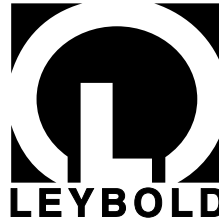


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## RUVAC RA Roots Pumps

RA 3001, 5001, 7001, 9001, 13000

Cat. No.  
119 50, 119 53, 119 60, 119 63, Custom

Operating Instructions

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**Warning** Indicates procedures that must be strictly observed to prevent hazards to persons.



**Caution** Indicates procedures that must strictly be observed to prevent damage to, or destruction of the equipment.

## Figures

The references to figures, e.g. (1/2) consist of the Fig. No. and the Item No. in that order.

## Leybold-Service

If a pump is returned to Leybold, indicate whether the pump free of substances damaging to health or whether it is contaminated.

If it is contaminated also indicate the nature of the hazard. Leybold must return any pumps without a "Declaration of Contamination" to the sender's address.

## Disposal of waste oil

Under the amended law relating to waste disposal dated November 1, 1986 (valid in the Federal Republic of Germany) the disposal of used oil is subject to new provisions. According to legislation relating to waste disposal the so-called principle of causality is applied. Hence, anyone in possession of used oil is responsible for its proper disposal.

Used oils coming from vacuum pumps must not be mixed with other substances.

Used oils from vacuum pumps (LH-oils on the basis of mineral oils) having been affected by normal contamination due to oxygen from the ambient air, increases in temperature and mechanical wear, must be disposed of as used oil in accordance with the regulations.

Used oils from vacuum pumps that have been contaminated by other substances must be labelled, stored and disposed of as special waste with reference to the kind of contamination.

When disposing of used oil please observe the safety regulations that are valid in your country.

In many countries proof of where the oil has finally been left is required by Law and often shipping of such contaminated waste requires permission by the authorities.

Waste disposal information is available through:

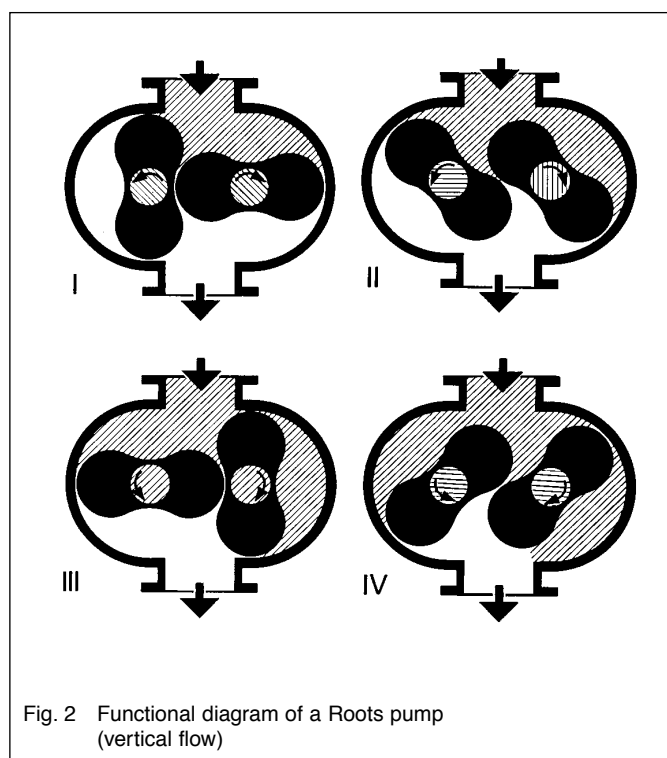
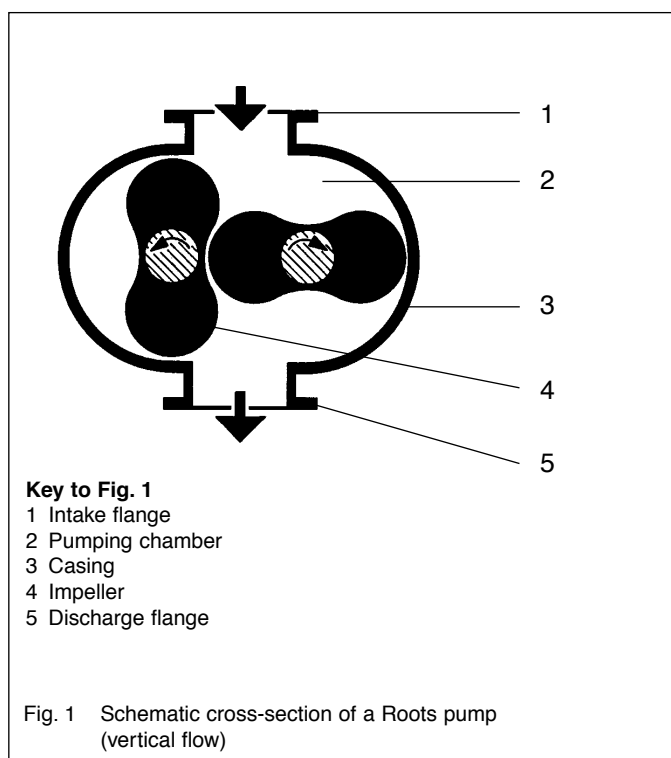
Bundesamt für Gewerbliche Wirtschaft (BAW)

Frankfurter Str. 29-31

D-65760 Eschborn/Taunus

Phone: +49 (0)6196 4041 - Telex: 415603/04

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



# 1 Description

## 1.1 Design and Function

The RUVAC RA 3001 to 9001 are Roots pumps driven directly by a canned motor. The RUVAC RA 13000 is driven via a V-belt.

The number in the designation indicates the pumping speed of the pump in  $\text{m}^3 \cdot \text{h}^{-1}$ .

Standard RUVAC pumps are not suitable for pumping oxygen at concentrations which exceed that of the atmosphere.

### 1.1.1 Principle of Operation

Roots pumps – also known as Roots blowers – contain in their pump casing (1/3) two symmetrical impellers (1/4) rotating in opposite directions. The impellers have roughly the cross section of a figure "8" and are synchronised by a toothed gearing 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. 2.

