Operation Manual
Rotavapor®
R-210/215

BÜCHI
SWITZERLAND

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Read this manual carefully before installing and running your system and note the safety precautions in chapter 2 in particular. Store the manual in the immediate vicinity of the instrument, so that it can be consulted at any time.

No technical modifications may be made to the instrument without the prior written agreement of BUCHI. Unauthorized modifications may affect the system safety or result in accidents.

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The English manual is the original language version and serves as basis for all translations into other languages. Other language versions can be downloaded at www.buchi.com.

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1 About this manual

This manual describes the Rotavapor and provides all information required for its safe operation and to maintain it in good working order.
It is addressed in particular to laboratory personnel and operators.

NOTE
The symbols pertaining to safety (WARNINGS and ATTENTIONS) are explained in chapter 2.

1.1 Reference documents

For information on the Vacuum Controller V-850/855 and the Vacuum Pump V-700/710, please refer to the corresponding manuals available in English, German, French, Spanish and Italian:

- Vacuum Controller, Operating Manual numbers 93081–93085
- Vacuum Pump, Operating Manual numbers 93090–93094

1.2 Trademarks

The following product names and any registered and unregistered trademarks mentioned in this manual are used for identification purposes only and remain the exclusive property of their respective owners:

- Rotavapor® is a registered trademark of BÜCHI Labortechnik AG

1.3 Abbreviations

FFKM: Perfluoroelastomer
PTFE: Polytetrafluoroethylene
NBR: Butadiene-acrylonitrile rubber
P+G: PLASTIC + Glass is a unique protective layer for glass components. It offers improved mechanical rupture resistance and increases protection against broken glass. It also makes sure that the sample is not lost in the receiving flask, if the flask is damaged.
PBT: Polybutylene Terephthalate
Rpm: Rotations per minute

2 Safety

This chapter points out the safety concept of the instrument and contains general rules of behavior and warnings from hazards concerning the use of the product.
The safety of users and personnel can only be ensured if these safety instructions and the safety-related warnings in the individual chapters are strictly observed and followed. Therefore, the manual must always be available to all persons performing the tasks described herein.

2.1 User qualification

The instrument may only be used by laboratory personnel and other persons who on account of training or professional experience have an overview of the dangers which can develop when operating the instrument.
Personnel without this training or persons who are currently being trained require careful instruction. The present Operation Manual serves as the basis for this.

2.2 Proper use

The instrument has been designed and built for laboratories. It serves for activities associated with evaporation of solvents.

It is used for:

- Distilling solvents
- Vaporizing of solvents
- Recrystallization
- Synthesis and cleaning of chemicals
- Soxhlet extractions
- Drying powders by means of the drying flask

The instrument can only be operated properly together with a heating bath.

2.3 Improper use

Applications not mentioned above are improper. Also, applications, which do not comply with the technical data, are considered improper. The operator bears the sole risk for any damages caused by such improper use.

The following uses are expressly forbidden:

- Use of the instrument in rooms which require ex-protected instruments.
- Use as a calibrating instrument for other instruments.
- Determination of samples, which can explode or inflame (example: explosives, etc.) due to shock, friction, heat or spark formation.
- Use in overpressure situations.
- Use of unappropriate water or oil baths, especially the use of heating sources with temperatures above 180 °C (e.g. a Bunsen burner, etc.).
- Processing of hard, brittle materials (e.g. stones, soil samples, etc.), which can lead to the destruction of the evaporating flask.
- Use with a sample weight of more than 3 kg within the evaporating flask.

2.4 Warning notices used in this manual

WARNING
Generally, the triangular warning symbol indicates the possibility of personal injury or even loss of life if the instructions are not followed.

WARNING
Hot surface.

WARNING
Electrical hazard.

WARNING
Biohazard.

ATTENTION
With the general "Read this" symbol, ATTENTIONs indicate the possibility of equipment damage, malfunctions or incorrect process results, if instructions are not followed.

NOTE
Useful tips for the easy operation of the instrument.

2.5 Product safety

The Rotavapor is designed and built in accordance with current state-of-the-art technology. Nevertheless, risks to users, property, and the environment can arise when the instrument is used carelessly or improperly.

The manufacturer has determined residual dangers emanating from the instrument

- if the instrument is operated by insufficiently trained personnel.
- if the instrument is not operated according to its proper use.

Appropriate warnings in this manual serve to make the user alert to these residual dangers.

2.5.1 Instrument-related hazards

Pay attention to the following safety notices:

WARNING
Potentially hot surfaces during operation, especially at the water or oil bath (up to 180 °C).

- *Always be aware of the risk of being burned.*
- *When using an oil bath, make sure that no water gets into the bath otherwise there is a serious risk of being splashed by hot oil.*

WARNING
Potential implosion risk if used with damaged glassware.

Risk of electrostatic discharge when the rotary evaporator is filled with solvents, e.g. via the feeding tube, or when drying powders are used.

- *Beware of damaged or cracked glass parts.*
- *Beware of the fire hazard.*

WARNING

Potential explosion risk if solvent vapors accumulate within the instrument housing.

- *Always use the instrument in a well ventilated area.*
- *Beware of damaged or cracked glass parts.*
- *Beware of the fire hazard.*

2.5.2 Other hazards

WARNING

Certain solvents in or in the vicinity of the Rotavapor can form peroxides and/or are highly inflammable.

- *Always be aware of the explosion risk when working with hazardous substances or with substances of unknown composition.*
- *Always provide a good ventilation within or in the vicinity of the system.*

2.5.3 Safety measures

Always wear personal protective equipment such as protective eye goggles, protective clothing and gloves when working with the instrument.

2.5.4 Safety elements

Electronics

- The heating bath is equipped with a mechanical and an electronic over-temperature protection.
  The mechanical over-temperature protection consists of a bimetal thermostat that, in case of over-temperature (over 260 °C), directly interrupts the power supply. It has to be set back manually after the bath has cooled down (see also chapter 8).
  The electronic over-temperature protection controls the temperature limit (actual bath temperature may not exceed the given temperature by 2 °C for more than 2 minutes), the heating rate (actual temperature may not rise by more than 5 °C during 5 seconds) and the function of the temperature sensor.
- The heating bath is equipped with safety fuses.
- Electronic control of the heating bath temperature - to prevent the product from overheating

Parts in direct contact with the instrument

- Safety catch for adjusting the immersion depth of the evaporating flask into the heating bath.
- Combi Clips for fixing the evaporating flask and for safe removal of fixed ground-glass joints.
- Ball joint clip for safe fixing of the receiving flask.
- Rods and holders for fixing the glass assemblies.
- Electronic over-current protection at the drive unit and lift motor.
- Safety spring preventing the vapor duct from dropping out.
- Automatic raising of the flask from the heating bath in case of a power failure.

Glass

- Use of high quality, inert 3.3 borosilicate glass.
- Use of tube clips GL-14 for preventing glass breakage.

Optional

- P+G is a unique protective layer for glass components. It offers improved mechanical damage resistance and increases protection against broken glass. It also makes sure that the solvent in the receiving flask is not spilling, if the flask is damaged.
- The protective shield (optional accessory) protects operators from broken glass, solvent splashes and hot heating medium in case of accidents or an implosion.
- With the support rod the condenser can additionally be clamped.

2.6 General safety rules

Responsibility of the operator

The head of laboratory is responsible for training his personnel.
The operator shall inform the manufacturer without delay of any safety-related incidents which might occur during operation of the instrument. Legal regulations, such as local, state and federal laws applying to the instrument must be strictly followed.

Duty of maintenance and care

The operator is responsible for ensuring that the instrument is operated in proper condition only, and that maintenance, service, and repair jobs are performed with care and on schedule, and by authorized personnel only.

Spare parts to be used

Use only genuine consumables and genuine spare parts for maintenance to assure good system performance and reliability. Any modifications to the spare parts used are only allowed with the prior written permission of the manufacturer.

Modifications

Modifications to the instrument are only permitted after prior consultation with and with the written approval of the manufacturer. Modifications and upgrades shall only be carried out by an authorized BUCHI technical engineer. The manufacturer will decline any claim resulting from unauthorized modifications.

3.3 Technical data overview

Table 3-5: Technical data

	R-210 Rotavapor without display	R-215 Rotavapor with display	B-491 Heating bath	B-495 Heating bath
Glass assemblies	A, V, C, S, E, CR, BY			
Dimensions (W x H x D)	550 x 575 x 415 mm		285 x 240 x 300 mm	310 x 230 x 320 mm
Weight	16 – 18 kg (depending on the glass assembly)		4 kg	5 kg
Connection voltage	100 – 240 V ± 10%		100 – 120 V or 220 – 240 V ± 10%	
Mains connection	3-pole (P, N, E) via power cord		3-pole (P, N, E) via power cord	
Frequency	50 / 60 Hz		50 / 60 Hz	
Heating power			1300 W	
Power consumption	max. 60 W		max. 1700 W	
Installation category	II		II	
Degree of protection	IP21		IP21	
Pollution degree	2		2	
Rotation speed range	20 – 280 rpm			
Flask size	50 – 4000 ml		up to 4000 ml	up to 5000 ml
Max. flask content	3 kg			
Temperature control range			20 °C – 180 °C	20 °C – 95 °C
Display		Rotation speed / vapor temperature	Set / actual temperature	
Temperature accuracy			± 3 °C	
Environmental conditions Temperature Altitude Humidity	for indoor use only 10 – 40 °C up to 2000 m maximum relative humidity 80% for temperatures up to 31 °C, and then linearly decreasing to 50% at 40 °C			
Bath content			4 l	5 l
Vacuum tightness of system with 1 l evapo-rating and 1 l receiving flask	5 mbar per 3 minutes at a pressure of < 10 mbar			
Temperature resistance P+G	ca. -70 °C – 60 °C			
Temperature resistance P+G low temperature	-80 °C – 50 °C			
Temperature resistance protective shield	< 160 °C			

