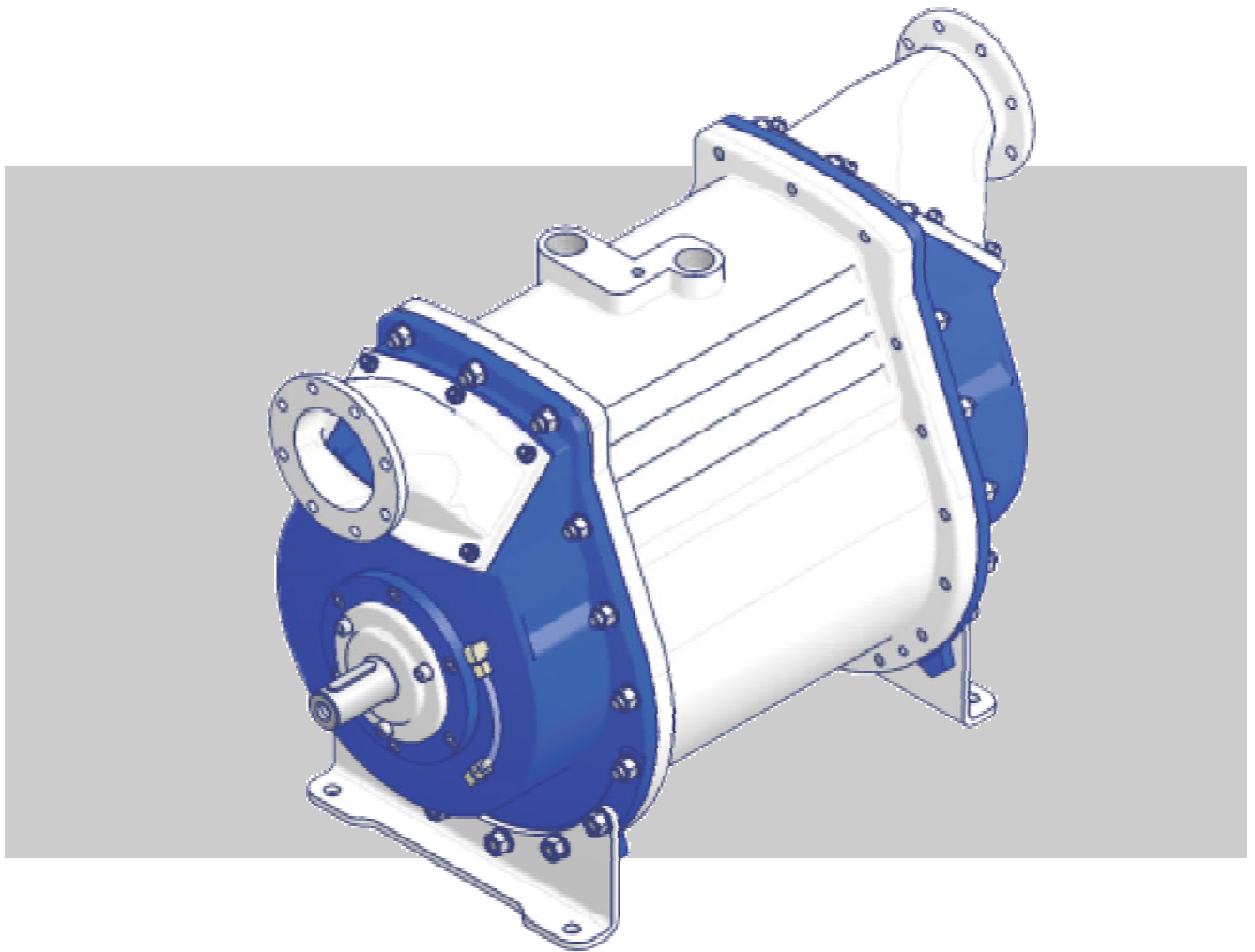


# Operating instructions

Liquid ring compressor vacuum pump  
VacuStar WR 2500 / WR 3100 / WR 4000



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**The operating instructions must be read by the machine operator prior to start-up!**

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# **1 General**

## **1.1 Information regarding the operating instructions**

These operating instructions provide important information on how to deal with the machine. Prerequisite for safe working is the observance of all specified safety notes and instructions.

In addition, the local accident preventions regulations valid at the machine's area of application and general safety regulations have to be complied with.

Carefully read the operating instructions before starting any work! They are part of the product, and must be kept near to the machine and accessible to the personnel at all times.

When passing the machine on to third parties, the operating instructions must also be handed over.

## General

### 1.2 Pictogram explanation

#### Warning-notes

Warning notes are characterised by pictograms in these operating instructions. The warnings are introduced by words which indicate the extent of the hazard.

It is absolutely essential to observe the notes and to proceed with caution in order to prevent accidents as well as bodily injuries and property damage.



#### **Danger!**

... points to an immediate dangerous situation, which will lead to death or serious injuries if it is not avoided.



#### **WARNING!**

... points to a potentially dangerous situation, which may lead to death or serious injuries if it is not avoided.



#### **ATTENTION!**

... points to a potentially dangerous situation, which may lead to minor or light injuries if it is not avoided.



#### **CAUTION!**

... points to a potentially dangerous situation, which may lead to property damage if it is not avoided.



#### **SAFETY NOTE ATEX!**

Only for machines with Ex-approval.  
This icon shows the special conditions that must be observed according to the approvals when conveying explosive gases and gas mixtures.

#### Hints and recommendations



#### **NOTE!**

... highlights useful hints and recommendations as well as information for an efficient and trouble-free operation.

