SUPERMODULYO
Instruction Manual

ThermoSavant

A Thermo Electron business

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1.0 OVERVIEW

1.1 SCOPE AND DEFINITIONS

This manual provides installation, operation and maintenance instructions for the SuperModulyo freeze dryer. You must use the SuperModulyo freeze dryer as specified in this manual. Read this manual before you install and operate the SuperModulyo freeze dryer.

Important safety information is highlighted as WARNING and CAUTION instructions; you must obey these instructions. The use of WARNINGS and CAUTIONS is defined below:

WARNING:

Warnings are given where failure to observe the instruction could result in injury or death to people.

CAUTION

Cautions are given where failure to observe the instruction could result in damage to the equipment, associated equipment and process.

In accordance with the recommendations of IEC1010, the following warning symbols may appear on the freeze dryer.


Caution - refer to accompanying documents


Caution - risk of electric shock


Caution - hot surface

The units used throughout this manual conform to the SI international system of units of measurement.

1.2 GENERAL DESCRIPTION

1.2.1 SUPERMODULYO FREEZE DRYER

The SuperModulyo freeze dryer (shown in Figure 1) is the ice condenser section of a freeze dryer system. It is suitable for a range of applications, from laboratory use to pilot plant feasibility studies.

The SuperModulyo freeze dryer has a refrigerated condenser chamber and a vacuum pump. The refrigerant is CFC-free. Temperature and pressure gauges, controls and indicators are on the front of the SuperModulyo freeze dryer. These components are described in the following sections (see Figure 2 for a schematic diagram of the components).

All of the SuperModulyo freeze dryer components are in a free-standing cabinet, which is designed to be located alongside standard-height laboratory work surfaces. The cabinet is fitted with casters for ease of locating the required operating position.

The SuperModulyo freeze dryer has inspection panels at the front, sides and rear of the cabinet.These can be removed for installation or maintenance.

In conjunction with suitable accessories, the SuperModulyo freeze dryer can be used to freeze dry materials in bulk trays, flasks, vials or ampules. A number of accessories are available from Thermo Savant; these include drying accessories and glassware. Refer to Section 8 for a full list of accessories.

Figure 1. The SuperModulyo Freeze Dryer

1.2.2 THE CONDENSER CHAMBER

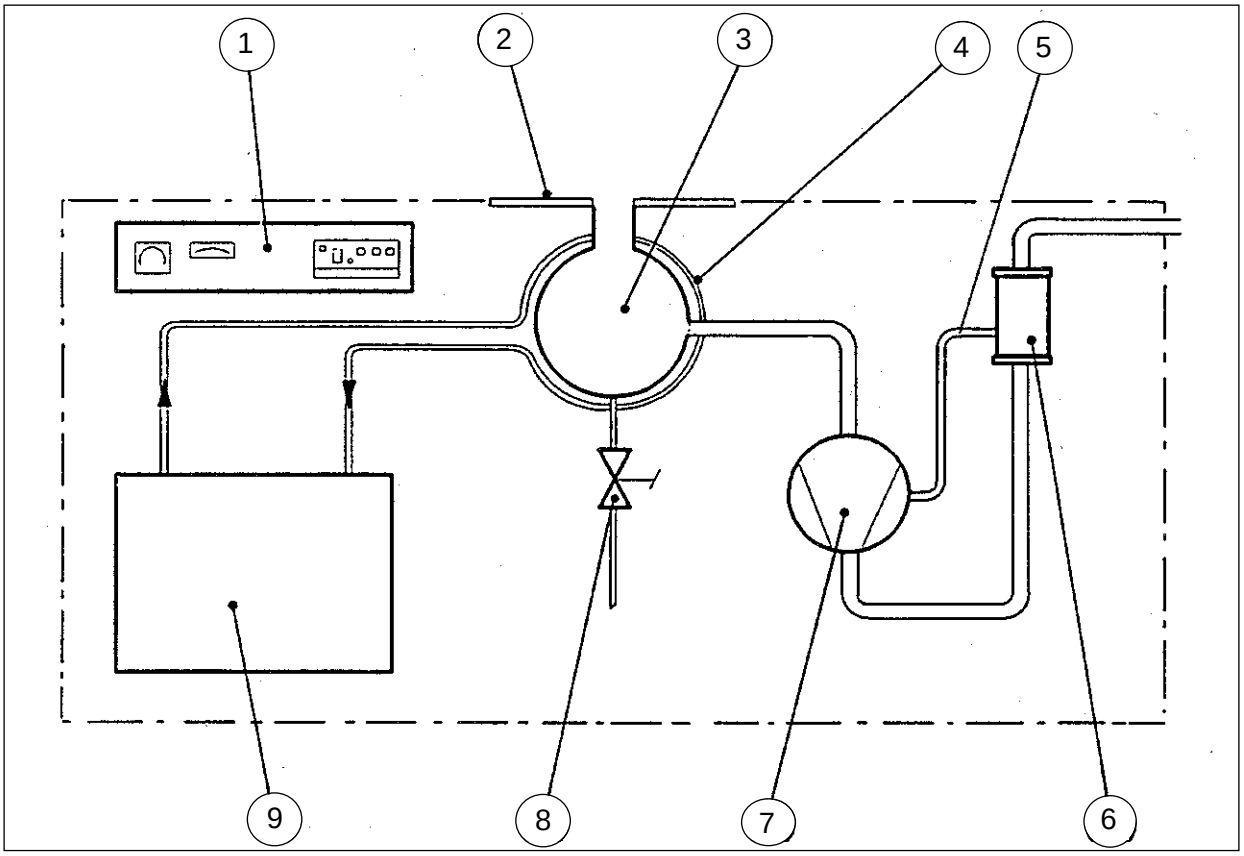
Refer to Figure 2. The condenser chamber (3) can trap 18 kg (40 lb) of ice. The external cooling-coil (4) cools the chamber wall, condensing water vapor to form ice. The temperature of the chamber wall under vacuum and normal operating conditions with no load applied is approximately -52 °C.

At the top of the condenser chamber is an accessory flange (2), which is compatible with the Modulyo range of accessories. The large opening of the accessory flange allows high vacuum-pumping rates to be achieved.

A transparent door at the front of the SuperModulyo freeze dryer allows easy inspection, cleaning and defrosting of the condenser chamber (3).

There is a valved drain pipe at the base of the condenser chamber; this drain pipe is used to drain water from the condenser chamber. The drain-pipe and the drain-valve (8) are accessible through the front inspection panel.

A vacuum pipeline connects the condenser chamber to the two-stage vacuum pump (7).



1. Gauges and control panel
2. Accessory flange
3. Condenser chamber
4. Cooling coil
5. Oil return tube
6. Oil mist filter
7. Vacuum pump
8. Drain valve
9. Refrigeration system

Figure 2. Schematic illustration of SuperModulyo freeze dryer components

1.2.3 REFRIGERATION SYSTEM

Refer to Figure 3 for the location of items in the following description.

The condenser chamber (1) is cooled by refrigerant, which evaporates in the cooling coil. The compressor (5) is a high-capacity, air-cooled, hermetically-sealed unit.

A heat exchanger (13) sub-cools the liquid refrigerant to the evaporating temperature before expansion. This increases the efficiency of the system.

A suction-line accumulator (10) in the return line from the cooling coil to the compressor (5) prevents slugs of liquid refrigerant, which might cause damage, from reaching the compressor.

A filter-dryer (9) in the line between the heat exchanger (13) and the liquid receiver (8) absorbs any residual particulate and water contamination in the system. The filter-dryer does not need to be serviced or replaced.

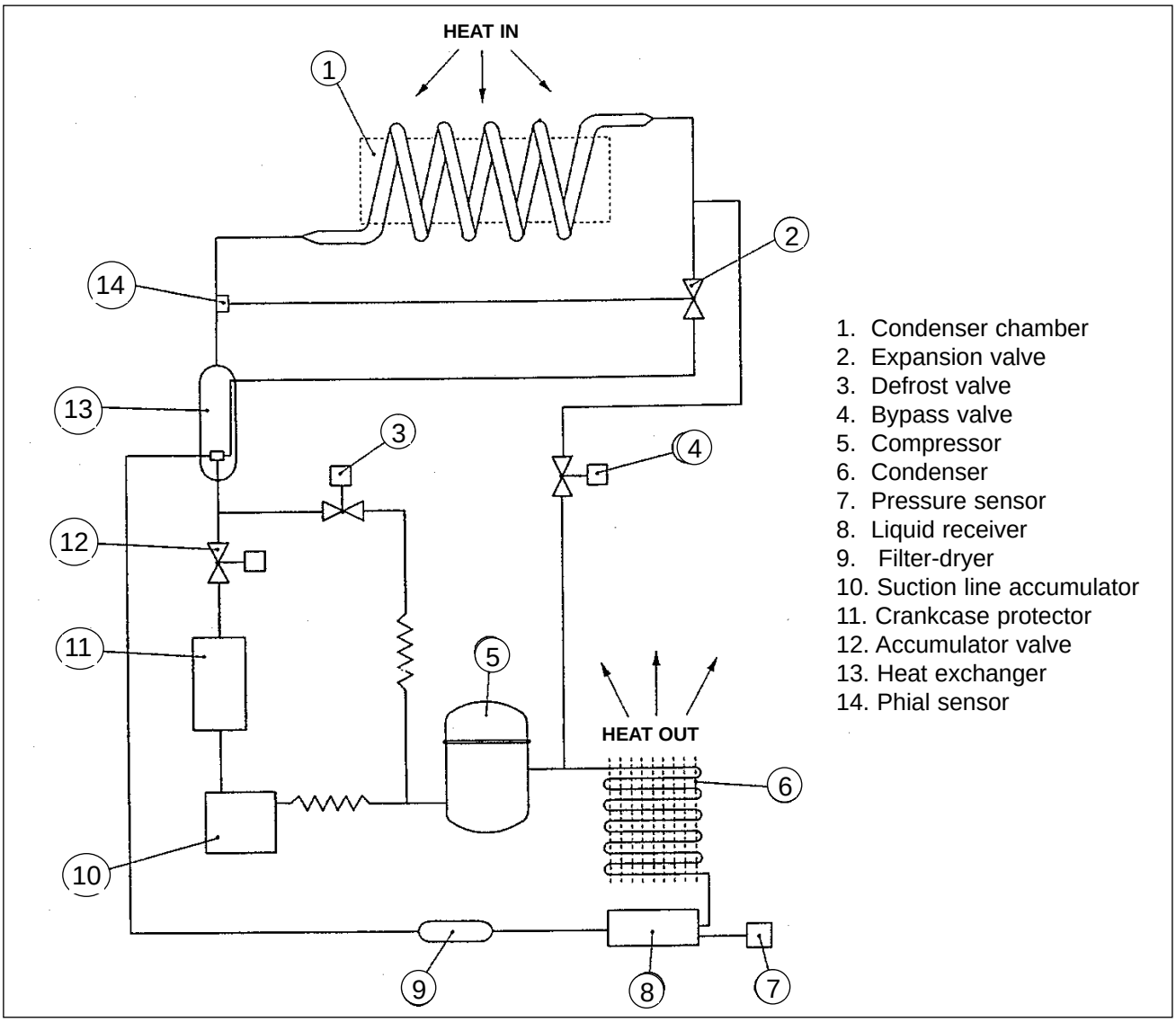


Figure 3. Refrigeration system

1.2.4 THE VACUUM PUMP

The SuperModulyo freeze dryer has a Thermo Savant VLP285 Vacuum Pump mounted inside. The vacuum pump is a two-stage, oil-sealed, rotary vane pump which is ideally suited to freeze drying.