3.4 Solvent table

Table 3-6: Solvent table

Solvent	Formula	Molar mass in g / mol	Evaporation energy in J / g	Boiling point at 1013 mbar	Density in g / cm3	Vacuum in mbar for boiling point at 40 °C
Acetone	CH_3H_6O	58.1	553	56	0.790	556
n-amylalcohol, n-pentanol	C_5H1_2O	88.1	595	37	0.814	11
Benzene	C_6H_6	78.1	548	80	0.877	236
n-butanol	$C_4H_{10}O$	74.1	620	118	0.810	25
tert. butanol (2-methyl-2-propanol)	$C_4H_{10}O$	74.1	590	82	0.789	130
Chlorobenzene	C_6H_5Cl	112.6	377	132	1.106	36
Chloroform	$CHCl_3$	119.4	264	62	1.483	474
Cyclohexane	C_6H_{12}	84.0	389	81	0.779	235
Diethylether	$C_4H_{10}O$	74.0	389	35	0.714	atmospheric
1,2-dichloroethane	$C_2H_4Cl_2$	99.0	335	84	1.235	210
1,2-dichloroethylene (cis)	$C_2H_2Cl_2$	97.0	322	60	1.284	479
1,2-dichloroethylene (trans)	$C_2H_2Cl_2$	97.0	314	48	1.257	751
Diisopropyl ether	$C_6H_{14}O$	102.0	318	68	0.724	375
Dioxane	$C_4H_8O_2$	88.1	406	101	1.034	107
DMF (dimethyl-formamide)	C_3H_7NO	73.1		153	0.949	11
Acetic acid	$C_2H_4O_2$	60.0	695	118	1.049	44
Ethanol	C_2H_6O	46.0	879	79	0.789	175
Ethylacetate	$C_4H_8O_2$	88.1	394	77	0.900	240
Heptane	C_7H_{16}	100.2	373	98	0.684	120
Hexane	C_6H_{14}	86.2	368	69	0.660	360
Isopropylalcohol	C_3H_8O	60.1	699	82	0.786	137
Isoamylalcohol (3-methyl-1-butanol)	$C_5H_{12}O$	88.1	595	129	0.809	14
Methylethylketone	C_4H_8O	72.1	473	80	0.805	243
Methanol	CH_4O	32.0	1227	65	0.791	337
Methylene chloride, dichloromethane	CH_2Cl_2	84.9	373	40	1.327	atmospheric
Pentane	C_5H_{12}	72.1	381	36	06.26	atmospheric
n-propylalcohol	C_3H_8O	60.1	787	97	0.804	67
Pentachloroethane	C_2HCl_5	202.3	201	162	1.680	13
1,1,2,2-tetra-chloroethane	$C_2H_2Cl_4$	167.9	247	146	1.595	20
Tetrachlorocarbon	CCl_4	153.8	226	77	1.594	271
1,1,1-trichloroethane	$C_2H_3Cl_3$	133.4	251	74	1.339	300
Tetra-chloro-ethylene	C_2Cl_4	165.8	234	121	1.623	53
THF (tetrahydrofurane)	C_4H_8O	72.1		67	0.889	374
Toluene	C_7H_8	92.2	427	111	0.867	77
Trichloroethylene	C_2HCl_3	131.3	264	87	1.464	183
Water	H_2O	18.0	2261	100	1.000	72
Xylene (mixture)	C_8H_{10}	106.2	389			25
o-xylene	C_8H_{10}	106.2		144	0.880	
m-xylene	C_8H_{10}	106.2		139	0.864	
p-xylene	C_8H_{10}	106.2		138	0.861	

③ Cooling area

The solvent vapor flows very quickly into the condenser. Here, the energy in the solvent vapor is transferred to the cooling medium (mostly water), so that the solvent condenses.

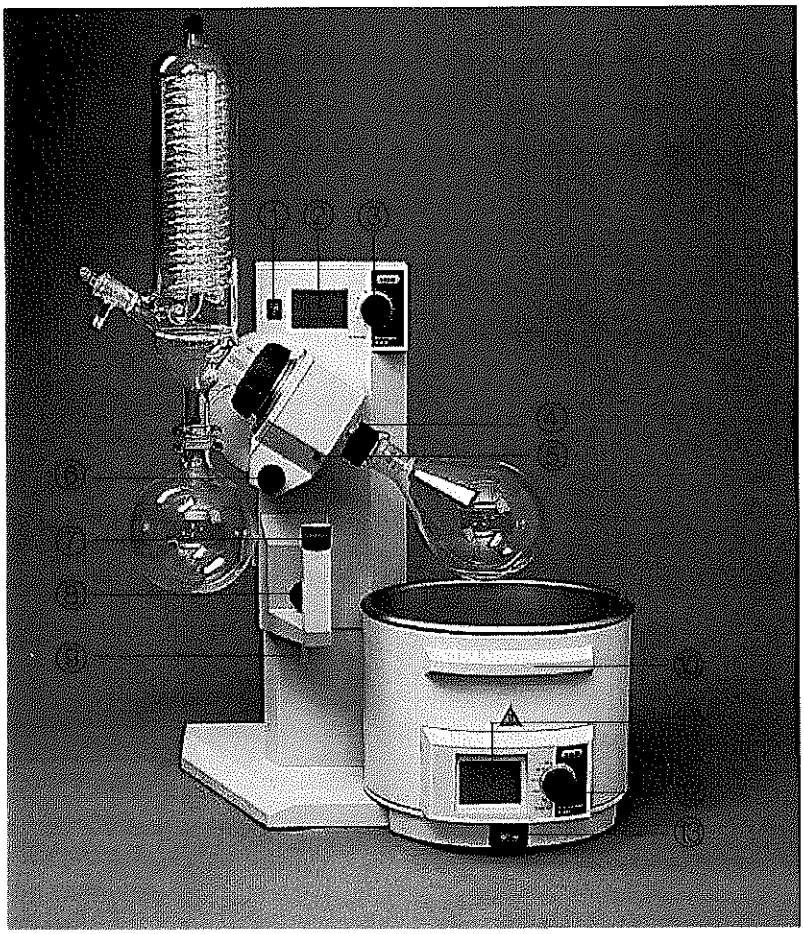
④ Receiving flask

The receiving flask collects the condensed solvent.

Vacuum

The vacuum reduces the boiling temperature and thus increases the distillation performance.
The evaporating performance is influenced by the distillation pressure (vacuum), the heating bath temperature, and the rotation speed and size of the evaporating flask.
For information on the optimum distillation conditions, see chapter Operation.

4.1.2 Controls of Rotavapor R-210/215



① Mains switch of Rotavapor
② Display for rotation speed and vapor temperature (only on R-215)
③ Adjusting knob for rotation speed
④ Combi Clip for easy flask / vapor duct removal
⑤ Lock button to block the drive unit
⑥ Knob for immersion angle adjustment
⑦ Electric quick-action jack to lower and raise the evaporating flask
⑧ Knob for end stop adjustment
⑨ End stop detection
⑩ Heating bath handle
⑪ Display of bath temperature
⑫ Adjusting knob for setting the bath temperature and selecting between water or oil bath operation
⑬ Mains switch of heating bath

Fig. 4.2: Overview of the Rotavapor

4.1.3 Rear connections of the Rotavapor

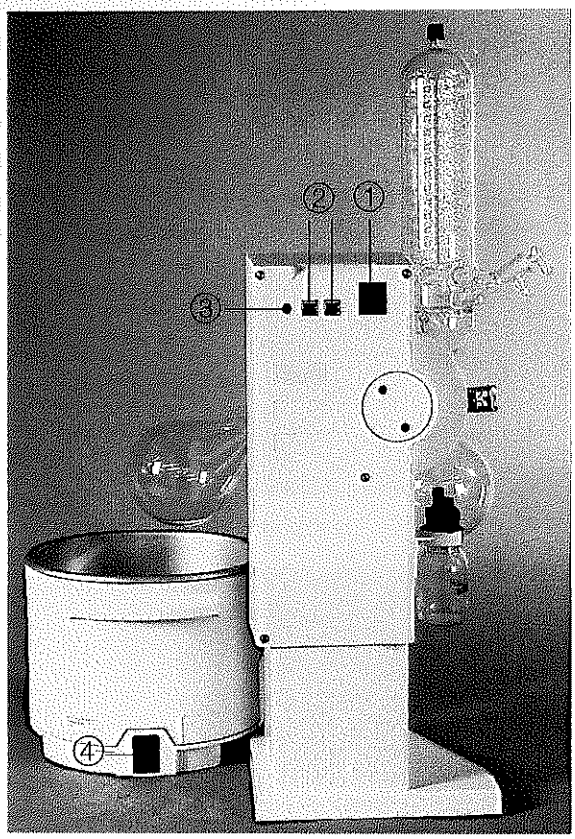


Fig. 4.3: Rear connections of the Rotavapor

① Power supply for Rotavapor
② Socket for control cable to the vacuum controller (RS-485) or the Vacuum Pump V-700/710 (to be used alternatively)
③ Socket for vapor temperature sensor
④ Power supply for heating bath

4.2 Motorized quick-action jack

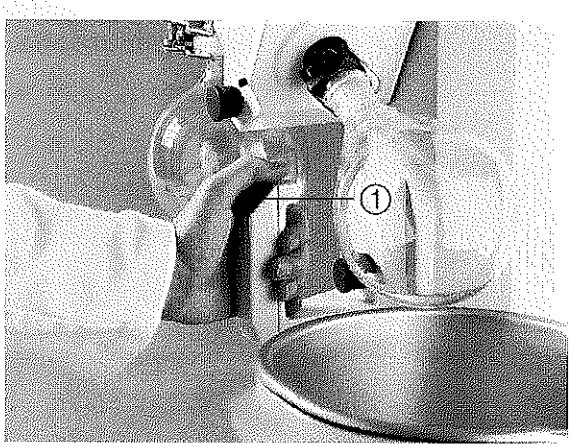


Fig. 4.4: Quick-action jack

With the motorized quick-action jack, the evaporating flask can be lowered into, and raised from, the water bath. This operation requires no physical effort. Motion is effected by an integral motor. The button ① which can be pushed up or down for the corresponding direction is located on the handle of the quick-action jack. When the instrument is switched off manually or if a power failure occurs, the flask is automatically raised from the heating bath.

4.3 Heating bath

The heating bath B-491 is multifunctional and can be used as a water bath or as an oil heating bath up to 180 °C. The Heating Bath B-495 can be used as water bath up to 95 °C.
If you use a water bath, which is not suitable for the operation above 100 °C only water may be used as heating medium (the use of any type of oils is not allowed). In case of an oil bath (e.g. B-491) only specially approved heating bath liquids may be used. We advice against using silicone oils and low molecular weight PEGs (Mol weight < 400 g/mol).

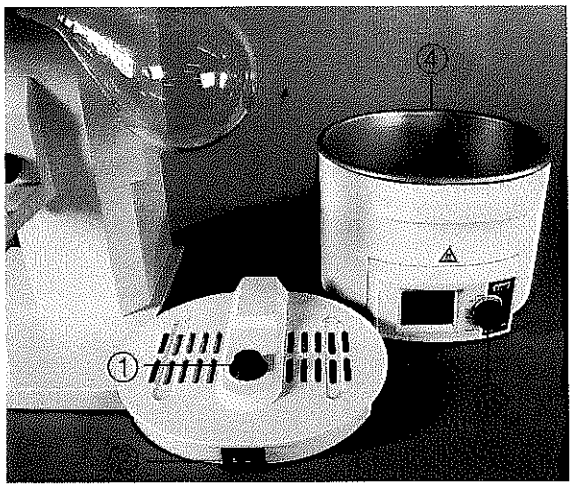


Fig. 4.5: Heating bath next to the base plate

① Power supply of heating bath
② Mains switch (splash water protected)
③ Adjusting knob for setting the bath temperature and selecting between water and oil bath
④ Handle for easy transport and movement

4.4 Combi Clip

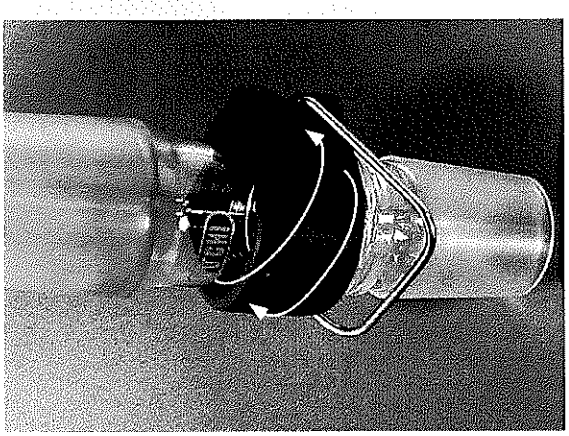


Fig. 4.6: Combi Clip

Depending on the direction the patented Combi Clip is turned, it performs the following functions:

Handling the evaporating flask:

- Release the evaporating flask by turning the clip counterclockwise.

