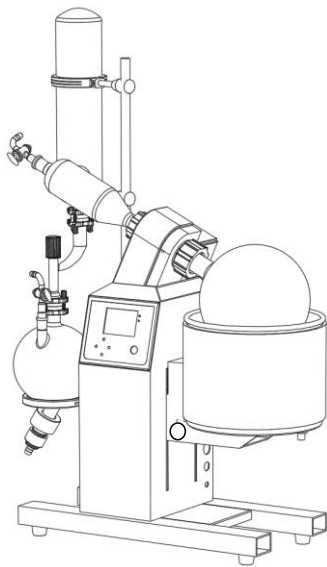


Cole-Parmer®

RV-400 Series

ROTARY EVAPORATOR



Instruction Manual

52411_5L Rotary Evaporator_ver_1.0



Applicable to 230V a.c. models only

User Warning



Failure to follow all warning and instructions could result in serious injury. Your safety is very important to us, we urge you to take the following precautions when using this product. We are not responsible for injury or damage caused by misuse.

- Instrument must be grounded and away from any electromagnetic interference
- Use instrument in a laboratory environment with proper ventilation
- Before using the instrument, the user must have some basic knowledge of the equipment/process and obtain related laboratory skills
- Do not retrofit the instrument, this may lead to electric shock or cause equipment failure
- Do not use instrument for applications not listed in the purpose section
- This instrument is not explosion proof; do not operate in an explosive environment
- If using flammable sample or organic solvents take caution in spilling hazards
- During operation be cautious of hot bath and rotating flask
- Do not disassemble the instrument. Electrical components can cause personal injury
- The instrument should use a separate power outlet
- Do not unplug the unit during operation. Turn off heating and rotating then switch the unit off before unplugging the instrument
- Proper personal protection equipment shall be used during operation
- Instrument cannot be repaired without authorization of the vendor/manufacture
- Do not position the unit in such a way as to make disconnection from power supply difficult.

NOTE: (This may affect the service life of the unit)

- Please make sure the power connection is correct and well grounded.
- Ensure that the glassware is free of cracks, chips, or any other notable defects. Do not use if defective.
- Check that all hosing (vacuum/chilling) does not have tears or kinks.
- Avoid cracking condenser barb connections or injection valve when assembling hosing by rotating and pushing hosing on connections.
- Avoid overtightening clamps on glass joints. This can affect the seal of the joint and create leak points. Double check all screws on clamps are evenly tightened.
- Check rotating screw caps on motor are tightened and making a seal with the glass.
- During operation place rotary evaporator on even surface and lock feet.
- Use vacuum grease in all connections.

Purpose

Rotary Evaporators are used to distill solvents from compounds with precise evaporation. These are especially useful when trying to separate organic compounds from ethanol, or any other low boiling point solvents. Boiling points can be lowered by pulling a vacuum on the system. The evaporating flask rotates with variable speeds, allowing you to spin the solution into a thin film around the flask. With a combination of a reduced pressure and large heating surface area, these are great for quick distillation.

Internal glass coil condenser cools solvent vapors, allowing them to fall into the collection flask. This leaves you with distilled solvent, ready to use again.

The heating element is controlled by a PID controller, accurate to the degree. Slowly raise temperatures to achieve your solvent's boiling point without disturbing the extract.

Structural Features

- Dual thermocouple positioned for accurate bath temperature control
- PTFE valve cores, corrosion-resistant without any pollution
- Check valve between collection flask and condenser to allow the emptying of recovered solvent without having to break vacuum
- Vacuum gauge and manifold for direct feedback of any vacuum loss
- Electric lifting bath with dual heating coils for uniformity
- Rigid frame to easily support and transport unit around laboratory
- Triple coiled condenser for maximum surface area
- Compact footprint

Unpacking

Note: The glassware set is fragile; unpack with care.

1. Open the package.
2. Check the parts according to the packing list. If there are any missing, please contact us.
3. Carefully clean the glass to maintain cleanliness before assembly.
4. Prepare all the tools needed for installation.

Connecting the unit to the main supply

The 230V unit will be supplied with an EU mains lead. Should the plug not be suitable for connecting to the mains power supply in your territory, replace the plug with a suitable alternative.

