



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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1 General information

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

Rotational vacuum concentrator

Do not use the rotational vacuum concentrator unless the following requirements are fulfilled:

- The rotational vacuum concentrator has been properly installed.
- The rotational vacuum concentrator is in a perfect technical state.
- The rotational vacuum concentrator is not located in an area with an explosion hazard.
- No unauthorised design modifications, additions or conversions without the written approval by Martin Christ Gefriertrocknungsanlagen GmbH have been performed.
- The accessories used have been approved by Martin Christ Gefriertrocknungsanlagen GmbH. This does not apply to commercially available freeze-drying vessels made of glass or plastic.

Christ rotational vacuum concentrators are solely intended for evaporation under rotation and vacuum. Possible areas of application include:

- Concentration of DNA/RNA, proteins, etc.,
- Sample preparation for HPLC/thin-layer chromatography, gas chromatography and mass spectroscopy,
- Isolation/synthesis of natural substances,
- High-throughput screening (HTS),
- General evaporation tasks in laboratories.

The intended use also includes:

- Observation of all of the notes and instructions that are included in the operating manual,
- Compliance with the inspection and maintenance instructions (see chapter 8 - "Maintenance and service").

1 General information

Exclusion of liability

Any use of the rotational vacuum concentrator other than the one described here or any use going beyond this description is regarded as improper use. Martin Christ Gefriertrocknungsanlagen GmbH cannot be held liable for any damage resulting from such improper use.

Requirements concerning the products used in the freeze-dryer

- The product must not damage the material of the components of the rotational vacuum concentrator or affect its mechanical strength.
- A reaction of the product following the supply of high amounts of energy during the evaporation process must be excluded.
- The product must not contain azides.



The additional information concerning special products in the following chapters must be absolutely observed (see chapter 1.2.1 - "Evaporation of solvent-containing products (non-aqueous media)" and chapter 1.2.2 - "Freeze-drying of acid-containing products")!

1.2.1 Evaporation of solvent-containing products (non-aqueous media)

In terms of the corrosion resistance, the use of organic solvents in aqueous solutions is acceptable.

By design, rotational vacuum concentrators are chemically resistant against most compounds that are typically used. However, by necessity, rotational vacuum concentrators comprise several different materials, some of which may be attacked and degraded by certain chemicals.

The manufacturing methods and/or conditions of exposure of the materials, as well as the way the chemicals are applied, can influence the results. Some of these factors are listed below:

- Manufacturing: Stress generated while sawing, sanding, machining, drilling, polishing and/or forming.
- Exposure: Length of exposure, stresses induced during the service life due to various loads (changes in temperature, etc.).
- Application of chemicals: by contact, rubbing, wiping, spraying, etc.

1 General information

With the exception of hydrochloric acid, nearly all standard solvents can be used. For further details, see the table below.

Solvent	Stainless steel	Aluminium	EPDM	PPS	Borosilicate glass	Experience
Acetic acid 20%	+	+	o	+	+	?
Formic acid	o	o	-	o	+	?
Trifluoroacetic acid (TFA)	+	+	+	+	+	?
Acetone	+	+	o	+	+	?
Acetonitrile	+	+	o	+	+	+
Cyclohexane	+	+	-	+	+	?
Dioxane	+	+	o	+	+	+
Dimethylformamide	+	+	o	+	+	?
Dimethyl sulfoxide	+	+	+	+	+	+
Dichloromethane	+	+	-	o	+	-
Ethanol	+	+	+	+	+	+
Isopropyl alcohol	+	+	+	+	+	?
Methanol	+	+	+	+	+	+
tert-Butanol	+	+	o	+	+	?
Toluene	+	+	-	o	+	+
Tetrahydrofuran	+	+	-	o	+	?
Pyridine	+	+	o	+	+	?

Legend:

- + No degradation to be expected
- o Moderate degradation; limited use
- Severe degradation; infrequent use recommended; immediate thorough cleaning required

Damage to the rotational vacuum concentrator and its accessories due to chemicals can be significantly reduced by cleaning immediately after the end of the programme. All parts of the rotational vacuum concentrator that have come into contact with the product must be checked regularly for signs of damage and replaced, if necessary.



Solvents not included in the above table must not be used.

1.2.2 Freeze-drying of acid-containing products

Evaporation of acid-containing products (with the exception of the substances listed under "Evaporation of solvent-containing products" with the concentration levels mentioned therein) is only permissible if special protective measures and equipment-related precautions are taken. Otherwise, there is a risk of damage to property and personal injury. Consultation of Martin Christ Gefriertrocknungsanlagen GmbH is absolutely mandatory in order to define the measures that need to be taken!

chapter 1.2.1 - "Evaporation of solvent-containing products (non-aqueous media)"

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

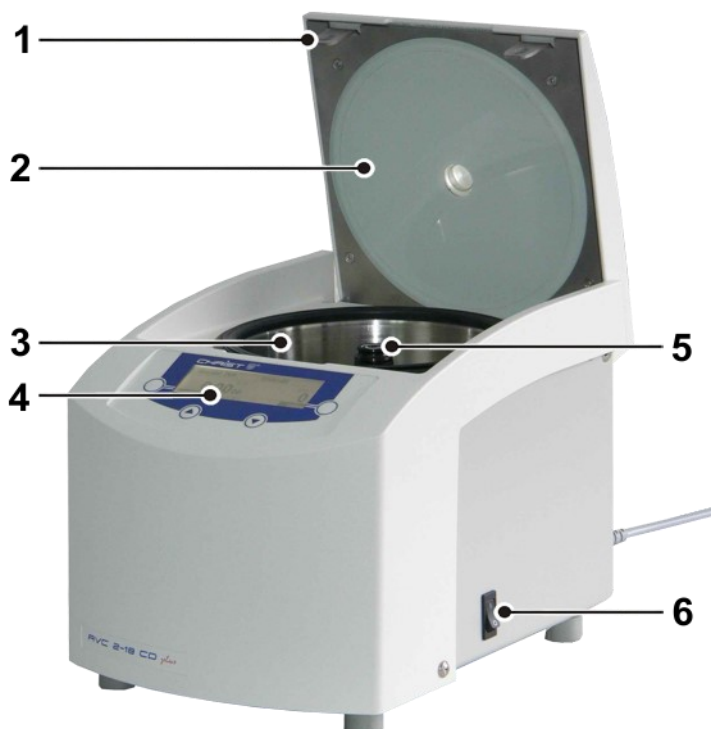


Fig. 1: Total view of the Rotational Vacuum Concentrator

- 7 Name plate (see chapter 2.1.2 - "Name plate")
- 8 Equipotential bonding screw (see chapter 3.8.4 - "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. 2: Rear view of the Rotational Vacuum Concentrator

2 Layout and mode of operation

2.1.2 Name plate

1	Serial number	1	Serial No.	00000	05 / 2015	4
2	Type	2	RVC 2-18 CDplus	100248		5
3	Nominal voltage		cool. system	1. stage	2. stage	
	Year of manufacture (month/year)		refrigerant			
	Part number		filling			
	Rated current / apparent power		max. pressure			
		3	230 V / 50/60 Hz	1,5 A / 0,3 kVA		6
			D-37520 Osterode am Harz, An der Unteren Söse 50, Germany			

Fig. 3: 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.

