-40 C and –85 C

ULTRA LOW-TEMPERATURE

UPRIGHT & CHEST FREEZER

(1993 - PRESENT)

SERVICE MANUAL

November 2002
Kendro Laboratory Products

301903H13

TABLE OF CONTENTS

INTRODUCTION

Ultra Low Temperature -85C/-40C Upright and -85C/-40C Chest freezers are base units, manufactured wholly at the Kendro Laboratory Products facility in Asheville, NC. Kendro Laboratory Products is a division of SPX Corporation

The Upright units come in 13, 17, 21, 25 and 32 cubic foot sizes. The Chest units come in 1, 3, 5, 7, 10, 14, 17, and 20 cubic foot sizes.

The purpose of this manual is to provide procedures developed to assist the field refrigeration technician 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.

SECTION 100 -- 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 a unique number in that it identifies the unit as a specific unit. No other unit has that same number.

DATA LABEL LOCATION

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

The data label is mounted on the outside of the cabinet. It can be found by looking on the upper left-hand side of the unit, near the front of the cabinet. Some older models may have a metal plate located on the outer, lower left hand side of the unit.

DATA LABEL INFORMATION

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

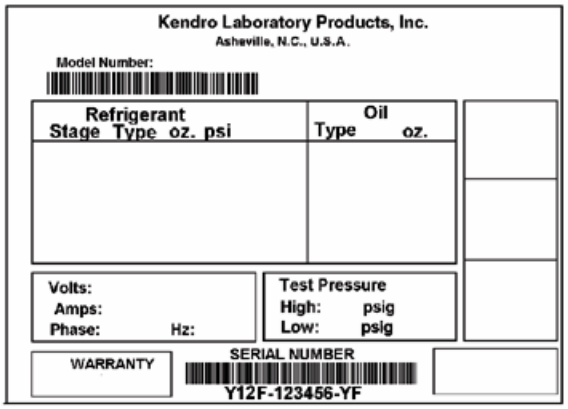

Figure 100-1
Data Label

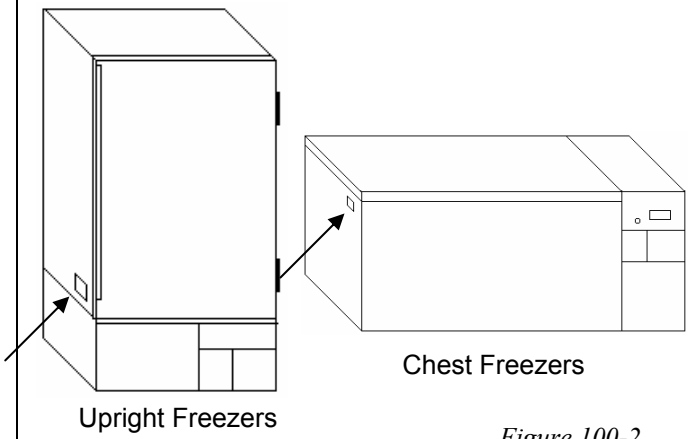

Figure 100-2
Dataplate Location

MODEL TYPES

Figure 100-3
17 ft^3, 21 ft^3 25, & 32 ft^3 Upright

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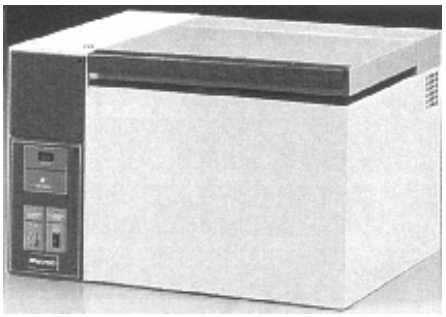

Figure 100-4
1ft^3 Countertop

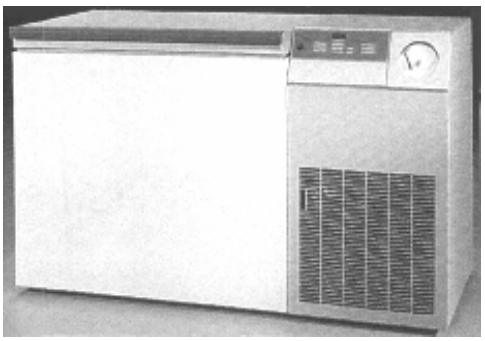

Figure 100-5
10 ft^3 Chest

MODEL TYPES (CONT.)

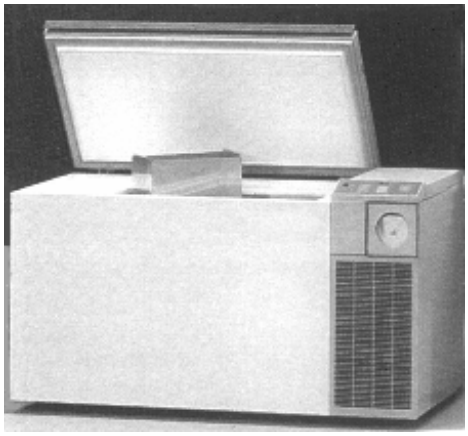

Figure 100-6
14ft³ Chest

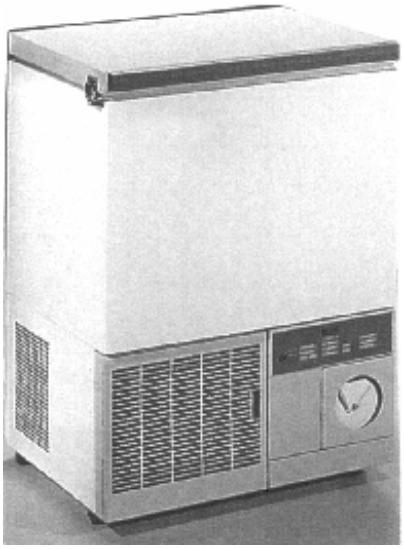

Figure 100-7
5 ft³ Chest

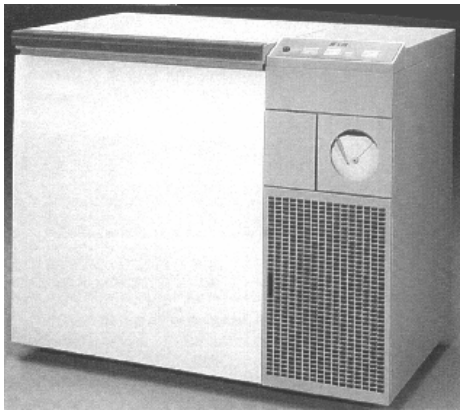

Figure 100-8
7ft³ Chest

MODEL TYPES (CONT.)

Figure 100-9
13 ft³ Upright
(Optional Recorder shown)

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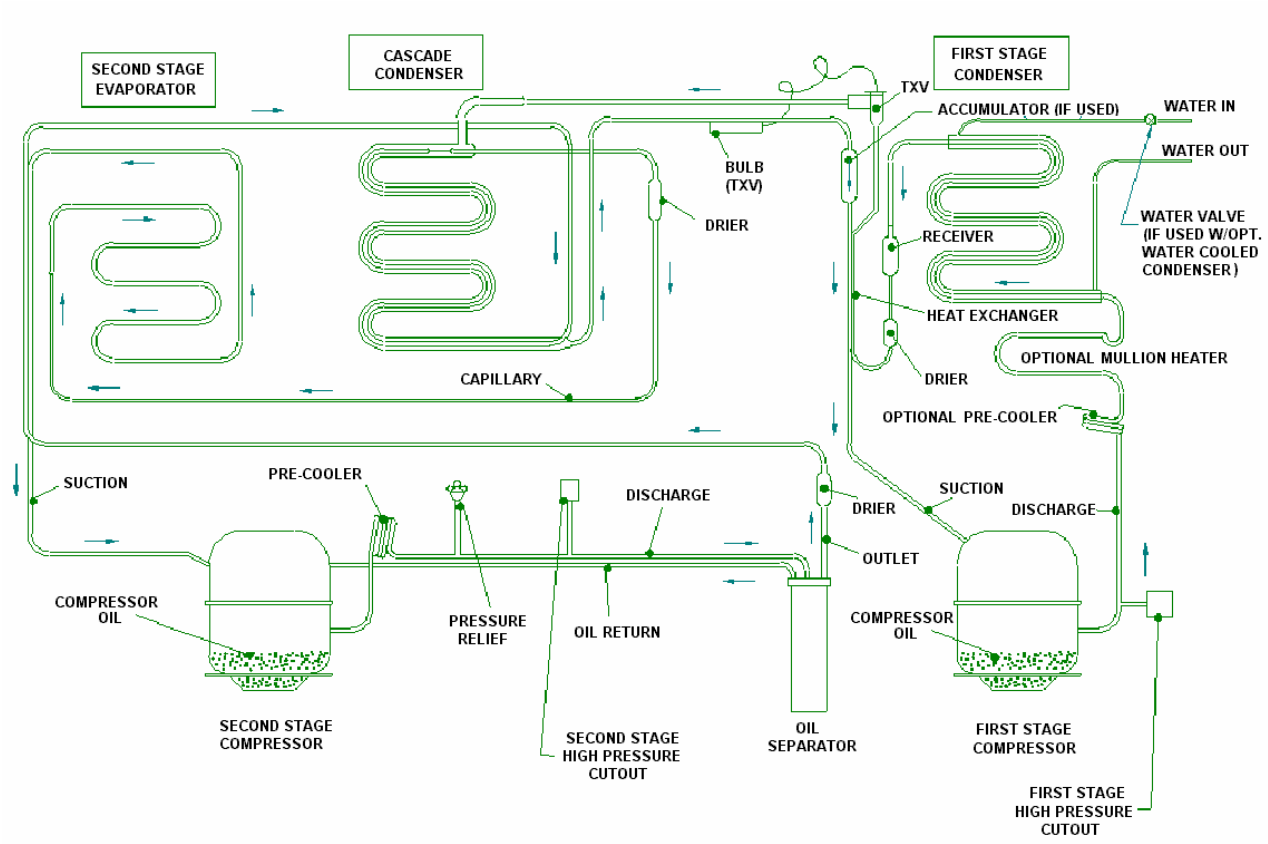
Figure 100-10
5ft³ Chest

Figure 100-11
7ft³ Chest
(Optional Recorder shown)

REFRIGERATION SYSTEM



REFRIGERATION SYSTEM (CONT.)

All of the units covered by this service manual use a one or two stage 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 or txv), 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 that any time a gas is compressed, the temperature and the pressure are increased. Since liquids such as water are incompressible, it very important that all of the refrigerant be in a gaseous state before it reaches the compressor.

The function of the compressor is 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 100-13
Legaci™ Compressor

Add picture of Copeland Semi

REFRIGERATION SYSTEM (CONT.)

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 refrigerator and/or 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 dryer" or other high quality dryer be used. This component serves two purposes:

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 100-14
Forced Air Condenser

Figure 100-15
Typical Drier-Strainer

REFRIGERATION SYSTEM (CONT.)

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.

Figure 100-16
Capillary Tube

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 refrigerator, 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.

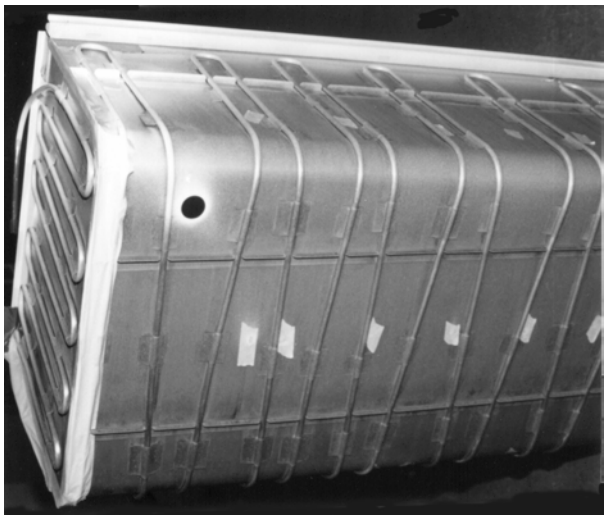


Figure 100-17
Evaporator

Suction Line

Immediately upon leaving the evaporator, the refrigerant must pass through the accumulator. This device is another defense in preventing liquid refrigerant from reaching the compressor. It simply accumulates any liquid that may still be in the line after it has left the evaporator. These devices are normally used on units with capillary tube type metering devices, but may also be used with systems that have the thermostatic expansion valves. Remember, also, that a portion of the outlet line of the evaporator leading back to the compressor suction is connected to the capillary tube or thermostatic expansion valve inlet line, which also adds additional heat to the refrigerant prior to reaching the compressor.

SECTION 200 -- SAFETY

Freezers are 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 person's 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 that may have sharp edges that may cause damage to wiring and electrical connections, not to mention personal injury.

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 well insulated, if applicable.

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.

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.

8. Never interfere with or bypass the operation of any switch, component or feature of the unit.

9. Before reconnecting the power supply, ensure uninsulated wires or terminals are not touching the cabinet

10. Never alter a power cord in order to make it fit an electrical outlet.

11. Be sure and reference any applicable wiring diagram(s) when reconnecting and replacing electrical components.

12. To avoid electrical shock, fire, and equipment damage, ensure that any wires or terminals touching the cabinet are insulated before connecting the power supply. 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.

13. 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.

14. 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.

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

REFRIGERANT SAFETY

1. The following is a list of the more common refrigerants that you will possibly be dealing with: R290, R134a, R508b, and R404a.

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

2. The following are effects of over exposure:

   light-headedness
   giddiness
   shortness of breath
   unconsciousness
   possibly death

Emergency and First Aid Procedures

Remove to fresh air
Call a physician
Do not give heart stimulating drugs such as epinephrine or similar drugs.

3. 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.

4. Do not have open flames in this area. These refrigerants, when exposed to open flame, may produce toxic compounds such as hydrogen chloride, hydrogen fluoride, and other acidic vapors may be produced when these refrigerants are exposed to open flames.

5. 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.

6. 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.

7. Also use facial and eye protection and gloves when handling liquid refrigerant.

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

9. Avoid breathing all refrigerants if possible.

10. Treat all refrigerant cylinders with care. Store in clean dry areas. Do not store at high temperatures.
11. The use of an air mask with an independent air supply is recommended in areas of high concentrations and poor ventilation.

SECTION 300 - 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 Value, Elite and the Ultima II ultra-low temperature freezers.

FEATURES

ELECTRONIC CONTROL & ALARM SYSTEM

Tamper-resistant touchpoint setpoint selection with adjustable operating temperature (Ultima II)

Key operated switch for main power and alarm system.

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

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

Low battery indicator (Not All Models)

Touchpad alarm test (Not All Models)

Power failure or temperature deviation outside alarm set limits triggers audible and visual warning. (Not all Models)

MICROPROCESSOR CONTROL

Tamper-resistant touchpoint data entry with adjustable operating temperature (Not all Models)

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. (Not All Models)

Clean filter indicator advises user to clean condenser intake filter. (Not all Models)

ALARM/MONITORING SYSTEM

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

A.I.M (Automatic Incident Monitor). (Not all Models) (see page 300.3 for details)

Low battery indicator (Not All Models)

Touchpad alarm power failure or temperature deviation outside alarm set limits triggers audible and visual warning. (Selected Models)

Independent high and low alarm setpoints adjustable in 1°C increments (Not all Models)

Low voltage indicator light (Selected Models)

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

Four (4) stainless steel interior shelves, (3) adjustable.

Anti-roll brakes

Five inner doors with positive latches

ADDITIONAL ULTIMA II FEATURES.

EXTREME AMBIENT ALERT

This alarm monitors the ambient temperature in the area of the freezer. If the temperature reaches 99f (+/- 3f), it could possibly effect the performance or reliability of your freezer, and 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 your samples.

LIFE GUARD

Life Guard actively monitors the condition of the compressors in the freezer. If the compressors should enter a harmful stress condition that could cause them harm, the Life Guard automatically turns the unit off and allows the compressors to cool down.
The compressors will be automatically started when the conditions are improved. During a Life Guard alert, the temperature inside your chamber may warm Slightly. However, this is a far superior option when compared to having a compressor failure and a complete warm up of your samples. If Life Guard is ever activated, please call a service provider immediately to investigate. Factors that may cause Life Guard to activate include extreme ambient conditions, extreme voltage conditions, excessive loading with warm product, extremely dirty condenser filters, doors left open, and other unusual circumstances.

SET POINT SECURITY

Not available on all models
Set Point Security allows you to lock in the control set point and alarm set points of your freezer to ensure that they may not be changed, accidentally or intentionally. When the key is in the third key position (alarm on), Set Point Security deactivates the up and down buttons on the control panel. This makes it impossible for the control set point, warm alarm, and cold alarm to be changed. Of course, pressing the appropriate buttons can still see these temperatures.

AIM (AUTOMATIC INCIDENT MONITOR)

Not available on all models
Although you cannot 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.

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) Compatable to Type "T"
* 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; R404, R134a, R508B, and R290 (Instrument Grade Propane)
* 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
* 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

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, 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 upon the model. The battery voltage at full charge is 12 VDC.

FAN MOTORS

Most fan motors used today are 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.

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% 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 +/- 1C at the coldest setting 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 (828) 658 - 2818

SECTION 400 - MAINTENANCE AND REPAIR PROCEDURES

CABINET
LEVELING OF A CHEST OR UPRIGHT FREEZER

A unit that is not level will not operate properly. It can cause imbalances in products and can cause problems in the refrigeration system. An unleveled 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.

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 leveling leg until the carpenter level indicates the unit is level from front to back, and from side to side.

Figure 401-1
Typical Chest and Upright Caster

DEFROSTING A CHEST OR UPRIGHT 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 the door or 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.

NOTE On upright models, towels should be placed in the cabinet floor and on the laboratory floor immediately in front of the cabinet to prevent the water from presenting a slip hazard.

Step 5: Start the unit by closing the door or 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.

DOOR ADJUSTMENT OF AN UPRIGHT FREEZER

The following steps will aid you in adjusting the hinges of an upright Ultra Low Temperature freezer.

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

Step 2. Install a bar clamp with 2" x 4" wooden blocks, as shown in Figure 403-1.

Step 3. Loosen the mounting screws that hold the hinge to the door.

Step 4. Align the door so that the top and latch edges are flush with the cabinet.

Step 5. Tighten the bar clamp to produce secure gasket seal.

Step 6. Tighten all mounting screws.

Add picture for new hinge

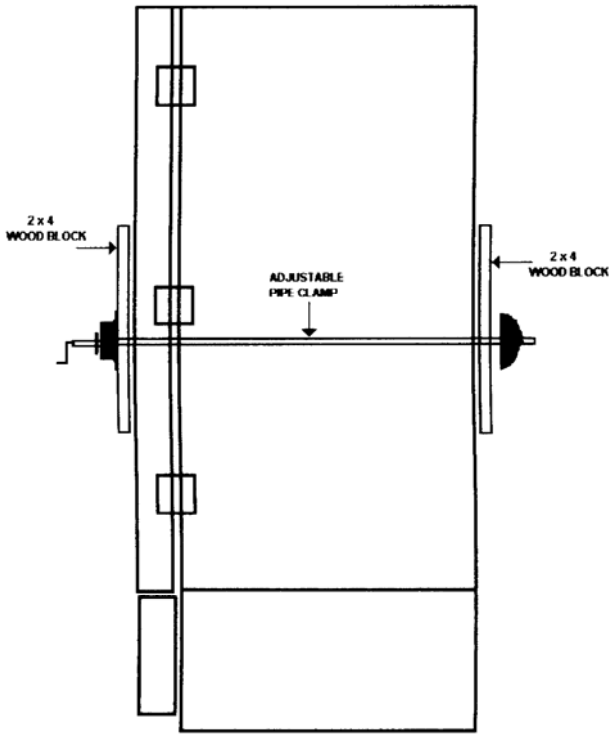


Figure 403-1
Hinge Adjustment Configuration

Figure 403-2
Upright Freezer Hinge

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.

Add warning symbol

CAUTION The hinge is under considerable spring tension. Removal or excessive loosening of screws could cause hinge to fly up and cause injury.

Step 2. Loosen the hinge screws that 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 3/4" wrench, 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

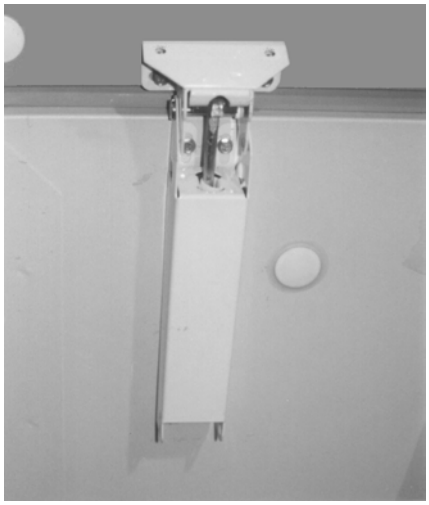


Figure 404-1
Chest Freezer Hinge

UPRIGHT FREEZER GASKET REPLACEMENT

The following steps will aid you in replacing the inner or outer gasket of an upright 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.

Step 3. Remove the desired (inner or outer) gasket by pulling it straight away from the door.

Step 4. Align the corners

Step 5. Press the retaining rib (corners first) on the new gasket into the groove in the door using a rubber hammer if necessary.

NOTE You may find it easier to remove the door and lay it on a flat surface with the gasket side up.

Add picture of new gasket

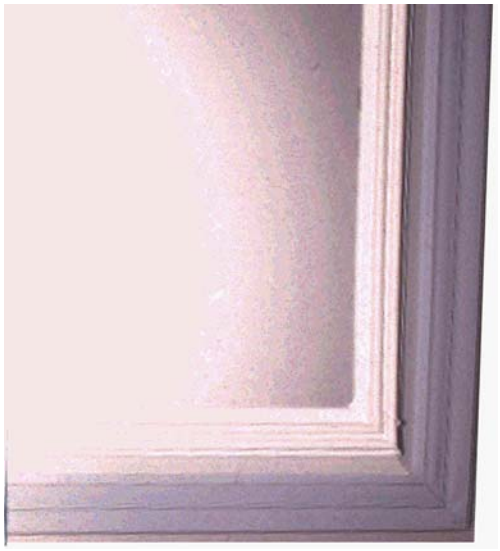


Figure 405-1
Typical Gasket
(inner or outer)

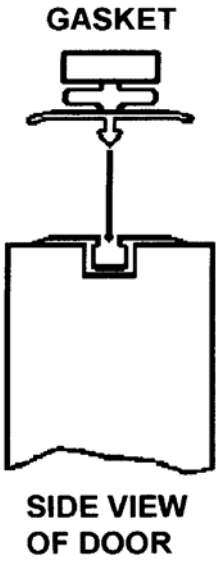


Figure 405-2
Gasket Insertion

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.

Add warning symbol

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

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

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 406-1
Chest Freezer Hinge

Figure 406-2
Chest Gasket

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

Step9. Adj. Per Adjustment Procedure

Step 10. Reattach power supply.

Step 11: Turn power key on.

Step 12: Check unit for proper operation.

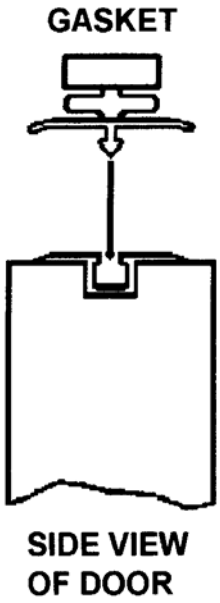


Figure 406-3
Gasket Insertion

HANDLE REPLACEMENT FOR CHEST FREEZER

The most used manual component of a chest freezer is the lid handle. The following steps are provided to give instructions on how to replace the handle of a -85C 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 the lid.

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

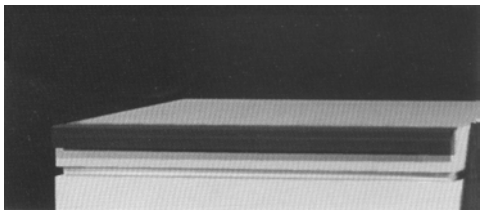


Figure 407-1
Lid Handle

UPRIGHT FREEZER CAM LATCH DOOR LOCK REPLACEMENT

The following steps are provided to give instructions on how to replace the latch of an upright freezer.

Before repairing, identify any circumstances contributing to latch problem such as shipping damage, excessive ice build-up, maneuvering overload, improper alignment of the latch of lid/door hinges, cabinet breaker geometry, or other. Review with owner and factory service department at 800-438-4851.

REMOVE UNWANTED LATCH.

Step 1 If necessary, secure door temporarily with strapping tape.
Step 2. Remove rear strike cover and rear strike.
Step 3. Remove front cover by removing fasteners then sliding vertically upward. Note concealed fasteners behind door handle.
Step 4. Remove latch assembly. Note, access holes allow removal of latch mounting fasteners without disassembly
Step 5. Inspect door and cabinet for damage. Pay careful attention to mounting points.
Step 6. Repair threads as necessary with ¼-20 tap or drill 25/64 (PN 38126H03) then replace with nutsert (PN305465H01).

NSTALL NEW LATCH

Step 1. Inspect new latch for workmanship flaws and/or handling damage. Mechanism should have a tight feel, lock should engage smoothly and fully.
Step 2. Attach new strike to cabinet with (4) ¼-20 fasteners and hardened washers. Align horizontally flush with cabinet edge or with a slight overhang. Torque 60 in-lb. (6.75 N-m).

NOTE Inability to achieve torque may indicate damaged threads

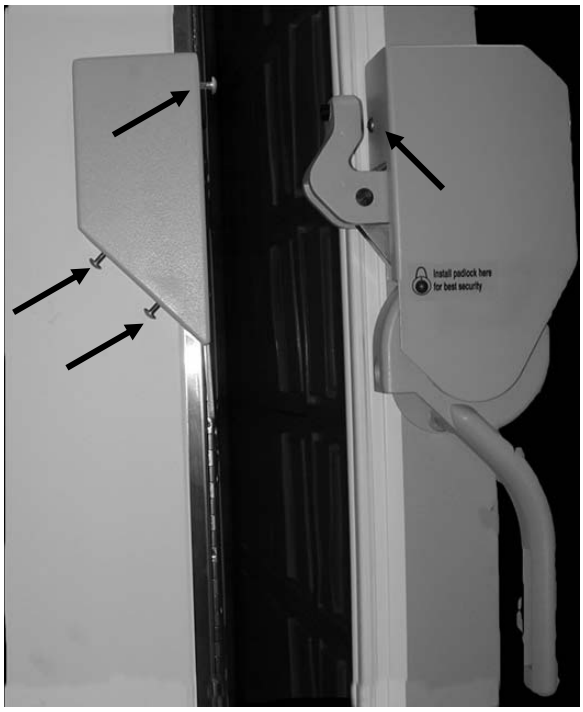


Figure 408-1
Strike (2b) and Latch (2c) Cover Mounting Screws

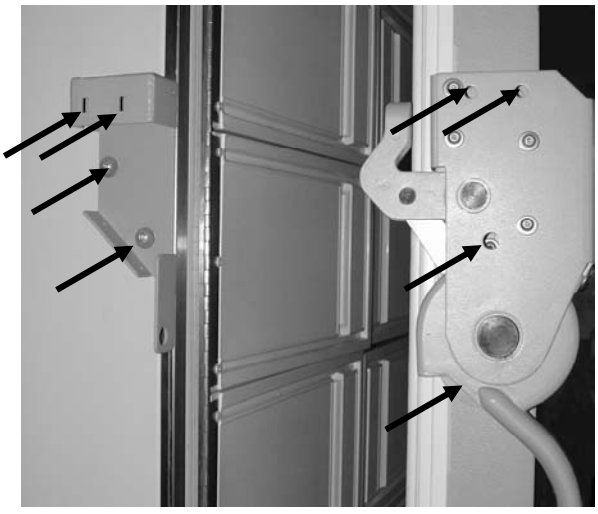


Figure 408-2
Strike and Latch Mounting Screws and / or Access Holes

Step 3. Attach latch assembly to door with (4) ¼-20 fasteners and hardened washers. Align vertically so top surface is flush with rear strike. Torque 60 in-lb. (6.75 N-m).

NOTE Disassembling latch is not required nor recommended.

Step 4. Put a small amount of white lithium grease at strike point.

CAUTION Excessive door compression may damage latch and/or cabinet.

Step 5. Adjust rear strike horizontally to achieve exterior gasket compression thickness of approximately 11/16 inch (18mm).

Step 6. Fine tune gasket compression with miro-adjustment screw located in catch. Install front and rear covers. Top surfaces should align.

CAUTION Only the micro-adjustment screw's chamfered portion should extend beyond the catch surface to prevent snagging on the strike during close. If necessary, loosen and reposition strike rearward to assure smooth operation.

Step 7. Verify operation. Neither latch nor cabinet panels should deflect noticeably during operation. No interference should exist between latch components and freezer. Fasteners remain secure. Padlock and built in lock engage smoothly.

NOTE 2 –4 drops ICI46H POE lubricant may be squirted into main or interlink bearings to eliminate squeaks.

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.

CAUTION Disconnect all power to unit.

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 two inches.

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.

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.

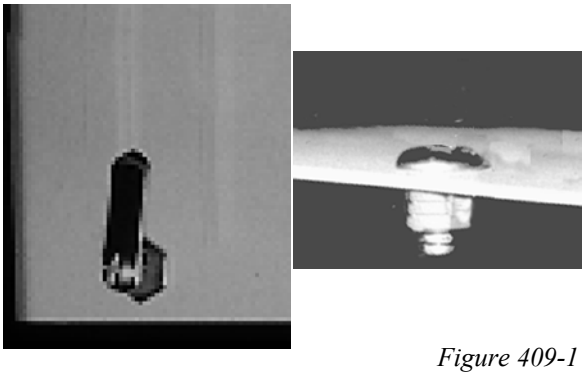


Figure 409-1
Chest Freezer Lid Lock
(installed on the unit)

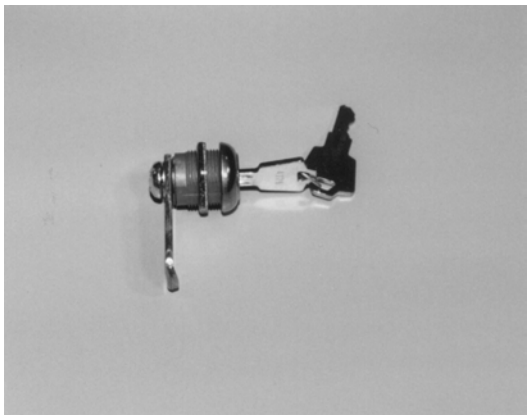


Figure 409-2
Chest Freezer Lid Lock Component Parts

UPRIGHT FREEZER EXTERIOR DOOR HINGE REPLACEMENT

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

Step 1: Strap the door to the cabinet to prevent it from moving or falling. (See DOOR ASSEMBLY REPLACEMENT AND SEAL CHECK ON UPRIGHT UNITS, for door removal).

