



RVC 2-18 CDplus

Part no. 100248



Rotational Vacuum
Concentrator

Operating Manual

Please retain for later use!

In case of inquiries, please state the following numbers:

Order number:

Serial number:

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Table of contents

1	General information	9
1.1	Importance of the operating manual	9
1.2	Intended use	9
1.3	Warranty and liability	9
1.4	Copyright	10
1.5	Explanation of symbols	10
1.6	Standards and regulations	10
1.7	Scope of supply	10
2	Layout and mode of operation	11
2.1	Layout of the RVC	11
2.1.1	Functional and operating elements	11
2.1.2	Name plate	12
2.2	Mode of operation	13
2.2.1	Principle of the rotational vacuum concentration	13
2.2.1.1	Advantages of the rotational vacuum concentration	14
2.2.1.2	Examples of use	15
3	Safety	16
3.1	Marking of the unit	16
3.2	Explanation of the symbols and notes	17
3.3	Responsibility of the operator	18
3.4	Operating personnel	18
3.5	Informal safety instructions	18
3.6	Safety instructions	19
3.6.1	Electrical safety	19
3.6.2	Mechanical safety	19
3.6.3	Fire prevention	20
3.6.4	Thermal safety	20
3.6.5	Chemical and biological safety	20
3.6.6	Safety instructions for evaporation	21
3.7	Safety devices	21
3.7.1	Lid lock device	21
3.7.2	System check	21
3.7.3	Power failure safety	21
3.7.4	Earth conductor check	21
3.8	Procedures in the event of hazards and accidents	22
3.9	Remaining hazards	22
4	Storage and transport	23
4.1	Storage conditions	23
4.2	Dimensions and weight	23
4.3	Packaging	23
4.4	Transport safety device	24
4.5	On-site transport	24

Table of contents

5	Set-up and connection	26
5.1	Installation site	26
5.2	Power supply	26
5.2.1	Connection	26
5.2.2	Customer-provided fuses.....	26
5.3	Aeration valve	27
5.4	Vacuum connections.....	27
5.5	Connection of a vacuum pump and/or a cooling trap	28
5.5.1	Withdrawal of the vapours by a vacuum pump.....	28
5.5.2	Condensation of the vapours in a cooling trap	29
5.6	Connection of an electromagnetic stop valve	30
6	Operation.....	31
6.1	Initial start-up	31
6.2	Switching the RVC on	31
6.3	Opening and closing the lid.....	31
6.4	Installation of rotors and accessories	32
6.4.1	Installation of angle rotors.....	32
6.4.2	Installation of swing-out rotors	33
6.4.3	Installation of accessories.....	33
6.4.3.1	Tubes.....	34
6.4.3.2	Rotor blocks.....	35
6.4.3.3	Buckets.....	35
6.5	CDplus control system.....	37
6.5.1	User interface	37
6.5.2	Mode	40
6.5.3	Main menu.....	42
6.5.3.1	Changing the set values for the manual mode	42
6.5.3.2	Process and equipment information	43
6.5.3.3	Options	44
6.6	Switching the RVC off	46
7	Malfunctions and error correction.....	47
7.1	General malfunctions	47
7.1.1	Error messages	47
7.1.2	Process messages	48
7.1.3	System messages	48
7.1.4	Emergency lid release	49
7.1.5	Small flange connections.....	51
7.2	Service contact	52

Table of contents

8	Maintenance and service.....	53
8.1	Maintenance	53
8.1.1	Rotational vacuum concentrator	53
8.1.2	Rotor chamber	54
8.1.3	Accessories	57
8.1.3.1	Aluminium accessories	58
8.1.4	Glass breakage	58
8.2	Disinfection of the rotor chamber and accessories.....	59
8.3	Autoclaving	59
8.4	Service	60
8.5	Return of defective parts.....	60
9	Disposal.....	62
9.1	Disposal of the RVC.....	62
9.2	Disposal of the packaging	62
10	Technical data.....	63
10.1	Ambient conditions	64
10.2	Technical documentation	64
11	Appendix	65
11.1	Rotor program.....	65
11.2	Overview of evaporation times.....	67
11.3	Brief operating instructions	69
11.4	EC declaration of conformity	71
11.5	Declaration of conformity – China RoHS 2.....	73
12	Glossary	75
13	Index	77

Table of contents

1 General information

1.1 Importance of the operating manual

A fundamental requirement for the safe and trouble-free operation of the unit is to be familiar with the fundamental safety instructions and all possible hazards.

The operating manual includes important information concerning the safe operation of the rotational vacuum concentrator (RVC).

This operating manual, and in particular the notes on safety and hazards, must be observed by all persons operating the unit.

In addition, the local rules and regulations for the prevention of accidents must be complied with.

1.2 Intended use

CHRIST rotational vacuum concentrators are solely intended for evaporation under rotation, e.g. for the following tasks:

- concentration of DNA/RNA, proteins etc.
- preparation of samples for HPLC/thin layer chromatography, gas chromatography, mass-spectrometry
- isolation and synthesis of organic substances
- high-throughput-screening (HTS)
- general in-lab evaporation.

Any other use beyond this area of application is regarded as improper use. Martin Christ Gefriertrocknungsanlagen GmbH cannot be held liable for any damage resulting from such improper use.

The intended use also includes:

- observation of all the notes and instructions included in the operating manual
- compliance with the inspection and maintenance instructions
- prohibition of any type of extensions to, or conversions of, the unit.

1.3 Warranty and liability

The warranty and liability are subject to our "General Terms and Conditions" that were distributed to the operator upon the conclusion of the contract.

Warranty and liability claims are excluded if they are due to one or several of the following reasons:

- improper use
- non-compliance with the safety instructions and hazard warnings in the operating manual
- improper installation, start-up, operation, and maintenance of the RVC.

1 General information

1.4 Copyright

The copyright concerning the operating manual remains with Martin Christ Gefriertrocknungsanlagen GmbH.

The operating manual is solely intended for the operator and their personnel. It includes instructions and information that may not be

- duplicated,
- distributed, or
- communicated in any other way neither in full nor in parts.

Non-compliance may be prosecuted under criminal law.

1.5 Explanation of symbols

In this operating manual, the specialist terms that are explained in the glossary (see chapter 12 - "Glossary") are marked by an arrow and printed in italics (e.g. → *safety pressure*).

1.6 Standards and regulations

EC-Declaration of conformity (see appendix)

1.7 Scope of supply

The scope of supply comprises:

- 1 hexagon socket key (size 2.5)
- 1 operating manual

Accessories and commissioning

According to your order, our order confirmation, and our delivery note.

2 Layout and mode of operation

2.1 Layout of the RVC

2.1.1 Functional and operating elements

- 1 Lid lock device
- 2 Lid
- 3 Rotor chamber
- 4 User interface (see chapter 6.5.1 - "User interface")
- 5 Rotor shaft
- 6 Mains power switch



Abb. 1: Total view of the Rotational Vacuum Concentrator

- 7 Name plate (see chapter 2.1.2 - "Name plate")
- 8 Equipotential bonding screw (see chapter 3.7.4 - "Earth conductor check")
- 9 Connection for mains cable, with a fuse drawer
- 10 Electrical connection of the stop valve
- 11 Vacuum connection
- 12 Connection for aeration



Fig. 1: Rear view of the Rotational Vacuum Concentrator

2 Layout and mode of operation

2.1.2 Name plate

- 1 Serial number
- 2 Type
- 3 Nominal voltage
- 4 Year of manufacture (month/year)
- 5 Part number
- 6 Rated current / apparent power



Fig. 2: Example of a name plate

2 Layout and mode of operation

2.2 Mode of operation

2.2.1 Principle of the rotational vacuum concentration

This method is used for the particularly quick and gentle evaporation, drying, purification, and concentration of samples.

Rotational vacuum concentration is an alternative to rotary evaporators that use high temperatures and operate nearly at normal pressure. Because of the vacuum, the sample boils at low temperatures, and water as well as organic solvents can be evaporated in a particularly gentle manner. Due to the fact that the sample rotates like in a centrifuge, the → *Boiling retardation* is prevented so efficiently that low pressure can be used. As a result, temperature-sensitive samples can be concentrated by evaporation without being damaged.

The solvent can be collected in a cooling trap and disposed of immediately if desired.

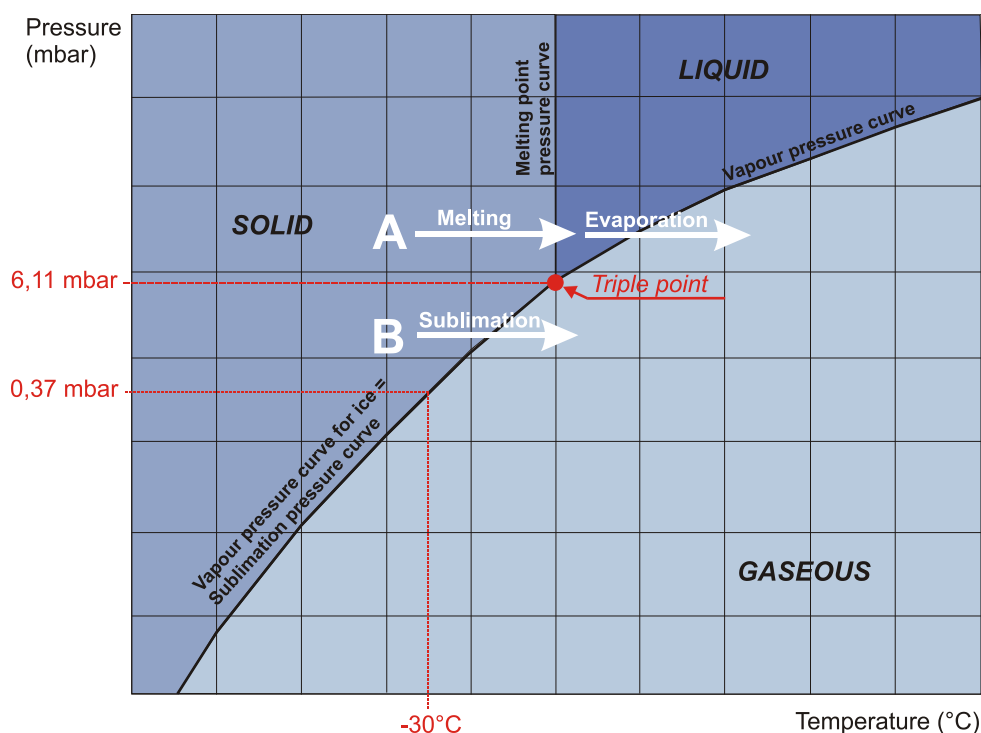


Fig. 2: Vapour pressure curve for ice and water

2 Layout and mode of operation

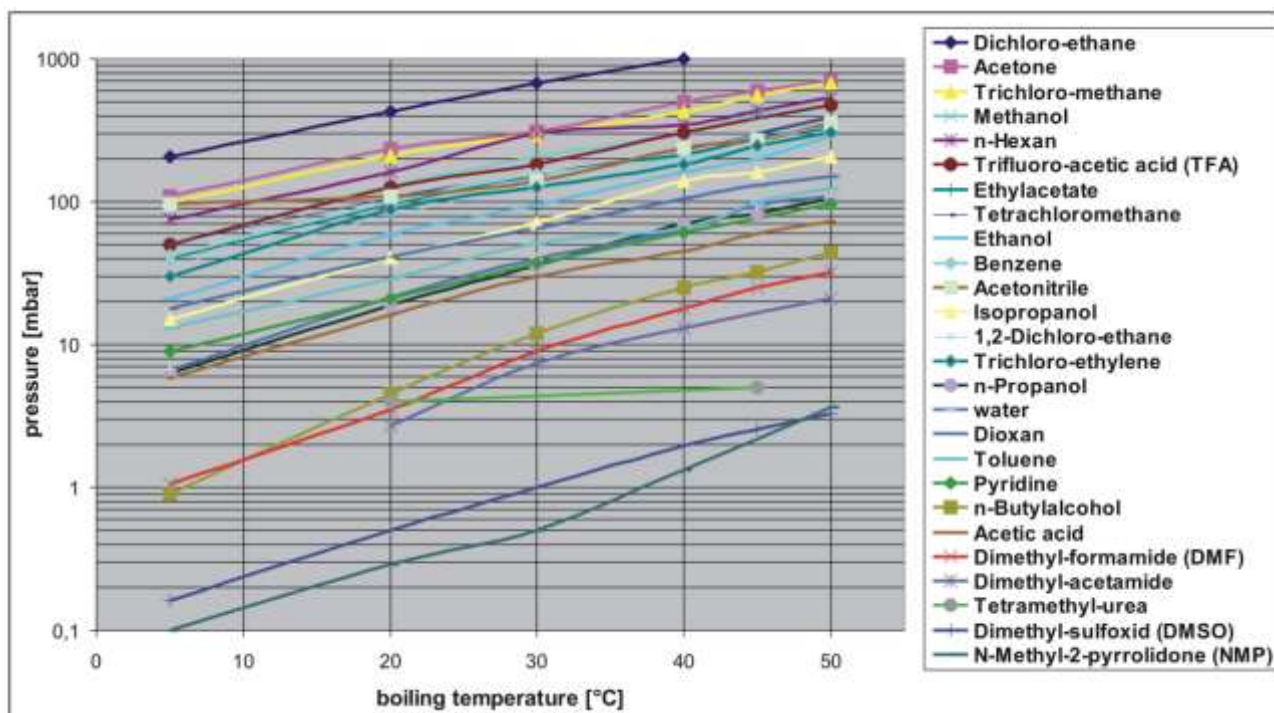


Fig. 3: Vapour pressure curves of commonly used organic solvents

2.2.1.1 Advantages of the rotational vacuum concentration

- No foaming of the samples, minimum loss.
- Several samples can be dried simultaneously.
- Concentration of the sample on the bottom of the vessel. This is particularly advantageous for small volumes or dilute solutions.
- Suitable for drying aqueous and solvent-containing samples.
- For volumes < 1 ml up to > 3 l.
- Reproducible drying processes thanks to controlled process parameters, such as the rotor chamber temperature (energy input for the evaporation) and vacuum (up to the automatic adjustment of the optimum operating pressure – depending on the pump systems).
- Easy and safe solvent recovery.