### 1.3 Limitation of liability

All specifications and notes in these operating instructions were compiled with consideration to the valid standards and regulations, the state of the art as well as to our long-standing knowledge and experience.

The manufacturer is not liable for damages caused by:

- Non-observance of the operating instructions.
- Improper use
- Deployment of non-trained personnel
- Arbitrary modifications
- Technical changes
- Use of non-approved spare and wear parts.

The actual scope of supply may differ from the explanations and illustrations described in this manual in case of special designs, if additional order options are made use of, or due to latest technical changes.

Incidentally, the responsibilities agreed upon in the delivery contract, the general terms and conditions as well as the manufacturer's conditions of delivery and the statutory provisions valid at the time of contract conclusion shall apply.

#### Warranty

The manufacture guarantees the correct functioning of the applied process technology and the performance parameters identified.

The warranty period commences on the date the machine is delivered to the customer.

### 1.4 Copyright

Surrendering the operating instructions to third parties without written permission of the manufacturer is not permitted.



**NOTE!**

*Content details; texts; drawings; pictures and other illustrations are protected by copyright are subject to industrial property rights. Any improper use shall be liable to prosecution.*

Any type and form of duplication also of extracts as well as the exploitation and/or communication of the contents are not permitted without the manufacturer's written declaration of consent.

## General

### 1.5 Spare parts



#### **WARNING!**

#### **Risk of injury by incorrect spare parts!**

Incorrect or faulty replacement parts may cause damage, faulty function or total breakdown, as well as impairing safety.

Therefore:

- Use only the manufacturer's original spare parts.

Procure spare parts from authorised dealers or directly from the manufacturer. Refer to page 2 for address.

### 1.6 Warranty terms

Warranty terms see General Terms of Sale.

### 1.7 Customer service

Our customer service can be contacted for any technical advice.

Information about the responsible contact person can be retrieved by telephone, fax, email or via the Internet at any time, refer to manufacturer's address on page 2.



## 2 Safety

### 2.1 Intended use



**WARNING!**  
**Risk of explosion!**

The type WR 4000 will be available in explosion proof design from 2011.

Therefore:

- Do not use type WR 4000 in explosive atmosphere up to this date.

The machines of the VacuStar WR series are exclusively intended for the compression or extraction of filtered air or filtered water saturated air.

The VacuStar WR in the explosion proof design complies with Directive 94/9/EC (ATEX) and is suitable for conveying explosive gases and gas mixtures of explosion group IIB, temperature class T5 from explosive zone 1 and zone 2 areas

No explosive atmosphere is allowed in the area around the VacuStar WR. The vacuum pump may only be opened when it is stopped and when there is no explosive atmosphere around.

Labelling of the machine on the rating plate.



II 2G ck IIB T5 (i): Zone 1 and Zone 2 inside, no explosive atmosphere outside.

In temperature class T5, the gas temperature is limited to 95 °C, and must be secured.

### 2.2 Intended use



The following criteria in essence define the proper operation.:

- Technical Data in Table. 2
- Solids may not be sucked into VacuStar.



If explosive gases or gas mixtures are conveyed the following regulations have to be observed.

- 94/9/E6 (ATEX 95), Requirement on equipment
- 99/92/E6 (ATEX 137), Assembly, installation and operation of equipment

Only use machine for the intended use.

All specifications in these operating instructions have to be strictly complied with (technical data, ATEX regulations, etc.)



## Safety

Any warranty claims shall also be forfeited in such case. The operator alone shall be responsible for any damage arising from improper use.

### 2.2.1 Acceptance and monitoring

The VacuStar W itself is not subject to any acceptance and monitoring obligation.

### 2.3 Operator's responsibility

The machine is used for industrial purposes. The operator of the machine is therefore subject to the legal obligations concerning occupational safety.

The provisions valid at the place of installation as well as the safety and accident prevention regulations of the Institution for statutory accident insurance and prevention must be observed

The operator must in particular

- inform himself on the valid industrial safety regulations.
- determine the additional hazards that arise from the special working conditions at the machine's place of installation by means of a hazard assessment.
- implement the necessary rules of conduct for operation of the machine at the place of installation by means of user instructions.
- check at regular intervals during the machine's entire period of use whether the user instructions correspond to the current state of the body of rules and regulations
- adapt the operation instructions, if necessary to the new regulations, standards, and operating conditions.
- clearly regulate the responsibilities for installing, operating, maintaining and cleaning the device.
- ensure that all employees working on or with the machine have read and understood the operating instructions. In addition he must at regular intervals train the employees in how to deal with the machine and inform them about potential hazards.

In addition, it is the operator's responsibility to ensure that:

- the machine is always in a technically perfect condition.
- the machine is maintained in accordance with specified maintenance intervals.
- all safety equipment is regularly checked for completeness and correct functioning.

## 2.4 Operating personnel

### 2.4.1 Requirements

**WARNING!****Risk of injury in case of inadequate qualification!**

Improper handling can lead to considerable bodily injuries and property damage.

Therefore:

- Have any activities only carried out by the individuals designated for that purpose.

The operating instructions specify the following qualification requirements for the different fields of activity:

**■ Instructed persons**

have been instructed during instructions provided by the operator with regard to the work assigned to them and possible hazards arising from improper conduct.

**■ Specialised staff**

is due to its technical training, knowledge and experience as well as due to its knowledge of the pertinent regulations able to carry out the work assigned to it and to independently recognise potential hazards.

