



ROTARY VACUUM EVAPORATOR

RVO 400

User manual

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1. INTRODUCTION

1.1 Apparatus use and specifications

Rotary vacuum evaporator RVO 400 is advanced model of the company INGOS Ltd.. INGOS Ltd. continuous in tradition of the Czech traditional laboratory equipment producers. RVO 400 is a member of the new model line marked 400 allow use of flasks from 20ml up to 4000ml. Innovated design offer user friendly interface and ensures more comfort and easier operation while evaporating.

1. The apparatus is fitted with a digital vacuum control and measuring system. Vacuum ratio is driven by diaphragm vacuum pump control.
2. User comfort assure heating bath equipped with motorized lift and manually tilted rotary casing head.
3. Rotation of the evaporating flask, height of the heating bath, the vacuum ratio and length of evaporation can be digitally set and controlled with optional wireless remote controller. All controlled values can be stored in memories.
4. Standard glass assembly can be adapt or enlarged on request. A wide range of flasks can be used, from 20 ml up to 4 l. Three types of chillers can be used as well as many glass accessories.

1.2 Technical characteristics

Evaporating flasks	20 – 4000 ml
Rotation speed	0 up to 200 rpm
Bath temperature	max. 100°C for water filling max. 180°C for oil filling
Regulation accuracy	±1°C up to 100°C ±3°C up to 180°C
Pressure difference	50 hPa (can be modified according to user's requirements)
Power supply	230V, ±10%, 50Hz
Power input	max.2000 W (excluding vacuum pump)
Weight without glass	20 kg
Dimensions (w x h x d)	650 x 950 x 360 mm (including glass)

1.3 Symbol Explanation

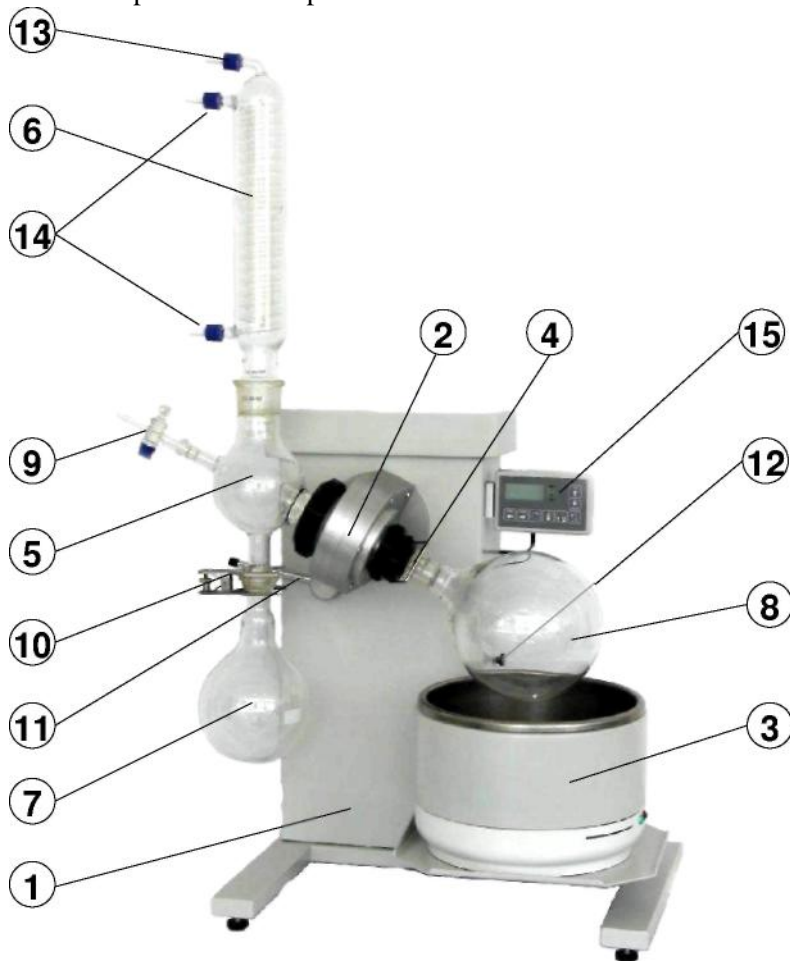


- hot surface

2. TECHNICAL DESCRIPTION

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Individual parts of the evaporator and their location can be seen on fig. 1.



- | | |
|---|--|
| 1. Stand | 9. Filling pipe with valve |
| 2. Rotary casing head | 10. Fixed clip |
| 3. Heating bath | 11. Head tilt stick |
| 4. Suck pipe | 12. Lift top position stopper screw |
| 5. Ball adapter | 13. Fitting - vacuum connection joint socket |
| 6. Condenser | 14. Fitting - cooling water connection |
| 7. Receiving flask 1000 or 2000 ml, ball KS 35/20 | 15. Keyboard |
| 8. Round bottom flask 1000 or 2000 or 4000 ml, point NZ 29/32 | |

Fig.1 Location of individual parts of RVO

For complete list of basic accessories see paragraph 7.2.1.

3. STARTING OF OPERATION

3.1 Unpacking of the apparatus

Unpack the apparatus from the transport package, check the evaporators surface and check all items according to the delivery note. If the apparatus is damaged or if an item is missing, contact your supplier or the manufacturer. Caution: apply silicone Vaseline to the all joints of the glass assembly.

