Operating instructions

according to ATEX 2014/34/EU

for the use in potentially explosive areas

VacuStar WR 2500 / WR 3100 / WR 4000

Dok-ID: 5152 / BA / EN

Release: Rev 01 / 21.11.2022

The operating instructions must be read by the VacuStar WR operator before start-up!

Translation of the original operating manual

Großmattstraße 14
79618 Rheinfelden / Germany

Phone: +49 (0)7623 71741-0
Customer service: +49 (0)7623 71741-0
E-Mail: info@cvs-eng.de
Internet: www.cvs-eng.de

Contents

Contents

1 General

1.1 Information on the operating instructions

These operating instructions provide important information about installation and start-up of the VacuStar WR. A precondition for safe operation is the observance of all specified safety and handling instructions.
Furthermore, all local accident prevention regulations and general safety regulations valid for the application area of the VacuStar WR must be observed.
Carefully read the operating instructions before starting any work! It is a product component and must be kept in direct proximity of the VacuStar WR, well accessible to the personnel at all times.
When passing the VacuStar WR on to third parties, the operating instructions must also be handed over.

1.2 Pictogram explanation

Warning notes

Warning notes are characterised by pictograms in these mounting instructions. The warning notes are marked by signal words expressing 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 immediately dangerous situation, which can lead to death or serious injuries if it is not avoided.

WARNING!
... points to an immediately dangerous situation, which can lead to death or serious injuries if it is not avoided.

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

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

Safety note ATEX!
... points to regulations, information and 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 manufacturer guarantees the correct functioning of the applied process technology and the performance parameters identified.

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

Wear parts

Wear parts are all components coming into immediate contact with the material to be processed (e.g. bearings, shaft sealing rings, etc.).

These components are excluded from the warranty and any

1.4 Copyright protection

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 and 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..

1.5 Spare parts

WARNING!
Risk of injury by incorrect spare parts!

WARNUNG!
Verletzungsgefahr durch falsche Ersatzteile!
Incorrect or defective spare parts can result in damage, malfunctions or total failure and also impair safety..
Therefore:
- Use only the manufacturer's original spare parts.
- Repairs to the VacuStar WR may only be carried out by CVS or personnel trained by CVS

Procure spare parts from authorised dealers or directly from the manufacturer. Refer to page 2 for address.
A list of spare and wear parts can be found in the enclosure..

1.6 Warranty conditions

The warranty conditions are included in the sales documentation as a separate document.

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, E-mail or via the Internet at any time, refer to manufacturer's address on page 2.

2 Safety

2.1 Intended use

The VacuStar WR is exclusively intended for the compression or extraction of filtered air or filtered gases of explosion groups IIA, IIB or IIC.

The VacuStar WR in the explosion proof design complies with Directive 2014/34/EU (ATEX) and is suitable for conveying explosive gases and gas mixtures of explosion group IIC and temperature class T4.

The VacuStar WR meets category 1G (Zone 0) inside.

Die VacuStar WR can be used in Zone 1 resp. Zone 2 (category 2G).

For safe use, the specifications in these operating instructions regarding ignition source monitoring in accordance with ISO 80079-37 must be observed.

The VacuStar WR may only be opened when it is stopped and when there is no explosive atmosphere around it.

Marking of the VacuStar WR on the rating plate:
II 1 G Ex h IIC T4 Ga (internal)
II 2 G Ex h IIC T4 Gb (external)

2.2 Proper operation

For safe use, safety-oriented evaluations in terms of ignition source monitoring according to ISO 80079-37 must be provided:

- Temperature sensor(s) at the gas outlet
- Level sensor (process water level)
- Flow sensor(s) (process water supply)

Measuring points and installation instructions see chapter 4.4

Only use the VacuStar WR as intended. All specifications in these installation and operating instructions have to be strictly complied with (technical data, ATEX regulations, etc.)
All types of claims due to damage arising from improper use are excluded. The operator alone shall be responsible for any damage arising from improper use.

2.3 Acceptance and monitoring

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

2.4 Operator's responsibility

The VacuStar WR is used for industrial purposes. The operator of the VacuStar WR 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 VacuStar WR's place of installation by means of a hazard assessment.
- implement the necessary rules of conduct for operation of the VacuStar WR at the place of installation by means of user instructions.
- check at regular intervals during the VacuStar WR'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 VacuStar WR.
- ensure that all employees working on or with the VacuStar WR have read and understood the operating instructions. In addition he must at regular intervals train the employees in how to deal with the VacuStar WR 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.

2.5 Requirements placed upon the specialised staff

WARNING!
Danger of injury due to insufficient qualification!
Improper handling can lead to significant personal injury and damage to property.
Therefore:
– Any activities may only be carried out by the persons designated for this purpose.

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

- **Specialists**
  are due to their technical training, knowledge and experience and their knowledge of the pertinent regulations able to carry out the work assigned to them and to independently recognize potential hazards.
- **Electrical specialists**
  are, due to their technical training, knowledge and experiences and their knowledge of the relevant standards and regulations, able to work on electrical systems and to independently recognize possible hazards.

2.6 Personal protective equipment

When handling the VacuStar WR, it is necessary to wear personal protective equipment, in order 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.

2.7 Occupational safety and special risks

The remaining risks that result from the 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.