## 2.5 Protective Equipment

It is necessary to wear personal protective equipment when dealing with the machine so as to minimise health hazards

- Before carrying out any work, properly don the necessary protective equipment such as gloves, safety goggles, etc. and wear during work.

## Safety

### 2.6 Occupational safety and special dangers

The remaining risks, which result from hazard analysis, are specified in the following section.

Observe the safety notes listed here and the warning notes in the other chapters of these instructions to reduce health hazards and to avoid dangerous situations.

#### Danger pictograms on the device

The relevant dangerous spots on the machine are identified by these pictograms:



**DANGER!**  
**General danger pictogram!**

... denotes general dangerous situations for individuals. Non-observance of the safety instructions can result in severe injuries or death.



**DANGER!**  
**Explosion protection pictogram!**

...denotes regulations and information that need to be observed in potentially explosive areas. Explosion protection class, temperature ranges, etc. must be observed!



**DANGER!**  
**Danger of burns!**

... denotes the presence of a hot surface.

**Hazard notes and occupational safety.**

**For your own safety and that of the machine, the following information must be observed and complied with:**

**Improper operation****DANGER!****Danger due to improper operation!**

- Only use machine in a perfect technical condition. Malfunctions that are relevant for safety have to be promptly eliminated.
- Conversions of the machine are not permissible and can impair safety
- Never bridge any safety equipment or put it out of operation.
- Any work on the machine and/or on electrical equipment must be carried out by specialised staff.
- Repair and maintenance work may only be carried out when the machine is stationary. Secure the machine against restarting!
- the machine may not be under pressure or negative pressure while work is being carried out on it. Close shut-off vane on vehicle side and ventilate line between machine and shut-off vane or drain excess pressure manually from safety valve. Observe pressure gauge indication!
- the driver's protective equipment may only be removed when the machine is stationary and has to be correctly refitted after completion of work.
- Only dismantle accidental contact protection after machine and pressure pipe have cooled down.
- It is an environmental protection requirement that any liquids arising during maintenance work (e.g. cooling oil, cooling water, etc.) are collected and disposed of in an environmentally compatible manner.
- The machine may only be opened for maintenance and repair work by specialised staff if the machine is stationary and no potentially explosive atmosphere is present.



## Safety

### Moving components



#### **WARNING!**

##### **Risk of injury by moving components!**

Powered rotating components can cause the most serious injuries!

Therefore during operation:

- It is absolutely forbidden for persons to stay in the hazard area or in the immediate vicinity!
- Do not put safety devices and/or functions out of operation and do not render them inoperative or bypass them.
- Never reach into open outlets and inlets or into running equipment.

Before entering the hazard area:

- Switch off power supply and secure against restarting.
- Wait for standstill of lagging components.
- Wait for automatic dissipation and /or discharge of residual energies (compressed air).

### Compressed air



#### **WARNING!**

##### **Risk of injury due to compressed air!**

Pneumatic energies can cause the most serious injuries.

In case of damage to individual components, air can be discharged under high pressure and injure e.g. the eyes.

Therefore:

- Before starting any work, first depressurise pressurised components. Pay attention to accumulators. Accumulator pressure must also be completely relieved.
- Do not change pressure settings beyond the maximum values.

### Signposting



#### **WARNING!**

##### **Risk of injury by illegible signs or labels!**

Labels and signs can become dirty or unrecognisable in the course of time.

Therefore:

- Always keep safety, warning and operation instructions in a well legible condition.
- Immediately replace damaged or obliterated signs or labels.

**Improper transport****Danger!**  
**Danger by falling down or tilting of the machine!**

The weight of the machine may injure a person and cause serious bruising!

Therefore:

- Depending on the dead weight and size of the machine, use a pallet on which the machine can be moved by means of a fork lift.
- For lifting the machine, use suitable lifting gear (sling, etc.) that is designed for the weight of the machine. When putting the slings in position, take care to avoid putting stress on individual components.
- Only use eye bolts provided for that purpose. See page 19, Fig.1, Pos. 8

**Start-up, operation****WARNING!**  
**Risk of injury due to improper start-up and operation!**

Improper start-up and operation can lead to serious bodily injuries or property damage.

Therefore:

- Have all work during initial operation exclusively performed by the manufacturer's employees or by his authorized representatives or by trained personnel.
- Start-up and operation may only be performed by adequately qualified personnel that has been authorised and instructed by the operator.
- Before the start of any work, ensure that all covers and protective devices are correctly installed and function correctly.
- Never override any protective equipment during operation.
- Pay attention to tidiness and cleanliness in the working area! Loosely stacked or scattered components and tools are accident sources.

## Safety

### Electrical system



**DANGER!**  
**Mortal danger due to electric current!**

There is mortal danger in case of contact with live components.

Activated electrically driven components can start to move uncontrolled and cause severest injuries.

Therefore:

- Switch off the electric power supply before commencing any work and secure against restarting.
- Work on the electrical system, on individual electrical components and on the connections may only be carried out by electrical specialists.

### Maintenance and trouble shooting



**WARNING!**  
**Risk of injury due to improper maintenance and trouble shooting!**

Improper maintenance and trouble shooting can lead to serious bodily injuries or property damage.

Therefore:

- Maintenance work and trouble shooting work may only be carried out by sufficiently qualified and instructed personnel.
- Secure machine against restarting, switch off drives!
- Before starting any work, provide for sufficient space and freedom of movement during assembly.
- Pay attention to tidiness and cleanliness in the assembly area! Loosely stacked or scattered components and tools are accident sources.

