

RUVAC WA / WAU 251/501/1001/2001

Roots vacuum pumps
ATEX Categories 3 i and 3 i/o

Installation and Operating Instructions GA03107_002_C0

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

DANGER



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

WARNING



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

CAUTION



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

NOTICE



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

Figures

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

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

Retain the Operating Instructions for further use.

Safety Information

0 Important Safety Information

0.1 Mechanical Hazards

- 1 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.

WARNING



Safety Information

- 13 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.

WARNING**0.2 Electrical Hazards**

- 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.
-

Safety Information

0.3 Thermal Hazards

- 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 Before any servicing and maintenance work always let the pump cool down first.
- 4 Note the warning information on the housing surface. If these warning notices have been removed, are covered or obstructed, include corresponding additional warning information

CAUTION



0.4 Hazards Caused by Materials and Substances

- 1 The vacuum line must be leaktight. Hazardous process gases may escape or the pumped gases can react with air or atmospheric humidity. After installation of the pump and after servicing work on the vacuum system, a leak test will always be necessary.
When pumping 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.
- 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.

DANGER



Safety Information

- 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 When changing the oil, remove any escaped oil as otherwise there exists the risk of slipping.
- 8 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.

CAUTION



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 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 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 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. Check based on the nameplates for which zone the pump is suited. Motor and accessories when installed within an explosion hazard zone must also be approved for this zone.

CAUTION



0.6 Noise Hazard

- 1 The noise level produced by the RUVAC is between 64 and 80 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).

Safety Information

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 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.
- 7 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.
- 8 The ingress of particles and liquids must be avoided under all circumstances.
- 9 Before installing, all flange covers must be removed.
- 10 The location where the RUVAC is installed must be selected such that all controls are easily accessible.
- 11 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 $> 1^\circ$ from the vertical are avoided.

NOTICE



RUVAC Roots Pumps WA/WAU ATEX

Category 3 (inside)

Category 3 (inside) and (outside)

Important information for operating the RUVAC WA/WAU 251/501/1001/2001 ATEX Category 3 Roots pumps in potentially explosive atmospheres

The Roots pumps RUVAC WA/WAU 251/501/1001/2001 ATEX Category 3 (inside) respectively 3 (inside) and 3 (outside) have been designed and manufactured especially for the purpose of complying with the requirements of Equipment Group II, Category 3 of the "ATEX Directive (Directive 2014/34/EU) for conforming utilisation of equipment and protection facilities in explosion hazard areas".

Classification and Marking of the Pump

The pumps RUVAC WA 251 to 2001 ATEX Category 3 (inside) and (outside) fulfil both for the inside (process gas side) as well as also for the outside of the pump the basic safety requirements laid down in the guideline.

These pumps are marked as follows:



|| (inside) 3G IIC TX¹⁾ (50 Hz)* (12 °C <Ta< 40 °C) X

respectively



|| (inside) 3G IIC TX¹⁾ (50 Hz)*

|| (outside) 3G IIC T3/T4 - (12 °C <Ta< 40 °C) X

* The ATEX certification is valid only for operation at 50 Hz. The temperature class "outside" may be subject to further restrictions due to the motor used.

1) TX refers to the temperature classes and depends on the specific usage conditions.
Explanations on this are given in the following text.

Explanation of the Symbols

II

Equipment Group II applies to all equipment for use in areas which can be endangered by an explosive atmosphere except in underground mining operations and their related above ground systems which can be endangered by mine gas and/or combustible dust.

Inside/outside

Specifies the category/conditions according to which the **inside (i)** (i.e. sections of the equipment in contact with the process gas flow) and the **outside (o)** of the equipment are classified provided these differ.

3

Category 3 comprises equipment which is designed such that it can be operated in agreement with the characteristic quantities (operating parameters) specified by the manufacturer and which ensure a normal level of protection. Equipment belonging to this category is intended for use in areas where it needs not to be expected that an explosive atmosphere occurs due to gases, vapors, mists or raised dust but, in case such an atmosphere should occur in spite of this then according to all probability only rarely and briefly. Equipment belonging to this category ensures during normal operation the required degree of safety.

G

For areas with an explosive atmosphere caused by gases, vapors or mists in the air.

The pump is not suited for areas with an explosive atmosphere caused by explosive dusts.

II, IIA, IIB or IIC

Explosion Groups: these are subdivisions for equipment belonging to Group II which is employed in connection with some protection types. This subdivision is based on the concept of the maximum permitted gap and the minimum ignition current of the explosive mixture. Refer to Annex A of the European Standard EN 50014. (EN 50014 electrical apparatus for potentially explosive atmospheres — General requirements).

Equipment marked with IIB is suited for applications which require equipment with the marking IIA. Correspondingly equipment marked with IIC is suited for applications which require equipment belonging to Explosion Group IIA or IIB. Equipment which is suited for all types of application can be marked by II or not marked at all.

TX (Temperature Class 1 - 6)

Temperature class: Classification of equipment in classes depending on their maximum surface temperature corresponding to the following table:

Temperature class	Maximum surface temperature (°C)
T1	450
T2	300
T3	200
T4	135
T5	100
T6	85

Example: Pumps belonging to temperature class T3 must only be utilised to pump gases which exhibit an ignition temperature of over 200 °C.

By design the gas temperatures in the case of the RUVAC are higher than the surface temperatures.

The temperature class and the actual maximum surface temperature of the equipment includes a safety margin with respect to the minimum ignition temperature of the potentially explosive atmosphere as demanded in EN 13463-1.

50 Hz

The nominal frequency for operation as an ATEX pump is 50 Hz.

Ta

The permissible ambient temperature for operating the pump is
12 °C < Ta < 40 °C.

X

Special operating conditions need to be maintained! The special conditions and notes given in the Operating Instructions and given in this chapter apply.

Usage Conditions

The operating temperature limits much depend on the application conditions.

Ignition Protection Type and Marking of the Electrical Components of the RUVAC WA/WAU ATEX Kat. 3 (i) and 3 (o) / 3 (o)

a) Motor:

Ex e IIC T3 (200 °C) bzw. Ex de IIC T4 (135 °C)

b) Temperature sensor (only permissible for T3 operation)

In order to ensure that in any operating mode and in case the forevacuum pump is affected by malfunctions, so that the machine does not exceed temperature class T3, the use of a temperature sensor is required (not included in the delivery). This temperature sensor measures the gas temperature at the discharge flange of the RUVAC.

Ignition protection type, for example  1/2 G Ex ib IIC T6.

Determining the Operating Range

for TX in ATEX Zone 2 (i) and (o) X (Category 3 (i) and (o))

The possible operating range for temperature classification TX is based on the effective pumping speed of the backing pump which is used (ScrewLine, for example) and connected to the discharge port of the RUVAC and the effective pumping speed of the RUVAC.

From this effective pumping speed there results the effective compression ratio K_{eff} . This is limited by the envelope K_0 as maximum compression, and at high pressures by the maximum permissible pressure difference.

$$K_{\text{eff}} = \frac{\text{Effective pumping speed RUVAC}}{\text{Effective pumping speed of the backing pump at the discharge port RUVAC}}$$

$$K_{\text{eff}} = \frac{p_v = (\text{compression pressure} - \text{pressure at the discharge side RUVAC})}{p_a = \text{Operating pressure RUVAC (intake side)}}$$

K_{eff} = Effective compression ratio

Operation Keeping below Limit Temperatures

Basic diagram:

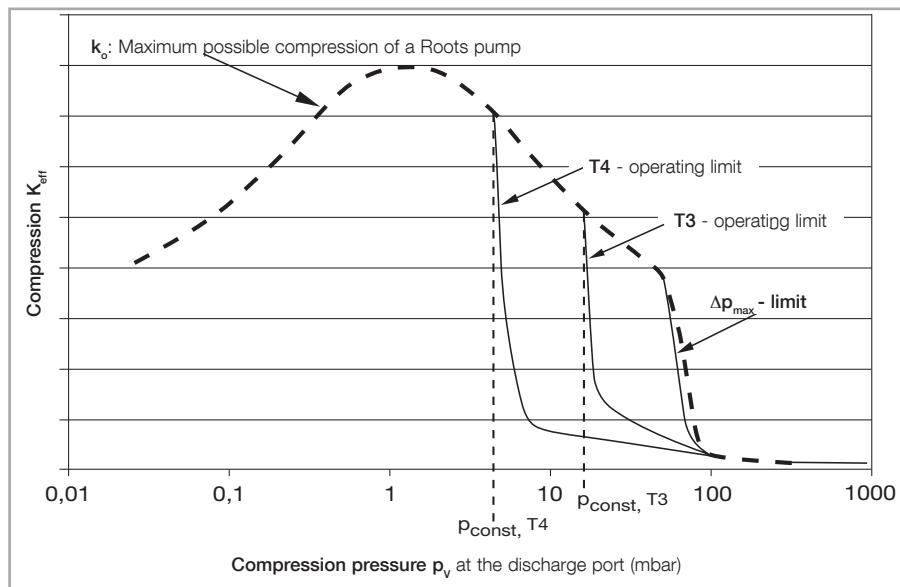


Diagram 1

Below a certain compression pressure $p_v \leq p_{\text{const, TX}}$ the RUVAC WA/WAU fulfills at all times the requirements of temperature classification TX. When it is ensured that this respective pressure is not exceeded and provided the backing pump system is capable of supplying the specified pumping speed at all times, then no temperature monitoring for the Roots pump will be necessary. The intake pressure p_a then results from the ATEX-specific forevacuum pressures $p_{\text{const, TX}}$ given in Table 2 and the effective compression ratio k_{eff} . If k_{eff} is not known, it is recommended to use k_{th} .

$$k_{\text{th}} = \frac{\text{Nominal pumping speed RUVAC}}{\text{Nominal pumping speed backing pump}}$$

k_{th} = Theoretical compression ratio

Equation (1)

$$(1) \quad p_{a, \text{max. permissible}} = p_{\text{const, TX}} / k_{\text{th}}$$

$p_{a, \text{max. permissible}}$ = maximum permissible operating pressure RUVAC
(intake side) for complying with TX

$p_{\text{const, TX}}$ = Table value for TX (see table), pressure at Roots pump discharge side

k_{th} = Theoretical compression ratio

Table 2: Maximum forevacuum pressures p_{const} for complying with TX

RUVAC [mbar]	Δp_{max} [mbar]	Generally the following applies to the max. pressure difference		
		T2	T3	T4
WA/WAU 251	80	$\Delta p_{\text{max}} / (k_{\text{th}} - 1)^*$	57	13
WA/WAU 501	80	$\Delta p_{\text{max}} / (k_{\text{th}} - 1)^*$	34	11
WA/WAU 1001	80	$\Delta p_{\text{max}} / (k_{\text{th}} - 1)^*$	23	7
WA/WAU 2001	50	25	12	3

Δp_{max} = Maximum permissible pressure difference for continuous operation: $p_v - p_a$

* The RUVAC WAU fulfils in every operating range the T2 limit. The pressure balance line limits the pressure difference.

$p_{\text{const, TX}}$ = Table value for TX (see table), pressure at RUVAC discharge port

k_{th} = Theoretical compression ratio

p_v = Compression pressure = Pressure at the RUVAC discharge side

p_a = Operating pressure RUVAC (intake side)

For the operating range with higher pressures p_v from $p_{\text{const, TX}}$ the following applies: The higher the ratio pumping speed Roots pump/pumping speed backing pump ($= k_{\text{eff}}$) is, the higher the gas temperatures at the discharge side of the Roots pump will be.

ATEX operation of the RUVAC WA **and** WAU above $p_{\text{const, TX}}$ is only permissible after having asked Leybold for a design rating.

Within this respective pressure range $p_v > p_{\text{const, TX}}$ the installation of the temperature sensor which has been described is mandatory.

In the following cases the installation of a temperature sensor is mandatory independently of the operating range:

- The gas inlet temperature at the RUVAC exceeds 40 °C.
- Thermally critical gases at high concentrations are being pumped (at times) like, for example, argon, helium or other noble gases.

CAUTION

Equation (2):

$$(2) \quad p_{a, \text{max. permissible}} \leq p_v / k_{\text{eff, permissible}} \leq \Delta p_{\text{max}} / (k_{\text{th}} - 1)$$

If k_{eff} cannot be reliably determined, here too k_{th} must be applied.

Generally the following applies to ATEX applications:

$$p_E \text{ (cut-in pressure, see Section 4)} = p_{a, \text{max. permissible}}$$

Fitting the Pt 100 Temperature Sensor

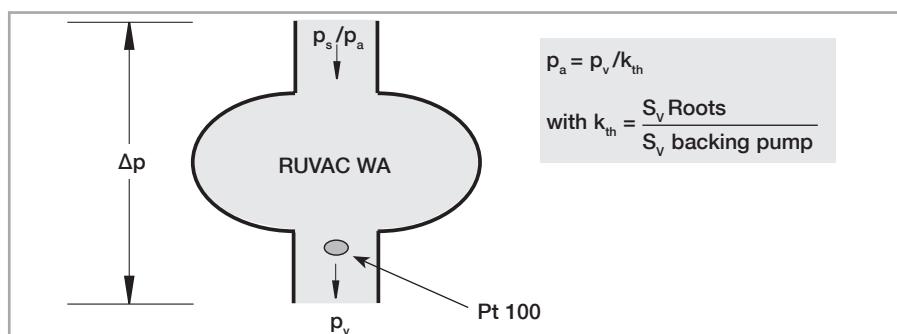


Fig. 0.1 Temperature measurement with the temperature sensor Pt 100 for T3 operation

The tip of the Pt 100 temperature sensor (P/N 155 010 - not included in the delivery) measures the gas temperature in the middle of the RUVAC's discharge flange (see Fig. 0.1 and 0.2). Depending on the size of the RUVAC pump respectively its flange, the Pt 100 sensor needs to be fitted at different positions. The temperature sensor Pt 100 is equipped with three installation marks (**marks A,B,C**, see Fig. 0.2). According to the information given in the following table the Pt 100 must be inserted up to the respective mark into the clamp fitting and secured reliably. In the enclosed installation instructions for the clamp fitting, the required torque levels are stated. Before installing, the transport protectors must be removed.