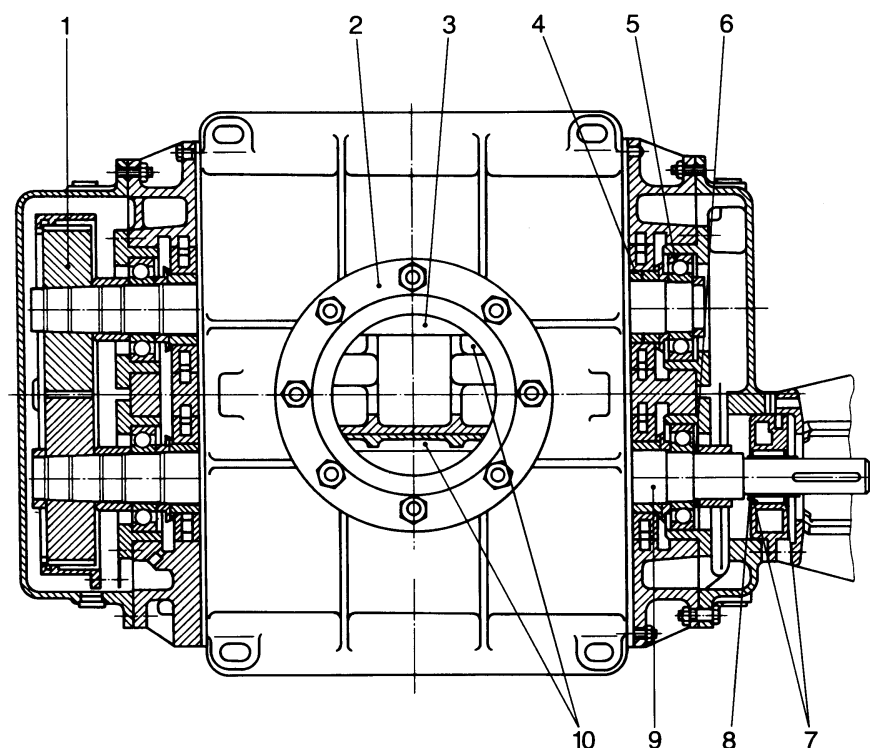
In impeller positions I and II, the volume in the intake flange is increased. When the impellers rotate further to position III, part of the volume is sealed off from the intake side.

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  $n = 3,600 \text{ rpm}$  at a mains frequency of 60 Hz for the RUVAC RA 3001). 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.



**Key to Fig. 3**

- 1 Pair of gearwheels
- 2 Intake flange
- 3 Driven impeller shaft
- 4 Impeller seals
- 5 Bearing
- 6 Splash disc
- 7 Shaft seals
- 8 Bushing
- 9 Drive shaft
- 10 Impellers

Fig. 3 Longitudinal section of a RUVAC RA 3001 (without motor, other models are similar)

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 ( $p < 10$  mbar) the attainable compression ratio is decisive.

For these reasons Roots pumps can not pump against atmospheric pressure without additional means; they are thus either used in connection with backing pumps or in closed gas cycles.

The pump's power consumption depends not only on the volume of the pumping chamber and the rotational speed of the pump, but also on the pressure differential between the discharge and intake flanges (see Fig. 6).

### 1.1.2 Design

RUVAC Roots pumps can pump gas in the vertical or horizontal direction. The direction required must be stated when ordering the pump. The direction may be changed, but this conversion should only be made by Leybold.

Although the pumping chamber of Roots pumps is free of sealing agents and lubricants, the two gearwheels of the synchromesh gearing (3/1) and the bearings (3/5) of the impeller shafts are lubricated with oil. 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 (3/4). During operation of the pump, the side chambers are evacuated via the impeller seals.

In the bearing chamber on the side of the motor a splash disk (3/6) and in the front end bearing chamber an oil guidance arrangement ensure that the bearings and gearwheels receive sufficient lubricant at all recommended speeds.

The motor of the RUVAC RA 3001 to 9001 is directly flanged to the coupling housing. The pump shaft (3/9) and the motor shaft are linked by means of an elastic coupling. The shaft of the other impeller (3/3) is driven via the synchromesh gear. In the case of the RUVAC 13000 the shaft (3/9) is driven via a V-belt.

The feedthrough of the shafts of the impellers between the evacuated bearing chamber and the atmosphere is sealed by two shaft seals. The shaft seals are oiled. They are located in a shaft seal housing having a separate oil reservoir. The oil level in the shaft seal housing can be checked at an oiler.

The housing for the shaft sealing ring is air-cooled. The air flow for cooling of the motor and the pump is produced by a motor fan.

Incorporated in the stator coils of the motor is one each PTC resistor which serves the purpose of monitoring the temperature of the motor.

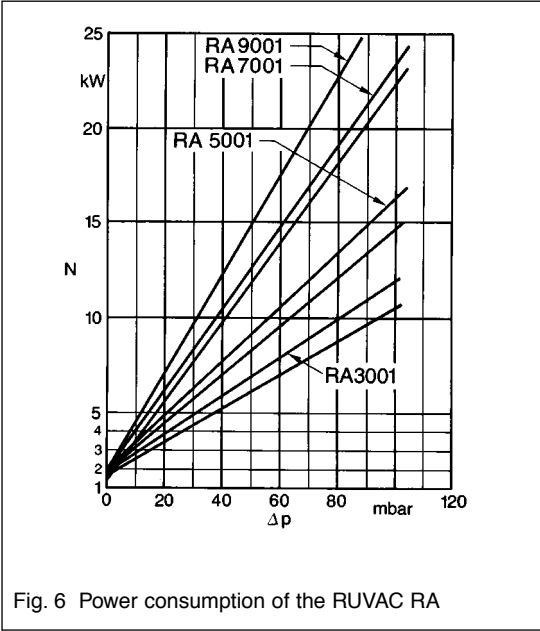
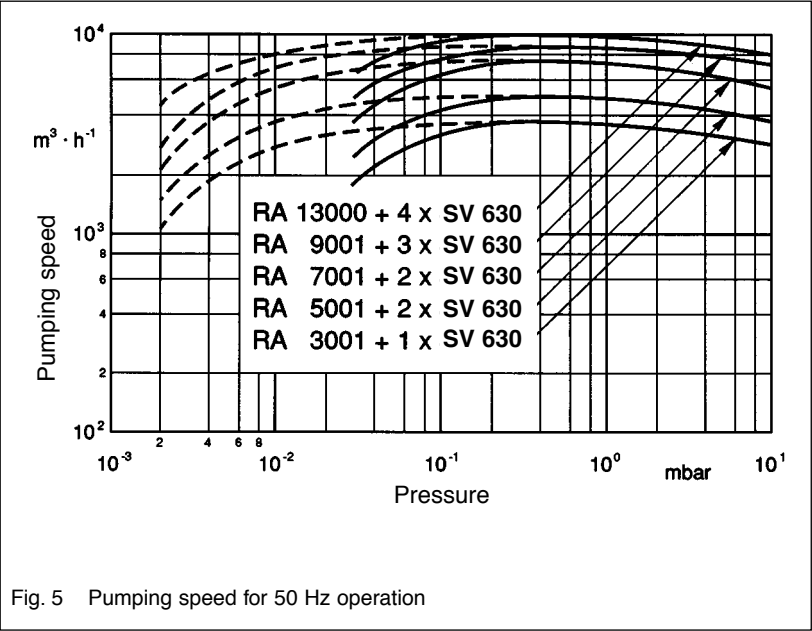
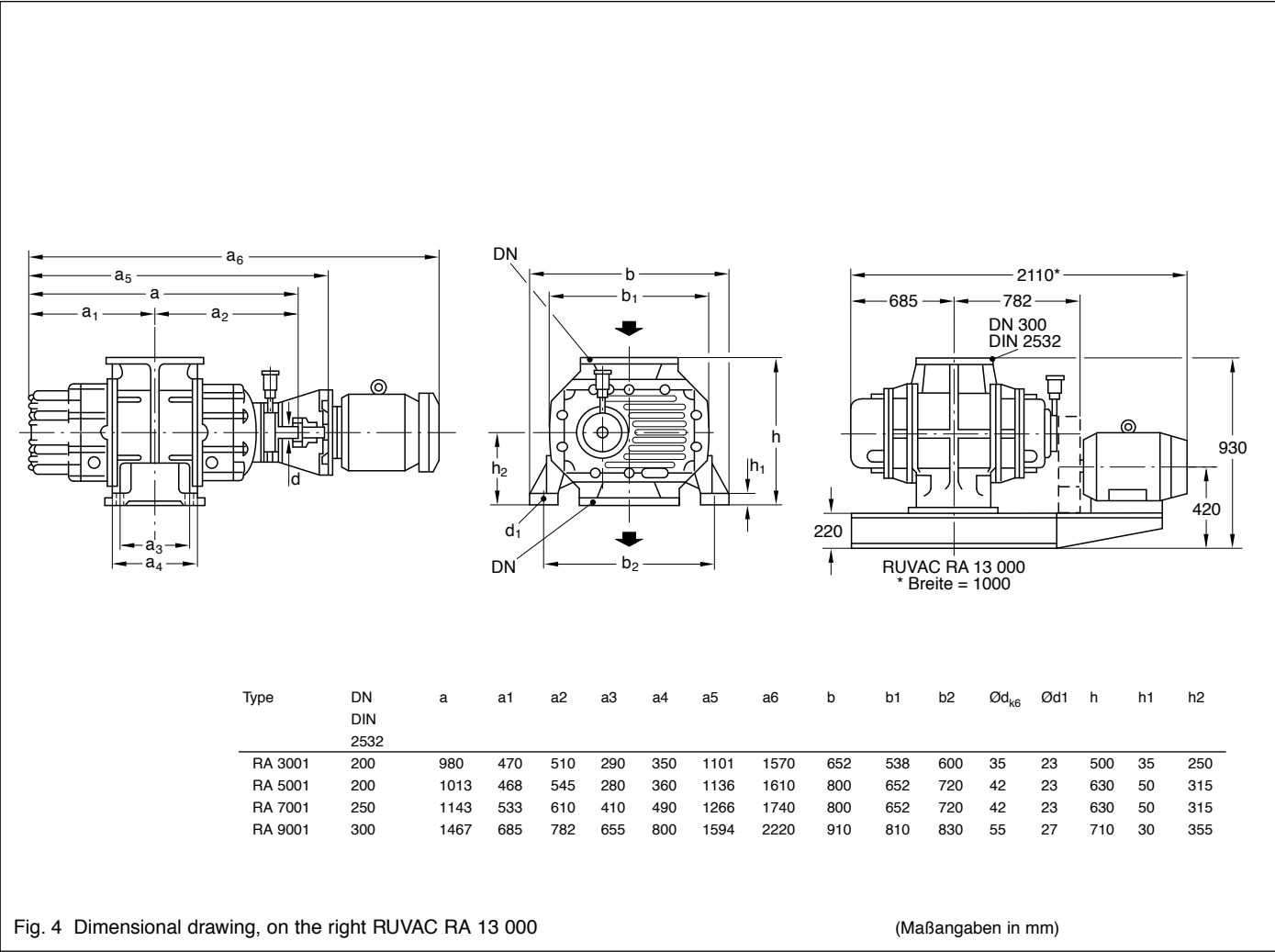
## 1.2 Supplied Equipment

