



an SP Industries Company

OPERATOR'S INSTRUCTION MANUAL

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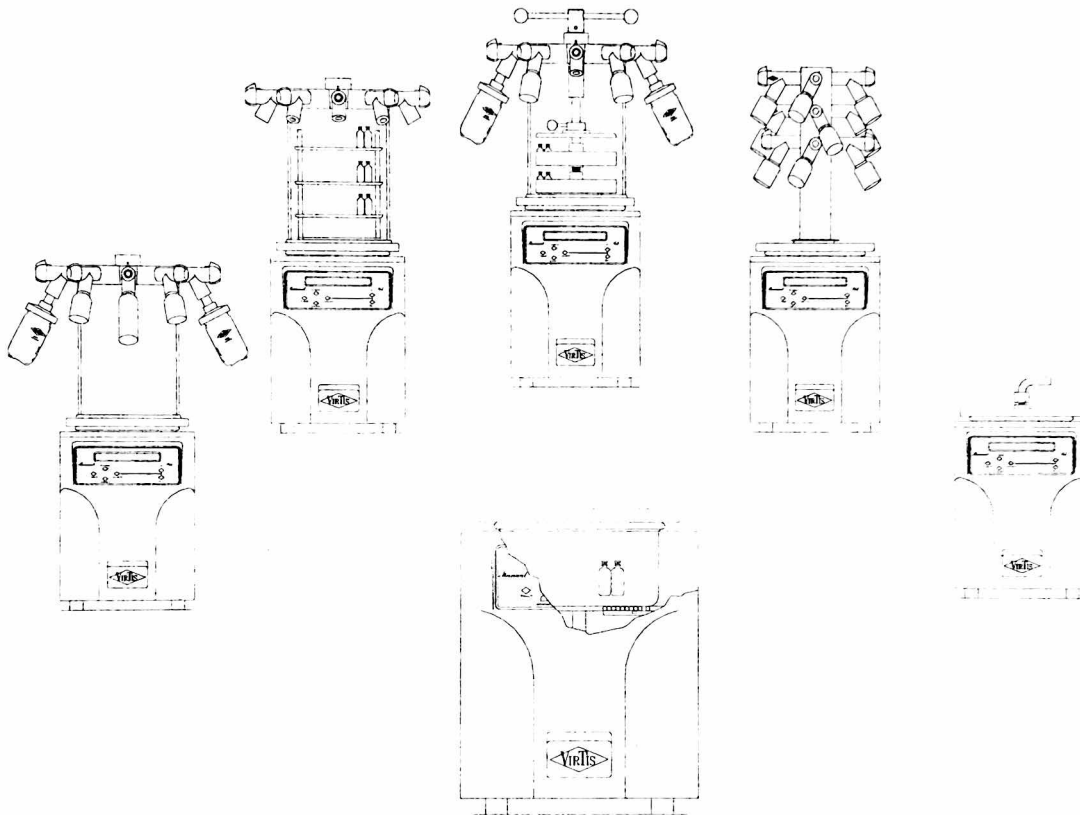
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Benchtop 2K, 4K, 6K Operation Manual

Produced by Joan Miller

VirTis

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BenchTop 2K, 4 K, 6K Operation Manual

VirTis

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BenchTop 2K, 4 K, 6K Operation Manual

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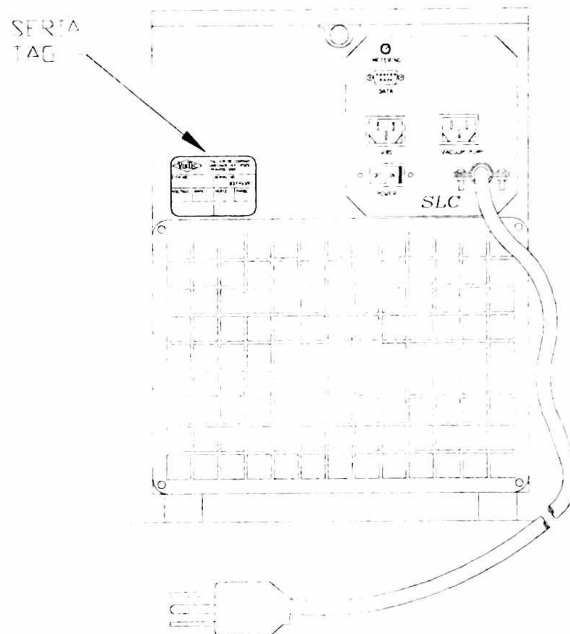
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WARRANTY

Provides details on coverage and transportation damage

Please take this opportunity to complete and return the warranty registration card for your BenchTop 2K, 4K or 6K Freeze Dryer.

At this time find the serial tag on your new BenchTop Freeze Dryer (located on the side of the unit next to the electrical cord, or in the back of the unit) and record the information below for future reference.



Your BenchTop Freeze Dryer is warranted by VirTis to be free of defects in material and workmanship when operated under normal conditions as specified in the instructions provided in this manual.

WARRANTY

VirTis warrants that the product will conform to the specifications, drawings, samples or other descriptions specified by Buyer or if none are so specified, to VirTis' standards specifications for such material, and will be free from defects in material and workmanship when properly installed by VirTis' or in accordance with VirTis' written instructions and operated under normal and proper use and service for a period of twelve months from the date of installation of the product or 15 months from the date of shipment, whichever occurs sooner.

VirTis' sole responsibility under this warranty will be to repair or replace, at VirTis' option, any product which VirTis determined to be nonconforming or defective within the warranty period, provided that Buyer notifies VirTis of the defect immediately in writing. VirTis shall have no responsibility for unauthorized repairs, replacements, or product modifications or any product failures resulting from such unauthorized repairs, replacements or product modifications negligently or otherwise made by persons other than VirTis' employees or VirTis' authorized representatives. VirTis shall have no responsibility for ordinary wear and tear, erosion, corrosion, unintended use, misuse, abuse or improper handling, operation, storage or maintenance by Buyer or any third party.

This warranty covers the costs of parts and labor to repair or replace defective product at Seller's factory. This warranty does not cover transportation charges to ship the product to and from Seller's factory or the costs of travel, room and board if VirTis' employees conduct repair at Buyer's location. In lieu of repair or replacement at VirTis' factory, VirTis may, in its discretion, authorize a third party to perform the repair or replacement at Buyer's location, at VirTis' sole expense. No product should be returned to VirTis without prior approval of VirTis.

Except as expressly set forth above, VirTis does not make and expressly disclaims any and all warranties of merchantability or fitness for a particular purpose and any other warranty, express or implied, with respect to the sale, installation, design or use of its products, and VirTis shall not be liable for any punitive, incidental or consequential damages resulting from the use of or any defects in its products.

INTRODUCTION

Provides an overview of the BenchTop 2K, 4K and 6K Freeze Dryer.

What is the BenchTop Freeze Dryer?

The VirTis BenchTop is a mechanically refrigerated condenser module that can be used as a freeze dryer or a cold trap, as well as for initial product freezing.

If used as	Result...	Needed equipment	Refer to optional sections
BenchTop 2K, 4K or 6K Freeze Dryer	Takes product from frozen to dried state, effectively removing <99% of moisture	Base unit with Vacuum Pump, with or without Manifold/Adapter Plate & applicable Tubing	Freeze Dryer Set Up, Freeze Drying Concepts, Manifold Freeze Drying
Cold Trap Condenser Module	Traps vapors coming off a vacuum concentrator or gel dryer	Base Unit, Vacuum Pump, Vacuum Concentrator or Gel Dryer	Cold Trap Instructions
Product Freezer	*Freezes samples as low as -90° C.	Base Unit	Operational Summary

*This temperature is based on which model refrigeration system you have purchased.

Why Freeze Dry products?

Freeze drying is used as a preservation or processing technique for a wide variety of products.

Freeze drying may be a useful method for preserving a product that is (1) biologically or chemically active at normal temperatures (2) is subject to physical degradation or (3) requires long term storage at temperatures above freezing.

Why use the condenser module as a cold trap?

When using a vacuum concentrator or gel dryer, the condenser module will trap the vapors being driven off the product before they reach the vacuum pump.

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Note: If you are trying to trap organic solvents, a low temperature condenser is required.

How easy is it to change back and forth from a freeze dryer to a condenser module?

The base unit stays the same; the only change is substituting the vacuum cover plate with $\frac{3}{4}$ S.S. port for the manifold/adaptor plate or the plain cover plate and connecting the necessary tubing. The plain vacuum cover plate is provided if no manifold is ordered. The manifold adaptor plate is required when any manifold is ordered.

What advantages does the BenchTop Freeze Dryer have?

- Unit can be utilized as a benchtop freeze dryer or a cold trap
- Condenser design allows for rapid ice removal (defrost)
- 2.5 to 6.0 liter trapping capacity
- Digital display monitors all significant freeze drying parameters
- Product freezing can be accomplished in the condenser chamber

The BenchTop 2, 4 and 6K product line insures flexibility by allowing a choice of options, manifolds and vacuum pumps. Your unit is specific to your requirements, so you will need to review standard sections as well as the relevant optional information provided in this manual.

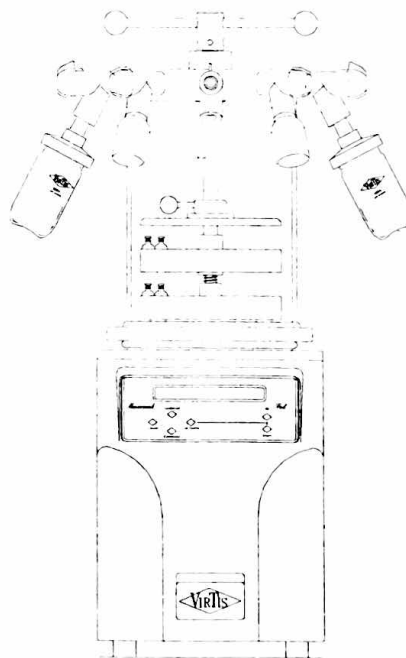


Figure 1 – Unit and drying manifold shown as a BenchTop 2K Freeze Dryer with stoppering accessory.

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INITIAL SET UP

Gives instructions on unpacking and setting up Freeze Dryer.