Add Warning symbol and note

Step 2: Locate and remove the screws which secure the hinge to the cabinet. Retain the screws and any washers removed.

Step 3: Remove the hinge.

Step 4: Place and secure the new hinge using the screws and washers from step #1.

Step 5: Adjust hinges per DOOR ADJUSTMENT OF AN UPRIGHT FREEZER.

Step 6: Monitor unit for proper operation.

Note for above. Make sure door is secure. Remove and replace only one hing at the time.

Figure 410-1
Upright Freezer Hinge

Picture of new hinge.

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.

Add warnign symbol

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 4: LID ADJUSTMENT OF A CHEST FREEZER.

Step 7: Monitor unit for proper operation.

Note for above, The hinge is under considerable tension, movement of the hinge must be controlled as the screws are removed to avoid injury.

Figure 411-1
Chest Freezer Hinge Assembly

UPRIGHT FREEZER INTERIOR DOOR REPLACEMENT

Ultra Low Temperature freezer upright units come equipped with a set of inner doors attached to a single piano hinge that extends the height of the cabinet. This procedure will aid you in replacing one or more than one inner door on these types of units.

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 and secure the outer door.

Step 4: Open the inner door to be removed, remove the three bolts securing the door to the hinge, and remove the door.
Warning symbol

NOTE To replace the hinge, remove all doors and the nine bolts securing the hinge to the cabinet, then remove the hinge.

Step 5: Install components in the reverse order.

Figure 412-1
Inner Door Piano Hinge

Figure 412-2
Inner Door

DOOR ASSEMBLY REPLACEMENT AND SEAL CHECK ON UPRIGHT UNITS

The following steps will aid you in replacing the outer door 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: It will be necessary to disconnect the electrical control wiring to the door before attempting to remove the door.

Add warnign symbol

Step 4: To remove the door, lift straight up, lifting the hinge pins out of hinges mounted on the cabinet.

Step 5: Install new door by placing hinge pins down into cabinet hinges. There should be 3/4" clearance between hinge side of door and cabinet.

Step 6: Check the gasket for a good flat surface and that the gasket does not roll on hinge side.

Step 7: Reinstall eye level control panel.

Step 8: Reconnect power supply and turn key switch to the Power On position. Check unit for proper operation.

Note to go with warning symbol. The door is heavy, get the necessary assistance to help remove and replace.

Figure 413-1
Upright Door Assembly

New picture with new door latch

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.

Add warning symbol and note

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.

Step 8. To adjust the lid tension , take a 3/4" 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.

See, Read hinge replacement procedure for removal of hine from cabinet and replacement. Lid is heavy get the necessary assistance to help in removeing and replacing.

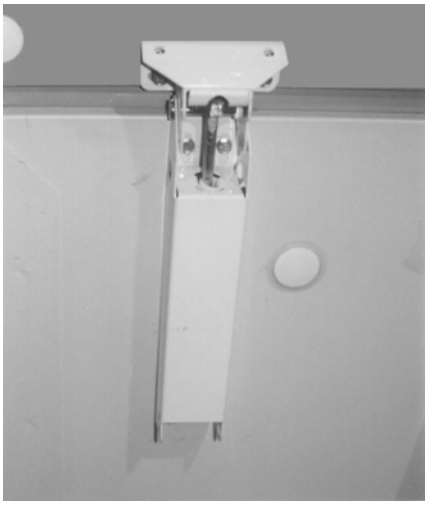


Figure 414-1
Chest Hinge

Figure 414-2
Chest Freezer Tension Adjusting Nut

BREAKER STRIP REPLACEMENT ON A CHEST OR UPRIGHT 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. See note below.

Step 5: Install the new breaker strip.

Step 6: Install the corner retainers.

NOTE When replacing the bottom breaker strip of an upright freezer; the inner lip will have a bead of silicon as a moisture barrier. Use a putty knife to cut the bead. Remove the old silicon and replace with a fresh application when the new breaker strip is installed.

Figure 415-1
Upright Freezer Breaker Strip Retainer

415-2
Chest Freezer Breaker Strip Retainer

CHEST AND UPRIGHT 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 replacing 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 or 416-2. The filter is attached to the backside of the front grill. The filter is held in place with hook-and-loop 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 hook-and-loop patches.

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 416-1
Upright Freezer Filter Location

Figure 416-2
Chest Freezer Filter Location

LEVELING LEG REPLACEMENT

The following steps will aid you in replacing one or more of the units leveling legs.

Step 1: Carefully raise or tilt the unit eight to twelve inches from the floor.

CAUTION
Add warning symbol

Do not tilt the unit rearward without blocking the rear casters, due to the personnel hazard caused by the unit rolling on the rear casters. Ensure that you have adequate assistance to prevent the unit from tipping.

Step 2: Grasp the leveling leg and turn it in a counter-clockwise direction to remove.

Step 3: Position the new leveling leg in the location of the original, and turn the leg in the clockwise direction to install.

Step 4: Ensure the unit is level from front to back, and from left to right, by turning the legs clockwise to shorten the leg (lowering that particular corner of the cabinet), or counter-clockwise to extend the leg (raising that particular corner).

Figure 417-1
Leveling Leg
(installed on unit)

Figure 417-2
Leveling Leg

CASTER REPLACEMENT

The following steps will aid you in replacing the casters on an upright or chest model.

CAUTION

Add warning symbol

Do not tilt the unit rearward without blocking the rear casters, due to the personnel hazard caused by the unit rolling on the rear casters. Ensure that you have adequate assistance to prevent the unit from tipping.

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 LEVELING OF A CHEST OR UPRIGHT FREEZER.

Figure 418-1
Caster Attached To Cabinet

Figure 418-2
Caster

ELECTRICAL / ELECTRONIC

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.

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.
Add warnign symbol Electrical Hazard

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,

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.

Do not move from side to side, or up and down, as this may cause a loose connection.

Figure 419-1
Compressor Relay Housing

Figure 419-2
Start Relay

(Continued next page)

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.

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 419-3
Compressor Relay Terminals

Add Picture of Copeland Semi Compressor

CONTROL RELAY EVALUATION AND REPLACEMENT

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

Add warnign symobol Electririal Hazard

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. However, on older series units this voltage would be line voltage, 115 volts or 208/230 volts.

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 were 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.

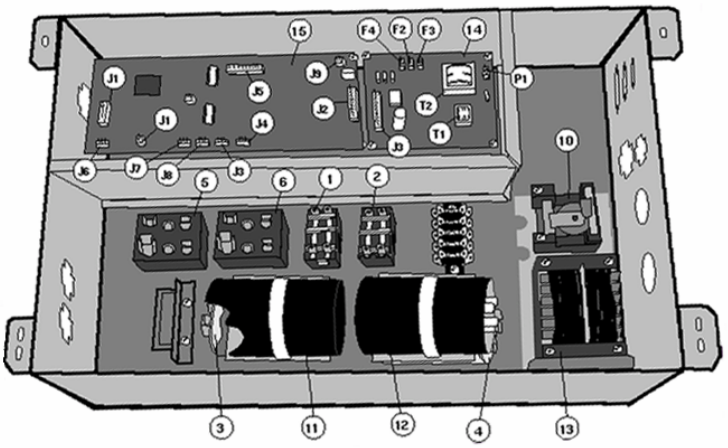


Figure 420-1
Upright Freezer Control Relay Location
(Number 1 and 2 on illustration)

Add Figure 500.3 or redraw for single stage unit.

OR

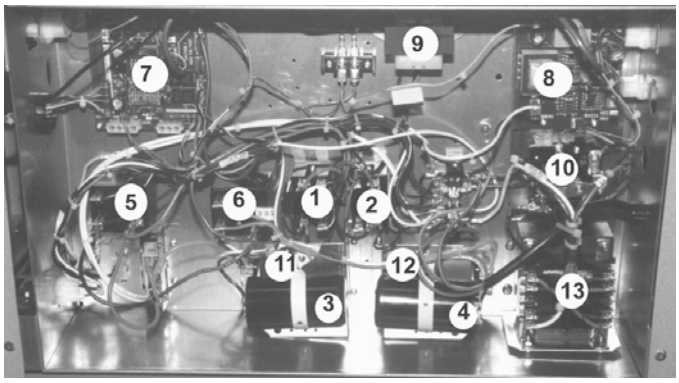


Figure 420-2
Control Relay Location (Upright)
(Number 1 and 2 on illustration

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: Notice the position of the relay in the mounting bracket. Unlatch the clips on each side of the relay and pull the relay from the relay mounting bracket.

Step 9: Secure the replacement relay into the mounting bracket. 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: Ensure that the key switch is still in the off position.

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

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.

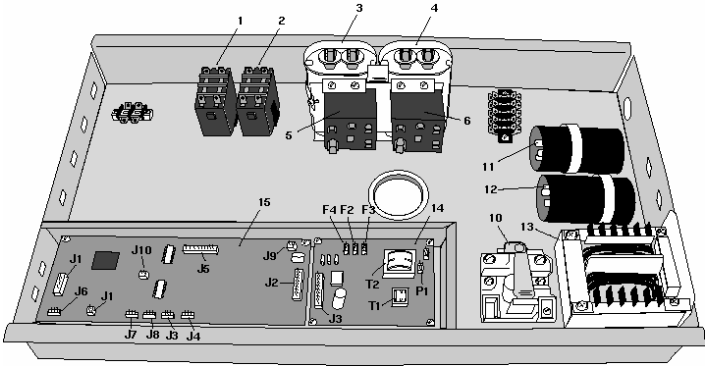


Figure 420-3-1
Chest Freezer Control Relay Location
(Number 1 and 2 on illustration)

Add in Figure 500.4 for single stage, copy or redraw

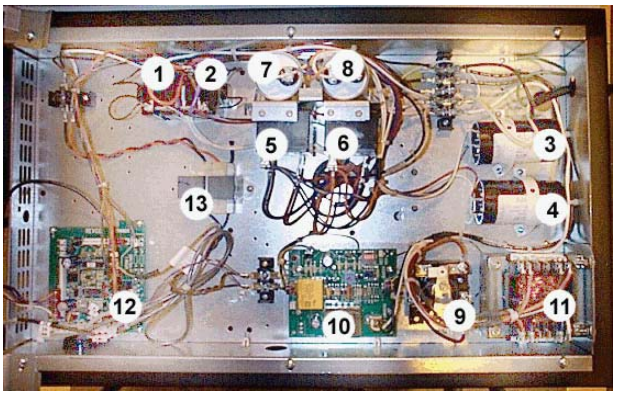


Figure 420-4
Control Relay Location (Chest)
(Number 1 and 2 on illustration)

Need new relay picture.

Figure 420-5
Control Relay

CAPACITOR EVALUATION AND REPLACEMENT

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

Add Electrical warnign symbol .

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. (A capacitor tester is Required for proper testing)

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.

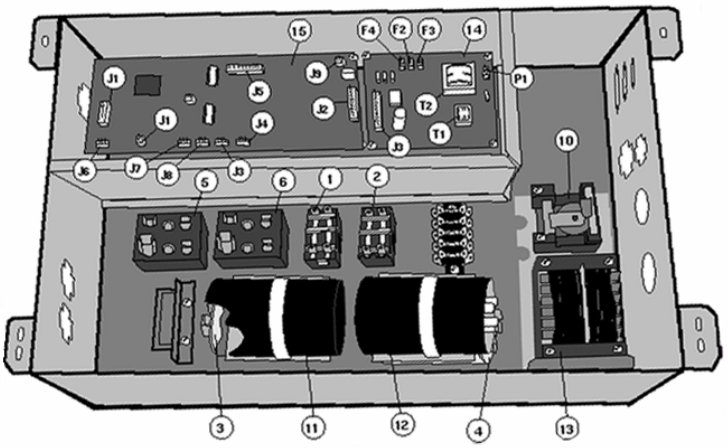


Figure 421-1
Upright Freezer Control Relay Location
(Number 1 and 2 on illustration)

OR

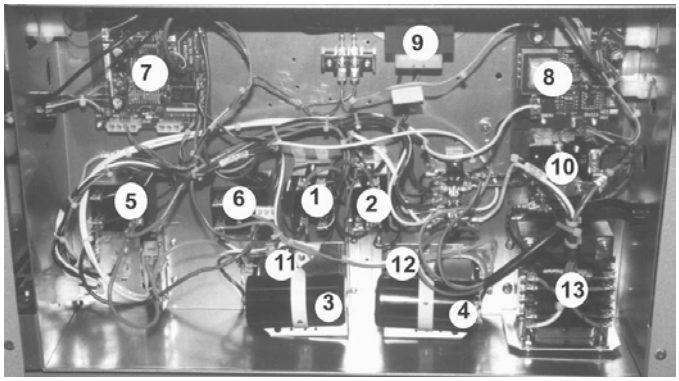


Figure 421-2
Control Relay Location (Upright)
(Number 1 and 2 on illustration

Add figure 500.3 for single stage, copy or redraw.

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.

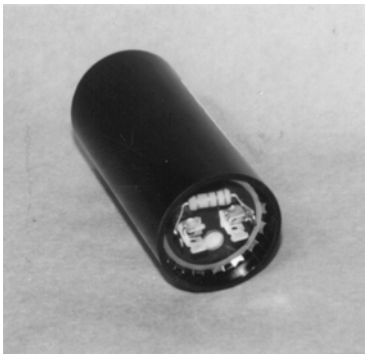


Figure 421-3
Start Capacitor

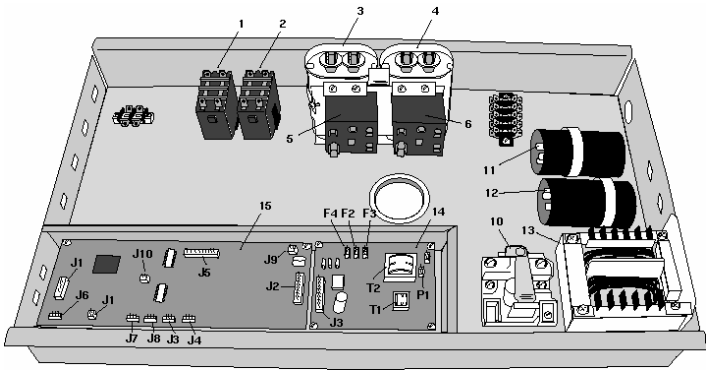


Figure 421-3
Chest Freezer Control Relay Location
(Number 11/12 and 3/4 on illustration

OR

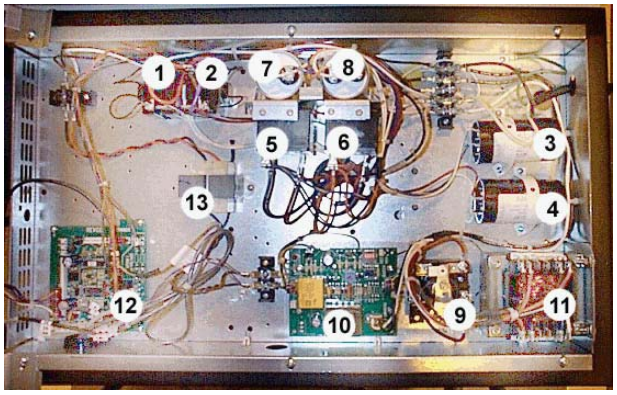


Figure 421-4
Chest Freezer Control Relay Location
(Number 11/12 and 3/4 on illustration)

Add figure 500.4 for single stage, copy or redraw

Figure 421-4
Run Capacitor

VOLTAGE BOOST RELAY EVALUATION AND REPLACEMENT

The following steps will aid in evaluating and replacing the voltage boost relay on Ultra Low Temperature freezer.

EVALUATION

Add electrical warnign symbol

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. Measure the voltage 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.

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.

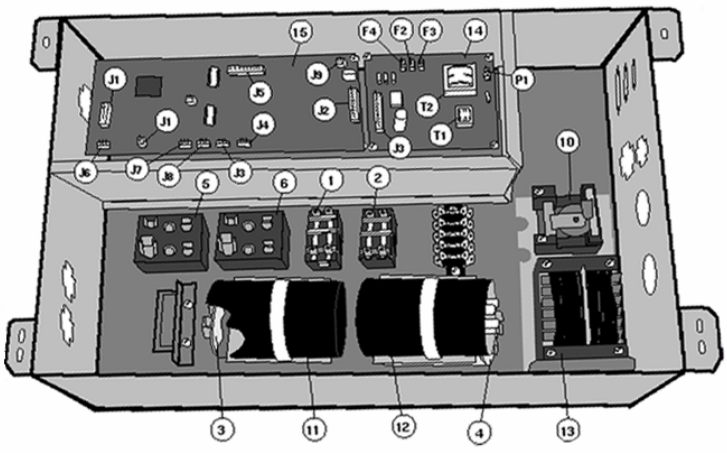


Figure 422-1
Upright Freezer Voltage Boost Relay
(Number 10 on illustration)

OR

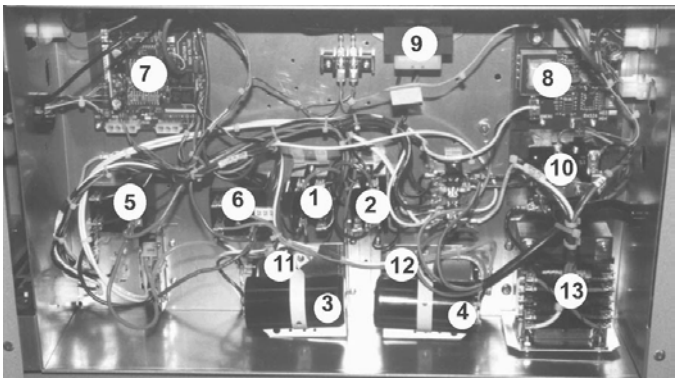


Figure 422-2
Upright Freezer Voltage Boost Relay
(Number 10 on illustration

Add figure 500.3 for single stage, copy or redraw

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.

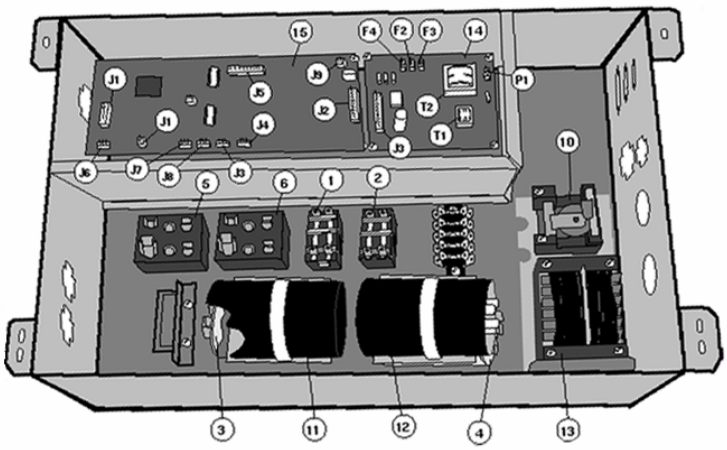


Figure 422-3
Chest Freezer Voltage Boost Relay
(Number 10 on illustration)

OR

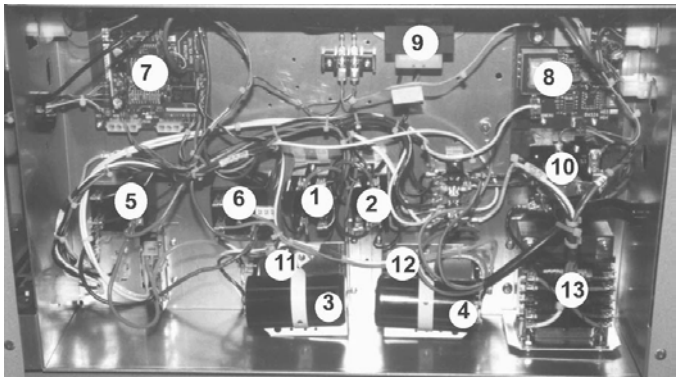


Figure 422-4
Chest Freezer Voltage Boost Relay
(Number 10 on illustration

Add figure 500.4 for single stage, copy or redraw.

SURGE SUPPRESSER EVALUATION & REPLACEMENT (UPRIGHT FREEZER)

The surge suppresser on an upright model is mounted in the unit section, just behind the filter access opening. Open the filter door and the surge suppresser will be on the left-hand side.

The following steps will aid you in replacing the surge suppresser.

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.

REPLACEMENT

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

Step 2: Open condenser filter grill as if to clean the filter

Step 3: Remove the Phillips screws attaching the suppresser mounting bracket to the left front corner.

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 mounting bracket cabinet and remove the suppresser.

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.

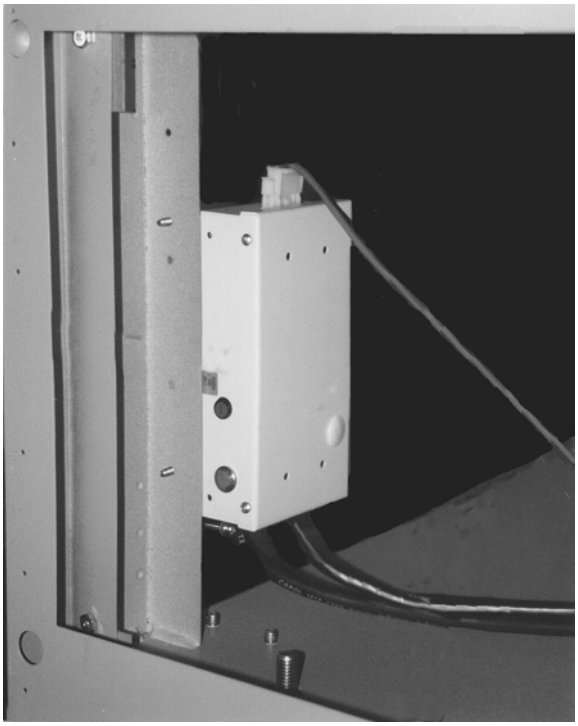


Figure 423-1
Surge Suppresser Location on Upright Units

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.

Step 9. Replace the mounting bracket, and install the Phillips screws removed in Step 3

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.

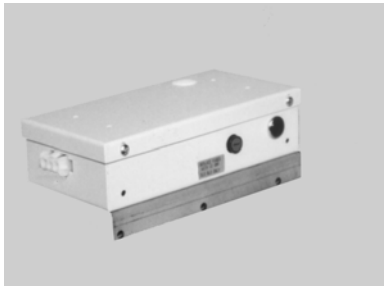


Figure 423-2
Surge Suppresser

SURGE SUPPRESSER EVALUATION & REPLACEMENT (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.

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.

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.

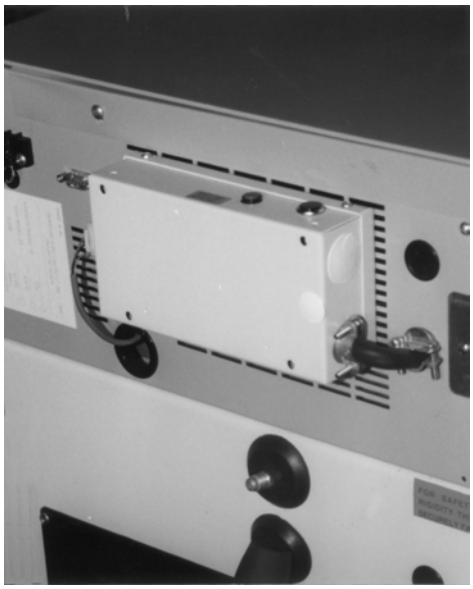


Figure 424-1
Surge Suppresser Location on Chest Freezer

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.

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.

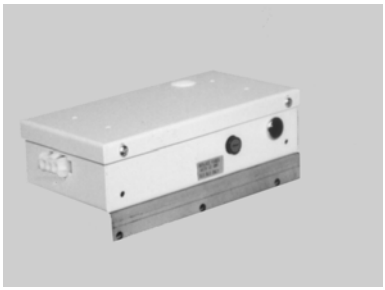


Figure 424-2
Surge Suppresser

"MICRO" CONTROL PRINTED CIRCUIT BOARD EVALUATION & REPLACEMENT

The junction box that houses the "Micro" Control PCB is in the right side of the base of an upright freezer or at the right end of a chest freezer; beneath the upper cover.

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

Add electrical warnign symbol

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).

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. (Two stage only)

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 -- 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.
(Not on all models)

J8 Compressor Sensor connector (where used) - Pins 1 & 2. (Selected Models)
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

Electrical warnign symbol

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.

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

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

Step 7. Install the 6 screws that secure the PCB.

Step 8. Connect the connectors, following the labels.

Step 9. Plug in the freezer and turn the key 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 VR1 on the "Micro" Power Supply PCB per Procedure 26: "MICRO" POWER SUPPLY PRINTED CIRCUIT BOARD EVALUATION AND REPLACEMENT

Step 12: Install the covers and allow the unit to pull down before loading.

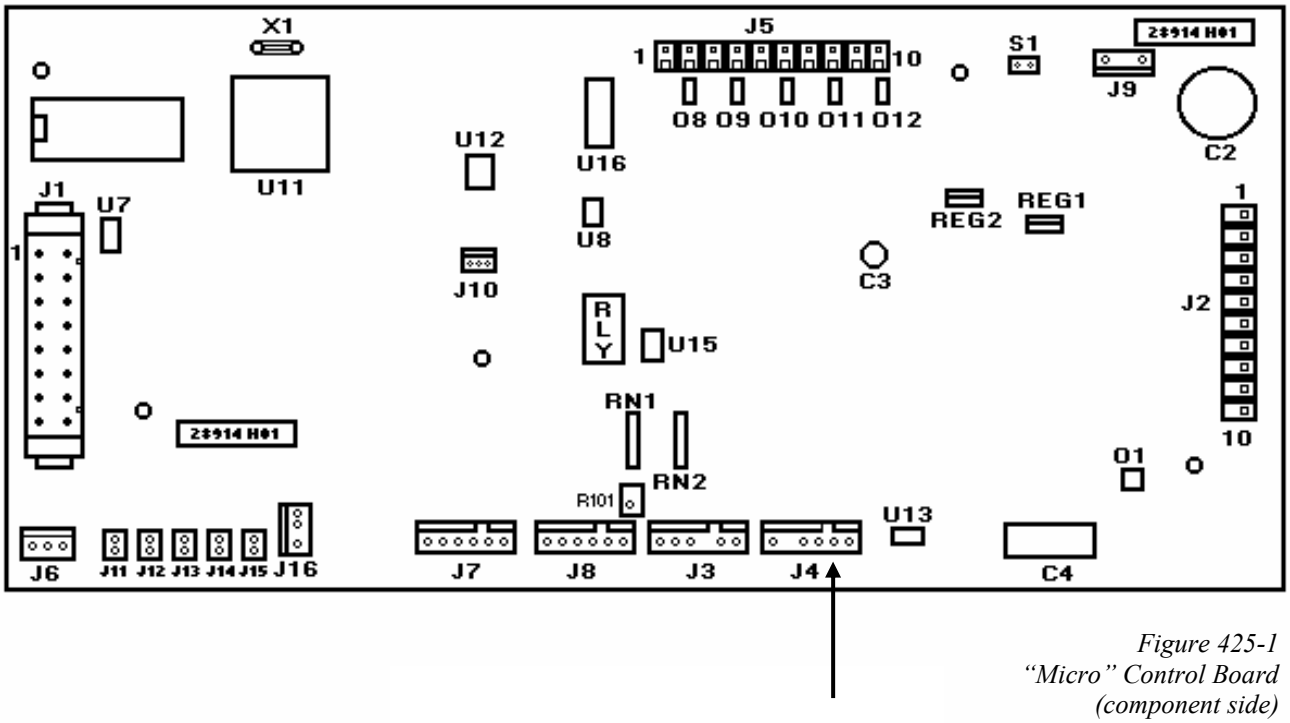


Figure 425-1
"Micro" Control Board
(component side)

"MICRO" POWER SUPPLY PCB EVALUATION AND REPLACEMENT

The junction box which houses the "Micro" Power Supply PCB is in the right side of the base of an upright freezer or at the right end of a chest freezer; beneath the upper cover.

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

Add electrical warning symbol

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 Backup 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 VR1 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 Three jumpers used on BLOCK 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

Warning — Always wear a personal grounding device when handling the PCB(s).

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

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.

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 the key to the "Power On" position.

Step 10: Adjust VR1 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 VR1 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.

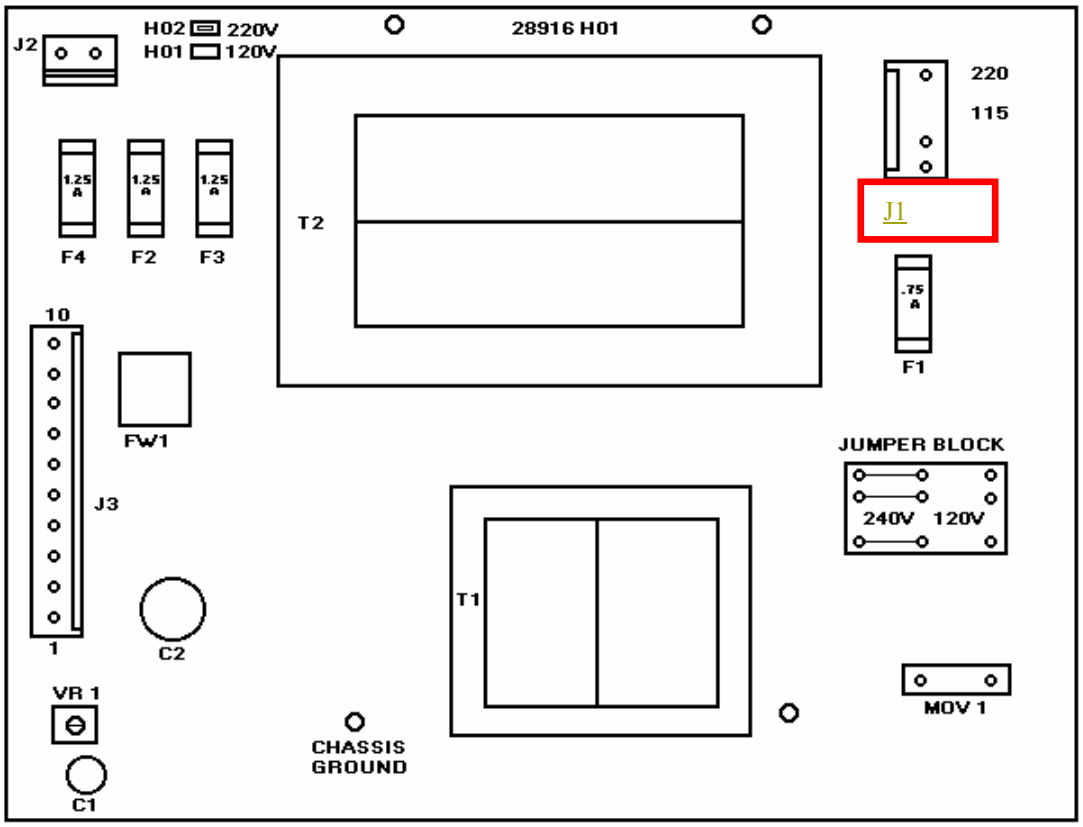


Figure 426-1
"Micro" Power Board
H01

H01 board shown, see note on H03 Board, which is dual voltage rated

"MICRO" DISPLAY PCB

The "Micro" Display PCB is located at eye level on the door of the upright freezers or beneath the upper cover at the right end of the chest freezers.
Warning Ware grounding strap when handeling boards

ACCESSING THE "MICRO" DISPLAY PCB ON AN UPRIGHT

Step 1. Remove the screws from the bottom of the eye level control panel.