THIS OPERATION SHOULD ONLY BE UNDERTAKEN BY A QUALIFIED ELECTRICIAN. NOTE: Refer to the equipment rating plate to ensure that the plug and fusing are suitable for the voltage and wattage stated.

cable wiring is colored as follows:

UK / EU mains cable wiring is colored as follows:

Brown – Live

Blue – Neutral

Green/Yellow - Earth

Should the mains lead require replacement, cable of 1.5 mm² /14 AWG of harmonized code H05VV-F should be selected. This is dependent upon the power rating of the unit, see technical specifications.

IF IN DOUBT CONSULT A QUALIFIED ELECTRICIAN

Technical Specifications

Model	RV-400A-5 52411-96, 52411-97
Rotational Speed	20 ~ 140 rpm
Bath Temp Range	RT+5°C ~ 99°C / RT+41°F ~ 210°F
Speed Setting	Knob Setting + LCD Controller
Lifting Method	Automatic
Bath Heating Method	Built-in heating coils
Rotational Motor	DC Brushless
Total Condensing Surface Area	0.278 m ² / 431 in ²
Vacuum Seal	PTFE Coating
Dimensions W x H x D (mm)	860 x 1120 x 410
Bath Inner Dimension Diameter x Height (mm)	280 x 175
Water Bath Material	Stainless Steel + Corrosion Resistant Coating
Water Bath Voltage/Power	120V-1500W, 220V-2000W
Main Unit Voltage/Power	120V-1800W, 220V-2300W
Mains Voltage of Power Supply	120V 50/60Hz, 220V 50/60Hz
Ambient Operating Temperature	5°C ~ 35°C / 41°F ~ 95°F
Barometric Pressure	86 ~ 106 KPa
Altitude Max	2000_m
Pollution Degree	2

* RT = Room Temperature

* rpm = rotation per minute

Breaker information

Located on back of unit



Model number	Cable/plug (US) Black – Live White – Neutral Green - Earth	Cable/plug (EU) Brown – Live Blue – Neutral Green/Yellow - Earth	Fuse
52411-96	14AWG		16A Breaker
52411-97		1.5mm ² /H05VV-F	16A Breaker

Breaker reset

- Power unit off
- Open back panel of unit by removing the 2 screws pictured above
- Breaker is located at bottom
- Switch breaker off and then on again
- Replace back panel and secure with screws

