THERMOTRON®

A Venturedyne, Ltd., Company

S/SM-Series Environmental Test Chamber Instruction Manual

Revision 3: October 17, 2011

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Table of Contents

General Information

Section A: Installation

Section B: Operation

Section C: Preventive Maintenance

Section D: Service

Section E: Parts Lists and Drawings

Section F: Appendix

Important Safety Instructions

Before you operate this chamber, read these warnings:

- Do not try to do electrical or refrigeration work if you are not approved. This manual does not replace electrical or refrigeration training.
- Directly connect the chamber to a dedicated electrical circuit in accordance with local codes. Do not use an extension cord or power strip to connect the chamber to an electrical outlet. If the supplied power cable is too short, consult Thermotron Industries or a licensed electrician.
- Do not operate this chamber unless it is fully assembled.
- Be sure the area around the chamber is satisfactorily ventilated if the chamber has one of these systems:
  - Gaseous nitrogen (GN_2) purge system
  - Liquid nitrogen (LN_2) injection system
  - Pressurized carbon dioxide (CO_2) injection system

  Nitrogen and carbon dioxide gases displace oxygen, which can cause suffocation and death. You must dilute these gases with a sufficient quantity of breathable room air. To safely install and use these systems, obey the instructions on the gas containers and in this manual.
- Do not operate this chamber if volatile material is in the area.
- Do not put into the chamber material that can explode, burn, or give off poisonous fumes at high temperatures. Use this chamber only for tests on material that the chamber was made for.

  This chamber is not explosion-resistant. Open-coil heaters can cause fumes to explode, even at low temperatures. Death or injury can occur.

  Petroleum-based and chemical-based material also can cause damage to chamber components. This will void the warranty.
- If a chemical spill occurs inside the chamber, refer to the accidental release measures listed in the chemical's Material Safety Data Sheets.
- Before you start the chamber, be sure the chamber door is closed.
- Do not stop or remove power from the chamber until the chamber air is near room temperature or lower. If you stop or remove power from the chamber when the chamber air is hot, heat can continue to increase. This can cause damage to the heat links and other components.
- Before you open the chamber door at the end of a test:
  - Be sure the air in the chamber is near room temperature.
  - Be sure the circulator fan has stopped turning.
- Stay away from air, objects, or surfaces that are hot or cold. They can cause burns or frostbite.

- Do not keep the primary power disconnected longer than necessary. When the primary power is off, the pump-down system cannot operate. As the temperature near the chamber becomes cooler, the pump-down system operates less frequently. The low-side compressor can then contain liquid refrigerant, which can cause damage to the compressor. Before you apply power to the chamber, be sure that the temperature of the compressor is at least +13°C (+55°F).
- Disconnect the primary power before you do electrical work on the chamber. The electrical system has dangerously high voltages that can kill you.
- Disconnect the primary power before you do work near parts that move. Do not remove guards or shields. Even when the chamber is off, fans and compressors can ALWAYS start when the primary power is connected.
- Do not put the machinery section at an angle of more than 45° without special instructions from Thermotron Industries.
- Keep this manual where it will be available to persons who use the chamber. This manual contains important safety data.

Read all the safety labels on the chamber:

- Red and white **DANGER** labels show risks that WILL immediately kill or injure you.
- Orange and black **WARNING** labels show risks that can kill or injure you.
- Yellow and black **CAUTION** labels show risks that can injure you or cause damage to products or property.
- Blue and white safety instruction labels are important reminders that you must read before you operate the chamber.
- Make sure that all warning labels stay attached to the chamber. You can buy new labels from Thermotron Industries.

Humidity system supply water requirements

It is your responsibility to provide proper supply water for your chamber's humidity system. Improper supply water can damage the humidity system.

NOTE: Any failures due to improper supply water are not covered under warranty.

To make sure your chamber's humidity supply water is adequate, you must determine the water's resistance in ohm-centimeters. The supply water must be clean and fall within the following resistances:

- 50k ohm-cm to 1M ohm-cm if you are not using a demineralizer.
- 2k ohm-cm to 50M ohm-cm if you are using a demineralizer.

If you use a demineralizer, you must follow the limits listed in the following table to avoid damaging your chamber's humidity system.

Humidity system water usage	
Model	***Maximum humidity water usage****
SM-4	0.28 liters/hour
SM-8	0.28 liters/hour
SM-16	0.66 liters/hour
SM-27	0.66 liters/hour
SM-32	0.66 liters/hour
* Based on +85°C and 95% RH operation.	

Water resistance guidelines	
Supply water resistance (ohm-cm)	***Cartridge water capacity (liters*)***
10,000	2,070
5,000	1,037
2,000	416
* All liters are approximate and based on +25°C water temperature.	

Notes

- The vapor generator should be drained monthly. Refer to "Draining the vapor generator" in Section C of this manual.
- All low-humidity chambers must first be operated in a temperature-only mode to evaporate any water condensation from inside the chamber before low-humidity specifications can be met.
- Refer to Section A (Installation) and Section C (Preventive Maintenance) for additional information.

Chamber capacity

CAUTION: To prevent damage to the sloped liner floor, protect any sharp corners or edges.

Standard chamber capacity				
Model	***Maximum floor capacity***	***Standard wire shelf capacity***	***Expanded metal shelf capacity***	***Total maximum capacity***
S/SM-4	114 kg / 251 lbs.	68 kg / 150 lbs.	68 kg / 150 lbs.	182 kg / 401 lbs.
S/SM-5.5	114 kg / 251 lbs.	23 kg / 50 lbs.	N/A	137 kg / 302 lbs.
S/SM-8	114 kg / 251 lbs.	68 kg / 150 lbs.	68 kg / 150 lbs.	182 kg / 401 lbs.
S/SM-16	114 kg / 251 lbs.	68 kg / 150 lbs.	68 kg / 150 lbs.	182 kg / 401 lbs.
S/SM-27	114 kg / 251 lbs.	68 kg / 150 lbs.	68 kg / 150 lbs.	182 kg / 401 lbs.
S/SM-32	114 kg / 251 lbs.	68 kg / 150 lbs.	68 kg / 150 lbs.	182 kg / 401 lbs.

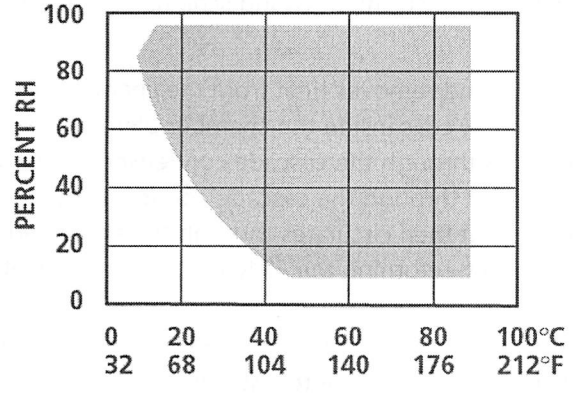
Notes

- All load capacities are specified as static loads. Load capacities cannot be guaranteed if a load is dropped on the floor or a shelf, or if the chamber is moved or transported while loaded.
- The floor capacity can be increased to 182 kilograms if your chamber was engineered to include a spreader plate or load bar.
- Any load capacity requirements exceeding specifications will require engineering.

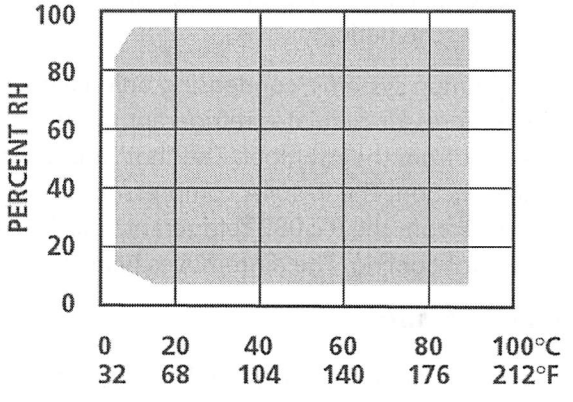
Performance specifications: SM-16-8200	
Temperature parameters	
Temperature range	+180°C to -68°C
Temperature control	+/- 0.3°C
Temperature uniformity[1]	+/- 0.7°C
Humidity specifications	
Humidity range	10 to 98% RH
Dry bulb temperature range	7°C to 88°C
Dew point temperature range	7°C to 87°C
Humidity control	+/- 2.5% RH
Humidity uniformity[2]	+/- 1.0% RH
Performance capacity	
Cooling[3]	
+180°C to -65°C	80 minutes
+71°C to -65°C	54 minutes
+85°C to -40°C	31 minutes
Heating[3]	
-40°C to +85°C	21 minutes
-65°C to +71°C	22 minutes
-65°C to +180°C	54 minutes

1. Temperature uniformity is the standard deviation from the mean measured at either -25°C or +100°C.
2. Based on temperature uniformity specifications.
3. Air temperature with an empty chamber.

ULTRA LOW TEMPERATURE / HUMIDITY CHAMBER



WITH OPTIONAL LOW HUMIDITY PACKAGE



General Description

Serial number 43216
Model number SM-16

Chamber electrical systems

CAUTION: This chamber has two separate sources of power.

The electrical systems consist of the electrical compartment and the control transformer.

- The electrical compartment contains the power panel, which distributes the main power to the chamber. Refer to the electrical schematic. The power panel contains the circuit breakers, fuses, contactors, and other electrical components that protect the electrical system and the operator.
- The control transformer steps down the main power to the power required by the instrumentation and control circuits.

Chamber environmental systems

The chamber's environmental systems are described below.

Air circulation system

Two chamber circulator provides air circulation through the test space. Refer to the electrical schematic. The circulators operate whenever the 8200 programmer/controller enables the control system.

Heating system

Nichrome heating coils provide heat to the chamber. The 8200 provides control to the heaters through digital output 1 of the CM2 control module. Refer to the electrical and the instrument wiring schematics.

Cooling system

Cooling is provided by a cascade refrigeration system: a one-horsepower R-404A system combined with a two-horsepower R-508B system. The 8200 provides cooling control to the system through solid-state relay 13 of CM2 control module. Refer to electrical schematic, the instrument wiring schematic, and the refrigeration schematic.

The refrigeration systems' condensing unit maintains pressure and removes heat from the chamber. The R-508B compressor circulates refrigerant through the evaporator coils inside the chamber plenum to remove heat from the chamber. The "hot" refrigerant circulates through the cascade condenser inside the machinery section. The R-404A compressor circulates refrigerant through the cascade condenser to remove heat from the R-508B refrigerant. The R-404A refrigerant then circulates through the air-cooled condenser for cooling. The air removes heat from the refrigerant, returning the R-404A to the liquid state.

Chamber plenum

The chamber plenum provides the heating, cooling, and air circulation to the test space. The plenum contains the air circulators, heater coils, and evaporator.

8200 programmer/controller

The 8200 is a programmable microcomputer that controls and monitors the chamber functions. You can program the 8200 to automatically operate your chamber, or you can manually operate the chamber using the 8200 display. You also can operate the 8200 from a computer using the Ethernet (TCP/IP) or the RS-232/485 interface.

The following paragraphs describe the interface between the 8200 and your chamber. For more detailed information, see the *8200 Display Module Instruction Manual.*

LIGHT button

The **LIGHT** button on the 8200 display operates the interior lights through solid-state relay 9 of the CM2 control module.

Option settings

The option settings allow you to select the available chamber options. This chamber has the humidity option available. Turn this option on when you want to run in humidity mode. This option disables the cascade system, and allows the 8200 to use the humidity system control outputs. The humidity range is between 20% and 95% relative humidity.

Solid-state relay boards

The 8200 uses solid-state relay boards on the control module for its control signals, including the auxiliary relays. Terminal block TB2 on the relay board provides the chamber control system connections. For an electrical description of the solid-state relay boards, see "Solid-state relay boards" in the *CM2 Control Module Technical Manual.*

Computer interface

Each 8200 display module is equipped with two independent computer interface ports. The 8200 can communicate through both ports at the same time:

- **Network (TCP/IP)**: Communication through the 8200 display module's Ethernet connector. This connector is a standard eight-pin RJ45 connector, but only makes use of four pins (two twisted pair). It is intended to enable a personal computer to communicate with an 8200 display module over a standard Ethernet network.
- **Computer I/O**: Communication through the control module com port capable of **either** RS-232, RS-485, or GPIB (IEEE-488).

For information on using a computer interface, see the *8200 Display Module Instruction Manual.*

Watlow Series L temperature limit

Your chamber is equipped with a Watlow Series L temperature limit that acts as the high limit switch (HLS). If the chamber temperature is greater than +191°C, this high limit switch will disable the heaters and circulators, preventing chamber operation. For additional information, refer to the Watlow manual in Section F.

A guide to the installation instructions

These instructions contain important information, but they are **not** intended to be a complete guide to installation. The illustrations may not match your chamber. Before starting up the chamber, make sure it is completely assembled according to the engineering drawings in Section E of this manual.

Read and follow the installation instructions checked below. **The instructions that are not checked do not apply to your chamber.**

Section A: Installation

*Follow all **WARNINGS** to prevent death or personal injury.*

WARNING: To safely install or start up the chamber, you must read the Important Safety Instructions on pages i-ii and everything checked on page A1. If you need help, contact the nearest Thermotron field service office.

WARNING: Do not perform the start-up procedure until all other installation is complete. Before starting up the chamber, you must read the instructions in Section B.

WARNING: Dangerously high voltages are present. Do not turn on the electrical power until you are instructed to do so in the start-up procedure.

WARNING: Disconnect the electrical power before working near moving parts. Keep all guards and shields in place.

WARNING: The gases from gaseous nitrogen (GN_2) purge systems, liquid nitrogen (LN_2) injection systems, and liquid carbon dioxide (CO_2) injection systems displace oxygen. These gases must be adequately diluted by breathable room air. Using the chamber in a poorly ventilated area results in a lack of oxygen, which could cause death. To safely install and use these systems, you must follow the instructions on the material containers, the installation instructions in this section of the manual, and the operating instructions in Section B of this manual.

WARNING: The automatic pump-down system can start a compressor and condenser fan at ANY time while the main power is connected.

*Follow all **CAUTIONS** to prevent equipment damage.*

CAUTION: This equipment is heavy; use the proper equipment to move it. Do not put strain on pipes or external components.

CAUTION: Never tip a refrigeration system more than 45° unless instructed by Thermotron Industries.

CAUTION: Use the electrical power supply shown on your chamber's electrical drawing and serial tag, located above the electrical compartment. Air, water, and other supplies must be within the limits shown in the applicable drawings in Section E of this manual.

CAUTION: Use silver/phosphorus/copper brazing alloy for all connections on refrigeration lines. Provide a constant, low-pressure purge of gaseous nitrogen (GN_2) on all refrigeration lines being soldered.

CAUTION: Do not use a refrigeration compressor as a vacuum pump.

CAUTION: If the chamber is removed from main power for any length of time, the R-404A, R-507, or R-134a compressor could contain liquid refrigerant, which can damage or destroy a compressor. Let the compressor warm to at least +13°C (+55°F) before applying main power. If the compressor is at +13°C (+55°F) or above, you may apply main power immediately. (As the ambient temperature becomes cooler, fewer pump-downs occur, and the possibility of damage increases.)

CAUTION: Do not use a refrigeration compressor as a vacuum pump.

Location

When choosing where to locate your Thermotron chamber, note the following:

- The floor must be solid, level, and able to support the weight of the chamber plus the product being tested.
- Allow for enough space around the chamber to fully open all doors and lift off all service panels. This will ensure adequate space for air circulation and serviceability.
- Because heat is produced when the chamber operates, you must provide enough ventilation to prevent excess heat build-up.
- If liquid nitrogen (LN_2), gaseous nitrogen (GN_2), or liquid carbon dioxide (CO_2) will be injected into the chamber, the location must be adequately ventilated to dilute the gas that is left in the chamber after each test.

WARNING: The gases from gaseous nitrogen (GN_2) purge systems, liquid nitrogen (LN_2) injection systems, and liquid carbon dioxide (CO_2) injection systems displace oxygen. These gases must be adequately diluted by breathable room air. Using the chamber in a poorly ventilated area results in a lack of oxygen, which could cause death.

Setting up your chamber

1. Inspect the chamber to see that no damage was done during shipment. If the chamber was damaged, note the damage on the bill of lading and contact the carrier or Thermotron Industries.
2. Remove the plastic wrapping and cut the metal bands holding the chamber to the skid.
3. You can move the chamber using the fork lift or, if the floor is smooth and level, you can roll the chamber on its casters.
4. Using a fork lift from the side, lift the chamber off the skid. **CAUTION**: The forks must extend through to the opposite side of the chamber.
5. Place the chamber in an area that will allow enough space on all sides for air circulation and service access.
6. Lock the casters if the casters have locks.
7. Turn the leveling pads down by hand until they meet the floor.
8. To determine if the chamber is level, place a carpenter's level that is at least two feet long along the length and width of the chamber. For best results, place the level on the edge of the chamber, ***not*** on the door or top sheet. Adjust the leveling pads as needed.
9. When the chamber is level and the door is operating properly, tighten the securing nut against the threaded insert.

Installing port gloves

CAUTION: To keep the port gloves from melting, remove them from the test space before operating the chamber above +65°C (+150°F). To remove gloves, pull them to the outside of the test space and insert the port plugs from the inside.

1. Remove the port plug and hose clamp from the glove port.
2. From the outside, insert the correct glove into the port and put the cuff of the glove around the port rim.
3. Fasten the glove in place with the hose clamp.

Directly connecting a demineralized water supply

CAUTION: The incoming humidity water must be demineralized and have a specific resistance of 50,000 to 1,000,000 ohm-cm. Do not use ultrapure water. See the humidity system supply water requirements on page iii of this manual.

1. Find the water inlet and outlet on your chamber. Refer to the assembly drawings in Section E for the inlet location.
2. Connect the humidity drain hose to an open drain.
3. If your chamber has a solid-state humidity sensor, make sure the DRAIN valve is closed on the vapor generator.
4. Connect your demineralized water supply directly to the humidity water inlet, and adjust the water regulator to 20 psig.
5. Check for leaks.