Assembly of the VacuStar WR

The relevant dangerous spots on the VacuStar WR 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 VacuStar WR in a perfect technical condition. Malfunctions that are relevant for safety have to be promptly eliminated.
- Conversions of the VacuStar WR are not permissible and can impair safety.
- Never bridge any safety equipment or put it out of operation.
- Any work on the VacuStar WR and/or on electrical equipment must be carried out by specialised staff.
- Repair and maintenance work may only be carried out when the VacuStar WR is stationary. For this, the VacuStar WR must be secured against restarting!
- The VacuStar WR may not be under pressure or in a state of vacuum while work is being carried out on it.
  Close shut-off valve on the vehicle side and vent the pipe between VacuStar WR and shutoff valve or manually relieve excess pressure at safety valve. Observe pressure gauge!
- The drive's protective equipment may only be removed when the VacuStar WR is stationary and has to be correctly refitted after completion of work.
- Only dismantle accidental contact protection after VacuStar WR 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 specialized staff if the VacuStar WR is stationary and no potentially explosive atmosphere is present.

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 the 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 pictograms!
Labels and signs can become dirty or unrecognisable in the course of time.
Therefore:
- Always keep safety, warning and operating 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 VacuStar WR!
The weight of the VacuStar WR may injure a person and cause serious bruising!
Therefore:
- Depending on the dead weight and size of the VacuStar WR, use a pallet on which the VacuStar WR can be moved by means of a fork lift.
- For lifting the VacuStar WR, use suitable lifting gear (slings, etc.) that is designed for the weight of the VacuStar WR.
- 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 24, Fig. 3, 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 authorised 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.

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 troubleshooting

WARNING!
Risk of injury due to improper maintenance and troubleshooting!
Improper maintenance and troubleshooting can lead to serious bodily injuries or property damage.
Therefore:

- Maintenance work and troubleshooting work may only be carried out by sufficiently qualified and instructed personnel.
- Protect VacuStar W from being restarted, 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:

- Repairs to the VacuStar WR may only be carried out by CVS or personnel trained by CVS.
- 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 troubleshooting, check correct functioning of safety equipment.

2.9 Special conditions for the safe use of the VacuStar WR in potentially explosive atmospheres

Danger!

Danger from improper operation!

For the safe assembly, operation and maintenance of the VacuStar WR when used in potentially explosive areas, the following special conditions must be observed:

1. The liquid ring compressor vacuum pumps types VacuStar WR 2500, WR 3100 and WR 4000 are suitable for compressing or extracting filtered explosive gases and gas mixtures. A suitable air filter (filter fineness <0.5 mm) must therefore be installed in the intake line. The condition of this filter must be checked regularly. Solid substances must not be brought into the machine either via the process water or via the suction side
2. The liquid ring compressor vacuum pumps types VacuStar WR 2500, WR 3100 and WR 4000 may only be opened when they are at a standstill and in the absence of an explosive atmosphere and only in accordance with the manufacturer's specifications.
3. The liquid ring compressor vacuum pumps types VacuStar WR 2500, WR 3100 and WR 4000 are to be integrated into the potential equalization of the entire system using only the existing potential equalization connections (s. page 24, Fig. 3, Pos. 13).
4. The drive of the VacuStar WR is not part of this EU type examination certificate. It can be done by means of a belt drive or a suitable flexible coupling. The relevant suitability according to Directive 2014/34/EU must be proven.
5. The water level indicator on the VacuStar WR must be checked each time before it is switched on to ensure that it is at least 20 mm below the axle height.

6. Safety-related monitoring measures and safety devices are required for safe operation. These are described in more detail in the operating instructions or in these assembly instructions. The evaluation of the electrical equipment / sensors must be carried out via a safety-related PLC, which safely shuts down the system or safely prevents it from being switched on. The specified ignition protection system types are specified according to EN ISO 80079-37:2016. Before the first intended use, the program must be validated according to the manufacturer's specifications and protected against unauthorized changes. (see 5153-MA Mounting instructions "VacuStar WR 2500 / WR 3100 / WR 4000".

In particular, the following measures are prescribed :

- Temperature monitoring at the gas outlet using suitable temperature sensors (2x "b1" or 1x "b2"). The switch-off temperature must be set to a maximum of 75°C. The distance to the pressure port of the pump must not exceed 1 m.
- Flow monitoring of the process water circuit using suitable flow sensors (2x "b1" or 1x "b2"). The switch-off value must be set to a minimum of 10 l/min.
- Level monitoring of the water level in the pump using a suitable level switch (1x "b1"). The switch-on value must be set to a minimum level of 20 mm below the axle height.

Various safety devices must also be provided:

- Operating pressure manometer in the pressure line
- Overpressure safety valve in the pressure line (set to maximum operating pressure)
- Underpressure vacuum gauge in the suction line
- Suction-side cell ventilation valve (set to 350...550 mbar)

7. The VacuStar WR have a connection for cell ventilation. A cell ventilation device must be installed by the vehicle manufacturer and dimensioned in such a way that the machine can be operated without damage when the suction-side slide is closed.
8. A non-return valve must be installed immediately before the suction flange to prevent the air or process water from flowing back into the suction line.
9. A water stop valve must be installed to prevent pump overfilling.
10. A sufficiently dimensioned process water tank is required to ensure a continuous service water cycle.
11. The operating water temperature of maximum 55 °C must not be exceeded. Suitable measures for monitoring the temperature display and, if necessary, cooling must be provided for this.

