

OPERATING INSTRUCTIONS FOR:

MODEL 100-SRC

SUBLIMATOR

The Virtis Co., Inc.
Route 208
Gardiner, NY 12525

NOTE: OUR NEW AREA CODE IS 845
PLEASE UPDATE YOUR RECORDS

Tel. 914/255-5000
800/431-8232
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100 SRC
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VIRTIS LIMITED WARRANTY
(Domestic Sales)

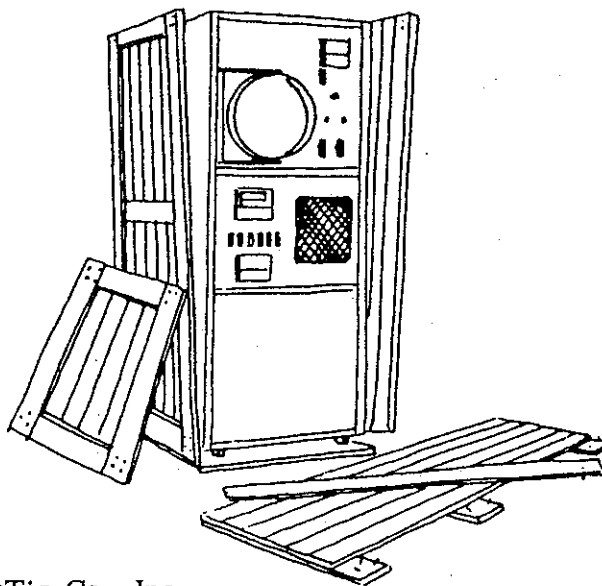
1. VirTis equipment is guaranteed to be free of defects in workmanship and/or material for a period of twelve months after date of delivery.
2. During this twelve month warranty period, parts found, on our inspection, to be defective in workmanship and/or material will be replaced. Parts, expendable items, and labor will be supplied at no charge F. O. B. factory.
3. If prior approval is obtained from the factory service department, VirTis will reimburse the cost of repairs or service, made at customers expense, of items covered by this warranty.
4. Travel time and direct travel expenses incurred by our personnel are not covered by this warranty.
5. Shipping damage is not covered by this warranty. Claims for shipping damage should be made against carriers responsible for shipment.

The above constitutes our full and only guarantee.

INSPECTION

1. Inspect contents of this shipment immediately upon arrival. Check packing material for possible small accessory items. If damage is obvious, **DO NOT ACCEPT** shipment from carrier without a signed notification of damages.
2. When concealed damage and/or loss is discovered, contact the delivering carrier immediately to make an inspection report. Keep the contents and packing material and any paperwork intact until the written report is obtained.
 - a. If your shipment is F.O.B. destination, file your claim with VirTis with the inspection report and other supporting documents.
 - b. If your shipment is F.O.B. factory, file your claim with the delivering carrier, accompanied by the inspection report and other supporting documents.

VirTis will cooperate in the matter of collecting your claims, but we are not responsible for the collection or free replacement of the material. Replacement parts will be shipped and invoiced to you, making them a part of your claim.

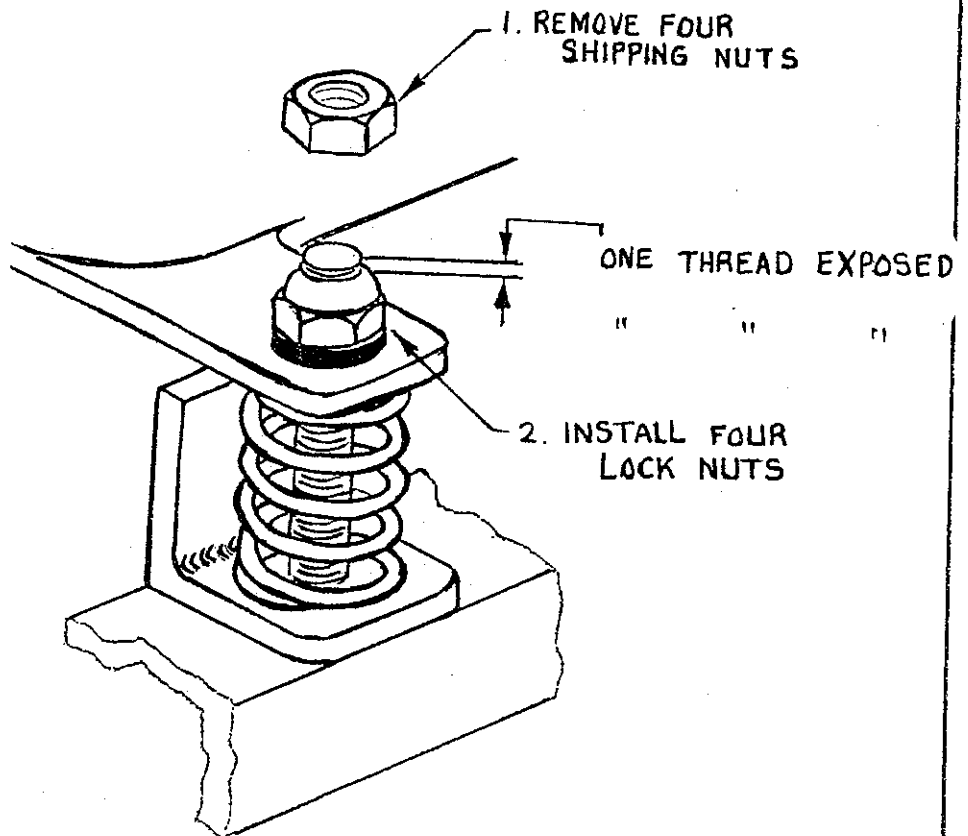


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IV INSTALLATION

A. Basic Set-up

1. Check voltage, phase, frequency and amperage as listed in the Specifications and on the serial tag, against your available electric supply; they must match.
2. Position the unit on a firm level floor, and in an area providing adequate air circulation; the back of the machine should be at least 4" away from the wall. The maximum room temperature for efficient operation should be $+25^{\circ}\text{C}/+77^{\circ}\text{F}$.
3. Release the refrigeration compressor spring mounts.