Installing a demineralizer

CAUTION: The incoming humidity water must be demineralized and have a specific resistance of 2,000 to 50,000 ohm-cm. Do not use ultrapure water. See the humidity system supply water requirements on page iii of this manual.

1. Find the water inlet and outlet on your chamber. Refer to the assembly drawings in Section E for the inlet location.
2. Connect the humidity drain hose to an open drain.
3. Place a gasket or O-ring on the top opening of the demineralizer cartridge and place a gasket or O-ring on the bottom fitting of the demineralizer holder.
4. Insert the top of the cartridge into the top fitting of the demineralizer holder and slide the bottom of the cartridge into the bottom fitting of the demineralizer holder.
5. Tighten the securing nut.
6. Make sure the valve on top of the demineralizer holder is open.
7. Make sure the DRAIN valve is closed on the vapor generator.
8. Connect your water supply to the demineralizer's inlet and set the water pressure regulator to 20 psig.
9. Check for leaks.

Installing a water purification system

CAUTION: The incoming humidity water must be demineralized and have a specific resistance of 2,000 to 50,000 ohm-cm. Do not use ultrapure water. See the humidity system supply water requirements on page iii of this manual.

1. Find the water inlet and outlet on your chamber. Refer to the assembly drawings in Section E for the inlet location.
2. Connect the humidity drain hose to an open drain.
3. Place the supplied water filter in the water filter bowl and screw the bowl into the fitting.
4. Tighten the assembly using the supplied plastic wrench. **CAUTION**: Use the supplied wrench only, or you could break the bowl.
5. Install the demineralizer cartridge.
   - Place a gasket or O-ring on the top opening of the demineralizer cartridge and place a gasket or O-ring on the bottom fitting of the demineralizer holder.
   - Insert the top of the cartridge into the top fitting of the demineralizer holder and slide the bottom of the cartridge into the bottom fitting of the demineralizer holder.
   - Tighten the securing nut.
   - Make sure the valve on top of the demineralizer holder is open.
6. Make sure the DRAIN valve is closed on the vapor generator.
7. Connect your water supply to the filter assembly and set the water pressure regulator to 20 psig.
8. Check for leaks.

Installing a pressurized water recirculation system

CAUTION: The incoming humidity water must be demineralized and have a specific resistance of 2,000 to 50,000 ohm-cm. Do not use ultrapure water. See the humidity water supply requirements in the front of the manual.

1. Find the water inlet and outlet on your chamber. Refer to the assembly drawings in Section E for the inlet location.
2. Connect the humidity drain hose to an open drain.
3. Place the supplied water filter in the water filter bowl and screw the bowl into the fitting.
4. Tighten the assembly using the supplied plastic wrench. **CAUTION**: Use the supplied wrench only, or you could break the bowl.
5. Install the demineralizer cartridge.
6. Place a gasket or O-ring on the top opening of the demineralizer cartridge and place a gasket or O-ring on the bottom fitting of the demineralizer holder.
7. Insert the top of the cartridge into the top fitting of the demineralizer holder and slide the bottom of the cartridge into the bottom fitting of the demineralizer holder.
8. Tighten the securing nut.
9. Make sure the valve on top of the demineralizer holder is open.
10. Make sure the DRAIN valve is closed on the vapor generator.
11. Connect your water supply to the inlet on the recirculation tank, or manually add water to the tank through the opening on the top.
    - If you connect a water supply to the inlet, the tank will automatically fill until a float shuts the water off. The pump starts running when you turn on the chamber power. Set the water pressure regulator at 20 psig, and check for leaks.
    - If you add water to the recirculation tank, the pump starts running when you turn the chamber power on. Check for leaks.

    NOTE: If the recirculator pump stops and the LOW WATER lamp lights, you need to add more water to the tank and press the RESET button. If the pump stops again and the LOW WATER lamp lights, repeat this step. You should only have to add water if you do not have a water supply hooked up to the recirculation tank.

Connecting a dry air purge system

1. Locate the fitting labeled air inlet. Refer to the assembly drawings in Section E for the inlet location.
2. Attach an air supply to the inlet. The air must be clean, oil-free, and free of liquid water. The air inlet pressure should be 60-100 psig.
3. While the purge is operating, adjust the flowmeter according to the dryer manual in Section F.

Installing a GN_2, LN_2, or CO_2 system

WARNING: Improper installation of a liquid nitrogen (LN_2), gaseous nitrogen (GN_2), or liquid carbon dioxide (CO_2) system can cause death by suffocation. Make sure the chamber is vented according to the following instructions.

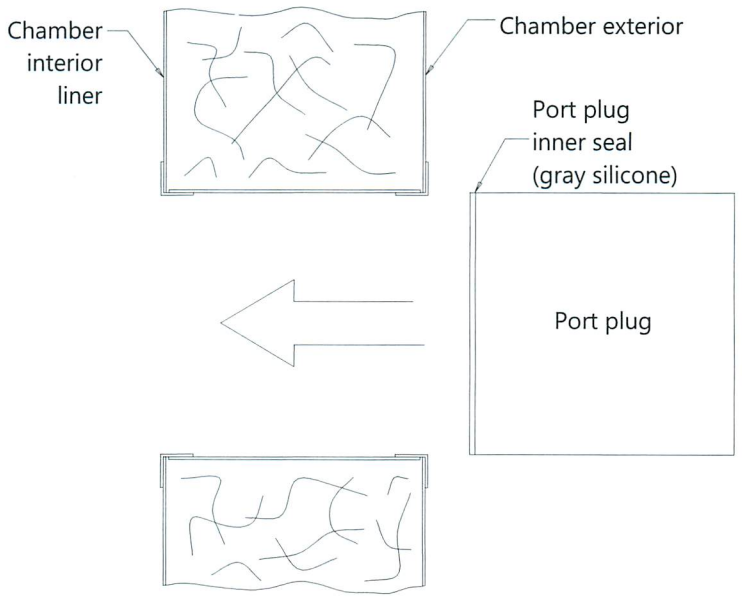
These instructions apply only to chambers that have injection cooling, boost cooling, or a GN_2 purge system. For a list of your chamber's options, refer to "General description" on page vi.

1. Connect a vent line from the chamber vent, located on top of the chamber, to the outside of the building.
   - The vent can be hard plastic, steel, copper, or flexible.
   - Make sure the vent outlet is not near a fresh air intake to the building.
   - Make the vent as short and straight as possible.
   - The vent line must be at least as large in diameter as the chamber vent.
2. Find the chamber inlet labeled LN_2, GN_2, or CO_2. Refer to the LN_2, GN_2, or CO_2 layout drawings in Section E for the inlet location.
3. Connect the needed supply using the appropriate size copper line:
   - For LN_2 systems, connect a liquid nitrogen supply to the inlet at a maximum pressure of 40 psig. Include a high-pressure relief valve in the line, and insulate the line.
   - For GN_2 systems, connect a gaseous nitrogen supply to the inlet at a maximum pressure of 100 psig.
   - For CO_2 systems, connect a carbon dioxide supply to the inlet at a maximum pressure of 1,000 psig. Include a high-pressure relief valve in the line, and insulate the line.
4. Pressurize the line and check for leaks using a leak-detecting solution.

Installing humidity port plugs

It is very important to properly install port plugs for low humidity operation. Improper installation of port plugs will result in poor low humidity performance and can lead to damage to the chamber exterior.

Any humidity port plugs must be properly installed to ensure a good seal. From the outside of the chamber, insert the inner seal end of the port plug into the port. Refer to the illustration to the right.



Connecting the condenser water supply

CAUTION: The pressure of your water supply must be at least 30 psig.

CAUTION: The supply and drain piping must be at least as large as the inlet and outlet fittings. If you are connecting more than one chamber to the same line, make sure the piping is large enough to handle the combined water requirements.

1. Find the water inlet and outlet on your chamber.
    - The condenser will be oriented horizontally or vertically, and the water will flow counter to the refrigerant.
    - To determine which hook-up is the inlet and which is the outlet, check the chamber labels or the assembly drawings in Section E of this manual.
    - To determine your chamber's water supply requirements, refer to page iii of this manual.
2. Connect the drain outlet to your drain.
3. Flush the line with water to remove any debris.
4. Connect the water supply line to the water inlet.

NOTE: Glycol 50/50 mix by mass has a specific heat capacity of about 0.75 BTU/lb °F, thus requiring increased flow rates in same-system comparisons with water.

Installing refrigeration piping

WARNING: Do not attempt to install refrigeration piping if you are not a qualified refrigeration technician. You could injure yourself or damage the chamber. This manual is not a substitute for refrigeration training.

CAUTION: To reduce copper oxide contamination, use a constant low-pressure gaseous nitrogen (GN_2) purge on all refrigeration lines being brazed and soldered.

CAUTION: Use silver/phosphorous/copper brazing alloy for all connections on refrigeration lines.

CAUTION: Do not use a refrigeration compressor as a vacuum pump.

1. Connect the piping according to the refrigeration drawings.
2. Install inverted traps on the inlet lines to the air-cooled condenser.
3. Test for leaks on all joints you have soldered, and insulate the lines as necessary. (Double insulate R-23 or R-508B liquid lines.)
4. Use a portable vacuum pump to evacuate the refrigeration system(s) to 500 microns. The system must maintain 500 microns for at least 10 minutes with the pump off and the manifolds closed.

Installing electrical wiring

WARNING: Do not attempt to perform electrical work if you are not qualified. This manual is not a substitute for electrical training.

WARNING: Unless the main disconnect switch is turned off, the programmer/controller will begin operating the chamber as soon as power is connected to the chamber.

Install the main power wiring according to the electrical schematic in Section E of this manual and the power requirements shown on the serial tag located above the electrical compartment. Use an electrical supply system with a separate electrical ground conductor and use the correct size circuit breaker or fuse. Leave the main power disconnect switch off; it will be turned on during start-up procedures.

Make sure the input voltage is correct (refer to the electrical schematic in Section E), and connect your chamber to the power supply. Run the supply line into the electrical compartment using the connector required by the applicable electrical code. Connect power leads to the disconnect switch terminals and run the ground wire to the ground block on the electrical panel.

Starting up a chamber

WARNING: You must operate the chamber to perform this procedure. Do not attempt to operate the chamber unless you have read the instructions in Section B that are checked on page B1.

WARNING: Do not start up the chamber until all the other installation procedures are complete. Make sure the chamber is completely assembled according to your engineering drawings.

CAUTION: If the chamber is removed from main power for any length of time, your R-134a, R-507, or R-404A compressor could contain liquid refrigerant, which can damage or destroy a compressor. Check your chamber's refrigeration schematic and perform one of these steps:

- If your compressor has a crankcase heater only, feel the base of the compressor. If it is warm to the touch, you can resume operation. If it is cool to the touch, you must leave the main power on without operating the chamber until the compressor is warm to the touch.
- If your compressor has a pump-down pressure switch (PDPS), you should let the compressor warm to ambient temperature if it is cold before applying main power. If the compressor is at ambient temperature or above, you may apply main power immediately. (As ambient temperature becomes cooler, fewer pump-downs occur, and the possibility of damage increases.)

NOTE: If your chamber has injection cooling only, please disregard references to mechanical refrigeration.

1. Find any service valves that have red tags attached. For each valve with a red tag:
   - Remove the service cap.
   - Loosen the packing gland.
   - Turn the valve stem all the way out (backseat).
   - Remove the red tag.
   - Tighten the packing gland.
   - Replace the service cap.
   - Leak check the valve and cap assembly.
2. If your chamber has a water-cooled condenser, make sure the water supply is on.
3. Make sure the chamber power is off and the electrical compartment door is closed.
4. Make sure the input voltage is correct (refer to your electrical schematics), and connect your chamber to the power supply.
5. If your compressor has a crankcase heater, turn the main power on and wait until the compressor becomes warm to the touch before operating the chamber. If your chamber has a pump-down pressure switch (PDPS), allow the chamber to warm to ambient temperature, and turn on the main power.
6. To perform a test, refer to "Performing a test" in Section B of this manual.

A guide to the operation instructions

Read and follow the operating instructions that are checked below. **The instructions that are not checked do not apply to your chamber.**

Section B: Operation

*Follow all **WARNINGS** to prevent death or personal injury.*

WARNING: To safely operate the chamber, you must read the Important Safety Instructions on pages i-ii and all instructions in Section B that are checked on page B1.

WARNING: Avoid exposing yourself to air or equipment that is not near room temperature.

WARNING: Port gloves do not insulate your hands. Using gloves left in a chamber when the temperature is lower than 0°C (+32 °F) or higher than +37.8°C (+100°F) could cause frostbite or burn your hands.

WARNING: Avoid moving parts such as fan blades even when the chamber is not operating. Keep all guards and shields in place.

WARNING: Use this chamber only for testing the products it was designed to test. Do not put products in the chamber that could burn or explode at high temperatures. **NOTE**: Open coil heaters could cause fumes to explode even at low temperatures.

WARNING: Keep the chamber door closed while the chamber is operating.

WARNING: The gases from gaseous nitrogen (GN_2) purge systems, liquid nitrogen (LN_2) injection systems, and liquid carbon dioxide (CO_2) injection systems displace oxygen. These gases must be adequately diluted by breathable room air. Using the chamber in a poorly ventilated area results in a lack of oxygen, which could cause death. To safely install and use these systems, you must follow the instructions on the material containers, the installation instructions in Section A of this manual, and the operating instructions in this section of the manual.

*Follow all **CAUTIONS** to prevent equipment damage.*

CAUTION: If your chamber is removed from main power for any length of time, your R-507, R-404A, or R-134a compressor could contain liquid refrigerant, which can damage or destroy a compressor. Check you chamber's refrigeration schematic and perform one of these steps:

- If your compressor has a crankcase heater only, feel the base of the compressor. If it is warm to the touch you can resume operation. If it is cool to the touch, you must leave the main power on without operating the chamber until the compressor is warm to the touch.
- If your compressor has a pump-down pressure switch (PDPS), you should let the compressor warm to ambient temperature if it is cold before applying main power. If the compressor is at ambient temperature or above, you may apply main power immediately. (As ambient temperature becomes cooler, fewer pump-downs occur, and the possibility of damage increases.)

CAUTION: Do not operate the chamber beyond the specifications given on page v.

CAUTION: Product protection is your responsibility. To protect your product from temperatures that are too high or too low, you must use a product protection device such as a Therm-Alarm. To see if your chamber is equipped with a Therm-Alarm, refer to "General description" on page vi.

CAUTION: To keep port gloves from melting, remove them from the test space before operating the chamber above +65°C (+150°F). To remove gloves, pull them to the outside of the test space and insert the port plugs from the inside.

CAUTION: Before resetting a safety device, read "What to do if the chamber does not operate" later in this section of the manual.

Performing a test

WARNING: Read everything checked on page B1 before operating the chamber.

NOTE: For a description of your chamber's systems, controls, and instrumentation, refer to "General description" on page vi.

NOTE: If your chamber is equipped with a Therm-Alarm, the high limit has been set to +30°C at the factory. Thermotron recommends resetting this limit to a more suitable value to prevent Therm-Alarm trips while using your chamber. For additional information, see the Therm-Alarm section of your programmer/controller manual.

NOTE: Refer to the *8200 Display Module Instruction Manual* as needed.

Operating the chamber in program mode

1. Load the products into the chamber and close the door.
2. Program a test on the 8200. Program any systems and/or options on or off for each interval as needed to perform the test.
3. Using the run program mode, start the test with the 8200.
4. Before removing a product after a test, operate the chamber back to ambient temperature.

WARNING: Read everything checked on page B1 before operating the chamber.

NOTE: For a description of your chamber's systems, controls, and instrumentation, refer to "General description" on page vi.

NOTE: If your chamber is equipped with a Therm-Alarm, the high limit has been set to +30°C at the factory. Thermotron recommends resetting this limit to a more suitable value to prevent Therm-Alarm trips while using your chamber. For additional information, see the Therm-Alarm section of your programmer/controller manual.

NOTE: Refer to the *8200 Display Module Instruction Manual* as needed.

Operating the chamber in manual mode

1. Load the products into the chamber and close the door.
2. At the 8200, use the manual mode to operate the chamber. Turn any systems and/or options on or off as needed to perform the test.
3. Before removing a product after a test, operate the chamber back to ambient temperature.

Connecting and disconnecting the electrical power

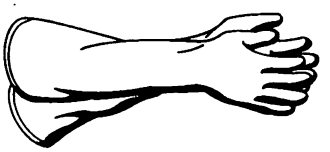
Use the main power disconnect switch to turn the main power on or off. If your chamber has a Thermotron-supplied disconnect switch on the electrical compartment door, put this switch in the OFF position to disconnect the electrical power. Put it in the ON position to connect the electrical power.

Although at times you must disconnect the electrical power, do not leave the power off for longer than necessary, or a refrigeration trip may occur.

Using port gloves

WARNING: The port gloves do not insulate your hands. Using gloves left in a chamber when the temperature is lower than 0°C (+32°F) or higher than +37.8°C (+100°F) could cause frostbite or burn your hands.

CAUTION: To keep the port gloves from melting, remove them from the test space before operating the chamber above +65°C (+150°F). To remove the port gloves, pull them to the outside of the test space and insert the port plugs from the inside.



Use the port gloves to handle a product on test without opening the chamber door.

What to do if the chamber does not operate

WARNING: If you need further service, get qualified help. Attempting to service the chamber without adequate training can cause death or serious injury, or could damage the chamber.

CAUTION: If a switch trips more than once, get qualified help; the cause of the tripping must be determined before you use the chamber. Improper resetting can result in damage to the chamber and the product under test.

Thermotron chambers have safety devices that prevent the chamber from operating when a problem exists. Some commonly used safety devices that can be reset by the operator are explained here. If necessary, call the Thermotron Product Support office at (616) 392-6550 between 8:00 am and 5:30 pm Eastern Standard Time.

A Therm-Alarm, System Monitor, or other optional instrument can cause trips that can be reset by the operator. (The System Monitor can also tell you what caused the failure.) For more information, see the programmer/controller instruction manual following Section F of this manual.

