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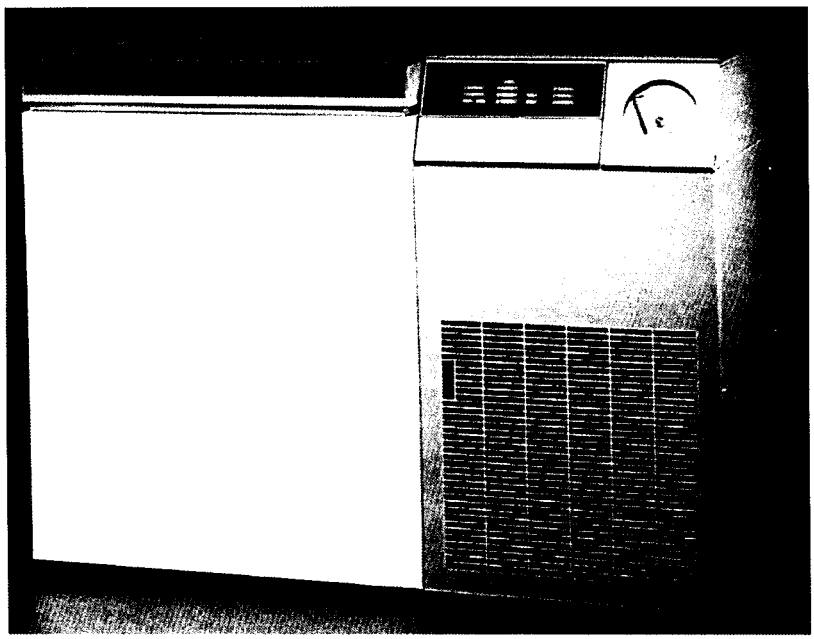
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Thermo Electron Corporation

-140°C and -150°C Chest AutoCascade Ultima Series Freezer



Service Manual

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Part No. 301905H01 Rev F

Thermo Electron Corporation

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INTRODUCTION

Ultra Low Temperature -140°C and -150°C Chest freezers are base units, manufactured wholly at the Thermo Electron Corporation facility in Asheville, NC.

The -140°C and -150°C Chest units come in 7, 10, and 14 cubic foot sizes.

The -140°C and -150°C Chest freezer units come in two different series based upon their control systems. These series are the Elite and Ultima.

The Thermo Electron Corporation distributes this group of products under different model and brand names. The service technician needs to be familiar with the many different models. The purpose of this manual is to introduce you to some of the different models supplied by Thermo Electron Corporation, as well as supplying you with procedures developed to assist you in troubleshooting and repairing certain conditions.

Product specifications are subject to change without written notice. Progressive product changes will be entered into the service manual as it is revised. The manual is intended as an aid to persons qualified in the service of applicable equipment. It is not intended to teach unqualified persons on applicable equipment all procedures necessary to make repairs.

02/27/06 Rev. F changed company name to Thermo Electron from Kendro

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GENERAL INFORMATION

MODEL NUMBER AND SERIAL NUMBER IDENTIFICATION

Model numbers are important to know, since they identify the unit as to what group it is in. This number does not identify a unit specifically; but rather, indicates to what group this unit belongs.

The serial number is important in that it identifies the unit as a specific unit. In other words, it is the name of the unit that is specific for that unit, and no other unit has that same name.

DATA LABEL LOCATION

The model and serial numbers of your freezer are printed on a plastic identification label and mounted on the unit. This label is commonly referred to as the data label. It is called this because the most important information concerning your unit can be gathered from the model number and the serial number identification.

The data label is normally mounted on the outside of the cabinet. It can be found by looking on the left-hand side of the unit near the front of the cabinet

DATA LABEL INFORMATION

Much information can be gathered from a data label. Of course the model and serial numbers can be found there. Information such as type of refrigerant, voltage rating, frequency rating, and current rating, are also normally found on a data label.

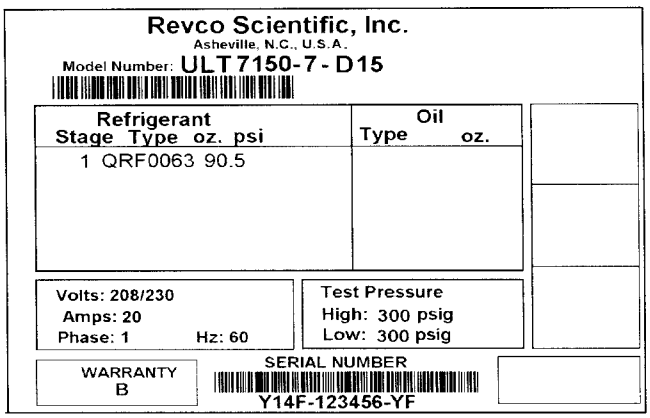


Figure 100-1
Typical Data Label

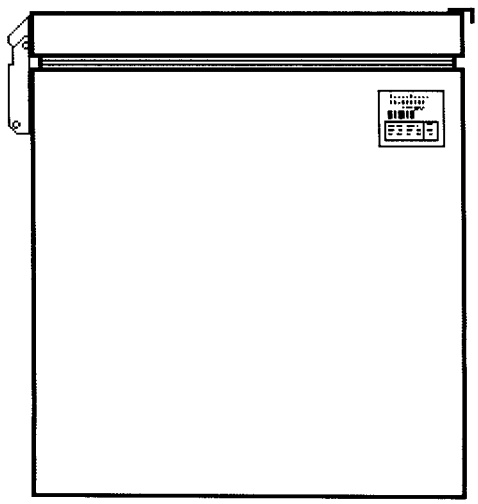


Figure 100-2
Data Label Location

Figure 100-3
7 ft^3 Chest
(-150°C only)

Figure 100-4
10 ft^3 Chest
(-140°C only)

REFRIGERATION SYSTEM

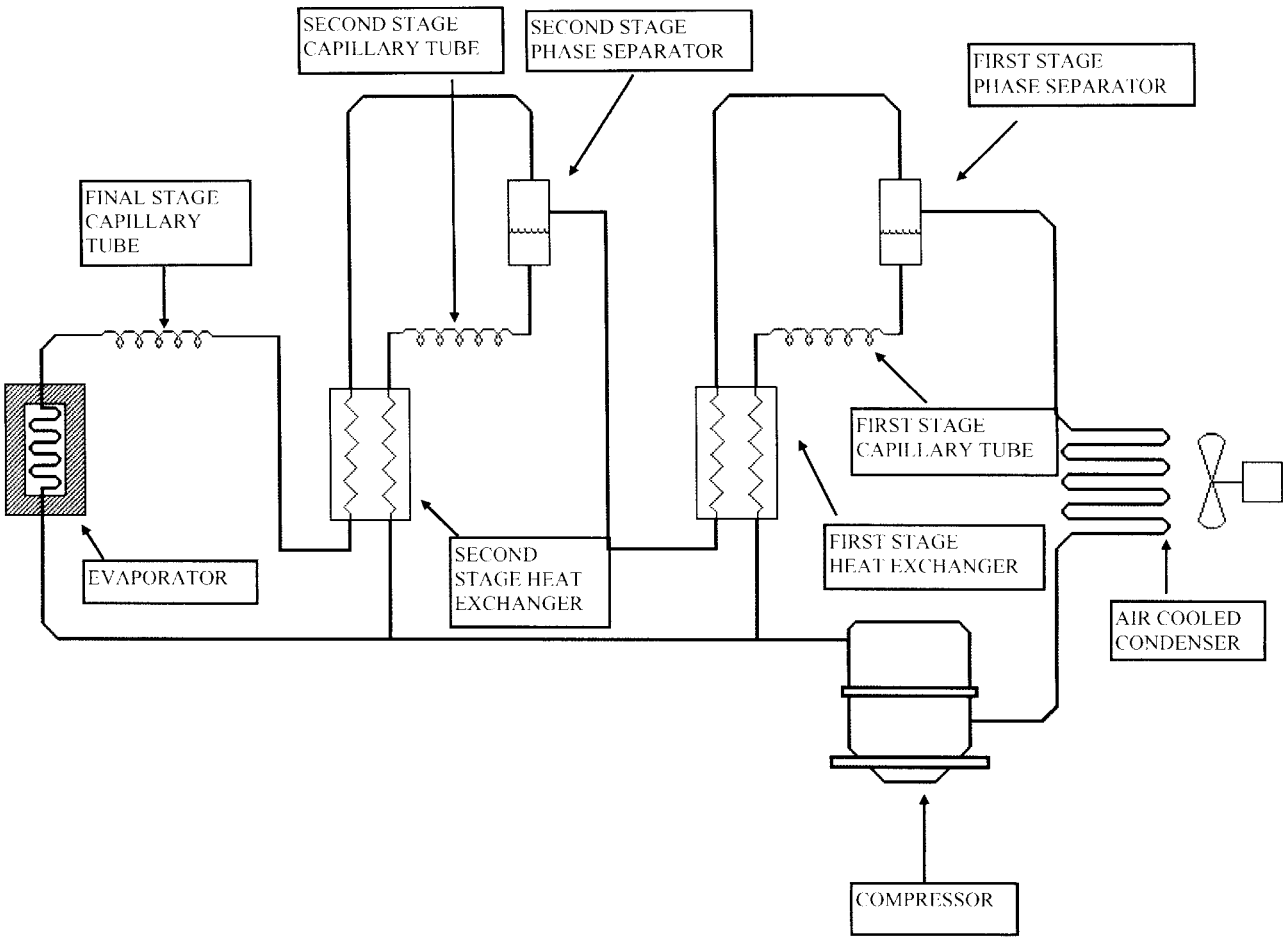


Figure 100-5
Typical Auto Cascade Refrigeration System

All of the units covered by this service manual utilize an autocascade refrigeration system for cooling the unit. The fundamental components of a refrigeration system are: the compressor, condenser, drier-strainer, metering device (normally a capillary tube), and the evaporator. Every refrigeration system operates using some configuration of most, if not all of these components.

The following is a description of the components of the refrigeration cycle:

Compressor

The function of the compressor is to take the relatively cool gaseous refrigerant at its suction, and raise the pressure and temperature of the refrigerant by compressing it. Remember, any time a gas is compressed the temperature, as well as the pressure, is increased. Since liquids such as water are incompressible, it is very important that all of the refrigerant be a gas before it reaches the compressor.

The function of the compressor can be summed up in this one statement: It is needed to add useful work energy to the refrigerant. The size and ratings of the compressors depends upon the application and size of the system.

Figure 100-6
Typical Compressor

Condenser

The purpose of the condenser is to take the hot gaseous refrigerant, remove latent heat of condensation and cause it to condense. This is needed in order to extract energy from the refrigeration cycle. The reason the energy needs to be extracted is so that when the refrigerant reaches the evaporator this energy can be "put back in" which is where the cooling action for the freezer takes place.

Drier-Strainer

As the condensed (liquid) refrigerant leaves the condenser, it passes through the drier-strainer which removes any moisture (except the liquid refrigerant) or impurities before passing through the metering device. It is important that a "molecular sieve drier" or other high quality dryer be used. This components function is two fold.

1. It prevents moisture, such as water, from staying entrained in the refrigerant and possibly doing damage to the compressor or other components in the refrigeration cycle.

2. It prevents any foreign material from becoming lodged in the metering device and decreasing the efficiency of the cycle.

Figure 100-7
Typical Forced Air Condenser

Figure 100-8
Typical Drier-Strainer

Capillary Tube

The capillary tube is simply a length of tubing attached to the outlet tubing somewhere downstream of the drier-strainer and the inlet of the evaporator. The diameter and length of the tube depends on the application of the system involved and the capacity of that system, and are calibrated to meter the right amount of refrigerant required for that particular model. A predetermined length of the capillary tube is soldered along the exterior of the suction line, forming a heat exchanger which helps to cool the liquid refrigerant in the capillary tube and heat the refrigerant in the compressor suction line. The capillary tube then connects to the evaporator where the tubing expands back to its original size.

Evaporator

As the refrigerant passes through the evaporator it is changed from a liquid to a vapor. Since the pressure of the refrigerant is at a slightly lower pressure and with the addition of heat, from the internal compartment of the freezer, the liquids temperature is raised above the boiling point for that refrigerant and the change of phase from a liquid to vapor takes place. All of the liquid should have been changed to a vapor at the outlet of the evaporator, ensuring that only gaseous refrigerant is sent to the compressor.

Figure 100-9
Evaporator

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SAFETY

Freezers complex machines. Any attempt to repair a freezer should be done with caution. There can never be too much said or written concerning safety in any area of work, especially when dealing with electricity and refrigerants. Safety should be every persons concern and is every persons responsibility. Your personal safety begins with knowledge of the equipment that you are working on. We are concerned with your safety; therefore, we have written a few ideas and reminders of safety concerns while working on freezers.

ELECTRICAL SAFETY

1. Know the location of the freezer's circuit breakers or fuses. Ensure all breakers and/or fuses are clearly marked for quick identification and reference.

2. Before servicing any freezer, unplug the power cord. Do not perform any maintenance or remove an access panel on an energized unit. None of the repairs in this manual require the freezer to have electrical power applied during maintenance.

3. Be careful when handling freezer access panels, parts, or any components which may have sharp edges which may cause damage to wiring and electrical connections, not to mention personal injury.

4. Always use the correct tool for a job and be sure those tools are in good condition. Ensure that tools to be used on electrical devices are will insulated, if applicable.

5. Never interfere with or bypass the operation of any switch, component or feature of the unit. Interlocks, relays, and switches are designed with a specific purpose and should, therefore, not be altered.

6. Use only approved replacement parts that are the correct size, rating, and capacity as the original part. If you have a question concerning replacement parts, call the factory Technical Services Department at 1-800-438-4851.

7. When replacing any component, be sure any green ground wires are reconnected securely in their original positions to avoid danger of shock or short circuit.

ELECTRICAL SAFETY (cont.)

8. Before reconnecting the power supply, make sure no uninsulated wires or terminals are touching the cabinet, as this can lead to electrical shock, fires, and equipment damage. Electrical wiring and all grounds must be correctly reconnected and secured away from sharp edges, components and moving parts. All panels and covers should be reinstalled before the freezer is plugged in.

9. Never alter a power cord in order to make it fit an electrical outlet. The line cord must be plugged into a grounded, three prong receptacle. Never cut or remove the third (ground) prong from the power cord connector.

10. Never substitute ordinary wire for any internal wiring of a freezer. The internal wiring of these units carry a special rating due to the somewhat high currents that they can be subjected to at times. This heavy current load generates heat which can melt ordinary wire. It is vitally important that all connections are tight and secure.

11. Throughout this service manual, additional safety precautions dealing with specific procedures may be presented. This information should be carefully read and observed.

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REFRIGERANT SAFETY

1. The following is a list of the more common refrigerants that you will possibly be dealing with: R11, R12, R14, R22, R23, R114, R134a, R500, R404a, MP66, Argon.

CAUTION
None of these refrigerants will support life! All are classified as asphyxiants.

2. The following are effects of over exposure:

   a. light headedness
   b. giddiness
   c. shortness of breath
   d. unconsciousness
   e. possibly death

Emergency and First Aid Procedures

1. Remove to fresh air

2. Call a physician

3. Do not give heart stimulating drugs such as epinephrine or similar drugs.

4. As all of the refrigerants listed have a vapor density of 3.00 or over 7.00, proper ventilation is mandatory, especially in the low places where the heavy vapor could collect.

5. Remove or extinguish all open flames in this area. If listed refrigerants are exposed to open flame, toxic compounds may be produced such as hydrogen chloride and hydrogen fluoride and or other acidic vapors.

6. Smoking should never take place around any of the listed refrigerants. Deadly phosgene gas, which can kill very quickly, is also one of the compounds that these refrigerants can break down into if they come in contact with a high enough temperature flame.

Safety While Handling

1. Hydrochloric and Hydrofluoric acids can be produced due to the chemical decomposition of refrigerant.

2. Always use facial and eye protection, as well as gloves when opening a system that has suffered a "burn out". The possibility of Hydrofluoric acid is high.

3. Also use facial and eye protection when handling liquid refrigerant.

4. The use of an air mask with an independent air supply is recommended in areas of high concentrations and poor ventilation.

5. Always use protective gloves when handling liquid refrigerant.

6. Avoid breathing all refrigerants if at all possible.

7. Treat all refrigerant cylinders with care. Store in clean dry areas. Do not store at high temperatures.

8. Always comply with safe handling and usage practices while working with refrigerants.

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TECHNICAL INFORMATION

The information provided in this section is intended to give you as much information about the unit you will be performing maintenance on as possible. All of the numbers given are general in nature and may possibly be different for the model that you are working on. The reason for this may be the possibility that the particular unit that you may be working with is a special order unit, and is unique for its specific application.

The following information contains specifications that apply to the Elite series, Upright units.

Microprocessor Control System

Tamper-resistant touch-pad data entry with adjustable operating temperature

A.I.M (Automatic Incident Monitor). Refer to the A.I.M. description on page 300.5

Key operated switch for main power and alarm system.

Extra large digital temperature display, with a resolution to 1°C.

On-board AC power monitoring with digital read-out of actual line voltage.

Clean filter indicator advises user to clean condenser intake filter.

Alarm/Monitoring System

Built-in safety alarm system with automatic continuous-charge battery back-up.

Low battery indicator

Touch-pad alarm test

Digital display of actual battery standby capacity

RS-232 data port

Power failure or temperature deviation triggers audible and visual warning.

Independent high and low alarm setpoints adjustable in 1°C increments

Low voltage indicator light

Exterior alarm contacts for remote alarm

Cabinet Construction

Recessed, heavy-duty casters

Noise abatement insulation package.

Minimum 5" foamed in placed urethane insulation, CFC free.

All-steel cabinet with high-impact epoxy finish for easy cleaning.

Built-in access port, 1" diameter

Heavy duty counter-balanced lid with keyed lid lock built-in for security

Full length lid handle

Independent, double-seal lid gaskets and sub-lids.

AIM (Automatic Incident Monitor):

Although you can't see this feature, it is extremely important for the ongoing safety of your stored samples. AIM monitors the temperature of the freezer and compares it to the alarm limits you have set. If the unit temperature ever exceeds an alarm limit, the appropriate alarm will flash rapidly, about one flash per second. If this condition ever occurs while you are not present and then self-corrects, AIM is activated. AIM lets you know that a temperature deviation occurred while you were gone but has self-corrected. Instead of flashing rapidly, the alarm will flash slowly, about one flash every 3 seconds. The most extreme chamber temperature registered during this deviation can be seen by simultaneously pressing the appropriate alarm set point button and the cabinet temperature button. This feature guarantees that you always know the temperatures of your stored samples. The slow flash of the AIM alarm can be reset by pressing the alarm reset button. The AIM monitor works for warm alarm, cold alarm, Life Guard, power failure, and extreme ambient alert.

Extreme Ambient Alert

This alarm monitors the ambient temperature in the area of the freezer. If the temperature ever gets too warm and could possibly effect the performance or reliability of your freezer, the Extreme Ambient Alert will activate. This alarm is also under the umbrella of AIM, so that you can be sure that safe temperatures exist even when no one is present. Comfortable ambient conditions lead to long life of your freezer and safety of the samples.

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MAINTENANCE AND REPAIR PROCEDURES

PREVENTIVE MAINTENANCE

Preventive maintenance is the best way to ensure that the unit you own or service continues to operate at its optimum level. The following instructions will help you in your preventive maintenance program.

Condenser Cleaning

Clean the condenser at least semi-annually; or more often if the equipment is located in a dust prone area.

Condenser Filter Cleaning

Clean the condenser filter every two or three months. Shake or vacuum the filter first, then rinse the filter in clean water. Let the filter dry, then replace the filter on the unit.

Gasket Maintenance

Periodically check the gaskets around the door or lid for punctures or tears. Gasket leaks are indicated by a streak of frost build up in the interior of the cabinet. Keep the lid and door gaskets clean and frost free by wiping gently with a soft cloth or brush.

Defrost Procedure

Defrost the cabinet every six to twelve months, depending on the amount of ice or frost on the cabinet interior. To reduce ice build up, daily brushing (with a soft brush) of the cabinet interior keeps the normal frost from turning into ice.

To defrost the cabinet, remove your product and turn the unit off by the key switch and unplug the power cord. Let the cabinet warm to room ambient temperature, then wipe down the cabinet interior using dry towels. Wash and rinse the interior of the cabinet with a solution of baking soda and warm water. Turn the unit on and allow it to pull down to set-point temperature, then reload your product back into the freezer.

Alarm Battery Maintenance

Check the condition of the alarm battery at least annually. Check the input charging voltage and the battery output voltage. The charging voltage input is 14 to 35 VDC depending the model. The battery voltage at full charge is 12 VDC.

Fan Motors

Most fan motors used today is a maintenance free (sealed type) and do not require oil maintenance, but some previous motors may come with an oil port. Inspection of the motor will determine which type is being used. If an oil port is present, then a couple of drops of oil once annually is sufficient.

PREVENTIVE MAINTENANCE (cont.)

Cabinet Leveling

Check the cabinet to ensure that it is level. Check from the front to the back and then side to side, check the level on a (6) month schedule.

Cabinet Clearance

Ensure that the cabinet has proper clearance, a minimum of six inches of space from the sides, back and top of the cabinet is required.

Voltage Requirements

Check the voltage requirements every three to six months. Verify that the source voltage is within +10 and -5 percent of the rated data plate voltage.

Center Air Temperature Validation

Check the center air temperature using a thermocouple located physically in the geometric center of the cabinet versus the control panel electronic display. The temperature should match the display within +/- 1°C for most models.

Electrical Wires

Check the electrical control box for any burnt or discolored wires due to lose connections or low voltage conditions.

a. Maintenance should only be performed by trained personnel.

b. For additional information or assistance you may contact TECHNICAL SERVICES at (800) 438 - 4851 or (704) 658 - 2891.

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RECOMMENDED TOOL LIST

One of the keys to doing a job correctly is using proper tools. The following list is NOT all-inclusive of the tools you might need to perform the procedures listed in this manual. However, these tools will be needed to perform many of the steps in these procedures.

Vacuum Pump (Capability of 50 microns)
Electronic Digital Thermometer (Reads below 200C)
Compound Gauge Set (4 way) with Hoses
AC Volt-Watt Meter
Hermetic Unit Analyzer
Manometer
Tachometer
Portable Oxy-Acetylene Torch Set
Regulator and Lines for Nitrogen
Flaring Set and Swaging Tool Set
Standard Hand Tools (Screw Drivers, Wrenches, Pliers, etc.)
Refrigerants; R12, R22, R502, R134a, R500, R290 (Instrument Grade Propane), MP66
Grit Cloth for Cleaning Lines
Cordless Driver-Drill (Reversible)
Vacuum Gauge (Electronic) Televac
Electronic Leak Detector (CFC and Non-CFC)
Electronic Refrigerant Charging Scales
Multimeter Volt-Ohm, Amp Meter (Analog and Digital)
On-Off Cycle Chart Recorder
Millie-Volt Meter
Sling Psychrometer
Presto Light Torch
Dry Nitrogen (Portable "R" Type Cylinder
Set of Flare Hand Valves or Process Tube Adapters
Tubing Cutter(s) Large and Small
Pinch Off Tool
Recovery System (with tanks)
Good Set of Tubing Bender
Tube Reamer

PROCEDURE 1
LEVELING OF A CHEST FREEZER

A unit that is not level will not operate properly. It can cause imbalances in products and can also cause problems in the refrigeration system. An unlevel unit can also cause misalignments of other components such as the door, lid, and/or the gasket.

The following steps will aid you in aligning a freezer unit.

Step 1: Locate the freezer in a level area free from vibration, with a minimum of six (6) inches (15.24 cm) of space on the sides, rear, and top. Also, allow enough clearance so that the door or lid can swing open at least 90 degrees.

Step 2: Place a carpenters level along the rear edge of the unit, and then along the right hand edge of the unit, to determine the offset from level.

Figure 401-1
Typical Chest Caster

Step 3: To level chest models, leave the casters in place and shim the low wheel/caster until the carpenter level indicates the unit is level from front to back and from side to side. Use strips of sheet metal at least 0.5 inches (1.25 cm) wider than the caster, placed underneath the caster to level the unit.