2 Layout and mode of operation

2.2.1.2 Examples of use














- DNA/RNA (mainly water, ethanol, or methanol as solvent)
- Oligo-synthesis, peptides
- PCR (polymer chain reaction)
- HPLC (mainly water/acetonitrile as solvent)
- Isolation/synthesis of organic substances
- Storage and handling of substances (substance libraries)
- Combinational chemistry
- High-throughput-screening (HTS)
- Analysis of food and environmental samples, toxicology
- Forensic applications
- General laboratory evaporation

3 Safety

3 Safety

3.1 Marking of the unit

The following symbols are used for CHRIST RVC:

	Dangerous voltage		On (Power)
	Hot surface		Off (Power)
	Caution! Risk of bruising		Name plate (see chapter 2.1.2 - "Name plate")
	Attention, consult the operating manual		CE mark in compliance with the directive 2006/42/EC
	Protective earth (ground)		Unplug the mains plug
	Earth (ground)		China RoHS 2 mark (only for China)
	Arrow indicating the direction of rotation		

i NOTE

Safety indications on the rotational vacuum concentrator must be kept readable at all times. If necessary, they must be replaced.

i NOTE

Not all of the symbols/labels are used for this RVC type.

3.2 Explanation of the symbols and notes

This operating manual uses the following names and symbols to indicate hazards:



This symbol stands for a **direct** hazard to the life and health of persons. Non-observance of these symbols **causes** serious health problems up to life-endangering injuries.



This symbol stands for a **direct** hazard to the life and health of persons due to electrical voltage. Non-observance of these symbols **causes** serious health problems up to life-endangering injuries.



This symbol stands for a **potential** hazard to the life and health of persons. Non-observance of these symbols **can** cause serious health problems up to life-endangering injuries.



This symbol indicates a potentially hazardous situation. Non-observance of these notes can cause minor injuries or damage to property.



This symbol indicates important information.

3 Safety

3.3 Responsibility of the operator

The operator is responsible for authorising only qualified personnel to work on the RVC (see chapter 3.4 - "Operating personnel").

The areas of responsibility of the personnel concerning the operation, maintenance, and care of the unit must be clearly defined.

The safety-conscious work of the personnel in compliance with the operating manual and the relevant EC and national health and safety regulations as well as with the accident prevention regulations must be checked at regular intervals (e.g. every month).

The RVC must be maintained regularly (see chapter 8 - "Maintenance and service").

3.4 Operating personnel

Persons operating the unit must

- be familiar with the fundamental regulations concerning workplace safety and accident prevention
- have read and understood this operating manual (and in particular the safety sections and warning notes) and confirmed this with their signature.

3.5 Informal safety instructions

This operating manual is part of the product.

- The operating manual must be kept at the location of use of the RVC. Ensure that it is accessible at all times.
- The operating manual must be handed over to any subsequent owner or operator of the RVC.
- Any changes made must be added to the operating manual.
- In addition to the operating manual, the general and local rules and regulations concerning the prevention of accidents and the protection of the environment must also be supplied.
- Safety and danger indications on the RVC must be kept readable at all times. If necessary, they must be replaced.

3.6 Safety instructions

3.6.1 Electrical safety

CHRIST rotational vacuum concentrators are units of safety class I. The RVCs are equipped with a three-wire power cord and a 230 VAC safety plug with earthing contact. Please comply with the following points in order to preserve this safety feature:



DANGER

- Ensure that the local mains voltage matches the nominal voltage that is stated on the name plate.
- Do not place any dangerous material, e.g. glass vessels containing liquid substances, within the safety area of 30 cm around the RVC. Spilled liquids may get into the RVC and damage the electrical or mechanical components.
- Work on the power supply system must only be performed by certified electricians.
- Inspect the electrical equipment of the unit regularly. Defects such as loose or burnt cables must be eliminated immediately.

3.6.2 Mechanical safety

In order to ensure the safe operation of the RVC, please comply with the following points:



WARNING

- Do not use the RVC if it was installed incorrectly.
- Do not use the RVC without panels.
- Do not use the RVC with accessories that show signs of damage.
- Only use the RVC with accessories that have been approved by the manufacturer. In case of doubt, contact the manufacturer (see chapter 7.2 - "Service contact").
- Do not hold your fingers between the lid and the housing when closing the lid. Risk of crushing!
- Do not hit or move the RVC during its operation.
- Do not lean against or rest on the RVC during its operation.
- Check the RVC and accessories before every start-up for any visible signs of damage.
- Do not evaporate any substances that could damage the material of the rotors, rotor chamber or lid of the RVC in any way. Highly corrosive substances (e.g. hydrogen chloride HCl) damage the material and affect the mechanical strength of the rotors and accessories.
- Stop the RVC immediately in the event of a malfunction. Eliminate the malfunction or contact the after-sales service of Martin Christ Gefriertrocknungsanlagen GmbH (see chapter 7 - "Malfunctions and error correction").
- Ensure that all repairs are performed only by authorised and specialised personnel (see chapter 7.2 - "Service contact").

3 Safety

3.6.3 Fire prevention

Fuses protect certain electrical circuits within the RVC against over-current conditions.



- Always use fuses of the same type and rating.
- Do not evaporate explosive or inflammable substances.
- Do not use the RVC within hazardous locations where there is a risk of explosion.

3.6.4 Thermal safety

During the evaporation process, the housing, lid and interior of the RVC can reach surface temperatures of more than +50°C.



- Open and close the lid at the heat-insulated handle!
- Ensure that no limbs come into contact with hot unit parts or accessories. Danger of burns!
- Wear heat-resistant gloves when inserting or removing the rotors.

3.6.5 Chemical and biological safety

If pathogenic, toxic, or radioactive samples are intended to be evaporated, it is in the responsibility of the user to ensure that all necessary safety regulations, guidelines, precautions, and practices are adhered to accordingly.



- Infectious, toxic, pathogenic, and radioactive substances must be evaporated in suitable accessories. Take suitable precautions for your own safety!
- Do not evaporate corrosive products (especially substances containing acids) without special protective measures and devices such as, for example, a cooling trap for the protection of the vacuum pump. Contact the manufacturer (see chapter 7.2 - "Service contact").
- Special caution is necessary when handling azides, as a dangerous explosive develops in combination with copper or nonferrous metals! It is absolutely necessary to contact the manufacturer (see chapter 7.2 - "Service contact").
- Keep informed about local measures to avoid harmful emissions (depending on the substances to be evaporated).
- As personal protective equipment, safety gloves are required for the use of the RVC.
The materials to be evaporated may, however, require additional special safety measures (e.g. drying of infectious, toxic, radioactive, or pathogenic substances)

3.6.6 Safety instructions for evaporation

The following instructions must be observed prior to every evaporation process:



- Ensure that the RVC was set up and connected properly (see chapter 5 - "Set-up and connection").
- Maintain a safety distance of at least 30 cm (12 inches) around the RVC.
- Do not store any dangerous goods in the safety area of the RVC.
- Do not stay in the safety area longer than what is absolutely necessary for the operation of the RVC.
- Only use accessories that have been approved by the manufacturer (except for commercial vessels made of glass or synthetic materials). We explicitly warn against the use of equipment of poor quality. Breaking glass or bursting vessels can cause dangerous imbalances.
- Observe the instructions on the installation of accessories (see chapter 6.4.3 - "Installation of accessories").

3.7 Safety devices

3.7.1 Lid lock device

The RVC can only be started when the lid is properly closed. The lid can only be opened when the rotor has stopped. If the lid is open, the RVC cannot be started.

3.7.2 System check

An internal system check monitors the data transfer and sensor signals with regard to plausibility. Errors are detected by continuous self-monitoring of the system. Error messages are displayed in the process & equipment info menu (see chapter 6.5.3.2 - "Process and equipment information" or chapter 7.1.1 - "Error messages").

3.7.3 Power failure safety

The unit stores the current process parameters cyclically. In the event of a power failure, the electromagnetic stop valve towards the vacuum pump will close automatically, and the rotor decelerates brakeless. The rotor chamber will not be aerated. After the restart of the power supply, the evaporation process continues with the last stored parameters.

3.7.4 Earth conductor check

For the earth conductor check, there is an equipotential bonding screw on the rear panel of the RVC. An earth conductor check can be carried out with the aid of a suitable measuring instrument.

3 Safety

3.8 Procedures in the event of hazards and accidents

**Fire:**

- A fire in the electrical control system must be extinguished with a CO₂ fire extinguisher!
- Burning oil must be extinguished with a CO₂ fire extinguisher or powder fire extinguisher!

Hazardous electrical incident:

- Set the mains power switch of the control system to the "0" position in order to interrupt the power supply completely.

Burns:

- Small-area burns (e.g. finger) should be cooled immediately with lukewarm water for approximately 2 minutes.
- Large-area burns should not be cooled because of the resulting risk of hypothermia.
- Cover the burns loosely and in a sterile manner (e.g. with a sterile dressing).
- Cover the injured person with a blanket.

IF IN DOUBT, CALL THE EMERGENCY PHYSICIAN (AMBULANCE)!

3.9 Remaining hazards

All CHRIST rotational vacuum concentrators were built state-of-the-art and according to the accepted safety rules. However, danger to life and limb of the operator, or of third parties, or impairments of the units or other material assets cannot be completely excluded when the units are being used.

- Use the RVC only for the purpose that it was originally intended for (see chapter 1.2 - "Intended use").
- Use the RVC only if it is in a perfect running state.
- Immediately eliminate any problems that can affect safety.

4 Storage and transport

4.1 Storage conditions

In order to ensure the protection against mechanical and climatic influences, the guidelines of the German Federal Association for Wooden Packages, Pallets, and Export Packaging (Bundesverband Holzpackmittel, Paletten, Exportverpackung e.V.), the so-called HPE packaging guidelines, must be applied when packing and storing the RVC.

The storage must be:

- dust-free
- dry
- free from excessive temperature fluctuations
- free from mechanical load.

4.2 Dimensions and weight

Values for the RVC without a vacuum pump:

	RVC 2-18 CDplus
Height:	240 mm
Height with open lid:	410 mm
Width:	247 mm
Depth:	320 mm + 30 mm vacuum connection
Weight:	approx. 14 kg

4.3 Packaging

The RVC is packaged in a cardboard box or in a wooden crate, depending on the scope of supply.

- After opening the packaging, take out the box containing the accessories.
- Remove the packaging material.
- Lift the RVC upwards and out of the crate/cardboard box with a sufficient number of people to lift it safely. When lifting the unit, always reach under it from the side.



CAUTION

The **RVC 2-18 CDplus** weighs approx. 14 kg!

- Retain the packaging for any possible future transport of the RVC.

4 Storage and transport

4.4 Transport safety device

The following transport safety devices must be removed prior to start-up:

- Remove the heat shrink tube at the hose nozzle of the aeration valve (see the illustration below).



Fig. 4: Hose nozzle of the aeration valve with heat shrink tube

- Remove the layers of paper between the lid and rotor chamber; they prevent the lid from getting stuck during the transport.

4.5 On-site transport

- The RVC can be transported by a suitable number of persons who reach under it from the sides.



CAUTION

The **RVC 2-18 CDplus** weighs approx. 14 kg!

- When lifting the RVC, always reach under it from the side. Do not grab the unit at the plastic control panel (see figures below).

correct



Fig. 5: Lifting the RVC

incorrect



4 Storage and transport

- When setting the unit down, ensure that the feet are upright (see figures below).

correct



incorrect



Fig. 6: Unit feet

- If the rotational vacuum concentrator needs to be transported over long distances, transport it in suitable packaging, and if at all possible, the original packaging.

5 Set-up and connection

5 Set-up and connection

5.1 Installation site

Operate the RVC only in closed and dry rooms.

- The table must be stable and have a solid, even tabletop.
- Ensure sufficient ventilation. Do not place any paper, cloth, or similar material behind or under the unit, since otherwise the air circulation will be impaired.
- Keep a safety distance of at least 30 cm from the wall so that the vents in the unit remain fully effective.
- The ambient temperature must be in the range of +10°C to +25°C.
- Do not subject the RVC to thermal stress, e.g. by positioning it near heat generators.
- Avoid direct sunlight (UV radiation).

5.2 Power supply

5.2.1 Connection



DANGER

The operating voltage on the name plate must correspond to the local supply voltage

CHRIST rotational vacuum concentrators are units of safety class I. Units of the type **RVC 2-18 CDplus** have a three-wire power cord with an IEC C13 connector (see chapter 10 - "Technical data").

An equipotential bonding screw is located on the back (see chapter 2.1.1 - "Functional and operating elements"). This equipotential bonding screw can be used to perform an earth conductor check.

5.2.2 Customer-provided fuses

Typically, the RVC must be protected with 16 Amp G fuses that are to be provided by the customer.

5 Set-up and connection

5.3 Aeration valve

The RVC is equipped with an electromagnetic aeration valve. The rotor chamber is aerated through this valve after the end of the evaporation process.



Unpressurised inert gas can also be used for aerating the rotor chamber.

5.4 Vacuum connections

The vacuum connection is realised by way of a vacuum hose with standard flange connections, clamping rings, or chains, and centring rings.



The small flange connections must be installed correctly in order to prevent leaks (see chapter 7.1.5 - "Small flange connections").