Some chambers have pressure switches located on gray or white boxes near the compressor(s). If your chamber stops operating, check these switches. You can reset them either by pushing in a button or by pushing down a tab that is located in the upper left corner of the box. If your chamber will not start up or starts up and quits again, get qualified help.

Some chambers (usually those with LN_2 or CO_2 cooling) have a low limit switch (LLS). The LLS trips if the chamber gets too cold. After the chamber has returned to an acceptable temperature, the LLS resets automatically.

A guide to the preventive maintenance instructions

Read and follow the preventive maintenance instructions checked below. **The instructions that are not checked do not apply to your chamber.** The OEM literature section following Section F of this manual may contain additional preventive maintenance instructions.

Every week

Every month

Every three months

Section C: Preventive Maintenance

*Follow all **WARNINGS** to prevent death or personal injury.*

WARNING: Dangerously high voltages that can kill you are present. Disconnect the electrical power before doing any electrical work.

WARNING: Disconnect the electrical power before working near moving parts. Replace any guards or shields that you remove.

WARNING: Do not attempt to perform electrical or refrigeration work if you are not qualified. This manual is not a substitute for electrical or refrigeration training.

WARNING: To safely perform preventive maintenance, you must read the Important Safety Instructions on pages i-ii and everything in Section C that is checked on page C1. Before operating the chamber, you must read the instructions in Section B that are checked on page B1.

WARNING: Unless the manual states otherwise, make sure the chamber is not operating and allow the components you are servicing to reach room temperature before performing any maintenance or service.

WARNING: The automatic pump-down system can start a compressor at ANY time while the main power is connected.

*Follow all **CAUTIONS** to prevent equipment damage.*

CAUTION: For additional preventive maintenance information, refer to the OEM literature section following Section F of this manual.

CAUTION: Although at times you must disconnect the main power for safety reasons, do not leave it off for longer than necessary. The automatic pump-down system cannot operate when the main power is off.

NOTE: Use the main power disconnect switch to disconnect the electrical power from the chamber. If your disconnect switch is supplied by Thermotron, it is located on the electrical compartment door; put this switch in the OFF position to disconnect the electrical power.

NOTE: The System Monitor can remind you when maintenance is due. If your chamber has a System Monitor, see the System Monitor sections of the programmer/controller instruction manual for more information.

Checking the R-23 or R-508B charge (for chambers with built-in refrigeration gauges)

CAUTION: The refrigeration system must be at room temperature. If you leave the chamber off at night, check the charge in the morning.

Suggested frequency: Every week

1. Make sure the refrigeration system is at room temperature. The system may need to be off for 12 hours or more to reach room temperature.

   NOTE: If your refrigeration gauges have shut-off valves, open the valves while checking the gauges, and close them when you are done.

2. Make sure the R-23 or R-508B discharge and suction gauges show the same pressure.

3. Compare the pressure shown on the gauges with the low-stage standby pressure shown on the serial tag located on the electrical compartment. If the pressure shown on the gauges is more than 5 psig below the pressure shown on the tag, the system must be charged. Before turning to the charging instructions, check the R-23 or R-508B charge using a refrigeration gauge manifold.

Checking the R-134a, R-507,or R-404A charge

WARNING: You must operate the chamber to perform this procedure. Do not attempt to operate the chamber unless you have read the instructions in Section B that are checked on page B1.

Suggested frequency: Every week

1. Remove the necessary panel(s) from the machinery section and find the refrigerant sight glass. The sight glass is located after the filter dryer in the refrigeration line.

2. Remove the cap on the sight glass.

3. Operate the chamber for five minutes at a set point that requires maximum cooling.

4. Check the refrigerant sight glass. If a large amount of bubbles appear in the sight glass, you must charge the system. See the instructions in Section D, "Charging the R-134a, R-404A, or R-507 high-stage or single-stage refrigeration system."

Cleaning the air-cooled condenser

Suggested frequency: Every week

Check for dirt in the condenser fin coils. If you see dirt, disconnect the condenser's electrical power and either vacuum the dirt out of the fin coils or use compressed air to blow it out. If you use compressed air, blow the dirt to the outside of the machinery section so that it will not become lodged in the coil. Also, check the condenser for signs of rubbing or abrasion on tubing, and make sure the fan blades are tight and the condenser fan motor is bracketed down tightly.

Checking and replacing the demineralizer

WARNING: Changing the demineralizer cartridge can expose you to scalding water and cause injury. Thermotron recommends draining the vapor generator before you replace the demineralizer cartridge.

Suggested frequency: Every week

Look at the demineralizer cartridge. Cartridges start as a mix of white and purple beads, which gradually change to a gold color. The color changes from top to bottom. When only the bottom three inches are not gold, replace the cartridge. Replacement cartridges are available from Thermotron Industries.

Replacing the demineralizer cartridge

1. Make sure the chamber is in stop mode.
2. Loosen the securing nut at the bottom of the bracket.
3. Remove the used cartridge by pulling the bottom of the cartridge out of the fitting.
4. The washers usually will remain in the fittings when you remove the used cartridge. If the washers from the used cartridge did not stay in place, place a washer on the top opening of the new cartridge, and place a washer on the bottom fitting of the fixture.
5. Insert the end of the new cartridge marked TOP into the top fitting of the fixture and slide the bottom of the cartridge into the bottom fitting.
6. Tighten the securing nut.
7. Check to make sure there are no leaks.

NOTE: To extend the life of the new demineralizer cartridge, replace the water filter. Refer to "Checking and replacing the water filter" later in this section.

Checking and replacing the water filter

Suggested frequency: Every week

To extend the life of the demineralizer cartridge, replace the water filter whenever it looks dirty and each time you change the demineralizer cartridge.

Changing the water filter

1. Make sure the chamber is in stop mode.
2. Use the supplied plastic wrench to loosen the filter bowl.
3. Unscrew the filter bowl from the assembly. Be careful — the bowl will be full of water.
4. Pour out the water and discard the used filter.
5. Place a new filter in the bowl and screw it onto the assembly.
6. Before tightening the bowl, run the chamber in humidity mode until the bowl is filled with water.
7. After the bowl is filled with water, use the supplied plastic wrench to tighten the filter bowl.
8. Close the access door.

Draining the vapor generator

WARNING: Vapor generators contain hot, pressurized water. Make sure the drain valve is connected to a drain pipe. Keep clear of the drain pipe's opening when opening the drain valve.

Suggested frequency: Every month

1. Disconnect the power to the chamber by turning the disconnect switch to OFF.
2. Open the service panel and locate the vapor generator.
3. Open the drain valve lever and let the vapor generator drain for a few minutes.
4. Close the drain valve.
5. Reconnect the power to the chamber by turning the disconnect switch to ON.
6. Close the service panel.

NOTE: Thermotron recommends you drain, disassemble, inspect, and clean the vapor generator at least once a year.

Checking and replacing the dry air purge filter

Suggested frequency: Every month

NOTE: If the filter element is very dirty, check it more frequently.

1. Shut off or disconnect the air supply.
2. Drain the filter by unscrewing the petcock on the filter bowl. **NOTE**: Depending on the quality of the air supply, you may need to drain the filter weekly or more often.
3. Remove the filter bowl and check the filter element.
   - If the element is dirty, replace it with a new one. New filter elements are available from Thermotron Industries.
   - If large amounts of oil and water are always present, the dryer could be damaged. Replacement dryers are available from Thermotron Industries.
4. Replace the filter bowl; do not use a wrench to tighten it.

Miscellaneous checks

WARNING: High voltages that can kill are present. Use extreme caution.

WARNING: Do not attempt to perform electrical work if you are not qualified. This manual is not a substitute for electrical training.

Suggested frequency: Every three months

- Check the operating currents of the circulator(s), heaters, compressor(s), and other components. Make sure they match the values (±10%) on the electrical drawings in Section E. Keep a log of these values so you will see any changes that could indicate the need to service your chamber.
- Disconnect the electrical power and check for loose electrical connections in the electrical compartment and at any remote parts of the chamber. Also, visually check for warping or pitting on contactors.
- Make sure all warning labels are firmly attached and easy to read. New labels are available from Thermotron Industries.
- Check the chamber door seals for rips, cracks, or deterioration.
- Make sure the circulator fans are tightly connected to their shafts and can spin freely.
- Make sure the instrument sensor(s) are positioned in the strongest air flow for accurate temperature and humidity readings.

On chambers with mechanical refrigeration, check for corrosion or abrasion on refrigeration lines. Check the compressor(s) for loose or broken mounting hardware.

Checking the oil level in a compressor

WARNING: You must operate the chamber to perform this procedure. Do not attempt to operate the chamber unless you have read the instructions in Section B that are checked on page B1.

Suggested frequency: Every three months

NOTE: You can check the oil level only on semi-hermetic compressors, Maneurop hermetic compressors, and Copeland scroll compressors.

1. Open the service panel.
2. Operate the chamber at a set point that requires maximum cooling.
3. The oil should fill half of the sight glass. If the oil is low, refer to "Adding refrigeration oil" in Section D of this manual.
4. Close the service panel.

Testing safety switches

Suggested frequency: Every three months

NOTE: For the most accurate results, test safety switches one at a time.

NOTE: The table on page D3 lists common safety switches. Check your electrical drawings and your chamber to see which ones are on it. You should also look at the drawings to find out if the chamber has any switches that are not listed in the table.

To test a switch, set it so it will trip under normal testing conditions, and operate the chamber with no load. For example, to test a low limit switch, raise the limit of the switch so it is within the normal testing range you use, and program the chamber to perform a pull-down. If the switch is working, it will trip and shut the chamber down when the air temperature reaches the temperature setting on the switch.

If the switch is not working, replace it. You can get replacement switches from Thermotron Industries.

Checking the R-23 or R-508B charge using a refrigeration gauge manifold

WARNING: Do not attempt to check the charge using a refrigeration gauge manifold if you are not a qualified refrigeration technician. You could seriously injure yourself or damage the chamber. This manual is not a substitute for refrigeration training.

CAUTION: Before performing this procedure, make sure the chamber is *off* and the refrigeration system is at *room temperature*. NOTE: When a chamber remains idle for several days, some of the refrigerant can be absorbed in the compressor oil, resulting in a lower refrigerant standby pressure, Once the cooling system is run, the refrigerant releases from the oil, and the standby pressure should return to normal levels.

CAUTION: Use only a calibrated gauge manifold to perform this procedure.

Suggested frequency: Every three months

1. Shut off the refrigeration system and allow the entire R-23 or R-508B system to reach room temperature.
2. Open the service panel.
3. Connect the hoses from the suction and discharge gauges to the R-23 or R-508B suction and discharge service valves.
4. Open both manifold valves and allow the pressure to equalize.
5. Compare the pressure shown on the manifold gauges to the R-23 or R-508B standby pressure shown on the serial tag located above the electrical compartment.
    - If the pressure is 5 psig or more below the pressure on the serial tag, you must check the system for leaks, make any necessary repairs, and charge the system. Refer to "Charging the R-23 or R-508B refrigeration system" in Section D of this manual.
    - If the system does not need charging:
        a. Remove the hoses.
        b. Replace the service valve cap.
        c. Check the service valve cap for leaks.
6. Close the service panel.

Checking the R-404A or R-507 discharge pressure

WARNING: You must operate the chamber to perform this procedure. Do not attempt to operate the chamber unless you have read the instructions in Section B that are checked on page B1.

Suggested frequency: Every three months

Air-cooled chambers with gauges

1. The chamber should be performing a pull-down.
2. Use the status mode function to check the high-stage discharge pressure. For detailed instructions, see the System Monitor sections of the programmer/controller instruction manual.
3. Compare the high-stage discharge pressure to the temperature/pressure saturation chart in the front pocket of this binder. To find the correct pressure on the chart, add 20°F (7°C) to the actual ambient temperature, and use this adjusted temperature when checking the chart.

Air-cooled chambers without gauges

If your chamber does not have built-in gauges, you need to use a refrigeration gauge manifold:

1. Connect a hose to the discharge service valve.
2. Open the manifold gauge and read the pressure.
3. Compare it to the pressure on the temperature/pressure saturation chart. To find the correct pressure, you need to add 20°F (7°C) to the actual ambient temperature and use this adjusted temperature when checking the chart.

Water-cooled chambers

If you have a water-cooled system, your system must be within ±5% of the head pressure listed on the refrigeration schematic in Section E of this manual. If the discharge pressure is incorrect, you must determine the cause. Possible causes for an incorrect pressure include:

- Refrigerant overcharge or undercharge
- Failure of a fan motor
- Dirt or scaly deposits in the condenser
- Low water flow through the condenser
- Condenser water supply too warm

On a water-cooled system, you can adjust the R-404A or R-507 discharge pressure with the condenser's water valve. The water valve has a marking on top indicating how to lower or raise the pressure. Lowering the pressure raises the flow, and raising the pressure lowers the flow.

Cleaning your chamber

CAUTION: When cleaning, do not allow the programmer/controller to get wet.

Suggested frequency: As needed

Through normal use your test chamber will occasionally require cleaning. When cleaning, please follow the guidelines listed below.

- To clean the outside painted surface of the chamber, use a soft cloth and a solution of diluted, non-abrasive, mild detergent.
- To clean the window:
  1. Wipe using a soft cloth or sponge dampened with a mild soap or detergent.
  2. Dry with a soft cloth or chamois.
- To clean the surface of the work space, use soap, non-abrasive detergent, or oven cleaner.
- To clean the programmer/controller, gently wipe with a damp cloth.

A guide to the service instructions

This section contains instructions for some common service procedures; for professional service help, contact the nearest Thermotron field service office. **The instructions that are not checked do not apply to your chamber.**

Section D: Service

NOTE: **If you need technical assistance troubleshooting problems with your Thermotron environmental test chamber, please contact the Thermotron Technical Liaison office at (616) 392-6550 between 8:00 am and 5:30 pm Eastern Standard Time.**

*Follow all **WARNINGS** to prevent death or personal injury.*

WARNING: Dangerously high voltages that can kill you are present. Disconnect the electrical power before doing any electrical work.

WARNING: Disconnect electrical power before working near moving parts. Replace any guards or shields you remove. Keep fingers away from compressor head fans.

WARNING: When working with a refrigerant, follow all safety instructions on the refrigerant container.

WARNING: Do not attempt to perform electrical or refrigeration work if you are not qualified. This manual is not a substitute for electrical or refrigeration training.

WARNING: To safely service the chamber, you must read the Important Safety Instructions on pages i-ii and everything in Section D that is checked on page D1. Before operating the chamber, you must read the instructions in Section B that are checked on page B1.

WARNING: Before performing any maintenance or service, make sure the chamber is not operating. Allow all parts being serviced to reach room temperature.

WARNING: The automatic pump-down system can start a compressor at ANY time while the main power is connected.

*Read all **CAUTIONS** to prevent equipment damage.*

CAUTION: You must be electrically grounded if you service static-sensitive components.

CAUTION: Overcharging a refrigeration system can destroy the compressor(s).

CAUTION: You must add Thermotec fluid to the R-23 or R-508B refrigeration system if you evacuate it, change the oil in the compressor, or replace the compressor. For the amount, check the serial tag located above the electrical compartment. The number of ounces needed is listed after the word Thermotec.

CAUTION: Although at times you must disconnect the main power for safety reasons, do not leave it off for longer than necessary. The automatic pump-down system cannot operate when the main power is off.

NOTE: Use the main power disconnect switch to disconnect the electrical power. If this switch is supplied by Thermotron, it is located on the electrical compartment door. Put this switch in the OFF position to disconnect the electrical power, and install your locking device in the handle.

NOTE: If you experience repeated humidity heater failures, they may be due to humidity water contamination caused by the products under test. In this case you should consider changing your humidity water system from a recirculating system to a total loss system. For more information, call the nearest Thermotron field service office.

NOTE: For additional service information, see the OEM literature section following Section F of this manual.

Resetting safety switches

CAUTION: Do not hold reset switches in — release them immediately. If a switch continues tripping, find and correct the cause before using the chamber. Improper resetting can result in damage to the chamber and the product.

Safety switches shut systems down if the system condition exceed the switch limits.

- Automatic-reset switches reset themselves when the cause of the trip it corrected.
- Manual-reset switches must be reset by you. To reset a manual-reset switch, push the button or tab on the switch after the cause of the trip is corrected.
- Some switches need to cool down or heat up before they can be reset.

Some commonly used switches are listed in the table below.

Safety switches			
Switch	***Abbreviation***	***Location***	***Reason for tripping***
Low limit	LLS	Externally mounted	The chamber temperature is too low.
Humidity heat limit	THS	Machinery section of humidity chambers	The temperature inside of the vapor tank is too high.
High pressure	HPS	Machinery section	The refrigerant pressure is too high.
Low pressure	LPS	Machinery section	The refrigerant pressure is too low.
Pump reset		Pressurized water recirculation tank lid	The water level in the recirculation tank is too low.

Therm-Alarms and other optional instruments can also act as safety switches. See the configuration sheet, controller manual, and OEM literature for more information on these instruments.

Checking and replacing heat links

WARNING: Disconnect the electrical power when checking and replacing the heat links. High voltages that can kill you are present.

Heat links remove power from the heating coils if the temperature at the heating coils is too high. Usually, heat links blow because of a lack of sufficient air flow from the circulator(s). If one or more heat links are blown, the chamber heats slowly or does not heat at all. Blown heat links must be replaced.

Replacing heat links

1. Disconnect the power from the chamber. Allow the entire chamber to reach **room temperature**.
2. Remove any sensors from the cover on the plenum and then remove the plenum cover.
3. Find the heat link(s). Heat links are tubular in shape and look similar to resistors. They are located on the heater studs or on a bracket mounted near the heaters.
4. Perform a resistance test on the heat link(s) using an ohm meter. (You cannot check them visually.)
   - If the ohm meter reads 0, the heat link is working.
   - If the ohm meter reads ∞ (open), the heat link is blown and must be replaced.
5. Follow this procedure to change the heat link(s).
   a. Loosen the two nuts that hold the heat link.
   b. Remove the blown heat link.
   c. Install a new heat link.
   d. Tighten the two nuts.

