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Models:

**8516, 8517, 8523, 8525,
8526, and 8560**

8500 Series Non-CFC
Ultra-Low Temperature Upright Freezers

Manual No. 7028516

Rev. 2

Read this Instruction Manual.

Failure to read, understand and follow the instructions in this manual may result in damage to the unit, injury to operating personnel and poor equipment performance.

Caution: All internal adjustments and maintenance must be performed by qualified service personnel.

**Refer to the serial tag on the
rear cover of this manual**



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This product is not intended for any use(s) other than the use(s) in the labeling or this user's manual.

MANUAL NO. 7028516			
REV	ECR/ECN	DATE	DESCRIPTION
--	18249/SI-7545	7/7/99	Added P/N 195517 air filter kit to parts list ccp
--	--	10/30/98	Added battery replacement time to Section 3.3/ Ed Dutton ccp
--	16484	9/1/98	Add caution to section 6.7 re: rechargeable type batteries deg
--	FR-1203	5/26/98	Added metric units to ref. drawing for IEC-1010 deg
--	--	1/20/98	Added "Climatic Class T" to Section 2.2 deg
--	SI-6703	1/5/98	Revised electrical schematics heg
2	see description	11/21/97	Revised per FR-1145, FR-1146, FR-1160 and SI-6706 heg
REV	ECR/ECN	DATE	DESCRIPTION

Do You Need Information or Assistance on Forma Scientific Products?

If you do, please contact us 8:00 a.m. to 7:00 p.m. (Eastern Time) at:

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1-888-213-1790	Toll Free, U.S. and Canada
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Forma's **Sales Support** can provide information on pricing and give you quotations. We can take your order and provide delivery information on major equipment items or make arrangements to have your local sales representative contact you. Our products are listed on the Internet and we can be contacted through our Internet home page.

The Forma **Product Service Support** can supply technical information about proper setup, operation or troubleshooting of your equipment. We can fill your needs for spare or replacement parts or provide you with on-site service. We can also provide you with a quotation on our Extended Warranty for your Forma products.

Whatever Forma products you need or use, we will be happy to discuss your applications. If you are experiencing technical problems, working together, we will help you locate the problem and, chances are, correct it yourself...over the telephone without a service call.



When more extensive service is necessary, we will assist you with direct factory trained technicians or a qualified service organization for on-the-spot repair. If your service need is covered by the Forma warranty, we will arrange for the unit to be repaired at our expense and to your satisfaction.


Regardless of your needs, Forma's professional telephone technicians are available to assist you Monday through Friday from 8:00 a.m. to 7:00 p.m. Eastern Time. Please contact us by telephone or fax. If you wish to write, our mailing address is:


Forma Scientific, Inc.
PO Box 649
Marietta, OH 45750

International customers please contact your local Forma Scientific distributor.

General Safety Notes used in this Manual

	<p>Important operating and/or maintenance instructions. Read the accompanying text carefully.</p> <p>Ce symbole attire l'attention de l'utilisateur sur des instructions importantes de fonctionnement et/ou d'entretien. Il peut être utilisé seul ou avec d'autres symboles de sécurité. Lire attentivement le texte d'accompagnement.</p> <p>Wichtige Betriebs- und/oder Wartungshinweise. Lesen Sie den nachfolgenden Text sorgfältig.</p> <p>Importante instrucciones de operacion y/o mantenimiento. Lea el texto acompanante cuidadosamente.</p>
	<p>Potential electrical hazards. Only qualified persons should perform procedures associated with this symbol.</p> <p>Ce symbole attire l'attention de l'utilisateur sur des risques électriques potentiels. Seules des personnes qualifiées doivent appliquer les instructions et les procédures associées à ce symbole.</p> <p>Gefahr von Stromschlägen. Nur qualifizierte Personen sollten die Tätigkeiten ausführen, die mit diesem Symbol bezeichnet sind.</p> <p>Potencial de riesgos electricos. Solo personas das capacitadas deben ejecutar los procedimientos asociadas con este simbolo.</p>

	<p>Equipment being maintained or serviced must be turned off and locked off to prevent possible injury.</p> <p>Risques potentiels liés à l'énergie. L'équipement en entretien ou en maintenance doit être éteint et mis sous clé pour éviter des blessures possibles.</p> <p>Geräte, an denen Wartungs- oder Servicearbeiten durchgeführt werden, müssen abgeschaltet und abgeschlossen werden, um Verletzungen zu vermeiden.</p> <p>El equipo recibiendo servicio o mantenimiento debe ser apagado y asegurado para prevenir danos.</p>
---	--

	<p>Hot surface(s) present which may cause burns to unprotected skin or to materials which may be damaged by elevated temperatures</p> <p>Présence de surface(s) chaude(s) pouvant causer des brûlures sur la peau non protégée, ou sur des matières pouvant être endommagées par des températures élevées.</p> <p>Heiße Oberfläche(n) können ungeschützter Haut Verbrennungen zufügen oder Schäden an Materialien verursachen, die nicht hitzebeständig sind.</p> <p>Superficias calientes que pueden causar quemaduras a piel sin protección o a materiales que pueden estar danados por elevadas temperaturas.</p>
--	--

- √ Always use the proper protective equipment (clothing, gloves, goggles etc.).
- √ Always dissipate extreme cold or heat and wear protective clothing.
- √ Always follow good hygiene practices.
- √ Each individual is responsible for his or her own safety.

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Section 1 - Receiving

1.1 Preliminary Inspection

This item was thoroughly inspected and carefully packed prior to shipment and all necessary precautions were taken to ensure safe arrival of the merchandise at its destination. Immediately upon receipt, before the unit is moved from the receiving area, carefully examine the shipment for loss or damage. Unpack the shipment and inspect both interior and exterior for any in-transit damage.

1.2 Visible Loss or Damage

If any loss or damage is discovered, note any discrepancies on the delivery receipt. Failure to adequately describe such evidence of loss or damage may result in the carrier refusing to honor a damage claim. Immediately call the delivering carrier and request that their representative perform an inspection. Do not discard any of the packing material and under no circumstances move the shipment from the receiving area.

1.3 Responsibility for Shipping Damage

For products shipped F.O.B. Marietta, Ohio, the responsibility of Forma Scientific, Inc. ends when the merchandise is loaded onto the carrier's vehicle.

On F.O.B. Destination shipments, Forma Scientific's and the carrier's responsibility ends when your Receiving Department personnel sign a free and clear delivery receipt.

Whenever possible, Forma Scientific, Inc. will assist in settling claims for loss or in-transit damage.

Section 2 - Installation

2.1 Introduction

The 8500 Series Forma Scientific non-CFC, Ultra-Low Temperature Freezers feature front-to-back air circulation for cooler compressor temperatures, increased performance and reliability and longer compressor life. In this unique system, ambient air enters the front grill of the freezer and passes through the filter, condenser and compressor housing, exiting out of the rear of the unit.

An enlarged condenser and two cooling fans also contribute to better efficiency and help extend compressor life. Cleaning the air filter and condenser fins is done from the front of the unit.

Other important features of the Forma Scientific 8500 Series Freezers are:

a. Enviro-Scan Microprocessor Monitoring System

Enviro-Scan uses a digital display, audible and visual indicators and a touch sensitive key pad to provide total control of all freezer functions. The module digitally displays chamber temperature and control setpoint, to the nearest degree C. High and low alarm set points are easily programmed. A back-up battery system supplies power to the monitoring system during electrical outages.

An RS-232 port provides a computer interface and monitoring of temperatures and alarms. A remote alarm connector is also a standard feature.

b. Non-CFC, non-HCFC and non-flammable refrigerants

Committed to a safer, healthier environment, Forma Scientific has phased out the use of ozone depleting CFC (chlorofluorocarbons) in all of the company's refrigerated products. Forma also uses non-CFC foamed-in-place urethane insulation and all packaging materials used in shipping are non-CFC.

c. Peak Control System

Due to the increased demands on today's refrigeration systems, Forma Scientific has engineered a compressor protection system called PEAK Control. In this system, a pressure switch senses excessive compressor discharge pressure. When the discharge pressure exceeds the design limit, a solenoid valve opens allowing refrigerant to enter an expansion tank. The refrigerant returns to the system through a capillary tube. The PEAK Control System continues to monitor system pressures, insuring they stay within design limits to help extend compressor life.

d. "Smart" Condenser Fans

For maximum compressor protection, all Forma ULT freezers include two tube axial fans in the compressor housing. When both compressors are running, both fans operate to pull ambient air through the condenser and over the compressors. When both compressors are off, one fan remains ready to cycle on when the thermostat senses a temperature rise above 32°C.

e. Built-In Automatic Voltage Compensation

A built-in, automatic voltage compensator is built into every Forma 8500 Series non-CFC, Ultra-Low Temperature Freezer to detect and respond to high or low voltage situations. Voltage from the incoming power supply is monitored and adjusted by the automatic voltage compensator, ensuring compressor operation within design parameters. A light on the front of the control panel indicates when incoming voltage is being corrected.

An enlarged condenser and two temperature controlled cooling fans also contribute to better efficiency, even in high ambient conditions.

2.2 Environmental Conditions

The Forma 8500 Series ULT Freezers are designed to operate in the following environmental conditions:

- Indoors
- Altitudes up to 2,000 meters
- Temperature Range of +5°C to +40°C.
- Maximum relative humidity of 80% for temperatures up to 31°C, decreasing linearly to 50% at 40°C.
- Mains supply voltage fluctuation of $\pm 10\%$ of nominal.
- Installation Category (Overvoltage Category) II, Pollution Degree 2.
- Climatic Class T (Tropical)³

¹ Installation category (overvoltage category) defines the level of transient overvoltage which the instrument is designed to withstand safely. It depends on the nature of the electricity supply and its overvoltage protection means. For example, in CAT II which is the category used for instruments in installations supplied from a supply comparable to public mains such as hospital and research laboratories and most industrial laboratories, the expected transient overvoltage is 2500 V for a 230 V supply and 1500 V for a 120 V supply.

² Pollution degree describes the amount of conductive pollution present in the operating environment. Pollution degree 2 assumes that normally only non-conductive pollution such as dust occurs with the exception of occasional conductivity caused by condensation.

³ Class T (Tropical) means that the freezers are electrically safe in a 43°C ambient.

2.3 Installing the Wall Bumpers

The parts bag contains two (2) 1/4-20 x 5-1/2" bumper bolts and two (2) neoprene caps. Install the bolts (the holes are pre-tapped) on the back side of the compressor section. Install a neoprene cap on each bolt.

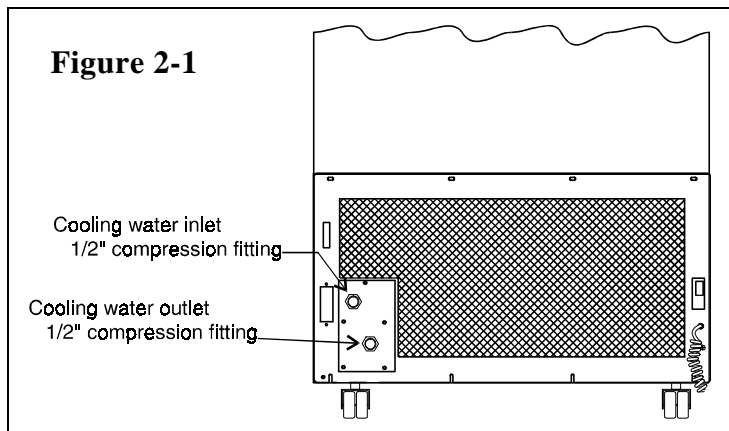


For proper ventilation and air flow, a minimum of 5" of clear space is required behind the freezer. An additional 5" (minimum) of clear space is also required on both sides of the freezer. When locating the back of the freezer toward a wall or obstacle(s), make sure that the wall bumpers are installed.

2.4 Location

Locate the freezer on a firm, level surface in an area of minimum ambient temperature fluctuation.

2.5 Connecting the Water Supply to the (optional) Water Cooled Condenser

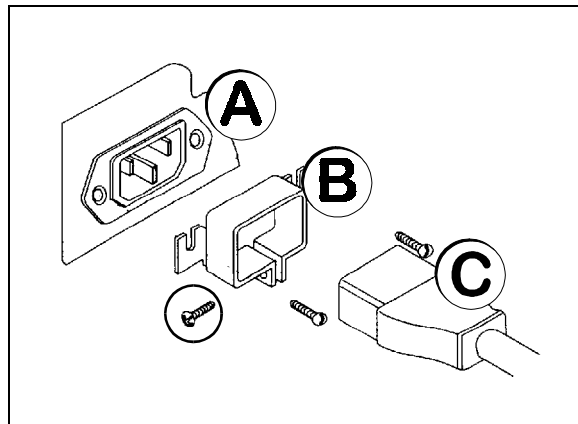


1. Insert a 1/2" OD copper water line into the cold water inlet (top) and tighten the compression fitting.
2. Insert a 1/2"OD drain line into the water outlet (bottom) and tighten the compression fitting. Direct the drain line to a suitable drain.

Note: The condensing units must be provided with enough water for adequate cooling. The units require approximately 1 GPM of 65°F (18.3°C) of tap water per horsepower, or 3 GPM of 85°F (29.4°C) water per horsepower.

2.6 Attaching the Power Cord

Plug the cord set (item C in the illustration at the right) into the back of the unit below the power switch. Secure it with the screw provided and identified by the circle. The line cord retainer (B) is secured to receptacle (A) by the factory with the two screws shown.



2.7 Connecting Power to the Freezer



Forma Scientific, Inc. recommends that the freezer be operated on a dedicated electrical circuit to avoid circuit overload.

Before connecting the freezer to an adequate power source, refer to the electrical data plate mounted on the back of the unit, the schematics located in Section 11, or to the electrical specifications listed in Section 8.

2.8 Deactivating the Enviro-Scan Monitor for Storage

The Enviro-Scan Monitor has been deactivated (placed in a sleep mode) prior to shipment. The monitor re-activates when power is applied to the freezer. If electrical power is lost or the freezer is disconnected, the monitor will be sustained by the battery back-up.

Whenever the freezer is unplugged for storage, the "Enviro-Scan" must be de-activated to preserve the life of the battery and preserve the warranty.

- Turn off or unplug the freezer.
- Obtain the access code prompt by pressing the UP ARROW key and the BATTERY % CHARGE key simultaneously. A "1" must appear in the display window. If a "1" does not appear in the window, repeat step 2.
- Enter the four digit access code. The Access Code set at the factory = 1,2,3,4. For Access Code information, refer to Section 3.2 and Section 4.1. To change the Access Code refer to Section 5.3.

- After entering the four digit Access Code, press the ENTER key and "CAL" will appear in the window.
- Press the DOWN ARROW key.

The Enviro-Scan monitor is now deactivated (placed in a sleep mode) until electrical power is restored.

2.9 RS-232 Output Interface

The 8500 series freezers are equipped with an RS-232 Serial Communication Interface for the remote transmission of sensor data. A standard DB-25S connector is located on the rear of the compressor housing. The data is "dumb printer" formatted, which permits interfacing with either a computer or a serial printer.

Three wires are used for the RS-232 interface:

- 1) TX Data = Pin 2
- 2) RX Data = Pin 3
- 3) Signal Ground = Pin 7

The data format is seven-bit ASCII with a leading zero (8th bit). Each character is transmitted with one start-bit, eight data-bits, and two stop-bits, totaling eleven bits. NO parity-bit is included. Baud rate is 1200.

A data transfer sequence is transmitted according to the following format. X refers to the variable numerical temperature data.

(NUL) (-) XXX (SP) C (SP) (OVERTEMP) (SP) (LF) (CR) (EOT) (SP) (UNDER TEMP)

The words "OVERTEMP" or "UNDER TEMP" are transmitted with the temperature if one of those conditions exists at the time the data is transmitted. When there is no alarm condition, spaces will be sent instead so that there is always a total of 20 characters sent.

- SP** - space
- LF** - line feed
- CR** - carriage return
- EOT** - end of text
- NUL** - null character (00)

The Enviro-Scan Monitor transmits temperature and alarm condition data when power is first applied to the Monitor and then once every hour.

The Enviro-Scan Monitor responds to two ASCII commands from the remote:

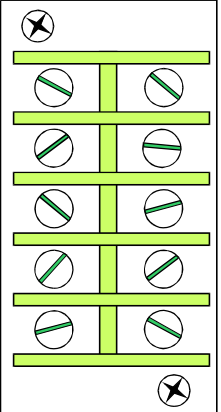
Key	Pin #	Description
	1	Over temperature Common
	2	Over temperature N.C.
	3	Over temperature N.O.
	4	Millivolt Out (Positive +)
	5	Under temperature N.C.
	6	Millivolt Out (Negative -)
	7	Under temperature Common
	8	Under temperature N.O.
	9	(Not Used)
	10	(Not Used)

Figure 2-3

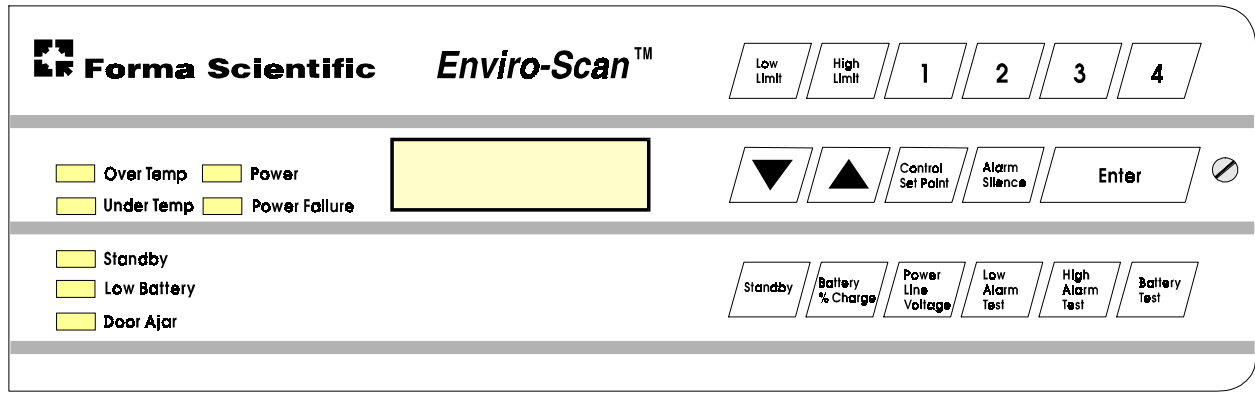


IMPORTANT USER INFORMATION

Caution! Stored product should be protected by an activated alarm system capable of initiating a timely response 24 hours/day. Forma Alarms provide interconnect for centralized monitoring.

Section 3 - Enviro-Scan Monitor

3.1 The Enviro-Scan Monitor



**Figure 3-1
Enviro-Scan Monitor**

The Enviro-Scan Monitor provides constant monitoring of the freezer's operation. The numerical LCD display provides a readout of the freezer chamber temperature in increments of one degree Celsius.

Some functions of the Enviro-Scan Monitor require the entry of a four digit security code to access, display or change them. Access code 1,2,3,4 is programmed into each unit at the factory. This code may be changed to any four digit combination of the numbers 1,2,3, and 4. (Section 5.3 describes the procedures to change the Access Code.)

Functions requiring no access code are:

- | | |
|----------------|--------------------|
| Alarm Silence | Power Line Voltage |
| Enter | Low Alarm Test |
| Standby | High Alarm Test |
| Battery Charge | Battery Test |

Other features include:

- | | |
|---------------------|------------------------------|
| Over Temp light | Under Temp light |
| Standby light | Low Battery light |
| Door Ajar light | Power light |
| Power Failure light | Condenser Hot light (hidden) |

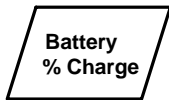
3.2 Main Power Switch (mains disconnect)

The main power switch is located on the back of the refrigeration unit, directly above the line cord.

Off = (o)

On = (I)

3.3 Key Functions Requiring No Access Code (Refer to Figure 3-1)



Displays the Enviro-Scan Monitor backup battery's percent of charge. The reading gives some indication of how long the monitor will operate on battery backup. The Backup system is designed to maintain monitor operation for at least 72 hours. A reading of 50%, when on battery power, indicates that the monitor will run for approximately 36 hours.

