Cincinnati Sub-Zero

# Installation
# Operation
# Maintenance
# Manual
# ZP Series

58911 rev G
09/2023

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*Note: CSZ is continuously upgrading the components used in its equipment. Consequently, the physical appearance of certain components may vary from that shown.*

# INTRODUCTION

This manual has been tailored to match the specific features and options provided on your Temperature Chamber at the time of original manufacture. The last section of the manual is the specific information section. This area was developed in an attempt to better define items on CSZ chambers that are “SPECIFIC” to a customer. Please refer to this section for warranty, controller PID parameters, and calibration/verification test data sheets.

Cincinnati Sub-Zero Temperature Chamber:

**MODEL NO.** _____

**SERIAL NO.** _____

**DO NOT USE THIS MANUAL IN AN ATTEMPT TO OPERATE OR MAINTAIN ANY OTHER MODEL OR SERIAL NUMBER.**

**PLEASE READ THIS ENTIRE MANUAL BEFORE OPERATING THIS UNIT.**

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## CHAMBER LABELS AND MEANINGS

Some graphical safety labels may be replaced with textual based safety labels. Read the entire manual for other safety information that is applicable to our chamber.

| | | | |
|---|---|---|---|
|  | **GENERAL DANGER, CONSULT MANUAL** |  | **WEAR EYE PROTECTION** |
|  | **ELECTRICAL SHOCK** |  | **TURN OFF AND LOCK OUT SYSTEM POWER BEFORE SERVICING** |
|  | **EXPLOSION, ARC FLASH HAZARD** |  | **WEAR PROTECTIVE GLOVES** |
|  | **LOW TEMPERATURE** |  | **FORKLIFT RIGHT, DESIGNATES CHAMBER LIFTING POINTS** |
|  | **HOT SURFACE** |  | **FORKLIFT LEFT, DESIGNATES CHAMBER LIFTING POINTS** |
|  | **KEEP HANDS CLEAR; PINCH HAZARD** |  | **DO NOT OPERATE WITH PACEMAKER** |
|  | **CONSULT OPERATORS MANUAL BEFORE OPERATING** |  | **PROTECTIVE CONDUCTOR TERMINAL** |

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*THESE CHAPTERS INCLUDED FOR PRINT MANUALS*

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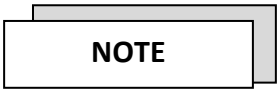
# INTRODUCTION


Warnings contained in this manual are identified by this symbol. Warnings identify any conditions or practices that, if not strictly observed, could result in personal injury or possible loss of life.


Cautions in this manual are identified by this symbol. Cautions identify any condition or practice that, if not strictly observed, could result in damage to, or destruction of, the system equipment. Please read all precautions before operating your unit.




Notes contained in this manual are identified by this symbol. Notes identify items of importance to proper operation and maintenance.

This instrument has been designed and tested in accordance with IEC Publication 61010-1:2010. Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use and has been supplied in a safe condition. The instruction documentation contains information and warnings which must be followed by the user to ensure safe operation and to maintain the instrument in a safe condition.

# GENERAL SAFETY PRECAUTIONS

The following are general safety precautions that are not related to any specific procedures and therefore do not appear elsewhere in this manual. These are recommended precautions that must be understood and applied during many phases of operation and maintenance of the equipment.

**IMPORTANT:** All OSHA and other applicable local and national codes, regulations, and guidelines regarding lockout/tagout procedures must be followed. This includes a lockable disconnect switch.

### KEEP AWAY FROM LIVE CIRCUITS

Operating personnel should at all times observe all safety precautions. Do not replace components or make adjustments inside the equipment with the high voltage supply turned on. Under certain conditions, dangerous potentials may still exist when the power switch is in the off position due to charges retained by capacitors. To avoid injury, always remove power and discharge and ground a circuit before touching it.

**NOTE:** Keep unit away from flammable substances.

### DO NOT SERVICE OR ADJUST ALONE

No one should reach into an enclosure to service or adjust equipment except in the presence of someone who is capable of rendering aid.

### RESUSCITATION

Personnel working with or near high voltages should be familiar with modern methods of resuscitation. Such information may be obtained from the Local Red Cross Agency or other qualified national safety organizations.

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DO NOT replace components or make adjustments inside the equipment with the main power supply turned on. Under certain conditions, dangerous potentials may still exist when the power switch is in the off position due to charges retained by capacitors. To avoid injury, always remove power and ground a circuit before touching it.


Paint thinners, cleaning solutions and other chemicals or solvents should never be stored in the vicinity of the unit. High operating temperatures and live electrical circuits could ignite fumes and cause an explosion.