If components must be replaced:

- Pay attention to correct installation of spare parts.
- Properly reassemble all fastening elements.
- Observe screw tightening torques.
- Before restarting, ensure that all covers and protective devices are correctly installed and function correctly.
- After completion of maintenance work and trouble shooting, check correct function and safety equipment.



### 3 Technical Data

General data	Unit	WR 2500	WR 3100	WR 4000
Nominal operating vacuum <sup>1)</sup>	[mbar]	400		
Weight without water filling	[kg]	175	192	298
Permissible misalignment in longitudinal direction	[°]	5		
Process liquid	–	Water or water –glycol mixture		

1) Consult CVS for suction temperature and /or altitudes outside the permissible working range.

Tab. 1: General data

Permissible working range	Unit	WR 2500	WR 3100	WR 4000
Input speed	[1/min]	800...1600		800...1300
Suction temperature <sup>1)</sup>	[°C]	–20...+60		
Outlet temperature	[°C]	max. 65		
Geodetic height <sup>1)</sup>	[m]	0...1000		
Maximum operating vacuum <sup>4)</sup>	[mbar]	130		
Maximum final overpressure with direct drive <sup>3)</sup>	[bar]	1.5	1.5	1.0
Maximum final overpressure with V-belt drive <sup>3)</sup>	[bar]	1.0	0.5	0.5

1) Consult CVS for suction temperature and /or altitudes outside the permissible working area.

2) Excess pressure = 0 bar, suction and ambient temperature = 20 °C

3) Vacuum = 0 mbar, suction and ambient temperature = 20 °C

4) Process water temperature = 20 °C

Tab. 2: Permissible working range

VacuStar performance characteristics	Unit	WR 2500	WR 3100	WR 4000
Vacuum operation, suction pressure: 400 mbar <sup>1), 3)</sup>				
Rotation speed	[1/min]	1600	1300	1300
Maximum intake volume flow <sup>1), 3), 4)</sup>	[m <sup>3</sup> /h]	2500	3100	4063
Coupling power <sup>1), 3), 4)</sup>	[kW]	73	88	117
Intake volume flow <sup>1), 3)</sup>	[m <sup>3</sup> /h]	2016	2427	3521
Coupling power <sup>1), 3)</sup>	[kW]	61	76	107,5
Pressure operation, excess pressure: 0,5 bar <sup>2), 3)</sup>				
Coupling power	[kW]	77	94	131,5
Intake volume flow	[m <sup>3</sup> /h]	1936	2469	3496
Sound pressure level at 7 m distance at 400 mbar / 0,5 bar excess pressure	[dB(A)]	70	72	73

1) Excess pressure = 0 bar, suction and ambient temperature = 20 °C

2) Vacuum = 0 mbar, suction and ambient temperature = 20 °C

3) Process water temperature = 20 °C

4) Water vapour saturated air 55 °C

Tab. 3: Performance characteristics



## Technical Data

VacuStar process water circulation unit	Unit	WR 2500	WR 3100	WR 4000
Maximum process water inlet temperature VacuStar	[°C]	55		
pH-value	–	5...8		
Process water circulating quantity in vacuum operation at 400 mbar <sup>1)</sup>	[l/min]	70...90	70...90	70...90

1) Excess pressure= 0 bar

2) Vacuum = 0 mbar

3) Based on a radiator of a specific cooling capacity  $P_{spez} = 3,5 \text{ kW} / (\text{m}^2 \cdot \text{°C})$

$$P_{spez} = P_{ab} / [(t_{\text{Wasser ein}} - t_{\text{Luft ein}}) \cdot A_{\text{Kühler}}]$$

4) Heat to be dissipated for operation with water vapour saturated air on request