The Battery % Charge display may not indicate the full number of hours of monitor backup power. The % of charge can vary depending on the age, usage and condition of the battery. For a consistent and dependable charge, replace the battery every 2-3 years.

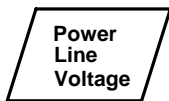


Silences all alarms for approximately 30 minutes and changes the display to cabinet temperature.



Displays cabinet temperature.

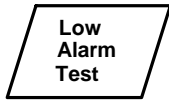
This key is also used for functions requiring the access code.



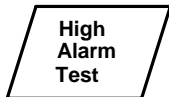
Displays the operating voltage of the freezer when both compressors are running. A zero will be displayed on the LCD when the line voltage reading drops below 100 volts on a 208/220 volt circuit (50 volts on a 115 volt circuit).



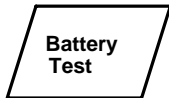
The standby key silences the audible alarm after an alarm condition or a power failure. *The standby key will silence the audible alarm only.* The alarm light will stay on until the alarm condition has been corrected. A built-in ring-back feature audibly signals that the unit has returned to normal setpoint limits. Press the STANDBY key to remove the audible tone.



The alarm limit must be set to within 45°C of actual cabinet temperature to perform this test. If the alarm limit is not set within this limit, a long tone will sound and no test will occur. If within limits, the alarm will be activated when the probe temperature drops below the low alarm limit. The test may be aborted at any time by pressing ENTER. All other key functions are "locked-out" during this test.



The alarm limit must be set to within 45°C of actual cabinet temperature to perform this test. If the alarm limit is not set within this limit, a long tone will sound and no test will occur. If within limits, the probe will be heated until it reaches the alarm limit and the alarm will be activated. The probe will then gradually cool back to the actual cabinet temperature. The test may be aborted at any time by pressing ENTER. All other key functions are "locked-out" during this test.

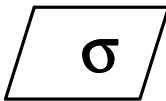


Disconnects the main power from the monitor, making it switch and operate on battery power.

a. Access Keys:

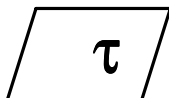
Keys 1,2,3 and 4 are used for the entry of the four digit Access Code.

3.4 Key Functions Requiring the Access Code (refer to Figure 3-1)

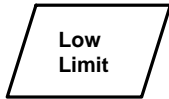


Pressing the up arrow key will increase the display by increments of one division. If this key is held down for more than two seconds the display will increment automatically.

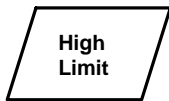
Note: The up and down arrow keys are used for setting the high and low limits and all calibration functions.



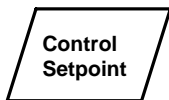
Pressing the down arrow key will decrease the display by increments of one division. If this key is held down for more than two seconds the display will increment automatically.



The low limit key is used to establish a Low Limit set point. When the chamber temperature reaches (or exceeds) the Low Limit set point, the audible alarm will sound and the UNDER TEMP indicating light will come on. The remote alarm contacts, located on the back of freezer, will also be activated. Refer to Section 4.2 for Low Limit setting instructions.



The high limit key is used to establish a High Limit set point. When the chamber temperature reaches, or exceeds, the High Limit set point, the audible alarm will sound and the OVER TEMP indicating light will come on. The remote alarm contacts, located on the back of the freezer, will also be activated. Refer to Section 4.2 for High Limit setting instructions.



After depressing this key and entering the access code, the setting for the temperature control will appear in the display. The control setting is adjusted by turning the Set Point Adjusting Screw located on the far right of the monitor panel.

Note: When in a battery backup condition (AC power off), the control set point value is replaced with "--" to prevent false data from being displayed. Press ENTER to return to the temperature display.



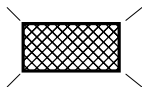
- a. **Set Point Adjustment Screw** located to the right of the ENTER key is used to set the operating temperature of the freezer. An adjustment screwdriver is located on the back panel of the compressor section. (See Figure 3-2 and Figure 2-1).

3.5 Audible Alarm and Control Panel Indicators

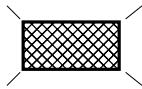
Audible Alarm:

Provides a pulsing audible tone whenever an alarm condition is present. The DOOR AJAR audible alarm has a 30 second delay to prevent nuisance alarms when the door is opened. Pressing the ALARM SILENCE key will silence all alarms for 30 minutes.

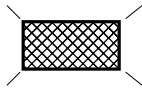
Note: When in STANDBY mode, the audible alarm is silent until all alarm conditions are cleared. Audible alarm conditions include OVER TEMP, UNDER TEMP, DOOR AJAR and AC power failure.



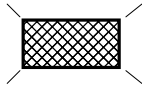
Over Temp (LED): Flashes when an over temperature condition exists.



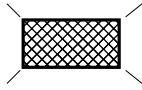
Under Temp (LED): Flashes when an under temperature condition exists.



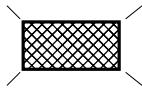
Standby (LED): Lights when in standby mode.



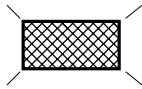
Low Battery (LED): On when battery state of charge is below 50% and AC power is on. When AC power is off the LOW BATTERY LED comes on when the battery state of charge is below 15%.



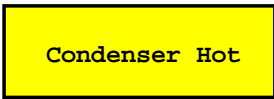
Door Ajar (LED): Flashes when the freezer lid is open.



Power (LED): Lights when the AC power is on. Off when the AC power is off.



Power Failure (LED): Lights when power is removed from the unit. Press Silence or Standby to silence the audible alarm. Deactivate the Enviro-Scan Monitor if unit is to be turned off for more than five hours. (Refer to Section 2.6)



The words Condenser Hot will appear in the alpha-numeric display and a audible alarm will sound for 12 seconds every 15 minutes when the thermostat on the condenser reaches 40° C. This condition typically indicates a clogged condenser, fan failure, dirty filter or high ambient temperature conditions. The audible alarm is silenced only by correcting the problem causing the alarm.



The user should immediately check the air filter (Figure 3-2) and the condenser for cleanliness and the fan for proper operation. Failure to do so may cause compressor damage and result in loss of the freezer contents. Refer to Section 6.1, "Cleaning the Condenser" and Section 6.2, "Cleaning the Air Filter".

3.6 Double Door Freezer (Factory-Built Option)

Double door models of the Forma ULT freezers are available as a factory-built option. These freezers reduce the amount of temperature loss by allowing longer term material to be stored in the bottom portion of the freezer, and more frequently accessed, short term material to be stored on the upper shelves. Operation of the double door freezers is the same as single door models.

Stock # 189757 - 13 cu. ft. Models, 120 VAC

Stock # 189759 - 13 cu. ft. Models, 220 VAC

Inventory rack ordering information for 13 cu. ft. (368 Liters) Models is listed below.

Order No.	Description	Max Qty per Chamber
189771	Rack includes (9) 3" boxes for top chamber	8
189795	Rack includes (12) 2" boxes for top chamber Dimensions: 5.5" W x 9.7" H x 16.1" F-B (14.0cm x 24.6cm x 40.9cm)	8
820009	Rack includes (9) 3" boxes for bottom chamber	8
820015	Rack includes (15) 2" boxes for bottom chamber Dimensions: 5.5" W x 10.9" H x 16.5" F-B (14.0cm x 27.4cm x 41.9cm)	8

3.7 Set Point Adjustment Screwdriver

A small screwdriver, located on the lower left side of the freezer frame, is used to set the temperature Set Point. To remove the screwdriver from its holder, pull downward on the black knob located directly below the temperature recorder compartment. The knob is the handle of the screwdriver. Refer to Figure 3-2.

3.8 Automatic Voltage Compensation System

The Forma Ultra-Low Temperature Freezer is equipped with an automatic line voltage compensation system which monitors in-coming electrical power and automatically adjusts the voltage directed to the freezer power supply. This compensation system ensures that the compressor operates within specification and provides an additional margin of product protection.

A green LED indicating light, labeled "Voltage Compensation", indicates when the system is in operation. The light is located on the front of the compressor section. (See Figure 3-2)

3.9 CoBex Temperature Recorder (optional)

Operation of the recorder chart drive is automatic when power is applied to the freezer. In the event of a power failure, the 9 Volt back-up battery will allow the recorder to sense and record temperature for about 24 hours. Refer to Section 4.4 and the CoBex booklet included with this manual.

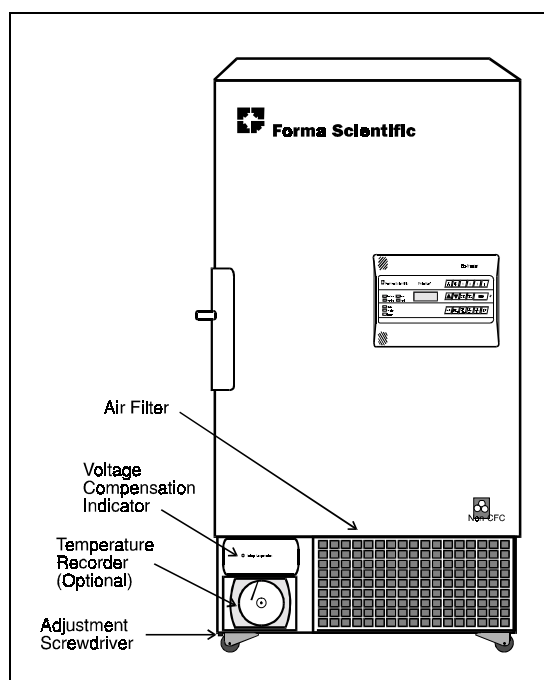


Figure 3-2

Section 4 - Start Up

4.1 Setting the Operating Temperature

- Turn the freezer on. The cabinet temperature will be displayed in the LCD window.
- Press the CONTROL SET POINT key and a "1" will appear in the LCD window.
- Enter access code (1,2,3,4). The "1" will remain in the LCD window.
- Press the ENTER key and the word "SET", along with the control set point temperature will be displayed in the LCD window.
- If an operating temperature other than that displayed in the window is desired, turn the temperature set point screw using the adjustment screwdriver. The set point screw is located to the right of the ENTER key on the Enviro-Scan Monitor control panel. (The adjustment screwdriver is located on the bottom of the freezer frame. Refer to Figure 3-2.)

Note: Forma Scientific recommends setting the cabinet temperature no colder than necessary for product storage.

- Press the ENTER key and the LCD display will return to the cabinet temperature.

4.2 Setting the Low and High Limit Set Points

The High Limit set point is factory-set at -65°C . The Low Limit set point is set at three degrees below the operating temperature. If another temperature limit set point is desired, it is set as follows:

a. To display or change the Low Limit Set Point:

- Press the LOW LIMIT key and a "1" will appear in the LCD window.
- Enter the access code (1,2,3,4).

The "1" will remain in the LCD window.

- Press the ENTER key and the Low Limit temperature along with the word "SET LOW LIMIT" will be displayed in the LCD window.
- Change the existing Low Limit temperature by pressing the UP or DOWN arrow keys.
- Press the ENTER key and the LCD display will return to cabinet temperature.

b. To display or change the High Limit Set Point:

- Press the HIGH LIMIT key and a "1" will appear in the LCD window.
- Enter access code (1,2,3,4).

A "1" will remain in the LCD window.

- Press the ENTER key and the existing High Limit along with the word "SET HIGH LIMIT" will be displayed in the LCD window.
- Change the existing HIGH LIMIT by depressing either the UP or DOWN arrow keys.
- Press the ENTER key and the LCD display will return to cabinet temperature.

4.3 General Recommendations

Avoid opening the door for extended time periods. Room air, which is higher in humidity, will replace chamber air and cause frost to develop. Allowing the door to remain open for extended time periods will cause the chamber to "warm-up", putting undue stress on the compressors.



This unit is not a "quick-freeze" device. Freezing large quantities of liquid, or high-water content items, will temporarily increase the temperature and will cause the compressors to operate for a prolonged time period. Damage to the compressors may result and product safety may be jeopardized.

4.4 Preparing the (optional) CoBex Temperature Recorder

a. Installing the chart recorder battery

The seven-day circular chart recorder is located on the bottom front of the freezer cabinet and is protected by a glass door.

To prepare the recorder for operation, open the glass door and snap the connector onto the 9-volt battery as shown in Figure 4-1. If the freezer is operating, the green LED will show a steady light. If the freezer is not turned on, the LED will flash.

If the battery is weak or not connected, the green LED will flash. If power is lost to the cabinet, the LED will also flash as the Alarm/Monitor goes into the alarm state. When replacing the 9-volt battery, replace with the same style battery.

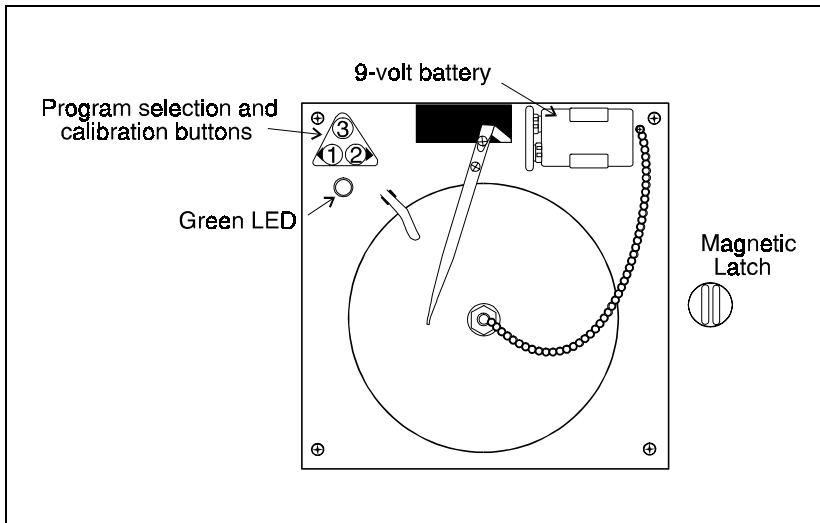


Figure 4-1

b. Installing the chart paper

(Refer to Figure 4-2) Press and hold button #3 for about one second until the pen begins to move to the left. Unscrew the knob at the center of the chart and install the paper, positioning the chart so the correct time line coincides with the time line groove on the chart plate. Replace the knob and press the #3 button until the pen begins to move to the right.

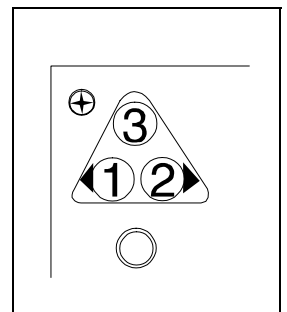


Figure 4-2

c. Changing the recorder range

The chart recorder contains eight temperature ranges and is factory-programmed for the freezer.

1. Press and hold button #3 for one second, then let the pen move off of the chart paper.

2. Press and hold for five seconds either button #1 or button #2.
3. Release the button and the green LED will begin to flash. Count the number of flashes to determine the present program setting.
4. To change the program setting, press the left or right arrows to increase or decrease the count.
5. When the desired program number is flashing, press the change chart button to bring the pen arm back onto the chart. Recording will begin in the new program.

Note: Changing ranges may require an offset calibration as outlined in the following procedure. See the *CoBex Installation, Operation and Service Instructions* manual.

Program No.	Range		
Program 1	-40°C	to	30°C
Program 2	0°C	to	60°C
Program 3	-100°C	to	38°C
Program 4	-5°C	to	50°C
Program 5	0°C	to	100°C
Program 6	-100°C	to	-200°C
Program 7	-115°C	to	50°C
Program 8	-10°C	to	70°C

d. Calibrating the chart recorder

The recorder must be in service for 24 hours before performing the following calibration procedure.

1. Place an accurate thermometer in the chamber next to the recorder’s probe.
2. After about three minutes, compare the thermometer with the chart recorder.

3. If an adjustment is necessary, press the #1 button to move the pen to the left or the #2 to move the pen to the right. The button must be held about five seconds before the pen begins to move. Release the button when the pen matches the thermometer.

Temperature probes for the CoBex Recorder and for the Enviro-Scan monitor are located in the left front corner of the freezer chamber. (Figure 4-3) Figures 4-4 and 4-5 illustrate the temperature probes and the probe cover.

Note: The felt-tip pen on the CoBex recorder requires periodic replacement. Usually the ink will appear to fade before replacement becomes necessary. Additional pen tips may be purchased from Forma Scientific, Inc.

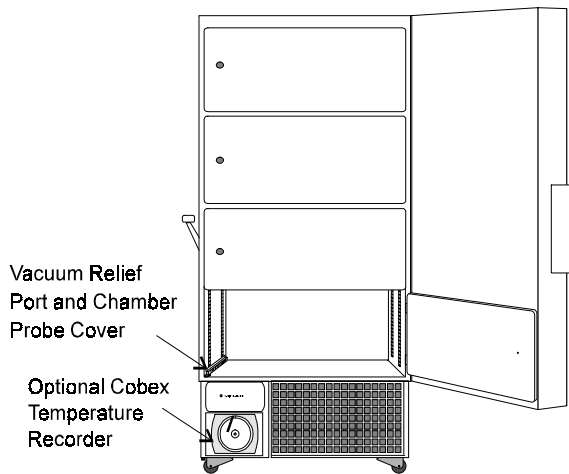
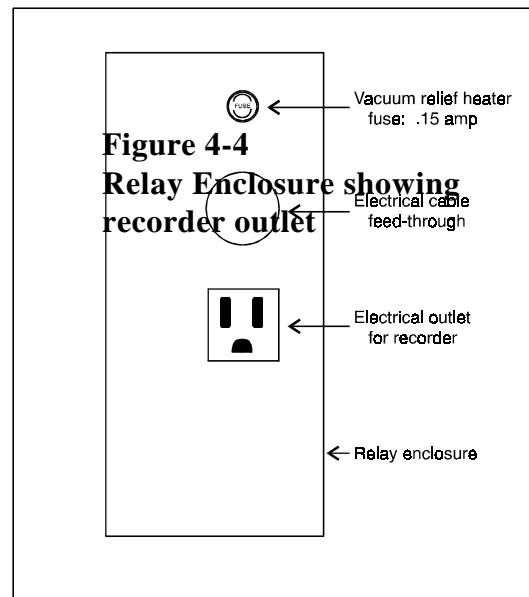


Figure 4-3
Temperature Recorder and Chamber Probe Locations



e. Recorder Outlet

The 115 VAC recorder outlet is located at the end of the relay enclosure. Refer to Figure 4-4.



The outlet is to be only used for the CoBex recorders supplied by Forma.