Step 2. Pull the bottom of the control panel out and down. (Cut awary the silicon at the top of panel on units with the control panel below the door.

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

ACCESSING THE "MICRO" DISPLAY PCB ON AN 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. See chart

S4 should be "ON" for all applications except Heraeus brand units.

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

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

Microprocessor Options			
Brand	Setpoint Security (J1)	1st Stage Overtemp (J2)	Extreme Ambient (J3)
Elite	X		X
Ultima II	X		X

SW1 Configuration		
SW1	115V	208/230V
S1	On	On
S2	On	Off
S3	On	On

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

Step 1. Label and disconnect the connectors on the Display PCB.

Step 2. Remove the screws that secure the Display PCB.

Step 3. Remove the Display PCB.

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

Step 5. Install the new Display PCB.

(Continued next page)

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

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

Step 8. Install the covers.

Step 9. Plug in the freezer and turn the key to the "Power On" position.

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

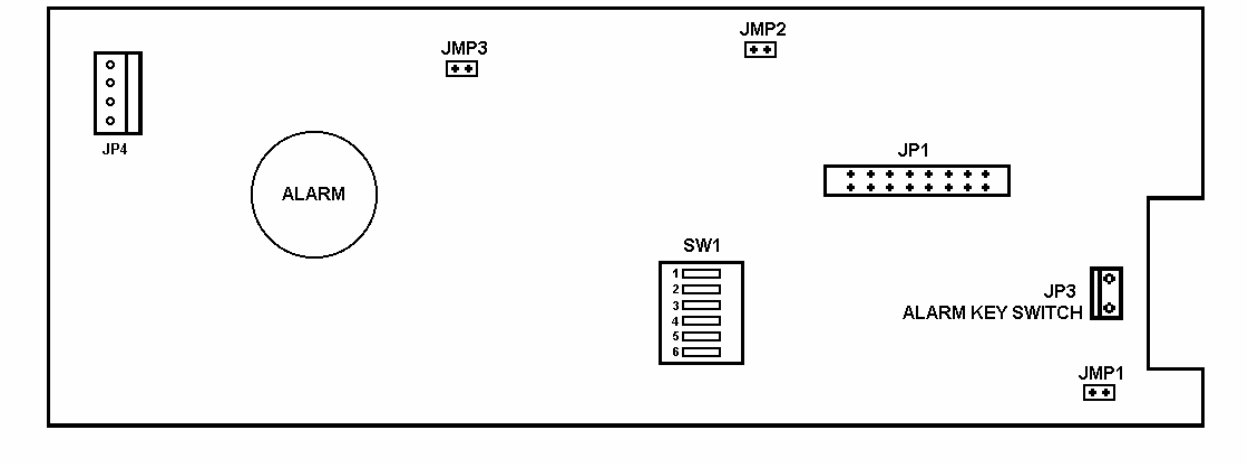


Figure 427-1
Display Board
(solder side)

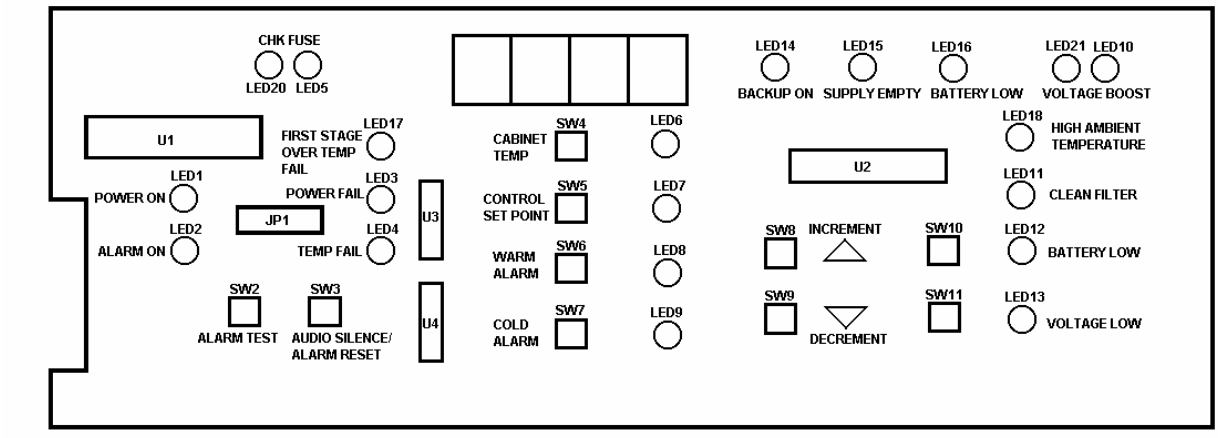


Figure 427-2
Display Board
(component side)

Control Display Harness Replacement (Upright and Chest)

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.

UPRIGHT MODELS

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. To gain access to the control display harness, remove the screws securing the solid panel on the right side bottom facing the cabinet. After removal of the screws, set the panel aside. (on chest you have to remove the top control housing to gain addess to the screws holding the display panel.)

Step 5. Remove the screws from the bottom of the display board housing. Retain the screws, they will be used for reassemble.

Step 6. After removing the display screws, gently pull the display housing toward you from the bottom. This will allow access to the display board and harness.

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 7. 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.

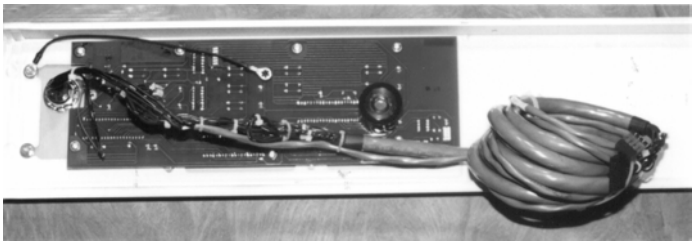


Figure 428-1
Display Harness Location

Step 8. Cut any tyraps holding the main harness to the key switch cable. Remove the support clamp and carefully pull the harness down through the PVC port located in the corner of the display cutout in the door.

Step 9. Locate and remove the control board cover screws and set this panel and its screws aside.

Step 10: Locate the 16 pin harness (lockable IDC connector header) male connector on the control board and pull or push the claims 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.

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

Step 14: Re-install the control board electrical cover.

Step 15: Push the new harness up through the PVC port at the bottom of the door and into the display board access area.

Step 16: Place the male connector plug of the new harness into the header pin housing on display board.

(Continued on next page)

Step 17: With the plug in place PUSH the plug downward, this will cause the clamps to self-lock.

Step 18: Install the clamp previously removed and tyrap the harness back to the key switch cable.

Step 19: Re-install the display board housing into its frame and install the screws previous removed.

Step 20: After checking all wiring connections to ensure you have good electrical connections, then reconnect the AC power and the battery system wires.

Step 21: Test the system electrically for proper operation.

CHEST MODELS

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 backward away from the display panel. Remove and set the cover aside.

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.

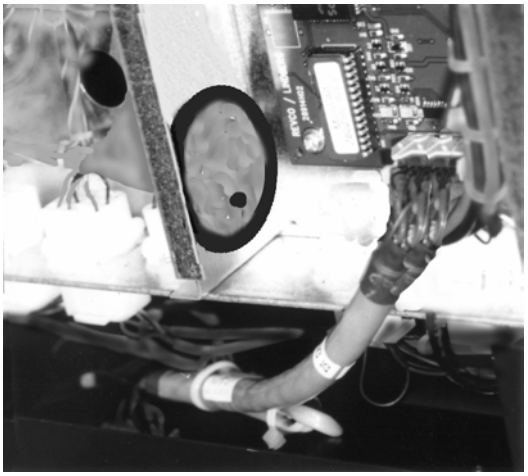


Figure 428-2
Display Harness Location

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.

(Continued next page)

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

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.

HEAT EXCHANGER SENSOR REPLACEMENT (UPRIGHTS)

(Not used on single stage units.)
The following steps will aid you in replacing the heat exchanger sensor on an Upright, Ultra Low Temperature freezer.

EVALUATION

Step 1: To determine if the sensor is reading correctly, you will need to check the resistance. On the micro control board, remove connector J4 and place the meter leads between the red and black wires. Compare the resistance with the temperature / resistance chart (Table 2) to determine if the sensor is reading correctly.

Step 2: The heat exchanger temperature can be checked via the control panel on units that have the warm and cold alarm set point buttons. Press and hold the cabinet temperature, cold alarm set point, alarm battery low, and the voltage low buttons simultaneously. This will display the temperature the heat exchanger probe is sensing. Normal temperature reading is -32/-34°C or colder.

CAUTION When performing work inside the electrical junction box, make sure the unit is de-energized unplugged and the circuit breaker is locked and tagged out.

REPLACEMENT

Step 1: Warm cabinet to room temperature, remove all screws from the side and top of panel, and remove the panel.

Step 2: Trace the heat exchanger cable to the electrical junction box and remove the connector.

Step 3: Remove the wire ties that secure the sensor cable to the cabinet.

Step 4: Remove the sealant from the sensor well and then remove the sensor by gently pulling it out of the sensor well.

Step 5: Replace and reseal the new sensor, then reassemble in the reverse order.

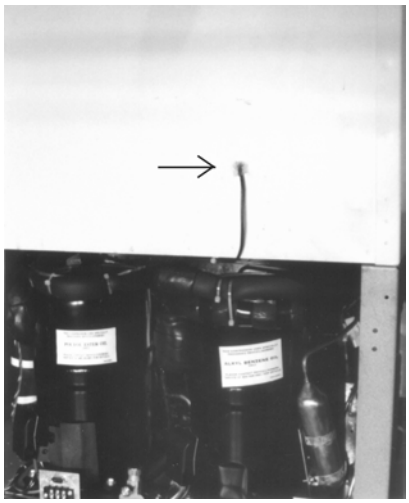


Figure 429-1
Upright Unit Heat Exchanger Sensor

HEAT EXCHANGER SENSOR REPLACEMENT (CHESTS)

The following steps will aid you in replacing the heat exchanger sensor on a Chest, Ultra Low Temperature freezer.

EVALUATION

Step 1: To determine if the sensor is reading correctly, you will need to check the resistance. On the micro control board, remove connector J4 and place the meter leads between the red and black wires. Compare the resistance with the temperature/resistance chart to determine if the sensor is reading correctly.

Step 2: The heat exchanger temperature can be checked via the control panel on units that have the warm and cold alarm set point buttons. Press and hold the cabinet temperature, cold alarm set point, alarm battery low, and the voltage low buttons simultaneously. This will display the temperature the heat exchanger probe is sensing. Normal temperature reading is -32/-34C or colder.

CAUTION When performing work inside the electrical junction box, make sure the unit is de-energized unplugged and the circuit breaker is locked and tagged out.

REPLACEMENT

Step 1: Warm cabinet to room temperature, remove all screws from the side and top panel and remove the panels.

Step 2: Trace the heat exchanger cable to the electrical junction box and remove the connector.

Step 3: Remove the wire ties that secure the sensor cable to the cabinet.

Step 4: Remove the sealant from the sensor well and then remove the sensor by gently pulling it out of the sensor well.

Step 5: Replace and reseal the new sensor, then reassemble in the reverse order

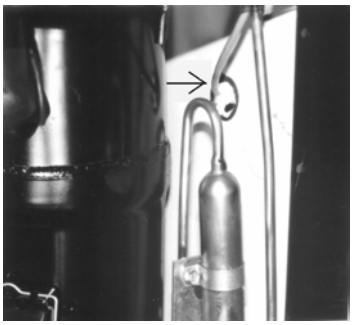


Figure 430-1
Chest Unit Heat Exchanger Sensor ***Replacement***

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. Failure of this sensor will cause the refrigeration system to run continuously, and the display to show “+199” (if open) or “-199” (if shorted).

EVALUATION

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

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

Step 2: Measure the resistance of the Cabinet Control / Display Sensor

Step 3: Find this resistance and the corresponding temperature in the RTD resistance/temperature chart (Table 2).

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.

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 key switch 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.

Figure 431-1
Cabinet Control/Display Sensor Location (Upright)

Figure 431-2
Cabinet Control/Display Sensor Location (Chest)

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

Step 5. Remove the sensor 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.

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 led 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.

AMBIENT/CONDENSER SENSOR EVALUATION AND REPLACEMENT (UPRIGHT)

(Not used on all models)
The following steps will aid you in evaluating and replacing the Ambient / Condenser Sensor on an Upright Ultra Low Temperature freezer.

EVALUATION

Step 1: To check the Ambient Sensor remove connector J7 and check the mV signal between the red and black wires, pins 4 & 5. Compare the reading to the temperature / voltage table (Table 21) to determine if the sensor is good.

Step 2: To check the Condenser Sensor, remove connector J8 and check the mV signal between the red and black wires at terminals 4 & 5. Compare reading to the temperature / voltage table (Table 21) 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 zeroed. To zero:

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.

REPLACEMENT

Step 1: To replace the ambient sensor, open the filter door. The sensor is located in the bottom 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 with silicone.

CAUTION When performing work inside the electrical junction box, make sure the unit is de-energized unplugged and the circuit breaker is locked and tagged out.

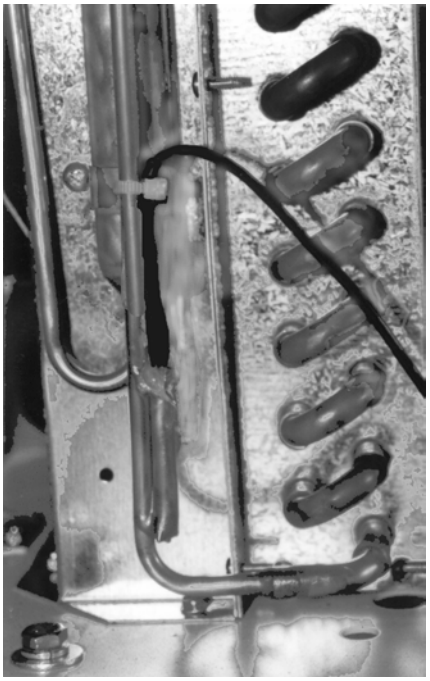


Figure 432-1
Condenser Sensor Location

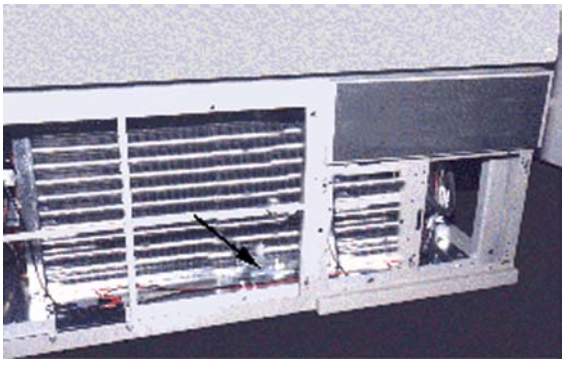


Figure 432-2
Upright Freezer Ambient Sensor Location

AMBIENT/CONDENSER SENSOR EVALUATION AND REPLACEMENT (CHESTS)

(Not used on all Models)

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 mV signal between the red and black wires, pins 4 & 5. Compare the reading to the temperature / voltage table (Table 21) to determine if the sensor is good.

Step 2: To check the Condenser Sensor, remove connector J8 and check the mV signal between the red and black wires at terminals 4 & 5. Compare reading with the Voltage/ Temperature table (Table 21) 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 zeroed. To zero:

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.

REPLACEMENT

Step 1: To replace the ambient sensor, open the filter door. The sensor is sealed in 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.

CAUTION When performing work inside the electrical junction box, make sure the unit is de-energized unplugged and the circuit breaker is locked and tagged out.

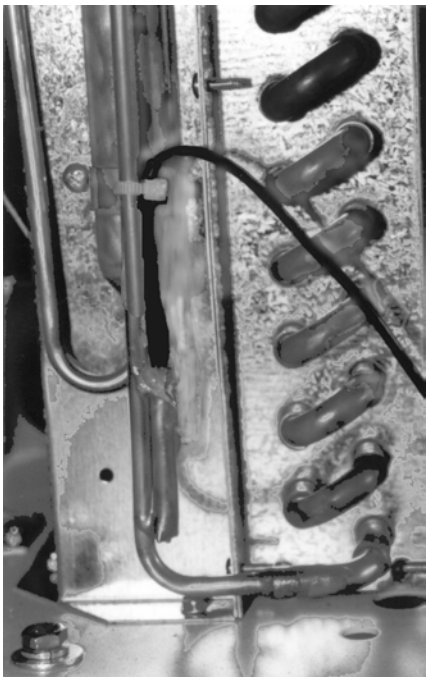


Figure 433-1
Condenser Sensor Location

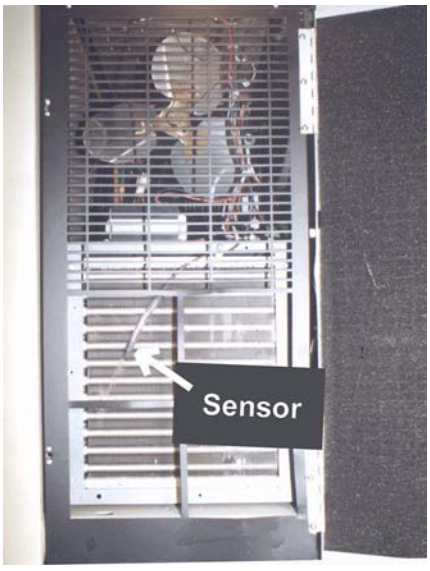


Figure 433-2
Chest Freezer Ambient Sensor Location

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 only by qualified personnel. The freezer must be at room temperature before beginning this procedure.

Step 1: Turn the main key switch 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.

a. On a chest unit, this connector is located on a vertical pylon at the middle of the upper deck just behind the right end panel.

b. On an upright unit, this connector is located on the front end of the junction box.

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

Figure 436-1
Recorder Location on an Upright Unit

Need to replace this picture

Figure 436-2
Recorder Location on a Chest Unit

Need to replace this picture

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.

Step 8: Calibrate the recorder per *Calibrating Temp Recorder* procedure

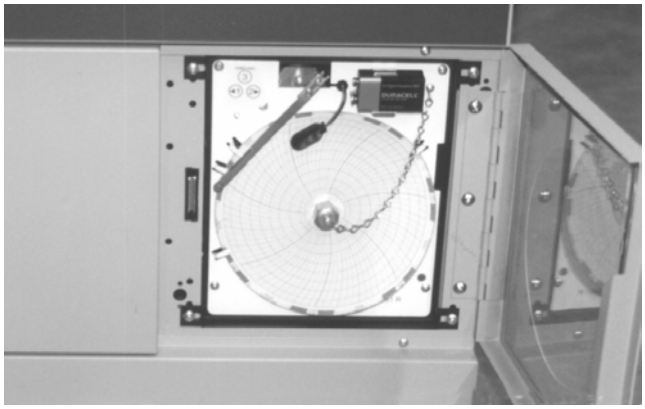


Figure 436-3
Chart Recorder with Door Open

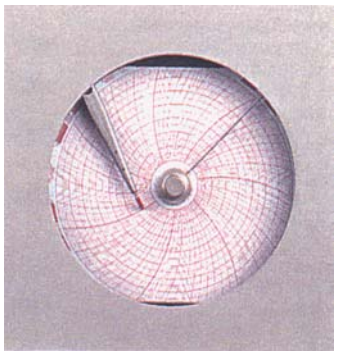


Figure 436-4
Recorder Face with Door Closed

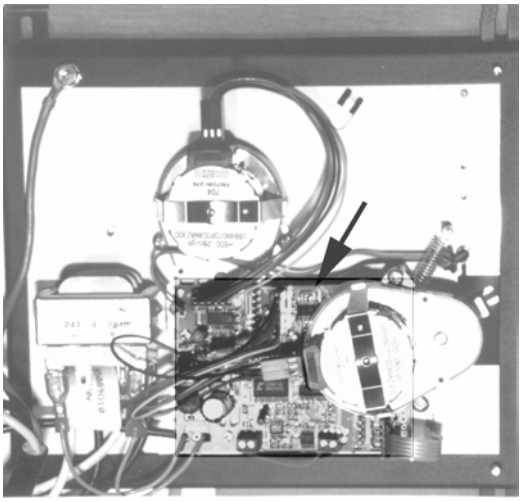


Figure 436-5
Recorder Main PCB

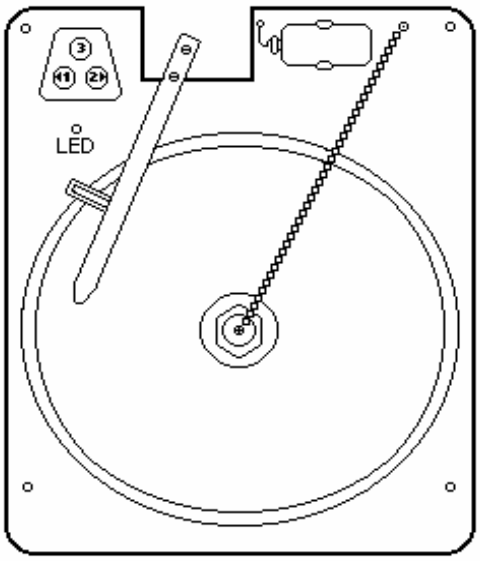


Figure 436-6
Chart Recorder Face

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 only by qualified personnel. The freezer must be at room temperature before beginning this procedure.

Step 1: Turn the main key switch 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. On a chest unit, this connector is located on a vertical pylon at the middle of the upper deck just behind the right end panel. On an upright unit, this connector is located on the front end of the junction box.

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.

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.

Figure 437-1
Temperature Sensor Location (Upright)

Figure 437-2
Temperature Sensor Location (Chest)

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.

Step 16: Calibrate the recorder per Procedure 69, *Calibrating Temp Recorder*

Figure 437-3
Recorder Sensor Cabinet Penetration
(Upright)

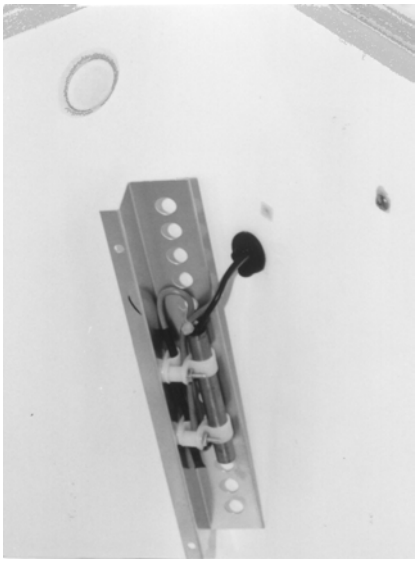


Figure 437-4
Recorder Sensor Cabinet Penetration
(Chest)

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, 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 wires from the battery's positive and negative terminals 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.

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.

(Continued on next page)

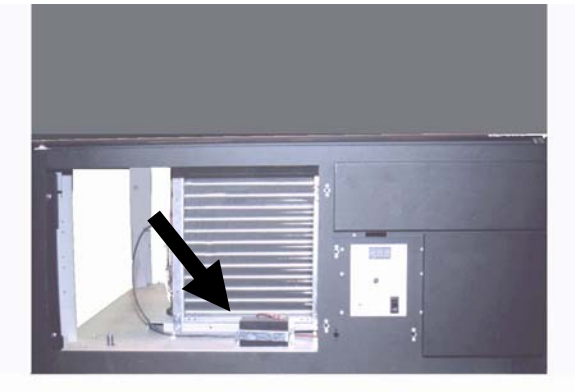


Figure 439-1
Alarm Battery Location (Upright

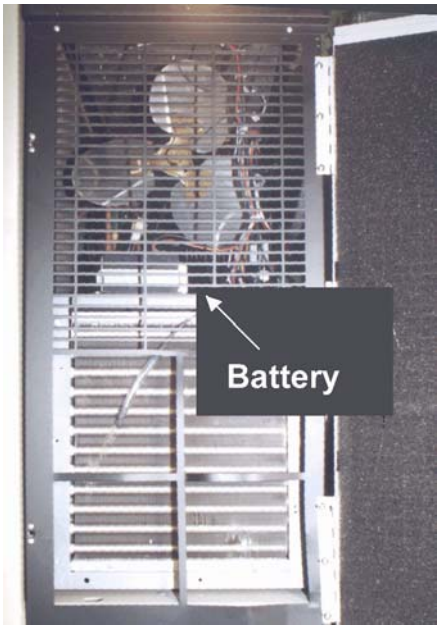


Figure 439-2
Alarm Battery Location (Chest)

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

Step 7: Monitor unit for proper operation.

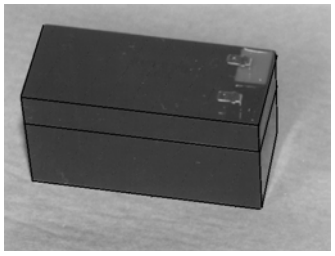


Figure 439-3
Alarm Battery

VOLTAGE BOOST TRANSFORMER EVALUATION AND REPLACEMENT

CAUTION — The presence of life-threatening voltages requires these tests be performed only by trained and qualified personnel

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

Step 1: Locate the boost transformer: #13

a. On chest freezers, locate the two 120v/12v (or, 220v/12 VAC) boost transformers by removing the control housing top/access cover behind the digital display.

b. On upright freezers, locate the single transformer by removing the access panel on the right side of the control housing.

Step 2: With the unit plugged in and the power switch in the On position, ~120 Vac (or, ~220V on 208-230V units) should be measured across the primary leads of the transformer, and an additional ~10-12 Vac should be measured across the secondary leads (line voltage plus 10-12 Vac).

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 Off the power switch 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.

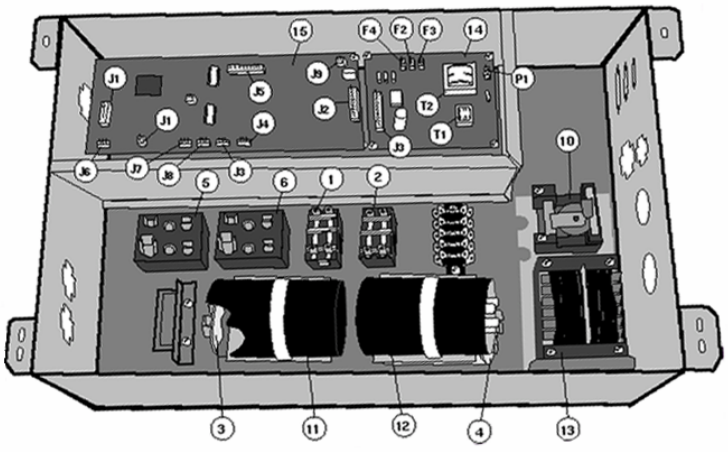


Figure 440-1
Upright Freezer Voltage Boost Transformer
(Number 13 on illustration)

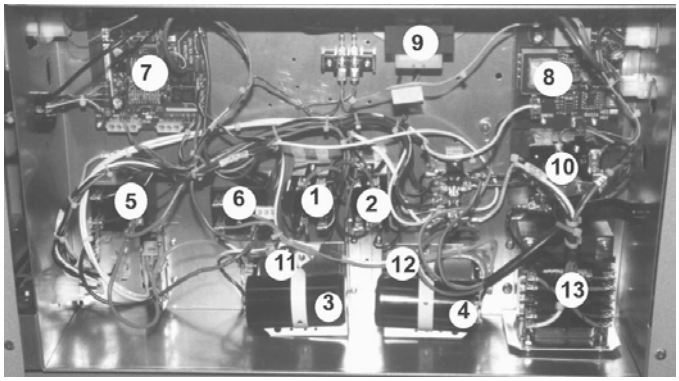


Figure 440-2
Upright Freezer Voltage Boost Transformer
(Number 13 on illustration)

Add figure 500.3 for single stage.

Step 4: Test the new transformer by performing Step 2, above. If 12 Vac 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.

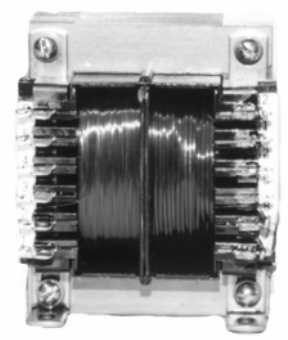


Figure 440-3
Boost Transformer

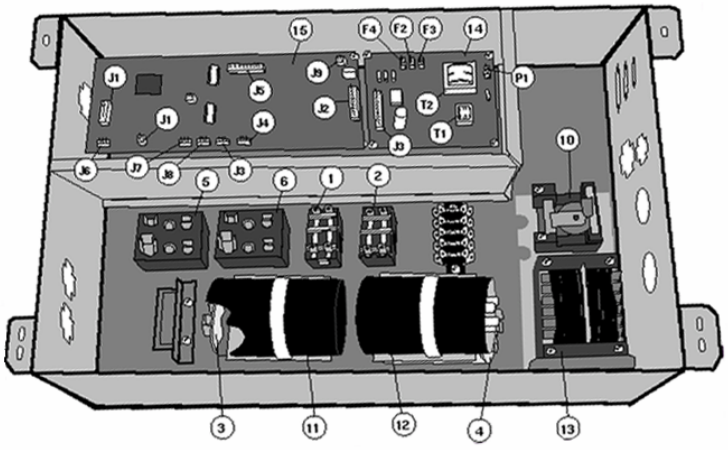


Figure 440-3
Chest Freezer Voltage Boost Transformer
(Number 13 on illustration)

OR

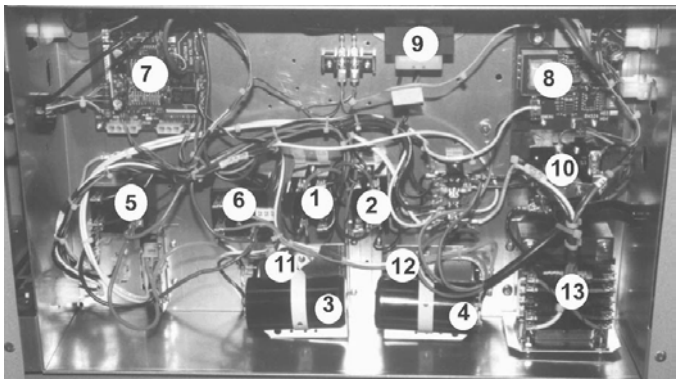


Figure 440-4
Upright Freezer Voltage Boost Transformer
(Number 13 on illustration)
)

Add figure 500.3 for single stage

EVALUATION AND REPLACEMENT OF FAN MOTOR AND BLADE

The following steps will aid in evaluating and replacing a freezer condenser fan motor. The fan motor, blades, and shroud are a single assembly.