Step 4: To level upright models, use a 3/4" (19mm) open-end wrench to turn the front leveling leg until the carpenter level indicates the unit is level from front to back, and from side to side.

Thermo Electron Corporation

PROCEDURE 2
DEFROSTING A CHEST FREEZER

Every time a freezer is opened, a certain amount of water, depending on the relative humidity, enters the freezer compartment. This water obviously turns to frost, collecting on the sides and surfaces of the freezer. This frost accumulation can lead to decreased efficiency and temperature control.

It is recommended that the unit be defrosted when the ice accumulation reaches a thickness of 0.25" (6.4mm) or more.

Step 1: Transfer product to another freezer of equal temperature.

Step 2: Leave the unit set for the desired operating temperature, turn the power/key switch to the Power Off position, and unplug the unit's power cord.

Step 3: Open lid and leave the unit undisturbed for a minimum of twenty-four (24) hours; failure to do so could cause oil logging problems when the unit is restarted, thus preventing the unit from getting fully cold.

Step 4: Use towels or a sponge and bucket to collect the water on the cabinet floor and dry the walls.

PROCEDURE 2 (cont.)

Step 5: Start the unit by closing the lid, plug the power cord into the wall receptacle, and turn the power switch to the Power On position.

Step 6: Leave the temperature control set for the desired operating temperature and allow 10-12 hours of operation in order for the unit to return to operating temperature.

Step 7: If the unit has a selectable Alarm On position, select the Alarm On position after the temperature display is colder than the Warm Alarm setpoint.

Step 8: Monitor for proper operation.

Thermo Electron Corporation

PROCEDURE 3
LID ADJUSTMENT OF A CHEST FREEZER

The following steps will aid you in adjusting the lid of a chest type Ultra Low Temperature freezer.

Step 1: Ensure the freezer cabinet is level from front to back, and left to right.

NOTE
The hinge mounting screws are elongated for up and down positioning to obtain proper gasket seal on hinge side of lid.

Step 2: Loosen the hinge screws which attach the hinge to the cabinet.

Step 3: Align the cabinet for proper gasket seal.

Step 4: Tighten the hinge mounting screws.

Step 3: Fully open the lid

Step 4: With a 1/2" deep well socket, turn the hinge tension nut to compress the spring until the lid remains open.

Step 5: Close the lid and monitor unit for proper operation

Figure 403-1
Typical Chest Freezer Hinge

Thermo Electron Corporation

PROCEDURE 4
CHEST FREEZER GASKET REPLACEMENT

The following steps will aid you in replacing the gasket on a chest type Ultra Low Temperature freezer.

NOTE
The new gasket will be wrinkled and folded when it is unpacked. Immerse the gasket in warm water until it becomes pliable. Lay the gasket flat and allow to dry. Care should be taken not to stretch or tear the gasket during handling.

Step 1: Transfer product to another freezer of equal temperature.

Step 2: Leave the unit set for the desired operating temperature, turn the power/key switch to the Power Off position, and unplug the unit's power cord.

CAUTION
The hinges on a chest freezer are under tension when the lid is closed. Care should be taken to avoid injury.

Step 3: Remove the 5/16" screws that attach the lid hinges to the cabinet

Step 4: Remove the lid from the cabinet.

Step 5: Lay the lid, gasket side up, on a flat surface and remove the desired (inner or outer) gasket by pulling it straight away from the lid.

Figure 404-1
Typical Chest Freezer Hinge

Figure 404-2
Typical Chest Gasket

PROCEDURE 4 (cont.)

Step 6: Lay the new gasket in place and align the corners.

Step 7: Press the retaining rib (corners first) on the new gasket into the groove in the lid using a rubber hammer if necessary.

Step 8: Install the lid

Step 9: Reattach power supply.

Step 10: Turn power key on.

Step 11: Check unit for proper operation.

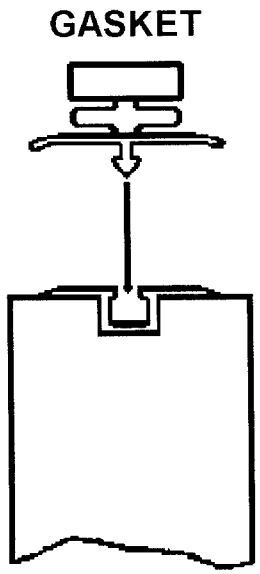


Figure 404-3
Gasket Insertion

Thermo Electron Corporation

PROCEDURE 5
HANDLE REPLACEMENT FOR CHEST FREEZER

The most used manual component of a freezer is the door or lid handle. The following steps are provided to give instructions on how to replace the handle of a chest freezer.

Step 1: Locate and remove the screws securing the handle. Be sure to retain the screws and any washers used.

Step 2: Remove the handle from door or lid.

Step 3: Set the new handle in its proper place and secure it to the door or lid using the screws and washers used in Step 1.

Figure 405-1
Typical Lid Handle

Thermo Electron Corporation

PROCEDURE 6
CHEST FREEZER LID LOCK REPLACEMENT

The following steps will aid you in replacing the lock on the lid of a chest type Ultra Low Temperature freezer.

Step 1: Remove the screws at the rear of the control housing cover.

Step 2: Slide the cover towards the rear of the unit approximately 2 inches. A rubber hammer may be needed to remove the control housing cover.

Step 3: Turn the control housing cover over. Remove the screw securing the pivoting tab to the locking mechanism.

Step 4: Remove the pivoting tab.

Step 5: Remove the nut securing the locking mechanism to the cover.

Step 6: Remove the locking mechanism from the cover.

Step 7: On the new locking mechanism; remove the screw securing the pivoting tab to the locking mechanism.

Step 8: Install the locking mechanism into the cover.

Step 9: Install the pivoting tab.

Figure 406-1
Typical Chest Freezer Lid Lock
(installed on the unit)

Figure 406-2
Chest Freezer Lid Lock Component Parts

PROCEDURE 6 (cont.)

Step 10: Verify the direction of rotation of the locking mechanism when the key is turned is correct.

Step 11: Install the screw to secure the pivoting tab.

Step 12: Install the cover. A rubber hammer may be needed to install the control housing cover.

Step 13: Install the screws at the rear of the control housing cover.

PROCEDURE 7
CHEST FREEZER HINGE REPLACEMENT

The following steps are provided to aid you in replacing the hinges on a chest type freezer unit.

CAUTION:
The hinges on a chest are under tension when the lid is closed. Care should be taken to avoid injury.

Step 1: Locate and remove the screws (retain the screws and any washers used) securing the bottom half of the hinge.

Step 2: Maintain hand pressure against the hinge as the last screw is removed to prevent the hinge from springing open.

Step 3: Locate and remove the screws (retain the screws and any washers used) securing the upper half of the hinge.

Step 4: Remove the hinge.

Step 5: Place and secure the new hinge, upper half first, using the screws and washers from step #1.

Step 6: Adjust hinges per PROCEDURE 3: LID ADJUSTMENT OF A CHEST FREEZER.

Step 7: Monitor unit for proper operation.

Figure 407-1
Typical Chest Freezer Hinge Assembly

Thermo Electron Corporation

PROCEDURE 8
LID ASSEMBLY REPLACEMENT AND SEAL CHECK ON CHEST UNITS

The following steps will aid you in replacing the lid assembly and performing a seal check.

Step 1: Transfer product to another freezer of equal temperature.

Step 2: Leave the unit set for the desired operating temperature, turn the power/key switch to the Power Off position, and unplug the unit's power cord.

Step 3: Remove the 5/16" screws that attach the lid hinges to the cabinet

CAUTION
There will be tension on the hinges with the lid closed

Step 4: Remove the lid from the cabinet.

Step 5: Remove the hinges and install on new lid.

Step 6: Place lid on cabinet and attach hinges back to the cabinet.

Step 7: Close the lid and make sure the gasket is sealing properly in the front of unit. There should be 7/8" of clearance between the lid and cabinet.

Figure 408-1
Typical Chest Hinge

PROCEDURE 8 (cont.)

Step 8: To adjust the lid tension , take a 1/2" deep weld socket and adjust the spring tension at the bottom of hinges.

Step 9: Reconnect power supply and turn key switch to the Power On position.

Step 10: Check unit for proper operation.

Figure 408-2
Chest Freezer Tension Adjusting Nut

Thermo Electron Corporation

PROCEDURE 9
BREAKER STRIP REPLACEMENT ON A CHEST FREEZER

The following steps will aid you in replacing the breaker strip on an Ultra Low Temperature freezer.

Step 1: Unload the freezer and allow it to warm completely.

Step 2: Locate and remove the screws that secure the corner retainer at each end of the breaker strip to be replaced.

Step 3: Remove the screws along the inner edge that secure the breaker strip to the cabinet.

Step 4: Remove the breaker strip.

Step 5: Install the new breaker strip.

Step 6: Install the corner retainers.

Figure 409-1
Chest Freezer Breaker Strip Retainers

Thermo Electron Corporation

PROCEDURE 10
CHEST FREEZER FILTER REPLACEMENT

It is important for the proper operation of the unit that the grill filter be changed periodically. This is necessary to insure proper air flow to the components in order that they remain cool.

The following steps are provided to aid you in changing out the filter on an upright or chest freezer.

Step 1: Open the front grill by pulling at the hand hold in the front grill. See Figure 416-1. The filter is attached to the backside of the front grill. The filter is held in place with Velcro patches that are secured to the back of the grill.

Step 2: Pull the filter loose from the grill.

Step 3: Install the new filter by aligning the filter with the grill and pressing firmly at the points of the Velcro.

Step 4: Close the front grill being sure the grill snaps closed. It may be necessary to apply pressure at the top and bottom corners of the grill for the snaps to catch.

Figure 410-1
Chest Freezer Filter Location

PROCEDURE 11
CASTER REPLACEMENT

The following steps will aid you in replacing the casters on a chest model.

Step 1: Carefully raise unit approximately two feet from the floor. Alternatively, block all the casters to prevent a personnel hazard caused by the unit rolling, and tilt the unit to access the problematic caster assembly.

Step 2: Remove the four bolts holding the caster assembly to the bottom of the cabinet; remove the caster assembly.

Step 3: Position new caster assembly in the location of the original caster assembly; install the four mounting bolts.

Step 4: Carefully lower the unit to the floor.

Step 5: Ensure unit is level in accordance with PROCEDURE 1: LEVELING OF A CHEST FREEZER.

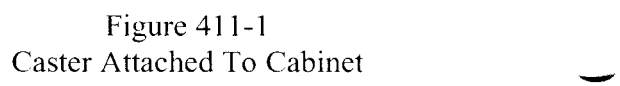


Figure 411-1
Caster Attached To Cabinet



Figure 411-2
New Caster

Thermo Electron Corporation

PROCEDURE 12
COMPRESSOR RELAY EVALUATION AND REPLACEMENT

When a single-phase motor is operating, there is a voltage produced across the starting windings above and beyond the voltage being applied to the motor. The starting windings produce a back electromotive force. The potential relay is designed to open, dropping the starting circuit, when the motor reaches a certain back electromotive force that is predetermined by the manufacturer of the motor. As the motor speed increases, so does the back electromotive force. When the speed approaches 75% to 80% of full speed, the back electromotive force will be large enough to drop the starting circuit by energizing the potential relay coil. The potential relay is easy to troubleshoot because there are only two parts of the relay that must be checked.

Follow the steps below in checking the potential relay and replacing a defective relay, if used.

NOTE
Units with scroll compressors will not normally use a compressor relay (PSC, permanent split capacitor compressor wiring configuration

Step 1: Turn the unit off with the switch and disconnect the power cord from the power source. If the unit is hard wired to a power source, de-energize and tag out the power disconnect to the unit. Reference O.S.H.A. regulations 1910-147 regarding tag out and de-energizing potential electrical sources.

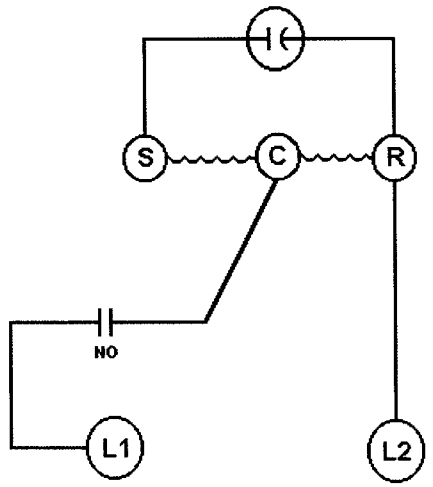


Figure 412-1
Compressor Relay (factory installed)

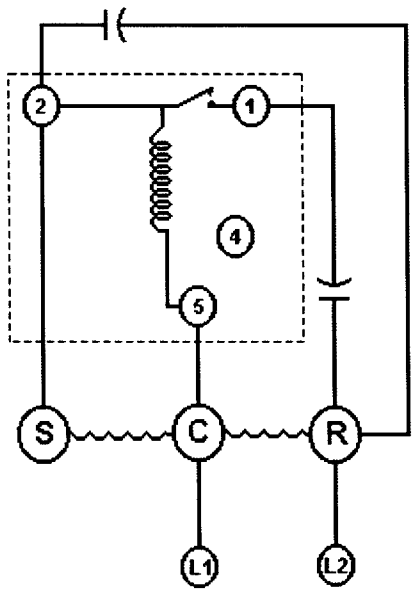


Figure 412-2
Compressor Relay (replacement)

PROCEDURE 12 (cont.)

Step 2: Mark each wire as to its location on the relay. Using small pliers carefully pull the connectors from the relay terminals. Pull straight out, do not move from side to side or up and down, this may cause a loose connection.

Step 3: Use an ohmmeter to check for continuity through the relay coil. The coil will check as good, open, or shorted. The coil terminals are 2 and 5. Use the Rx 20k scale setting.

Step 4: With an ohmmeter check across the relay contacts. Potential relay contacts are normally closed when the relay is not energized. The resistance of the contacts should be zero. The contact terminals are 1 and 2.

Step 5: If the coil or the contacts of the relay check as defective, the relay must be replaced. When replacing the relay, you must be sure and replace with a relay of the same rating.

Step 6: Remove the defective relay by removing the mounting screws.

Step 7: Secure the replacement relay.

PROCEDURE 12 (cont.)

Step 8: Reconnect the wires that were removed in step 1. This step should be very easy, since you should have marked each wire and its location on the relay. Push the wire terminals straight onto the relay terminals, being sure not to move them from side to side or up and down to avoid a possible loose connection.

Step 9: Connect the power cord to the power source. Remove any lock out/tag out devices installed and re-energize the system. Turn on/off switch on and test run unit.

Figure 412-3
New Compressor Relay

PROCEDURE 13
CONTROL RELAY EVALUATION AND REPLACEMENT

Follow the steps listed below in checking the control relay and replacing a defective relay.

Step 1: First make sure that there is proper voltage to the unit and that the control set point is lower than the digital display indicates the cabinet temperature to be.

Step 2: Check for voltage to the coil of the relay. In most cases on units that were manufactured after March 1992, this would be 24 volts AC.

Step 3: If you have voltage to the coil of the relay, then check across the contact side of the relay. If the relay is energized, the contacts should be closed and you would have a voltage reading of 00 volts. If the contacts are open you would read line voltage.

Step 4: If the relay coil is energized and the contacts are not closed, the relay must be replaced.

Step 5: Turn the unit off with the switch and disconnect the power cord from the power source. If the unit is hard wired to a power source, de-energize and tag out the power disconnect to the unit. Reference O.S.H.A. regulations 1910-147 regarding tag out and de-energizing potential electrical sources.

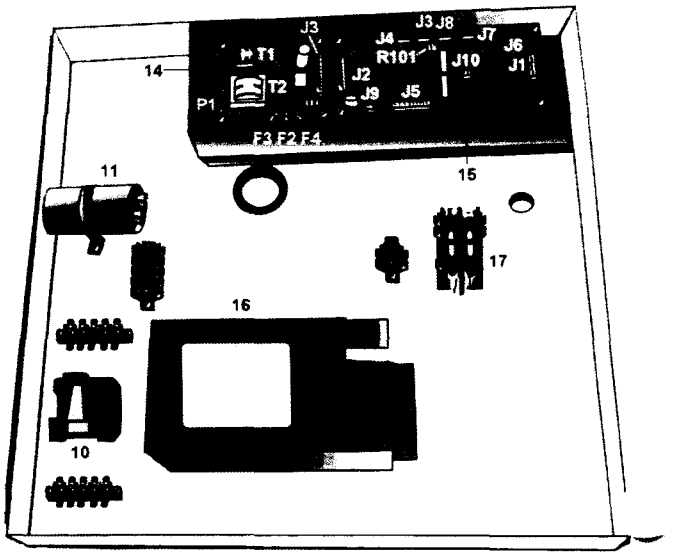


Figure 413-1
Control Relay Location
(Number 17 on illustration)

PROCEDURE 13 (cont.)

Step 6: Mark each wire as to its location on the control relay.

Step 7: Using small pliers carefully pull the connectors from the relay terminals. Pull straight out, do not move from side to side or up and down, this may cause a loose connection.

Step 8: Remove the four screws that mount the relay to the box and pull the relay out. Take note as to the way the relay was positioned into the electrical box.

Step 9: Secure the replacement relay into the electrical box. The replacement relay should be the exact same relay that was removed.

Step 10: Reconnect the electrical wires that were removed in step 6, pushing the wire terminals straight onto the relay terminals and being sure not to move them from side to side or up and down to avoid a possible loose connection.

Step 11: Check to be sure the key switch is still in the off position.

Step 12: Connect the power cord to the power source.

Figure 413-2
New Control Relay

PROCEDURE 13 (cont.)

Step 13: Remove any lock out/tag out devices installed and re-energize the system.

Step 14: Turn key switch to the power on position.

Step 15: Monitor unit for proper operation.

Thermo Electron Corporation

PROCEDURE 14
CAPACITOR EVALUATION AND REPLACEMENT

The following steps will aid you in evaluating and replacing a start or run capacitor, where used.

NOTE
Scroll compressors do not use start capacitors

Step 1: Turn the unit off by the power switch and disconnect power cord from the receptacle. If the unit is hard wired to a power source, de-energize and tag out the power disconnect to the unit. Reference O.S.H.A. regulations 1910-147 regarding tag out and de-energizing potential electrical sources.

Step 2: Mark each wire as to its location on the capacitor.

Step 3: Visually inspect the start capacitor. Any capacitor found to be bulging, leaking, or damaged must be replaced.

Step 4: Make sure capacitors are discharged before checking.

Step 5: With an ohmmeter, check for continuity between each capacitor terminal and the case. Continuity indicates a short and the capacitor must be replaced.

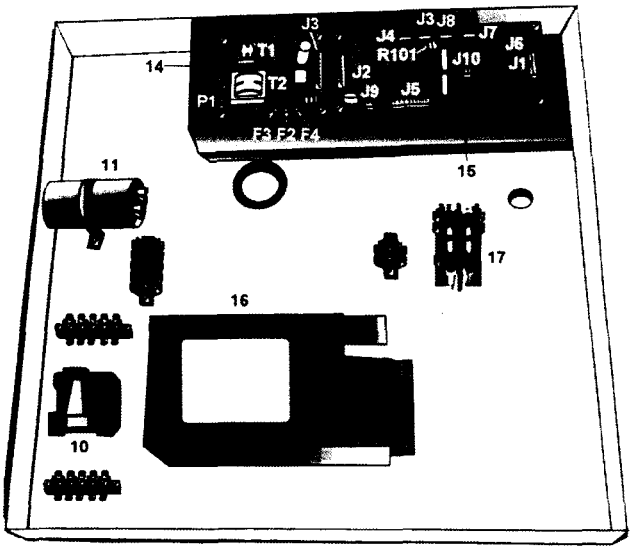


Figure 414-1
Run Capacitor Location, if used
(Number 11 on illustration)

PROCEDURE 14 (cont.)

Step 6: If a capacitor tester is not available, an ohmmeter set at the highest resistance scale can be used to check for shorts or open circuits in the capacitor.

Step 7: With a good capacitor, the indicator should first move to zero and then gradually increase to infinity.

Step 8: If there is no movement of the ohmmeter indicator, an open circuit is indicated.

Step 9: If the ohmmeter indicator moves to zero and remains there or on a low resistance reading, a short circuit is indicated.

Step 10: Always replace the capacitor with the same rated capacitor.

Step 11: Connect wires to capacitor terminals and secure capacitor into the bracket.

Step 12: Connect the power cord to the power source. Remove any lock out/tag out devices installed and re-energize the system.

Step 13: Turn power switch to on position.

Step 14: Monitor the unit for proper operation.

Figure 414-2
New Capacitor

Thermo Electron Corporation

PROCEDURE 15
VOLTAGE BOOST RELAY EVALUATION AND REPLACEMENT

The following steps will aid in evaluating and replacing the voltage boost relay on Ultra Low Temperature freezer. This relay is not used on 3 phase units.

CAUTION
High voltage is present!

Evaluation

Step 1: With the relay in the de-energized position, there should be no voltage to the coil terminals #1 AND #2. The common terminal #3 would be closed to terminal #6. With a voltmeter, check between terminals #3 AND #6; there should be zero volts. Between terminals #3 AND #5, should read line voltage.

Step 2: When the relay is energized, check between terminals #1 AND #2. This should read 24 volts AC. When the relay is energized, the common terminal #3 would be closed to terminal #5. With a voltmeter check between terminals #3 and #6; this should be line voltage.

Replacement

Step 1: Turn the unit off with the switch and disconnect the power cord from the power source. If the unit is hard wired to a power source, de-energize and tag out the power disconnect to the unit. Reference O.S.H.A. regulation 1910-147 regarding tag out and de-energizing potential electrical sources.

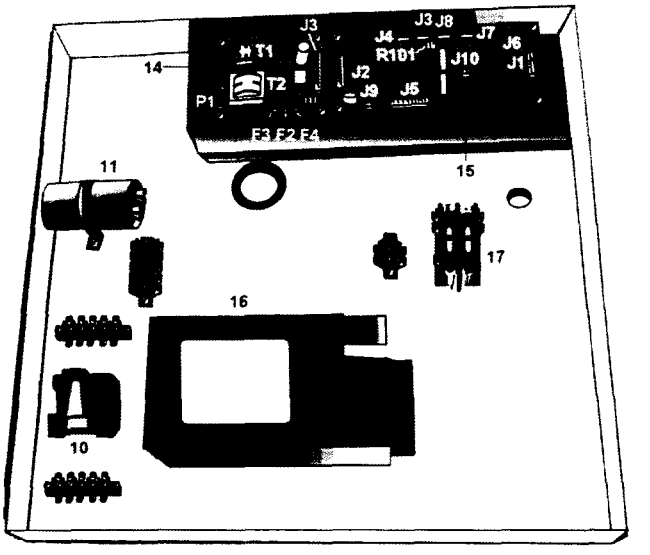


Figure 415-1
Voltage Boost Relay Location, if used
(Number 10 on illustration)

PROCEDURE 15 (cont.)

Step 2: Mark each wire as to its location on the relay.

Step 3: Loosen the terminal screws and remove the wires.

Step 4: Remove the two (2) mounting screws that secure the relay to the mounting plate.

Step 5: Secure the replacement relay with the same two (2) screws that were removed in Step 4.

Step 6: Reconnect the wires to the relay. This should be done with ease as the wires were marked before they were removed.

Step 7: Make sure that the screw terminals are tight to avoid any loose connections.

Step 8: Double check the wire positions for proper connections.

Step 9: Connect the power cord to the power source.

Step 10: Remove any lock out/tag out devices installed and re-energize the system.

Step 11: Turn on/off switch on and test run the unit.

Figure 415-2
Replacement Voltage Boost Relay, if used

Thermo Electron Corporation

PROCEDURE 16
SURGE SUPPRESSER EVALUATION AND REPLACEMENT ON A CHEST FREEZER

The surge suppresser on a chest model is mounted on the back of the control housing via four screws.

The following steps will aid you in replacing the surge suppresser. The surge suppresser is not used on 3 phase units.

Evaluation

Step 1: Ensure the green indicator light(s) on the surge suppresser is(are) lit; if not, replace the adjacent fuse. If the Check Fuse indication extinguishes, the problem is resolved; if not, proceed with Step 2.

Step 2: Disconnect the three-pin connector from the surge suppresser and ensure the Check Fuse indication illuminates.