3.2 Apparatus assembly

1. Keyboard can be hanged on the apparatus or can be laid beside it. When hanged, keyboard can be positioned parallel or using adaptor in perpendicular position see fig. 1. Use the shorter keyboard connection cable if the keyboard is hanging, or the longer cable when keyboard is laid. Plug connection cable in to the keyboard and to the socket at the back of apparatus marked KEYBOARD (fig. 2, pos. 1).
2. Place the heating bath on the lift table fig. 1, insert the bath cable into the socket under the mains switch (fig. 2 pos.10) and plug the connector of the bath temperature sensor into the socket (fig. 2 pos.3) marked THERMOMETER.
3. Pour approximately 1 l of liquid into the heating bath.

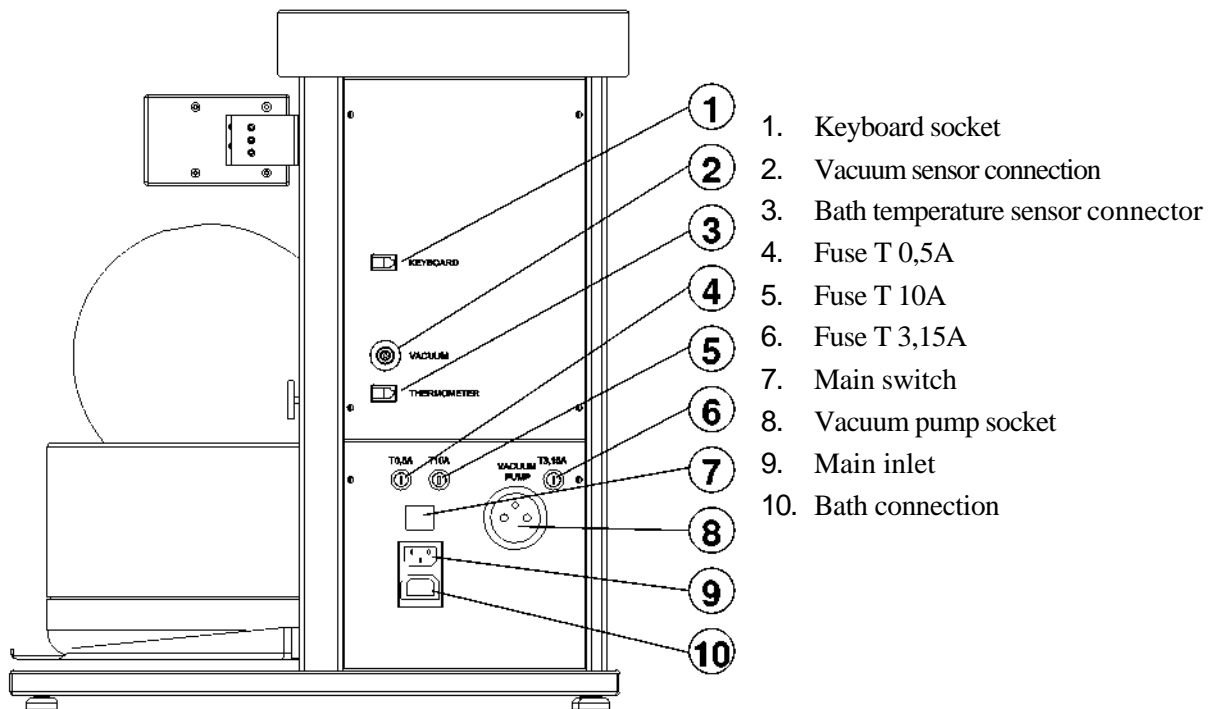
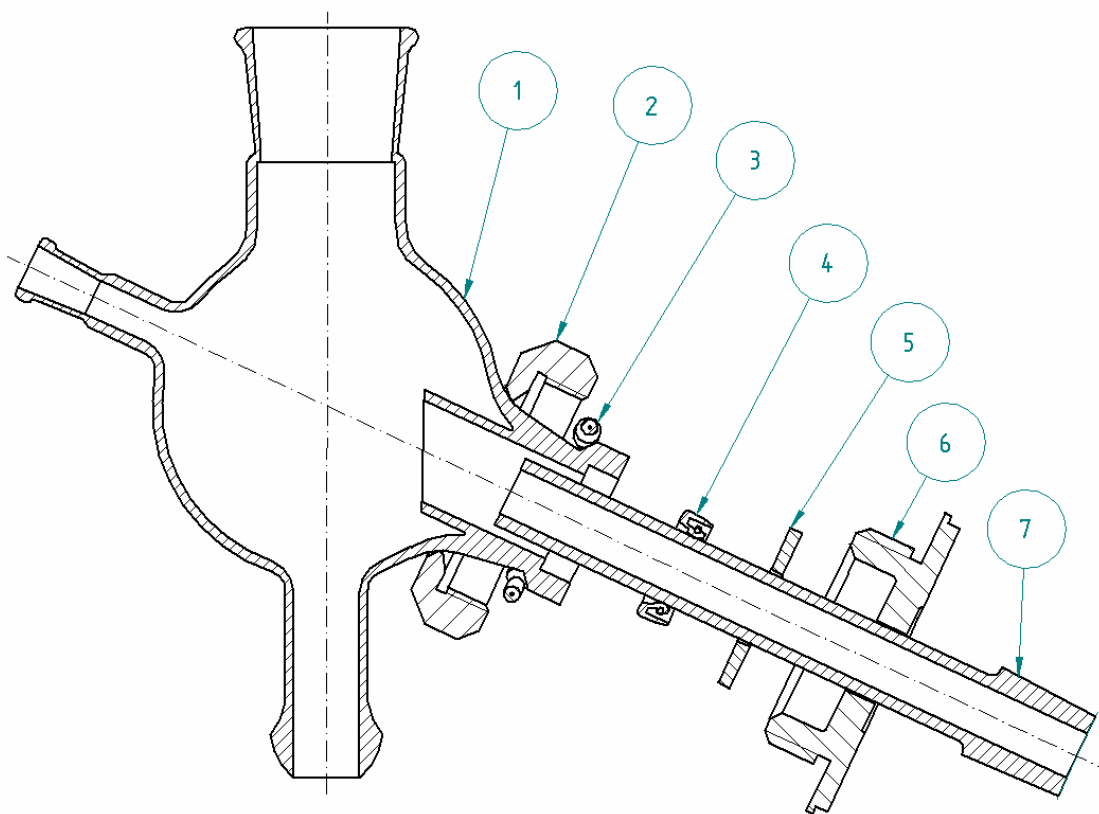