ACCESSING THE FAN MOTOR

* Upright units: Remove the left and right side access panels.
* Chest units: Remove the right side access panel.

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 motor 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” screws holding the motor shroud to the condenser.

Step 3. Disconnect all electrical connections from condenser fan; cut plastic wire ties from shroud.

Step 4. Remove the fan assembly from the unit.

Step 5. Install the new motor assembly in the reverse order.

Step 6. Reconnect power supply and check for proper operation.

Step 7. Reinstall access panels

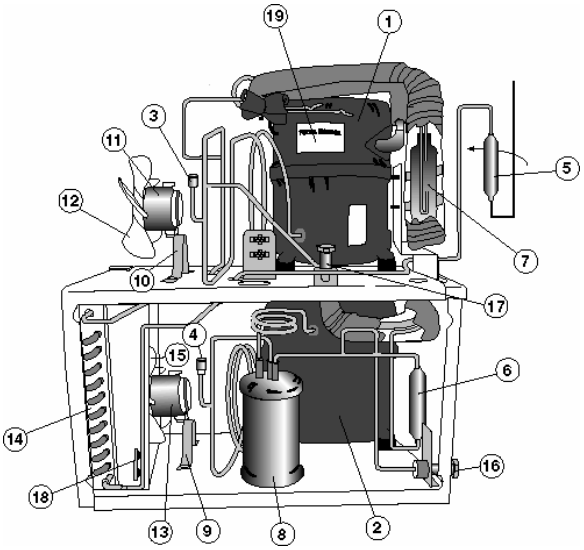


Figure 441-2
Chest Condenser Fan Location
(Number 13 on illustration)

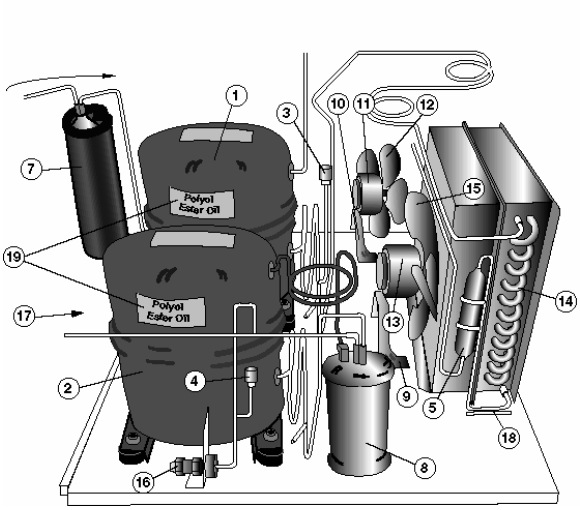


Figure 441-1
Upright Condenser Fan Location
(Number 9 on illustration)

Add figure 500.1 and 500.2

Solid State Control Board Replacement for Value-featured Freezers

The solid state control board is used to control the temperature and alarm functions of value series models. The following steps will aid you in replacing the solid state control board for an upright or chest freezer.

Step 1: Turn the unit off 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.

NOTE Chest Units: To gain access to the control and display panel, remove the remove the access panels (two) just below the display panel. The left panel is for the LN_2 or $C0_2$ control system and can only be removed by removing the screws from inside the refrigeration deck area. Remove the screws holding the recorder access panel if not equipped with a recorder.

Step 5: Remove the screws from the solid panel on the right side bottom and set aside.

Step 6: Remove the access panels of the LN_2 or $C0_2$ systems and Recorder (if so equipped) by pulling the panels toward you. They are installed with bullet catches.

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.

NOTE Upright Units: Cut the seal (silicone) from around the top of the panel.

Step 7: With both panels removed, the screws holding the bottom of the control display panels are accessible. Remove those screws and lift the control panel upward and off the cabinet frame. Slide panel to right then left. Must cut silicon seal above panel.

Step 8: With the control display panel in hand, now locate the female pin housing (18 pin) and gently remove the connector from the control board.

Step 9. Remove the screws holding the control board in place on the panel and then remove the board from the panel.

Step 10: Place the defective board in the packaging that the new control board was packaged.

Step 11: Re-install the new board in reverse order.

STEP. 12 RESEAL THE PANEL WHERE THE SILICON WAS CUT.

VOLTAGE BOOST CONTROL PCB

The voltage control PCB helps to protect the system from low line voltage situations by constantly monitoring the line voltage and providing a measure of compensation. When the line voltage drops to a given level (see chart), a relay adds a step-up transformer to boost the line voltage by ~15Vac. When the line voltage returns to normal, the relay de-energizes and the transformer is disabled.

The threshold at which the boost transformer is energized can be adjusted as follows:

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

Step 1. Turn off the key switch and unplug the unit from the power receptacle.

Step 2. Access the Voltage Boost PCB by removing the side panel of an upright unit, or by removing the top cover from behind the control panel.

Step 3. Connect the output of a variable power transformer to PCB connector J1. Reconnect the power cord and adjust the transformer for the applicable "ON" voltage (listed below).

Step 4. Adjust potentiometer R9 just to the point that the red LED (D6) illuminates. If the calibration cannot be performed, or if the 12Vac relay signal is missing from J2 (pins 1&3), then replace the PCB.

Connector J1	115V: Pins 1 & 3 208-240V: Pins 1 & 4

Step 5. Turn off the key switch and unplug the unit from the power receptacle.

Step 6. Label and disconnect the wiring harnesses

Step 7. Remove the four mounting screws and withdraw the PCB from the cabinet.

Step 8. Replace in the reverse order.

Step 9. Unplug the power cord and disconnect the variable transformer.

Step 10. Replace the access panels, plug in the power cord, and resume operation.

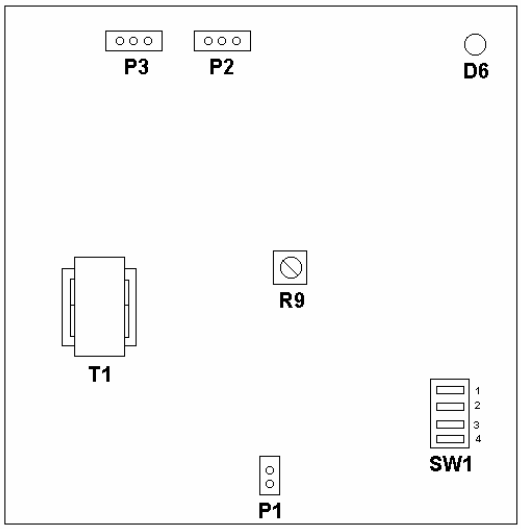
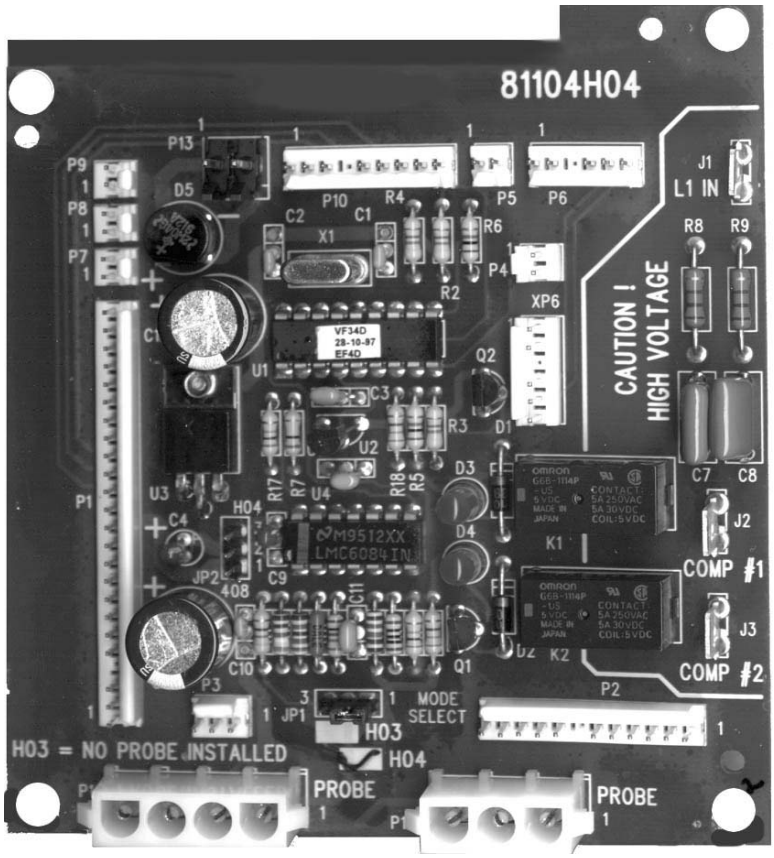


Figure 427-1
Voltage Boost PCB

Voltage Code	Boost "ON"	Boost "OFF"	SW1 -1	SW2 -2	SW3 -3	SW4 -4
A,N	98-100V	103-105V	On	On	Off	On
B,D,E	196-198V	202-204V	On	Off	On	On
V,W,M	219-221V	225-227V	On	Off	On	On
R,S,T,U	185-187V	191-193V	On	Off	Off	On
C	207-209V	213-215V	Off	On	Off	On

INTERSTAGE INTERCONNECT ("D62") PCB
FOR VALUE-FEATURED FREEZERS

These two pages describe the function and operation, and the evaluation and replacement procedures for the 81104.



FUNCTION AND OPERATION

The 81104 PCB originated as a connector board to allow signals to be brought in from various areas and delivered to and from the 408 temperature control PCB. The 408 PCB has only one output for a compressor and it became necessary to incorporate a two part time delay in the starting of the second stage compressor. It was then determined that a limited temperature control of the second stage would greatly increase performance and reliability of larger freezers.

The compressor start signal from the temperature control PCB has been interrupted by a microcontrol on the 81104 PCB to perform multiple timing functions before turning on the compressor. Upon initial application of power to the unit, the compressor start signal to the second stage compressor is delayed by ten minutes. This delay allows the first stage compressor to pull the temperature in the heat exchanger down to a point that the second stage can operate. After the system has reached temperature and cycled off for the first time, the second stage compressor is delayed by only 55 seconds; this allows startup current of the first stage to subside before initiating the second stage compressor to start. The micro also acts as a defrost timer, turning off both compressors for ten minutes every 8 hours. This defrost time is not associated with compressor on time but only assures that every 8 hours the compressor will be off a minimum of 10 minutes whether or not the compressor is running.

The 81104 PCB also has a temperature input because some of the larger units, under extreme conditions, required more time at startup. Because the required time varied due to load and ambient temperature, an RTD temperature sensor was added at the heat exchanger to determine the load on the second stage. When the unit is first started, the controller waits ten minutes (after first start this changes to 55 sec.), then looks for the temperature at the heat exchanger to be below -34°C. When the temperature reaches -34°C the second stage will be started. However, if the temperature rises above -17C the second stage will be turned off and will remain off until the temperature once again gets below -34°C. Mode select JP1 (pins 2&3) puts a fixed 82 ohm resistor in the place of the temperature, simulating a temperature below -40 at all times; this permits the timer to control the system operation. JP1 pins 1 & 2 if the unit has a Ht.Ex. Sensor

(Continued next page)

FUNCTIONAL EVALUATION

Step 1 Change the temperature setpoint to –90°C

Step 2 Turn the key switch to the power Off position and unplug the power cord for and disconnect the battery 60 seconds.

Step 3 Reconnect the power cord and alarm battery and turn the key switch to power On

Step 4 Ensure that line voltage for the 1st stage control relay is immediately measured on J2 ("COMP #1"); replace the 81104 PCB if line voltage is missing from J2.

Step 5 Begin timing the 2nd stage delay.

NOTE Chest Cabinets: Ensure that the unit has an RTD plugged into P12 if the cabinet interior is larger than 17 ft^3. If the 1st stage is operating properly, then after ten minutes the heat exchange temperature should be below –34°c

Step 6 After ten minutes, ensure that line voltage for the 2nd stage control relay is measured on J3 ("COMP #2").

Step7 If line voltage is not measured on J3, then measure the resistance of the RTD across the red and black wires (see Appendix). If the resistance equates to –34°C or colder (or if the sensor does not exist) but line voltage is not measured on J3, then replace the 81104 PCB

Step 8Raise the temperature setpoint to allow the system to cycle. Use a stopwatch to ensure the 2nd stage starts fifty-five (55) seconds after the 1st stage starts. If P12 is colder than –34°c (or doesn't exist) but the 2nd stage does not attempt to start, replace the PCB.

REPLACEMENT PROCEDURE

Step 1. Turn the key switch to the Off position and unplug the power cord.

Step 2. Label and disconnect the harnesses from the 81104 PCB.

Step 3. Remove the mounting screws from the four corners of the PCB and remove it from the cabinet.

Step 4. Install the replacement PCB in the reverse order.

STEP 5. CONFIRM JP1 AND JP2 ARE SET THE SAME AS THE ORIGINAL BOARD

TEMPERATURE CALIBRATION PROCEDURE

Before calibrating the display, the unit must have been operating 8-10 hours *with a setpoint of –90°C or maximum allowable cold set point and a thermocouple in the geometric center of the cabinet.*

MICROPROCESSOR BASED UNITS

The temperature display may be adjusted by entering an offset value (maximum range: +6c / -5c).

VIEW Offset:

Depress and hold the Cabinet Temperature, Cold Alarm Setpoint, and Alarm Battery touchpads to view the current Offset value.

Step 2. CHANGE Offset:

Step 1. To create a positive (+) offset, depress and hold the Cabinet Temperature, Cold Alarm Setpoint, and Alarm Battery touchpads, then release the Cold Alarm Setpoint and press the Up arrow to create a positive offset (maximum value of +6c).

Step 2. To create a negative offset with a value of X (for example, -3), depress and hold the Cabinet Temperature, Cold Alarm Setpoint, and Alarm Battery touchpads, then release the Cold Alarm Setpoint and press the Up arrow to create a positive offset (maximum value of +6c). Continue to depress the Up arrow key until a value equal to X + 1 (3+1) is viewed in the display, then depress the Down arrow once to decrement the value AND simultaneously change it to a negative (-) value (for example, -3).

Step 3. Release all touchpads and the offset value will automatically be incorporated into the digital display and temperature control.

ELECTRONIC PCB BASED UNITS

Step 1. Locate the adjustment potentiometer cutout, right of the digital display.

Figure 464-1
Temperature Calibration Potentiometer

Step 2. Using the potentiometer, adjust the digital display to match the measured temperature value.

PRESSURE EQUALIZATION PORT HEATER REPLACEMENT PROCEDURE

(On selected units)

Opening the door of an upright freezer allows the cold air to fall out and be replaced with warm moist air. When the door is closed, a temporary vacum is created as the warm air contracts; this makes opening the door very difficult until the vacum dissipates by drawing air around the door gasket. The *Pressure Equalization Port* (PEP) is located in the front center of the cabinet floor of an upright freezer, and consists of a heater-wrapped metal tube to permit an exchange of air between the cabinet and ambient atmosphere. Copper wool conducts heat from the metal tube to the plastic cap to prevent frost build-up.

EVALUATION OF HEATER

Step 1. Turn off the key switch and unplug the unit from the power receptacle.

Step 2. Access the PEP by removing the side access panels and opening the condenser grill.

Step 3. Remove / unplug the wires from __ and measure with an ohmmeter across the two white wires; the 8W heater should be replaced if it does not measure 1650 Ohms for 115V units (or, 6600 Ohms for 230V units).

REPLACEMENT OF HEATER

A. Super-Insulation units

Step 1. SI Units Only: Remove the two screws securing the check valve (Fig. 458-2) and remove it.

Step 2. Remove the three screws in the PEP mounting flange, break the silicone seal, and withdraw the heater assembly.

(Continued next page)

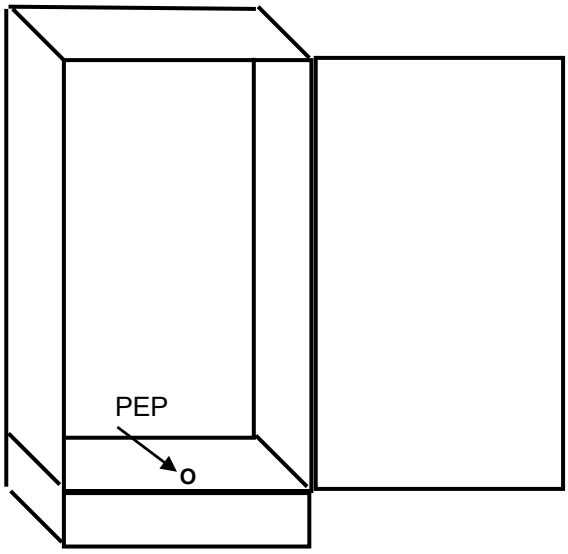
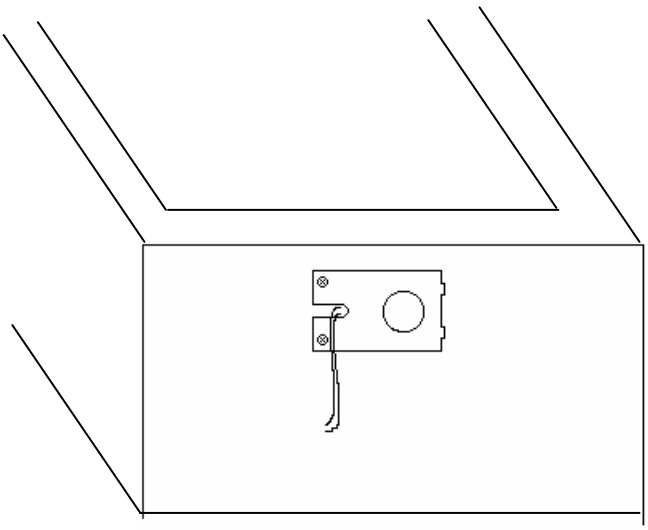


Figure 458-1
Upright Freezer PEP Location



Number this figure

B. Standard Foam-Insulation Units

Step 1. The metal tube is held in place with a Heyco bushing at the bottom. Grasp the metal tube with pliers and pull straight down to release. Remove heater assembly from the cabinet.

NOTE **A silicon seal must be placed between the PEP flange and the cabinet.**

Step 2. Remove the copper wool from the PEP assembly and install it in the replacement.

Step 3. Assembly is in the reverse order.

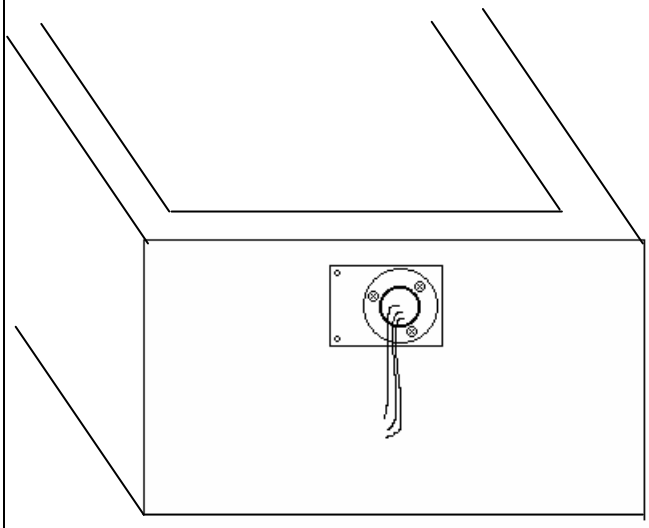


Figure 458-3
SI PEP Flange Screws

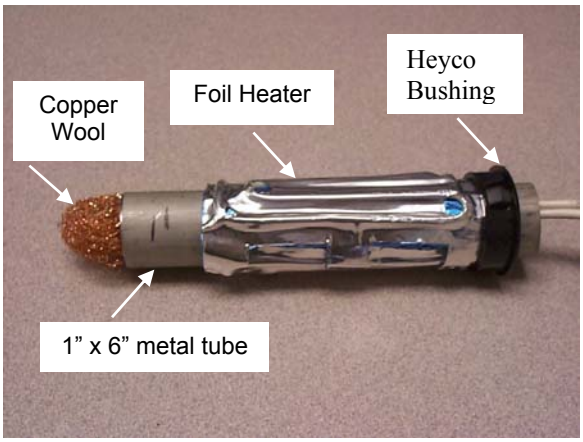


Figure 458-4
PEP Heater Assembly

FIRST STAGE SYSTEM CLEAN-UP/FLUSHING (APPLIES TO BOTH SINGLE AND TWO STAGE).

The following steps will aid you in performing a cleanup/flush of the first stage refrigeration system of a two stage 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: Locate the first stage system, and install line taps on to the process tubes of both the high and low side of the compressor. The process tubes are the ¼ inch size stubbed off lines attached to the system.

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

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.

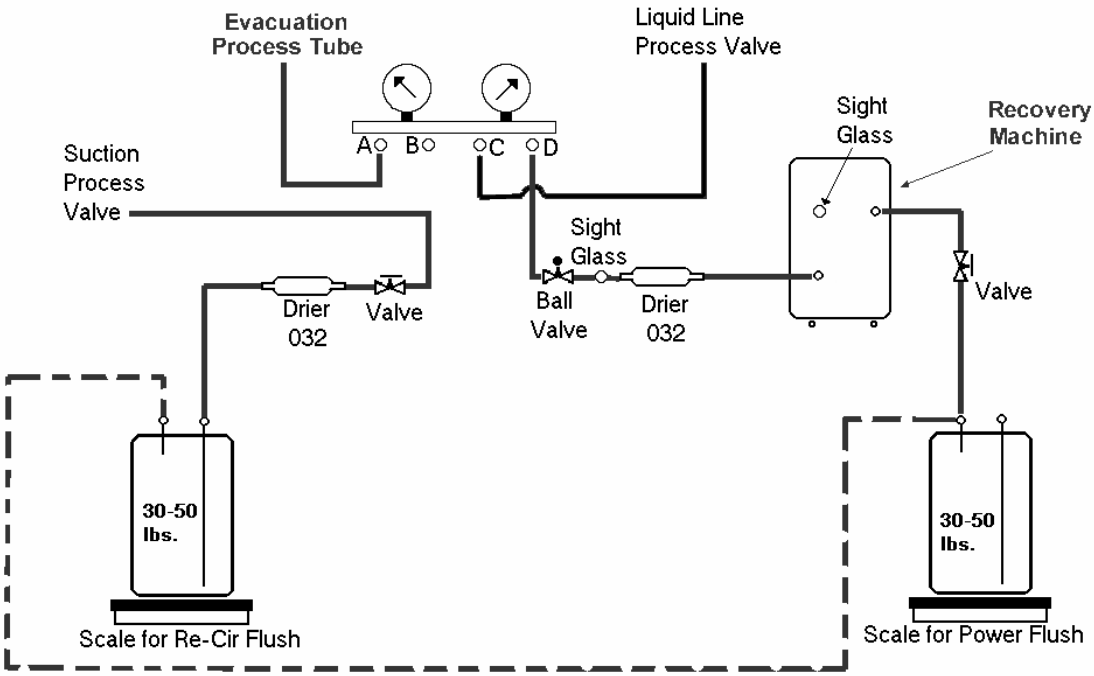


Figure 442-1
Recommended Backflush Setup

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.

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

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 sandpaper; emery cloth is preferred.

Step 9: Cut the tubing on the discharge side of the system just beyond the liquid line drier; this should be a ¼ inch tube. See drawing provided.

Step 10: Install a process tube connector or weld a ¼ copper line and use a frare adaptor/connector. These connectors are used for ease of connection of the hoses used for flushing.

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

Step 11: Cut the tubing at the compressor just upstream of the accumulator.

Step 12: Install a 3/8 inch process tube adapter or braze a) ¼ copper line to the 3/8 for processingto the suction line coming from the cabinet.

Step 13: Connect the flushing hoses as per the drawing, using the valves, drier(s), and sightglasses.

Step 14: Install the sight glass and shut off valve on the ¼ inch hose that was connected to the system liquid drier.

Step 15: Braze in an HH drier just before the recovery machine. This drier is used to protect the recovery machine and aid in cleaning up the flushing solvent.

Step 16: Invert your liquid solvent tank and allow the liquid to go through the compound side of the gauge. Connect to the center port of the gauge. The center port hose is connected to the filter drier then through the sight glass. Use the shut-off valve to control the flow into the evaporator (3/8 tube).

Step 17: Use a recovery tank to collect the recondensed 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 repeatedly.

Step 18: During the flushing process, the essential thing to remember is: keep a "liquid in" and "liquid out" flush. The shut off valve before the recovery machine is used to control this liquid flow.

Step 19: 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.

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

Step 20: 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 20 minutes or greater with 15 pounds or more of flushing solvent through the system.

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 21: 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. Do not be fooled that after a few minutes the sight is clear, and stop flushing.

Step 22: Continue flushing no less than 15 to 20 minutes after the sight glass is clean, clear and has a solid liquid flow.

Step 23: After flushing the evaporator side of the system, follow the same hook up procedure for the condenser side of the system.

Step 24: When flushing of both sides of the system is complete, always install a new system liquid drier, accumulator, compressor (if required) and any other components or tubing necessary.

Step 25: Follow other procedures for replacing the drier ,compressor evacuating and charging. See the index for these procedures.

Step 26: After completion of the flushing and component replacement, insure that the key switch is in the off position.

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.

SECOND STAGE SYSTEM CLEAN-UP/FLUSHING

The following steps will aid you in performing a cleanup/flush of the second stage refrigeration system of a two stage 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: Locate the second stage system, and install line taps on to the process tubes of both the high and low side of the compressor. The process tubes are the ¼ inch size stubbed off lines attached to the system.

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

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.

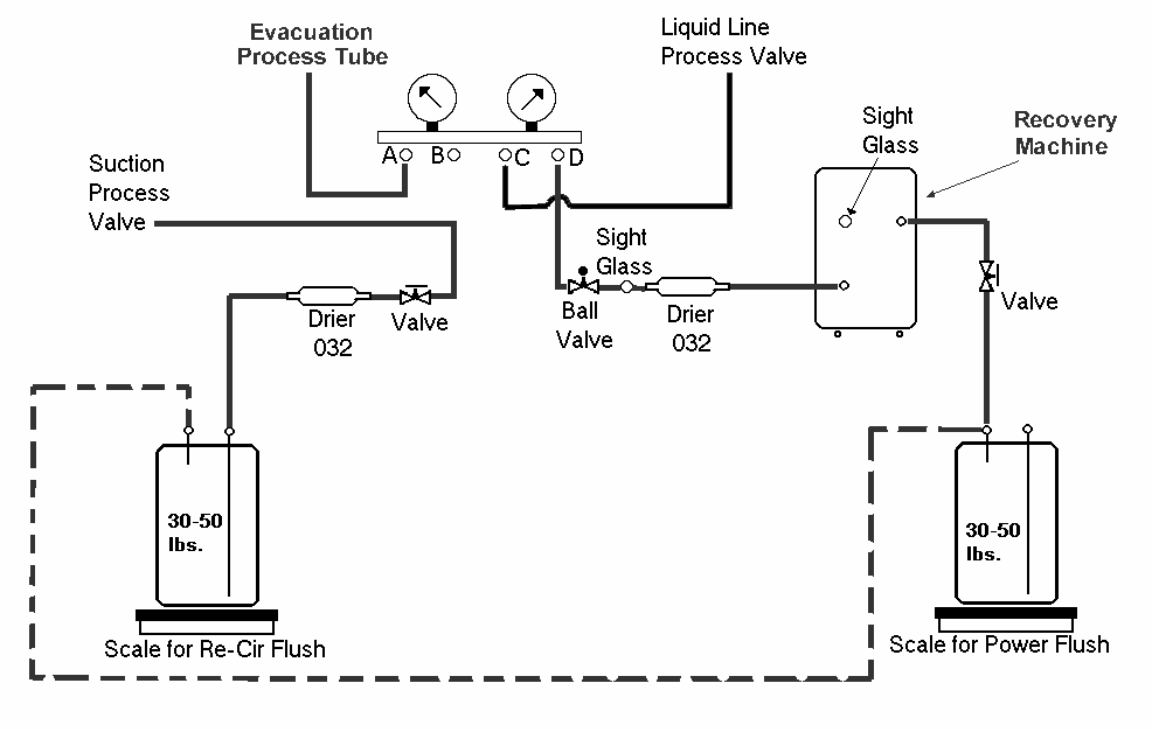


Figure 443-1
Recommended Backflush Setup

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.

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

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

NOTE Do not use any type of steel wool or sandpaper; emery cloth is preferred. When cutting the tubing use proper tubing cutters for this process.

Step 9: Cut the tubing on the discharge side of the system, approximately 5 to 6 inches back of the cabinet wall. There is soldered heat-exchanger on this line from the oil separator discharge line where the suction return line and the discharge line meet.

NOTE On some models you may have to unsolder this heat exchange and separate in order to make the cuts necessary for flushing. See drawing provided.

Step 10: Install a process tube connector or weld a ¼ copper line and use a flare adaptor/connector. These connectors are used for ease of connection of the hoses used for flushing.

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

Step 11: Cut the suction return tubing at the cabinet wall approximately 5 to 6 inches from the wall.

Step 12: Install a 3/8 inch process tube adapter or braze a ¼ copperline to the 3/8 for processing to the suction line coming from the cabinet.

NOTE Process tube adapters (quick connects) may be used.

Step 13: Connect the flushing hoses as per the drawing, using the valves, drier(s), and sight-glasses.

Step 14: Install the sight glass and shut off valve on the ¼ inch hose that was connected to the system liquid drier.

Step 15: Braze in a HH drier just before the recovery machine. This drier is used to protect the recovery machine and aid in cleaning up the flushing solvent.

Step 16: Invert your liquid solvent tank and allow the liquid to go through the compound side of the gauge. Connect to the center port of the gauge. The center port hose is connected to the filter drier then through the sight glass. Use the shut-off valve to control the flow into the evaporator (3/8 tube).

Step 17: Use a recovery tank to collect the recondensed 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 repeatedly.

Step 18: During the flushing process, the essential thing to remember is to keep a "liquid in" and "liquid out" flush. The shut off valve before the recovery machine is used to control this liquid flow.

Step 19: 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 20: 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 20 minutes or greater with 15 pounds or more of flushing solvent through the system.

NOTE These are ONLY estimates; actual amounts and time will need to be determined by you for a properly cleaned system.

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 21: 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. Do not be fooled that after a few minutes the sight is clear and stop flushing.