Main Components Diagram

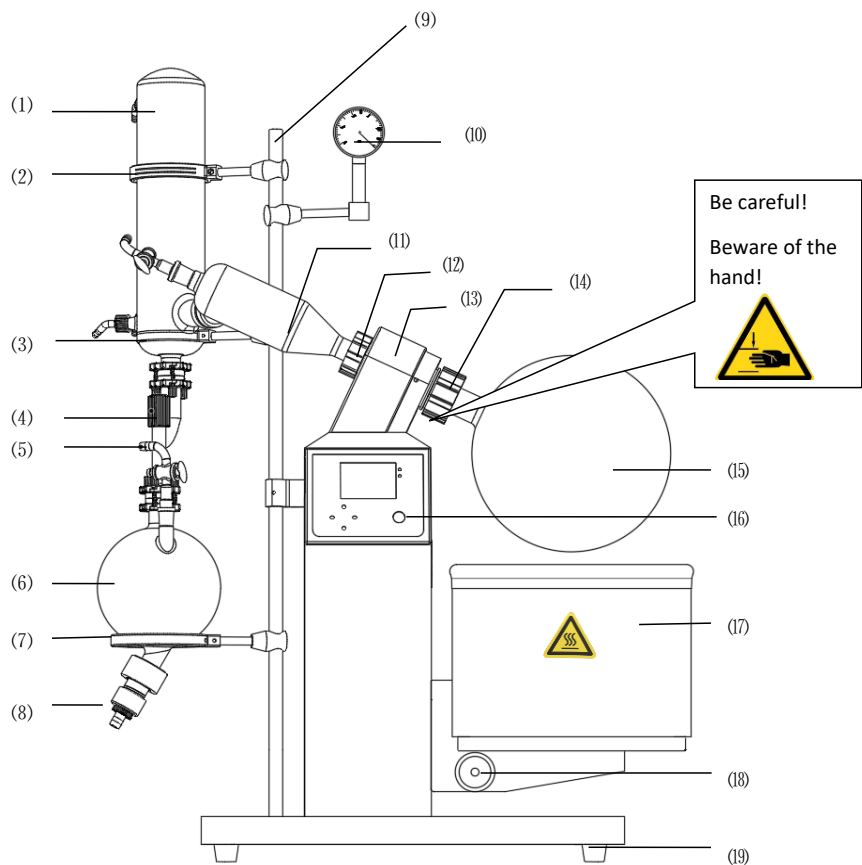


Figure 1

- | | | |
|---------------------------|----------------------------------|------------------------------------------|
| 1. Main Condenser | 7. Receiving Flask Support Ring | 13. Machine Head |
| 2. Main Condenser Clamp | 8. Discharge valve | 14. Evaporating Flask Nut and Washer Set |
| 3. Condenser Support Ring | 9. Mounting Pole | 15. Evaporating Flask |
| 4. Stop valve | 10. Vacuum gauge (Optional) | 16. Operating Panel |
| 5. Release valve | 11. Bump Trap | 17. Heating Bath |
| 6. Receiving Flask | 12. Bump Trap Nut and Washer Set | 18. Temperature limit controller |
| | | 19. Castor Wheel |

Condenser Structure Diagram:

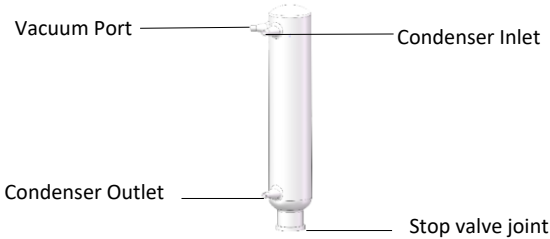


Figure 2

Bump Trap Structure Diagram:

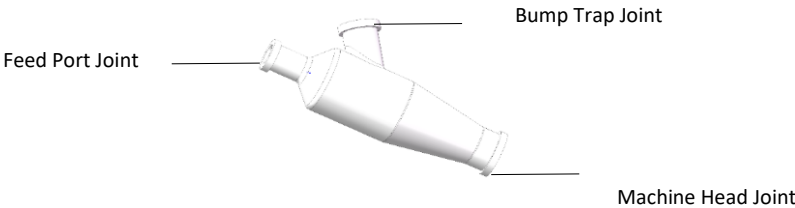


Figure 3

Stop valve structure diagram:

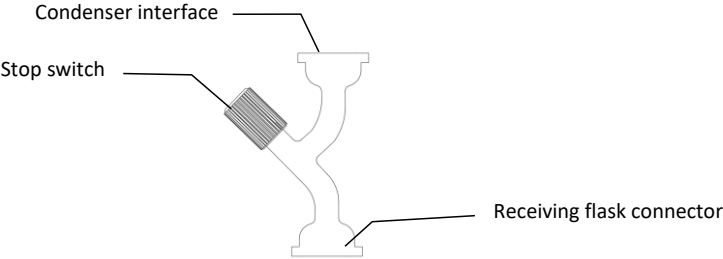


Figure 4

Receiving Flask Structure Diagram:

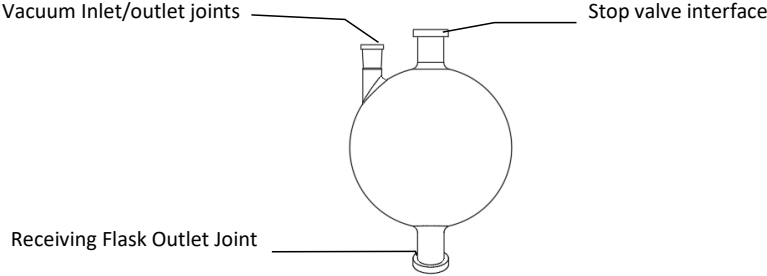


Figure 5

Operating Panel Diagram

Commented [HDA1]: Change to show CP branded fascia

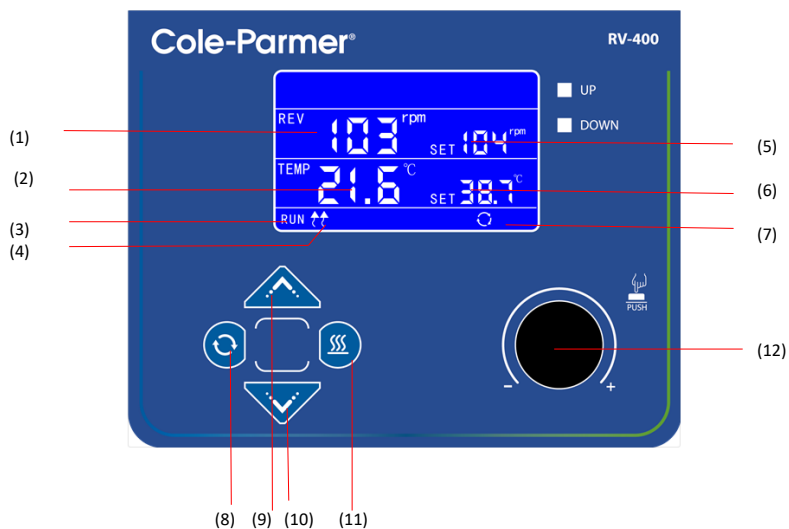






Figure 6

1. REV: As the Evaporating Flask is rotating, this will display the revolutions per minute.
2. TEMP: Displays the current temperature in degrees Celsius.
3. RUN: Indicates when in heating or rotating status.
4. Heating indicator: Arrows appear when the heating function is operating
5. REV SET: Indicates the manually set speed in revolutions per minute.
6. TEMP SET: Displays the manually set temperature in degrees Celsius.
7. Rotation indicator: Rotating arrows appear whenever rotation is in motion.
8.  Turns on/off the rotation function.
9.  Adjusts the heating bath height; Press and hold this key to raise the water bath automatically.
10.  Adjusts the heating bath height; Press and hold this key to lower the height of water bath automatically
11.  Turns on/off the heating function;

12. "Knob" Used to set the time, temperatures, and speed values manually.

Operation Panel Instructions

Powering the unit: Plug in the power cord and press the on/off switch on the lower left side of body.

When the rotary evaporator is on:

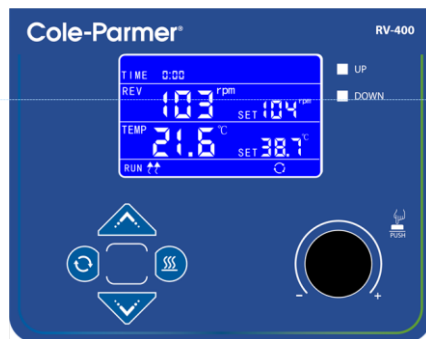
1. After the controller is powered on, it performs a self-test where all the values are displayed. This is a standard state.
2. Speed setting- Press the knob twice, when "REV SET" flashes, turn the knob to adjust the desired speed value. To confirm value, press knob again.
3. Temperature setting- Press the knob thrice, when "TEMP SET" value flashes, turn the knob to adjust the temperature speed value. To confirm value, press knob again.
4. When the speed, time and temperature setting are set, press the rotation key or the heating key to begin the operation.
5. Self-Tuning- if the temperature output is not the desired one, start auto-tuning. To access this function, press and hold the temperature key more than 3 seconds. The temperature display area flashes, and the controller enters the self-tuning. The temperature values will change three times; the new set of PID parameters will appear. To exit, press and hold the temperature key for 3 seconds.

Note: CALL IN TO PERFORM THE SELF-TUNING FUNCTION. FAILURE TO DO SO MAY DAMAGE THE UNIT AND VOID WARRANTY.

Operation of timer function

Time function is turned off.

If you need to turn it on, press the knob about 5 seconds until LK appears, turn the knob to set LK=168 and find the parameter "nt", set nt value as 1, press the knob until the Time appears in the screen.



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Operation of over-temperature protector

Over-temperature protector is an independent protective system. When temperature is out of control due to failure of the controller or the temperature in the working room reaches the set value for temperature limit on the over-temperature dial, the protector will cut off heating automatically and give an alarm sound. (As is shown in the right figure) when temperature in the working room is lower than the limit value, the protective system will be cancelled

and the instrument resumes work. Such circulation will continue till fault is removed. Specific operation is done as follows:

1. The set value of temperature limit should be

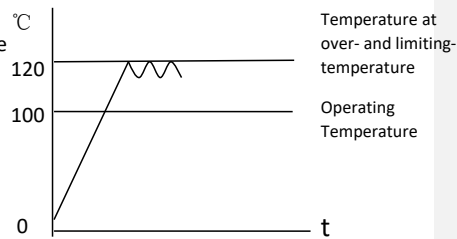
bigger than or equal to

$$(SV+AL) + (10\sim15) \text{ } ^\circ\text{C}$$

2. As is shown in Figure, Rotate the knob to make the desired temperature limit temperature value align with the scale indicator line

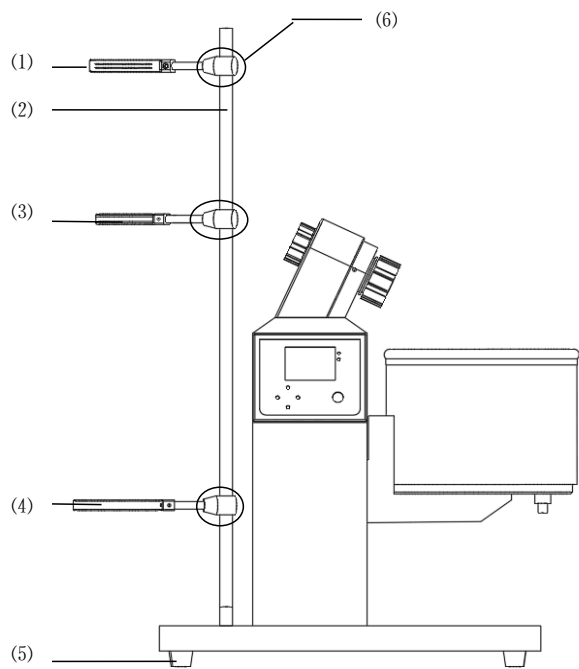
For example: $SV=100^\circ\text{C}$, $AL=10$

Then 150°C should be set up



Scale indicator line

Mounting Pole Diagram



1. Condenser Mount Clamp
2. Mounting Pole
3. Condenser Support Assembly
4. Receiving Flask Support Clamp
5. Castor Wheel
6. holder (three pieces in total)

Figure 7

Installation Process:

To adjust the height of the condenser clamp (Fig. 7(1)) and the condenser bracket and the collection bottle bracket (Fig. 7(3)(4)), simply loosen the two screws on the holder and move up and down to the desired height. Tighten the screws.

Unit Diagram

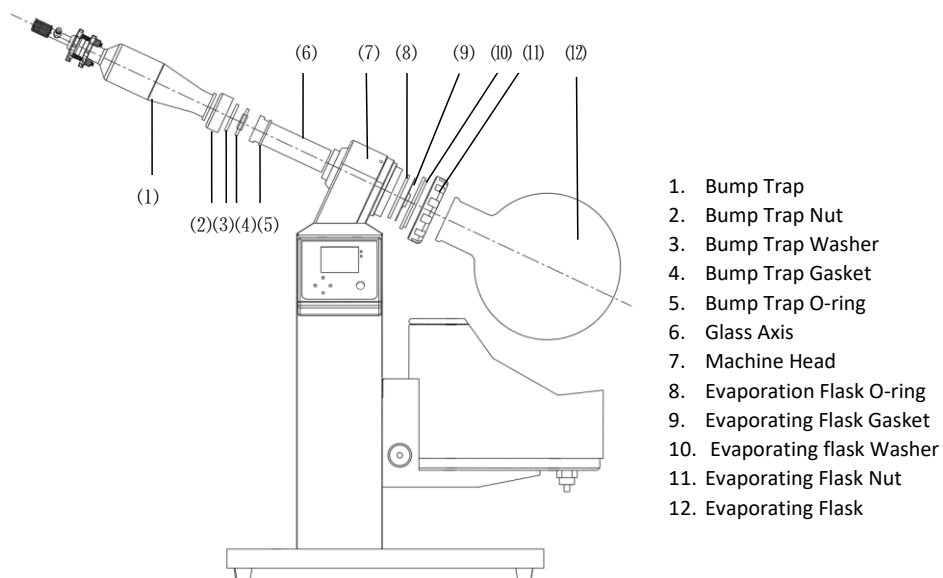


Figure 8

Installation Process:

1. Put the bump trap O-ring on the glass axis, then insert it into the machine head from the left side. Make sure the O-ring sits flush on the machine head and glass axis.
2. Put the bump trap nut and washer on the machine head connector. Insert the bump trap gasket in the machine head connector and insert it into the left side of the glass axis. Tighten the bump trap nut.
3. Install the evaporation flask O-ring and gasket on the right-side of the machine head. Then place the evaporating flask nut on the evaporation flask joint and tighten firmly.