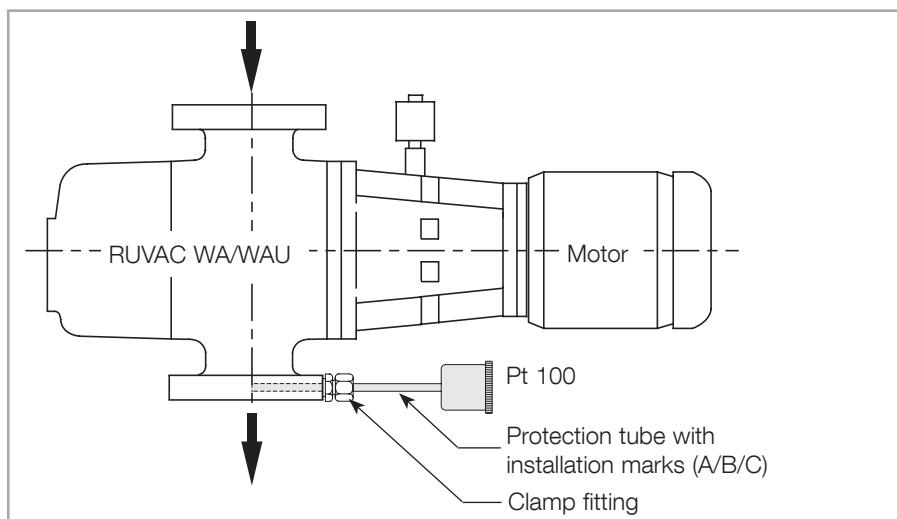


Fig. 0.2 Position of the temperature sensor at the discharge flange of the RUVAC WA/WAU

Through the installation position and the measurement tolerances of the Pt 100, the shutdown temperatures listed in the table needed to be taken into account. Proper operation of the monitoring facilities must be checked before commissioning the equipment in accordance with prEN 13463-6, Section 10.2. The monitoring facility must fulfil the functional failure rate 1 (FFR1) of prEN 13463-6. Here the requirements laid down in prEN 13463-6 must also be taken into account.

Pt 100 signal processing

Exceeding the shutdown temperature of the sensor must reliably shut down the Roots pump.

RUVAC WA/WAU	251	501	1001	2001
Installation position				
Markings on the protection tube (Fig. 0.2)	A	A	B	C
Shutdown temperature which needs to be set up for T3 (200 °C)	100 °C	100 °C	100 °C	100 °C
Shutdown temperature which needs to be set up for T4 (135 °C)			Not permissible for T4 operation	

Examples for Operation within Different Temperature Classes

T2

As can be seen from Table 2, the maximum pressure difference defines the limit for the WA 251, WA 501 and WA 1001. For the WAU 251-2001, T2 is fulfilled at all times. For operating the WA 2001 above the compression pressure p_{const} (25 mbar) and with required compliance with T2, please contact Leybold for rating information.

T3

WA/WAU 251 – 2001: For operation above the compression pressure p_{const} , T3 please contact Leybold for rating information. When the RUVAC WA is operated within this range, then the temperature sensor which has been described must be installed.

T4

WA/WAU 251 – 2001: For operation above the compression pressure p_{const} , T4 please contact Leybold for rating information.

Example for T3 without temperature monitoring

A RUVAC WA 501 ATEX Kat. 3 (i) / (o) is being operated together with a liquid ring pump and a steam ejector pump. The liquid ring pump and the steam ejector pump generate a pumping speed of approximately $150 \text{ m}^3/\text{h}$.

ATEX requirement: The WA 501 must not exceed the temperature T3 (200°C).

The nominal pumping speed of the WA 501 is $505 \text{ m}^3/\text{h}$.

k_{th} = Nominal pumping speed RUVAC / nominal pumping speed backing pump = $505 \text{ m}^3/\text{h} / 150 \text{ m}^3/\text{h} = 3.36$

According to equation (1): $p_a = p_{const} / k_{th}$

p_{const} (T3) = 34 mbar (see table)

Thus it follows that: $p_a = 34 \text{ mbar} / 3.36 = 9.2 \text{ mbar}$

Result

Under these conditions the WA 501 may be switched on at an inlet pressure (= process pressure) of **9.2 mbar** and continuously operated. Here the requirements of temperature classification T3 are fulfilled at all times.

Example for T3 with temperature monitoring

Under these conditions the WA 501 may be switched on at an inlet pressure (= process pressure) of **9.2 mbar** and continuously operated. Here the requirements of temperature classification T3 are fulfilled at all times.

A RUVAC WA 501 ATEX Kat. 3 (i) / (o) is being operated together with a liquid ring pump and a steam ejector pump. The liquid ring pump and the steam ejector pump generate a pumping speed of approximately $150 \text{ m}^3/\text{h}$.

ATEX requirement: The WA 501 must not exceed the temperature T3 (200°C).

However, the process pressure (p_a) is limited from the side of the system to 20 mbar.

For $p_{a, \text{max. permissible}}$ the following value was determined (see above):

$$p_a = 34 \text{ mbar} / 3.36 = 9.2 \text{ mbar}$$

The maximum operating pressure for T3 is at 9.2 mbar thus below the given process pressure of $p_a = 20 \text{ mbar}$. For this reason the operator must contact Leybold before commissioning so as to clarify the possibility of T3 operation under these conditions. Temperature monitoring with the PT100 (Kat-Nr. 155 010) will in any case be necessary above $p_a = 9.2 \text{ mbar}$.

In order to determine whether T3 compliance can be maintained at this process pressure, please contact the Leybold for a review and rating information. For this, information on the pumping speed characteristic of your backing vacuum pump system as well as the lengths and diameters of the connecting lines is required.

Example for calculating p_E and p_a for a T2 application

A RUVAC WA 501 is being operated together with a backing pump at a pumping speed of approximately 150 m³/ h. Compliance with temperature classification T2 is required. This will be the case for the WA 501 in all operating modes (see normal operation).

The nominal pumping speed of the WA 501 is 505 m³/ h.

$$k_{th} = \text{Nominal pumping speed RUVAC} / \text{Nominal pumping speed vacuum pump} \\ = 505 \text{ m}^3/\text{h} / 150 \text{ m}^3/\text{h} = 3.36$$

$$\text{According to equation (2): } p_s = p_E \leq \Delta p_{max} / (k_{th} - 1)$$

$$\Delta p_{max} (\text{WA 501}) = 80 \text{ mbar} \text{ (see Table)}$$

$$\text{Thus it follows that: } p_s \leq p_E = 80 \text{ mbar} / (3.36 - 1) = 34 \text{ mbar approx.}$$

Result:

Under these conditions the WA 501 may be switched on at an inlet pressure (= process pressure) of **34 mbar** max. and continuously operated. Here the requirements of temperature classification T2 are fulfilled at all times.

Related Electrical Equipment

Provided the pump is approved for operation in explosion hazard areas, all electrical equipment supplied together with the pump like, for example, valves, sensors, is also approved for operation in such areas. The same conditions which apply to operation of the pump apply also to the accessories.

Related Accessories

The Leybold accessories available for this pump are also suited for operation in explosion hazard areas. The same conditions which apply to operation of the pump apply also to the accessories. When using other accessories with this pump, it needs to be ensured that such accessories are suited for operation in explosion hazard areas.

Areas of Application

The inside (the process gas side) of this vacuum pump is so designed and rated that the occurrence of foreseeable ignition sources can be excluded during normal operation. Provided the pump is operated within the limits of the parameters specified in the Operating Instructions, the pump will offer a normal degree of protection. It is therefore suited for operation under conditions under which it is unlikely that explosive atmospheres are caused by gases, vapors or mists in the air or should these occur then only rarely and for a short period of time (i.e. Zone 2). The same conditions apply to outside components of the pumps which have been certified.

CAUTION

If only the inside of the pump (process side) has been certified for use in explosive atmospheres, then the pump itself must not be installed and operated within explosion hazard areas.

Outside of the pump: Zone definitions

Areas in which explosive atmospheres (gases, vapors or mists) in the air can occur are classified in three zones according to the frequency and the duration of the occurrence of an explosive atmosphere. These zones are designated as Zone 0, 1 and 2.

The definitions for these zones are described in the Annex I of the «Atex Directives (Directive 99/92/EG) for the improvement of health protection and safety of staff which might be endangered by explosive atmospheres».

Notes relating to the definitions for the three zones relating to areas with explosive atmospheres are given in the Directive 99/92/EG and the corresponding guide (COM (2003) 515), together with the European standard EN 60079-10 (Electrical apparatus for explosive gas atmospheres. - Part 10 Classification of hazardous areas). Additionally further information on the avoidance of explosions and on the topic of explosion protection can be found in the Directive 99/92/EG and the corresponding guide.

This information can be downloaded from the EU Internet site.

Ignition Temperatures of Gases/Vapors

The pumps are suited only for applications in which potentially explosive gas or vapor mixtures have an ignition temperature of over 200 °C (T3) or 135 °C for T4.

The ignition temperatures of gases or vapors, sometimes also termed auto-ignition temperature can be taken from the material safety data sheets.

The pump is not suited for operation in potentially explosive gas mixtures in which the oxygen concentration is over 21% or if reactive, aggressive or corrosive gases are present.

Additional Installation Requirements "X"

In addition to the installation information provided in the main Operating Instructions, the following needs to be ensured:

The pump must exclusively be filled and operated with the oil LVO 100 or LVO 210 as the operating agent.

The use of other oils can result in higher surface temperatures thereby causing severe damage to the pump.

The pump must be installed such that the oil level sight glass can be read off easily and can not be damaged.

Install the pump such that only minimal quantities of dust can deposit themselves on the surfaces. In those cases where dust deposits form, measures need to be introduced which ensure that these are removed on a regular basis.

The permissible ambient temperature is between 12 °C and 40 °C.

The maximum discharge pressure (= forevacuum pressure) must not exceed p_{const} when no temperature monitoring has been installed for the RUVAC WA/WAU. Here the following applies to the inlet pressure: $p_a = p_{\text{const}} / k_{\text{th}}$.

If the pump (outside) has been certified for operation in areas with explosive atmospheres, the special information contained in the European standards EN 60079-14 «Electrical apparatus for explosive gas atmospheres Part - 14» and EN 60079-17 «Electrical apparatus for explosive gas atmospheres - Part 17» needs to be complied with.

The pumps are not suited for applications in which abrasive and cohesive substances or condensable vapors are produced which may form sticky, tough, layer-forming deposits. After having switched off the Roots pump, its pistons are subjected to post-heating and for this reason it is essential to maintain a cooling down time of 30 minutes. Thereafter the pump may be switched on again.

NOTICE**NOTICE**

Potential Ignition Sources

An assessment of the ignition hazard was performed in accordance with the European standard EN 13463-1 (EN 13463-1 Non-electrical equipment for potentially explosive atmospheres - Part 1: Basic method and requirements). And based on this assessment the ignition sources listed in the following which may occur during operation of the pump, were determined:

Potential ignition sources	Remarks
Hot surfaces	Inside and outside due to gas compression
Hot gases	Are produced within the pump and ejected at the exhaust
Mechanical sparks	Will not occur during normal operation
Electric sparks	Outside the pump due to motor, accessories
Static electricity	Can occur provided conducting parts of the pump have not been connected to ground
Chemical reactions	--

Protective Measures

Hot Surfaces

Compression of the gases will cause the surfaces to heat up during normal operation of the vacuum pump. Tests have shown that in the case of conforming utilisation of the pump (in line with these instructions) the process gas path which may come in to contact with a potentially explosive atmosphere attains, when operated at a nominal frequency of 50 Hz, a maximum temperature of less than 200 °C for T3 or 135 °C for T4.

The maximum temperatures are attained in the case of continuous operation at a discharge pressure ranging between 40 and 80 mbar (inlet pressure = discharge pressure / true compression ratio) and at a diminishing gas throughput ($Q_0 = 0 \text{ m}^3/\text{h}$). The temperature which will be attained in practice will depend on the true compression ratio and the gas throughput.

Equally the outside of the pump may attain a maximum surface temperature of over 80 °C, the maximum surface temperature will remain below 200 °C for T3 or 135 °C for T4 at 50 Hz nominal operation (these temperatures include safety margins in accordance with EN13463-1).

CAUTION



Higher maximum surface temperatures can occur when not filling and operating the pump with oil LVO 100 or LVO 210.

In the case of the ATEX pump versions no PFPE must be used.

Mechanical Sparks

During normal operation no sparks due to mechanical causes will occur. The fan and the fan cowl are so designed that a sufficient clearance is maintained thereby excluding the possibility of a contact.

The ingress of particles into the pump must be avoided so as to avoid the formation of hotspots due to friction. The pump must only be operated with the inlet screen in place.

Electric Sparks

These can be caused by the electric motor and the accessories supplied with the pump. If the pump has been approved for operation in areas with an explosive atmosphere, then motor and supplied accessories have the same classification as the pump. Motor and accessories need to be installed and used in agreement with the enclosed manufacturer's information.

Static Electricity

The pump needs to be sufficiently grounded so as to avoid any electrostatic charging. This is attained when the ground connection is properly connected at the point provided for this purpose. During normal operation no dangerous electrical charges will be produced (for further information relating to the hazards caused by static electricity, see CENELEC report CLC/TR 50404: 2003 Electrostatics - Code of practice for the avoidance of hazards due to static electricity).

Exclusively use original Leybold spare parts, since only these have been designed such that proper grounding is ensured.

Chemical Reactions

The pump must not be used in connection with reactive or corrosive gases, which might result in an exothermal chemical reaction.

Additional Safety Measures

Overheating the pump can give rise to temperatures which exceed the maximum permitted temperature TX. Compliance with the operating parameters stated in these Operating Instructions must be ensured.

The maintenance intervals need to be complied with for safe operation.