The pump outlet has an oil mist filter (EMF20) which prevents the escape of oil mist into the atmosphere. The pump exhaust is piped to a connection on the rear service panel of the SuperModulyo freeze dryer. This connection must be used to connect the pump exhaust to the exhaust-extraction system.

The pump has a Gas Ballast Oil Return Kit (GBORK), which returns oil trapped in the oil mist filter to the pump. The Gas Ballast Oil Return Kit (GBORK) also ensures that the pump is operated with full gas ballast. This removes condensable vapors which are not trapped within the condenser chamber; if not removed, these vapors contaminate the oil in the pump.

1.2.5 GAUGES AND CONTROL PANEL

The SuperModulyo freeze dryer gauges and control panel are described in Table 1 and shown in Figure 4.

Table 1. Control/indicator and Use

CB10A	This rocker-action circuit-breaker switches the SuperModulyo freeze dryer on and off (position 'O' = off, position '1' = on).
MAINS	This lamp illuminates when the SuperModulyo freeze dryer is connected to the electrical supply and CB10A is switched on.
FRIDGE	Use this button to switch the refrigeration system on and off. A lamp on the button goes on when the SuperModulyo freeze dryer is connected to the electrical supply, CB10A is switched on and the refrigeration system is on.
PUMP	Use this button to switch the vacuum pump on and off. A lamp on the button goes on when the SuperModulyo freeze dryer is connected to the electrical supply, CB10A is switched on and the vacuum pump is on.
DEFROST	Use this button to defrost the SuperModulyo freeze dryer; the refrigeration system must be on (that is, the lamp on the FRIDGE button must be on) when defrosting the SuperModulyo freeze dryer. A lamp on the button goes on when the SuperModulyo freeze dryer is connected to the electrical supply, CB10A is switched on, the FRIDGE button is on and defrost is selected.
PRESSURE GAUGE	This gauge shows the pressure (in mbar) inside the condenser chamber when the SuperModulyo freeze dryer is connected to the electrical supply and CB10A is switched on.
TEMPERATURE GAUGE	This gauge shows the temperature (in ˚C) of the condenser chamber.

1 Pressure gauge
2. Temperature gauge
3. Control panel

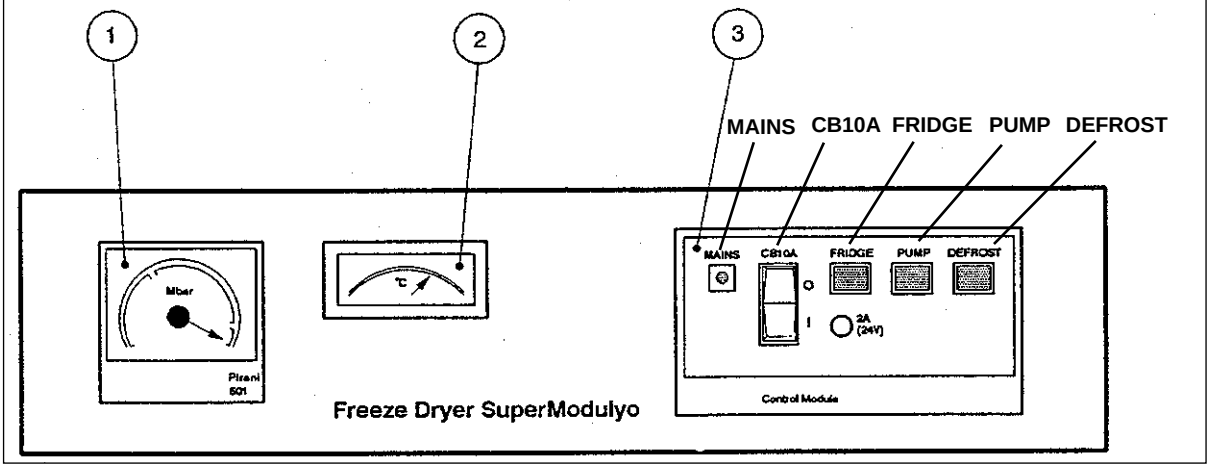


Figure 4. Control panel and gauges

1.2.6 PROTECTION DEVICES

The SuperModulyo freeze dryer is protected by a circuit breaker (CB10A mounted on the control panel). If necessary, you can reset the circuit breaker. Do not reset the circuit breaker more than once unless the fault, which originally caused the circuit breaker to trip, was found and repaired.

The 24-volt control circuit inside the SuperModulyo freeze dryer is protected by a fuse. The fuse holder is mounted on the control panel.

The electrical supply to the SuperModulyo freeze dryer must be suitably fused (refer to Section 3.3).

1.3 FREEZE DRYING PROCESS

1.3.1 INTRODUCTION

When using the SuperModulyo freeze dryer, we recommend keeping accurate records of all operating parameters (that is: load, drying times, temperature, pressure and so forth). This data can be used to help determine the optimum cycle for efficient operation with various products.

Some factors which affect the freeze drying process are described in the following sections.

1.3.2 THE FREEZING PROCESS

The product to be freeze dried must be pre-frozen before it is placed in (or on) the drying accessory. The thickness of the ice (and hence the product) will affect the length of time needed to dry a given sample. In general, the thickness should be less than 10 mm. A range of product containers is available from Thermo Savant; these are shown in Table 2.

Table 2. Product Containers

Container	Method of freezing
Bulk Tray	Freeze with a cabinet freezer. The maximum recommended product depth is 10 mm.
Vials	Freeze with a cabinet freezer. The maximum recommended depth of fill is 10 mm.
Ampules	Pre-freeze in a cabinet freezer or dry with a Thermo Savant spin freeze accessory.
Flasks	Shell-freeze to a maximum thickness of 10 mm.

1.3.3 THE DRYING PROCESS

When the condenser has reached a temperature of approximately -52 ˚C (indicated by the temperature gauge on the front panel), the vacuum pump can be switched on (see Section 4). The pressure in the condenser chamber then starts to drop, thus producing the conditions necessary for freeze drying to occur. The ice in the pre-frozen product then sublimes (that is, changes directly from the solid state to the vapor state without melting).

The time required to dry a product varies and is determined by a number of factors, which include: the type of product, its formulation, product concentration and thickness, the type of container used, the temperatures of the product and the condenser, and the system performance.

Freeze drying requires an input of heat energy to the product to change the ice into water vapor. When using the SuperModulyo freeze dryer, enough energy may be absorbed solely from the surroundings. Alternatively, a heated accessory may be used to supplement this heat input. If a heated accessory is used, the accessory should not be switched on until the pressure in the condenser chamber has stabilized.

When deciding on the quantity of heat input required, or when trying to optimize the drying cycle for a particular product, it is important to observe the physical appearance of the product whenever possible during the drying process. If the product has been correctly frozen, it will usually appear to be compact and uniform in color. If the product is uneven in color, or if signs of boiling are visible, then the product may have been incorrectly frozen or may have undergone some physical change, possibly from the application of too much heat.

A wide range of factors has to be considered when trying to optimize the drying cycle for a given product. To assist in this optimization, we therefore recommend taking note of the rate of change of both temperature and pressure within the condenser chamber during the freeze drying process.

1.3.4 TEMPERATURE AND VAPOR PRESSURE

When water vapor is sublimed from a frozen product, the temperature of the product drops to a point where the heat loss due to sublimation is equal to the heat gained (from the surroundings or from a heated accessory). The amount of heat received by the product determines its temperature and vapor pressure. This, in turn, determines the pressure differential, that is, the driving force between the product and the condenser.

For example, with reference to Figure 5, which shows typical vapor pressure plotted against temperature for aqueous solutions:

- With the condenser chamber at a temperature of -50 ˚C, vapor pressure for water will be 3.9 x 10^{-2} mbar. If the product temperature stabilizes at -30 ˚C, vapor pressure will be 3.7 x 10^{-1} mbar.

- If the temperature of the product rises to -10 ˚C, the vapor pressure will be 2.6 mbar, an increase in the driving force between the product and the condenser temperature.