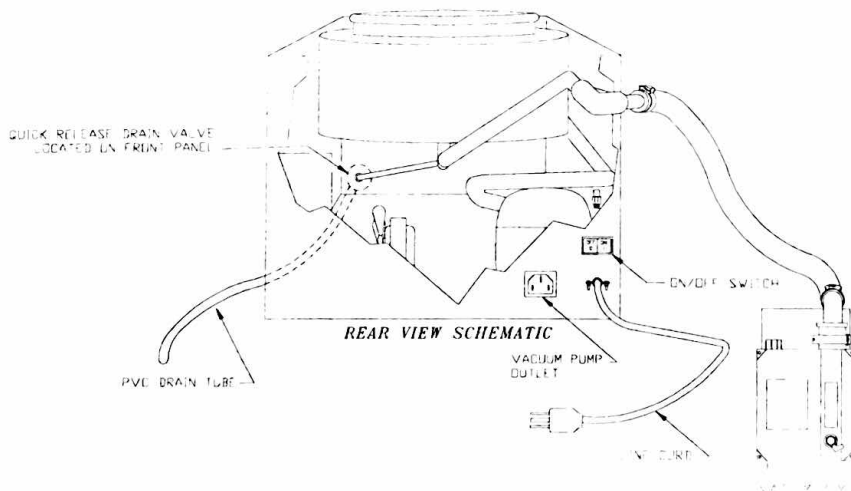
If you purchased the unit directly from VirTis, a representative will assist you in the set-up of your new Benchtop. If you are not acquainted with the VirTis Representative in your area, please contact VirTis for their name and phone number.

- Remove carefully all packing materials and inspect for concealed shipping damage. In the unlikely event that shipping damage has occurred, retain all packing material and immediately contact the transportation center.
- Make certain that the outlet you intend to use has the same voltage and capacity as listed on the serial tag located on your unit. In some locations where electrical connections vary (for example 220v 50Hz) the unit has been shipped without a plug. Follow the instructions below to make the appropriate plug connection.

The line cord has three individual conductors inside the outer jacket. Skin back enough of this jacket to facilitate installation of the plug. The three individual conductors now exposed are BROWN, BLUE, and GREEN with a YELLOW tracer. Connect the BROWN wire to the line or hot terminal on the plug. Connect the BLUE wire to the neutral terminal, and connect the GREEN/YELLOW wire to the ground terminal.

The vacuum pump must be remotely mounted, see **Vacuum Pump Installation** section before proceeding.

Refer to either **Cold Trap Section** or **Freeze Dryer Set Up** for proper configuration of equipment.



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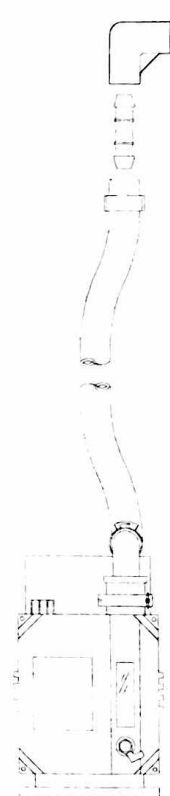
VACUUM PUMP INSTALLATION

Provides step-by-step instructions on how to connect a vacuum pump

A remotely mounted vacuum pump is necessary for operation. The vacuum pump must be a two stage, high vacuum pump that does not exceed the maximum allowable amperage shown on the BenchTop 2, 4 or 6K's serial tag.

Installing a Vacuum Pump

1. Position the vacuum pump next to the Benchtop left, right, or below.
2. Locate the inlet port on your vacuum pump. (refer to separate vacuum pump manual)
3. Remove any material other than the inlet filter screen and gasket
4. Place the adapter on the inlet port and secure with a fitting (if adapter is not present, contact VirTis to order correct part).
5. Remove all objects from the outlet port of the vacuum pump but retain for possible future use.
6. Confirm that the On/Off switch on the back panel is in the Off position.
7. The additional switch on the vacuum pump motor must be left in the ON position so that on/off control will be affected by the switch on the front panel of the BenchTop 2, 4 or 6K.
8. Plug the vacuum pump into the receptacle marked "VACUUM" on the back of the unit. Note: The voltage, phase and frequency of the vacuum pump must match the receptacle.
9. Check that the vacuum pump oil level is adequate. The oil level should read midway in the sight glass.



Note: If you are installing a previously used vacuum pump then refer to page 24 for instructions on checking and changing vacuum pump oil.

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Oil Mist Eliminators

It is suggested that you install an Oil Mist Eliminator (OME) to reduce fumes from the vacuum pump.

VirTis Part #253013 Oil Mist Eliminator, Plastic for 65, 96 & 127 LPM Vacuum Pumps

VirTis Part #258665 Vacuum Pump Adapter to 65, 96 & 127 LPM Vacuum Pumps.

An adapter is required to install an Oil Mist Eliminator depending on model of vacuum pump. Please specify model of vacuum pump when placing an order so the correct adapter is configured. If you have a different model vacuum pump than shown on page 7, contact your VirTis Sales Representative or VirTis directly.

FREEZE DRYER SET UP

Gives instructions on setting up unit

1. Position the BenchTop and Vacuum Pump in a convenient location that provides enough space to easily connect the units. The pump may be located to the right, to the left, or below the unit. Cut the supplied vacuum tubing to a convenient length as short as possible. *
2. Check (install if necessary) the condenser gasket (black rubber ring with a slit in it) it should have a very light film of vacuum grease on the outer surface.
3. If unit is to be used as a freezer, the condenser should be covered to prevent air circulation from warming the samples.
4. If unit is to be used as a manifold dryer, place manifold adapter plate (clear acrylic circular disk with a hole in it) over the gasket.
5. Place another condenser gasket around the bottom lip of the manifold if the manifold is an acrylic drum manifold. If you purchased a stainless steel manifold, you should have a black o-ring that will be placed in the groove of the manifold adapter plate.
6. Attach a Quickseal Valve #171926 to each port on the manifold making certain that each is in the closed position. A thin coating of vacuum grease was applied prior to shipping.
7. If you have an acrylic drum manifold, install the tapered plug in the top center of the manifold. Before installing the tapered plug apply a coating of vacuum grease to the tapered surface. Turn the plug slowly 360 degrees clockwise, then 360 degrees counter clockwise to ensure a good seal between the surface of the plug and the manifold.

*The ¾" I.D. rubber hose should be cut with a hacksaw while clamped securely in a vice. If you do not wish to cut the hose it may be used at its full length, but it may take up more space than necessary.

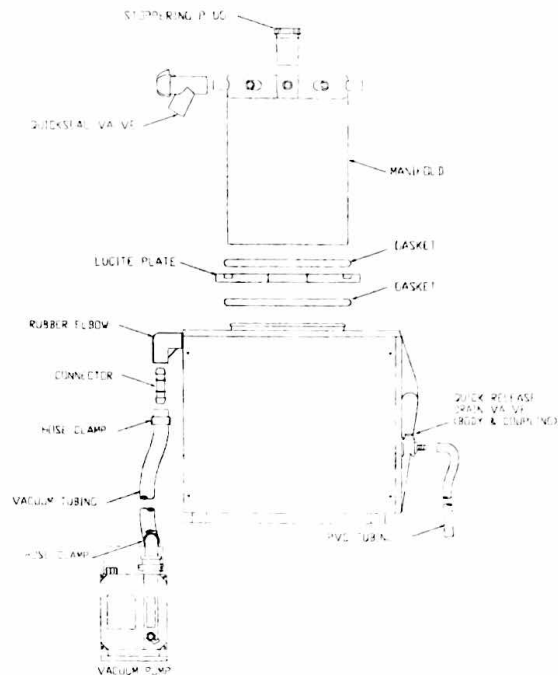
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Benchtop 2, 4, or 6K shown with acrylic manifold

8. Connect the BenchTop using $\frac{3}{4}$ " tubing to the vacuum pump.

If connecting to a VirTis Vacuum Pump: Attach the $\frac{3}{4}$ " tubing from the BenchTop to the intake nipple provided on the pump, add a Tubing Clamp and tighten securely.

9. Plug the unit's electrical cord into an appropriate outlet. The control panel display should illuminate.

The **operation summary** on pages 15-16 lists complete instructions on operating equipment.

A 90° rubber elbow (#386808), a plastic connector (#367424) and four feet of $\frac{3}{4}$ inch I.D. rubber vacuum tubing (#196287) are supplied with the unit for connection to the vacuum pump.

Vacuum Baffle Plate:

A unique feature of the BenchTop 2, 4 and 6K is the 3-position vacuum baffle plate (see figure 3)

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Position #1: Baffle Plate on chamber bottom:

By raising the handle on the baffle plate above the plate, the plate can be dropped to the bottom of the chamber for product freezing on the baffle plate. In some cases it may be more convenient to remove the baffle plate completely and freeze directly on the bottom of the chamber.

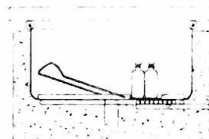
Note that freeze-drying cannot be done with the baffle on the chamber bottom since the vacuum port will be blocked and the product will remain too cold for water vapor transfer.

Position #2: Baffle Plate in raised position:

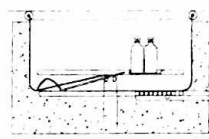
When freeze drying products directly on the baffle this is the proper position, with the handle position against the bottom side of the condenser side wall. This allows the most room above the baffle to fit items to be dried, while still allowing room for ice build up on the condenser below the baffle plate.

Position #3 Baffle plate fully raised: The handle is directly under the baffle allowing the greatest room for ice formation. This is the best position when the unit is being used for manifold drying, drying a bulk or stoppering rack, or when the unit is being used as a cold trap.

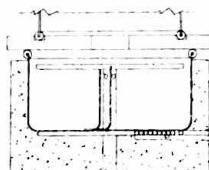
Note that the baffle must always be used when freeze drying to prevent water vapor from entering the vacuum pump.



POSITION #1



POSITION #2



POSITION #3

Figure 3 – Vacuum Baffle Plate

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Freeze Drying Concepts

Gives a general overview of freeze drying principles and process

Freeze Drying works by a process known as sublimation which occurs when a product is taken from a frozen to a gaseous state, by-passing the liquid stage.

Your BenchTop 2, 4, or 6K liter freeze dryer creates an optimal environment for sublimation to occur by combining the four necessary requirements for freeze drying:

1. Freezing

The product must be frozen before freeze drying can be started. Product freezing can be accomplished in the condenser chamber where the bottom is directly refrigerated. Other common methods of pre-freezing a product are to use a dry ice bath or a lab freezer. The products' frozen temperature should be a minimum of -40°C . To minimize freeze drying time and to protect product against melt back, the product should be frozen in the thinnest cross section possible.

2. Vacuum

This is the removal of air and other non-condensable vapors from the chamber to facilitate vapor migration. The vacuum system creates a nearly pressure free environment to allow the vapor from the frozen product to easily flow towards the cold condenser surface.

3. Heating

Carefully controlled heat input to the frozen product speeds the drying process. The BenchTop unit is designed principally as a manifold freeze dryer. By exposing the glassware containing the frozen product to ambient (room) temperature, the ambient energy helps drive the drying process by adding heat. This causes the frozen solvents in the product to sublime and then migrate to the colder surface of the condenser walls. Electrically heated bulk and stoppering accessories are available to speed drying.

In its simplest configuration, as a freeze dryer, products will freeze dry on the partially raised vacuum baffle in the center of the condenser. Heat input will be by radiation through the acrylic cover.