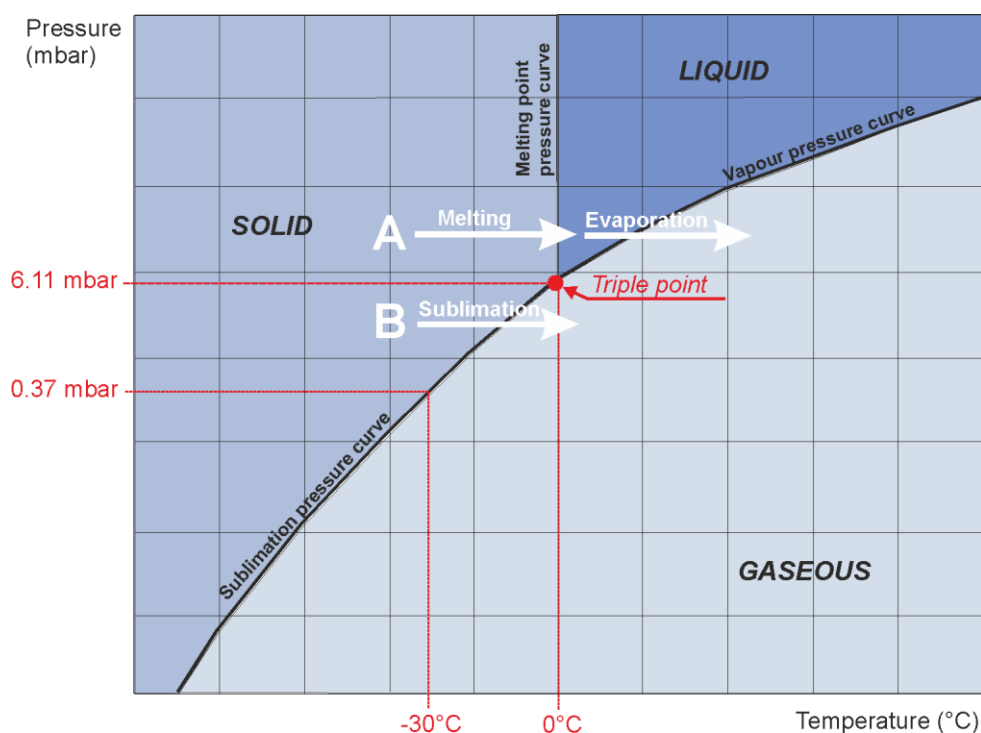


Fig. 4: Vapour pressure curve for ice and water

2 Layout and mode of operation

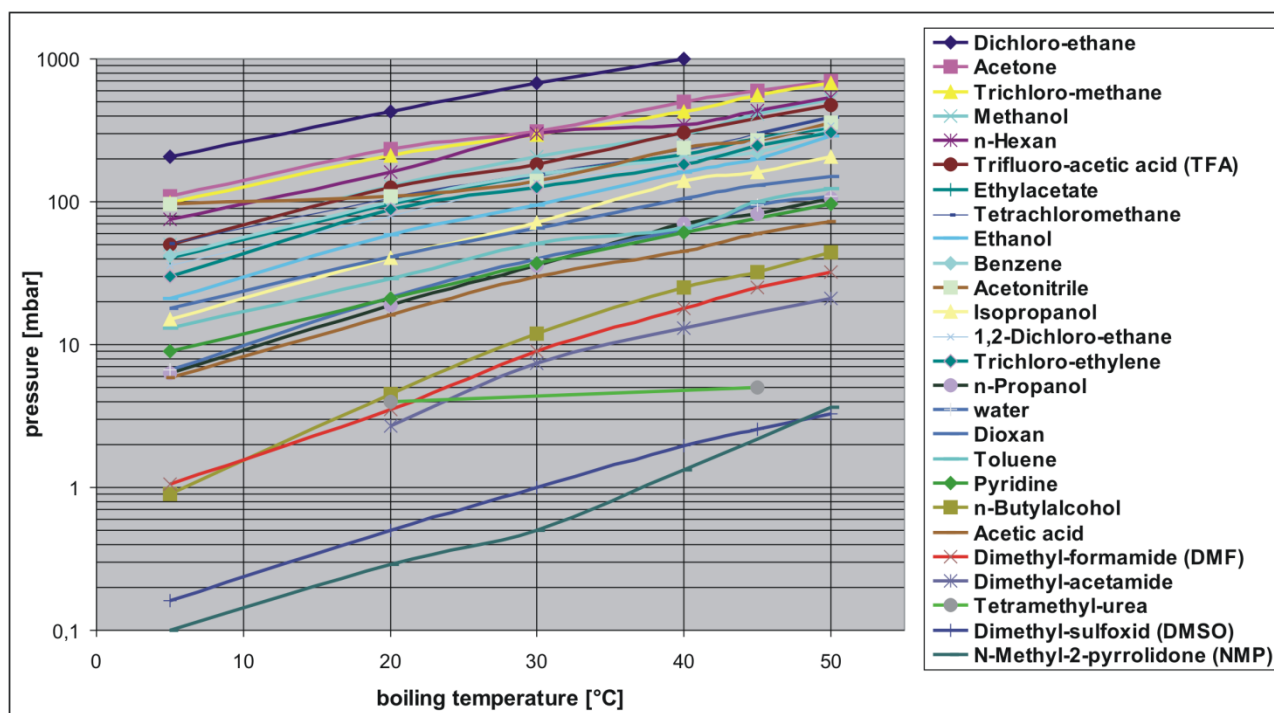


Fig. 5: Vapour pressure curves of commonly used organic solvents

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.

2.2.1.2 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

3.1 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		UKCA mark (only for UK)

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 Safety

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.

3.3 Responsibility of the operator

The operator is the person who uses the freeze-dryer for commercial or economic purposes or lets a third party use it and who bears the legal product responsibility for the protection of the users, personnel or third parties during operation.

Operating personnel

The operator is obliged to ensure that

- the persons working on/with the freeze dryer
 - have been specifically ordered to operate the system by the operator,
 - have been trained in terms of the operation of this system,
 - have been duly informed about the specific hazards associated with the system, supply media and starting/final products as well as about the correct conduct and necessary measures to take in the event of accidents or malfunctions,
 - are familiar with the fundamental health, safety and accident prevention regulations,
 - have read and understood this operating manual (in particular the safety sections and warning notes) and confirmed this with their signature.
- the areas of responsibility of the personnel concerning the operation, maintenance and care of the unit are clearly defined.
- the safety-conscious work of the personnel in compliance with the operating manual and the relevant EC health and safety directives and the national laws concerning health and safety and the prevention of accidents are checked at regular intervals (e.g. every month).

Work area

The operator must

- observe the system limits defined by the manufacturer in which a risk assessment for explosive atmospheres has been performed. The defined system limits include
 - the rotor chamber up to the pressure control valve, aeration and micro-injection valve block
 - the glass lid
 - the vacuum measurement technology.
- perform a risk assessment concerning potential accidents in connection with the rotational vacuum concentrator and take design-related countermeasures, if necessary.
- Perform a risk assessment in view of the specific hazards associated with the processing of the respective product in the rotational vacuum concentrator (e.g. ignition/explosion hazard, leakage of harmful product residues at the outlets of the chamber) and take the corresponding measures, if necessary.
- perform a compatibility test of all substances that are used in the rotational vacuum concentrator (both products to be dried and cleaning agents, etc.) that come into contact with chamber walls, pipes and seals. The use of substances that damage the material (stainless steel

3 Safety

1.4404 and 1.4435, aluminium, borosilicate glass, EPDM and PPS) or weaken the mechanical strength is prohibited.

- have the system maintained at regular intervals (see chapter 8 - "Maintenance and service").
- Any parts or components that are not in perfect working order must be replaced without delay.

3.3.1 Evaporation of solvent-containing products

With regards of corrosion resistance, the use of some organic in aqueous solutions with low concentrations is acceptable.

Under certain circumstances, the evaporation of products containing solvents may lead to the formation of explosive mixtures. This is why the operator must draw up special operating instructions/SOPs including precise instructions

- concerning the chamber pressure and temperature for every product that is to be processed in the RVC,
- concerning the inspection of the RVC in view of damage caused by the solvent that is used (see chapter 1.2.1 - "Evaporation of solvent-containing products (non-aqueous media)").

3.4 Requirements concerning the personnel



DANGER

Risk of injury if the personnel are not sufficiently qualified

If unqualified personnel perform work on the freeze-dryer or are present in the danger zone of the freeze-dryer, hazards result that can cause serious injuries and considerable damage to property.

- Ensure that all the tasks are performed by personnel with the corresponding qualifications.
- Ensure that unqualified personnel stay clear of the danger zones.



DANGER

Risk of fatal injury to unauthorised persons due to hazards in the danger zone or work area

Unauthorised persons who do not fulfil the requirements described herein are not aware of the hazards in the work area. This is why there is a risk of serious or even fatal injuries for unauthorised persons.

- Ensure that unauthorised persons stay clear of the danger zone and work area.
- If in doubt, address these persons and instruct them to leave the danger zone and work area.
- Interrupt any running work if unauthorised persons are present in the danger zone or work area.

This manual uses the following personnel qualifications for various areas of activity:

Qualified electrician

Due to their special training, knowledge, experience and familiarity with the relevant standards and regulations, qualified electricians are in the position to perform work on electrical systems and to autonomously identify and prevent possible hazards.