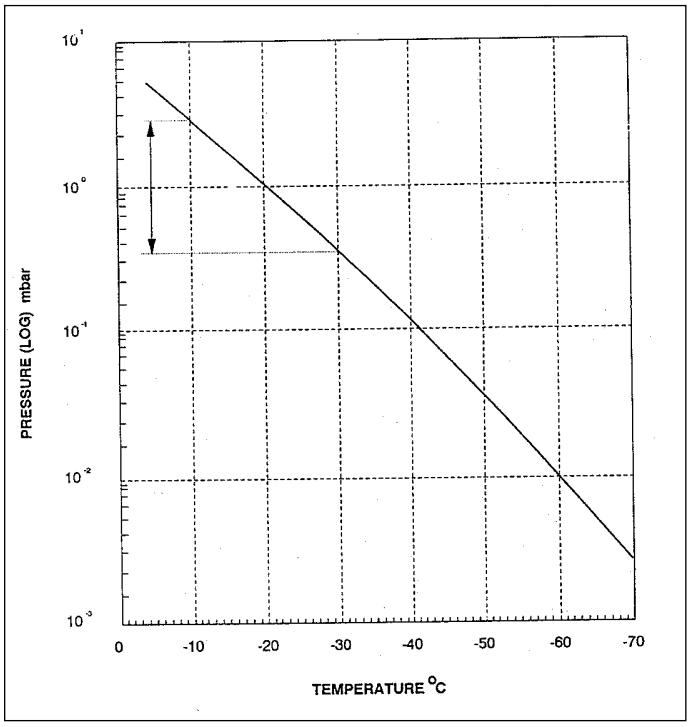


Figure 5. Vapor pressure and temperature

- From Figure 5, the increased pressure differential is (2.6 mbar - 3.7 x 10^{-1} mbar) = 2.23 mbar.

You must therefore keep the temperature of the product as high as possible for faster drying, but do not allow the product to melt or collapse.

2.0 TECHNICAL DATA

2.1 GENERAL

Dimensions

Height	900 mm (35.4 in.)
Width	650 mm (25.6 in.)
Depth	700 mm (27.6 in.)
Accessory-flange diameter	370 mm (14.6 in.)
Mass	180 kg (396 lb)
Ambient operating temperature range	12 to 30 ˚C
Maximum ambient storage temperature	50 ˚C

Condenser

Ice capacity (in 12 hours)	6.0 kg (13 lb)
Ice capacity (in 24 hours)	10.5 kg (23 lb)
Maximum ice capacity	18.0 kg (40 lb)
Operating temperature (at 22 ˚C ambient temperature)	-52 ± 5 ˚C
Surface fixed area	0.4 m^2 (260 $in.^2$)
Volume	44.5 liters (11.8 gal.)

Thermocouple Type E (chromel/constantan)

Pressure measurement

Unit	Pirani 501
Gauge head	Pirani gauge head

2.2 REFRIGERATION SYSTEM DATA

Compressor

Type	0.75 hp hermetic unit
Refrigerant type	ISCEON 69L
Refrigerant charge	2 kg
Normal suction line pressure	1 inch vac
Thermostatic evaporation valve	Danfoss TY2

2.3 VACUUM PUMP

Model	Thermo Savant VLP285 Pump
Type	Two-stage, rotary vane vacuum pump
Pumping speed	
50 Hz	12.0 $m^3 h^{-1}$
60 Hz	14.2 $m^3 h^{-1}$
Ultimate vacuum (High Throughput mode)	4 x 10^{-2} mbar
Maximum water vapor inlet pressure	7 mbar
Maximum water vapor pumping speed	0.18 kg. h^{-1}
Maximum oil capacity	1.0 liter (0.26 US gal.)
Oil type	SPO1-B

2.4 ELECTRICAL DATA

Electrical supply	220-240 V, 50 Hz, 1-phase or 220 V, 60 Hz, 1-phase
Power rating	1.2 kW
Protection	
Internal (24 V AC circuit)	2 A fuse
External	13 A fuse

2.5 CONSTRUCTION DETAILS

2.5.1 LEGISLATION AND STANDARDS

The SuperModulyo freeze dryer has been designed in compliance with the following legislation and standards:

ESCHLE 1986 Electrical Safety Code for Hospital Laboratory Equipment

It is in conformity with the following standards(s) or other normative documents(s)

EN50081-1	Electromagnetic Compatibility, General Emission Standard. Generic Standard Class: Domestic, Commercial & Light Industrial.
EN50082-2	Electromagnetic Compatibility, General Immunity Standard.. Generic Standard Class: Industrial.
Pneurop 6606	Vacuum Flange and Connections.

following the provisions of

73/023/EEC	Low Voltage Directive.
89/336/EEC	Electromagnetic Compatibility Directive.

2.5.2 CONSTRUCTION MATERIALS

Item	Material
Cabinet	Galvanized steel
Front door	Clear acrylic
Condenser chamber	Stainless steel

3.0 INSTALLATION

3.1 UNPACK AND INSPECT

Remove all packing materials and inspect the SuperModulyo freeze dryer.If the SuperModulyo freeze dryer is damaged, notify your supplier and the carrier in writing within three days; state the Item Number and Serial Number of the SuperModulyo freeze dryer together with your order number and your supplier's invoice number. Retain all packing materials for inspection. Do not use the SuperModulyo freeze dryer if it is damaged.

Check that your package contains the items listed in Table 3. If any of these items are missing, notify your supplier in writing within three days.

Table 3. Component check list

Qty	Description	Check (√)
1	SuperModulyo Freeze Dryer	❒
1	Instruction Manual	❒
1	Warranty Card	❒

If the SuperModulyo freeze dryer is not to be used immediately, replace the protective covers. Store the SuperModulyo freeze dryer in suitable conditions as described in Section 7.

3.2 LOCATE THE SUPERMODULYO FREEZE DRYER

The SuperModulyo freeze dryer has casters to allow you to easily locate the unit. Locate the SuperModulyo freeze dryer in its required operating position, within convenient access to a suitable electrical supply and to your exhaust-extraction system.

When locating the SuperModulyo freeze dryer, consider ease of access for maintenance and repair work, where removing the cover of the SuperModulyo freeze dryer is necessary (see Figures 7 and 8).

We recommend that you leave a gap of at least 3 feet (1 meter) between the right-hand side of the unit and any wall or obstruction. If you do not leave a sufficient gap, you will not be able to access the SuperModulyo freeze dryer through the side inspection panel.

3.3 CONNECT THE ELECTRICAL SUPPLY

WARNING **Ensure that the electrical installation of the SuperModulyo freeze dryer conforms with your local and national safety requirements. It must be connected to a suitably fused and protected electrical supply and a suitable earth point.**

1. Make sure that the SuperModulyo freeze dryer is suitable for use with your electrical supply voltage and frequency.
2. The SuperModulyo freeze dryer is supplied with a 6 feet (2 meters) length of 3-core electrical supply cable. Connect the cable to the electrical supply as shown below.
3. Connect a fuse rated at 13 A (at 240 V AC) at the electrical supply outlet to protect the SuperModulyo freeze dryer.

CORE	Electrical Supply Connection
Brown (Black)	Live or Line 1
Blue (White)	Neutral or Line 2
Green/Yellow (Green)	Earth

3.4 REMOVE AND OPEN THE INSPECTION PANELS

Note: Each inspection panel has an earth lead attached. You must disconnect the earth lead before you can completely remove an inspection panel.

Remove the right-hand side inspection panel and open the front inspection panel before you continue installation. Use the following procedure to remove the side panel and open the front panel:

1. Press in the top of the catch at the top-center of the right-hand panel (see Figure 6, detail A).
2. Lift the lever of the catch to release the locking bar (see Figure 6, detail B).
3. Turn the level clockwise through 90˚ to open the lock (see Figure 6, detail C).
4. Pull the top of the panel out and lift the panel upwards to remove it (see Figure 7).
5. Pull the handle at the top of the front inspection panel and swing the panel downwards to open it (see Figure 8).

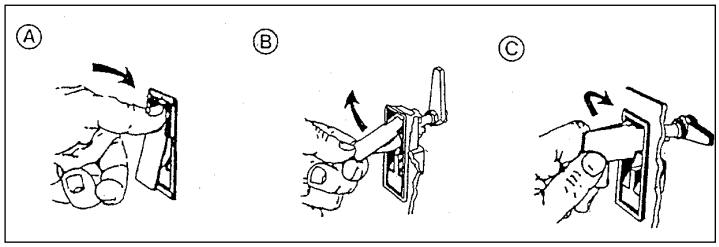


Figure 6 - Release the side inspection panel catch

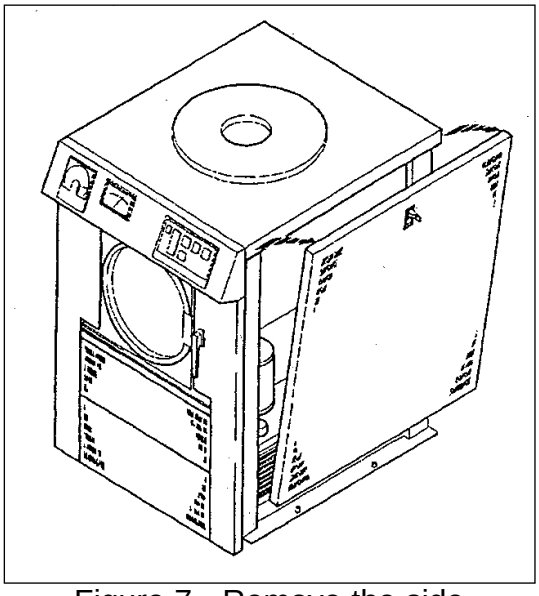


Figure 7 - Remove the side inspection panel

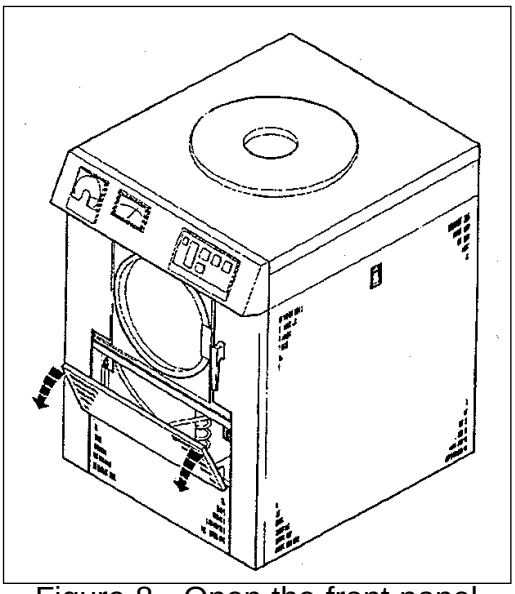


Figure 8 - Open the front panel

3.5 PREPARE THE VACUUM PUMP

3.5.1 REMOVE THE PUMP SHIPPING BOLTS

There are two red shipping bolts on the vacuum pump, one bolt on each side of the pump. These bolts must be removed before using the pump. Retain the bolts for future use.