4. Condensing

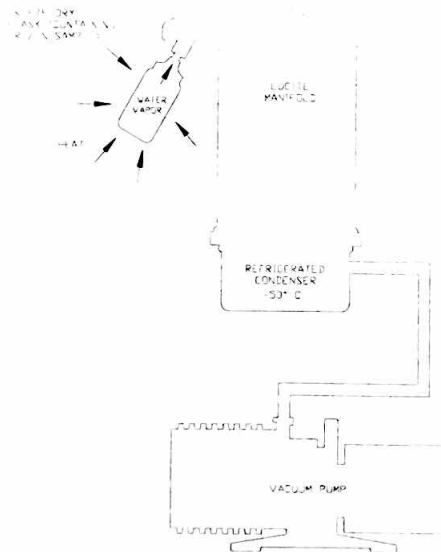
The trapping of water vapor molecules in the form of ice on the condenser surface effectively removes moisture from the product. The refrigeration system cools the internal condenser at the bottom of the chamber to attract and trap vapors migrating off the product.

The condenser is located under the manifold to provide the shortest vapor path to achieve a maximum drying rate. The condenser capacity ranges from 2.5 to 6 liters, which indicates the maximum volume that can be condensed from the product before defrosting is necessary.

Related Information

The Freeze Drying process is completely product dependent and will change with each product.

The condenser temperature must be cold enough to effectively trap the vapors being driven off the product. If the condenser is not cold enough then the excess vapors may be pulled into the vacuum pump. There are options available such as a filter trap or liquid nitrogen trap to compensate for this problem. Contact your VirTis representative for more information.



*BENCHTOP 2K
SYSTEM CONFIGURATION*

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OPERATION SUMMARY

Lists step by step instructions for easy reference

Expected results: Freeze Drying removes >99% of the moisture without compromising the product's integrity. The process is completely product dependent, generally taking 24-72 hours.

1. Prepare Product and System

- Freeze the product to a minimum of -40°C
- Insure that the system can hold vacuum:
 - check connections, ports, drain and Quickseal Valves are closed
 - check that unit is clean and dry (manifold or vacuum concentrator, condenser and drain line)

2. Refrigeration/Condenser

- Press "Condenser" button to begin cooling condenser.
- Wait 20-30 minutes until condenser has reached at least -40°C.

3. Vacuum

- Press vacuum button to create a pressure free environment, using either vacuum switch on front panel or the switch on the vacuum pump.
- Wait 10-15 minutes until the system is under 100 millitorr before proceeding.

4. Add Product

- If using a manifold – attach flasks individually to begin the freeze drying process. Do not add additional flasks until the vacuum has recovered to at least 200 millitorr.
- If using a vacuum concentrator – add samples and begin spinning. Refer to the cold trap instructions on page 35.

5. Monitor Process

- Insure that system parameters (refrigeration and vacuum) stay within normal ranges.
- Check condenser ice build-up periodically to determine if defrosting is necessary.

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- Observe the product to determine if drying is complete. For Manifold Drying, the process is complete when the outside of the flask loses condensation and the product appears dry.

6. Remove Product

- For Manifold Drying, close Quickseal Valves and remove flasks.
- If using a vacuum concentrator, turn off unit and close Quickseal Valve on the back of the unit.

7. Shutdown Unit

- Release vacuum from the system by inserting the drain line or opening a Quickseal Valve.
- Switch off vacuum
- Switch off refrigeration

8. Defrost Condenser

- Normally the ice bond will break when vacuum is released and the ice may immediately be lifted out of the condenser. If not, place drain line in a suitable container to collect melted condensate. A small amount of hot water added to the condenser will speed defrost, but do not fill the condenser more than half full or water may enter the vacuum pump via gravity backfill.
- The defrost time is usually immediate with the ice bond broken and the ice plug may be removed. Do not chip away at the ice, as this will damage the condenser.
- Wipe out all moisture in the condenser, manifold or vacuum concentrator and on the gasket surface. Any additional water can be removed with condenser drain line.
- Thoroughly clean and rinse the condenser with a mild detergent or baking soda solution (to neutralize acids), dry and empty drain line.
- Remove the drain line from the unit to re-seal the drain fitting.

9. Perform Maintenance

Check vacuum pump oil level and clarity. See Maintenance section on page 37.

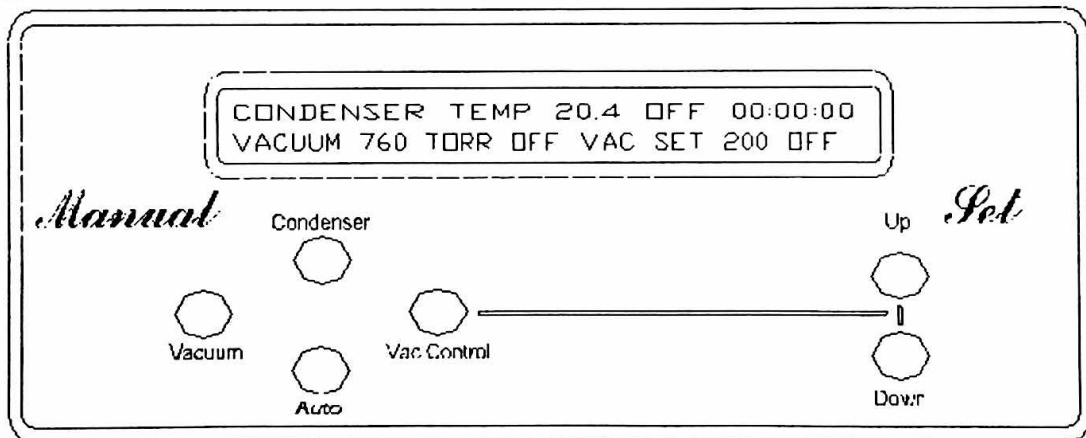
FRONT PANEL DISPLAY

A constant digital display of both vacuum and condenser temperature readings are initiated as soon as the unit is plugged into the appropriate electrical outlet. There are 6 buttons on the panel. The condenser button activates the condenser refrigeration system for product freezing/freeze drying. The vacuum button activates the vacuum pump if the pump is plugged into the receptacle marked vacuum on the back of the Benchtop.

Below is a drawing of the "SLC" Standard Lyo Control Panel.

The following pages give operation instructions on the "SLC" and the "ALC" Auto Lyo Controls.

The Benchtop 2K is only supplied with the "SLC". The Benchtop 4K and 6K can be supplied with the "SLC" or the "ALC". If you are not sure which model you have, check the back of the machine for the label that will tell you, then go to the instructions for the use of your particular unit.



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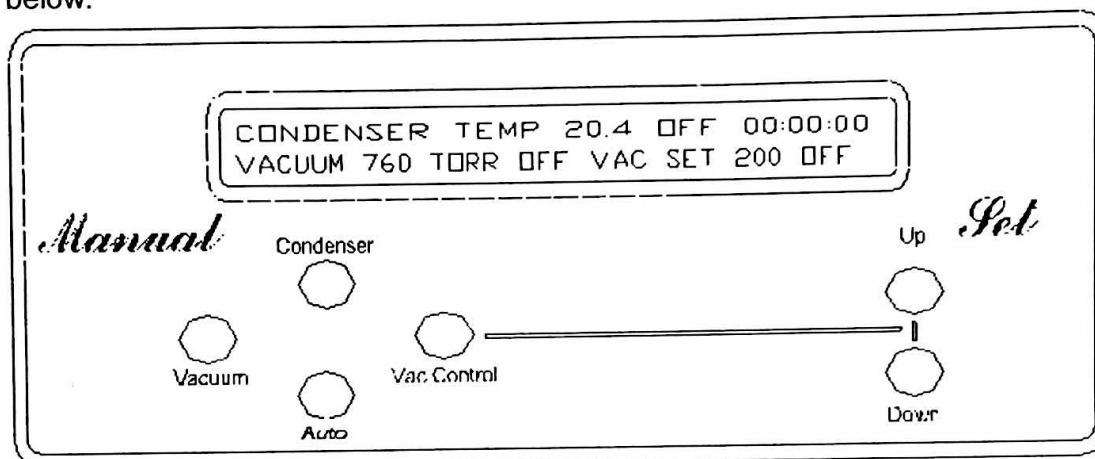
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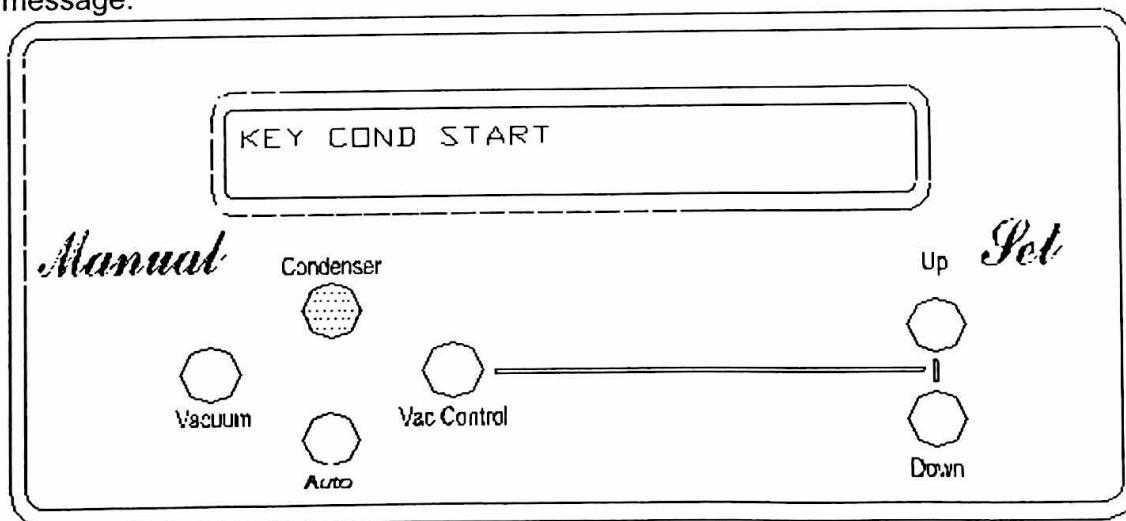
Operating Instructions for the Standard Lyo-Control VirTis Benchtop 2K, 4K and 6K Freeze Dryers

After following instructions for installation and set-up of the freeze dryer, the manifold and the vacuum pump, connect the line cord to the correct electrical outlet and turn the unit on.

1. When the unit is powered on the following screen will appear on your SLC control panel. The "00:00:00" stands for run time. The other parts of the display are described below.



2. To start your condenser press the condenser button, you will hear your refrigeration system come on and the screen on your SLC will give you this message.



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Note: Wait until your condenser temperature reads -40°C or colder, which will take about 20 minutes or less, then go on to the next step.

3. Press the vacuum button and you will see this message appear for a few seconds. The screen will then look like the screen in instruction #1 but the condenser temp and vacuum torr will both say ON.