The RUVAC RA pumps are supplied as standard for a vertical pumping direction. If a horizontal pumping direction is required, this must be stated when ordering the pump.

The housing for the shaft sealing ring is supplied with an oil filling. The oil for the bearing spaces is **not** included with the delivery.

The pumps are equipped with connection flanges to DIN 2532, ND 10/16.

**Caution** A dirt collection sieve should always be installed on the intake side in order to protect the pump. Please order this item separately (see Section 1.4).



## 1.3 Technical Data

50 Hz operation, SI units, "Euro versions"

<b>RUUVAC RA</b>		<b>3001</b>	<b>5001</b>	<b>7001</b>	<b>9001</b>	<b>13000</b>
Nominal pumping speed <sup>1)</sup>	m <sup>3</sup> · h <sup>-1</sup>	3900	5550	7470	9720	13000
Maximum pumping speed - at pumping speed for the backing pump of	m <sup>3</sup> · h <sup>-1</sup> m <sup>3</sup> · h <sup>-1</sup>	3300 630	5000 1260	6800 1850	8800 1850	12000 2600
Maximum allowable pressure differential - in continuous operation <sup>2)</sup> - for less than 3 minutes	mbar mbar	53 93	53 93	53 93	66 133	53 93
Mains voltage at the motor, 50 Hz	V	380 - 420 / 660 - 725 Y				
Mains voltage at the motor, 60 Hz <sup>3)</sup>	V	440 - 480 Δ				
Motor power, 50 Hz	kW	11	15	18,5	22	30
Protection	IP	54	54	54	54	54
Trigger temperature for the PTC resistors	°C	130	130	130	130	130
Nominal speed at 50 Hz	min <sup>-1</sup>	3000	3000	3000	1500	2000
Max. permissible speed <sup>5)</sup>	min <sup>-1</sup>	3600	3000	3000	1800	2000
Oil filling, approx. - vertical flow - horizontal flow	l l	7,0 3,5	12,0 5,4	12,0 5,4	11,0 7,6	11,0 7,6
Noise level <sup>3)</sup>	dB (A)	77	78	79	69	72
Weight, complete, approx.	kg	620	770	870	1500	-
Intake flange <sup>4)</sup> Discharge flange <sup>4)</sup>	DN DN	200 200	200 200	250 250	300 300	300 300
Permissible ambient temperatures	°C	12 - 40				
<b>RUUVAC RA with motor coupling and lantern</b>	<b>Kat.-Nr.</b>	<b>119 50</b>	<b>119 53</b>	<b>119 60</b>	<b>119 63</b>	<b>auf Anfr.</b>

<sup>1)</sup> as per DIN 28400 ff..

<sup>2)</sup> for a ratio of 1:4 max.

<sup>3)</sup> at an operating pressure < 10<sup>-1</sup> mbar, 50 Hz operation

<sup>4)</sup> as per DIN 2532, ND 10/16

<sup>5)</sup> please note that not all machines may be operated with 60 Hz supplies. Select a different model, as required

## 1.4 Accessories

	Cat. No.
<b>Diaphragm pressure switch SM 42</b>	
0.5 to 6 mbar	164 05
5 to 50 mbar	164 06
40 to 400 mbar	164 07

<b>Accessories for mounting SM 42</b>	
Adapter	168 39
Right-angle bend DN 25 KF	184 37
Centering ring DN 20 KF/25 KF, 2x	183 57
Clamping ring DN 20 KF, 2x	183 42

<b>Pressure switch PS 114</b>	<b>160 01</b>
<b>Pressure switch PS 115</b>	<b>160 04</b>
<b>Pressure switch PS 112 Ex</b>	<b>160 91</b>

<b>Accessories for mounting PS 114/115/112 Ex</b>	
Adapter	168 40
Right-angle bend DN 16 KF	184 36
Centering ring DN 16 KF, 2x	183 26
Clamping ring DN 16 KF, 2x	183 41

<b>Contact amplifier SV 110, 230 V</b>	<b>160 78</b>
--	---------------

<b>Oil N 62*</b> , 20 l	177 03
<b>Oil HE-200*</b> , 5 gal	98-198-008

N 62 is an oil grade of LH Cologne, and HE-200 is an oil grade of LVP Export. They are interchangeable and comply with ISO VG 100. For other quantities, see catalogue.