Step 3: On the harness connector, use the center pin as the ground reference and measure to each of the outside pins. One is the 8.0 VDC power supply coming from the control board; the other pin typically measures ~7.8 VDC, and is the signal wire back to the control board.

Step 4: Jumper together the Ground and Signal pins. Proper operation of the harness, control board, and display board will be confirmed if the Check Fuse indication extinguishes; if so, replace the surge suppresser.

Figure 416-1
Surge Suppresser Location, if used

Replacement

Step 1: Turn key switch to the Off position and unplug unit from the wall electrical outlet.

Step 2: Pull freezer away from the wall to gain access to the surge suppresser.

Step 3: Unplug the three pin connector from the side of the surge suppresser.

Step 4: Remove the four Phillips screws from the top and bottom of the base, and remove the cover with the green indicator attached. Label, disconnect and withdraw the power leads from inside the suppresser.

Step 5: Remove the five Phillips screws affixing the suppresser to the cabinet and remove the suppresser.

Step 6: Install replacement surge suppresser, affixing it to the mounting bracket cabinet and replacing the five Phillips screws removed in Step 5.

Step 7: Insert and connect the power leads into the surge suppresser.

Step 8: Install the cover with the green indicator, and the four Phillips screws from the top and bottom of the base.

Figure 416-2
New Surge Suppresser, if used

PROCEDURE 16 (cont.)

Step 10: Connect the power cord to the power source.

Step 11: Remove any lock out/tag out devices installed and re-energize the system.

Step 12: Turn on/off switch on and test run the unit.

PROCEDURE 17
TEMPERATURE RECORDER REPLACEMENT

The temperature recorder is located on the front of the unit.

The following steps are provided to aid you in replacing the temperature recorder on an Ultra Low Temperature freezer.

CAUTION
High voltages may be present: service should be performed by qualified personnel only.

Step 1: Turn the main keylock to the "OFF" position and disconnect AC power from the unit.

Step 2: Open the recorder door and remove the screws that secure the recorder in place.

Step 3: Unplug the recorder AC power connector. This connector is located on a vertical pylon at the middle of the upper deck just behind the right end panel

Step 4: Disconnect the sensor wires from JP-1O on the RECORDER MAIN PCB.

Figure 417-1
Recorder Location

PROCEDURE 17 (cont.)

Step 5: Connect the sensor to the new recorder.

Step 6: Install the new recorder in the front panel opening.

Step 7: Connect the recorder AC power connector.

Figure 417-2
Recorder Main PCB

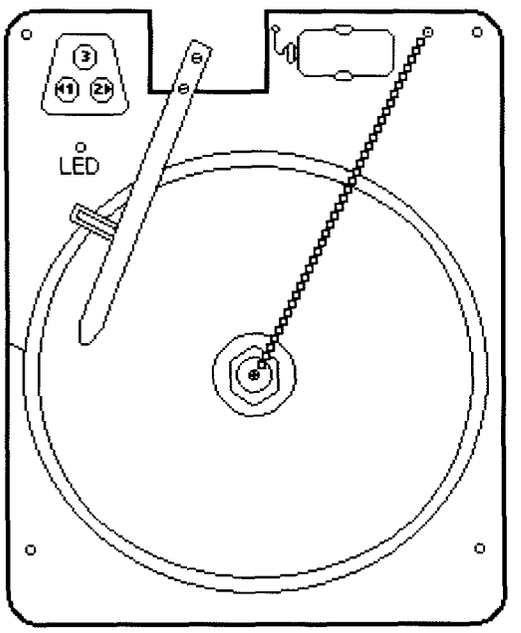


Figure 417-3
Typical Chart Recorder Face

Thermo Electron Corporation

PROCEDURE 18
TEMPERATURE RECORDER SENSOR REPLACEMENT

The temperature recorder sensor is located in the right rear corner of the chamber in the sensor shield.

The following steps will aid you in replacing the temperature recorder sensor.

CAUTION
High voltages may be present: service should be performed by qualified personnel only. The freezer must be at room temperature before beginning this procedure.

Step 1: Turn the main keylock to the "OFF" position and disconnect AC power from the unit.

Step 2: Open the recorder door and remove the screws that secure the recorder in place.

Step 3: Unplug the recorder AC power connector. This connector is located on a vertical pylon at the middle of the upper deck just behind the right end panel.

Step 4: Disconnect the sensor wires from JP-1O on the RECORDER MAIN PCB.

Step 5: Unscrew the screws securing the sensor shield in the freezer compartment.

Figure 418-1
Temperature Sensor Location

PROCEDURE 18 (cont.)

Step 6: Remove the recorder sensor from its mount on the sensor shield.

Step 7: Remove the grommets from both sides (freezer compartment and compressor compartment) of the access hole and separate the recorder sensor lead.

Step 8: Pull the old recorder sensor out.

Step 9: Install the new recorder sensor.

Step 10: Place the recorder sensor lead in the grommets on both sides (freezer compartment and compressor compartment) of the access hole and install the grommets.

Step 11: Install the recorder sensor in its mount on the sensor shield.

Step 12: Install the screws securing the sensor shield in the freezer compartment.

Step 13: Connect the sensor to the recorder.

Step 14: Install the recorder in the front panel opening.

Step 15: Connect the recorder AC power connector.

Figure 418-2
Recorder Sensor Cabinet Penetration

Thermo Electron Corporation

PROCEDURE 19
ALARM BATTERY EVALUATION AND REPLACEMENT

The following steps will aid you in evaluating and, if necessary, replacing the alarm battery.

Step 1: Locate the alarm battery, mounted on the floor behind the condenser filter grill.

Step 2: Connect the red lead of a voltmeter to the positive (+) terminal of the battery, and the voltmeter's black lead to the negative (-) terminal.

Step 3: Turn the unit Off and unplug the freezer from the wall receptacle and measure the battery voltage. The measured voltage should be ~12 VDC; if so, battery and charging circuit are good. However, if the unit has recently experienced a power failure a lower value will typically be measured until the battery has recharged. (See step 6)

Step 4: If the battery voltage is low (less than ~12 VDC) then disconnect the wire from the battery's positive terminal and connect the voltmeter to the two wires; plug the freezer into the wall receptacle.

a. If the freezer setpoints are adjusted with a small screwdriver, the voltmeter should measure 12-13 VDC if the charging circuit is good; if not, replace the control board.

Figure 419-1
Alarm Battery Location

b. If the freezer setpoints are adjusted with Up and Down arrow touch pads, the voltmeter should measure ~30-40 VDC; if not, replace the control board.

Step 5: If the battery voltage is low without a recent power failure, but the battery charging voltage is good, replace the battery as follows:

a. Label and disconnect the two leads from the gel cell battery.

b. Remove the screws and retaining strip; remove battery.

c. Install new battery in the reverse process.

Figure 419-2
New Alarm Battery

Step 6: Allow 7-10 days for the battery to fully charge.

Step 7: Monitor unit for proper operation.

PROCEDURE 20
VOLTAGE BOOST TRANSFORMER EVALUATION AND REPLACEMENT

CAUTION
THE PRESENCE OF LIFE-THREATENING VOLTAGES REQUIRES THESE TESTS BE PERFORMED ONLY BY TRAINED AND QUALIFIED PERSONNEL

Step 1: Locate the boost transformer by removing the control housing top/access cover behind the digital display.

NOTE
Be sure and reference the applicable wiring diagram to ensure proper wiring scheme while performing the following steps.

Step 2: With the unit plugged in and the power switch in the On position, ~208V to 240 volts should be measured across the primary leads of the transformer, and an additional ~14-16 VAC should be measured across the secondary leads (line voltage plus 14-16 VAC).

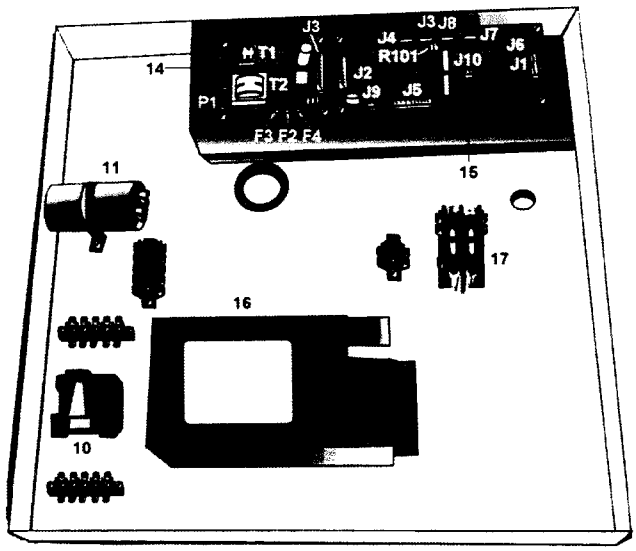


Figure 420-1
Buck/Boost Transformer Location (Chest)
(Number 16 on illustration)

PROCEDURE 20 (cont.)

Step 3: If the primary voltage and all wiring connections are correct but the secondary voltage is not, then replace the boost transformer as follows. If the primary voltage is incorrect then check the wiring to the primary side of the transformer.

a. Turn the unit Off and unplug the unit.

b. Label each of the wires as to their function and pin number.

c. Remove the four mounting bolts securing the transformer to the cabinet.

d. Install the new transformer by reversing the process.

Step 4: Test the new transformer by performing Step 2, above. If the reading is not 14-16 VAC above line (primary) voltage is still not measured on the secondary, check all wiring and connections before calling the factory for assistance.

Step 5: Replace covers removed in Step 1.

Step 6: Monitor for normal operation.

Figure 420-2
New Buck/Boost Transformer

Thermo Electron Corporation

PROCEDURE 21
"MICRO" CONTROL PRINTED CIRCUIT BOARD EVALUATION AND REPLACEMENT

The junction box which houses the "Micro" Control PCB is in the right end of the unit; beneath the upper cover.

CAUTION
High voltages may be present: service should be performed by qualified personnel only.

Evaluation

Check inputs and outputs per the following:

J1 Display PCB connector - no checks can be made.

J2 Power Supply PCB connector-10 pin.
- PIN 1 +Vdc line voltage monitor for low voltage detection and voltage boost control.
- PIN 2 Monitor ground.
- PIN 3 30 VDC - main power for the control board.
- PIN 4 24 VAC triac voltage return
- PIN 5 24 VAC triac.
- PIN 6 Ground
- PIN 7 LED return
- PIN 8 NC (no connection)
- PIN 9 Battery +12 VDC (from J3 PIN 2 of the Power Supply PCB).
- PIN 10 Battery -12 VDC (from J3 PIN 1 of the Power Supply PCB).

PROCEDURE 21 (cont.)

J3 Cabinet Sensor connector -
Pins 1 & 2
No board checks can be made.

J4 Heat Exchanger sensor connector -
Pins 1 & 2
No board checks can be made.

J5 Triac Output connector
PIN 2 24 VAC output of triac 1 to compressor #1 contactor
PIN 4 24 VAC output of triac 2 to compressor #2 contactor where used.
PIN 6 24 VAC output of triac 3 to delog heater where used.
PIN 8 24 VAC output of triac 4 to voltage boost
PIN 10 24 VAC output of triac 5 to unused.
PINS 1, 3, 5, 7 & 9 connected to 24 VAC.

J6 Remote Alarm Contact connector
PIN 1 normally open (NO) contact.
PIN 2 normally closed (NC) contact.
PIN 3 common (C) contact.

J7 Ambient Sensor connector -
Pins 4 & 5
No board checks can be made.

J8 Compressor Sensor connector (where used) - Pins 1 & 2.
Condenser Sensor connector - Pins 4 & 5
No board checks can be made.

J9 Key Switch connector
(when terminals are connected; controller is "ON")

J10 RS-232 connector
PIN 1 RXD
PIN 2 TXD
PIN 3 ground

J11 not connected
J12 not connected
J13 not connected
J14 not connected
J15 not connected

J16 Surge Suppresser connector
PIN 1 logic signal (a logical 1 is >2,4<5.0 VDC; a logical 0 is <2.4 VDC).
PIN 2 ground.
PIN 3 8.0 VDC source.

Replacement

NOTE
Always wear a personal grounding device before handling the PCB(s).

CAUTION
High voltages may be present: service should be performed by qualified personnel only.

PROCEDURE 21 (cont.)

Step 1: Disconnect unit from power supply.

Step 2: Disconnect battery.

Step 3: Label and disconnect the connectors on the "Micro" Control PCB.

Step 4: Remove the 6 screws that secure the "Micro" Control PCB.

Step 5: Remove the "Micro" Control PCB.

Step 6: Install the new "Micro" Control PCB.

Step 7: Install the 6 screws that secure the "Micro" Control PCB.

Step 8: Connect the connectors, following the labels.

Step 9: Plug in the freezer and turn on the keylock to the "Power On" position.

Step 10: When the 1st stage compressor starts, press the following four (4) buttons at the same time: CABINET TEMP; COLD ALARM; DOWN ARROW; VOLTAGE LOW.

Step 11: Adjust R-101 full counter-clockwise on the "Micro" Control PCB, in accordance with applicable steps of PROCEDURE 43: "MICRO" CONTROL BOARD POTENTIOMETER "R101" ADJUSTMENT

Step 12: Adjust VR-1 on the "Micro" Power Supply PCB per PROCEDURE 22: "MICRO" POWER SUPPLY PRINTED CIRCUIT BOARD EVALUATION AND REPLACEMENT

Step 13: Install the covers and allow the unit to pull down before loading.

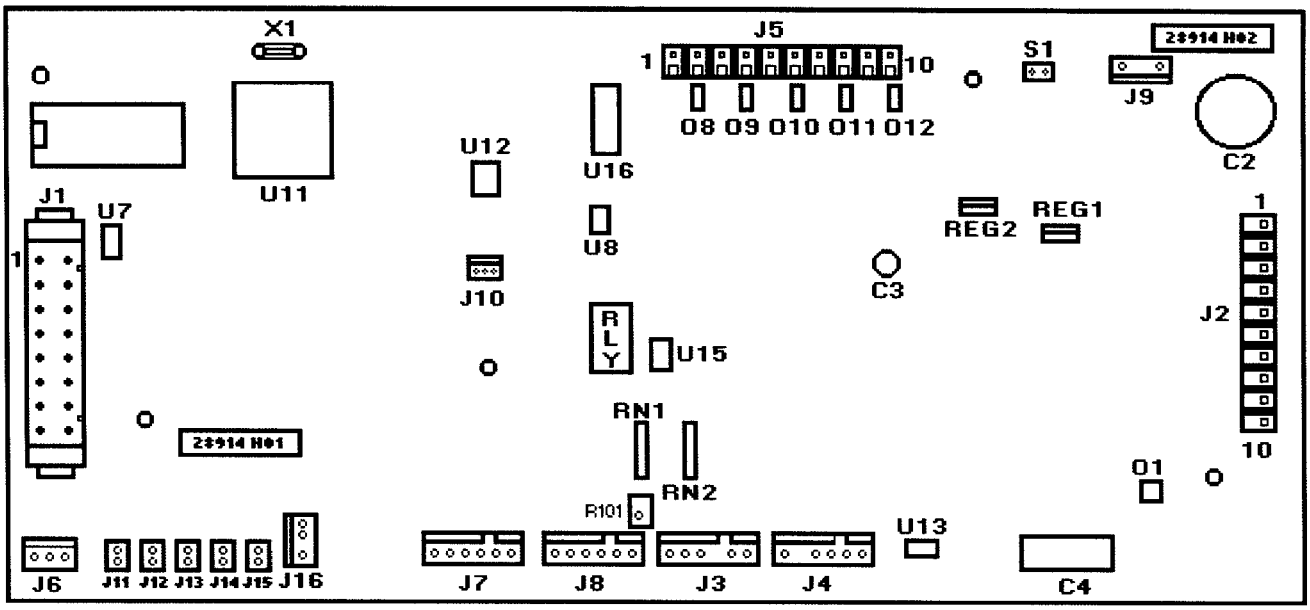


Figure 421-1
"Micro" Control Board
(component side)

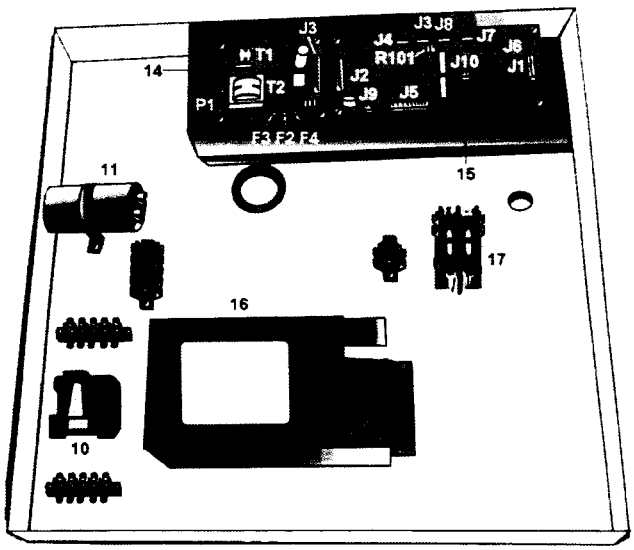


Figure 421-2
"Micro" Control Board
(Number 15 on illustration below)

PROCEDURE 22
"MICRO" POWER SUPPLY PRINTED CIRCUIT BOARD EVALUATION AND REPLACEMENT

The junction box which houses the "Micro" Power Supply PCB is in the right end of the unit, beneath the upper cover.

CAUTION
High voltages may be present: Service should be performed by qualified personnel only.

Evaluation

Check inputs and outputs per the following:

J1 AC Power Unit
- PIN 1 Line 1 (L1).
- PIN 2 NC (no connection).
- PIN 3 Line 2 (L2) on 208/230 VAC systems.
- PIN 4 Neutral (N) on 120 VAC systems.

NOTE
For the "H03" revision board: PIN 3 and PIN 4 are connected together and the input voltage is selected by the onboard voltage selector slide switch. The onboard voltage selector slide switch replaces the jumper block (detailed below).

J2 Alarm Back-Up Battery connection - 2 pin.

PIN 1 Battery +12 VDC (connects to J3 PIN 2 of the Power Supply PCB).

PIN 2 Battery -12 VDC (connects to J3 PIN 1 of the Power Supply PCB).

J3 "Micro" Control PCB connector - 10 pin

PIN 10 +Vdc line voltage monitor for low voltage detection and voltage boost system control (see VR-1 instructions below for adjustment).

PIN 9 Monitor ground.

PIN 8 30 VDC - main power for the control board.

PIN 7 24 VAC triac voltage return.

PIN 6 24 VAC triac

PIN 5 Ground

PIN 4 LED return

PIN 3 NC (no connection).

PIN 2 Battery +12 VDC (feeds J2 PIN 9 of the "Micro" Control PCB).

PIN 1 Batter -12 VDC (feeds J2 PIN 10 of the "Micro" Control PCB).

JUMPER BLOCK Three jumpers used on the "H01" and "H02" revision boards for selecting the input line voltage.

FUSES Four fuses, each rated for 250 volts, are used to protect the system.

F1 0.75 amp. Input power protection.

F2 1.25 amp. Protects the 24 VAC for the triac circuits.

F3 1.25 amp. Fast acting protection for 30 VDC power to the "Micro" Control PCB.

F4 1.25 amp. Alarm battery back-up circuit protection.

Replacement

NOTE
Always wear a personal grounding device before handling the PCB(s).

CAUTION
High voltages may be present: service should be performed by qualified personnel only.

Step 1: Disconnect unit from power supply.

Step 2: Disconnect battery.

Step 3: Label and disconnect the connectors on the "Micro" Power Supply PCB.

Step 4: Remove the 4 screws that secure the "Micro" Power Supply PCB.

PROCEDURE 22 (cont.)

Step 5: Remove the "Micro" Power Supply PCB.

Step 6: Install the new "Micro" Power Supply PCB.

Step 7: Install the 4 screws that secure the "Micro" Power Supply PCB.

Step 8: Connect the connectors, following the labels.

Step 9: Plug in the freezer and turn on the keylock to the "Power On" position.

Step 10: Adjust VR-1 on the "Micro" Power Supply PCB.

a. Measure the input voltage at J1 on the "Micro" Power Supply PCB.

b. Press the "Voltage Low" on the control panel.

c. Adjust VR-1 on the "Micro" Power Supply PCB until the value "read" in Step 10.b is equal the value measured in Step 10.a.

Step 11: Install the covers and allow the unit to pull down before loading.

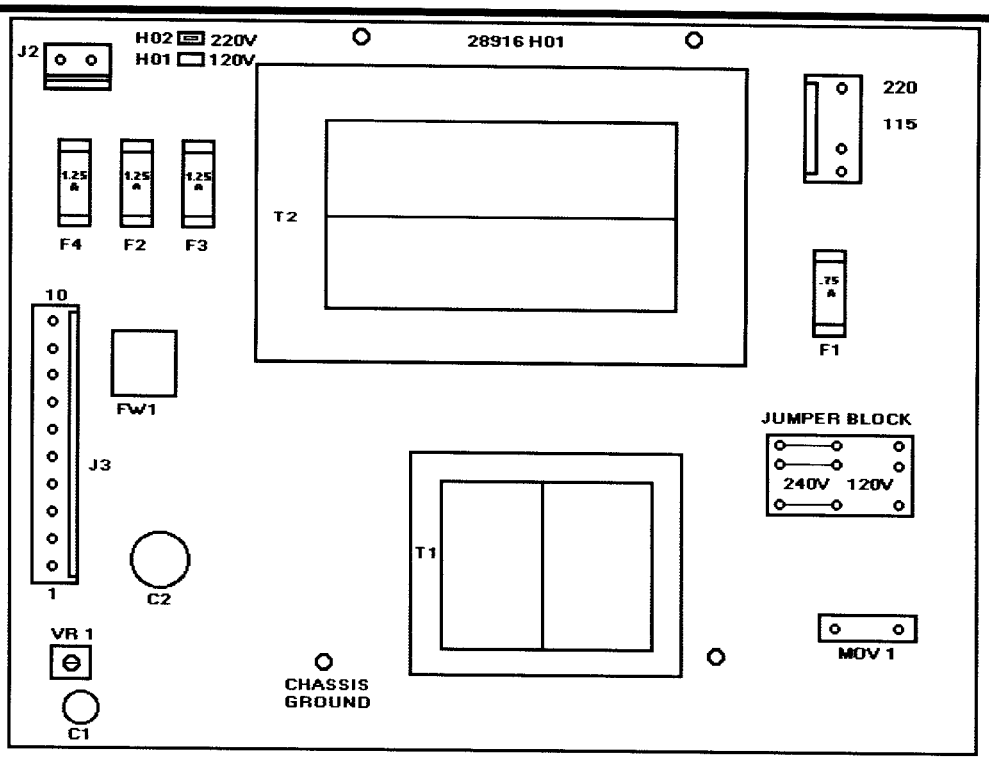


Figure 422-1
"Micro" Power Board

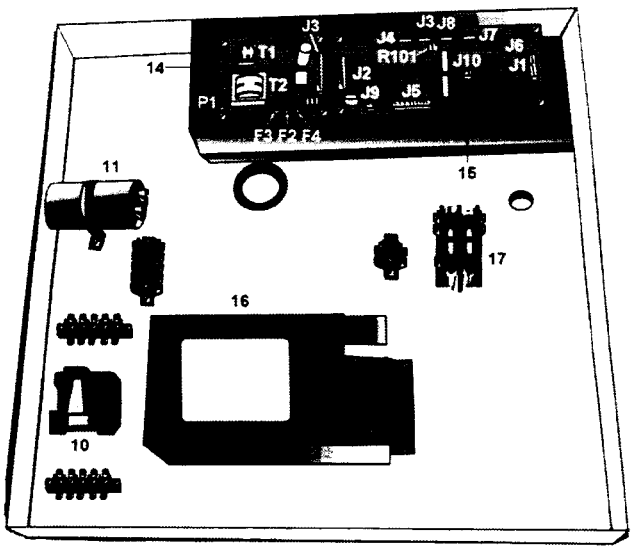


Figure 422-2
"Micro" Power Board
(Number 14 on illustration)

PROCEDURE 23
"MICRO" DISPLAY PRINTED CIRCUIT BOARD

The "Micro" Display PCB is located beneath the upper cover at the right end of the chest freezers.