Additional Maintenance Requirements

In those cases where dust can deposit itself on the pump or the motor surfaces, measures must be introduced which ensure that such deposits are removed on a regular basis.

In order to ensure that the defined safety level is complied with, use only original Leybold accessories and spare parts.

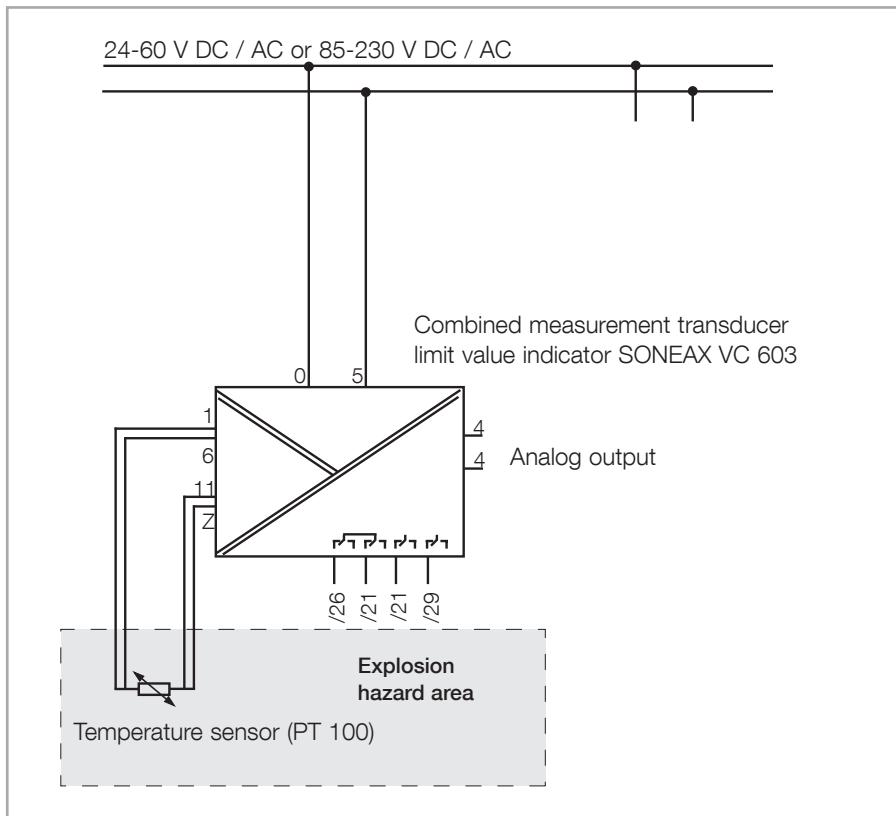


Fig. 0.3 Connection of the temperature sensor (circuit recommendation)

How must the Temperature Sensor be Connected Electrically?

Leybold describes here a recommended circuit for the electrical connection. The circuit shown (Fig. 0.3) represents one possibility of processing the signal, other circuit implementations can produce the same results!

Due to the installation position and the tolerances stated for the temperature measurement, and for compliance with temperature classification TX, the RUVAC WA/WAU must be shut down reliably at the shutdown temperatures stated in Table 1. T4 operation is excluded.

1 Description

1.1 Design and Function

The RUVAC WA and RUVAC WAU are Roots vacuum pumps which are driven directly by an electric motor.

The WAU types have a pressure balance line between the discharge and intake flange.

Standard RUVAC pumps are not suited for pumping of oxygen when the oxygen concentration exceeds that in the atmosphere.

Before planning to use RUVAC pumps for pumping of highly aggressive gases, contact us first.

The inside (the process gas side) of this vacuum pump is so designed and rated that the occurrence of foreseeable ignition sources can be excluded during normal operation. The pump carries an **ATEX 3 inside** identification and when a corresponding motor has been connected also an **ATEX 3 outside** identification. For details please refer to the ATEX section.

The operator is responsible regarding conforming utilisation of the RUVAC pumps and compliance with the statutory requirements from the ATEX operator directive (99/92/EG).

1.1.1 Principle of Operation

Roots pumps - also known as Roots blowers - contain in their pump casing two symmetrical impellers rotating in opposite directions (see fig. 1.1). 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.

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 back-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.

Description

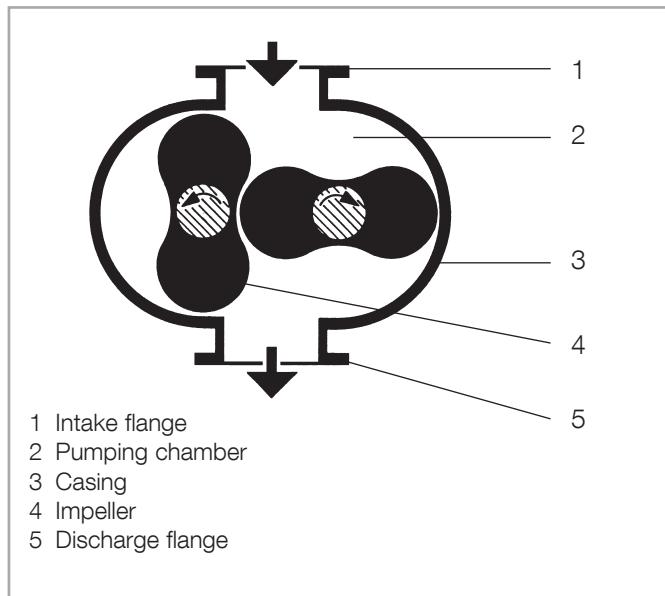


Fig. 1.1 Schematic cross-section of a Roots pump (vertical flow)

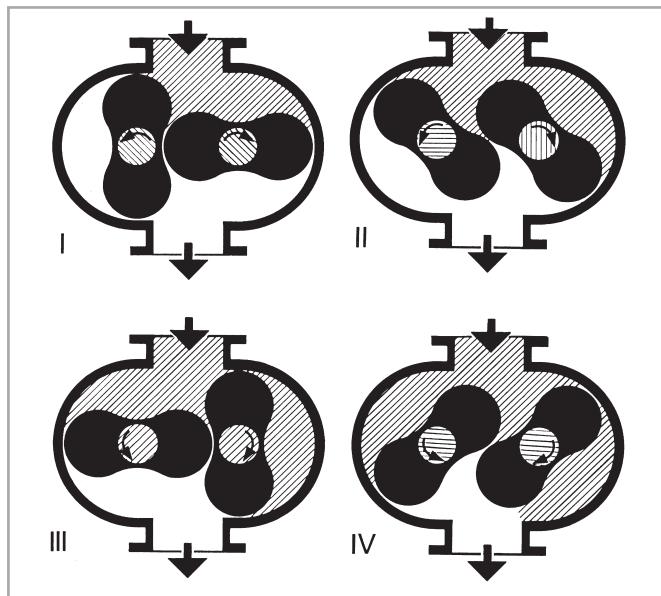


Fig. 1.2 Functional diagram of a Roots pump (vertical flow)

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.

RUVCAC WA/WAU 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.

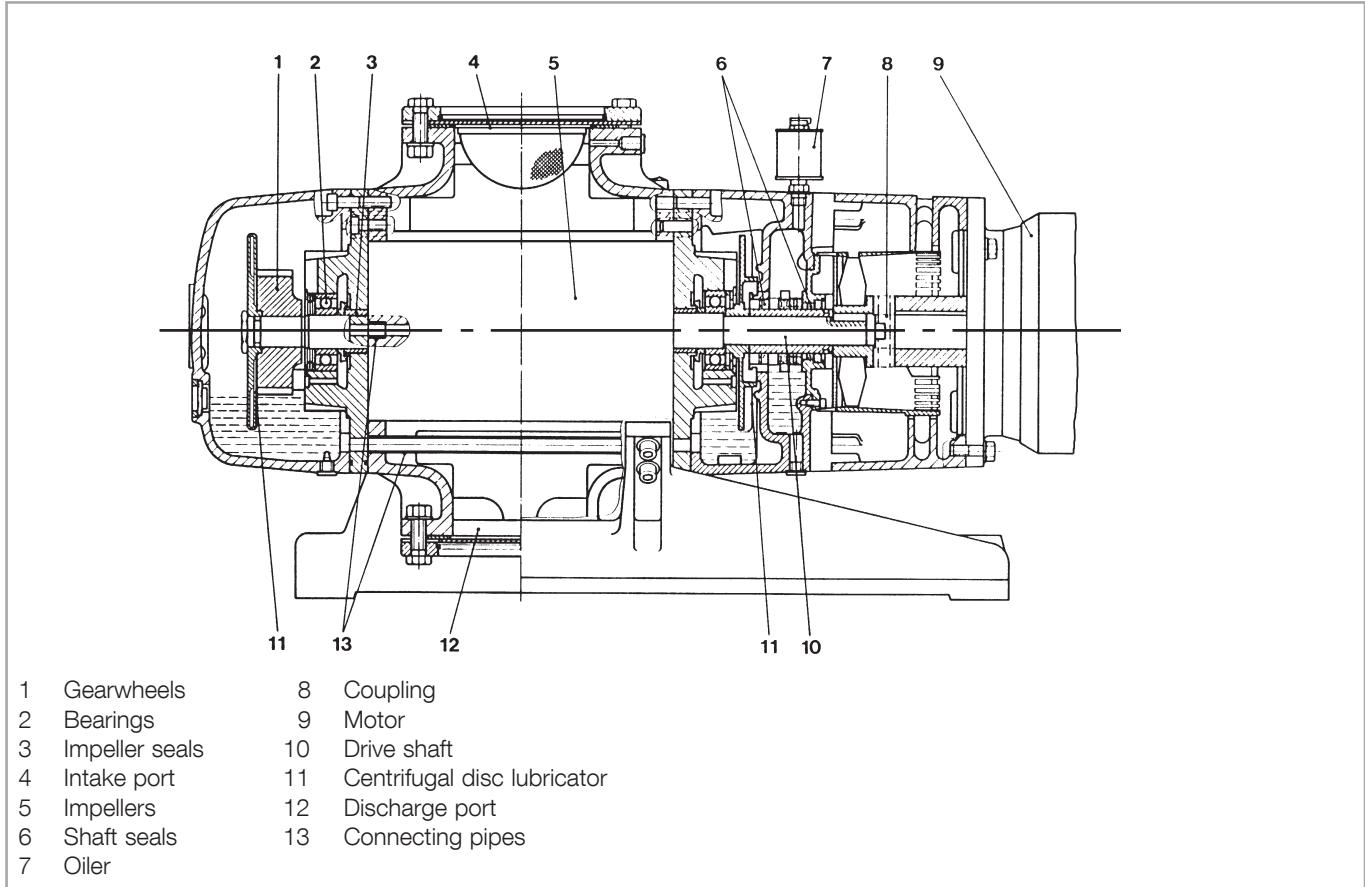


Fig. 1.3 Longitudinal section of a RUVAC WAU 2001 (vertical flow)

1.1.2 Design

RUVCAC 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 and the bearings are lubricated with mineral oil (see fig. 1.3). 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. 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. 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.

Description

The motor of the RUVAC WA/WAU is directly flanged to the coupling housing. One shaft of the pump is linked to the shaft of the motor by an elastic coupling. The shaft of the other impeller is driven via the synchromesh gear.

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

The speed is then increased to 3,600 rpm and the pumping speed increases correspondingly.

For ATEX applications, 50 Hz operation only is permissible.

Motors for operation in connection with special supply voltages or frequencies as well as explosion hazard protected motors are available upon request.

The feedthrough of the impeller's shaft between the evacuated bearing space and the atmosphere is sealed by means of shaft seals. The shaft seals are immersed in oil. They are located in a seal housing with a separate oil reservoir. The oil level in the shaft seal housing can be checked at oiler.

RUVAC WA/WAUs are air-cooled. The airflow for cooling the motor and pump is produced by a fan which sits on the motor.

An additional blade wheel is located on the coupling for additional cooling.

1.1.3 Pressure Balance Line

The RUVAC **WAU** 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 (see section 4.1). The RUVAC 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.

In the case of short cycle operation we recommend the use of a gear chamber evacuation facility so as to avoid oil spreading, see Section 1.5.

NOTICE



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

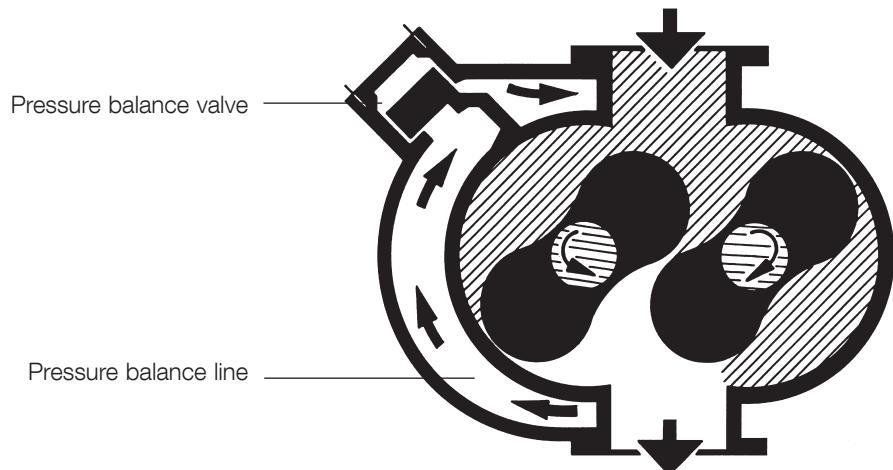


Fig. 1.4 Schematic diagram of a Roots pump with pressure balance line

1.1.4 Lubricants

The standard RUVAC WA/WAU pumps are ready for operation with mineral oil or synthetic oil.

In case of operation with mineral oil we recommend our vacuum pump oil LVO 100, in case of operation with synthetic oil we recommend LVO 210.

WA/WAU pumps running with a filling of PFPE today no longer meet the world-wide requirements for semiconductor processes. For such applications the WS/WSU models should be preferred.