3.5.2 FILL THE PUMP WITH OIL

This pump is supplied filled with oil. Check oil level prior to initial use. Refer to Figure 9 and fill the pump if necessary with SPO1 oil as described below.

1. Check that the pump oil level is between the MIN and MAX markers on the bezel of the sight glass (Figure 10, item 2). The oil must be clean and transparent.
2. If oil level is below MAX mark, unscrew and remove one of the oil filler-plugs (Figure 9, item 2).
3. Use a suitable clean funnel to pour oil into the pump until the oil level just reaches the MAX mark on the bezel at the top of the sight glass (Figure 10, item 2). If the oil level goes above the MAX mark, drain the excess oil from the pump: refer to Section 5.7.
4. After a few minutes, recheck the oil level. If the oil level is now below the MAX mark, pour more oil into the pump.
5. Refit the oil filler plug (2). Tighten the filler plug, firmly by hand. Do not over-tighten.

3.5.3 PRESET THE VACUUM PUMP CONTROLS

The vacuum pump controls are preset when supplied. Use the following procedure to preset the controls if their positions have been changed.

1. Refer to Figure 9. Ensure that the mode selector (4, under Savant name plate) is in the High Throughput position. To select High Throughput, remove nameplate (requires allen wrench), turn the mode selector fully anti-clockwise until it touches the inner face of the side panel of the pump, then gently tighten by hand.

2. Ensure that the on/off switch (5) is in the “on” position.

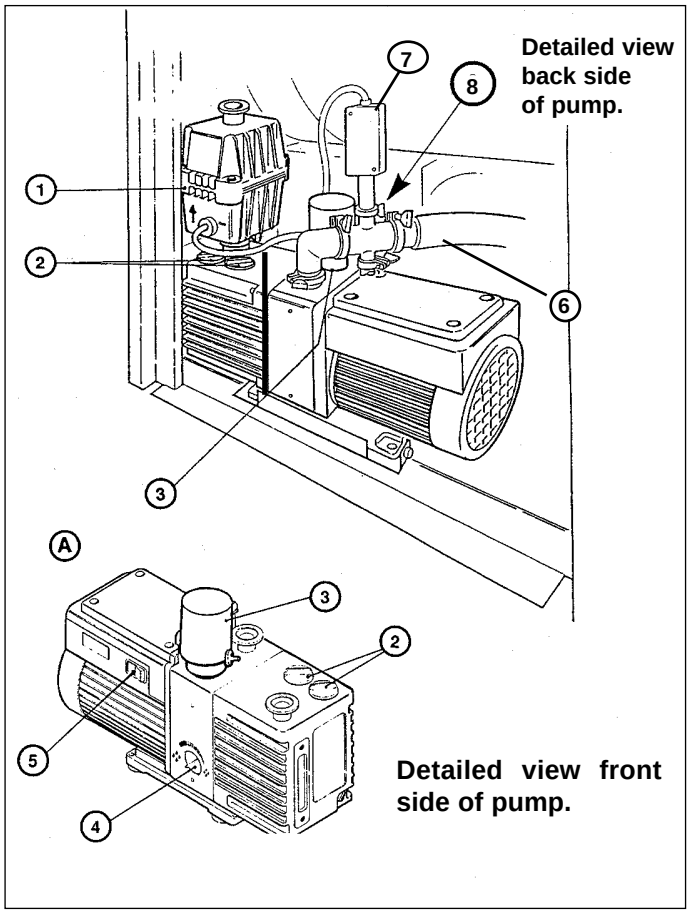
3.6 CONNECT THE PUMP EXHAUST

WARNING

Conduct the exhaust to a suitable treatment plant to prevent the discharge of oil mist to the surrounding atmosphere.

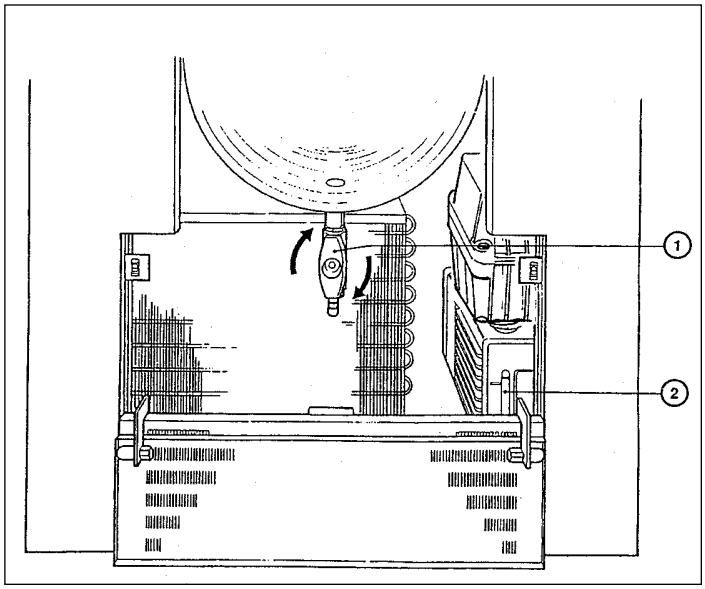
The exhaust outlet from the vacuum pump is piped to a 1/2 inch nozzle connector on the rear service panel of the SuperModulyo freeze dryer. A pipe must be fitted to this connector to pipe the exhaust gases of the vacuum pump to a suitable treatment plant.

When fitting the pipe, make sure that it does not obstruct the working area and present a safety hazard.



1. Oil mist filter (EMF20)
2. Oil filler plugs
3. Oil return assembly (GBORK)
4. Mode selector
5. On/off switch
6. Vacuum inlet hose
7. Pirani gauge
8. Pirani gauge clamp

Figure 9. Vacuum pump components



1. Air-admit and drain valve (shown open)
2. Vacuum pump oil sight glass

Figure 10. Front inspection area

3.7 TEST AFTER INSTALLATION

CAUTION

Do not attempt to use the SuperModulyo freeze dryer if it fails the installation test. If you do, poor performance may result in the loss of the product being freeze dried.

Once the SuperModulyo freeze dryer is installed, use the procedure below to test that the unit operates correctly.

1. Switch on the electrical supply.
2. Move CB10A on the control panel to the “on” position, that is, put the switch to the “I” position. Check that the MAINS lamp on the control panel goes on.
3. Seal the accessory flange; use a blanking plate or a drying accessory.
4. Press the PUMP button on the control panel.
5. Check that the pressure in the condenser chamber (as indicated by the pressure gauge) goes below atmospheric pressure. When blanked off with a plate (i.e. no drying accessory attached). The unit should eventually draw down to below 6 x 10^{-2}mbar (<4.5 x 10^{-2} torr).
6. Press the FRIDGE button on the control panel. Allow the SuperModulyo freeze dryer to operate for approximately 30 minutes, then check that the temperature (as shown by the temperature gauge) is below -50 ˚C. If this temperature is reached, the SuperModulyo freeze dryer is ready for use; continue at Step 7 below.

If any of the checks in Steps 5 or 6 above fail, switch the SuperModulyo freeze dryer off and disconnect the electrical supply. Refer to Section 6 to identify and rectify any fault or contact your supplier for advice. Do not attempt to use the SuperModulyo freeze dryer.

7. When satisfied that the SuperModulyo freeze dryer operates correctly, carry out the shut-down procedure defined in section 4.7.

3.8 CLOSE AND REPLACE THE INSPECTION PANELS

Before using the SuperModulyo freeze dryer, close and replace the inspection panels. To close and replace the panels, use the procedures in Section 3.4 in reverse.

4 OPERATION

4.1 SAFETY

WARNING

If you intend to freeze dry products which contain sodium azide, make sure that your accessories and your exhaust treatment plant are suitable for the treatment of sodium azide. If they are not suitable, there is a severe risk of explosion.

Sodium azide is sometimes used as a stabilizing agent in freeze drying processes. Sodium azide is toxic and, when dry, is highly explosive. If you freeze dry a product which contains sodium azide, a chemical reaction can occur in the presence of heavy metals such as copper, lead, zinc and cadmium. The result of this reaction is the formation of metal azides which are highly unstable and explosive.

The SuperModulyo freeze dryer unit contains no heavy metals and may be used, with care, to freeze dry products which contain sodium azide. Ensure that the exhaust treatment plant and the accessories you use (chambers, trays and so forth) are suitable for freeze drying products which contain sodium azide.

4.2 SEQUENCE OF OPERATION

Operation of the SuperModulyo freeze dryer can involve a number of different steps, as shown in Table 4.

Table 4. Freeze Drying Operations

Operation step	Refer to Section
Prepare the SuperModulyo	4.3
Fit the product container and any other necessary accessory	4.4
Load the product(s)	—
Pre-cool the SuperModulyo	4.5
Dry the product	4.6
Shut down	4.7

Before freeze drying a product, always prepare the SuperModulyo freeze dryer as described in Section 4.3. Always dry the product and shut down the unit as described in Sections 4.6 and 4.7.

However, the order in which the other three steps are carried out depends on the type of product container or other accessory used and the type of product to be freeze dried. In some circumstances you will need to pre-cool the SuperModulyo freeze dryer with the accessory flange open to atmosphere; in other circumstances, fit the product container, then pre-cool the unit and then load the product to be freeze dried.

If it is not clear which sequence of operations to use, refer to the instruction manual supplied with the product container or other accessories which you will use.

4.3 CLEAN AND PREPARE THE SUPERMODULYO FREEZE DRYER

Note: Use only mild detergents to clean the condenser chamber, accessories and connecting pipeline. Some of the Savant accessories are made from acrylic materials and must not be cleaned with organic solvents.

Before first using the SuperModulyo freeze dryer, and between freeze drying cycles, prepare the SuperModulyo freeze dryer, as follows:

1. To remove any water left in the bottom of the condenser chamber, open the drain valve (Figure 10, item 1) and allow any water to drain into a suitable container. To open the drain valve, turn it until it is vertical and in-line with the drain tube.

2. When the chamber is completely drained, close the valve; turn it until it is horizontal, that is, at a right-angle to the drain tube.