Accessing the "Micro" Display PCB on an Ultima Chest

Step 1: Remove the control housing cover.

Step 2: Remove the screws (and nuts if present) from the back of the control panel.

Step 3: The "Micro" Display PCB may be accessed at the back of the control panel.

Evaluation

Check inputs and outputs per the following

JP1 "Micro" Display PCB connector.
No checks can be made

JP3 Alarm Key Switch connector
PIN 1 24 VDC when the "Alarm On" key switch position is selected.
PIN 2 NC (no connection).

JP4 Backup System connector (present only if the unit has built-in backup system).
PIN 1 12 VDC when the backup system is turned "ON".
PIN 2 12 VDC when the backup system liquid supply is "Empty".

JMP1 on for Setpoint Security (where used).
JMP2 on for First Stage Over-Temperature Alarm
JMP3 on for Extreme Ambient Temperature Alarm (where used).
SW1 Configuration DIP Switch
S1, S2, & S3 are used for voltage code selection.
S4 should be "ON" for all applications
S5 should be "ON" if the unit is equipped with a Surge Suppresser.
S6 should be "ON" if the unit is equipped with a Voltage Safeguard.

Replacement

NOTE
Always wear a personal grounding device before handling the PCB(s).

CAUTION
High voltages may be present: service should be performed by qualified personnel only.

Step 1: Label and disconnect the connectors on the "Micro" Display PCB.

Step 2: Remove the screws that secure the "Micro" Display PCB.

PROCEDURE 23 (cont.)

Step 3: Remove the "Micro" Display PCB.

Step 4: Set the jumpers (JMP1, JMP2, & JMP3) and the Configuration DIP Switch on the new "Micro" Display PCB to the same positions as on the original "Micro" Display PCB.

Step 5: Install the new "Micro" Display PCB.

Step 6: Install the screws that secure the "Micro" Display PCB.

Step 7: Connect the connectors to the "Micro" Display PCB following the labels.

Step 8: Install the covers.

Step 9: Plug in the freezer and turn on the keylock to the "Power On" position.

Step 10: Allow the unit to pull down before loading.

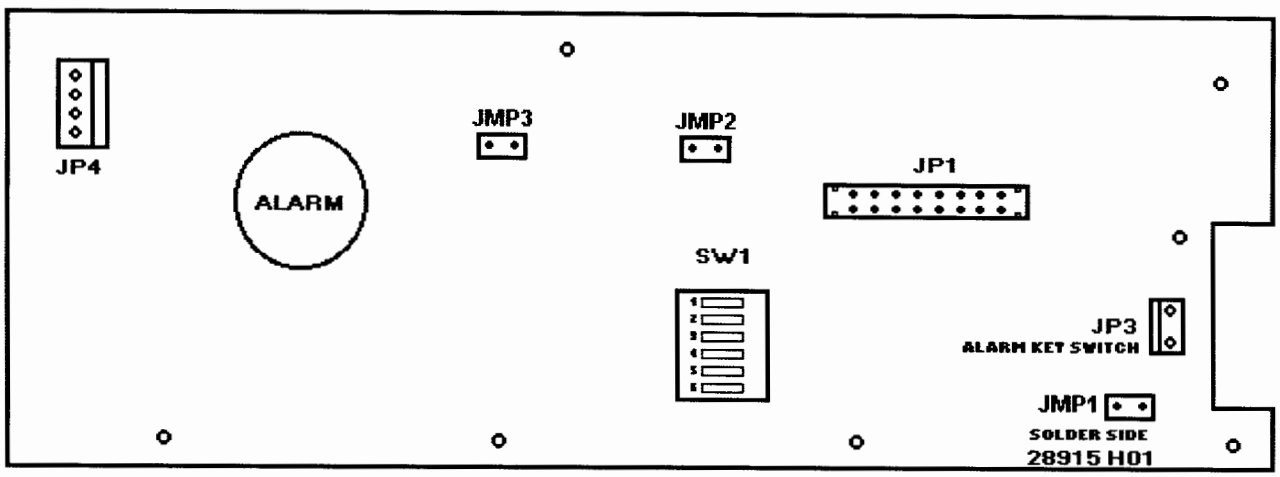


Figure 423-1
Display Board
(solder side)

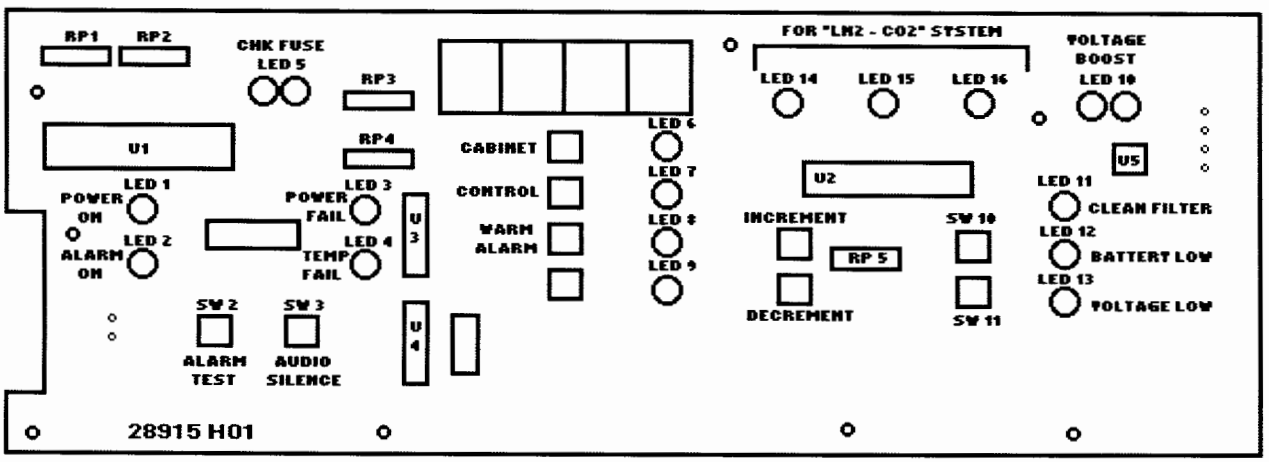


Figure 423-2
Display Board
(component side)

Thermo Electron Corporation

PROCEDURE 24
CONTROL DISPLAY HARNESS REPLACEMENT

The control display harness is used to carry the electrical current and signal between the display board and the control board. Failure of this harness will result in temperature malfunction of the system.

Step 1: Turn the power off first by turning the key switch to the off position.

Step 2: Unplug the power cord from the wall receptacle. Follow O.S.H.A. regulations' 1910-147 regarding tag out and de-energized potential electrical sources.

Step 3: Check for any voltage at the input power terminal; there should be zero potential.

Step 4: Remove the end panel screws; this is the solid panel on the right side, facing the unit. Set the panel and screws aside.

Step 5: To gain access to the control display harness, remove the screws securing the control deck cover. These screws are located in the back side of the cabinet, just above the power cord and alarm terminals.

Step 6: After removal of these screws, pull the cover up and slide it backwards away from the display panel. Remove and set the cover aside.

Figure 424-1
Display Harness Location

PROCEDURE 24 (cont.)

Step 7: Locate the screws holding the display housing cover and remove.

Step 8: Pull the display housing up toward you and slide forward.

CAUTION
Wear a grounding strap when working with any electronic controls. Without a grounding strap, high static electricity may damage the new controls. Before attempting to remove the control board, remove one electrical lead from the 12 VDC battery post.

Step 9: Locate the 16 pin harness (lockable IDC connector header) male connector on the display board and pull or push the clamps opposite of each other. This will release the connector plug from the header pin.

Step 10: Locate the 16 pin harness (lockable IDC connector header) male connector on the control board and pull or push the clamps opposite of each other. This will release the connector plug from the header pin.

Step 11: Remove the defective harness and replace it with the new harness.

Step 12: Place the male connector plug into the header pin housing on both the display and control boards.

PROCEDURE 24 (cont.)

Step 13: With the plug in place PUSH the plug downward, this will cause the clamps to self-lock.

Step 14: Reassemble the display housing to the electrical deck using the screws previous removed.

Step 15: Reassemble the electrical control cover with the screws previous removed.

Step 16: After checking all connections to ensure you have good electrical connections, then reconnect the AC power and the battery system wires.

Step 17: Test the system electrically for proper operation.

Thermo Electron Corporation

PROCEDURE 25
CABINET CONTROL / DISPLAY SENSOR EVALUATION & REPLACEMENT

The Cabinet Control / Display Sensor is located in the right rear corner of the chamber in the sensor shield.

Evaluation

> **CAUTION**
> High voltages may be present: service should be performed by qualified personnel only.

Step 1: Unplug the Cabinet Control / Display Sensor where it terminates at the control board J3 connector.

Step 2: Measure the resistance of the Cabinet Control / Display Sensor. Place the meter leads between the white and green wires.

Step 3: Find this resistance and the corresponding temperature in the RTD RESISTANCE TABLE (see appendix).

Step 4: Measure the temperature in the freezer compartment.

Step 5: If the temperature measured in step #4 does not equal the temperature found in step #3; replace the Cabinet Control / Display Sensor.

Figure 425-1
Cabinet Control/Display Sensor Location

Replacement

CAUTION
High voltages may be present: service should be performed by qualified personnel only.

NOTE
The freezer must be at room temperature before beginning this procedure

Step 1: Turn the main keylock to the "OFF" position and disconnect AC power from the unit.

Step 2: For Micro Control chest units; unplug the sensor connector at the front of the junction box.

Step 3: For Micro Control upright units; unplug the sensor connector at the rear of the junction box. Remove the lower right side panel and the lower rear panel to the access the rear of the junction box.

Step 4: Unscrew the screws securing the sensor shield in the freezer compartment.

Step 5: Remove the from its mount on the sensor shield.

Step 6: Remove the grommets from both sides (freezer compartment and compressor compartment) of the access hole and separate the Cabinet Control / Display Sensor lead.

PROCEDURE 25 (cont.)

Step 7: Pull the old Cabinet Control / Display Sensor out.

Step 8: Install the new Cabinet Control / Display Sensor.

Step 9: Place the Cabinet Control / Display Sensor lead in the grommets on both sides (freezer compartment and compressor compartment) of the access hole and install the grommets.

Step 10: Install the Cabinet Control / Display Sensor in its mount on the sensor shield.

Step 11: Install the screws securing the sensor shield in the freezer compartment.

Step 12: Plug the sensor into the connector in the junction box.

Step 13: Install all panels

Step 14: Connect power, turn unit on and test for proper operation.

Thermo Electron Corporation

PROCEDURE 26
AMBIENT/CONDENSER SENSOR EVALUATION AND REPLACEMENT

The following steps will aid you in evaluating and replacing the Ambient / Condenser Sensor on a Chest type Ultra Low Temperature freezer.

Evaluation

Step 1: To check the Ambient Sensor remove connector J7 and check the millivolt signal between the red and black wires, pins 4 & 5. Compare the reading to the temperature / voltage table to determine if the sensor is good.

Step 2: To check the Condenser Sensor, remove connector J8 and check the millivolt signal between the red and black wires at terminals 4 & 5. Compare reading with the temperature/voltage table to determine of the sensor is good.

Step 3: If the "clean filter light" is on and the filter and condenser are clean, the sensor needs to be rezeroed. To rezero:

a. Turn the power off at the key switch

b. After 5 minutes, restart the unit and immediately press and hold the following buttons: CABINET TEMPERATURE; COLD ALARM; DOWN ARROW; VOLTAGE LOW. If successful, the display will read "00" and the clean filter light should go out.

Figure 426-1
Ambient/Condenser Sensor Locations

Replacement

Step 1: To replace the ambient sensor, open the filter door. The sensor is located in the middle of the cabinet sealed in a rubber tubing. Remove the sensor and trace the cable back to the electrical junction box.

Step 2: Remove all necessary wire ties and replace in the reverse order.

Step 3: To replace the condenser sensor, locate the sensor well on the side of the condenser. Remove the sensor and trace the sensor cable back to the electrical junction box. Remove all necessary wire ties and reinstall in the reverse order. Be sure to reseal the sensor in the condenser well.

WARNING
When performing work inside the electrical junction box, make sure the unit is deenergized, unplugged and the circuit breaker is locked and tagged out.

Thermo Electron Corporation

PROCEDURE 27
EVALUATION AND REPLACEMENT OF FAN MOTOR AND BLADE

The following steps will aid you in performing an evaluation of the performance and a replacement of a freezers condenser fan motor.

Evaluation

Step 1: If the condenser fan motor blades are not turning, check to make sure the blades are not binding on fan shroud, tubing, etc.

Step 2: If the blades are free, check for loose electrical connections and voltage to the motors.

Step 3: If connections and voltages are good, check the motors for an open motor winding by checking resistance across motor leads.

Replacement

Step 1: Unplug the freezer from the electrical source to which it is connected.

Step 2: Remove the four 5/16" Phillips screws holding the motor bracket to the unit pan.

Step 3: Disconnect all electrical connections from condenser fan.

Figure 427-1
Condenser Fan

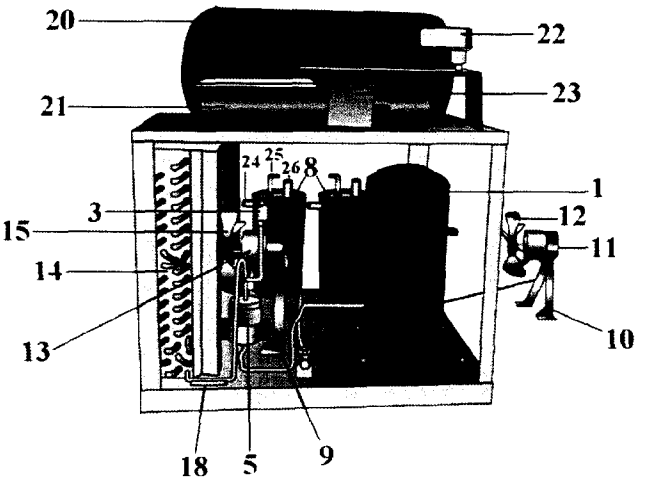


Figure 427-2
Fan Assembly Location
(Numbers 9, 13, & 15)

PROCEDURE 27 (cont.)

Step 4: Remove the fan blade by turning the Allen set screw on the fan blade hub counter clockwise and removing the blade from the motor shaft.

Step 5: Remove the motor bracket by removing the four 1/4" screws attaching the bracket to the motor.

Step 6: Install the new motor as follow:

a. Using 1/4" screws, attach the bracket onto the new motor.

b. Place the blade on the motor making sure the Allen screw is secure on the flat part of the motor shaft.

c. Install and tighten the blade Allen screw nut.

d. Reinstall the fan motor bracket into the base.

e. Reconnect the electrical connection

Step 7: Reconnect power supply and check for proper operation.

Figure 427-3
Typical Fan Motor Assembly

Thermo Electron Corporation

PROCEDURE 28
REFRIGERATION SYSTEM CLEAN-UP/FLUSHING

The following steps will aid you in performing a cleanup/flush of the refrigeration system of an MRA or Auto Cascade Ultra Low Temperature freezer.

Step 1: Turn the power off first by turning the key switch to the off position.

Step 2: Unplug the power cord from the wall receptacle. Follow O.S.H.A. regulations 1910-147 regarding tag out and de-energized potential electrical sources.

Step 3: Check for any voltage at the input power terminal; there should be zero potential.

Step 4: Install line taps on the process tubes of both H1, H4, and H5 (see Figure 428-2).

NOTE
Line taps are to be used for refrigerant recovery ONLY. No evacuation or charging should be done using line taps.

NOTE
Do not pierce the line at this time. Follow line tap manufacturing instructions for installation and line piercing of system.

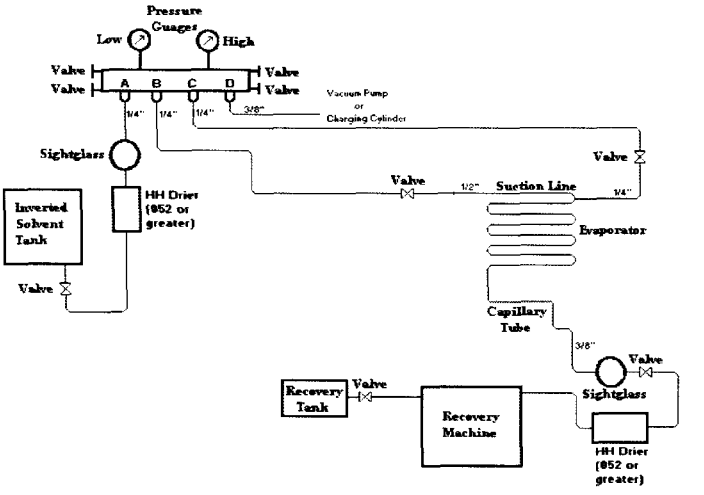


Figure 428-1
Possible Flushing Setup
Using a 4-Way Manifold

CAUTION
When working with refrigerants, hand, eye and face protection is required. Liquid refrigerants are very cold in nature; therefore may cause burns. There may also be a possibility of an acid condition due to a compressor burn out.

Step 5: It will be necessary to recover the refrigerant charge from the system. Recover the refrigerant charge in accordance to State and Federal EPA regulations. You will need to pierce the line after connection of the hoses to the manifold gauges.

Step 6: Take an oil sample of the oil for an acid test, if positive then special care is required. Compressor and other components will need to be replaced later after flushing of the system is complete.

NOTE
If the system is acidic, then soak the entire system with R-11. Soak for at least 48 hours. Remember to install a pressure relief with a rating of 400 psi in one of the process tubes.

Step 7: After recovering the refrigerant, purge the system with a nitrogen charge. Only a low system charge is required.

PROCEDURE 28 (cont.)

Step 8: Clean the tubing at the location of where you plan to cut the tubing. When cutting the tubing use proper tubing cutters. Do this cleaning by using some sort of sanding cloth.

NOTE
Do not use any type of steel wool or sand paper, emery cloth is preferred.

Step 9: Cut the three tubing lines approximately eight (8) inches from the cabinet. These three lines are the 1/2 inch suction, the 3/8 inch liquid, and the 1/4 inch line to the bypass valve. (See Figure 428-2)

Step 10: Install process tube adapters on the three lines. These connectors are used for ease of connecting the flushing hoses.

Step 11: Connect the flushing hoses as per the drawing, using the valves, drier(s), and sight-glasses. See Figure 428-1.

a. Install a dryer and sightglass in line of first port (A) on low side of four port manifold gauge.

b. Install process line from second port (B), of four port manifold, to 1/2" line of cabinet gauge.

c. Install process line from third port (C), of four port manifold gauge, to 1/4" bypass line coming from cabinet.

PROCEDURE 28 (cont.)

d. Install a process line from 3/8" line at cabinet to a sightglass, then to a shutoff valve, a dryer, and then to the recovery machine using flare nuts.

NOTE
Flushing solvent recommended is either R-12 or R-142b/R-22 in a 60/40 mix.

Step 12: Add dry nitrogen pressure, approximately 150 to 200 psi, in order to maintain a high pressure push of liquid through the system being flushed.

Step 13: Invert your liquid solvent tank and allow the liquid to go through the compound side of the gauge. Use the shut-off valve to control the flow into the evaporator. This is a reverse flow process.

Step 14: Use a recovery tank to collect the re-condensed flushing solvent after the recovery machine. If your recovery machine is capable of condensing the flushing solvent fast enough you may by pass the recovery tank and connect back to a tee leading into the compound side of the manifold gauge. This will allow the solvent to be used over and over.

PROCEDURE 28 (cont.)

Step 15: During the flushing process, the important thing to remember is to keep a **liquid** in and **liquid** out flush. It is vitally important that the fluid remain a liquid. The shut off valve prior to the recovery machine is used to control this liquid flow.

Step 16: View the flow through the sight glass. If liquid is not present, then close the valve in order for the pressure and liquid to build up in the evaporator (remember, you are flushing in reverse flow). If there is not a liquid in and out flow, then proper cleaning of the capillary tube and suction tubing is not being obtained.

Step 17: Cleaning or flushing time will depend on the reclaim system you are using, the condition of the system you are flushing, and the type of flushing solvent used. Average flushing time is 40 minutes or greater with 15 lbs or more of flushing solvent through the system.

NOTE
These are only estimates, actual amounts and times will need to be determined by you for a properly cleaned system.

NOTE
REMEMBER, DO NOT TAKE SHORT CUTS, BECAUSE THEY WILL ONLY CAUSE FAILURE LATER.

NOTE
Follow the requirements of your recovery/reclaim machine. There may be filters located inside the machine which require replacing. Following any safety warnings that may apply for your recovery machine.

Step 18: Alternate the flow of liquid from ports "B" and "C" to ensure proper flushing of the evaporator and internal heat exchangers.

Step 19: During the flushing process, note the sight glass for clean liquid flow. If at any time you view any sludge, oil or dirt of any kind, then continue flushing the system until the solvent is clean and clear. Don't be fooled if after a few minutes the sightglass is clear and stop flushing.

Step 20: Continue flushing no less than 15 to 20 minutes after the sight glass is clean while still maintaining a clear, solid liquid flow.

Step 21: After flushing the evaporator side of the system, follow the same hook up procedure for the condenser side of the system.

PROCEDURE 28 (cont.)

Step 22: When flushing of both sides of the system is complete, always install a new system liquid drier, oil separator, compressor (if required) and any other components or tubing necessary.

Step 23: Remove process tube adapters and reconnect the three tubing lines at the cabinet.

Step 24: Follow other procedures for replacing the drier and compressor. See the index for these procedures.

Step 25: After completion of the flushing and component replacement, insure that the key switch is in the off position.

Step 26: Evacuate and recharge the system per their respective procedures. These procedures are listed in the index.

Step 27: Remove any lock out tags or devices installed earlier, then connect the power cord to the power source.

Step 28: The system is now ready to run.

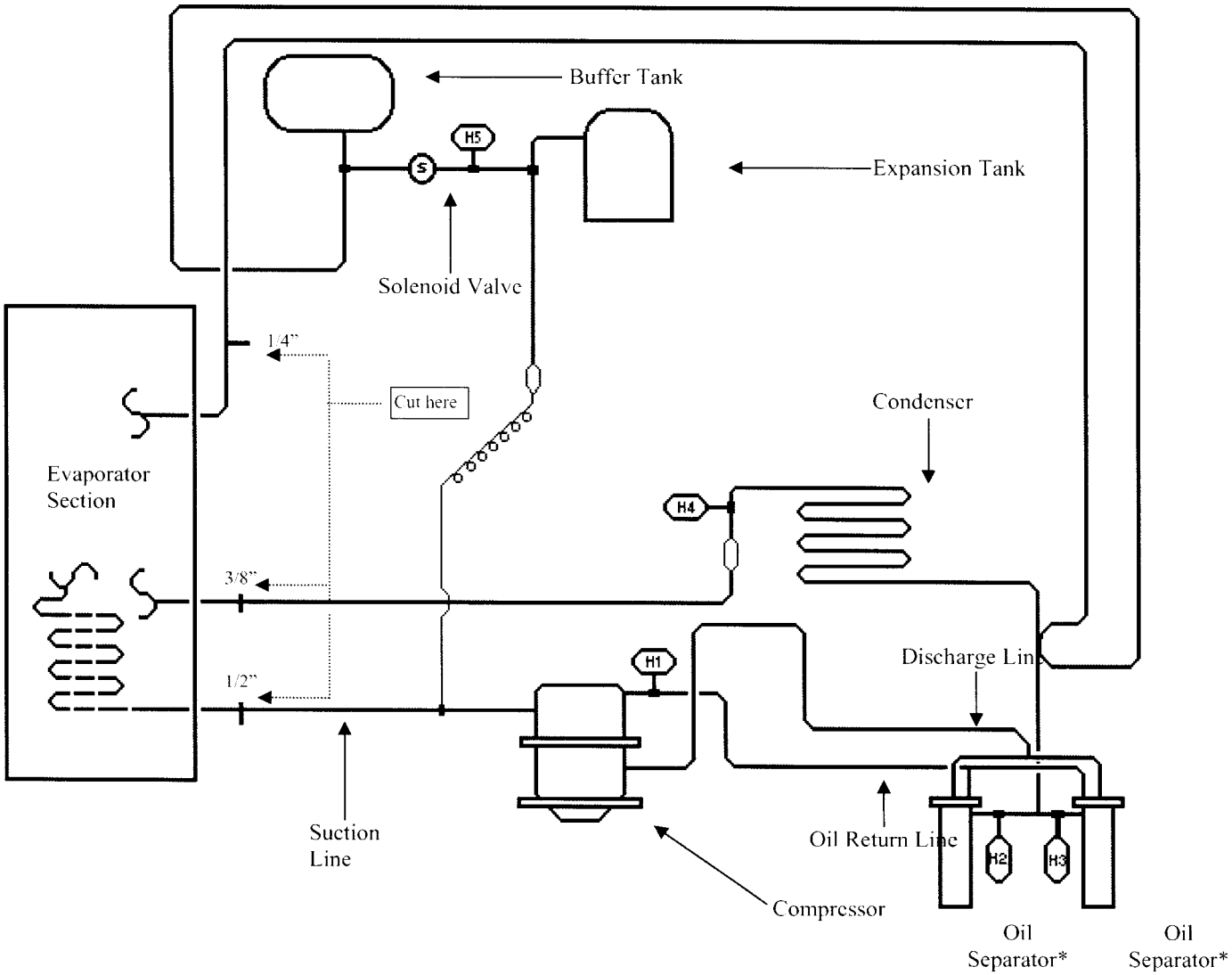


Figure 428-2
Refrigeration System Evacuation Schematic

* Some units may only have one oil separator.