NOTICE

1.2 Standard Specification

RUVAC WA/WAU's are supplied for vertical flow as standard. The shaft seal housing is supplied with a filling of oil.

Before the pump is shipped the oil has been drained out. The quantity of oil needed for running the pump is supplied in a separate container.

The intake flanges of all pumps contain an inlet screen and have been vented with nitrogen for protection against corrosion. The flanges are sealed with plastic adhesive film.

The WA/WAU models without a motor have been prepared for operation in connection with a motor which complies with the IEC standard. The motor flange is sealed with a cardboard disc. The coupling is included with the pump.

Description

1.3 Technical Data

For ATEX applications, only the values for 50 Hz apply.

RUVAC WA/WAU		251	501	1001	2001
Nominal pumping speed at 50 Hz ¹⁾	m ³ · h ⁻¹	253	505	1000	2050
Max. pumping speed at 50 Hz	m ³ · h ⁻¹	210	410	800	1850
Nominal pumping speed at 60 Hz ¹⁾	m ³ · h ⁻¹	304	606	1200	2460
Max. pumping speed at 60 Hz	m ³ · h ⁻¹	251	530	1000	2100
■ with backing pump TRIVAC	D 65 B		-	-	-
■ with backing pump SOGEVAC		SV 200	SV 300	SV 630 F	
Ultimate partial pressure ²⁾	mbar	< 2 · 10 ⁻⁵	< 8 · 10 ⁻³	< 8 · 10 ⁻³	< 8 · 10 ⁻³
Ultimate total pressure ²⁾	mbar	< 8 · 10 ⁻⁴	< 4 · 10 ⁻²	< 4 · 10 ⁻²	< 4 · 10 ⁻²
Poss. cut-in pressure ²⁾ – RUVAC WA	mbar	90	100	60	30
Maximum allowable pressure differential in continuous operation ³⁾	mbar	80	80	80	50
Leak rate, integral	mbar · l · s ⁻¹		≤ 5 · 10 ⁻⁴		
Permissible ambient temperatures	°C		12 - 40		
Main supply IEC motor ⁸⁾	YY/Y V	220-240/ 380-420	220-240/ 380-420	220-240/ 380-420	– 380-420
Temperature class		F	F	F	F
Motor power	kW	1.1	2.2	4.0	7.5
Nominal speed, 50/60 Hz	min ⁻¹		3000 / 3600		
Max. permissible speed	min ⁻¹		3600		
Motor protection category	IP		55		
Oil filling for the bearing chamber ⁴⁾ vertical pumping action, approx.	I	1. Filling 5 / 2. Filling 0.5 / 0.4	1. Filling 5 / 2. Filling 1. Filling 0.9 / 0.8	1. Filling 5 / 2. Filling 2.0 / 1.8	4.2 / 3.6
horizontal pumping action, approx.	I	0.5 / 0.4	0.8 / 0.7	1.2 / 1.1	2.0 / 1.8
Oil filling of the shaft sealing ring housing	I	0.6	1.0	1.3	1.6
Connection flanges	DN	63 ISO - K	63 ISO - K	100 ISO - K	160 ISO - K
Weight WA / WAU	kg	85 / 89	128 / 133	220 / 225	400 / 406
Noise level ⁶⁾	dB (A)	< 64	< 67	< 75	< 80

¹⁾ To DIN 28 400 and subsequent numbers

²⁾ 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.

³⁾ Applicable for ratio up to 1 : 10 between backing pump and Roots vacuum pump at 3000 rpm

⁴⁾ Authoritative, however, is the oil level at the oil-level glass

⁵⁾ After a complete disassembly

⁶⁾ At an operating pressure below < 10⁻¹ mbar (< 0.75 x 10⁻¹ Torr)

⁸⁾ Motor voltage and current may deviate depending on the type of motor.
Please always note the information on the nameplate.

Description

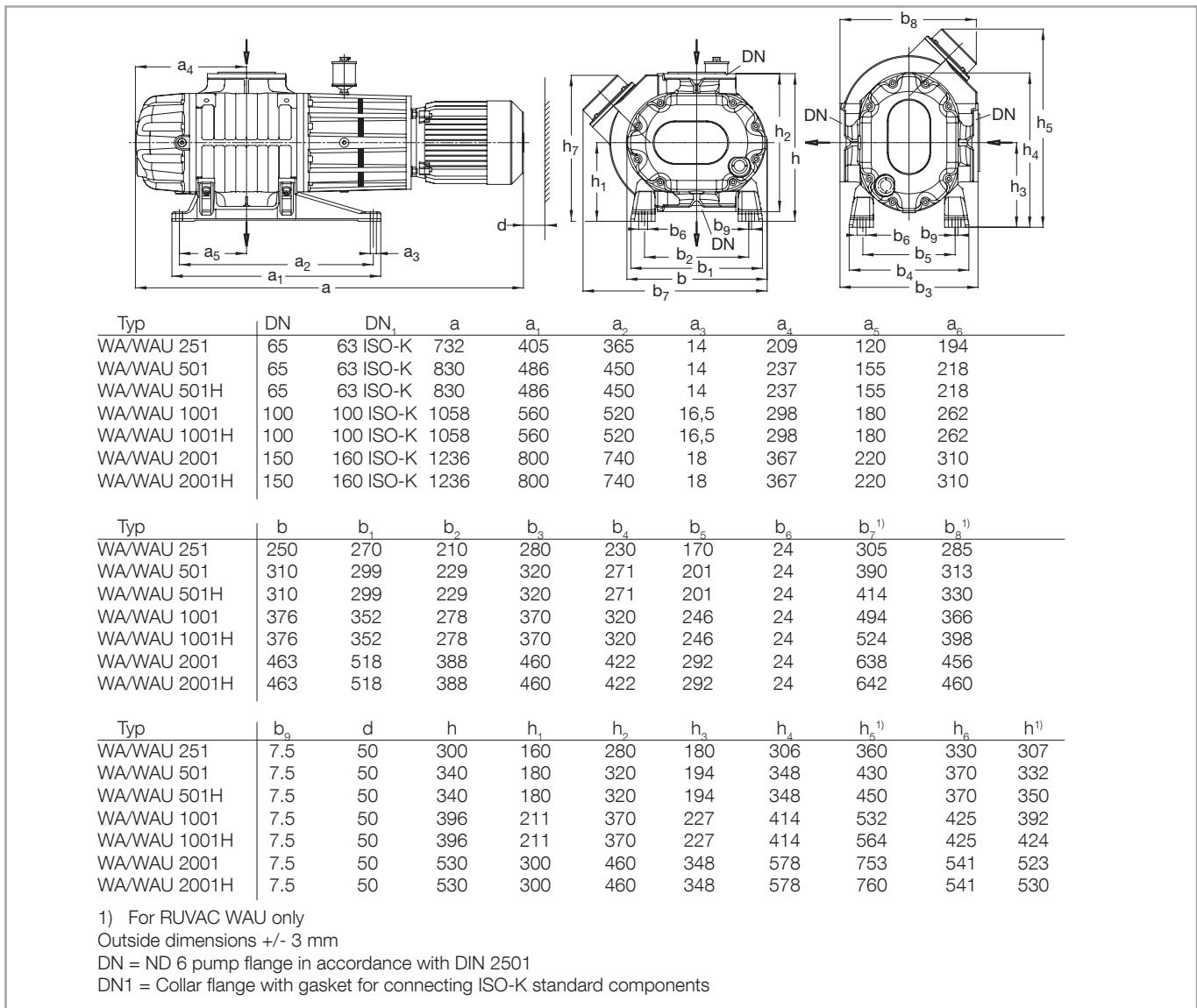


Fig. 1.5 Dimensional drawing for the RUVAC WA/WAU pumps

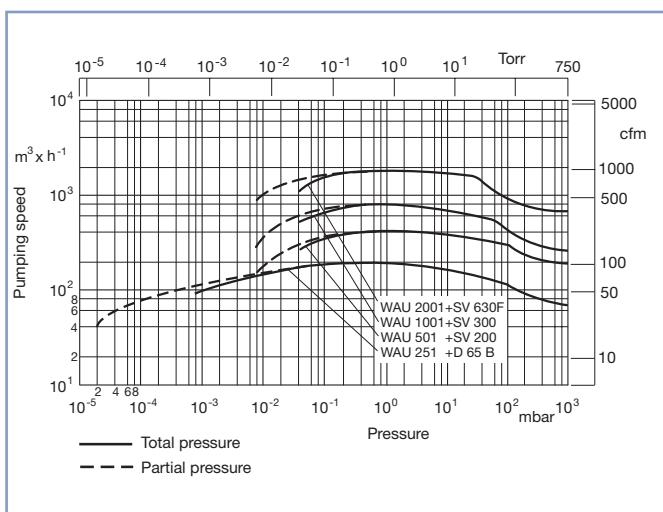


Fig. 1.6 Pumping speed of the RUVAC WA/WAU, 50 Hz

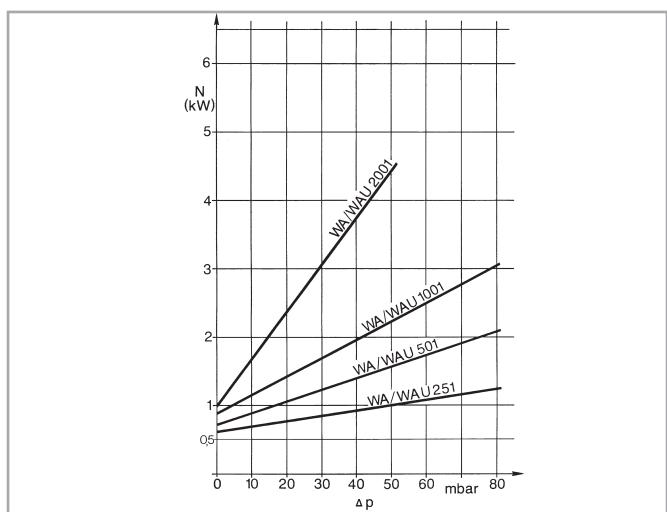


Fig. 1.7 Power consumption of the RUVAC WA/WAU

Description

1.3.1 Motor Data

	WA(U) 251	WA(U) 501	WA(U) 1001	WA(U) 2001
Motor Type	AMH 80Z BA2	AMH 90L BA2	AMH 112M AA2	AMH 1325 TA2
Motor Power 50/60Hz	1.1 kW	2.2 kW	4 kW	7.5 kW
Number of phases		3		
Number of pole pairs		1		
Nominal Frequency		50/60 Hz		
Nominal rotating speed 50Hz 60Hz	2900 rpm 3410 rpm	2910 rpm 3505 rpm	2910 rpm 3510 rpm	2940 rpm 3540 rpm
Nominal voltage 50 Hz				
200-240 V	5.7 A	9.4 A	15.6 A	28 A
200 V (IE2)	5.0 A	9.2 A	14.2 A	27.2 A
380-400 V (IE2)	2.5 A	4.6 A	7.1 A	13.6 A
60 Hz				
200-240 V	4.8 A	8.2 A	13.5 A	27 A
208-240 V (EPAct)	4.4 A	7.8 A	12.6 A	24 A
380-480 V	2.4 A	4.1 A	6.7 A	13.5 A
416-480 V (EPAct)	2.2 A	3.9 A	6.3 A	12 A
Nominal Efficiency [%]				
50 Hz/400 V	100% 75% 50%	81.5 80.6 76.9	85.5 85.2 83.5	88.6 88.4 86.6
60 Hz/460 V	100% 75% 50%	82.5 81.0 76.7	86.3 84.9 81.5	88.4 87.3 84.2
Max. ambient temperature			40 °C	
Type of protection			IP 55	
Max. installation height			1000 m	
Supplier	Lafert SpA / Via J.F.Kennedy / I-30027 San Doná di Piave (Venezia)			

Description

1.4 Ordering data

Roots vacuum pump	WA/WAU 251	WA/WAU(H) 501	WA/WAU(H) 1001	WA/WAU(H) 2001
RUVAC WA	117 20	117 30	117 40	117 50
WA with horizontal flow	–	128 38	–	113 42
RUVAC WAU	117 21	117 31	117 41	117 51
WAU with horizontal flow	–	–	–	167 004
RUVAC WA, ohne Motor	117 24	117 34	117 44	112 54
RUVAC WAU, ohne Motor	155 011V	155 008	112 17	113 22
RUVAC WAU H, mit ACE-Dämpfer	–	118 31	118 41	118 51
WAU H with ACE vibration absorber and LVO 210	–	–	–	167 022

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

RUVAC WS/WSU(H) seal kit	194 60	194 64	194 68	194 72
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
RUVAC WA US conversion kit, consisting of ANSI flanges 3 in., NEMA motor flange, coupling and installation components	155 013V	155 014V	155 015V	155 016V
ACE vibration absorber (DA-Ventil)	–	200 03 251	200 03 252	100 22
Frequency converter RUVATRONIC	RT 5/251	RT 5/501	RT 5/1001	RT 5/2001
	500 001 381	500 001 382	500 001 383	500 001 384

Spare parts

Shaft sealing ring replacement kit Kit WA/WAU	EK 110 002 661	EK 110 002 661	EK 110 002 662	EK 110 002 662
Major maintenance kit				
WA	EK 110 002 663	EK 110 002 664	EK 110 002 667	EK 110 002 669
WAU	EK 110 002 665	EK 110 002 666	EK 110 002 668	EK 110 002 670

Description

Accessories for all RUVAC WA/WAU

	Part Nos
Temperature sensor (Pt 100)	155 010
Oil drain facility (M 16 x 1.5) ■ with straight drain coupling ■ with right-angled drain coupling	190 02 200 14 271
Pressure switch PS 115 (stainless steel) adjustable ¹⁾	160 04
Pressure switch adjustment	160 05
Accessories for mounting PS 115 Adapter Right-angle bend DN 16 KF Centering ring DN 16 KF, 2 x Clamping ring DN 16 KF, 2x	168 40 184 36 183 26 183 41
Contact amplifier SV 110, 230 V	160 78
Gearbox Evacuation Kit for RUVAC WA/WAU 1001/2001	155 184V
Mineral oil LVO 100 1 litre 5 litres 20 litres 208 litres	L10001 L10005 L10020 L10099
Ester oil LVO 210 1 litre 5 litres 20 litres 208 litres	L21001 L21005 L21020 L21099

1) Not certified in accordance with ATEX 2014/34/EU, processing is only permissible in connection with an intrinsically safe electric circuit. As an alternative for use within explosion hazard areas, the pressure transducer Cerabar M PMC41 from the company Firma Endress + Hauser is available. When ordering the pressure transducer please also state the corresponding pressure range.