Qualified electricians have been specifically trained for the environment in which they work and they are familiar with all the relevant standards and regulations.

Qualified electricians must fulfil the requirements as set out in the applicable legal provisions concerning the prevention of accidents.

Specialised personnel

Due to their special training, knowledge, experience and familiarity with the relevant regulations, specialised personnel are in the position to perform any tasks assigned to them and to autonomously identify and prevent possible hazards.

Operating personnel

It must be ensured that persons operating the unit

- have been specifically ordered to operate the unit and made aware of dangers originating from the freeze-dryer, supply media, starting and end products by the operator,
- are familiar with the fundamental regulations concerning workplace safety and accident prevention
- have been trained in terms of the operation of this unit, and
- 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 Safety

3.6 Safety notes concerning the transport, set-up and connection and initial start-up of the freeze-dryer

The following notes and instructions must be observed in order to protect all persons and property.

3.6.1 General hazards



WARNING

General risk of injury

Among the general hazards during the transport, set-up, connection and commissioning of the unit are impact hazards, crushing hazards, grazing hazards, cutting hazards, etc.

This may lead to severe injuries.

- Comply with the fundamental health and safety rules and regulations as well as with the rules and regulations for the prevention of accidents!
- Wear personal protective equipment (safety shoes, work gloves and, if necessary, a hardhat)!

3.6.2 Hazards caused by improper transport



DANGER

Risk of injury caused by the uncontrolled movement of loads

Units that are not properly secured can, for example, slip or fall over.

- Prior to transporting the rotational vacuum concentrator, read the chapter (see chapter 4 - "Storage and transport")thoroughly!

3.6.3 Hazards caused by improper set-up



WARNING

Risk of injury due to poor accessibility of the unit

In cramped spaces or locations with poor accessibility, sharp edges and corners may protrude into the work area.

Injuries due to impact or abrasion may result.

- When setting up the rotational vacuum concentrator, ensure that it is freely accessible!
- Comply with the fundamental health and safety rules and regulations as well as with the rules and regulations for the prevention of accidents!

3.6.4 Hazards caused by an improper connection

**WARNING**

Risk of injury due to improper connections

Improper connections may lead to electrical malfunctions and failure when the unit is in operation.

This may lead to severe damage to health or even life-threatening injuries.

- The local supply voltage must match the voltage that is stated on the name plate of the unit.
- Do not position any hazardous materials, e.g. glass vessels containing liquids, within the 30 cm safety range around the unit. Spilled liquids can penetrate the unit and cause damage to the electrical and mechanical components.
- Do not store hazardous substances of any kind in the safety range around the rotational vacuum concentrator.
- Only qualified electricians are authorised to perform work on the electrical system of the unit!
- The electrical equipment of the unit must be checked at regular intervals.
- Defects such as loose connections or damaged cables must be eliminated immediately.

3.7 Safety notes concerning the operation

For the protection of persons and property, it is essential to observe the following instructions for operating the appliance.

**WARNING**

Risk of injury due to improper operation!

To ensure safe operation of the rotational vacuum concentrators, the following measures must be observed:

- Do not operate the rotational vacuum concentrator if it has not been installed properly!
- Never operate the rotational vacuum concentrator with accessories that are damaged.

3 Safety

3.7.1 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

Danger to life due to electric shock!

There is a risk of electric shock if live components are touched.

Ventricular fibrillation, cardiac arrest or respiratory paralysis may occur..

- 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.
- Never operate the rotary vacuum concentrator with the casing removed.

3.7.2 Hazards through the lid



WARNING

Danger of crushing when closing the lid!

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

3.7.3 Hazards due to damaged accessories



WARNING

Risk of injury due to chemically or mechanically damaged accessories

Even the smallest material fatigue, such as scratches or cracks, can lead to serious damage.

- Damaged rotors can cause a crash and, depending on the substance, harmful and hot substances may be released.
- Damaged accessories can cause glass breakage. This, in turn, may result in further damage to the unit and its accessories as well as to the loss of the samples.

3.7.4 Hazards due to hot surfaces**WARNING****Risk of burns on hot surfaces!**

During operation of the rotational vacuum concentrator, the housing, lid and rotor chamber of the unit can reach surface temperatures of over +50°C .

- Open and close the lid only at the thermally insulated lid handle!
- Limbs must not come into contact with hot appliance or accessory parts. There is a risk of burns!
- Wear heat-resistant gloves when inserting or removing the rotor!
- Do not touch the surfaces intentionally!
- Never operate the rotary vacuum concentrator with the casing removed!
- Let the chamber cool down before maintenance work!

3.7.5 Hazards due to flammable and explosive substances**DANGER****Hazards due to flammable and explosive substances!**

- Evaporating explosive or flammable substances is prohibited!
- Never operate the rotational vacuum concentrator in an explosive atmosphere!
- Do not evaporate substances that can create an explosive atmosphere!

3.7.6 Hazards caused by harmful products**DANGER****Risk of poisoning/infection caused by the products**

When loading and unloading the chamber, the personnel are exposed to the product.

Skin contact or the inhalation of particles may cause severe damage to health depending on the product in question.

- Wear suitable protective clothes, gloves and respiratory protection!

**DANGER****Risk of poisoning/infection caused by the products**

During the maintenance of parts coming into contact with the product (e.g. all of the parts inside the chambers and the vacuum pump), the personnel may be exposed to product residues.

Skin contact or the inhalation of particles may cause severe damage to health depending on the product in question.

- Take suitable decontamination measures prior to commencing maintenance!
- Wear suitable protective clothes, gloves and respiratory protection, if necessary!

3 Safety

3.7.7 Hazards caused by contaminated condensate (defrosting water)



WARNING

Danger of poisoning/infection due to contact with the condensate (defrosting water)

The condensate may contain harmful substances originating from the product.

Contact with the condensate may cause severe damage to health.

- Ensure the environmentally sound disposal of the condensate in compliance with the local rules and regulations!
- Wear suitable protective clothes, gloves and, if necessary, respiratory protection when performing maintenance tasks (especially when cleaning the valves and when replacing the seals)!

3.7.8 Safety instructions for evaporation

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



WARNING

- 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 6.4.2 - "Installation of accessories").

3.7.9 Hazards due to the evaporation of harmful precursors

If infectious, toxic, pathogenic or radioactive substances are to be evaporated, the user is responsible for ensuring that all applicable safety regulations, guidelines, precautions and safety measures are observed.



DANGER

Risk of poisoning/infection from the starting products!

- Infectious, toxic, pathogenic and radioactive substances may only be evaporated in suitable vessels. For your own protection, it is essential to take appropriate precautions!
- Do not evaporate corrosive raw materials (especially acidic substances) without special protective measures and equipment (e.g. additional cold trap to protect the vacuum pump). It is essential to consult the manufacturer (see chapter 7.2 - "Service contact").



DANGER

Explosion hazard due to azides!

- Special care must be taken when handling azides, as a dangerous explosive is formed in combination with copper or non-ferrous metals! It is essential to consult the manufacturer (see chapter 7.2 - "Service contact").
- Local measures for the containment of harmful emissions must be observed (depending on the substances to be dried).
- Heat-resistant gloves are required as protective clothing for operating the rotary vacuum concentrator. The material to be dried may require further safety measures (e.g. drying of infectious, toxic, radioactive or pathogenic substances).).

3 Safety

3.8 Safety devices



WARNING

The safety devices have been installed to protect the personnel using the unit against injury.

If all of the safety devices are not fully functional **and** if all of the operating elements are not freely accessible, serious health damage may result.

- The safety-relevant operating elements (mains power switch) must be accessible at all times!
- Do not manipulate, remove or disable the safety devices or guards in any way!
- The correct operation of the safety devices must be checked at regular intervals in accordance with the applicable national and international laws, rules and regulations concerning health and safety and the prevention of accidents!

3.8.1 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.

3.8.2 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").

3.8.3 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.

3.8.4 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.

3.9 Procedures in the event of hazards and accidents

Hazardous electrical incident:

- Switch the mains switch off in order to interrupt the power supply completely.

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!

Unconsciousness/paralysis due to nitrogen or refrigerant:

- While ensuring your **own safety** (e.g. self-contained breathing apparatus) remove the affected persons to fresh air. Keep them warm and calm. **Get medical attention immediately!** In case of respiratory arrest, give artificial respiration.