Fig. 2. Connectors

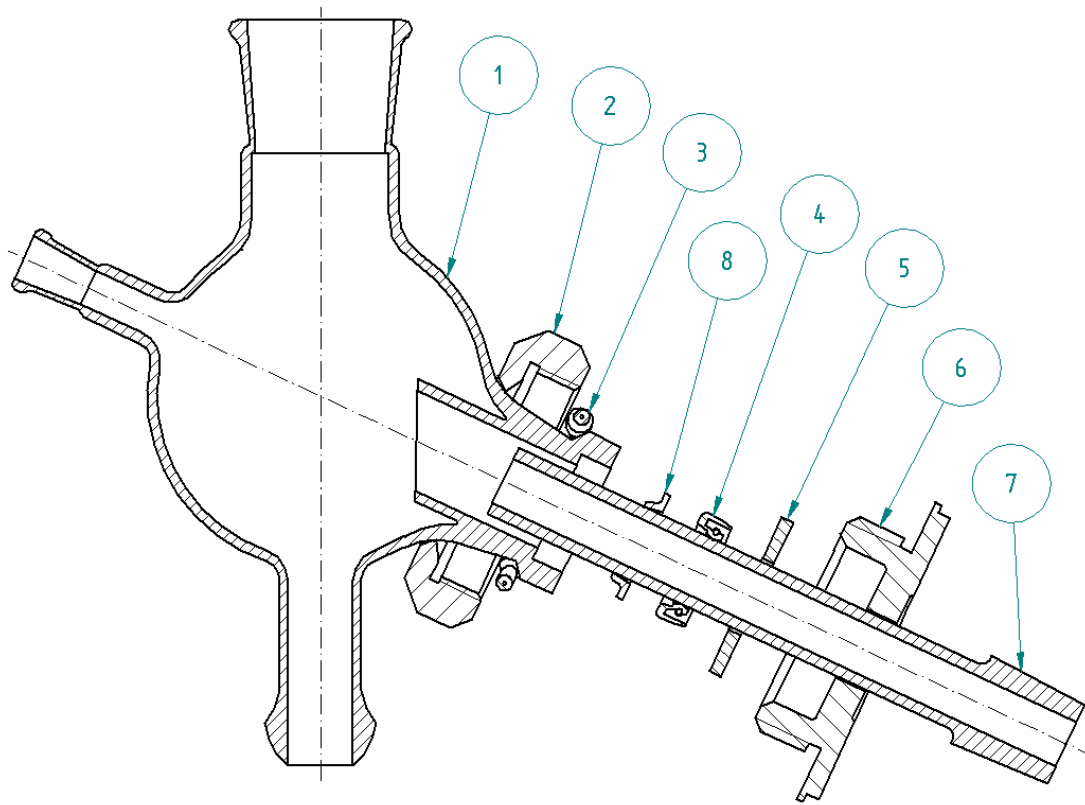
4. Rotation blocking knob, which is placed on the rotary casing head, set to the "Lock" position (marking by red point) (for easier locking try to turn the casing a little). Insert suck pipe in to the rotary casing until the siting touches the plastic collar. Than tighten the nut on the rotating casing. Finally "Unlock" the blocking knob (marking by green point).

5. The opposite side of the head with the rotary casing contains a fixed housing with a nut. Unscrew the nut (fig. 3 pos.2), put it on the fitted part of the ball adapter (fig. 3 pos.1), insert the bead-type securing ring (fig. 3 pos.3) in such a way that it can latch behind the fitted part of the ball adapter. Check that the gufero sealing, treated with silicone Vaseline, has been inserted inside the fitted part (fig. 3 pos.4), its open side should face out of the fitting. Check that the flat sealing (fig. 3 pos.5) has been inserted in the casing and put carefully the ball adapter with gufero and nut on the suck pipe (fig. 3 pos.6), push the ball adapter until it stops and tighten the nut properly (fig. 3 pos.2). The spherical joint of the ball adapter faces down.
6. Do not forget to apply silicone Vaseline to all glass parts joints.
7. Install the condenser into the joint in the upper part of the ball adapter. The upper outlet of the condenser serves for the connection of the vacuum source. Connect the outlet of the condenser to the socket for the measurement of vacuum, marked VACUUM, and to the vacuum source with the help of a "T" union. Other outlets serve for connection of cooling water.
8. Attach the receiving flask with ball joint to the ball adapter with the help of a fixed clip, tighten properly.
9. Put the round bottom flask on the pipe and secure it with a wire combi-clip.
10. Insert the filing pipe with a valve (valve closed) into the ball adapter.