The Leybold accessories (with exception of the pressure switch and switching amplifier) available for this pump are also suited for operation in explosion hazard areas. The same conditions which apply to operation of the pump apply also to the accessories. When using other accessories with this pump, it needs to be ensured that such accessories are suited for operation in explosion hazard areas.

Transport and Storage

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, see Fig. 2.1.

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.

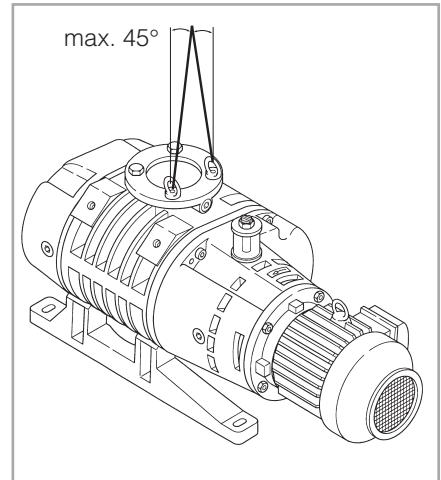


Fig. 2.1 Transport

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

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. It will not be required to drain out the oil from the shaft seal housing (oiler).

The pump should be transported and stored in a horizontal position (5° max. tilt). Otherwise the oil from the shaft seal housing (oiler) may drain. In addition, 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.

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

Temperature -20 °C to +60 °C

Storage site dry

Maximum atmospheric humidity 95 %, non-condensing

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

CAUTION



NOTICE



Installation

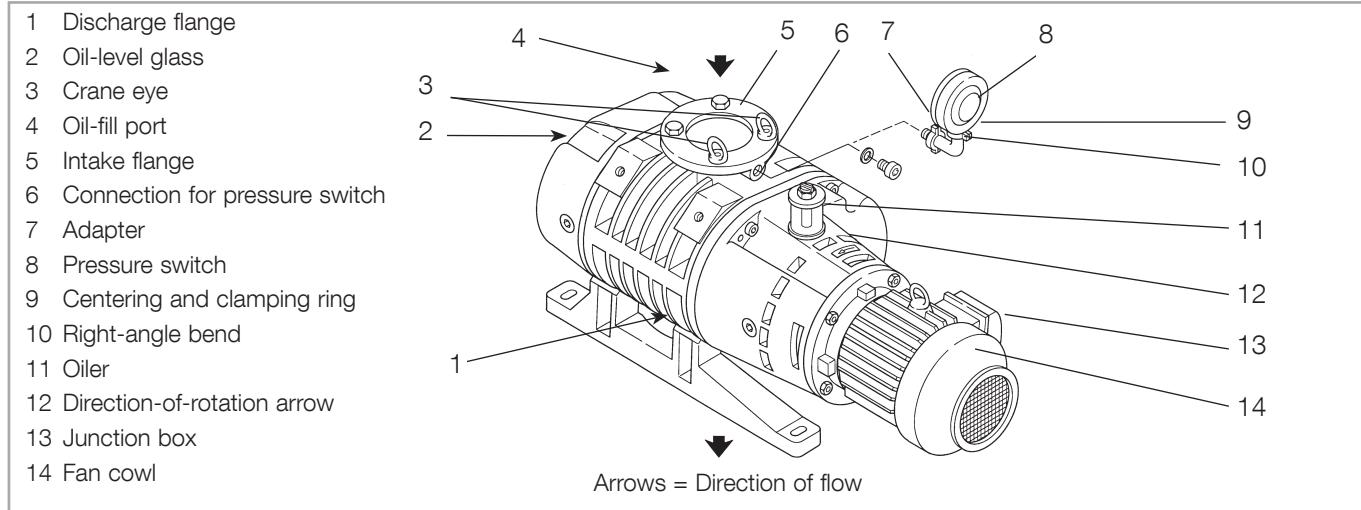


Fig. 3.1 Connections and controls

3 Installation

NOTICE



Only fill in the oil after having installed the pump.

3.1 Installation

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

NOTICE



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

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.

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

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

NOTICE



3.1.1 Filling in of the oil

The housing for the shaft seal and the oiler are filled with oil when the pump is supplied. The oil level must be visible in the oiler.

Correct oil level: 1/3 of the oiler must be filled when the pump is cold. Top up oil as required.

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

Unscrew the oil-fill plug and add oil.

An oil without additives and of viscosity class ISO VG 100 (formerly SAE 30) must be used for the pump. We recommend our special oils LVO 100 or LVO 210. 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 3.3 which apply to switched off pumps (at standstill) must be correctly maintained.

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.

NOTICE



Installation

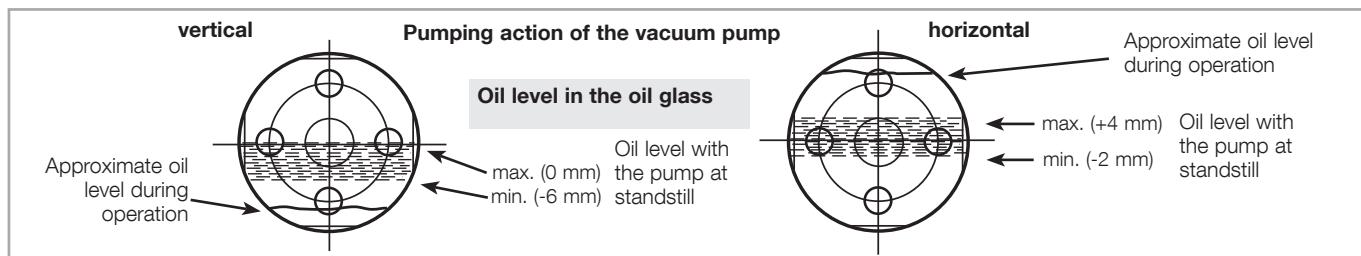


Fig. 3.2 WA/WAU 251-2001 with LVO 100, WA/WAU 251-1001 with LVO 210

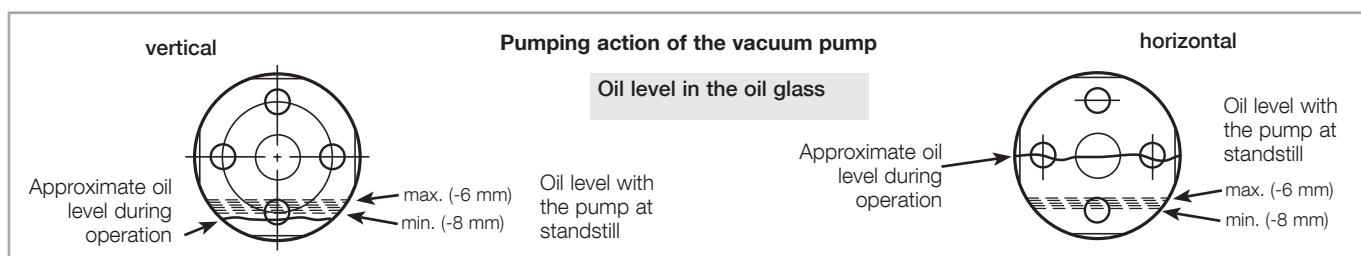


Fig. 3.3 WAU 2001 with LVO 210

Fig. 3.2 - 3.3 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.

The inside (the process gas side) of this vacuum pump is so designed and rated that the occurrence of foreseeable ignition sources can be excluded during normal operation. The pump carries an **ATEX 3 inside** identification and when a corresponding motor has been connected also an **ATEX 3 outside** identification. For details please refer to the ATEX section.

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.
- Use of pump and frequency converter in explosion hazard areas which exceed the specifications laid down in the ATEX identification of pump and motor.
- 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.

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

WARNING



Installation

3.3 Electrical Connection

For pumps without a motor, first fit a suitable motor, see Section 3.5.

WARNING



Notice safety information 0.2.

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.

NOTICE



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

The WA/WAU pumps are only limited suitable for operation in connection with frequency converters. The max. permissible speed is 3,600 rpm regardless of the size of the pump.

For ATEX applications, frequency converter operation is not possible.

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

The pump needs to be sufficiently grounded so as to avoid any electrostatic charging. This is attained when the ground connection is properly connected at the point provided for this purpose. During normal operation no dangerous electrical charges will be produced (for further information relating to the hazards caused by static electricity, see CENELEC report CLC/TR 50404: 2003 Electrostatics - Code of practice for the avoidance of hazards due to static electricity).

Connect the pump to the correct mains voltage through the terminals provided in the junction box.

Only the fittings provided on the junction box may be used.

The pump has no switching devices of its own. All protection measures in connection with the power supply need to be implemented from the side of the plant in the full responsibility of the customer.

After a mains power failure the pump will restart automatically once the power returns.

If for this reason there results in connection with the application a danger potential it needs to be ensured that a restart can only be performed after a manual reset. This applies equally **emergency** shutdowns.

Installation

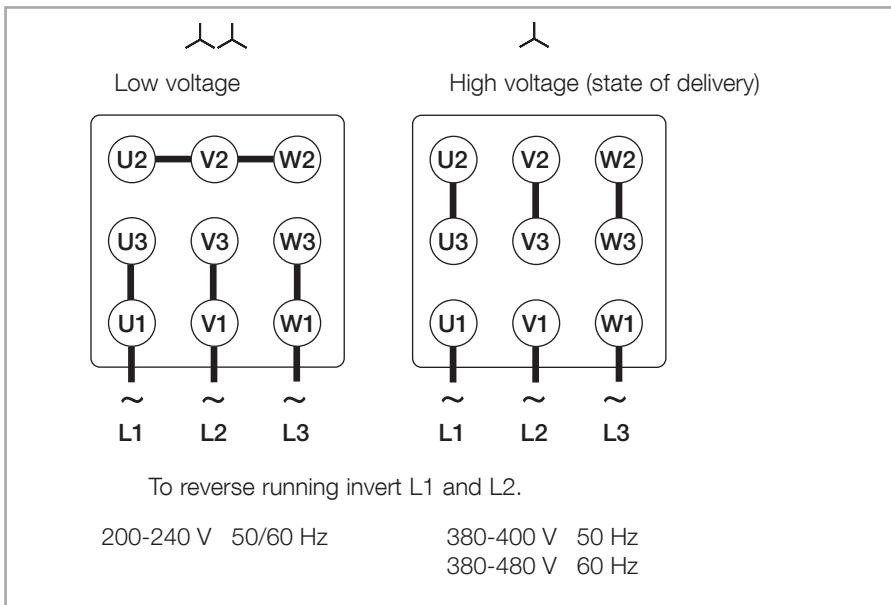


Fig. 3.4 Electrical connection

The electric motor must be protected with a motor protection switch.

The local connection conditions will possibly necessitate means for the purpose of reducing the surge currents upon switching the pump on. Star-delta start-up is not possible.

Installation

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 on the motor flange shows the correct direction of rotation for the impeller connected to the motor shaft (see fig. 3.1). 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.

Pressure switch

For ATEX applications process the signal with an intrinsically safe electric circuit only.

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

At Leybold, the pressure switch PS 115 is set to a fixed value. When ordering the pressure switch please state the required switch-on pressure.

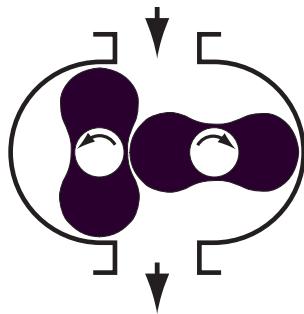
After removing a screw plug, the pressure switch together with an adapter and a right-angle bend can be mounted on the bore (see fig. 3.1).

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

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

Temperature sensor

(see ATEX Section)



3.4 Connecting the Flanges

Already small quantities of liquids (from the vacuum chamber or the piping) can lead to liquid damages within the pump. These may lead to a deformation of the impellers and may entirely destroy the pump. Suitable protective measures should be provided as required in the piping on the 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 (see Fig. 3.1).

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.

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.

When using the pumps in explosion hazard areas the use of an inlet screen is mandatory.

NOTICE



NOTICE



Installation

3.5 Connecting the ATEX-Motor

The RUVAC WA pump can also be ordered without a connected motor (see Ordering Data).

NOTICE



When motor is fitted by the customer, the operator will be responsible for selecting and operating the motor. Mounting the motor has an influence on the operation and reliability of various pump components, coupling and bearings in particular. Not complying with the technical data and installation information in the following will void CE and ATEX conformity resulting in a rejection of any warranty claims.

The ATEX category for the outside area can change depending on the type of motor. Use only such motors which are approved for the respective category.

T3 motors of the type Exe have, as standard, different flange and shaft diameters. These motors must be ordered with a reduced diameter (see following Table).