Tab. 4: Process water circulation

## 4 Design and function

### 4.1 Design

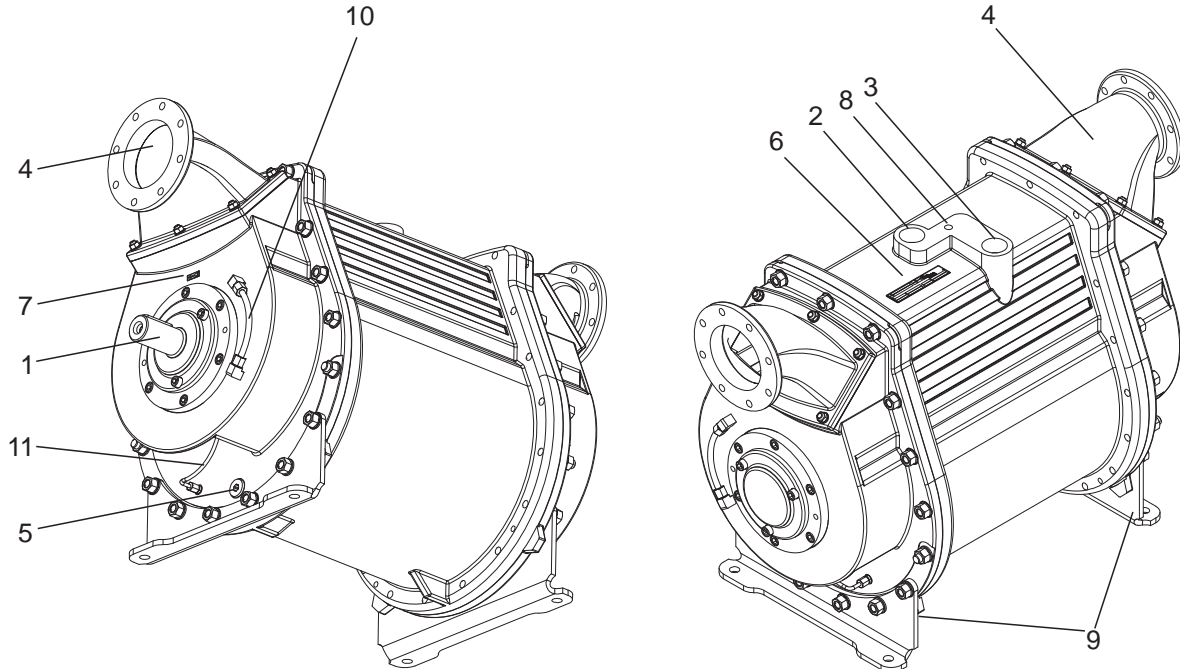


Fig. 1: Design

- |   |   |    |                                    |
|---|---|----|------------------------------------|
| 1 | Drive shaft   | 6  | Rating plate                       |
| 2 | Connection process water  | 7  | Rotation arrow                     |
| 3 | Connection cell ventilation   | 8  | Thread for eye bolt                |
| 4 | Connecting flange for pressure or suction connection (flange DIN 28459-125) | 9  | Fixing foot                        |
| 5 | Process water draining  | 10 | Process water indicator            |
|   |   | 11 | Liquid supply for slide ring seals |

### 4.2 Function

#### VacuStar

The liquid ring pump works according to the positive displacement principle. At a sufficiently high speed, a rotating liquid ring is formed in the casing. In conjunction with the impeller, cells form that are separated from each other and steadily grow (sucking) or shrink (compressing) with each revolution.

#### Lubrication

All moving parts are without contact. The lubrication of the machine is limited to the impeller bearing. The bearings are fitted with permanent grease.

#### Cooling

The unit is cooled by the process water and/or the liquid ring. A radiator in the process water circulation dissipates the heat to the environment.



## Design and function

### Shaft sealing

Maintenance-free slide ring seals separate the working space from the bearings and/or the atmosphere.

### Sense of rotation

See rotation arrow Page 19, Fig.1, Pos. 7.

### Process water circulation and cell ventilation

The air flowing through the VacuStar absorbs humidity from the liquid ring, and is 100% saturated when it exits. Only the water drops are separated in the reservoir. The steam component is dissipated to the environment.

### Process water consumption

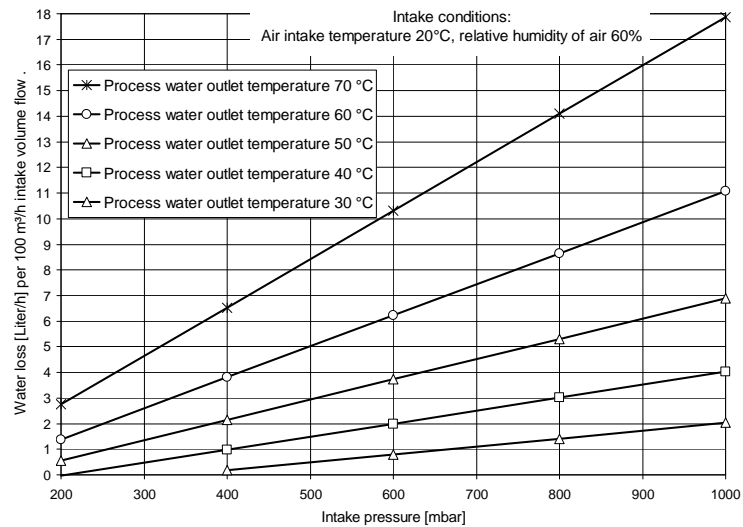


Fig. 2: Process water delivery

Fig. 2 shows the process water delivery from the reservoir for an intake volume flow of 100 m<sup>3</sup>/h as a function of intake pressure and process water temperature.

#### Typical process water loss calculation:

- Type: WR 3100
- Intake pressure: 400 mbar
- Intake volume flow according to Tab. 3: 2427 m<sup>3</sup>/h
- Process water outlet temperature: 50 °C
- Water loss for intake pressure and process water outlet temperature according to Fig. 2:  
2,1 l/h pro 100 m<sup>3</sup>/h intake air

$$\text{Process water loss} = 2,1 \cdot \frac{2427}{100} = 50,97 \text{ l/h}$$

In operation with cell ventilation, the process water loss is increased as a function of the additional air throughput.

### **4.3 Control and display elements**

Depending on the installation situation, different display elements such as pressure gauge, temperature gauge and negative pressure display are mounted.



## Transport and storage

# 5 Transport and storage

## 5.1 Safety notes for the transport

See chapter 2.6 "Occupational safety and special risks".

**Personal protective equipment** See chapter 2.5.

## 5.2 Transport

The machine fastened on a baseplate must be transported by means of a fork lift or suitable straps. The lifting gear must be designed for the weight of the machine.

### For future transports:

- Seal all open connections with protective caps (prevents penetration of dirt and water)
- Secure against vibrations
- Drain all process and operating media
- Securely fasten machine prior to transport (e.g. screw it onto a pallet)
- Transport and put down machine with a fork lift or secure with straps and lift with suitable lifting gear.

## 5.3 Storage

### Storage of packages

Store packages under the following conditions:

- Do not store outdoors.
- Store dry and dust free.
- Do not expose to aggressive media.
- Protect against solar irradiation.
- Avoid mechanical vibrations.
- Storage temperature: -10 bis +60 °C
- Relative humidity: max. 95%, non-condensing
- Check the general state of all parts and the packaging in regular intervals if storage is longer than 3 months. If necessary, brush up or recondition the preservation.