3. If acidic or corrosive products have been processed, flush the condenser chamber and drain tube with clean water.

4. Make sure that the condenser chamber is dry.

5. Make sure that the unit is clean, particularly the accessory flange. If the flange is not clean, you will not get a good vacuum seal and the performance of the SuperModulyo freeze dryer will be poor.

6. Select a suitable drying accessory for the product. Wipe clean the sealing ring of the accessory and check the sealing ring for damage; if it is damaged, fit a new sealing ring.

You should not need to lubricate the accessory sealing ring, however if it is dry, apply a light wipe of high vacuum grease.

If there appears to be a leak in the system, check that the drain valve is fully closed and that all seals are clean. If the SuperModulyo freeze dryer continues to leak, contact your supplier or Thermo Savant for advice.

4.4 FIT THE PRODUCT CONTAINER AND OTHER ACCESSORIES

A drying accessory may be connected to the SuperModulyo freeze dryer accessory flange.

The flange has a diameter of 370 mm (14.6 in.) and accessories have a rubber sealing ring to seal the accessory to the flange. Once positioned, the weight of the accessory is sufficient to produce an air-tight seal under vacuum conditions.

4.5 PRE-COOL THE SUPERMODULYO FREEZE DRYER

WARNING

Do not touch any part of the condenser chamber during or immediately after the cooling process. The condenser chamber is at a very low temperature and can cause tissue damage.

1. Make sure that the SuperModulyo freeze dryer is connected to the electrical supply. Switch on the SuperModulyo freeze dryer (that is, move the CB10A switch on the control panel to the “I” position) and check that the MAINS lamp goes on.

2. Leave the SuperModulyo freeze dryer on until the temperature of the condenser chamber (as indicated by the temperature gauge) is less than -40 ˚C.

3. Wait an additional five minutes.

4.6 DRYING

Press the PUMP button on the control panel to switch the pump on.

Note the following advice:

- When a load is first applied to the SuperModulyo freeze dryer, the temperature may rise for a few minutes. This is because the evaporation rate from the product is initially high.

  If the temperature does not drop to near its original value (that is, the temperature at which the pump was switched on) within a few minutes, the unit will overload. Reduce the amount of product to prevent melting.

- If you wish to dry a number of flasks, first attach one flask, evacuate the flask and allow the vacuum to recover. Attach the next flask, evacuate it and allow the vacuum to recover. Attach and evacuate the remaining flasks in the same way.

  If this procedure is used, you can easily identify any flasks that leak. This procedure also prevents rapid pressure increases, which might cause flasks to fall off of the drying accessory.

- If there appears to be a vacuum leak in the system, check that the drain valve is fully closed and that all seals are clean. If the SuperModulyo freeze dryer continues to leak, contact your supplier or Savant for advice.

- In general, a pressure of at least 50 to 100 millitorr (5×10^{-2} to 1×10^{-1} Torr) is required to maintain samples frozen (the smaller the number, the better the vacuum). This corresponds to 6.665×10^{-2} mbar to 1.333×10^{-1} mbar. The value will vary depending on the formulation of the product being dried and other factors, so it is important to observe how your samples behave at various temperatures, pressures, loads and running conditions. A visual cue may be used as a guide: at 100 mtorr (10^{-1} Torr), the gauge needle points straight up; when low pressure (‘better vacuum’) is achieved, the needle points left.

4.7 SHUT DOWN

WARNING

Do not touch any part of the condenser chamber during or immediately after the cooling process. The condenser chamber is at a very low temperature and can cause tissue damage.

CAUTION

If you use a manifold assembly, do not admit air into the SuperModulyo freeze dryer through the drain valve until all flasks have been removed, or the flasks may fall off of the manifolds.

Note: We recommend that you shut down the SuperModulyo freeze dryer if you will not use it for several hours. If you do not, you may get water condensation on the SuperModulyo freeze dryer components. See Section 4.8 for more information.

Look at the appearance of the product and consult data gathered from previous freeze drying operations to determine the time at which freeze drying process has finished. Once the process has finished, shut down the SuperModulyo freeze dryer as follows:

1. If you use a manifold accessory, vent and remove each flask in turn with the manifold valves.

2. Press the PUMP button on the control panel to switch the vacuum pump off.

3. If you are using other accessories, slowly open the drain valve to admit air to the system.

4. Remove the product when the pressure in the system has reached atmospheric pressure.

5. Press the DEFROST button on the control panel.

6. Open the condenser chamber front door.

7. When the plug of ice in the condenser chamber is free to move, carefully remove it; use an ice handle (p art number F05653000) or wear protective gloves. Place the ice in a suitable container and allow it to melt before disposing of it.

8. Press the DEFROST button again to shut off the defrost cycle, then press the FRIDGE button to switch off the refrigeration system.

4.7 SHUT DOWN (cont'd)

9. Remove the drying accessory.

10. Make sure that the condenser chamber is clean and dry, then close the condenser chamber front door and seal the accessory flange; use a blanking plate or a drying accessory.

11. Press the PUMP button to start the vacuum pump. Operate the pump for approximately 30 minutes to purge the pump of condensable vapors.

12. Press the PUMP button again to switch the pump off.

13. Switch off the SuperModulyo freeze dryer (that is, move CB10A on the control panel to the "O" position) and make sure that the MAINS lamp goes off.

4.8 WATER CONDENSATION

If operating the SuperModulyo freeze dryer with no load for several hours, the internal components of the SuperModulyo freeze dryer get very cold. Atmospheric water vapor will then condense onto the cold surfaces and may drip out of the bottom of the SuperModulyo freeze dryer cabinet. You may therefore see puddles of water under the SuperModulyo freeze dryer, which give the impression that water is leaking from the chamber.

If you see water dripping out of the SuperModulyo freeze dryer cabinet, inspect the chamber. If there is ice in the chamber, the water is probably not leaking from the chamber, but is dripping from the cold surfaces inside the SuperModulyo freeze dryer cabinet. Always check this carefully before contacting your supplier or Thermo Savant for advice.

To avoid leaking, we recommend switching off the SuperModulyo freeze dryer when it is not in use for three or four hours. This is particularly important if using the SuperModulyo freeze dryer in a high humidity environment.

5.0 MAINTENANCE

5.1 INTRODUCTION

The SuperModulyo freeze dryer is designed to require little user maintenance and contains no user-serviceable parts, with the exception of the vacuum pump and mist filter. The preparation procedures of Section 4.3 are sufficient to maintain the SuperModulyo freeze dryer in serviceable condition between drying processes.

Refer to Section 5.2 for the recommended maintenance plan.

5.1.1 PRECAUTIONS

WARNING

Obey the safety instructions given below and take note of appropriate precautions. If you do not, you can cause injury to people and damage to equipment.

- A suitably trained technician must maintain the SuperModulyo freeze dryer. There are no user-serviceable parts.
- Isolate the SuperModulyo freeze dryer from the electrical supply before you start maintenance work, so that it cannot be operated accidentally.
- Dispose of components and oil safely (see Section 7).
- Take care to protect sealing faces from damage.

5.2 MAINTENANCE PLAN

The plan in Table 5 details the minimum maintenance operations necessary to maintain the SuperModulyo freeze dryer in normal use. Instructions for each operation are given in the section shown. The required frequency of maintenance will depend on how often you use the SuperModulyo freeze dryer and the types of product which you freeze dry. If necessary, adjust the maintenance plan according to your experience.

Table 5. Maintenance Plan

Operation	Frequency	Refer to Section
Check the vacuum pump oil level	6 Months	5.3
Change the oil mist filter odor element	Monthly	5.4
Change the oil mist filter element	6 Months	5.5
Inspect the Gas Ballast Oil Return Kit (GBORK)	Monthly	5.6
Change the vacuum pump oil	6 Months	5.7
Service the vacuum pump	Yearly	5.8

5.3 CHECK THE VACUUM PUMP OIL LEVEL

Check that the pump oil level is between the MIN and MAX markers on the bezel of the sight glass (Figure 10, item 2). The oil must be clean and transparent.

Add more oil if necessary (refer to Section 3.5.2) or change the oil as described in Section 5.7.

5.4 CHANGE THE OIL MIST FILTER ODOR ELEMENT

Change the odor element every month as described in the instruction manual for the EMF oil mist filters (refer to Supplementary Publication, 206-3100-00). The EMF20 filter unit is used on the SuperModulyo.

5.5 CHANGE THE OIL MIST FILTER ELEMENT

Refer to Figure 11. Inspect the Gas Ballast Oil Return Kit (GBORK) every month.

- Check that the oil return assembly (5) is securely fitted to the pump.
- Check that the oil return tubing (3) is securely fitted to the oil return assembly and to the oil mist filter (1).
- Check that there are are no blockages in the GBORK.
- Check that the GBORK operates correctly.

Refer to Figure 12. If one or both of the air inlets (2) or the restrictor plate (3) of the oil return assembly are blocked:

1. Switch off the pump and allow it to cool to a safe temperature. Isolate the pump from the electrical supply, so that it cannot be operated accidentally.
2. Undo and remove the three screws (1) which secure the restrictor plate (3) and remove the plate from the oil return assembly.
3. Use a suitable tool to remove the blockage from the air inlet (2).
4. Refit the restrictor plate (3) to the oil return assembly and secure with the three screws (1), then reconnect the pump to th electrical supply.

Note: For high gas ballast flow, orient the restrictor plate so that the two circular indentations on top are aligned with the single indentation on the side of the oil return assembly.