4. If you wish to control vacuum, press the Vac Control button and you can then change the vacuum level by using the Up or Down buttons located on the right hand side of the control panel. The screen will then read vac set ON. To disable this, press the Vac Control button again.

Note: If you notice after doing this that the vacuum is not holding well the silver metering valve, located on the back of the freeze dryer may need to be adjusted. Turn the knob slowly in one direction to check to see whether it is too far open or closed. This is factory adjusted but could be moved in shipment or unpacking.

Once the condenser and vacuum parameters have been satisfied (condenser below -40°C and vacuum at 100 millitorr) you can start to put on your samples.

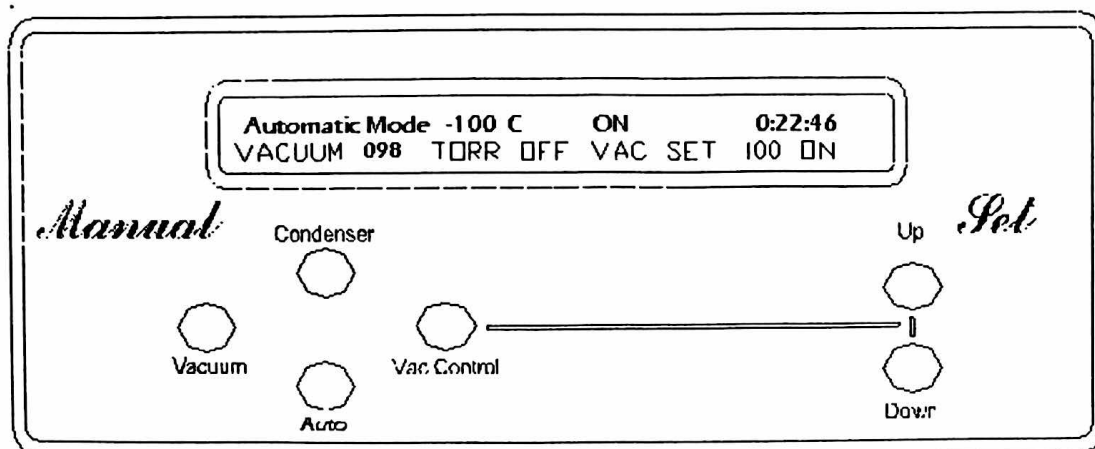
5. Auto Button: The purpose of it is to enable the system to automatically energize the condenser and when its temperature attains -45°C to automatically turn on the vacuum pump. So if you want to eliminate waiting for the condenser to cool down and then the vacuum pump to come on at the appropriate time, just press the auto button instead of steps 1,2,3 above. When you return the system should be in a mode to accept product. (Make sure the manifold is in place, and all quickseal valves are closed before walking away or the system will not be able to attain vacuum)

When the controller is in the auto mode one can convert the displayed pressure to the equivalent ice temperature by pressing either the vacuum or condenser buttons. This conversion of condenser temperature to pressure in millitorr is used to also convert pressure to the equivalent temperature value. The conversion will assist you in determining the optimal conditions for your freeze drying process. Since the system is in auto mode these keys no longer control their individual functions. By pressing the auto button once again the system returns to manual.

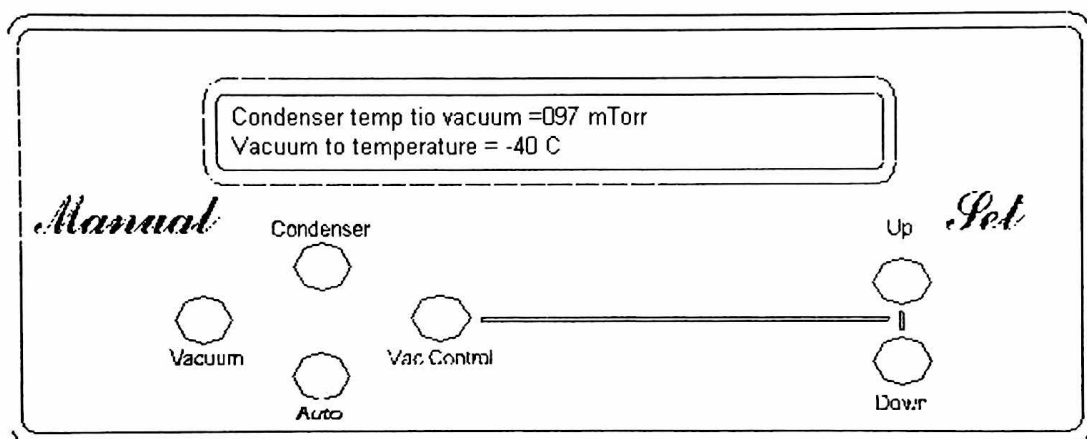
The screen will look like this:

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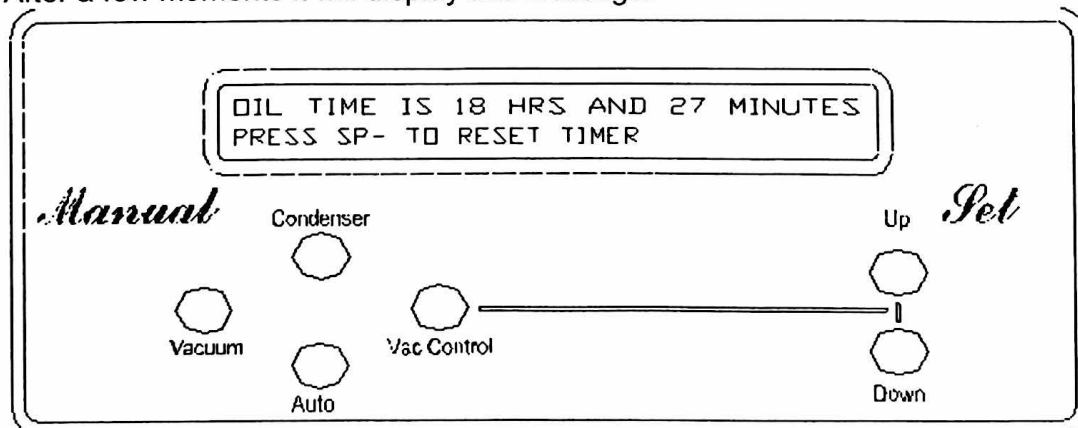
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The auto button will also give you a display that looks like this when you push either the condenser or vacuum button when in the auto mode:



After a few moments it will display this message:



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This gives you the amount of time that the pump has been running. The factory has pre-programmed the Benchtop to give you an alarm when the vacuum pump has been run for 900 hours. You will get a message saying maintenance is required. You can clear this message by pressing any button.

To re-set the alarm and clear the amount of accumulated hours, press the down button. This will give you a message the says " reset"

7. In case of a power failure, the screen will say "power out" you can clear that message also by pressing any button. Once the power comes back on the unit will take the system back to the configuration it was in when the power went out. It will do this even if someone is not there to clear the message.

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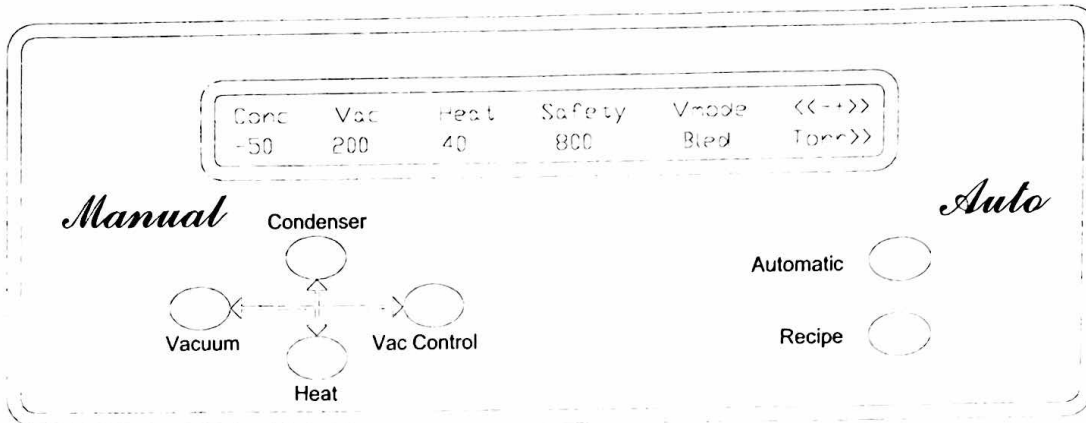
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Using the Auto Lyo Control in the Recipe Mode.

To get into the recipe mode, press and hold the recipe button.

The screen will look like this.



Setting the Parameters of the Recipe

If you look at the screen above, there are 6 different parameters that need to be set up before starting the freeze dryer.

Please note: Use the up/down arrow buttons (yellow/pink) to change the values of the parameters. Use the left/right arrow buttons (red/light pink) to move the cursor to the next parameter.

#1. “Cond” – The first value to be set.

The value for “Cond” is the temperature at which you want the vacuum pump to come on. Use the up/down buttons to adjust the value. A typical value would be -40 degrees C.

Press the right arrow button (light pink) to get to the next value to be set “Vac”

#2. “Vac” – This setting does three things:

- Will initialize the heater if you have a heated rack, once the vacuum has reached this specified vacuum level.
- This will initialize vacuum and will alarm if it takes more than one hour to get down to the set point.

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- It will control vacuum if you have called up a mode in the recipe to control vacuum. See "Vmode" #5 for selection of vacuum control.

Press the right arrow button to get to the next value to be set "Heat"

#3. "Heat" – Controls temperature of optional heat racks based on this recipe value.

The probe measures the shelf temperature and based on this the heat will be controlled.

Press the right arrow button to get to the next value to be set "Safety"

#4. "Safety" – This is the numerical value that when exceeded for more than 20 minutes will alarm.

This "safety" is for when you add a flask to the manifold. At this time, the vacuum will go up while the system is evacuating the new sample. The unit will not alarm immediately, because this is normal. However, if the vacuum does not recover after 20 minutes, it will alarm to let you know that it has not recovered. The typical setting for this is 800 millitorr.

Press the right arrow button to get to the next value to be set "Vmode"

#5. "Vmode" – There are four choices for this parameter. Press up/down arrow keys to see the four different choices.

- "None" – No vacuum control.
- "Bled" – Uses the metering valve and the vacuum control solenoid to control vacuum.
- "Vbs" – If you purchased the optional VBS, this will control the vacuum via this valve. If you did not purchase the optional VBS, you cannot use this choice.
- "Sav" – This will start and stop the vacuum pump based on the vacuum that you put in under "Vac" (See #2). There is a deadband of 10 millitorr, which means if you set the "Vac" parameter at 200, the vacuum pump will turn off at 190 and turn on at 210 millitorr.