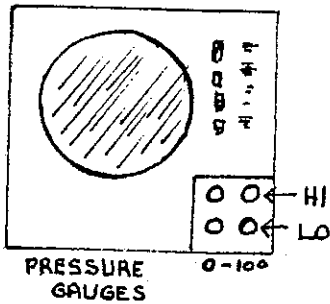
4. Open The Vacuum Chamber Door and make sure that the gasket inside has a very light film of vacuum grease where it touches the lucite door.

B. Set-Up

1. All VirTis Sublimators are equipped with a 2-stage gas ballast vacuum pump specially designed for freeze-drying and sized to rapidly evacuate the vacuum chamber.

2. When your unit arrives, note that 2 electrical leads (red and black) are not connected in the terminal box. Please read attached tags and connect as directed.

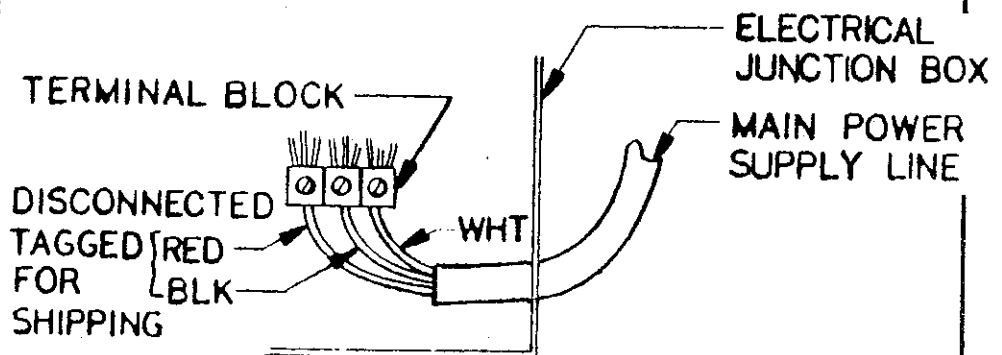
** SEE diagram below --



a.) For Direct Drive Pump - (Alcatel) -- switch ON Shelf Heat momentarily and note the pressure differential on the pressure gauges on the lower right front of the unit. There should be a difference of 10-12 lbs. pressure. If none shows, the electrical leads should be reversed.

b.) For Pully Type Pump -- switch on Vacuum momentarily and note vacuum pump pully rotation. If rotation does not follow direction of arrows on pump body you have connected them wrong - reverse the 2 electrical leads and test again.

3. Check the Vacuum Pump Oil level. The pump is shipped with oil in it, which should be just visible in the sight glass on the front of the pump. Add oil only if necessary, DO NOT OVERFILL! The oil level will rise during operation and should be half way up the sight glass under normal conditions. NOTE: see enclosed pump manual for oil change, etc. You may wish to have a vent or exhaust port from the room to evacuate any smoke or oil vapors. (Vapor filters are also available)



C. Water Line Connections

1. Attach hoses to the standard 1" water line connections tagged "in" - "out". A valve for water control is provided. The water inlet temperature should be no higher than +24°C (+75°F).

The requirement for water-cooled refrigeration system follows:

25 SRC Bulk - (@75°F)	1/2 g/p/m:	3 g/p/m/full load
50 SRC Bulk - (at 75°F)	3 g/p/m:	5 gal/p/m/full load
51 SRC Stop. - " "	3 g/p/m:	5 gal/p/m/full load
100 SRC Bulk - " "	6 g/p/m:	10 gal/p/m/full load
101 SRC Stop. - " "	6 g/p/m:	10 gal/p/m/full load
250 SRC Bulk - " "	8 g/p/m:	15 gal/p/m/full load
251 SRC Stop. - " "	8 g/p/m:	15 gal/p/m/full load
500 SRC Bulk - " "	15 g/p/m:	20 gal/p/m/full load
501 SRC Stop. - " "	15 g/p/m:	20 gal/p/m/full load

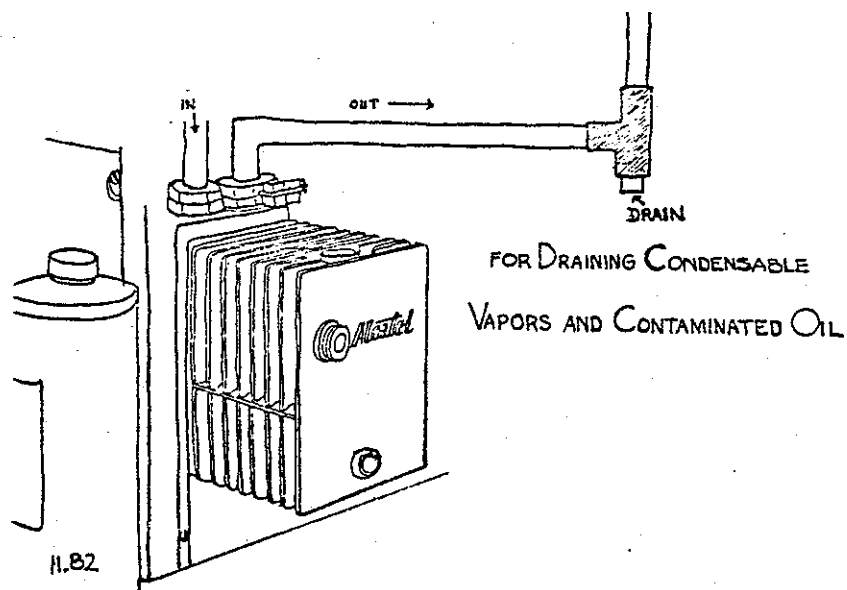
NOTE: The cooling water should be free of sediment.

2. For defrost, a hot or cold water line should be connected to the hose adapter at the solenoid valve at back upper left of unit. A hand valve should be installed to control the flow of water when the electric solenoid is open. Make provision for the water that will come out of the drain line during defrosting by hooking into an existing drainage system or floor drain.