NOTE

Secure the flask with one hand so that it does not fall down.

- Fix the mounted evaporating flask by pressing down the clamp and turning the clip clockwise.

Handling the vapor duct:

- Remove the evaporating flask first, then turn the clip clockwise until the vapor duct is released.

NOTE

Press the lock button to block the drive unit (position 5 in Fig. 4.2) while removing the vapor duct or fixing the evaporating flask.

4.5 Vapor temperature sensor

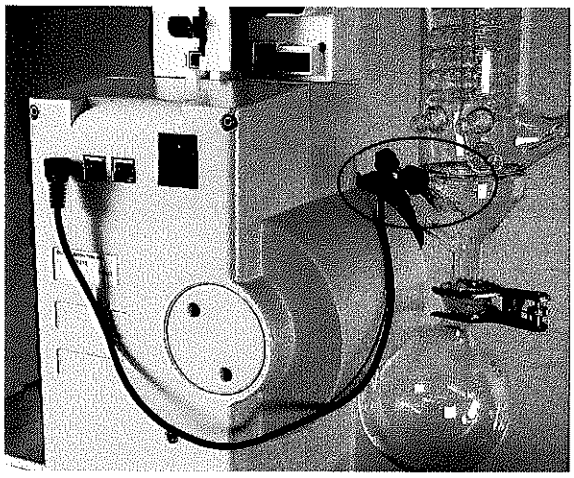


Fig. 4.7: Vapor temperature sensor

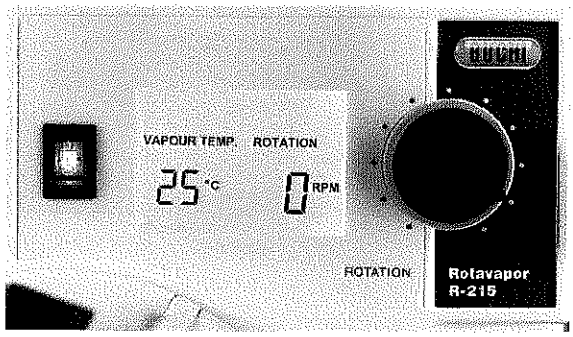


Fig. 4.8: Vapor temperature display at the R-215

The vapor temperature sensor measures the temperature of the vapor entering the condenser. This temperature is displayed on the display for vapor temperature and rotation speed (only with R-215).

4.6 Protective shield (optional)

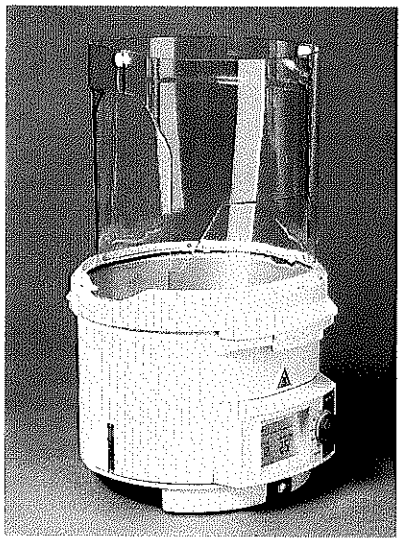


Fig. 4.9: Protective shield

The protective shield protects the user from splashes of heating medium when the flask is rotating and from pieces of broken glass in the unlikely event of an implosion of the evaporating flask.

4.7 Valve unit

Fig. 4.10: Valve unit

If using the Rotavapor without the Vacuum Pumps V-700/710, or with a vacuum controller other then the V-850/855, the valve unit shuts off the connection ot the vacuum source when the set point of the vacuum controller is reached. Also, the valve unit serves as a separator to collect small amounts of liquid that may have condensed in the vacuum tubing thereby protecting the pump against contamination.

4.8 Woulff bottle

Fig. 4.11: Woulff bottle

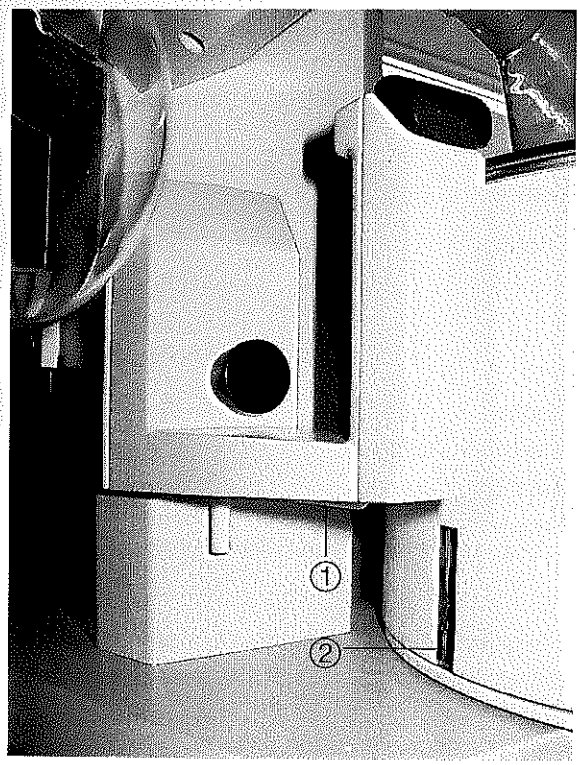
The Woulff bottle serves as safety vessel between the Rotavapor and the vacuum pump. In case of an impure distillation the condensate is collected in the Woulff bottle and thus cannot reach the pump.

4.9 Combination of Rotavapor and vacuum controller

The vacuum controller controls the selected pressure within the Rotavapor and constantly corrects any deviations. The Rotavapor and the vacuum controller can be connected, so that the starting and stopping of the rotation and the raising and lowering of the evaporating flask is carried out by the vacuum controller, i.e. when suitably configured:

- the distillation is started via the vacuum controller, the evaporating flask is lowered until it reaches the desired stop position (adjustable) and the rotation is started.
- the distillation is stopped via the vacuum controller, the rotation is stopped and the evaporating flask is raised from the bath.

4.10 Infrared interface



① Receiver
② Transmitter

Fig. 4.12: Infrared interface

The infrared interface transmits heating bath data to the controller. An interruption of the communication with the interface does not affect the process.

Function of the infrared interface:

- Transmits the current heating bath temperature to enable working with the solvent table.
- Reads out the heating bath data (set / actual temperature) and transmits them to the Rotavapor. From there, the data is transmitted via the RS-485-port to the vacuum controller (V-850/V-855).

5 Putting into operation

This chapter describes how the instrument is installed and gives instructions on initial startup.

NOTE

Inspect the instrument for damages during unpacking. If necessary, prepare a status report immediately to inform the postal company, railway company or transportation company.

Keep the original packaging for future transportation.

5.1 Installation site

Place the instrument on a stable, horizontal plane and consider the maximum product dimensions. Perform the distillations under vacuum with the Rotavapor placed under a fume hood. If this is not possible due to shortage of space, mount the protective shield (optional accessory) and lead the exhaust gas from the pump into the fume hood.

5.2 Electrical connections

ATTENTION

Make sure that the voltage on the socket corresponds to the voltage given on the type plate of the instrument.

Always connect the instrument to an earthed socket. External connections and extension cables must be provided with an earthed conductor lead (3-pole couplings, cable or plug equipment) as the mains lead has a molded plug, thus avoiding risks due to inadvertent defective wiring.

Make sure that no electric sparks form in the instrument or its surroundings as they might damage the instrument.

5.3 Commissioning the heating bath

Place the bath on the base plate of the Rotavapor.

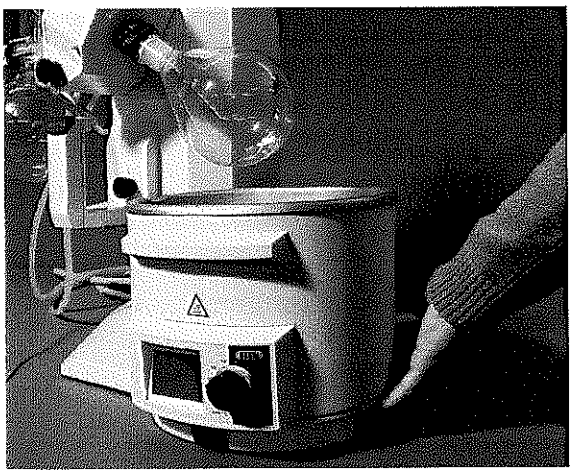


Fig. 5.1: Moving the heating bath

If you need to adjust the position of the bath, lift it up slightly at the right-hand side and pull or push it to the desired position.

Saving energy

For heating baths there are various ways to save energy. By using floating balls in the water bath, evaporation of water is reduced. As a result, the bath heating has to switch on less often. This measure helps to save up to 50% of energy. At the same time approximately 70% less water is used. Additionally, a cover is available to put over the heating bath during operation which also saves energy between distillations.

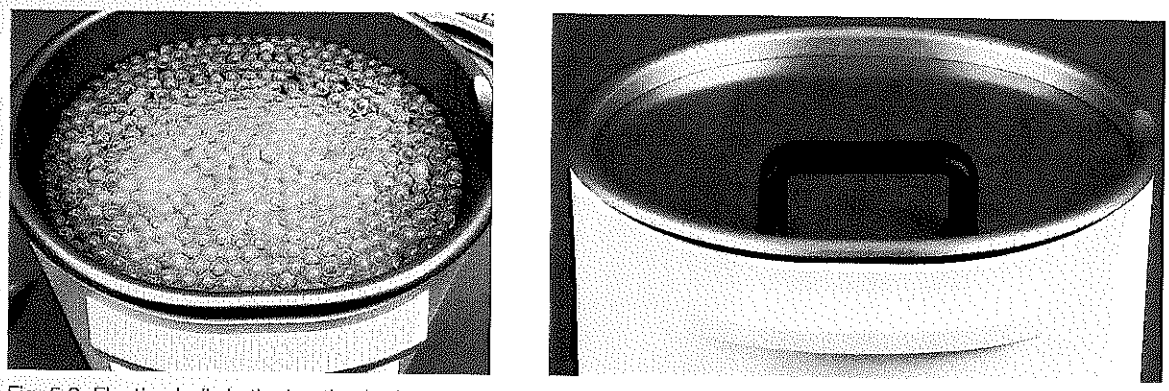


Fig. 5.2: Floating balls in the heating bath medium and cover for heating bath

NOTE

Turn on the heating bath about 10 –15 minutes before starting the distillation, since the bath has a certain warm-up time. Turn off the heating bath after a distillation.

ATTENTION

As soon as the power plug is connected and the mains switch is turned on, the bath starts heating if the actual temperature is below the set temperature. For this reason, make sure that there is always heating medium in the bath to prevent instrument damage.