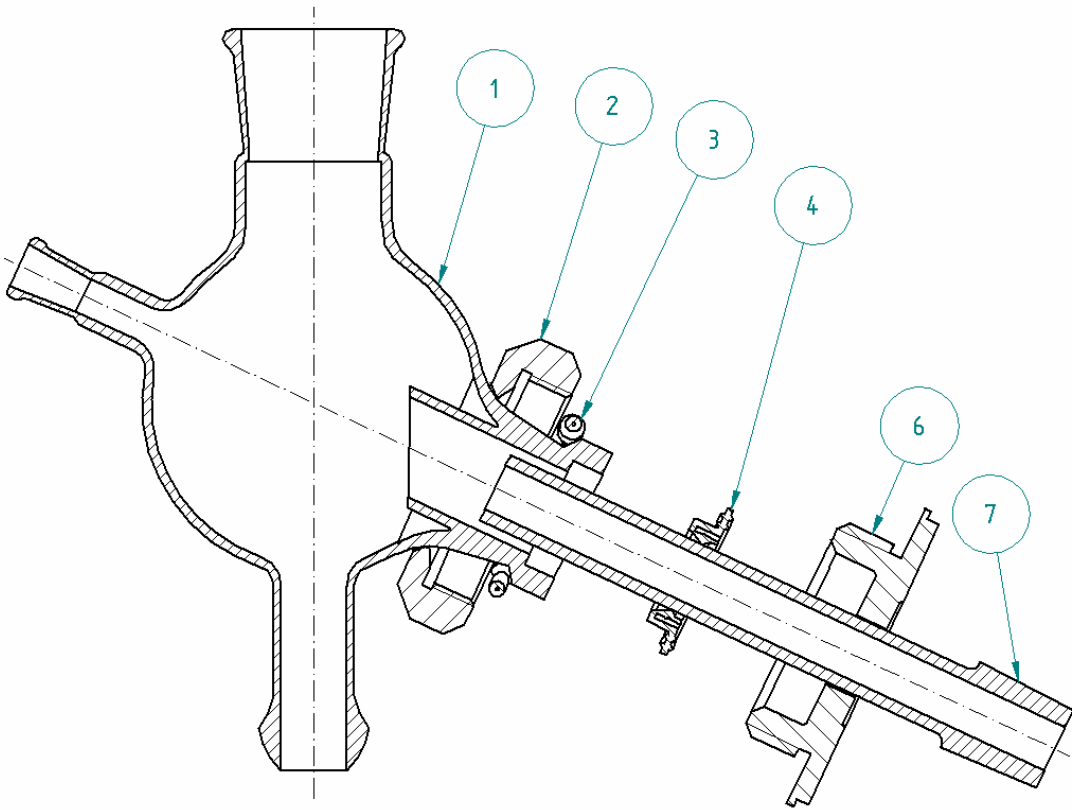
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|----------------------------|-----------------|
| 1. Ball adapter | 5. Flat sealing |
| 2. Nut | 6. Housing |
| 3. Bead-type securing ring | 7. Suck pipe |
| 4. Gufero sealing 35/22/10 | |

Fig. 3a. Ball adapter sealing



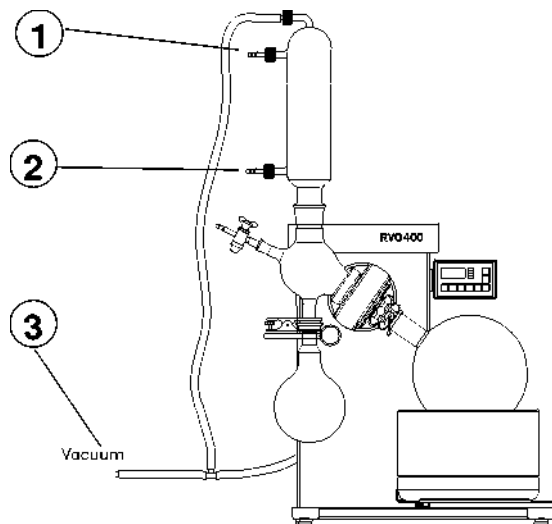
- 1. Ball adapter
- 2. Nut
- 3. Bead-type securing ring
- 4. Gufero sealing 35/22/7
- 5. Flat sealing
- 6. Housing
- 7. Suck pipe
- 8. Scraper ring (chemical resistant)

Fig. 3b. Ball adapter sealing (chemical resistant)



- 1. Ball adapter
- 2. Nut
- 3. Bead-type securing ring
- 4. PTFE sealing
- 5. -----
- 6. Housing
- 7. Suck pipe