3. Check the Vacuum Release Valve and Sterile Air inlet to make sure they are closed and hoses are in proper place; all switches should be in the "OFF" position and the drain valve closed or plugged.

NOTE: For your protection and well-being may we suggest your facility make arrangements for an adequate vacuum pump exhaust system - pump vapors are quite unpleasant in the lab and cannot be tolerated in a clean room. Exhaust lines should have an I. D. size no smaller than that of the pump. Filters are available, a hood may be used, or the pump can be vented to the outside.

Suggestion: a line going horizontally from the pump across to a "T" with drainable trap, then 90° vertical to outside vent.



Place trap as close to the pump as possible; a simple disconnect should also be put into the line making it easier to move the pump for oil drainage.

V. FEATURES:

The VirTis Sublimator is a quality freeze-dryer designed to remove the water and solvent content of product materials under controlled conditions.

The four basic steps performed in this process include:

- a. Rapid freezing of the sample and chilling to below eutectic temperatures.
- b. Creation and maintenance of high vacuum (5 microns minimum).
- c. Controlled heating of the frozen product.
- d. Condensing of water vapor molecules.

The following paragraphs briefly describe the system and operation of the sublimator to provide the reader with a fundamental knowledge of the unit.

1. Trays:

Stainless steel trays and covers available with this VirTis Sublimator are suited for sterile operations and may be used to process product in bulk or stoppering modes. Various designs are available to suit almost any material or process. Contact the factory for details.

2. Shelf Heating/Cooling:

The hollow stainless steel plate shelves are heated and cooled by a continuously pumped, high flow rate, heat transfer system. The fluid is heated by means of an electric heater and cooling in a shell and tube heat exchanger refrigerated by the refrigeration system.

During the shelf freezing cycle, the full capacity of the refrigeration system is directed to the heat exchanger through a full flow expansion valve.

During the shelf heating cycle the shelf temperature probe, located directly between the heater outlet and shelf inlet manifold, operates to maintain extremely close control. Should the set point be exceeded, the cooler is fed a limited amount of refrigerant through a capillary to maintain the set point temperature. This full control is particularly useful in drying at below ambient temperatures, where product eutectics are low or viability sensitive. Please note that this full control feature operates only during an actual freeze-drying cycle while the condenser is in operation.

3. Vacuum System:

All VirTis Sublimators are equipped with two-stage gas ballast vacuum pumps designed especially for freeze-drying and sized for rapid evacuation of vacuum chambers.

Accurate measurement of vacuum is provided by a VirTis Model 10-324 Thermocouple Vacuum Gauge mounted on the sublimator control panel. The vacuum release valve connected to the air inlet port permits introduction of sterile air or de-contaminating gases into the vacuum chamber.

4. Condenser:

A smooth 270 cylindrical inner portion (top 90 degrees excluded) of the stainless steel vacuum drum is directly wetted by refrigerant on the outside surface flowing through a stainless steel channeled jacket. This provides an excellent short-path condenser for the large volumes of water vapor as they flow from the frozen product. Low condenser temperature is essential to establish a pressure differential between the product surface and the condenser surface.

5. Refrigeration System:

The high BTU capacity at ultra-low temperatures essential to the freeze-drying process is achieved in VirTis Sublimators by direct expansion of a low boiling point refrigerant in the shelf heat exchanger or condenser. Refrigerant flow is directed to either the shelf system or condenser by solenoid valves and the flow rate is automatically metered in response to load requirements by thermostatic expansion valves.

The refrigeration system is powered by a hermetically-sealed compressor and the system is fully protected against burnout, overload, and pressure build-up. VirTis employs a water-cooled refrigeration system in order to provide high heat removal rates.

VI. PRE-OPERATION CHECK:

1. Verify that the Heat Transfer Fluid Pump switch is ON. This switch is located inside the electrical access panel on the right side of the unit.
2. The heat transfer fluid should be visible in the sight glass at the front of this unit. If not, see Page 14.
3. Refrigeration System:

CAUTION: Do not attempt to operate water-cooled units until cooling water lines have been connected, as outlined on Page 4.

- a. Set the shelf controller to maximum low (-100°C). Switch on Freeze. The shelf temperature will drop to -40°C (between 1 1/2 to 2 1/2 hours, depending upon the number of shelves).....
 - b. Switch on Condenser and then turn off Freeze. This prevents the compressor from shutting off and then restarting. The condenser temperature controller has been set at the factory for -62°C . The condenser temperature will reach -62°C in approximately one-half hour.
4. Vacuum System:
 - a. Switch on Condenser.
 - b. Close the vacuum drum drain and the vacuum release valve.
 - c. Coat the door gasket with a light film of Dow Corning High Vacuum Grease, VirTis Catalog Number 10-010VG.
 - d. Close the door and tighten the latch. (See Page 17 if door adjustment is necessary.)
 - e. Switch on the vacuum pump when the condenser temperature has reached -40°C or lower.

NOTE: All VirTis Sublimator vacuum chambers are factory tested to 5 microns absolute vacuum. This sublimator will typically pump down to 50 microns in twenty minutes (with condenser on and clean dry chamber).

5. Shelf Heat:

Set the shelf temperature controller to $+65^{\circ}\text{C}$ and switch on Shelf Heat. Observe the shelf temperature rise.

6. Water Defrost

Shut off Vacuum, Condenser, and Shelf Heat. Open the drain valve, close the chamber door tightly and switch on Defrost. A spray of water will be directed at the condenser surface from the tubes at the top right and left-hand sides of the shelf assembly. Full load defrost should be complete in approximately forty-five minutes. Defrost can be operated with the Shelf Heat on to facilitate the actual defrosting.