Specific motor data		WA 251	WA 501	WA 1001	WA 2001	
Type		3-ph. motor	3-ph. motor	3-ph. motor	3-ph. motor	
Model ¹		IM B5	IM B5	IM B5	IM B5	
Size ¹		80 L	90 L	112 M	132 M	
Flange		FF165	FF165	FF215	FF265	
Nominal power rating ²	P	kW	1.1	2.2	4	7.5
Outside flange diameter	D1	mm	200	200	250	300
Pitch circle diameter, bolts	D2	mm	165	165	215	265
Screw size	M	-	M10	M10	M12	M12
Number of screws	N	-	4	4	4	4
Centering diameter ²	D3	mm	130 _{j6}	130 _{j6}	180 _{j6}	230 _{j6}
Shaft journal, motor ²	D4	mm	19 _{j6}	24 _{j6}	28 _{j6}	38 _{k6}
Concentricity, shaft journal ³	X1	mm	0.04	0.04	0.04	0.05
Coaxiality, centering flange ³	X2	mm	0.1	0.1	0.1	0.125
Run out, mounting flange ³	X3	mm	0.1	0.1	0.1	0.125

¹ Motor in accordance with EN 60034-1, EN 60034-7, DIN 52677 Part 3

² Three-phase motors with standardised dimensions and power ratings in accordance with EN 50347

³ Concentricity of the shaft journals, coaxiality and run out of the mounting flange in accordance with DIN 42955, see also Fig. 3.5

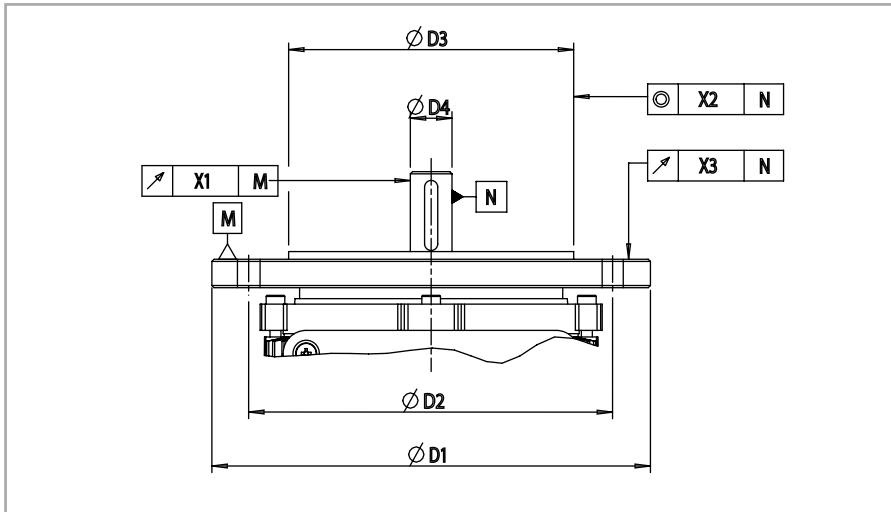


Fig. 3.5

3.5.1 General Installation Information

Make sure that the respective motor complies with the information given in the Table (see also Fig. 3.5).

For mounting the motors use only the original parts supplied by Leybold.

- Motor coupling half
- Coupling star
- Nuts and washers

When mounting motors for WA 1001 or larger pumps, we recommend the use of a lifting device.

The motor must be fitted with the pump aligned horizontally. Tilting the pump by over 5° can cause oil to flow from the gear chambers into the pump chamber.

All mating surfaces and centering surfaces must be clean, undamaged and free of any paint residues.

Only air cooled motors must be used. The fan on the side of the motor is also required to cool the pump housing. If this air cooling arrangement is not present, then the surface temperatures may under certain circumstances exceed the permissible temperature range for the pump (T₃, T₄).

NOTICE



Installation

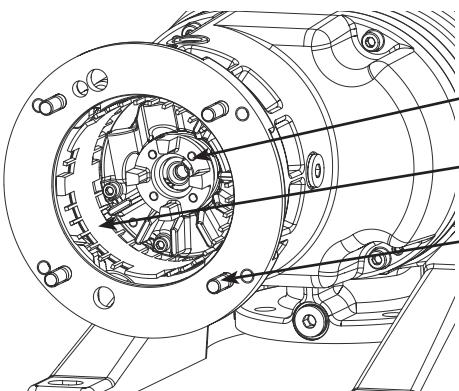


Fig. 3.6 Pump with preassembled coupling half

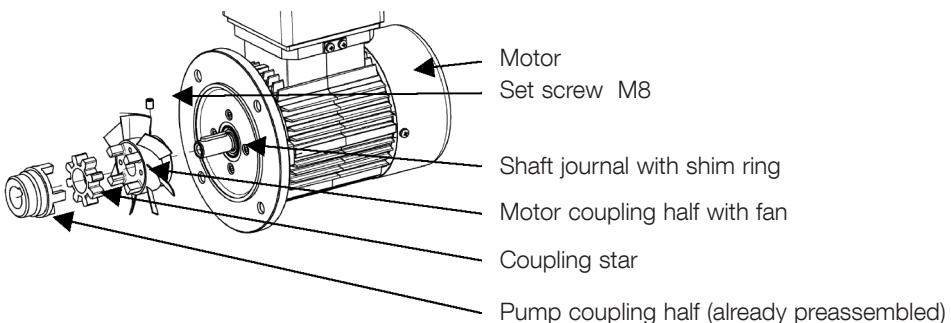


Fig. 3.7 Mounting the coupling half at the motor

3.5.2 Fitting the Coupling

The RUVAC WA is supplied by Leybold with the coupling (Fig. 3.6) preassembled on the pump's shaft. The coupling half (Fig. 3.7) for the motor side and the coupling star are enclosed. Depending on the type of pump, a fan wheel has been attached with an adhesive to the coupling half on the motor side.

Vertically place the motor on a matching pin, the fan housing must not be used for supporting purposes.

Check the shaft journal and the shim ring for any damage.

Lightly grease shaft journal and the bore in the coupling half.

Warm the coupling half (to approximately 80 °C) and push, respectively press it on to the shaft journal.

The bores in the coupling are manufactured to tolerance class H7, the shaft journals of the motor to tolerance class j6 resp. k6.

The axial distance L1 (Fig. 3.8) to the flange surface (area M in Fig. 3.5) needs to be maintained according to the table.

WARNING



When not complying with this requirement there exists the likelihood of a mechanical contact and thus the creation of sparks between the coupling halves.

Affix the coupling half with the M8 set screw (4.7), torque 10 Nm.

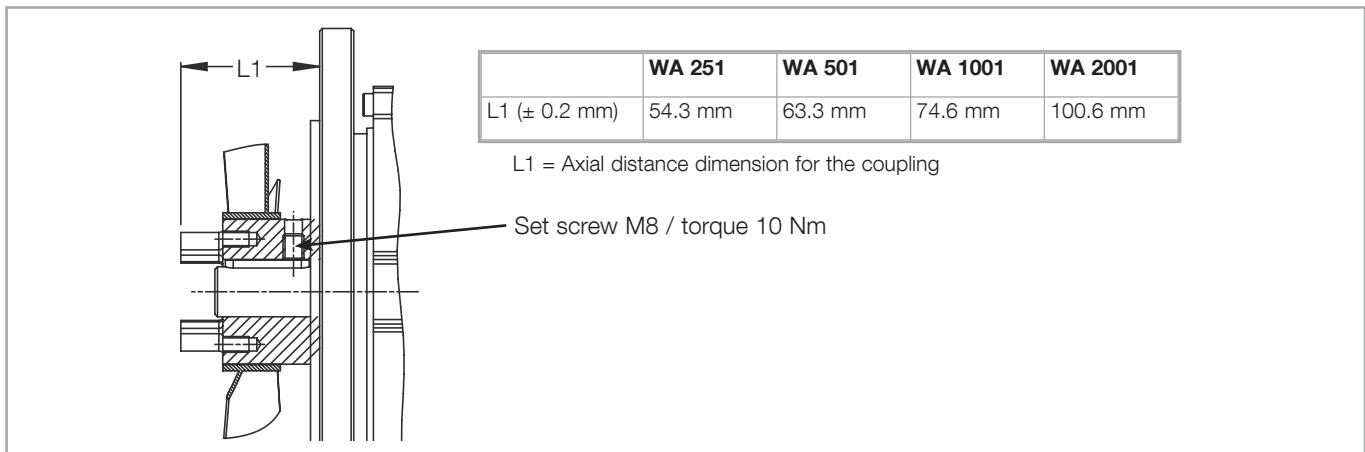


Fig. 3.8 Checking the axial distance dimension for the coupling

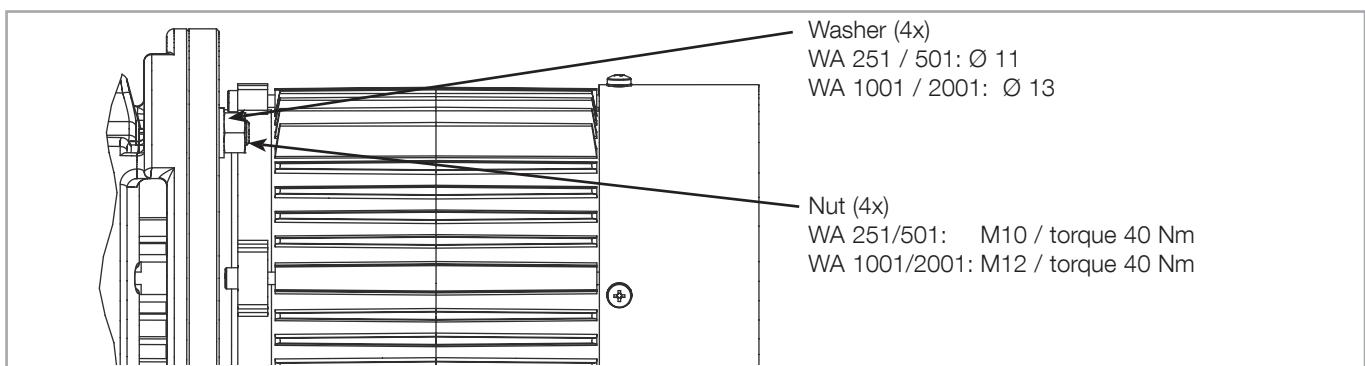


Fig. 3.9 View of the fitted motor

3.5.3 Fitting the Motor

At the pump's flange the respective studs have been preassembled, the washers and nuts which must be used have been enclosed with the pump.

Check to ensure that the touch protection (Fig. 3.6) has been correctly fitted in the pump's flange.

Insert the coupling star into the coupling half on the side of the pump.

Align the coupling halves and push the motor on making sure that the flange surfaces run in parallel.

Any tilt between motor axis and impeller axis can give rise to increased wear on the coupling star.

Fit washers and nuts, and tighten according to the torque levels given in Fig. 3.9.

3.5.4 Electrical Connection

Connect the motor according to Section 3.3 and to the information of the manufacturer of the motor.

Operation

4 Operation

4.1 Start-up

NOTICE



Check the pump motor's direction of rotation and the oil level in the oiler and the bearing chambers (see Section 3.1.1).

NOTICE



RUVAC WAU

The RUVAC WAU 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.

RUVAC WA

Do not switch on the RUVAC WA until 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

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

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

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

p_E = Switch-on pressure

Δp_{\max} = Maximum permissible pressure difference (see Technical Data)

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

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

Example - Pump combination:

RUVAC WA 501²⁾ / Sogevac SV 100

$$k_{\text{th}} = \frac{505 \text{ m}^3 \cdot \text{h}^{-1}}{100 \text{ m}^3 \cdot \text{h}^{-1}} \sim 5$$

$$p_E \sim \frac{80 \text{ mbar}}{5 - 1} \sim 20 \text{ mbar}$$

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.

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

NOTICE



Switching on Again at ATEX Operation

If the pump was shut down, then a cooldown phase of 30 minutes needs to be maintained before switching on again. This prevents the ignition temperature from being exceeded because of the internal temperature increase.

Since due to the better cooling of the pump housing it cools down faster than the impellers inside, and inadequate cooling down time can cause a mechanical contact between impellers and pump housing.

4.2 Operation

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

The screws of the flanges on the suction and the pressure side must not be loosened in the presence of a vacuum even if the pump is not running.

During operation of the RUVAC, check the oil level and the condition of the oil in the oil level glass and the oiler from time to time. Correct as required (see Sections 5.2 and 5.3). Normally, the oil LVO 100 is light brown. If it turns dark, this is a sign of early ageing due to excessively high temperatures.

For ATEX operation check the oil levels daily. Moreover, check the coupling daily as to any running noises.

CAUTION



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.

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.

CAUTION



Note the labels on the pump.

Operation

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.

The oil level for the shaft seal housing must always be visible in the oiler (see fig. 4.1). The correct oil level is 1/3 of the height of the oil when the pump is cold 1/2 of the height of the oiler when the pump is warm. Top up any oil as required.

In case of operation with mineral oil we recommend our vacuum pump oil LVO 100, in case of operation with synthetic oil we recommend LVO 210.

If it is required to top up oil very often, it is quite likely that a shaft seal is faulty.

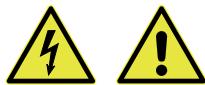
4.3 Shutdown and Storage

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. 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.

Zum Transportieren und Lagern der Pumpe beachten Sie bitte die Hinweise in Abschnitt 2.

4.4 Changing from Vertical to Horizontal Flow

The RUVAC WA/WAUs 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 sealing screws and drain out the oil from the side chambers (see fig. 4.2). Drain the oil from the oiler (see section 5.3).

Seal off of the bottom opening with the closure screw and a seal which is in perfect condition so that a vacuum-tight seal is attained again.

Unscrew the pump's feet, turn the pump by 90° and as shown in figure 1.5 (dimensional drawing) fit the feet for the changed direction of pumping action.

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.