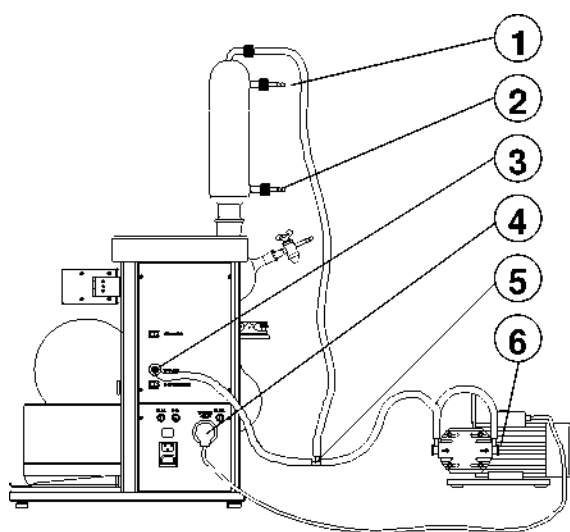
Fig. 3c. Ball adapter sealing (chemical resistant)



- 1. Cooling water outlet
- 2. Cooling water inlet
- 3. Vacuum connection

Fig. 4. Tube connection scheme

11. Connect the main cord. (fig. 2 pos.9)
12. Lift the heating bath using the lift to its working position. At the bath top position adjust the lift stopper and fill in the liquid in the heating bath in such a way that the round-bottom flask can be sufficiently immersed in the liquid. The maximum liquid level is approximately 20 mm below the edge of the heating bath. Flask can be immerse and emerge by tilt the rotary casing head. For tilt use stick on the left side of the apparatus. When tilt the head move stick carefully, pay attention to glass equipment.
13. When removing the round bottom flask, release the vacuum first (e.g. use the filling pipe valve). For easier manipulation use the rotation blocking knob to lock the rotation. Carefully unscrew the wire combi-clip, until the flask is released. During the flask removing, work with caution.
14. When the vacuum control is desired, connect the mains cable of vacuum pump into the socket on the back side of the apparatus. In this case connection between condenser vacuum outlet and vacuum measurement socket has to be established!



- | | |
|-----------------------------|---------------------------------------|
| 1. Cooling water outlet | 4. Controlled vacuum pump plug socket |
| 2. Cooling water inlet | 5. "T" union |
| 3. Vacuum sensor connection | 6. Vacuum pump |

Fig. 5. Connection plan for vacuum control

Caution : It is not possible to use the glass part if it features visible scratches or any other defects ! W hen controlling the vacuum, only the diaphragm vacuum pump with maximum input

650 W, can be plugged in the evaporator!

3.3 Apparatus control

The apparatus start operation by means of switching the mains switch on (fig. 2, pos. 7). When the apparatus is switched on, the display starts lighting.

The keys **LESS** and **MORE** serve for the adjustment of the display value.

By pressing the key with a rotation symbol you can start the rotation of the evaporating flask. The correct function is indicated by the highlighting in the upper left of the key. Always check if the lock's knob of rotation is in position unlocked. (When the rotation is switched-on, and the lock's knob of rotation is in locked position, socked with the glass tube will not rotating and the display starts rotation lighting will flash.)

By pressing the key with a temperature symbol you will initiate the heating of the bath. The correct function is indicated by the highlighting in the upper left part of the key. Simultaneously with the heating activation is activated vacuum control. **1 2** represents the memories in which it is possible to store two settings of the controlled parameters. The active memory is indicated by the highlighting in the upper left (right) of the key.

The mode key (marked with two arrows) serves for the switching between the variables measured. **RPM** - revolutions, **°C** - temperature, **hPa** [hPa=100Pa] - vacuum and timer [mm:ss]. The switching over is indicated by the highlighting of the variable in question.

By using the key **UP** you can lift the heating bath upwards. By using the key **DOWN** you can make the heating bath go downwards. The upward movement of the bath is limited by the lift top position stopper screw which is situated on (viz. fig. 1 pos.12) the right side of the apparatus. The downward movement of the bath is limited through a firmly pre-set end switch. **Be careful! While you are lifting the heating bath pay particular attention for the bath liquid not to overflow the bath edge.**

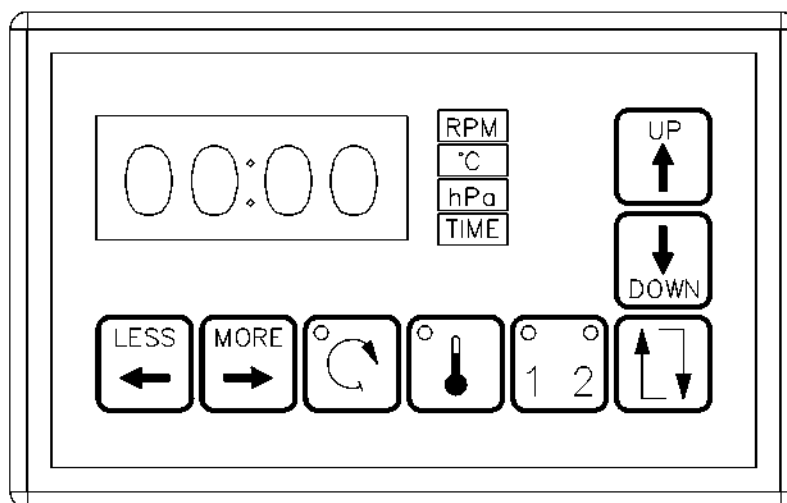


Fig. 6. Keyboard

3.3.1 Adjustment of revolutions

Switch over to **RPM** by using the mode key. The display will show the revolutions value pre-set. By pressing the keys **LESS** or **MORE** you can change this value. If you keep these keys pressed for a longer time, the speed of change in the value to be set will increase on a progressive basis. The apparatus enables you to set both directions of the rotation. The opposite direction of the rotation is indicated with the - minus sign.