**DO NOT** touch refrigeration piping during chamber operation. The refrigeration piping can become extremely hot or extremely cold and cause severe burns.


Lockout main power prior to securing. High voltage remains present on main electrical panel with covers removed.


The chamber door must remain closed during operation. If the door is required to be open, wear safety goggles to prevent the high velocity airflow from blowing particles or objects into eyes.


This chamber operates at extreme temperatures. Avoid any personal contact with objects and surfaces that may be hot or cold to prevent severe burns or frostbite.


The refrigeration unit is a pressurized system and hazards exist which could result in personal injury. It is therefore recommended that removal and installation of the hermetic compressor be performed by experienced personnel only. Failure to follow these instructions may result in serious personal injury.


Gaseous nitrogen/CO2 vent connection must be ducted to the outdoors to prevent displacement of oxygen around the unit.


**DO NOT** place items in the chamber that could burn or explode at high temperatures. This chamber uses open wire heating elements which generate surface temperatures over 1000°F (537°C). This is **NOT** an explosion-proof chamber.


PRODUCT PROTECTION. Chambers are equipped with high heat limits or safety devices. These safety devices are installed to protect the chamber from exceeding design limits. These safety devices remove power ONLY from the chamber heaters and **DO NOT** remove power from customer product. Provisions must be made to de-energize the product on test and the chamber in the event of an over-temperature protection.


All OSHA and other applicable local and national codes, regulations, and guidelines regarding lockout/tagout procedures must be followed while servicing this unit. This may include a lockable disconnect switch to remove power from the equipment while servicing.


**DO NOT** reach into an enclosure to service or adjust equipment except in the presence of someone who is capable of rendering aid.


**Do NOT** climb or place top-heavy objects on the top of the chamber.

**WARNING** All loads must be removed from the chamber prior to transport and/or maintenance and securing. The chamber door must be shut prior to transport or moving.

**WARNING** The installation manual and all notes on the electrical schematic must be followed to ensure safe installation, operation, and maintenance.

**WARNING** Window frame may become hot during operation.

**WARNING** There are **NO** provisions for venting fumes.

**WARNING** No operator serviceable parts inside equipment. Refer all servicing to qualified service personnel. To prevent electric shock, do not open lower enclosure panels.

**WARNING** This product requires a protective earth conductor connection. Any interruption of the protective conductor inside or outside of the instrument is likely to make the instrument dangerous. Intentional interruption is prohibited.

**WARNING** Do not position the instrument such that access to the disconnect device is impaired or that any of the chamber vents are blocked.

**WARNING** If this instrument is not used as specified, the protection provided by the equipment could be impaired. This instrument must only be used in a normal condition (in which all means of protection are intact).

**WARNING** For continued protection against fire hazard, qualified service personnel must replace fuses and circuit breakers with the same type and rating only. The use of other fuses and circuit breakers is prohibited. Disconnect chamber from electrical supply before changing fuses or resetting circuit breakers.

**WARNING** Prior to servicing the equipment, the supply power should be disconnected by moving the main disconnect switch to the OFF (O) position. Failure to do so can result in service personnel being exposed to accessible hazardous voltages. Follow all local and national lockout and tagout procedures.

**CAUTION** **DO NOT** put corrosive substances into the chamber. Examples of corrosive substances include, but are not limited to, Chlorine, Chlorides, and Acids.

**CAUTION** **DO NOT** place items in the chamber which can emit corrosive vapors or substances.

**CAUTION** To prevent damage to your test samples and the chamber's compressors, DO NOT exceed the live load rating of the chamber. (See the General Description Section of this manual for the live load rating for your unit.)

**CAUTION** Running temperature/humidity points outside of the standard range can cause damage to the refrigeration compressor(s).

**CAUTION** Before switching on this equipment, ensure the supply voltage is correct.

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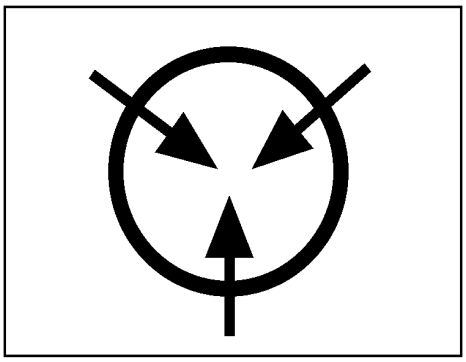
## ELECTROSTATIC DISCHARGE SENSITIVE DEVICES



This manual contains maintenance procedures for parts and assemblies sensitive to damage by electrostatic discharge (ESD). Parts or assemblies are identified as ESD sensitive by the symbol to the left.