VII OPERATION:

1. Loading the Sublimator:

- a. Bulk product may be poured or placed directly into the stainless steel sublimator trays. Vials or serum bottles may be loaded into the trays or placed directly on the sublimator shelves.
- b. Product temperature thermistor or thermocouple probes should be placed in the product prior to freezing so temperatures can be shown on the thermistor indicator on the control panel.
- c. Load each tray into the sublimator by positioning it on the shelf to engage the tray hold-down rails on either side. Slide, do not force, the trays into position.
- d. Check the position of all trays, covers (if used), and probes before starting the freezing cycle. Connect all probes to their corresponding panel jacks.

2. The Freezing Cycle:

- a. Set the shelf controller to maximum low (-100°C) unless specific conditions dictate otherwise. Switch ON Freeze and pre-cool shelf (or shelves) to at least -30°C prior to loading. If the product has been previously frozen, do not load the sublimator until the shelf temperature is lower than the product eutectic point.
- b. Close the chamber door and allow product to freeze to a temperature below the eutectic point for the particular product. After the probes reach the desired low temperature, continue the freezing process for an additional 1 to 3 hours to make sure the product is fully frozen.

3. The Drying Cycle:

- a. Switch ON Condenser and switch OFF Freeze after the product is fully frozen as determined by product temperature or visual inspection.
- b. Close drain and vacuum release valve
- c. When condenser temperature reaches -40°C switch ON Vacuum. Operate the vacuum pump with the gas ballast open to avoid oil contamination when a large quantity of product is processed. See Vacuum Pump Manual for further instructions and information.
- d. When 100 microns vacuum is registered, switch ON Shelf Heat.

- e. Set the Shelf Temperature Control to the desired set point. A setting of 20-30° C is considered a good range; however, on runs with sensitive products lower initial fluid temperature will be required to prevent overloading during the first several hours of the freeze-drying run. Experience will determine the optimum parameters for each product.

As heat is supplied, the sample will begin to sublime. Formation of ice on the condenser will be noted and the condenser temperature may rise slightly. Check the vacuum pressure, shelf and condenser temperatures periodically during the drying cycle. Excessive heat input will cause a significant rise in condenser temperature and vacuum pressure. Under these conditions product meltback may occur. Avoid this difficulty by limiting shelf temperature.

Typical drying cycles range from 12 to 36 hours. Drying rates are determined by physical properties of the product, quantity of product, and rate of heat input.

- f. Continue sublimation until dryness is determined by one or more of the following indicators:
1. Condenser temperature will approach its maximum low.
 2. Vacuum will approach the maximum low.
 3. Appearance of the product may indicate the extent of dryness.
 4. The Sample Temperature Indicator, if employed, will register steady temperature close to shelf temperature.

When the end point is determined, continue the drying cycle for a few hours to insure total product dryness.

5. Tray Removal:

- a. Break vacuum to chamber via the Vacuum Release Valve on the front of the unit.
- b. Switch off Vacuum to stop the vacuum pump.
- c. Open door.
- d. Remove trays and temperature probes.
- e. Switch off Condenser and Shelf Heat.

6. Condenser Defrost:

- a. Close chamber door.
- b. Open Defrost Drain Valve.
- c. Switch on Defrost.
- d. Adjust the water supply valve to prevent excessive water accumulation in the vacuum chamber.
- e. Switch off Defrost when all ice has melted.

VIII MAINTENANCE AND REPAIR:

1. The Vacuum System

- a. The vacuum pump oil level should be checked before and after each freeze-drying run. The condensate must be drained completely before starting another run to prevent water from getting into vacuum pump oil.

Add oil as required - do not overfill - (see pump manual).

Check oil periodically and replace any oil that appears dirty or contaminated. A common cause of contamination, water vapor absorption, may be prevented by operating pump with gas ballast open.

On belt driven pumps, check "V" belt tension from time to time. If belt stretches, loosen mounting bolts and re-position drive motor to correct tension. Refer to manual (pump) for more detailed information.

- b. The vacuum system is connected at the pump by gum rubber tubing held by 2 hose clamps. Check rubber for signs of deterioration or cracking. Also inspect tubing connections at vacuum gauge and vacuum release valve for restriction or leaking. Replace defective tubing to avoid potential vacuum leaks.
- c. The thermocouple vacuum gauge probe may need periodic cleaning. (See Annex 15B)
- d. All VirTis sublimators are factory-tested to 5 microns vacuum as read on a McLeod Gauge. In operation, the actual vacuum reading is determined by the condenser temperature, ice vapor pressure and product vapor pressure. To test for vacuum leaks, remove the product, defrost the condenser and re-cool the condenser to -60°C . Under these conditions, the vacuum should read 25 microns or lower. If proper vacuum is not observed, proceed as follows:
 - To test vacuum pump, place rubber stopper with tube through it on in-take port of pump to McLeod gauge on other end (see illustration 1-A). Vacuum should go down to 5 microns in 10 minutes.
 - If unit has been run with gas ballast closed, open and allow 2 hrs. of operation before noting vacuum. If proper vacuum is not reached, drain and flush pump, add new oil, re-check vacuum. If 25 microns still cannot be reached, contact VirTis for help. If 25 microns is attained, continue troubleshooting.
 - Make sure rubber vacuum connections are greased -- reconnect to vacuum system.
 - Check door gasket for possible cracks; clean and coat with new vacuum grease -- re-test vacuum again with condenser at -60°C .

- Check all hoses, gaskets, drain valves, gauges, stoppering valves, etc. in the vacuum system. The easiest way to locate a leak in any one of these is to separate it from the vacuum system. (See Drawing 2-A). By placing a hemostat or clamp on any one of the hoses marked on the drawing, you are eliminating a valve, hose, or whatever from the system. After placing your clamp on the chosen location, give the pump a chance to pull down vacuum - perhaps 10 minutes. By watching the vacuum gauge you should see the pressure decrease rather quickly once you have eliminated the leak.

There are several other methods of locating vacuum leaks. If you have not eliminated the leak using any of the above methods, contact the VirTis Service Department for assistance. Be sure you have your model and serial number handy when calling.

2. The Shelf Heating/Cooling System

The fluid level at ambient conditions should be just visible in the bottom of the sight glass. Nitrogen pressure must be 60 psig at ambient temperature. Do not overfill the system with fluid or pressure.