Operation

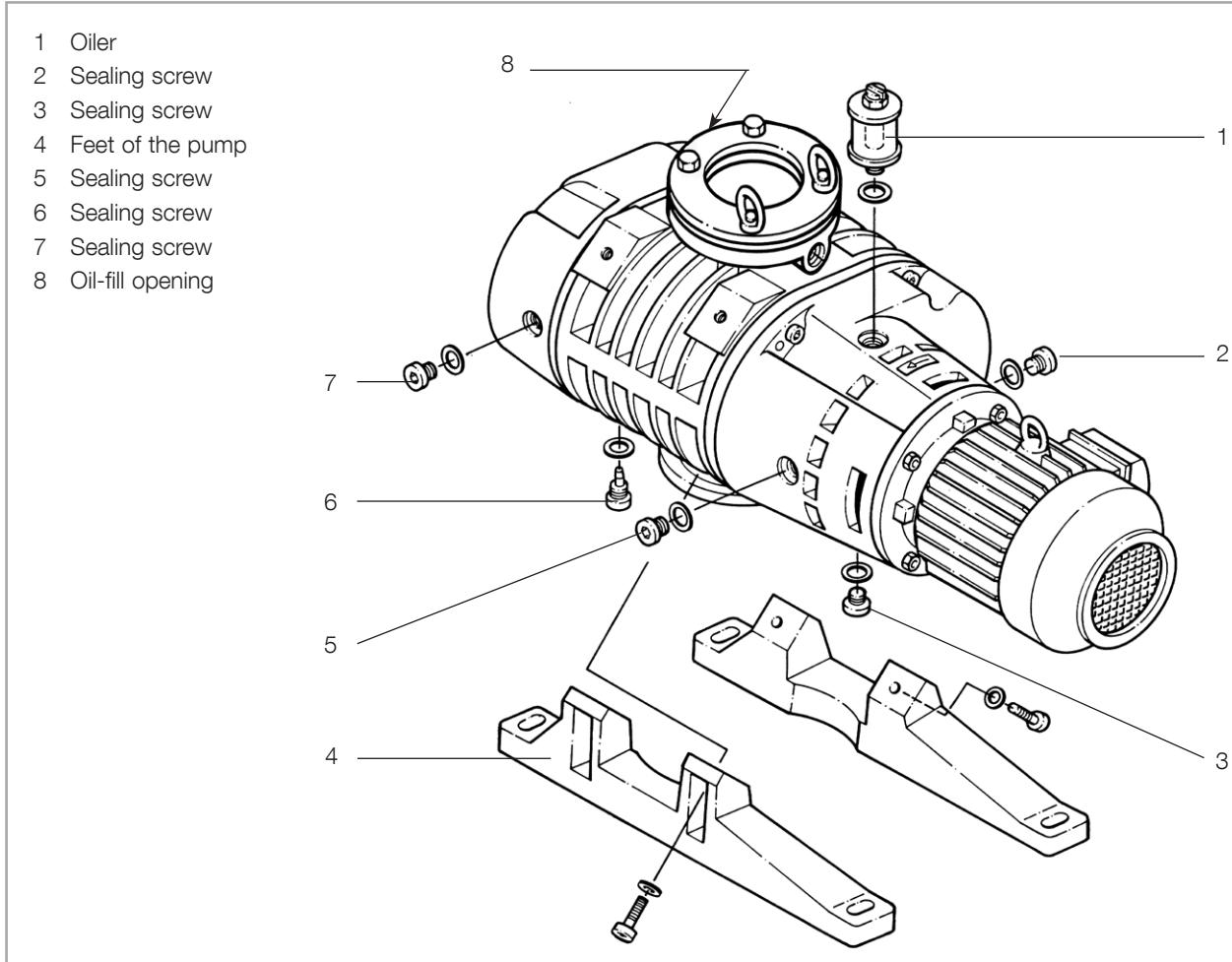


Fig. 4.1 Changing the direction of flow

Unscrew oiler and sealing screw. Screw in the oiler from the top using a perfect gasket and screw in the sealing screw from the side also using a perfect gasket.

Fill in the oil for the side chambers at and the oil for the shaft seal housing at the oiler.

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 WAU is designed to work with both vertical and horizontal flow of the pump.

Operation

- 1 Oil-drain screw for horizontal gas flow
- 2 Oil-drain screw for vertical gas flow
- 3 Oil level glass
- 4 Oil-fill screw

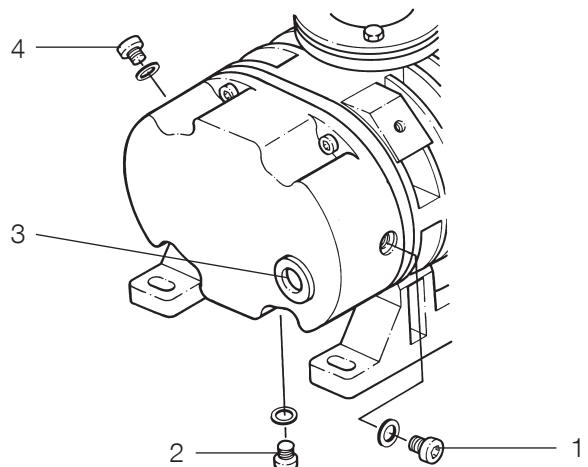


Fig. 4.2 Changing the oil

5 Maintenance

5.1 Safety Information

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

Notice safety information 0.1 to 0.3.

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.

WARNING



Maintenance

5.2 Exchanging the Oil / Bearing Chambers

CAUTION



Observe all safety information provided in sections 0.3 to 0.5.

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 (e.g. PFPE) must be used.

Very little oil is consumed by wear in the bearings and the gear under clean operating conditions. Under normal operating conditions, change the oil annually.

Change the oil more frequently when pumping corrosive vapours 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 for LVO 100 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 (see Section 1.5).

Unscrew the oil-drain screws and the oil-fill screw and drain the oil (see fig. 4.2).

Clean the sealing surface and firmly reinstall the oil-drain screw 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.

Only use Leybold oil.

NOTICE



Mineral oils and synthetic oils 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 3.3 - 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.

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 using a gasket which is in perfect condition. Wipe off any oil residues from the casing.

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.

5.3 Oil change / Shaft Seal Housing

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

The oil in the shaft seal housing should be changed every 3,000 operating hours.

Unscrew the oil-drain screw under the shaft seal housing, drain out the oil and screw in the oil-drain screw using a gasket which is in perfect condition (see fig. 4.1).

Only use Leybold oil.

Mineral oils and synthetic oils do not mix.

Fill in fresh oil at the oiler. The oil level for the shaft seal housing must be visible in the oiler.

Maximum level – when the pump is warm = 1/2 of the height of the oiler
 – when the pump is cold = 1/3 of the height of the oiler.

Wipe off any oil residues from the casing.

NOTICE

NOTICE

CAUTION

NOTICE

Maintenance

5.4 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.

5.5 Cleaning the Intake Screen

CAUTION



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

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.

5.6 Cleaning the Pumping Chamber

CAUTION



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

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

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

Then change the oil.

CAUTION



During cleaning, the impellers 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.

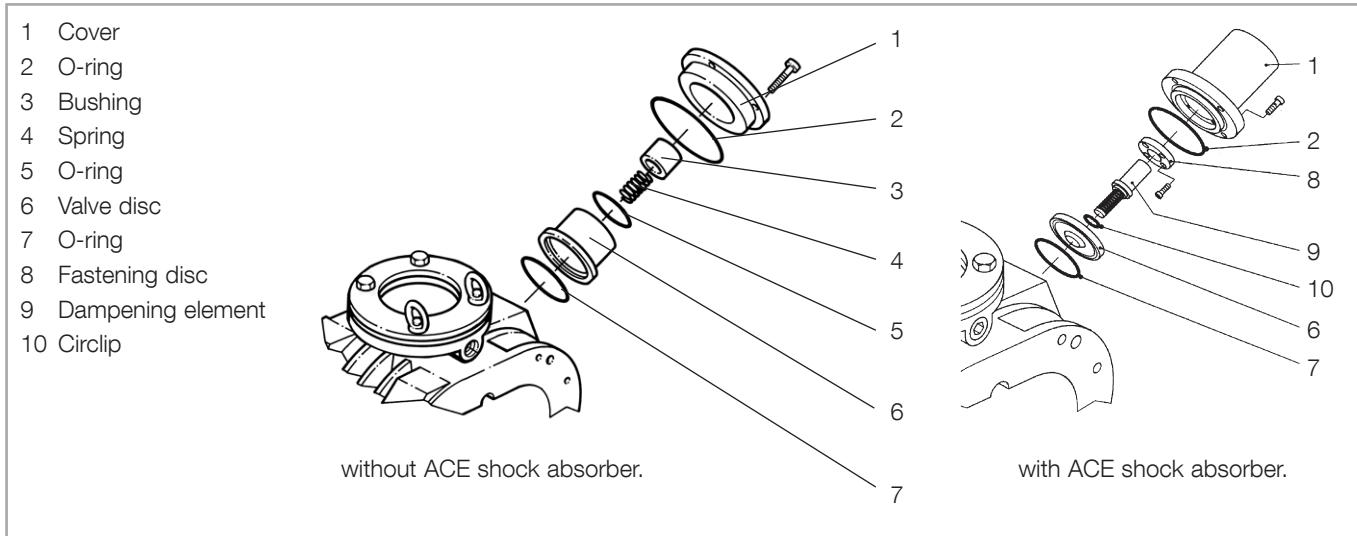


Fig. 5.1 Valve of the pressure balance line

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.

5.7 Cleaning the Valve of the Pressure Balance Line

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

Remove the screws and take off the cover with O-ring.

Take out the spring.

Remove the valve disk with O-rings.

If the bushing 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. Finally a leak test should be run.

NOTICE



CAUTION



Maintenance

5.8 Exchanging the Shaft Seals

CAUTION



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

The shaft feedthrough of the RUVAC WA/WAU 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 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.

CAUTION



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

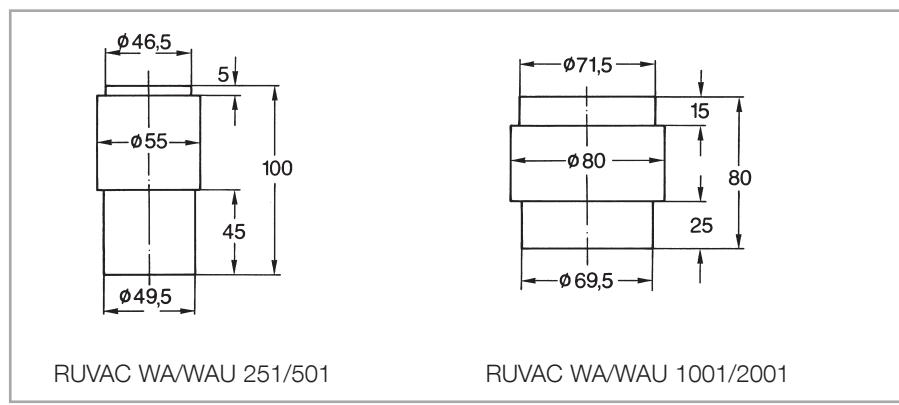


Fig. 5.2 Dimensions in mm for shaft seal drivers

5.8.1 Preparations

Unscrew sealing screw with the gasket, drain the oil out from the shaft seal housing and screw the sealing screw back in using a gasket which is in perfect condition.

Support the motor so that it can not drop.

Unscrew the nuts and remove the motor with the coupling piece.

Remove protection tube. Remove the coupling element.

Unscrew screw with the disc and pull off coupling piece using the puller.

Remove key.

Unscrew screws.

5.8.2 RUVAC WA/WAU 251, 501

(see figs. 5.2 and 5.3).

Pull the shaft seal housing out. Forcing threads are provided on the shaft seal housing for this purpose.

Take the O-ring out of the flange of the coupling.

Use a puller to pull the bushing off from the shaft.

Take the O-ring from the shaft.

Take the O-ring from the housing. Remove securing ring.

Pull out the shaft seal.

Take out snap ring and felt ring.

Take out shaft seal. Remove securing ring.

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

Fit securing ring.

Use shaft seal driver to drive the shaft seal down to the securing ring.

Fit felt ring and snap ring.

Use shaft seal driver to drive the shaft seal down. Here the depth must be defined by the tool.

Fit securing ring.

Now reassemble the parts in the reverse order as for disassembly.

Before starting the pump, fill in the required amount of oil at the oiler (see Section 3.1.1).

Maintenance

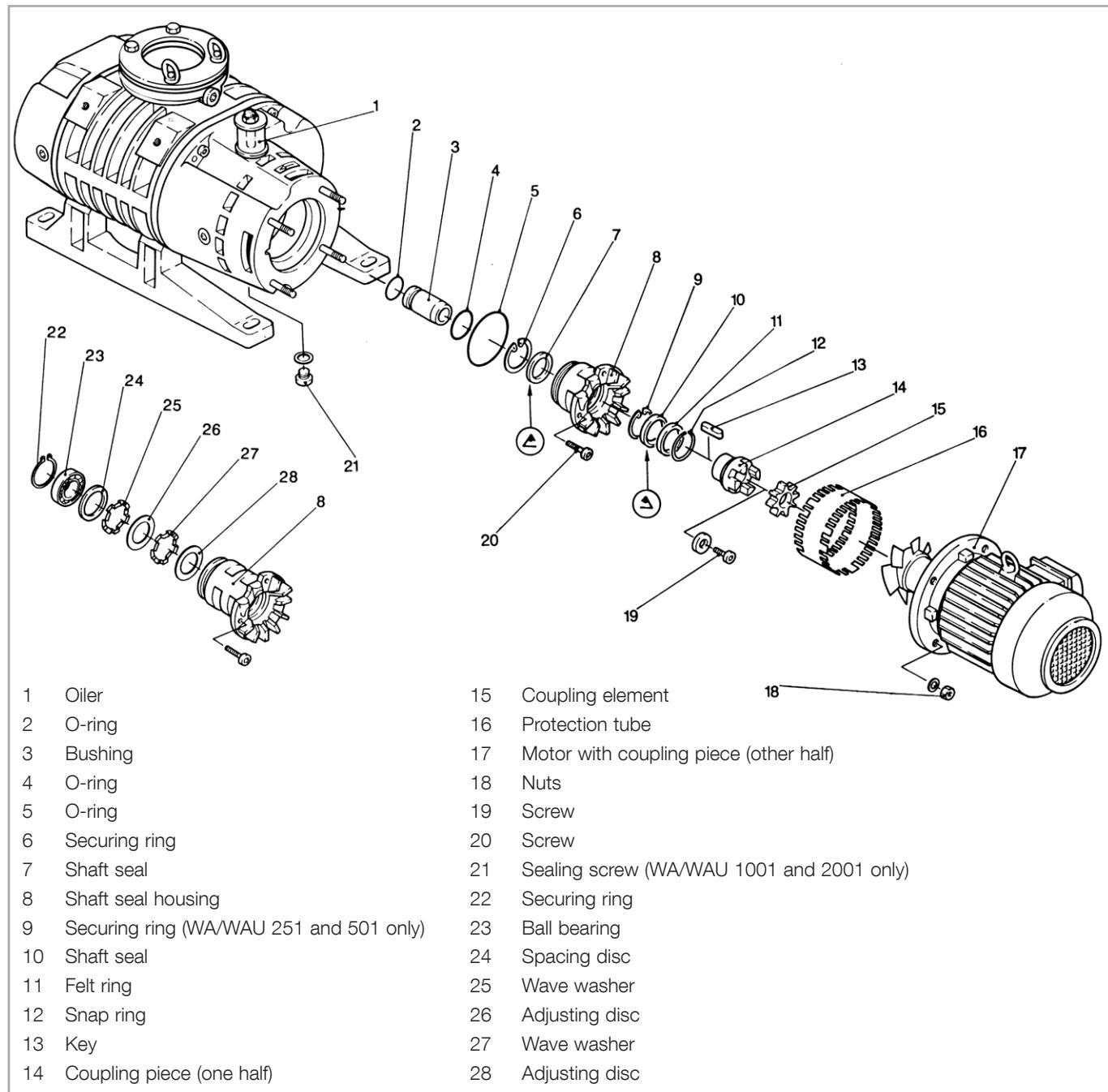


Fig. 5.3 Exchanging the shaft seal

5.8.3 RUVAC WA/WAU 1001, 2001

(see figs. 5.2 and 5.3).