Electric shock:

- While ensuring your **own safety**, interrupt the circuit as quickly as possible (mains switch at the right side of the freeze-dryer). Keep the affected persons warm and calm. **Get medical attention immediately!** Check consciousness and breathing continuously. In the case of unconsciousness or lack of normal breathing, perform cardiopulmonary resuscitation (CPR).

Burns:

- Cool small-area burns (e.g. finger) immediately with cold water for approximately 2 minutes.
- Do not cool if larger areas of the body surface are burnt since there is a risk of hypothermia.
- Cover the burns loosely and in a sterile manner (e.g. with sterile dressing).
- Keep the affected persons warm and calm.

Chemical burns:

- Eyes:
Rinse the eyes thoroughly with plenty of water with the lid gap wide open for at least 15 minutes (eyewash bottle). **Consult an ophthalmologist immediately** even if there are no immediate symptoms. If possible, continue rinsing the eyes during the transport to the ophthalmologist.
- Respiratory tract:
While using a **suitable breathing apparatus**, remove the affected persons to fresh air. Keep them warm and calm. **Get medical attention immediately!** In case of irregular breathing or respiratory arrest, give artificial respiration.
- Skin:
Wash with plenty of water. Remove contaminated clothing. Rinse the

3 Safety

affected skin areas under flowing water for at least 10 minutes. **Get medical attention immediately!**

- Oesophagus:

Do not put anything into the mouth of an unconscious person. Wash the mouth out with water. If the person is conscious: Give the affected person plenty of water to drink (2 glasses maximum). Do not induce vomiting. In case of spontaneous vomiting, keep the head of the affected person lying on his/her stomach low in order to prevent any liquid from entering the respiratory tract. **Get medical attention immediately!**

IF IN DOUBT; CALL AN EMERGENCY PHYSICIAN!

3.10 Maintenance and cleaning of the rotational vacuum concentrator

The substances and materials that are used must be properly handled and disposed of (Please refer to the safety data sheets!). This particularly applies to

- the handling of lyes and acids.

Compliance with the national rules and regulations must be ensured.

3.11 Measures to ensure the safe operation of the rotational vacuum concentrator

To ensure the safe operation of the rotational vacuum concentrator, the following measures must be taken prior to using the unit:

Set-up, connection and operation

- Ensure the proper set-up and correct connection of the rotational vacuum concentrator (see chapter 5 - "Set-up and connection").
- Perform a visual inspection of the rotational vacuum concentrator and its accessories prior to every use in order to detect damage.
- Do not bump or move the rotational vacuum concentrator during operation.
- Do not lean on or against the rotational vacuum concentrator during operation.
- Take the rotational vacuum concentrator immediately out of operation in the event of malfunctions. Eliminate the faults (see chapter 7 - "Malfunctions and error correction") or contact the service department of Martin Christ Gefriertrocknungsanlagen GmbH (see chapter 7.2 - "Service contact").
- Only specialised personnel are authorised to perform repairs.

Fire protection

- Some of the electrical circuits of the rotational vacuum concentrator are protected by way of fuses. When replacing the fuses, ensure to use fuses of the same type and rating.

Safety range

- Keep a safety range of at least 30 cm free around the rotational vacuum concentrator.
- Do not store hazardous substances of any kind in the safety range around the rotational vacuum concentrator.
- Do not position any potentially hazardous materials, e.g. glass vessels containing liquids, within the safety range. Spilled liquids can penetrate the unit and cause damage to the electrical and mechanical components.
- Persons must not remain in the safety area of the rotational vacuum concentrator for longer than is necessary for operation.

Accessories

- Do not use the rotational vacuum concentrator with damaged accessories.
- Observe the limit values concerning the load capacity of the accessories.
- Only use accessories that have been approved by Martin Christ Gefriertrocknungsanlagen GmbH. This does not apply to commercially available vessels made of glass or plastic. We explicitly warn against the use of equipment of poor quality! Breaking glass or bursting vessels can cause dangerous situations during the evaporation process.

Handling of hazardous substances

- The generally applicable regulations for handling flammable substances in laboratories/workplaces must be observed.
- The appropriate safety precautions must be observed during sample preparation as well as during the loading and unloading of the rotational vacuum concentrator.
- Be careful when handling hazardous substances such as strong acids or bases, radioactive substances and volatile organic compounds: If these types of substances leak or spill, they must be cleaned up immediately.
- If samples containing hazardous substances such as strong acids or bases, radioactive substances or volatile organic compounds leak or spill inside a chamber, they must be promptly cleaned up.
- Be careful when handling solvents: Sources of ignition must be kept away.
- When using flammable or hazardous solvents, the vacuum pump must be vented to or operated inside a fume hood.

3 Safety

3.12 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. 6: 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



incorrect



Fig. 7: Lifting the RVC

4 Storage and transport

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

correct



incorrect



Fig. 8: 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 Type of connection



Danger to life due to electric shock!

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

Christ rotational vacuum concentrators are units of protection class I. Rotational vacuum concentrators of this type have a three-wire power cord with an IEC C13 connector.



The removable power cord must not be replaced with a power cord of inadequate rating!

An equipotential bonding screw is located on the back (see chapter 10 - "Technical data"), This equipotential bonding screw can be used to perform an earth conductor check.

(see chapter 2.1.1 - "Functional and operating elements")

5.2.2 Customer-provided fuses

Sufficiently rated fuse protection of the rotational vacuum concentrator in the electrical system of the building is required.

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 pumps

To ensure its intended use, the rotational vacuum concentrator RVC 2-18 CDplus must be used with one of the following vacuum pumps:



The dimensioning of the vacuum pump depends on the accessories installed on the system.

- Diaphragm pump Vacuubrand MZ 2C
- Diaphragm pump Vacuubrand MZ 2C with AK/EK
- Diaphragm pump Vacuubrand MZ 2C Vario
- Diaphragm pump Vacuubrand MD 4C with AK/EK

5 Set-up and connection

5.5 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

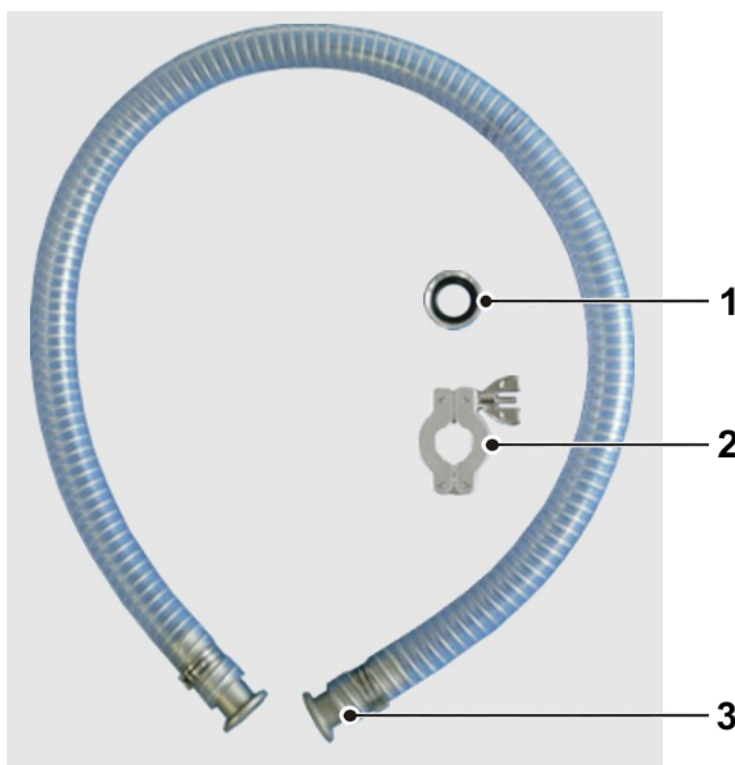


Fig. 9: Connecting pieces for vacuum connection

5.6 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.