5.3.1 Heating Bath B-495

The Heating Bath B-495 is delivered with the bath replenishment mounted, see figure below.

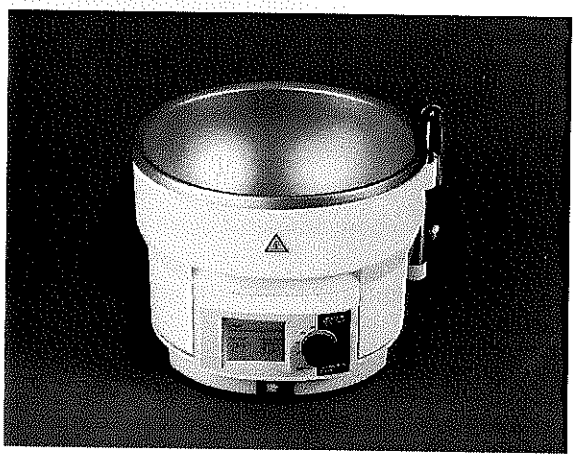
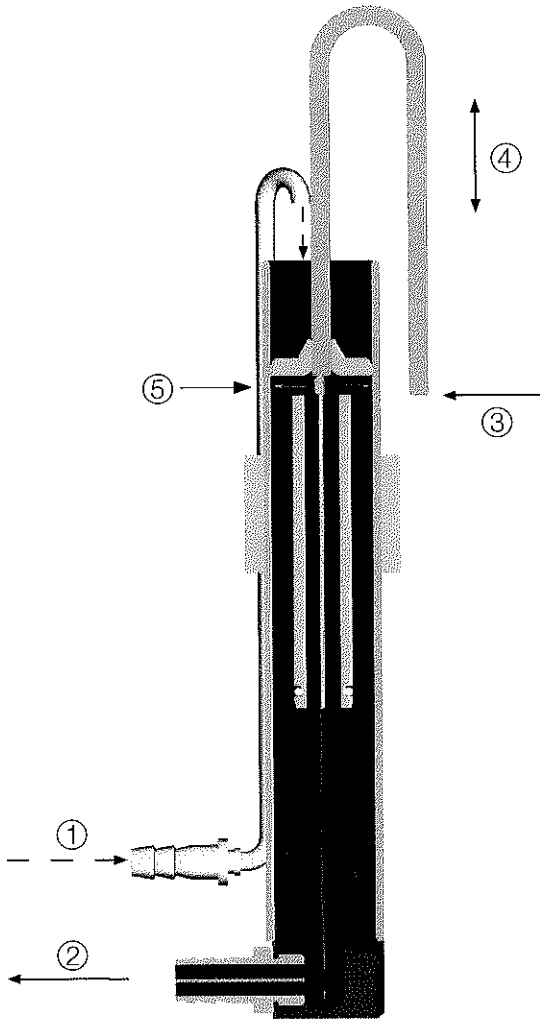


Fig. 5.3: Heating Bath B-495 with water replenishment on the right-hand side

The function and water flux of the Heating Bath B-495 can be seen from the figure below.



① Water inlet
② Water outlet
③ Water level indication
④ Level adjustment for the replenishment
⑤ Overflow

Connect the feeding water hose to the hose connection for the water inlet ①.
Position ③ indicates the water level within the heating bath and can be adjusted by pulling up or down the level adjustment tube ④. Thus, the overflow in the cylinder ⑤ is moved up or down and therewith changes the water level within the heating bath by means of the corresponding tube. Connect the drain hose to the hose connection for the water outlet ②. The excess water coming from the overflow is drained off here.

Fig. 5.4: Water flux within the heating bath replenishment of the Heating Bath B-495

5.3.2 Heating medium

If you use a water bath, which is not suitable for the operation above 100 °C only water may be used as heating medium (the use of any type of oils is not allowed). In case of an oil bath (e.g. B-491) only specially approved heating bath liquids may be used. We advice against using silicone oils and low molecular weight PEGs (Mol weight < 400 g/mol). We recommend Ucon HTF 14, Sigma-Aldrich AG as heating oil.

When the heating bath is used with heating oil
You should change the heating oil occasionally depending on the status of the oil (color, odor). If the oil vaporizes (expecially low molecular weight PEG) make sure that it does not condense on the surface of the Rotavapor as it can peel away the coating.

When the heating bath is used with water, please consider the following notes: Depending on the water hardness a mixture of deionized water with distilled water to a ratio of 1:1 volume shares is allowed. The use of the water bath with pure distilled or deionized water is not allowed due to the corrosiveness towards stainless steel. In case the use of pure deionized or distilled water as heating medium cannot be avoided, the addition of 1 - 2 g borax ($Na_2B_4O_7$ x 10 H_2O) per liter water is mandatory.

5.4 Glass assembly

To install the glass assembly, consider the following:

- To fasten the flanges you do not have to remove the flange screwed connection (position ⑤ in Fig. 5.3). Just open the flange screwed connection wide enough, so that the flange can be pushed through.
- You can also secure the glass assemblies V, S, C, E, CR, BY using the corresponding optional support rod.
- Secure the receiving flask with the clip provided for this purpose.

ATTENTION

Check the glassware for damages prior to each operation and use only glassware that is in perfect condition. Glassware with cracks, stars or other damages can break during operation.

NOTE

To achieve optimum tightness of the system, all joints on the condenser side must be greased.

5.5 Installing the condenser and the seal

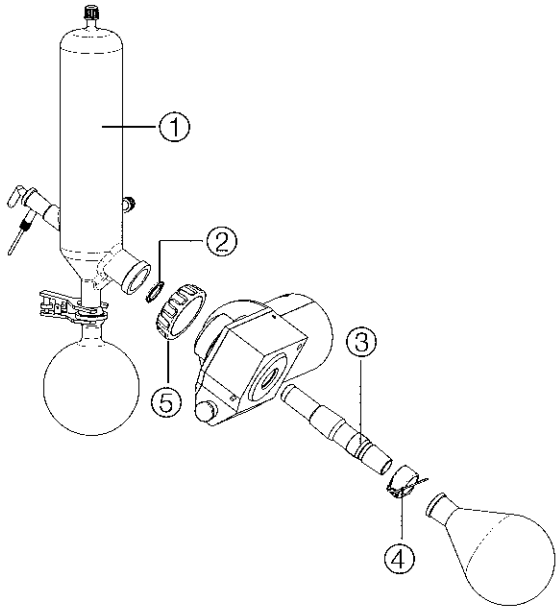


Fig. 5.5: Exploded view of condenser and seal

When installing the condenser and mounting the seal, consider the following order:

- Insert the vapor duct ③ until a click sound is heard.
- Fix the seal ② to the condenser ①.
- Screw on the condenser with the flange screwed connection ⑤ (normally, the flange screwed connection must not be removed)
- Screw the Combi Clip ④ onto the vapor duct.

5.6 Installing the reflux insert

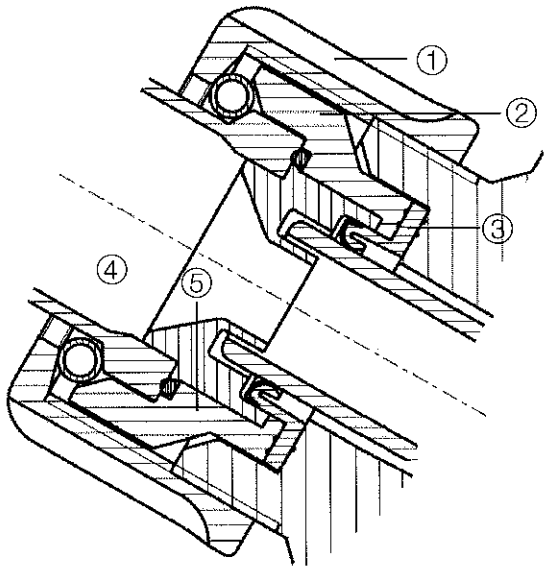


Fig. 5.6: Installing the reflux insert

To install the reflux insert, proceed as follows:

- Take the standard flange screwed connection off the drive unit.
- Fix the gasket WD 26 (seal) (position 3) to the reflux insert (position 2).
- Mount the reflux insert onto the drive unit.
- Mount the flange srewed connection (position 1) without tightening it.
- Check whether the O-ring (position 5) is positioned properly within the reflux insert.
- Mount the condenser of the glass assembly (position 4) to the drive unit and fix it by tightening the flange screwed connection.

5.7 Mounting the support rod (optional accessory)

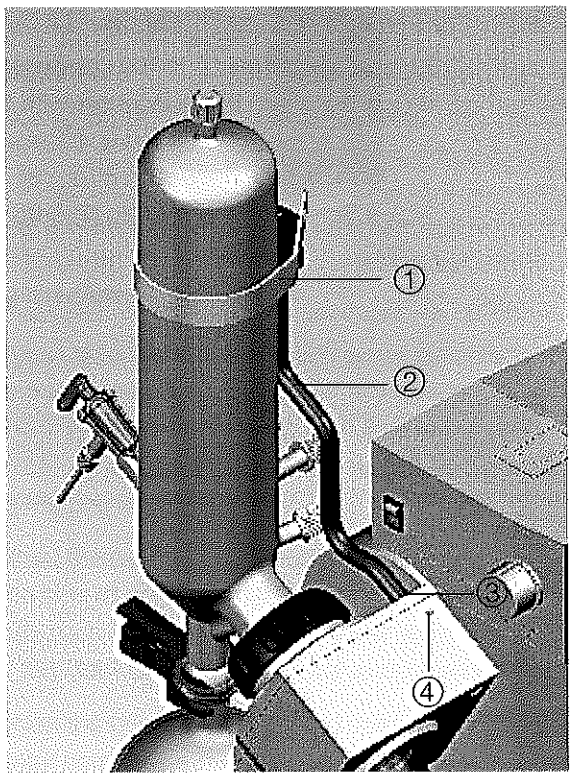


Fig. 5.7: Mounting the support rod

The support rod with bracket and plastic clip is used with the glass assemblies V, C, S, BY and CR. It is optional and has the sole purpose of providing additional stability. We especially recommend it for the glass assemblies C and CR.