Use a puller to pull out shaft seal housing and bushing together.

Remove O-rings.

Pull the bushing out of the housing.

Take the O-ring out of the housing. Remove securing ring.

Pull out shaft seal.

Pull out snap ring and felt ring.

Remove shaft seal.

Remove securing ring. Pull out bearing.

Take out spacing disc, wave washers as well as adjusting discs.

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

Place adjusting disc, wave washer, adjusting disc, wave washer and spacing disc into the housing.

Drive bearing back in.

Fit securing ring.

Use shaft seal driver to drive the shaft seal down to the stop

Fit felt ring and snap ring.

Use shaft seal driver to drive the shaft seal down.

Here the depth must be defined by the tool.

Fit securing ring.

Now reassemble the parts in the reverse order as for disassembly.

Before starting the pump, fill in the required amount of oil at the oiler (see section 3.1.1).

Maintenance

5.9 Exchanging the Bearings

For ATEX applications the pump **must** be completely refurbished every 15,000 operating hours or every three years, including replacement of the bearings and the coupling as well as inspecting the toothed wheels. For this please ask us for a quotation.

5.10 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 → Documents → 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.

5.11 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 the coupling for running noises		Daily for ATEX operation	
Check oil quality	Visual	Weekly	In the normal state LVO 100 is light brown LVO 210 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 100 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.
Clean motor fan and cooling fins		The cleaning intervals will depend on the ambient conditions.	See Section 5.4.
Check the oil level in the shaft sealing ring housing			The oil level in the oiler can be checked during operation (see Section 4.2)
Exchange the oil for the shaft sealing ring housing.		after 3000 operating hours	See Section 5.3
Replace bearings and coupling, completely refurbish the pump		For ATEX applications every 15,000 operating hours or every three years	See Section 5.9

Troubleshooting

6 Troubleshooting

Malfunction	Likely cause	Remedy	Repair
Pump does not start up.	Motor incorrectly connected. Pressure switch is defective. Oil is too thick. Motor defective. Pump has seized: defective impellers, bearings or toothed gears.	Connect motor correctly. Replace the pressure switch. Exchange the oil or warm up oil and pump. Replace the motor. Leybold Service.	3.4 3.4 5.2 3.5 -
Motor protection switch trips.	Motor defective. Motor protection switch incorrectly set. Pump seizes mechanically.	Replace the motor. Set motor protection correctly. Leybold Service.	3.5 3.3 -
Pumpe wird zu warm	Ambient temperature is too high or cooling air flow is obstructed. Pump is operating in the wrong pressure range. Pressure differences too high. Gas temperature is too high. Clearance between housing and rotors are too small due to - contamination - distortion of the pump Friction resistance is too high due to contaminated bearings and/or contaminated oil. Oil level is too high. Oil level is too low. Wrong oil filled in. Bearing is defective. Valve of the pressure balance line does not open.	Install the pump at a suitable place or ensure a sufficient flow of cooling air. Check the pressure levels within the system. Check the pressure levels within the system. Check system. Clean pumping chamber. Affix and connect the pump free of tension. Change oil. Drain oil down to the correct level. Top up oil to the correct level. Drain oil, fill in correct oil. Leybold Service. Clean the valve or have it repaired.	3.1 - - - 5.4 3.1/3.5 5.2 5.2 5.2 5.2 5.2 5.6
Power consumption of the motor is too high.	Like "Pump gets too hot". Incorrect mains voltage for the motor.	Like malfunction "Pump gets too hot". Connect the motor to the correct mains voltage	- 1.3/3.4
Pump is too loud.	Motor defective. Distances between housing and rotors is too small due to - contamination - distortion of the pump Bearing or gear damage. Pistons make contact with the housing. Rotor is running untrue. Oil slinger disc makes contact with the gear housing or the oil pipe. Oil pump is blocked or defective.	Replace the motor. Clean pumping chamber. Affix and connect the pump free of tensions. Leybold Service, shutdown pump immediately. Leybold Service, shutdown pump immediately. Leybold Service, shutdown pump immediately. Leybold Service.	3.5 5.4 3.1/3.5 - - - - -
		Leybold Service, shutdown pump immediately.	

Troubleshooting

Malfunction	Likely cause	Remedy	Repair
Pump is losing oil.	Oil leak is apparent: Oil drain plug is leaky. Oil level glasses leaky. Gear cover is leaky. Leaky coupling flange No oil leak is apparent: See malfunction „Oil in the pump chamber“.	Drain oil, firmly screw in a new oil drain plug with the gasket, fill in correct oil quantity Leybold Service. Replace the O-ring of the gear cover. Replace the O-ring of the coupling flange. See malfunction „Oil in the pump chamber“.	5.2 - - - -
The oil level in the oiler drops.	Visible oil leak: Outer shaft sealing ring is defective. No visible oil leak: Inner shaft sealing ring is defective.	Replace the shaft sealing rings. In case the oil loss is only slight, the pump may continue to operate providing it is ensured that a sufficient quantity of oil is topped up at the oiler. Replace the shaft sealing rings. Switch the pump off; the draining out oil enters into the bearing chambers causing there an unacceptably high oil a level.	5.8 - -
Oil gets too dark.	Oil has been used up. Pump gets too hot.	Exchange the oil. See malfunction „Pump gets too hot“; after remedy of the malfunction, exchange the oil.	5.2 -
Oil in the pump chamber.	Oil level is too high. Oil is ejected from the system. Pump is not standing horizontally. Pump has a gas leak towards the outside. Pump has an internal leak. Piston rings are defective.	Drain the oil down to the correct level. Check system. Place the pump correctly. 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. Leybold Service. Leybold Service.	5.2 - 3.1 5.2 -
Pump does not attain its pumping speed.	Intake screen is clogged. Motor incorrectly connected. Vacuum pump system has a gas leak. Valve of the pressure balance line does not close (WAU only).	Clean intake screen. Connect motor correctly. Detect leak and seal it. Clean the valve or have it repaired.	5.3 3.4 - 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 "5.10 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.

Notes

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: Roots Booster RUVAC

Type designation: WA ATEX, WAU ATEX

Part numbers:

11342, 11720, 11721, 11730, 11731, 11740, 11741, 11750, 11751,
11831, 11841, 11851, 12838, 167004, 167022, 167096, 11168,
11841A, 11851A, 167022A:

Marking:

II 3-/ G IIC TX (50Hz) X
12°C<Ta<40°C

Part numbers: 11217, 11254, 11322, 11724, 11734, 11744, 155008, 155011V:

Marking: II 3/3 G IIC TX (50Hz) X
12°C<Ta<40°C

The products complies to the following Directives:

ATEX equipment directive (2014/34/EU)

Electromagnetic Compatibility (2014/30/EU)

The following harmonized standards have been applied:

EN 13463-1:2009

Non-electrical equipment for use in potentially explosive atmospheres — Part 1: Basic method and 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

Documentation officer:

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documentation@leybold.com

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

EC Declaration of Incorporation

(Translation of original Declaration of Incorporation)

The manufacturer: Leybold GmbH
Bonner Strasse 498
D-50968 Köln
Germany

herewith declares that the following product:

Product designation: Roots Booster RUVAC
Type designation: WA ATEX, WAU ATEX
Part number: 11217, 11254, 11322, 11342, 11720, 11721, 11724, 11730, 11731, 11734, 11740, 11741, 11744, 11750, 11751, 11831, 11841, 11851, 12838, 155008, 167004, 167022, 167096, 11168, 11841A, 11851A, 155011V, 167022A

complies with the following fundamental requirements of the **Machinery Directive (2006/42/EC)**:
Annex I, Paragraph 1.1.2, 1.1.3, 1.1.5, 1.2.1, 1.2.3, 1.2.4.1, 1.2.4.2, 1.2.6, 1.3.1, 1.3.2, 1.3.3, 1.3.4, 1.3.7, 1.5.1, 1.5.2, 1.5.4, 1.5.5, 1.5.13, 1.6.1 and 1.7.1

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.

The following harmonised 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 Part1: General requirements

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

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

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

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documentation@leybold.com

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

Contamination Declaration

Tips for declaring correctly



Why such a declaration?

Our customers operate in a variety of sectors and with the related applications. Furthermore, there are a large number of applications and internal uses, which in some cases are not known to us. On the other hand, the handling of different materials and substances can result in hazards for our employees.

A. Description of the device

You will make it easier for us to repair or service the device if you enter all the information required here. In particular in the case of justified claims under warranty, we can then settle the matter quickly. The details are also necessary for our own process organisation: for procuring spare parts and storing relevant components.

B. Ambient conditions

For inexpensive repairs it is important to know what the pump has been used for so far. If for example – the best-case scenario for us – the pump has not been in operation, there is no need for cleaning. For severely soiled devices or mounted parts we can then ensure consistent component quality.

C. Description of process substances

1. Which substances has our pump been in contact with?
2. Are these substances harmless?
3. If the pump has been warmed or heated, other hazards are possible.

By telling us the applications you are aware of, you make it easier for us to select the protective measures (technical, organisational, personnel) in our service centers. We can then try to prevent any risk to the health of our staff or at least reduce it to a minimum.

D. Binding signature

You complete the declaration by adding your legally binding signature. You thus assure us that you are acting in good faith and will not expose our staff to any unnecessary risk.

Hazards due to chemicals

The relevant legislation has divided chemicals into various categories of risk, with different symbols for different hazardous substances (see above). For continued use it is important to indicate known hazards, so as to avert injury to repair staff when they open or later repair the pump. This can be crucial if you are going to send us a soiled pump. Airlines for instance refuse to transport devices in case of inflammable gases or adhesion of toxic substances.

Important note for transport

For the pump to be transported safely it must be free of residues, properly sealed and well packed. Reusable packaging materials are available for the purpose. This can be crucial if you are going to send us a soiled pump. Airlines for instance refuse to transport devices in case of inflammable gases or adhesion of toxic substances.

Important note for returns

In order to obtain an appraisal of the general conditions, please complete and add the cover note on the outside in fully legible form.

Other useful hints

Please note that your employees must in certain cases use personal protective equipment when they are packing or handling our pumps. A carry-over or dispersion of hazardous substances or oils is dangerous, and it is costly to remove them.

If your staff injure themselves when using or handling your pump, or if there is the possibility of a „near miss“ accident, please let us know. We too are concerned to reduce accidents and develop means of improvement.

Many thanks for your understanding.

Declaration of Contamination of Compressors, Vacuum Pumps and Components

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

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

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

Customer/Dep./Institute :	Reason for return: <input checked="" type="checkbox"/> applicable please mark																		
Address :	Repair:	<input type="checkbox"/> chargeable	<input type="checkbox"/> warranty																
Person to contact:	Exchange:	<input type="checkbox"/> chargeable	<input type="checkbox"/> warranty																
Phone : Fax:	<input type="checkbox"/> Exchange already arranged / received																		
End user:	Return only:	<input type="checkbox"/> rent	<input type="checkbox"/> loan																
	Calibration:	<input type="checkbox"/> DKD	<input type="checkbox"/> Factory-calibr.																
	<input type="checkbox"/> Quality test certificate DIN 55350-18-4.2.1																		
A. Description of the Leybold product:	Failure description:																		
Material description :																			
Catalog number:	Additional parts:																		
Serial number:	Application-Tool:																		
Type of oil (ForeVacuum-Pumps) :	Application- Process:																		
B. Condition of the equipment <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>No¹⁾</th> <th>Yes</th> <th>No</th> </tr> </thead> <tbody> <tr> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> </tr> </tbody> </table>				No ¹⁾	Yes	No	<input type="checkbox"/>												
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<input type="checkbox"/>	<input type="checkbox"/>																		
C. Description of processed substances (Please fill in absolutely) <p>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)</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td>X Tradename:</td> <td>Chemical name:</td> </tr> <tr> <td>a)</td> <td></td> </tr> <tr> <td>b)</td> <td></td> </tr> <tr> <td>c)</td> <td></td> </tr> <tr> <td>d)</td> <td></td> </tr> </table> <p>2. Are these substances harmful ?</p> <p>3. Dangerous decomposition products when heated ?</p> <p>If yes, which ? _____</p> <p>²⁾ Components contaminated by microbiological, explosive or radioactive products/substances will not be accepted without written evidence of decontamination.</p>				X Tradename:	Chemical name:	a)		b)		c)		d)							
X Tradename:	Chemical name:																		
a)																			
b)																			
c)																			
d)																			

D. Legally binding declaration

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

Name of authorized person (block letters) : _____



Date

signature of authorized person

firm stamp

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