To position the evaporation flask, then insert an Allen wrench into the small hole located in the machine head. Adjust the glass axis position and align the hole in the shaft with the hole in the base. wrench keeps the position of the glass axis static. Next, install the evaporating flask with the evaporating flask nut.

Note: During installation, handle glassware with care. The evaporation flask joint should be greased to have a good seal.

Condenser and Receiving Flask Diagram

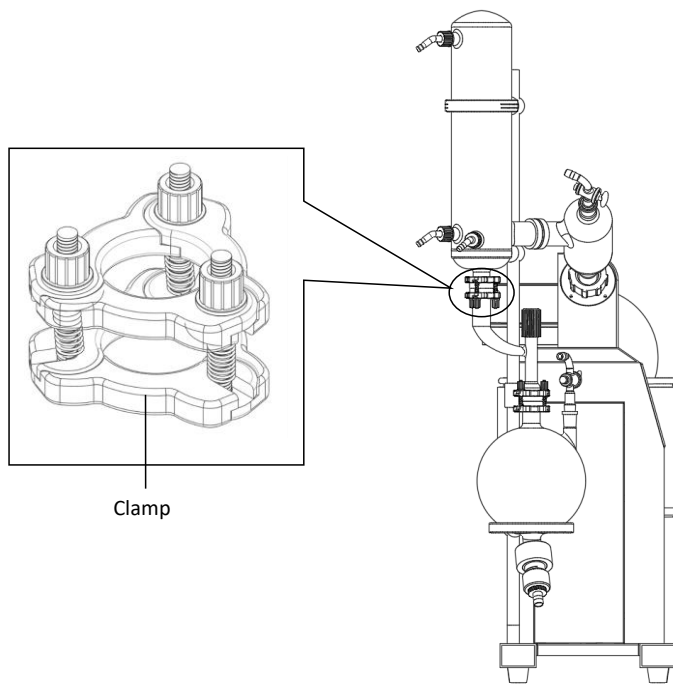


Figure 9

Installation Process:

1. Auxiliary Condenser - Fix the auxiliary condenser support assembly on the mounting pole and place the auxiliary condenser on it. Adjust the height, so that the auxiliary condenser bump trap joint and the bump trap condenser joint are at the same level for clamping. Next, tighten the screws for the auxiliary condenser support assembly and clamp mount. Install the clamp rings on the bump trap and auxiliary condenser joints, then tighten with the screws.
2. Main Condenser- To install the main condenser, fix the main condenser support assembly on the mounting pole and place the main condenser on the support assembly. Align the main condenser joint with the auxiliary condenser joint and repeat the clamp installation steps from the auxiliary condenser installation.

3. Receiving Flask- Loosen the two screws on the receiving flask support ring and adjust to the desired height; Tighten screws. Place the receiving flask on the support ring and install the clamp on the receiving flask joint, and the auxiliary condenser joint.
4. Drain Valve- Install the drain valve directly into outlet of the receiving flask; tighten with clamp.
5. Vacuum Gauge - Install the vacuum gauge in its holder, and clamp. Adjust bracket if needed.

Operating Instructions

Ensure that the unit environment meets the following conditions for use:

1. Use in a location with:
 - a. Low humidity
 - b. Good ventilation
2. Do **not** use in a location with
 - a. Direct sunlight
 - b. Heavy dust
 - c. Corrosive gas
 - d. Intense shock source or electromagnetic fields

Note: The unit should be placed on solid ground without direct sunlight. There should be no less than a 50cm gap around the unit, and a height gap of no less than 100cm. Ensure that the unit does not move due to vibration when turned on and lock the feet.