The following are general precautions that should be observed when handling ESD sensitive devices or assemblies:

1. Handling ESD sensitive devices at approved field force protective work stations.
2. Keep work area free of static generators, such as plastic cups, foam cushions, and rayon or polyester apparel.
3. Avoid static-producing activities, such as wiping feet and removing or putting on smocks while in the work area.
4. Use ESD protective equipment, such as grounded work benches, grounded tools and test equipment, conductive flooring, air ionizers, personnel ground straps with 1 megohm minimum resistance, and protective apparel whenever possible.
5. Store and transport ESD sensitive devices in protective bags, tote boxes, or trays. Use original packaging whenever possible.
6. Remove power and signals before removing or installing ESD sensitive devices or assemblies.
7. Handle ESD sensitive circuit card assemblies by their shunt bars or edges. Do not touch parts, terminals, or circuitry. Do not use canned coolant for fault isolation.

**WARNING**

**DO NOT BYPASS** any of the safety features provided in this equipment. Failure to follow these instructions could result in serious personal injury or death.

**WARNING**

Cincinnati Sub-Zero chambers are equipped with high heat limits, or safety devices. These safety devices are installed to protect the unit from exceeding design limits. These safety devices remove power ONLY from the chamber heaters and DO NOT remove power from your product. Provisions must be made to de-energize the product under test and the chamber in the event of an over-temperature condition.

**WARNING**

**DO NOT** touch refrigeration lines while the unit is in operation. Lines can become extremely hot or very cold and can cause severe burns.

**WARNING**

The chamber high limit and other latching thermostats and thermal cut outs can only be reset by properly trained service personnel. Only access the chamber sub panel or remove any side rear service panels if you are a qualified service personnel.

# SAFETY FEATURES

Cincinnati Sub-Zero incorporates many safety features in the design of its equipment. These safety features provide protection for the equipment, as well as for operating and maintenance personnel. **SEE WARNING.**

## ELECTRICAL CIRCUIT PROTECTION

1. All power circuits and control circuits are separately protected by circuit breakers or fuses.
2. Compressors have internal inherent electrical overload protection which will shut down the compressor in the event of an electrical or thermal overload.
3. All power to the chamber heaters passes through a non-cycling power contactor. This contactor is controlled by the chamber over-temperature limit and an optional High/Low test limit control and is de-energized if either a chamber is over-temperature, or a test item over/under-temperature condition exists.

## REFRIGERATION SYSTEM PROTECTION

1. The refrigeration systems utilize refrigerants which are non-flammable and non-explosive.
2. The refrigeration system is equipped with pressure controls. These controls will shut down the compressor if a high or low pressure condition is reached. Refer to the Refrigeration Flow Diagram and the Electrical Schematic for the specific pressure controls on your unit. Contact Cincinnati Sub Zero with any questions.

## OVER-TEMPERATURE PROTECTION

The high temperature cutoff is installed to protect the chamber from exceeding design limits. This safety device removes power only from the chamber heaters when an over-temperature condition exists in the chamber. They DO NOT remove power from the product being tested.

## PRODUCT HIGH LIMIT (IF EQUIPPED)

The product high temperature limit can be used to protect the product being tested and the chamber from overheating. The thermocouple hanging from the back of the chamber can be attached to the customer product. The product safety should be checked for proper operation every three (3) months.

## CHAMBER HIGH LIMIT

This device is intended for chamber over-temperature protection only. It is preset to open at the temperature indicated on the Electrical Schematic.

