend on the ambient conditions.	See Section 5.3.

6 Troubleshooting

Malfunction	Likely cause	Remedy	Repair
Pump does not start up.	Motor incorrectly connected.	Connect motor correctly.	3.4
	Overtemperature switch or motor stator defective.	Leybold Service.	-
	Pressure switch is defective.	Replace the pressure switch.	3.4
	Lubricant is too thick.	Exchange the lubricant or warm up lubricant and pump.	5.2
	Motor rotor defective.	Leybold Service.	-
	Pump has seized: defective impellers, bearings or toothed gears.	Leybold Service.	-
Pump gets too hot.	Ambient temperature is too high or cooling air flow is obstructed.	Install the pump at a suitable place or ensure a sufficient flow of cooling air.	3.1
	Pump is operating in the wrong pressure range.	Check the pressure levels within the system.	-
	Pressure differences too high.	Check the pressure levels within the system. Check system.	-
	Gas temperature is too high.	Clean pumping chamber. Affix and connect the pump free of tension.	-
	Clearance between housing and rotors are too small due to - contamination - distortion of the pump		5.4 3.1/3.5
	Friction resistance is too high due to contaminated bearings and/or contaminated lubricant.	Drain lubricant down to the correct level. Top up lubricant to the correct level.	
	Lubricant level is too high.	Drain lubricant, fill in correct lubricant.	5.2
	Lubricant level is too low.	Leybold Service.	5.2
	Wrong lubricant filled in.	Connect the fan correctly.	5.2
	Bearing is defective.	Leybold Service.	-
	Fan improperly/not connected.	Clean the valve or have it repaired.	3.4
	Fan defective.		-
	Valve of the pressure balance line does not open.		5.6
Power consumption of the motor is too high.	Like „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

Troubleshooting

Malfunction	Likely cause	Remedy	Repair
Pump is too loud.	Motor stator defective.	Leybold Service.	-
	Motor rotor defective.	Leybold Service.	-
	Distances between housing and rotors is too small due to - contamination - distortion of the pump	Clean pumping chamber. Affix and connect the pump free of tensions.	5.4 3.1/3.5
	Bearing or gear damage.	Leybold Service, shutdown pump immediately.	-
	Pistons make contact with the housing.		-
	Rotor is running untrue.	Leybold Service, shutdown pump immediately.	-
	Oil slinger disc makes contact with the gear housing or the oil pipe.	Leybold Service, shutdown pump immediately.	-
	Oil pump is blocked or defective.	Leybold Service.	-
		Leybold Service, shutdown pump immediately.	
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	5.2
	Oil level glasses leaky.	Leybold Service.	-
	Gear cover is leaky.	Replace the O-ring of the gear cover.	-
	Puddle under the motor, leak in the seal.	Leybold Service, shutdown pump immediately.	-
	No lubricant leak is apparent: See malfunction „Lubricant in the pump chamber“.		-
		See malfunction „Lubricant in the pump chamber“.	
Oil gets too dark.	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.	3.1
	Pump has a gas leak towards the outside.	Check to see that the oil fill and oil drain plugs are correctly seated, if required replace gaskets. Replace the O-ring of the gear cover.	5.2
	Pump has an internal leak.	Leybold Service.	-
	Piston rings are defective.	Leybold Service.	-
Pump does not attain its pumping speed.	Intake screen is clogged.	Clean intake screen.	5.3
	Motor incorrectly connected.	Connect motor correctly.	3.4
	Vacuum pump system has a gas leak.	Detect leak and seal it.	-
	Valve of the pressure balance line does not close (WSU only).	Clean the valve or have it repaired.	5.6

Disposal

7 Wearing and Original Spare Parts

Original spare parts are available from the Leybold 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.

WARNING

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 “5.7 Leybold 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 (Leybold 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.

EU Declaration of Conformity

(Translation of original Declaration of Conformity)

The manufacturer:

Leybold GmbH
Bonner Strasse 498
D-50968 Köln, Germany

herewith declares that the products specified and listed below which we have placed on the market, comply with the applicable EU Directives. This declaration becomes invalid if modifications are made to the product without agreement of Leybold GmbH.

Product designation: Ruvac

Type designation: WS, WSU, WSLF

Part numbers: 11375, 11391, 11722, 11723, 11727, 11728, 11732, 11733, 11737, 11738, 11742, 11743, 11747, 11752, 11753, 11757, 11794, 11833, 11843, 11853, 12860, 12860NRTL, 13552, 15044, 15047, 15095, 15096, 15111, 15112, 15113, 15114, 155007, 155009, 155042, 155042NRTL, 155053, 155054, 155066, 155110, 155111, 155112, 155113, 155114, 155140, 155141, 155142, 167007, 167026, 167042, 167043, 167044, 167056, 167082, 167097, 7850009, 7850010, 7850010NRTL, 20003123, 20003197, 20003198, 20003200, 11853A, 155004V, 155143V, 155144V, 155145V, 167044A, 167129V, 167187V, 7850001V, 7850002V, 7850011V, E155110, E155111, E155112, E155113, E155114

The products complies to the following Directives:

Machinery Directive (2006/42/EC)

The safety objectives of the Low Voltage Directive 2014/35/EU were complied with in accordance with Appendix 1 No 1.5.1 of Machinery Directive 2006/42/EC.

Electromagnetic Compatibility (2014/30/EU)

The following harmonized standards have been applied:

EN 1012-2:1996+A1:2009	Compressors and vacuum pumps - Safety requirements Part 2: Vacuum pumps
EN 60204-1:2006	Safety of machinery — Electrical equipment of machines — Part 1: General requirements
EN 61000-6-2:2005/AC:2005	Electromagnetic compatibility (EMC) — Part 6-2: Generic standards — Immunity for industrial environments
EN 61000-6-4:2007/A1:2011	Electromagnetic compatibility (EMC) — Part 6-4: Generic standards — Emission standard for industrial environments

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Cologne, September 01, 2016

ppa. Martin Tollner
VP / Head of Product Lines

Cologne, September 01, 2016

ppa. Dr. Monika Mattern-Klosson
Head of Quality & Business Process Management

Document No.: 300476779-002-A3

Leybold

Declaration of Contamination of Compressors, Vacuum Pumps and Components

The repair and / or servicing of compressors, va cuum 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: ☒ applicable please mark

Repair: ☐ chargeable ☐ warranty

Exchange: ☐ chargeable ☐ warranty

☐ Exchange already arranged / received

Return only: ☐ rent ☐ loan ☐ for credit

Calibration: ☐ DKD ☐ Factory-calibr.

☐ Quality test certificate DIN 55350-18-4.2.1

A. Description of the Leybold 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**
1. Has the equipment been used	☐	☐ →	
2. Drained (Product/service fluid)	↓	☐	☐
3. All openings sealed airtight		☐	
4. Purged		☐	☐
If yes, which cleaning agent			
and which method of cleaning			

[1] If answered with "No", go to **D**. ←

Contamination :	**No**[1]	**Yes**
toxic	☐	☐
corrosive	☐	☐
flammable	☐	☐
explosive [2]	☐	☐
radioactive [2]	☐	☐
microbiological [2]	☐	☐
other harmful substances	☐	☐

↓

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)		

	No	**Yes**
2. **Are these substances harmful ?**	☐	☐ ←
3. **Dangerous decomposition products when heated ?**	☐	☐

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

17200001_002_C0

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