Step 22: Continue flushing no less that 15 to 20 minutes after the sight glass is clean, clear and has a solid liquid flow.

Step 23: Flushing the evaporator side of the system will also clean the condenser side (the heat exchanger) of the system.

Step 24: When flushing of both sides of the system is complete, always install a new system liquid drier, accumulator, (compressor if required) and any other components or tubing necessary.

Step 25: Follow other procedures for replacing the drier and compressor. See the index for these procedures.

Step 26: After completion of the flushing and component replacement, insure that the key switch is in the off position.

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.

FIRST STAGE PRESSURE SWITCH EVALUATION AND REPLACEMENT

The first stage of a single or two stage Ultra Low Temperature Freezer is equipped with a high pressure switch. This switch is set to cutout at 400 PSIG, and is a manual reset.

If system head pressure reaches the cutout 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.

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.

a. On units equipped with micro-controls, this voltage will be 24 volts A/C.

b. On units without micro controls, this voltage will be line voltage (120v or 230v).

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

a. If the switch is closed, the voltmeter will indicate 0 volts.

b. If the switch is open, the voltmeter will indicate voltage needed for control relay.

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.)

TEST HIGH PRESSURE SWITCH BEFORE INSTALLATION:

Step 5. Verify that switch will open if pressure reaches 400 PSIG +/- 20 PSIG.

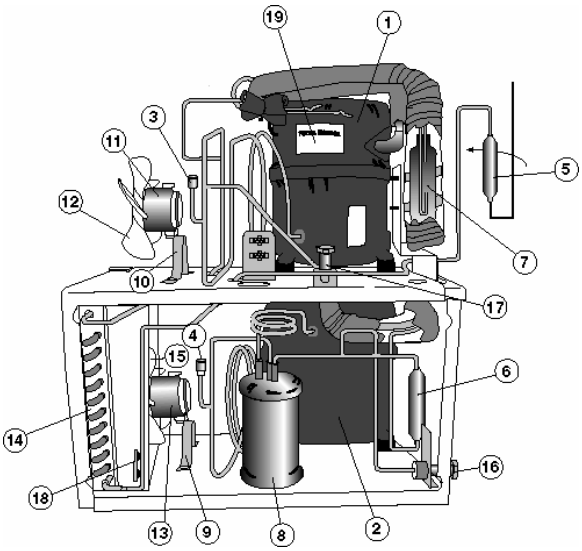


Figure 444-1
High Pressure Switch Location
(Number 3 on illustration)

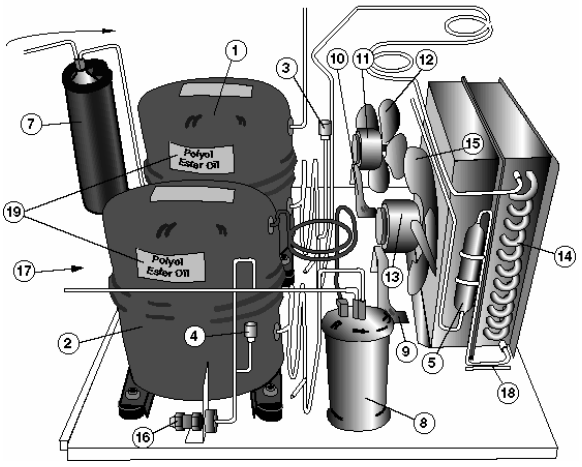


Figure 444-2
High Pressure Switch Location
(Number 3 on illustration)

Add figure 500.1 and 500.2 for single stage

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:

(Read Notes 1 – 5.)

Step 11: Purge the system with nitrogen.

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

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

Step 14: Prepare the 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.

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.

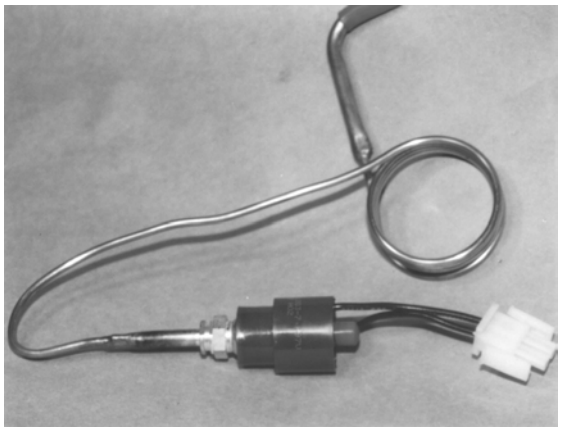


Figure 444-3
High Pressure Switch

NOTE 1 It will be necessary to recover the refrigerant charge from the system. Recover the gas charge in accordance with current EPA and local regulations. Read and follow instructions for "Refrigerant Recovery" before proceeding.

NOTE 2 When using a torch for desoldering or brazing be sure you employ shields as required to prevent the flame from reaching other components this could be effected by heat.

NOTE 3 Care must be taken not to overheat the new switch when installing. Wrap the top of switch with damp cloth to prevent overheating while soldering.

NOTE 4 If this is being done in a facility, be sure to comply with any fire codes for the location and the facility.

NOTE 5 Always have a fire extinguisher available whenever using a torch.

(Continued next page)

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

SECOND STAGE PRESSURE SWITCH EVALUATION AND REPLACEMENT

The 2nd Stage is equipped with a high pressure switch. This HP switch is set to cutout at 300 PSIG, to cut in at 200 PSIG, and is an "Automatic Reset" pressure switch.

If system head pressure reaches the cutout point, switch contacts will open and will automatically reset when the pressure drops to the cut-in point. This will restart the second stage compressor. (No reset button on this switch).

EVALUATION PROCEDURE:

During normal operation, the switch contacts should be closed.

Step 1: If the second stage compressor is not running, check the voltage through the high pressure 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 voltmeter across the wires to the HP switch.

a. If the switch is closed, the voltmeter will indicate 0 volts.

b. If the switch is open, the voltmeter will indicate voltage needed for control relay.

NOTE The HP switch will close after pressure drops below the cut-in point (200 PSIG.). (It is normal for the system to cycle several times on head pressure on initial start-up.)

Step 3: After system has pulled down to temperature, system should not cycle on the HP switch.

Step 4: Should the system continue to cycle on the HP switch you will need to check the performance of the first stage refrigeration system.

Step 5: If the pressure switch is found defective, it must be replaced.

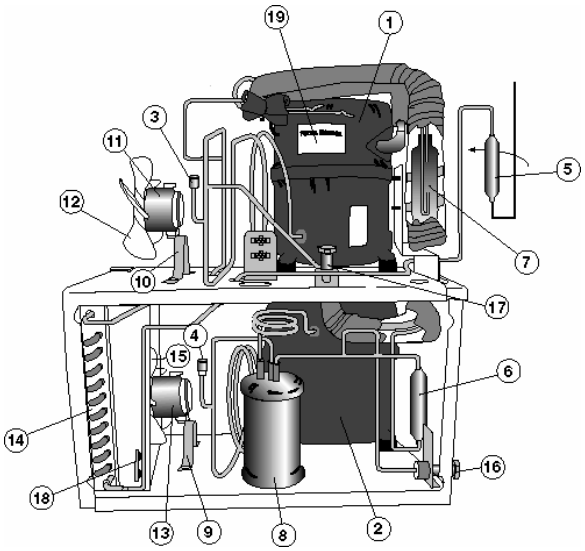


Figure 445-1
High Pressure Switch Location
(Number 4 on illustration)

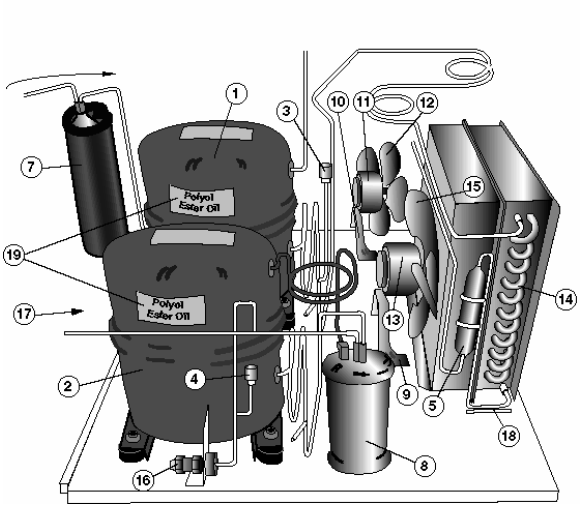


Figure 445-2
High Pressure Switch Location
(Number 4 on illustration)

TEST HIGH PRESSURE SWITCH BEFORE INSTALLATION:

Step 6: Verify that switch will open if pressure reaches 300 PSIG. and will close when the pressure drops to 200 PSIG, by attaching the switch to a high pressure nitrogen tank with a regulator.

Step 7: Verify that contacts are closed with no pressure to the switch.

Step 8: Slowly increase pressure to switch. When pressure reaches 300 PSIG., the contacts should open.

Step 9: Lower pressure to 200 PSIG; the contacts should close at this point.

REPLACEMENT PROCEDURE:

(See notes 1 – 5)

Step 10: Purge the system with nitrogen.

Step 11: Disconnect the electrical connections to the pressure switch at the plug connector.

Step 12: Remove the defective pressure switch. This may be accomplished by desoldering or cutting.

Step 13: 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 14: 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.

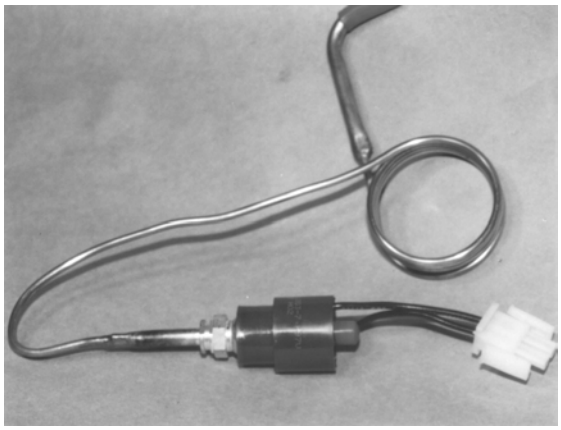


Figure 445-3
High Pressure Switch

Needs correct picture

NOTE 1 It will be necessary to recover the refrigerant charge from the system. Recover the gas charge in accordance with current EPA and local regulations. Read and follow instructions for "Refrigerant Recovery" before proceeding.

NOTE 2 When using a torch for desoldering or brazing be sure you employ shields as required to prevent the flame from reaching other components this could be effected by heat.

NOTE 3 Care must be taken not to overheat the new switch when installing. Wrap the top of switch with damp cloth to prevent overheating while soldering.

NOTE 4 If this is being done in a facility, be sure to comply with any fire codes for the location and the facility.

NOTE 5 Always have a fire extinguisher available any time you are using a torch.

(Continued next page)

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 15. Reconnect the electrical connections to the pressure switch at the plug connector.

Step 16. Purge the system with nitrogen.

Step 17. Recharge System

FIRST STAGE COMPRESSOR REPLACEMENT

PREPARE UNIT FOR REPLACEMENT

Disconnect all power from the unit.

Ensure that the freezer has been off sufficient time for all components to have warmed or cooled to room temperature Access the compressor:

GAIN ACCESS TO THE COMPRESSOR:

Chest units
Remove the large right side panel (facing the control panel) and rear panel to access the condensing unit (Not all units).

Upright units

a. Remove the right side panel (facing the control panel).

b. Drill out the poprivets that secure the electrical box to the cabinet, and disconnect all harnesses.

c. Remove the electrical box.

d. Install line taps on the discharge & suction ¼" process lines, and recover all refrigerant in accordance to State and Federal EPA regulations.

REMOVAL OF COMPRESSOR

Step 1. To prevent pulling contaminants into the system, use dry nitrogen to break the vacuum and bring the system to a low positive pressure.

Step 2. Disconnect the suction and discharge service valves from the compressor by removing the two bolts that secure them to the compressor (Not all units will have Service valves. Remember to cap the service valves to prevent contamination from entering the refrigeration system.

Step 3. Remove the electrical cover from the compressor location varies with compressor type. Label and disconnect the wires from the compressor.

NOTE The system should be backflushed any time a compressor is replaced.

CAUTION The compressor mounting springs (not all compressors have external springs) are different colors (blue and brown) to facilitate proper placement, because they provide differing tension. Ensure these are installed in their original locations.

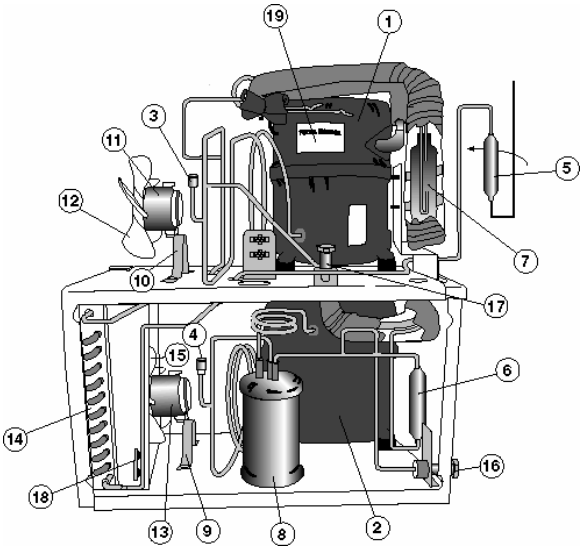


Figure 446-1
1st Stage Compressor Location
(Number 1 on illustration)

Add figure 500.1 for single stage

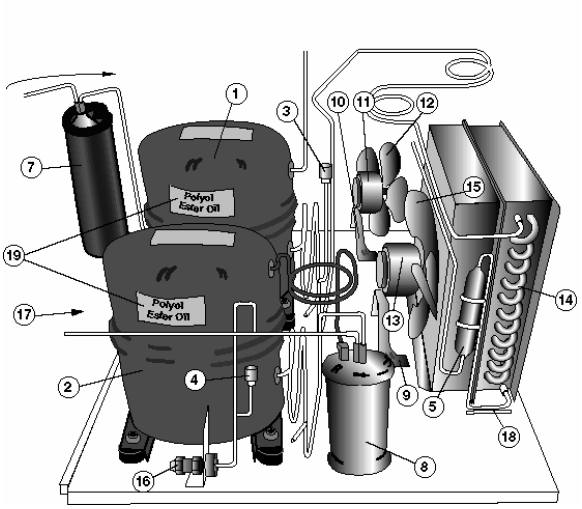


Figure 446-2
1st Stage Compressor Location
(Number 1 on illustration)

Add figure 500.2 for single stage

Step 4. Remove the four (4) nuts that secure the compressor to the refrigeration deck. Remember to save the nuts and mounting springs on which the compressor sets.

Step 5. Remove the defective first stage compressor and test the oil for acid. Also cut the lines and remove the suction accumulator.

CAUTION Cap off all remaining lines to prevent moisture contamination from migrating into the system.

CAUTION The compressor weights approximately 60 pounds. Use caution and employ proper lifting procedures when moving the compressor.

CAUTION Oxidation will form at the heated joint unless a low volume nitrogen flow is maintained. Such oxidation could easily break free and cause a restriction later.

CAUTION Install the new compressor and starting components onto the refrigeration deck. Install the previously removed springs and bolts in their original configuration.

INSTALLATION OF NEW COMPRESSOR

CAUTION Verify that the sight glass is at least 5/8 full and that the compressor is of the correct oil & electrical rating, as specified by the label on the compressor. (not all compressors have a sight glass)

Step 1. After the system has been flushed, install a new filter/drier, and connect all copper lines.

Step 2. Inspect the service valves (if used) for damage; replace if necessary. Install the service valves with new gaskets, using caution to prevent damage to the gaskets

.

Figure 446-3 Compressor

Step 3. Wire the new compressor according to the labeled wires from the defective compressor and re-install the electrical components' cover.

Step 4. Pressurize the system with dry nitrogen and leak check. If no leaks are detected, start evacuation (see Procedure 51).

NOTE Always use copper process lines directly to gauges and the vacuum pump. Ensure the suction lines are insulated.

Step 5. Re-install the electrical box on upright units while the system evacuates. Reconnect all necessary harnesses and check for any loose connection in the electrical box due to moving.

Step 6. Insulate the suction side, from the compressor to the cabinet.

Step 7. Charge the system after the system meets blank off standards (see Procedure 54).

Step 8. Replace access panels and return system to operation.

SECOND STAGE COMPRESSOR REPLACEMENT

PREPARE UNIT FOR REPLACEMENT

Step 1. Disconnect all power from the unit.

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

GAIN ACCESS TO THE COMPRESSOR:

Chest units

Remove the large right side panel (facing the control panel) and rear panel to access the condensing unit.

Upright units

a. Remove the left side panel (facing the control panel) and the rear panel.

b. Install line taps on the discharge & suction ¼" process lines, and recover all refrigerant in accordance to State and Federal EPA regulations.

REMOVAL OF COMPRESSOR

Step 1. Use dry nitrogen to break the vacuum and bring the system to a low positive pressure, to prevent pulling contaminants into the system.

Step 2. Remove the oil separator

a. Remove the mounting bolt from the bottom of the oil separator bracket.

b. Cut the three (3) copper lines approximately six inches (6") from the separator and cap them.

c. Place the oil separator on a work bench with the copper lines pointed upward to prevent oil leakage.

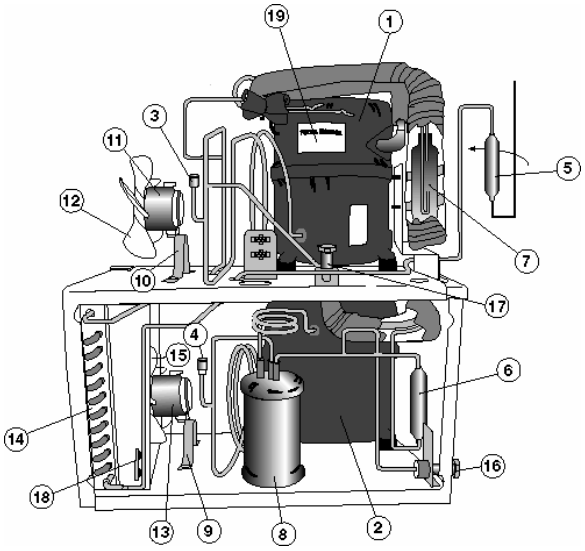


Figure 447-1
2nd Stage Compressor Location
(Number 2 on illustration)

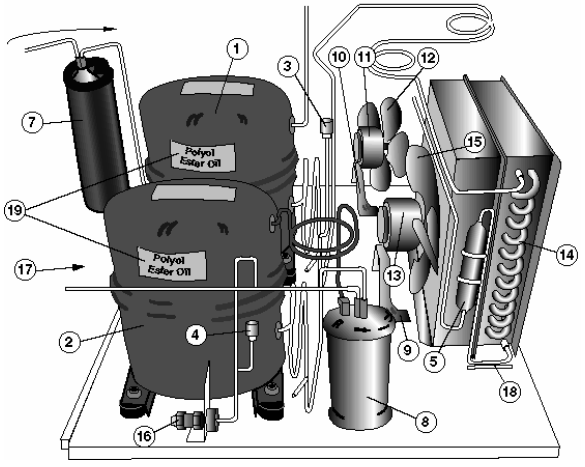


Figure 447-2
2nd Stage Compressor Location
(Number 2 on illustration)

Step 3. Disconnect the suction and discharge service valves (if used) from the compressor by removing the two bolts that secure them to the compressor. Remember to cap the service valves to prevent contamination from entering the refrigeration system.

Step 4. Remove the electrical cover (location depends on compressor type) from the compressor. Label and disconnect the wires from the compressor.

NOTE The system should be backflushed any time a compressor is replaced.

CAUTION The compressor mounting springs (not used on all compressors) are different colors (blue and brown) to facilitate proper placement, because they provide differing tension. Ensure these are installed in their original locations.

Step 5. Remove the four (4) nuts that secure the compressor to the refrigeration deck. Remember to save the nuts and mounting springs on which the compressor sets.

CAUTION Cap off all remaining lines to prevent moisture contamination from migrating into the system.

The compressor weights approximately 60 pounds. Use caution and employ proper lifting procedures when moving the compressor.

Step 6. Remove the defective second stage compressor from the unit and test the oil. If acidic, also replace the Receiver.

INSTALLATION OF NEW COMPRESSOR

CAUTION Verify that the compressor sight glass (not all compressors have a sight glass) is at least 5/8 full and that the compressor is of the correct electrical rating & oil, as specified by the label on the compressor.

CAUTION Oxidation will form at the heated joint unless a low volume nitrogen flow is maintained. Such oxidation could easily break free and cause a restriction later.

Step 1. Replace the filter drier after the system has been flushed

Step 2. Install the new compressor and starting components onto the refrigeration deck. Install the previously removed springs (not all compressor have external springs)and bolts in their original configuration.

Step 3. Inspect the service valves (not all compressors have ser. Valves) for damage; replace if necessary. Install the service valves with new gaskets, using caution to prevent damage to the gaskets. (if used)

Step 4. Wire the new compressor according to the labeled wires from the defective compressor and re-install the electrical components' cover.

Step 5. Inspect the new oil separator to ensure that it is full and contains the correct type of oil. Plumb the oil separator with new copper lengths equal to what was removed with the old separator, and install it. Connect all copper lines.

Step 6. Pressurize the system with dry nitrogen and leak check. If no leaks are detected, start evacuation (see Procedure 51).

NOTE Always use copper process lines directly to gauges and the vacuum pump. Ensure the suction lines are insulated.

Step 7. Reinstall the electrical box on upright units while the system evacuates. Reconnect all necessary harnesses and check for any loose connection in the electrical box due to moving.

Step 8. Insulate the suction side, from the compressor to the cabinet.

Step 9. Charge the system after the system meets blank off standards (see Procedure 54).

Step 10. Replace access panels and return system to operation.

Step 11.

Figure 447-3
Legaci™ Compressor

AIR COOLED CONDENSER REPLACEMENT (CHESTS) (SINGLE AND TWO STAGE)

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 temperature ambient 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 / high pressure gas to a low temperature liquid.

ACCESS THE CONDENSER

Step 1. Turn key switch to the Off position and unplug the unit.

Step 2. Access the condenser by removing the side access panel.

Step 3. Unplug the condenser fan motor and cut any plastic wire ties.

Step 4. Unbolt and remove the condenser motor bracket with motor attached.

Step 5. Recover gas from both systems.

Step 6. Cut 1 st stage receiver lines and cap them to prevent moisture migration into the system or receiver.(All units do not have receivers)

REMOVE THE CONDENSER

Step 1. Cut the condenser inlet & outlet lines and cap them to prevent moisture migration into the system

Step 2. Unbolt condenser and shroud from the deck, and remove them from the freezer.

CAUTION Cap off all remaining lines to prevent moisture contamination from migrating into the system.

The compressor weights approximately 60 pounds. Use caution and employ proper lifting procedures when moving the compressor. (It is not necessary to remove the compressor on all untis)

Maintain a low-volume flow of dry nitrogen when brazing to prevent oxidation & a possible future restriction.

INSTALL THE NEW CONDENSER

Step 1. Attach the fan shroud to the new condenser

Step 2. Install the new condenser in the reverse order

Step 3. See Procedures 52 - 55 for evacuation & system charging instructions.

Figure 449-1
Chest Condenser

AIR COOLED CONDENSER REPLACEMENT (UPRIGHTS)

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 temperature ambient 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 / high pressure gas to a low temperature liquid.

ACCESS THE CONDENSER

Step 1. Turn key switch to the Off position and unplug the unit.

Step 2. Remove the side access panels.

Step 3. Remove the front grill with the grill attached (if applicable) by removing the mounting bolt in each corner

Step 4. Open the filter door to access the two bolts on the left.

Step 5. Remove the nuts from the two bolts on the left via the removed access panel.

Step 6. Remove the battery and bracket, located in front of the condenser.

REMOVE THE CONDENSER

Step 1. Unbolt the plastic pipe clamp above the condenser fan motor/shroud.

Step 2. Cut any plastic wire ties securing harnesses to the fan motor shroud.

NOTE The condenser fan motor connector is sealed to the fan motor with a bead of silicon to prevent disconnection caused by vibration.

Step 3. Unplug the 2-pin connector from the top of the condenser fan motor shroud

Step 4. Recover the first stage gas.

Step 5. Cut the inlet & outlet lines; cap all lines to prevent moisture from migrating into the system

Step 6. Remove the four (4) condenser mounting bolts from the inner and outer bottom corners.

Step 7. Slide the condenser out the front.

CAUTION Maintain a low-volume flow of dry nitrogen when brazing to prevent oxidation & a possible future restriction.

INSTALL THE CONDENSER

Step 1. Remove the condenser fan/shrouds and attach them to the new condenser.

Step 2. Install the new condenser in the reverse order.

Step 3. See Evacuation & Refrigerant Charging instructions.

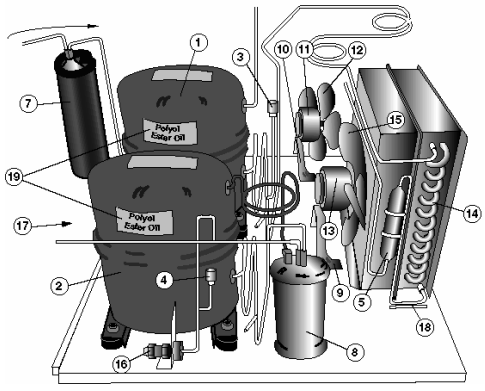


Figure 450-1
First Stage Condenser (#10)

Add figure 500.1 and 500.2

FIRST AND SECOND STAGE REFRIGERATION SYSTEM EVACUATION

The following steps will aid you in performing an evacuation of the first stage 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 Use all copper lines

Step 1: Make certain that the service manifold is connected to both “hi-side” and “low side” valves or process tubes.

Step 2: To perform a good evacuation, one must optimize both “hi-side” and “low side” connections of the system.

Step 3: Connect the vacum pump and allow it to operate until it reaches the maximum attainable vacum.

Step 4: Valve off the pump – the micron gauge should not rise to more than 200 microns in twenty minutes.

NOTE A final “blankoff” of 200 microns is required to ensure that all non-condensables have been removed from the refrigeration system.

Step 5: If the micro gauge exceeds 200 micros in twenty minutes, another evacuation is required.

Step 6: Break the vacum with dry nitrogen.

Step 7: With nitrogen still in the system, drain and replace the vacum pump oil.

Step 8: Repeat Steps 3-5 until the proper blankoff is achieved

Step 9: Charge the system.

NOTE Be sure to change the vacum pump oil after each pull-down to minimize evacuation time.

FIRST STAGE 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 to be left on the process tube after completion of the repair.

CAUTION — Maintain a low-volume flow of dry nitrogen when brazing to prevent oxidation & a possible future restriction.

Step 1. After the cabinet (first stage) has met the blank off requirements in microns, you are ready for charging of the required refrigerant(s).

Step 2. The refrigerants used in first stage systems most likely will be a mixed charge; an example is (R290 and R134a).

NOTE — R290 is instrument grade propane; using lesser grades of propane may cause failure of the system.

Step 3. When charging a system utilizing multiple refrigerants, remember to charge the R290 or R404 (or the lowest pressure Refrigerant first) first, due to the static pressure. Follow with the other refrigerants in order of their static pressure.

a. The R290 and R404 is charged into the system with the system in a deep vacuum.

b. Charge through a capillary tube of 25 to 30 inches long by .032 diameter, and a number 032 solid core drier; allowing retention time. This process will allow the drier to absorb any moisture that may be in the refrigerant.

c. The R290 or R404 will be charged from the deep vacuum to a predetermined positive pressure reading on the compound manifold gauge. Or by weight depending on the application.

d. Refer to the data plate or call the technical service department for the amount required.

Step 4. After reaching the required positive R290 or R404, 134a charge amount, per the data plate, then charge in by weight the next refrigerant (example R404), all as per the data plate. Both of the refrigerants will be charged using a electronic refrigerant charging scale.

CAUTION — Charge all refrigerants through a 032, solid core drier to reduce moisture introduced into the system.

Step 5. Upon completion of the charging procedure, remove any lock out tags or devices installed earlier, then connect the power cord to the power source.

Step 6. The system is now ready to run.

Step 7. Watch the system pull down and record the pressure reading for future service troubleshooting. You should not have to adjust the charge, but the charge can be adjusted, if necessary. After you are satisfied that the system is operating satisfactory, then turn the system off and allow the system pressure to equalize. Now you can pinch off and cut off the process (suction and discharge) lines. Seal the end of the tubing using 15% silver brazing rod (example Stay-Silv 15), and use Stay-Brite silver solder to strengthen the pinch off area.

Use the set-up shown below or equal

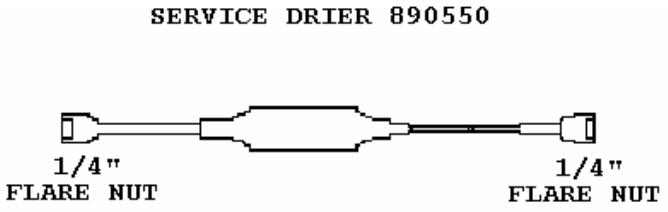


Figure 454-1
Drier-Strainer Assembly

SECOND STAGE 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 above 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.

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

Step 1. After the cabinet (second stage) has met the blank off requirements in microns, you then are ready for charging of the required refrigerant.

Step 2. The refrigerants used in second stage systems will be a mixed charge; example (R290 and R503b or R044 and R508b). Mixture depends on design.

NOTE R290 is an instrument grade propane; using lesser grades of propane may cause failure of the system.

Step 3. When charging a system utilizing multiple refrigerants, remember to charge the R290 or R404 first, due to the static pressure. Follow with the other refrigerants in order of their static pressure.

a. The R290 or R404 is charged into the system with the system in a deep vacuum.

b. Charge through a capillary tube of 25 to 30 inches long by .032 diameter, and a number 032 solid core drier; allowing retention time. This process will allow the drier to absorb any moisture that may be in the refrigerant.

c. The R290 or R404 will be charged from the deep vacuum to a predetermined positive pressure reading on the compound manifold gauge.

a. Refer to the data plate or call the technical service department for the amount required.

Step 4. After reaching the required positive R290 or R404 charge amount per the data plate, charge in the next refrigerant (example R508b) as per the data plate. Both of the refrigerants will be charged into the system by static.

a. Charge the R508B slowly into the system.

b. Watch the static pressure rise on the compound gauge to the required amount.

c. Shut the refrigerant valve off used to flow the refrigerant.

d. Wait for three or four minutes; the refrigerant oil will absorb the initial refrigerant charge.

e. You now can open the refrigerant valve slowly, allowing the refrigerant to slowly charge the system back to the desired compound gauge reading

f. Refer to the data plate or call the technical service department for the amount required.