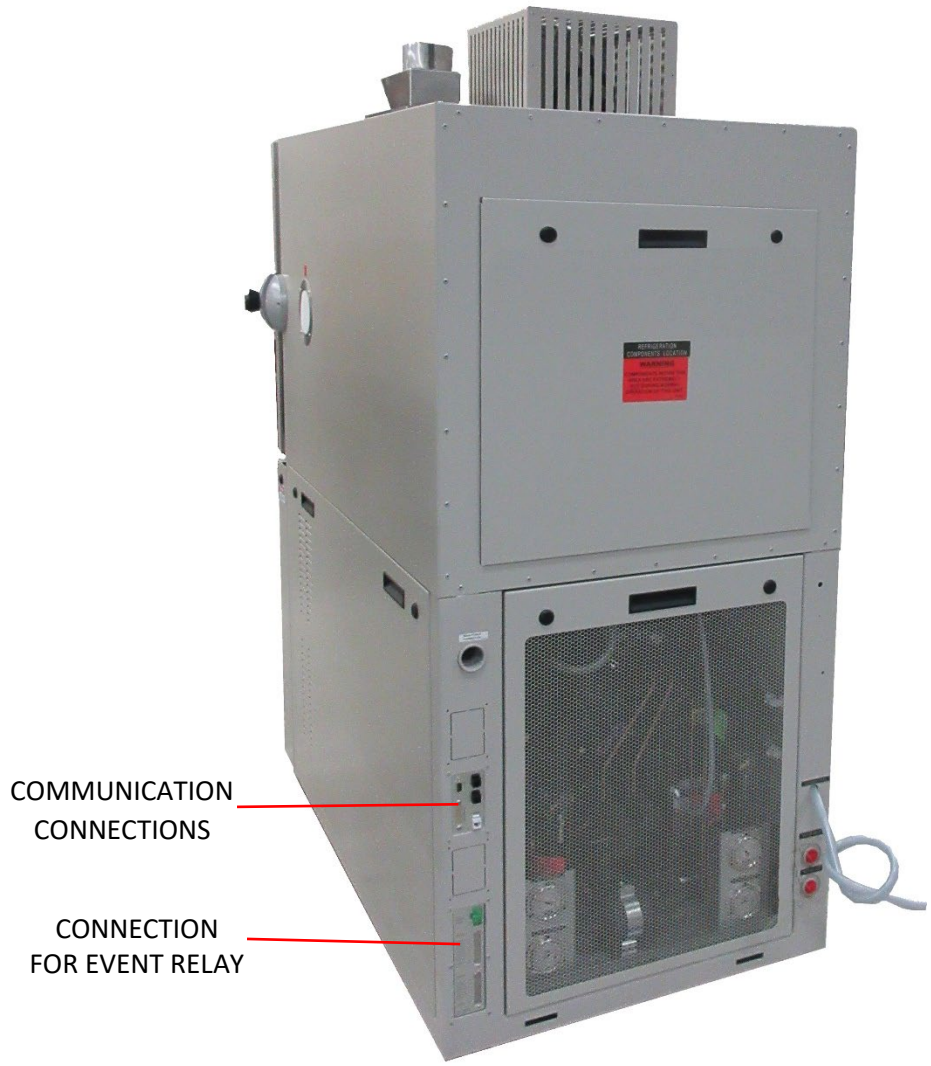



Figure 1-1: Communication Plates

*Note: CSZ is continuously upgrading the components used in its equipment. Consequently, the physical appearance of certain components may vary from that shown.*

**NOTE**

*Connection for event relay(s). Do not connect 115-volt power to these connections. Customer events should only be connected to a 24VDC/AC source. See EZT-570 User Manual for exact specifications.*

# CHAPTER 2: GENERAL DESCRIPTION

**NOTE**

Condensation on exterior surfaces is normal when operating at cold temperatures for an extended period of time.

## SYSTEM DESCRIPTION

The ZP-Series Temperature chambers are pre-engineered chambers designed to provide an environment with specific temperature (humidity) conditions. The standard ZP model is composed of the following: 1. Controller, 2. Chamber, 3. Refrigeration/ Heating components. Optional equipment includes, but is not limited to: 4. Humidity, 5. Pen Recorders, 6. High/Low Limit, 7. IEEE-488 Serial Interface, 8. Boost Cooling System, 9. GN2 Purge, 10. Dry Air Purge, 11. Limited Temperature Sheath Heaters.

The chambers have a standard range of -94°F to +375°F (-70°C to +190°C) cascade, -50°F to +375°F (-45°C to +190°C) Tundra, and -30°F to +375°F (-34°C to +190°C) single stage which provide both heating and cooling as required. Chambers with optional humidity are designed to provide a minimum of 10% and a maximum of 98% relative humidity, as limited by a 45°F (7°C) dewpoint and a 185°F (85°C) maximum dry bulb temperature. Refer to Figure 2 for Achievable Humidity Points. The chambers are designed to operate in a commercial environment, i.e., temperature of +75°F +/- 10°F (+23°C +/- 6°C), maximum dew point of 55°F (12.8°C), and an altitude of 7,000 ft. (2133.6M). Refer to the specifications at the end of this section for additional information.

## CONTROLLER

The standard controller is composed of a CSZ EZT-570S/L Controller, a High/Low limit, and communications electronics. Detailed operating instructions for the controller are found in the controller user's manuals on the digital media that accompanied the chamber. Other optional controllers available include the Watlow F4. See Operating Instructions in Chapter 4 for more information regarding chamber controllers.