- 1 Centring ring
- 2 Clamping ring
- 3 Flange connection

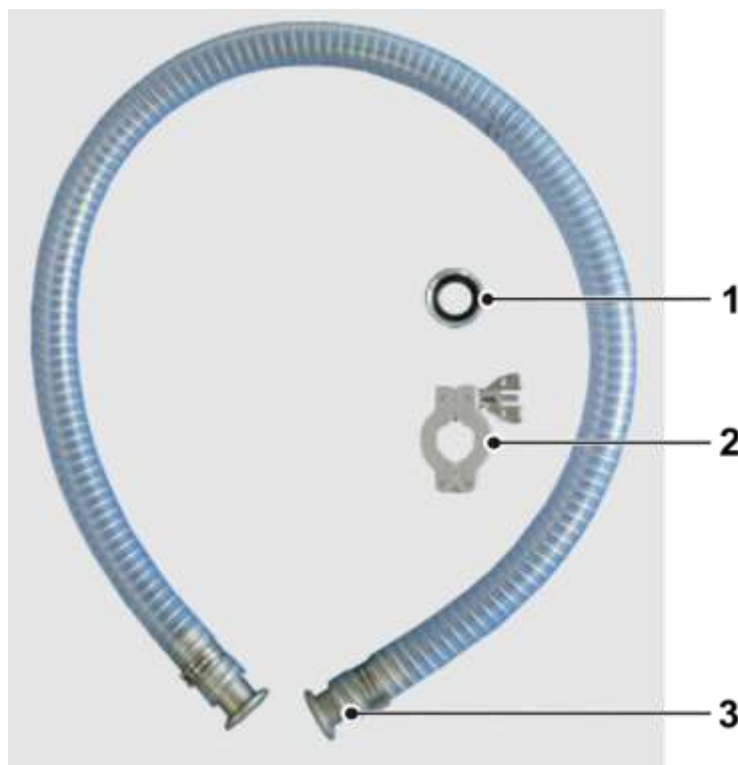


Fig. 3: Connecting pieces for vacuum connection

5 Set-up and connection

5.5 Connection of a vacuum pump and/or a cooling trap

In order to withdraw and condense the vapours that are formed, the RVC can be connected with further components.

5.5.1 Withdrawal of the vapours by a vacuum pump

The vapours are withdrawn by a vacuum pump, e.g. the vacuum diaphragm pump for chemical applications "MZ 2C" or "MD 4C", followed by condensation in a liquid-cooled emission condenser.

This application is suitable for low-boiling samples containing solvents. The vacuum pump must be connected to the RVC. The connector of the stop valve must be plugged into the socket on the back of the unit.

- 1 RVC
- 2 Vacuum hose
- 3 Vacuum pump
- 4 Electromagnetic stop valve

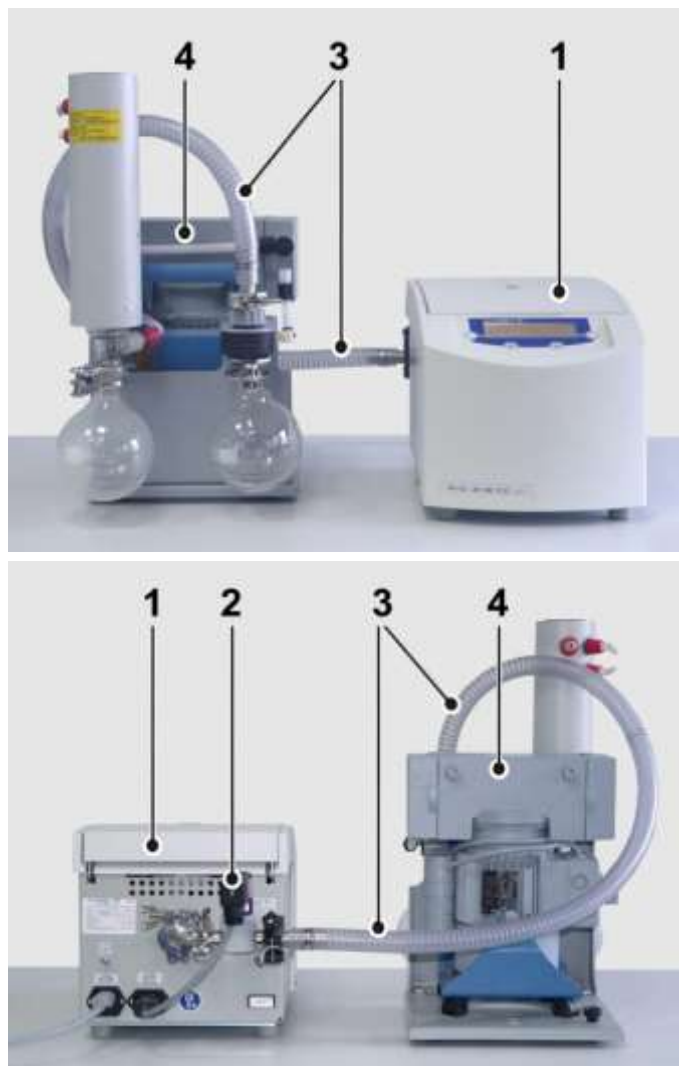


Fig. 7: Combination of the RVC with a vacuum pump and a stop valve; front and rear view

5 Set-up and connection

5.5.2 Condensation of the vapours in a cooling trap

The vapours are condensed upstream of the vacuum pump in a cooling trap, e.g. "CT 02-50" or "CT 04-50".

The application is suitable for water-base, low-boiling samples containing solvents. The RVC, the cooling trap and the vacuum pump must be connected. The connector of the stop valve must be plugged into the socket on the back of the unit.

- 1 RVC
- 2 Vacuum hoses
- 3 Cover with connecting hoses
- 4 Cooling trap
- 5 Vacuum pump
- 6 Electromagnetic stop valve

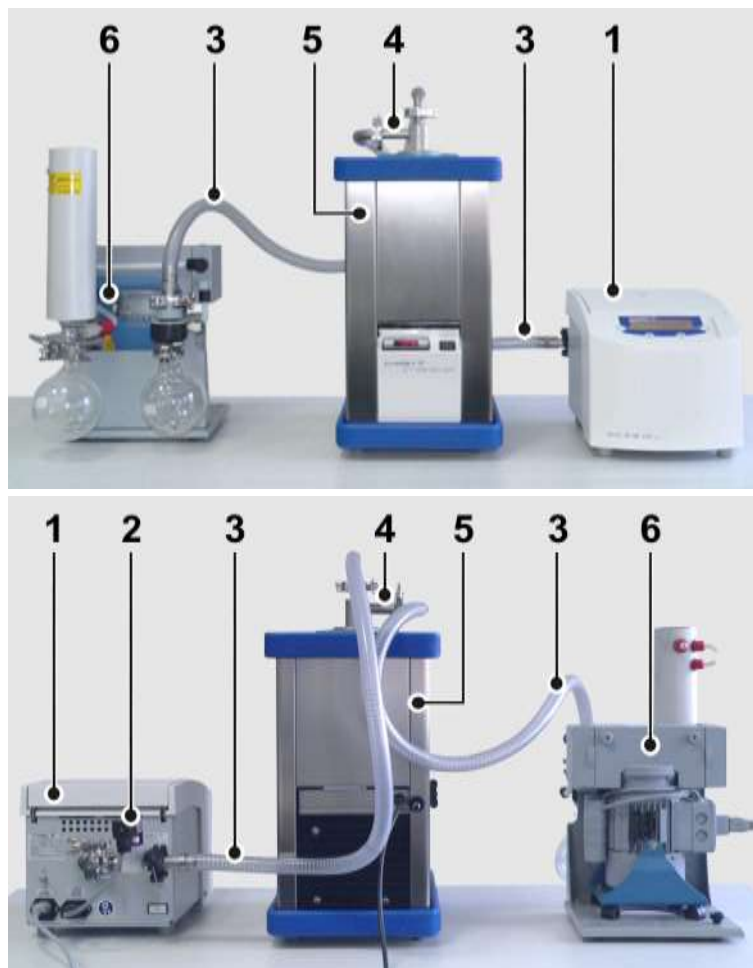


Fig. 8: Combination of the RVC with vacuum pump and cooling trap, front and rear view

5 Set-up and connection

5.6 Connection of an electromagnetic stop valve

The electromagnetic stop valve must be installed at the back of the rotational vacuum concentrator between the chamber and the vacuum pump or the cooling trap (depending on the type of application, chapter 5.5 - "Connection of a vacuum pump and/or a cooling trap").



Observe the installation direction of the stop valve!



Only for GEMÜ solenoid valves, type 52 (DN6):

GEMÜ solenoid valves of this type must be installed contrary to the marked flow direction (see the illustration)!

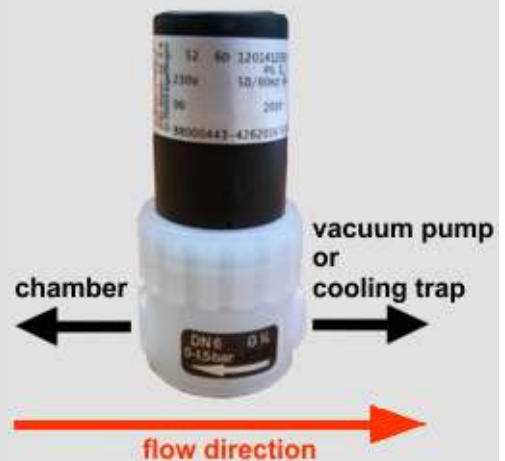


Fig. 9: Gemü solenoid valve, type 52 (DN6)

6 Operation

6.1 Initial start-up



Before the initial start-up, please ensure that your RVC is properly set up and installed (see chapter 5 - "Set-up and connection")

6.2 Switching the RVC on

- Press the mains power switch on the right-hand side of the unit.
The CDplus control unit performs a self-test and an initialisation. This may take several seconds.
- Follow the safety instructions and hazard warnings !

6.3 Opening and closing the lid

The lid can be opened if the rotor chamber is aerated and if the rotor is at a standstill. The rotational vacuum concentrator cannot be started if the lid is open.

- Select "mode" with the left-hand function key.
- Select "Open lid" with the up and down keys.
- To close, press slightly on the lid until both locks are locked.



Do not place your fingers between the lid and the housing when closing the lid. Risk of crushing!

6 Operation

6.4 Installation of rotors and accessories

6.4.1 Installation of angle rotors

- Only use inserts that are suitable for the rotor (see chapter 11.1 - "Rotor program").
- Always load the opposite inserts of the rotors with the same accessories and fill to avoid imbalance.
- Push the loaded rotor onto the rotor shaft until it reaches the stop.



NOTE

Depending on the version, up to three rotors can be pushed onto the rotor shaft at the same time.

- Follow the safety instructions and hazard warnings (see chapter 3 - "Safety")!

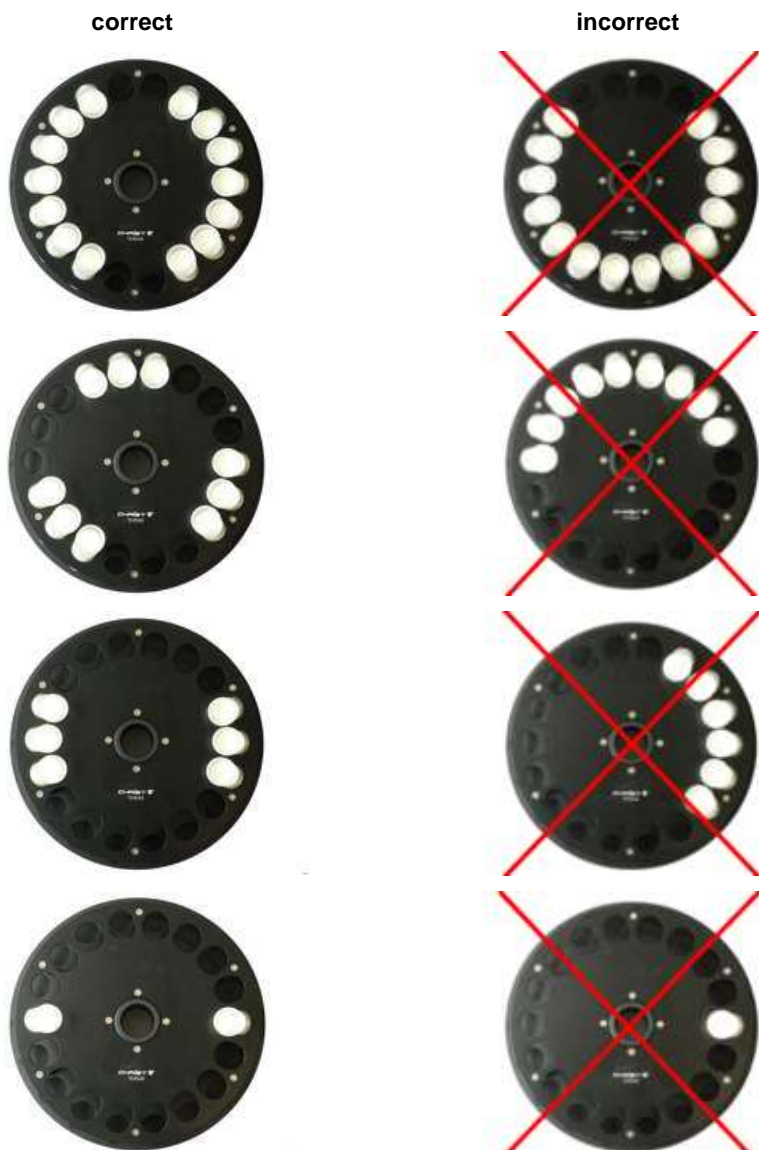


Fig. 10: Symmetrical loading of angle rotors

6.4.2 Installation of swing-out rotors

- Push the loaded rotor onto the rotor shaft until it reaches the stop.
- Follow the safety instructions and hazard warnings (see chapter 3 - "Safety")!