Thermo Electron Corporation

PROCEDURE 29
HIGH PRESSURE SWITCH EVALUATION AND REPLACEMENT

The refrigeration system of a single stage Ultra Low Temperature Freezer is equipped with a high pressure switch. This switch is set to cut-out at 400 psig, and is a manual reset.

If system head pressure reaches the cut-out point, switch contacts will open and will require manual reset to restart the system. Reset button is located on the top of the switch as shown. Depress button to reset the switch. Also see PROCEDURE 30: BYPASS SWITCH EVALUATION AND REPLACEMENT

Evaluation Procedure:

During normal operation, the switch contacts should be closed.

Step 1: If the compressor is not running, check the voltage through the High Pressure (HP) switch to the control relay. This voltage will be 24 volts A/C

Step 2: If you have no voltage to the control relay, check the HP switch by placing a volt-meter across the wires to the HP switch.

a. If the switch is closed, the volt-meter will indicate 0 volts.

b. If the switch is open, the volt-meter will indicate voltage needed for control relay.

Figure 429-1
Chest High Pressure Switch

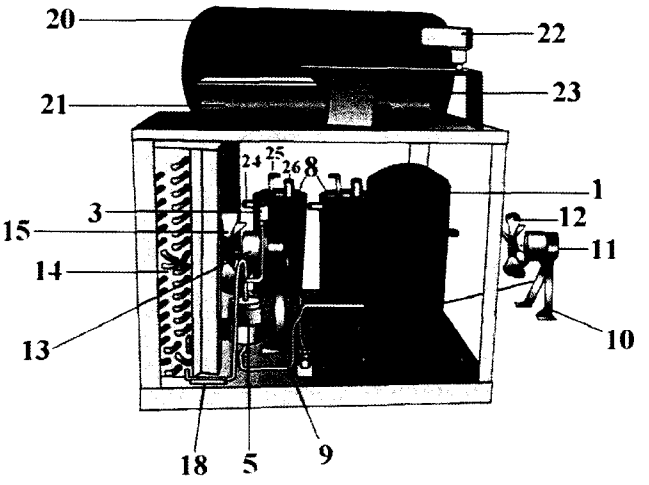


Figure 429-2
Chest High Pressure Switch Location
(Number 3 on illustration)

Step 3: If open, reset the switch and verify system operation.

Step 4: Evaluate system and determine cause for the HP switch to have opened. (Possible causes could be high ambient temperature or blocked / dirty condenser filter, or the bypass switch may be bad; see PROCEDURE 30.)

Test High Pressure Switch before installation:

Step 5: Verify that switch will open if pressure reaches 400 psig.

Step 6: Attach switch to high pressure nitrogen tank with a regulator.

Step 7: Reset switch and verify that contacts are closed.

Step 8: Slowly increase pressure to switch. When pressure reaches 400 psig., the contacts should open.

Step 9: Lower pressure to 0 psig., contacts should remain open.

Step 10: Reset switch to close contacts.

Replacement Procedure:

> **NOTE**
> It will be necessary to recover the refrigerant charge from the system. Recover the refrigerant charge in accordance with current EPA and local regulations. Read and follow instructions for "Refrigerant Recovery" before proceeding.

Step 11: Purge the system with nitrogen.

Step 12: Disconnect the electrical connections to the pressure switch at the plug connector.

Step 13: Remove the defective pressure switch. This may be accomplished by either de-soldering or cutting.

a. If you de-solder the line from the switch you must have nitrogen flow present within the system to prevent oxidation of the tubing. Nitrogen flow should not exceed 1 psig.

1) When using a torch for de-soldering or brazing be sure you employ shields as required to prevent the flame from reaching other components which could be effected by heat.

Figure 429-3
New High Pressure Switch

2) Care must be taken not to overheat the new switch when re-installing. Wrap the top of switch with damp cloth to prevent overheating while soldering.

3) If this is being done in a facility be sure you are in compliance with any fire codes for the location and the facility.

4) Always have a fire extinguisher available any time you are using a torch.

b. If you elect to cut the line consider just how you will make the connection when re-installing the switch.

Step 14: Prepare replacement pressure switch for installation.

a. Verify that switch is exact replacement for switch being removed.

b. Remove plastic cap from 1/4" copper tubing.

Step 15: Install replacement switch.

a. Verify that all copper tubing is clean and free of trash.

PROCEDURE 29 (cont.)

b. Start nitrogen flow through system (as described in previous steps).

c. Position switch in original location.

d. Wrap the top of switch with a damp cloth to prevent overheating while soldering.

e. Braze the line connection. Be sure to always have nitrogen flowing in the tube while brazing.

f. Allow copper tubing to cool.

g. Clean brazed joints using abrasive pad or cloth.

Step 16: Reconnect the electrical connections to the pressure switch at the plug connector.

Step 17: Purge the system with nitrogen.

Step 18: Recharge System (See "Refrigerant Charging Instructions")

Thermo Electron Corporation

PROCEDURE 30
BYPASS SWITCH EVALUATION AND REPLACEMENT

Auto Cascade units also have a bypass pressure control that regulates high pressure discharge gas at 300 psig. This switch cuts out at 260 psig.

If the contacts on this switch stick in the open position, system pressure could rise high enough to cause the high pressure control switch to open.

To check the bypass switch, perform the following:

Step 1: Remove the gray cover.

Step 2: Check across the switch terminals with a voltmeter.

If the voltmeter reads line voltage, the switch is open. If the system pressure is higher than the switch setting, replace the bypass switch using the following steps:

NOTE

It will be necessary to recover the refrigerant charge from the system. Recover the refrigerant charge in accordance with current EPA and local regulations. Read and follow instructions for "Refrigerant Recovery" before proceeding.

Step 11: Purge the system with nitrogen.

Step 12: Disconnect the electrical connections to the bypass switch at the plug connector.

Figure 430-1
Bypass Switch Location

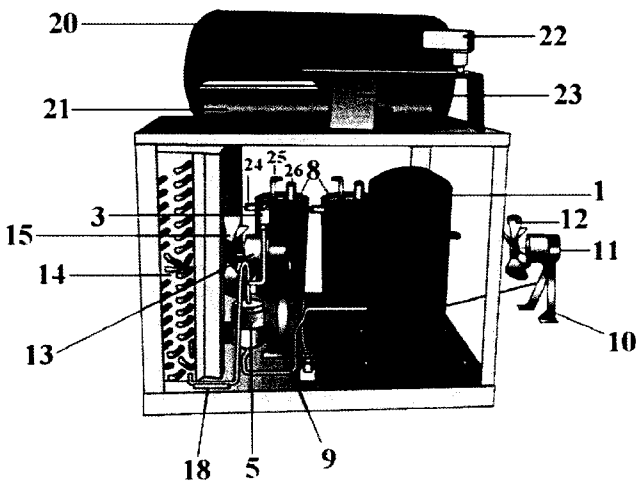


Figure 430-2
Bypass Solenoid and Switch Location
(Numbers 22 & 23 on illustration)

Step 13: Remove the defective bypass switch. This may be accomplished by either de-soldering or cutting.

a. If you de-solder the line from the switch you must have nitrogen flow present within the system to prevent oxidation of the tubing. Nitrogen flow should not exceed 1 psig.

1) When using a torch for de-soldering or brazing be sure you employ shields as required to prevent the flame from reaching other components which could be effected by heat.

2) Care must be taken not to overheat the new switch when re-installing. Wrap the top of switch with damp cloth to prevent overheating while soldering.

3) If this is being done in a facility be sure you are in compliance with any fire codes for the location and the facility.

4) Always have a fire extinguisher available any time you are using a torch.

Figure 430-3
New Bypass Valve and Solenoid

b. If you elect to cut the line consider just how you will make the connection when re-installing the switch.

Step 14: Prepare replacement bypass switch for installation.

a. Verify that switch is exact replacement for switch being removed.

b. Remove plastic cap from 1/4" copper tubing.

Step 15: Install replacement switch.

a. Verify that all copper tubing is clean and free of trash.

b. Start nitrogen flow through system (as described in previous steps).

c. Position switch in original location.

d. Wrap the top of switch with a damp cloth to prevent overheating while soldering.

e. Braze the line connection. Be sure to always have nitrogen flowing in the tube while brazing.

PROCEDURE 30 (cont.)

f. Allow copper tubing to cool.

g. Clean brazed joints using abrasive pad or cloth.

Step 16: Reconnect the electrical connections to the bypass switch at the plug connector.

Step 17: Purge the system with nitrogen.

Step 18: Recharge System (See "Refrigerant Charging Instructions")

Thermo Electron Corporation

PROCEDURE 31
COMPRESSOR REPLACEMENT

It is important to determine why a compressor failed and to make sure that the reason for the failure has been corrected.

Step 1: Unplug the unit power cord from the receptacle. If the unit is hard wired to a power source, de-energize and tag out the power disconnect to the unit. Reference O.S.H.A regulations 1910-147 regarding tag out and de-energizing potential electrical sources.

Step 2: Ensure that the freezer has been off sufficient time for all components to have warmed or cooled to room temp.

Step 3: Check for voltage at the input power terminal and at the compressor. There should be zero potential. If there is any indication of an electrical potential at any point refer to Step 1.

Step 4: Remove the protective cover from over the compressor terminals. Tag each wire as to its location Start, Run, Common. Using a small pliers careful pull the connector from the compressor terminal. (Pull straight out do not move from side to side or wiggle, this may cause a loose connection)

Figure 431-1
Compressor

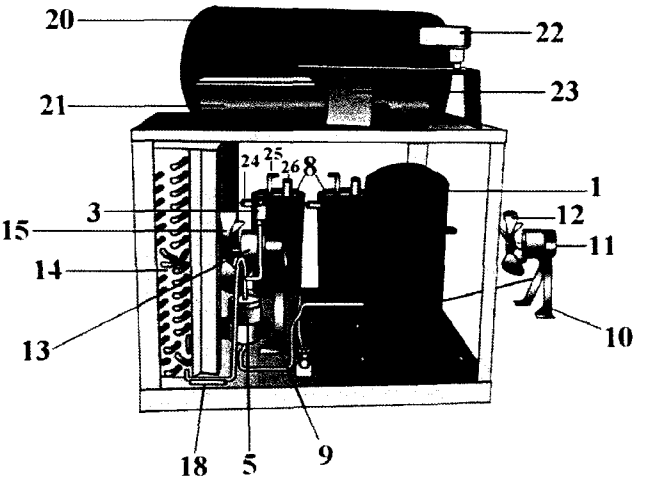


Figure 431-2
Compressor Location
(Figure 1 on illustration)

PROCEDURE 31 (cont.)

Step 5: Secure the three wires removed from the compressor in a location that is out of the way and protected during the following steps for removal of the compressor.

Step 6: Measure the resistance of the compressor windings, Common to Run, Common to Start, Run to Start. The resistance of the Run to Start windings should equal the combined resistance of the Common to Start and the Common to Run. Record these values.

Step 7: Measure the resistance of each winding to ground. Record these values.

NOTE

Steps 6 and 7 will assist you in determining if the failure has caused failure of the compressor windings. Some of the types of failures that may be detected in Steps 6 and 7 would be an open winding, a turn to turn short and an open internal over load, (if the compressor has an internal over load protector). This will also determine if a winding is shorted to ground.

Step 8: It will be necessary to recover the refrigerant charge from the system. Recover the refrigerant charge in accordance with current EPA and local regulations. (Read step nine before proceeding)

PROCEDURE 31 (cont.)

Step 9: You will find two 1/4" stubbed off, lines attached to the system. One is a low side and one is a high side process line which are used to charge the system at the factory. You will also find a service valve mounted to the refrigeration deck, this valve is attached to the discharge line of the first stage, this valve is to be used to recover the refrigerant charge. If you encounter a unit that does not have a service valve as described, you will have to locate the discharge process line and make a recovery connection by use of a line tap.

Step 10: Purge the system with nitrogen.

Step 11: The next step is now to remove the defective compressor.

Step 12: In removing the compressor, it will be necessary to disconnect the discharge an suction line from the compressor. This can be accomplished by cutting the suction line approximately six (6) inches from the compressor. Also cut the oil return line three (3) inches from the compressor.

Step 13: The compressor is secured to the compressor deck with four bolts. Using a box end wrench or socket remove all four bolts. The compressor is now ready to be removed.

Step 14: Slide the compressor to the rear if this is a upright or to the side or end if this is a chest. The compressor weights about 60 to 150 pounds, depending on the type of compressor. Use caution and employ proper lifting procedures when removing the compressor from the refrigeration deck. Set the compressor on the floor or on your work bench if available. Remove the rubber mounting legs and metal inserts and save for use in the new compressor (see note below). If you have the replacement compressor now is a good time to ensure it is a exact match for the old compressor by adding stubs to the suction and discharge line to exactly match the old compressor.

NOTE
Semi-hermetic Copeland compressors have spring mounts.

Step 15: An oil sample should now be taken from the compressor and tested for acid and a color test should also be run at this time. Note which type of oil is in the compressor Zerol or Polyol Ester. If it is Zerol use a Virginia TKO Acid test kit. If it is Polyol Ester use a KMP Corporation ETK Acid test kit.

PROCEDURE 31 (cont.)

Step 16: If the compressor oil tests acidic, the system must be properly flushed.

Step 17: It is recommended that the system be flushed and properly cleaned even if the oil test is not acidic.

Step 18: Remove the dryer from the system.

Step 19: It is recommended that the oil separator be changed out when changing out the compressor. While the compressor is out of the unit is a good time to change out the oil separator. To change out the oil separator, perform the following:

a. Cut the discharge line approximately 8" from the condenser inlet.

b. Cut the 1/4" oil return line approximately 3" from the compressor.

c. Cut the 1/4" hot gas line approximately 8" from the oil separator.

d. Remove the four Phillips screws from the bracket of each separator.

e. Remove the oil separator assembly. Store on table or workbench to ensure next assembly can be structured to exact match.

Figure 431-3
New Compressor

PROCEDURE 31 (cont.)

Step 20: Check outlet of used oil separator assembly. If inner color of the copper is shiny and bright, the condenser should be clean. If inner copper is a dark and dull color, the condenser must be flushed along with the evaporator tank.

Step 21: After the system evaluation has been completed, install the new oil separator assembly, constructed exactly the same as the old assembly. Mount the oil separators to the deck with the four Phillips screws taken out of the old assembly. Connect the discharge line of the oil separator assembly to the inlet of the condenser with the braze-in coupling. When brazing be sure to use nitrogen about 1 psig to eliminate oxidation and other contaminates.

Step 22: Prepare the new compressor for installation. Be sure to braze the stubs on the suction and discharge to exact match of the old compressor. Be sure to cap all lines until ready to braze.

CAUTION
Use correct lifting procedures when placing compressor into place.

PROCEDURE 31 (cont.)

Step 23: Install the new compressor being sure to use all safety procedures. Set the compressor back on the deck. If this is a semi-hermetic compressor, set the compressor back on the spring and studs.

Step 24: Bolt down the compressor with the bolts or screws removed in Step 14.

Step 25: Install a new drier in the position of the old one on the deck.

Step 26: It is now necessary to leak check all connections. If no leaks are detected proceed to Step 27, if leaks are detected they must be corrected before proceeding.

Step 27: Proceed to evacuate the system until such time as you can isolate the system from the vacuum pump and the micron reading does not exceed 200 microns in 20 minutes. If the system is at or below 200 microns in the 20 minute time frame the system is ready for charging. This is known as a blank off test.

Step 28: When the system is properly evacuated, it is ready for charging. Charge in the correct amount of refrigerant using a electronic scale to weigh in the proper amount of refrigerants as specified on the data plate on the side of the freezer.

PROCEDURE 31 (cont.)

Step 29: Install the electrical connection removed in Step 4, since you properly tagged the wires when they were removed, the installation should be very easy. You should use a pair of pliers and push the connector straight on the terminal do not twist or wiggle, as this may cause a poor connection.

Step 30: Install the terminal cover and clip on the compressor.

Step 31: New electrical components must be installed before the compressor is started. You will receive a new potential relay, start capacitor and run capacitor with each new compressor. The electrical components will be located in the junction box. Locate the first stage components, check the new components against the old components to ensure they are a exact match. Remove the components one at the time and install the replacement components. Note the wire location and install the connections exactly as removed.

Step 32: Install all covers removed.

Step 33: Insulate all lines that were originally insulated and seal.

Step 34: Insure the key switch on the unit is in the off position.

Step 35: Connect the power cord to the power source.

Thermo Electron Corporation

PROCEDURE 32
AIR COOLED CONDENSER REPLACEMENT FOR A CHEST FREEZER

The condenser coil is used to condense the high pressure, high temperature refrigerant. This is done by ambient air being drawn across the condenser fins and tubes, while high temperature refrigerant gas is being circulated through the condenser coils. The lower ambient temperature air is cooler than the discharge refrigerant gas; therefore allowing the refrigerant gas to lose its temperature. This process allows the refrigerant gas to change from a high temperature, and pressure gas to a lower temperature liquid.

Step 1: Turn the power off first by turning the key switch to the off position.

Step 2: Unplug the power cord from the wall receptacle. Follow O.S.H.A. regulations' 1910-147 regarding tag out and de-energized potential electrical sources.

Step 3: Check for any voltage at the input power terminal; there should be zero potential.

Step 4: Remove the end panel screws; then set the panel and screws aside. Open the front grill of the unit; this will aid in gaining access to the necessary parts to be removed.

Figure 432-1
Air Cooled Condenser Location

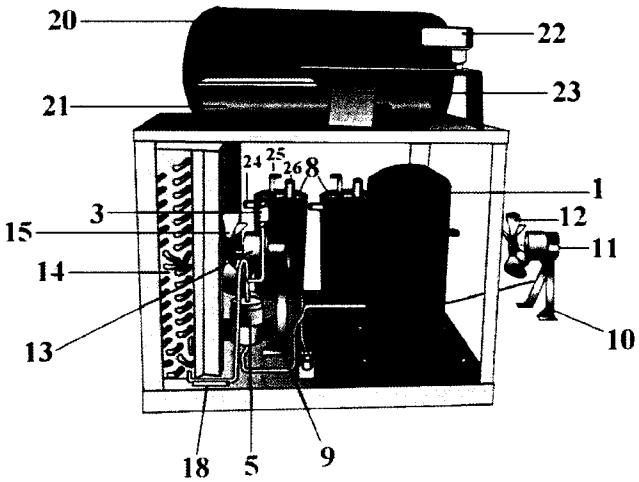


Figure 432-2
Air Cooled Condenser Location
(Number 14 on illustration)

CAUTION
Working with refrigerants requires hand, eye and face protection. Liquid refrigerants are very cold in nature; therefore may cause burns. There may also be a possibility of an acid condition due to a burned out compressor.

Step 5: It will be necessary to recover the refrigerant charge from the system. Follow the refrigerant recovery procedure found in this manual; check the index for this procedure. Recover the refrigerant charge in accordance to local and Federal EPA regulations

CAUTION
Follow the requirements of your recovery and reclaim equipment. Follow any SAFETY warnings that may apply for your recovery equipment.

Step 6: After recovery of the refrigerant, purge the system with a dry nitrogen charge. Only a low pressure charge is required for the system (2 PSIG max.). The low nitrogen pressure will assist in keeping burrs from entering the system when cutting the condenser tubing.

Step 7: Remove the sensor used to read the condensers' discharge outlet temperature from its tube bracket. This can be done by gently removing the silicone from around the sensor top. Then gently pull the outlet sensor from the tube, and place it out of the way.

NOTE
This sensor is not found on all models.

Step 8: Remove the condenser inlet air sensor (if so equipped), (also known as the clean filter sensor) from its location, and move it so it does not interfere with the removal of the condenser.

Step 9: Remove the screws that are holding the condenser fan motor bracket in place. Move the fan motor and bracket so it is out of your way.

Step 10: Remove the support screws holding the inlet and outlet tubing.

Step 11: Remove the screws holding the fan shroud in place and move the shroud out of your way.

Step 12: Remove the screws from the front of the condenser near the bottom. These two screws support the front of the condenser and can be accessed from the filter grill area.

Figure 432-3
New Air Cooled Condenser

Step 13: Clean the tubing at the location of where you plan to cut the tubing. Do this cleaning by using a sanding cloth.

NOTE
Do not use any type of steel wool or sand paper; emery cloth is preferred.

NOTE
On some models the refrigerant drier may be clamped to the side of the condenser frame; if so, unscrew the bracket(s) and place them to the side. Retain any brackets that may need to be reused when installing the new drier.

Step 14: Follow the drier replacement procedure for this process, see index of the manual for this procedure.

Step 15: Locate an area on the condenser tubing inlet and outlet that is easy for cutting and brazing the tubing back after replacement of the condenser coil.

Step 16: Cut the tubing and remove the existing condenser coil and replace it with the new condenser coil. Make sure the new condenser is the same size and type.

NOTE
Use proper tubing cutters for this process

Step 17: Follow the above procedure in reverse when reinstalling the fan motor, shroud, mounting screws and any sensor(s) that were removed.

Step 18: After installation of the new condenser is complete the system is now ready for leak checking and evacuation.

Step 19: Follow the procedures for evacuation and recharging. See the index for these procedures.

CAUTION
Always remember to install a new refrigerant drier after breaking into any refrigerant system. Also, install any safety devices that were removed, such as panels, guards, shrouds and grills.

Thermo Electron Corporation

PROCEDURE 33
DRIER REPLACEMENT

Any time a component on the refrigeration system of a freezer is replaced, or when evidence that the drier's performance has degraded, then the drier must be replaced. This procedure is for replacement of the refrigeration drier only.

Step 1: Turn the power off first by turning the key switch to the off position.

Step 2: Unplug the power cord from the wall receptacle. Follow O.S.H.A. regulations 1910-147 regarding tag out and de-energized potential electrical sources.

Step 3: Check for any voltage at the input power terminal; there should be zero potential.

Step 4: Remove any grills or protective covers from the unit.

Step 5: Install line taps onto the process tubes of both the high and low side of the compressor.

NOTE
Do not pierce the line at this time. Follow line tap manufacturing instructions for installation and line piercing of system.

Figure 433-1
Drier Location

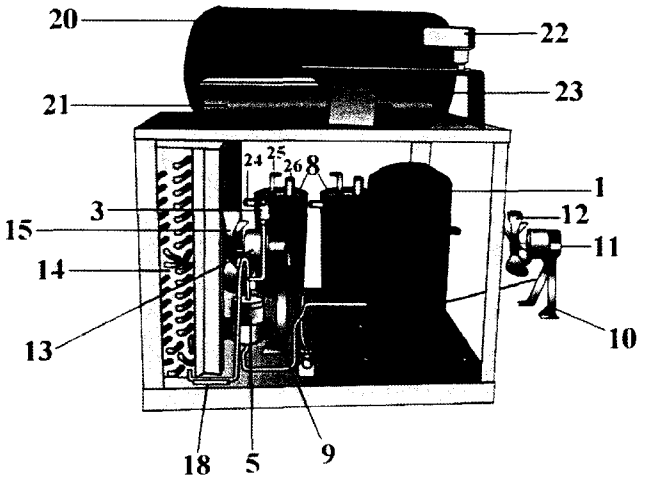


Figure 433-2
Drier Location
(Number 5 on illustration)

CAUTION
When working with refrigerants, hand, eye and face protection is required. Liquid refrigerants are very cold in nature; therefore may cause burns. There may also be a possibility of an acid condition due to a compressor burn out.