## CHAMBER

**A. Chamber Interior**

The chamber interior consists of the front workspace and the rear component area, separated by a stainless-steel plenum cover. A probe bracket is behind the grille in the upper left corner of the plenum. The bracket contains the probes for the controller, recorder (if required), and RH sensor (if humidity option is installed). The area behind the plenum cover contains the refrigeration evaporator coil, heater limit thermocouple, evaporator fan(s), humidification inlet (if humidity option is installed), auxiliary cooling nozzle (if auxiliary cooling option is installed), and the dehumidification coil (if humidity option is installed). These items may only be accessed by removal of the plenum cover by properly trained service personnel.

B. **Chamber Exterior**

Fiberglass insulation is used with a high temperature binder for temperatures up to 500°F (260°C). The cabinet is constructed with a minimum of mechanical contact between the liner and the exterior to reduce conductive heat losses and minimize condensation on the exterior cabinet.

A multiple-pane window assembly in the door of the chamber allows viewing of the chamber interior during operation. The window is constructed of tempered glass panes with a heater harness to assure frost-free viewing during low temperature chamber operation. Under certain ambient conditions, it may be normal to see some condensation around the outer window frame area during low temperature operation.

## REFRIGERATION/HEATING COMPONENTS

A. **Refrigeration**

ZP-Series chambers use one of three types of mechanical refrigeration systems: single stage, Tundra®, and cascade. A single stage system is used when the chamber's ultimate low temperature is -30°F (-34°C) or higher. The Tundra system is used when the chambers ultimate low temperature is -50°F (-45°C) or higher. A cascade system is used when the chamber's ultimate low temperature is -94°F (-70°C). The single stage system uses refrigerant R-404A. The cascade system uses refrigerant R-404A in System #1 and R-508B/R-23 in System #2. The Tundra System uses refrigerant R-410A.

The refrigeration system can either be air cooled or water cooled depending on the model of chamber. Standard ZP-Series chambers above 3.5 HP are air cooled.

Chambers with compressors which are 10 HP (having nominally approx. 12kW of capacity with R-404A refrigerant at 60 Hz operation) and larger are water cooled.

All refrigeration components are selected to ensure safe, reliable, and balanced operation. The components may be purchased from the CSZ Service Department or a local refrigeration wholesaler.

**B. Heating**

Open-coil nichrome heating elements are standard on all systems. The heaters are mounted in porcelain insulators attached to stainless steel frames. The heaters are located behind the rear plenum and do not radiate directly into the test space.

Limited temperature sheath heaters are an option for chambers that may contain flammable vapors. See the last section of this chapter for more information.