To add the heat transfer fluid to the unit, proceed as follows:

- a. Turn the Heat Transfer Pump switch to OFF
- b. Turn on Freeze. This allows the refrigeration system to cool the fluid and this limits the amount of vapor that escapes.
- c. Release the nitrogen pressure at the service valve.
- d. Add heat transfer fluid from a pressurized cylinder through a refrigeration charging hose.
- e. When the liquid level becomes visible in the sight glass, cease filling.
- f. Turn off Freeze
- g. Return Heat Transfer Pump switch to ON
- h. Re-pressurize to 60 psig with nitrogen. Some nitrogen will dissolve into the fluid and a drop in pressure will result over a period of several hours. Adjust to 60 psig.

3. Refrigeration System:

Under normal operating conditions the hermetically sealed refrigeration system, which is designed for continuous operation, will not require attention. The compressor is fully protected against thermal and electrical overload and the system is protected by a high-low pressure cut-out.

Standard refrigeration procedures are applicable to the care and service of VirTis Sublimators. Refer to the refrigeration system service chart and the refrigeration specification sheet on the following pages in event of breakdown.

Re-Charging Procedure:

- a. Evacuate the system with a two-stage vacuum pump capable of 5 microns ultimate vacuum. Connect pump-down lines to all charging valves.
- b. Electrically disconnect the compressor.
- c. Set the shelf and condenser controls to above ambient and switch on Freeze and Condenser alternately during pump-down to insure total evacuation.
- d. Evacuate to 5 microns of vacuum for at least 4 hours.

CAUTION: Failure to remove all traces of moisture from the system will result in erratic refrigeration performance.

- e. Add dry refrigerant to the system as specified on the refrigeration specification sheet.
- f. Electrically connect the compressor.
- g. Switch on Freeze and cool shelves to specified low temperature. Verify charge by noting suction and discharge pressures. (See Annex #7 for refrigerant temperature-pressure chart.) Check the oil level sight glass after start-up and add oil if necessary.

Additional information on compressors and related service may be found in:

Copelametic Service Manual #5904
Copeland Refrigeration Corporation
Sidney, Ohio

4. Electrical System:

The electrical system is composed of 3 parts:

- a. Front Panel
- b. Electrical Box (located on right side of machine).
- c. Logic Panel (located in electrical box).

The front panel controls the operation of the Sublimator. There are five (5) lighted push buttons labeled Freeze, Condenser, Vacuum, Shelf Heat and Defrost. (ETO and Programmer are optional.) These switches control the Sublimator through a low voltage logic system. The lamps are illuminated if the push button is depressed, however, the function is not enabled if it would have an adverse effect on the machine's operation. Example: In a normal freeze-drying run the following buttons would be depressed -- Condenser, Vacuum and Shelf Heat. If accidentally a technician pushed the Defrost button the light would illuminate, but the Defrost Function would not occur since it would flood the chamber. The Defrost button must be depressed again to extinguish the lamp and remove the improper function.

In the electrical box are the power relays, autoformers and circuit breakers. The autoformers are fused on both legs of the input. These autoformers are used to supply electrical power for all 115 Volt components such as the logic panel, TVG, and the Product Temperature Indicator; also a convenience outlet on the rear of the electrical box.

There are 4 heavy duty motor-starters, to control the compressor, heater, vacuum pump and circulating pump.

The Heat Transfer Pump has a service by-pass switch. This switch is located on the right side of the electrical box and is accessible from the side of the machine.

The Logic Panel is mounted in the left side of the electrical box. The Logic Panel contains the interfacing of low to high power relays, and a printed circuit board. Also provided on the Logic Panel is a series of 10 switches which are used for service purposes only. These switches are normally in the upper position.

With the assistance of the customer our Service Department can quickly isolate problems using these switches.

5. General Maintenance:

- a. Door adjustment may be necessary to assure total initial contact against the door gasket. To adjust, loosen the top door pivot bolt (located at top center), rotate the top eccentric bushing until desired contact is achieved, and tighten pivot bolt.
- b. Thoroughly clean and rinse the trays and the vacuum chamber interior after each operation. This is essential to insure the removal of corrosive materials. See Annex #10 for table listing corrosion resistance of stainless steel.

Whenever a problem does exist call our Service Department at 914/255-5000.

VACUUM TROUBLE SHOOTING GUIDE

If a vacuum cannot be obtained while performing the function test and following the vacuum service chart (Table 1) try the following procedures:

The vacuum pump should be isolated from the unit and tested separately. This test must be done to determine whether the system has a vacuum leak or a defective pump. It is recommended that the pump be tested with the vacuum gauge that is equipped with the unit. The vacuum probe sensor is normally located in the main vacuum line between the pump and the vacuum chamber. If the unit is equipped with our Manual Purge System (MPS) or Electric Purge System (EPS) option, it would make it very easy. If neither option is available on your unit, the main vacuum port must be blocked off upstream of the vacuum gauge sensor with a rubber stopper. This can be done on some models by looking inside the vacuum chamber and placing the stopper into the main inlet port. On other units, a rubber connecting tube with the stainless steel hose clamps will need to be removed and blocked off. If this test does not pull the vacuum down to specs, another vacuum gauge that has been tested should be attached to determine if it is a faulty gauge or pump problem.

If the vacuum gauge and pump test meet specs and the Vacuum Service Chart was followed, there presumably is a vacuum leak in the system. If the unit is equipped with an external condenser, it should be isolated from the product chamber. This should determine whether the leak is in the condenser chamber or the product chamber.

If the leak has been isolated to the product chamber or condenser chamber, soapy water may be used to locate the leak. It should be applied to all piping and electrical pass-thrus that exit the vacuum chamber. This test should be done with the unit at room temperature. The vacuum can then be applied for approximately 20 or 30 seconds and shut off. Looking very carefully at the suspected leak areas, you will see bubbles appear where the air is pulling inward. The size of the bubbles will greatly depend on the size of the leak. Larger leaks will produce very large pronounced bubbles and small ones may show up as only small white specks. The vacuum pump can be turned on and off to obtain a lower pressure but care must be taken not to reduce the pressure too much as this will produce violent bubbling everywhere, making it impossible to pinpoint the leak.