6.4.3 Installation of accessories

- Only use inserts that are suitable for the rotor (see chapter 11.1 - "Rotor program").
- In swing-out rotors, all places of a rotor must be loaded with buckets..
- Always load the opposite inserts of the rotors with the same accessories and fill to avoid imbalance.

Evaporation with different tube sizes

Working with different tube sizes is possible. In this case, however, it is very important that the inserts are installed symmetrically (see figure).

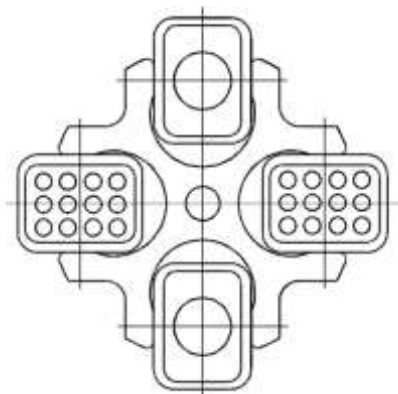


Fig. 11: Permissible loading of the swing-out rotor with different tube sizes

6 Operation

Evaporation with low capacity

The tubes must be installed symmetrically so that the buckets and their inserts are loaded evenly to avoid imbalance.

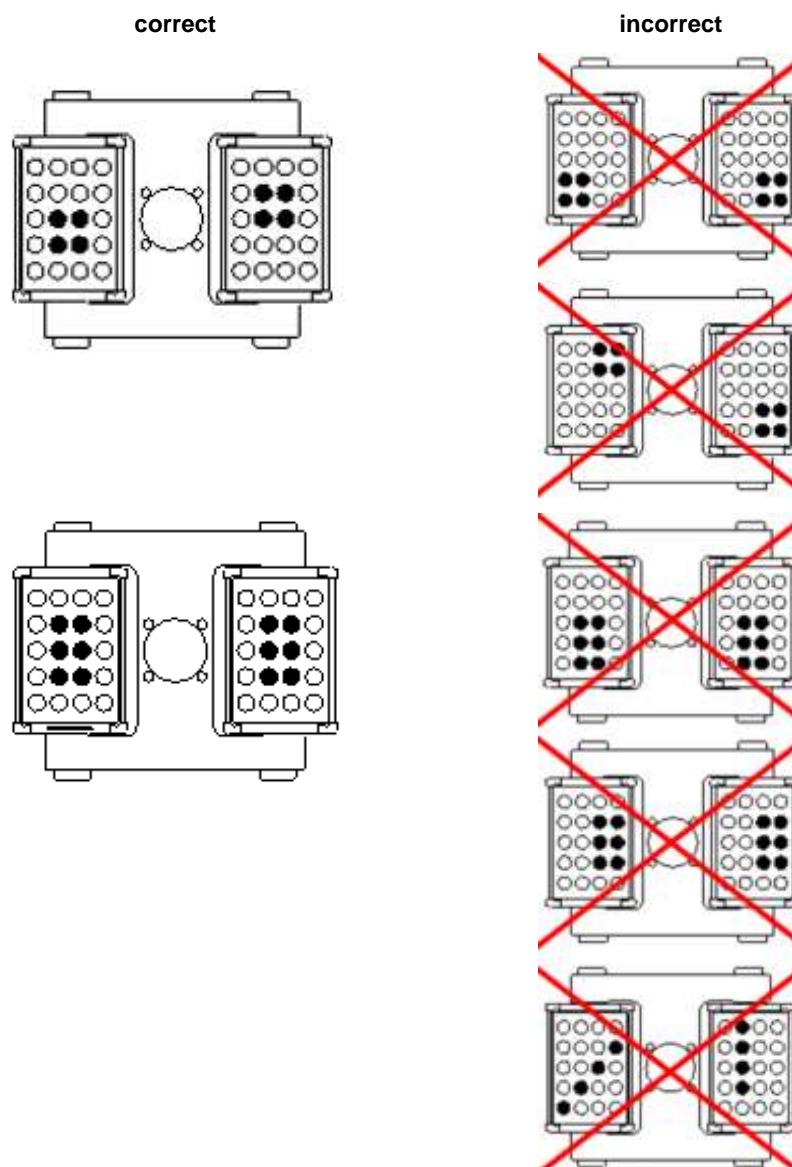


Fig. 12: Permissible loading of swing-out rotors with low capacity

6.4.3.1 Tubes

- Load the tubes outside of the rotational vacuum concentrator. Solvents in the buckets or rotor blocks cause corrosion.
- Fill the tubes carefully and arrange them according to their weight.
- Follow the safety instructions and hazard warnings(see chapter 3 - "Safety")!

6.4.3.2 Rotor blocks

- Always load the rotor blocks symmetrically with the same accessories and fill to avoid imbalance.

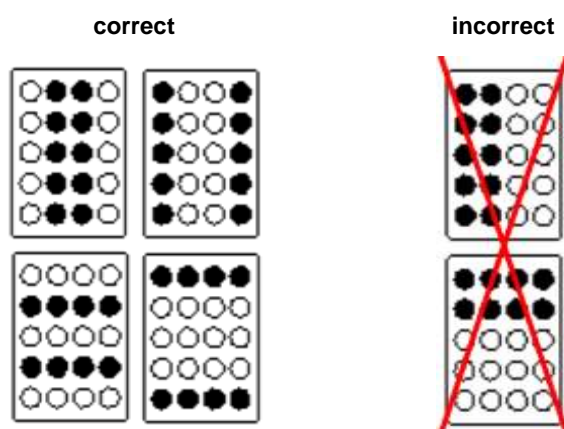


Fig. 13: Symmetrical loading of the rotor blocks

6.4.3.3 Buckets

- Load each bucket symmetrically to its pivotal point to ensure swinging to 90° under rotation.

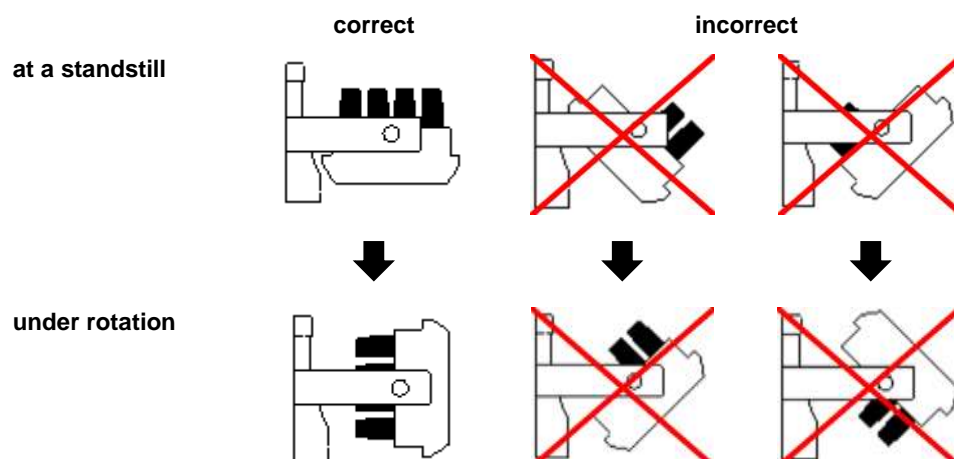


Fig. 14: Symmetrical loading of the buckets

6 Operation

- The balance point of the loaded bucket must be located considerably below the pivotal point. If the balance point is too near the pivotal point, the loaded bucket can be levered out of the bearings.

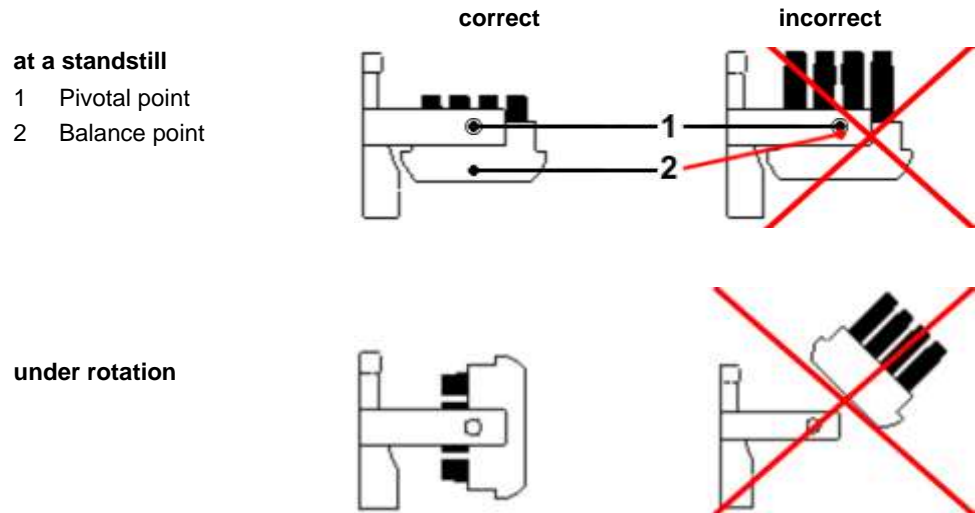


Fig. 15: Loading of buckets considering the balance point

6.5 CDplus control system

The control system CDplus ("Concentrator Display plus") stands for a convenient user interface for the intuitive control of evaporation processes under rotation.

6.5.1 User interface

- 1 Left function key
- 2 Right function key
- 3 „Up“ key
- 4 „Down“ key
- 5 Display

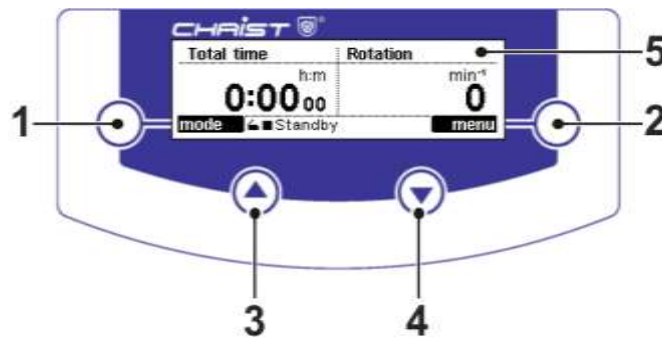


Fig. 16: User interface of the CDplus control system

Function keys (1+2)

The function of these keys depends on the menus and operating states of the unit. The current key function is displayed in the black field next to the key.



Fig. 17: Display of the assignment of the function keys;
here: left key "mode", right key "menu"

Up and down keys (3+4)

These keys are used to select the available functions and values or to change the selected parameter values.

In addition, these keys also control the indication of the measurement value channels in the value windows. The "up" key is assigned to the left value window, whereas the "down" key controls the right value window.

- For a selection, press the "up" or "down" key repeatedly until the desired measurement value channel is indicated in the respective value window.

6 Operation

Display (5)

The main window of the display is divided into three areas: the values windows, the assignment of the function keys and the status bar. The main window shows the process data, e.g. set values and actual values, menus, and process-relevant information (see figure).

- 6 Values window
- 7 Assignment of the function keys
- 8 Status bar

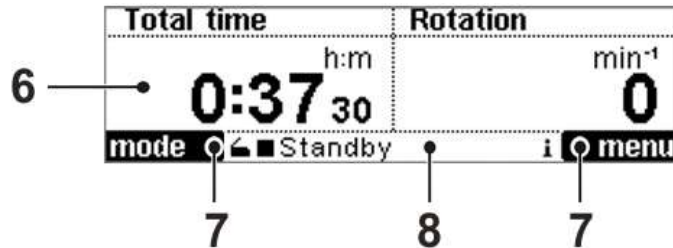


Fig. 18: Structure of the CDplus display

Values window (6)

The values window is displayed after the initialisation of the CDplus control system. It is divided into two areas. The indication of the measurement value channels is controlled by way of the "up" and "down" keys (see above). Each value window is structured as follows:

- 9 Measuring channel
- 10 Set value (only shown in the run mode)
- 11 Unit of the measured value
- 12 Actual value

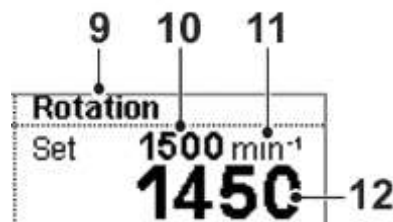


Fig. 19: Values window

The available measurement values can be displayed in the values window on the left as well as in the values window on the right so that a combination of the following values can be selected:

- Rotor speed
- Rotor chamber temperature
- Total time (indicates the total runtime of the process)
- Section time (indicates the runtime of an individual phase, e.g. warm-up, evaporation)

Assignment of the function keys (7)

See "function keys" (1+2)

Status bar (8)

The status bar shows information regarding the lid status, current operating mode, active phase, and any pending information. The status bar is visible at all times.

- 13 Lid status
- 14 Icon for the operating mode
- 15 Active phase
- 16 Info icon

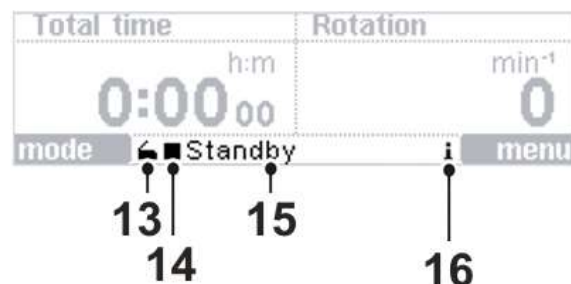


Fig. 20: Status bar

Lid status (13)



The lid is open.



The lid is closed.



The lid is not completely closed.

- Press both sides of the lid down in order to close the lid completely.

Operating mode (14)



Standby The rotational vacuum concentrator is in the standby mode. All aggregates are switched off.



The rotational vacuum concentrator is in the run mode. The timer is deactivated.



The rotational vacuum concentrator is in the run mode. The timer is activated.

Active phases (15)

Open lid The rotor is at a standstill, and the lid can be opened.