12. The maximum intake temperature of 60 °C must not be exceeded.
13. The settings of the safety devices are to be carried out in accordance with the manufacturer's instructions and must not be changed. Appropriate locking measures must be taken.
14. The maximum operating pressures and flow rates are to be ensured using suitable explosion-proof suction and pressure lines (11.6 barg).
15. The effectiveness of the monitoring measures must be ensured before commissioning and through regular recurring checks (see chapter 7.3)
16. The VacuStar WR must not be painted in conventional way, as non-conductive layers can result in electrostatic discharges .

Therefore:

Set up and operate VacuStar WR in unpainted condition. The metallic housing parts are protected from normal environmental influences by a hard anodic coating

or

order the VacuStar WR ex works with an ATEX-compliant coating that meets the requirements of DIN EN ISO 80079-36 chapter 6.7.5 section d)

17. Only CVS original spare parts may be used for maintenance and repair of the VacuStar WR

3 Technical data

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

Tab. 1: General data

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

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

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

Technical data

VacuStar WR performance data vacuum operation	Unit	WR 2500	WR 3100	WR 4000
Suction pressure: 400 mbar [1), 2)]				
Speed	[1/min]	1600		1300
Maximum intake volume flow [1), 2), 3)]	[m^3/h]	2500	3100	4063
Coupling power [1), 2), 3)]	[kW]	73	88	117
Intake volume flow [1), 2)]	[m^3/h]	2016	2427	3521
Coupling power [1), 2)]	[kW]	61	76	107.5
Sound pressure level at 7 m distance at 400 mbar	[dB(A)]	70	72	73

1) *Excess pressure = 0 bar, suction and ambient temperature = 20 °C*
2) *Process water temperature = 20 °C*
3) *Water vapour saturated air = 55 °C*

Tab. 3: Performance data vacuum operation

VacuStar WR performance data pressure operation	Unit	WR 2500	WR 3100	WR 4000
Excess pressure: 0.5 bar [1), 2)]				
Coupling power	[kW]	77	94	131.5
Intake volume flow	[m^3/h]	1936	2469	3496
Sound pressure level at 7 m distance at 0.5 bar excess pressure	[dB(A)]	70	72	73

1) *Vacuum = 0 mbar, suction and ambient temperature = 20 °C*
2) *Process water temperature = 20 °C*

Tab. 4: Performance data pressure operation

VacuStar WR process water circulation	*Unit*	*WR 2500*	*WR 3100*	*WR 4000*
Maximum process water inlet temperature VacuStar WR	*[°C]*	*55*		
pH-value	*–*	*5…8*		
Process water circulating quantity in vacuum operation at 400 mbar [1)]	*[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 kW / (m² • °C)*
$P_{spez} = P_{ab} / [(t_{water} - t_{air\ in}) \bullet A_{radiator}]$
4) *Heat quantity to be dissipated, for operation with water vapour saturated air, on request*

Tab. 5: Process water circulation

3.1 Rating plate

The rating plate is located on the top of the VacuStar WR (s. Fig. 3, Pos. 6)

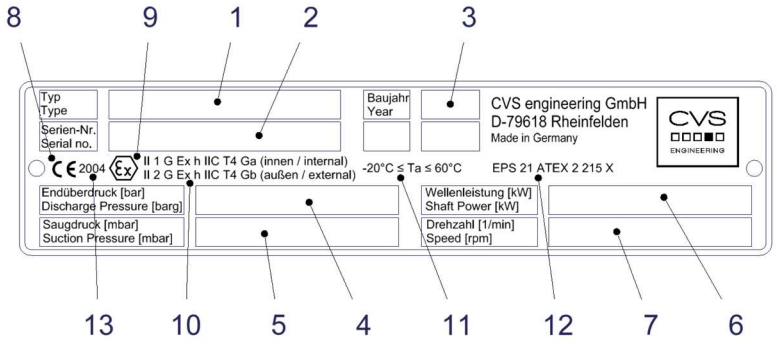

Fig. 1: Rating plate

1	pump type	8	CE marking
2	serial number	9	Ex marking
3	month of construction / year	10	Labeling according to 2014/24/EU
4	final overpressure	11	Ambient temperature range
5	suction pressure	12	Type examination certificate
6	shaft power in kW	13	Code of the notified body
7	speed in 1/min		

3.2 ATEX-Marking

II 1 G Ex h IIC T4 Ga (innen / internal)
II 2 G Ex h IIC T4 Gb (außen / external) -20°C ≤ Ta ≤ 60°C

Fig. 2: ATEX-Marking

	Label for Ex-products
II	Equipment group (II = non-mining)
1 G	Device category (1 G = use in Zone 0 explosive gas atmosphere)
2 G	Device category (2 G = use in zone 1 explosive gas atmosphere)
Ex	Explosion-proof device
h	Type of protection (h = non-electrical)
IIC	Gas group (IIC e.g. hydrogen)
T4	Temperature class (T4 = maximum surface temperature 135 °C)
Ga	Equipment protection level (Ga ≙ category 1 G)
Gb	Equipment protection level (Gb ≙ category 2 G)
internal	in the pump interior
external	outside of the pump
-20°C ≤ Ta ≤ 60°C	permissible ambient temperature range
EPS 21 ATEX 2 215 X	No. of the type examination certificate
X	Reference to special conditions