3.3.2 Setting of temperatures

Switch to °C by using the mode key. For a short time the display will show the temperature value pre-set, which is followed by the real temperature value. If you touch the keys **LESS** or **MORE** the pre-set value will be shown and can be changed by pressing the above mentioned keys. If you keep LESS/MORE keys pressed for a longer time, the speed of change in the value to be set will increase on a progressive basis.

3.3.3 Adjustment of vacuum

Switch to **hPa** by using the mode key. If you touch the keys **LESS** or **MORE** the pre-set value will be shown. This value can be changed by pressing the above mentioned keys. The factory pre-set pressure difference of switching is 50 hPa (it can be modified upon request).

The vacuum control is switched-on together with switching-on the heating bath. In case you want to control vacuum only heating of the bath is unwanted, adjust the bath heating temperature lower than the ambient temperature and switch the bath heating on.

3.3.4 Adjustment of operating time (Timer)

Switch to **Time** by using the mode key. The pre-set value of the operation time will show up. If the display shows pre-set value **00:00**, the operating time is not limited. Pre-setting carry out by using the keys **LESS** and **MORE**. When the rotation is switched ON, the time is measured. The measuring is indicated by the flashing display, showing indication TIME. When the pre-set time is over, bath will automatically descend to the bottom position, bath heating and rotation will be switched OFF. In case the apparatus controls the vacuum pump, the vacuum pump will be switched OFF together with the heating and rotation. The rotating casing keeps the electrical block-out and the display shows permanent final value of the time.

Note : The setting of revolutions, temperature under pressure and time can be carried out also if the rotation and heating bath operation are ON. **Be careful while adjusting revolutions if the apparatus is in operation! The adjustment should be carried out only by means of repeated short pressings of the keys LESS and MORE . If you keep the above mentioned keys pressed, you will achieve maximum revolutions in a short time!**

After switching the apparatus ON or while switching the memory over you must observe the principle that the rotation is always OFF, which holds for the operation of the heating bath as well. We recommend you to check the pre-set rate of revolutions still before you switch the rotation ON.

3.3.5 Storing the values pre-set into the memory

If the window is highlighted above the number **1**, you are storing the data into the memory **1**, namely by pressing the key **1 2** for a time of at least 5s (the window above the number 1 shall turn on again). Thus you will store the current setting of rotation, temperature pressure and operating time. If you do not want the operating time to limit you will store into the memory the setting of the time **00:00**. By every pressing the key **1 2** you will switch over to the second memory. The setting is carried out by same way as for the first memory.

The values pre-set can be changed even during the apparatus operation. If you do not store them again, the apparatus will remember the last adjustments stored and the apparatus will automatically switch over to these settings after being switched OFF and ON.

4. MAINTENANCE

4.1 Apparatus maintenance

Do not leave the evaporator surface contaminated from corrosive substances. It could damage the evaporator coating. Clean the contaminated surface with a clean soft cloth. The cloth may be moistened but not wet. It is also possible to use ordinary washing means for cleaning purposes. It is forbidden to clean the heating bath with the means which could spoil its smooth surface. In case of sediments of furning,impurities, particulates of water rusts ,use the cleaning compounds for cleaning of furning or mellow solution of HCL. In process of cleaning use the protective means recommended by producer of applied cleaning compounds.

Caution: Disconnect the apparatus from the network while cleaning it with a wet cloth!

4.2 Sealing replacement

Disassemble the condenser, remove the releasing pipe with the valve, remove the ball-and-socket ground joint flask, release the nut of the ball adapter and carefully remove the actual adapter. Release the gufero sealing, clean the ball adapter, slightly apply silicone Vaseline onto the new sealing and mount it into the ball adapter. The sealing cavity faces out of the ball adapter. If necessary, replace also the flat sealing between the ball adapter and the head fitted with a rotary casing. Perform the assembly according to the point 3.2. Apply a light layer of silicone Vaseline to the gufero sealing approximately after 80 operation hours (more often if necessary).

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5. DEFECTS AND TROUBLESHOOTING

5.1 Leakage

The main cause of leakage is usually an incorrect sealing assembly. At first you should check that all joints have been installed correctly. If it is the case, disassemble the glass and verify the condition of the ball adapter sealing and flat sealing, if necessary replace them. Carefully assemble according to the instructions, switch the rotation ON and start the vacuum pressure up.

5.2 Other failures

The apparatus does not respond when you switch it ON. Check fuses, possibly replace with new ones featuring the same parameters (fig. 2, T 0.5A and T 10A). The window of the rotation key is flashing, rotating parts are not moving. Ensure that Rotation blocking knob is set to "Unlock" and than press rotation key again. The window of the rotation key is flashing. Check that there is not anything which could impede the flask from its rotation (manually), switch the mains switch OFF and ON and press the rotation key again. The window of the temperature key is flashing. This indicates that the temperature sensor have been connected incorrectly. Check the sensor connection, quantity of liquid in the heating bath and switch the main switch OFF and ON and press the temperature key again. Controlled vacuum pump is not running, even the pump mains cable is correctly plug in the rear of evaporator as well as vacuum connecting hose. Check the vacuum pump fuse, possibly replace it with new one featuring the same parameters (fig. 2, T3,15A).