### Ordering numbers for ISO-K collar flanges for RA pumps

	RA 3001	RA 7001	RA 9001 RA 13 000
Ref.-No. of the complete collar flanges for the intake and the pressure sides.	200 14 472	200 14 473	200 14 474
<b>Intake side</b>	200 DIN-250 ISO-K	250 DIN-250 ISO-K	300 DIN-350 ISO-K
Adapter flange	200 13 750	200 13 751	200 13 886
Centering ring	233 93 340	233 93 340	233 93 109
Outer ring	233 93 339	233 93 332	233 93 205
Clamping screws (qty.)	201 98 163 (3)	201 98 163 (3)	201 98 163 (3)
O-ring	239 50 739	239 50 740	239 70 180
O-ring	239 50 740	239 50 740	239 50 743
Dirt sieve	200 13 011	200 13 012	200 13 013
<b>Discharge side</b>	200 DIN-160 ISO-K	250 DIN-250 ISO-K	300 DIN-250 ISO-K
Adapter flange	200 13 749	200 13 751	200 13 752
Centering ring	200 07 328	233 93 340	233 93 340
Outer ring	200 07 330	233 93 332	233 93 332
Clamping screws (qty.)	201 98 163 (2)	201 98 163 (3)	201 98 163 (3)
O-ring	239 50 739	230 50 740	230 70 180
O-ring	239 50 727	239 50 740	239 50 740

## 2 *Transportation and Storage*

Roots pumps are heavy machines (> 70 kg) made of cast iron and thus should only be lifted using suitable lifting equipment.

**Caution** Before transporting the pump always drain out the oil from the bearing chambers (see Section 5.2). Screw the oil-drain plug with its gasket back in and wipe any oil droplets off from the casing.

Draining out of the oil contained in the shaft seal housing (oiler) is not necessary.

The pump should be transported and stored in a horizontal position (5 ° max. tilt with respect to its longitudinal axis). 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.

The pump must only be transported and installed horizontally. Otherwise the oil reservoir in the shaft seal chamber (oiler) may escape.

When shelving the pump for a longer period of time, the oil should be drained out. Also seal off the flanges of the pump with a piece of foil or the cardboard discs initially supplied with the pump using the collars. Place a bag with desiccant in the pump chamber, if required.

The area of the motor (fan and slits at the flange of the motor) must be protected against dust and dripping water.

## 3 Installation and Connection

### 3.1 Installation

Install RUVAC RA pumps on a flat, perfectly horizontal surface. If the pump is not level, lubricant may enter the pumping chamber from the gear chambers.

Screw the two feet to the motor side of the pump. Fit the other two feet with spacers so that in case of a thermally expanding casing the axial displacement will be as small as possible (see Fig. 7).

**Caution** 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.



**Warning** 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 firmly.

Use the following screws:

RA 3001 - 7001: 4 x M 20

RA 9001 - 13000: 4 x M 24

Keep the air intake and exhaust ducts for cooling the motor unobstructed and clean them from dust and deposits from time to time.

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

Set up the motor of the RUVAC RA 13000 next to the pump. Link the shaft on the pump to the shaft on the motor by means of the 5 V-belts supplied. The V-belts have been tensioned correctly when they can be indented at a testing force of 75 N by 1.55 mm per 100 mm shaft spacing and per V-belt. Check tensioning of the V-belt after 30 minutes and also after 24 hours. Re-tension the V-belts as required.



**Warning** The V-belt protector must always remain in place during operation of the pump. Never operate the pump without its V-belt protector.

### 3.2 Electrical Connections

#### Warning

Disconnect the mains before doing work on the wiring.



Electrical connections must be made by a skilled electrician as defined by VDE 0105 and in accordance with the guidelines of VDE 0100.



For proper connection, a suitable motor protection switch must be used. Set the switch in accordance with the rating on the motor nameplate.

Connect the pump to the correct mains voltage through the terminals provided in the junction box (see Fig. 8). Always provide an uninterrupted connection for the protective ground conductor  $\oplus$  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 diagram (Fig. 8).

The motor is equipped with PTC resistors (temperature sensors). For connection of these see Fig. 8.

#### Caution Notes concerning the PTC resistors

The trigger temperature of the PTC resistors is 130 °C. The applied voltage must never exceed 2.5 V. To check the resistors use only a measurement bridge or a resistance meter. If one resistor has failed, you may short auxiliary terminals A1 and A2 to bypass the failed resistor (some pumps are not equipped with auxiliary terminals).

The RA models are only **conditionally** suited for operation in connection with frequency converters. For the speeds of all pump sizes, see Section 1.3 - Technical Data. Consult us for advice.

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.

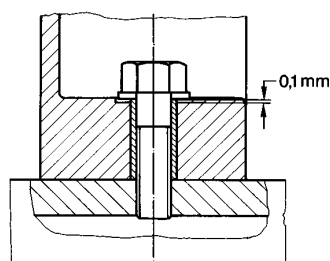


Fig. 7 Attachment screw with spacer

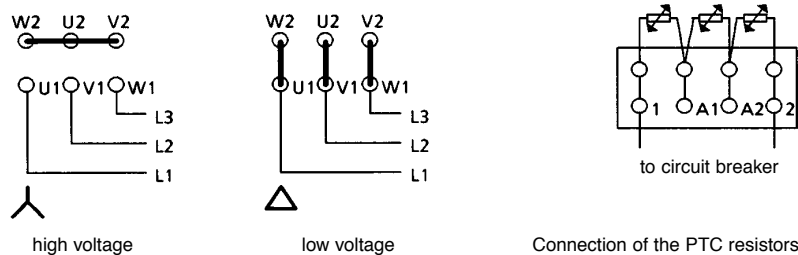


Fig. 8 Electrical connection

**Key to Fig. 9**

- 1 Pressure switch
- 2 Centering and clamping ring
- 3 Bend
- 4 Centering and clamping ring
- 5 Adapter

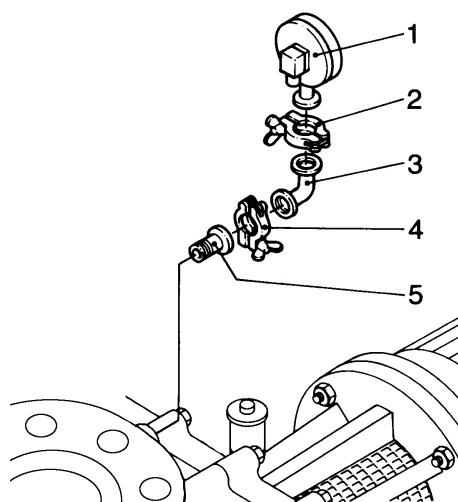


Fig. 9 Attachment of the pressure switch

An arrow (15/13) on the coupling cage shows the correct direction of rotation of 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.