To attach the support rod to the drive unit, proceed as follows:

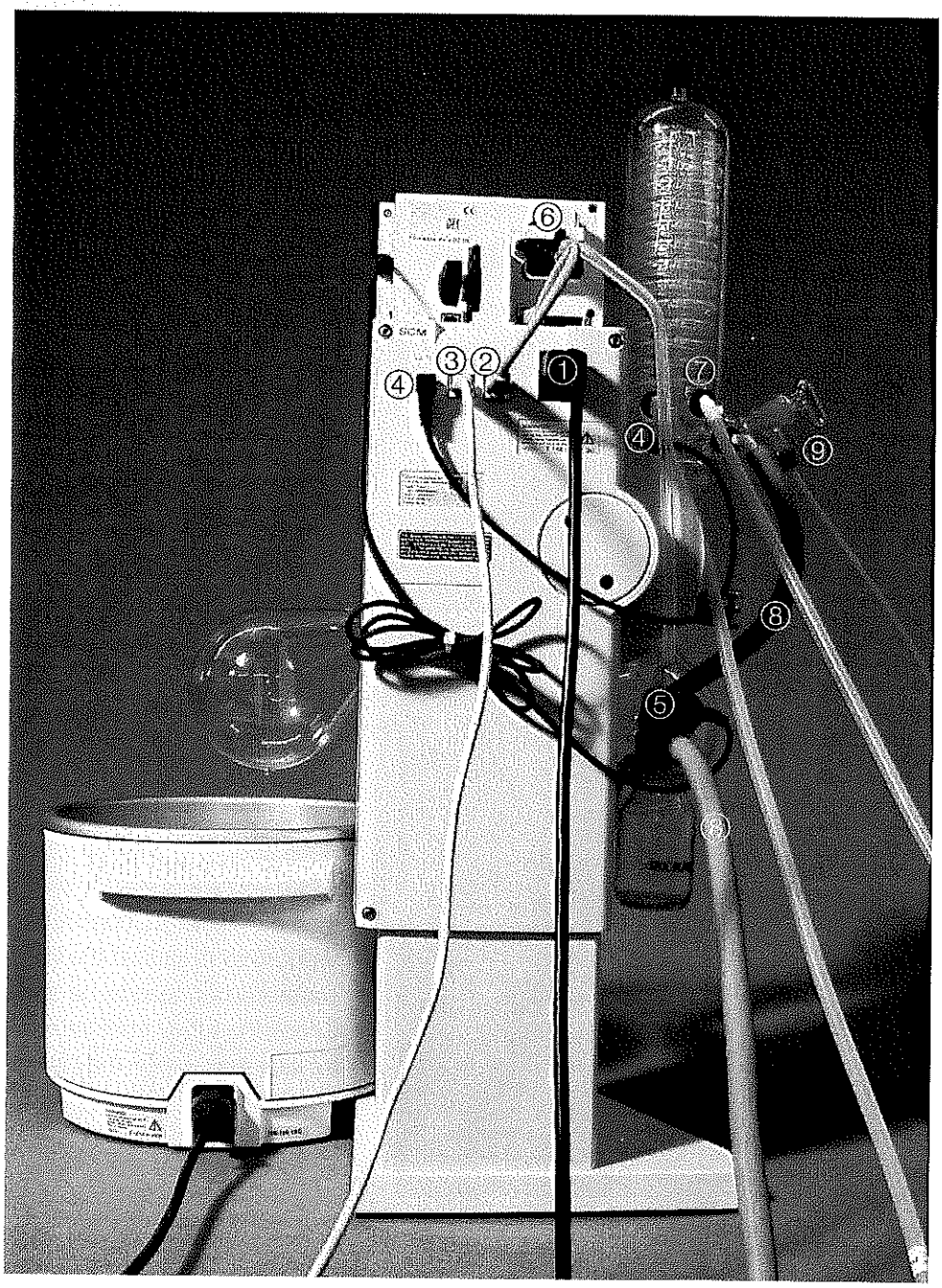
- Insert the support rod ② into the hole ③ on the drive unit.
- Secure the support rod by means of the screw ④.
- Fasten the clip ① at the desired height by means of the wing nut.

ATTENTION

The support rod is not designed to carry the weight of the glass assembly on its own. Its sole purpose is to stop the glass assembly tilting forward or backwards when the flanged coupling is released.

5.8 Tube connections

5.8.1 Connection scheme



① Mains connection
② Communication vacuum controller / Rotavapor
③ Communication vacuum pump / Rotavapor
④ Communication temperature sensor
⑤ Vacuum connection controller / Woulff bottle or valve unit (only if no Vacuum Pump V 700/710 is used)
⑥ Inert gas connection
⑦ Cooling water connections
⑧ Vacuum connection glass assembly / valve unit or Woulff bottle
⑨ Connection evaporating flask feed via stop-cock

Fig. 5.8: Tubing scheme

5.8.2 Cooling water tubes

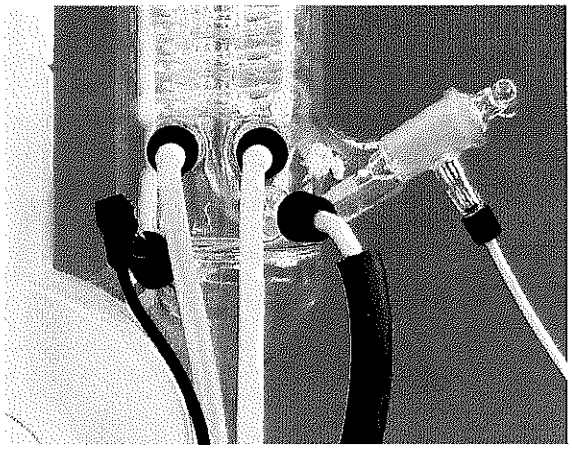


Fig. 5.9: Cooling water tubes

When connecting the white cooling water tubes, consider the following:

- Use tube clips GL-14.
- The tubes used must all have the same inner diameter (approximately 6 mm).
- For safety reasons, secure the tubes with commercial tube pivoting clamps or cable binders.
- To save cooling water, you can use the Distillation Chiller B-741.
- Check the tubes from time to time and replace them when they are brittle.

5.8.3 Vacuum tubes

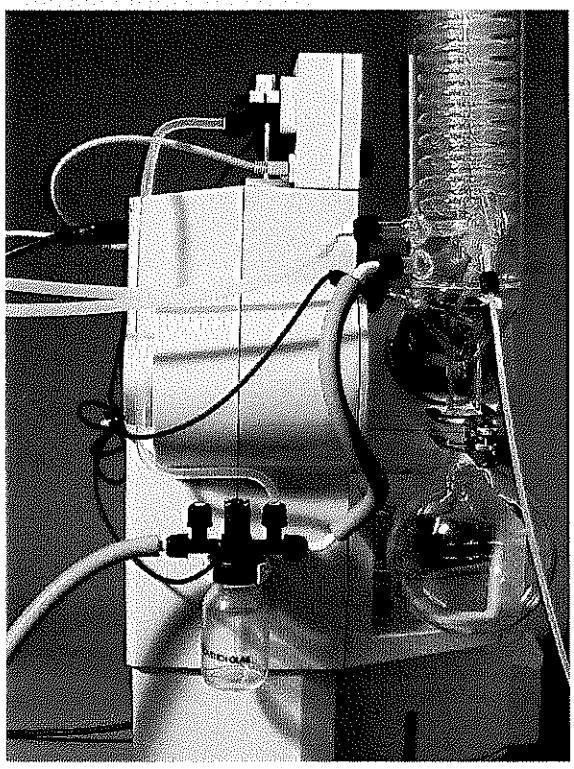


Fig. 5.10: Vacuum tubes

When connecting the vacuum tubes, proceed as follows:

- Use tube clips GL-14.
- The tubes used must all have the same inner diameter (approximately 5 mm).
- Keep vacuum tubes as short as possible.
- When you are operating with the new BUCHI Vacuum Controller V-850/855 and Vacuum Pump V-700/710 connect a Woulff bottle between the vacuum source and the Rotavapor.
- When you are operating with a pump other than a V-700/710, connect a valve unit to the V-850/855 to control the vacuum.
- Tubes do not need to be secured.
- Check the tubes from time to time and replace them when they are brittle.

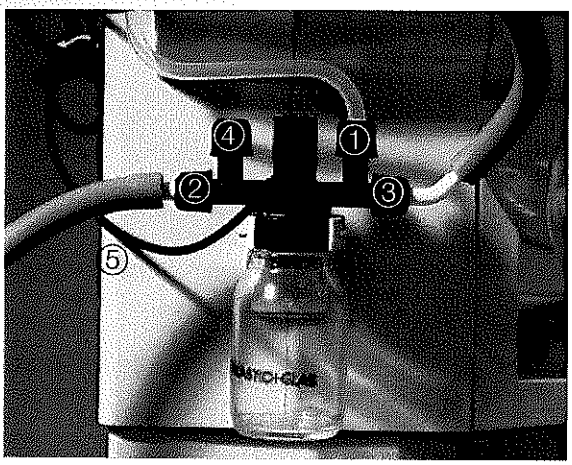
5.8.4 Tube connections to the valve unit

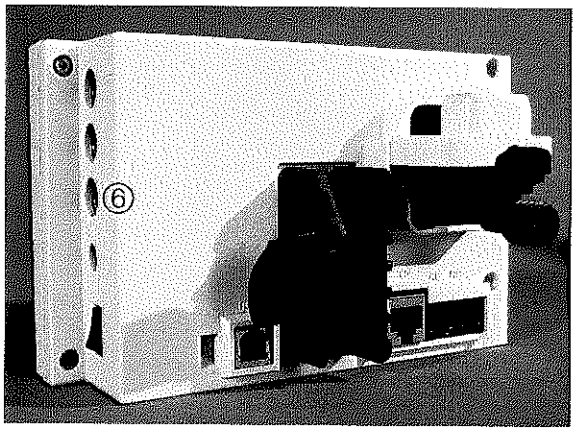
To connect the valve unit electrically, proceed as follows:

- Connect the connection "1" of the valve unit to the glass assembly of the Rotavapor.
- Connect the "Pump" connection of the valve unit to the pump inlet.
- Connect the "CONTR" connection of the valve unit to the vacuum controller.

NOTE

When the tube clip to an additional instrument is not used, close it with a screw cap.





① Tube connection to the controller
② Tube connection to the vacuum pump
③ Tube connection to the Rotavapor
④ Tube connection to an additional instrument
⑤ Connection cable from the valve unit to the vacuum controller
⑥ Cable connection for the valve unit at the vacuum controller (VALVE)

Fig. 5.11: Tube connections to the valve unit

5.9 Installing the vacuum controller

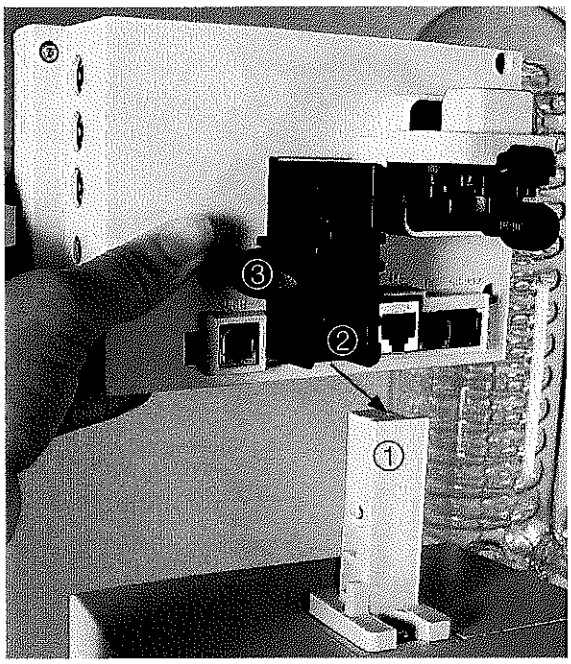
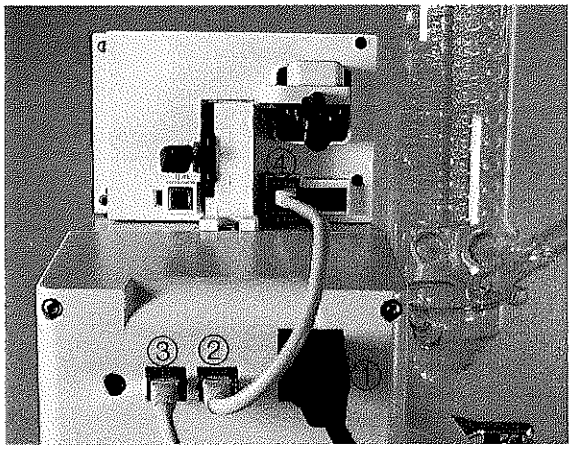


Fig. 5.12: Installing the vacuum controller

To install the vacuum controller on the Rotavapor, proceed as follows:

- Screw the holder ① for the vacuum controller to the top of the Rotavapor.
- Slide the guide rail ② of the vacuum controller over the holder.
- Fix the vacuum controller to the holder by tightening the wing nut ③.