Step 6: It will be necessary to recover the refrigerant charge from the system. Recover the refrigerant charge in accordance to local and Federal EPA regulations. You will need to pierce the line after connection of the hoses to the manifold gauges.

NOTE
Follow the requirements of your recovery/reclaim machine. There may be filters located inside the machine which require replacing. Follow any SAFETY warnings that may apply for your recovery machine.

CAUTION
Take a sample of the oil for an acid test, if positive then special care is required. Compressor and other components will need to be replaced later on after flushing of the system. Review the back flushing procedure prior to attempting to flush a system.

Step 7: After recovering the refrigerant, purge the system with a nitrogen charge. Only a low pressure charge is required for the system.

Figure 433-3
New Refrigerant Drier

PROCEDURE 33 (cont.)

Step 8: Clean the tubing at the location of where you plan to cut the tubing. Do this cleaning by using a sanding cloth.

NOTE
Do not use any type of steel wool or sand paper, emery cloth is preferred.

Step 9: Locate the drier, and proceed to cut the tubing on both sides of the drier. Use proper tubing cutters for this process.

Step 10: Remove the old drier and discard properly according to local and Federal EPA regulations. Follow good refrigeration practices.

NOTE
Retain all brackets; they may need to be reused when installing the new drier.

Step 11: Install the new factory-provided replacement drier in the same location as the one removed. Drier position should be 45° or greater, never install the drier in a horizontal position. If another drier (other than the one provided by Thermo Electron Corporation) is used, then caution must be exercised. Make sure that any replacement drier is either a solid core or molecular sieve spring loaded drier. A loose filled drier

may allow desiccant to break down and flow into the refrigeration stream. A three cubic inch (.032 inch) size drier is sufficient in most cases.

CAUTION
While brazing any tubing, use a low flow of nitrogen to prevent oxidation during brazing. Also, wrap the drier to protect it from extreme heat during the re-brazing process.

NOTE
Remember, do not take short cuts, they will only cause failures later.

Step 12: After completion of the component (drier) replacement, the system is now ready for evacuation.

CAUTION
Always remember to install any safety devises that were removed, such as panels, guards, and grills.

Step 13: Follow other procedures for evacuation or replacing any other component. See the index for these procedures.

Thermo Electron Corporation

PROCEDURE 34
REFRIGERATION SYSTEM EVACUATION FOR CFC AND NON-CFC UNITS

The following steps will aid you in performing an evacuation of the refrigeration system of an Ultra Low Temperature freezer.

The entire freezer should be stabilized to room temperature before evacuation is begun.

It is crucial that a good and proper evacuation be performed.

NOTE
The 1/4" lines from the manifold to the process tubes are to be all copper lines.

Step 1: Ensure that the 4 port service manifold is connected to the H1, H4, and H5 process lines for Non-CFC units (See Figure 434-1) or H1, H3, and H4 for CFC units (See Figure 434-2).

Step 2: Ensure the vacuum pump is connected to the last port (D) (See Figure 434-1 or Figure 434-2). A vacuum pump capable of achieving a deep vacuum of 50 microns or less must be used. Use a thermistor type vacuum gauge for proper evacuation indication, and locate this thermistor vacuum gauge in a position that is physically above the refrigeration system; this will prevent possible oil contamination of the thermistor.

PROCEDURE 34 (cont.)

Step 3: Ensure the system is at 0 psig as read on the manifold gauges. If a positive pressure (>0 psig) exists on the system, relieve pressure on the system until 0 psig is achieved.

Step 4: Start the vacuum pump.

Step 5: Open the process line valves H1, H4, and H5 for a Non-CFC unit, or H1, H3, and H4 for a CFC unit. Open these valves slowly, one at a time.

NOTE
Evacuation will take several hours to reach the required blankoff vacuum. Before a blankoff is started, the unit is to be in a deep vacuum (50 microns or less)

Step 6: A final "blankoff" is required before the unit can be charged. This will be measured in microns.

NOTE
Blankoff reading is to be read 20 minutes after the vacuum pump valve has been closed. See Figure 434-1.

a. If the compressor, oil separator(s), and filter-dryers have been changed, a blankoff value of 200 microns in twenty minutes is acceptable.

b. If the compressor and the oil separator(s) have not been changed but the dryers have, then a blankoff value of 400 microns in twenty minutes is acceptable.

Step 7: After blankoff requirements have been met, open the vacuum pump valve to allow system to return to a deep vacuum.

Step 8: Continue vacuum pump operation until ready to recharge system with refrigerant.

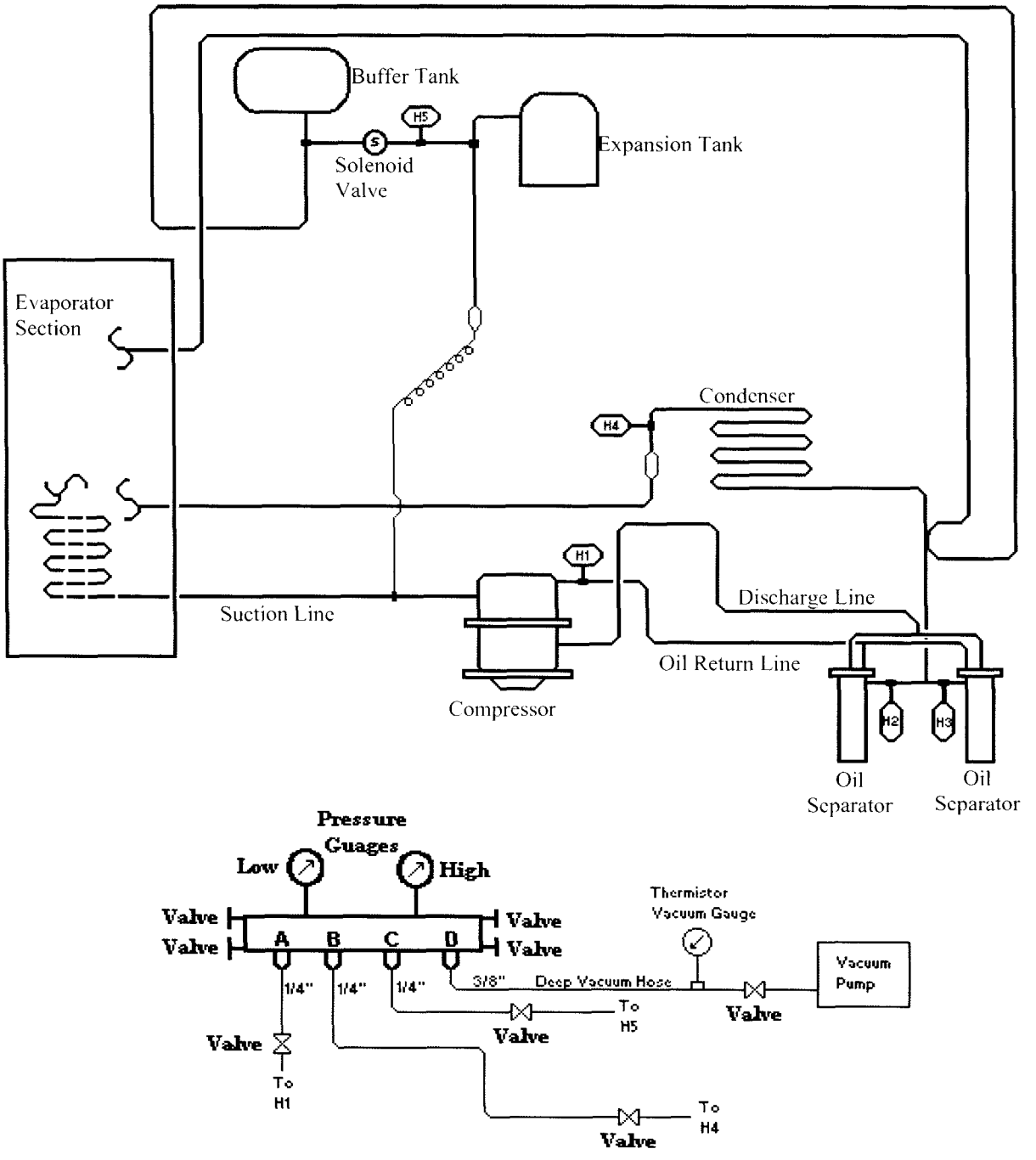
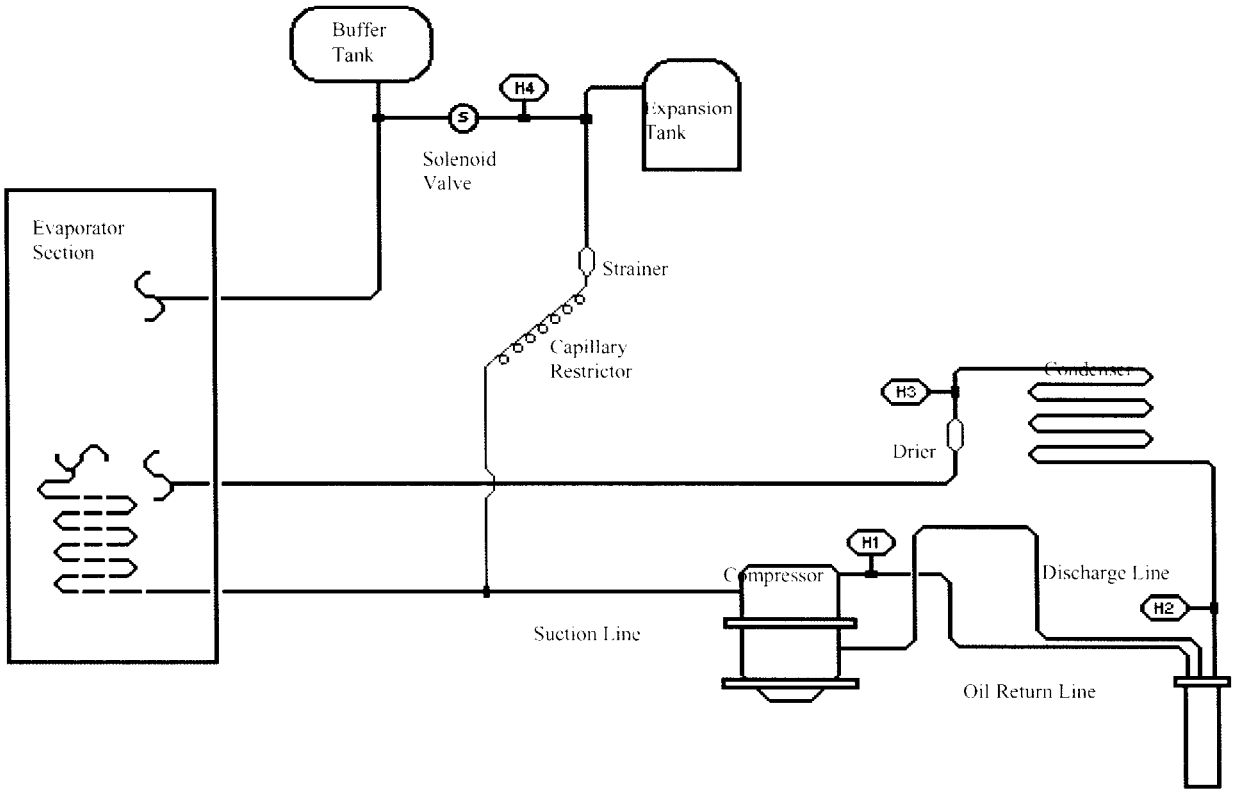


Figure 434-1
Non-CFC Refrigeration System Schematic
* Some units may only have one oil separator.



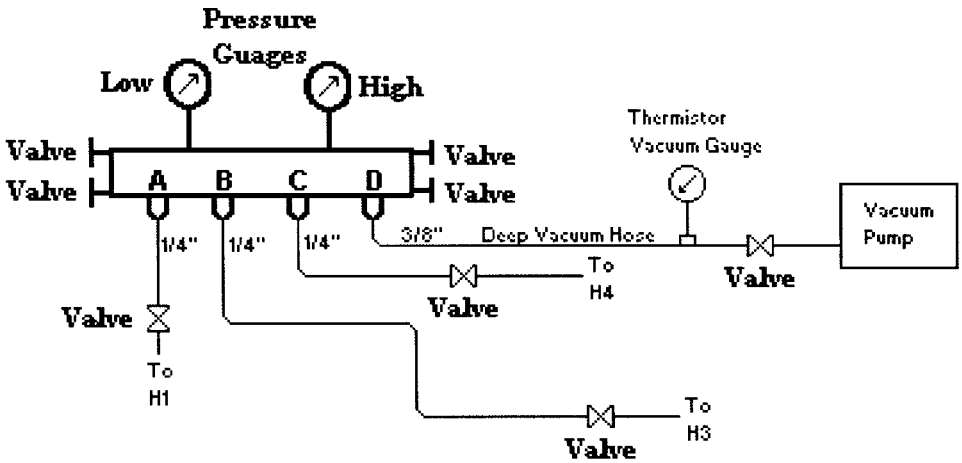


Figure 434-2
CFC Refrigeration System Schematic

Thermo Electron Corporation

PROCEDURE 35
NON-CFC REFRIGERATION SYSTEM CHARGING

This procedure is for charging of the system only. The recovery, backflushing and evacuation processes should have already been completed at this stage. If you have any questions concerning these processes, review those procedures as required in making your repair.

CAUTION
When working with refrigerants, hand, eye and face protection is required. Liquid refrigerants are very cold in nature; therefore may cause burns. There may also be a possibility of an acid condition due to a compressor burnout.

CAUTION
Schrader valve connections are not intended to be left on the process tube after completion of the repair, and are **not** to be used for processing, evacuating, charging, or flushing the refrigeration system.

CAUTION
While brazing any tubing, use a low flow of nitrogen to prevent oxidation during brazing.

Step 1: After the cabinet has met the blank off requirements in microns, you are ready for charging of the required refrigerant(s). Be sure all manifold valves are closed.

NOTE
Remember, do not take short cuts, they will only cause failure later.

NOTE
Service refrigerant charges for the "MRA" (mixed refrigerant autocascade) systems have been increased. The refrigerant charge for the "MRA" systems are supplied in a disposable cylinder. The refrigerants contained within the cylinder will be in both liquid and vapor phases.

NOTE
Some models require 2 cylinders for a complete charge.

Step 2: Disconnect the vacuum hose, if used, attached to port "D" on the high side of the manifold. Install a 3/8" copper line at this manifold connection.

Step 3: Connect the liquid cylinder to the 3/8" line on high side of the four port manifold. Purge air from the line (dmenimus release).

Step 4: With all valves on the manifold closed, perform the following:

a. Ensure that the 1/4" line from port "A" on the low side of the manifold is connected to H1. Refer to Figure 435-1.

b. Ensure that the 1/4" line from port "B" on the low side of the manifold is connected to H4. Refer to Figure 435-1.

c. Ensure that the 1/4" line from port "C" on the high side of the manifold is connected to H5. Refer to Figure 435-1.

Step 5: Invert the cylinder with the valve open. Introduce the liquid into the system by opening the 3/8" high side valve and H4 valve. Be sure all liquid enters the system at the outlet of the condenser. After liquid has been charged, invert the cylinder so that vapor is introduced.

Step 6: Close valve to H4, invert the cylinder back to its normal position, and open valve to H1. This will remove the remainder of vapor from the first cylinder. Run the compressor for 1 minute to help remove the vapor. Close off H1 valve. Close all valves on the manifold. Remove the empty cylinder

Step 7: With manifold valves closed, install (if necessary), in an upright position, the second cylinder to the 3/8" line. Purge (minimal release) 3/8" line at manifold.

PROCEDURE 35 (cont.)

Step 8: After purge is complete, open valve at H5 to allow refrigerant to enter the system.

Step 9: When pressure is equalized, close valve to H5..

Step 10: Open valve to H1. Start and run the compressor until charging cylinder reaches approximately 40 psig. Close valve to H1. Turn the compressor off, wait ten (10) minutes, and then compare soak (high side pressure) to the chart located at the end of this procedure.

Step 11: Should the soak pressure still be low, open valve to H1, start and run the compressor, which will remove more refrigerant from the cylinder. Close valve to H1 and turn off the compressor. Wait ten (10) minutes and check the soak pressure. Repeat this process until the correct soak pressure is obtained.

Step 12: The system is now ready to run.

Step 13: Start the compressor and monitor. Permit the system to operate for approximately 24 hours to reach the lowest temperature. Make a final temperature check.

Step 14: After the unit has made temperature and you are satisfied with its performance, turn the unit off and allow the system to equalize. Now you can pinch off all process tubes. Cut and seal the ends of the tubing using 15% silver brazing rod and use Stay Brite 60-40 resin core solder to strengthen the pinch off area. Leak check using a good electronic leak detector to ensure a proper seal.

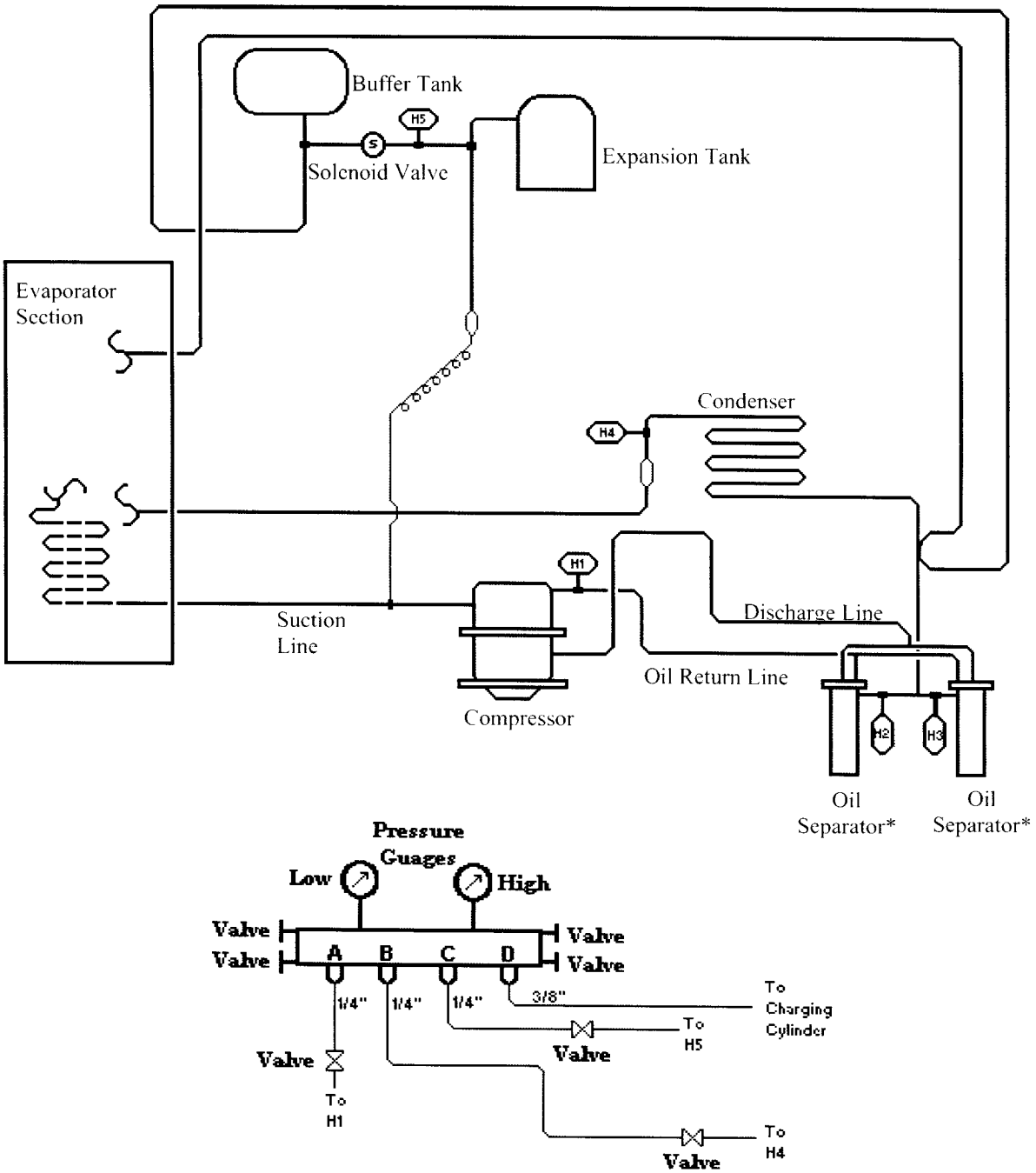


Figure 435-1
Non-CFC Refrigeration System Schematic
* Some units may only have one oil separator.

PROCEDURE 36
CFC REFRIGERATION SYSTEM CHARGING

Service refrigerant charges for the "MRA" systems have been increased. The refrigerant charge for the "MRA" systems are supplied in a disposable cylinder. The refrigerants contained within the cylinder will be in both liquid and/or vapor phases.

NOTE
Refer to Figure 436-1 for the manifold and refrigeration system connections.

NOTE
Some models require 2 cylinders for a complete charge. See Step 7 below.

Step 1: After the cabinet has met the blank off requirements in microns, you are ready for charging of the required refrigerant(s). Be sure all manifold valves are closed.

Step 2: Disconnect the vacuum hose, if used, attached to port "D" on the high side of the manifold. Install a 3/8" copper line at this manifold connection.

Step 3: Connect the refrigerant cylinder to the manifold. Be sure that the "Hi side"- discharge service valve (if used) on the compressor is "backseated" after evacuation to prevent any of the liquid portion of the charge from entering the system at this point. If a service valve is not present at this point, close valve to "H1" process tube. All liquid must be installed at the condenser outlet "H3".

PROCEDURE 36 (cont.)

WARNING
Do not attempt to charge any liquid into the oil separator process tube connection "H2".

Step 4: Invert the cylinder with the valve open. Introduce the "liquid" phase refrigerant into the system through the "Hi side" of the manifold or process tube point "H3", at the condenser outlet. Do not introduce the liquid refrigerant at any other point in the system.

Step 5: After all the liquid has been introduced (at the outlet of the air-cooled condenser) through the above mentioned points, close the valve to H3.

Step 6: Open the "Low side" valve on the manifold and introduce the vapor phase refrigerant into the system through the suction line service valve, or process tube "H1" Compressor operation will be required to aid in the addition of the remaining refrigerant.

NOTE
Units without suction service valve - maximum compressor run time is one (1) minute.

PROCEDURE 36 (cont.)

Step 7: Units that require a two (2) cylinder charge:

a. Charge all of the liquid charge as stated in Steps 3-6.

b. Close manifold valve to "H3"

c. Open service manifold valves to "H4" to install remaining vapor in the cylinder.

d. Close the valve to H4.

e. Open the valve to H1.

f. Operate the compressor for one (1) minute to remove the vapor from the cylinder. Close valve to "H1" and stop the compressor.

g. Connect the smaller cylinder to the charging manifold at the same location from which the large cylinder was removed.

h. Purge (minimal release) this charging line .

i. Open the valve to H1 and allow the refrigerant to enter the system.

j. Wait ten minutes.

k. Start the compressor to pull additional refrigerant into the system.

l. Continue with Step 8.

PROCEDURE 36 (cont.)

Step 8: When the charging cylinder pressure reaches approximately 40 psig, close the cylinder valve, stop the compressor, and allow the system pressure to equilibrate for 10 minutes. Compare static system pressure with published amount for the model concerned (see charging information table at the end of this procedure). If soak pressure is low, add a small amount of the remaining refrigerant vapor and recheck the soak pressure. Continue this procedure until the proper soak pressure is attained.