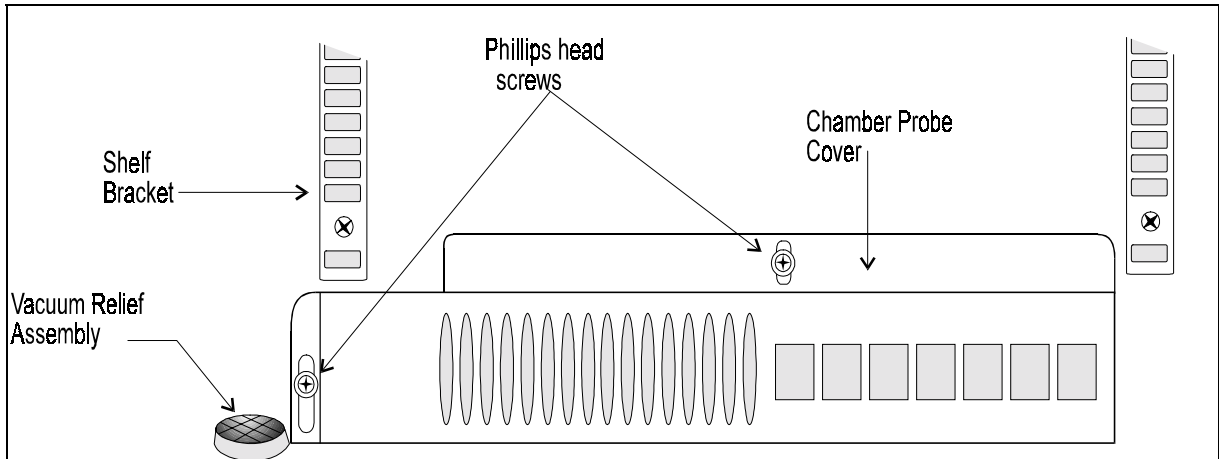


Figure 4-5
Chamber Probe Cover and Vacuum Relief Assembly

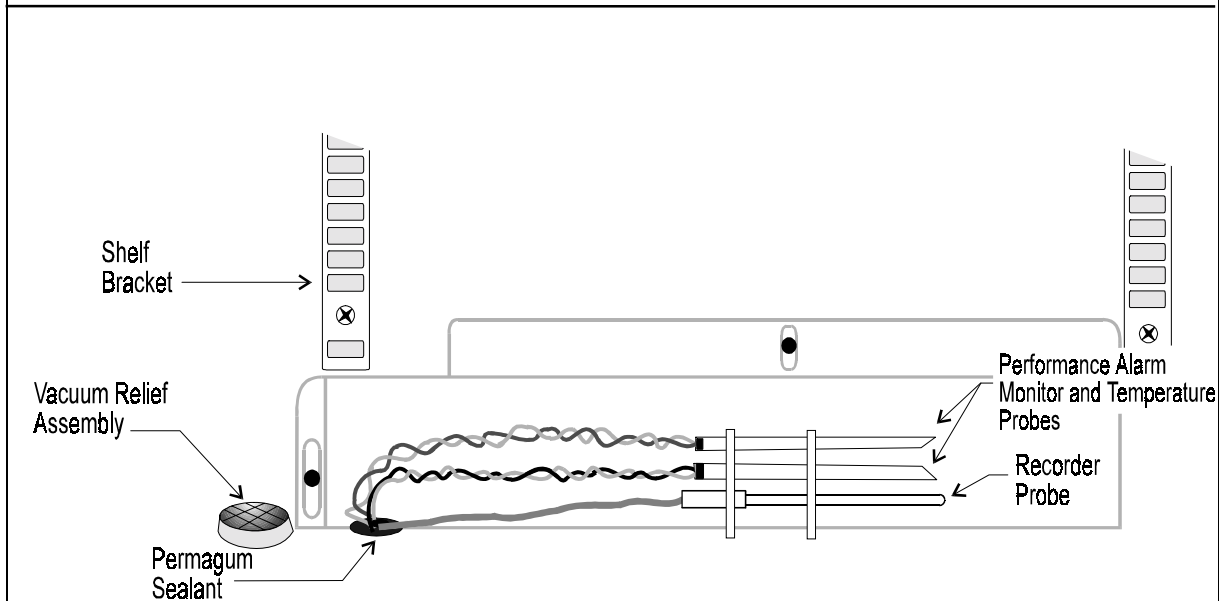


Figure 4-6
Locations of the Performance Alarm Monitor and
Temperature Recorder Probes
(Cover removed)

Section 5 - Calibration

5.1 Calibration

Calibration of the freezer control system is done from the monitor keypad. Access to the calibration mode requires entry of the four digit access code.

Note: The access code (1,2,3,4) is assigned at the factory.

To obtain the access code prompt, *simultaneously* press the UP ARROW key and the BATTERY %CHARGE key.

Note: The keys must be pressed firmly and at the same time.

When this has been done correctly a "1" will appear in the display window. After keying in the access code, press ENTER and "CAL" will appear in the display. At this point, the parameter to be calibrated may be selected by pressing its associated display function key.

Note: When changing calibration values, pressing the UP or DOWN arrow keys for more than two seconds will cause the displayed value to increment automatically.

5.2 Calibrating the Temperature Alarm Monitor Probe



Servicing must be performed by qualified service personnel only!

The Enviro-Scan Temperature Monitor has been factory calibrated.

The 8500 series freezer must be calibrated when the unit is at the low end of its operating temperature (-75°C,-86°C). The probe cannot be properly calibrated at ambient temperatures.

Equipment needed: Accurate remote bulb low temperature thermometer or thermocouple.

- Allow the freezer temperature to stabilize at its temperature set point.
- Fully open the freezer door.
- Open the bottom two inner doors and place the thermometer near the probe cover.
- Allow the freezer chamber temperature to stabilize after closing the door.
- Obtain the prompt for the Access Code by pressing the Up Arrow and the Battery %Charge keys *simultaneously*. A "1" will appear in the display window. If a "1" does not appear in the window, push the keys again.
- Enter the four digit Access Code. (Factory default is 1 2 3 4) Press Enter.
- "CAL" will appear in the display.
- Press Enter again and the temperature measured by the alarm monitor probe will be displayed.
- Press the "1" key. A small "set" will appear to the left of the temperature in the display. Press the "1" key again so that "set" disappears. This is the Zero Mode. Calibration of the temperature alarm monitor probe can only be made if "set" is not showing.
- The temperature reading on the display must match the temperature shown by the remote thermometer. If they do not agree, match them by pressing the Up and Down Arrow keys.
- When the two temperatures match, press Enter to return to the normal temperature display.

5.3 Calibrating the Control Set Point Temperature Probe

- Obtain the prompt for the Access Code by pressing the Up Arrow and the Battery %Charge keys *simultaneously*. A "1" will appear in the display window. If a "1" does not appear in the window, push the keys again.
- Enter the four digit Access Code. (Factory default is 1 2 3 4) Press Enter.
- "CAL" will appear in the display.

- Press the “Control Set Point” key and the cabinet temperature measured by the control probe will be displayed.
- Press the “1” key. A small “set” will appear to the left of the temperature in the display. Press the “1” key again so that “set” disappears. This is the Zero Mode. Calibration of the temperature alarm monitor probe can only be made if “set” is not showing.
- The temperature reading on the display must match the temperature shown by the remote thermometer. If they do not agree, match them by pressing the Up and Down Arrow keys.
- When the two temperatures match, press Enter to return to the normal temperature display.

5.4 Changing the Access Code (Access code set at the factory is 1 2 3 4)

- Obtain access code prompt by depressing the up arrow key and the BATTERY %CHARGE key *simultaneously*. A "1" will appear in the display window.

Note: The keys must be pressed firmly and at the same time. If a "1" does not appear in the window, repeat step 1.

- Enter the *current* four digit access code.
- Press ENTER. "CAL" will appear in the display.
- Depress the (4) key and a "1" will appear in the display prompting the *new* access code entry.
- Key in the *new* four digit code using any combination of the numbers 1, 2, 3 and 4. The monitor will accept the last four digits if more than four are entered. If less than four digits are entered, the display returns to temperature and does not change the access code.
- Depress ENTER to change to the new code and return to the temperature display.

Note: If the Access Code is changed and the new number combination is misplaced or forgotten, contact the Forma Scientific Service Department, 1-800-848-3080

Section 6 - Routine Maintenance

6.1 Cleaning the Cabinet Exterior

Clean the freezer exterior with soap and water and a general use laboratory disinfectant. Rinse with water.

6.2 Cleaning the Condenser



***De-energize all potential sources of energy to unit.
Lockout/tagout the de-energized controls.***

The Condenser Hot light illuminates when the temperature in the refrigeration compartment reaches 40° C, which typically indicates a clogged air filter, a clogged condenser, or a fan failure. This compartment temperature increase may also be the result of operating the freezer in high ambient temperatures.

The efficiency of the refrigeration unit is directly related to the temperature of the air entering the air-cooled condenser. Dust in the condenser fins slows the rate of heat dissipation and increases compressor operating temperature (also decreasing compressor life). A dirty condenser will reduce the overall performance of the refrigeration system in terms of recovery time and set point control accuracy **and may ultimately cause compressor failure.**

The air-cooled condenser (the finned surface located in the center area of the refrigeration compartment) should be cleaned as often as necessary to ensure efficient compressor operation. *Forma Scientific, Inc. recommends a minimum of twice a year.*

To clean the condenser, remove the front grill by grasping the assembly at the corners and gently pulling it away from the frame. Clean the compressor housings and condenser fins with a vacuum cleaner or air-hose. Other refrigeration system parts are cleaned by removing the back and side panels. (Refer to Figure 6-1.)

Note: Before replacing the grill, inspect the filter for cleanliness and clean or replace it if necessary. Refer to Figure 6-1.

Compressors and fan motors are permanently lubricated and do not require servicing.

After cleaning, remove the lockout/tagout devices and return the unit to service.

6.3 Cleaning the Air Filter (refer to Figure 6-1)

A foam air filter is located at the front of the freezer base. When the filter appears dirty it can be easily removed for cleaning. The filter and grill assembly are held in place by snap fasteners on each corner of the grill.

Remove the grill by grasping it at the corners and gently pulling it away from the frame. Remove the filter and wash it with a mild detergent. Dry it by pressing it between two towels. Should the filter become torn or excessively dirty, a replacement may be ordered from Forma Scientific, Inc. (Part # 760162).

6.4 Defrosting the Chamber

The type of frost formed in the chamber is generally very soft and may be easily removed with a soft cloth. *Do not* use any type of abrasive brushes. A complete defrosting may occasionally be required. To completely defrost the chamber:

- Remove all product and place it in another freezer.
- Turn the unit off and pull the plug.
- Open all of the doors and place towels on the chamber floor.
- Allow the frost to melt and become loose.
- Remove the frost with a soft cloth.
- After defrosting is complete, clean the interior with a non-chloride detergent and wipe the chamber dry with a clean cloth.



Do not use strong alkaline or caustic agents. Stainless steel is corrosion resistant, not corrosion proof. Do not use solutions of sodium hypochlorite (Purex, Clorox, etc.), as they may also cause pitting and rusting.

6.5 Cleaning the Door Gasket

Routinely (monthly) check the door gasket for any perforations that will cause air leaks. Frost will form around all leakage areas. Frost accumulation on the door gasket may be removed with a soft cloth.

6.6 Cleaning the Vacuum Relief Port (Refer to Figures 6-1 and 6-2 also Figures 4-5 and 4-6)

The vacuum relief port on the Model 8500 Series freezers is located in the lower left front of the chamber interior. Routinely check the vacuum relief port for frost accumulation and clean as necessary, using a soft cloth.



The vacuum relief port contains a small heating element to reduce frost build-up. If the freezer is not disconnected from the electrical supply or turned off at the power switch, the heating element will continue to operate and may cause injury to personnel cleaning the freezer chamber.

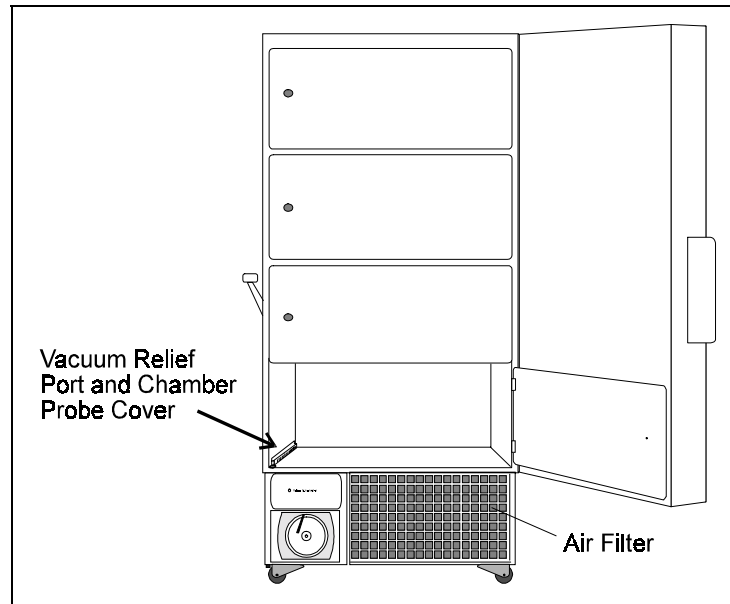


Figure 6-1

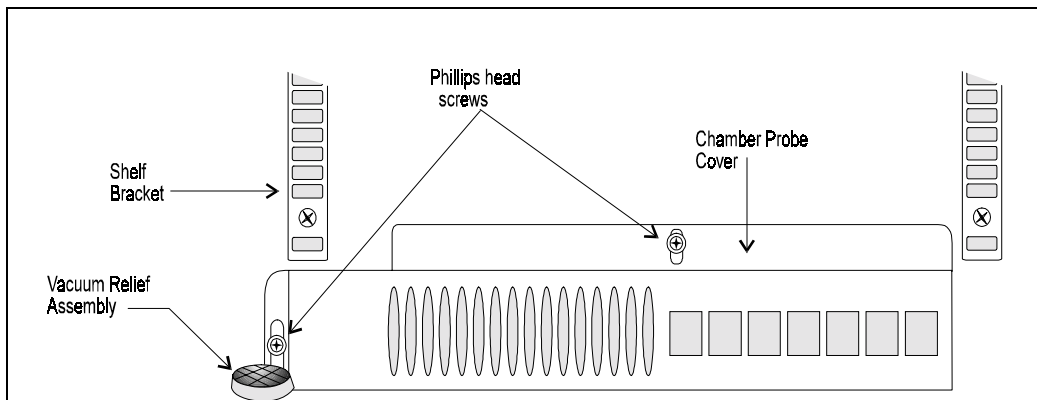


Figure 6-2
Vacuum Relief and Probe Cover Assemblies

6.7 Replacing the Performance Monitor/Alarm Battery



For a consistent and dependable charge, replace the battery every 2-3 years. Replacement batteries must be of the rechargeable type and are available from Forma Scientific, Inc. Refer to the parts list for stock number and description of the replacement batteries.

Dispose of the used batteries in a safe manner and in accord with good environmental practices.

- Turn off electrical power to the freezer.
- Remove the four screws and lock washers securing the front panel.
- Unplug the battery connection and remove the screws securing the batter to the base.
- Align the replacement battery pack with the red and black wires in the harness.
- Plug in the battery (red to positive and black to negative) and replace the front panel.

Section 7 - Service



7.1 Servicing the Refrigeration System

Caution: Servicing must be performed by qualified service personnel only.

In the event of a unit malfunction, check all electrical components including starting relays, thermal protectors, and starting capacitors for the compressors.

Electrical schematics and drawings with parts for the refrigeration system are included with this manual.

Caution: Repair work should be performed only by personnel who have had prior experience with cascade refrigeration systems.

Note: A service manual entitled "ULTRA-LOW REFRIGERATION SYSTEM SERVICE GUIDE" is available from Forma Scientific, Inc. Call or write for details.

7.2 Troubleshooting Guide

The chart on the following page is intended as guide to troubleshooting the system. Servicing of the freezer must only be performed by qualified service personnel.

7.3 8500 Series Cabinet Hardware

(Refer to the detail drawings on the following pages)

- a. Door Latch Assembly Detail
- b. Door Hinge Assembly Detail
- c. Vacuum Valve Heater Assembly Detail