If you are unable to locate the leak in this manner, please contact the Virtis Service Department for more information or for scheduling of a service technician.

TABLE 1
VACUUM SERVICE CHART

SYMPTOM	CAUSE	CORRECTION
Vacuum pump will not start	<p>Incorrect electrical phasing</p> <p>No power to pump motor</p> <p>Power to motor OK, but pump will not start.</p>	<p>See installation instruction</p> <p>Vacuum pump electrical contactor off on rest. If pump motor is 3-phase, test for proper electrical supply on both sides of contactor.</p> <p>Vacuum pump may be seized. Motor should be removed (800 vacuum pump manual) and started without pump attached. This will determine if the problem is in the motor or the pump. If the pump motor is seized, it should be rebuilt or replaced.</p>
Vacuum pump runs, but unit has no vacuum	<p>Vacuum release valve left on</p> <p>Condenser drain valve left open.</p> <p>Door gasket not sealing on lucite door properly.</p>	<p>Turn off vacuum release switch.</p> <p>Close valve, located in service panel.</p> <p>Open lucite door and lift up on the inside of the gasket. This will release the vacuum under the gasket, causing the gasket to make a better contact with the lucite allowing a proper seal. A properly bonded door should show a distinctive 1" wide ring where the gasket comes in contact with the lucite.</p>

TABLE 1
Page 2

	<p>Vacuum Brake Solenoid (VBS) not opening.</p> <p>Water defrost solenoid leaking.</p> <p>Water under the door gasket.</p>	<p>Check power to coil with vacuum pump on. If proper voltage is going to the coil and coil tests OK, the valve should be disassembled and inspected. Replaco if necessary.</p> <p>Disassemble valve and inspect; repair or replaced. For testing purposes, a stopper can be inserted into the center of the disassembled valve body. This will eliminate the possibility of the diaphragm leaking.</p> <p>Remove door gasket and remove any condensation that may have collected. Door gasket should be dry and grease-free on the inside.</p>
<p>Unit pulls vacuum but doesn't register on Sentry display or other vacuum gauges.</p>	<p>Defective probe.</p> <p>Vacuum level not low enough to register.</p>	<p>Test with McLeod gauge and replace the probe if necessary.</p> <p>Test for vacuum leaks. See Vacuum Trouble-Shooting Guide or call VIT's Servicio Dept. for assistance.</p>

TABLE 2
REFRIGERATION SERVICE CHART

SYMPTOM	CAUSE	CORRECTION
Compressor doesn't start.	<p>Compressor's electrical contactor is "off" on reset.</p> <p>Compressor is "off" on oil pressure control.</p>	<p>Press reset on contactor.</p> <p>Reset manually on oil protection control located on the compressor. Check oil level: It should be between 1/4 and 1/2 in the sight glass. Adjust accordingly. If level is OK, there could be an internal problem in the compressor. Consult VirTis Service Dept. or compressor manufacturer.</p> <p>Replace compressor.</p>
Compressor starts and stops.	<p>Compressor pulling excessive amperage LRA (Locked Rotor Amps).</p> <p>Compressor is cycling on Hi pressure control.</p> <p>Compressor is cycling on Lo pressure control.</p>	<p>Check for proper water flow to unit.</p> <p>Inlet water temperature above 75 degrees F.</p> <p>Non-condensable (air) in freon system.</p> <p>Repair suction side leak, evacuate system and recharge per specifications.</p> <p>Solenoid valves are not opening. Check voltage to coil. Low freon charge - locate leak.</p> <p>Repair, evacuate, and recharge to specifications.</p>

TABLE 2
Page 2

<p>Condenser temperature OK, shelf temperature will not go down.</p>	<p>Shelf solenoid not opening.</p> <p>Shelf expansion valve.</p> <p>Low heat transfer fluid.</p> <p>No nitrogen pressure in heat transfer system.</p> <p>Heat transfer pump not circulating.</p> <p>3-phase pump rotation in wrong direction.</p> <p>Heat transfer pump not turning.</p> <p>Condenser solenoid not opening.</p> <p>Condenser expansion valve.</p>	<p>Check voltage to coil - replace coil if necessary.</p> <p>Expansion valve remote bulb - Sensor not attached to line properly. Expansion valve out of adjustment - readjustment needed.</p> <p>Check heat transfer level at service access panel; fluid should 1/2 sight glass. Add if necessary.</p> <p>10 psig nitrogen pressure should be added to nitrogen charge access valve.</p> <p>No nitrogen pressure.</p> <p>Switch phase.</p> <p>Check voltage to pump motor. Replace pump if necessary.</p> <p>See shelf solenoid.</p> <p>See shelf expansion valve.</p>
<p>Shelf temperature not at specified low temperature.</p>	<p>Shelf expansion valve improperly adjusted.</p>	<p>Readjust valve so the compressed suction service valve has frost on it, but not on the body of the compressor; this should be at specified temperature.</p>
<p>Condenser temperature not at specified low temperature.</p>	<p>Condenser expansion valve improperly adjusted.</p>	<p>See shelf adjustment.</p>
<p>Water will not flow through unit when compressor is running.</p>	<p>Fusible plug on water condenser has blown.</p>	<p>Find cause, repair. Replace plug. Evacuate system and recharge to specifications.</p>
<p>Fusible plug blown.</p>	<p>Air in freon system.</p> <p>Water supply to unit was cut off.</p> <p>Water temperature above 75 degrees F.</p>	<p>Repair suction leak. Evacuate and recharge.</p> <p>Check water distribution system.</p> <p>Change water to cooling tower or chilled water supply.</p>