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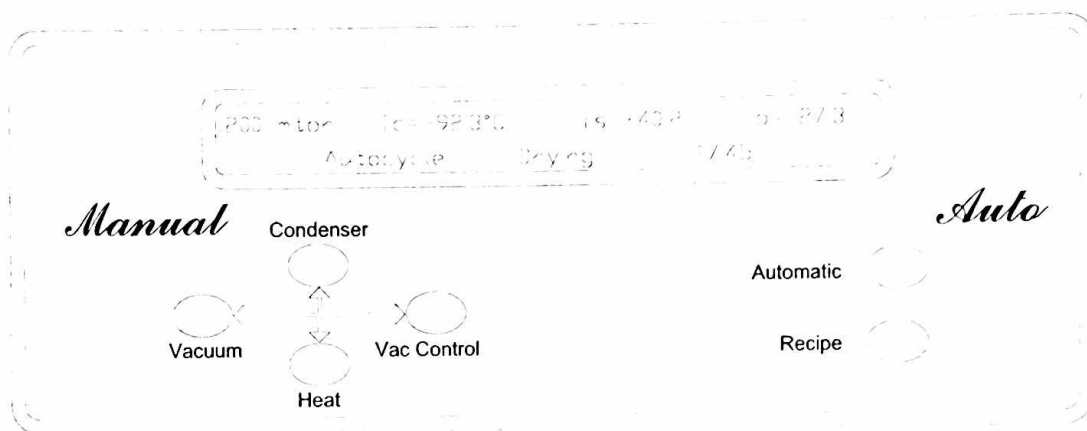
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Press the right arrow button to get to the next value to be set "Torr"

#6. "Torr" – Unit of measure for vacuum system.

You can choose Torr or Bar for your unit of measure on the vacuum system.

Final Step: Press the right arrow button when the cursor is all the way over under the last parameter "Torr". The screen will say "Saving Setpoints". To start the unit running in the auto mode, hit the auto button. Wait for condenser temperature and vacuum to hit setpoints and add samples.



The manual buttons have no real functions at this time except to do conversions. See following section on "conversions".

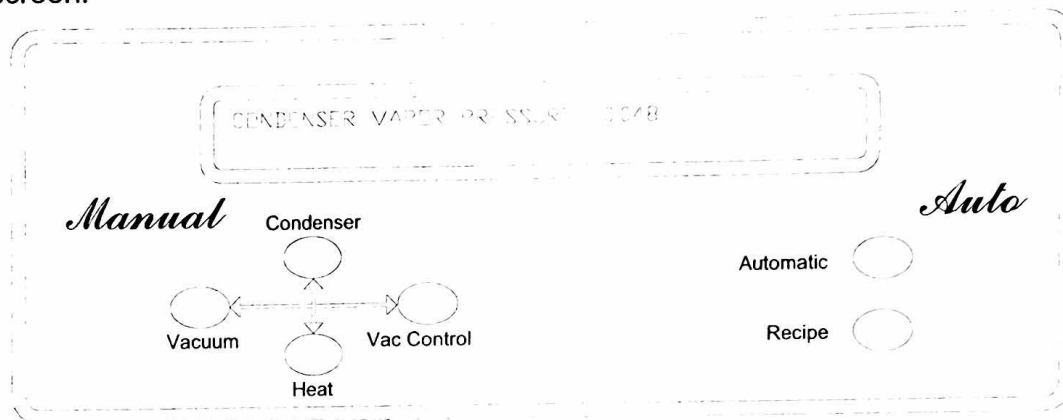
Conversions

When the system is in the "auto mode" the key on the left hand side of the control panel, the "manual" key, have no functions except to do conversions.

An example of this is taking a temperature and converting it to its corresponding vapor pressure.

Condenser

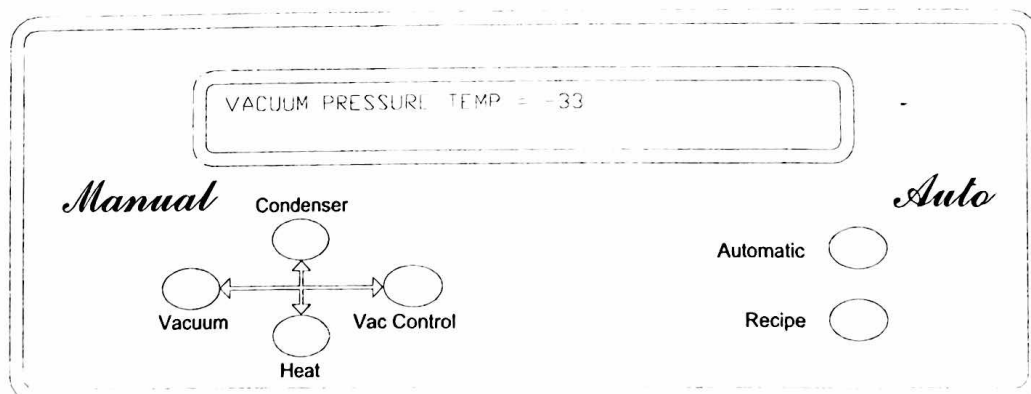
Pressing the "Condenser" key in the "auto" mode will give you the following screen.



This converts the condenser temperature at that time to its corresponding vapor pressure.

Vacuum

Pressing the "Vacuum" key in the "auto" mode will give you the following screen.



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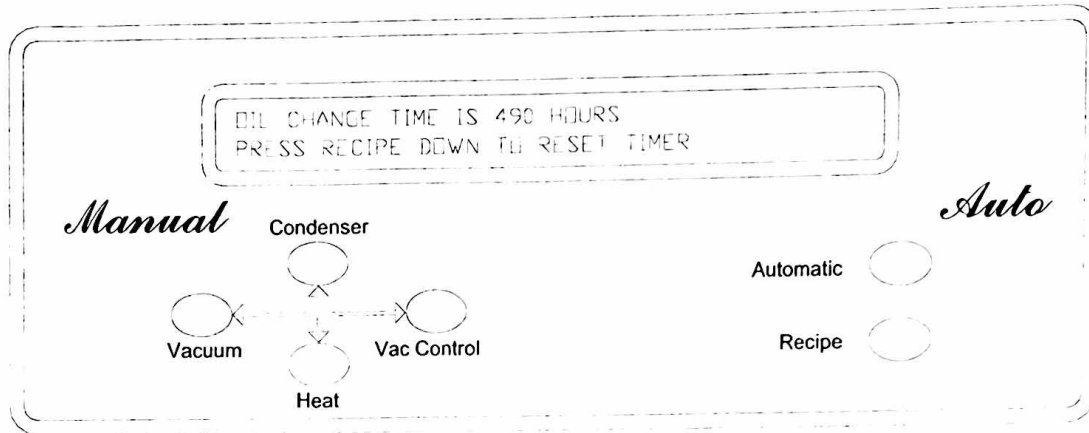
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This converts the vacuum pressure in the system to its corresponding vacuum pressure temperature.

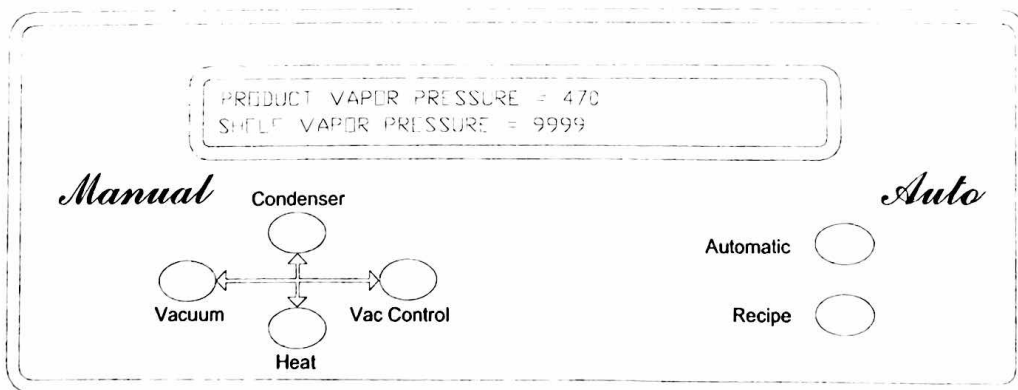
Following the above screen, another screen will come up and look like this.



This tells you how long the pump has been running without someone re-setting it after changing the vacuum pump oil. The timer should be re-set after changing the vacuum pump oil each time. This will help you keep track of how often you should change your pump oil. If you log the hours each time, you should get an average amount of time you can wait before changing the oil.

Heat

Pressing the "Heat" key in the "auto" mode will give you a screen that looks like this.



This screen serves two functions:

The first is it will take the temperature of the product and convert it to its corresponding vapor pressure.

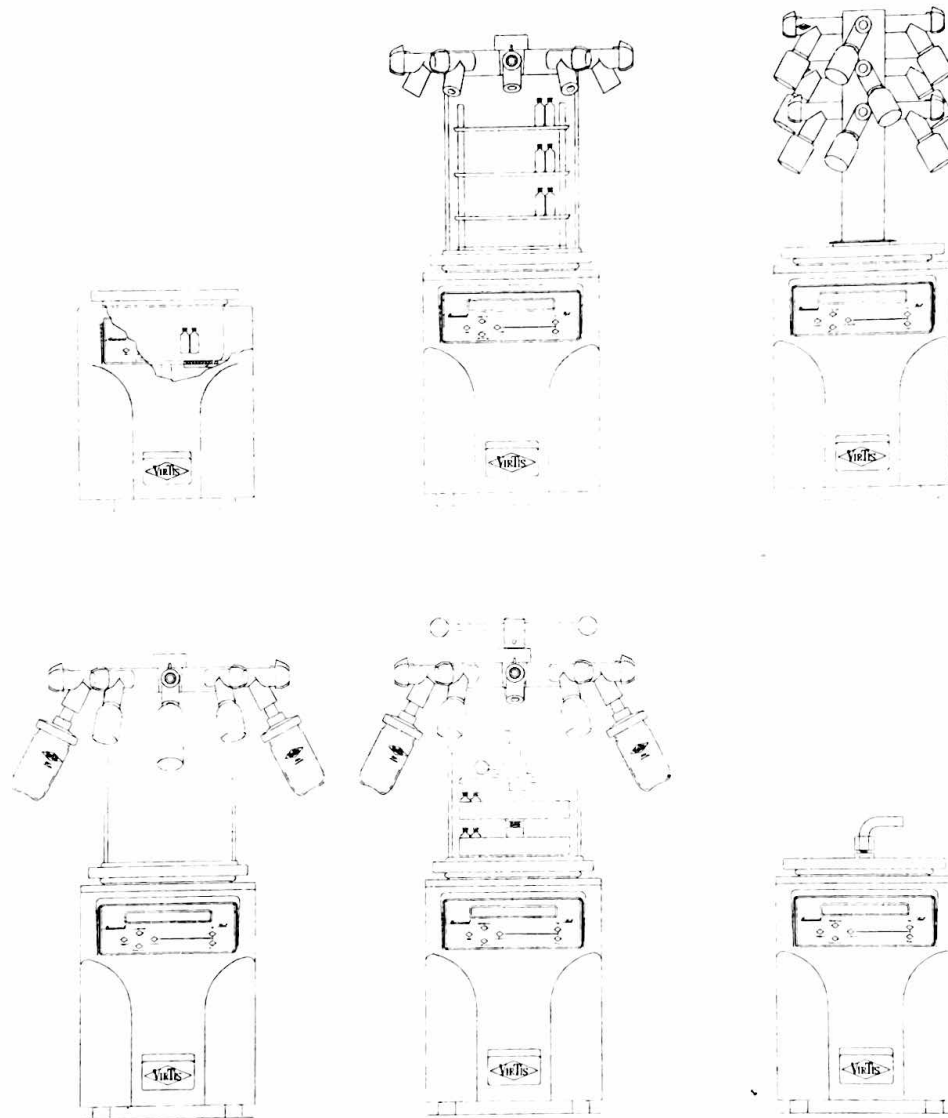
The second line takes the temperature of the shelf and converts it to its corresponding vapor pressure.