Refer to Figure 11. If the restrictor (7) is blocked:

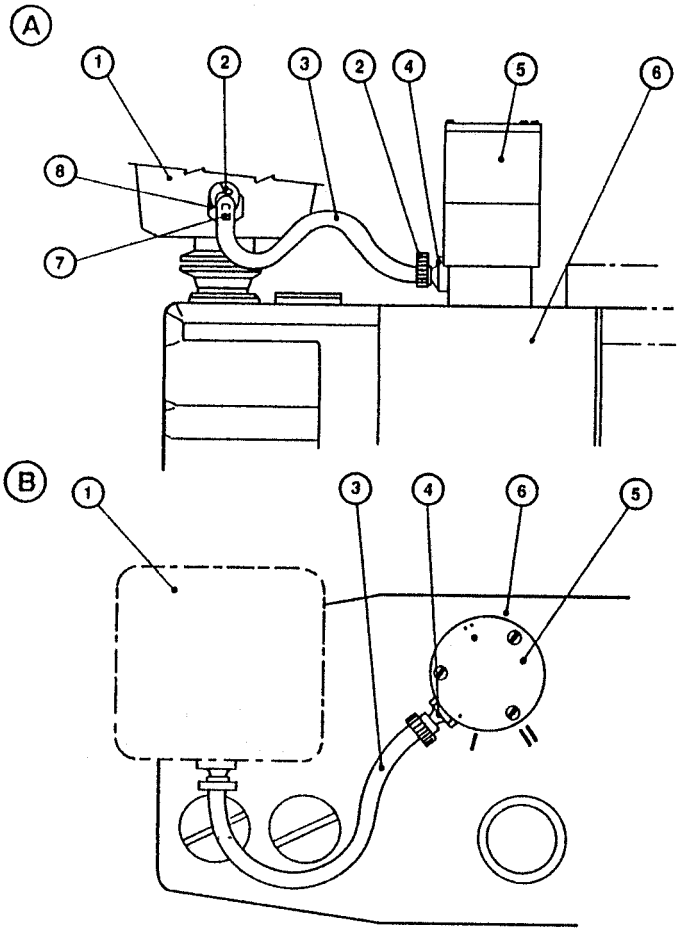
1. Switch off the pump and allow it to cool to a safe temperature. Isolate the pump from the electrical supply, so that it cannot be operated accidentally.

2. Undo and remove the clip (2) on the oil mist filter end of the oil return tubing (3), then remove the end of the tubing from the tubing connector (8) on the oil mist filter (1).

3. Remove the restrictor (7) from the oil return tubing and remove the blockage from the restrictor.

4. Refit the restrictor (7) in the end of the oil return tubing (3), fit the end of the tubing to the tubing connector (8) on the oil mist filter, then use the clip (2) to secure the end of the oil return tubing.

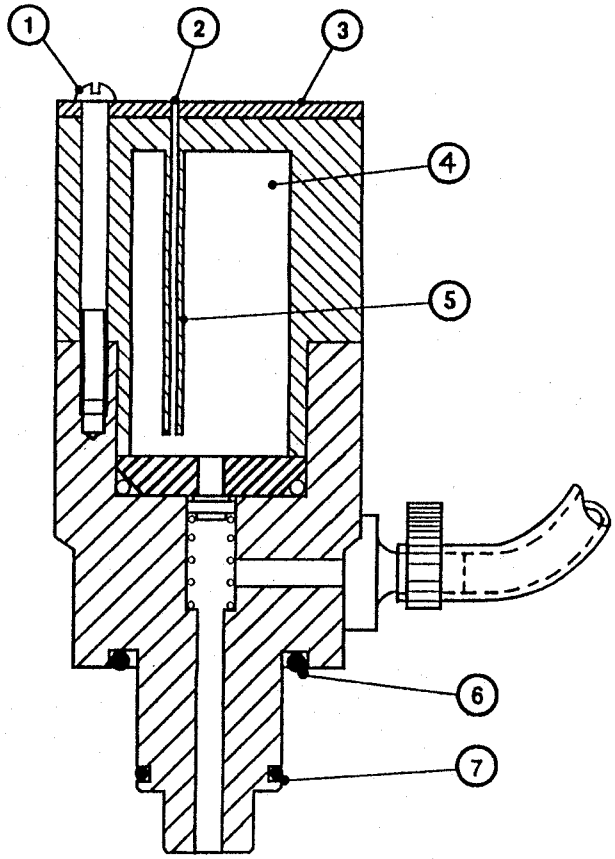
5. Reconnect the pump to the electrical supply.



A–Side view (pump inlet nozzle omitted for clarity)
B–Top view

1. Oil mist filter (EMF20)
2. Clip
3. Oil return tubing
4. Tubing connector
5. Oil return assembly (stainless steel)
6. VLP285
7. Restrictor (inside tubing)
8. Tubing connector for EMF20

Figure 11. Gas Ballast Oil Return Kit (GBORK)



1. Screw
2. Air inlet
3. Restrictor plate
4. Expansion chamber
5. Silencer tube
6. 'O' ring A
7. 'O' ring B

Figure 12. Part sectional view of the oil return assembly

5.6 INSPECT THE GAS BALLAST OIL RETURN KIT

Change the filter element every six months as described in the instruction manual for the EMF oil mist filters (refer to the Supplementary Publication, 206-3100-00). The EMF20 filter unit is used on the SuperModulyo.

5.7 CHANGE THE VACUUM PUMP OIL

WARNING

This vacuum pump weighs approximately 30 kgs (66 lbs). Use proper lifting techniques to avoid injury.

WARNING

Allow the vacuum pump to cool to ambient temperature prior to changing the oil.

1. Remove the right-hand and front inspection panels (refer to Section 3.4)

2. Unplug the line cord from the pump.

3. Check to confirm that the two red shipping bolts have been removed from the pump. Refer to section 3.5.1 to remove the bolts if they are still in place.

4. Loosen the hose clamp (this requires a flat bladed screwdriver or 8 mm nut driver) and disconnect the flexible vacuum inlet hose (Figure 9, item 6) from the top of the pump.

5. Loosen the clamp securing the Pirani Gauge (Figure 9, item 8).

6. Gently remove the Pirani Gauge and “O” ring gasket.

7. Remove the exhaust hose from the top of the oil mist filter (refer to Figure 9).

8. Carefully slide the pump approximately two inches (5 cm) toward the rear of the enclosure.

9. Carefully lift the pump out of the enclosure.

5.7 CHANGE THE VACUUM PUMP OIL (cont'd)

10. Place the pump on an elevated surface with the pump drain plug overhanging the edge of the surface.

11. Place a wide shallow pan immediately below the drain plug and carefully open the drain.

12. Allow the oil to completely drain from the pump and replace the drain plug.

13. If the oil is excessively dirty, flushing fluid may be used to flush the pump. Remove oil filler plug (Figure 9, item 2). Fill pump with SFF1 flushing fluid to just under MAX mark on the bezel of the sight glass (Figure 10, item 2). Refit the oil filler plug. Run pump for 20 minutes, then drain. If necessary, repeat with clean flushing fluid, until fluid drains clear. Increase the frequency of oil changes to prevent damage to the pump.

14. Fill the pump with clean SPO1 oil as described in section 3.5.2.

15. Re-install the pump into the enclosure.

16. Re-attach the Pirani Gauge making certain to first position to "O" ring over the opening on the top of the pump.

17. Re-attach the vacuum inlet hose and exhaust hose.

18. Re-attach the line cord to the pump.

19. Replace the right-hand and front inspection covers.

5.8 SERVICE THE VACUUM PUMP

Inspect and clean the vacuum pump inlet filter, gas-ballast control, oil-level sight-glass and motor fan cover yearly, as described in the pump instruction manual (refer to Supplementary Publication 096-3000-00).

Clean and overhaul the pump and check the condition of the pump motor every 15,000 hours, as described in the pump instruction manual.
Fit new blades to the vacuum pump every 30,000 hours, as described in the pump instruction manual.

6.0 FAULT FINDING AND RECTIFICATION

6.1 INTRODUCTION

The following sections describe possible problems and their possible solutions and are intended as a guide to the user and to qualified service engineers. Some of the solutions can be carried out by the user, however others (which are clearly identified) must be carried out only by approved Thermo Savant service engineers.

6.2 SAFETY

WARNING

Obey the safety instructions given below and take note of appropriate precautions. If you do not, you can cause injury to people and damage to equipment.

6.2.1 PRECAUTIONS

- Isolate the SuperModulyo freeze dryer from the electrical supply and defrost it before you start work.
- Do not touch any part of the condenser chamber during or immediately after the cooling process. The condenser chamber is at a very low temperature and can cause tissue damage.
- Do not pour water at a temperature greater than 50 ˚C into the condenser chamber when it is cold. If you do, this may result in a dangerous rise in pressure in the refrigeration system.
- Ensure that you perform fault finding in a well-ventilated area.
- After you have rectified a fault, ensure that the electrical installation of the SuperModulyo freeze dryer conforms with your local and national safety requirements. The SuperModulyo must be connected to a suitably fused and protected electrical supply as well as suitable earth point.

6.2.2 REFRIGERANT LEAKS

The refrigerant used in the SuperModulyo freeze dryer is heavier than air and is an asphyxiant by the displacement of oxygen.

If a refrigerant leak is suspected, place the SuperModulyo freeze dryer in a well-ventilated area. Do not allow naked flames or smoking near the SuperModulyo freeze dryer, as products of combustion of the refrigerant include dangerous fluorides and chlorides.

If refrigerant vapor is inhaled, obtain medical help immediately. Take the victim to a ventilated, uncontaminated area; if the victim's breathing is weak or has stopped, apply artificial ventilation, preferably using an oxygen resuscitator. Do not use adrenalin or other cardiac stimulants.

At normal atmospheric pressure, the refrigerant will evaporate at -40 ˚C. Contact with skin or eyes can cause cold burns. If contact has taken place, obtain medical help immediately. We recommend that you use the following first aid procedure: remove clothing from the affected area; carefully irrigate the affected area with tepid water for at least 15 minutes; apply a sterile dressing and treat the wound as you would a heat burn.

6.3 ELECTRICAL FAULTS

6.3.1 FAULT FINDING

If an electrical fault is suspected, **call for certified service assistance ONLY**, to identify the possible causes and actions to cure the fault. If the fault persists after completing the recommended action, contact your supplier or Savant before you use the SuperModulyo freeze dryer again.

6.3.2 LOOSE CONNECTIONS AND FAULTY COMPONENTS

The circuit diagrams for the SuperModulyo freeze dryer are shown in Figures 13 and 14 on pages 36 and 37. Use these diagrams to check for and rectify loose connections or faulty electrical components.

To access components within the SuperModulyo freeze dryer, remove the covers as described in Section 3.4. Use the electrical fault-finding information below to troubleshoot the system.