5.6.1 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

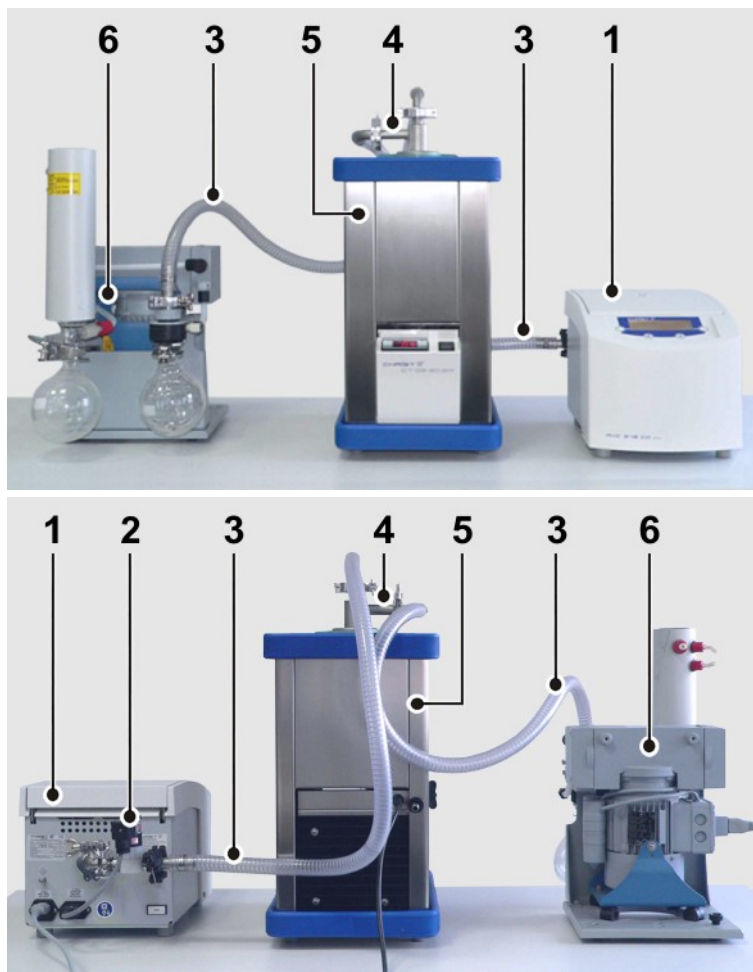


Fig. 10: Combination of the RVC with vacuum pump and cooling trap, front and rear view

5 Set-up and connection

5.6.2 Condensation of the vapours in a cooling trap

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

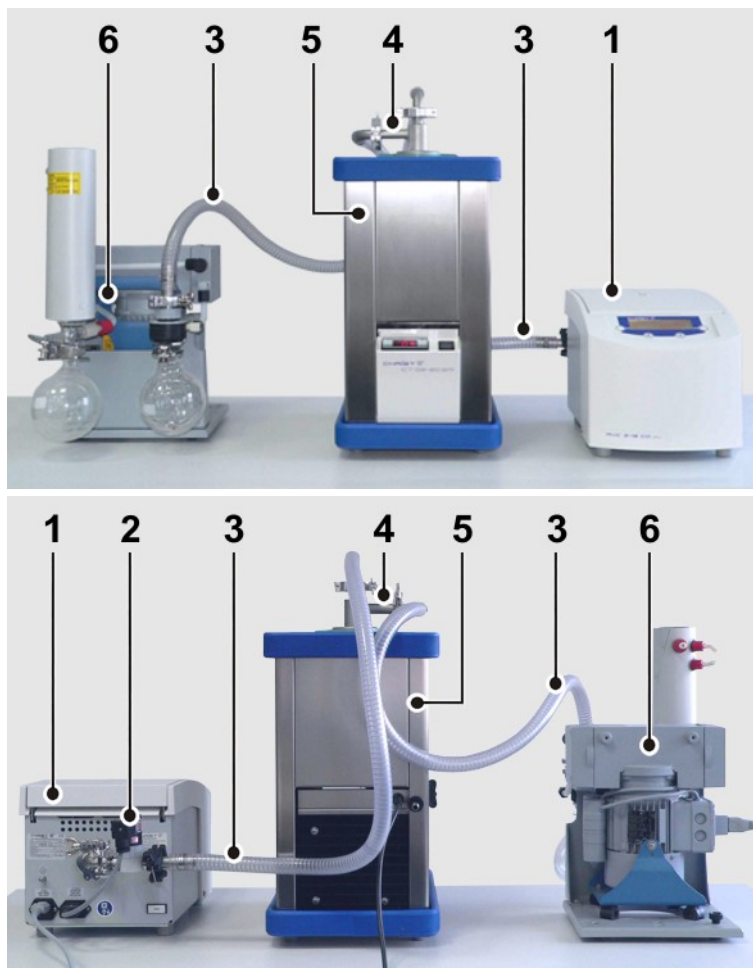


Fig. 11: Combination of the RVC with vacuum pump and cooling trap, front and rear view

5.7 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 5.6 - "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)!

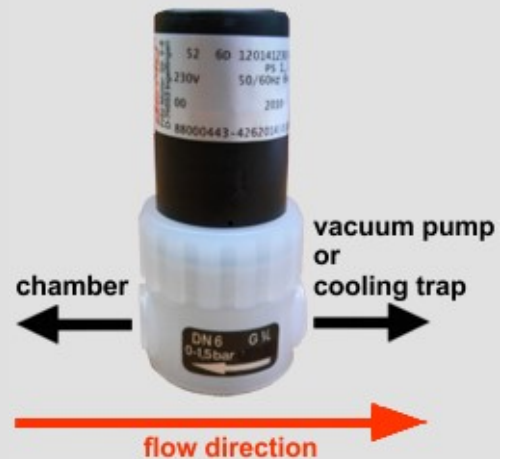


Fig. 12: Gemü solenoid valve, type 52 (DN6)

6 Operation

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.



Danger of crushing when closing the lid!

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

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.



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")!

6 Operation

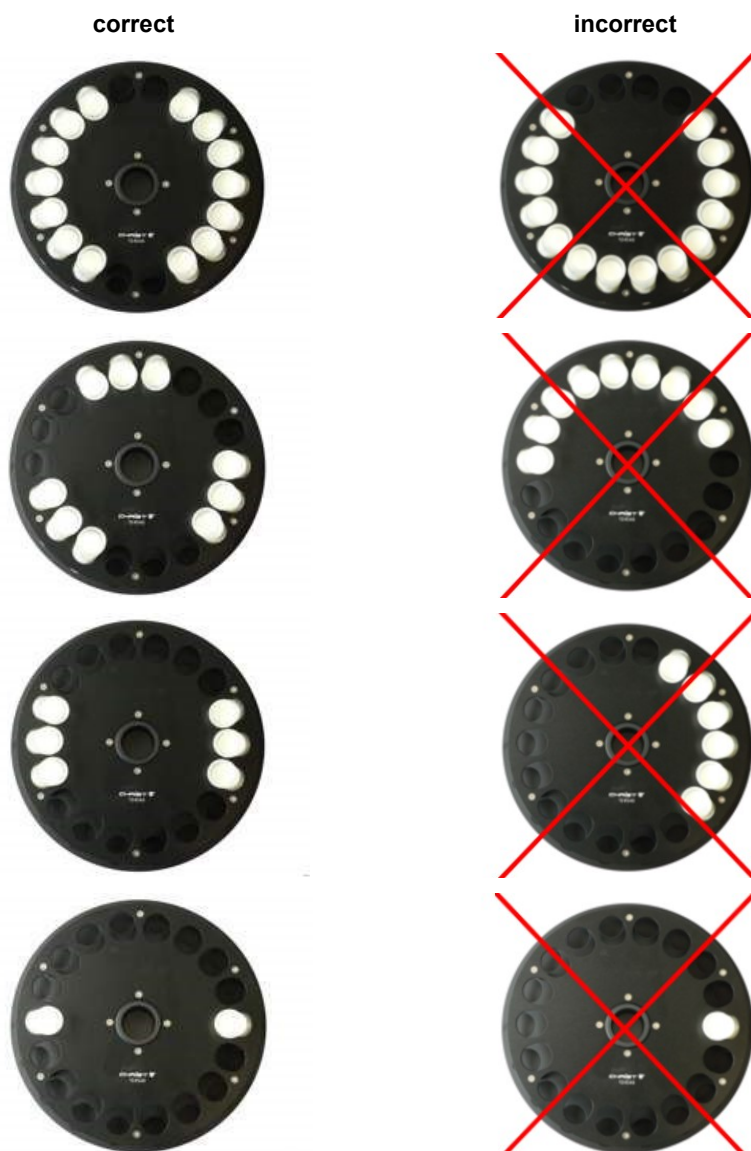


Fig. 13: Symmetrical loading of angle rotors

6.4.2 Installation of accessories

- 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.