Warm-up The vacuum pump and/or the cooling trap are in the warm-up phase.

Evaporation manual The RVC is in a manual-controlled evaporation run.

Pending information (16)



If any messages are pending, the info icon flashes every second to draw the user's attention to error messages, process messages, or general information concerning the process or the unit.

The messages can be displayed in the process and equipment information window (see chapter 6.5.3.2 - "Process and equipment information")

6 Operation

6.5.2 Mode

The mode selection can be activated by pressing the left-hand function key in the active values window. The individual phases can be selected as follows:

- Press the left-hand function key "mode". The menu "Start with phase..." appears (see figure).
- Select the desired menu item with the up and down keys.
- Press the right-hand function key "enter" to confirm.

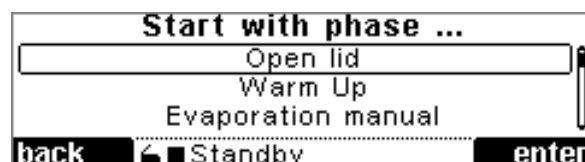


Fig. 21: Selecting the mode

Opening the lid

The lid can only be opened if the rotor is at a standstill. It is not possible to open the lid during an evaporation process



DANGER

During the evaporation process, the housing, lid and interior of the rotational vacuum concentrator can reach surface temperatures of more than +50°C.

Risk of burns!

Warm-up

Before starting an evaporation process, the vacuum pump and the cooling trap should warm-up until they reach their respective operating temperatures.

For this purpose, the warm-up phase can be started with or without a rotor. The time and the temperature can be preselected (see chapter 6.5.3.3 - "Options").

During the warm-up phase, the following processes take place:

- The rotor chamber is preheated - with or without a rotor - when the lid is closed.
- The vacuum pump is switched on, the stop valve is closed. After the warm-up phase, the following message is displayed:

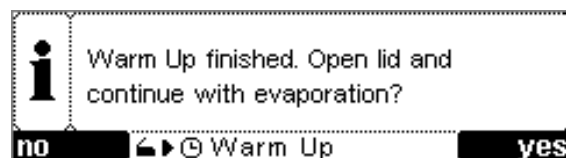


Fig. 22: Message after the warm-up

- Open the lid and remove the rotor in order to load it with the product or insert the loaded rotor.

- Close the lid. A menu appears:

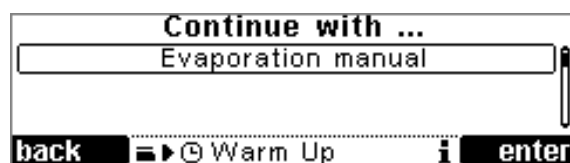


Fig. 23: Selection for continuing the evaporation

- Continue the process by selecting the desired phase.

Stopping the warm-up phase prematurely

During the warm-up phase, the functions "Open lid", "Continue with phase", or "Stop warm-up" can be selected with the left-hand function key "mode".

If one of these functions is selected, the warm-up phase will be stopped prematurely.

Evaporation manual

If the unit is in the standby mode, the evaporation phase can be started directly without a warm-up phase. For this purpose, select from the menu "Start with phase" the item "Evaporation manual".

Stopping the evaporation process prematurely

If the timer is active, the evaporation process will be stopped automatically when the preset time is over. The process can also be aborted manually.

- Open the menu "Select mode" with the left-hand function key.
- Select the function "Stop evaporation".
- Press the right-hand function key to confirm.

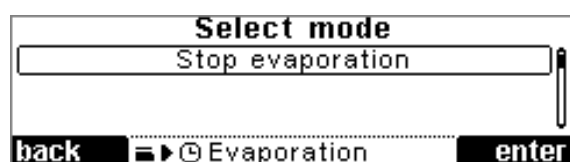


Fig. 24: Stopping an evaporation process

In order to stop the evaporation process, the chamber is completely aerated and the rotor is brought to a standstill. Then, the system inquires as to whether the lid should be opened.

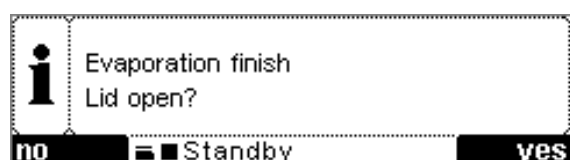


Fig. 25: Message after stopping an evaporation process

6 Operation

6.5.3 Main menu

The main menu can be activated by pressing the right-hand function key "menu" in the main window. It includes the following submenus:

- Changing the set values for the manual mode (see chapter 6.5.3.1 - "Changing the set values for the manual mode ")
- Process- & equipment information system (see chapter 6.5.3.2 - "Process and equipment information")
- Options (see chapter 6.5.3.3 - "Options")

- 1 Menu list
- 2 Menu title
- 3 Focus
- 4 Scrollbar
- 5 Function key „Quit menu“
- 6 Function key „Open menu“

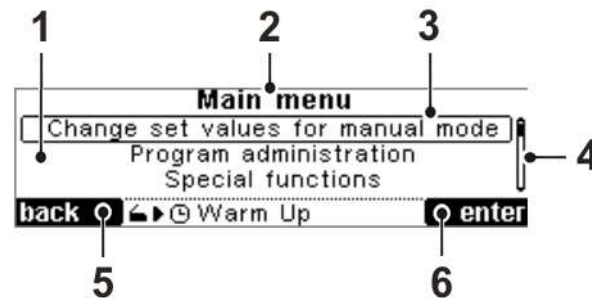


Fig. 26: Structure of the main menu

6.5.3.1 Changing the set values for the manual mode

- Select the set value with the up and down keys. The selected value is displayed in the focus.



Fig. 27: Manual mode – selecting a set value

- Press the right-hand function key to start the editing mode. The focus is displayed in an inverted manner.



Fig. 28: The selected set value is displayed in an inverted manner

- Change the set value with the up/down keys.
- Press the right-hand function key "ok" to confirm.

The set value is edited. For the manual evaporation process, several set values must be defined.

Timer Evaporation

The time can be set between 1 minute and 200 hours. Using the down key as of the time 00:01 h:m calls up the symbol ∞ . The timer is now deactivated and the RVC operates continuously.

Timer Heating

The value that is set under "Timer Evaporation" is also used for "Timer Heating".

For some evaporation processes, however, it makes sense to reduce the heating time. In this case, the value "Timer Heating" must be changed. The value "Timer Heating" is always lower or equal to the value "Timer Evaporation".

Temperature

The temperature can be set between -80°C and $+60^{\circ}\text{C}$.



Because the RVC has no active cooling, it is not possible to reach temperatures below room temperature. Under certain conditions (e.g. if a frozen product is loaded into the unit) it may be reasonable to select a temperature below room temperature.

6.5.3.2 Process and equipment information

The "Process & equipment Information " menu informs the user about any error, process, or system messages.

In the event of a message, a sound signal can be heard and the symbol " i " is displayed on the status bar. In addition, the process and equipment information is displayed. If the user is in a menu, the window will not be displayed until the user quits the main menu.

- 1 Message
- 2 Status of the Information
- 3 Number of messages pending
- 4 Function key for quitting the menu
- 5 Function key for acknowledging the message

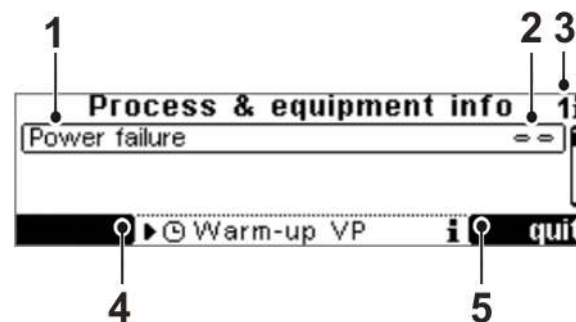


Fig. 29: Structure of the process & equipment info window

In addition, the menu can be opened at any time to check whether any messages are pending.




A detailed list of all messages can be found in chapter 7 "Malfunctions and error correction".


6 Operation

Information status

Every piece of information shown in the process & equipment information window receives a certain status:

 = Information present, not acknowledged

 ✓ Information present, acknowledged

 = Error no longer present, information not acknowledged

The sound signal continues until all the information is acknowledged.

Once some information is no longer present but has been acknowledged, the information will be removed from the process & equipment information window.

In order to quit the process & equipment information window, you have to acknowledge all of the pieces of information so that the left-hand function key "back" can be displayed.

6.5.3.3 Options



Fig. 30: Menu "Options"

Change display contrast

- Select the menu "Change display contrast".
- Change the contrast by pressing the up/down keys.
- Confirm the new setting by pressing the right-hand function key.

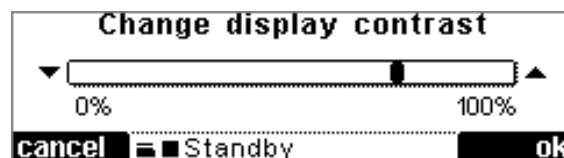


Fig. 31: Changing the contrast

Select language

The CDplus control system can be used in German or English.

- Select the menu "Select language".
- Select the language using the up/down keys.
- Confirm the input by pressing the right-hand function key.



Fig. 32: Selecting a language

Settings

The Settings menu is used to customise the operation and process management of the control system.

- Select the desired menu.
- Change the value using the up/down keys.
- Confirm the input by pressing the right-hand function key.

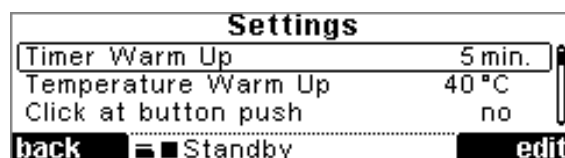


Fig. 33: Settings menu

Timer warm-up

You can set a warm-up time between 5 and 99 minutes.

Temperature warm-up

During the warm-up phase, the rotor temperature is set to the set temperature.

Click at button push

If this function is activated, a brief sound signal can be heard whenever a key is pressed.

High temperature resolution

Temperatures are displayed in the values window with a resolution of $\frac{1}{10}^{\circ}\text{C}$ (instead of a resolution of 1°C).

Rotor speed

The rotor speed can be set in a range between 100 rpm and 1,750 rpm.



NOTE

We guarantee that a speed of 1,350 rpm can be reached with all of the available rotors. Higher speeds are possible in individual cases.

Continuous operation VP

If this option is set to “yes”, the vacuum pump will not be switched off after the evaporation. Instead, it will remain active. This is useful if several evaporation processes are started in succession.

6 Operation

Service menu

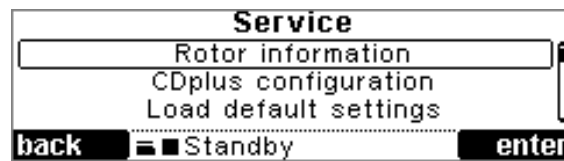


Fig. 34: Service menu

Load default settings

All set values and parameters are reset to the delivery status of the RVC. The reset requires confirmation.

Extended service menu

The extended service menu is exclusively reserved for service engineers. This area is password-protected and not available to the user.

6.6 Switching the RVC off

The RVC must be in the standby status.

- Switch the RVC off by pressing the mains power switch on the right-hand side panel.

7 Malfunctions and error correction

7.1 General malfunctions

Malfunctions are displayed in the menu "Process & equipment info" (see chapter 6.5.3.2 - "Process and equipment information"). A sound signal sounds when an error message is generated.

- Eliminate the source of the problem (see the following chapters).
- Acknowledge the error messages by pressing the right-hand function key.

7.1.1 Error messages

Error	Possible reason	Correction
Lid cannot be opened	<ul style="list-style-type: none"> • The rotor chamber is not aerated completely 	<ul style="list-style-type: none"> • Aerate the rotor chamber completely
Lid contacts error	<ul style="list-style-type: none"> • The system has detected an open lid during the evaporation. The rotor will be stopped immediately. The lid must be closed while the rotor is moving. 	<ul style="list-style-type: none"> • Check the lid contacts. If necessary, contact the after-sales service (see chapter 7.2 - "Service contact")
Rotor overtemperature	<ul style="list-style-type: none"> • The maximum permissible rotor temperature has been exceeded 	<ul style="list-style-type: none"> • If the system does not cool down, disconnect it immediately from the power supply. • Contact the after-sales service (see chapter 7.2 - "Service contact")
Chamber overtemperature	<ul style="list-style-type: none"> • The maximum permissible chamber temperature has been exceeded. 	<ul style="list-style-type: none"> • If the system does not cool down, disconnect it immediately from the power supply. • Contact the after-sales-service (see chapter 7.2 - "Service contact").
Permissible imbalance exceeded	<ul style="list-style-type: none"> • The rotor will be stopped immediately, the process will also be stopped. <ul style="list-style-type: none"> – improper loading of the rotor – glass breakage during the evaporation – uneven evaporation 	<ul style="list-style-type: none"> • Eliminate the imbalance and restart the unit. If the error is still present, contact the after sales-service (see chapter 7.2 - "Service contact")
VSK3000 calibration error	<ul style="list-style-type: none"> • Incorrect calibration of the vacuum sensor VSK3000 	<ul style="list-style-type: none"> • The sensor must be recalibrated (see the separate operating manual).

7 Malfunctions and error correction

7.1.2 Process messages

Error	Possible reason	Correction
Mains power failure	<ul style="list-style-type: none"> A mains power failure will be detected if the power supply is interrupted under normal conditions (run mode). 	<ul style="list-style-type: none"> The process will continue once the mains power is available again. The process times will be reset to zero. The set control values will be preserved.
Factory settings loaded	<ul style="list-style-type: none"> All parameters are reset to the delivery status of the system. 	<ul style="list-style-type: none"> The factory settings will be loaded if the corresponding menu command is executed in the service menu or if an error occurred in the parameter memory.
Nominal rotor speed not reached	<ul style="list-style-type: none"> After two minutes, the rotor has still not reached 90% of its nominal speed. <ul style="list-style-type: none"> set speed is too high drive moves sluggishly 	<ul style="list-style-type: none"> Check the set speed. When the rotor is at a standstill and the system is switched off, check whether the drive moves sluggishly, by hand. Contact the after-sales service (see chapter 7.2 - "Service contact").
Safety pressure not reached	<ul style="list-style-type: none"> The safety pressure inside the rotor chamber must be reached within 5 minutes after the start of an evaporation process. 	<ul style="list-style-type: none"> Check whether the value that was entered for the safety pressure is not too low. Check the components for any possible leaks.