5.10 Cable connections to the Rotavapor



① Mains connection
② Communication vacuum controller / Rotavapor
③ Communication vacuum pump / Rotavapor
④ Communication vacuum controller / Rotavapor

Fig. 5.13: Cable connections to the Rotavapor

To make the electrical connections between the vacuum controller and the Rotavapor, proceed as follows:

- Connect the power supply ① of the Rotavapor to the mains.
- Connect the communication cable ④ of the vacuum controller to the Rotavapor ②.
- Connect the communication cable ③ to the Vacuum Pump V-700 / 710.

5.11 Installing the vapor temperature sensor

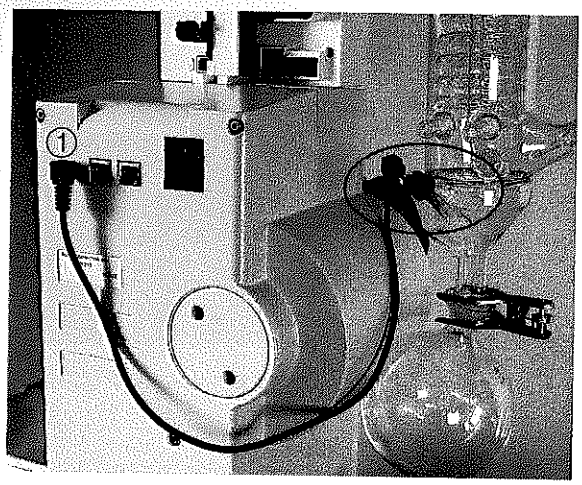


Fig. 5.14: Vapor temperature sensor

To measure the vapor temperature during operation, the vapor temperature sensor must be connected.

For this purpose:

- Plug it into the socket at the rear of the R-215 ① (with an R-210 this is not possible).
- Introduce the sensor into the corresponding opening in the condenser and tighten it with the GL-14 screw.

5.12 Functional test

Carry out the functional test after all described steps for putting the instrument into operation are finished.

Vacuum tightness test

NOTE

The vacuum tightness test can only be carried out with a vacuum controller installed or when you have a pressure measuring device (manometer) connected to the tube between the pump and the Rotavapor.

For this purpose, proceed as follows:

- Start the instrument and adjust the rotation speed as desired.
- Apply a vacuum. The instrument is now evacuated while the flask is rotating.
- Now interrupt the vacuum to the Rotavapor by carefully bending the tube. You should see on the vacuum controller or on the measuring device whether the vacuum in the system remains constant, i.e. the pressure increase per minute should be less than 3 mbar.
- If the vacuum does not remain constant, check all tube clips, retighten them and grease all ball joints at the condenser side.
- If that still does not help, replace the seals as described in chapter 7.3.2.
- Afterwards, repeat the steps described above until the tightness test is passed.

Rotation speed test (for R-215 only)

To carry out the rotation speed test at the R-215, proceed as follows:

- Slowly turn the adjusting knob for the rotation speed on the Rotavapor clockwise from the minimum to the maximum setting. At rotations per minute > 20 the motor should turn smoothly at each knob position. When the knob is not turned, the indication of the rotation speed should only change by two digits up or down. In case the rotation speed does not remain constant or there are problems with the motor, call the BUCHI customer service.

6 Operation

This chapter explains the operating elements and possible operating modes. It gives instructions on how to operate the Rotavapor properly and safely.

ATTENTION
Check the glassware for damages prior to each operation and use only glassware in perfect condition. Glassware with cracks, stars or other damages can break during operation.

6.1 Settings at the heating bath

6.1.1 Setting the heating bath temperature

ATTENTION
As soon as the power plug is connected and the mains switch is turned on, the bath starts heating if the actual temperature is below the set temperature. For this reason, make sure that there is always heating medium in the bath to prevent heating bath damage.

WARNING
The heating bath can reach temperatures up to 180 °C. To avoid burns, consider the following:

- *Never remove a rotating flask from the bath because splashing oil can result in burns.*
- *Make sure that no liquid can overflow from the bath when the evaporating flask is submerged.*
- *Install the protective shield (optional accessory) only to a cold heating bath.*

6.1.2 Switching the B-491 from water bath mode to oil bath mode

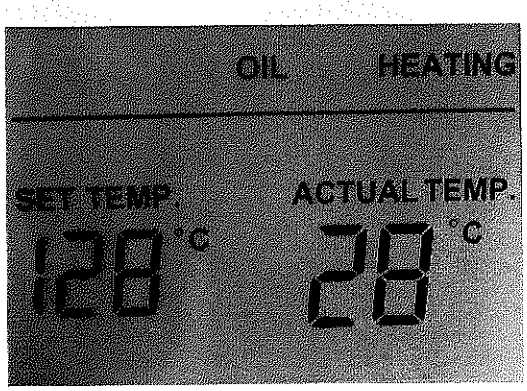


Fig. 6.1: Display in oil bath mode

To switch the heating bath from water bath mode to oil bath mode, proceed as follows:

- Switch off the heating bath.
- Turn the adjusting knob to any position except for 0 °C or 180 °C.
- Switch on the heating bath.
- As soon as the temperature is indicated on the display, turn the knob to the 180 °C position within 3 seconds. The indication "OIL" will now appear on the display.

ATTENTION
In the oil bath mode, always operate the bath with oil as the heating medium as water might start boiling and evaporating which would lead to a heating bath damage.

After the oil bath has been standing opened for a prolonged period, condensation water can accumulate at the bottom. When the bath is used again, it must be heated above 100 °C with rotating flask to drive the water out.

NOTE
A setting up to 180 °C is only possible in oil bath mode.

6.1.3 Switching the B-491 from oil bath mode to water bath mode

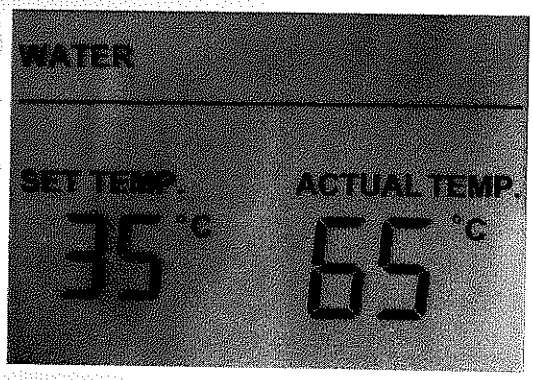


Fig. 6.2: Display in water bath mode

To switch the heating bath from oil bath mode to water bath mode, proceed as follows:

- Switch off the heating bath.
- Turn the adjusting knob to any position except for 0 °C or 180 °C.
- Switch on the heating bath.
- As soon as the temperature is indicated on the display, turn the knob to the 0 °C position within 3 seconds. The indication "WATER" will now appear on the display.

NOTE

In water bath mode, the heating bath can be operated with both water or oil.

A setting up to 95 °C is possible in water bath mode.

6.1.4 Selecting the set temperature

With this setting you can ensure, that the heating bath temperature cannot be changed during the distillation process.

To carry out the setting, proceed as follows:

- Switch off the heating bath.
- Turn the adjusting knob to the 180 °C / 95 °C (max) position.
- Switch on the heating bath. The set temperature setting flashes in the display.
- Turn the knob within 10 seconds to the desired set temperature, e.g. 60 °C and wait until the set temperature setting stops flashing.

This temperature is now kept whenever the heating bath is switched on and cannot be changed with the adjusting knob anymore.

6.1.5 Changing / switching off the set temperature

To change or switch off the set temperature, proceed as follows:

- Switch off the heating bath.
- Turn the adjusting knob to the 0 °C (min) position.
- Switch on the heating bath. The set temperature setting is now deleted and the temperature can be selected via the knob again.

6.2 Immersion angle of the evaporating flask into the heating bath

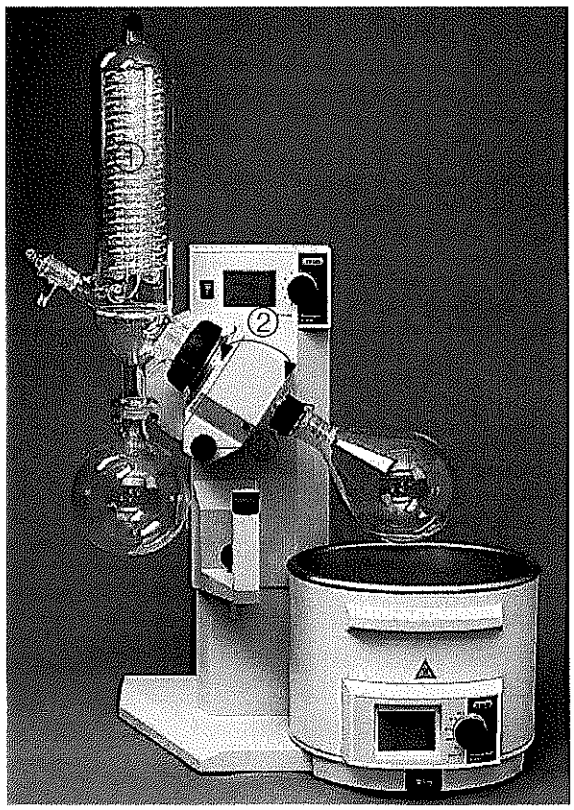


Fig. 6.3: Immersion angle of the evaporating flask into the heating bath

The immersion angle into the heating bath is, by default, set to 30°.
If you need to operate with another angle, e.g. when operating with a small flask, the angle can be changed as follows:

- Turn off the instrument.
- Hold the glass assembly ① with the one hand and loosen the anchoring ③ with the other hand by pulling the knob.
- Set the condenser in the desired position by tilting the drive unit ② accordingly and let it catch.
- Release the knob.

ATTENTION

Risk of instrument damage.