      NOTE: Make sure that the nuts are tight. Loose nuts can cause a blown heat link.
6. Replace the plenum cover and reattach any control sensors that were removed.
7. Reconnect the electrical power.

Adding refrigeration oil

WARNING: You must operate the chamber to perform this procedure. Do not attempt to operate the chamber unless you have read the instructions in Section B that are checked on page B1.

NOTE: You can add oil only to semi-hermetic compressors, Maneurop hermetic compressors, and Copeland scroll compressors. To check the oil level, refer to "Checking the oil level in a compressor" in Section C of this manual.

1. Open the service panel.
2. Connect the hose of the oil hand pump to the suction service valve and purge the air from the hose.
3. Operate the cooling system so the compressor(s) are running. Run the chamber to a stable condition for 30 minutes.
4. Pump oil until it fills half of the compressor sight glass. **NOTE**: Pump only a small amount of oil at a time.
5. Wait several minutes and check the oil level in the sight glass again.
   - If the oil fills half the sight glass, close the valve, remove the hose, and replace the service cap.
   - If the oil fills less than half the sight glass, add more oil.
   - Close the service panel.

R-404A and R-507 special charging instructions

CAUTION: R-404A and R-507 must always be transferred as a liquid from the tank into the system.

R-404A and R-507 are blends of refrigerants. They do not have constant boiling points, and the blend compositions vary as they boil, which results in a temperature variation or temperature glide. Because R-404A and R-507 are blends of refrigerants, they must always be transferred into the system as a liquid, not as a vapor.

When handling R-404A and R-507, remember the following points:

- Always liquid charge — never vapor charge.
- Charge R-404A and R-507 systems using the sight glass method. Refer to "Charging the R-134a, R-404A, or R-507 high-stage or single-stage refrigeration system" later in this section of the manual.
- Keep R-404A and R-507 tightly capped to prevent leaking. If the refrigerants leak, the blends will fractionate and will not have R-404A or R-507 cooling properties.

Recovering used refrigerant

Any time you need to evacuate a refrigeration system for any reason, you must collect the refrigerant. The Clean Air Act prohibits venting the refrigerant to the air.

If you are properly certified you can recover the refrigerant yourself using a commercially available recovery unit, or you can have a professional do it for you. You may also call our field service engineers to recover the refrigerant for you. To arrange to have the procedure done, call the Thermotron Product Support office at (616) 392-6550 between 8:00 am and 5:30 pm Eastern Standard Time.

You can recharge your refrigeration system using the recovered refrigerant as long as it is not contaminated. If the refrigerant is contaminated, you can ship it to Thermotron for disposal, but the contaminated refrigerant will remain your property until it is properly disposed of.

Charging the R-23 or R-508B refrigeration system

WARNING: Do not attempt to charge the system if you are not a qualified refrigeration technician. You could seriously injure yourself or damage the chamber. This manual is not a substitute for refrigeration training.

WARNING: Read the safety instructions on the refrigerant tank. R-23 or R-508B refrigerant is under very high pressure in the tank. Do not open the outlet valve rapidly.

CAUTION: Make sure the chamber is off and the refrigeration system is at room temperature before charging the system.

NOTE: To check the refrigerant charge, refer to "Checking the R-23 or R-508B charge using a refrigeration gauge manifold" in Section C of this manual.

1. Make sure you have the correct refrigerant. Refer to the serial tag above the electrical compartment.
2. The chamber ***must not*** be running during this procedure. Disconnect the power to your chamber using the disconnect switch, and allow the chamber to reach room temperature.
3. Open the service panel.
4. Connect a hose from the refrigerant tank to the center fitting of the refrigeration gauge manifold.
5. Connect hoses from the suction and discharge gauges on the refrigeration gauge manifold to the suction and discharge service valves.
6. Purge the hoses.
7. Charge the system by adding refrigerant to both the suction and discharge sides at the same time.
8. Wait a few minutes after you charge the system for the pressure to equalize. Read the pressures on the gauges. Both should show the same pressure.
9. Compare the gauge pressure with the standby pressure on the serial tag located above the electrical compartment. If it is less than the required pressure, you must add more refrigerant.
10. Disconnect and remove the refrigeration gauge manifold.
11. Check the compressor amperage to make sure the system is not overcharged. If the system is overcharged, the amperage will be higher than normal.
12. Close the service panel.

Charging the R-134a, R-404A, or R-507 high-stage or single-stage refrigeration system

WARNING: DO NOT attempt to charge the system if you are not a qualified refrigeration technician. You could seriously injure or kill yourself or damage the chamber.

WARNING: This manual is not a substitute for electrical or refrigeration training.

WARNING: You must operate the chamber to perform this procedure. Do not attempt to operate the chamber unless you have read the instructions in Section B that are checked on page B1.

WARNING: Read the safety instructions on the refrigerant tank.

CAUTION: ALWAYS liquid charge R-507 and R-404A systems to prevent fractionation of the blend.

NOTE: To check the charge, see "Checking the R-404A or R-507 discharge pressure" in Section C of this manual.

1. Make sure you have the correct refrigerant. Refer to the serial tag above the electrical compartment.
2. Connect a hose from the center fitting of the refrigeration gauge manifold to the refrigerant tank.
3. Connect a hose from the suction gauge on the refrigeration gauge manifold to the suction service valve and purge the charging hose.
4. Charge the system during a pull-down:
   - Always liquid charge R-507 and R-404A. For special charging instructions, see "R-404A and R-507 special charging instructions" earlier in this section of the manual.
   - Watch the sight glass. When it is clear (bubble-free) for 10 seconds, shut off your tank of refrigerant.
   - Make sure bubbles do not reappear. If they do, add more refrigerant.
5. Check the compressor amperage to make sure the system is not overcharged. If the system is overcharged, the amperage will be higher than normal.

Replacing a circulator fan blade

1. Disconnect the main power to the chamber.
2. Remove any sensors attached to the plenum cover, and remove the plenum cover.
3. Take the fan blade off the shaft.
   a. Remove the set screw with an Allen wrench.
   b. Pull the fan blade off the shaft.
4. Disconnect the fan motor wiring.
5. Remove the circulator motor.
   a. On the back of the chamber, remove the motor guard.
   b. Remove the motor mounting screws that hold the circulator motor in place, and pull the motor and shaft away from the chamber.
6. Install the new motor.
   a. Apply a bead of non-hardening caulk around the circulator shaft hole.
   b. Center the vapor seal over the motor port.
   c. Insert the shaft of the circulator through the vapor seal and into the motor port.
   d. Attach the motor with the motor mounting screws and washers. Do not tighten the screws yet.
7. Install the fan blade.
   a. Slide the fan blade on the shaft with the hub facing you.
   b. Insert the set screw so it contacts the flat side of the shaft. Do not tighten the set screw yet.
8. Spin the fan blade with your hand to make sure it spins freely. If it hits something, adjust the position of the motor.
9. Tighten the motor mounting screws.
10. Test again for free movement of the fan blade. Re-adjust the motor's position if necessary.
11. Reconnect the fan motor wiring and test with power applied to the chamber.

Recommended Spare Parts

To minimize down time, maintain a supply of spare parts. See the parts list in this section to determine the appropriate parts and part (item) numbers.

High usage parts

Contactors

Demineralizer cartridges

Filter dryers

Fuses

Heat links

Solenoids

Water purification filters

Low usage parts with long lead times

Circulator motor and fan blade assemblies

Compressors

Other recommended spare parts

Light bulbs and lamps

Expansion valves

Injection valves

Fan blades

Heating coils

Limit switches

Pressure switches

Push button switches

Relays

Thermocouples

Thermostats

Calling Thermotron for assistance

At Thermotron, our telephone staff is trained to match your current needs to the proper person or department. To accomplish this, they need the following information:

- Your name
- The name of your company
- The model and serial number of the chamber
- A brief description of the problem, question, or request

Once you obtain this information, contact the parts and logistics department at Thermotron Industries in Holland, Michigan. Telephone (616) 392-6550 between 7:30 a.m. and 5:30 p.m. Eastern Standard (Daylight) Time. The telephone staff person who takes your call will use the above information to determine how to assist you or where to direct your call.

Returning materials

What to do if a part or Thermotron instrument fails

1. Contact your local Thermotron Field Service office. A service representative will help you determine the nature of the problem and the proper steps to resolving the problem.
2. To return a part or Thermotron instrument, follow these steps:
   a. Contact the Parts and Logistics department at Thermotron Industries in Holland, Michigan, USA. The telephone number is (616) 392-6550, and the fax number is (616) 393-4549. The hours of operation are 7:30 a.m. to 5:30 p.m. Eastern Standard (Daylight) Time.
   b. When you telephone, our staff needs the following information
      - Your name
      - The name of your company
      - The model and serial number of your chamber
      - A brief description of the failure.
   c. Parts and Logistics will authorize return of the material and issue a Returned Material Tag (RMT) number.
   d. Write the name and telephone number of a contact person at your location and the RMT number on the packing list.
   e. Write the RMT number in a visible location on the outside of the shipping container.
   f. Ship all parts FOB to:

      Thermotron Industries
      836 Brooks Avenue
      Holland MI 49423
      ATTN: (Issued RMT Number)

      NOTE: If the defective part is received within 30 days of the issuance of the RMT number, Thermotron will replace the part under the terms of the warranty at no charge. If the part is received after 30 days, Thermotron will invoice the customer for the full cost of the replacement part.

What to do if a non-Thermotron instrument fails

1. Contact the original equipment manufacturer according to the instructions in the OEM instrument manual. Follow the manufacturer's procedure for replacing the failed instrument.
2. To contract Thermotron to install the instrument at the prevailing rates, contact your local Thermotron Field Service office.

Glossary

ambient: The temperature and other conditions of the air surrounding the chamber.

auxiliary relay: A solid-state relay operated by an auxiliary output that uses the TTL output to switch a line voltage. Auxiliary relays operate additional systems or circuits. You can turn these outputs on or off during programmed intervals, or you can operate them in manual mode.

bypass mode: The condition of a mechanical refrigeration system during heat-up, in which the compressor is running but some or all of the refrigerant does not pass through the evaporator. Instead of passing through cooling coils, the refrigerant either is rerouted to the suction line, or rerouted through a heat exchanger and then to the suction line.

cascade: A two-stage mechanical refrigeration system with two compressors and a cascade condenser. The refrigerant of the first compressor removes heat from the test space. The refrigerant of the second compressor removes heat from the refrigerant of the first stage. An air-cooled or water-cooled condenser then removes the heat from the refrigerant of the second stage.

CO_2: Liquid carbon dioxide; used to remove heat from the test space.

console: The section where you control the test functions of the chamber. The console usually contains the control panel and the instrumentation. A console can be attached to the chamber, or it can be a separate, remote unit.

dew point: The temperature at which vapor (at 100 percent humidity) begins to condense and deposit as small drops on cool surfaces.

dry bulb temperature: The actual test space (chamber) air temperature.

GN_2: Gaseous nitrogen; used to purge moisture from the test space or to create an inert gas environment.

gpm: Gallons per minute; a unit of liquid flow rate.

inches of water: A unit of pressure.

interval: A segment of a program.

kW: Kilowatt; a unit of electrical power. One kW equals 1,000 watts.

live load: Heat produced by a product being tested.

LN_2: Liquid nitrogen; used to remove heat from the test space.

machinery section: The section of the chamber containing the electrical wiring and mechanical equipment. The machinery section usually contains the electrical compartment, the cascade condenser for a cascade refrigeration system, and the compressor(s) for a mechanical refrigeration system. The machinery section can be attached to the chamber, or it can be a separate, remote unit.

machinery section panels: Removable panels that enclose the machinery section.

plenum: The contained area inside the test space and behind the baffle in which the air is circulated through the environmental conditioning systems for the environmental test. The plenum usually contains the heaters, evaporator coils, circulator blades, and other equipment needed to heat, cool, humidify, and dehumidify chambers.

port: An opening designed to allow access to the test space.

port plug: A piece of insulation material that fits into a chamber port.

product: The device or equipment the chamber tests.

psig: Pounds per square inch gauge; a unit of pressure. **NOTE**: 0 psig equals 14.69 psia at 0 feet (sea level).

pull-down: The process of the chamber going from a higher temperature set point to a lower temperature set point.

purge: An option, either dry air or gaseous nitrogen (GN_2), used to reduce moisture inside the test space. You can use the purge system after a humidity interval to help remove the moisture from the chamber. You also can use the purge system just before and during a temperature pull-down to help keep moisture from condensing and freezing on the evaporator coils. A GN_2 purge can also be used to create an inert gas environment.

R-23, R-134a, R-404A, R-507, or R-508B: Types of refrigerant.

relative humidity (RH): A percentage of the maximum amount of moisture that the air can hold at a given temperature and pressure.

resistance temperature device (RTD): An electronic device used to sense temperature as a function of resistance.

scfm: Standard cubic feet per minute; a unit of gaseous flow rate.

serial tag: A label attached to the chamber above the electrical compartment. The serial tag lists the chamber's electrical and refrigeration requirements, serial number, and model number.

set point: An assigned value for a test space condition such as temperature or humidity. The initial set point is the value assigned at the beginning of an interval. The final set point is the value the chamber must reach within an interval. Current set points are set by the programmer/controller when going from the initial to the final set point.

single stage: A mechanical refrigeration system with one compressor. The refrigerant of the compressor removes heat from the chamber. An air-cooled or water-cooled condenser then removes the heat from the refrigerant. Compare to cascade.

suction pressure: The pounds per square inch gauge of refrigerant present at the compressor's inlet or suction line.

test space: The space within the test compartment where the product is tested.

Therm-Alarm: A product protection instrument that monitors the temperature of the product under test. If the temperature exceeds either the high or low temperature you select, the Therm-Alarm disables the chamber control systems and alerts you with audible and visible alarms.

thermocouple (t/c): A device used to sense temperature as a function of voltage.

transducer: A device that converts information from one medium, such as pressure, to another, such as current.

CUSTOMER PARTS LIST

43216.001 S/SM16

Seq Description
13 ELEC SUB

Component	Description	Qty Per	U/M
1036012	RELAY SS 25A 530VAC 3-32DC NO	2.00	EA
1207647	SOCKET RELAY IDEC 2PDT 10AMP	2.00	EA
1207655	RELAY IDEC 2PDT 10A RU SERIES	2.00	EA
1212252	RAIL PHOENIX 35MM PERFORATED	1.00	EA
1212870	BREAKER CIRCUIT 1A 5X20MM PHX	1.00	EA
1212888	TERMINAL BLOCK FUSE PHOENIX	1.00	EA
1218347	TERM BLK ST2.5 1|2 1TIER PE	5.00	EA
1218355	TERM BLK ST2.5 1|2 1TIER GREY	53.00	EA
1218371	JUMPER PHOENIX ST2.5 2 POS	11.00	EA
1218389	JUMPER PHOENIX ST2.5 3 POS	3.00	EA
1218402	JUMPER PHOENIX ST2.5 5 POS	1.00	EA
1218428	COVER END ST2.5 1|2 1TIER GREY	2.00	EA
1218444	MARKER STRIP ST2.5 BLANK CENTR	6.00	EA
1218494	MARKER STRIP ST4 BLANK CENTER	1.00	EA
1218509	TERM BLK ST6 1|1 1TIER PE	2.00	EA
1218517	COVER END ST6 1|1 1TIER GREY	2.00	EA
1218525	TERM BLK ST6 1|1 1TIER GREY	8.00	EA
1218541	MARKER STRIP ST6 BLANK CENTER	1.00	EA
1219034	JUMPER PHOENIX ST6 2 POS	1.00	EA
1219246	CLAMP FOR PHOENIX TERMINALS	2.00	EA
1222605	THERMOSTAT WATLOW HI LIMIT 275	1.00	EA
1223180	JUMPER PHOENIX ST6 3 POS	2.00	EA
1241146	BRACKET TERMINAL STRIP 70DEG	2.00	EA
1241798	PANEL INSERT S/SM4-27	1.00	EA
1246293	CONTACTOR AUX 1NO/NC DEFINTE P	2.00	EA
1247516	TERM BLK ST4 1|2 1TIER GREY	2.00	EA
1247728	COVER END ST4 1|2 1TEIR GREY	1.00	EA
1248033	CONTACTOR 30A DP 2P 120V COIL	2.00	EA
1248041	CONTACTOR 30A DP 3P 120V COIL	2.00	EA
1347918	CAPACITOR POLY .47UF250VAC20%L	1.00	EA
538733	WIRE MTW 19 STR UL 500 #12 BLK	40.00	FT
538806	WIRE MTW 26 STR UL 500 #16 RED	40.00	FT
538849	WIRE MTW 26 STR UL #16 WHITE	10.00	FT
544407	FUSE BUSS FERRULE TD 5A 250V	1.00	EA
552256	HEAT SINK ASSEMBLY	1.00	EA

CUSTOMER PARTS LIST

43216.001 S/SM16

Seq Description
13 ELEC SUB

Component	Description	Qty Per	U/M
557150	PANEL CHANNEL GREY HOLES 1X2	4.00	FT
566397	RESISTOR WW 2500 OHM 12W	1.00	EA
569450	RELAY SS 10A 280V 3-32VDC NO	1.00	EA
571218	TRANSFORMER MICRON 50-60HZ	1.00	EA
667471	PANEL CHANNEL COVER 1"	4.00	FT
702471	FUSE SHAWMUT RK5 250V 5A	1.00	EA
705659	SOCKET RELAY END CLIP	2.00	EA
723657	FUSE SHAWMUT RK5 250V 20A	4.00	EA
723673	FUSE SHAWMUT RK5 250V 30A	4.00	EA
724173	BLOCK FUSE 250V 2P 30A	4.00	EA
724181	BLOCK FUSE 250V 1P 30A MARAT	1.00	EA
793132	WIRE THHN 19 STR UL#10 GRN/YLW	2.00	FT
818909	WIRE THHN 19 STR 2500' 14GN/YL	2.00	FT
929646	TRANSFORMER 120VIN 24VOUT 55W	2.00	EA
955248	BRKT TRANSFORMER MTG	2.00	EA