## 6 Start-up and operation

### 6.1 Safety

See chapter 2.6 "Occupational safety and special risks".

#### Personal protective equipment

See chapter 2.5.

### 6.2 Start-up

#### Prior to initial start-up

The following points must be checked prior to initial start-up or after lengthier standstill:

- Fill in process water (clean drinking water) up to the maximum mark on the reservoir. Ventilate process water circulation. Add antifreeze according to manufacturer's specifications.
- Fill process water directly at the VacuStar up to half full (half shaft; see Page 19, Fig. 1, Pos. 10 "Process water indicator"). The water stop valves in process water inlets avoid filling the VacuStar from the process water reservoir.
- Make sure that the line cross-sections of suction and pressure lines are free inside.



#### **Caution!** **Risk of damaging the slide ring seal!**

The slide ring seal will be damaged when the machine runs dry, without liquid.

Therefore:

- Before the unit is started, the liquid ring pump must always be approximately half full (shaft centre) with liquid (see page 19, Fig. 1, Pos. 10).

#### Start-up

Proceed as follows during start-up:

- Open shut-off devices (if available)
- Start the VacuStar drive.



## Start-up and operation

### Inspection during operation

The following inspections have to be carried out during operation:

- During operation the liquid level must not fall below the minimum mark in the reservoir.
- Always turn the four-way cock until it hits the stop. Intermediate positions are not permitted.
- Pay attention to abnormal noise and leaks during operation. Switch off the machine if necessary.
- Check function of installed cell ventilation; the machine must run smoothly when the suction valve is closed.

Checking the operating data:

- Rotation speed has to be between:  
800...1600 min<sup>-1</sup> (WR 2500 / WR 3000) resp.  
800 1300 min<sup>-1</sup> (WR 4000).
- The cooling water temperature (return flow to the cooler) must not exceed 60 °C.
- Check positive working pressure at the pressure gauge (permissible pressure refer to rating plate).
- Operating vacuum at the vacuum meter (permissible vacuum refer to rating plate).

### Inspections, if explosive gases and gas mixtures are conveyed



#### **DANGER!**

**There is mortal danger in case of insufficient inspections!**

The following points must be observed when explosive gases and gas mixtures are conveyed:

- Prior to every machine start and during operation:
  - Check process liquid levels (VacuStar and reservoir).
  - Check system for leaks.
- Listen for abnormal noise during the suction process. Switch off the machine if necessary.
- Check the machine at regular intervals (daily) for signs of overheating and exceptional deformations. If necessary, switch off the machine or do not put into operation.

## 6.3 Switching off

To switch off the VacuStar proceed as follows:

- Switch off the drive to the VacuStar.
- Close the shut-off valves (if available).
- Drain the safety tank. Tank may not be under pressure then.



## 6.4 Inspections to be performed at standstill

### Process water liquid level

The permanent water loss leads to a low process water level in the system.

Prior to every start check the fill level in the reservoir of the VacuStar.

### Process water – pH-value

- Depending on the conveyed medium, the steady water delivery can lead to an increased concentration of harmful substances and thus to a change in the pH-value.
- The permissible pH-value of 5 to 8 must be checked at regular intervals (e.g. using litmus papyri) according to the operation experience.

### Safety valve

**The safety valve is no regulating device!**

**The operational capability must be checked on start-up and later at weekly intervals.**

The safety valve must be secured against maladjustments. Blocking or manipulating the safety valve can have penal consequences if it gives rise to an accident. Any warranty claims shall also be forfeited in such case.

### Ventilating valve

A ventilating valve can be installed on the suction side to secure the installation. When the set vacuum is reached, the ventilating valve opens and admits atmospheric auxiliary air into the system.

### Non-return valve in the suction line of the VacuStar

The non-return valve is maintenance-free, but is subject to wear like all other moving parts. We recommend a visual control every 6 months. In this connection, the non-return valve must be dismantled, cleaned, freed of deposits and checked for freedom of motion.

Worn out non-return valves must be replaced!

### Inspection of cell ventilation

For a save operation the VacuStar must be equipped with cell ventilation (see Page 19, Fig 1, Pos. 3). If there is ventilation from the atmosphere the suction filter sucks fresh air. The filter must be cleaned weekly and replaced in case of visible damage.

### Inspection of the VacuStar drive

For this, observe the instructions of the installer regarding the drives in use (e.g. hydraulic motor, V-belt drive).



## Maintenance

# 7 Maintenance

## 7.1 Safety

See chapter 2.6 "Occupational safety and special risks".

### Personal protective equipment

See chapter 2.5.

### Environmental protection

Observe the following information with regard to environmental protection during maintenance:

- Remove emerging, used or excessive grease at all lubricating points that are manually supplied with lubricant and dispose of in accordance with valid local regulations.

## 7.2 Maintenance schedule

The following describes the maintenance work that is necessary for an optimum, trouble-free operation. Maintenance intervals must be observed.

If increased wear of individual components or functional groups is determined during regular inspections, the operator has to reduce the required maintenance intervals on the basis of the actual signs of wear. Changes compared to the normal operation (increased power consumption, temperatures, vibrations, noises, etc. or respond of monitoring systems) lead to the assumption that the functions are impaired. These then have to be subjected to an inspection by specialised staff.