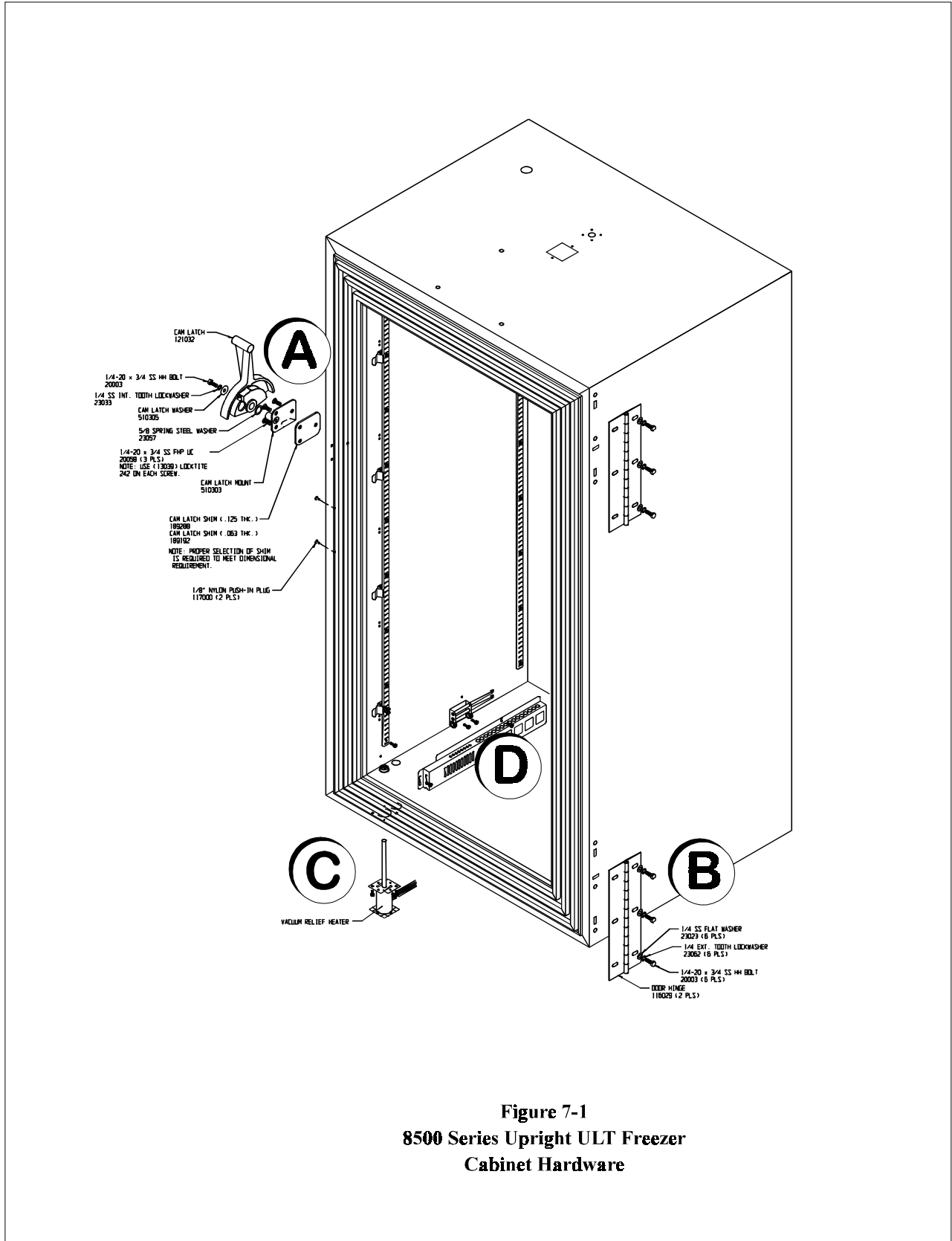


Figure 7-1
8500 Series Upright ULT Freezer
Cabinet Hardware

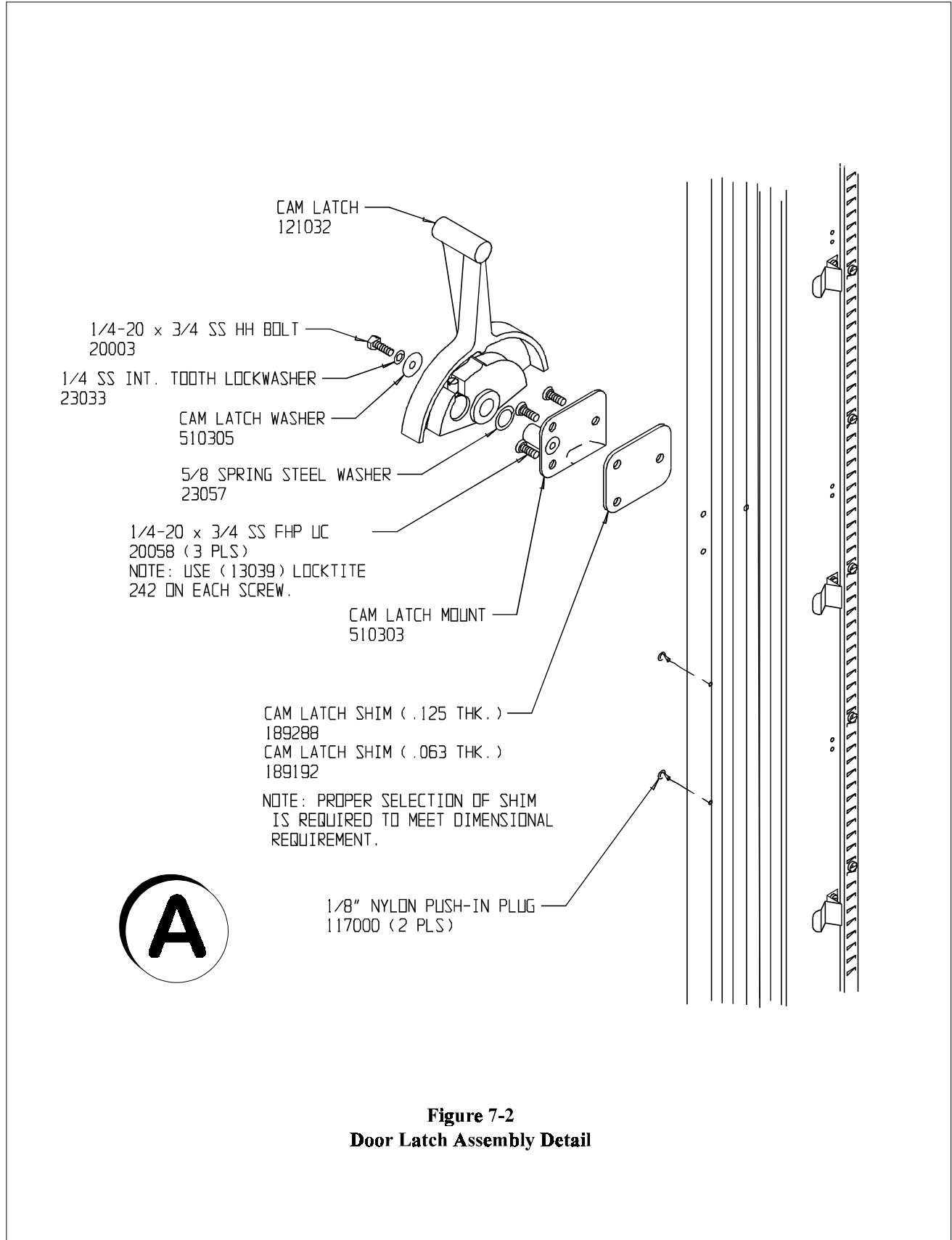


Figure 7-2
Door Latch Assembly Detail

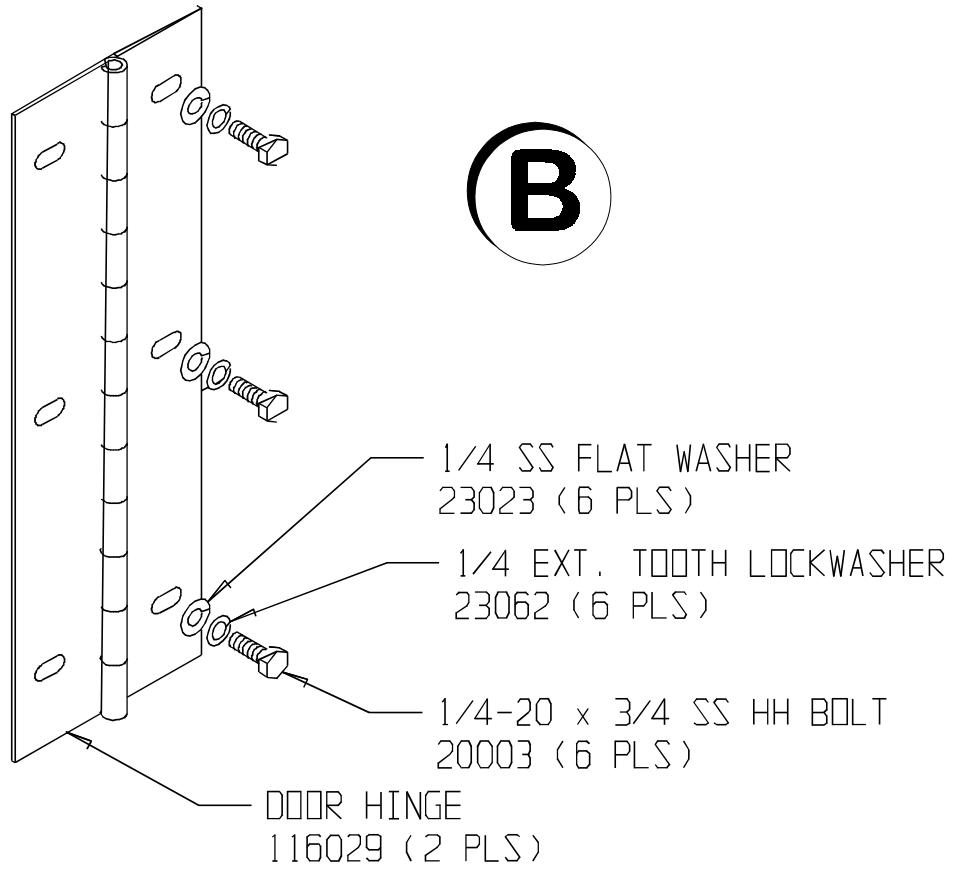


Figure 7-3
Door Hinge Assembly Detail

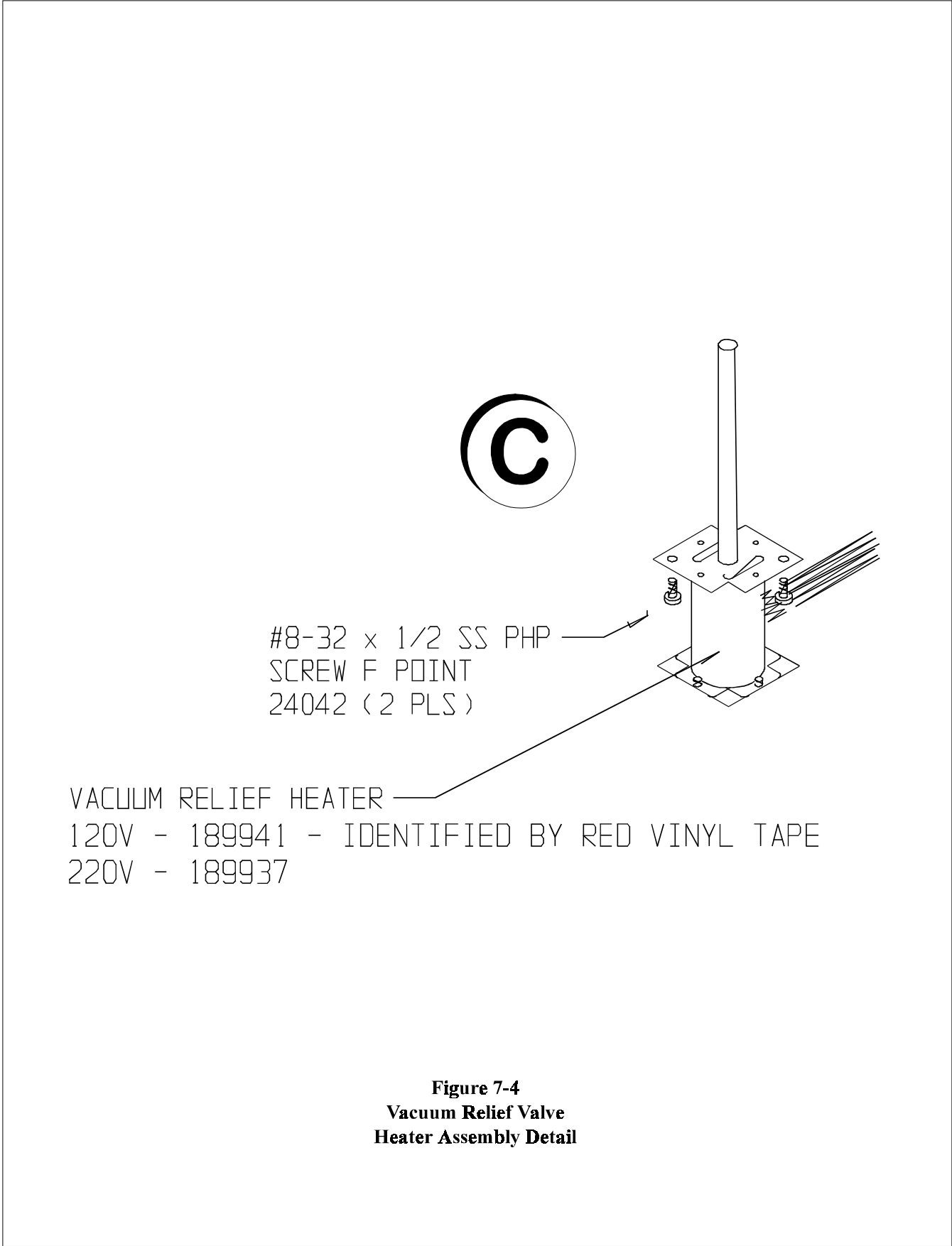


Figure 7-4
Vacuum Relief Valve
Heater Assembly Detail

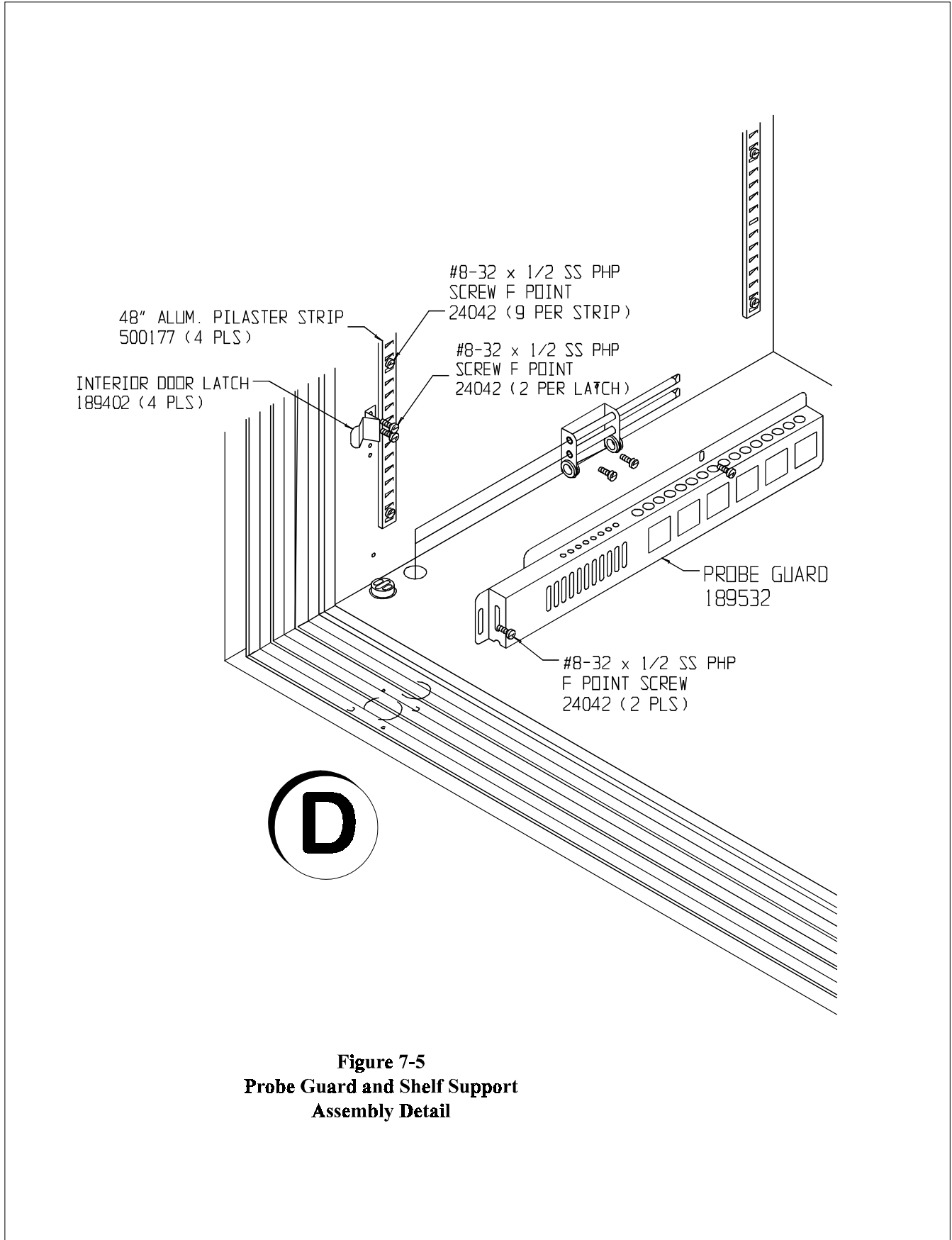


Figure 7-5
Probe Guard and Shelf Support
Assembly Detail

Symptom	Possible Cause
No Power Light on Monitor.	<ul style="list-style-type: none"> • Power line cord disconnected. • Circuit breaker tripped/open. • Main power switch OFF. • Pin-connector not plugged into the monitor board. • Fuse open on Temp Control board • Main fuse(s) open.
Chamber Temp Deviates from Set Point	<ul style="list-style-type: none"> • Too much warm product added • Door open too long • Insufficient voltage • Inadequate air circulation • Calibration • Dirty condenser • High Ambient Temperatures
Too Much Frost Build-Up	<ul style="list-style-type: none"> • Leaking or damaged door gasket
Freezer not Being Refrigerated (unit is receiving power)	<ul style="list-style-type: none"> • Compressor thermal overload open • Loss of refrigerant in either system • Defective compressor(s) • Defective temp control • Defective high pressure cut-off • Low stage compressor locked up • Main fuse(s) open
Display Problems in General	<ul style="list-style-type: none"> • Defective monitor board

Section 8 - Specifications

8.1

Specification	Models 8516 and 8517
Temperature	-50° C (-58°F) to -86° C (-123°F)
Exterior Dimensions	33.25" W x 79.0" H x 3.0" F-B (85 cm x 201 cm x 94 cm)
Interior Dimensions	23.0" W x 51.5" H x 25.25" F-B (58 cm x 131 cm x 64 cm)
Refrigeration	Two 1/2 HP Compressors (Cascade System)
Capacity	17.3 cu. ft. (490 liters)
Insulation	Type: CFC-free foamed-in-place urethane Sides: 5" (12.7cm) Door: 4.5" (11.3 cm)
Electrical	8516: 120 VAC, 1 PH, 60 Hz, 15.5 FLA Operating Range: 108VAC - 130VAC 8517: 230VAC, 1 PH, 50/60 Hz, 12.0 FLA Operating Range: 208VAC - 240VAC
Breaker Requirements	8516: 20 Amp, 120V, Dedicated Circuit, 20 Amp Time Delay Breaker 8517: 15 Amp, 230 VAC
Automatic Voltage Compensation	Low: Cut In: 110V, Cut Out: 115V, Volts Boost: 10 Cut In: 210V, Cut Out: 220V, Volts Boost: 18 High: Cut In: 125V, Cut Out: 120V Volts Buck: 10 Cut In: 235V, Cut Out: 225V, Volts Buck: 18
Shipping Weights	Ocean: 1000 lbs. (454 kg) Air/Container: 900 lbs. (408 kg) Motor: 758 lbs. (344 kg)

8.2

Specification	Model 8523
Temperature	-50° C (-58°F) to -86° C (-123°F)
Exterior Dimensions	40.75" W x 79.0" H x 71.0" F-B (103.5 cm x 201.7 cm x 94.0 cm)
Interior Dimensions	30.6" W x 51.5" H x 25.25" F-B (77 cm x 131 cm x 64 cm)
Refrigeration	Two, 3/4 HP Compressors (Cascade System)
Capacity	23 Cu. Ft. (652 liters)
Insulation	Type: CFC-free foamed-in-place urethane Sides: 5" (12.7cm) Door: 4.5" (11.3 cm)
Electrical	230VAC, 1 PH, 50/60 Hz, 14.0 FLA Operating Range: 208VAC - 240VAC
Breaker Requirements	15 Amp, 220 VAC (Dedicated circuit recommended)
Automatic Voltage Compensation	Low: Cut In: 210V, Cut Out: 220V, Volts Boost 18 High: Cut In: 235V, Cut Out: 225V, Volts Buck: 18
Shipping Weights	Ocean: 1104 lbs. (501 kg) Air/Container: 970 lbs. (440 kg) Motor: 875 lbs. (397 kg)

8.3

Specification	Models 8525 and 8526
Temperature	-50° C (-58°F) to -86° C (-123°F)
Exterior Dimensions	33.25" W x 79.0" H x 31.0" F-B (85 cm x 201cm x 79 cm)
Interior Dimensions	23.0" W x 51.5" H x 19.25" F-B (58 cm x 131 cm x 48.9 cm)
Refrigeration	Two, 1/2 HP Compressors (Cascade System)
Capacity	13 Cu. Ft. (368 liters)
Insulation	Type: CFC-free foamed-in-place urethane Sides: 5" (12.7cm) Door: 4.5" (11.3 cm)
Electrical	8525: 230VAC, 1 PH, 50/60 Hz, 12.0 FLA Operating Range: 208VAC - 240VAC 8526: 120VAC, 1 PH, 60Hz, 15.5 FLA Operating Range: 108VAC - 130VAC
Breaker Requirements	15 Amp, 220 VAC (Dedicated circuit recommended)
Automatic Voltage Compensation	Low: Cut In: 110V, Cut Out: 115V, Volts Boost: 10 Cut In: 210V, Cut Out: 220V, Volts Boost 18 High: Cut In: 125V, Cut Out: 120V Volts Buck: 10 Cut In: 235V, Cut Out: 225V, Volts Buck: 18
Shipping Weight	Ocean: 935 lbs. (424 kg) Air/Container: 850 lbs. (386 kg) Motor: 724 lbs. (328 kg)

8.4

Specification	Model 8560
Temperature	-50° C (-58°F) to -86° C (-123°F)
Exterior Dimensions	33.3" W x 78.8" H x 31.0" F-B (84.6 cm x 200.1 cm x 78.7 cm)
Interior Dimensions	23.3" W x 51.5" H x 19.3" F-B (58.4 cm x 130.8 cm x 49.0 cm)
Refrigeration	Two, 1/2 HP Compressors (Cascade System)
Capacity	13 Cu. Ft. (368 liters)
Insulation	Type: CFC-free foamed-in-place urethane Sides: 5" (12.7cm) Door: 4.5" (11.3 cm)
Electrical	230VAC, 1 PH, 50/60 Hz, 12.0 FLA Operating Range: 208VAC - 240VAC
Automatic Voltage Compensation	Low: Cut In: 210V, Cut Out: 220V, Volts Boost 18 High: Cut In: 235V, Cut Out: 225V, Volts Buck: 18
Shipping Weight	Ocean: 1000 lbs. (454 kg) Air/Container: 964 lbs. (437 kg) Motor: 801 lbs. (363 kg)