Vac Control

Pressing the "Vac Control" key will have no effect on anything in the system. It will show a message that states "No key function".

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Modules/Accessories



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Chemical Resistance of Acrylic Manifold

The table below gives an indication of the chemical resistance of the clear Acrylic Manifold. The code used to describe chemical resistance is as follows:

R = Resistant

The Acrylic Manifold withstands this substance for long periods and at temperatures up to 120°F (49°C).

LR = Limited Resistance

The Acrylic Manifold only resists the action of this substance for short periods at room temperatures. The resistance for a particular application must be determined.

N = Not Resistant

The Acrylic Manifold is not resistant to this substance. It is swelled, attacked, dissolved, or damaged in some manner.

Plastic materials can be attacked by chemicals in several ways. The methods of fabrication and/or conditions of exposure of the Acrylic Manifold, as well as the manner in which the chemicals are applied, can influence the final results even for "R" coded chemicals. Some of these factors are listed below.

Fabrication – Stress generated while sawing, sanding, machining, drilling, polishing, and/or forming.

Exposure - Length of exposure, stresses induced during the life of the product due to various loads, changes in temperatures, etc.

Application of Chemicals - by contact, rubbing, wiping, spraying, etc.

The table therefore should be used only as a general guide and, in case of doubt, supplemented by tests made under actual working conditions.

Chemical	Code	Chemical	Code	Chemical	Code
Acetic Acid (5%)	R	Ethyl Alcohol (50%)	LR	Nitric Acid (10%)	R
Acetic Acid (Glacial)	N	Ethyl Alcohol (95%)	N	Nitric Acid (40%)	LR
Acetic Anhydride	LR	Ethylene Dichloride	N	Nitric Acid (Conc.)	N
Acetone	N	Ethylene Glycol	R	Oleic Acid	R
Acetonitrile	N	2-Ethylhexyl Sebacate	R	Olive Oil	R
Ammonium Chloride (Saturated)	R	Formaldehyde (40%)	R	Phenol Solution (5%)	N
Ammonium Hydroxide (10%)	R	Gasoline (Regular, Leaded)	LR	Soap Solution (Ivory)	R
Ammonium Hydroxide (Conc.)	R	Glycerine	R	Sodium Carbonate (2%)	R
Aniline	N	Heptane	R	Sodium Carbonate (20%)	R
Battery Acid	R	Hexane (Commercial Grade)	R	Sodium Chloride (10%)	R
Benzene	N	Hydrochloric Acid	N	Sodium Hydroxide (1%)	R
Benzyl Alcohol	N	Hydrofluoric Acid (40%)	R	Sodium Hydroxide (10%)	R
Butyl Acetate	N	Hydrogen Peroxide (3%)	R	Sodium Hydroxide (60%)	R
Calcium Chloride (Sat.)	R	Hydrogen Peroxide (28%)	N	Sodium Hypochlorite (5%)	R
Calcium Hypochlorite	R	Isooctane	R	Sulfuric Acid (3%)	R
Carbon Tetrachloride	N	Isopropyl Alcohol	LR	Sulfuric Acid (30%)	R
Chloroform	N	Kerosene	R	Sulfuric Acid (Conc.)	N
Chromic Acid (40%)	N	Lacquer Thinner	N	Toluene	N
Citric Acid (10%)	R	Methyl Alcohol (50%)	LR	Transformer Oil	R
Cottonseed Oil (Edible)	R	Methyl Alcohol (100%)	N	Trichloroethylene	N
Detergent Solution (Heavy Duty)	R	Methyl Ethyl Ketone (MEK)	N	Turpentine	LR
Diesel Oil	R	Methylene Chloride	N	Water (Distilled)	R
Diethyl Ether	N	Mineral Oil	R	Xylene	N
Dimethyl Formamide	N	Naphtha (VM&P)	R	Trifluoroacetic Acid	N
Diethyl Phthalate	N				
Ethyl Acetate	N				

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Manifold Freeze Drying

Provides detail on how to freeze dry effectively

VirTis offers you a choice of drying manifolds depending on sample quantity and whether flasks, serum vials or ampoules are being used.

Manifold freeze drying allows you to clearly observe drying rates as glassware remains visible. Ambient room temperature surrounding the surface of the freeze drying flask provides enough heat to efficiently sublimate the ice content in the product.

Preparation of Samples:

1. Place product in appropriate freeze drying glassware (flasks, ampoules, vials, etc.)
2. Many samples that you may wish to freeze may be frozen in the condenser chamber. Remove the vacuum baffle plate from the condenser and place your sample container on the refrigerated chamber bottom. You may also freeze on the baffle plate itself by moving the handle above the baffle plate and dropping the plate to the chamber floor. Be sure to put the baffle back to one of its raised positions before commencing freeze drying.
3. Or, freeze product in a deep freezer or with a dry ice bath.
4. Avoid freezing the product to a greater cross section than 20mm or meltback may occur.

Optimal results require the product to remain frozen at a temperature below its freezing point throughout the drying process.

Freezing to -40°C is adequate for the majority of products. Dry ice methods freeze a product to approx. -70°C . Liquid Nitrogen methods freeze a product to approx. -190°C .

Instructions on connecting Wide Mouth Flasks to the Manifold:

1. Place sample in VirTis freeze drying flask
2. Ensure that filter paper and o-rings are correctly positioned in the flask top.
3. Snap cover securely onto glass flask
4. Choose an appropriate adapter (correct size for flask top and Quickseal Valve)
5. Fit adapter securely into flask top

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6. Connect the opposite end of the adapter into a Quickseal Valve on the manifold
7. Open the Quickseal Valve by turning white selector knob counter clockwise a half turn. See Figure #4

Note: Wide Mouth Flasks are the most popular glassware but numerous flasks, vials and ampoules are available. If you are not certain how the accessories work please contact your VirTis Sales representative or VirTis directly.

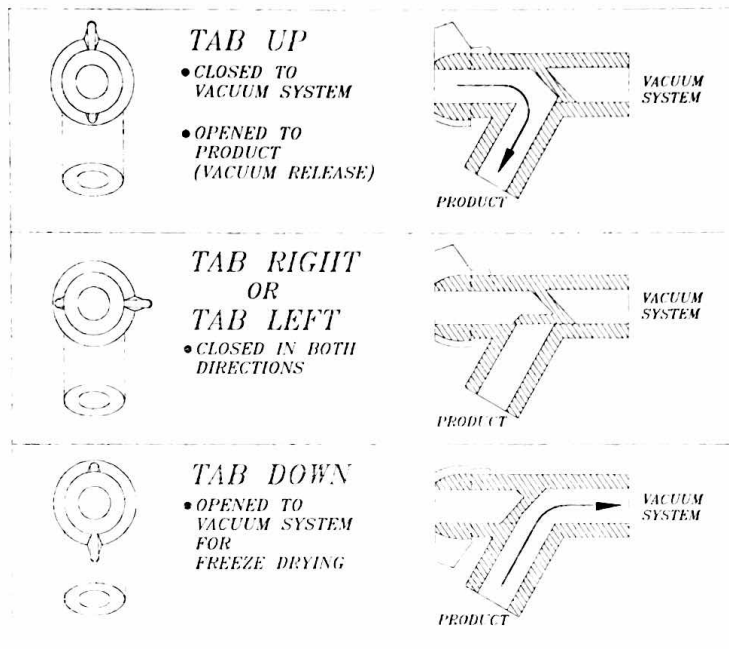


Figure #4

MeltBack

Products that have low freezing points are more prone to melt back during the freeze drying process. Melt back is a common phrase in freeze drying used to describe the condition of the product when it melts or defrosts before sublimating. If melt back occurs experiment with following guidelines:

- Decrease the volume and depth of the product
- Insulate the product container to slow down sublimation from ambient heat source
- Decrease the amount of product or number of samples connected.
- Verify that the equipment is functioning properly and insure that room temperature aids air-cooled refrigeration system.

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- Consider diluting product with water.

The reverse is also true. For certain products that dry readily, heat (such as a heat lamp) can be used to speed the freeze drying process.

Refer to Operation Summary on page 15 to begin freeze drying.

Adding/Removing Flasks

At any point during the process, a flask can be added or removed from the manifold by simply opening or closing the Quickseal Valve. This will affect the vacuum level within the system as the vacuum pump removes the air introduced with the new sample.

End Point

You can clearly observe drying rates during manifold drying since the glassware and product are completely visible. Since the glassware is exposed to room temperature, moisture within the environment condenses on the cold outer surface of the flask. As the product ice inside the glassware gradually sublimates (transforms from a frozen state directly to a vapor state), the frost on the outside of the glassware slowly recedes and eventually disappears. After this occurs, approximately 98% of the moisture has been removed. You can assume drying is complete (<1% moisture content) when the exterior of the glassware, by touch, is at room temperature.

Guidelines for preventing unnecessary breakage of glassware

- Avoid cleaning flasks with a wire brush as metal-to-glass abrasion creates microscopic scratches, which could cause flasks to break.
- Always fill flasks less than half of overall volume. A flask's working capacity is half of its maximum capacity. (For example a 600 ml flask has a working capacity of 300 ml.)
- When pre-freezing sample in a storage freezer, tilt flasks to a 30-45 degree angle to increase surface area and reduce stress on the glass.
- When placing flasks in glassware washers do not place in contact with other glass to prevent glass-to-glass abrasion from occurring.

Safety Coated Glassware

VirTis offers safety-coated glassware to reduce breakage and contain glass in case of implosion. Ask your VirTis representative for details or call VirTis for ordering information.

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Accessories

Ampoules and tear drying bulbs can be heat sealed while connected to the Quickseal Valve preserving the material under original vacuum. Also utilizing VirTis stoppering adapters, screw cap vials can be stoppered under original vacuum. See VirTis accessories or Freeze Drying Catalog for selection and appropriate part number.