In case of queries regarding the maintenance work and intervals contact the manufacturer (service-address → page 2).

For maintenance schedule refer to next page.

**Table Maintenance schedule**

Interval	Maintenance work	To be carried out by
Weekly	Check safety valve	Operator
	Check water stop valve	
	Clean cooling unit/ process water cooler	
	Clean VacuStar	
	Clean vacuum filter	
	Clean cell ventilating filter, replace if damaged	
	Check V-belt and V-belt tension, re-tension if necessary	
Monthly	Check fastening screws and tighten if necessary	Operator
Quarterly	Check cell ventilation valve	Specialised staff
Half-yearly	Check non-return valve of VacuStar	Specialised staff
5000 hrs or 3 years	Replace permanent grease filling	Specialised staff
15 000 hrs (10 000h)	Replace roller bearings	Specialised staff
15 000 hrs (10 000h)	Replace shaft sealing rings	Specialised staff
15 000 hrs (10 000h)	Replace slide ring seals	Specialised staff

*Values in ( ) apply for WR 4000*

### 7.3 Performance of maintenance work

#### Cleaning the VacuStar

Carrying out cleaning work:

1. Switch off system and secure against restarting.
2. Remove soiling appropriately. Observe the following:
  - Do not use aggressive cleaning agents.
  - After cleaning work, check that all previously opened covers and safety equipment are correctly installed and function correctly.

#### Clean process water radiator

Clean radiator cooling fins, cooling air must have a free-flow through the radiator cooling fins.

#### Process water circulation

Scale all parts carrying process water, if necessary.

#### Action after lengthy standstill

See chapter 6.4



## Maintenance

<b>Roller bearings lubrication</b>	Replace permanent grease filling of the roller bearings either after 5000 hrs or 3 years. Prior to a replacement, remove old grease and clean bearings. If grease is replaced (approx.30g per bearing) fill the bearing entirely, but the free space in the bearing housing only up to approx.30 – 40%.
<b>Replace roller bearings</b>	Replace roller bearings after 15 000 hrs (10 000 hrs for WR 4000) and fill them with grease accordingly if newly installed
<b>Shaft sealing rings</b>	After 15 000 hrs (10 000 hrs for WR 4000) replace the shaft sealing rings situated between bearings and slide seal rings as well as the shaft sealing ring situated between bearings and drive shaft together with the roller bearings.
<b>Slide ring sealings</b>	Replace slide ring seals together with the bearings after 15 000 hrs (10 000 hrs for WR 4000).
<b>Cleaning suction filter only for WR 2500 / WR 3100</b>	Clean the suction filter depending on accumulated dirt and specification in the maintenance schedule. To open the suction filter 1600 F (fine filter) and 1600 G (coarse filter), it is necessary to open a star handle, on the suction filter 1600 F-D (fine filter, pressure-resistant) and 1600 G-D (coarse filter, pressure-resistant), 5 star handles need to be opened to remove the lid. The hexagon nut on the stud bolt must be unscrewed to remove the filter cartridge.



**NOTE!**

*Pay attention during cleaning that no liquid, dirt or other objects get into the vacuum.*

**Cleaning procedure:**

- Rinse out filter casing with detergent
- Rinse out stainless steel fabric filter cartridge with detergent
- Carefully rinse out filter cartridge with fine filter cartridge.
- Check for damage after cleaning.
- Replace defective cartridge.
- Check round sealing ring on casing lid for damage.
- Damaged sealing rings must be replaced
- After cleaning, reassemble the filter in reverse order

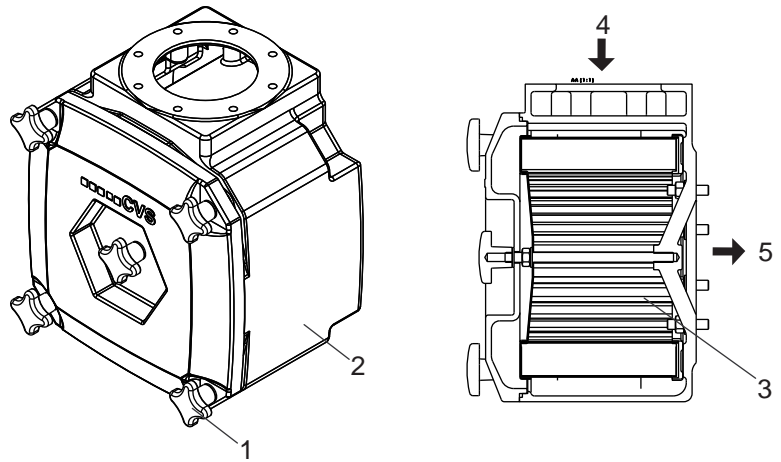


Fig. 3: Suction filter

- |   |                  |   |                         |
|---|------------------|---|-------------------------|
| 1 | Star handle      | 4 | Air inlet soiled air    |
| 2 | Casing           | 5 | Air outlet filtered air |
| 3 | Filter cartridge |   |                         |



## Malfunctions

# 8 Malfunctions

This chapter describes possible causes of malfunctions and trouble shooting tasks.

Reduce the maintenance intervals if similar malfunctions occur repeated due to above average intensive use so intervals correspond to the actual load.

If malfunctions cannot be corrected due to the notes, contact the manufacturer (→ p. 2)!

See chapter 2.6 "Occupational safety and special risks".

### Personal

- The trouble shooting work describes at this point can be carried out by the operator, unless otherwise indicated.
- Some work may only be carried out by specially trained specialised staff or exclusively by the manufacturer himself. This is specifically pointed out in the description of the individual malfunctions. Only electrical specialists may carry out work on the electrical system
- Components and parts may only be replaced by specialised staff.