CUSTOMER PARTS LIST

43216.001 S/SM16

Seq	Description
14	SL PREP

Component	Description	Qty Per	U/M
560410	GASKET SILICN IN 30.25IDX30.25	1.00	EA

CUSTOMER PARTS LIST

43216.001 S/SM16

Seq Description

15 CHAM PAINT

Component	Description	Qty Per	U/M
1119446	DOOR ELECT CMPT WELD S/SM16-7B	1.00	EA
1204746	COVER J-BOX S16-S32	1.00	EA
542380	BAFFLE CONDENSER SM16C	1.00	EA
605352	TOP SHEET S-16	1.00	EA
623171	BRACKET DOOR STOP	1.00	EA

CUSTOMER PARTS LIST

43216.001 S/SM16

Seq Description
16 START KIT

Component	Description	Qty Per	U/M
1078137	COMPRESSOR STARTKIT CS20KGEPFV	1.00	EA
1097791	KIT START 2HP TECUM COMP AVA	1.00	EA
1115353	BLOCK TERMINAL TECUMSEH STR KT	1.00	EA
1240750	CONDUIT HEYCO-FLEX II 3/8	7.00	FT
1276971	HARNESS 2HP PLUG COPE 200-230V	1.00	EA
1277032	HARNESS 2HP PLUG TEC 200-230V	1.00	EA
529880	CONDUIT EASY-FLEX 3/8"	3.00	FT
546604	CONDUIT SEALTI ANA UA GRY 3/4"	4.00	FT
546604	CONDUIT SEALTI ANA UA GRY 3/4"	8.00	FT
546671	CONN SEALTITE STR 3/4"STR	1.00	EA
546671	CONN SEALTITE STR 3/4"STR	3.00	EA
546728	CONN SEALTITE ANG 3/4"X45DEG	1.00	EA
546728	CONN SEALTITE ANG 3/4"X45DEG	1.00	EA
575213	WIRE THHN 19 STR UL #14 RED	187.00	FT
575248	WIRE THHN 19 STR UL #14 WHITE	28.00	FT
575434	WIRE THHN 19STR UL 2500'#14YEL	46.00	FT
575523	WIRE THHN 19STR UL 2500 #12BLK	74.00	FT
579022	CONNECTOR FLEXIBLE 3/8"STRAIGH	3.00	EA
579375	CONNECTOR FLEXIBLE 3/8" 90*	4.00	EA
616605	TERMINAL SQ D GROUND BAR KIT	1.00	EA
754161	WIRE THHN 19 STR UL #10 BLK	44.00	FT
793132	WIRE THHN 19 STR UL#10 GRN/YLW	21.00	FT
818569	CONNECTOR POLYTUFF II 1/2" 90'	2.00	EA
818577	CONNECTOR POLYTUFF II 1/2"	4.00	EA
818585	CONDUIT POLYTUFF II 1/2"	5.00	FT

CUSTOMER PARTS LIST

43216.001 S/SM16

Seq 20 Description: CABINET

Component	Description	Qty Per	U/M
1004212	GROMMET SILI 1/2IDX1/16 GRV	6.00	EA
1131008	FIN COIL SM16/32 EVAP W/POTTNG	1.00	EA
1135735	LAMP CLEAR OVEN 60W 130V	1.00	EA
1138351	KIT WIRE S-SM32-78 LIGHT	1.00	PR
1190010	GUARD LIGHT SE2000L	1.00	EA
1256785	HEATER ASSEMBLY S/SM16/27 DOM	1.00	EA
1320128	PORT ASSEMBLY 4.0"ID X 6.06"LG	2.00	EA
1330759	VENT 502 GASKET	1.00	EA
1330864	VENT 502 ASSEMBLY	1.00	EA
1337468	BRKT SENSOR HMM100/211	1.00	EA
1351959	PORT 502 WELD-IN ASSY 6" WALL	1.00	EA
529866	BRACKET CLAMP 1-5/8	4.00	EA
534045	GASKET NEOP EDGE ANGLE 40DURO	15.00	FT
542800	BAFFLE	1.00	EA
543010	SLEEVE MOTOR PART S32	2.00	EA
543030	DISC INSULATOR LIGHT SKT	1.00	EA
543100	BAFFLE FAN SHROUD	2.00	EA
544075	WASHER SILICONE H T 1/8"THK	4.00	EA
545510	LATCH 550 COMPLETE PARTS	1.00	EA
548534	CONNECTOR EMT COMP TYPE 1/2"	1.00	EA
550954	HINGE SHIM-5"	1.00	EA
560453	GASKET SILICN OUTR 41.75X41.75	1.00	EA
568012	GASKET NEOP TAPE 1/4 X 5/8	1.00	FT
584673	STANDOFF CERAMIC INSULATOR 1"	4.00	EA
599476	DEFLECTOR AIR	1.00	EA
613738	RETAINER COIL	4.00	EA
736910	RECEPTACLE, ONE PIECE PLTED CU	1.00	EA
760560	MOTOR CIRCULATOR COMPLETESPD	2.00	EA
815306	BAFFLE FRONT S-SM16	1.00	EA
854123	SCREW SOCKET HD BUTTON SS	2.00	EA
918016	GUARD MOTOR SPD	2.00	EA
958069	GROMMET SILI 3/16IDX1/16"GRV	4.00	EA

CUSTOMER PARTS LIST

43216.001 S/SM16

Seq	Description
23	DOOR ASSY

Component	Description	Qty Per	U/M
1079531	CABLE ASSY CAT5 RJ45 TP 15'LG	1.00	EA
1103233	CONNECTOR POLYTUFF II 3/4" 90'	2.00	EA
1170214	WINDOW 2 PANES HEATED 17X23	1.00	EA
1180243	HEAT CORD ASSY S/SE 42 WATTS	1.00	EA
1269819	BRKT 8200 DISPLAY BEZEL MTG	1.00	EA
1332379	SCREW BUTTON HD SKT BLACK 18-8	12.00	EA
1337379	WINDOW FRAME 17X23 W/SCREWS	1.00	EA
1351307	GASKET NEO TAPE 5/16THK X 1/2W	7.00	FT
5393065	RIVNUT CLOSED END 10-32 GRIP	12.00	EA
550202	HINGE BUTT 5X5X.180	2.00	EA
555689	NUT LOCK ST F/RIGID CONDUI 3/4	2.00	EA

CUSTOMER PARTS LIST

43216.001 S/SM16

Seq Description
25 COND UNIT

Component	Description	Qty Per	U/M
1011698	FILTER DRIER 1/2 ODF	1.00	EA
1022657	CONDENSING FAN MTG BRKT 2HP	2.00	EA
1029112	BRACKET VAPOR/RECEIVE TANK SPD	1.00	EA
1076012	FAN BLD LAU 14"15"3BL KBHUB CW	2.00	EA
1077953	SWITCH PRESSURE DUAL CE	1.00	EA
1077979	SWITCH PRESSURE HIGH CE	1.00	EA
1081473	KIT COMPRESSOR MTG 2HP-3HP	1.00	EA
1097806	COMPRESSOR 2HP 230/1/50-60	1.00	EA
1114967	R-23 DISCHARGE COMP TO OIL SEP	1.00	EA
1114983	LINE R-23 FR COIL TO DUMP VLV	1.00	EA
1115060	LINE 404 DISCHARG COMP TO COIL	1.00	EA
1115167	LINE R23 HT GAS SOL FROM TEE	1.00	EA
1115191	LINE R-23 FR TANK TO COMP	1.00	EA
1115264	LINE R-23 FR DUMP VLV TO TANK	1.00	EA
1115280	LINE 404 LOW PRESSURE SWITCH	1.00	EA
1115387	LINE R-23 FR TANK TO TANK	1.00	EA
1115476	LINE R-23 OIL RETURN LINE	1.00	EA
1123089	LIQD FRM DR/CL TO TNK/TNK TO D	1.00	EA
1128479	508 FROM OIL SEP TO DRIER	1.00	EA
1128487	508 DISCH OIL SEP TO COIL	1.00	EA
1128495	508 DRIER TO TOP KIT	1.00	EA
1364245	COMPRESSOR 2HP 200-230/1/60	1.00	EA
531130	COUPLING CU STAKED STOP 1/4	1.00	EA
535696	ELBOW CU 3/8 90 SR STR ACR	1.00	EA
535718	ELBOW CU 1/2 90 SR STR ACR	1.00	EA
541912	CLAMP HOSE SS 5-3/8 TO 7	1.00	EA
545365	VALVE RELIEF ATMOSPHERIC 1/8"	1.00	EA
545446	VALVE RELIEF ATMOSPHERIC 1/4"	2.00	EA
547503	TUBING SILICONE GREY 1-3/8	1.00	FT
547538	TUBING SILICONE 1/2"ID 11/16OD	2.00	FT
547619	BRACKET SOLENOID SS "6"	1.00	EA
550504	REDUCER CU 5/8X1/2	1.00	EA
550512	REDUCER CU 5/8X3/8	1.00	EA
555514	TANK VERTICAL 10 # PUMP CAP	3.00	EA
558785	INSULATION ARMAFLEX SPONGE	2.00	FT

CUSTOMER PARTS LIST

43216.001 S/SM16

Seq Description
25 COND UNIT

Component	Description	Qty Per	U/M
562340	BUSHING STRAIN RELEIF SR-7W-2	1.00	EA
562693	FILTER DRIER 3/8" ODF	1.00	EA
564882	HANGER BRACKET STEEL WALL 21/2	1.00	EA
575841	NUT FLARE 3/8	1.00	EA
576791S	SCREW HH CAP 18-8 1/4-20X1-1/2	8.00	EA
577771	TUBING COPPER CAPILLARY .055	8.00	FT
578174	VALVE PRESSURE REG 5/8"W/STRNR	1.00	EA
579073	CONNECTOR FLEX. 3/8" FAN	2.00	EA
580497	TUBING VINYL CLEAR 1/4"	4.00	FT
580519	TUBING VINYL CLEAR 1/2"	4.00	FT
657409	SCREW HH CAP 18.8 1/4-20X2 1/2	1.00	EA
667064	FIN COIL	1.00	EA
670626	MOTOR FAN CONDENSOR 50W 230V	2.00	EA
672602	HOUSING FAN	1.00	EA
803618	VALVE SOLENOID 120/50-60	1.00	EA
897779	SEPARATOR OIL TEMPRITE 1/2"	1.00	EA
912840	SLEEVE GROMMET F/TECUMSEH COMP	4.00	EA
912859	GROMMET FOR TECUMSEH HERM COMP	4.00	EA
946877	BASE CONDENSER 2HP R22/23 SM32	1.00	EA
955132	BRKT VALVE MTG	1.00	EA
958468	DRIP PAN SS SPD S-SM 16-32	1.00	EA
976970	OIL ARTIC 22CC 1 GAL	5.00	OZ
995231	BRACKET RECEIVER MTG 2HP	1.00	EA

CUSTOMER PARTS LIST

43216.001 S/SM16

Seq Description

26 BASE ASSY

Component	Description	Qty Per	U/M
1054858	LINE ALL - TRANSDUCER TUBE CON	4.00	EA
552345	FIN COIL DEHUM 28X24 SM16&32	1.00	EA
575892	NUT FLARE 1/4	4.00	EA
698091	GAUGE PRESSURE NOSHOK 30"-200#	2.00	EA
698105	GAUGE PRESSURE NOSHOK 0-400#	2.00	EA
811246	DRIP PAN FOR SM16	1.00	EA
813729	HINGE OFFSET KNUCKLE TYPE A	2.00	EA

CUSTOMER PARTS LIST

43216.001 S/SM16

Seq 30 Description REFRID

Component	Description	Qty Per	U/M
1097953	VALVE ROTOLOCK 7/8"ID SWEAT	1.00	EA
1122944	404 SUCTION LINE CHMBR TO CASC	1.00	EA
1122952	404 SUCTION LINE FROM CASCADE	1.00	EA
1122960	508 EQUALIZER FROM EXP VALVE	1.00	EA
1122978	404 BYPASS 2HP CASCADE	1.00	EA
1122986	508 FROM EXP VALVE TO COIL 2HP	1.00	EA
1123047	508 SUCTION LINE FROM COIL 2HP	1.00	EA
1123063	508 INJECTION AND BYPASS 2HP	1.00	EA
1123071	404 H-C SOL VALVE 2 HP CASCADE	1.00	EA
1123152	508 LIQUID FROM CASCADE TO SOL	1.00	EA
1123160	404 LIQUID FROM MACH 2HP	1.00	EA
1123178	404 D-H SOL VALVE 2HP CASCADE	1.00	EA
1123259	508 BYPASS CASCADE 2HP	1.00	EA
1123267	508 LIQUID FROM TEE TO SOL 2HP	1.00	EA
1129255	INSUL. PIPE IMCOLOC 7/8" SPLIT	6.00	FT
1155840	LINE STEAM GENERATOR DRAIN	1.00	EA
1164522	EXCHANGER HEAT BRAZED PLATE	1.00	EA
1165536	HEATER SPD HUM 3KW 240 T-STAT	1.00	EA
1204615	PANEL TOPKIT S/SM 2HP BRZD PLT	1.00	EA
1217317	BRACKET UNIV WTT CSCD SPD CHAM	1.00	EA
1314826	TUBING POLYETHYLENE 1/40D THIN	10.00	FT
1341996	REGULATOR WATER W/GAUGE 0-30 P	1.00	EA
1364041	VALVE BALL 7/8" ODS W/ ACCESS	1.00	EA
529470	RETURN BEND COPPER FIT-FIL	1.00	EA
531130	COUPLING CU STAKED STOP 1/4	1.00	EA
535351	ELBOW CU 7/8 45' EL	2.00	EA
535424	ELBOW CU 1/2 45' ST EL	1.00	EA
535440	ELBOW CU 7/8 90 SR CUP ACR	4.00	EA
535637	ELBOW CU 7/8 90 SR FTG ACR	1.00	EA
535696	ELBOW CU 3/8 90 SR STR ACR	1.00	EA
550474	REDUCER CU 3/8X1/4	1.00	EA
564815	HANGER STRAP ST THIN WALL 1"	3.00	EA
574802	TEE COPPER 3/8X3/8X1/4	1.00	EA
575868	NUT FLARE 1/2	1.00	EA
577631	TUBING COPPER REFRIG GRADE 3/8	10.00	FT

CUSTOMER PARTS LIST

43216.001 S/SM16

Seq Description
30 REFRID

Component	Description	Qty Per	U/M
577658	TUBING COPPER REFRIG GRADE 1/2	4.00	FT
577666	TUBING COPPER REFRIG GRADE 5/8	1.00	FT
577674	TUBING COPPER REFRIG GRADE 1/8	30.00	FT
577690	TUBING COPPER REFRIG GRADE 1/4	2.00	FT
577755	TUBING COPPER CAPILLARY .042	4.00	FT
577771	TUBING COPPER CAPILLARY .055	6.00	FT
577801	TUBING COPPER CAPILLARY .080"	2.00	FT
578816	NIPPLE BRASS 1/4 X CLOSE	1.00	EA
581299	BUSHING BRASS 1/4X1/8	1.00	EA
581620	TUBING COPPER HD DN 7/8	6.00	FT
582376	STRAP TUBE BRASS WS-1100 1/4"	4.00	EA
582384	STRAP TUBE BRASS WS-1100 3/8"	2.00	EA
605069	TUBING COPPER CAPILLARY .031	7.00	FT
738239	FITTING BULKHEAD POLYPRO 1/4HS	1.00	EA
738271	ELBOW POLYPRO 1/40DHOSEX1/4MPT	2.00	EA
778583	BRACKET VALVE EXPANSION LH	3.00	EA
797472	SCREW PAN HD SS 8-32 X 2-1/4	2.00	EA
799009	RUBBER SILICONE 50 DURO GRAY	1.00	FT
812854	HUMIDITY VAPOR GENRTR SM16&32	1.00	EA
825174	BRACKET MTG SUCT LINE TOPKIT	2.00	EA
941530	VALVE AUTO EXPANSION	2.00	EA
972819	VALVE EXPANSION R23 3/8X1/2SAE	1.00	EA
984892	VALVE EXPANSION R404A 3/8X1/2	1.00	EA
984906	VALVE EXPANSION R404A 3/8X1/2	1.00	EA

CUSTOMER PARTS LIST

43216.001 S/SM16

Seq Description
40 ELEC

Component	Description	Qty Per	U/M
1013721	TERMINAL BLOCK PLUG 2 POS 5MM	12.00	EA
1013739	TERMINAL BLOCK PLUG 3 POS 5MM	8.00	EA
1047916	TUBE SHRINK GREEN & YLL STRIP	6.00	FT
1056397	PCB ASSY SSR 4 EVENT ENH 240V	2.00	EA
1063973	THERMOCOUPLE T20 LUG 20FT	1.00	EA
1103241	CONDUIT POLYTUFF II 3/4"	1.00	FT
1175549	TERMINAL BLOCK PLUG 5POS 12A	1.00	EA
1175565	TERMINAL BLOCK PLUG 4POS 8A	6.00	EA
1187172	TERMINAL BLOCK PLUG 10POS 8A	2.00	EA
1191105	CONN BLKHD RJ45 COUPLER	1.00	EA
1199721	SCREW METRIC PAN HD M4X20MM LG	2.00	EA
1218559	TERM BLK ST10 1|1 1TIER GREY	8.00	EA
1223732	THERMOCOUPLE T20 LUG 30FT	1.00	EA
1240750	CONDUIT HEYCO-FLEX II 3/8	3.00	FT
1242142	BRKT DISCONNECT MTG S/SM16-32	1.00	EA
1242249	DISCONNECT HANDLE ALTERED S/SM	1.00	EA
1261138	SWITCH DISCONNECT 125A C-H	1.00	EA
1269746	BEZEL 8200 DISPLAY S/SM16-32	1.00	EA
1269754	BEZEL DISCONNECT S/SM-8200	1.00	EA
1270200	INST 8200 DISPLAY	1.00	EA
1270886	RIVET SNAP PLASTIC 197DIAX30LG	6.00	EA
1270941	CABLE ASSY USB ESD GUARD 1FT	1.00	EA
1275218	INST SERIAL I/O CONVERTER	1.00	EA
1275975	CABLE ASSY USB 8200 TO BH 1FT	1.00	EA
1276060	INST CONTROL MODULE 2	1.00	EA
1276604	CONNECTOR PLUG 6POS 3.5MM	5.00	EA
1279034	CABLE ASSY CM2 COMP ID 3.5FT	1.00	EA
1332141	SENSOR HUMIDITY CAL 1345877	1.00	EA
538806	WIRE MTW 26 STR UL 500 #16 RED	75.00	FT
538849	WIRE MTW 26 STR UL #16 WHITE	15.00	FT
538873	WIRE MTW 19 STR UL BLUE #16	45.00	FT
544240	TERMINAL LUG 14/-1/0	1.00	EA
557142	PANEL CHANNEL GREY HOLES 2X2	2.00	FT
575469	WIRE THHN 19 STR UL #6 BLACK	10.00	FT
5774968	SCREW HEX SL WSHR 10-32 X 1/2	4.00	EA