Use the set-up shown below or equal

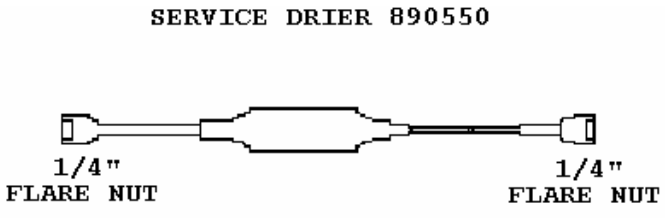


Figure 455-1
Drier-Strainer Assembly

CAUTION — Charge all refrigerants through an 032, solid core drier to reduce moisture introduced into the system.

CAUTION — Refrigerant is at a very high pressure. Extreme caution must be taken. Use a regulator to control the refrigerant flow and pressure. Do not exceed the limits of your equipment.

CAUTION — When charging, do not boost the charge more than one time after once reaching the initial required gauge pressure.

Step 5. Now that you have completed the charging procedure, remove any lock out tags or devices installed earlier, then connect the power cord to the power source.

Step 6. The system is now ready to run.

Step 7. Watch the system pull down and record the pressure reading for future service troubleshooting. You should not have to adjust the charge, but the charge can be adjusted, if necessary. After you are satisfied that the system is operating satisfactorily, then turn the system off and allow the system pressure to equalize. With both gauges showing a positive pressure, pinch off and cut off the process (suction and discharge) lines. Seal the end of the tubing using 15% silver brazing rod (example Stay-Silv 15), and use Stay-Brite silver solder to strengthen the pinch off area.

NOTE — When cutting the process lines leave them about 10 to 12 inches longer than the cabinet back wall. Leak check all pinch off points, then bend the excess process tubes back under the cabinet and tyrap or tape them in place.

CO2 / LN_2 DOOR SAFETY SWITCH EVALUATION AND REPLACEMENT

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

Step 1: Open outer door and locate the safety switch in the top left corner of the bottom freezer panel.

Step 2: Open the filter door to access the wiring going to the safety switch

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: Check the switch with an ohmmeter. If the rocker arm is in the open position, the contacts will be open. If the rocker arm is in the closed position, the contacts will be closed. If switch is defective, replace with the same type of switch.

Step 5: Reassemble the wiring

Figure 456-1
Door Safety Switch Location

CO_2 / LN_2 LID SAFETY SWITCH EVALUATION AND REPLACEMENT

Ultra low temperature freezers may come with a Carbon Dioxide or Liquid Nitrogen 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 two 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 ohmmeter. If switch is defective , replace with the same type of switch.

Step 6: Reassemble the wiring and mounting plate.

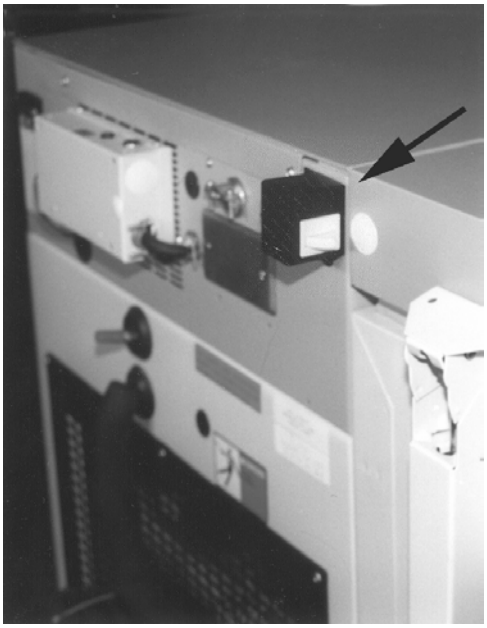


Figure 457-1
Lid Safety Switch Location

CO_2 / LN_2 PRESSURE SWITCH ASSEMBLY EVALUATION AND REPLACEMENT

The CO_2 or Liquid Nitrogen 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 switch, set to cut out at 750 PSIG and LN2 is set to cut out at 5 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 pressure. From the supply tank to the backup system. If the pressure is greater than the specified cutout value of 750 PSIG for co2 or 15 PSIG for LN2., 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 1. Remove covers from the backup system control assembly and pressure switch.

Step 2. Locate the pressure switch.

Step 3. Locate the adjustment nut at the top of the pressure switch, just above the adjustment scale on the end of the switch.

Step 4. Loosen the locking screw located on the side of the pressure switch.

Step 5. Turn hex nut clock-wise to raise the setting on the pressure switch.

Step 6. Adjust the pressure switch to cutout at 750 PSIG for Co2 and 5 PSIG for LN2

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 750 PSIG for Co2 and 15 PSIG for LN2.

Step 8: Tighten and secure the locking screw when adjustment is complete.

Step 9: Reinstall covers with power disconnected.

Step 10: Restart the system and verify operation.

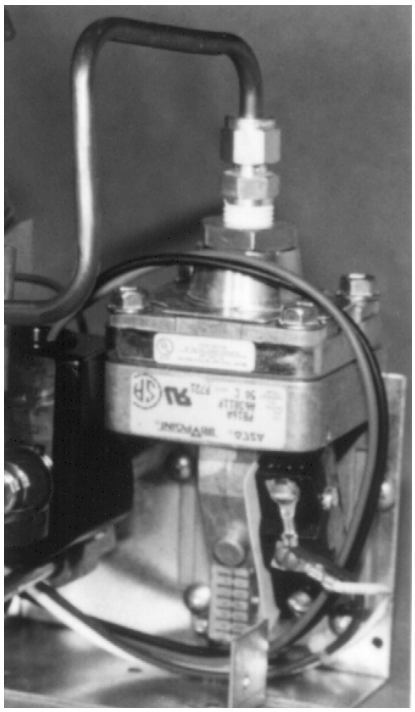


Figure 459-1
LCO_2 and LN2 Pressure Switch
Switches are different but look similar.

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 1: Disconnect the CO_2 / LN2 supply line from the backup system.

Step 2: Disconnect power supply from the unit and the backup system.

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

Step 4: Disconnect the wires from the pressure switch and mark the wires for location.

Step 5: 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 6: Remove the four (4) screws holding the switch to the mounting bracket. Remove the defective control.

Step 7: Install replacement control using the four (4) mounting screws.

Step 8: Reinstall the 1/4" copper tubing and tighten the brass hex-nut.

Step 9: Reconnect the wires to the pressure switch.

Step 10: Verify correct location when connecting wires.

Step 11: Reconnect the CO_2 / LN2 supply to the system.

Step 12: Apply pressure to the system and check for leaks in the tubing connections and on pressure switch body.

Step 13: Reconnect the power supply to the system.

Step 14: Verify operation and pressure switch settings.

Step 15: Reinstall covers with power disconnected.

Step 16: Restart the system and verify operation.

LCO_2 RUPTURE DISC EVALUATION AND REPLACEMENT

The CO_2 Backup system Rupture Disc is designed to prevent excessive pressure buildup 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.

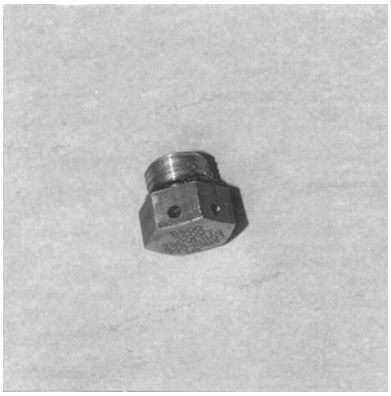


Figure 461-1
CO_2 Rupture Disc

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

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

e. 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.

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.

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 1. Disconnect the LN2 supply line from the backup system.

Step 2. Disconnect power supply from the unit and the backup system.

Step 3. The distribution tube is connected to a 1/2" elbow just outside the cabinet using 1/2" feral fittings.

Step 4. Remove the insulation from the elbow to expose the connection.

Step 5. Disconnect the distribution tube from the supply line using an open-end wrench.

Step 6. Inspect the replacement part, verifying the correct shape and location of liquid distribution holes.

Step 7: Install the replacement distribution tube by inserting the closed end into the cabinet.

Figure 462-1
LN2 Distribution Tube Location

Step 8: 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 9: Verify position of the distribution holes; they must direct the flow of liquid away from the door or lid.

Step 10: Reconnect the supply tubing to the distribution tube.

Step 11: Tighten securely using an open-end wrench.

Step 12: Reconnect the LN2 supply to the system.

Step 13: Apply pressure to the system and check for leaks in tubing connections.

Step 14: Insulate the connections to the distribution tube.

Step 15: Reinstall covers with power disconnected.

Step 16: Restart the system and verify flow through the Distribution tube.

BUILT-IN LCO2 / LN2 BACKUP SYSTEM TEMPERATURE CALIBRATION

Step 1. Place a thermocouple at the geometric center of the cabinet and record the temperature.

Step 2. Turn off the power switch and disconnect the unit from the electrical source.

Step 3. Remove the dummy panel covering the backup system, and the dummy panel to the right of the backup system.

NOTE Use caution when removing the last of the six mounting screws to prevent the backup system from falling inside the cabinet.

Step 4. Remove the six mounting screws securing the backup system module behind the face-plate.

Step 5. Withdraw the backup system through the hole behind the right hand dummy panel, being careful not to pull the harnesses.

Step 6. Disconnect the 9 pin and the 3 pin connectors.

Step 7. Remove the ten (10) screws securing the back plate to the backup system control module.

Step 8. Lay the backup system module on its side and reconnect the two (2) connectors.

NOTE The connectors are keyed to prevent accidental inappropriate connections.

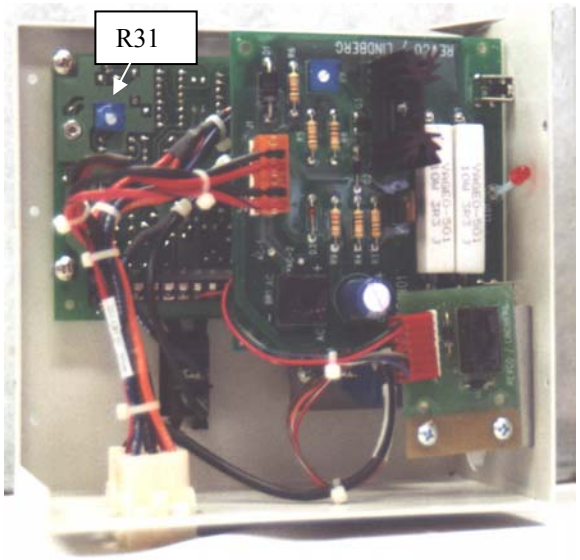


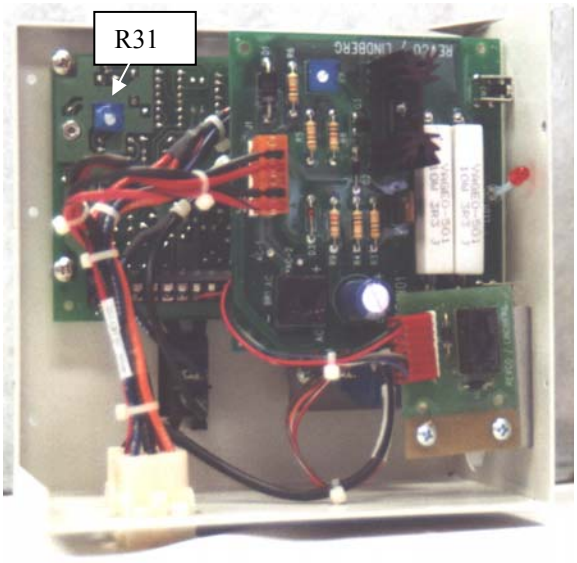
Figure 465-1
Calibration Potentiometer Location

Step 9. Locate R31 on the solder side of the temperature control board which has the digital display attached.

Step 10. Turn on the backup system via the rocker switch on the front panel, and adjust R31 until the backup system temperature display matches the temperature recorded in Step 1.

Step 11. Reassemble the system in the reverse order.

Step 12.



INSTALLATION OF CHEST FREEZER INVENTORY CONTROL RACK SYSTEM

Step 1. Place a plastic sheet in tank bottom.

Step 2. Remove front and rear breaker strip screws.

Step 3. Lift up the front breaker strip & install rack assembly so that the rectangular slots line up with the breaker strip screws.

Step 4. Set the breaker strip back I place and replace the breaker strip screws.

Step 5. Repeat these procedures for installing the rack assembly.

Step 6. Install baskets as illustrated

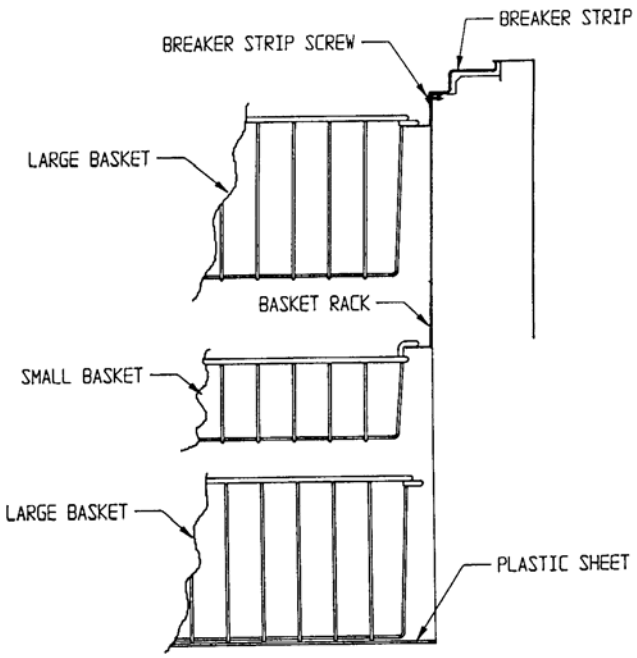


Figure 467-1
Inventory Control System Installation

COBEX TEMPERATURE RECORDER

This product includes a manufacturer-installed electronic temperature recorder. These instructions are provided to assist with the initial set-up, operation, and general maintenance of the recorder.

SETUP AND OPERATION

The recorder has been factory-installed, programmed, and calibrated for your new system. Operation will begin when the system is powered on. To prepare the recorder to function properly, you should perform the following steps:

Step 1. Review figure below to become familiar with recorder features.

Step 2. Open recorder door to access recorder.

Step 3. For back-up power, connect the 9 volt DC battery located at the recorder's upper right hand corner.

Step 4. Install clean chart paper (refer to Changing Chart Paper, below).

Step 5. Remove plastic cap from pen stylus (ink or pressure sensitive) and close recorder door.

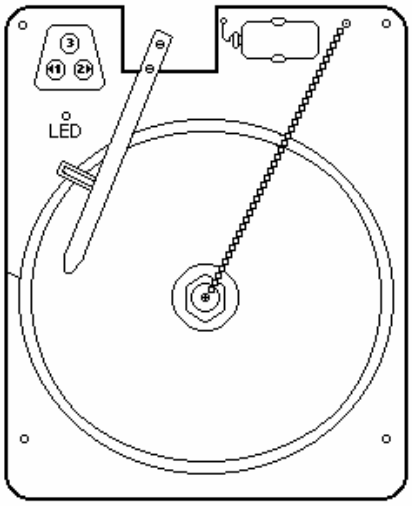
NOTE	Recorder may not respond until the system reaches temperatures within the recorder's range.

This should complete operator set up. Additional information is provided for maintenance and trouble-shooting as required.

MAINTENANCE

Power Supply
The recorder normally operates with AC power when the system is operating. If AC power fails, the LED indicator flashes to alert you to a power failure. The recorder will continue sensing cabinet temperature and the chart will continue turning for approximately 24 hours with back-up power provided by the 9 volt battery. Both the battery and main power are O.K. when the LED indicator glows continuously.

Changing Chart Paper



Cobex Recorder Face

Step 1. Locate the pressure sensitive buttons at the front, upper left of the recorder panel.

Step 2. Press and hold the change chart button (#3) for 1 second; pen will move off scale.

Step 3. Unscrew center nut, remove old chart paper, and install new chart paper.

Step 4. Carefully align the day and time with the reference mark on the recorder panel.

Step 5. Replace center nut and hand tighten. Press the change chart button (#3) again to resume temperature recording.

Changing Marker Pen
For recorders having a marker pen rather than a stylus for pressure-sensitive paper, the pen provided is a fiber-tipped cartridge type that is attached to the pen arm. As the pen ink supply runs out, the pen color will become lighter indicating the pen should be replaced.

Step 1. To install a new pen, loosen the (2) screws at the top of the arm.

Step 2. Slip the pen cartridge out and remove the "U" shaped clip tab from the pen; discard the old pen.

Step 3. Insert the clip tab into a new pen and then re-fasten to the pen arm.

Step 4. When re-attaching the pen arm confirm the pen tip is in the same location.

Step 5. Recheck the calibration.

Changing Temperature Range Program

Step 1. This recorder is capable of operating in multiple pre-programmed temperature ranges

Step 2. To select a different the temperature range, press the #3 Chart Change button to move the pen off chart.

Step 3. Press and hold #1 5-7 seconds and release; observe that the LED blinks.

Step 4. Using the left (#1) button to increase, or the right (#2) button to decrease the number of flashes, select the desired number of blinks (see chart).

Step 5. Press the change chart button (#3) when the desired program is set and observe that the pen moves to the outer edge of the chart for 5 seconds.

Step 6. Step 6 After 5 seconds, the LED indicator will glow continuously and the pen arm will move to begin recording temperature. ranges. The correct temperature range program was selected upon factory installation and is retained even during power interruptions. If the temperature range is wrong for any reason, it can be easily reprogrammed

Step 6.
Calibration

This recorder has been accurately calibrated at the factory and retains calibration even during power interruptions. If required, however, adjustments can be made as follows:

Step 1. Run unit continuously at bottom-out temperature. Continue steady operation at least 30 minutes to provide adequate time for recorder response.

Step 2. Measure cabinet center air temperature with a calibrated temperature monitor.

Step 3. Compare recorder temperature to center air temperature. If necessary, adjust recorder by pressing the left (#1) and right (#2) chart buttons.

NOTE	The pen does not begin to move until the button is held for 5 seconds.

Number of Flashes	Temperature Range	Applications	Option #
1	-40 to +25°C	Refrigerators	6*83-7*
2	-115 to +50°C	ULT's	6*83-6*
3	-200 to 0°C	Cryogenic	6*83-5*
4	0 to +60	Newer Units Only	

COBEX RECORDER TROUBLESHOOTING GUIDE

Symptom	Possible Cause	Corrective Action
Pen Goes to Center or Goes Off Chart	Wrong Range	a. Push #3 “Chart Change”. b. With pen off chart, hold #1 for 7 seconds. c. Release. (Note: No range recall). d. Green LED Flashes. e. Push #1 or #2 to change: 1 flash -40 to +25C 2 flashes -115 to +50C 3 flashes -200 to 0C 4 flashes 0 to +60C (newer units only) f. Push #3 again.
	Not Calibrated	a. Push #3. Pen comes off chart. b. Push #3 again. Pen stops briefly on returning to chart. c. Stopping point should be at edge of chart. If not perform the following: d. Ensure pen arm is aligned with pen arm bracket. If not, loosen screws and adjust. During stopping interval, adjust pen arm using #1 and #2 to align pen arm with edge of chart. e. Place probe in cold water for 5 min. Slow response. f. Measure the water temperature with a thermometer. g. Adjust calibration using #1 and #2 to make recorder read same temperature as thermometer. h. Put probe back into solution. i. Wait 5 minutes and adjust to cabinet temperature.
	Bad Probe	a. Check probe connections Red wire connected to J6 pin 1 Both black wires to J6 pin 2 b. Measure voltage across J6 approximate voltages are as follows: -150C = 35mV -85C = 75mV -30C = 100mV 3.5C = 110mV 25C = 120mV (ambient) Probe open circuit =1.23v (approximately) Probe short circuit = 0.0v (recorder possibly) faulty. Replace probe. If still 0.0v return/replace recorder. >2.0v = Replace recorder and probe. If probe voltage is off by more than a factor of 2 then probe is faulty.

COBEX RECORDER TROUBLESHOOTING GUIDE (CONTINUED)

Symptom	Possible Cause	Corrective Action
LED flashing	Low Battery	Replace 9V battery with new Alkaline.
	No AC Power	a. Remove battery. b. If LED goes out, then no power is getting to the unit. c. Check power and transformer connections. Transformer secondary is approximately 15v AC. d. Be sure transformer is wired for proper voltage.
LED won't light	LED burnt or recorder is dead	a. Remove battery. b. Disconnect or turn off power. c. Restore power. d. Reconnect battery. e. Return entire unit if not working.
Pen will not come completely off chart	Pen arm displaced	a. Unscrew pen arm b. Align pen arm with pen arm bracket c. Recalibrate ("Not Calibrated")
Pen Not Printing	Chart Loose	a. Tighten chart knob b. Attempt to turn chart counter-clockwise c. If chart turns tighten knob more
	No Pen Pressure	a. Unscrew pen arm b. Bend pen arm slightly downward c. Reattach d. Recalibrate ("Not Calibrated")
Pen Indicating Wrong Temp	Not Calibrated	Recalibrate (see "Not Calibrated")
	Wrong Chart	Be sure proper chart is used with selected range 1 Flash -40 to +25C 2 Flashes -115 to +50C 3 Flashes -200 to 0C 4 Flashes 0 to -+60C (newer units only
No Recorded Line (Chart Not Turning)	No Pen Pressure	a. Unscrew pen arm. b. Bend pen arm slightly downward. c. Reattach pen arm d. Recalibrate ("Not Calibrated").
	Chart Loose	a. Tighten chart knob. b. Attempt to turn chart counter-clockwise. c. If chart turns, tighten knob more.

SECTION 500 - APPENDIX

Change reference tables 4 –9 above to the two new charging tables on the disk reference to point to a new set of tables which covers all models for gas and refrigerant. Remove the words Harris Classic from table No. 7.

TABLE 1: FAHRENHEIT - CENTRIGADE TEMPERATURE CONVERSION

C	Deg	F		C	Deg	F		C	Deg	F
-102.8	-153	-243.4		-76.7	-106	-158.8		-50.6	-59	-74.2
-102.2	-152	-241.6		-76.1	-105	-157.0		-50.0	-58	-72.4
-101.7	-151	-239.8		-75.6	-104	-155.2		-49.4	-57	-70.6
-101.1	-150	-238.0		-75.0	-103	-153.4		-48.9	-56	-68.8
-100.6	-149	-236.2		-74.4	-102	-151.6		-48.3	-55	-67.0
-100.0	-148	-234.4		-73.9	-101	-149.8		-47.8	-54	-65.2
-99.4	-147	-232.6		-73.3	-100	-148.0		-47.2	-53	-63.4
-98.9	-146	-230.8		-72.8	-99	-146.2		-46.7	-52	-61.6
-98.3	-145	-229.0		-72.2	-98	-144.4		-46.1	-51	-59.8
-97.8	-144	-227.2		-71.7	-97	-142.6		-45.6	-50	-58.0
-97.2	-143	-225.4		-71.1	-96	-140.8		-45.0	-49	-56.2
-96.7	-142	-223.6		-70.6	-95	-139.0		-44.4	-48	-54.4
-96.1	-141	-221.8		-70.0	-94	-137.2		-43.9	-47	-52.6
-95.6	-140	-220.0		-69.4	-93	-135.4		-43.3	-46	-50.8
-95.0	-139	-218.2		-68.9	-92	-133.6		-42.8	-45	-49.0
-94.4	-138	-216.4		-68.3	-91	-131.8		-42.2	-44	-47.2
-93.9	-137	-214.6		-67.8	-90	-130.0		-41.7	-43	-45.4
-93.3	-136	-212.8		-67.2	-89	-128.2		-41.1	-42	-43.6
-92.8	-135	-211.0		-66.7	-88	-126.4		-40.6	-41	-41.8
-92.2	-134	-209.2		-66.1	-87	-124.6		-40.0	-40	-40.0
-91.7	-133	-207.4		-65.6	-86	-122.8		-39.4	-39	-38.2
-91.1	-132	-205.6		-65.0	-85	-121.0		-38.9	-38	-36.4
-90.6	-131	-203.8		-64.4	-84	-119.2		-38.3	-37	-34.6
-90.0	-130	-202.0		-63.9	-83	-117.4		-37.8	-36	-32.8
-89.4	-129	-200.2		-63.3	-82	-115.6		-37.2	-35	-31.0
-88.9	-128	-198.4		-62.8	-81	-113.8		-36.7	-34	-29.2
-88.3	-127	-196.6		-62.2	-80	-112.0		-36.1	-33	-27.4
-87.8	-126	-194.8		-61.7	-79	-110.2		-35.6	-32	-25.6
-87.2	-125	-193.0		-61.1	-78	-108.4		-35.0	-31	-23.8
-86.7	-124	-191.2		-60.6	-77	-106.6		-34.4	-30	-22.0
-86.1	-123	-189.4		-60.0	-76	-104.8		-33.9	-29	-20.2
-85.6	-122	-187.6		-59.4	-75	-103.0		-33.3	-28	-18.4
-85.0	-121	-185.8		-58.9	-74	-101.2		-32.8	-27	-16.6
-84.4	-120	-184.0		-58.3	-73	-99.4		-32.2	-26	-14.8
-83.9	-119	-182.2		-57.8	-72	-97.6		-31.7	-25	-13.0
-83.3	-118	-180.4		-57.2	-71	-95.8		-31.1	-24	-11.2
-82.8	-117	-178.6		-56.7	-70	-94.0		-30.6	-23	-9.4
-82.2	-116	-176.8		-56.1	-69	-92.2		-30.0	-22	-7.6
-81.7	-115	-175.0		-55.6	-68	-90.4		-29.4	-21	-5.8
-81.1	-114	-173.2		-55.0	-67	-88.6		-28.9	-20	-4.0
-80.6	-113	-171.4		-54.4	-66	-86.8		-28.3	-19	-2.2
-80.0	-112	-169.6		-53.9	-65	-85.0		-27.8	-18	-0.4
-79.4	-111	-167.8		-53.3	-64	-83.2		-27.2	-17	1.4
-78.9	-110	-166.0		-52.8	-63	-81.4		-26.7	-16	3.2
-78.3	-109	-164.2		-52.2	-62	-79.6		-26.1	-15	5.0
-77.8	-108	-162.4		-51.7	-61	-77.8		-25.6	-14	6.8
-77.2	-107	-160.6		-51.1	-60	-76.0		-25.0	-13	8.6

TABLE 2: RESISTANCE VERSUS TEMPERATURE -- 100Ω 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—MODEL NUMBER CROSS-REFERENCE (PART 1 of 6

REVCO MODEL #	REVCO RED CELL MODEL #	ALLEGIANCE GOLD MODEL #	ALLEGIANCE STD MODEL #	ALLEGIANCE RED CELL MODEL #	ASAHI "J" MODEL #	FISHER STD MODEL #
ULT390-3,5-A,D,V,W					ULT390-3,5,7J-A,D,V,W	
ULT790-3,5-A,D,V,W	CFRC790-5-A,D,V,W				ULT790-3,5,7J-A	
ULT1x90-3,5-A,D,V,W					ULT1x90-3,5,7J-A,D,V,W	
ULT2090-3,5-A,D,V,W	CFRC2090-5-A,D,V,W				ULT2090-3,5,7J-A,D,V,W	
ULTx90-7-A,D,V,W	CFRCx90-7-A,D,V,W	Cx90 A,D,V,W	SSCx90 A,D,V,W			C90-xA,D,V,W
ULT1x90-7-A,D,V,W	CFRC1x90-7-A	C1x90 A,D,V,W	SSC1x90 A,D,V,W	RC1x90A,D,V,W		C90-1xA,D,V,W
ULT2090-7-A,D,V,W	CFRC2090-7-A,D,V,W	C2090 A,D,V,W	SSC2090 A,D,V,W	RC2090A,D,V,W		C90-20A,D,V,W
ULTx90-9-A,D,V,W	CFRC790-9-A,D,V,W					
ULT1x90-9-A,D,V,W	CFRC1x90-9-A,D,V,W					
ULT2090-9-A,D,V,W	CFRC2090-9-A,D,V,W					
ULT1x86-3,5-A,D,V,W	UFRC1x86-5-A,D,V,W				ULT1x86-3,5,7J-A,D,V,W	
ULT2x86-3,5-A,D,V,W					ULT2x86-3,5,7J-A,D,V,W	
ULT1x86-7-A,D,V,W	UFRC1x86-7-A,D,V,W	U1x86 A,D,V,W	SSU1x86 A,D,V,W	RCU1x86 A,D,V,W		U86-1xA
ULT2x86-7-A,D,V,W		U2x86 A,D,V,W	SSU2x86 A,D,V,W			U86-2xA,D,V,W
ULT1x86-9-A,D,V,W	UFRC1x86-9-A,D,V,W					
ULT3286-9SI-D,V,W					ULT3286-9SIJ-D.V,W	
ULT185-3,5-A,D,V,W		C185 A,V				
ULT1x75-3,5-A,D,V,W		C1075 A,V	SSC1075 A,V			
ULT2075-3,5-A,D,V,W		C2075 A,V	SSC2075 A,V			
ULT1x75-3,5-A,D,V,W		U1x75 A,V	SSU1x75 A,V			
ULT2x75-3,5-A,D,V,W		U2x75 A,V	SSU2x75 A,V			

TABLE 3—MODEL NUMBER CROSS-REFERENCE (PART 2 of 6

REVCO MODEL #	FISHER STD MODEL #	FISHER ISOTEMP MODEL #	FISHER REDCELL MODEL #	HARRIS ESSENTIAL MODEL #	HARRIS CUSTOM MODEL #	
ULT390-3,5-A,D,V,W				ELT-3LS-90A,D,V,W	SLT-3LS-90A,D,V,W	
ULT-590UC-3A,D,V,W				PLT-5UC-90-3A,D,V,W	SLT-5LS-90A,D,V,W	
ULT790-3,5-A,D,V,W				ELT-7LS-90A,D,V,W	SLT-7LS-90A,D,V,W	
ULT1x90-3,5-A,D,V,W				ELT-1xLS-90A,D,V,W	SLT-1xLS-90A,D,V,W	
ULT2090-3,5-A,D,V,W				ELT-20LS-90A,D,V,W	SLT-20LS-90A,D,V,W	
ULTx90-7-A,D,V,W	C90-xA,D,V,W	I807CA,D,V,W	I807CRCA,D,V,W	ELT-xLS-90-A,D,V		
ULT1x90-7-A,D,V,W	C90-1xA,D,V,W					
ULT2090-7-A,D,V,W	C90-20A,D,V,W	I820CA,D,V,W				
ULT1x86-3,5-A,D,V,W				ELT-1xV-85 A,D,V,W	SLT-1xV-85 A,D,V,W	
ULT2x86-3,5-A,D,V,W				ELT-2xV-85 A,D,V,W	SLT-2xV-85 A,D,V,W	
ULT1x86-7-A,D,V,W	U86-1xA	I81xUA	I81xURCA,D,V,W			
ULT2x86-7-A,D,V,W	U86-2xA,D,V,W	I82xUA,D,V,W				
ULT3286-9SI-D,V,W						
ULT185-3,5-A,D,V,W					SLT-1LS-85 A,D,V,W	
ULT1x75-3,5-A,D,V,W					SLT-10LS-75A,V	
ULT2075-3,5-A,D,V,W					SLT-20LS-75A,V	
ULT1x75-3,5-A,D,V,W					SLT-1xV-75A,V	
ULT2x75-3,5-A,D,V,W					SLT-2xV-75A,V	