TEMPERATURE PRESSURE CHART

°F.	°C.	R12	R22	R502	R13B1	R13	R503
150	65.6	232.0	384.3	404.0	527		
145	62.8	218.0	359.6	381.1	509		
140	60.0	204.5	338.0	359.2	481		
135	57.2	192.0	317.9	338.2	455		
130	54.4	179.0	298.8	318.0	429		
125	51.7	167.5	280.5	298.7	405		
120	48.9	157.1	262.6	280.3	381		
115	46.1	146.5	246.0	266.1	359		
110	43.3	136.0	228.7	245.8	337		
105	40.6	126.2	213.1	229.7	316		
100	37.8	116.9	197.9	214.4	297.0		
95	35.0	108.1	184.8	199.7	278.2		
90	32.2	99.6	170.1	185.8	260.3		
85	29.4	91.7	158.0	172.5	243.4		
80	26.7	84.1	145.0	159.9	227.4	520.8	
75	23.9	76.9	133.8	147.9	212.1	489.1	
70	21.1	70.1	122.5	136.6	197.7	458.7	
65	18.4	63.7	112.0	125.8	183.1	429.9	597.7
60	15.6	57.7	102.5	115.6	170.2	402.3	561.0
55	12.8	52.0	93.2	107.9	157.5	376.2	525.6
50	10.0	46.7	84.7	96.9	145.7	351.2	491.7
45	7.3	41.7	77.0	87.7	134.3	327.5	459.2
40	4.4	37.0	69.0	80.2	123.6	304.9	428.2
35	1.7	32.6	62.0	72.6	113.3	283.5	398.7
32	0.0	30.1	57.8	68.2	106.5	271.3	381.7
30	-1.1	28.5	55.2	65.4	103.3	263.2	370.6
25	-3.9	24.6	49.0	58.7	94.3	244.0	343.9
20	-6.7	21.1	43.3	52.4	85.6	225.7	318.5
15	-9.4	17.7	37.7	46.5	77.6	208.4	294.5
10	-12.2	14.7	33.0	41.1	70.1	192.1	271.8
5	-15.0	11.8	28.3	36.0	63.2	176.7	250.3
0	-17.8	9.2	24.1	31.2	56.4	162.1	230.0
-5	-20.6	6.8	20.3	26.8	50.3	148.4	211.0
-10	-23.2	4.5	16.6	22.8	44.6	135.4	193.0
-15	-26.1	2.4	13.3	19.0	39.2	123.2	176.1
-20	-28.9	0.6	10.3	15.5	34.2	111.7	160.3
-25	-31.7	2.3	7.5	12.3	29.5	100.9	145.5
-30	-34.4	5.5	5.0	9.4	25.2	90.9	131.6
-35	-37.2	8.3	2.7	6.7	21.3	81.5	118.7
-40	-40.0	11.0	0.6	4.3	17.7	72.7	106.7
-45	-42.8	13.3	2.6	2.0	14.3	64.6	95.5
-50	-45.6	15.4	6.0	0.0	11.2	57.0	85.1
-55	-48.3	17.3	9.1	3.6	8.4	50.0	75.5
-60	-51.1	19.0	11.9	6.9	5.8	43.5	66.6
-65	-53.9	20.5	14.4	9.9	3.4	37.5	58.4
-70	-56.7	21.8	16.6	12.6	1.3	32.0	50.8
-75	-59.4	23.0	18.5	15.0	1.4	27.9	43.9
-80	-62.2	24.1	20.2	17.1	5.0	22.3	37.5
-85	-65.0	25.0	21.7	18.9	8.2	18.1	31.7
-90	-67.8	25.7	23.0	20.6	11.1	14.2	26.4
-95	-70.6	26.4	24.1	21.9	13.7	10.7	21.6
-100	-73.3	27.0	25.1	23.3	16.0	7.5	17.3
-105	-76.1	27.5	25.9	24.3	18.0	4.7	13.3
-110	-78.9	27.9	26.6	25.3	19.7	2.1	9.8
-115	-81.7	28.3	27.2	26.0	21.5	0.3	6.6
-120	-84.4	28.6	27.7	26.7	22.9	4.5	3.8
-125	-87.2	28.9	28.2	27.2	24.1	8.2	1.2
-130	-90.0	29.1	28.5	27.8	25.1	11.4	2.1
-135	-92.7	29.3	28.8	28.1	26.0	14.3	6.1
-140	-96.0	29.4	29.0	28.5	26.7	16.8	9.7
-145	-98.3	29.5	29.2	28.7	27.2	19.0	12.8
-150	-101.1	29.6	29.4	29.0	27.6	20.8	15.5

ICE VAPOR PRESSURE vs. TEMPERATURE

°C	Microns Hg.
0	4,579.0
-2	3,880.0
-4	3,280.0
-6	2,765.0
-8	2,326.0
-10	1,950.0
-12	1,632.0
-14	1,361.0
-16	1,132.0
-18	939.0
-20	776.0
-22	640.0
-24	526.0
-26	430.0
-28	351.0
-30	285.9
-32	231.8
-34	187.3
-36	150.7
-38	120.9
-40	96.6
-42	76.8
-44	60.9
-46	48.1
-48	37.8
-50	26.9
-52	23.0
-54	17.8
-56	13.8
-58	10.6
-60	8.08
-62	6.14
-64	4.64
-66	3.49
-68	2.61
-70	1.94
-72	1.43
-74	1.05
-76	0.76
-78	0.56
-80	0.40
-82	0.29
-84	0.20
-86	0.14
-88	0.10
-90	0.070
-92	0.048
-94	0.033
-96	0.022
-98	0.015

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VIRTIS #10-324 THERMOCOUPLE VACUUM GAUGE

INSTALLATION, CALIBRATION AND OPERATING INSTRUCTIONS

The VirTis #10-324 Thermocouple Vacuum Gauge is a compact, self-contained instrument, designed primarily for panel mounting. It is supplied with a 6 ft. line cord and a 10 ft. thermocouple gauge cable. The instrument is line voltage regulated, and a temperature sensitive element to compensate for temperature is built into the thermocouple cable socket. The indicator dial, which covers the pressure range from 1 to 1000 microns (1 micron is 1/1000 of 1 mm of mercury, or 1/1000 or 1 torr), is calibrated for a thermocouple gauge in dry air. The mechanical zero adjust is located on the front of the instrument. The pressure calibration can be reached through a hole in the rear cover (fig. 1d).