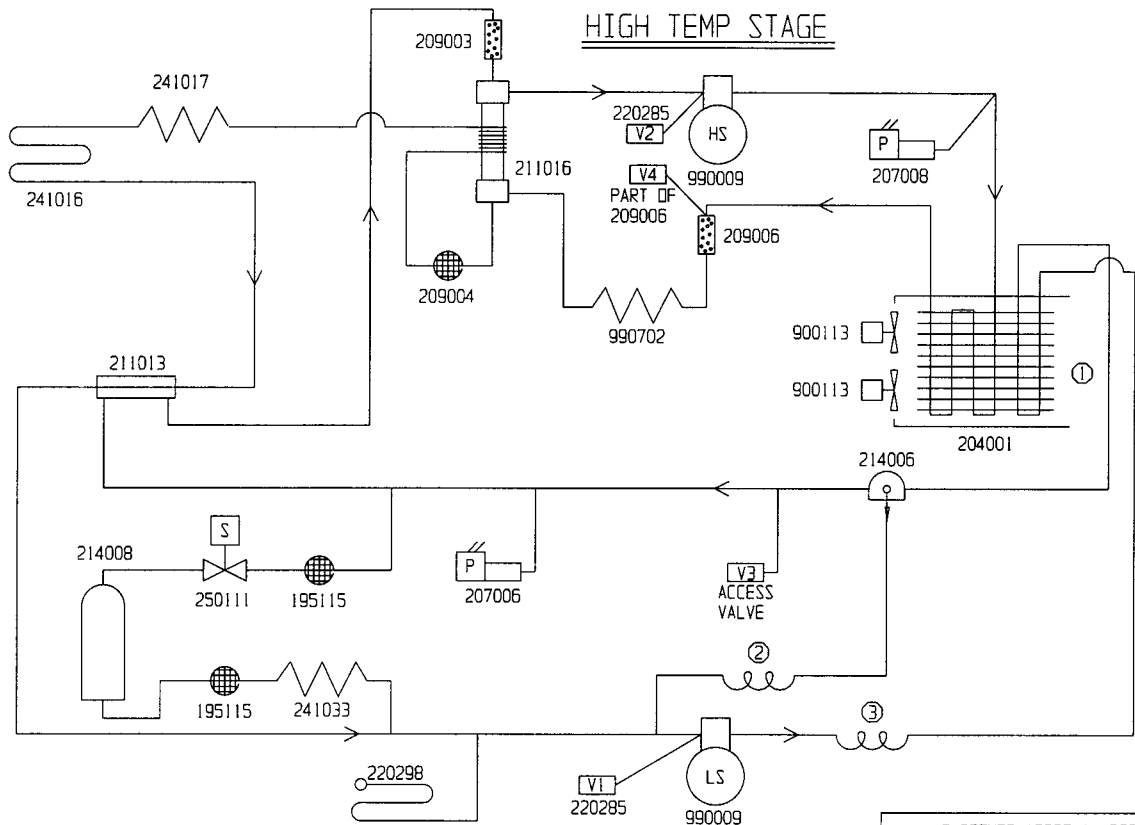
Section 9 - Spare Parts

Models 8516, 8517, 8523, 8525, 8526 and 8560

Stock #	Qty	Description
190671	1	Temperature Control Board
400101	1	Thermostat 40°C
400863	1	Monitor Board (Wired)
290041	1	Temperature Monitor Probe
400064	1	Battery 6V, 8 AH (Rechargeable)
214006	1	Oil Separator
209003	1	Dryer 3/8 ODF
209006	1	Dryer 1/4 ODS
250111	1	Solenoid Valve "Peak Control"
250115	1	Solenoid Valve (220V models only) "Peak Control"
207008	1	Pressure Switch, Cutout (high pressure cut-out @ 350 PSIG)
900113	2	Tubeaxial Fan, 115V (8516, 8526)
900111	2	Tubeaxial Fan, 220V (8517, 8523, 8525 and 8560)
760162	1	Air Filter, 21.4" x 13.4"
195517	1	(5) 760162 Air Filters
132041	1	Door Heater, 115V, for (optional) Double Door Freezer
132042	1	Door Heater, 230V, for (optional) Double Door Freezer
285613	1	15 Amp Fuse, (230V) Slo-Blow (Mains)
285614	1	20 Amp Fuse, (120V) Slo-Blow (Mains)
230115	1	0.15 Amp Fuse (Vacuum Relief Heater)
133008	1	Heater (Vacuum Relief Port)
1990009	1	Low Stage Compressor with Zerol 150T, 115V, 1/2 HP (Models 8516, 8526)
2990009	1	High Stage Compressor Compressor/with Ester Oil, 115V, 1/2 HP (Models 8516, 8526)
1990004	1	Low Stage Compressor with Zerol 150T, 220V, 1/2 HP (Models 8517, 8525, 8560)
2990004	1	High Stage Compressor Compressor/with Ester Oil, 220V, 1/2 HP (Models 8517, 8525, 8560)
1990014	1	Low Stage Compressor with Zerol 150T, 230V, 3/4 HP (Model 8523)
2990014	1	High Stage Compressor/with Ester Oil, 230V, 3/4 HP (Model 8523)
970023	70# cyl	Refrigerant R-134A, High Stage
970022	70# cyl	Refrigerant R-23, Low Stage
970009	14.5 oz	Propane
970010	1	Propane Tank Adapter
143021	1 gal	Zerol 150T

290041	1	Control Probe
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Section 10 - Refrigeration Drawings



CASCADE REFRIGERATION

HIGH TEMPERATURE STAGE:
 REFRIGERANT R-134a: 765 gr (27 OZ)
 MOBIL EAL-22: COMPRESSOR 1134 gr (40 OZ)

LOW TEMPERATURE STAGE:
 *REFRIGERANT R-290: 26 gr (0.9 OZ) (30" VAC. - 0 PSIG)
 *REFRIGERANT R-23: 227 gr (8.0 OZ) (0 PSIG - 85 PSIG)
 ZEROL 150T: (COMPRESSOR) 1134 gr (40 OZ)
 (OIL SEPARATOR) 425 gr (15 OZ)
 DESUPER HEAT COIL: ① TOP FOUR PASSES OF R-134a
 AIR-COOLED CONDENSER
 VIB. ISD. COIL ② 1 COIL 1/4" TUBING X 4" DIA.
 DESUPER HEAT/VIB. ISD. COIL ③ 2 COILS 5/16" TUBING X 6-3/4" DIA.

*WHEN SYSTEM IS AT 24°C

LOW TEMP STAGE

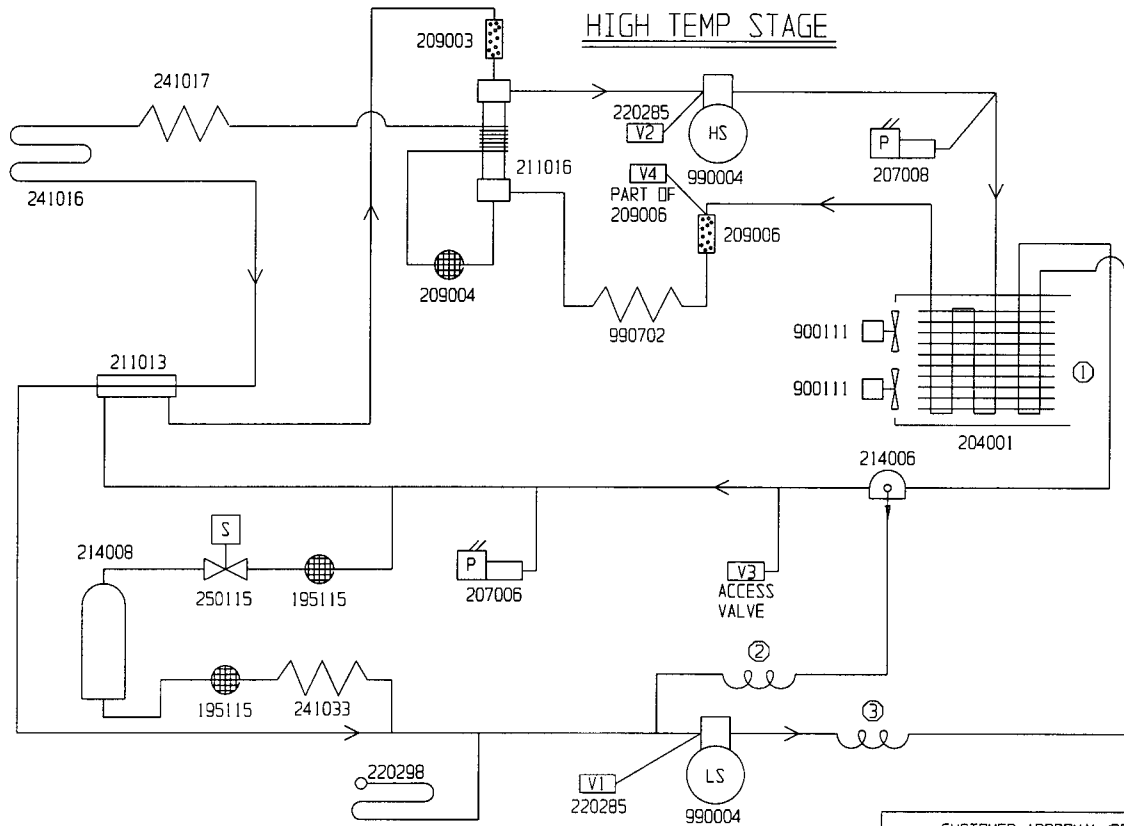
CUSTOMER APPROVAL/REFERENCE							
APPROVED BY	5	FR-1203	04-10-98	RLM	KDG	HEG	ADDED METRIC UNITS FOR IEC-1010
APPROVING FIRM	4	FR-1146	11-04-97	LDC	KDG	LDN	ADDED 700 & ALT. SELECT
DATE OF APPROVAL	3	FR-1146	08-07-97	LDC	KDG	LDN	ADDED ALT. BRAND MODEL 5466
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	2	FR-1025	10-04-96	AT	POK	LDN	IEC-1010 UP-DATES
	1	FR-765	10-21-94	LDC	KDG	LDN	214008 WAS 993102
REV	ECR NO.	DATE	BY	CAD	APPD	DESCRIPTION OF REVISION	
	DATE	8-23-93	DWN	AT	CAD	AT	APPD JV SCALE NONE
CUSTOMER							
JOB TITLE 716, 916, 5416, 5466 & 8516 -86°C 17 CU FT U.R. FREEZER							
DWG TITLE REFRIGERATION SCHEMATIC							
LOCATION				JOB NUMBER		DRAWING NUMBER	
FREEZERS						8516-90-0-B	



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CASCADE REFRIGERATION



HIGH TEMPERATURE STAGE:
 REFRIGERANT R-134a: 765 gr (27 OZ)
 MOBIL EAL-22: COMPRESSOR 1134 gr (40 OZ)

LOW TEMPERATURE STAGE:
 *REFRIGERANT R-290: 26 gr (0.9 OZ) (30" VAC. - 0 PSIG)
 *REFRIGERANT R-23: 227 gr (8.0 OZ) (0 PSIG - 85 PSIG)
 ZEROL 150T: (COMPRESSOR) 1134 gr (40 OZ)
 (OIL SEPARATOR) 425 gr (15 OZ)
 DESUPER HEAT COIL: ① TOP FOUR PASSES OF R-134a
 AIR-COOLED CONDENSER
 VIB. ISO. COIL ② 1 COIL 1/4" TUBING X 4" DIA.
 DESUPER HEAT/VIB. ISO. COIL ③ 2 COILS 5/16" TUBING X 6-3/4" DIA.

*WHEN SYSTEM IS AT 24°C

LOW TEMP STAGE

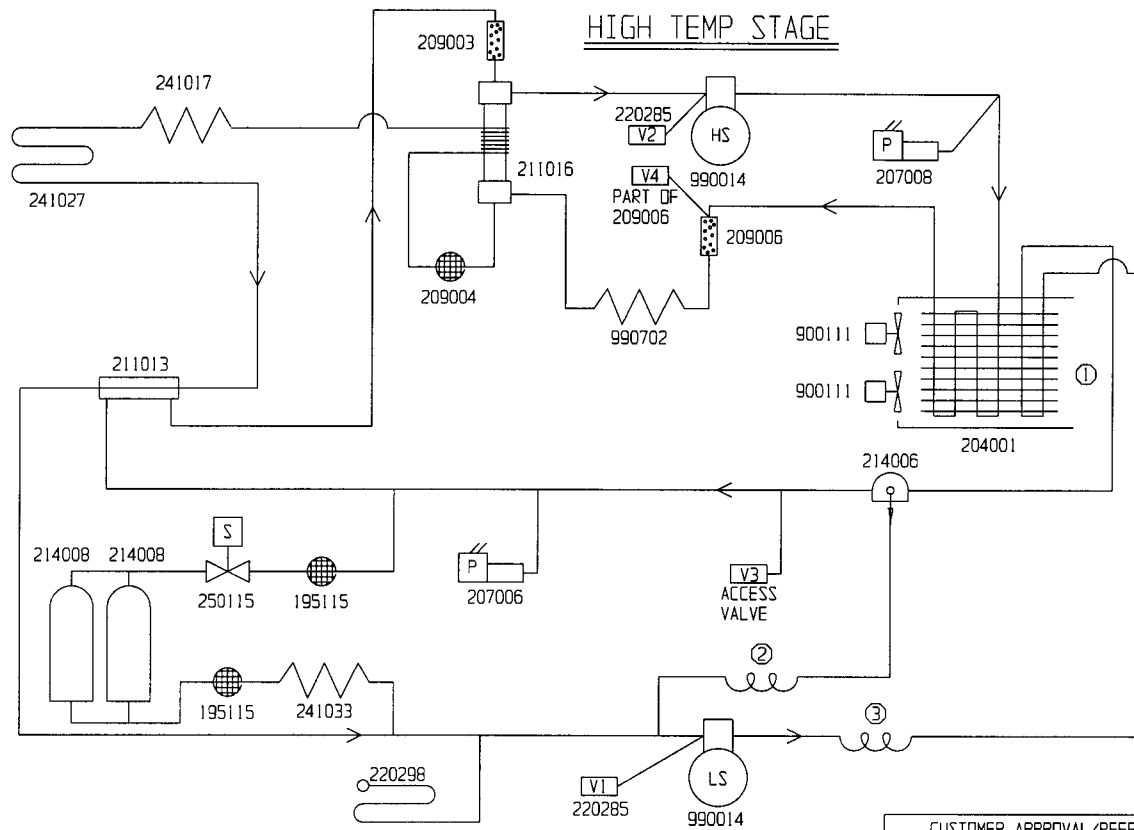
CUSTOMER APPROVAL/REFERENCE		6	FR-1203	04-10-98	RLM	KDG	HEG	ADDED METRIC UNITS FOR IEC-1010
APPROVED BY	_____	5	FR-1146	11-04-97	LDC	KDG	LDN	ADDED 700 & ALT. SELECT
APPROVING FIRM	_____	4	FR-1146	08-07-97	LDC	KDG	LDN	ADDED ALT. BRAND MODEL 5467
DATE OF APPROVAL	_____	3	FR-1025	10-04-96	AT	PKD	LDN	IEC-1010 UP-DATES
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REV	ECR NO.	DATE	BY	CAD	APPD	DESCRIPTION OF REVISION		
DATE	8-23-93	DWN	AT	CAD	AT	APPD	JV	SCALE NONE
CUSTOMER								
JOB TITLE 717, 917, 5417, 5467 & 8517 -86°C 17 CU FT U.R. FREEZER								
DWG TITLE REFRIGERATION SCHEMATIC								
LOCATION			JOB NUMBER			DRAWING NUMBER		
FREEZERS						8517-90-0-B		



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CASCADE REFRIGERATION



HIGH TEMPERATURE STAGE:
 REFRIGERANT R-134a: 765 gr (27 OZ)
 MOBIL EAL-22: COMPRESSOR 1134 gr (40 OZ)

LOW TEMPERATURE STAGE:
 *REFRIGERANT R-290: 37 gr (1.3 OZ) (30" VAC. - 0 PSIG)
 *REFRIGERANT R-23: 405 gr (14.3 OZ) (0 PSIG - 100 PSIG)
 ZEROL 150T: (COMPRESSOR) 1134 gr (40 OZ)
 (OIL SEPARATOR) 425 gr (15 OZ)
 DESUPER HEAT COIL: ① TOP FOUR PASSES OF R-134a
 AIR-COOLED CONDENSER
 VIB. ISO. COIL ② 1 COIL 1/4" TUBING X 4" DIA.
 DESUPER HEAT/VIB. ISO. COIL ③ 2 COILS 5/16" TUBING X 6-3/4" DIA.

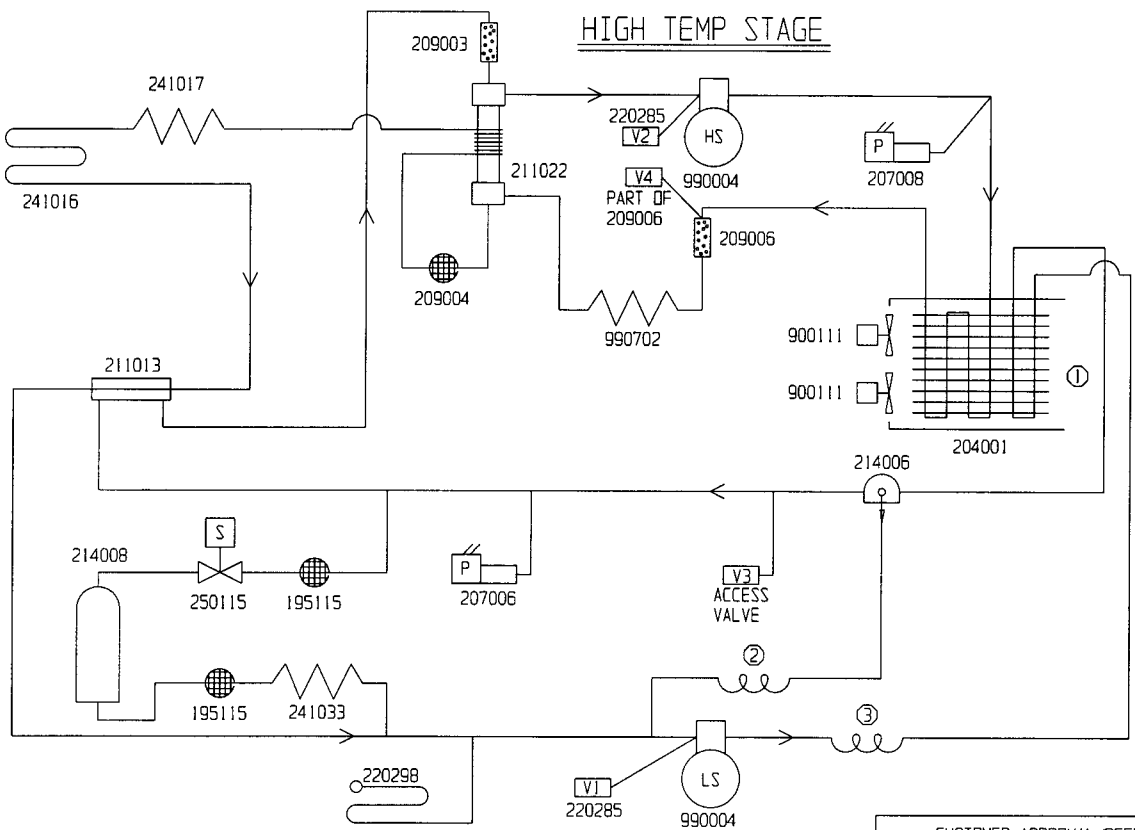
*WHEN SYSTEM IS AT 24°C

LOW TEMP STAGE

CUSTOMER APPROVAL/REFERENCE						
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6	FR-1146	11-04-97	LDC	KDG	LON	ADDED 700 & ALT. SELECT
5	FR-1146	08-07-97	LDC	KDG	LON	ADDED ALT. BRAND MODEL 5463
4	FR-1025	10-04-96	AT	PKD	LON	IEC-1010 UP-DATES
3	FR-781	11-11-94	AT	KDG	LON	250115 WAS 250111
REV	ECN NO.	DATE	BY	CAD	APPD	DESCRIPTION OF REVISION
		8-23-93	DWN	AT	CAD AT	APPD JV SCALE NONE
CUSTOMER						
JOB TITLE 723, 923, 5423, 5463 & 8523 -86°C 23 CU FT U.R. FREEZER						
DWG TITLE REFRIGERATION SCHEMATIC						
LOCATION			JOB NUMBER		DRAWING NUMBER	
FREEZERS					8523-90-0-B	


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CASCADE REFRIGERATION



HIGH TEMPERATURE STAGE:
 REFRIGERANT R-134a: 765 gr (27 OZ)
 MOBIL EAL-22: COMPRESSOR 1134 gr (40 OZ)

LOW TEMPERATURE STAGE:
 *REFRIGERANT R-290: 26 gr (0.9 OZ) (30" VAC. - 0 PSIG)
 *REFRIGERANT R-23: 224 gr (7.9 OZ) (0 PSIG - 85 PSIG)
 ZEROL 150T: (COMPRESSOR) 1134 gr (40 OZ)
 (OIL SEPARATOR) 426 gr (15 OZ)
 DESUPER HEAT COIL: ① TOP FOUR PASSES OF R-134a
 AIR-COOLED CONDENSER
 VIB. ISO. COIL ② 1 COIL 1/4" TUBING X 4" DIA.
 DESUPER HEAT/VIB. ISO. COIL ③ 2 COILS 5/16" TUBING X 6-3/4" DIA.