Replacement Quickseal Valves

VirTis Part #171926 – 3/4" Quickseal Valves

VirTis Part #171884 – 1/2" Quickseal Valves

Standard manifolds have 3/4" Quickseal Valves. As a special order 1/2" are also available. To determine size, remove Quickseal Valve and measure the diameter of the steel port.

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COLD TRAP SECTION

Lists information relevant to using condenser module as a cold trap

The BenchTop 2, 4, and 6K condenser module condenses and collects vapors being driven off a product in a vacuum concentrator (gel dryer etc.). Condensing the vapors prevents them from migrating to the vacuum pump and causing damage.

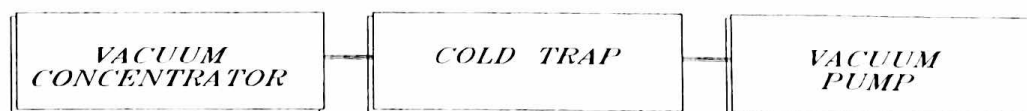
Background Information

Under conditions of high vacuum, the vapor pressure of the solvent collecting on the condenser is much lower than that of the product. When vapor molecules leave the product in the vacuum concentrator, they migrate toward the low pressure areas in the condenser. Upon contacting the condenser, the vapors give up their heat energy and condense. Whether ice forms or not is dependent on the chemical properties of the solvent being condensed. Efficient evaporation rates are dependent on maintaining this vapor pressure differential.

Product Requirements

The following requirements need to be considered: (1) freezing and condensing points of solvents, (2) overall volume and (3) any particular properties such as toxicity.

This process is completely product dependent, which means that applications will vary in terms of temperature requirements, process time and special consideration.

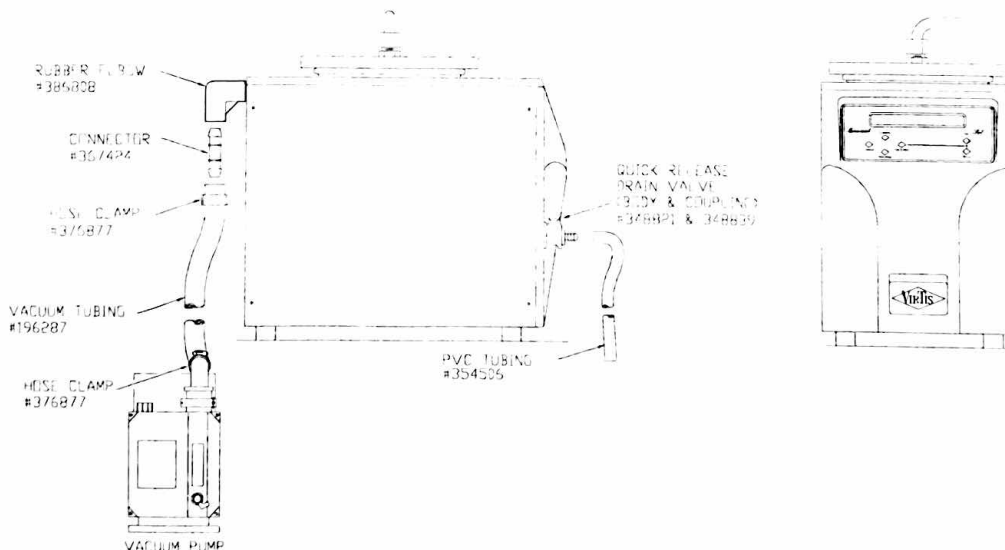


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Set Up Information for Cold Trap

If the BenchTop 2, 4, or 6K will be used as a cold trap to condense vapors off a vacuum concentrator or gel dryer then the following setup is recommended.

- 1) Position the Vacuum Concentrator, BenchTop and Vacuum Pump in a convenient location that provides enough space to easily connect the units.
- 2) Place the Vacuum Cover Plate, (acrylic plate with stainless steel elbow(s) on the gasket of the BenchTop.
- 3) Connect the BenchTop using $\frac{3}{4}$ " tubing, VirTis #196287 to the vacuum concentrator or gel dryer.
 - Estimate the length of tubing required to adequately reach the back of the vacuum concentrator without any tension.
 - If necessary cut the tubing to the proper length and attach tubing clamps securing both ends.
- 4) Now from the back of the BenchTop Freeze Dryer, connect the vacuum pump right, left, or below the unit, again using the $\frac{3}{4}$ inch I.D. tubing. The tubing may have to be cut to a convenient length if mounted left or right. Hold the tubing securely in a vise and use a hacksaw for cutting.



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GENERAL MAINTENANCE

Provides instructions on how to maintain the BenchTop 2, 4 or 6K Freeze Dryers.

Proper periodic maintenance is the key to an efficiently operating unit with minimal downtime.

Vacuum Pump:

Clean oil is necessary for the best vacuum and efficiency of the complete system. Checking and changing the oil on a consistent basis will greatly extend the life of the vacuum pump. Vacuum Pump Oil should be changed on an "as-needed" basis by checking the oil after each freeze drying run. The following is a basic guideline to visually checking the oil. Drain a small amount (approximately 100 ml) of oil from the pump drain line. Use a clear container to capture the sample.

- Pale yellow or clear vacuum pump oil – indicates good condition
- Dark vacuum pump oil – indicates acid contamination
- Cloudy gray vacuum pump oil – indicates water contamination

Use only VirTis vacuum pump oil or equivalent when changing the oil as this particular oil is specially refined for vacuum pumps.

VirTis Part#185181 - One Gallon can of Vacuum Pump Oil

VirTis Part#185207 - Two Gallon can of Vacuum Pump Oil

VirTis Part#277228 - One Liter of Synthetic Oil

Changing the Vacuum Pump Oil:

Change the oil right after shutting the freeze dryer down, while the oil is still hot.

1. Protect hands from the hot oil
2. Make sure vacuum is released in condenser
3. Drain the contaminated oil into a suitable container
4. Add the new oil while visually checking the sight glass to insure proper level
5. If pump oil is particularly contaminated then operate pump for 10-15 minutes to flush any residual contaminated oil from interior components and repeat steps 3 and 4 to complete the process.

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If corrosive materials are frequently being freeze dried then oil must be checked and changed more frequently. In addition a VirTis Filter Trap should be installed to protect the vacuum pump.

VirTis Part #272310 – Freestanding filter trap

VirTis Part #250365 – Soda sorb cartridge for acid

VirTis Part #250373 – Activated Charcoal cartridge for organic solvents

VirTis Part #266783 – Molecular Sieve cartridge for water vapor

Please note cartridges must be ordered separately.

For further details on care and operation of the vacuum pump, consult the vacuum pump manual

Gas ballast Valve on the Vacuum Pump:

The gas ballast valve removes moisture (water, alcohol etc...) from the pump oil. During freeze drying or cold trap use, vapors could bypass the condenser and end up in the vacuum pump. If this happens the vapors will degrade the oil causing excessive wear as well as higher vacuum pressure.

When the ballast is open, it allows a controlled amount of air into the second stage pump cylinder. This reduces the partial pressure and increases the pump's operating temperature in order to release vapors.

Refer to the separate pump manual for the location of the gas ballast valve.

Gas Ballast Procedure:

1. Wait for the vacuum pump to reach normal operating temperature (70-80 degrees C)
2. Open the Gas Ballast while the pump is operating.
3. Leave the Gas Ballast open for 45-60 minutes while the pump is operating. This is usually sufficient to remove all of the condensables from the oil.
4. Remember to close the gas ballast valve when finished. Operating the pump with the gas ballast valve open causes slightly higher ultimate pressure, increased oil consumption and an oil mist exhaust.

NOTE: This can be done towards the end of the freeze drying cycle.

An oil mist eliminator is available from VirTis.

VirTis part #253013 – Plastic Oil Mist Eliminator (Adapter #258665 required)

(Refer to Page 46 for spare parts list)

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Condenser:

The condenser is fabricated from stainless steel and under normal use can be rinsed and kept clean with a mild detergent.

If corrosive materials are being freeze dried, then thoroughly clean and rinse all parts of the freeze dryer that come in contact with product moisture. This prevents residual build-up of corrosive and contaminating materials on interior surfaces, protecting the freeze dryer and the next product to be processed. Add baking soda or any mild buffering agent to the rinse water to help neutralize acidic residue. Note: A siphon type squeeze bottle can be used to direct the rinse spray into difficult to reach areas.

Failure to properly neutralize corrosive materials will damage your freeze dryer and void the warranty.

Never allow the condenser to fill to more than half full of liquid to avoid causing liquid back flow into the vacuum pump.

Acrylic Cover:

Warning:

Clean acrylic cover with a mild detergent. Do not use organic solvents or abrasive cleaners.

Vacuum Tubing and Gaskets:

Inspect tubing and gaskets periodically for signs of age such as cracking or a dried appearance. Check gaskets by removing and inspecting interior surfaces for potential problems. A light coating of VirTis Vacuum Grease on the exterior surfaces will protect gaskets and tubing. Replace as needed.

Refrigeration:

Check and periodically clean side grill when unit is shutdown.

Efficiency of the refrigeration unit is greatly affected by the condition of the grill under the benchtop. If the grill becomes clogged with dirt and dust, the fan cannot pull air through it. Without this airflow, the condenser will not properly cool the refrigerant or cool the compressor motor. A soft brush or vacuum cleaner can be used to remove dirt and dust. A qualified Service Technician should check the static refrigeration charge every 18 months to insure a proper charge.

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The hermetically sealed refrigeration compressors do not require maintenance other than keeping the finned grill clean as described above. The BenchTop 2, 4 or 6K has a charging tag (located on the side of the unit next to the serial tag) listing the gas used and the static charge at a +70°F room temperature. The static charge should be checked periodically to insure that metal fatigue or vibration has not caused a loss of the refrigerant.

Allow at least four inches of space on all sides of the unit for proper airflow and cooling.

Consult the spare parts section on page 30 for a complete list of replacement parts.

Any questions?

Please contact the SPI Service and Support Company at 1-800-431-8232 and a trained technician will assist you.

Service contracts, extended warranties and maintenance programs are available, contact the VirTis Service Department for further information.

Phone #: 877-548-4666
Fax: 877-693-9273
E-Mail: repair/service@virtis.com

TROUBLE SHOOTING GUIDE

Gives a checklist to diagnose common problems

Vacuum Problems

Remember maximum vacuum (5 millitorr) is only achievable with a clean dry system. Initial vacuum will be affected by the amount of product loaded on the unit. For efficient freeze drying, vacuum should be below 200 millitorr. Product may need to be introduced in stages to keep the vacuum under acceptable levels.

The following is a checklist to eliminate possible causes.

- ✓ Was the condenser drained after the last run?
- ✓ Is the drain line inserted into the drain valve? This must be removed.
- ✓ Are all accessory ports, valves or filters closed tightly? Check all connections for integrity.
- ✓ Is the condenser gasket clean and properly greased?
- ✓ Are all the Quickseal Valves in the closed position? (for units using a manifold)
- ✓ Are the Quickseal Valves in good condition? Is there a light coating of vacuum grease on the valve plug and on the valve port? (for units using a manifold)
- ✓ Is the vacuum pump oil clean and at the proper level? (check sight glass)
- ✓ Is the condenser maintaining the proper temperature? If the temperature rises due to refrigeration problems, moisture may be leaving the condenser walls and migrating to the vacuum pump, causing poor vacuum.