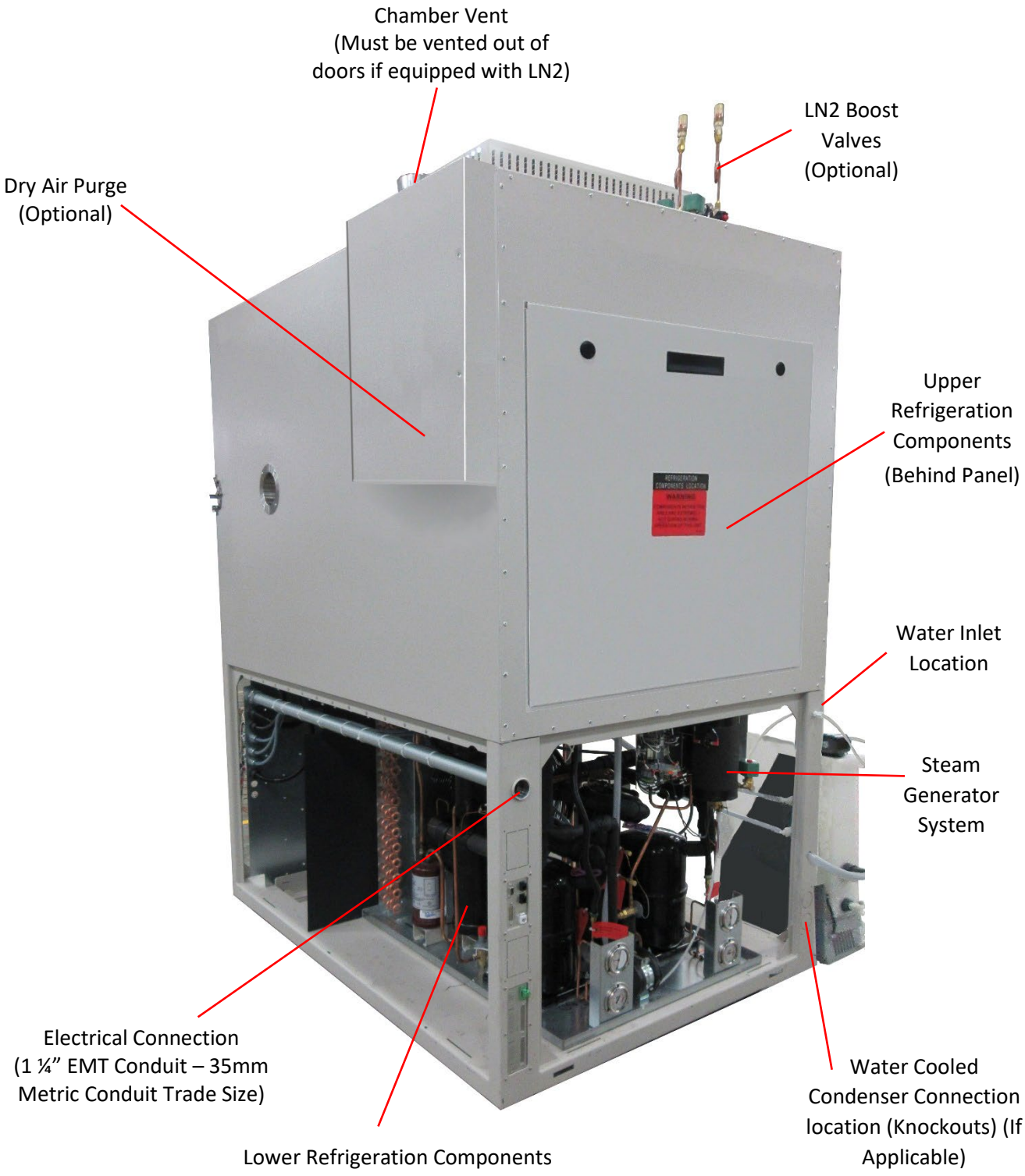



Figure 2-1: Chamber Components Location

*Note: CSZ is continuously upgrading the components used in its equipment. Consequently, the physical appearance of certain components may vary from that shown.*