6. SAFETY AND OPERATION CONDITIONS

6.1 Operation safety

Ensuring of rotation of the sample to be vaporized:	Current protection of the driving motor. If the resistance against rotation has increased above the prespecified limit, the driving motor voltage will be disconnected. (This situation will be signaled by the flashing of the rotation LED)
Protection of the heating bath lift:	Friction coupling between the driving motor and lifting equipment. In the case of an increase in resistance during the lifting of the bath above the specified limit the friction coupling could slip.
Protection of bath heating:	Electronically by means of a thermal protection against overheating. There will not be any heating if the incorporated sensor of the heating bath has been connected or if the difference of temperatures between sensors rises above the limit pre-specified by the manufacturer. (This situation will be signaled by the flashing of the LED for heating)

6.2 Operation conditions

The apparatus is designed for the work under ordinary laboratory conditions at temperatures of 10 to 30°C and air humidity up to 80% . The power supply is 230 V, 10 A, 50 Hz. The inlet cord should be connected into a socket circuit featuring protection from 10 A or 16 A (diaphragm vacuum pump connected). The inlet cord cannot be in contact with the heating bath. The socket designed for the connection of the heating bath is designed exclusively for this bath. Oil used in the bath must be designed for a temperature of at least 180°C. The bath volume shall not exceed 2 l.

It is forbidden to handle any bath which has been heated to a temperature exceeding 40°C in any other way than by using the apparatus lift. If you want to fill the liquid into the heating bath, always switch the vaporized sample rotation OFF. For temperatures up to 100°C use water as the filling of the heating bath (with regard to its higher thermal capacity).

Caution! If you are replacing the round-bottom flask after the vaporized solution has become thicker, pay particular attention and if it is not possible to remove the flask easily from the cone, carry out any other handling only after the cooling of the bath.

Caution! If you use oil as the filling of the heating bath, the heating bath must be properly dried before its being filled.

Caution! If you are working with oil heated above 100°C, you must ensure that no water can enter into the oil. If you are replacing the round-bottom flask, pay particular attention that no water drops shall enter into the oil. While working, use personal protection equipment (goggles, gloves, coat and shoes).

7. ACCESSORIES AND SPARE PARTS

7.1 Basic accessories (comes with evaporator)

Inlet cord Glass assembly

Round bottom flask (1000, 2000 or 4000 ml) NZ29/32

Receiving flask (1000 or 2000 ml) KS 35/20

Suck pipe

Ball adapter

Vertical condenser

Filling pipe with a valve

3 pieces of GL14 connection fitting

Sealing: gufero sealing 35/22/10 (Fig. 3a, pos. 4),

flat sealing (Fig. 3, pos. 5), or

gufero sealing 35/22/7 (Fig. 3b, pos. 4) with scraper ring

Fixed clip Keyboard

Adaptor Keyboard

Cables 0.4 and 2m

Tubing coupler PA vacuum tubing (100, 110 a 150cm)

Main inlet cord

7.2 Other accessories

7.2.1 Glass accessories (Fig. 7)

4SKL0021	Evaporating flask 50 ml, joint NZ29/32
4SKL0025	Evaporating flask 100 ml, joint NZ29/32
4SKL0022	Evaporating flask 250 ml, joint NZ29/32
4SKL0023	Evaporating flask 500 ml, joint NZ29/32
4SKL0004	Evaporating flask 1000 ml, joint NZ29/32
4SKL0003	Evaporating flask 2000 ml, joint NZ29/32
4SKL0012	Evaporating flask 4000 ml, joint NZ29/32 (only RVO400)
4SKL0017	Receiving flask 250 ml, joint KS35/20
4SKL0024	Receiving flask 500 ml, joint KS35/20
4SKL0006	Receiving flask 1000 ml, joint KS35/20
4SKL0034	Receiving flask 2000 ml, joint KS35/20
4SKL0005	Vertical condenser
4SKL0033	Diagonal condenser
4SKL0020	Dry ice trap
4SKL0001	Filling pipe with a valve - short
4SKL0002	Filling pipe with a valve - long
4SKL0008	Ball adapter
RO3212	Suck pipe