6.3.2 LOOSE CONNECTIONS AND FAULTY COMPONENTS (cont'd)

Symptom 1) There is no electrical supply to any components and the MAINS lamp is off.

Check (A): Has the circuit-breaker (CB10A) on the control panel tripped?
Action: If so, identify and rectify the cause of the problem, then reset the circuit-breaker (User). If the circuit-breaker trips repeatedly, check the electrical system and rectify any fault found (Service Engineer).

Check (B): Has the external fuse in the electrical supply line blown?
Action: If so, identify and rectify the cause of the problem, then replace the fuse (User). If the fuse blows repeatedly, check the electrical system and rectify any fault found (Service Engineer).

Check (C): Has the 2 A fuse on the control panel blown?
Action: If so, identify and rectify the cause of the problem, then replace the fuse (User). If the fuse blows repeatedly, check the electrical system and rectify any fault found (Service Engineer).

Check (D): Is there a loose electrical connection inside the unit?
Action: If so, repair the electrical connection (Service Engineer).

Symptom 2) The circuit-breaker on the control panel (CB10A) is on and the MAINS lamp is on, but the compressor does not start.

Check (A): Is there a loose electrical connection inside the unit?
Action: If so, repair the electrical connection. If not the compressor may be faulty (Service Engineer).

Check (B): Is the electrical supply voltage too low?
Action: Use an alternative electrical supply and/or remove any extension leads which can cause small voltage drops (User).

Symptom 3) The compressor starts but only runs for a short time before it stops.

Check (A) Have the motor windings failed?
Action: Check the electrical continuity of the windings. If necessary, replace the compressor (Service Engineer).

6.3.2 LOOSE CONNECTIONS AND FAULTY COMPONENTS (cont'd)

Symptom 4) The circuit-breaker on the control panel (CB10A) is on and the MAINS lamp is on, but the vacuum pump does not start.

Check (A): Is there is a loose connection inside the unit?
Action: If so, repair the electrical connection. If not, the vacuum pump may be faulty (Service Engineer).

Check (B): Is the electrical supply voltage too low?
Action: Use an alternative electrical supply and/or remove any extension leads which can cause small voltage drops (User).

Symptom 5) The vacuum pump starts but only runs for a short time before it stops again.

Check (A): Have the motor windings failed?
Action: Check the electrical continuity of the windings (Service Engineer). If necessary, replace the vacuum pump (User).

Symptom 6) The vacuum pump will not start.

Check (A): Is the on/off switch on the vacuum pump in the "on" position?
Action: If not move the switch to the "on" position (User).
If the switch is already in the "on" position, the vacuum pump may be faulty (Service Engineer).

Symptom 7) The lamp on the DEFROST button goes on, but the condenser chamber does not defrost.

Check (A): Is there a loose connection inside of the unit?
Action: If so, repair the electrical connection (Service Engineer).

Check (B): Does the defrost solenoid valve work?
Action: If not, replace the solenoid valve (Service Engineer).

6.4 REFRIGERATION FAULTS

6.4.1 REPEAT THE INSTALLATION TEST

If you suspect that there is a fault in the refrigeration system in the SuperModulyo freeze dryer, then:

1. Defrost the condenser chamber (refer to the defrosting instructions given in Section 4.7).

2. Repeat the installation tests of Section 3.7. Note the results at each step and then contact Thermo Savant service or an approved agent.

6.4.2 FAULT DIAGNOSIS

If symptoms occur, or the cause of a fault cannot be identified, contact your supplier or Thermo Savant for advice. **Call for certified service assistance ONLY.**

6.4.3 LEAK TEST

Leak test the refrigeration system with a halogen leak detector, which is sensitive to all refrigerants. Before starting leak tests, check the operation of the leak tester with refrigerant from the cylinder which will be used to recharge the SuperModulyo freeze dryer. The refrigerant used in the SuperModulyo freeze dryer is heavier than air, so you should check the highest joints on the unit first.

6.4.4 COMPONENT REPLACEMENT

Note: The refrigeration system should be left open to the atmosphere for as short a time as possible.

Only replace a component when you are sure that it is the cause of the fault. Components (particularly compressors) are often replaced unnecessarily and it is therefore recommended that you recheck your findings before replacing a component. Use the procedure below to replace a component in the refrigeration system.

1. Recover the refrigerant.

2. Remove the faulty component. Suitable pipe cutters must be used if cutting a pipe. If heat has to be applied to a joint, pass an inert gas through the system during the heating process and again during cooling.

3. Replace the component.

4. When repairs on the refrigeration system have been completed, replace the filter-dryer, as this is likely to have been contaminated.

5. Dehydrate the system and recharge the unit with refrigerant. Before the unit is completely recharged, check that any new or repaired joints do not leak. Use the refrigeration fault finding information below to troubleshoot the system.

Symptom 1) The compressor does not start.
Check (A): Is there an electrical fault?
Action: Refer to Section 6.3 and rectify any fault found (Service Engineer).

Symptom 2) The compressor starts but the temperature does not reach -50 ˚C.
Check (A): Is there sufficient ventilation?
Action: If not, relocate the SuperModulyo freeze dryer. There must be no restrictions to air flow to the sides and rear of the unit (User).

Check (B): Is the refrigerant charge low?
Action: Find the leak (see Section 6.4.3), then repair the leak and recharge the system with refrigerant (Service Engineer).

6.4.4 COMPONENT REPLACEMENT (cont'd)

Symptom 3) The compressor starts but the temperature does not reduce.
Check (A): Is the temperature gauge or thermocouple faulty?
Action: Check gauge and thermocouple and replace if necessary (Service Engineer).

Check (B): Is there a leak in the refrigeration system?
Action: Find the leak (see Section 6.4.3), then repair the leak and recharge the system with refrigerant (Service Engineer).

Symptom 4) The temperature rises to above -50 ˚C during drying and does not fall to below -50 ˚C again.
Check A): Is the load on the SuperModulyo freeze dryer too high?
Action: Reduce the amount of product being freeze dried (User).

6.4.5 RECHARGE WITH REFRIGERANT

If you need to recharge the unit due to a leak, locate and repair the leak before starting to recharge the refrigeration system (Service Engineer).

Use the correct type and quantity of refrigerant (refer to Section 2) to recharge the refrigeration system of the SuperModulyo freeze dryer with refrigerant. We recommend using the recharging valve on the liquid receiver to recharge the SuperModulyo freeze dryer.

6.5 POOR VACUUM PERFORMANCE

The vacuum system on the SuperModulyo freeze dryer is unlikely to cause problems during normal use. If you suspect a leak in the vacuum system, use the following procedure.

1. Defrost the condenser chamber (see Section 4.7), then thoroughly dry and clean the chamber (see Section 4.3).

2. Fit the accessory with the smallest volume or blank off the accessory flange.

3. Make sure that the quantity and quality of the oil in the vacuum pump is satisfactory (refer to Section 5.3).

4. Close the drain valve and press the PUMP button on the control panel to switch on the vacuum pump.

5. Allow the system to operate for approximately 12 hours.

6.5 POOR VACUUM PERFORMANCE (cont'd)

If there is no leak but the system is contaminated, the above procedure will purge the system of the contaminant. If the ultimate pressure is still poor, use the following procedure:

1. Check that all seals are clean and free from damage.

2. Check that there is no leak in the vacuum pipeline between the pump and the condenser chamber.

3. Check that the vacuum pump works correctly. Refer to the instruction manual for the pump (refer to Supplementary Publication, 096-3000-00) for additional pump fault finding actions.

4. Isolate the SuperModulyo freeze dryer from the electrical supply and remove the cover. Check all internal vacuum connections, including the vacuum pipeline, the drain valve and the drain valve connection.

If you cannot determine the cause of the problem, contact your supplier or Thermo Savant for advice.

7 STORAGE AND DISPOSAL

7.1 STORAGE

Store the SuperModulyo freeze dryer as follows:

1. If applicable, ensure that the SuperModulyo freeze dryer has been shut down as described in Section 4.7.

2. Disconnect the electrical supply and vacuum connections and clean the SuperModulyo freeze dryer (see Section 4.3).

3. Drain the oil from the vacuum pump and refill the pump with clean oil (see Sections 5.7 and 3.5.2).

4. Replace any protective covers supplied with the SuperModulyo freeze dryer.

5. Store the SuperModulyo freeze dryer in clean dry conditions until required.

6. When required for use, prepare and install the SuperModulyo freeze dryer as described in Section 3 of this manual.

If the SuperModulyo freeze dryer has been stored for more than a year, clean and overhaul the vacuum pump before using the SuperModulyo freeze dryer: refer to the pump instruction manual.

7.2 DISPOSAL

Dispose of the SuperModulyo freeze dryer, components and waste oil safely in accordance with all local and national safety and environmental requirements.

8.0 SPARES AND ACCESSORIES

8.1 INTRODUCTION

Thermo Savant products, spares and accessories are available from Thermo Savant distributors worldwide.

Order spare parts and accessories from your nearest Thermo Savant distributor. When ordering please state for each part required:

- Model and item number of equipment.
- Serial number (if any).
- Item number and description of part.

8.2 SPARES

Product	Item Number
Vacuum Pump Oil	SPO1-B (1 bottle), SPO1 (1 case)
Vacuum Pump Flushing Fluid	SFF1-B (1 bottle), SFF1 (1 case)
Oil Mist Filter, Element for EMF20	M90-0283-33
Oil Mist Odor Element for EMF20, 5/pk	M90-0283-34

Other spares available for the vacuum pump and the oil mist filter are listed in the instruction manuals for the pump and the filter (refer to Supplementary Publications, 096-3000-00 and 206-3100-00, respectively).

8.3 ACCESSORIES

Note: For full details on the accessories received with your system, refer to the Modulyo Accessories Manuals. An appropriate manual is shipped with drying accessories purchased from Thermo Savant. For additional accessories, contact Thermo Savant or your supplier for product information.