Maintenance

1. Do not dismantle the unit; internal components contain high temperatures and voltages. This can cause personal injury.
2. Use the correct cleaning supplies when cleaning. Do not spill water directly in the unit, use abrasive powders, thinners, petroleum, kerosene, or acid substances. Electric shock may occur.
3. Use a soft cloth to clean any dirt; hard to remove stains require the use of natural detergents.
4. Inspect equipment before use; if glassware is damaged do not use it.
5. Wipe the glassware joints with a soft cloth, then apply a small amount of vacuum grease.
6. When you first power the unit, allow the motor to run from slow to fast. To turn off, slow down the motor, then turn off.
7. For regular cleaning of the glass axis, remove the ring, and wipe the shaft with a soft cloth. Apply vacuum grease and re-install.

Electrical parts must **never** get wet or damp

Calculating Vapor Pressure of Ethanol

The following blog will show you how to effectively calculate the pressure a pure liquid will evaporate at with temperature being your known variable. Commonly known as the vapor pressure curve Figure 10.8 "Plots of Vapor Pressure versus Temperature for Several Liquids", all pure liquids have a set boiling temperature in relation to pressure. An increase in pressure will result in a higher boiling point, whereas decreasing the pressure or evacuating air from the atmosphere will lower the boiling point. During rotary evaporation we are trying to lower the boiling point of the solvent to make it easier and more efficient to recover. It's important to effectively evaporate and re-condense your solvent; if not you will contaminate the pump and have a lower percentage solvent recovery. The equation we will be using is known as Clausius-Clapeyron equation. It's important to know that this equation can only be used for pure liquids. Pure liquids are those which cannot be further separated. This equation can't be used with liquid mixtures, such as, gasoline because it's composed of many hydrocarbons which can be separated through evaporation.

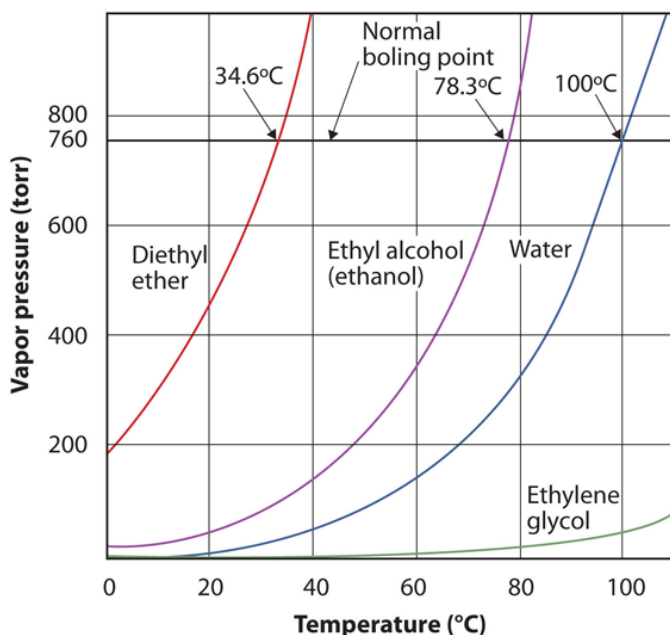


Figure 10.8 used from Introductory Chemistry – 1st Canadian Edition

First, we must get familiar with ethanol also known as ethyl alcohol, $CH_3 - CH_2 - OH$. We know that ethanol has an enthalpy of vaporization of $38,560 J/mol$ or $38.56 KJ/mol$ and a normal boiling point of $78.29^\circ C$. Next, we will determine a known temperature which the evaporating flask will experience during rotary evaporation. For this example, we will be using $50^\circ C$, but it can be changed to any desired temperature if the equipment is capable.

Clausius-Clapeyron Equation:

$$\ln\left(\frac{P_2}{P_1}\right) = \frac{\Delta H_{vap}}{R} \left(\frac{1}{T_1} - \frac{1}{T_2}\right)$$

P_1 = Calculated Pressure (torr)

P_2 = Atmosphere Pressure (torr)

ΔH_{vap} = Heat of Vaporization (J/mol)

R = Ideal Gas Constant ($J \cdot mol^{-1} \cdot K^{-1}$)

T_1 = Variable Control Temp (K)

T_2 = Normal Boiling Temp (K)