4 Design and function

4.1 Design

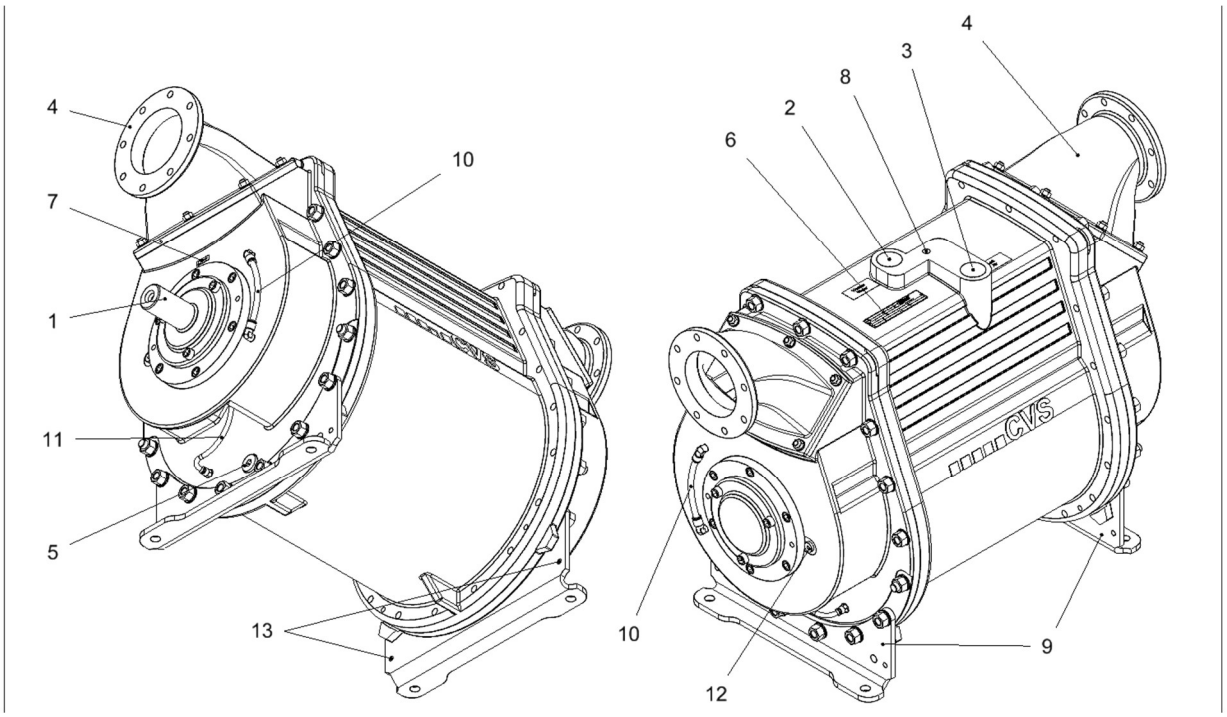

Fig. 3: Aufbau

1 Drive shaft
2 Connection process water
3 Cell ventilation connection
4 Connecting flange for pressure or suction connection (flange DIN 28459)
5 Process water draining
6 Rating plate
7 Rotation arrow
8 Thread for eye bolt
9 Fixing foot
10 Water level indicator / Attachment option for fill level sensor
11 Liquid supply for mechanical seal
12 Manuel fill level inspection
13 Potential equalization connection

4.2 Function

VacuStar WR

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.

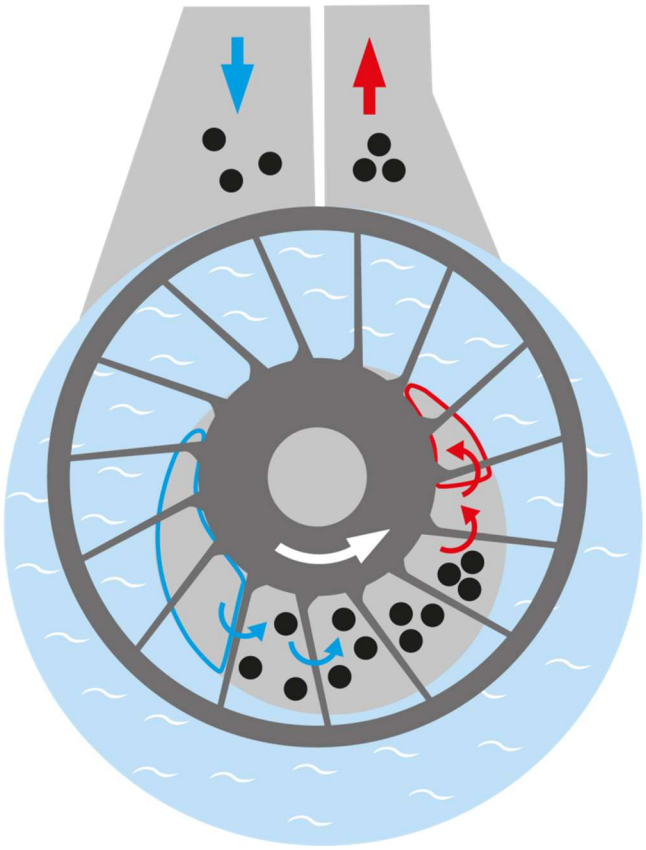

Fig. 4: Functional principle

Design and function

Lubrication

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

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.