Installation: A panel cutout, as shown in Fig. 1a is required for the installation of the VirTis #10-324 Thermocouple Gauge. The instrument is mounted from the front and fastened with three nuts supplied (figs. 1d, 1c).

Maintenance: Due to aging and contamination of the thermocouple gauge, recalibration may be necessary from time to time. The procedure below should then be followed. As the temperature compensation for the TC gauge is built into the TC cord socket, it is not advisable to cut the plug off the TC cord. If the cable is too long, it should be coiled.

Calibration:

1. With power disconnected, adjust the mechanical meter zero located on front of gauge until the needle reads OFF.
2. Connect a VirTis #10-224 McLeod Gauge to Freeze-dryer or a vacuum system capable of maintaining a pressure of less than 5.0 microns of mercury.
3. Connect the thermocouple probe of the VirTis #10-324 gauge. May be already connected to freeze-dryer.
4. Pump down the Freeze-Dryer or vacuum system to less than 5.0 micron.
5. Plug the line cord into a 115V, 50/60 cycle outlet.
6. Turn calibration control in the rear of the #10-324 gauge until the meter registers the same as the McLeod Gauge.
7. Allow the system to stabilize for approximately 15 minutes, and readjust the Zero if necessary.

Disassembly of Gauge: The VirTis #10-324 should give years of troublefree service but, if repairs are necessary, the following procedure of dismantling should be followed.

1. Unplug line cord.
2. Remove the two screws that hold the rear cover.
3. Slip cover as far back as the cables allow.
4. Unscrew the two nylon spacers.
5. Remove printed circuit card from meter.

NOTE: If, after assembly, the meter reads backwards, turn printed circuit card one-half turn.

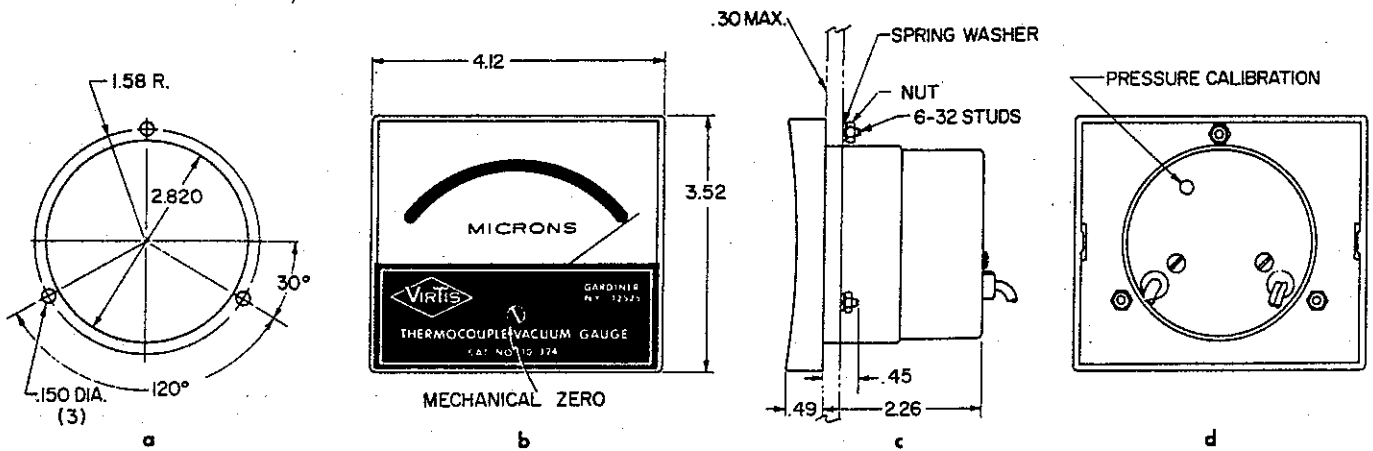


FIG. 1

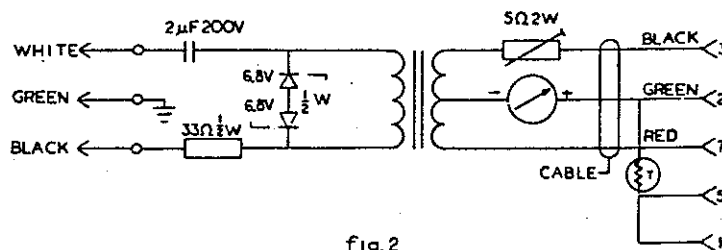


fig. 2

The VirTis Company reserves the right to change design and specifications without notice.



VIRTIS #10-324 THERMOCOUPLE VACUUM GAUGE

Cleaning the Thermocouple Probe

1. Disconnect and remove the probe from the vacuum system.
2. Wash the probe interior with a hot water and detergent solution such as Joy and Alconox. Agitate gently.
3. Rinse thoroughly with hot water.
4. Rinse with clean acetone or isopropyl alcohol.
5. Dry the probe by heating moderately for several hours and/or be evacuation on a water aspirator.

Do not use compressed air.

The thermocouple probe contains a very fine thermistor bead. It should be handled carefully to avoid damage. Install probe vertically with plug connector at top for best results at pressures above 10 torr.

For accurate pressure response and freedom from zero drift, the tube elements must remain clean. Therefore, the tube should be installed so as to minimize the entrance of oil vapor or process contaminants.

To install the thermocouple probe, use one of the following methods:

Thread the tubulation into a mating 1/8" pipe thread opening in the vacuum system. Seal the thread with Teflon tape, or other low vapor pressure sealing material.

OR

Slip fit the thermocouple probe into a short length of vacuum hose in the vacuum system. A light film of vacuum grease on the threads of the probe will seal the connection...however, make sure no vacuum grease enters the open end of the probe.