*WHEN SYSTEM IS AT 24°C

LOW TEMP STAGE

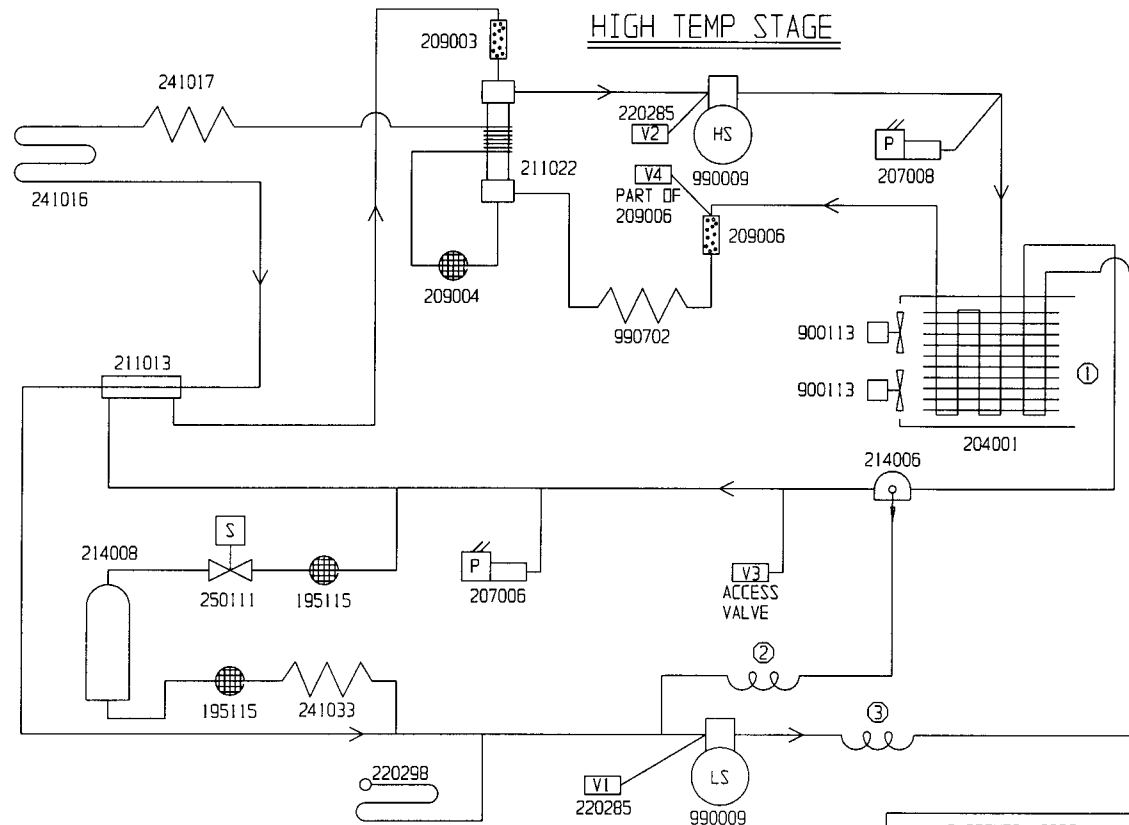
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6	FR-1146	11-04-97	LOC	KDG	LDN	ADDED 700 & ALT. SELECT
5	FR-1146	08-07-97	LOC	KDG	LDN	ADDED ALT. BRAND MODEL 5465
4	FR-1025	10-04-96	AT	PKD	LDN	IEC-1010 UP-DATES
3	FR-781	11-11-94	AT	KDG	LDN	250115 WAS 250111
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CUSTOMER APPROVAL/REFERENCE APPROVED BY _____ APPROVING FIRM _____ DATE OF APPROVAL _____						
DATE 8-23-93 DWN AT CAD AT APPD JV SCALE NONE						
JOB TITLE 725, 925, 5425, 5465						
JOB TITLE 8525 & 8560 -86°C 13 CU FT UPRIGHT FREEZER						
DWG TITLE REFRIGERATION SCHEMATIC						
LOCATION FREEZERS			JOB NUMBER		DRAWING NUMBER 8525-90-0-B	



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CASCADE REFRIGERATION



HIGH TEMPERATURE STAGE:
 REFRIGERANT R-134a: 765 gr (27 OZ)
 MOBIL EAL-22: COMPRESSOR 1134 gr (40 OZ)

LOW TEMPERATURE STAGE:
 *REFRIGERANT R-290: 26 gr (0.9 OZ) (30" VAC. - 0 PSIG)
 *REFRIGERANT R-23: 224 gr (7.9 OZ) (0 PSIG - 85 PSIG)
 ZEROL 150T: (COMPRESSOR) 1134 gr (40 OZ)
 (OIL SEPARATOR) 425 gr (15 OZ)
 DESUPER HEAT COIL: ① TOP FOUR PASSES OF R-134a
 AIR-COOLED CONDENSER
 VIB. ISO. COIL ② 1 COIL 1/4" TUBING X 4" DIA.
 DESUPER HEAT/VIB. ISO. COIL ③ 2 COILS 5/16" TUBING X 6-3/4" DIA.

*WHEN SYSTEM IS AT 24°C

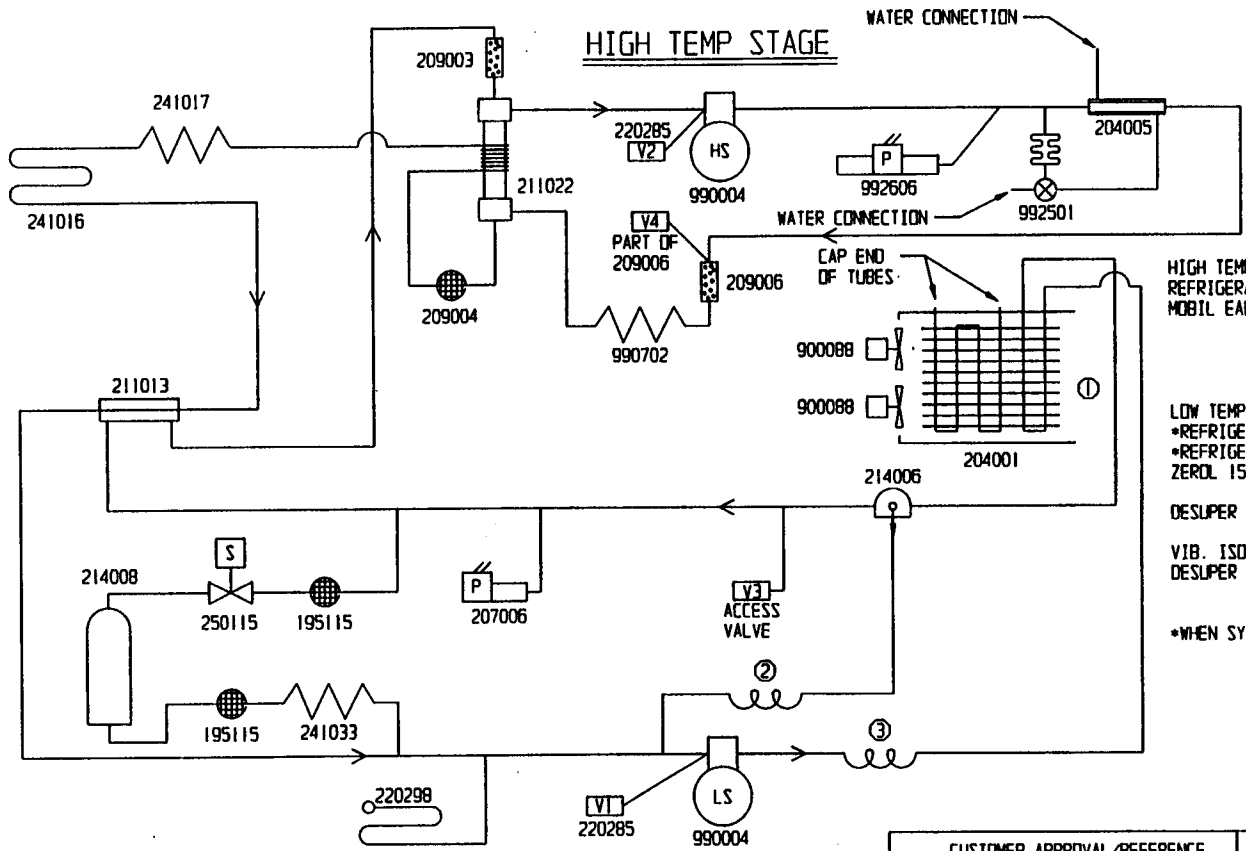
LOW TEMP STAGE

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APPROVED BY	_____	5	FR-1146	11-04-97	LDC	KDG	LDN	ADDED 700 & ALT. SELECT
APPROVING FIRM	_____	4	FR-1146	08-07-97	LDC	KDG	LDN	ADDED ALT. BRAND MODEL 5461
DATE OF APPROVAL	_____	3	FR-1025	10-04-96	AT	POK	LDN	IEC-1010 UP-DATES
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REV	ECR NO.	DATE	BY	CAD	APPD	DESCRIPTION OF REVISION		
		8-23-93	DWN AT	CAD AT	APPD JV	SCALE NONE		
JOB TITLE 726, 926, 5426, 5461,								
JOB TITLE 8526 -86°C 13 CU FT UPRIGHT FREEZER								
DWG TITLE REFRIGERATION SCHEMATIC								
LOCATION			JOB NUMBER		DRAWING NUMBER			
FREEZERS					8526-90-0-B			



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CASCADE REFRIGERATION

HIGH TEMPERATURE STAGE:
 REFRIGERANT R-134a: 27 OZ
 MOBIL EAL-22: COMPRESSOR 40 OZ

LOW TEMPERATURE STAGE:
 *REFRIGERANT R-290: 0.9 OZ (30" VAC. - 0 PSIG)
 *REFRIGERANT R-23: 7.9 OZ (0 PSIG - 85 PSIG)
 ZEROL 150T: (COMPRESSOR) 40 OZ
 (OIL SEPARATOR) 15 OZ
 DESUPER HEAT COIL: ① TOP FOUR PASSES OF R-134a
 AIR-COOLED CONDENSER
 VIB. ISO. COIL ② 1 COIL 1/4" TUBING X 4" DIA.
 DESUPER HEAT/VIB. ISO. COIL ③ 2 COILS 5/16" TUBING X 6-3/4" DIA.

*WHEN SYSTEM IS AT 24°C

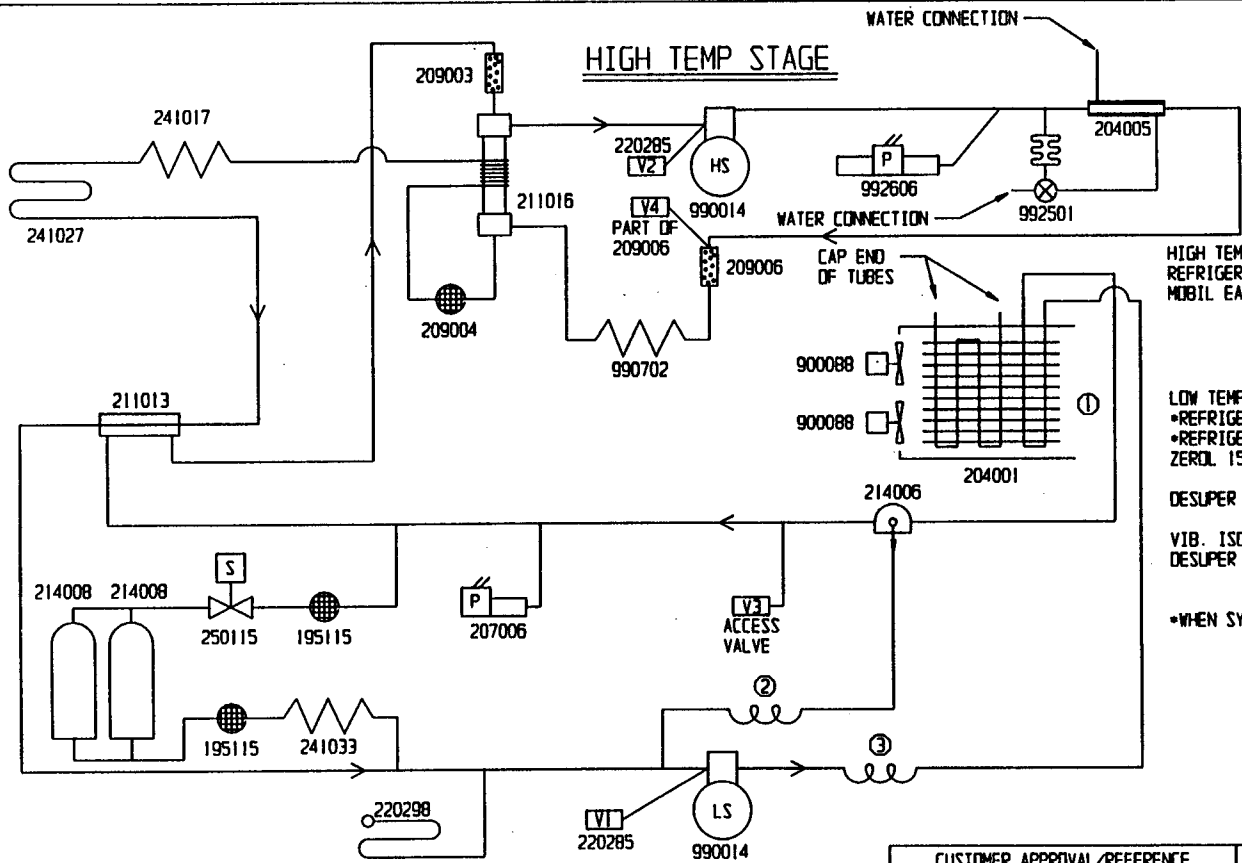
LOW TEMP STAGE

CUSTOMER APPROVAL/REFERENCE					
APPROVED BY					
APPROVING FIRM					
DATE OF APPROVAL					
THIS DOCUMENT CONTAINS PROPRIETARY INFORMATION AND SUCH INFORMATION IS NOT TO BE DISCLOSED TO OTHERS FOR ANY PURPOSE NOR USED FOR MANUFACTURING PURPOSES WITHOUT WRITTEN PERMISSION FROM FORMA SCIENTIFIC					
0	SI-5581	2-12-96	GJG	GJG	RELEASED FOR PRODUCTION
REV	ECR NO.	DATE	BY	CAD/APPD	DESCRIPTION OF REVISION
	DATE	2-9-96	DWN AT	CAD GJG APPD MSB	SCALE NONE
CUSTOMER					
JOB TITLE -86°C 13 CU FT UPRIGHT FREEZER					
DWG TITLE REFRIGERATION SCHEMATIC W/WATER COOLED CONDENSER					
LOCATION		JOB NUMBER		DRAWING NUMBER	
				189726-90-0-B	



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CASCADE REFRIGERATION

HIGH TEMPERATURE STAGE:
 REFRIGERANT R-134a: 27 OZ
 MOBIL EAL-22: COMPRESSOR 40 OZ

LOW TEMPERATURE STAGE:
 REFRIGERANT R-290: 1.3 OZ (30" VAC. - 0 PSIG)
 REFRIGERANT R-23: 14.3 OZ (0 PSIG - 100 PSIG)
 ZEROL 150T: (COMPRESSOR) 40 OZ
 (OIL SEPARATOR) 15 OZ
 DESUPER HEAT COIL: ① TOP FOUR PASSES OF R-134a
 AIR-COOLED CONDENSER
 VIB. ISO. COIL ② 1 COIL 1/4" TUBING X 4" DIA.
 DESUPER HEAT/VIB. ISO. COIL ③ 2 COILS 5/16" TUBING X 6-3/4" DIA.

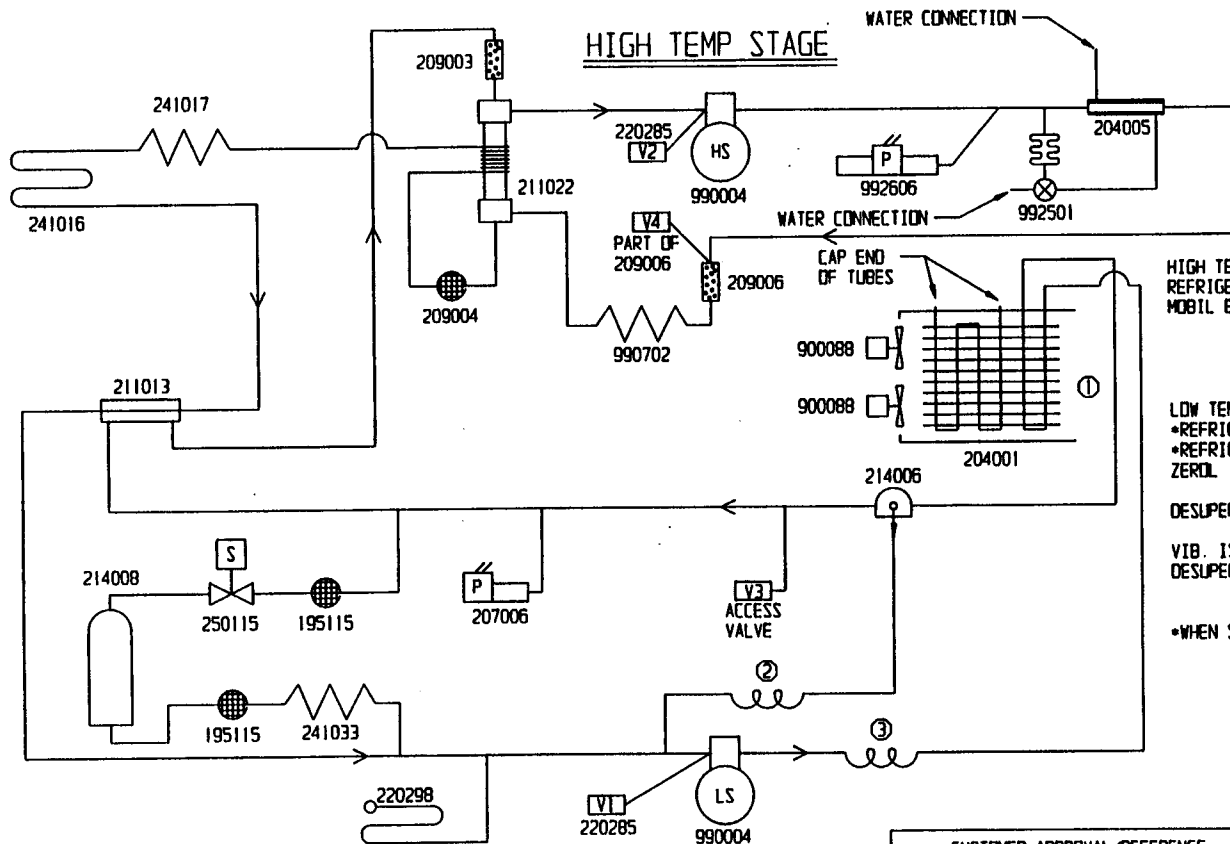
*WHEN SYSTEM IS AT 24°C

LOW TEMP STAGE

CUSTOMER APPROVAL/REFERENCE						
APPROVED BY						
APPROVING FIRM						
DATE OF APPROVAL						
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REV	ECN NO.	DATE	BY	CAD APPD	DESCRIPTION OF REVISION	
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DATE	8-23-93	OWN	AT	CAD GJG	APPD MSB	SCALE NONE
CUSTOMER						
JOB TITLE MODEL 923 -86°C 23 CU FT UPRIGHT FREEZER						
DWG TITLE REFRIGERATION SCHEMATIC W/WATER COOLED CONDENSER						
LOCATION		JOB NUMBER		DRAWING NUMBER		
				189871-90-0-B		


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BOX 649 MARIETTA, OHIO 45750 TELEF 24-5364
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CASCADE REFRIGERATION

HIGH TEMPERATURE STAGE:
 REFRIGERANT R-134a: 27 OZ
 MOBIL EAL-22: COMPRESSOR 40 OZ

LOW TEMPERATURE STAGE:
 *REFRIGERANT R-290: 0.9 OZ (30" VAC. - 0 PSIG)
 *REFRIGERANT R-23: 7.9 OZ (0 PSIG - 85 PSIG)
 ZEROL 150T: (COMPRESSOR) 40 OZ
 (OIL SEPARATOR) 15 OZ
 DESUPER HEAT COIL: ① TOP FOUR PASSES OF R-134a
 AIR-COOLED CONDENSER
 VIB. ISO. COIL ② 1 COIL 1/4" TUBING X 4" DIA.
 DESUPER HEAT/VIB. ISO. COIL ③ 2 COILS 5/16" TUBING X 6-3/4" DIA.