Shaft sealing

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

Sense of rotation

See rotating arrow page 24, Fig. 3, Pos. 7

Process water circulation and cell ventilation

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

Process water consumption

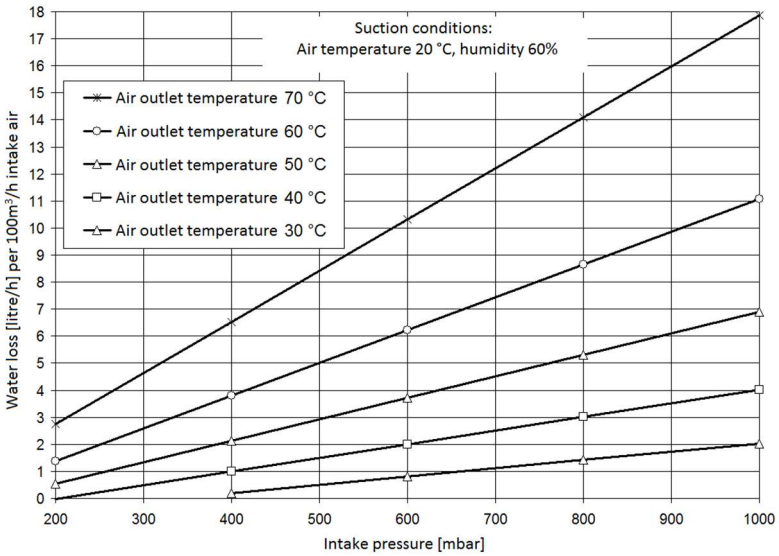

Fig. 5: Process water delivery

Fig. 5 shows the process water delivery from the reservoir for an intake volume flow of 100 m^3/h as a function of intake pressure and process water temperature.

Typical process water loss calculation:

Type : VacuStar WR 3100

Intake pressure: 400 mbar

Intake volume flow according to Tab. 3: 2427 m^3/h

Process water output temperature: 50 °C

Water loss for intake pressure and

process water outlet temperature according to Fig. 5:

2.1 l/h per 100 m^3/h intake air

Process water loss $= 2{,}1 \bullet \frac{2427}{100} = 50{,}97$ 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.

4.4 Ignition source monitoring

WARNING!
In order to protect the VacuStar WR for operation in potentially explosive areas, the safety devices must shut down the pump in the event of abnormal operation.

For safe operation of the VacuStar WR in potentially explosive areas, the system in which the VacuStar WR is installed must be equipped with the following safety-related sensors:

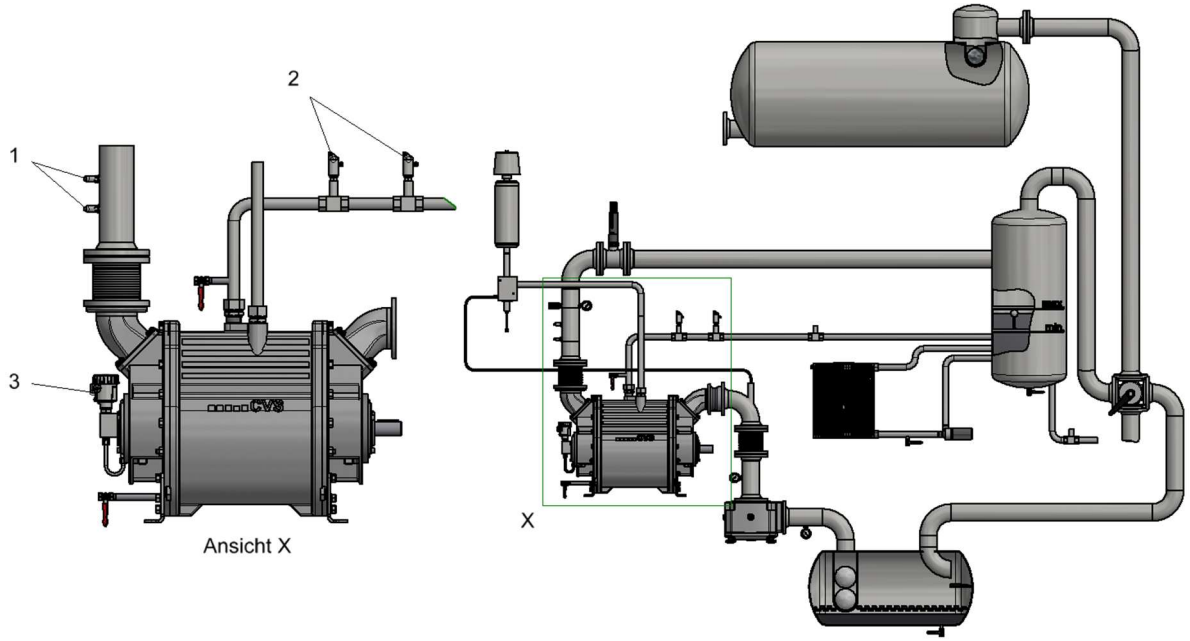

Fig. 6: Sensors for monitoring ignition sources

Pos.	Sensor	Measured value	Mounting location	Limit
1	Temperature sensor (redundant)	Gas exhaust temperature	Gas exhaust line, max. 1 m after pressure port	Shutdown of the pump drive at max. 75 °C
2	Flow sensor (redundant)	Process water volume flow	Process water supply line	Shutdown when falling below 10 l/min. Maximum delay after pump start 5 sec
3	Level sensor	Process water level in the VacuStar WR	Side cover of the VacuStar WR	Prevention of the pump starting when the minimum fill level is 20 mm below the axle height