- *Do not change the immersion angle while the instrument is operating.*
- *When the anchoring is loosened the glass assembly can tilt to the left, so that glass breakage can occur. Always support the glass assembly with one hand when you loosen the anchoring.*

6.3 Lowering and raising the evaporating flask into and out of the heating bath

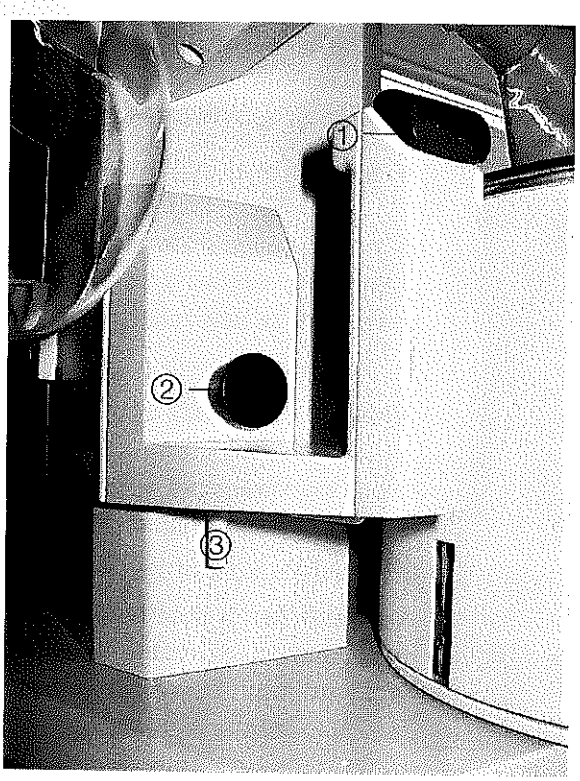


Fig. 6.4: Lowering and raising the evaporating flask

The stop-position of the quick-action jack can be adjusted so that neither the vapor tube, the manifold, or the Combi Clip touch the bottom or edge of the bath and a desired immersion depth of the evaporation flask in the heating bath is achieved.

To adjust the stop-position of the quick-action jack, proceed as follows:

- Push the button ① up or down to move the quick-action jack to the desired position.
- Pull the knob ② and release it again. The stop-position ③ is now fully extended and will remain in this position until adjusted again.

To re-adjust the stop-position later, push the button ① up to raise the quick-action jack a little, than proceed as described above.

NOTE

When a 4 l evaporating flask is used the stop-position extension (Order no.: 44466) must be used additionally.

6.4 Selecting the distillation conditions

To achieve optimal distillation conditions, the distillation energy supplied by the heating bath must be removed by the condenser.

To ensure this, operate the instrument according to the following rule of thumb:

Cooling water: max. 20 °C **Vapor: 40 °C** **Bath: 60 °C**

How are these conditions achieved?:

- Set the bath temperature to 60 °C.
- Set the cooling water temperature not higher than 20 °C.
- Allow cooling water to flow through the condenser at approximately 40 – 50 l/h.
- Define the operating vacuum in such a way, that the boiling point of the solvent is 40 °C. The corresponding pressure can be seen from the Solvent Table in chapter 3.

Advantages associated with bath temperatures of 60 °C:

- The evaporating flask can be replaced without risk of burns.
- The evaporation rate of the water from the heating bath is low (low energy loss).
- The heating bath energy is used at a good degree of efficiency.

This rule can also be applied to lower bath temperatures, e.g.:

Cooling water: 0 °C **Vapor: 20 °C** **Bath: 40 °C**

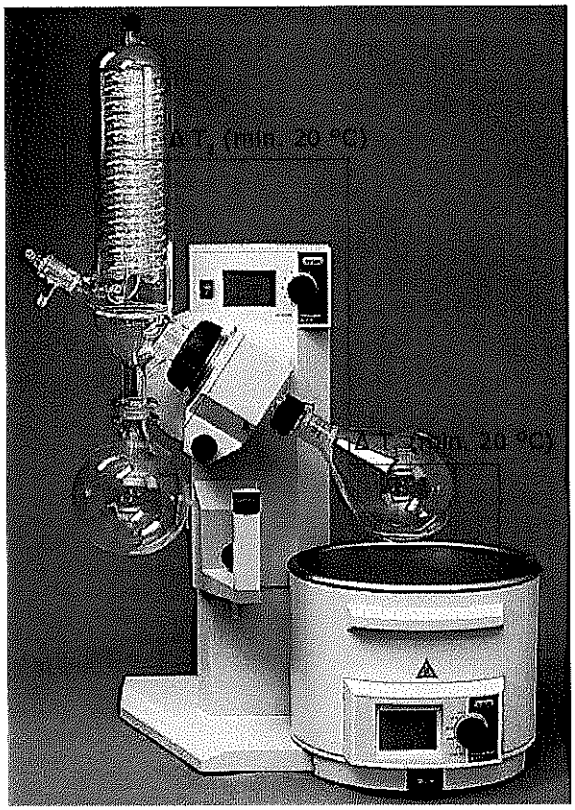


Fig. 6.5: 20-40-60 ° rule

6.5 Distilling

To start operating the instrument, the following conditions have to be fulfilled:

- All electrical connections are established correctly.
- All sealings are inserted correctly.
- All joints are greased.

To start operating the instrument, proceed as follows:

- Switch on the instrument.
- Allow cooling water with a temperature not higher than 20 °C to flow through the condenser at approx. 40–50 l/h.
- Set the heating bath temperature to the desired value as described above and wait, until the heating medium has reached its operating temperature.
- Fill the solution you want to distill into the evaporating flask and make sure it does not exceed the filling weight of 3 kg.
- Mount the evaporating flask.

NOTE

Choose the pressure in such a way that the boiling point of the solvent is 40 °C (see solvent table).

- Set the rotation speed.

NOTE

If the last distillation was an automatic one and you now want to carry out a manual distillation, turn the knob for the rotation speed to its leftmost position first before setting the rotation speed by turning the knob to the right. Otherwise the instrument will not start operating.

- Use the quick-action jack to submerge the flask into the bath.

ATTENTION

Risk of overflowing.

- *When you are operating with a 5 l heating bath, make sure that the controller is configured in a way that the flask is not automatically submerged into the heating bath to avoid an overflowing of the heating bath due to displacement. Introduce the flask manually instead.*
- After the set vacuum has been reached, wait for about 1–2 minutes to see whether distillation begins.
- If the distillation does not start, optimize the parameters (decrease the pressure gradually or increase the bath temperature).

Both possibilities lead to an increased distillation capacity, see also chapter 6.6.

6.6 Optimizing the distillation conditions

Depending on the solvent being distilled the distillation might have to be re-optimized. In the optimized case, the condenser should be steamed up to between 2/3 to 3/4, see figure below.

If this is not the case, there are two possibilities to optimize the distillation:

- When the heating bath has reached 60 °C slowly reduce the pressure. Thus, the boiling point of the solvent is reduced and ΔT_1 increases resulting in an increase of distillation capacity.
- When the heating bath has reached 60 °C increase the bath temperature. Thus ΔT_1 increases resulting in an increase of distillation capacity as well.

NOTE

When the bath temperature is increased, not all of the additional energy is used for distillation but a major part is discharged into the environment due to the increasing difference between heating bath and the ambient temperature.

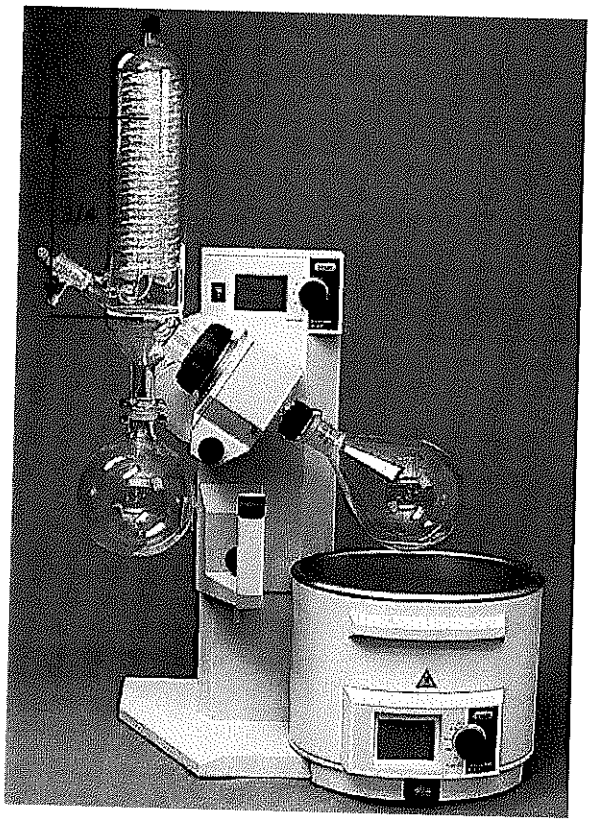


Fig. 6.6: Optimal condensation area of a condenser

6.7 When the distillation "dies out"

When the distillation "dies out", replace the receiving flask to eliminate the risk of back evaporation. Then, continue distillation. Repeat this process until all desired solvent is distilled off.
At the end of the distillation, stop the rotation, pull the flask off and aerate the system.
If you do not intend to immediately perform another distillation, turn off the heating bath and cooling water supply to save energy and resources.

7 Maintenance

This chapter gives instructions on all maintenance work to be performed in order to keep the instrument in good working condition.

WARNING

All maintenance and repair work requiring the opening or removal of instrument covers may only be carried out by trained personnel and with the tools provided for this purpose.

WARNING

Electrical hazard:

- *Prior to all maintenance work on the instrument switch off the power supply and remove all sources of flammable vapor.*

ATTENTION

When you carry out maintenance work at the lower part of the bath, always support it to prevent instrument damage.

Use only genuine consumables and genuine spare parts for maintenance and repair to assure good system performance and reliability. Any modifications to the spare parts used are only allowed with the prior written permission of the manufacturer.

7.1 Housing

Check the housing for defects (controls, plugs) and clean it regularly with a moist cloth.

ATTENTION

Never use solvents as cleaning agents as these might damage the instrument.

7.2 Tube connections and joints

Visually examine the tube connections regularly. When tubes become cracked and brittle, replace them with new tubes.
Grease all joints on the condenser side regularly to achieve optimum tightness of the system.

7.3 Sealing system

ATTENTION

When removing and reinstalling the seals, make sure not to damage them. Always move them perpendicularly to the axis of the glass parts and ensure no damage occurs to the sealing lip.

Never apply grease to the seals and never touch them with sharp object, otherwise they will get damaged.

7.3.1 Cleaning the seals

To prolong the lifetime of the seals, rinse them regularly with water, especially if "bumping" occurred during the distillation or if working with crystalline products. Afterwards, dry them with a solft cloth. To remove the seals, see chapter 5.5, Installing the condenser and the seal.

7.3.2 Replacing the seals

After 3 - 12 months, depending on the wear, the seals should be replaced.
Seals are subject to wear and tear, thus you should check them regularly and replace them, if necessary, e.g. if they do not pass the vacuum tightness test described in chapter 5.11 anymore. For this purpose, see chapter 5.5, Installing the condenser and the seal.

7.4 Heating bath

The inner surface of the heating bath should be cleaned if:

- The water bath is calcified or contaminated.
- The oil in the oil bath has changed (color, viscosity, etc.).
- Light rust spots occur.

For this purpose, remove the heating bath from the Rotavapor and empty it.
In the case of minor calcifications, use a non-abrasive cleaning agent (e.g. a bathroom cleaner). If the calcification is persistent, use e.g. acetic acid to remove it. Rinse the bath thoroughly afterwards. Rust spots can easily be removed with Scotch-Brite. Make sure to add Borax when using deionized water (see chapter 5.3).