*WHEN SYSTEM IS AT 24°C

LOW TEMP STAGE

CUSTOMER APPROVAL/REFERENCE						
APPROVED BY _____						
APPROVING FIRM _____						
DATE OF APPROVAL _____						
THIS DOCUMENT CONTAINS PROPRIETARY INFORMATION AND SUCH INFORMATION IS NOT TO BE DISCLOSED TO OTHERS FOR ANY PURPOSE NOR USED FOR MANUFACTURING PURPOSES WITHOUT WRITTEN PERMISSION FROM FORMA SCIENTIFIC						
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REV	ECR NO.	DATE	BY	CAD/APPD	DESCRIPTION OF REVISION	
	DATE	2-9-96	DWN AT	CAD G.J.G	APPD MSB	SCALE NONE
CUSTOMER						
JOB TITLE -86°C 17 CU FT UPRIGHT FREEZER						
DWG TITLE REFRIGERATION SCHEMATIC W/WATER COOLED CONDENSER						
LOCATION		JOB NUMBER		DRAWING NUMBER		
				189886-90-0-B		

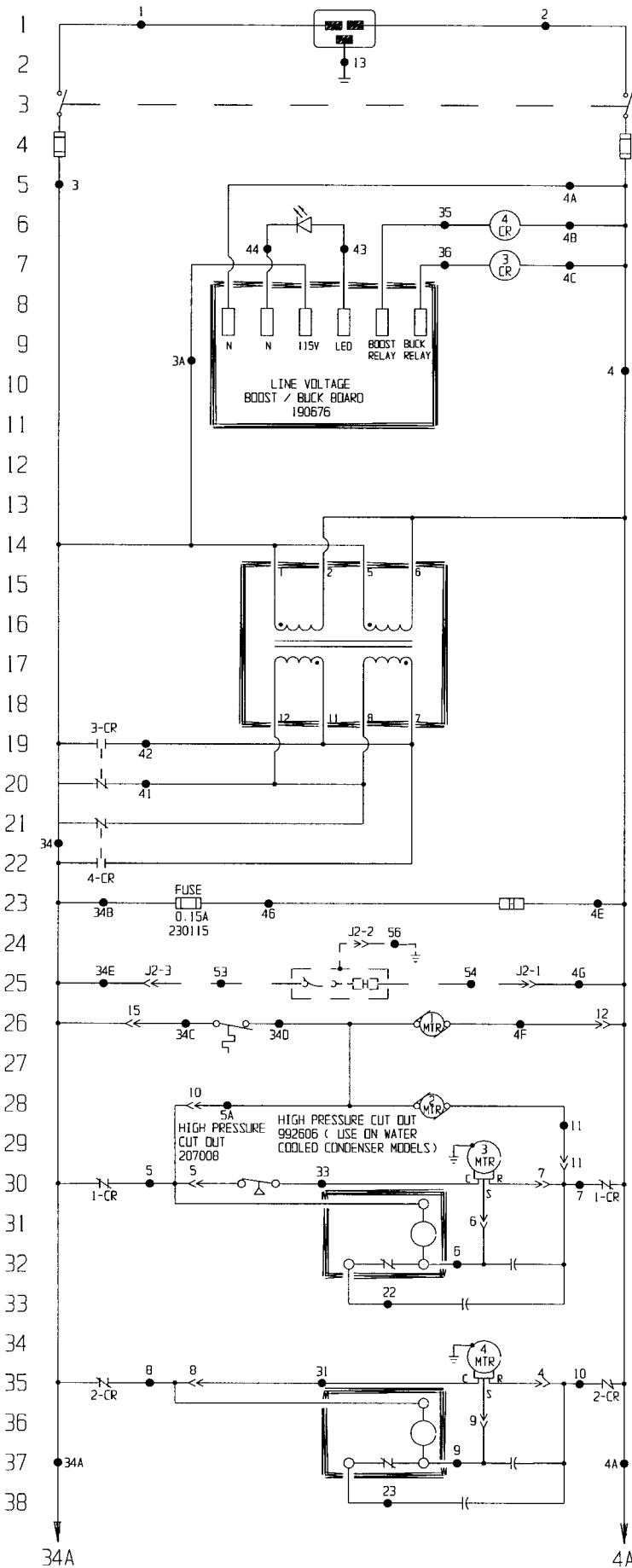


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Section 11 - Electrical Schematics

POWER CONNECTION
 120V, 1Ø, 2W, 60HZ, 15.5 FLA
 (OPERATING RANGE 108-130V)



- 460169
POWER INLET
- 360188
POWER SWITCH
- 285614
FUSE 20A
- 280059
VOLTAGE CORRECTION LED
- 300073
BOOST RELAY
20, 21
- 300073
BUCK RELAY
18, 19

- 420065
175VA TRANSFORMER

- 133007
VACUUM RELIEF PORT HEATER
12.5W @ 120VAC
UPRIGHT FREEZERS ONLY

- 132041
SPLIT DOOR HEATER
10W @ 120VAC
SPLIT DOOR OPTION ONLY

- 900113
TUBEAXIAL FAN

- 400105
BASE THERMOSTAT

- 900113
TUBEAXIAL FAN
- 990009
HIGH STAGE COMPRESSOR
1/2 H.P., 120V

- 300309
START RELAY

- 170108
RUN CAPACITOR
35UF, 370V

- 170012
START CAPACITOR
270-324UF, 125V

- 990009
LOW STAGE COMPRESSOR
1/2 H.P., 120V

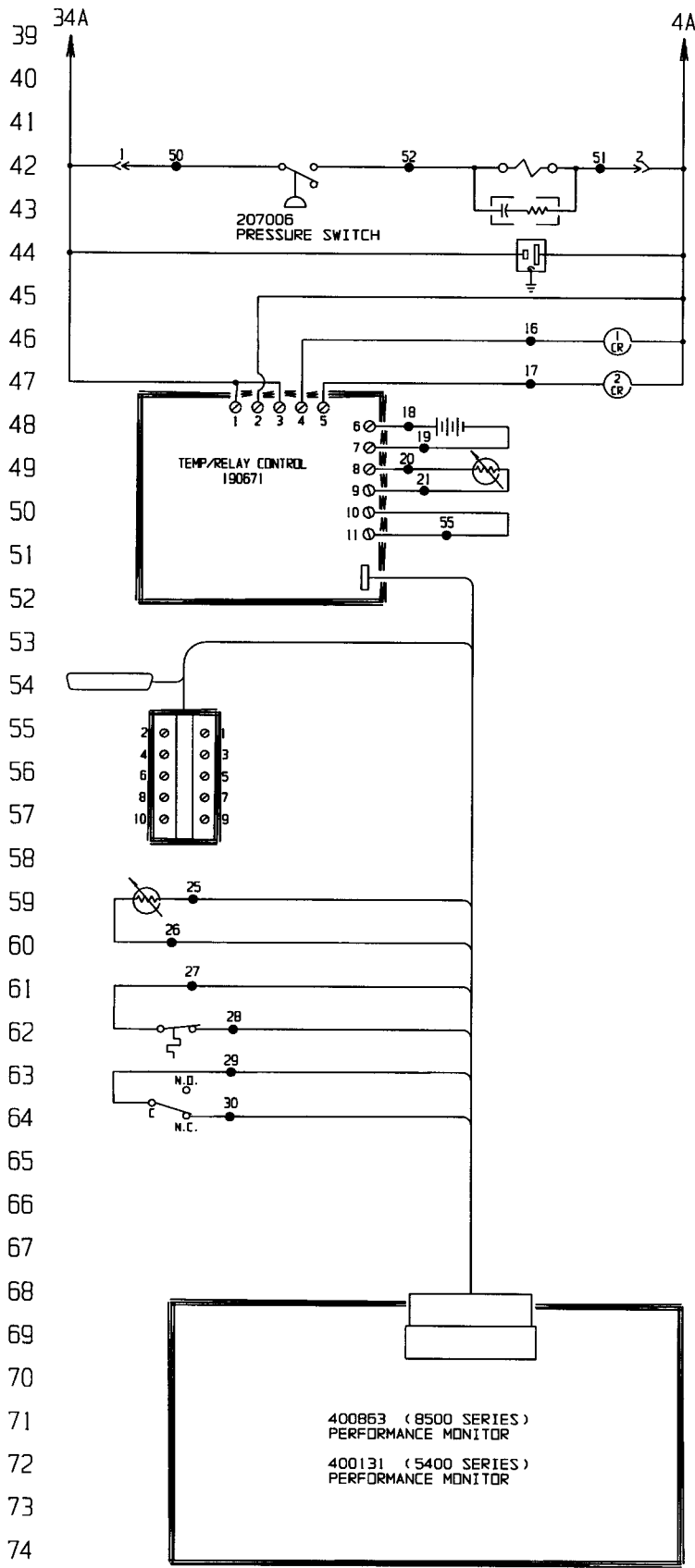
- 300309
START RELAY

- 170108
RUN CAPACITOR
35UF, 370V

- 170012
START CAPACITOR
270-324UF, 125V

Electrical Schematic
Forma Models:
 5416, 5426, 5439,
 5459, 8516, 8526,
 8539, and 8559
ULT Freezers

8516-70-0-D Rev. 9
 Page 1 of 3



- 250111 SOLENOID
- 270015 ARC SUPPRESSOR
- 460024 OUTLET OPTIONAL RECORDER
- 300230 HIGH STAGE CONTROL 30
- 300230 LOW STAGE CONTROL 35
- 400064 BATTERY, 6 VOLT, 8 A.H.
- 290041 TEMP CONTROL PROBE
- RS-232 PORT (SEE TABLE "A" AND SPECIFICATION)
- 370139 CUSTOMER REMOTE ALARM CONN. (SEE TABLE "B")
- 290041 TEMP MONITOR PROBE
- 400101 AIRFLOW MONITOR T-STAT, 40°C (OPEN ON RISE)
- 360157 UPRIGHT 285306 CHEST DOOR AJAR SWITCH (SHOWN IN DOOR OPEN POSITION)

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Electrical Schematic
Forma Models:
 5416, 5426, 5439,
 5459, 8516, 8526,
 8539, and 8559
 ULT Freezers

8516-70-0-D Rev. 9
 Page 2 of 3

WIRE REFERENCE CHART

	WIRE #	GAUGE	COLOR
	1	14	BLK
77	2	14	WHT
	3	14	BRN
	3A	20	BRN
78	4	14	WHT
	4A	20	WHT
79	4B	20	WHT
	4C	20	WHT
80	4D	20	WHT
	4E	18	BLU
81	4F	18	BLU
	4G	18	WHT
	5	14	BRN
82	5A	18	BRN
	6	14	RED
83	7	14	YEL
	8	14	BLK
84	9	14	PLR
	10	14	ORG
	11	18	YEL
85	13	14	GRN
	15	--	---
86	16	20	YEL
	17	20	ORG
	18	20	RED
87	19	20	BLK
	20	22	RED
88	21	22	WHT
	22	14	GRY
89	23	14	BLU
	25	22	RED
90	26	22	WHT
	27	20	BLK
	28	20	BLK
91	29	20	RED
	30	20	BLK
92	31	14	BLK
	32	--	---
	33	14	BRN
93	34	14	BLK
	34A	20	BLK
94	34B	18	BRN
	34C	18	BLK
	34D	18	BLK
95	34E	18	BLK
	35	20	ORG
96	36	20	YEL
	41	14	RED
97	42	14	BLK
	43	20	RED
98	44	20	BLK
	46	20	BRN
	50	18	BLK
99	51	18	WHT
	52	18	BRN
100	53	18	BLK
	54	18	WHT
101	55	20	BLU
	56	18	GRN/YEL

TABLE "A"

RS-232 PORT
PIN# 2 TXD
PIN# 3 RXD
PIN# 7 GND

RS-232 SPECIFICATION

BAUD = 1200
 PARITY = N
 BITS = 8
 STOP BITS = 2

TABLE "B"

CLUST. REMOTE ALARM CONNECTIONS	
TERM.#	DESCRIPTION
1	OVERTEMP COM.
2	OVERTEMP N.C.
3	OVERTEMP N.O.
4	MILLIVOLT OUT (POS.)
5	UNDERTEMP N.C.
6	MILLIVOLT OUT (NEG.)
7	UNDERTEMP COM.
8	UNDERTEMP N.O.
9	(NOT USED)
10	(NOT USED)

REMOTE CONTACT RATINGS

.5A @ 30VDC
 .6A @ 24VAC

NOTES:	
● Denotes Terminal Strip Connection	Parts List Reference Number
4-CR Lost Relay Number	○ Assembly
Lost Terminal Number	◇ Panel
56 Lost Wire Number	○ Refrigeration
	□ Wiring

CUSTOMER APPROVAL/REFERENCE
 APPROVED BY _____
 APPROVING FIRM _____
 DATE OF APPROVAL _____

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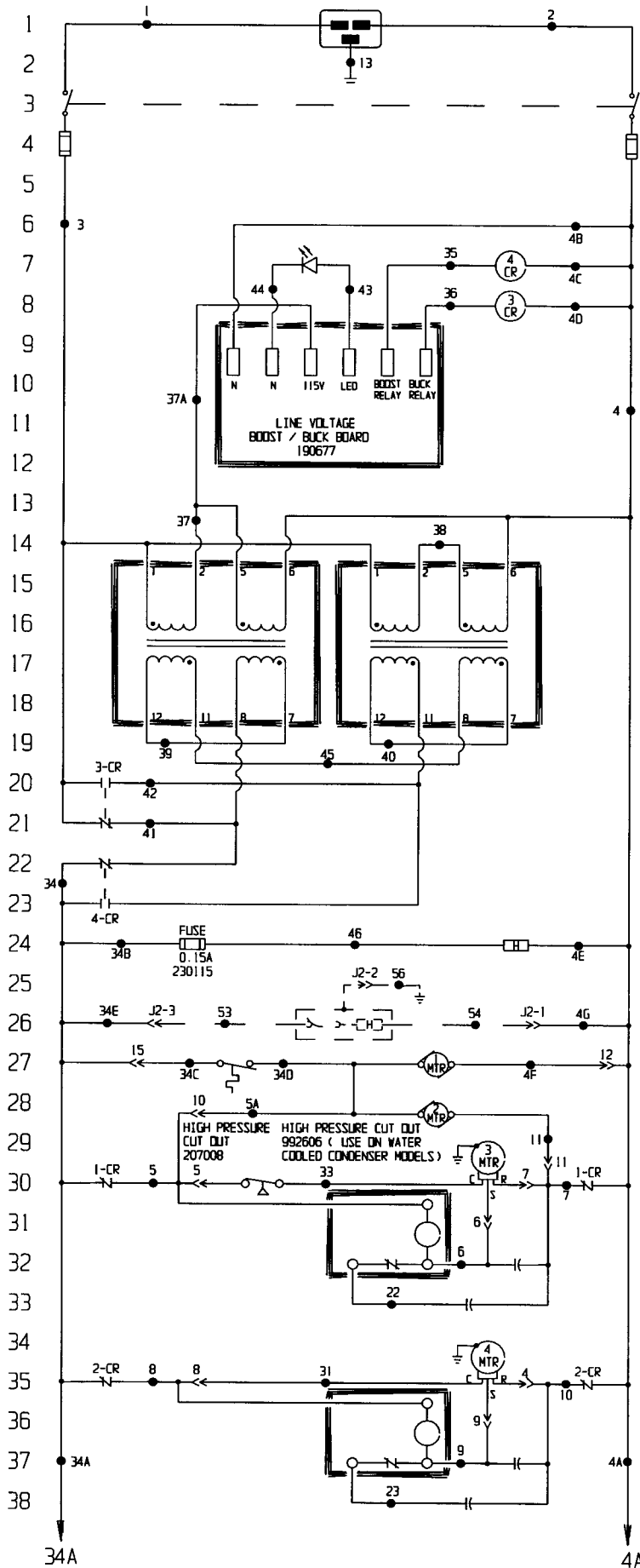
Forma Scientific

REV. 08/09/07, 08/02/09, 08/22/09, 08/23/09
 TEL: 708.454.9400 FAX: 708.454.9400

9	SI-6703	12-17-97	AT	KDG	HEG	ADD CONNECTORS FOR SPLIT DOOR OPT
8	SI-6706	11-18-97	AT	KDG	LON	REMOVE TEMP. CONTROL GRD. WIRE
7	FR-1146	11-18-97	AT	KDG	LON	ADDED ALT. SELECT MODELS
6	FR-1160	11-18-97	AFC	KDG	LON	ADDED OPERATING RANGE
5	FR-1116	04-24-97	AT	KDG	LON	ADDED (270015) ARC SUPPRESSOR
REV ECR NO.		DATE	BY	CAD	APPD	DESCRIPTION OF REVISION
		0-17-93	OWN	AT	CAD	AT APPD JV SCALE NONE
JOB TITLE		5416, 5426, 5439, 5459				
JOB TITLE		8516, 8526, 8539 & 8559 FREEZERS				
DWG TITLE		ELECTRICAL SCHEMATIC				
LOCATION		JOB NUMBER		DRAWING NUMBER		
				8516-70-0-D		

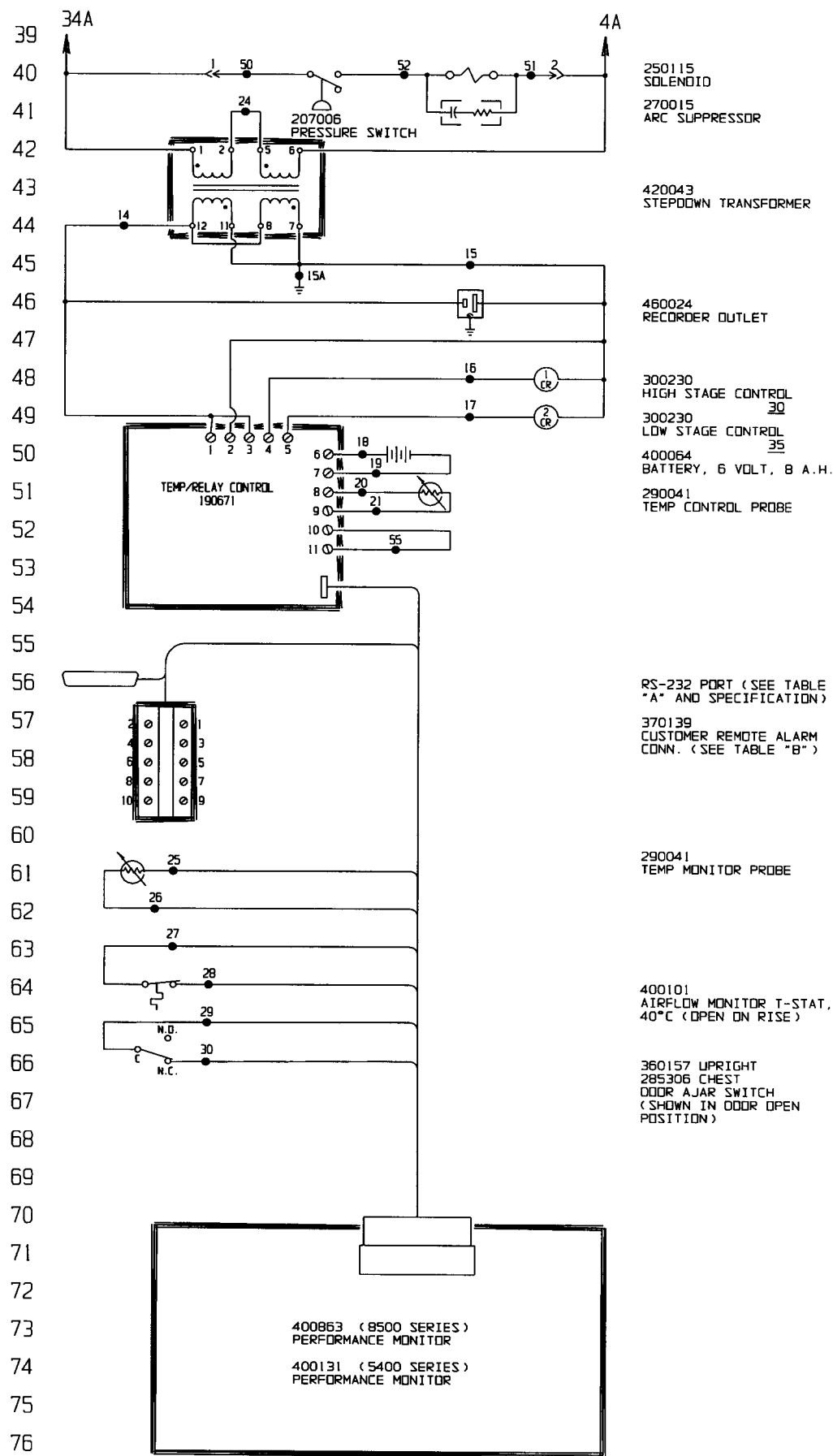
Electrical Schematic
Forma Models:
 5416, 5426, 5439,
 5459, 8516, 8526,
 8539, and 8559
 ULT Freezers