Solution:

$$T_1 = (50 + 273.15)K = 323.15K$$

$$T_2 = (78.29 + 273.15)K = 351.44K$$

P_1 = Calculating torr

P_2 = 760 torr

$$\Delta H_{vap} = 38.56 J/mol$$

$$R = 8.314 J \cdot mol^{-1} \cdot K^{-1}$$

$$\ln\left(\frac{760 \text{ torr}}{P_1}\right) = \left(\frac{38560 J \cdot mol^{-1}}{8.314 J \cdot K^{-1} \cdot mol^{-1}}\right) \left(\frac{1}{323.15K} - \frac{1}{351.44K}\right)$$

$$\ln\left(\frac{760 \text{ torr}}{P_1}\right) = 4638 \times (2.5 \times 10^{-4}) = 1.1595$$

$$\frac{760 \text{ torr}}{P_1} = e^{1.1595} = 3.188$$

$$P_1 = \frac{760 \text{ torr}}{3.188} = 238.4 \text{ torr}$$

We now know that if we can effectively control the evaporating flask internal temperature at 50°C we will need to reach a vacuum of 238.4 torr to begin evaporating ethanol. This calculation can be done at any desired temperature; feel free to use this as a tool to compute the optimal temperature and pressure to operate your rotary evaporator. Precise vacuum regulators are sold by us, feel free to contact us for more information.

Troubleshooting

Symptoms	Reason of failure	Troubleshooting method
Power switch is turned on, but switch light doesn't turn on.	The power cord is unplugged or not plugged in correctly. (When connected to the water bath, confirm the water bath power connection as well.)	Turn unit off. Then insert the power plug into the socket.
	Plug the power cord from the fuse with the power base off or not inserted tight.	Set the power to off, then plug the power cord into the power cord holder.
	Power is not applied	Please open the switchboard protection switch
	Power switch has failed.	Stop using it immediately and contact the dealer or the nearest service center of this product.
	Circuit board failure.	
Power switch lights the motor does not rotate.	Rusty bearings	Stop using it immediately and contact the dealer or the nearest service center of this product.
	The motor has failed	
	Circuit board failure.	
Evaporating flask oscillation	Internal gear wear	Re-install
	The installation for Evaporating flask is not good	Tighten
	The evaporating flask nut is not tight enough	
Abnormal sounds	Seal wear.	Please replace the seal
	Internal gear wear.	Stop using it immediately and contact the dealer or the nearest service center of this product.
	Drive lack of oil.	
	The motor has failed	
Noise from the gaskets	Glass axis gasket has poor contact	Please apply a thin layer of vacuum grease or water on the seal ring.
Vacuum leak	Rotating connection shaft wear.	Please replace the rotary connection shaft.
	Gasket wear	Please replace the seal.
	Bad gasket installation. (Opposite direction)	Please refer to the gasket installation method, re-install.
	Decompression with gas nozzle gasket aging.	Please replace the air nozzle seal gasket.
	Vacuum hose wear	Please replace the vacuum hose.

Packing List

Product name: **Rotary Evaporator**

Serial no.	Category	Name	Unit	Quantity	Remarks
1	Components	Host	Set	1	
2	Components	Pole	Pc	1	
3	Components	Glassware	Set	1	Evaporating flask, Receiving flask, condenser, Glass axis, valve, clamps, gaskets
4	Components	Clamp holder	Set	2	
5	Components	Bracket	Set	2	
6	Spare parts	Nozzle SET	Pc	3	
7	Document	User manual	Copy	1	
8	Document	Packing list	Copy	1	

Ordering Information

Order No.	Series	Model
52411-96	RV-400	RV-400A-5-120
52411-97	RV-400	RV-400A-5

Warranty Registration



UK

T: +44 (0) 1480 272279
E: uk.sales@antylia.com
W: coleparmer.co.uk

Germany

T: +49 (0) 9377 92030
E: de.sales@antylia.com
W: coleparmer.de

France

T: +33 (0) 1486 37800
E: fr.sales@antylia.com
W: coleparmer.fr

Italy

T: +39 (0) 284349215
E: it.sales@antylia.com
W: coleparmer.it

India

T: +9122 61394444
E: info@coleparmer.in
W: coleparmer.in

China

T: +1 847 549 7600
E: sales@antylia.com
W: coleparmer.com

USA

T: +1 847 549 7600
E: sales@antylia.com
W: coleparmer.com

Canada

T: +514 355 6100
E: info@antylia.ca
W: coleparmer.ca

Other

T: +1 847 549 7600

Cole-Parmer®

Antylia Scientific Ltd.
625 E. Bunker Ct.
Vernon Hills, IL
60061
United States

www.coleparmer.com