TABLE 3—MODEL NUMBER CROSS-REFERENCE (PART 3 of 6

REVCO MODEL #	HARRIS CUSTOM DELUXE MODEL #	HARRIS RED CELL MODEL #	HARRIS INDUSTRIAL MODEL #	HERAEUS REGULAR MODEL #	HERAEUS PLUS MODEL #	
ULT390-3,5-A,D,V,W			HIF385-A,D			
ULT-590UC-3A,D,V,W			HIF585-A,D			
ULT790-3,5-A,D,V,W			HIF785-A,D			
ULT1x90-3,5-A,D,V,W			HIF1x85-A,D	HFC386STD-A,V		
ULT2090-3,5-A,D,V,W			HIF2085-A,D			
ULTx90-7-A,D,V,W	DLT-xLS-90A,D,V,W					
ULT1x90-7-A,D,V,W	DLT-1xLS-90A,D,V,W	DLT-1xLS-90RCA				
ULT2090-7-A,D,V,W	DLT-20LS-90A,D,V,W					
ULTx90-9-A,D,V,W					HFC286PLUS-V	
ULT1x90-9-A,D,V,W						
ULT2090-9-A,D,V,W						
ULT1x86-3,5-A,D,V,W			HIF1xU85-A,D,V,W	HFU486STD-V		
ULT2x86-3,5-A,D,V,W			HIF2xU85-A,D,V,W	HFU686STD-V		
ULT1x86-7-A,D,V,W	DLT-1xV-85 A,D,V,W	DLT-1xV-85RC A,D,V,W				
ULT2x86-7-A,D,V,W	DLT-2xV-85 A,D,V,W					
ULT1x86-9-A,D,V,W						
ULT3286-9SI-D,V,W	HLT-32V-85SID,V,W35				HFU3285SITOP-D,V,W	
ULT185-3,5-A,D,V,W						
ULT1x75-3,5-A,D,V,W			HIF1075-A,D,V,W			
ULT2075-3,5-A,D,V,W			HIF2075-A,D,V,W			
ULT1x75-3,5-A,D,V,W			HIF1xU75-A,D,V,W			
ULT2x75-3,5-A,D,V,W			HIF2xU75-A,D,V,W			

TABLE 3—MODEL NUMBER CROSS-REFERENCE (PART 4 of 6

REVCO MODEL #	HEVI-DUTY MODEL #	JEWETT MODEL #	KELVINATOR EAGLE MODEL	KELVINATOR EAGLE XL MODEL	LAB IMPEX MODEL #	NUAIR MODEL #	PUFFER HUBBARD STANDRD MODEL #
ULT390-3,5-A,D,V,W		LTC-3A,D					ICF9003 A,D,V,W
ULT-590UC-3A,D,V,W							
ULT790-3,5-A,D,V,W		LTC-7A,D					ICF9007 A,D,V,W
ULT1x90-3,5-A,D,V,W							ICF901x A,D
ULT2090-3,5-A,D,V,W		LTC-20A,D					ICF9020 A,D
ULTx90-7-A,D,V,W	HDTCFx85A,D,V,W						
ULT1x90-7-A,D,V,W	HDTCF1x85A,D,V,W		UC1x30-A,D,V,	UC1x30XL-A,D,V	LIC-1x90W		
ULT2090-7-A,D,V,W	HDTCF2085A,D,V,W		UC2050-A,D,V,	UC2050XL-A,D,V	LIC-2090W		
ULTx90-9-A,D,V,W							
ULT1x90-9-A,D,V,W							
ULT2090-9-A,D,V,W							
ULT1x86-3,5-A,D,V,W		LTU-1xA,D				NU-661x-A,D,V,	IUF851x A,D
ULT2x86-3,5-A,D,V,W		LTU-2xA,D				NU-662x-A,D,V,	IUF852x A,D
ULT1x86-7-A,D,V,W	HDTCF1x8A,D,V,W		UC1x40-A,D,V,	UC1x40XL-A,D,V	LIU-1x86W		
ULT2x86-7-A,D,V,W	HDTCF2x8A,D,V,W		UC2020-A,D,V,	UC2020XL-A,D,V	LIU-2x86W		
ULT1x86-9-A,D,V,W							
ULT3286-9SI-D,V,W							
ULT185-3,5-A,D,V,W							
ULT1x75-3,5-A,D,V,	HDTCF1075A						ICF7510 A,V
ULT2075-3,5-A,D,V,	HDTCF2075A						ICF7520 A,V
ULT1x75-3,5-A,D,V,	HDTCF1x75A						IUF751x A,V
ULT2x75-3,5-A,D,V,	HDTCF2x75A						IUF7520 A,V

TABLE 3—MODEL NUMBER CROSS-REFERENCE (PART 5 of 6

REVCO MODEL #	PUFFER HUBBARD STANDRD MODEL #	PUFFER HUBBARD ECONOMY MODEL #	QUEUE BASIC MODEL #	QUEUE ADVANTAGE MODEL #	VWR STANDARD MODEL #
ULT390-3,5-A,D,V,W	ICF9003 A,D,V,W	EC8503 A,D,V			
ULT-590UC-3A,D,V,W			QLTUC-590V,W		
ULT790-3,5-A,D,V,W	ICF9007 A,D,V,W	EC8507 A,D,V,W			
ULT1x90-3,5-A,D,V,W	ICF901x A,D	EC851x A,D			
ULT2090-3,5-A,D,V,W	ICF9020 A,D	EC8520 A,D			
ULTx90-7-A,D,V,W			QBFx90 A,D,V,W	QLTx85 A,D,V,W	A,D,V,W850xC
ULT1x90-7-A,D,V,W			QBF1x90 AV	QLT1x85 A,D,V,W	A,D,V,W851xC
ULT2090-7-A,D,V,W			QBF2090 A,D,V,W	QLT2085 A,D,V,W	A,D,V,W8520C
ULTx90-9-A,D,V,W					
ULT1x90-9-A,D,V,W					
ULT2090-9-A,D,V,W					
ULT1x86-3,5-A,D,V,W	IUF851x A,D	EU861x A,D			
ULT2x86-3,5-A,D,V,W	IUF852x A,D	EU862x A,D			
ULT1x86-7-A,D,V,W			QBF1x85 A,D,V,W	QLT1x85 A,D,V,W	A,D,V,W851xU
ULT2x86-7-A,D,V,W			QBF2x85 A,D,V,W	QLT2x85 A,D,V,W	A,D,V,W8520U
ULT1x86-9-A,D,V,W					
ULT3286-9SI-D,V,W				QLT2585 D,V,W	
ULT185-3,5-A,D,V,W					
ULT1x75-3,5-A,D,V,W	ICF7510 A,V	EC7510 A,V		QLT1075 A,V	A7510C
ULT2075-3,5-A,D,V,W	ICF7520 A,V	EC7520 A,V		QLT2075 A,V	A7520C
ULT1x75-3,5-A,D,V,W	IUF751x A,V	EU751x A,V		QLT1x75 A,V	A751xU
ULT2x75-3,5-A,D,V,W	IUF7520 A,V	EU7520 A,V		QLT2x75 A,V	A7520U

TABLE 3—MODEL NUMBER CROSS-REFERENCE (PART 6 of 6

REVCO MODEL #	VWR STANDARD MODEL #	VWR SELECT MODEL #
ULT390-3,5-A,D,V,W		
ULT-590UC-3A,D,V,W		
ULT790-3,5-A,D,V,W		
ULT1x90-3,5-A,D,V,W		
ULT2090-3,5-A,D,V,W		
ULTx90-7-A,D,V,W	A,D,V,W850xC	A,D,V,W850x-SCF
ULT1x90-7-A,D,V,W	A,D,V,W851xC	A,D,V,W851x-SCF
ULT2090-7-A,D,V,W	A,D,V,W8520C	A,D,V,W8520-SCF
ULTx90-9-A,D,V,W		
ULT1x90-9-A,D,V,W		
ULT2090-9-A,D,V,W		
ULT1x86-3,5-A,D,V,W		
ULT2x86-3,5-A,D,V,W		
ULT1x86-7-A,D,V,W	A,D,V,W851xU	A,D,V,W851x-SUF
ULT2x86-7-A,D,V,W	A,D,V,W8520U	A,D,V,W8520-SUF
ULT1x86-9-A,D,V,W		
ULT3286-9SI-D,V,W		
ULT185-3,5-A,D,V,W		
ULT1x75-3,5-A,D,V,W	A7510C	
ULT2075-3,5-A,D,V,W	A7520C	
ULT1x75-3,5-A,D,V,W	A751xU	
ULT2x75-3,5-A,D,V,W	A7520U	

REVCO MODEL #	1st REFRIGERANT			2nd STG REFRIGERANT					
	TYPE	CHG	CHG	PROPANE		R-23		R-503	
		(OZ)	(PSIG)	(PSIG)	(OZ)	(PSIG)	(OZ)	(PSIG)	(OZ)
ULT1075-3,5,7-A(BA)	R-500	11.0		20	1.0			110	5.3
ULT1475-3,5,7-A(BA)	R-500	11.5		21	1.0			115	5.8
ULT1775-3,5,7-A(BA)	R-500	11.5		22	1.2			120	6.1
ULT2075-3,5,7-A(BA)	R-500	11.5		23	1.2			123	6.4
ULT1075-3,5,7,9-A(12)	PROP	1.0	49	20	0.9	130	4.5		
	+R-134a	8.75							
	+R-22	3.75							
ULT1475-3,5,7,9-A(12)	PROP	1.1	52	22	0.9	137	5.0		
	+R-134a	9.25							
	+R-22	3.75							
ULT1775-3,5,7,9-A(12)	PROP	1.1	52	23	1.0	142	5.2		
	+R-134a	9.25							
	+R-22	3.75							
ULT2075-3,5,7,9-A(12)	PROP	1.1	52	24	1.0	145	5.3		
	+R-134a	9.25							
	+R-22	3.75							
ULT1375-3,5,7-A(BA)	R-500	11.5		26	1.0			138	5.3
ULT1875-3,5,7-A(BA)	R-500	11.5		26	1.0			138	5.5
ULT2175-3,5,7-A(BA)	R-500	11.5		26	1.0			138	5.5
ULT1375-3,5,7,9-A(12)	PROP	1.2	49	28	1.1	161	5.6		
	+R-134a	10.0							
	+R-22	4.0							
ULT1875-3,5,7,9-A(12)	PROP	1.2	49	28	1.1	161	5.7		
	+R-134a	10.0							
	+R-22	4.0							
ULT2175-3,5,7,9-A(12)	PROP	1.2	49	28	1.1	161	5.7		
	+R-134a	10.0							
	+R-22	4.0							

REVCO MODEL #	1st REFRIGERANT TYPE	CHG (OZ)	CHG (PSIG)	2nd STG REFRIGERANT PROPANE (PSIG)	(OZ)	R-23 (PSIG)	(OZ)	R-503 (PSIG)	(OZ)
ULT185-3,5-A(BA)	R-500	2.5		23	1			139	4.4
	+R-502	8.5							
ULT390-3,5-*(BA)	R-500	3		20	0.8			110	4.6
	+R-502	9.5							
ULT590-3,5-*(BA)	R-500	2.5		21	1			117	5.5
	+R-502	8.5							
ULT790-3,5-*(BA)	R-500	2.5		21	1			117	5.5
	+R-502	8.5							
ULT1090-3,5-*(BA)	R-500	14		20	1.4			81	5
ULT1490-3,5-*(BA)	R-500	14.25		20	1.5			92	6.3
ULT1790-3,5-*(BA)	R-500	14.5		21	1.6			110	8.1
ULT2090-3,5-*(BA)	R-500	14.75		21	1.7			110	8.5
ULT185-5-A(12)	PROP	1	45	28	0.8	160	4.3		
	+R-134a	8.5							
	+R-22	3.5							
ULT390-3,5-*(12)	PROP	0.85	45	5	0.4	70	2.1		
	+R-134a	8.25							
	+R-22	3.5							
ULT590-3,5-*(12)	PROP	1	45	13	0.6	103	3.5		
	+R-134a	9							
	+R-22	3.75							
ULT790-3,5-*(12)	PROP	1	45	13	0.6	103	3.5		
	+R-134a	9							
	+R-22	3.75							
ULT1090-3,5-*(12)	PROP	2	46	16	1.3	96	5.5		
	+R-134a	9.25							
	+R-22	3.25							
ULT1490-3,5-*(12)	PROP	2	46	20	1.5	108	6.3		
	+R-134a	9.5							
	+R-22	3.25							
ULT1790-3,5-*(12)	PROP	2	46	25	1.8	126	7.6		
	+R-134a	9.75							
	+R-22	3.25							
ULT2090-3,5-*(12)	PROP	2	46	25	1.9	126	8		
	+R-134a	9.75							
	+R-22	3.5							
ULT390-3,5-*(14)	R-404A	8		9	0.8	59	2.7		
	+R-134a	5.25							
ULT590-3,5-*(14)	R-404A	8.5		4	0.6	57	2.9		
	+R-134a	5.75							
ULT790-3,5-*(14)	R-404A	8.5		6	0.8	71	4.1		
	+R-134a	5.75							
ULT1090-3,5-*(14)	R-404A	8.5		12	1	92	5.2		
	+R-134a	5.75							
ULT1490-3,5-*(14)	R-404A	8.75		15	1.2	103	6.1		

REVCO MODEL #	1st Stage Refrig		2nd Stage Refrig			
	TYPE	CHG (OZ)	PROPANE		R508b	
			(PSIG)	(OZ)	(PSIG)	(OZ)
ULT390-3,5,7,9-*(30)	R-404A +R-134a	15 6.50	17	0.8	87	4.3
ULT590-3,5,7,9-*(30)	R-404A +R-134a	13.5 5.75	22	0.7	110	4.0
ULT790-3,5,7,9-*(30)	R-404A +R-134a	14.0 6.0	22	1.1	110	6.4
ULT1090-3,5,7,9-*(30)	R-404A +R-134a	14.0 6.0	22	1.2	110	7.2
ULT1490-3,5,7,9-*(30)	R-404A +R-134a	14.0 6.0	22	1.4	110	8.4
ULT1790-3,5,7,9-*(30)	R-404A +R-134a	14.0 6.0	22	1.5	110	8.8
ULT2090-3,5,7,9-*(30)	R-404A +R-134a	14.0 6.0	22	1.6	115	10.2
			R404a (Vapor)		R508b	
ULT390-3,5,7,9-*(31,34,35)	R-404A +R-134a	16 7.0	V-2	0.8	71	4.3
ULT-590UC-*(31,34,35)	R404A R134A	14.75 6.25	V-2	0.8	113	6.9
ULT790-3,5,7,9-*(31,34,35)	R-404A +R-134a	14.75 6.25	V-2	1.1	95	6.4
ULT1090-3,5,7,9-*(31,34,35)	R-404A +R-134a	14.75 6.25	V-3	1.2	110	7.8
ULT1490-3,5,7,9-*(31,34,35)	R-404A +R-134a	14.75 6.25	V-3	1.4	115	10.7
ULT1790-3,5,7,9-*(31,34,35)	R-404A +R-134a	14.75 6.25	V-4	1.5	120	11.6
ULT2090-3,5,7,9-*(31,34,35)	R-404A +R-134a	14.75 6.25	V-4	1.7	125	13.1

REVCO MODEL #	1st REFRIGERANT			2nd STG REFRIGERANT					
	TYPE	CHG (OZ)	CHG (PSIG)	PROPANE (PSIG)	PROPANE (OZ)	R-23 (PSIG)	R-23 (OZ)	R-503 (PSIG)	R-503 (OZ)
ULT1386-3,5-*(BA)	R-500	13.0		15	1.1			95	5.8
ULT1786-3,5-*(BA)	R-500	14.5		15	1.1			95	5.9
ULT2186-3,5-*(BA)	R-500	14.25		15	1.1			96	6.1
ULT2586-3,5-*(BA)	R-500	14.0		15	1.1			96	6.3
ULT1386-3,5-*(12)	PROP +R-134a +R-22	2.0 9.25 3.25	40	9	0.9	88	4.7		
ULT1786-3,5-*(12)	PROP +R-134a +R-22	2.0 9.5 3.25	40	9	0.9	88	4.8		
ULT2186-3,5-*(12)	PROP +R-134a +R-22	2.0 9.75 3.25	40	9	0.9	88	4.8		
ULT2586-3,5-*(12)	PROP +R-134a +R-22	2.0 9.75 3.5	40	9	0.9	88	5.0		
ULT1386-3,5-*(14,29) ULT1786-3,5-*(14,29)	R-404A +R-134a	8.5 5.75		10	0.9	89	4.6		
ULT2186-3,5-*(14,29)	R-404A +R-134a	8.75 6		10	0.9	89	4.8		
ULT2586-3,5-*(14,29)	R-404A +R-134a	9.0 6		12	1.0	96	5.3		
ULT1386-7-*(BA)	R-500	13.0		15	1.1			95	5.8
ULT1786-7-*(BA)	R-500	14.5		15	1.1			95	5.9
ULT2186-7-*(BA)	R-500	14.25		15	1.1			96	6.1
ULT2586-7-*(BA)	R-500	14.0		15	1.1			96	6.3
ULT1386-7,9-*(12)	PROP +R-134a +R-22	2.0 9.25 3.25	40	9	0.9	88	4.7		
ULT1786-7,9-*(12)	PROP +R-134a +R-22	2.0 9.5 3.25	40	9	0.9	88	4.8		
ULT2186-7,9-*(12)	PROP +R-134a +R-22	2.0 9.75 3.25	40	9	0.9	88	4.8		
ULT2586-7,9-*(12)	PROP +R-134a +R-22	2.0 9.75 3.5	40	9	0.9	88	5.0		
ULT1386-7,9-*(14,28,29) ULT1786-7,9-*(14,28,29)	R-404A +R-134a	8.75 5.75		10	0.9	89	4.6		
ULT2186-7,9-*(14,28,29)	R-404A +R-134a	8.75 6		10	0.9	89	4.8		
ULT2586-7,9-*(14,28,29)	R-404A +R-134a	9.0 6.0		12	1.0	96	5.3		

REVCO MODEL #	1st Stage Refrig		2nd Stage Refrig			
	TYPE	CHG (OZ)	PROPANE		R508b	
			(PSIG)	(OZ)	(PSIG)	(OZ)
ULT1386-3,5,7,9-*(30)	R-404A +R-134a	15.5 6.75	20	1.1	103	5.4
ULT1786-3,5,7,9-*(30)	R-404A +R-134a	15.5 6.75	20	1.1	106	5.6
ULT2186-3,5,7,9-*(30)	R-404A +R-134a	15.5 6.75	20	1.1	106	5.8
ULT2586-3,5,7,9(J)-*(SI)(30)	R-404A +R-134a	17.0 7.25	22	1.2	116	6.6
			R404a (Vapor)		R508b	
ULT1186-3,5,7,9(J)-*(31,34)	R-404A +R-134A	13.25 4.50	V-3	1.0	106	6.1
ULT1386-3,5,7,9-*(31,34,35)	R-404A +R-134a	15.5 6.75	V-2	1.1	100	6.3
ULT1786-3,5,7,9-*(31,34,35)	R-404A +R-134a	15.5 6.75	V-3	1.1	110	7.2
ULT2186-3,5,7,9-*(34,35)	R-404A +R-134a	17.0 7.50	V-3	1.2	114	7.7
ULT2586-3,5,7,9(J)-*(SI)(31,34,35)	R-404A +R-134a	17.0 7.50	V-4	1.4	126	8.6
ULT3286***(35)	R404a R134a	32.0 8.0	V-10	1.8	223	20.0

MODEL #	1st STG OIL	1st STG REFRIGERANT				2nd STG REFRIGERANT					
	TYPE	CHG	TYPE	CHG	CHG	PROPANE		R-23		R-503	
		(OZ)		(OZ)	(PSIG)	(PSIG)	(OZ)	(PSIG)	(OZ)	(PSIG)	(OZ)
FOR AMBIENTS 65F TO 74F ONLY											
HLT-7LS-85*BA	Z150T	23	R-502 PROP	20 0.75		11	0.9			77	4.8
HLT-14LS-85*BA	Z150T	23				12	0.9			84	5.0
HLT-17LS-85*BA	Z150T	23				23	0.9			122	5.1
HLT-20LS-85*BA	Z150T	23				23	1.0			122	5.2
HLT-7LS-85*14	ICI 46H	23	PROP	0.75	14	16	0.5	115	2.6		
incl. Water cool opt#4506-3			R134A	4							
includes Delphi model			R404A	17							
HLT-14LS-85*14	ICI 46H	23	Same			16	0.6	115	3.4		
incl. Water cool opt#4506-3											
HLT-17LS-85*14	ICI 46H	23	Same			16	0.7	115	3.7		
incl. Water cool opt#4506-3											
HLT-20LS-85*14	ICI 46H	23	Same			16	0.8	115	4.1		
incl. Water cool opt#4506-3											
HLT-13V-85*BA	Z150T	23				21	1.0			114	5.2
HLT-17V-85*BA	Z150T	23	R-502	19.5		21	1.0			114	5.4
HLT-21V-85*BA	Z150T	23	PROP	0.75		21	1.1			114	5.5
HLT-25V-85*BA	Z150T	23				21	1.1			114	5.5
HLT-13V-85*14,29,32,33	ICI 46H	23	PROP	2.0				110	4.2		
HLT-17V-85*14,29,32,33	ICI 46H	23	R-134A	10				110	4.4		
HLT-21V-85*14,29,32,33	ICI 46H	23	R-404A	42	24	15	0.8	110	4.4		
HLT-25V-85(SI)*14,29,32,33	ICI 46H	23						110	4.4		
HLT-13V-85*14,29,32,33	ICI 46H	23	PROP	1.5		15	0.8	110	4.2		
w. Water Cool Cond.			R-134A	5							
OPTION 4506-2			R-404A	21							
HLT-17V-85*14,29,32,33	ICI 46H	23	Same			15	0.8	110	4.4		
w. Water Cool Cond.				1.5							
OPTION 4506-2				5							
HLT-21V-85*14,29,32,33	ICI 46H	23	Same	21	14	15	0.8	110	4.4		
w. Water Cool Cond.											
OPTION 4506-2											
HLT-25V-85(SI)*14,29,32,33	ICI 46H	23	Same			15	0.8	110	4.4		
w. Water Cool Cond.											
OPTION 4506-2											

(Continued on next page)

MODEL #	1st STG OIL		1st STG REFRIG			2nd STG REFRIGERANT			
	TYPE	CHG	TYPE	CHG	CHG	R404a Vapor		R508B	
		(OZ)		(OZ)	(PSIG)	(PSIG)	(OZ)	(PSIG)	(OZ)
FOR AMBIENTS 65F TO 74F ONLY									
HLT-7LS-85*31	ICI 46H					4.8	1.0	121	7.3
HLT-14LS-85*31	ICI 46H	23	R-134A R-404A	10.0 40.0		4.8	1.3	121	9.6
HLT-17LS-85*31	ICI 46H					4.8	1.4	121	10.5
HLT-20LS-85*31	ICI 46H					4.8	1.5	121	11.6
HLT-13V-85*35	ICI 46H					3.9	1.0	109	7.2
HLT-17V-85*35	ICI 46H	23	R-134A R-404A	10 42		3.9	1.0	109	7.4
HLT-21V-85*35	ICI 46H					3.9	1.0	109	7.6
HLT-25V-85(SI)*35	ICI 46H					3.9	1.1	109	7.7

TABLE 8 UPRIGHT OIL CHARGING INFORMATION

Freezer Interior	1st Stage Oil Charge		2nd Stage Oil Charge		
	Type	Ounces	Type	Ounces	
(All Voltages)				Compressor	Oil Separator
ULT-1386-5,9 (x30,31)	ICI32H	24	ICI32H	24	15
ULT-1786-5,9 (x30,31)	ICI32H	24	ICI32H	24	15
ULT-2186-5,9 (x30,31)	ICI32H	24	ICI32H	24	15
ULT-2586-5,9 (x30,31)	ICI32H	24	ICI32H	24	15

TABLE 9 CHEST OIL CHARGING INFORMATION

Freezer Interior	1st Stage Oil Charge		2nd Stage Oil Charge		
	Type	Ounces	Type	Ounces	
(All Voltages)				Compressor	Oil Separator
ULT-385-5,9 (x30,31)	ICI32H	24	ICI32H	24	15
ULT-585-5,9 (x30,31)	ICI32H	24	ICI32H	24	15
ULT-785-5,9 (x30,31)	ICI32H	24	ICI32H	24	15
ULT-1085-5,9 (x30,31)	ICI32H	24	ICI32H	24	15
ULT-1485-5,9 (x30,31)	ICI32H	24	ICI32H	24	15
ULT-1785-5,9 (x30,31)	ICI32H	24	ICI32H	24	15
ULT-2085-5,9 (x30,31)	ICI32H	24	ICI32H	24	15

TABLE 10: LM335 SENSOR MV / TEMPERATURE

(Clean Filter, Extreme Ambient, and Compressor Lifeguard Sensors)

Deg C	Deg F	Minimum	Maximum
18	64.4	2.88mV	2.94mV
19	66.2	2.89	2.95
20	68.0	2.90	2.96
21	69.8	2.91	2.97
22	71.6	2.92	2.98
23	73.4	2.93	2.99
24	75.2	2.94	3.00
25	77.0	2.95	3.01
26	78.8	2.96	3.02
27	80.6	2.97	3.03
28	82.4	2.98	3.04
29	84.2	2.99	3.05
30	86.0	3.00	3.06
31	87.8	3.01	3.07
32	89.6	3.02	3.08
33	91.4	3.03	3.09
34	93.2	3.04	3.10
35	95.0	3.05	3.11
36	96.8	3.06	3.12
37	98.6	3.07	3.13

Deg C	Deg F	Minimum	Maximum
38	100.4	3.08	3.14
39	102.2	3.09	3.15
40	104.0	3.10	3.16
41	105.8	3.11	3.17
42	107.6	3.12	3.18
43	109.4	3.13	3.19
44	111.2	3.14	3.20
45	113.0	3.15	3.21
46	114.8	3.16	3.22
47	116.6	3.17	3.23
48	118.4	3.18	3.24
49	120.2	3.19	3.25
50	122.0	3.20	3.26
51	123.8	3.21	3.27
52	125.6	3.22	3.28
53	127.4	3.23	3.29
54	129.2	3.24	3.30
55	131.0	3.25	3.31
56	132.8	3.26	3.32
57	134.6	3.27	3.33

TABLE 11: PARTS LIST

Nomenclature	Full-Featured Models	Value-Featured Models
Electronic		
Control PCB	28914H02	67057H07
Display PCB	28915H06	-
Power PCB	28916H03	-
D62 PCB	-	81104H04
Voltage Boost PCB	84524H04	84524H04
Voltage Boost Relay	49003H05	49003H05
Voltage Boost Transformer	84151H01	84151H01
Cabinet Temp Sensor, Interior	28957H75	28957H75
Heat Exchange Sensor (Upright / Chest)	28958H75 / 28958H25	28958H75 / 28958H25
Ambient Sensor	39608H01	-
Condenser Sensor	39609H01 / 39610H01	-
Compressor Hi-Temp Limit Sensor (Upright / Chest)	39609H01 / 39610H01	-
Control Relay, 1st or 2nd Stage	302819H01	302819H01
12V Battery, Alarm & Backup System	60678G02	60678G02
120V / 12V Step-Down Transformer	41026H74	41026H74
Recorder PCB	38597H01	38597H01
Recorder Sensor	85089G10	85089G10
Refrigeration / Electrical		
Compressor	303255Gxx	303255Gxx
Start / Run Capacitor	41678Hxx	41678Hxx
Condenser Fan Motor	05433H01	05433H01
Condenser Fan Motor Mounting Bracket	05434H01	05434H01
Condenser Fan Blade	04503Hxx	04503Hxx
Oil Separator (with oil)	33443G05	33443G05
Pressure Relief, 2nd Stage	68762H01	68762H01
Accumulator Assy, 1st Stage	303143G01	303143G01
HPC, 1st Stage, 400#/Manual reset	33547G02	33547G02
HPC, 2nd Stage, adjustable	33547G01	33547G01
Filter-Drier, 1st Stage	302543H01	302543H01
Filter-Drier, 2nd Stage	302543H01	302543H01
Cabinet / Mechanical		
Upright Door Latch	304991G01	304991G01
Chest Lid Lock	61429H01	61429H01
Caster	49060H04	49060H04
Inner Door Assy	302496Gxx	302496Gxx
Shelf Pilaster, Upright	48993H02	48993H02
Condenser Filter	80547HXX	80547HXX
Lid & Door Gasket (Inner / Outer)	63017Hxx / 63018Hxx	63017Hxx / 63018Hxx
Door Assembly	39607x	39607x
Lid Assembly	39117x	39117x
Backup System		
Backup System PCB	67057H07	67057H07
Backup System Sensor	85089G05	85089G05
Backup System LCO2 Rupture Disc	47438H01	47438H01
LCO2 Solenoid	33767H01	33767H01

Note- “x” or “xx”: Part Number is Size / Model Number dependent; call for complete Part Number

Backup System		
Backup System PCB	67057H07	67057H07
Backup System Sensor	85089G05	85089G05
Backup System LCO2 Rupture Disc	47438H01	47438H01
LCO2 Solenoid	33767H01	33767H01

Note- “x” or “xx”: Part Number is Size / Model Number dependent; call for complete Part Number

HEAT EXCHANGE SENSOR JUMPER ON H02 "MICRO" CONTROL BOARD

The following procedure should be used to install the heat exchange sensor jumper for the H02 Microprocessor Control Board.

Ensure that

f. the unit is NOT a two stage system that actually uses a Heat Exchange Sensor for control of the second stage.

g. the unit is NOT a -40C, -50C, -95C, -120C, -140C, or -150C unit (single stage or scroll)

h. the microprocessor control board has been replaced and is the proper replacement.

i. all electrical connections have been made and the unit is ready to operate, with the exception of power connection.

j. the unit has been disconnected from its main power source for maintenance.

Heat Exchange Sensor Jumper Installation for Ultima II (-9) through Elite (-5) Series Units

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

Step 2: Remove the original J4 harness connection.