7.1.3 System messages

Error	Possible reason	Correction
Invalid system type		<ul style="list-style-type: none"> Contact the after-sales service (see chapter 7.2 - "Service contact").
IO communication error 0x21	<ul style="list-style-type: none"> Failure of the CDplus IO module 	<ul style="list-style-type: none"> Switch the system off and then on again. If the error occurs again, contact the after-sales service (see chapter 7.2 - "Service contact")
IO communication error 0x30	<ul style="list-style-type: none"> Failure of the reading unit of the electronic rotor system 	<ul style="list-style-type: none"> Switch the system off and then on again. If the error occurs again, contact the after-sales service (see chapter 7.2 - "Service contact")
IO communication error 0x40	<ul style="list-style-type: none"> Failure of the motor control system 	<ul style="list-style-type: none"> Switch the system off and then on again. If the error occurs again, contact the after-sales service (see chapter 7.2 - "Service contact")
IO communication error 0x41	<ul style="list-style-type: none"> Failure of the imbalance detection module 	<ul style="list-style-type: none"> Switch the system off and then on again. If the error occurs again, contact the after-sales service (see chapter 7.2 - "Service contact")

7 Malfunctions and error correction

7.1.4 Emergency lid release

In the event of a power failure, it is possible to manually open the lid of the rotational vacuum concentrator.



- Do not actuate the emergency lid release before the rotor has stopped and the pressure has been relieved.
- Do not use the emergency lid release to open the lid during normal operation. Unlocked lid locks increase the risk of accidents!

- Switch off the mains power switch and disconnect the power cord from the socket.
- Check if the rotor is at a standstill and the rotor chamber is completely aerated.
- Pull the unit a bit over the edge of the table and jack it up (see figure below). Ensure that the centre of gravity of the unit is still on the table. If necessary, the unit must be secured by a second person.
- Unscrew the black plastic screw (approx. 8 mm).



Fig. 35: Loosening of the plastic screw

- Remove the stopper, e.g. with a screwdriver. The stopper is connected to a mechanical release string (see figure).

- 1 Release string
- 2 Plastic screw
- 3 Stopper

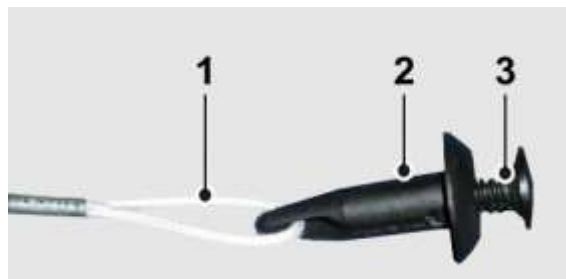


Fig. 36: Release string with stopper and screw

- Pull the stopper with the string vertically downwards until the lid lock unlocks.

7 Malfunctions and error correction



Fig. 37: Unlocking the lid locks

- Open the lid.
- After the emergency lid release has been used, reinstall the stopper in the reverse order.
- Try to locate the error source and contact the service if necessary (see chapter 7.2 - "Service contact").

7 Malfunctions and error correction

7.1.5 Small flange connections

Leakages are often due to improper small flange connections between the various components and hose connections or to leakages in the valves.

- Loosen the connection and place the centring ring (with sealing ring inside) in a centred manner between the flange connections.
- Seal the connection with the clamping ring or clamping chain by tightening the wing nut.
- Ensure that the centring ring neither slips out of place nor gets jammed.



Fig. 38: Small flange and centring ring



Fig. 39: Small flange with centring ring and small flange



Fig. 40: Attaching the clamping ring



Fig. 41: Tightened clamping ring

7 Malfunctions and error correction

7.2 Service contact

In the event of queries, malfunctions, or spare part enquiries:

From Germany:

Contact

Martin Christ Gefriertrocknungsanlagen GmbH

An der Unteren Söse 50

37520 Osterode (Germany)

Tel. +49 (0) 55 22 / 50 07-44 44

E-mail: support.lab@martinchrist.de

Outside Germany:

Contact our agency in your country. All agencies are listed at
www.martinchrist.de → [Sales Partners]



NOTE

If you would like to utilise our after-sales-service, please state the type of your RVC and its serial number.

8 Maintenance and service

The rotational vacuum concentrator and the accessories are subject to high mechanical stress. Thorough maintenance performed by the user extends the service life and prevents premature failure.



CAUTION

If corrosion or other damage occurs due to improper care, the manufacturer cannot be held liable or subject to any warranty claims.

- Use soap water or other water-soluble, mild cleaning agents for cleaning the RVC and the accessories.
- Do not use any corrosive or aggressive substances.
- Do not use solvents.
- Do not use agents with abrasive particles.
- Do not expose the RVC or its accessories to intensive UV radiation (e.g. sunlight) or thermal stress (e.g. by heat generators).

8.1 Maintenance

8.1.1 Rotational vacuum concentrator

- Switch off the rotational vacuum concentrator via the mains power switch and disconnect the power cord before cleaning.
- Carefully remove all product residues from the rotor chamber using a cloth.
- If the rotational vacuum concentrator has been contaminated with toxic, radioactive, or pathogenic substances, clean the rotor chamber immediately with a suitable decontamination agent (depending on the type of contamination).



WARNING

Take suitable precautions for your own safety if there is a risk of toxic, radioactive, or pathogenic contamination.

- Check the safety guard of the fan (at the front of the bottom side) at least once a year for dirt and clean it if necessary (e.g. with a vacuum cleaner).
- Open the rotational vacuum concentrator when it is not in use so that moisture can evaporate.

8 Maintenance and service

8.1.2 Rotor chamber

If the rotor chamber is contaminated or if glass is broken, the rotor chamber, the rotor shaft and the rotor must be cleaned immediately in order to prevent corrosion and damage to the ball bearings.

Cleaning of the rotor chamber

- 1 Rotor chamber
- 2 Cap
- 3 Rotor shaft

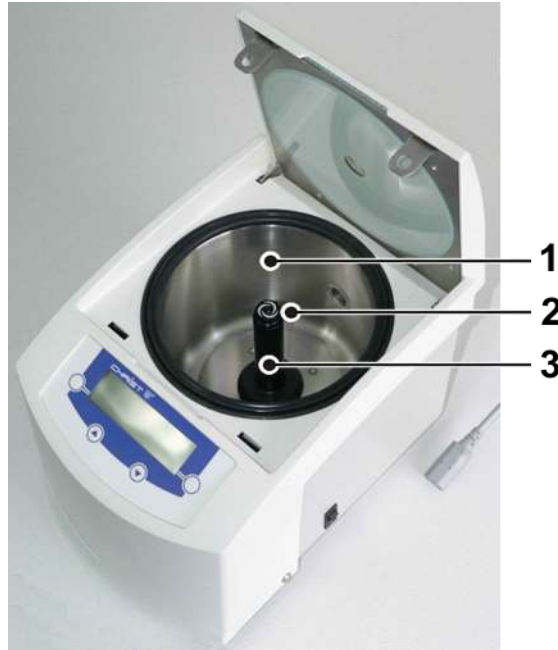


Fig. 42: Rotor chamber with rotor shaft

- Open the lid.
- Disconnect the power cord from the wall outlet or instrument receptacle before cleaning.



DANGER

Hot surface!
Let the rotor chamber cool down to room temperature!

- Pull off the cap.

8 Maintenance and service

- Remove the countersunk screw with the supplied hexagon socket key (size 2.5).

4 Countersunk screw



Fig. 43: Removing the countersunk screw

- Remove the thrust piece and the compression spring from the axle by lifting it vertically upward.
- Remove the rotor shaft from the axle by lifting it vertically upward.



Fig. 44: Removing the rotor shaft

- Clean the lid with a disinfectant or cleaning agent.
- Wipe out the rotor chamber and clean it with a cleaning agent or disinfectant.

8 Maintenance and service

- Clean the rotor shaft and the magnetic coupling.



CAUTION

Ensure that no cleaning agent or disinfectant gets into the ball bearings of the rotor shaft as it may wash out the ball bearing grease. This can lead to irreparable damage.

- 5 Rotor shaft with magnet coupling
- 6 Ball bearing
- 7 Hexagon socket key



Fig. 45: Rotor shaft with ball bearings

- Clean the thrust piece, the compression spring and the countersunk screw.
- Clean the cap and coat the O-ring of the cap with a thin layer of vacuum grease.

- 4 Thrust piece
- 5 Compression spring

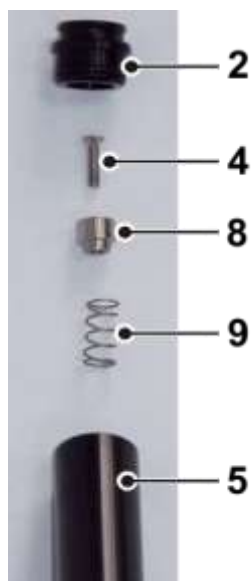


Fig. 46: Rotor shaft with thrust piece and compression spring

8 Maintenance and service

- Push the drive shaft onto the axle.
- Install the thrust piece and the compression spring on the axle and secure them in place with the countersunk screw with 1.5 Nm.
- Push the cap fully onto the drive shaft.
- Connect the power cord and switch the RVC on.
- Perform a test run.



NOTE

If the unit does not reach the necessary speed, the gap between the magnetic coupling and rotor chamber bottom may be too wide (optimum value: $2.4 \pm 0.3\text{mm}$).

- In this case, press the rotor shaft down!

8.1.3 Accessories



CAUTION

For the care of the accessories, special safety measures must be considered as these are measures that will ensure operational safety at the same time.

Chemical reactions as well as stress-corrosion (combination of oscillating pressure and chemical reaction) can affect or destroy the metals. Barely detectable cracks on the surface can expand and weaken the material without any visible signs.

- Check the material regularly (at least once a month) for
 - cracks
 - visible damage of the surface
 - pressure marks
 - signs of corrosion
 - other changes.
- Replace any damaged components immediately for your own safety.
- Immediately rinse off the rotors or accessories if any liquids that may cause corrosion come into contact with them.
- Clean the accessories outside the rotational vacuum concentrator once a week or preferably after each use.
- If the rotors or accessories have been contaminated with toxic, radioactive, or pathogenic substances, clean them immediately with a suitable decontamination agent (depending on the type of contamination). Take suitable precautions for your own safety if there is a risk of toxic, radioactive, or pathogenic contamination.

8 Maintenance and service

8.1.3.1 Aluminium accessories

Especially aluminium parts are susceptible to corrosion.

- Acid-containing cleaning agents and alkaline cleaning agents must be avoided.
- Grease aluminium parts at least once a week with slushing oil for the protection against corrosion.

This essentially increases their service life and reduces susceptibility to corrosion.

8.1.4 Glass breakage



CAUTION

In the case of glass breakage, immediately remove all glass particles (e.g. with a vacuum cleaner). Replace the rubber cushions since even thorough cleaning will not remove all glass particles.

Glass particles will damage the surface coating (e.g. anodising) of the buckets, which will then lead to corrosion.

Glass particles in the rubber cushions of the buckets will cause glass breakage again.

Glass particles on the pivot bearing of the load-bearing bolts prevent the buckets and rotor blocks from swinging evenly, which will cause an imbalance.

Glass particles in the rotor chamber will cause metal abrasion due to the circulation. This metal dust will not only pollute the rotor chamber, rotor, and materials to be evaporated but also damage the surfaces of the accessories, rotors, and rotor chamber.

In order to completely remove the glass particles and metal dust from the rotor chamber

- Grease the upper third of the rotor chamber with e.g. Vaseline.
- Then, let the rotor rotate for a few minutes at maximum speed and atmospheric pressure. The glass and metal particles will now collect at the greased part.
- Remove the grease with the glass and metal particles with a cloth.
- If necessary, repeat this procedure.
- Clean the rotor shaft.

8.2 Disinfection of the rotor chamber and accessories

- Use commercially-available disinfectants such as, for example, Incidur[®], Meliseptol[®], Sagrotan[®], Buraton[®] or Terralin[®] (available at chemist's shops or drugstores).
- The rotational vacuum concentrator and the accessories consist of various materials. A possible incompatibility must be considered.
- Before using cleaning or decontamination agents that were not recommended by us, contact the manufacturer to ensure that such a procedure will not damage the rotational vacuum concentrator.
- For autoclaving, consider the continuous heat resistance of the individual materials.
- Please contact us if you have any queries (see chapter 8.4 - "Service").


DANGER

If dangerous materials (e.g. infectious and pathogenic substances) are used, the RVC and the accessories must be disinfected.

8.3 Autoclaving

The service life of the accessories essentially depends on the frequency of autoclaving and use.

- Remove the existing O-rings so that the trapezoid notch can be reached by the hot steam. This prevents the formation of humidity in the notch..
- Replace the accessories immediately when the parts show changes in colour or structure or in the occurrence of leaks etc.

Accessories	Max. temp [°C]	Min. time [min]	Max. time [min]	Max. cycles
Glass tubes	134-138	3	40	-
Polycarbonate tubes	115-118	30	40	20
Polypropylene tubes	115-118	30	40	30
Teflon tubes	134-138	3	5	100
Aluminium rotors	134-138	3	20	-
Aluminium accessories	134-138	3	20	-

8 Maintenance and service

8.4 Service



DANGER

In the event of service work that requires the removal of the panels, there is a risk of electric shock or mechanical injury. Only qualified specialist personnel is authorised to perform this service work.