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.

Evaporation with low capacity

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

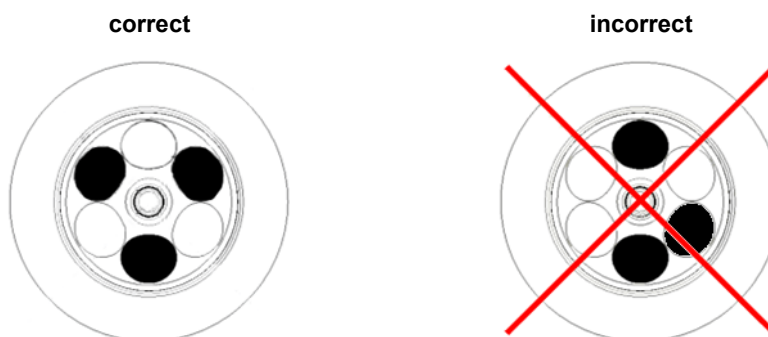


Fig. 14: Permissible loading of angle rotors with low capacity

6.4.2.1 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 Operation

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

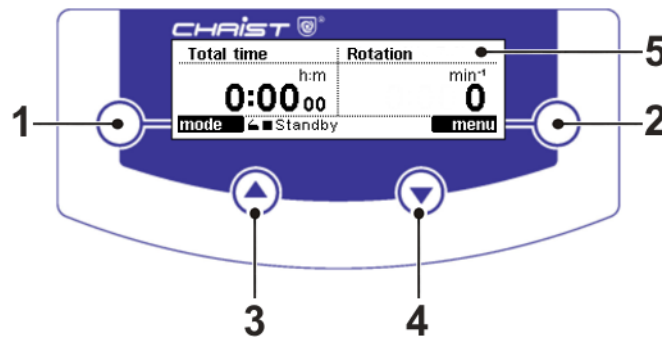


Fig. 15: User interface of the CDplus control system

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. 16: 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.

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 Operation

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

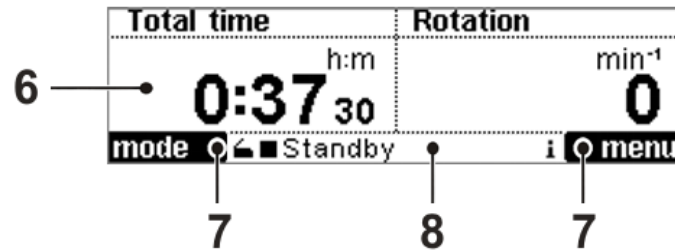


Fig. 17: Structure of the CDplus display

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

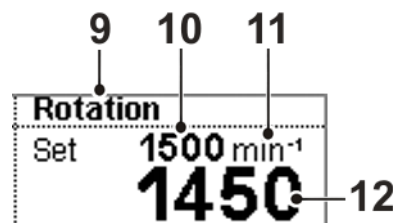


Fig. 18: Values window

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

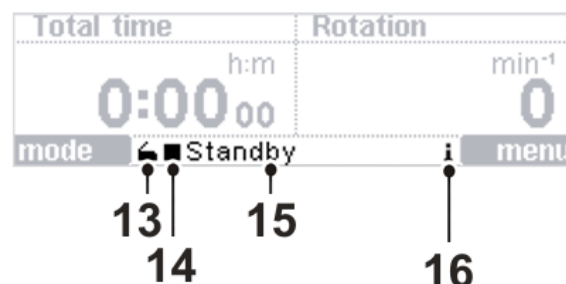


Fig. 19: Status bar

6 Operation

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")

6.5.2 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.

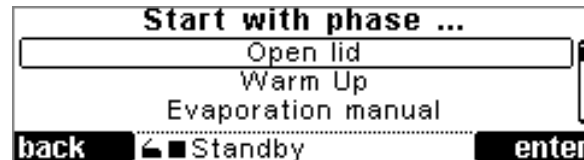


Fig. 20: Selecting the mode

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:

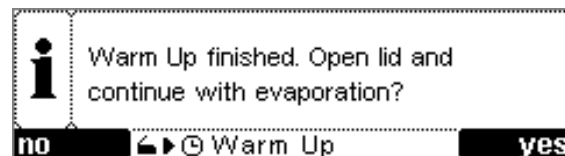


Fig. 21: Message after the warm-up

- 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:

6 Operation

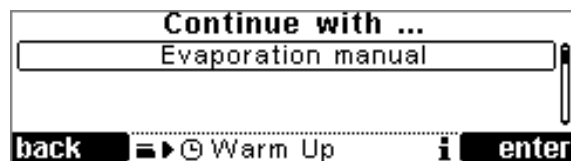


Fig. 22: Selection for continuing the evaporation

- 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.

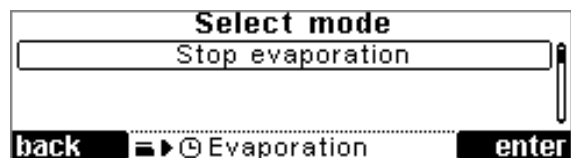


Fig. 23: Stopping an evaporation process

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.

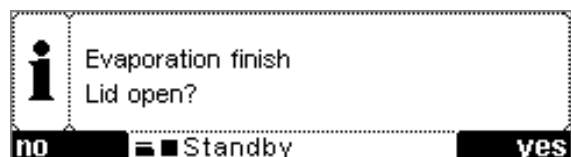


Fig. 24: Message after stopping an evaporation process

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“

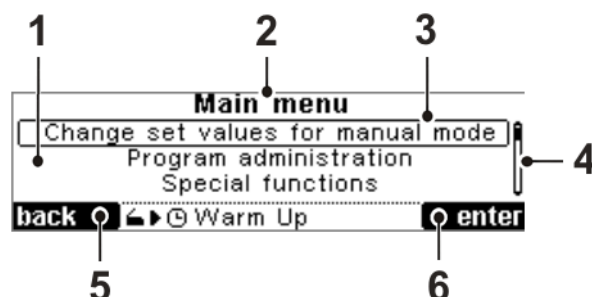


Fig. 25: Structure of the main menu

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. 26: 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. 27: 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.

6 Operation

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

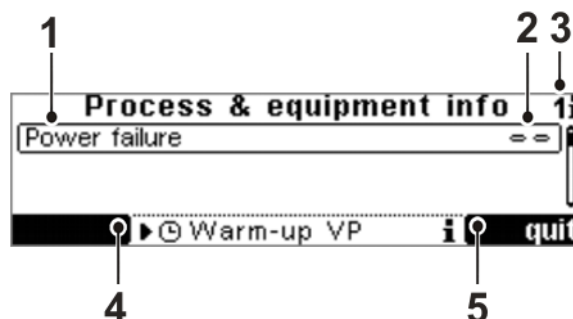


Fig. 28: Structure of the process & equipment info window

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".

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. 29: 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.

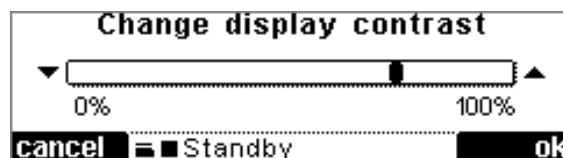


Fig. 30: Changing the contrast

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. 31: Selecting a language

6 Operation

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.

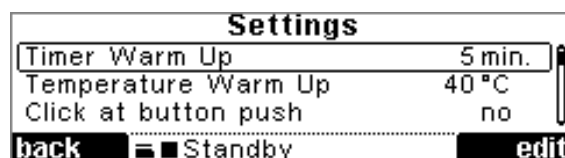


Fig. 32: Settings menu

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 $1/10^{\circ}\text{C}$ (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.

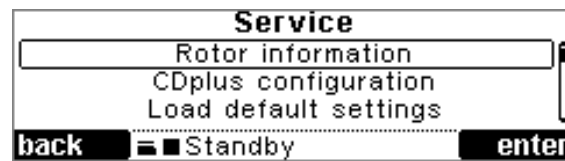


NOTE

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.