Step 9: After the system pressure has equalized and the correct soak pressure attained, close all manifold and process valves, backseat the suction service valve or pinch off process tube "H1", whichever line was used.

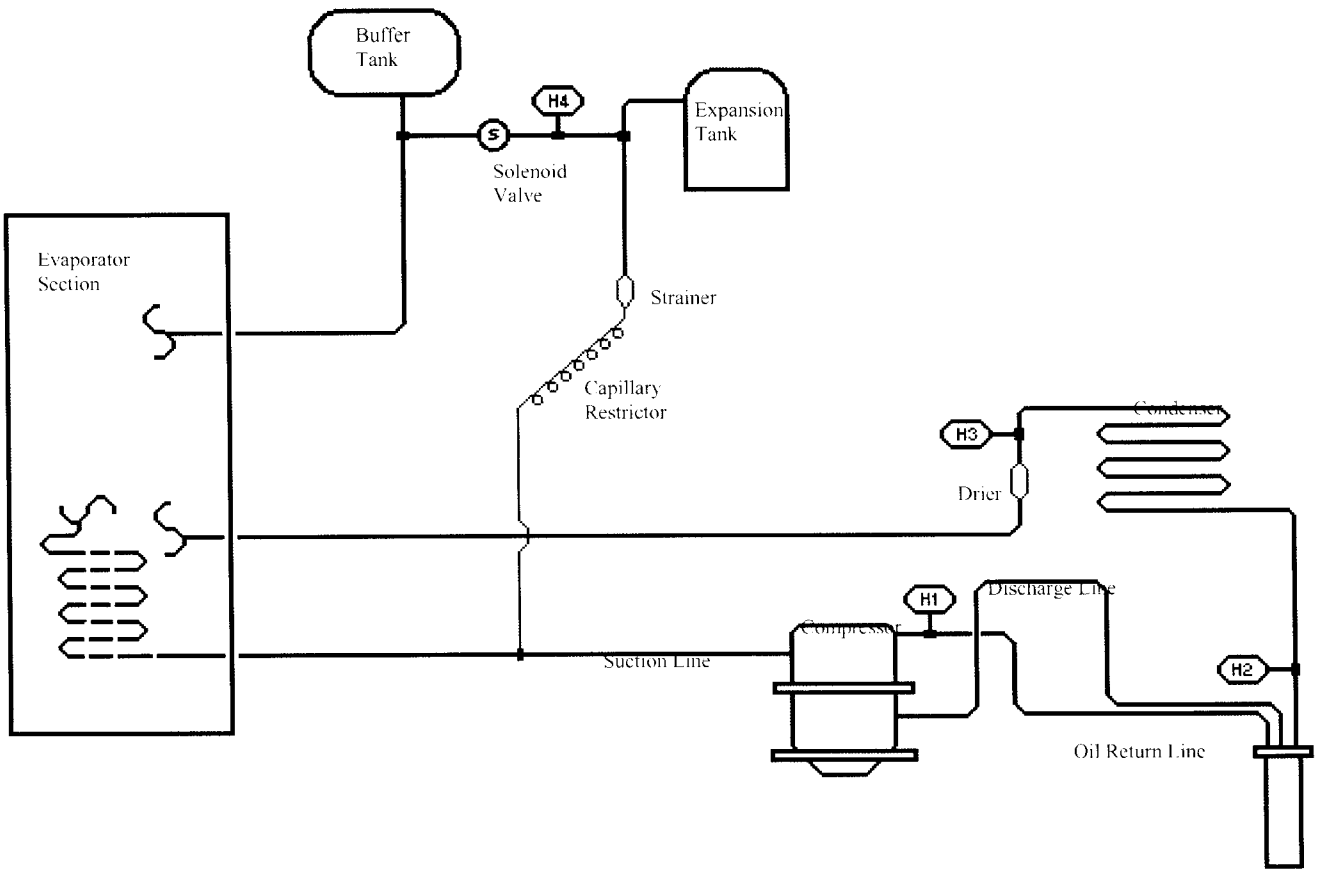
Step 10: After the unit has made temperature and you are satisfied with its performance, turn the unit off and allow the system to equalize. Now you can pinch off all process tubes. Cut and seal the ends of the tubing using 15% silver brazing rod and use Stay Brite 60-40 resin core solder to strengthen the pinch off area. Leak check using a good electronic leak detector to ensure a proper seal.

Step 11: Start the compressor and monitor the system temperature.

Step 12: Allow the system to operate for approximately 24 hours to reach the lowest temperature.

Step 13: Make a final check of all components.

PROCEDURE 36 (cont.)



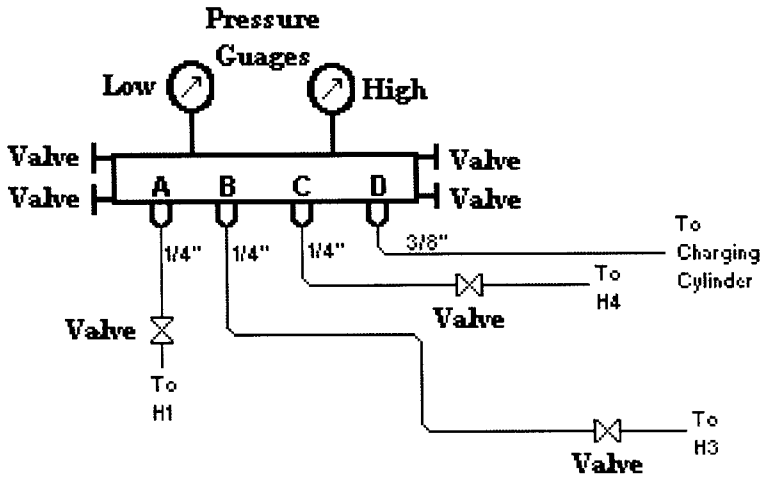


Figure 436-1
CFC Refrigeration System Schematic

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PROCEDURE 37
CHEST FREEZER LN_2 AND CO_2 LID
SAFETY SWITCH EVALUATION AND REPLACEMENT

Ultra low temperature freezers may come with a Low Pressure Nitrogen or Carbon Dioxide backup system. The following steps will aid you in evaluating and replacing the door safety switch.

Step 1: Locate safety switch mounted on the top right rear corner of the compressor console

Step 2: Remove the 2 mounting screws from the switch plate

Step 3: Remove 1 spade lug connector from the switch and insulate. Remove the other spade lug connector and insulate. If the two connectors were allowed to touch, it would cause the back-up system to start injecting.

Step 4: The switch contacts on a chest freezer are reversed. If the rocker arm is in the open position the switch will read closed. If the rocker arm is closed the switch will read open.

Step 5: Check the switch with an ohm meter. If switch is defective , replace with the same type of switch.

Step 6: Reassemble the wiring and mounting plate.



Figure 437-1
Lid Safety Switch Location

PROCEDURE 38
LN_2 PRESSURE SWITCH ASSEMBLY EVALUATION, ADJUSTMENT, AND REPLACEMENT

The LN_2 Backup system is equipped with a pressure switch to signal when the backup system supply is low or empty. The LN_2 system will have a low pressure set to cut in at 5 psig. and cut out at 15 psig. This switch will energize the "Supply Empty" light when the backup system supply is low or empty.

Evaluation Procedure

NOTE
During normal operation (with a full supply tank) the switch contacts should be open.

Step 1: Connect a gauge and measure the actual pressure in psig. From the supply tank to the backup system. If the pressure is greater than the specified cut-out value of 15 psig., the contacts should be open.

Step 2: Check the contacts on the pressure switch. If the contacts are closed the switch will need to be adjusted or replaced.

a. If the pressure switch needs to be adjusted, proceed to Step 3.

b. If the pressure switch needs to be replaced, proceed to Step 10.

Adjustment Procedure

Step 3: Remove covers from the backup system control assembly and pressure switch.

Step 4: Locate the pressure switch which is mounted on the side of the control assembly. The pressure scale is on the front of the control.

Step 5: Adjust the cut-out to 15 psig. on the scale using the cut-out adjustment screw located on top of the control. Turn the screw clock-wise to raise the setting for cut-out pressure.

Step 6: Adjust the cut-in to 5 psig. on the scale using the cut-in adjustment screw located on the top of the control. Turn the screw counter clock-wise to raise the setting for cut-in pressure.

NOTE
The scale on control is not an accurate indication of the setting.

Step 7: Verify actual setting by applying pressure to control to open the contacts at 15 psig and close contacts when pressure drops to 5 psig.

Step 8: Reinstall covers with power disconnected.

Figure 438-1
LN_2 Pressure Switch

PROCEDURE 38 (cont.)

Step 9: Restart the system and verify operation.

Replacement Procedure

Step 10: Disconnect power from the unit and the backup system.

Step 11: Close the supply valve

Step 12: Disconnect the LN2 supply line from the backup system.

Step 13: Bleed-off excess pressure from the system.

Step 14: Remove covers from the backup system control assembly.

Step 15: Disconnect the wires from the pressure switch. Mark the wires for location.

Step 16: Disconnect the 1/4" flare fitting on the line from the solenoid valve.

Step 17: Remove the two (2) screws holding the switch to the mounting bracket.

Step 18: Remove the defective control.

Step 19: Install the replacement control using the two (2) mounting screws.

Step 20: Re-route the capillary tubing in the same manner as the original.

PROCEDURE 38 (cont.)

Step 21: Reconnect the 1/4" flare fitting and tighten the brass flare nut.

Step 22: Reconnect the wires to the pressure switch.

Step 23: Verify correct location when connecting wires.

Step 24: Apply pressure to system and check for leaks in tubing connections and on the pressure switch body.

Step 25: Reconnect power supply to the system.

Step 26: Verify operation and pressure switch settings.

Step 27: Reinstall covers with power disconnected.

Step 28: Restart system and verify operation.

PROCEDURE 39
CO_2 PRESSURE SWITCH ASSEMBLY EVALUATION, ADJUSTMENT, AND REPLACEMENT

The CO_2 Backup system is equipped with a pressure switch to signal when the backup system supply is low or empty. The CO_2 system will have a high pressure set to cut out at 750 psig. This switch will energize the "Supply Empty" light when the backup system supply is low or empty.

Evaluation Procedure

NOTE
During normal operation (with a full supply tank) the switch contacts should be open.

Step 1: Connect a gauge and measure the actual pressure in psig. From the supply tank to the backup system. If the pressure is greater than the specified cut-out value of 750 psig., the contacts should be open.

Step 2: Check the contacts on the pressure switch. If the contacts are closed the switch will need to be adjusted or replaced.

a. If the pressure switch needs to be adjusted, proceed to Step 3.

b. If the pressure switch needs to be replaced, proceed to Step 13.

Adjustment Procedure

Step 3: Remove covers from the backup system control assembly and pressure switch.

PROCEDURE 39 (cont.)

Step 4: Locate the pressure switch.

Step 5: Locate the adjustment nut at the top of the pressure switch, just above the adjustment scale on the end of the switch.

Step 6: Loosen the locking screw located on the side of the pressure switch.

Step 7: Turn hex nut clock-wise to raise the setting on the pressure switch.

Step 8: Adjust the pressure switch to cut-out at 750 psig.

NOTE
The scale on control is not an accurate indication of the setting.

Step 9: Verify actual setting by applying pressure to control to open the contacts at 750 psig.

Step 10: Tighten and secure the locking screw when adjustment is complete.

Step 11: Reinstall covers with power disconnected.

Step 12: Restart the system and verify operation.

Figure 439-1
CO_2 Pressure Switch

Replacement Procedure

CAUTION
When closing the cylinder valve, be sure the injection solenoid is energized to allow all liquid to bleed off instead of being trapped in the supply tubing from the cylinder to the control unit. Failure to complete this will cause the rupture disc to activate, and this device requires replacement once activated.

Step 13: Disconnect the CO_2 supply line from the backup system.

Step 14: Disconnect power supply from the unit and the backup system.

Step 15: Remove the covers from the backup system control assembly.

Step 16: Disconnect the wires from the pressure switch and mark the wires for location.

Step 17: Disconnect the 1/4" copper tubing from the bottom of the switch. The brass hex-nut may be taken loose with a 1/2" open-end wrench.

Step 18: Remove the four (4) screws holding the switch to the mounting bracket. Remove the defective control.

Step 19: Install replacement control using the four (4) mounting screws.

PROCEDURE 39 (cont.)

Step 20: Reinstall the 1/4" copper tubing and tighten the brass hex-nut.

Step 21: Reconnect the wires to the pressure switch.

Step 22: Verify correct location when connecting wires.

Step 23: Reconnect the CO_2 supply to the system.

Step 24: Apply pressure to the system and check for leaks in the tubing connections and on pressure switch body.

Step 25: Reconnect the power supply to the system.

Step 26: Verify operation and pressure switch settings.

Step 27: Reinstall covers with power disconnected.

Step 28: Restart the system and verify operation.

PROCEDURE 40
LN_2 PRESSURE RELIEF VALVE EVALUATION AND REPLACEMENT

The LN_2 Backup system is equipped with a Pressure Relief Valve designed to allow excess pressure to bleed off. The valve is set to open at 50 psig and will reseat after venting.

Evaluation Procedure:

Step 1: Disconnect power supply to unit.

Step 2: Remove covers to gain access to the backup system valve assembly.

Step 3: Locate the Pressure Relief Valve mounted on the top of the assembly.

Step 4: Apply pressure to system (15 psig. To 35 psig.)

CAUTION
Do not exceed 40 psig.

Step 5: Check for leaks on brass valve body. Soap Bubbles or comparable leak detection compound may be used when leak checking Cover complete valve body with soap bubbles and watch for escaping pressure.

Step 6: Watch for at least 5-minutes.

Figure 440-1
LN_2 Relief Valve

PROCEDURE 40 (cont.)

Step 7: If a leak is detected, the Pressure Relief Valve will need to be replaced.

a. If the relief valve needs to be replaced, skip Step 8 and proceed to Step 9.

b. If the relief valve does not need to be replaced, proceed with Step 8

Step 8: Reinstall covers with power disconnected.

Replacement Procedure:

Step 9: When closing the LN2 cylinder valve be sure the injection solenoid is energized to allow all liquid to bleed off instead of being trapped in the supply tubing from the cylinder to the control unit. Failure to complete this will activate the pressure relief device.

Step 10: Disconnect the LN2 supply line from the backup system.

Step 11: Disconnect power supply from the unit and the backup system.

Step 12: Remove covers to access the backup system valve assembly.

Step 13: Locate the Pressure Relief Valve mounted on the top of the assembly.

Step 14: Remove the defective Pressure Relief Valve.

Step 15: Install the replacement valve on the system using a sealing compound on the threads to prevent leakage.

Step 16: Reconnect the LN2 supply to the system.

Step 17: Apply pressure to system and check for leaks in tubing connections and on the Pressure Relief Valve.

Step 18: Reinstall covers with power disconnected.

Step 19: Reconnect power supply to the system and the unit.

Step 20: Verify proper operation.

PROCEDURE 41
CO_2 RUPTURE DISC EVALUATION AND REPLACEMENT

The CO_2 Backup system Rupture Disc is designed to prevent excessive pressure build-up from any liquid trapped in the supply tubing when the cylinder valve is closed. It is set to open at 1300 psig and will not reseal after venting.

Evaluation Procedure:

Step 1: Disconnect power supply to unit.

Step 2: Remove covers to gain access to the backup system valve assembly.

Step 3: Locate the rupture disc mounted on the top of the assembly.

Step 4: Apply pressure to system. (750 psig. to 950 psig.)

CAUTION
Do not exceed 1000 psig.

Step 5: Check for leaks on rupture disc body. Soap Bubbles or comparable leak detection compound may be used when leak checking. Cover complete disc assembly with soap bubbles and watch for escaping pressure.

Step 6: Watch for at least 5-minutes.

Figure 441-1
CO_2 Rupture Disc

PROCEDURE 41 (cont.)

Step 7: If a leak is detected, the rupture disc will need to be replaced. Reinstall covers with power disconnected.

a. If the rupture disc needs to be replaced, skip Step 8 and proceed to Step 9.

b. If the rupture disc does not need to be replaced, proceed with Step 8

Step 8: Reinstall covers with power disconnected.

Replacement Procedure:

Step 9: When closing the CO2 cylinder valve be sure the injection solenoid is energized to allow all liquid to bleed off instead of being trapped in the supply tubing from the cylinder to the control unit. Failure to complete this will activate the pressure relief device.

Step 10: Disconnect the CO2 supply line from the backup system.

Step 11: Disconnect power supply from the unit and the backup system.

Step 12: Remove covers to access the backup system valve assembly.

Step 13: Locate the rupture disc mounted on the top of the assembly.

PROCEDURE 41 (cont.)

Step 14: Remove the defective rupture disc.

Step 15: Install the replacement valve on the system using a sealing compound on the threads to prevent leakage.

Step 16: Reconnect the CO2 supply to the system.

Step 17: Apply pressure to system and check for leaks in tubing connections and on the rupture disc.

Step 18: Reinstall covers with power disconnected.

Step 19: Reconnect power supply to the system and the unit.

Step 20: Verify proper operation.

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PROCEDURE 42
LN_2 DISTRIBUTION TUBE EVALUATION AND REPLACEMENT

The LN_2 Backup system is equipped with a distribution tube to direct the flow of liquid nitrogen into the cabinet when the solenoid valve is opened. The distribution tube is 1/2" OD stainless steel tubing with 1/8" holes to disperse the liquid nitrogen.

Evaluation Procedure

Step 1: Disconnect power supply to unit and turn off the backup system.

Step 2: Locate the distribution tube on the inside of the cabinet.

Step 3: Inspect the entire length of distribution tube for damage. Crimped or bent tubing may restrict flow. Damaged tubing will need to be replaced.

Replacement Procedure

NOTE
When closing the cylinder valve be sure the injection solenoid is energized to allow all liquid to bleed off instead of being trapped in the supply tubing from the cylinder to the control unit. Failure to complete this will activate the pressure relief device.

Step 4: Disconnect the LN2 supply line from the backup system.

Step 5: Disconnect power supply from the unit and the backup system.

Figure 442-1
LN2 Distribution Tube Location

PROCEDURE 42 (cont.)

Step 6: The distribution tube is connected to a 1/2" elbow just outside the cabinet using 1/2" feral fittings.

Step 7: Remove the insulation from the elbow to expose the connection.

Step 8: Disconnect the distribution tube from the supply line using an open end wrench.

Step 9: Inspect the replacement part, verifying the correct shape and location of liquid distribution holes.

Step 10: Install the replacement distribution tube by inserting the closed end into the cabinet.

Step 11: Mount the distribution tube by inserting the end through the rear porthole in the freezer and attaching to the side of the cabinet using the mounting brackets provided.

Step 12: Verify position of the distribution holes; they must direct the flow of liquid away from the door or lid.

Step 13: Reconnect the supply tubing to the distribution tube.

Step 14: Tighten securely using an open end wrench.

PROCEDURE 42 (cont.)

Step 15: Reconnect the LN2 supply to the system.

Step 16: Apply pressure to the system and check for leaks in tubing connections.

Step 17: Reinsulate the connections to the distribution tube.

Step 18: Reinstall covers with power disconnected.

Step 19: Restart the system and verify flow through the capillary tube.

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PROCEDURE 43
"MICRO" CONTROL BOARD POTENTIOMETER "R101" ADJUSTMENT

The following procedure should be used to adjust the setting of the R101 potentiometer for the H02 "Micro" Control Board. The following assumptions have been made with regards to this procedure:

- The unit has been disconnected from its main power source for maintenance.
- The "micro" control board has been replaced and is the proper replacement.
- All connections have been made up and the unit is ready to operate, with the exception of power connection.

Compressor Over-temperature Limit Setpoint Verification

Step 1: Ensure that key switch is in off position.

Step 2: Plug power cord into correct power source.

Step 3: Turn key switch to "on" position.

Step 4: Allow the micro to "reset" itself (approximately three seconds). Display will show cabinet temperature.

Step 5: When the 1st stage compressor starts, press the following two (2) buttons at the same time: COLD ALARM and CONTROL SETPOINT. This will display the compressor sensor over temperature limit setpoint. This temperature should read 94°C. If 94°C is not read on the display, press the up arrow key (▲) or down arrow key (▼) as necessary until the display shows 94°C.

Compressor Sensor Display Calibration.

The micro and display board used in the Ultima II may also be used in the -140°C and -150°C Autocascade series. If the current H02 Micro board and the current H06 display board are to go into a -140°C or -150°C unit, a one time calibration will be required on the micro. This is necessary because the -140°C and -150°C Autocascade units do not have a compressor sensor.

The compressor sensor would normally be attached electrically to pins 1 and 2 on the J8 connector on the micro control board. When the sensor is not used, as is the case with the -140°C and -150°C Autocascade units, the two connecting points will be jumpered together at connections 1 and 2 in the harness plug connector for the J8 plug to simulate a closed sensor. When this is done the potentiometer R-101 must be set to a specific value. The value of this potentiometer is what the micro is reading to simulate a compressor sensor.

PROCEDURE 43 (cont.)

Step 1: Ensure unit is secured and disconnected from its power source.

Step 2: Locate connector J8 on the micro board. Remove J8 plug from J8 pin housing.

Step 3: Check ohm reading across connections 1 & 2 of the J8 plug. If reading shows "open" or infinity this indicates that the jumper is not connected properly, missing, or possibly damaged.

a. Locate the 6 pin Molex connector plug where it enters the junction box.

b. Remove plug from connection and inspect jumper at pins 1 and 2

c. If the jumper is disconnected, reinsert ends of the jumper wire into pins 1 and 2 of the plug.

d. If the jumper wire is missing or damaged, call Service Department to receive replacement jumper.

e. Check ohm reading across connections 1 & 2 of the J8 plug again to verify circuit continuity.

Step 4: If reading is at or near "0", reconnect J8 plug to J8 pin housing.

PROCEDURE 43 (cont.)

Step 5: Ensure that key switch is in off position.

Step 6: Plug power cord into correct power source.

Step 7: Turn key switch to "on" position.

Step 8: Allow the micro to "reset" itself (approximately three seconds). Display will show cabinet temperature.

Step 9: From the display panel, depress the "WARM ALARM SET POINT", "COLD ALARM SET POINT" and "ALARM BATTERY LOW" key pads at the same time. The display should read $\leq$+82°C. If it is not in this range go to Step 10.

Step 10: Adjust Potentiometer R-101 fully counter-clockwise until it makes a "clicking" noise.

Step 11: Repeat steps 9 and 10 until display reads $\leq$+82°C.

Step 12: Seal Potentiometer R101 in position by placing a small amount of sealant such as fingernail polish on the adjusting screw.

Step 13: Turn unit off and disconnect power source.

Step 14: Reinstall "micro" cover.