If none of the above apply, try to isolate the problem by removing the manifold or the vacuum cover plate and placing a stopper in the vacuum intake tube at the bottom of the condenser. This will seal the vacuum tube, and when the vacuum pump is operated a good check of the components between the pump and the end of the tube will be obtained.

- If you get a good vacuum reading (as shown on the front panel or other vacuum gauge) in about 1 minute then this check will eliminate any problem with the pump, vacuum probe and vacuum tubing connections. At this point recheck manifold and gasket for joint separations and dirty or rough surfaces.
- If you do not get a normal vacuum reading (as shown on the front panel display or other vacuum gauge) in about 1 minute with the stopper inserted as described above, then start checking components one-by-one.

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- Change and flush oil in vacuum pump (refer to page 37 or a separate pump manual).
- Disassemble all vacuum tubing connections, clean with a mild alcohol such as methanol, apply a light coating of vacuum grease and reassemble.
- Check all threaded and welded connections and seal with vacuum sealant.
- If poor vacuum persists or testing vacuum with a second, calibrated gauge indicates a good vacuum reading, then the probable cause is the vacuum probe, which will have to be replaced.
VirTis Part #153650 – Vacuum Probe Tube

If following this checklist does not resolve the vacuum problem, contact the VirTis Service Department and a trained technician will assist you.

Product Melting

The most common reason is that the vacuum pressure is not sufficiently low to keep the product in a frozen state. Check for a vacuum leak or restriction in a vacuum hose as described above.

If the unit is functioning properly but the product is still melting then the product's freezing point (eutectic) may be too low to stay in a frozen state. A re-test using water only as a sample will determine if there is a mechanical or product-related problem.

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VER: 001 DATE: 12/20/01

BENCHTOP 2K SERIES	ES	XL
Condenser Blank-Off Temperature: °C	-55°C	-75
Condenser Capacity in 24 hours: liters	2	
Overall Condenser Capacity: Liters	2.5	
SLC CONTROL SYSTEM Condenser Temperature Vacuum indication (Millitorr or Millibar – selectable) Vacuum control Temperature – Vapor Pressure conversion System maintenance PC Interface	LCD Display -150°C to +100°C 760 Torr to 1 millitorr Vacuum Bleed type Push button Oil change RS- 232C	
Defrost Method	Hot Water	
Product Freezing in Condenser via 3 position shelf	-50°C	-65°C
System Refrigerant	89	V70C
Condenser Type	Bottom external coil	
Compressor Horsepower	.25KW, 1/3HP	
Vacuum Pump: Liters/Minutes –Exhaust Filter included	37.5 LPM (2.25m3/hr) 2-stage	
Average Time to 100 mt: Minutes	15	
Ultimate system vacuum:	5mTorr (7ubar)	
Acrylic drying manifold (option)	8 port with adapter plug	
Flask Connection (option)	8 Quickseal® Valves	
Base Cabinet Dimensions: Inches	12.5W x 19D x 15.5H	
Centimeters	31.7W x 48.3D x 39.4H	
Range of Weight: Pounds/Kilograms	59/26.5	
Warranty	2 Year Refrigeration	
Options -	Adjustable Drying Rack Stoppering assembly See Accessory listing	

VirTis
815 Route 208, Gardiner, NY 12525
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Rev: 4, 2/03/03

BenchTop 2K, 4 K, 6K Operation Manual

BENCHTOP 2K SERIES	ES	XL
Standard Voltages	100-115V 50/60HZ 208-230V 60 HZ 200-240V 50HZ	100-115V 50/60HZ 208-230V 60 HZ 200-240V 50HZ
Breaker Size	15 Amp (100-115V) 10 Amp (200-240V)	15 Amp (100-115V) 10 Amp (200-240V)
Required Electrical Receptacle (NEMA) 60HZ*	5-15-R (115V) 6-15-R (208-230V)	5-15-R (115V) 6-15-R (208-230V)
*200-240V 50 HZ units are supplied with Continental European plug type CEE7/7. Receptacle configuration for 50 HZ units varies with different countries.		

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VER: 001 DATE: 12/20/01

BENCHTOP 4K SERIES	XL	EL
Condenser Blank-Off Temperature: °C	-75° C	-105°C
Condenser Capacity in 24 hours: liters	3	
Condenser Performance – Liters Overall Condenser Capacity: Liters	8	
SLC CONTROL SYSTEM Condenser Temperature Vacuum indication (Millitorr or Millibar – selectable) Vacuum control Temperature – Vapor Pressure conversion System maintenance PC Interface	LCD Display -150°C to +100°C 760 Torr to 1 millitorr Vacuum Bleed type Push button Oil change RS- 232C	
Defrost Method	Hot Water	
Product Freezing in Condenser via 2 position shelf	-65° C	-90°C
System Refrigerants	V70C	89 / R1150
Condenser Type	Bottom external coil	
Compressor Horsepower	.37KW, 1/2HP	2X .37KW, 1/2HP
Vacuum Pump: Liters/Minute	37.5 LPM (2.25m3/hr) 2-stage	
Average Time to 100 mt: Minutes	18	
Ultimate system vacuum:	5mTorr (7uBar)	
Acrylic drying manifold (option)	12 port with adapter plug	
Flask Connection (option)	12 Quickseal® Valves	
Base Cabinet Dimensions: Inches	15.5W x 19D x 15.5H	
Centimeters	39.4W x 48.3D x 39.4H	
Range of Weight: Pounds/Kilograms	130 / 59	
Warranty	2 Year Refrigeration	
Options -	ALC Automatic Control Heated and unheated Racks See Accessory listing	

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BenchTop 2K, 4 K, 6K Operation Manual

BENCHTOP 4K SERIES	XL	EL
Standard Voltages	100-115V 50/60 HZ 208-230V 60 HZ 200-240V 50 HZ	208-230V 60 HZ 200-240V 50 HZ
Breaker Size	15 Amp (100-115V) 10 Amp (200-240V)	15 Amp
Required Electrical Receptacle (NEMA) 60 HZ*	5-15-R (115V) 6-15-R (208-230V)	6-15-R (208-230V)

* 200-240V 50 HZ units are supplied with Continental European plug type CEE7/7. Receptacle configuration for 50 HZ units varies with different countries.

BenchTop 2K, 4 K, 6K Operation Manual

VER: 001 DATE: 12/20/01

BENCHTOP 6K SERIES	ES	EL
Condenser Blank-Off Temperature: °C	-55°C	-85°C
Condenser Capacity in 24 hours: liters	5	
Overall Condenser Capacity: Liters	9	
SLC CONTROL SYSTEM Condenser Temperature Vacuum indication (Millitorr or Millibar – selectable) Vacuum control Temperature – Vapor Pressure conversion System maintenance PC Interface	LCD Display -150°C to +100°C 760 Torr to 1 millitorr Vacuum Bleed type Push button Oil change RS- 232C	
Defrost Method	Hot Water	
Product Freezing in Condenser chamber to:	-25°C	-40°C
System Refrigerants	89	R417B / R508B
Condenser Type	Internal coil	
Compressor Horsepower	.37KW, 1/2HP	2X, .37KW, 1/2HP
Vacuum Pump: Liters/Minute	37.5 LPM (2.25m3/hr)2-stage	
Average Time to 100 mt: Minutes	18	
Ultimate system vacuum:	5mTorr (7uBar)	
Acrylic drying manifold (option)	12 port with Adaptor plug	
Flask Connection (option)	12 Quickseal® Valves	
Base Cabinet Dimensions: inches	15.5W x 19D x 15.5H	
Centimeters	39.4W x 48.3D x 39.4H	
Range of Weight: Pounds/Kilograms	130 / 59	
Warranty	2 Year Refrigeration	
Options -	ALC Automatic Control Heated and unheated Racks See Accessory listing	

BenchTop 2K, 4 K, 6K Operation Manual

BENCHTOP 6K SERIES	ES	EL
Standard Voltages	100-115V 50/60 HZ 208-230V 60 HZ 200-240V 50 HZ	208-230V 60 HZ 200-240V 50 HZ
Breaker Size	15 Amp (100-115V) 10 Amp (200-240V)	15 Amp
Required Electrical Receptacle (NEMA) 60 HZ *	5-15-R (115V) 6-15-R (208-230V)	6-15-R (208-230V)

* 200-240V 50 HZ units are supplied with Continental European plug type CEE7/7.
Receptacle configuration for 50 HZ units varies with different Countries.

BenchTop 2K, 4 K, 6K Operation Manual

SPARE PARTS

Lists common replaceable parts and gives ordering information

BT 2K	BT 4K	BT 6K	Part #	Description
X	X	X	153650	Vacuum probe tube 10324pt.
	X	X	154328	12" gasket for condenser
X	X	X	171884	½" Quickseal Valves
X	X	X	171926	¾" Quickseal Valves
X	X	X	174730	Oil Charging Pump
X	X	X	185181	One gallon can of Vacuum Pump Oil
X	X	X	185207	Two gallon can of Vacuum Pump Oil
X	X	X	250365	Soda Sorb Cartridge for Acid
X	X	X	250373	Activated Charcoal Cartridge for Organic Solvent s
X	X	X	253013	Oil Mist Eliminator, Plastic for 65, 127LPM Vacuum Pumps
X	X	X	258665	Vacuum Pump Adapter for 65, 127 LPM Vacuum Pump (for #253013)
X	X	X	266783	Molecular Sieve Cartridge for Water Vapor
X	X	X	272310	Free Standing Filter Trap
X	X	X	277228	One Liter of Synthetic Oil
X	X	X	354506	Drain hose - clear tubing - 36 inches recommended
X	X	X	356808	90° Rubber elbow for vacuum port connection to vacuum pump tubing.
X	X	X	357699	High Vacuum grease (10 ea. Of .5 oz tubes)
		X	364604	Circuit breaker 10 AMP (ES)
X			366658	Oil Separator (XL)
X	X	X	367424	Plastic vac hose connector
X			372336	1/3 HP Compressor (ES,
		X	372343	Compressor 1/3 HP (ES)
X	X	X	374231	Neoprene foot for Benchtop
X			385282	9" gasket for condenser
X	X	X	386808	Rubber Elbow
X	X	X	398701	Fan 7.5" diameter
	X		401579	3/8 HP Compressor (EL)
		X	401579	Compressor 3/8 HP (EL)
X	X	X	406208	Needle valve for vacuum level control
X	X	X	381567	Acrylic manifold
X	X	X	387811	Manifold tapered plug

Contact the VirTis Sales Department at (800) 431-8232 for price and availability.

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