Service menu*Fig. 33: 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 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	• The rotor chamber is not aerated completely	• Aerate the rotor chamber completely
Lid contacts error	• 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.	• Check the lid contacts. If necessary, contact the after-sales service (see chapter 7.2 - "Service contact")
Rotor overtemperature	• The maximum permissible rotor temperature has been exceeded	• 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	• The maximum permissible chamber temperature has been exceeded.	• 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	• The rotor will be stopped immediately, the process will also be stopped. – improper loading of the rotor – glass breakage during the evaporation – uneven evaporation	• 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	• Incorrect calibration of the vacuum sensor VSK3000	• 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	A mains power failure will be detected if the power supply is interrupted under normal conditions (run mode).	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	All parameters are reset to the delivery status of the system.	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	- After two minutes, the rotor has still not reached 90% of its nominal speed. - set speed is too high - drive moves sluggishly	- 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	The safety pressure inside the rotor chamber must be reached within 5 minutes after the start of an evaporation process.	- 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		Contact the after-sales service (see chapter 7.2 - "Service contact").
IO communication error 0x21	Failure of the CDplus IO module	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	Failure of the reading unit of the electronic rotor system	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	Failure of the motor control system	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	Failure of the imbalance detection module	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. 34: 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

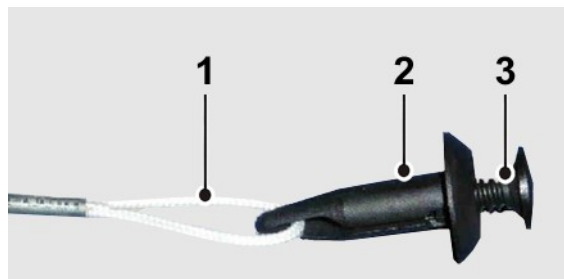


Fig. 35: Release string with stopper and screw

7 Malfunctions and error correction

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



Fig. 36: 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.

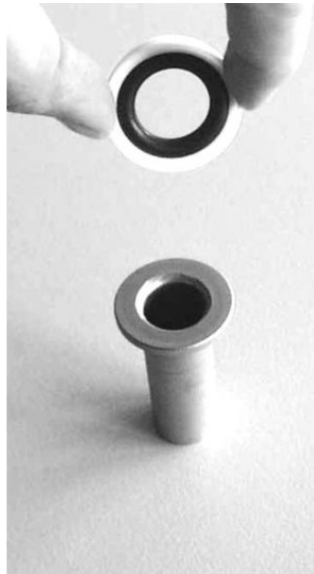


Fig. 37: Small flange and centring ring

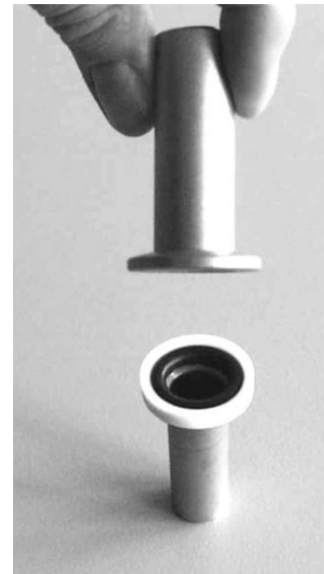


Fig. 38: Small flange with centring ring and small flange



Fig. 39: Attaching the clamping ring



Fig. 40: Tightened clamping ring

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]



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

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 General

The general state of the freeze-dryer must be checked at regular intervals. Any defects must be eliminated immediately! The following points are of particular importance:

- dirt
- leaks
- corrosion
- bent system components
- loose screw and flange connections
- higher noise levels
- loose cables
- missing or illegible safety notes and hazard warnings
- missing or illegible inscriptions on components, pipes (direction of flow) and cables
- etc.

8 Maintenance and service

Cleaning of the rotational vacuum concentrator



WARNING

Risk of burns on hot surfaces

After a drying process, some or all of the surfaces inside the chamber may still be hot.

There is a risk of burns when touching the surfaces.

- Wear suitable protective clothes and gloves!
- Do not touch the surfaces on purpose!
- Let the chamber cool down prior to commencing the maintenance!



DANGER

Risk of poisoning/infection caused by the products

When performing maintenance work on parts coming into contact with the product (e.g. all parts inside the chamber), the personnel may be exposed to product residues.

Skin contact or the inhalation of particles may cause severe damage to health depending on the product in question.

- Take suitable decontamination measures prior to commencing the maintenance!
- Wear suitable protective clothes and gloves!

- Switch the rotational vacuum concentrator off by actuating the mains power switch and disconnect the power cord from the wall outlet before cleaning.
- If the freeze-dryer has been contaminated with toxic, radioactive, or pathogenic substances, clean the inside immediately with a suitable decontamination agent (depending on the type of contamination, see (see chapter 8.2 - "Disinfection of the rotor chamber and accessories")).
- Remove product residues thoroughly with a cloth.
- Open the lid/ rotor chamber when the rotational vacuum concentrator is not in use so 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

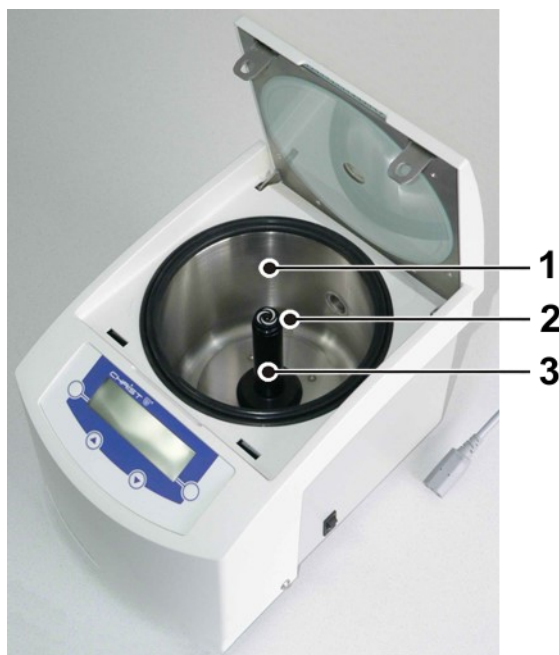


Fig. 41: Rotor chamber with rotor shaft

- 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

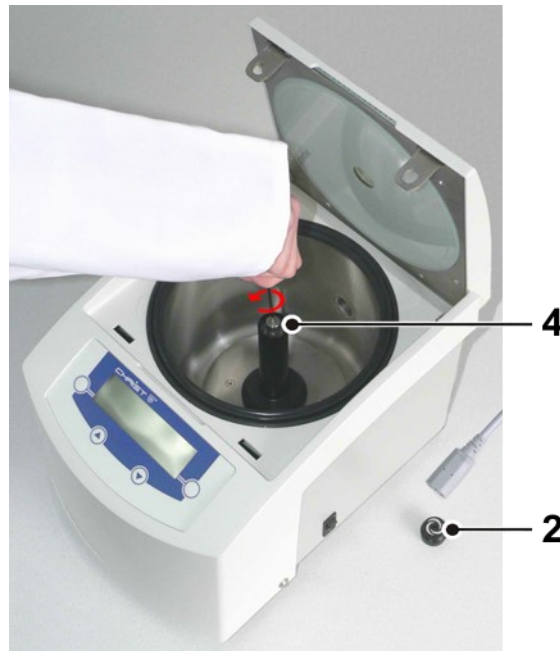


Fig. 42: Removing the countersunk screw

- 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.

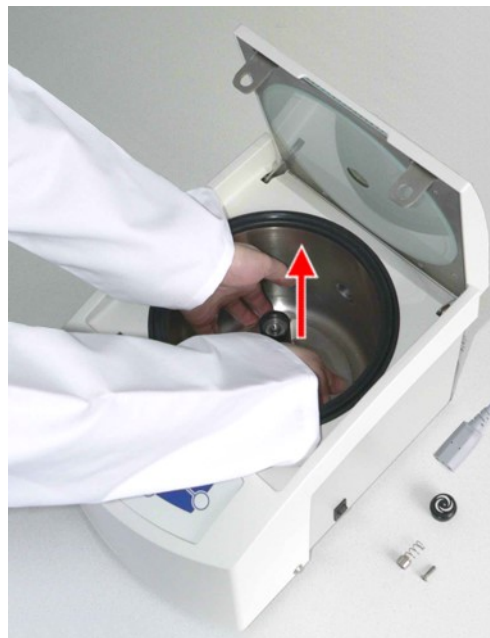


Fig. 43: Removing the rotor shaft

- 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. 44: 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

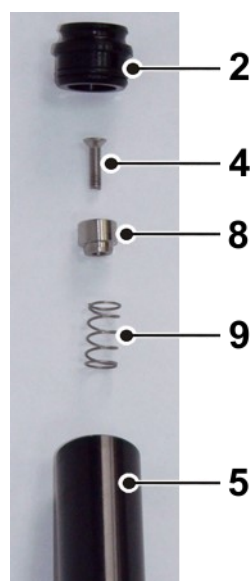


Fig. 45: Rotor shaft with thrust piece and compression spring

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



DANGER

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

- 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").