8.3.1 GLASSWARE AND ACCESSORIES

Product	Item Number
Wide-mouth flasks	
1000 ml	F05657000
500 ml	F05650000
300 ml	F05658000
Flask lid with adapter	F05659000
Flask lid filter, 100/pk	F05659222
Replacement ‘O’ ring for flask lid, 25/pk	H02125020-B

8.3.2 DRYING ACCESSORIES

Product	Item Number
Flask Drying	
8-port column manifold	F05656000
24-port column manifold	F05622000
16-port drum manifold	F05628000
24-port drum manifold	F05621000
Acrylic lid	F05632000
Manifold Valve	F05648000
Tray Drying	
Tray Cell (acrylic cylinder, acrylic lid, rack, 6 product trays)	TC60
Drying Tray Kit (rack and 6 product trays only)	KDT60
Acrylic cylinder, (350 mm diameter)	F05652000
Rack	F05629000
Product tray	F05630000
Heater mat for product tray	F05631000
Temperature controller for tray drying (115 V/60 Hz)	F05633115
Temperature controller for tray drying (230 V/50 Hz)	F05633000
Vial Drying	
Stoppering shelf unit (Vial Cell)	F05623000
Bottle retaining tray for Vial Cell	F02301124
Heater kit for stoppering shelf unit (115 V/60 Hz)	F05655115
Heater kit for stoppering shelf unit (230 V/50 Hz)	F05655000
Vials, stoppers, caps and crimpers are also available from Thermo Savant	
Ampule Drying	
Spin Freezer 96 (115 V/60 Hz)	F05637115
Spin Freezer 96 (230 V/50 Hz)	F05637000
Secondary drying manifold, Basic 1-column	F02964000
Secondary drying manifold, Additional 1-column	F02956000
Double-column secondary drying manifold	F02965000
Specimen Drying	
Bell jar	F02960000
Specimen dryer	F05627000
Pre-freeze shelf	F05624000
Acrylic cylinder and lid (above), are also used for specimen drying.	
High Capacity Vial and Bulk Tray Drying	
Refrigerated Chamber, RC300 (220 V/60 Hz)	F10002000
Refrigerated Chamber, RC300 (230 V/50 Hz)	F10001000
Vial loading tray for RC300	F10003000
Bulk sample loading tray for RC300	F10004000
Miscellaneous	
Isolation valve	F05643000
Ice handle	F05653000
Adapter flange	F05626000
Pipeline Attachment	F02305082

9.0 ENGINEERING DIAGRAMS

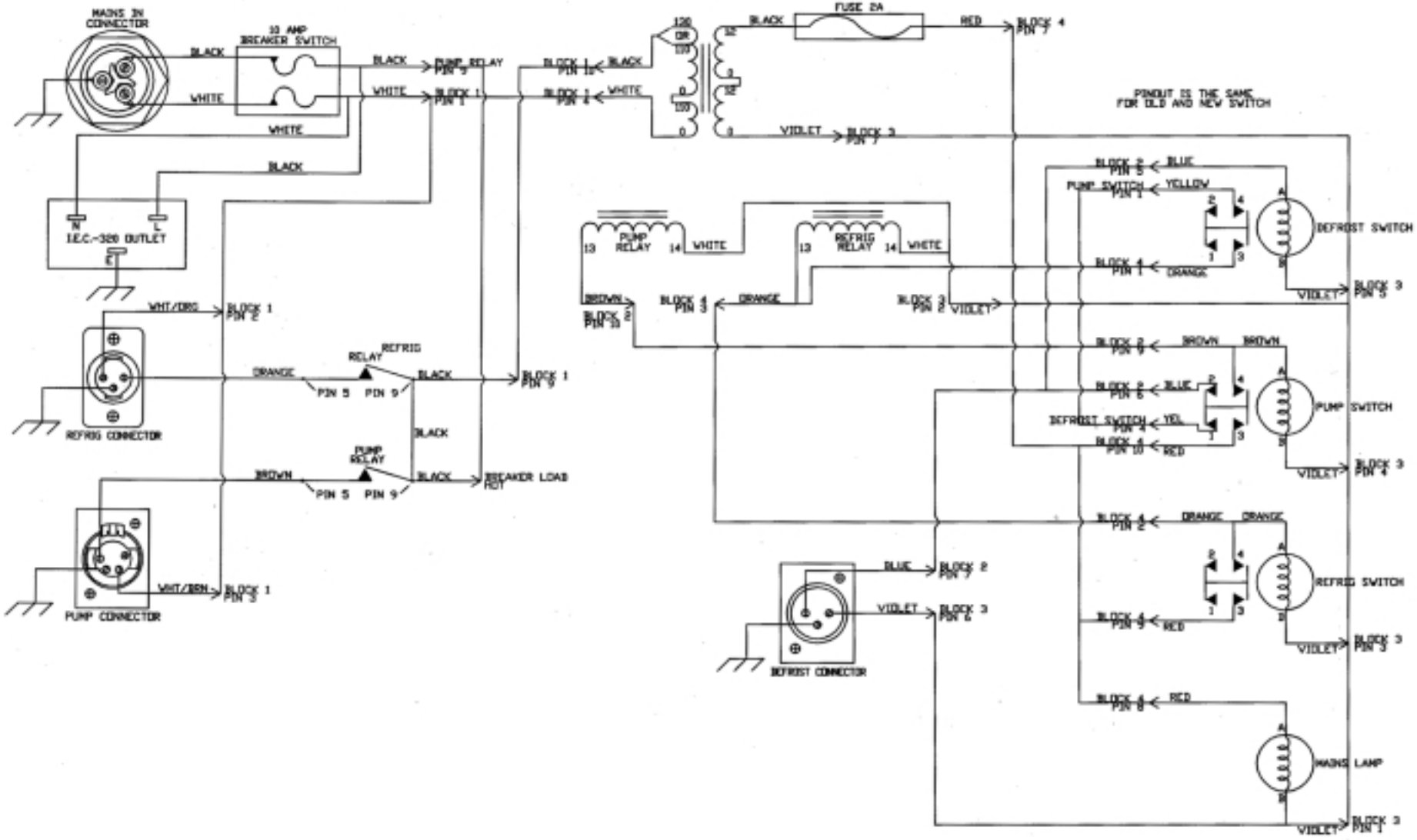


Figure 13 - SuperModulyo freeze dryer control module circuit diagram

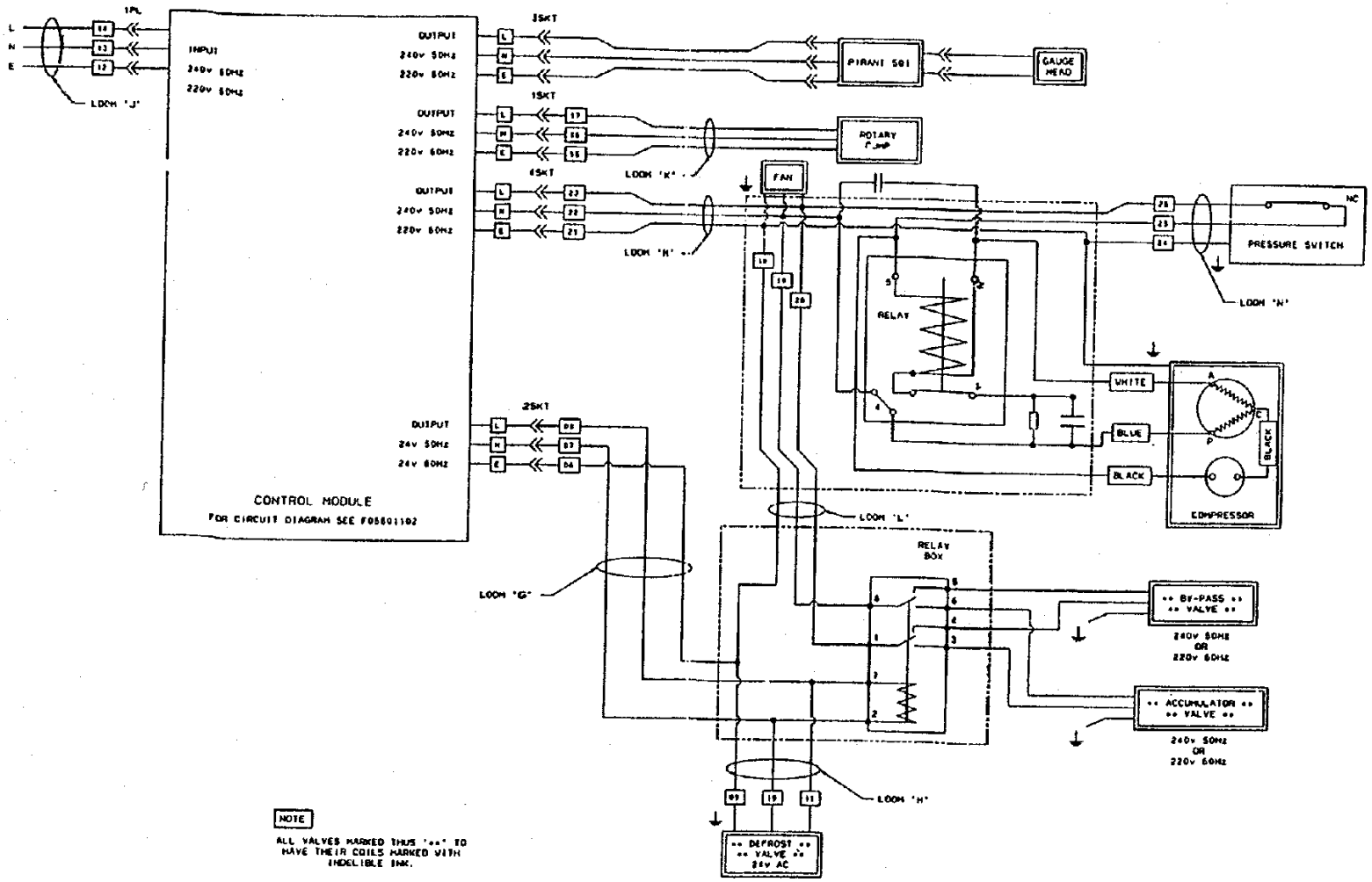


Figure 14 - SuperModulyo freeze dryer circuit diagram

100 Colin Drive • Holbrook, NY 11741-4306 USA
Tel: 631-244-2929 • 1-800-634-8886 • Fax: 631-244-0606
www.thermosavant.com • E-mail: savantec@savec.com

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