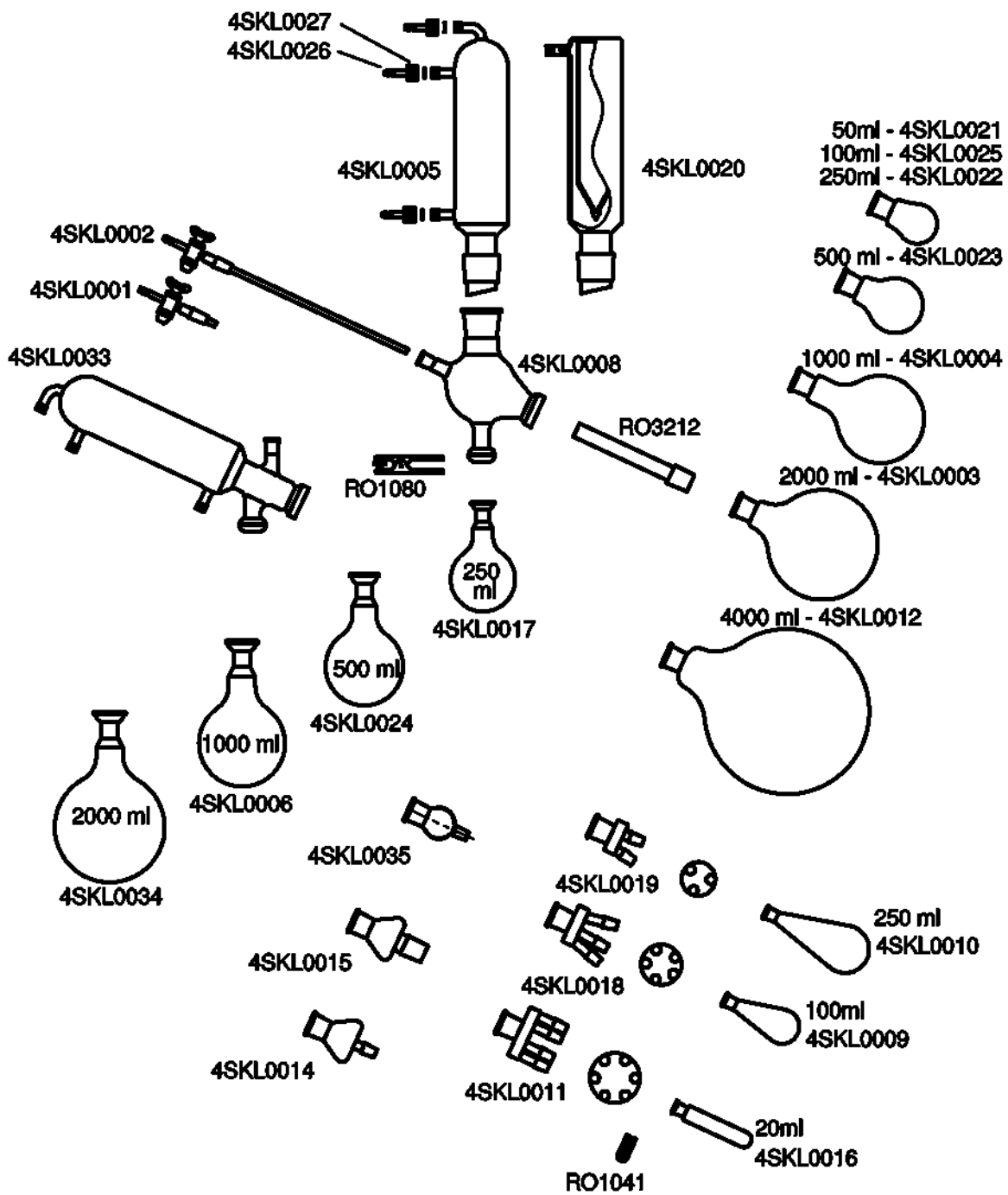
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4SKL0016	Test tube 20 ml, joint NZ14/23
4SKL0009	Flask 100 ml, joint NZ14/23
4SKL0010	Flask 250 ml, joint NZ14/23
4SKL0019	Spider with 3 sleeves NZ14/23 (max. flask 250ml)
4SKL0018	Spider with 5 sleeves NZ14/23 (max. flask 100ml)
4SKL0011	Spider with 6 sleeves NZ14/23 (max. flask 20ml)
4SKL0014	Foam trap NZ29/32 - NZ14/23
4SKL0015	Foam trap NZ29/32 - NZ29/32
4SKL0035	Adapter NZ29/32 - NZ14/23

7.2.2 Spare parts, other accessories

RO1520	Safety bath shield
1TOO0007	Gufero sealing 35/22/10 (Fig.3a)
1TG24524	Flat sealing
1TOO0009	Gufero sealing 35/22/7 (Fig.3b)
1TOO0010	Scraper ring
1TOO0011	Sealing PTFE (Fig.3c)
RO1080	Fixed clip (for KS32/20)
RO1041	Elastic clip (for NZ14/23)
4SKL0026	Straight fitting GL 14
4SKL0027	Cap nut GL 14
90000013	Tubing coupler
5HAD0003	PA Vacuum tubing
90000036	Vacuum pump (VM20D recommended) Spare diaphragms and sealing for VM20D Heating bath stainless steel
3VOD0003	Inlet cord
Fuses: T 10 A, T 3.15 A , T 0.5 A	





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Fig. 7. Glass accessories overview

8. CONCLUSION

8.1 Carrying out of repairs

All warranty and after-warranty repairs shall be carried out by the manufacturer or by the organization authorized by them. If the delivery note does not state otherwise, contact the distributor for any repair requirements.

8.2 Warranty

The product is covered by the manufacturer's warranty lasting for one year from the day of the handing over to the customer of the product. The apparatus can only be used in the way specified in these instructions. The apparatus cannot be used in any other way than as provided for in these instructions, otherwise the operation safety could be interfered.

If the conditions of these instructions are not met, the manufacturer will not be liable for damages which could arise.

8.3 Waste disposal

When the instruments operating life is over dispose it in respect to valid regulations, also it can be returned to the vendor or producer for liquidation.

Warning: Instrument contains parts (PCB's) which are rated as hazardous waste.

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9.1 List of pictures and tables

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