The rotational vacuum concentrator is subject to high mechanical stress. In order to be able to withstand this high level of stress, high-quality components were used during the production of the rotational vacuum concentrators. Nevertheless, wear cannot be excluded and it may not be visible from the outside.

This is why we recommend having the rotational vacuum concentrator checked by the manufacturer during an inspection once per year in the operating state and once every three years in the dismantled state.

Information and appointments:

In Germany:

Contact

Martin Christ Gefriertrocknungsanlagen GmbH

An der Unteren Söse 50

37520 Osterode

Tel. +49 (0) 55 22 / 50 07-44 44

E-mail: support.lab@martinchrist.de

Outside Germany:

- Contact our agency in your country. All agencies are listed at www.martinchrist.de → [Sales Partners]



NOTE

If you would like to utilise our service, please state the type of your RVC and its serial number.

8.5 Return of defective parts

Although we exercise great care during the production of our products, it may be necessary to return a unit or accessory to the manufacturer.

In order to ensure the quick and economical processing of returns of freeze-dryers, rotational vacuum concentrators, spare parts, or accessories, we require complete and extensive information concerning the process. Please fill in the following forms completely, sign them, enclose them with the return package, and send them together with the product to:

Martin Christ Gefriertrocknungsanlagen GmbH

An der Unteren Söse 50

37520 Osterode (Germany)

1. Declaration of decontamination

As a certified company and due to the legal regulations for the protection of our employees and of the environment, we are obliged to certify the harmlessness of all incoming goods. For this purpose, we require a declaration of decontamination.

- The form must be filled in completely and signed by authorised and specialised personnel only.
- Affix the original form in a clearly visible manner to the outside of the packaging.

**NOTE**

We will return the unit if no declaration of decontamination is provided!

2. Form for the return of defective parts

This form is for the product-related data. They facilitate the assignment, and they enable the quick processing of the return. If several parts are returned together in one packaging, please enclose a separate problem description for every defective part.

- A detailed problem description is necessary in order to perform the repair quickly and economically.
- Upon request, we will prepare and submit to you a cost estimate prior to performing the repair. Please confirm such cost estimate within 14 days. If the cost estimate has still not been confirmed after 4 weeks, we will return the unit. Please note that you must bear the incurred costs.

**NOTE**

The unit must be packaged in a transport-safe manner. Please use the original packaging, if at all possible.

If the product is dispatched to us in unsuitable packaging, you will be charged the cost for returning it to you in new packaging.

The forms can be downloaded online from
www.martinchrist.de → [Service] → [Overhaul, repair and leak testing].

9 Disposal

9 Disposal

9.1 Disposal of the RVC

Martin Christ Gefriertrocknungsanlagen GmbH is a registered manufacturer of electric and electronic devices that are solely intended for commercial use.

- Comply with all local rules and regulations.

9.2 Disposal of the packaging

- Dispose of the packaging, after having separated the individual materials.
- Comply with all local rules and regulations.

10 Technical data

Manufacturer:	Martin Christ Gefriertrocknungsanlagen GmbH
Type:	RVC 2-18 CDplus
Order number:	100248

Performance data	
Temperature:	+30 °C to +60 °C
Speed:	1,500 rpm
Relative centrifugal force:	210 x g
Max. permissible imbalance:	30 g
Max. density of material at process start:	2 kg / dm ³

Connection requirements (without vacuum pump and accessories)	
Electrical connection	1 x 230 V / 50/60 Hz
Protection class:	I
IP code:	11
Apparent power:	0.3 kVA
Rated current:	1.5 A
Mains fuse:	2 A F, Ø 5 mm x 20 mm
Stop valve connection:	230 V, 50/60 Hz, 20 W max.

Physical data	
Dimension of the unit	
Height:	240 mm
Height with open lid:	410 mm
Width:	247 mm
Depth:	320 mm + 30 mm vacuum connection
Dimensions of the rotor chamber	
Inside diameter:	180mm
Height, inside:	139 mm
Max. lid opening angle:	approx. 80°
Weight:	approx. 14 kg
Noise level according to DIN 45635:	40 dB (A)
EMC according to EN 55011:	Class B

10 Technical data

Equipment connections	
Vacuum connection:	Small flange connection DN16KF (ISO 28403, DIN 2861)
Aeration valve:	Hose nozzle, outside diameter 5.5 mm max. (DN3)
Mains input:	IEC C13 connector
Stop valve:	IEC C14 connector

10.1 Ambient conditions

- The figures are valid for an ambient temperature of +20°C.
- Allowable ambient temperature +10 °C to +25 °C.
- Max. humidity 80%.

10.2 Technical documentation

The technical documentation of this rotational vacuum concentrator (e.g. circuit diagrams and the safety data sheets of the manufacturers) are not attached to this operating manual.

You can order these documents from our service department (see chapter 7.2 - "Service contact").

11 Appendix

11.1 Rotor program

The actual rotor program can be downloaded from
www.martinchrist.de/Products/RVC_ → [unit type].

11 Appendix

11.2 Overview of evaporation times

	Vessel	Number of samples	Sample volume (ml)	Temperature (°C)	Pump	Cooling trap	Total time (min)
Water	10 ml test tube	24	9	45	MZ 2C	yes	635
	10 ml test tube	24	9	60	MZ 2C	yes	510
	1.5 ml Eppendorf caps	36	1	30	MZ 2C	yes	330
	1.5 ml Eppendorf caps	36	1	45	MZ 2C	yes	270
	1.5 ml Eppendorf caps	36	1	60	MZ 2C	yes	215
	1.5 ml Eppendorf caps	36	1	30	KnF	no	330
	1.5 ml Eppendorf caps	36	1	45	KnF	no	290
	1.5 ml Eppendorf caps	36	1	60	KnF	no	230
Toluol <chem>C6H5CH3</chem>	10 ml test tube	24	9	30	MZ 2C	yes	120
	10 ml test tube	24	9	45	MZ 2C	yes	91
	10 ml test tube	24	9	60	MZ 2C	yes	65
	1.5 ml Eppendorf caps	36	1	30	MZ 2C	yes	40
	1.5 ml Eppendorf caps	36	1	45	MZ 2C	yes	40
	1.5 ml Eppendorf caps	36	1	60	MZ 2C	yes	30
Acetonitrile <chem>C2H3N</chem>	10 ml test tube	24	9	30	MZ 2C	yes	120
	10 ml test tube	24	9	45	MZ 2C	yes	100
	10 ml test tube	24	9	60	MZ 2C	yes	80
	1.5 ml Eppendorf caps	36	1	30	MZ 2C	yes	45
	1.5 ml Eppendorf caps	36	1	45	MZ 2C	yes	40
	1.5 ml Eppendorf caps	36	1	60	MZ 2C	yes	30
1,4 Dioxane <chem>C4H8O2</chem>	10 ml test tube	24	9	30	MZ 2C	yes	165
	10 ml test tube	24	9	45	MZ 2C	yes	110
	10 ml test tube	24	9	60	MZ 2C	yes	80
	1.5 ml Eppendorf caps	36	1	30	MZ 2C	yes	55
	1.5 ml Eppendorf caps	36	1	45	MZ 2C	yes	45
	1.5 ml Eppendorf caps	36	1	60	MZ 2C	yes	35

11 Appendix

	Vessel	Number of samples	Sample volume (ml)	Temperature (°C)	Pump	Cooling trap	Total time (min)
Tert. butanol <chem>C4H10O</chem>	10 ml test tube	24	9	30	MZ 2C	yes	150
	10 ml test tube	24	9	45	MZ 2C	yes	105
	10 ml test tube	24	9	60	MZ 2C	yes	80
	1.5 ml Eppendorf caps	36	1	30	MZ 2C	yes	55
	1.5 ml Eppendorf caps	36	1	45	MZ 2C	yes	45
	1.5 ml Eppendorf caps	36	1	60	MZ 2C	yes	35
Methanol <chem>CH3OH</chem>	10 ml test tube	24	9	30	MZ 2C	yes	160
	10 ml test tube	24	9	45	MZ 2C	yes	130
	10 ml test tube	24	9	60	MZ 2C	yes	110
	1.5 ml Eppendorf caps	36	1	30	MZ 2C	yes	65
	1.5 ml Eppendorf caps	36	1	45	MZ 2C	yes	55
	1.5 ml Eppendorf caps	36	1	60	MZ 2C	yes	45
Ethanol <chem>C2H6O</chem>	10 ml test tube	24	9	30	MZ 2C	yes	165
	10 ml test tube	24	9	45	MZ 2C	yes	120
	10 ml test tube	24	9	60	MZ 2C	yes	105
	1.5 ml Eppendorf caps	36	1	30	MZ 2C	yes	60
	1.5 ml Eppendorf caps	36	1	45	MZ 2C	yes	50
	1.5 ml Eppendorf caps	36	1	60	MZ 2C	yes	40
1,2 Dichlorethane <chem>C2H4Cl2</chem>	10 ml test tube	24	9	30	MZ 2C	yes	100
	10 ml test tube	24	9	45	MZ 2C	yes	75
	10 ml test tube	24	9	60	MZ 2C	yes	60
	1.5 ml Eppendorf caps	36	1	30	MZ 2C	yes	45
	1.5 ml Eppendorf caps	36	1	45	MZ 2C	yes	35
	1.5 ml Eppendorf caps	36	1	60	MZ 2C	yes	30

11.3 Brief operating instructions

1. Switch on the system at the mains power switch down on the right side of the unit.
2. Switch the vacuum pump and/or the cooling trap on.
3. Close the lid.
4. Starting the warm-up phase:
 - Enter the set values for the warm-up phase into "menu" → "options" → "Timer warm-up" und "Temperature warm-up", confirm your entries and quit the menu.
 - Press the left-hand function key "mode".
 - Select the "Warm-up" menu and confirm.
 - Open the lid when the warm up phase has ended.
 - Install the rotors and close the lid.
5. Changing the set values for time, temperature, vacuum and safety pressure:
 - Select "menu" with the right-hand function key.
 - Select "Change set values for manual mode" from the main menu.
 - Select the set value by using the up/down keys and confirm with the right-hand function key "edit".
 - Change the set value by using the up/down keys and confirm with the right-hand function key "ok".
 - Quit the menu with the left-hand function key.
6. Starting the process "Evaporation manual" or "Evaporation program":
 - Open the menu "Start with phase..." by pressing the left-hand function key "mode".
 - Select "Evaporation manual" or "Evaporation program" using the up/down keys.
 - Start the evaporation process by pressing the right-hand function key.
 - The function "Evaporation program" can only be selected if a program has been created before.

The start of the evaporation process starts the following automatic process run:

- The rotor speed increases (rotating direction left)
 - At 70% of the selected maximum speed: the aeration valve closes automatically (to avoid delays in boiling)
 - At 80% of the selected maximum speed: the stop valve opens the connection to the vacuum pump
 - Further speed increase until the preselected maximum rotor speed is reached.
7. Interrupting an evaporation process:
 - Press the left-hand function key "mode".
 - Select "Stop evaporation" and confirm.

Without an interruption, the evaporation process ends after the preselected time. The following process runs automatically:

11 Appendix

- At maximum speed: the stop valve closes the connection to the vacuum pump, the aeration valve opens; the rotor speed is maintained for 30 sec (aeration phase, to avoid delays in boiling).
- Rotor decelerates until it is at a standstill. After the standstill of the rotor the lid can be opened in order to remove the rotors.

Functional and operating elements:

- 1 Lid lock device
- 2 Lid
- 3 Rotor chamber
- 4 User interface
- 5 Rotor shaft
- 6 Mains power switch



Fig. 47: Total view of the RVC 2-18 CDplus

- 7 Name plate
- 8 Equipotential bonding screw
- 9 Mains connection and mains fuse protection
- 10 Power supply connection of the stop valve
- 11 Vacuum connection
- 12 Connection for aeration



Abb. 48: Rear view of the RVC 2-18 CDplus

11.4 EC declaration of conformity



EC – DECLARATION OF CONFORMITY

in accordance with the EC Machinery Directive 2006/42/EC, annex II, part 1, section A

The product named hereinafter was developed, designed, and manufactured in compliance with the relevant, fundamental safety and health requirements of the listed EC directives.

In the event of modifications that were not authorised by us or if the product is used in a manner that is not in line with the intended purpose, this declaration will be rendered void.

<i>Product name:</i>	Rotational Vacuum Concentrator
<i>Product type:</i>	RVC 2-18 CDplus
<i>Order number:</i>	100248
<i>Directives:</i>	<div style="display: flex; justify-content: space-between;"> <div>2006/42/EG</div> <div>Machinery Directive</div> </div> <div style="display: flex; justify-content: space-between;"> <div>2014/35/EU</div> <div>Low Voltage Directive</div> </div> <div style="display: flex; justify-content: space-between;"> <div>2014/30/EU</div> <div>EMC Directive</div> </div>

Martin Christ Gefriertrocknungsanlagen GmbH

An der Unteren Söse 50

37520 Osterode

Germany

Osterode, 18/02/2016



M. Christ, Management

Authorised representative
for CE matters:

S. Krippendorff

CE_MaschR6_RVC2-18_CDplus_2015-12-14_en.docx

11 Appendix

11.5 Declaration of conformity – China RoHS 2



DECLARATION OF CONFORMITY

China RoHS 2 (Administrative Measures for the Restriction of the Use of Hazardous Substances in Electrical and Electronic Products)

Freeze-dryer models: Alpha 1-2 LDplus, Alpha 1-4 LDplus, Alpha 2-4 LDplus, Alpha 1-4 LSCplus, Alpha 2-4 LSCplus, Beta 1-8 LDplus, Beta 2-8 LDplus, Beta 1-8 LSCplus, Beta 2-8 LSCplus, Gamma 1-16 LSCplus, Gamma 2-16LSCplus, Delta 1-24 LSCplus, Delta 2-24 LSCplus

Rotational Vacuum Concentrator models: RVC 2-18 CDplus, RVC 2-18 CDplus HCl-resistant, RVC 2-25 CDplus, RVC 2-33 CDplus, RVC 2-33 CDplus with infrared heating

Christ Gefriertrocknungsanlagen GmbH has made reasonable effort to avoid the use of hazardous substances in the products (freeze-dryers and RVC).