**Warning**

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



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 RUVAC can be automatically switched on and off via a contactor using a pressure switch and the contact amplifier SV 110 (see Section 1.4).

The pressure switches SM 42 or PS 114/115 are set to a fixed threshold in our factory. Please specify the switching threshold for the pressure switch when ordering.

The contact amplifier is the same for all pressure switches.

Explosion hazard rated pressure switches and contact amplifiers are available upon request.

After removal of a sealing screw it is possible to fit the pressure switch (9/1) together with an adapter (9/5) and a bend (9/3) to bore (8/6).

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

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

### 3.3 Connection of the Flanges

**Caution** 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).

#### Warning



The RUVAC RA pumps have **not** been designed to pump ignitable or explosive mixtures without additional protection.

If the pumps are none-the-less to be used under such conditions, the customer himself must ensure that proper measures for the purpose of protection against explosions (pressure monitor, flame arresters etc.) are introduced in line with the requirements of the applicable laws.

In such cases it is advisable to contact us for advice.

If not already done, remove the protective cardboard pieces, foil or packing flanges from the flanges (10/1) and (10/5).

We recommend that you retain the transport flanges of the pumps 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.

**Caution** 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.

If required manually turn the blower after having tightened the flanges. It must turn easily. If a resistance is detected check all connections for mechanical strain once more and make sure that no such strains have built-up.

A dirt trap 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 dirt trap may reduce the pumping speed of the pump.

Observe the maintenance information provided in Section 5.5.

**Key to Fig. 10**

- 1 Intake flange
- 2 Terminal box
- 3 Discharge flange

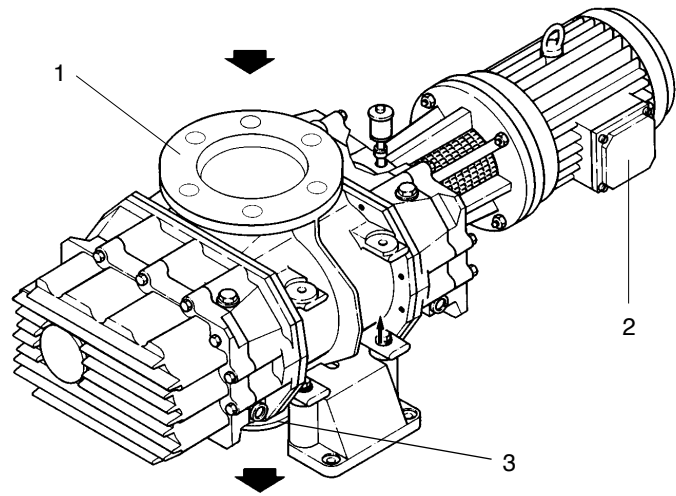


Fig. 10 Connection components (wide arrows = pumping direction)

## 4 Operation

### 4.1 Start-up

Check the pump motor's direction of rotation (see Section 3.2).

Check the oil levels in the bearing chambers and in the oiler (see Fig. 11 and Section 5.2 on page 16).

If required drain out some oil or top up some oil (see Section 5.2)

The RUVAC must only be switched on after the backing pump has evacuated the vacuum vessel to the cut-in pressure.

For processes in which condensable vapours 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 vapours in the cold pump.

The permissible cut-in pressure depends on the ratio between the Roots pump and the backing pump. It can be calculated according to the following formula:

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

$p_E$  = Cut-in pressure

$\Delta p_{\max}$  = Maximum permissible pressure differential (see technical data)

$k_{th}$  = theoretical compression ratio  
= nominal pumping speed of Roots pump / pumping speed of backing pump.

**Example:**

Pump combination:

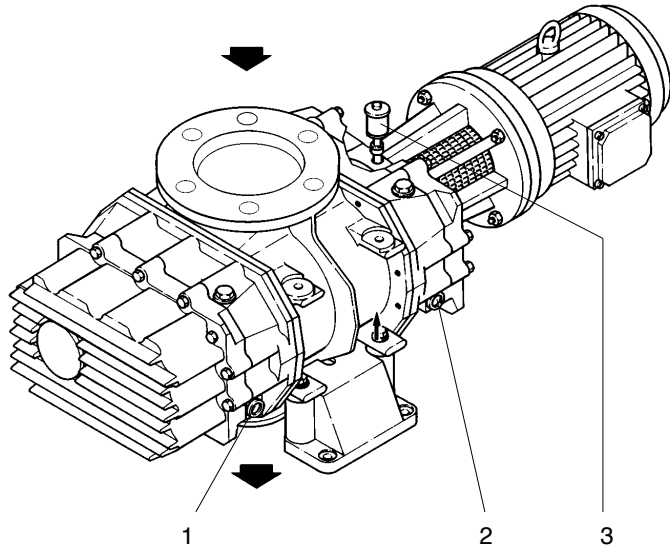
RUVAC RA 3001 / SOGEVAC SV 630

$$k_{th} = \frac{3900 \text{ m}^3 \cdot \text{h}^{-1}}{600 \text{ m}^3 \cdot \text{h}^{-1}} \sim 6.5$$

$$p_E = \frac{53 \text{ mbar}}{6.5 - 1} = 10 \text{ mbar}$$

With small vacuum vessels, the maximum permissible pressure differential may 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.

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



**Key to Fig. 11**

- 1 Oil level glass of the front bearing chamber
- 2 Oil level glass of the bearing chamber on the side of the motor
- 3 Oiler (Oil level check and oil reservoir for the shaft seals)

Fig. 11 Checking the oil levels

## 4.2 Operation

**Warning** Do not operate the pump without having connected the flanges to a vacuum system.



During operation of the RUVAC, check the oil level from time to time at three places (11/1, 11/2 and 11/3) and also the condition of the oil (see also Section 5.2). Normally, the oil N 62 or HE-200 is light-brown. If it turns dark, this is a sign of early ageing due to excessively high temperatures.

The oil level for the shaft seal housing must always be visible in the oiler. Top up oil as required. For this we recommend oils N 62 or HE-200.

If it is found necessary to top up oil frequently, it is very likely that a shaft seal has developed a fault (see Section 5.6).

**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, pumping speed of the backing pump) for a longer period may place an inadmissible thermal load on the pump. Increases in temperature which are not compensated by taking suitable measures may damage the Roots pump and/or the backing pump.

### Warning



During normal operation temperatures exceeding 80 °C may occur at the oil chambers and at the line on the pressure side. When touching these there is the danger of receiving burns. Note the labels on the pump.



Never open the oil-fill or oil-drain screw (Fig. 13) in the presence of a vacuum or while the pump is running. There is the danger that oil may squirt out.