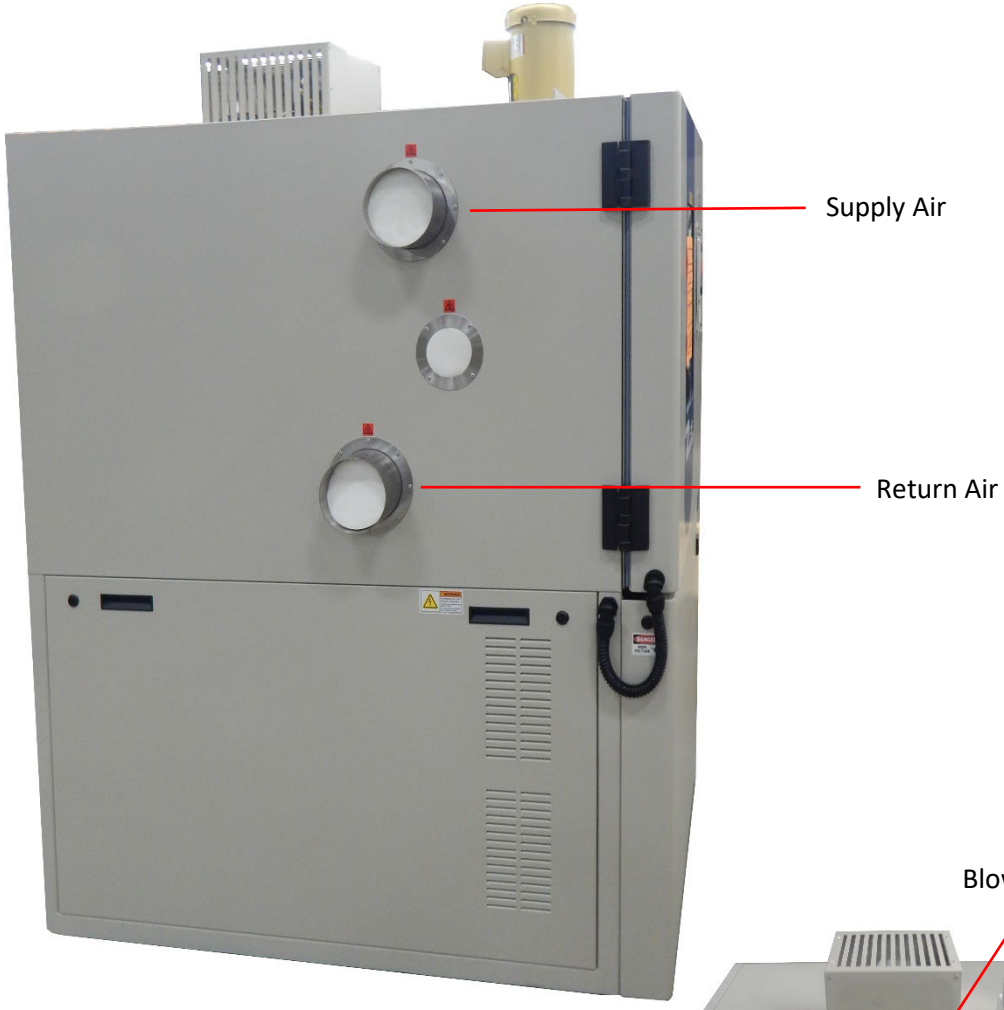



Figure 2-2: ZPRC Chamber – Side View

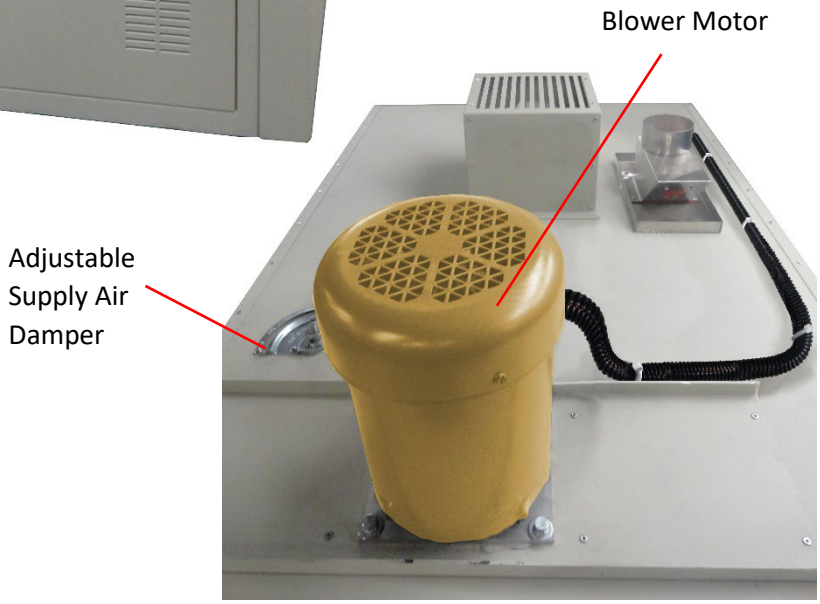



Figure 2-3: ZPRC Chamber – Top View

*Note: CSZ is continuously upgrading the components used in its equipment. Consequently, the physical appearance of certain components may vary from that shown.*

## HUMIDITY

The ZPH-Series chambers provide the same temperature ranges for heating and cooling as the ZP-Series, but add the ability to control humidity within the range of 10% to 98% relative humidity as limited by a 185°F (85°C) maximum dry bulb temperature and a 45°F (7°C) dewpoint. The chambers have the ability to control humidity as low as 5% when the Dry Air Purge / Low RH option is utilized. Standard systems use a steam generation humidity system. Refer to Figure 4. for more information on achievable humidity points.

**CAUTION**

Water specification 0.05 to 2 Mega OHMS in addition to <2mg/L of free chlorine

**WARNING**

Maximum water inlet pressure is 10 PSI (69kPa) for an atomizer and 25 PSI (172 kPa) for a boiler. Exceeding this pressure may cause catastrophic failure of the filter housing.

For optimal use of the atomizer and boiler systems, inlet water pressure should not fall below 10 PSI (69 kPa) for both boilers and atomizers.

**CAUTION**

Failure to maintain cartridge may result in chloride corrosion of stainless-steel interior surfaces which is not covered under warranty.

### HUMIDITY COMPONENTS (Steam Generator System)

The water supply connection for humidity is located at the rear of the unit. The following is a description and function of the major components.

A. (OPTIONAL) Water Valve and Rack Assembly (Located at the rear of unit)

1. The valve is used to temporarily turn off the water supply in order to change the demineralizer filter without interrupting chamber operation.
2. The rack holds the demineralizer filter.

B. (OPTIONAL) Demineralizer Filter (Located at rear of unit)

1. The filter removes most common impurities from tap or soft water.
2. The outer casing of the filter is transparent, and the crystals are visible. A new cartridge is violet or dark blue when water flows through it. A spent cartridge will turn brown, orange, yellow or white. The cartridge should be changed before it completely changes color. A reference mark is provided on the filter to indicate when it should be changed. Spare cartridges are available through the CSZ Service Department. Refer to the Humidity Maintenance Section for instructions on how to change the filter.