A Product Conformity Assessment (PCA) was performed in order to determine whether the concentration of harmful substances in all homogeneous materials of the component parts is above or below the MCV limit (Maximum Concentration Value limit) as defined in GB/T 26572:

Mercury and its compounds: 0.1 %

Cadmium (Cd) and its compounds: 0.01 %

Lead (Pb) and its compounds: 0.1 %

Hexavalent chromium (Cr (VI)) and its compounds: 0.1 %

Polybrominated biphenyls (PBB): 0.1 % Polybrominated diphenyl ethers (PBDE): 0.1 %

表1 产品中有害物质的名称及含量
Table 1: Name and content of hazardous substances in the product

部件名称 Component part (PCA)	有害物质 Hazardous substance					
	铅 Lead (Pb)	汞 Mercury (Hg)	镉 Cadmium (Cd)	六价铬 Hexavalent Chromium (Cr (VI))	多溴联苯 Poly-brominated biphenyls (PBB)	多溴二苯醚 Polybrominated diphenyl ethers (PBDE)
Electronic PCB, cables	X ¹⁾	○	○	○	○	○
Display	○	○	○	○	○	○
Housing	X ²⁾	○	○	○	○	○
Base, metal, accessories	X ²⁾	○	○	○	○	○

本表格依据SJ/T 11364的规定编制。
This table is made according to SJ/T 11364.

11 Appendix



O: 表示该有害物质在该部件所有均质材料中的含量均在GB/T 26572规定的限量要求以下。
Indicates that the content of the harmful substance in all homogeneous materials of the component part is below the limit as defined in GB/T 26572.)

X: 表示该有害物质至少在该部件的某一均质材料中的含量超出GB/T 26572规定的限量要求。(企业可在此处, 根据实际情况对上表打“X”的技术原因进行进一步说明。)
Indicates that the content of the harmful substance in at least one homogeneous material of the component part exceeds the limit as defined in GB/T 26572. (Contact the manufacturer for further technical information according to the actual situation.)

¹⁾ Contains parts in compliance with exemptions 6c, 7c.I, 7c.II and 37 of 2011/65/EU RoHS.

²⁾ Contains parts in compliance with exemptions 6a, 6b and 6c of 2011/65/EU RoHS.

Apart from the exemptions given in this table, none of the substances listed above have been intentionally added to the product or metallic coatings.

Martin Christ Gefriertrocknungsanlagen GmbH

An der Unteren Söse 50
37520 Osterode
Germany

Osterode, 01/08/2016



General Manager

12 Glossary

Boiling retardation

The temperature of a liquid can rise above the boiling point without the liquid actually starting to boil. Vibrations or shocks quickly lead to the formation of a large gas bubble that escapes explosively from the vessel. This phenomenon is known as boiling retardation. It occurs when neither the liquid nor the wall of the vessel include any condensation nuclei at which vapour bubbles might form.

Pressure increase test

The pressure increase test is used to determine whether the evaporation in the rotor chamber is complete. During the pressure increase test, the rotor chamber is separated from the cooling trap or vacuum pump by way of the stop valve. The system evaluates the pressure increase that is caused by any additionally released steam.

In order to perform the pressure increase test, limits for the pressure increase as well as the test duration must be defined beforehand.

Relative centrifugal force

The relative centrifugal force is the acceleration that the samples are subjected to during the rotation. The acceleration is stated as a multiple of the mean gravitational acceleration g . It can be increased by increasing the radius inside the rotor chamber and by increasing the speed. These three parameters are interdependent and linked with each other via the following formula:

$$\text{Relative centrifugal force } RCF = 11.18 \times 10^{-6} \times r \times n^2$$

r = radius in cm

n = speed in rpm

RCF without any dimension

12 Glossary

Safety pressure

Since the vacuum has a dominating influence on the product temperature, Martin Christ Gefriertrocknungsanlagen GmbH has integrated a so-called safety pressure function into their units in order to protect the products. If the pressure inside the rotor chamber rises too quickly – above the safety limit – the energy supply of the unit will be interrupted so that the evaporation process slows down.

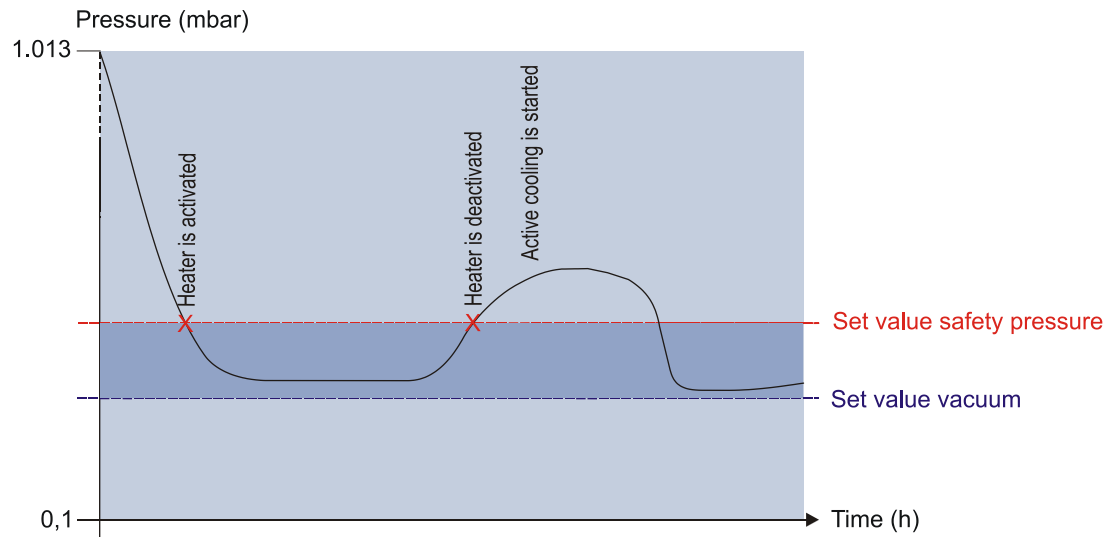


Fig. 49: Diagram describing the safety pressure function

13 Index

A

Accessories	19
Accessories, cleaning and care.....	57
Accident prevention	18
Active phases	39
Advantages of the rotational vacuum concentration.....	14
Aeration valve	27, 64
Aluminium accessories	59
Aluminium accessories, cleaning and care.	58
Aluminium rotor.....	59
Ambient conditions.....	64
Ambient temperature	64
Apparent power	12, 63
Assignment of the function keys.....	38
Autoclaving	59

B

Boiling retardation.....	75
Brief operating instructions.....	69
Bucket.....	35

C

Care of the accessories	57
CDplus control system	37
CE-Zeichen gemäß Richtlinie 2006/42/EG.	16
Chamber overtemperature	47
Change display contrast.....	44
Changing the set values for the manual mode	42
Chemical and biological safety.....	20
China RoHS 2 – Declaration of conformity.	73
Circuit diagrams.....	64
Cleaning agents.....	53
Cleaning of the rotor chamber.....	54
Cleaning the rotational vacuum concentrator	53
Cleaning the RVC and the accessories.....	53
Click at button push	45
Closing the lid	31
Condensation of the vapours in a cooling trap	29
Connection.....	26
Connection for aeration.....	11

Connection of a vacuum pump and/or a cooling trap.....	28
Connection requirements	63
Continuous operation vacuum pump.....	45
Copyright	10
Corrosion	34, 53, 54, 57
Cost estimate.....	61
Cracks	57
Customer-provided fuses	26

D

Damage to the ball bearings	54, 56
Dangerous goods.....	21
Dangerous materials.....	59
Declaration of conformity	71
Declaration of conformity – China RoHS 2.	73
Declaration of decontamination.....	61
Dimension of the unit	63
Dimensions and weight.....	23
Dimensions of the rotor chamber	63
Direct hazard to the life and health.....	17
Disinfection of the rotor chamber and accessories	59
Display.....	38
Disposal of the packaging	62
Disposal of the RVC.....	62

E

Earth conductor check	21
EC-Declaration of conformity	71
Electrical connection	63
Electrical connection of the stop valve	11
Electrical safety.....	19
Electromagnetic stop valve	30
EMC according to EN 55011	63
Emergency lid release	49
Emissions	20
Equipment connection	64
Equipotential bonding screw	11, 21, 26
Error correction	47
Error messages	21, 47
Evaporation with different tube sizes.....	33
Evaporation with low capacity	34
Examples of use	15

Index

Explanation of symbols	10	Lid contacts error	47
Explanation of the symbols and notes	17	Lid lock device	11, 21
Extended service menu	46	Lid status	39
F		Load default settings	46
Factory settings loaded	48	M	
Fire prevention	20	Main menu	42
Form for the return of defective parts	61	Mains fuse	63
Function keys	37	Mains input	64
Functional elements	11	Mains power failure	48
Fuse drawer	11	Mains power switch	11, 31
Fuses	20	Maintenance	53
G		Maintenance and service	53
GEMÜ solenoid valve	30	Malfunctions	47
General conditions	9	Manual evaporation	41
General malfunctions	47	Manufacturer	20, 21, 53, 62, 63
Glass breakage	58	Marking of the unit	16
Glass tubes	59	Max. density of material at process start	63
H		Max. humidity	64
Hazard warnings	9, 31	Max. lid opening angle	63
High temperature resolution	45	Max. permissible imbalance	63
Highly corrosive substances	19	Mechanical safety	19
I		Mode	40
Imbalance	21, 32	Mode of operation	13
Importance of the operating manual	9	N	
Important information	17	Name plate	12, 19, 26
Infectious substances	20	Noise level according to DIN 45635	63
Inflammable substances	20	Nominal rotor speed not reached	48
Informal safety instructions	18	Nominal voltage	12, 19
Information status	44	Notes on safety and hazards	9
Initial start-up	31	O	
Installation direction of the stop valve	30	On-site transport	24
Installation of accessories	33	Opening the lid	31, 40
Installation of angle rotors	32	Operating elements	11
Installation of rotors and accessories	32	Operating mode	39
Installation of swing-out rotors	33	Operating personnel	18
Installation site	26	Operating voltage	26
Intended use	9	Options	44
IO communication error	48	Order number	63
IP code	63	Overview of evaporation times	67
L		P	
Layout of the RVC	11	Packaging	23
Lid	11	Packaging, disposal	62
Lid cannot be opened	47	Part number	12

Index

Pathogenic substances	20	Safety distance	19, 21, 26
Pending information	39	Safety instructions.....	9, 31
Performance data	63	Safety instructions for evaporation	21
Permissible imbalance exceeded	47	Safety pressure.....	76
Physical data	63	Safety pressure not reached	48
Pivotal point	35, 36	Safety-conscious work	18
Polycarbonate tubes	59	Scope of supply	10
Polypropylene tubes	59	Select language	44
Potential hazard to the life and health	17	Serial number	12, 52, 60
Potentially hazardous situation.....	17	Service.....	60
Power cord.....	19	Service contact	52
Power failure safety	21	Service life	53, 58
Power supply	26	Service life of the accessories.....	59
Pressure increase test	75	Service menu.....	46
Pressure marks.....	57	Settings.....	45
Prevention of accidents.....	9, 18	Set-up and connection	26
Principle of the rotational vacuum concentration.....	13	Signs of corrosion	57
Procedures in the event of hazards and accidents.....	22	Small flange connections	51
Process and equipment information.....	43	Solvents.....	53
Process messages.....	48	Specialist personnel.....	60
Protection class	63	Speed	63
Protection of the environment	18	Standards and regulations	10
R		Status bar	39
Radioactive substances	20	Stop valve	64
Rated current	12, 63	Stop valve connection	63
Relative centrifugal force.....	63	Stop valve, electrical connection	11
Remaining hazards.....	22	Stopping the evaporation process prematurely	41
Remove the glass particles and the metal dust from the rotor chamber	58	Stopping the warm-up phase prematurely..	41
Responsibility of the operator.....	18	Storage and transport	23
Return of defective parts	60	Storage conditions	23
Risk of burns.....	40	Stress-corrosion.....	57
Rotor blocks.....	35	Supply voltage	26
Rotor chamber	11, 54	Surface temperature	20, 40
Rotor overtemperature	47	Susceptibility to corrosion	58
Rotor shaft	11	Switching the RVC off	46
Rotor speed	45	Switching the RVC on	31
S		System check	21
Safety area	21	System messages.....	48
Safety class	19	T	
Safety class I	26	Technical data	63
Safety data sheets	64	Technical documentation	64
Safety devices	21	Teflon tubes.....	59
		Temperature	43, 63
		Temperature warm-up	45

Index

Thermal safety	20
Thermal stress	26, 53
Timer Evaporation.....	43
Timer Heating	43
Timer warm-up.....	45
Toxic substances	20
Transport safety devices	24
Tubes.....	34
Type.....	12, 63
Type of the RVC	60

U

Up and down keys	37
User interface	11, 37
UV radiation.....	26, 53

V

Vacuum connection	11, 27, 64
Values window	38
Vapour pressure curve for ice and water....	13
Ventilation	26
Visible damage of the surface	57
VSK3000 calibration error	47

W

Warm-up.....	40
Warranty and liability.....	9
Weight	63
Withdrawal of the vapours by a vacuum pump	28

Y

Year of manufacture	12
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