CUSTOMER PARTS LIST

43216.001 S/SM16

Seq Description
40 ELEC

Component	Description	Qty Per	U/M
585955	WIRE ALPHA UNSHIELD FLAT 5/8	1.00	FT
616605	TERMINAL SQ D GROUND BAR KIT	1.00	EA
646105	WIRE SHIELDED 3 CONDUCTOR	20.00	FT
660116	WASHER FLAT NYLON ID.162 OD.31	2.00	EA
667463	PANEL CHANNEL COVER 2"	2.00	FT
670898	COVER BOX APPLETON 4-11/16	2.00	EA
745766	TERMINAL BLOCK PHOENIX 7 POS P	1.00	EA
766704	STANDOFF RAF #6-32 X 3/8"*	4.00	EA
793132	WIRE THHN 19 STR UL#10 GRN/YLW	10.00	FT
818186	TERMINAL JUMPER PHOENIX1401132	1.00	EA
818909	WIRE THHN 19 STR 2500' 14GN/YL	25.00	FT
932086	BOX SENSOR W/COVER	1.00	EA
963615	THERMOCOUPLE SHEATHED 'T' 20FT	1.00	EA

CUSTOMER PARTS LIST

43216.001 S/SM16

Seq	Description
97	SHIP PAINT

Component	Description	Qty Per	U/M
542440	PANEL LOWER OUTER SHELL TOP	1.00	EA
542450	PANEL TOP OUTER SHELL REAR S16	1.00	EA
542460	PANEL BACK MACHINERY SECTION	1.00	EA

CUSTOMER PARTS LIST

43216.001 S/SM16

Seq Description
110 SHIP

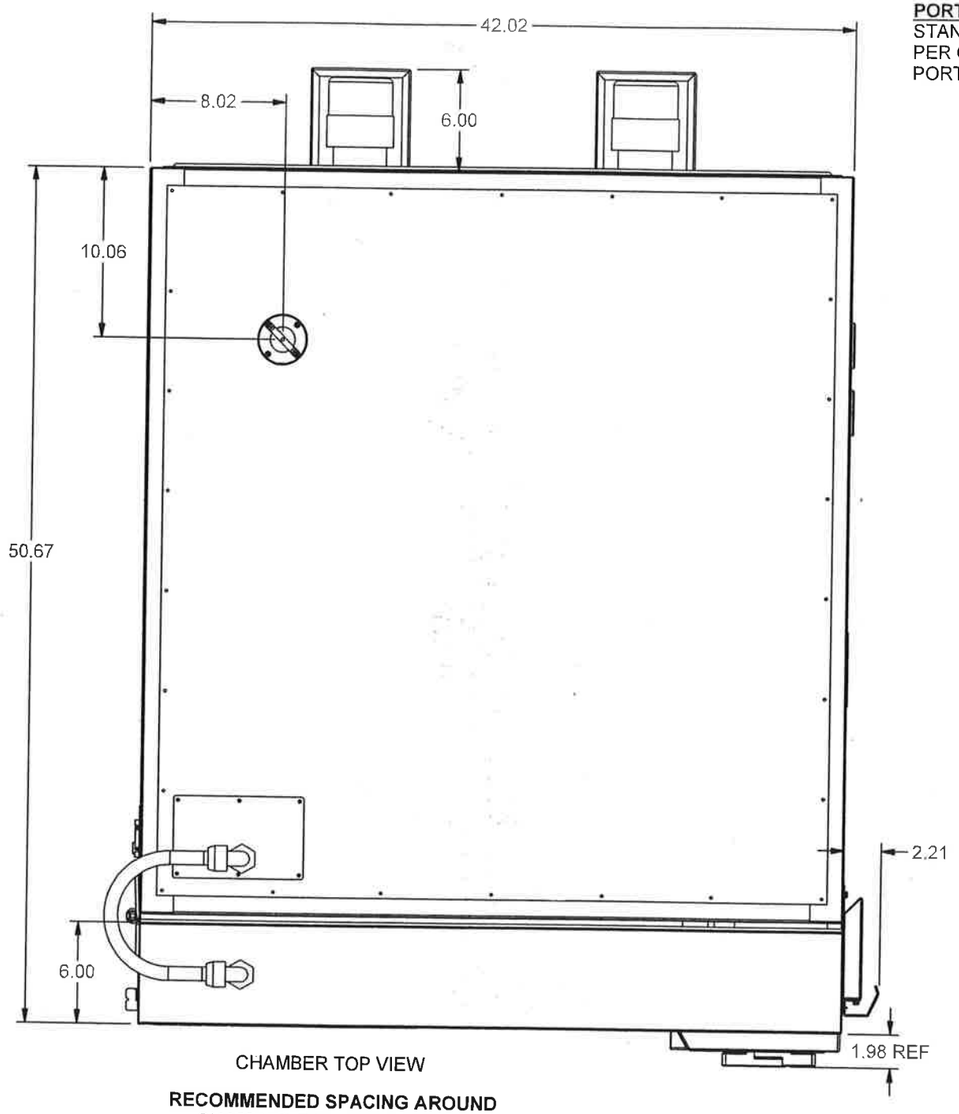
Component	Description	Qty Per	U/M
1106728	LABEL THERMOTRON W/COLOR BAR	1.00	EA
1204495	SHELF WIRE S/SM16 150 LB LOAD	1.00	EA
1244403	STYLUS WITH LOGO FOR 8800 LCD	1.00	EA
1271620	CSA DISC SUP BEFORE CHG FUSE	1.00	EA
1271638	CSA CAUT REPLA FUS W/SAME TYPE	1.00	EA
1271646	CSA DISC SUP BEFORE SERVICING	1.00	EA
1271662	CSA WARN GROUND CIRCUIT CONT	1.00	EA
562030	SHELF PILAS. BKTS CLIPS W/LIP	4.00	EA
679607	PORT PLUG HUMIDITY 4-1/4"	2.00	EA
813710	LATCH ADJ GRIP SOUTHCO 1/4HEX	1.00	EA
813737	LATCH MAGNETIC SOUTHCO	2.00	EA
813745	STRIKE FOR MAGNETIC CATCHSOUTH	2.00	EA

CUSTOMER PARTS LIST

43216.001 S/SM16

Seq Description
999

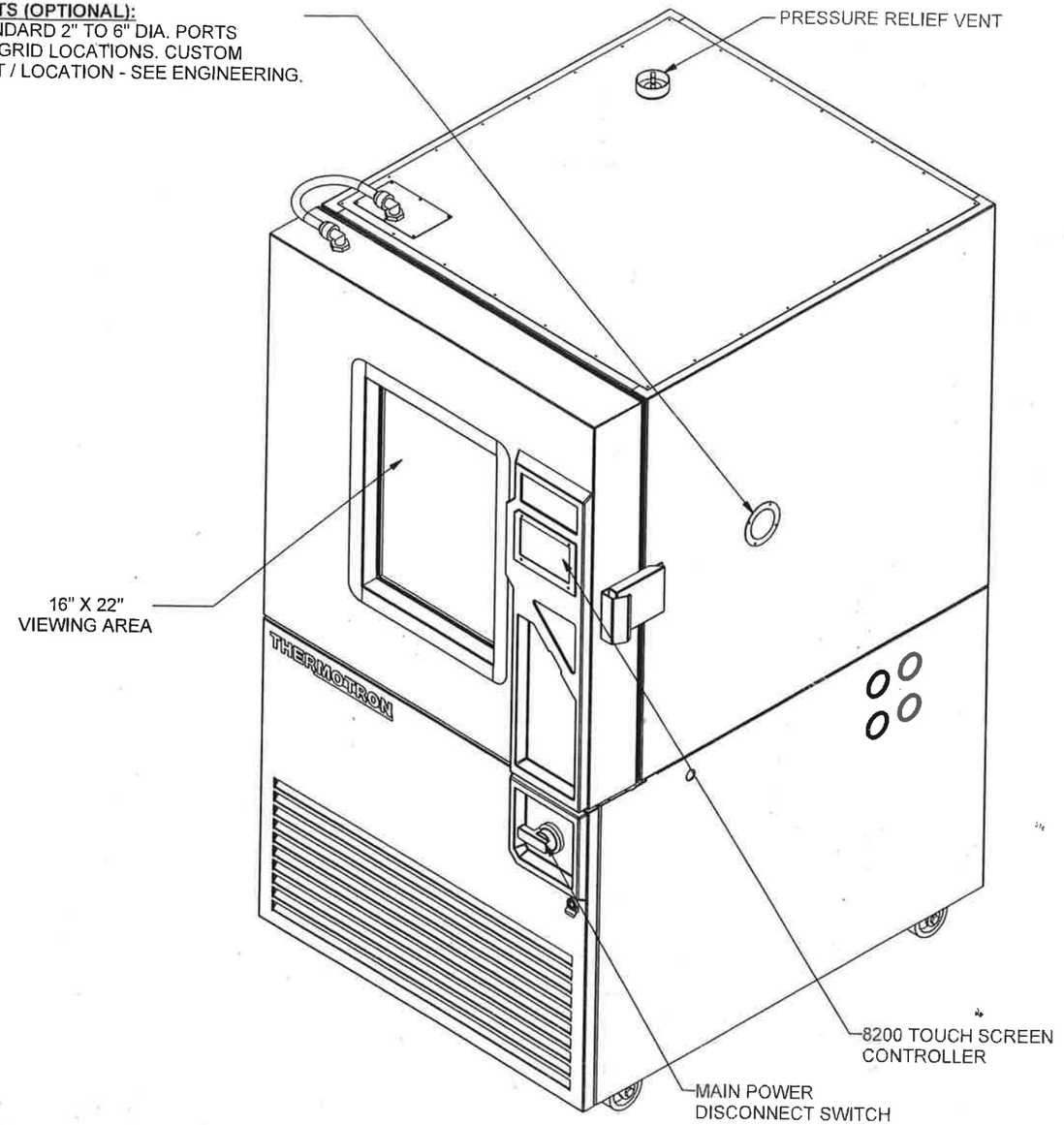
Component	Description	Qty Per	U/M
1028784	LABEL"CAUTION MOVIN USE1249720	1.00	EA
1028815	LABEL"CAUTION HOT/COLD SURFACE	1.00	EA
1028823	LABEL"NOTICE TO CUSTOMER"	1.00	EA
1048132	INSULATION FIBERGLAS 4" X 24"W	76.00	SF
1048140	INSULATION FIBERGLAS 2"X 24"W	76.00	SF
1164718	LABEL ANSIZ535 HAZARDOUS VOLT	2.00	EA
1212252	RAIL PHOENIX 35MM PERFORATED	1.00	EA
1247045	LABEL STATIC SENSITIVE COMPON	2.00	EA
1248897	LABEL "ARC FLASH HAZARD" 4"X2"	1.00	EA
1326823	LABEL "KYOTO PROTOCOL"	1.00	EA
529880	CONDUIT EASY-FLEX 3/8"	10.00	FT
534045	GASKET NEOP EDGE ANGLE 40DURO	14.00	FT
5489178	BAG POLY 66 X 53 X 121 4 MIL	1.00	EA
549840	TUBING SS 3/4 X .049	1.00	FT
562626	WIRE SHIELDED 10 CON 24AWG BEL	14.00	FT
571048	GASKET RUBBER CLOSED CELL SC41	20.00	FT
575213	WIRE THHN 19 STR UL #14 RED	60.00	FT
575248	WIRE THHN 19 STR UL #14 WHITE	14.00	FT
575523	WIRE THHN 19STR UL 2500 #12BLK	90.00	FT
577755	TUBING COPPER CAPILLARY .042	3.00	FT
577771	TUBING COPPER CAPILLARY .055	14.00	FT
577801	TUBING COPPER CAPILLARY .080"	2.00	FT
605069	TUBING COPPER CAPILLARY .031	7.00	FT
616605	TERMINAL SQ D GROUND BAR KIT	1.00	EA
663603	BASE FOR S16 & S32 CRATES	1.00	EA
667471	PANEL CHANNEL COVER 1"	2.00	FT
688460	LABEL SERIAL#&MODEL# (T-TRON)	1.00	EA
745529	PANEL CHANNEL GREY HOLES 1X1-1	2.00	FT
818909	WIRE THHN 19 STR 2500' 14GN/YL	36.00	FT
900435	WIRE SHIELDED 6 COND 20 AWG	14.00	FT
958069	GROMMET SILI 3/16IDX1/16"GRV	3.00	EA



CHAMBER TOP VIEW

RECOMMENDED SPACING AROUND CHAMBER FOR SERVICE AND OPERATION: 36" CLEARANCE AT THE FRONT AND REAR

PORTS (OPTIONAL):
STANDARD 2" TO 6" DIA. PORTS PER GRID LOCATIONS. CUSTOM PORT / LOCATION - SEE ENGINEERING.



REVISION HISTORY			
REV	DESCRIPTION	DATE	BY
A	4.38 WAS 4.00 PER ECR 4564	1/23/02	RW
B	REVISED DWG - ADD NEW CONTROLLER - ECR 6630	5/24/07	LRN
C	VENT REDESIGNED, HEIGHT WAS 1.80 - ECR 7681	4/12/2010	LRN