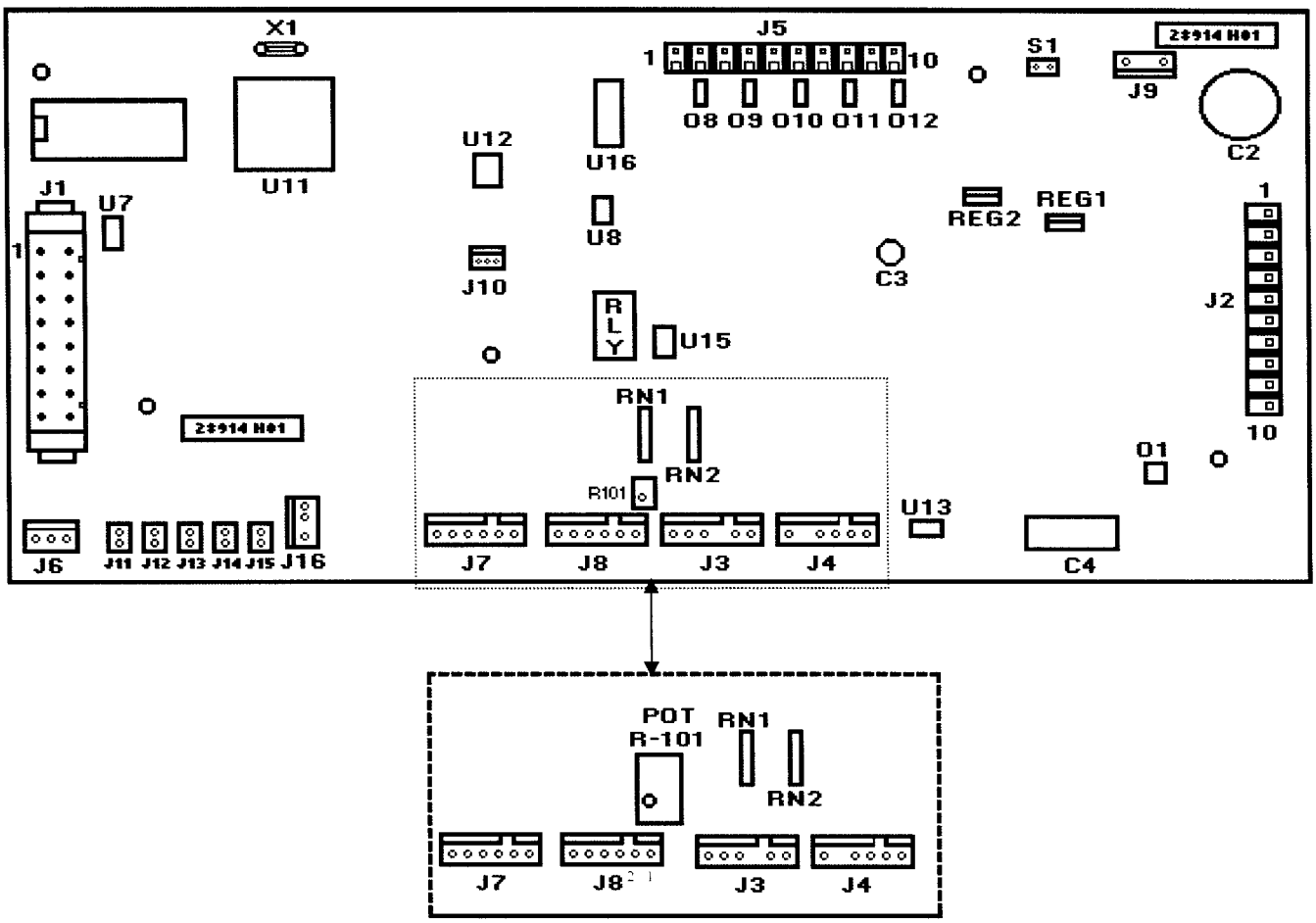


Figure 443-1
Potentiometer R101 Location

1. Compressor
3. High Pressure Switch
5. Drier
8. Oil Separator(s)
9. Condenser Fan Bracket
10. Circulating Fan Bracket
11. Circulating Fan Motor
12. Circulating Fan Blade
13. Condenser Fan Motor
14. Air Cooled Condenser
15. Condenser Fan Blade
18. Condenser Sensor
20. Expansion Tank
21. Buffer Tank
22. Bypass Solenoid
23. Bypass Switch
24. Oil Separator Outlet
25. Oil Return Line
26. Oil Separator Inlet

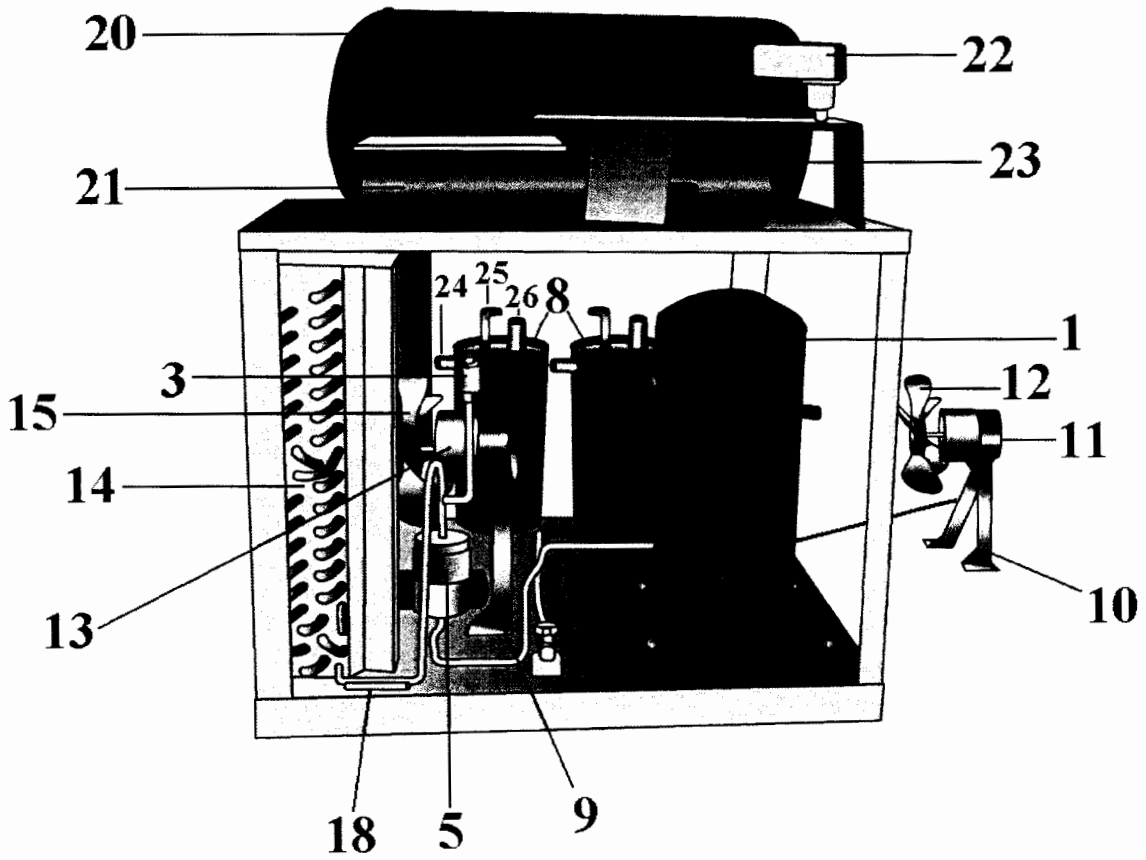


Figure 500-1
Chest Freezer Refrigeration Assembly
(Auto Cascade)

10. Buck Boost Relay
11. Run Capacitor
14. Power Board
15. Control Board
16. Buck Boost Transformer
17. Start Relay

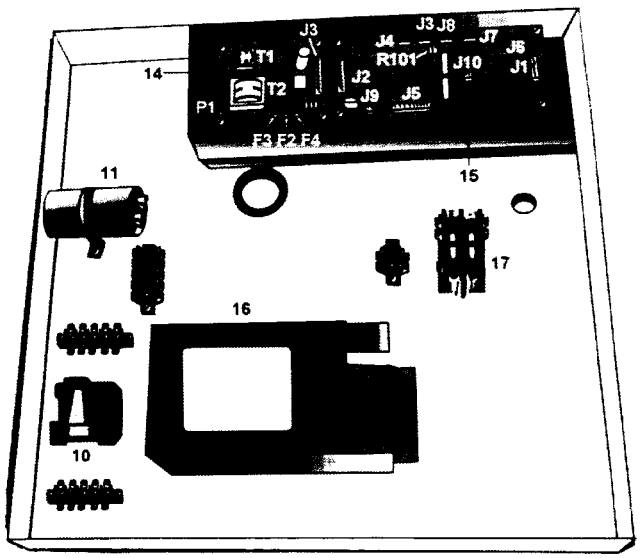


Figure 500-2
Chest Freezer Electrical Deck
(Auto Cascade)
500.2

Figure 500-3
Chest Freezer -140°C and -150°C Ultima Series Wiring Diagram
500.3

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TABLE 1 FAHRENHEIT - CENTIGRADE TEMPERATURE CONVERSION

C	DEG	F	C	DEG	F	C	DEG	F	C	DEG	F
-128.9	-200	-328	-102.8	-153	-243.4	-76.7	-106	-158.8	-50.6	-59	-74.2
-128.3	-199	-326.2	-102.2	-152	-241.6	-76.1	-105	-157	-50	-58	-72.4
-127.8	-198	-324.4	-101.7	-151	-239.8	-75.6	-104	-155.2	-49.4	-57	-70.6
-127.2	-197	-322.6	-101.1	-150	-238	-75	-103	-153.4	-48.9	-56	-68.8
-126.7	-196	-320.8	-100.6	-149	-236.2	-74.4	-102	-151.6	-48.3	-55	-67
-126.1	-195	-319	-100	-148	-234.4	-73.9	-101	-149.8	-47.8	-54	-65.2
-125.6	-194	-317.2	-99.4	-147	-232.6	-73.3	-100	-148	-47.2	-53	-63.4
-125	-193	-315.4	-98.9	-146	-230.8	-72.8	-99	-146.2	-46.7	-52	-61.6
-124.4	-192	-313.6	-98.3	-145	-229	-72.2	-98	-144.4	-46.1	-51	-59.8
-123.9	-191	-311.8	-97.8	-144	-227.2	-71.7	-97	-142.6	-45.6	-50	-58
-123.3	-190	-310	-97.2	-143	-225.4	-71.1	-96	-140.8	-45	-49	-56.2
-122.8	-189	-308.2	-96.7	-142	-223.6	-70.6	-95	-139	-44.4	-48	-54.4
-122.2	-188	-306.4	-96.1	-141	-221.8	-70	-94	-137.2	-43.9	-47	-52.6
-121.7	-187	-304.6	-95.6	-140	-220	-69.4	-93	-135.4	-43.3	-46	-50.8
-121.1	-186	-302.8	-95	-139	-218.2	-68.9	-92	-133.6	-42.8	-45	-49
-120.6	-185	-301	-94.4	-138	-216.4	-68.3	-91	-131.8	-42.2	-44	-47.2
-120	-184	-299.2	-93.9	-137	-214.6	-67.8	-90	-130	-41.7	-43	-45.4
-119.4	-183	-297.4	-93.3	-136	-212.8	-67.2	-89	-128.2	-41.1	-42	-43.6
-118.9	-182	-295.6	-92.8	-135	-211	-66.7	-88	-126.4	-40.6	-41	-41.8
-118.3	-181	-293.8	-92.2	-134	-209.2	-66.1	-87	-124.6	-40	-40	-40
-117.8	-180	-292	-91.7	-133	-207.4	-65.6	-86	-122.8	-39.4	-39	-38.2
-117.2	-179	-290.2	-91.1	-132	-205.6	-65	-85	-121	-38.9	-38	-36.4
-116.7	-178	-288.4	-90.6	-131	-203.8	-64.4	-84	-119.2	-38.3	-37	-34.6
-116.1	-177	-286.6	-90	-130	-202	-63.9	-83	-117.4	-37.8	-36	-32.8
-115.6	-176	-284.8	-89.4	-129	-200.2	-63.3	-82	-115.6	-37.2	-35	-31
-115	-175	-283	-88.9	-128	-198.4	-62.8	-81	-113.8	-36.7	-34	-29.2
-114.4	-174	-281.2	-88.3	-127	-196.6	-62.2	-80	-112	-36.1	-33	-27.4
-113.9	-173	-279.4	-87.8	-126	-194.8	-61.7	-79	-110.2	-35.6	-32	-25.6
-113.3	-172	-277.6	-87.2	-125	-193	-61.1	-78	-108.4	-35	-31	-23.8
-112.8	-171	-275.8	-86.7	-124	-191.2	-60.6	-77	-106.6	-34.4	-30	-22
-112.2	-170	-274	-86.1	-123	-189.4	-60	-76	-104.8	-33.9	-29	-20.2
-111.7	-169	-272.2	-85.6	-122	-187.6	-59.4	-75	-103	-33.3	-28	-18.4
-111.1	-168	-270.4	-85	-121	-185.8	-58.9	-74	-101.2	-32.8	-27	-16.6
-110.6	-167	-268.6	-84.4	-120	-184	-58.3	-73	-99.4	-32.2	-26	-14.8
-110	-166	-266.8	-83.9	-119	-182.2	-57.8	-72	-97.6	-31.7	-25	-13
-109.4	-165	-265	-83.3	-118	-180.4	-57.2	-71	-95.8	-31.1	-24	-11.2
-108.9	-164	-263.2	-82.8	-117	-178.6	-56.7	-70	-94	-30.6	-23	-9.4
-108.3	-163	-261.4	-82.2	-116	-176.8	-56.1	-69	-92.2	-30	-22	-7.6
-107.8	-162	-259.6	-81.7	-115	-175	-55.6	-68	-90.4	-29.4	-21	-5.8
-107.2	-161	-257.8	-81.1	-114	-173.2	-55	-67	-88.6	-28.9	-20	-4
-106.7	-160	-256	-80.6	-113	-171.4	-54.4	-66	-86.8	-28.3	-19	-2.2
-106.1	-159	-254.2	-80	-112	-169.6	-53.9	-65	-85	-27.8	-18	-0.4
-105.6	-158	-252.4	-79.4	-111	-167.8	-53.3	-64	-83.2	-27.2	-17	+1.4
-105	-157	-250.6	-78.9	-110	-166	-52.8	-63	-81.4	-26.7	-16	+3.2
-104.4	-156	-248.8	-78.3	-109	-164.2	-52.2	-62	-79.6	-26.1	-15	+5
-103.9	-155	-247	-77.8	-108	-162.4	-51.7	-61	-77.8	-25.6	-14	+6.8
-103.3	-154	-245.2	-77.2	-107	-160.6	-51.1	-60	-76	-25	-13	+8.6

TABLE 1 (cont.)

C	DEG	F	C	DEG	F	C	DEG	F	C	DEG	F
-24.4	-12	+10.4	-7.8	+18	+64.4	+8.9	+48	+118.4	+25.6	+78	+172.4
-23.9	-11	+12.2	-7.2	+19	+66.2	+9.4	+49	+120.2	+26.1	+79	+174.2
-23.3	-10	+14	-6.7	+20	+68	+10	+50	+122	+26.7	+80	+176
-22.8	-9	+15.8	-6.1	+21	+69.8	+10.6	+51	+123.8	+27.2	+81	+177.8
-22.2	-8	+17.6	-5.6	+22	+71.6	+11.1	+52	+125.6	+27.8	+82	+179.6
-21.7	-7	+19.4	-5	+23	+73.4	+11.7	+53	+127.4	+28.3	+83	+181.4
-21.1	-6	+21.2	-4.4	+24	+75.2	+12.2	+54	+129.2	+28.9	+84	+183.2
-20.6	-5	+23	-3.9	+25	+77	+12.8	+55	+131	+29.4	+85	+185
-20	-4	+24.8	-3.3	+26	+78.8	+13.3	+56	+132.8	+30	+86	+186.8
-19.4	-3	+26.6	-2.8	+27	+80.6	+13.9	+57	+134.6	+30.6	+87	+188.6
-18.9	-2	+28.4	-2.2	+28	+82.4	+14.4	+58	+136.4	+31.1	+88	+190.4
-18.3	-1	+30.2	-1.7	+29	+84.2	+15	+59	+138.2	+31.7	+89	+192.2
-17.8	0	+32	-1.1	+30	+86	+15.6	+60	+140	+32.2	+90	+194
-17.2	+1	+33.8	-0.6	+31	+87.8	+16.1	+61	+141.8	+32.8	+91	+195.8
-16.7	+2	+35.6	0.0	+32	+89.6	+16.7	+62	+143.6	+33.3	+92	+197.6
-16.1	+3	+37.4	+0.6	+33	+91.4	+17.2	+63	+145.4	+33.9	+93	+199.4
-15.6	+4	+39.2	+1.1	+34	+93.2	+17.8	+64	+147.2	+34.4	+94	+201.2
-15	+5	+41	+1.7	+35	+95	+18.3	+65	+149	+35	+95	+203
-14.4	+6	+42.8	+2.2	+36	+96.8	+18.9	+66	+150.8	+35.6	+96	+204.8
-13.9	+7	+44.6	+2.8	+37	+98.6	+19.4	+67	+152.6	+36.1	+97	+206.6
-13.3	+8	+46.4	+3.3	+38	+100.4	+20	+68	+154.4	+36.7	+98	+208.4
-12.8	+9	+48.2	+3.9	+39	+102.2	+20.6	+69	+156.2	+37.2	+99	+210.2
-12.2	+10	+50	+4.4	+40	+104	+21.1	+70	+158	+37.8	+100	+212
-11.7	+11	+51.8	+5	+41	+105.8	+21.7	+71	+159.8			
-11.1	+12	+53.6	+5.6	+42	+107.6	+22.2	+72	+161.6			
-10.6	+13	+55.4	+6.1	+43	+109.4	+22.8	+73	+163.4			
-10	+14	+57.2	+6.7	+44	+111.2	+23.3	+74	+165.2			
-9.4	+15	+59	+7.2	+45	+113	+23.9	+75	+167			
-8.9	+16	+60.8	+7.8	+46	+114.8	+24.4	+76	+168.8			
-8.3	+17	+62.6	+8.3	+47	+116.6	+25	+77	+170.6			

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TABLE 2: RESISTANCE VERSUS TEMPERATURE FOR A PLATINUM RTD

C	OHM	C	OHM	C	OHM	C	OHM	C	OHM	C	OHM
-181	27.19	-134	46.39	-87	65.51	-40	84.27	7	102.73	54	120.93
-180	27.60	-133	46.80	-86	65.91	-39	84.67	8	103.12	55	121.32
-179	28.02	-132	47.21	-85	66.31	-38	85.06	9	103.51	56	121.70
-178	28.44	-131	47.62	-84	66.72	-37	85.46	10	103.90	57	122.09
-177	28.85	-130	48.00	-83	67.12	-36	85.85	11	104.29	58	122.47
-176	29.26	-129	48.41	-82	67.52	-35	86.25	12	104.68	59	122.86
-175	29.67	-128	48.82	-81	67.92	-34	86.64	13	105.07	60	123.24
-174	30.08	-127	49.23	-80	68.33	-33	87.04	14	105.46	61	123.62
-173	30.49	-126	49.64	-79	68.73	-32	87.43	15	105.85	62	124.01
-172	30.89	-125	50.06	-78	69.13	-31	87.83	16	106.24	63	124.39
-171	31.30	-124	50.47	-77	69.53	-30	88.22	17	106.63	64	124.77
-170	31.71	-123	50.88	-76	69.93	-29	88.62	18	107.02	65	125.16
-169	32.12	-122	51.29	-75	70.33	-28	89.01	19	107.40	66	125.54
-168	32.53	-121	51.70	-74	70.73	-27	89.40	20	107.79	67	125.92
-167	32.93	-120	52.11	-73	71.13	-26	89.80	21	108.18	68	126.31
-166	33.34	-119	52.52	-72	71.53	-25	90.19	22	108.57	69	126.69
-165	33.75	-118	52.92	-71	71.93	-24	90.59	23	108.96		
-164	34.16	-117	53.33	-70	72.33	-23	90.98	24	109.35		
-163	34.57	-116	53.74	-69	72.73	-22	91.37	25	109.73		
-162	34.97	-115	54.15	-68	73.13	-21	91.77	26	110.12		
-161	35.38	-114	54.56	-67	73.53	-20	92.16	27	110.51		
-160	35.79	-113	54.97	-66	73.93	-19	92.55	28	110.90		
-159	36.20	-112	55.38	-65	74.33	-18	92.95	29	111.28		
-158	36.61	-111	55.78	-64	74.73	-17	93.34	30	111.67		
-157	37.02	-110	56.19	-63	75.13	-16	93.73	31	112.06		
-156	37.42	-109	56.60	-62	75.53	-15	94.12	32	112.45		
-155	37.83	-108	57.00	-61	75.93	-14	94.52	33	112.83		
-154	38.23	-107	57.41	-60	76.33	-13	94.91	34	113.22		
-153	38.65	-106	57.82	-59	76.73	-12	95.30	35	113.61		
-152	39.05	-105	58.22	-58	77.13	-11	95.69	36	113.99		
-151	39.46	-104	58.63	-57	77.52	-10	96.09	37	114.38		
-150	39.87	-103	59.04	-56	77.92	-9	96.48	38	114.77		
-149	40.28	-102	59.44	-55	78.32	-8	96.87	39	115.15		
-148	40.68	-101	59.85	-54	78.72	-7	97.26	40	115.54		
-147	41.09	-100	60.25	-53	79.11	-6	97.65	41	115.93		
-146	41.50	-99	60.66	-52	79.51	-5	98.04	42	116.31		
-145	41.91	-98	61.06	-51	79.91	-4	98.44	43	116.70		
-144	42.32	-97	61.47	-50	80.31	-3	98.83	44	117.08		
-143	42.72	-96	61.87	-49	80.70	-2	99.22	45	117.47		
-142	43.13	-95	62.28	-48	81.10	-1	99.61	46	117.85		
-141	43.54	-94	62.68	-47	81.50	0	100.00	47	118.24		
-140	43.95	-93	63.09	-46	81.89	1	100.39	48	118.62		
-139	44.35	-92	63.49	-45	82.29	2	100.78	49	119.01		
-138	44.76	-91	63.90	-44	82.69	3	101.17	50	119.40		
-137	45.17	-90	64.30	-43	83.08	4	101.56	51	119.78		
-136	45.58	-89	64.70	-42	83.48	5	101.95	52	120.16		
-135	45.99	-88	65.11	-41	83.88	6	102.34	53	120.55		

TABLE 3: ELECTRICAL INFORMATION

CODE	VOLTAGE	Hz	PHASES
D	208-230	60	1
V	220	50	1
E	208-230	60	3
R	200	50	3
M	380	50	3
W	240	50	1

TABLE 4: CHARGING INFORMATION

MODEL	CHARGE	STATIC SOAK PRESSURE RANGE
ULT7150-(BA)	QFR0053	107 - 115 psig
ULT10140-(BA)	QFR0054	114 - 124 psig
ULT7150-(12)	QFR0057	to 140 psig
ULT10140-(12)	QFR0058	to 140 psig
ULT7150-(15)	QFR0063	135 - 145 psig
ULT10140-(15)	QFR0062	130 - 140 psig

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TABLE 5: QC10140 NOMINAL SPECIFICATIONS

	Ambient Condition			
Specifications	60F	70F	77F	90F
Application, Rating and Electrical Data				
Application	Storage for General Laboratory Materials			
Temperature Rating	-130°C to -140°C at 90°F (32°C) Ambient			
Maximum Heat Rejection	8,900Btu/Hr.	9,500 Btu/Hr.	10,200 Btu/Hr.	11,400 Btu/Hr.
Temperature Uniformity	Approximately Setpoint -1°C / +2°C at 77°F (25°C) Ambient			
Temperature Stability	Approximately Setpoint ± 2°C at 77°F (25°C) Ambient			
Operation of Refrigeration System and Service Data				
Bottom-out C/A Temp.	-145°C	-144°C	-143°C	-141°C
Discharge Pressure	185 psig	235 psig	245 psig	270 psig
Suction Pressure	30 psig	32 psig	35 psig	37 psig
Pulldown Time	8 Hours	10 Hours	11 Hours	13 Hours
C0	-57°C/-71°F	-52°C/-63°F	-42°C/-44°F	-27°C/-17°F
C1	-57°C/-71°F	-52°C/-63°F	-42°C/-44°F	-27°C/-17°F
C2	-87°C/-125°F	-83°C/-118°F	-75°C/-103°F	-64°C/-83°F
C3	-108°C/-162°F	-99°C/-147°F	-99°C/-147°F	-100°C/-148°F
C4	-149°C/-236°F	-147°C/-234°F	-146°C/-231°F	-144°C/-227°F
C5	-135°C/-211°F	-144°C/-228°F	-139°C/-218°F	-131°C/-205°F
Evaporator Inlet	-155°C/-247°F	-154°C/-244°F	-152°C/-242°F	-150°C/-238°F
Evaporator Outlet	-146°C/-233°F	-144°C/-228°F	-143°C/-225°F	-142°C/-224°F
Delog Cycle	10 Minutes Automatic Shutdown Time Every 8 Hours			
Noise Level (Sound Pressure)	57.7 dBA (Measured at 5' away and 5' high)			
Compressor Fan	Continuous Operation			
Micro-Based Control Features				
Warm Alarm	Standard			
Cold Alarm	Standard			
RS232 Port	Standard			
Clean Filter Alarm	Standard			
Power Failure Alarm	Standard			
Tempreature Failure Alarm	Standard			
Voltage Safeguard	Standard			

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