POWER CONNECTION
 230V, 1Ø, 2W, 50/60HZ, 12.0 FLA
 (OPERATING RANGE 208-240V)



- 460169
POWER INLET
- 360188
POWER SWITCH
- 285613
FUSE 15A
- 280059
VOLTAGE CORRECTION LED
- 300073
BOOST RELAY
20, 21
- 300073
BUCK RELAY
18, 19
- 420066
130VA TRANSFORMER, 2
- 133008
VACUUM RELIEF PORT HEATER
12.5W @ 220VAC
UPRIGHT FREEZERS ONLY
- 132042
SPLIT DOOR HEATER
10W @ 240VAC
SPLIT DOOR OPTION ONLY
- 900111
TUBEAXIAL FAN
- 400105
BASE THERMOSTAT
- 900111
TUBEAXIAL FAN
- 990004
HIGH STAGE COMPRESSOR
1/2 H.P., 220V
- 300310
START RELAY
- 170101
RUN CAPACITOR
5µF, 370V
- 170010
START CAPACITOR
88-108µF, 250V
- 990004
LOW STAGE COMPRESSOR
1/2 H.P., 220V
- 300310
START RELAY
- 170101
RUN CAPACITOR
5µF, 370V
- 170010
START CAPACITOR
88-108µF, 250V

Electrical Schematic
 Forma Models:
 5417, 5425, 5438,
 5458, 8517, 8525,
 8538, 8558, 8560,
 and 8590
 ULT Freezers



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250115
SOLENOID

270015
ARC SUPPRESSOR

420043
STEPPDOWN TRANSFORMER

460024
RECORDER OUTLET

300230
HIGH STAGE CONTROL
30

300230
LOW STAGE CONTROL
35

400064
BATTERY, 6 VOLT, 8 A.H.

290041
TEMP CONTROL PROBE

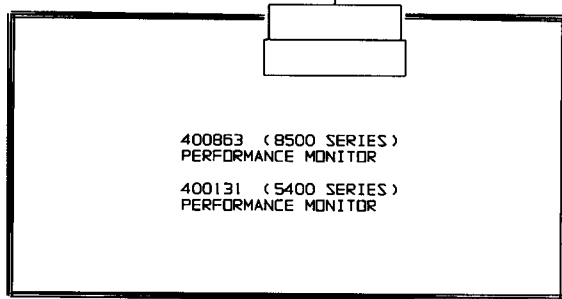
RS-232 PORT (SEE TABLE
"A" AND SPECIFICATION)

370139
CUSTOMER REMOTE ALARM
CONN. (SEE TABLE "B")

290041
TEMP MONITOR PROBE

400101
AIRFLOW MONITOR T-STAT,
40°C (OPEN ON RISE)

360157 UPRIGHT
285306 CHEST
DOOR AJAR SWITCH
(SHOWN IN DOOR OPEN
POSITION)



Electrical Schematic
Forma Models:
 5417, 5425, 5438,
 5458, 8517, 8525,
 8538, 8558, 8560,
 and 8590
ULT Freezers

WIRE REFERENCE CHART

WIRE #	GAUGE	COLOR
1	14	BRN
2	14	BLU
3	14	BRN
4	14	BLU
4A	20	BLU
4B	20	BLU
4C	20	BLU
4D	20	BLU
4E	18	BLU
4F	18	BLU
4G	18	WHT
5	14	BRN
5A	18	BRN
6	14	RED
7	14	YEL
8	14	BLK
9	14	PUR
10	14	ORG
11	18	YEL
13	14	GRN/YEL
14	20	BLK
15	20	WHT
15A	20	GRN
16	20	YEL
17	20	ORG
18	20	RED
19	20	BLK
20	22	RED
21	22	WHT
22	14	GRY
23	14	BLU
24	20	PUR
25	22	RED
26	22	WHT
27	20	BLK
28	20	BLK
29	20	RED
30	20	BLK
31	14	BLK
32	--	---
33	14	BRN
34	14	BRN
34A	20	BRN
34B	18	BRN
34C	18	BLK
34D	18	BLK
34E	18	BLK
35	20	ORG
36	20	YEL
37	14	PUR
37A	20	PUR
38	14	PUR
39	14	ORG
40	14	YEL
41	14	RED
42	14	BLK
43	20	RED
44	20	BLK
45	14	GRY
46	20	BRN
50	18	BLK
51	18	WHT
52	18	BRN
53	18	BLK
54	18	WHT
55	20	BLU
56	18	GRN/YEL

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TABLE "A"

RS-232	PORT
PIN# 2	TXD
PIN# 3	RXD
PIN# 7	GND

RS-232 SPECIFICATION

BAUD = 1200
PARITY = N
BITS = 8
STOP BITS = 2

TABLE "B"

CUST. REMOTE ALARM CONNECTIONS	
TERM. #	DESCRIPTION
1	OVERTEMP COM.
2	OVERTEMP N.C.
3	OVERTEMP N.D.
4	MILLIVOLT OUT (POS.)
5	UNDERTEMP N.C.
6	MILLIVOLT OUT (NEG.)
7	UNDERTEMP COM.
8	UNDERTEMP N.D.
9	(NOT USED)
10	(NOT USED)

REMOTE CONTACT RATINGS

.5A @ 30VDC
.6A @ 24VAC

NOTES:	
⊗ Denotes Terminal Strip Connection	Parts List Reference Number
4-CR Lost Relay Number	○ Assembly
N/A Lost Terminal Number	◇ Panel
54 Lost Wire Number	○ Refrigeration
	□ Wiring

CUSTOMER APPROVAL/REFERENCE
APPROVED BY _____
APPROVING FIRM _____
DATE OF APPROVAL _____

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Forma Scientific

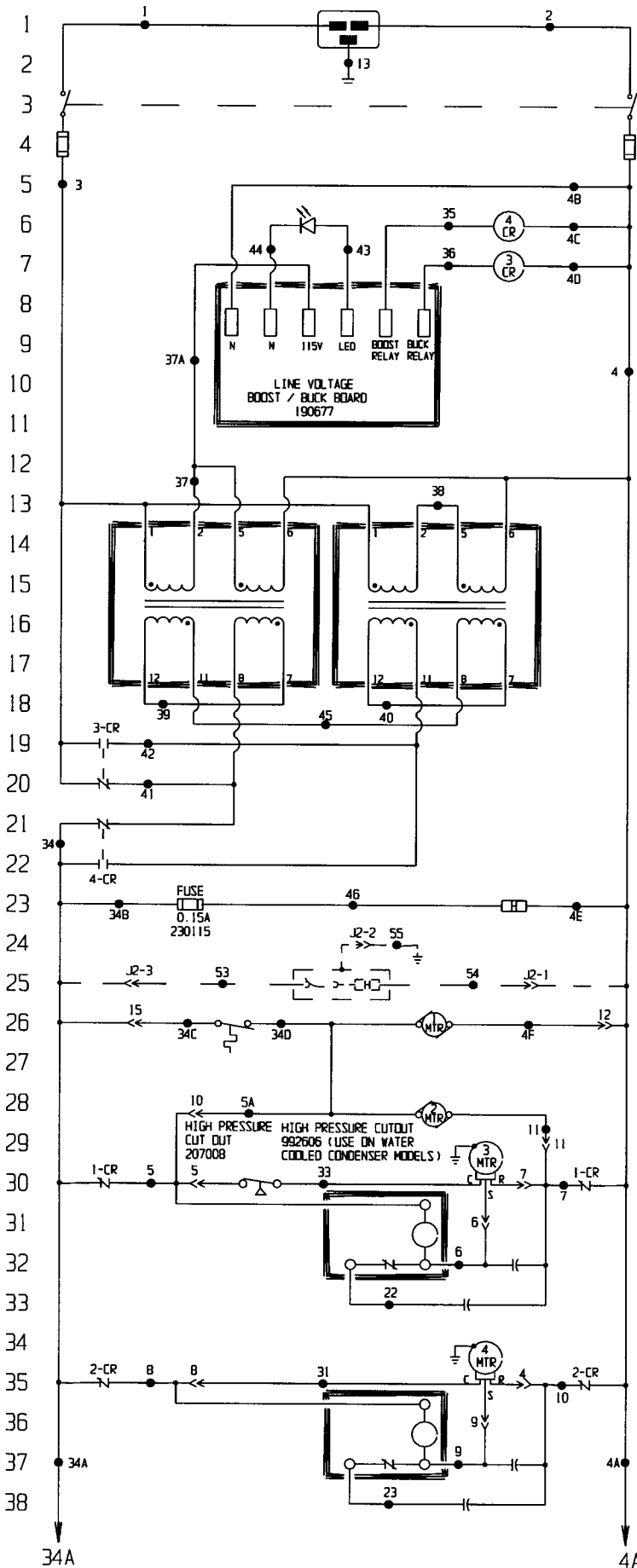
BOX 540 MINNETKA, OHIO 43750 TELE: 34-2384
TOLL FREE USA 800-946-2080, OHIO 614-373-4783

11	SI-6703	12-17-97	AT	KDG	HEG	ADD CONNECTORS FOR SPLIT DOOR OPT				
10	SI-6706	11-18-97	AT	KDG	LON	REMOVE TEMP. CONTROL GRD. WIRE				
9	FR-1146	11-18-97	AT	KDG	LON	ADDED ALT. SELECT MODELS				
8	FR-1160	11-18-97	AFC	KDG	LON	ADDED OPERATING RANGE				
7	FR-1116	04-24-97	AT	KDG	LON	ADDED (270015) ARC SUPPRESSOR				
REV	ECR NO.	DATE	BY	CAD	APPO	DESCRIPTION OF REVISION				
		DATE 8-17-93	DWN	AT	CAD	AT	APPO	JV	SCALE	NONE
JOB TITLE		5417, 5425, 5438, 5458								
JOB TITLE		8517, 8525, 8538, 8558, 8560 & 8590 FREEZERS								
DWG TITLE		ELECTRICAL SCHEMATIC								
LOCATION		JOB NUMBER		DRAWING NUMBER						
				8517-70-0-D						

Electrical Schematic
Forma Models:
5417, 5425, 5438,
5458, 8517, 8525,
8538, 8558, 8560,
and 8590
ULT Freezers

8517-70-0-D Rev. 11
Page 3 of 3

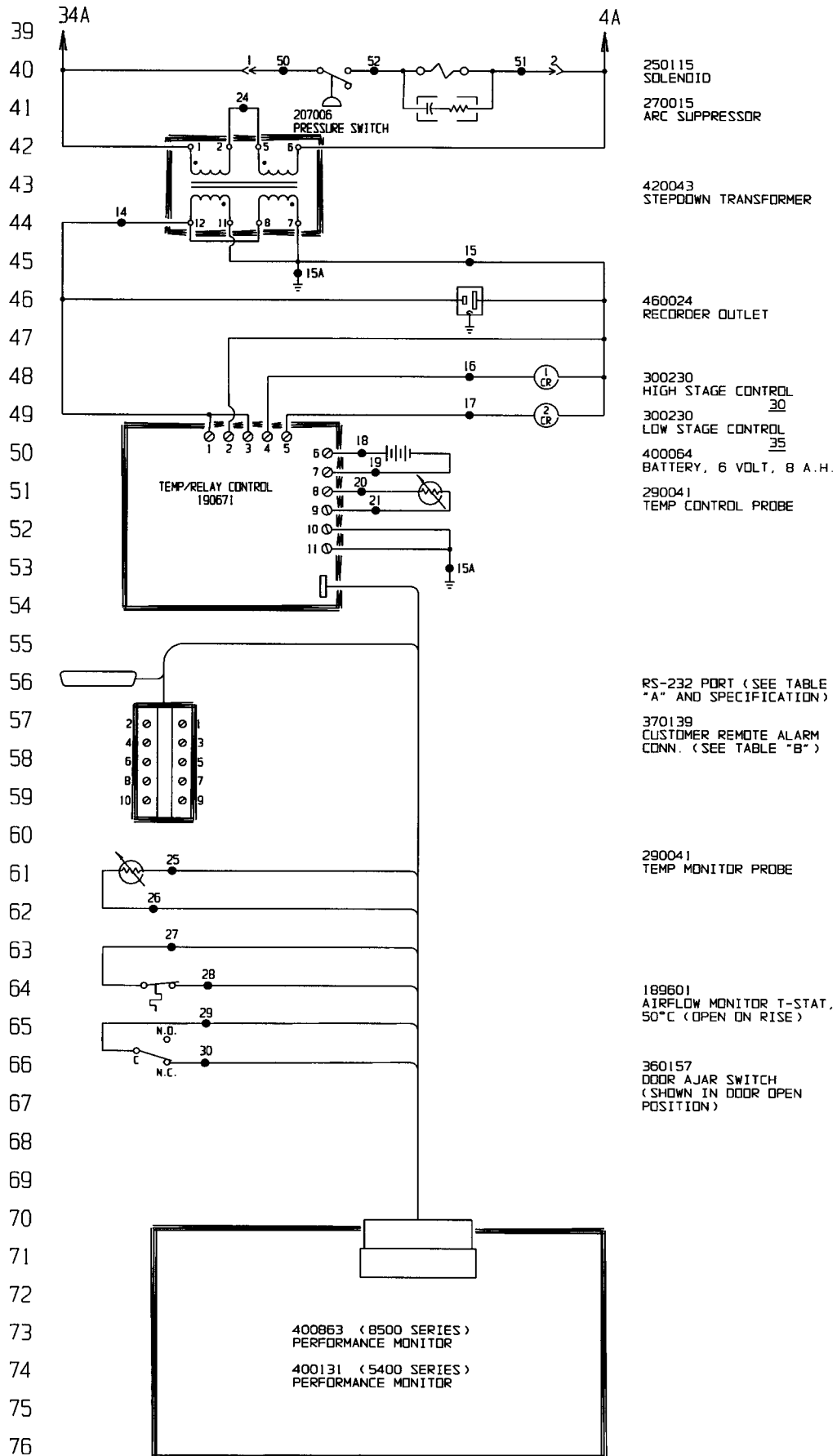
POWER CONNECTION
 230V, 1 ϕ , 2W, 50/60HZ, 14.0 FLA
 (OPERATING RANGE 208-240V)



- 460169
POWER INLET
- 360188
POWER SWITCH
- 285613
FUSE 15A
- 280059
VOLTAGE CORRECTION LED
- 300073
BOOST RELAY
20, 21
- 300073
BUCK RELAY
18, 19
- 420066
130VA TRANSFORMER, 2
- 133008
VACUUM RELIEF PORT HEATER
12.5W @ 220VAC
- 132043
SPLIT DOOR HEATER
13W @ 240VAC
SPLIT DOOR OPTION ONLY
- 900111
TUBEAXIAL FAN
- 400105
BASE THERMOSTAT
- 900111
TUBEAXIAL FAN
- 990014
HIGH STAGE COMPRESSOR
3/4 H.P., 220V
- 300308
START RELAY
- 170101
RUN CAPACITOR
5UF, 370V
- 170036
START CAPACITOR
145-175UF, 250V
- 990014
LOW STAGE COMPRESSOR
3/4 H.P., 220V
- 300308
START RELAY
- 170101
RUN CAPACITOR
5UF, 370V
- 170036
START CAPACITOR
145-175UF, 250V

Electrical Schematic
Forma Models:
8523 and 5423
ULT Freezers

8523-70-0-D Rev. 11
Page 1 of 3



Electrical Schematic
Forma Models:
8523 and 5423
ULT Freezers

WIRE REFERENCE CHART

	WIRE #	GAUGE	COLOR
77	1	14	BRN
78	2	14	BLU
	3	14	BRN
79	4	14	BLU
	4A	20	BLU
	4B	20	BLU
80	4C	20	BLU
	4D	20	BLU
	4E	18	BLU
81	4F	18	BLU
	5	14	BRN
82	5A	18	BRN
	6	14	RED
	7	14	YEL
83	8	14	BLK
	9	14	PUR
84	10	14	ORG
	11	18	YEL
85	13	14	GRN/YEL
	14	20	BLK
86	15	20	WHT
	15A	20	GRN
	16	20	YEL
87	17	20	ORG
	18	20	RED
	19	20	BLK
88	20	22	RED
	21	22	WHT
	22	14	GRY
89	23	14	BLU
	24	20	PUR
90	25	22	RED
	26	22	WHT
	27	20	BLK
91	28	20	BLK
	29	20	RED
92	30	20	BLK
	31	14	BLK
	32	--	---
93	33	14	BRN
	34	14	BRN
94	34A	20	BRN
	34B	18	BRN
	34C	18	BLK
95	34D	18	BLK
	35	20	ORG
96	36	20	YEL
	37	14	PUR
97	37A	20	PUR
	38	14	PUR
	39	14	ORG
98	40	14	YEL
	41	14	RED
99	42	14	BLK
	43	20	RED
	44	20	BLK
100	45	14	GRY
	46	20	BRN
101	50	18	BLK
	51	18	WHT
	52	18	BRN
102	53	18	BLK
	54	18	WHT
103	55	18	GRN/YEL

TABLE "A"

RS-232 PORT
PIN# 2 TXD
PIN# 3 RXD
PIN# 7 GND

RS-232 SPECIFICATION

BAUD = 1200
 PARITY = N
 BITS = 8
 STOP BITS = 2

TABLE "B"

CUST. REMOTE ALARM CONNECTIONS	
TERM. #	DESCRIPTION
1	OVERTEMP COM.
2	OVERTEMP N.C.
3	OVERTEMP N.O.
4	MILLIVOLT OUT (POS.)
5	UNDERTEMP N.C.
6	MILLIVOLT OUT (NEG.)
7	UNDERTEMP COM.
8	UNDERTEMP N.O.
9	(NOT USED)
10	(NOT USED)

REMOTE CONTACT RATINGS

.5A @ 30VDC
 .6A @ 24VAC

NOTES:

<input checked="" type="checkbox"/> Denotes Terminal Strip Connection	Parts List Reference Number
4-CR Lost Relay Number	<input type="checkbox"/> Assembly
N/A Lost Terminal Number	<input type="checkbox"/> Panel
55 Lost Wire Number	<input type="checkbox"/> Refrigeration
	<input type="checkbox"/> Wiring

CUSTOMER APPROVAL/REFERENCE

APPROVED BY _____
 APPROVING FIRM _____
 DATE OF APPROVAL _____

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Forma Scientific

BOX 940 WAREHO. DHD 4570 TEL# 34-434
 TEL. FREE USA 800-946-3000, DHD 514-373-4763

11	SI-6703	12-17-97	AT	KDG	HEG	ADD CONNECTORS FOR SPLIT DOOR OPT				
10	FR-1146	11-19-97	AT	KDG	LON	ADDED ALT. SELECT MODEL				
9	FR-1160	11-19-97	AFC	KDG	LON	ADDED OPERATING RANGE				
8	FR-1116	05-09-97	AT	KDG	LON	ADDED (270015) ARC SUPPRESSOR				
7	SI-5244	05-08-97	GJG	GJG	LON	ADD NOTE FOR WATER COND.				
REV	ECR NO.	DATE	BY	CAD	APPO	DESCRIPTION OF REVISION				
	DATE	8-17-93	DWN	AT	CAD	AT	APPO	JV	SCALE	NONE
CUSTOMER										
JOB TITLE 8523 & 5423 FREEZER										
DWG TITLE ELECTRICAL SCHEMATIC										
LOCATION				JOB NUMBER			DRAWING NUMBER			
							8523-70-0-D			

Electrical Schematic
 Forma Models:
 8523 and 5423
 ULT Freezers