THERMOTRON

Thermotron Industries, Holland, Michigan 49423 USA

FILENAME: 5405.idw

NOTES
DO NOT SCALE DRAWING
DEBURR ALL SHARP EDGES
DIMENSIONS ARE IN INCHES UNLESS NOTED

TOLERANCE
UNLESS NOTED
.XX± .02 .XXX± .015
HOLE DIA ± .005
ANG± 1.5°

BEND ALLOWANCE:
MATERIAL:
FINISH:
DRAWN BY: RW DATE: 5/24/2007
DESIGNER: RW CHECKED BY: JEN

COMP. NO. 1270022

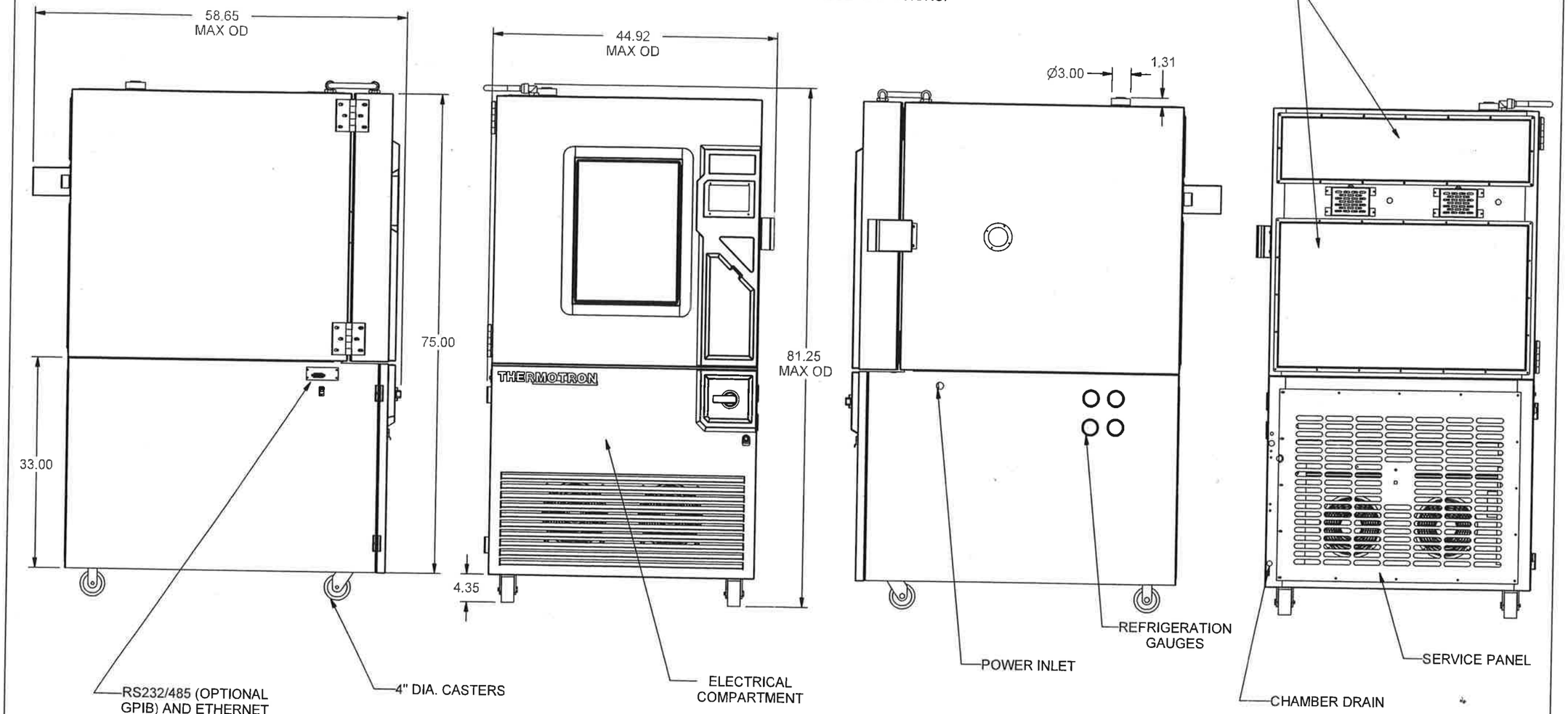
DESCRIPTION
S/SM-16 CHAMBER ASSEMBLY

DWG NO. 5405 REV C

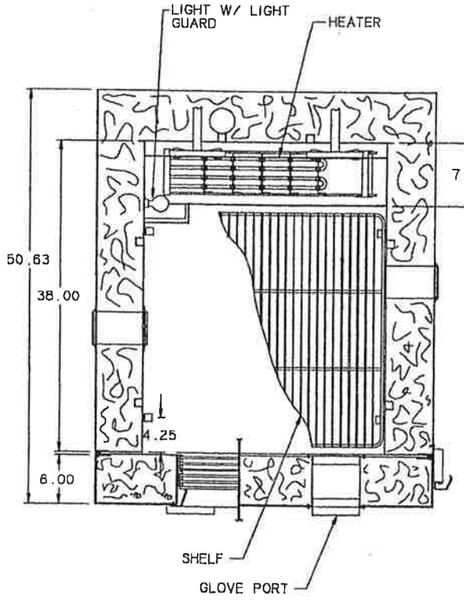
SHEET 1 OF 2

B

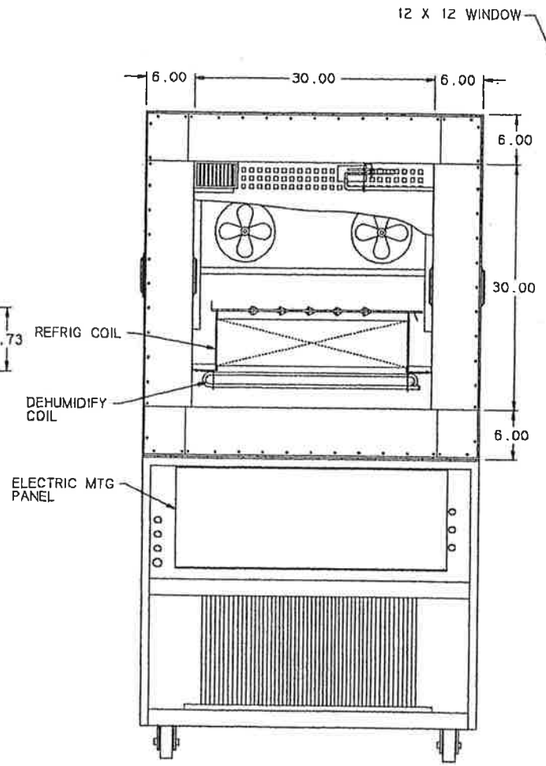
NOTE: MAX OD DIMS DO NOT INCLUDE ALLOWANCE FOR OPTIONS (E.G. DRY AIR PURGE). OPTIONS WILL INCREASE THESE DIMENSIONS.



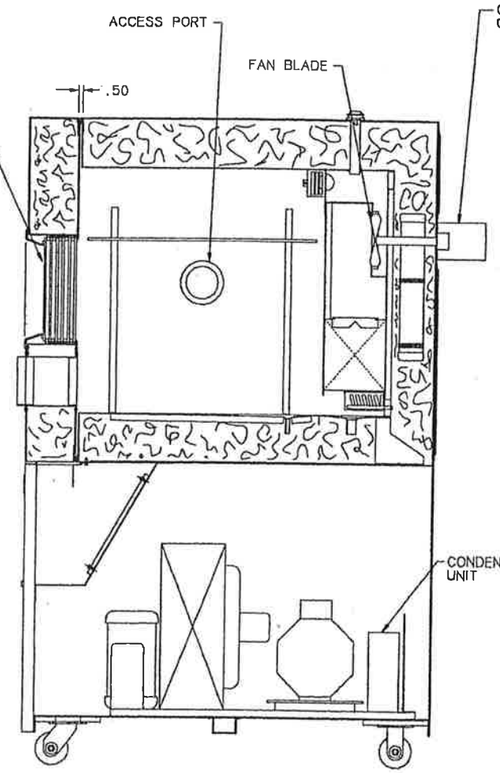
THERMOTRON	FILENAME: 5405.idw				COMP. NO. 1270022
The system designs on this print incorporate proprietary designs and CONFIDENTIAL TRADE SECRETS OF THERMOTRON INDUSTRIES. Access to this information is RESTRICTED. DO NOT use, disclose, publish or copy this information without express authorization. Thermotron Industries, Holland, Michigan 49423 USA	**NOTES** DO NOT SCALE DRAWING DEBURR ALL SHARP EDGES DIMENSIONS ARE IN INCHES UNLESS NOTED	**TOLERANCE** UNLESS NOTED .XX± .02 .XXX± .015 HOLE DIA ± .005 ANG± 1.5'	BEND ALLOWANCE: MATERIAL: FINISH: DRAWN BY: RW DESIGNER: RW	DATE: 5/24/2007 CHECKED BY: JEN	DESCRIPTION S/SM-16 CHAMBER ASSEMBLY DWG NO. 5405 SHEET 2 OF 2 REV C B



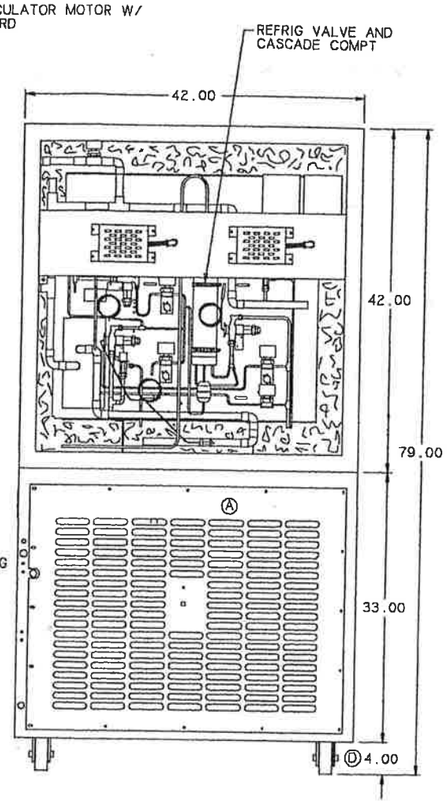
TOP VIEW



FRONT VIEW



RH SID VIEW



REAR VIEW

WORK SPACE DIMENSIONS:
30 WIDE X 30.25 DEEP X 30 HIGH

THERMOTRON

Thermotron Industries Inc., Holland, Michigan 49423 USA

ALL REVISIONS REQUIRE PROCESSING THROUGH RELEASE DEPT

SYM	DATE	CHANGE	BY	SYM	DATE	CHANGE	BY
A	11/1/99	REV. BACK PANEL	GLB				
B	5/2/00	CORRECTED CASTER HEIGHT ECR 3881 CS					
C	5/2/00	12X12 WINDOW WAS 20X20 ECR 3830 CS					
C	5/2/00	12X12 WINDOW WAS 20X20 ECR 3830 CS					
D	2/5/01	SHORTEN CASTORS BY .375	JEN				

CAD FILE: INTLYT16

TOLERANCE:

MAT'L:

FINISH:

SCALE: NA

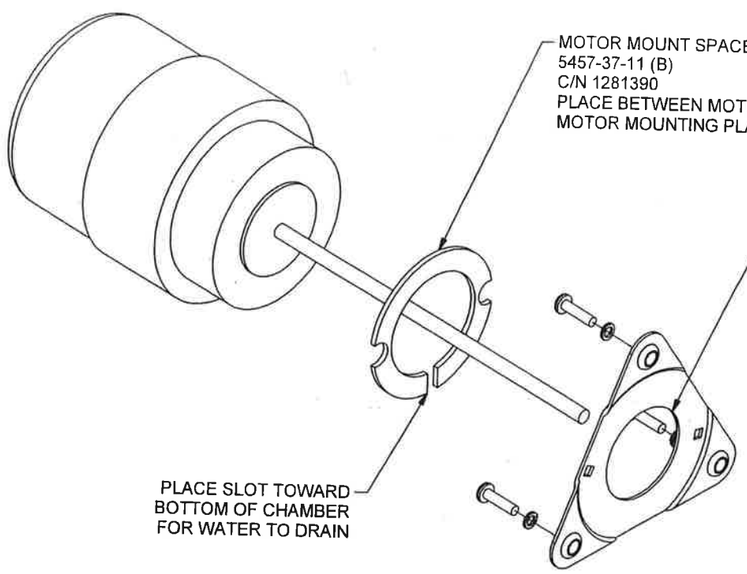
DRAWN BY: BAC 3/31/93

CHK'D:

DESCRIPTION
S-SM16
INTERIOR
LAYOUT

DWG NO. 5248-10-9

B



MOTOR MOUNT SPACER
5457-37-11 (B)
C/N 1281390
PLACE BETWEEN MOTOR AND
MOTOR MOUNTING PLATE

STEP 1
DO NOT SEAL AROUND OPENING
IN MOTOR MOUNTING PLATE
WITH SILASTIC

PLACE SLOT TOWARD
BOTTOM OF CHAMBER
FOR WATER TO DRAIN

STEP 2
CENTER SPONGE SEALING
WASHER OVER SHAFT
5457-37-12
C/N 552299

ALTER SPONGE WASHER:
ENLARGE HOLE TO 1-1/4" DIA

LAY A CONTINUOUS
BEAD OF SILICONE
AROUND HOLE IN
WASHER - THIS SIDE ONLY

STEP 3
SLIDE WASHER DOWN SHAFT UNTIL IT JUST CLEARS
THE MOTOR MOUNTING BRACKET. BLACK SIDE OF
WASHER SHOULD BE FACING THE MOTOR.

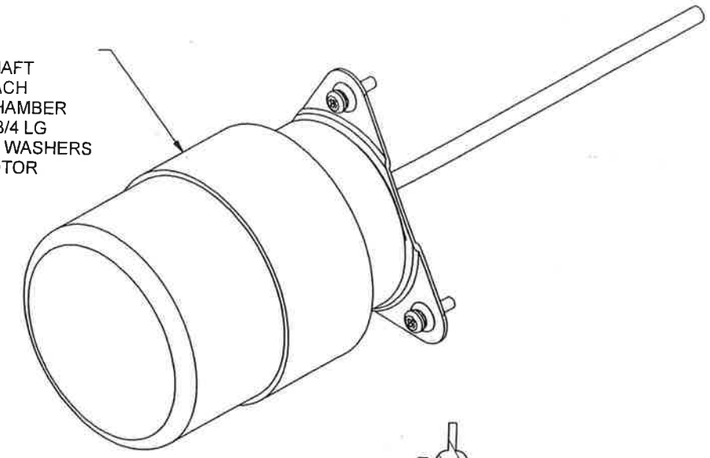
THE WASHER SHOULD BE CLOSE TO THE MOTOR MOUNTING
BRACKET. BUT MUST NOT RUB ANY PART WHEN
SHAFT ROTATES. SEE CROSS SECTION AT RIGHT

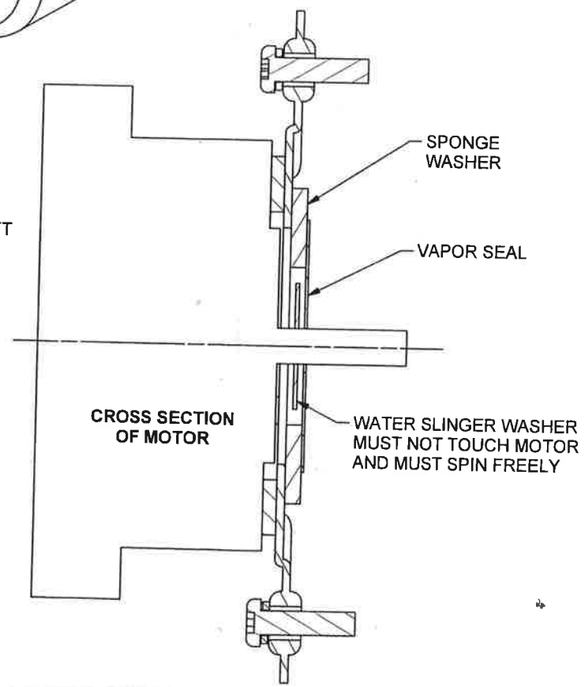
NOTE:
THE WATER SLINGER IS NOT REQUIRED ON S1.2 CHAMBERS
DUE TO THE MOTORS VERTICAL ORIENTATION

STEP 4
CENTER MOTOR SHAFT
VAPOR SEAL OVER SHAFT
5457-37-13
C/N 552302

WHEN INSTALLING THE MOTOR
ONTO THE CHAMBER. LAY A
CONTINUOUS BEAD OF SILICONE
AROUND HOLE IN VAPOR SEAL.

STEP 5
CENTER MOTOR SHAFT
IN PORT THEN ATTACH
MOTOR ASSY TO CHAMBER
USING THE 10-32 X 3/4 LG
SCREWS AND LOCK WASHERS
PROVIDED WITH MOTOR





CROSS SECTION OF MOTOR

REV	DESCRIPTION	DATE	BY
A	DWG NO. WAS 5387-9-29 ECR 7584	2/9/2010	NAD

THERMOTRON

Thermotron Industries, Holland, Michigan 49423 USA

FILENAME: 5457-37-10.idw

COMP. NO.:

NOTES
DO NOT SCALE DRAWING
DEBURR ALL SHARP EDGES
DIMENSIONS ARE IN INCHES
UNLESS NOTED

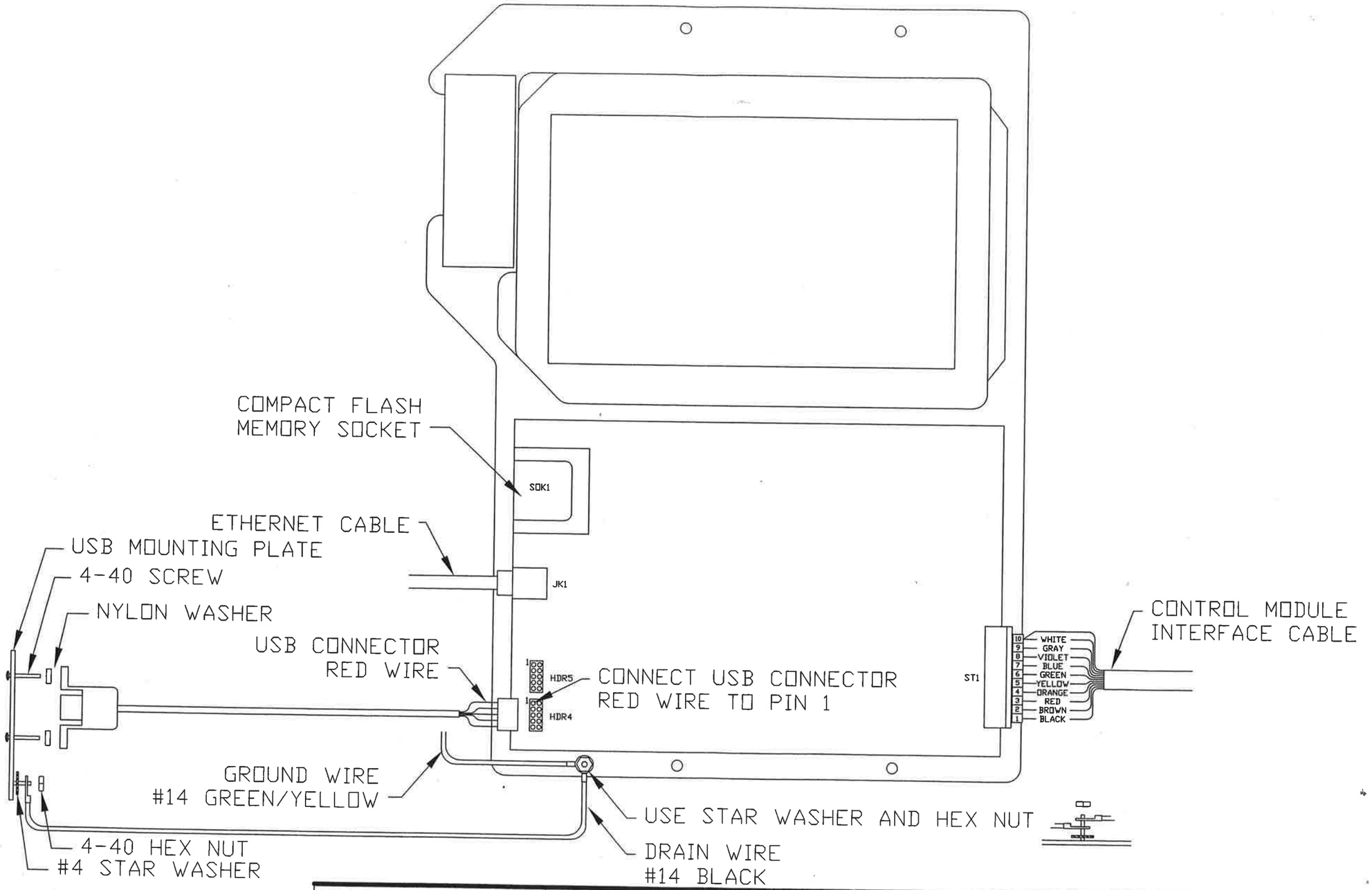
TOLERANCE
UNLESS NOTED
.XX± .02 .XXX± .015
HOLE DIA ± .005
ANG± 1.5'