**Key to Fig. 12**

- 1 Shaft
- 2 Impeller seals
- 3 Barrier gas bore
- 4 Branch leading to the other impeller seals
- 5 Valve
- 6 Pressure gauge
- 7 Flow controller

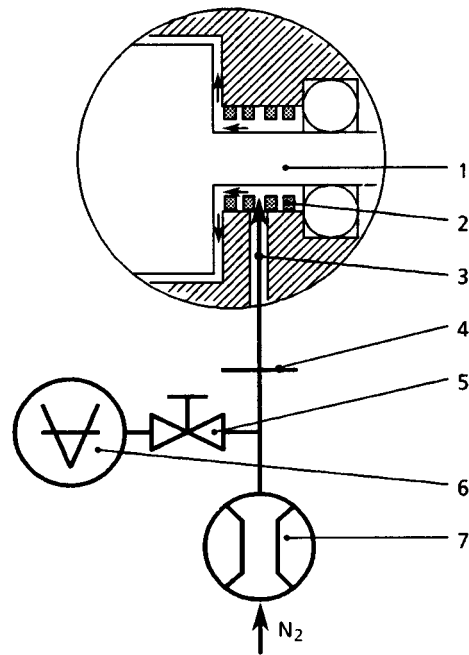


Fig. 12 Schematic diagram for the barrier gas facility

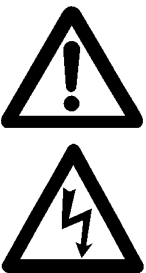
### 4.3 Shutdown and Storage

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.  $N_2$ ) 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 possible contamination of the pump.  
Observe all safety regulations.



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

### 4.4 Option: RUVAC RA with Barrier Gas Facility

Upon request the RUVAC RA is supplied equipped with a barrier gas facility.

Shown in Fig. 12 is a schematic diagram of the barrier gas facility. The barrier gas is admitted between the impeller seals (12/2). Thus a gas flow is created which passes over the impeller seals and flows into the pump chamber of the pump. This gas flow prevents the entry of the pumped medium into the bearings and bearing chambers. Since the barrier gas is admitted between the impeller seals, the passage of oil from the bearing chambers into the pump chamber is prevented.

The barrier gas flow must be set on the flow controller (12/7) to such a level that the pressure as measured by the pressure gauge (12/6) is approximately 10 mbar greater compared to the pressure at the discharge of the RUVAC.

The components (12/4) to (12/7) are only supplied upon request with the barrier gas facility.

## 5 Maintenance

### 5.1 Safety Information

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

#### Warning



Disconnect the electrical power before disassembling the pump and vent it to atmospheric pressure. Make absolutely sure that the pump cannot be accidentally started.



If the pump has been pumping harmful substances, determine the nature of hazard and introduce suitable safety measures.



Always wear safety goggles when drying or blowing out the pump with pressurised air.



Observe all safety regulations !

If you send a pump to LEYBOLD for repair please indicate all harmful substances existing in or around the pump or which might be present. For this use the "Declaration of Contamination" form which has been prepared by us and which we will provide upon request.

Any pump received by us without, or an incompletely filled in declaration will delay the repair.

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

#### Caution

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

When disposing of used lubricants please observe the relevant environmental regulations.

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 Oil

#### Warning



Observe all safety information provided in Section 5.1.

Very little lubricant is consumed by wear in the bearings and the gear under clean operating conditions. We recommend changing the oil after the first 500 hours of operation to remove any wearing residue. Then, under normal operating conditions, change the oil after every 3,000 hours of operation.

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

#### 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 - there is the danger of receiving burns.



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

Unscrew the two oil-drain plugs (13/4) and the two oil-fill plugs (13/1) and drain the oil.

Clean the sealing surfaces and firmly reinstall the plug (13/4) using a gasket which is in perfect condition.

Fill new oil into the two bearing chambers.

Only oil of viscosity class ISO VG 100 (previously SAE 30) must be used. We strongly recommend the use of our special oils N 62 or HE-200. When planning to operate the pump with a different kind of oil or with special lubricants, contact us first for advice.

**Key to Fig 13**

- 1 Oil fill plugs
- 2 Oiler (oil check and oil reservoir for the shaft seals)
- 3 Oil level glasses
- 4 Oil drain plugs

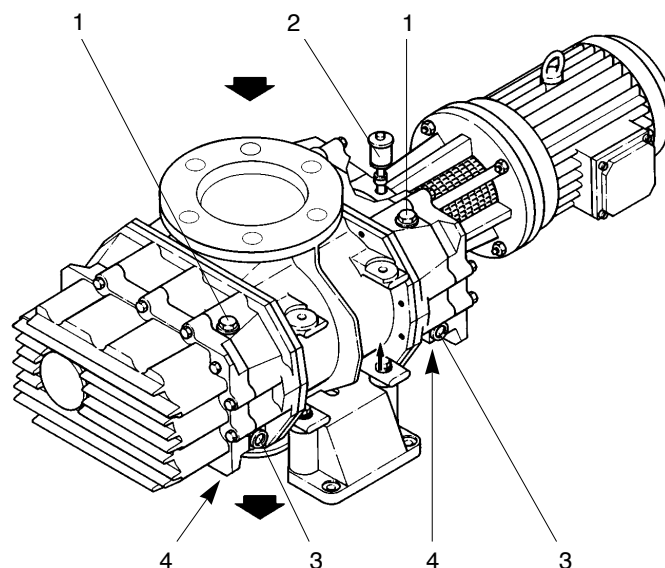


Fig. 13 Oil change

Check the **oil level** in both bearing chambers while the pump is at **standstill**.

Correct oil level for **vertical** flow:

- on the side of the motor at the centre of the oil level glass (14/3),
- on the front side at the upper third of the oil level glass (14/2).

Correct oil level for **horizontal** flow:

- on the side of the motor at the upper third of the oil level glass (14/2),
- on the front side at upper rim of the oil level glass (14/1).

**Caution** 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.

Clean the oil-fill port and reinstall the plugs (13/1) using a gasket which is in perfect condition. Wipe off any oil residues.

**Caution** 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.

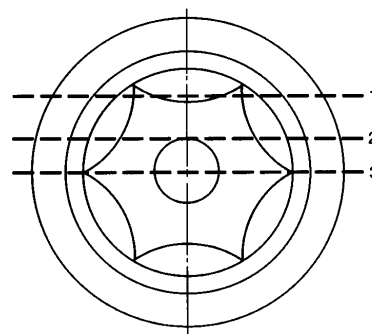


Fig. 14 Oil levels

Check the oil level at the shaft seal housing regularly.

The oil level for the shaft seal housing must be visible in the oiler (13/2). If required top up some oil at the oiler.

**Maximum level**

- when the pump is **warm** = 1/2 of the oiler's height
- when the pump is **cold** = 1/3 of the oiler's height.

Wipe off any oil residues from the casing.

## 5.3 Cleaning the Fan Cowl and the Cooling Fins

**Warning** Observe all safety information provided in Section 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 Pumping Chamber

**Warning** Observe all safety information provided in Section 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 oil.

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



**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.

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

## 5.5 Exchanging the Shaft Seals

**Warning** Observe all safety information provided in Section 5.1.



The shaft feedthrough of the RUVAC RA is sealed with two shaft seals. In order to reduce wear on the shaft, these shaft seals run on a bushing.

A dropping oil level in the oiler is a sign for malfunctioning shaft seals.