### Personal protective equipment

See chapter 2.5.

### Environmental protection

See chapter 7.1.

### Conduct in case of malfunctions

The following basically applies:

1. Immediately press emergency-stop in case of malfunctions if there is an immediate danger for people or items.
2. Switch of all power supplies and secure against restarting.
3. Reform responsible on site.
4. Depending on the kind of malfunction authorised specialised staff must find it out and correct the cause.

## 8.1 Recommissioning after corrective action or trouble shooting

After corrective action or trouble shooting:

1. Reset emergency-stops.
2. Acknowledge error or malfunction message on the control.
3. Make sure that there is no person in the dangerous area.
4. Start according to the notes in chapter “Start-up”.

## 8.2 Malfunction table

Malfunction	Possible cause	Corrective action	Execution
<b>VacuStar delivery rate decreases</b>	Vacuum filter soiled	Clean vacuum filter	Operator
	Leaky suction line/ fitting	Look for leaky spots and eliminate leak	Specialised staff
	Speed too low	Correct speed	Operator
	Process water quantity too small	Fill process water up to max. filling rate	Operator
	Process water temperature too high	Check re- cooling or water quantity	Specialised staff
<b>Abnormal noise emission</b>	Machine is out of alignment	Align machine accurately	Specialised staff
	Bearing defective	Replace bearing (or have it replaced)	
	Speed incorrect	Maintain speed	Operator
	Pressure incorrect	Maintain nominal pressure	Operator
	Vacuum incorrect	Maintain nominal vacuum, check exhaust system and clean if necessary	Operator
	Process water temperature too high	Check re- cooling or water quantity	Specialised staff
	Process water highly contaminated with particles	Replace process water	Specialised staff
	Foreign matter in the machine	Remove foreign matter. Rinse the machine	Specialised staff
	Non-return valve rattles	Check non-return valve	Specialised staff
	Cell ventilating valve does not open	Check cell ventilating valve	Specialised staff
<b>Operating pressure or operating vacuum is not obtained</b>	Pressure gauge or vacuum meter indicate incorrectly	Replace pressure gauge or vacuum meter	Specialised staff
	V-belts are slipping	Check v-belt tension and re-tension if necessary	Operator
	Four-way cock in wrong position	Correctly adjust four-way cock	Operator
	Process water quantity too small	Fill in correct process water quantity	Operator



## Malfuncions

<b>Malfunction</b>	<b>Possible cause</b>	<b>Corrective action</b>	<b>Execution</b>
<b>Cooling water temperature exceeds 65°C</b>	Too little process water in the system	Fill process water	Operator
	Radiator soiled/ process water chambers in the VacuStar are silty	Clean radiator, clean cooling water chambers in the VacuStar	Operator
	Process water quantity too low	Fill in correct process water quantity	Operator
<b>Silt/ foreign matter in the machine</b>	Foreign matter has been sucked over into the machine	VacuStar / clean lines. Change process water.	Operator
<b>Power requirement too high</b>	Speed too high	Maintain speed range	Operator
	Final pressure too high	Maintain nominal pressure, check safety valve	Operator
	Pressure gauge indicates incorrectly	Replace pressure gauge	Operator
<b>Safety valve blows off</b>	Closed valves in the pressure line	Open valves	Operator
	Clogging in pressure system	Eliminate clogging	Operator
	Pressure gauge indicates incorrectly	Replace pressure gauge	Operator
<b>Ventilating valve responds</b>	Closed valves in the suction line	Open valves	Operator
	Suction filter clogged	Clean suction filter, if necessary replace filter cartridge	Operator
	Vacuum meter indicates incorrectly	Replace vacuum meter	Specialised staff
<b>Water escapes from the drain borehole</b>	Slide ring seal is damaged	Replace seal	Specialised staff



## 9 Spare parts

Find the spare and wear parts, which are necessary for normal repair in the table below.

### Spare and wear parts WR 2500 / WR 3100

Part	Quantity	Article number
Bearing grease	400 g	530 010-00
Roller bearings	2	411 126-01
Slide ring seal	2	461 315-00
Shaft sealing ring AS 55x72x8	1	461 105-00
Shaft sealing ring AS 80x100x10	2	461 161-00
Filter cartridge for suction filter 1600 F	1	432 020-00
Filter cartridge for suction filter 1600 G	1	432 021-00

### Spare and wear parts WR 4000

Part	Quantity	Article number
Bearing grease	400 g	530 010-00
Roller bearings	2	411 133-00
Slide ring seal	2	461 319-00
Shaft sealing ring AS 65x90x10	1	461 133-00
Shaft sealing ring AS 100x120x12	2	461 182-00

#### Customer service:

In case of queries regarding the product, spare part orders, repairs, replacement machines and dispatch of fitters, please contact our customer service: Tel.: +49 (0)7623 71741-31

## 10 Decommissioning and disposal

A VacuStar unit that is no longer usable should not be recycled as complete unit, but disassembled into individual components and recycled according to material types.

Non-recyclable materials have to be disposed of in an environmentally compatible manner.

- Prior to decommissioning and disposal of the machine, it must be completely separated from the surrounding units.
- The disassembly and disposal of the machine may only be carried out by specialised staff.
- If hazardous or poisonous material were conveyed, the machine must be decontaminated prior to disposal.
- The machine has to be disposed of in accordance with the respective country-specific regulations.



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