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 to life due to electric shock!

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]



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 specialist personnel only.
- Affix the original form in a clearly visible manner to the outside of the packaging.



We will return the part/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 defective part/unit. Please note that you must bear the incurred costs.



The part/unit must be packaged in a transport-safe manner. Please use the original packaging for the unit, 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 centrifuge



In accordance with the directive 2012/19/EU, Martin Christ Rotational Vacuum Concentrator are marked with the symbol shown to the left. This symbol means that it is not permissible to dispose of the unit among household waste.

- You can return these centrifuges free of cost to Martin Christ Gefriertrocknungsanlage GmbH.
- Ensure that the unit is decontaminated. Fill in a declaration of decontamination.
- Comply with any other applicable 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
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

- Use in closed spaces
- Altitudes up to 2,000 m
- Ambient temperature between +5°C and +25°C
- Maximum relative humidity of 80%
- Mains voltage fluctuations of up to $\pm 10\%$ of the rated voltage

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 (RVC 2-18 and RVC 2-25)

	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

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	Vessel	Number of samples	Sample volume (ml)	Temperature (°C)	Pump	Cooling trap	Total time (min)
Tert. butanol C ₄ H ₁₀ O	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 CH ₃ OH	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 C ₂ H ₆ O	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 C ₂ H ₄ Cl ₂	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

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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:

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- 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

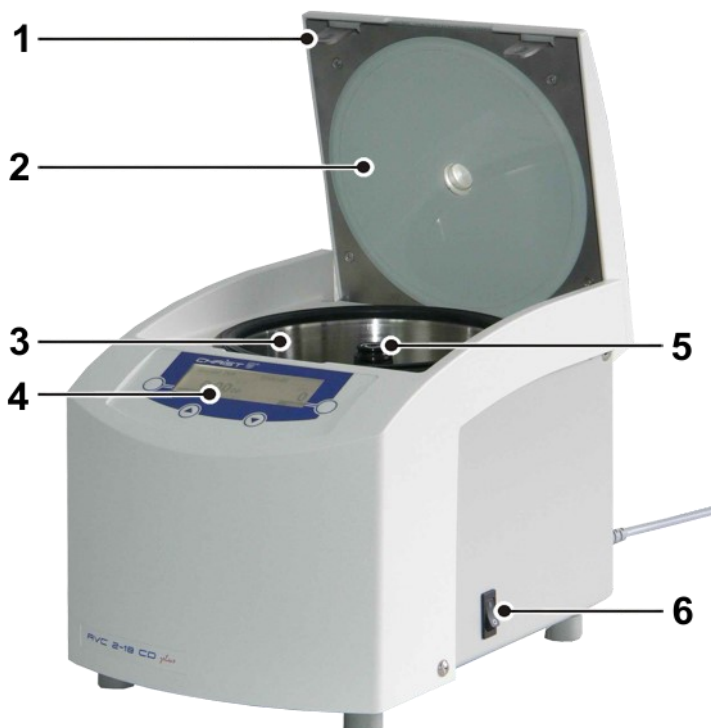


Fig. 46: Total view of the Rotational Vacuum Concentrator

- 7 Name plate
- 8 Equipotential bonding screw
- 9 Connection for mains cable, with a fuse drawer
- 10 Electrical connection of the stop valve
- 11 Vacuum connection
- 12 Connection for aeration



Fig. 47: Rear view of the Rotational Vacuum Concentrator

11 Appendix

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>	2006/42/EG Machinery Directive 2014/35/EU Low Voltage Directive 2014/30/EU EMC Directive

Martin Christ Gefriertrocknungsanlagen GmbH

An der Unteren Söse 50
37520 Osterode
Germany

Authorised representative
for CE matters:
S. Krippendorff

Osterode, 18/02/2016



M. Christ, Management

CE_MaschRL_RVC2-18_CDplus_2015-12-14_en.docx

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11.5 UKCA declaration of conformity



UKCA – DECLARATION OF CONFORMITY

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

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.

Product name:	Rotational Vacuum Concentrator
Product type:	RVC 2-18 CDplus
Order number:	100248
Manufacturer:	Martin Christ Gefriertrocknungsanlagen GmbH An der Unteren Söse 50 37520 Osterode am Harz Germany
Directives:	Supply of Machinery (Safety) Regulations 2008 Electrical Equipment (Safety) Regulations 2016 Electromagnetic Compatibility Regulations 2016 Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations 2012
Normes:	DIN EN 378-1:2021-06 DIN EN 378-2:2018-04 DIN EN 378-3:2020-12 DIN EN 61010-1:2020-03 DIN EN IEC 61000-6-2:2019-11 DIN EN IEC 61000-6-3:2022-06 DIN EN 55011:2022-05

UK Authorised Representative:



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Osterode, 13/12/2022



Dr. F. Harms, Management

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11.6 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 LSCbasic, Alpha 2-4 LSCbasic, Alpha 3-4 LSCbasic, Alpha 1-4 LSCplus, Alpha 2-4 LSCplus, Beta 1-8 LSCbasic, Beta 2-8 LSCbasic, 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

Cooling trap models: CT 02-50 SR, CT 04-50 SR

Cooling bath model: CB 18-40

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⁾	O	O	O	O	O
Display	O	O	O	O	O	O
Housing	X ²⁾	O	O	O	O	O
Base, metal, accessories	X ²⁾	O	O	O	O	O

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

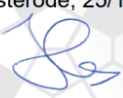
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- O: 表示该有害物质在该部件所有均质材料中的含量均在GB/T 26572规定的限量要求以下。
Indicates that the content of the harmful substance in all homogeneous materials of the component part is below the limit as defined in GB/T 26572.)
- X: 表示该有害物质至少在该部件的某一均质材料中的含量超出GB/T 26572规定的限量要求。（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 26752. (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, 25/11/2021

F. Harms, Management

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.

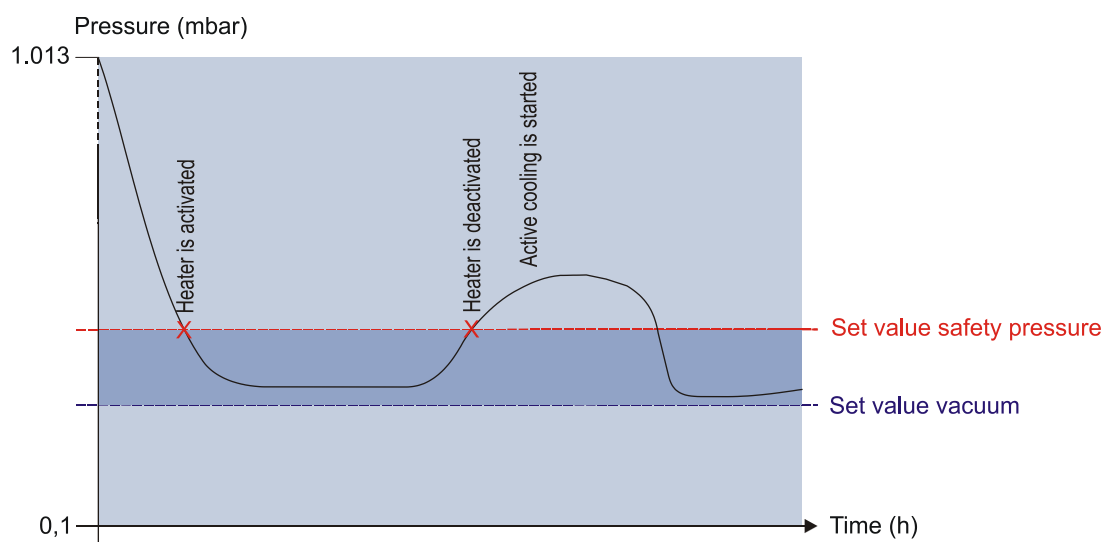


Fig. 48: Diagram describing the safety pressure function

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