When the oil level in the oiler drops and when no oil appears under the shaft seal housing, it is likely that the inner shaft seal is faulty. In this case the oil flows from the shaft seal housing into the bearing spaces of the pump thereby creating in the bearing spaces an unacceptably high oil level. In such a case the pump must be switched off immediately and it must be repaired.

When the oil level in the oiler drops and when oil appears under the shaft seal housing, it is likely that only the outer shaft seal is malfunctioning. If the oil loss is only slight, the pump may still be operated for some time, provided the lost oil is topped up regularly.

**Warning** Collect the oil which drips out under the motor. There is the danger that someone may slip. Have the pump repaired.



### Required Special Tools:

Puller for the bushing:  
Span 250 mm, span depth 200 mm.

Shaft seal driver according to Fig. 16.

Place an oil trough under the shaft seal housing.

Support the motor so that it can not drop.

Unscrew the nuts and remove the motor with the coupling half (15/12).

Remove the coupling element (15/11).

Unscrew the screws and remove the coupling cage (15/10).

Unscrew the pin and pull the coupling half (15/9) off on the side of the pump.

Remove key (15/8).

Unscrew the screws and pull off the shaft seal housing (15/6).

Remove the securing ring (15/4) from the housing.

Force the shaft seals (15/5) and (15/7) out of the housing.

Pull the bushing (15/3) off from the shaft.

Remove O-ring (15/2) and spacing ring (15/1).

It is strongly recommended always to exchange the shaft seals, the bushing and the O-ring against new parts. Clean all other parts and replace them as required.

Reassemble in the reverse order as during disassembly.

While doing so, ensure that the recess on the bushing is placed correctly for the key.

Use shaft seal driver to drive the shaft seals down. They must not be edged in any way.

Apply some oil to the sealing lips of the shaft seals. Be careful when pushing the sealing ring housing on to the bushing!

Before starting the pump up, fill in oil at the oiler.

**Key to Fig. 15**

- 1 Spacing ring
- 2 O-ring
- 3 Bushing
- 4 Securing ring
- 5 Shaft seal
- 6 Shaft seal housing
- 7 Shaft seal
- 8 Key
- 9 Coupling half on the side of the pump
- 10 Coupling cage
- 11 Coupling element
- 12 Motor with coupling half
- 13 Arrow indicating the direction of rotation

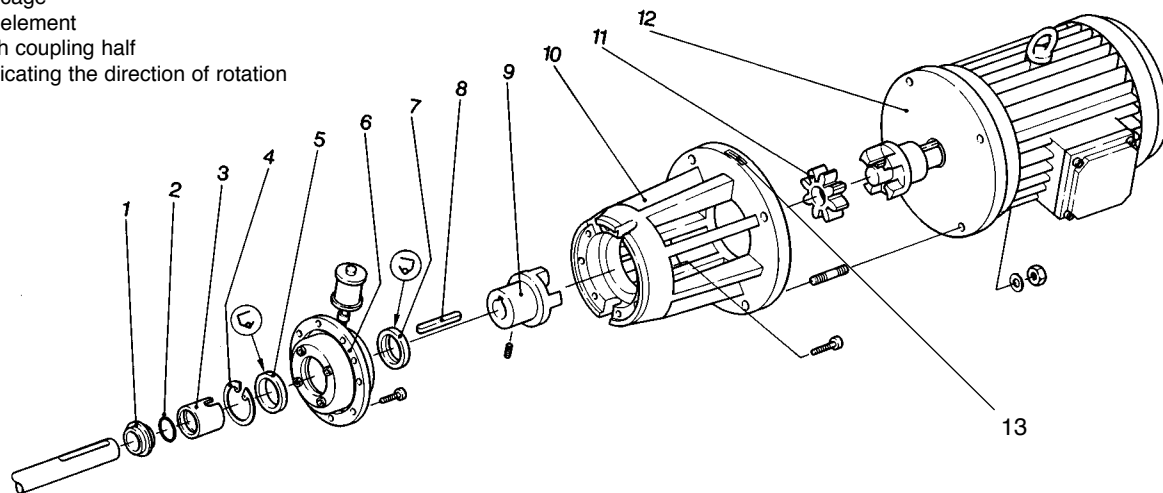
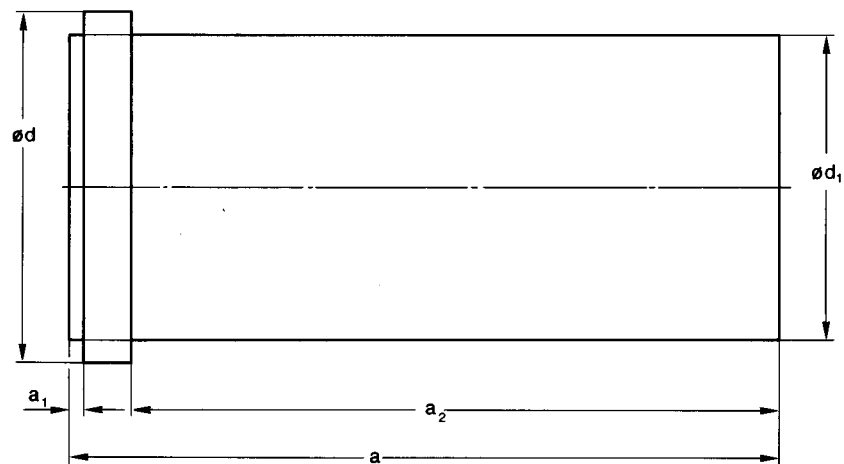


Fig. 15 Exchanging the shaft seals



	a	a1	a2	Ø d	Ø d1
RA 3001	150	3	137	75	64.5
RA 5001, 7001,	150	3	137	90	79.5
RA 9001, 13000	150	2	138	95	85.5

Fig. 16 Shaft seal driver

## 5.6 Leybold Service

If a pump is returned 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 the hazard. For this you must use a form which has been prepared by us which we will provide upon request.

A copy of this form is reproduced at the end of these Operating Instructions: "Declaration of Contamination of Vacuum Instruments and Components".

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

This „Declaration of Contamination“ is required to meet German Law and to protect our personnel.

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

### **Warning**

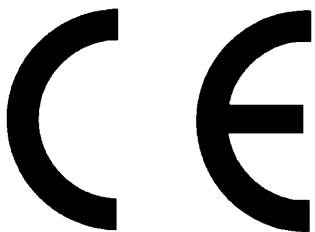


Package the pump in such a way that it will not be damaged during shipping and so that no contaminants can escape from the package.