BEND ALLOWANCE:
MATERIAL:
FINISH:
DRAWN BY: NAD DATE: 2/9/2010
DESIGNER: NAD CHKD: RW

DESCRIPTION
1/15 HP CIRCULATOR MOTOR
INSTALLATION - S/SM SERIES &
SE300/400

DWG NO. **5457-37-10** REV A **B**

SHEET 1 OF 1



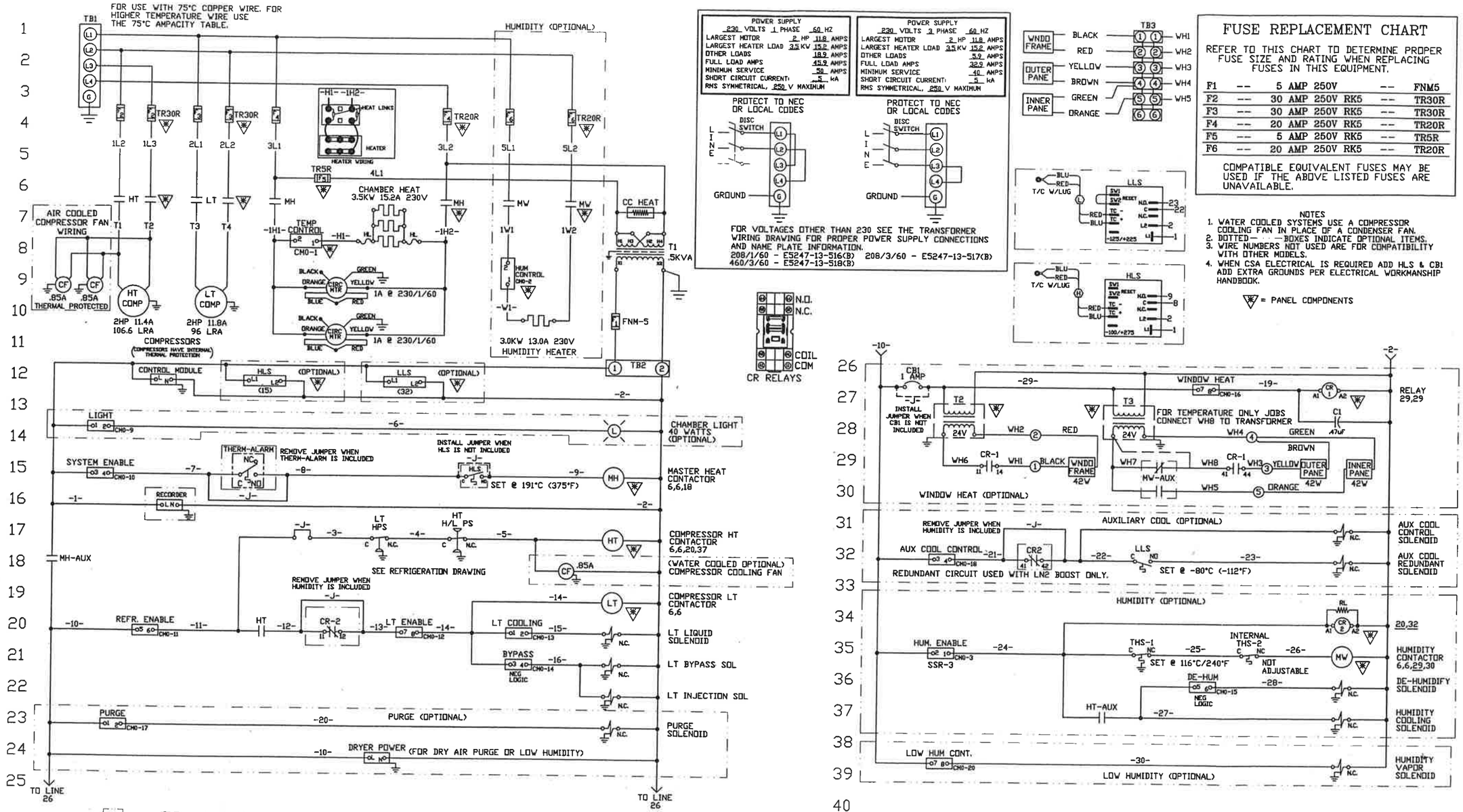
THERMOTRON

Thermotron Industries, Holland Michigan 49423 USA

MODEL NO.:	SERIAL NO.: STD DWG	DESCRIPTION
8200 CONTROLLER		8200 CONTROLLER LAYOUT

SYM	DATE	REVISION	BY
A	2/20/08	ADDED DRAIN WIRE DETAIL (ECR 6900)	RVD

DRAWN BY: RVD	DATE: 1/23/08	DWG NO. E5425-13-30	B
DESIGNER: RVD	CHECKED BY: SJM	SHEET 1 OF 1	



[ ] = OPTIONS

OPEN (UL) POWER PANEL

REFER TO POWER PANEL MATERIAL LIST FOR COMPONENT IDENTIFICATION.

ALL MOTORS MUST HAVE MOTOR CONTROLLERS AND RUNNING OVERCURRENT PROTECTION.

SEE THE ELECTRICAL PANEL FOR THE LISTING MARK

THERMOTRON

Thermotron Industries, Holland Michigan 49423 USA

MODEL NO.: S/SM-16, 27, 32

SERIAL NO.: STD DWG

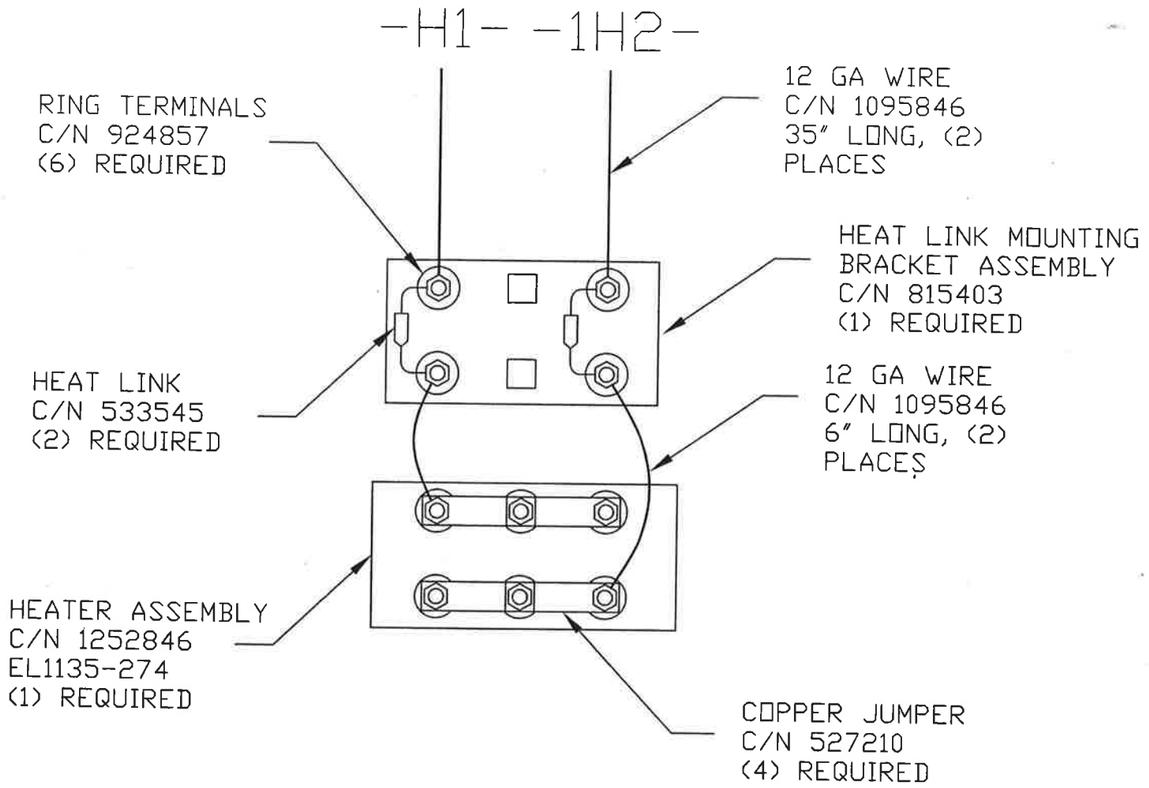
DESCRIPTION: ELECTRICAL SCHEMATIC

SYM	DATE	REVISION	BY
E	3/21/2012	ADDED S/SM-32 TO TITLE BLOCK (ECR 8463)	EH

DRAWN BY: GEO | DATE: 6/10/09 | DESIGNER: RVD | CHECKED BY: dgm

DWG NO. E5405-13-22 B

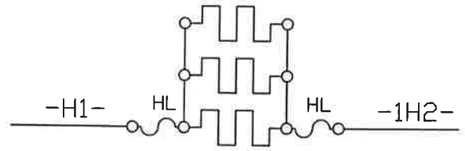
SHEET 1 OF 2



HEATER WIRING
ASSEMBLY C/N 1256785

SCHEMATIC REPRESENTATION

CHAMBER HEAT
3.5KW 15.2A 230V



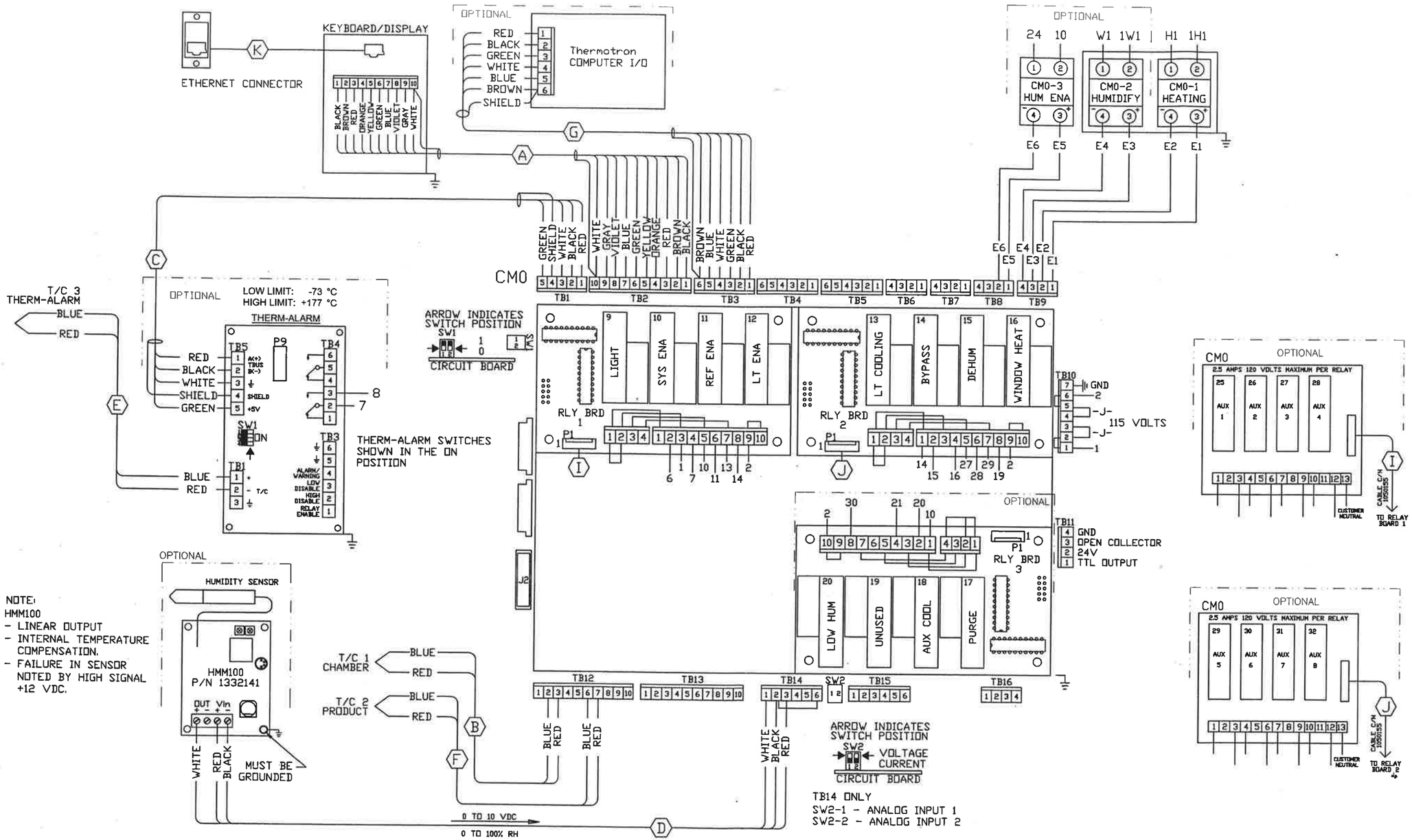
THIS DRAWING IS FOR USE WITH STANDARD ASSEMBLE-TO-ORDER (ATO) JOBS AND MAY NOT BE SUITABLE FOR USE WITH "CUSTOM" ENGINEERED JOBS.

NOTES:
1. DO NOT SCALE DRAWING.
2. DEBURR ALL SHARP EDGES.
3. DIMENSIONS ARE IN INCHES.

SYM	DATE	REVISION	BY
A	3/21/2012	ADDED S/SM-32 TO TITLE BLOCK (ECR 8463)	EH

MODEL NO.: S/SM-16, 27, 32	SERIAL NO.: STD DWG	DESCRIPTION: HEATER WIRING DOMESTIC VOLTAGES	
DRAWN BY: GEO	DATE: 6/10/09	DWG NO. E5405-13-22	B
DESIGNER: RVD	CHECKED BY: BJM	SHEET 2 OF 2	

PSD @ Thermotron can

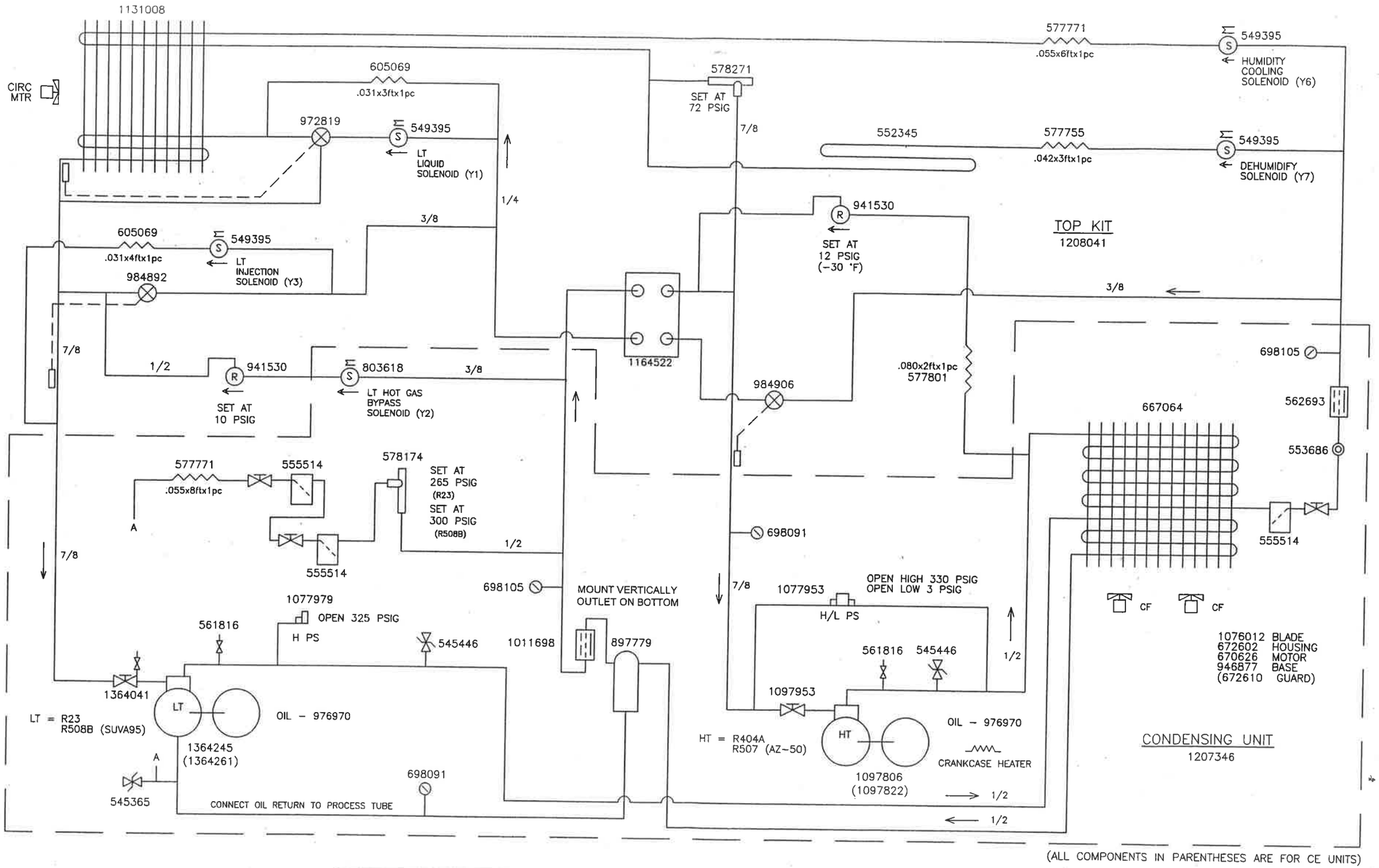


NOTE:
HMM100
- LINEAR OUTPUT
- INTERNAL TEMPERATURE COMPENSATION.
- FAILURE IN SENSOR NOTED BY HIGH SIGNAL +12 VDC.

[ ] = OPTIONAL

MODEL NO.:	SERIAL NO.: STD DWG	DESCRIPTION
S/SM-16, 27, 32		INSTRUMENT WIRING

SYM	DATE	REVISION	BY	DRAWN BY: GEO	DATE: 6/10/09	DWG NO.	B
C	3/21/2012	ADDED S/SM-32 TO TITLE BLOCK (ECR 8463)	EH	DESIGNER: RVD	CHECKED BY: sjm	E5405-13-23 SHEET 1 OF 1	



(ALL COMPONENTS IN PARENTHESES ARE FOR CE UNITS)

PATH: F:\Product Masters\S & SM\S-SM-16\refrig

CUSTOMER:	MODEL NO.: SM-16/27/32 (CE)	VOLTAGE:	DESCRIPTION: REFRIGERATION SCHEMATIC	COMP. NO.
		SERIAL NO.:		

SYM	DATE	REVISION	BY	DRAWN BY: BJC	DATE: 2/20/04	DWG NO. R5405-12-6	
E	5/14/12	CORRECT SUCTION VALVE ORIENTATION - ECR #8523	CJE	DESIGNER: BJC	CHECKED BY:	SHEET 1 OF 1	B