Step 3. Install the 305369H01 heat exchange sensor jumper on to J4

Step 4. Ensure that the key switch is in Off position.

Step 5. Plug power cord into correct power source.

Step 6. Turn key switch to the On position.

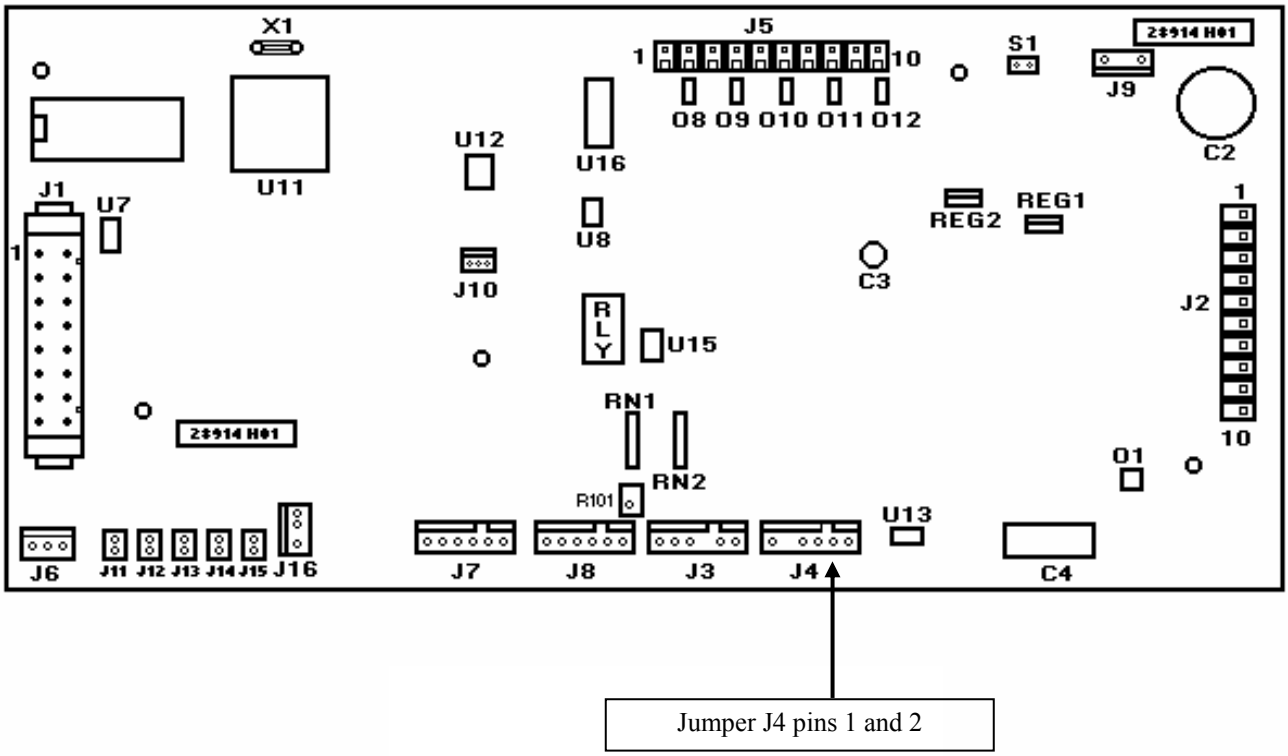
Step 7. Allow the control board to "reset" itself (approximately three seconds). Display will show cabinet temperature.

NOTE Failure to install the jumper will cause the cabinet temperature to read incorrectly.

Step 8: Turn the unit off and disconnect power source.

Step 9. Reinstall microprocessor control board cover.

Heat Exchange Sensor Jumper Location – J4



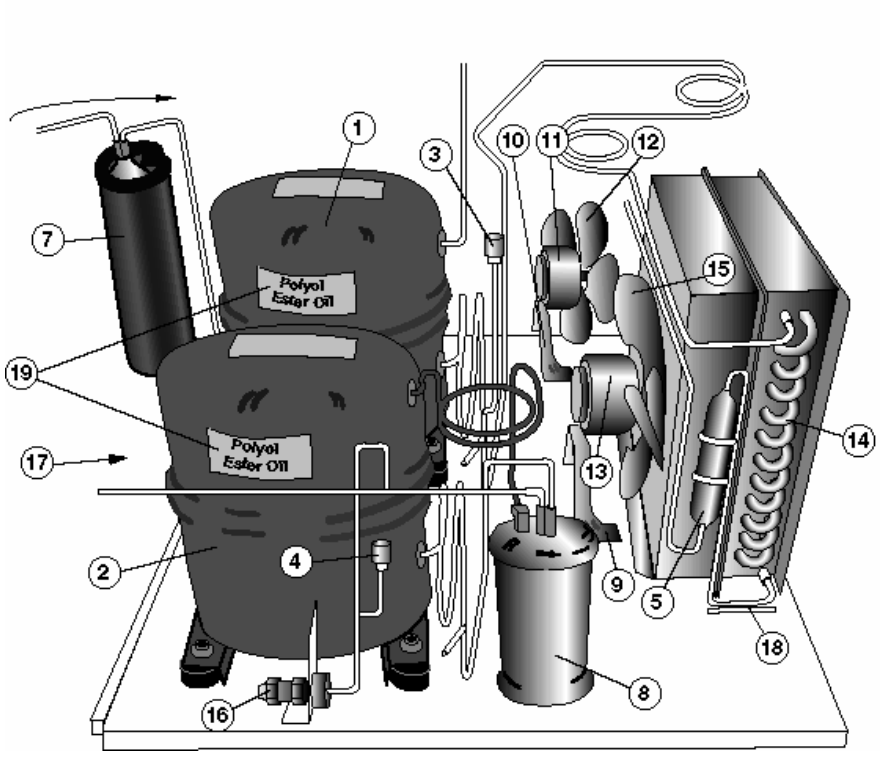


Figure 500-1- Refrigeration Assembly
Upright Freezer

Key

1. Compressor, 1st stage
2. Compressor, 2nd Stage
3. High Pressure Switch, 1st Stage
4. High Pressure Switch, 2nd Stage
5. Filter-Drier, 1st Stage
6. Filter-Drier, 2nd Stage
7. Suction Accumulator, 1st Stage
8. Oil Separator, 2nd Stage
9. Fan Motor Bracket
10. Fan Motor
11. Fan Blade
12. Fan Blade
13. Condenser Fan Motor
14. Condenser
15. Condenser Fan Motor Blade
16. Access Valve
17. Process Tube
18. Condenser Sensor Well
19. POE Oil Label

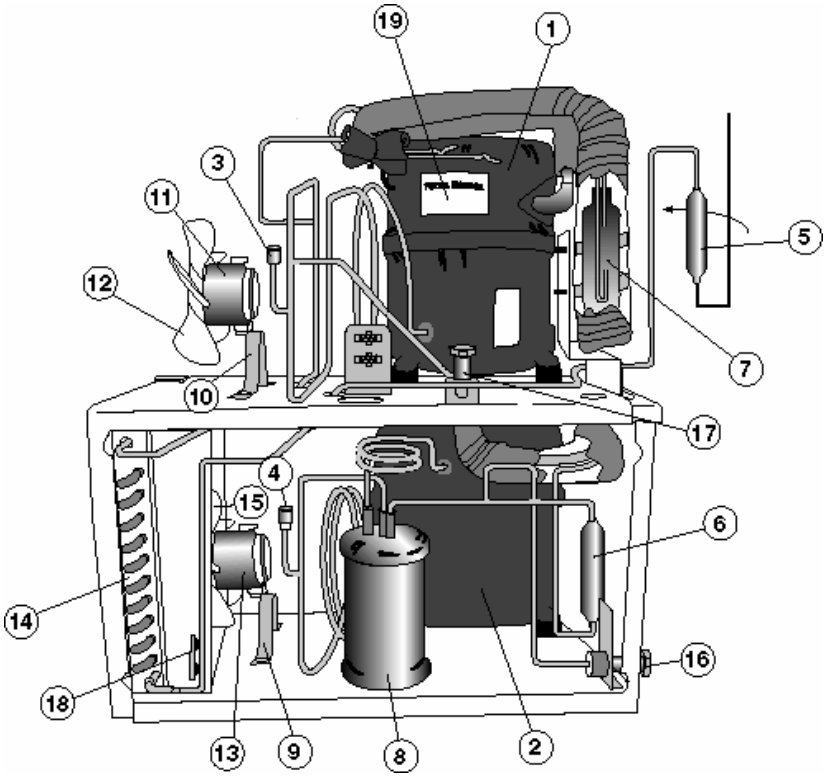


Figure 500-2- Refrigeration Assembly
Chest Freezer

Key

1. Compressor, 1st stage
2. Compressor, 2nd Stage
3. High Pressure Switch, 1st Stage
4. High Pressure Switch, 2nd Stage
5. Filter-Drier, 1st Stage
6. Filter-Drier, 2nd Stage
7. Suction Accumulator, 1st Stage
8. Oil Separator, 2nd Stage
9. Fan Motor Bracket
10. Fan Motor
11. Fan Blade
12. Fan Blade
13. Condenser Fan Motor
14. Condenser
15. Condenser Fan Motor Blade
16. Access Valve
17. Process Tube
18. Condenser Sensor Well
19. POE Oil Label

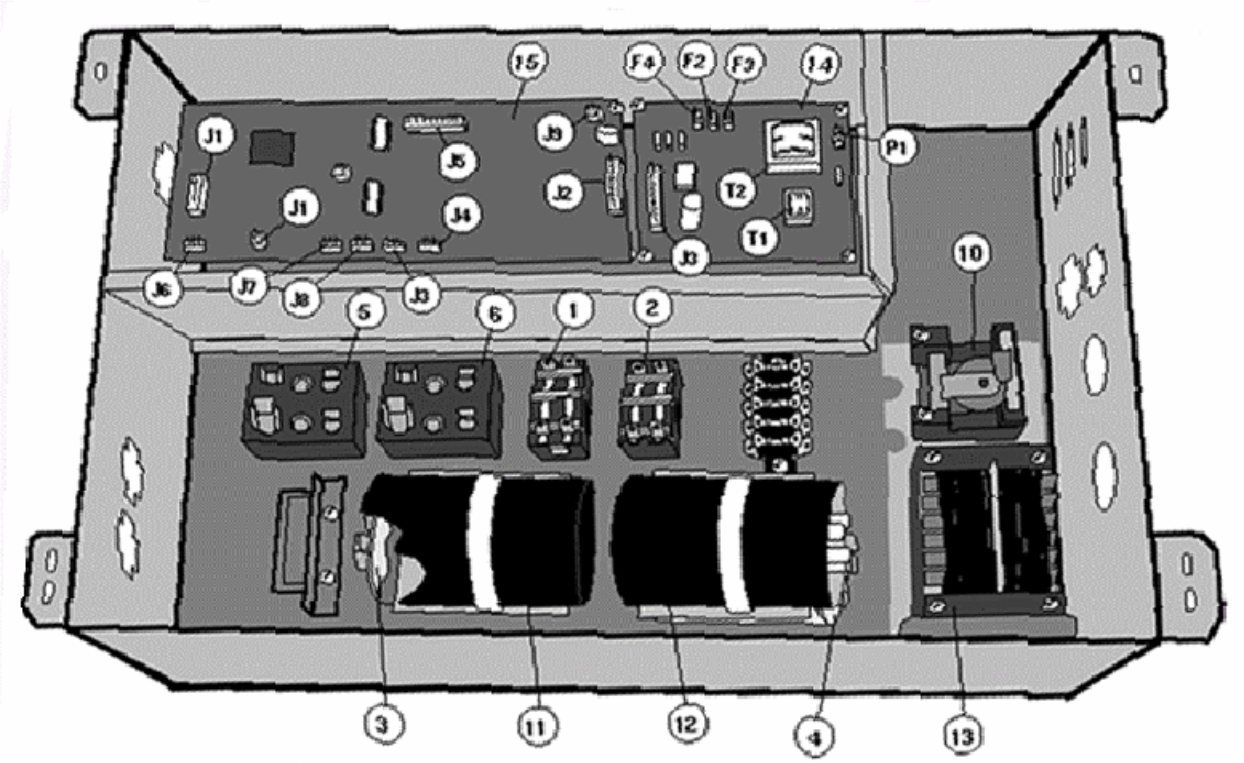


Figure 500-3 Electrical Deck
Upright Full-Featured Freezer

Key

1. Control Relay, 1st Stage
2. Control Relay, 2nd Stage
3. Run Capacitor, 1st Stage
4. Run Capacitor, 2nd Stage
5. Start Relay, 1st Stage
6. Start Relay, 2nd Stage
10. Voltage Boost Relay
11. Start Capacitor, 1st Stage
12. Start Capacitor, 2nd Stage
13. Voltage Boost Transformer
    (Two on 208v - 230v Chest units)
14. Power Supply PCB
15. Microprocessor Control PCB

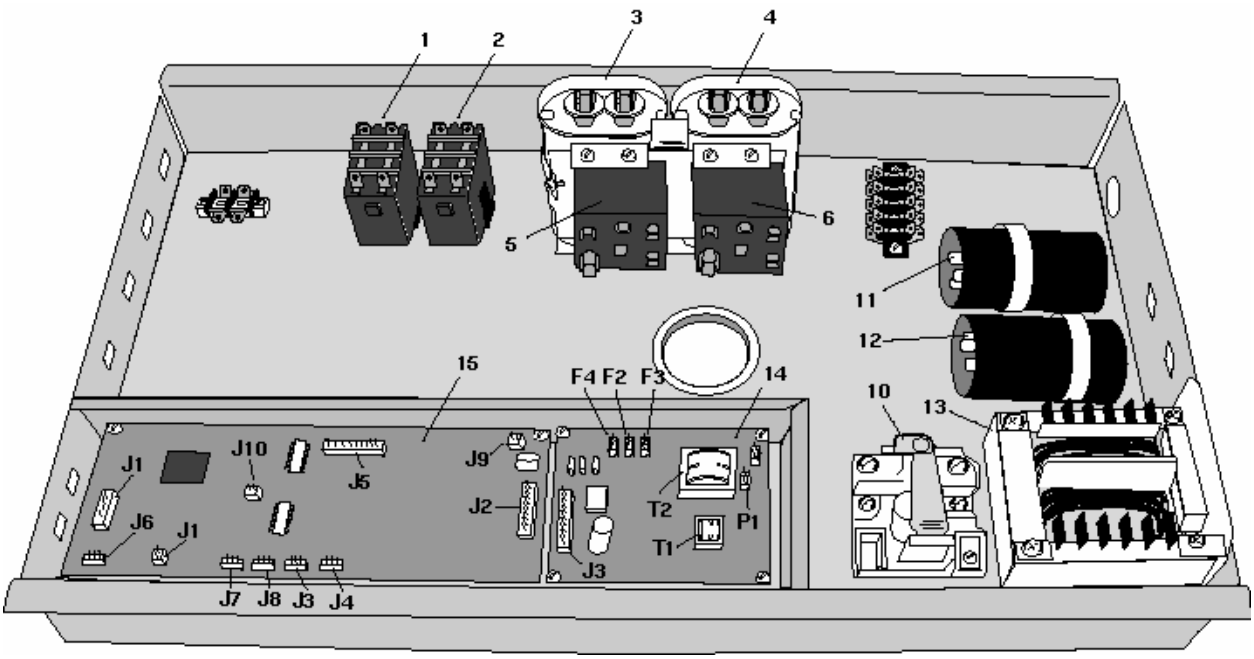


Figure 500-4 Electrical Deck
Chest Full-Featured Freezer

Key

1. Control Relay, 1st Stage
2. Control Relay, 2nd Stage
3. Run Capacitor, 1st Stage
4. Run Capacitor, 2nd Stage
5. Start Relay, 1st Stage
6. Start Relay, 2nd Stage
10. Voltage Boost Relay
11. Start Capacitor, 1st Stage
12. Start Capacitor, 2nd Stage
13. Voltage Boost Transformer
14. Power Supply PCB
15. Microprocessor Control PCB

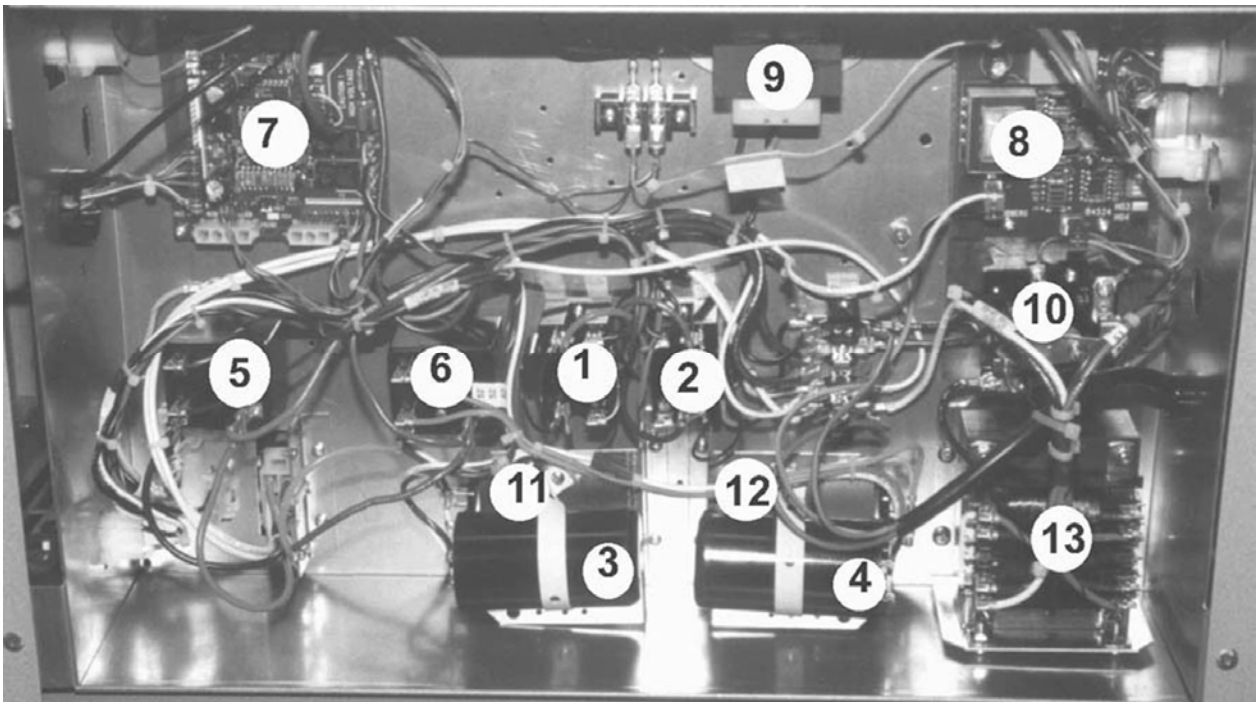


Figure 500-5 Electrical Deck
Upright Value-Featured Freezer

Key

1. Control Relay, 1st Stage
2. Control Relay, 2nd Stage
3. Run Capacitor, 1st Stage
4. Run Capacitor, 2nd Stage
5. Start Relay, 1st Stage
6. Start Relay, 2nd Stage
7. Interconnect (D62) PCB
8. Voltage Boost Control PCB
9. 120V / 12V Transformer
10. Voltage Boost Relay
11. Start Capacitor, 1st Stage
12. Start Capacitor, 2nd Stage
13. Voltage Boost Transformer

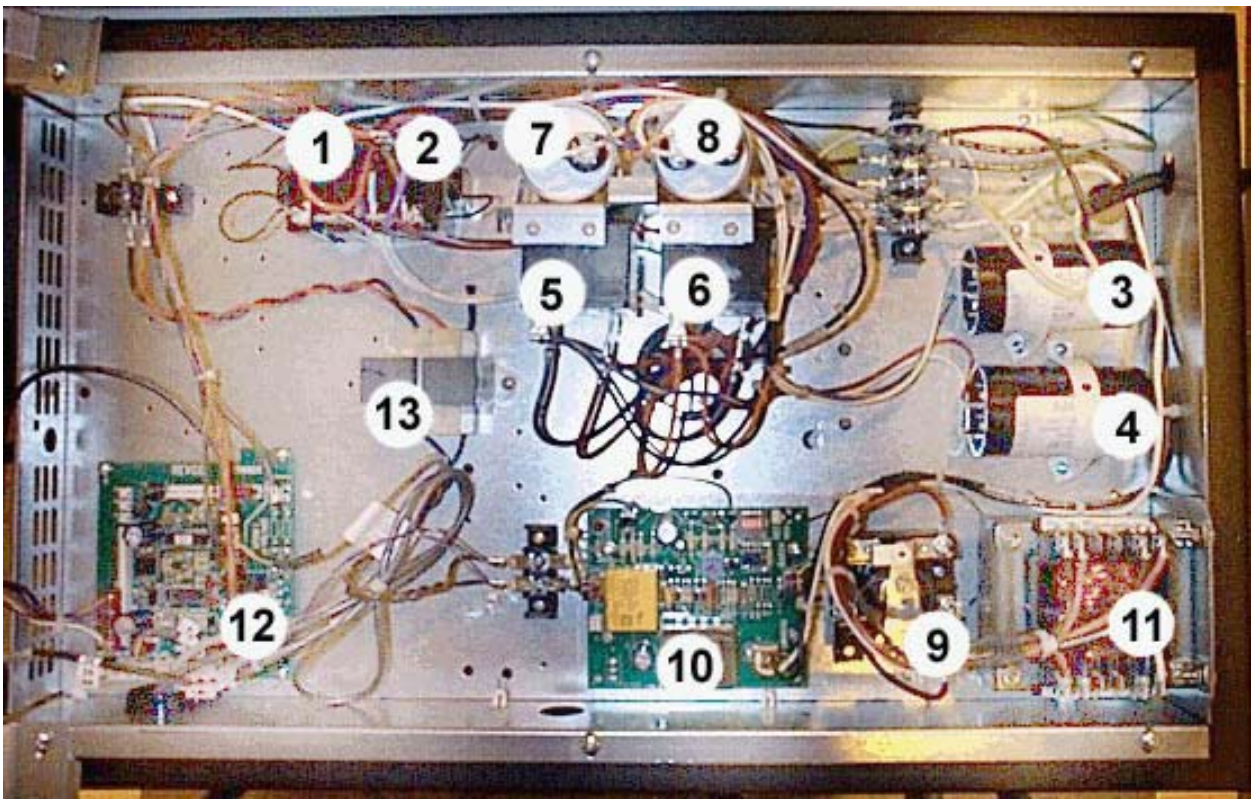


Figure 500-6 Electrical Deck
Chest Value-Featured Freezer

Key

1. Control Relay, 1st Stage
2. Control Relay, 2nd Stage
3. Run Capacitor, 1st Stage
4. Run Capacitor, 2nd Stage
5. Start Relay, 1st Stage
6. Start Relay, 2nd Stage
7. Start Capacitor, 1st Stage
8. Start Capacitor, 2nd Stage
9. Voltage Boost Relay
10. Voltage Boost Control PCB
11. Voltage Boost Transformer
12. Interconnect (D62) PCB
13. 120V / 12V Transformer

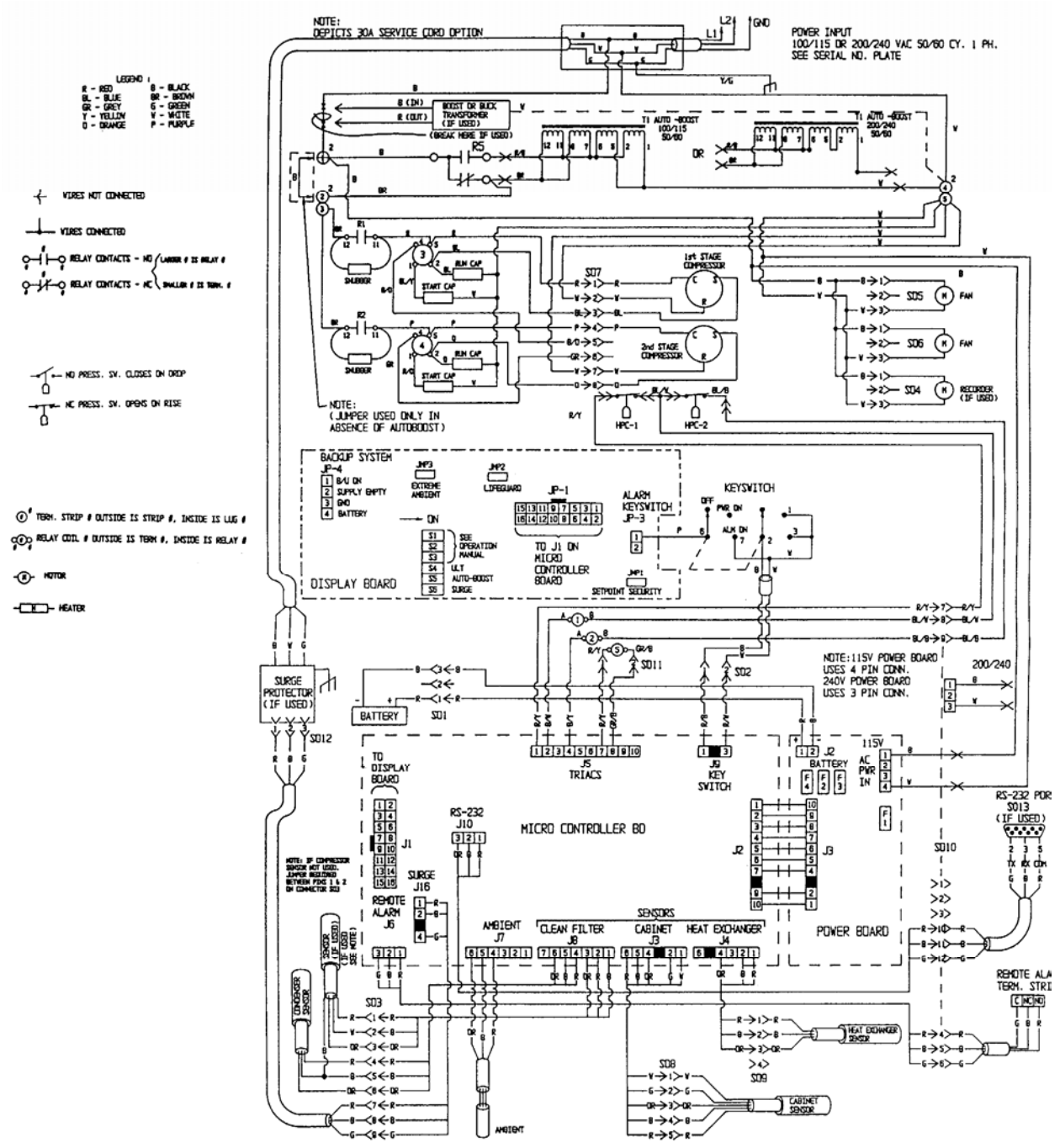


Figure 500-7 Wiring Diagram
Upright & Chest Full-Featured Freeze

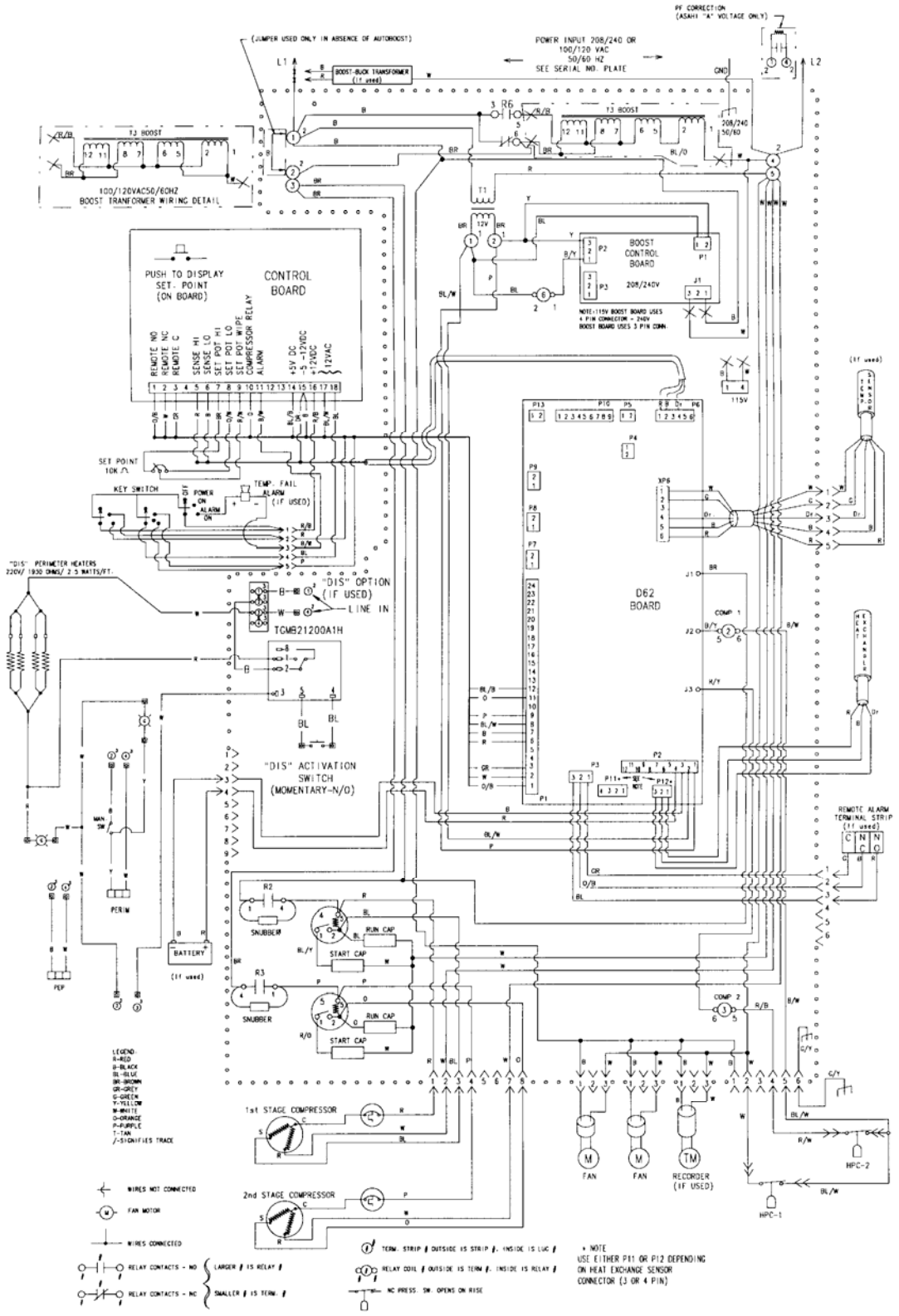


Figure 500-8 Wiring Diagram
Upright & Chest Value-Featured Freeze

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