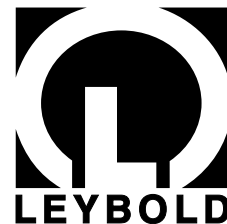
# 6 Troubleshooting

Fault	Possible cause	Remedy	Repair
Pump does not start.	Motor is connected incorrectly. Faulty pressure switch. Oil is too thick. Motor rotor is malfunctioning. Pump has seized up: damaged impellers, bearings or gearwheels.	Connect the motor correctly. Replace the pressure switch. Change the oil or warm the oil and the pump. Leybold Service Leybold Service	3.2 3.2 5.2 - -
Pump gets too hot.	Ambient temperature is too high or cooling air supply is restricted. Pump is working in the wrong pressure range. Pressure differential is too great. Gas temperature is too high. Clearance between casing and impellers is too small due to: - contamination - distortion of pump. Excessive frictional resistance due to contaminated bearings and/or oil. Oil level is too high. Oil level is too low. Wrong oil has been used. Bearings are malfunctioning.	Install the pump at a suitable site or ensure enough cooling air. Check pressure values of vacuum system. Check pressure values of vacuum system. Check the vacuum system.  Clean the pumping chamber. Install and connect the pump without strains. Exchange oil.  Drain some oil to reach the correct level. Add oil to reach the correct level. Drain oil and fill in correct lubricant. Leybold Service	3.1/5.3 - - -  5.5 3.1  5.2 5.2 5.2 -
Power consumption of the motor is too high.	See fault "Pump gets too hot". Wrong mains voltage supply for the motor. Motor is malfunctioning. Oil is too thick	See fault "Pump gets too hot". Connect the motor to the correct voltage supply. Repair the motor or exchange it. Exchange the oil or warm up the oil and the pump.	- 3.2 - -
Pump is too loud.	Clearance between casing and impellers is too small due to : - contamination - distortion of the pump. Bearing or gearing is damaged. Impellers strike the casing. Rotor runs out of true.	Clean the pumping chamber. Install and connect the pump without strains. Leybold Service, switch off the pump immediately. Leybold Service, switch off the pump immediately. Leybold Service, switch off the pump immediately.	5.5 3.1 - - -
Pump loses oil.	Oil leak is visible: Oil-drain plug is not tight.  Oil-level glass is not tight. Gearbox cover is not tight. Oil puddle under the motor. No oil leak is visible: See fault "Oil in the pumping chamber".	Drain lubricant, firmly screw in the oil-drain plug with a new gasket, fill in the correct quantity. Leybold Service Replace the O-ring of the gearbox cover. Leybold Service, switch off the pump immediately.  See fault "Oil in the pumping chamber".	5.2 - - - -
Oil level in the oiler drops.	Oil leak is visible: Outer shaft seal is malfunctioning.  No oil leak is visible: Inner shaft seal is malfunctioning.	Exchange shaft seals. If the oil loss is only slight, the pump may still be operated for some time provided the lost oil is topped up regularly. Exchange shaft seals. Switch the pump off; oil flows into the bearing spaces of the pump thereby creating in the bearing spaces an unacceptably high oil level.	5.6  5.6
Oil turns dark.	Oil has broken down. Pump gets too hot.	Change the oil. See fault "Pump gets too hot"; after solving the problem, change the oil.	5.2
Oil in the pumping chamber.	Oil level is too high. Oil leaks out of the system. Pump is not installed on a flat horizontal surface. Pump has an external leak.  Pump has an internal leak. Impeller seals are malfunctioning.	Drain lubricant to reach the correct oil level. Check system. Install pump correctly. Check proper fit of oil-fill and oil-drain plugs, replace gaskets if necessary. Replace O-ring of the gearbox cover. Leybold Service Leybold Service	5.2 - 3.1 3.1/5.2 - - -
Pumping speed of the pump is too low.	Dirt trap in the intake flange is clogged. Motor is connected incorrectly. Motor faulty. Pump or pump system has a leak. Clearance of impellers is too large. Bearing is malfunctioning. Flow resistance in the intake or discharge line is too high.	Clean the dirt trap. Connect the motor correctly. Leybold Service Find and seal the leak. Leybold Service Leybold Service Use intake and discharge lines of sufficient diameter.	5.4 3.2 - - - -

\* for repair information, refer to the stated section in the Operating Instructions



## EEC Declaration of Conformity



We - LEYBOLD Vacuum GmbH - herewith declare that the products defined below meet the basic requirements regarding safety and health of the relevant EEC directives by design, type and versions which are brought into circulation by us.

In case of any product changes made without our approval, this declaration will be void.

Designation of the products: Roots pump

Types:

RA 3001, 5001, 7001, 9001, 13 000

Cat. No.

119 50, 119 53, 119 60, 119 63, Custom

### **The products conform to the following directives:**

- EEC Directive on Machinery (89/392/EWG) and subsequent 91/368/EWG
- EEC Directive on Low-Voltages (73/23/EWG)
- EEC - EMI Directive (89/336/EWG)

### **Applied harmonised standards:**

- |                            |           |
|----------------------------|-----------|
| • EN 292 Part 1 and Part 2 | Nov. 1991 |
| • pr. EN 1012 Part 2       | 1993      |
| • EN 60 204                | 1993      |

### **Applied national standards and technical specifications:**

- |              |            |
|--------------|------------|
| • DIN 31 001 | April 1983 |
|--------------|------------|

Cologne, January 15, 1996

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Plingen, Business Area Manager  
Forevacuum pumps

Cologne, January 15, 1996

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Frings, Design Department Manager  
Forevacuum pumps

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## Declaration of Contamination of Vacuum Equipment and Components

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

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

### 1. Description of Vacuum Equipment and Components

- Equipment type/model: \_\_\_\_\_
- Code No.: \_\_\_\_\_
- Serial No.: \_\_\_\_\_
- Invoice No.: \_\_\_\_\_
- Delivery date: \_\_\_\_\_

### 2. Reason for Return

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### 3. Condition of the Vacuum Equipment and Components

- Has the equipment been used?  
yes ☐ no ☐
- What type of pump oil/liquid was used? \_\_\_\_\_
- Is the equipment free from potentially harmful substances?  
yes ☐ (go to Section 5)  
no ☐ (go to Section 4)

### 4. Process related Contamination of Vacuum Equipment and Components:

- toxic yes ☐ no ☐
- corrosive yes ☐ no ☐
- explosive\*) yes ☐ no ☐
- biological hazard\*) yes ☐ no ☐
- radioactive\*) yes ☐ no ☐
- other harmful substances yes ☐ no ☐

\*) Vacuum equipment and components which have been contaminated by biological explosive or radioactive substances, will not accepted without written evidence of decontamination!

Please list all substances, gases and by-products which may have come into contact with the equipment:

Trade name Product name Manufacturer	Chemical name (or Symbol)	Dangerous material class	Measures if spillage	First aid in case of human contact
1.				
2.				
3.				
4.				
5.				

### 5. Legally Binding Declaration

I hereby declare that the information supplied on this form is complete and accurate. The despatch of the contaminated vacuum equipment and components will be in accordance with the appropriate regulations covering Packaging, Transportation and Labelling of Dangerous Substances.

Name of organisation or company: \_\_\_\_\_

Address: \_\_\_\_\_ Post code: \_\_\_\_\_

Tel.: \_\_\_\_\_

Fax: \_\_\_\_\_ Telex: \_\_\_\_\_

Name: \_\_\_\_\_

Job title: \_\_\_\_\_

Date: \_\_\_\_\_ Company stamp: \_\_\_\_\_

Legally binding signature: \_\_\_\_\_



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