7.5 Glass components

To prolong the lifetime of the glass components, consider the following:

- Rinse glass components with water and commercial cleaning agent (e.g. a mild soap solution).

NOTE
We recommend cleaning all the glass components manually.

- Use an alkaline cleaner to remove dirt, e.g. algae, adhering within the condenser coil.

NOTE
When a thin copper wire is introduced into the condenser coil, the risk of dirt adhering to the condenser coil is reduced.

- Remove grease from joints. After you have cleaned and completely dried each glass component, visually inspect the components for glass splinters or cracks. Since these components are under vacuum when the Rotavapor is operating, they are subject to strain.

Regularly check the glass components for damages and only use glassware that is in perfect condition. Glassware with cracks, stars or other damages can break during operation.

8 Troubleshooting

This chapter helps to resume operation after a minor problem has occurred with the instrument. It lists possible occurrences, their probable cause and suggests how to remedy the problem.
The troubleshooting table below lists possible malfunctions and errors of the instrument. The operator is enabled to correct some of those problems or errors by him/herself. For this, appropriate corrective measures are listed in the column "Corrective measure".
The elimination of more complicated malfunctions or errors is usually performed by a BUCHI technical engineer who has access to the official service manuals. In this case, please refer to your local BUCHI customer service agent.

8.1 Malfunctions and their remedy

Table 8-1: General malfunction and their remedy

Malfunction	Possible cause	Corrective measure
Instrument does not work	Mains switch off	Switch on mains switch
	Instrument is not connected to power supply	Check if mains connection is okay
	Fuse defective	Replace the fuse. If the malfunction occurs again, contact the BUCHI customer service.
Bath does not heat	Mains switch off	Switch on mains switch
	Instrument is not connected to power supply	Check mains connection
	Over temperature protection was activated	Let the bath cool down and empty it. Set back the temperature probe by pressing the button at the bottom of the heating bath by means of a flattended metal rod (e.g. a Torx or hexagon wrench), Ø ~4 mm. See Fig. 8.1
	Fuse defective	Replace the fuse. If the malfunction occurs again, contact the BUCHI customer service.
Servo lift does not work	Various causes	Contact the BUCHI customer service
Flask does not rotate	Adjusting knob for rotation speed at 0	Turn adjusting knob for rotation speed clockwise until rotation starts
	Restart instrument	Turn adjusting knob for rotation speed to 0 then slowly turn clock-wise until rotation starts
System is leaking	Joints have not been greased	Grease joints
	Tube clips have not been fixed correctly or are defective	Check tube clips
	Tubes are leaky (brittle)	Replace tubes
	Sealing system has been installed incorrectly	Check sealing system
	Seal is defective	Replace seal

Table 8-2: Malfunctions with vacuum controller and vacuum pump and their remedy

Malfunction	Possible cause	Corrective measure
Frequent switching of valve or pump	System is leaky	Check all sealing points (tubes and their connections)
	Choosen hysteresis is too small	Choose larger hysteresis (if end-vacuum is higher than 700 mbar, switch to automatic hysteresis)
Valve does not switch	Valve does not shut off	Valve is dirty or the valve cable is not connected
Vacuum is not reached	Back evaporation at Rotavapor	Empty receiving flask
	Water pressure of water jet pump is too low	Open water tap completely
Distillation "died out"		Manually decrease the pressure until the distillation starts again
Distillation stopped, although not dried out completely	Back evaporation from the receiving flask is too strong (especially for solvent mixtures)	Empty receiving flask and restart distillation
	Malfunction in distillation procedure which is not exactly defined (e.g. sudden cooling, heat flow too low, etc.)	Decrease the pressure manually until the distillation starts again

Table 8-3: Error messages heating bath

Error number	Displayed at	Possible cause	Remedy
E01	Heating bath display	Bath temperature sensor is defective	Contact the BUCHI customer service
E02	Heating bath display	Excess temperature, bath is not full enough or empty	Switch off the instrument and let it cool down. Fill the heating bath and switch on the instrument again.
E03	Error is read out via the RS-485 interface and can be read out at the vacuum controller	The EEPROM of the bath contains inconsistent data or is defective	Contact the BUCHI customer service
E04	Heating bath display	The bath is empty or has been filled with hot liquid	Switch off the instrument and let it cool down. Fill the bath with heating medium and switch the instrument on again.
E70	Heating bath display	Program error due to a software or an electronical error	Switch the instrument off and on again. When the error still occurs, contact the BUCHI customer service.

Table 8-4: Error messages Rotavapor

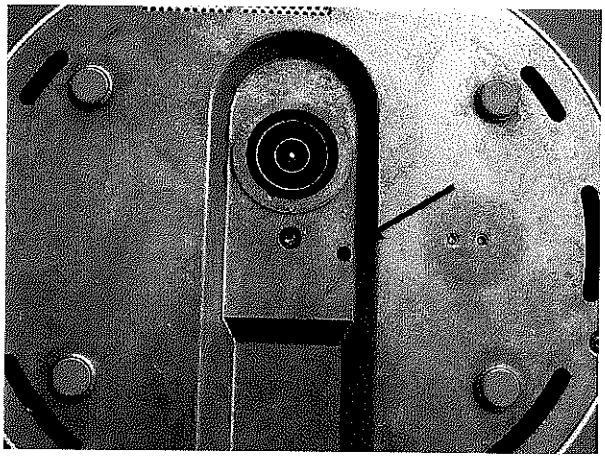
Error number	Displayed at	Possible cause	Remedy
E10	R-215	Lift error (excess temperature on the PCB or motor current too high)	Contact the BUCHI customer service
E11	Error is read out via the RS-485 interface and can be read out at the vacuum controller	The EEPROM of the Rotavapor contains inconsistent data or is defective	Contact the BUCHI customer service
E12	Error is read out via the RS-485 interface and can be read out at the vacuum controller	Error during writing to the EEPROM of the Rotavapor	Contact the BUCHI customer service
E13	Error is read out via the RS-485 interface and can be read out at the vacuum controller	No communication with the bath (IR-interface)	Make sure there are no obstacles between the bath and the receiver Contact the BUCHI customer service
E14	R-215	Rotation motor is blocked	Check whether the motor can rotate freely by turning the flask manually. If no external cause can be found and removed, contact the BUCHI customer service.
E15	R-215	Program error due to a software or an electronical error	Switch the instrument off and on again. If the error occurs again, contact the BUCHI customer service.

NOTE

As the R-210 has no display, for future versions it is planned to transmit all error messages to the RS-485 interface, where they can be read out via a special software.

In case several errors are pending, the one with the highest priority will be displayed.

Reset of the overtemperature sensor at the bottom of the heating bath



Let the bath cool down and empty it.
Then set back the temperature probe by pressing the button at the bottom of the heating bath by means of a flattended metal rod (e.g. a Torx or hexagon wrench), Ø ~4 mm. See Fig. 8.1.

Fig. 8.1: Heating bath B-491 bottom view

8.2 Customer service

Only authorised service personnel are allowed to perform repair work on the instrument. These persons have a comprehensive technical training and knowledge of possible dangers which might arise from the instrument.
Addresses of official BUCHI customer service offices are given on the BUCHI website under: www.buchi.com. If malfunctions occur on your instrument or you have technical questions or application problems, contact one of these offices.

The customer service offers the following:

- Spare part delivery
- Repairs
- Technical advice

9 Shutdown, storage, transport and disposal

This chapter instructs how to shut down the instrument, how to pack it for storage or transport, and specifies the storage and shipping conditions.

9.1 Storage and transport

WARNING

Biohazard:

- *Remove all dangerous substances from the instrument and clean it thoroughly.*

Store and transport the instrument in its original packaging.

WARNING

Electrical hazard:

- *Always remove the plug connector at the socket first to avoid having energized cables lying about.*

9.2 Disposal

To dispose of the instrument in an environmentally friendly manner, a list of materials is given in chapter 3. This helps to ensure that the components are separated and recycled correctly. Make especially sure to dispose of the gas springs appropriately.
Please follow valid regional and local laws concerning disposal.

NOTE

When you send the instrument back to the manufacturer for repair work, please copy the health and safety clearance form on the following page, fill it in and enclose it in the instrument package.

9.3 Health and safety clearance form

Declaration concerning safety, potential hazards and safe disposal of waste, e.g. used oil.
Safety and health of our staff, laws and regulations regarding the handling of dangerous goods, occupational health and safety regulations, safety at work laws and regulations regarding safe disposal of waste, e.g. waste oil, require that for all Rotavapors and other products this form must be send to our office duly completed and signed before any equipment is repaired or dispatched to our premises.
Products will not be accepted for any procedure and handling and repair / DKD calibration will not start before we have received this declaration.

a) Fax or post a **completed copy of this form** to us in advance. The declaration must arrive before the equipment. **Enclose a second, completed copy with the product.** If the product is contaminated you must notify the carrier **(GGVE, GGVS, RID, ADR)**.
b) Inevitably, the repair process will be delayed considerably, if this information is missing or this procedure is not obeyed. We hope for your understanding for these measures which are beyond our control and that you will assist us in expediting the repair procedure.
c) **Make sure that you know all about the substances which have been in contact with the equipment and that all questions have been answered correctly and in detail.**

1. Product (Model): .....

2. Serial No.: .....

3. List of substances in contact with the equipment or reaction products:

3.1 Chemical/substance name, chemical symbol:

a) .....
b) .....
c) .....
d) .....

3.2 Important information and precautions, e.g. danger classification

a) .....
b) .....
c) .....
d) .....

4. Declaration (please mark as applicable):

¤ **4.1 for non dangerous goods:**
We assure for the returned product that
- neither toxic, corrosive, bilogically active, explosive, radioactive nor contamination dangerous in any way has occurred.
- the product is free of dangerous substances.

The oil or residues of pumped media have been drained.

¤ **4.2 for dangerous goods:**
We assure for the returned product that
- all substances, toxic, corrosive, biologically active, explosive, radioactive or dangerous in any way which have pumped or been in contact with the product are listed in 3.1, that the information is complete and that we have not withheld any information.
- the product, in accordance with regulations, has been
¤ cleaned
¤ decontaminated
¤ sterilized

5. Way of transport / carrier:

.....

Day of dispatch to BÜCHI Labortechnik AG:

.....

We declare that the following measures - where applicable - have been taken:
- The oil has been drained from the product.

Important: Dispose of according to national regulations.
- The interior of the product has been cleaned.
- All inlet and outlet ports of the product have been sealed.
- The product has been properly packed, if necessary, please order an original packaging (costs will be charged) and marked as appropriate.
- The carrier has been informed about the hazardous nature of goods (if applicable).

Signature: .....

Name (print): .....

Job title (print): .....

Company's seal: .....

Date: .....

10 Spare parts

This chapter lists spare parts, accessories, and optional extras, including all of the relevant order information for ordering from BUCHI. Always state the product designation and part number when ordering any spare parts.
Use only genuine BUCHI consumables and spare parts for maintenance and repair to ensure optimum system performance and reliability. Prior written permission of the manufacturer should be obtained before any modifications are made to the spare parts used.