Tab. 6: Sensors for ignition sources monitoring

5 Transport and storage

5.1 Safety notes for transport

see chapter 2.7 "Occupational safety and special risks".

5.2 Transport

The VacuStar WR fastened on a pallet must be transported by means of a fork lift or suitable lifting gear. The lifting gear must be designed for the weight of the VacuStar WR.

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 the VacuStar WR prior to transport (e.g. screw it onto a pallet)
- Transport and put down the VacuStar WR 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…+60 °C
- Relative humidity: max. 95%, non-condensing
- If storage lasts longer than 3 months, regularly check the general condition of all parts and of the packaging. If necessary, brush up or recondition the preservation.

6 Installation and assembly

6.1 Safety

see chapter 2.7 "Occupational safety and special risks".

6.2 Start-up

Works prior to initial start-up

The following points must be checked prior to initial start-up or after a lengthier standstill:
Fill in process water (clean tap water) up to the maximum mark on the reservoir. Bleed the circuit. Add antifreeze according to manufacturer's specifications.
Top up process water directly on the VacuStar WR up to the middle of the shaft (see page 24, Fig. 3, Pos. 10). The water stop valves in the process water supply line prevent the VacuStar WR from being filled up from the process water reservoir.
Do not overfill the VacuStar WR. Maximum water level 50 mm above axle height.
Check the pipes for continuity and residues.

ATTENTION!
Risk of damaging the mechanical seal!
The mechanical 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 24, Fig. 3, Pos. 10).

Start-up

Proceed as follows during start-up:
- Check process water level at the VacuStar WR
- Open shut-off devices (if installed).
- Start the VacuStar WR drive.
- Check the operating data.

Inspections during operation

The following inspections have to be carried out during operation:

- The liquid level in the reservoir must not be lower than the minimum mark during operation.
- Always turn the four-way valve until it hits the stop. Intermediate positions are not permitted
- Check whether pressure or vacuum builds up.
- Pay attention to abnormal noises and leaks during operation. If necessary, switch off VacuStar WR.
- Drain the condensate at the safety trap. Vessel may not be in a state of vacuum when condensate is drained.

Checking the operating data:

- The speed must be between:
  800...1600 min-1 (WR 2500 / WR 3000) or
  800...1300 min-1 (WR 4000).
- The cooling water outlet temperature (return flow to radiator) may be max. 60 °C.
- Check the positive working pressure at the pressure gauge (permissible pressure see Tab. 4, page 22).
- Check the operating vacuum at the vacuum meter (permissible vacuum see Tab. 3, page 22).

6.3 Switching off

To switch off the VacuStar WR, proceed as follows:

- Switch off drive for the VacuStar WR
- Close the shut-off valves (if installed)
- Drain the safety tank. Vessel may not be in a state of vacuum when condensate is drained.

6.4 Inspections to be performed at standstill

Inspections of 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 WR.

CAUTION!
Contamination of the level indicators!
After a long period of operation, the hoses of the fill level indicator can get dirty. This can make it difficult or even impossible to check the fill level before the pump.

– Clean or replace the hoses of the level indicator regularly (see chapter 7.3)

pH value of the process water

- 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 5 ... 8 must be checked (using litmus paper, for example) at regular intervals according to the operation experience.

Safety valve inspection

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 adjustment. Blocking or manipulation of the safety valve can have criminal consequences in the event of an accident. Any warranty claim will then expire.
A maximum pressure according to the type plate is permissible. According to the technical data, chapter 3, this can be lower depending on the type of drive.

Inspection of the 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.

Check of the non-return valve in the suction line of the VacuStar WR

The non-return valve is maintenance-free, but is subject to wear like all other moving parts. We recommend a visual inspection 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 WR must be equipped with a cell ventilation (see page 24, Fig. 3, Pos. 3). If there is a 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 WR drive

For this, observe the instructions of the installer regarding the drives in use (e.g. hydraulic motor, V-belt drive).
The customer's drive technology must meet the requirements of the ATEX Directive 2014/34/EU.

7 Maintenance

7.1 Safety during maintenance work

see chapter 2.7 "Occupational safety and special risks".

Personal protective equipment

The following must be worn during all maintenance work:

- Safety working clothing
- Protective gloves
- Safety shoes
- Safety goggles

DANGER!
Danger from improper maintenance!

– Only carry out all maintenance work when the drive is switched off and the VacuStar WR is depressurised and free of gas!
Pressure control on the pressure gauge operating pressure!

CAUTION!
Set up a warning sign "Attention maintenance work!"

CAUTION!
Servicing and maintenance work may only be carried out by CVS or personnel trained by CVS who are familiar with the technology and explosion protection and the possible dangers.

Environmental protection

Observe the following information on environmental protection during maintenance:
Remove escaping, used or excess grease from all lubrication points that are manually supplied with lubricant and dispose of them in accordance with the applicable 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 normal operation (increased power consumption, temperatures, vibrations, noises, etc. or response 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.

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 WR	
	Clean vacuum filter	
	Clean cell ventilating filter, replace if damaged	
	Check the level indicator hoses, clean or replace if necessary	
	Check V-belt tension and re-tension if necessary	
Monthly	Check fastening screws and tighten if necessary	Operator
	Check the effectiveness of the ignition source monitoring - Temperature sensor at the gas outlet - Level sensor (liquid level) - Flow switch (water supply)	Specialised staff
Quarterly	Check cell ventilation valve	Specialised staff
Half-yearly	Check non-return valve of VacuStar WR	Specialised staff
5000 hrs or 3 years	Replace permanent grease filling	Specialised staff
15.000 h (10.000h)	Replace roller bearings	Specialised staff
15.000 h (10.000h)	Replace shaft sealing rings	Specialised staff
15.000 h (10.000h)	Replace mechanical seal	Specialised staff

Values in ( ) apply to WR 4000

Tab. 7: Maintenance schedule

HINWEIS!

Greater contamination of the industrial water may be discharged by draining approx. 5 litres of industrial water at the drainage hose, item 5, during operation.

7.3 Performance of maintenance work

Check the effectiveness of the ignition source monitoring

WARNING!
The function of the installed ignition source monitoring must be checked regularly. Only air may be used as the conveying medium, never explosive gases.
The manufacturer's instructions for the sensors must be observed.
The tests must be documented in writing.

		Functional test	Line break test
1	Temperature	• Operate the pump in vacuum mode at the lowest possible pressure. • The pump drive must switch off when a maximum of 75 °C is reached. • The threshold value in the controller can be temporarily lowered for testing (e.g. to 40 °C)	• Operate the pump in vacuum mode. • Disconnect the line connection of the first temperature sensor. • The pump drive must switch off. • Repeat the process for the second temperature sensor
2	Flow	• Operate the pump in free flow or vacuum mode. • Gradually close the water supply at the ball valve of the water supply item 24. • The pump drive must switch off if the flow falls below 10 l/min.	• Operate the pump in free flow or vacuum mode. • Disconnect the line connection of the first flow sensor. • The pump drive must switch off. • Repeat the process for the second flow sensor
3	Level	• With the drive switched off, drain the water level in the VacuStar WR at the drainage connection item 2 to 20 mm below the axle height (check on the water level indicator Pos. 18) • It must not be possible to switch on the drive.	• Disconnect the line connection of the fill level sensor. • It must not be possible to switch on the drive.

Tab. 8: Test of the ignition source monitoring

Cleaning the VacuStar WR

Carrying out cleaning work:

1. Switch off system and secure against restarting.

WARNING!
Risk of injury due to compressed air!
Pneumatic energies can cause the most serious injuries.
In the 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.

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.

Clean/replace level indicator

Remove and clean or replace dirty level gauge hoses.

Action after lengthy standstill

see chapter 6.2

Lubrication of roller bearings

Replace permanent grease filling of the roller bearings either after 5,000 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%.

Replace roller bearings

Replace roller bearings after 15,000 hrs (10,000 h for WR 4000) and fill them with grease accordingly if newly installed.

Maintenance

Shaft sealing rings

After 15,000 hrs (10,000 h 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.

Mechanical seal

Replace mechanical seals together with the bearings after 15,000 hrs (10,000 h for WR 4000).

Cleaning suction filter

Clean the suction filter depending on accumulated dirt or the specification in the maintenance schedule.

Disassembly:
Release the cross-handle (1) to open the suction filter. 5 cross-handles (1) must be released in the pressure-right design. Remove the lid (2), hexagon nut (5), washer and filter element (4).

Cleaning:

- Wash the lid (1) and housing (3) with cleaning agents.
- Wash the coarse filter element (4) with cleaning agents and blow it out with compressed air from the inside outwards.
- Blow the fine filter element (4) out carefully with compressed air from the inside outwards.
- Do not tap out the filter element (4). Check for damage after cleaning. Replace damaged filter elements.

NOTE!

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

Assembly:

- Inserting the filter element (4)
- Install the washer and the hexagon nut (5). Press the filter element (4) well against the housing (3) and tighten the hexagon nut (5) manually. Turn the nut (5) by about 0.5 to 1 turns onwards with a wrench.
- Installing the round seal (6) at the lid (2)
- Insert the lid (2) into the housing (3). Tighten the cross-handle (1) or cross-handles (1) well manually.

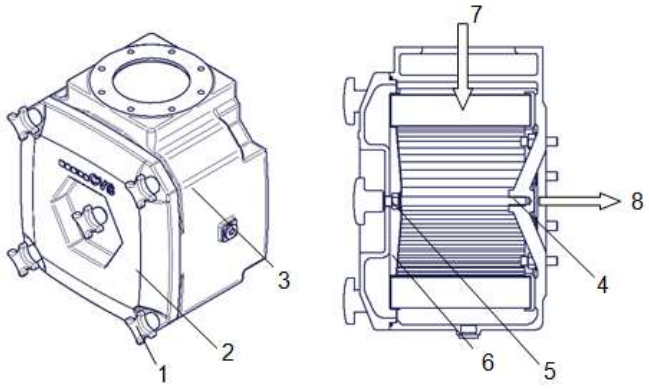

Fig. 7: Suction filter

1	Star handle	5	Hexagon nut
2	Lid	6	O-Ring
3	Housing	7	Air inlet (dirt side)
4	Filter element	8	Air exit (clean side)

8 Malfunctions

This chapter describes possible causes of malfunctions and troubleshooting tasks.
Reduce the maintenance intervals if similar malfunctions occur repeatedly due to above-average intensive use so intervals correspond to the actual load.
Contact the manufacturer in case of malfunctions that cannot be repaired with the aid of the following information (see page 2)!

8.1 Safety

See chapter 2.7 "Occupational safety and special risks".

Personnel

- The trouble shooting work described 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 2.6

Environmental protection

See chapter 7.1

Conduct in the case of malfunctions

The following basically applies:

1. Immediately trigger an emergency-stop in case of malfunctions constituting an immediate danger for individuals or material assets.
2. Switch of all power supplies and secure against restarting.
3. Inform person in charge at the place of installation.
4. Depending on the type of malfunction, have the cause determined and eliminated by responsible and authorised specialised personnel.

8.2 Recommissioning after corrective action

After corrective action or trouble shooting:

1. Reset emergency stops.
2. Acknowledge error message or malfunction at the control system.
3. Ensure that nobody is staying in the hazard area.
4. Start in accordance with the instructions in chapter „start-up".

8.3 Malfunction table

Malfunction:	Possible cause	Corrective action	Execution
Förderleistung der VacuStar WR lässt nach	Vacuum filter soiled	Clean vacuum filter	Operator
	Leaky suction line/ fittings	Look for leaky spots and eliminate leak	Specialised staff
	Speed too low	Correct speed	Operator
	Process water quantity too low	Top up process water to max. filling level	Operator
	Process water temperature too high	Check re-cooling or water quantity	Specialised staff
	Non-return valve does not fully open	Check non-return valve, if necessary clean or replace	Specialised staff
Abnormal noise emission	VacuStar WR is not sufficiently aligned	Align the VacuStar WR precisely.	Specialised staff
	Bearing defective	Replace bearing (or have it replaced)	
	Speed incorrect	Maintain speed range	Operator
	Pressure incorrect	Maintain nominal pressure	Operator
	Pressure 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 bodies in the VacuStar WR	Remove foreign matter. Flush VacuStar WR	Specialised staff
	Non-return valve rattles	Check non-return valve	Specialised staff
	Cell ventilating valve does not open	Check cell ventilating valve	Specialised staff

Malfunctions

Malfunction:	Possible cause	Corrective action	Execution
Operating pressure or operating vacuum is not obtained	Pressure gauge or vacuum gauge do not indicate correctly.	Replace pressure gauge or vacuum meter	Specialised staff
	V-belts are slipping	Check V-belt tension and re-tension if necessary	Operator
	Four way valve in wrong position	Correctly adjust four way valve	Operator
	Process water quantity too low	Fill in correct process water quantity	Operator
Cooling water temperature exceeds 65 °C	Too little process water in the system	Fill process water	Operator
	Radiator soiled/ process water chambers in the VacuStar WR are silty	Clean radiator, clean cooling water chambers inside the VacuStar WR	Operator
	Process water quantity too low	Fill in correct process water quantity	Operator
	Defective cell ventilation	Check cell ventilating, if necessary clean or replace	Specialised staff
Silt/ foreign matter in the VacuStar WR	Foreign matter has been sucked over into the VacuStar WR	VacuStar WR / clean lines. Change process water	Operator
Power requirement too high	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
Safety valve blows off	Closed valves in the pressure line	Open valves	Operator
	Clogging in pressure system	Eliminate clogging	Operator
	Pressure gauge indicates incorrectly	Replace pressure gauge	Operator
Ventilating valve responds	Closed valves in the suction line	Open valves	Operator
	Suction filter clogged	Clean suction filter, if necessary replace filter cartridge	Operator
	Pressure gauge indicates incorrectly	Replace vacuum meter	Specialised staff
Water escapes from the drain borehole	Mechanical seal is damaged.	Replace seal	Specialised staff

9 Spare parts

We recommend stocking a service package as well as a suction filter cartridge.
The service package comprises all wear parts that are required for a normal repair.

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

Service packages

Model	Service package	Filter cartridge
VacuStar WR 2500 / WR 3100	990 091-SP	432 020-00
VacuStar WR 4000	990 036-SP	432 021-00

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
Mechanical seal	2	461 323-00
Shaft sealing ring AS 55x72x8	1	461 105-00
Shaft sealing ring AS 80x100x10	2	461 161-00
Filter cartridge for suction filter1600 F	1	432 020-00
Filter cartridge for suction filter1600 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
Mechanical seal	2	461 319-00
Shaft sealing ring AS 65x90x10	1	461 133-00
Shaft sealing ring AS 100x120x12	2	461 182-00

10 Decommissioning and disposal

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

11 Index

Index