C. Water Fill Solenoid

1. This is a normally closed solenoid valve and is energized (opened) only when the float switch in the steam generator drops below the reset level. The valve remains energized until the water is at the right level.

D. Steam Generator System

1. The steam generator provides humidity in the form of steam. The steam generator has a multi-level float switch which controls the water level. The heater boils the water to generate steam. The steam is injected into the chamber.
2. A high temperature safety thermostat is located on the side of the steam generator. It will remove heater power if an over-temperature situation is reached.

E. (OPTIONAL) Water pressure regulator

1. Reduces incoming water pressure to 10 PSI (69 kPa) for an atomizer and 25PSI (172 kPa) for a boiler.

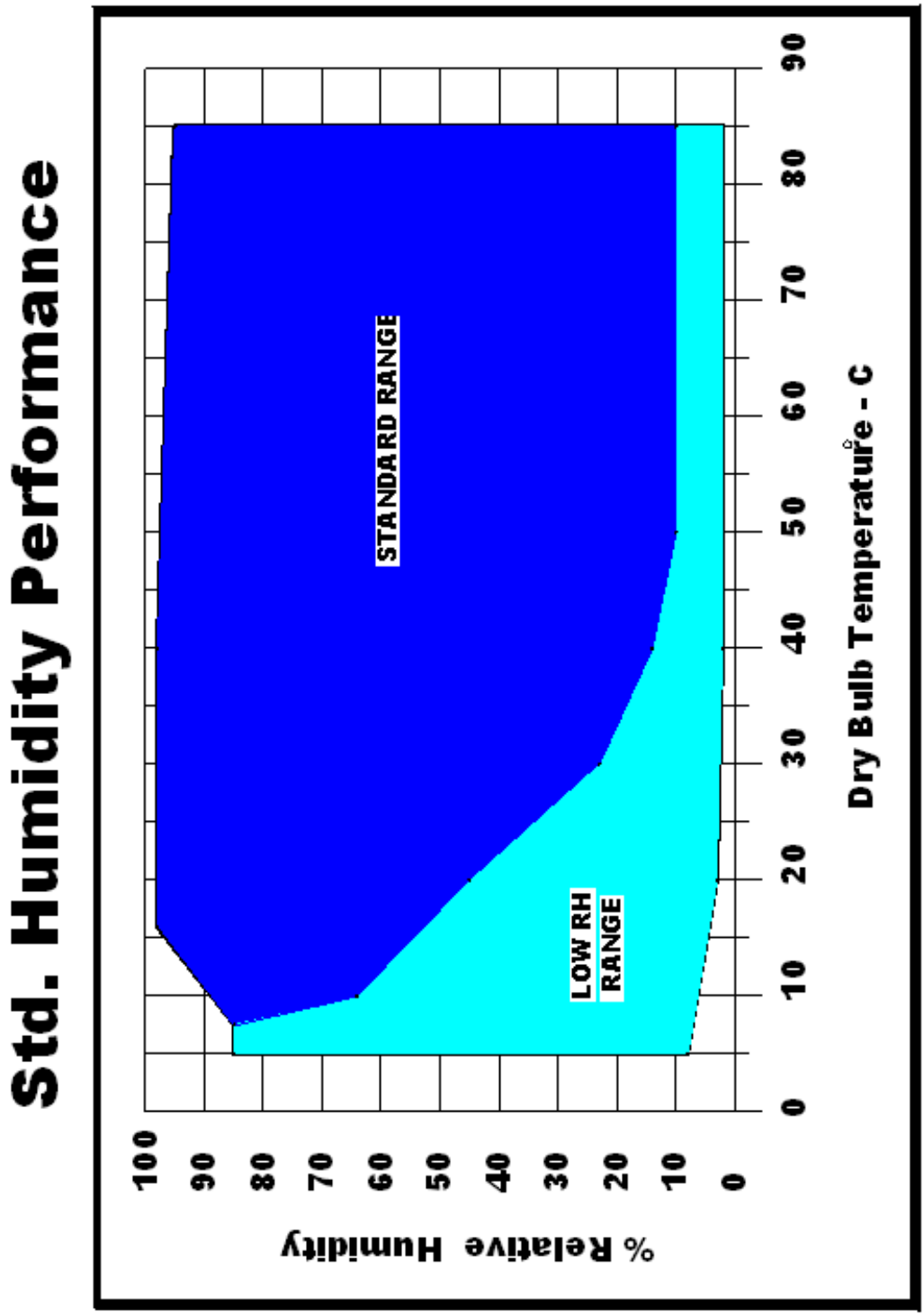



Figure 2-4: Achievable Humidity Points

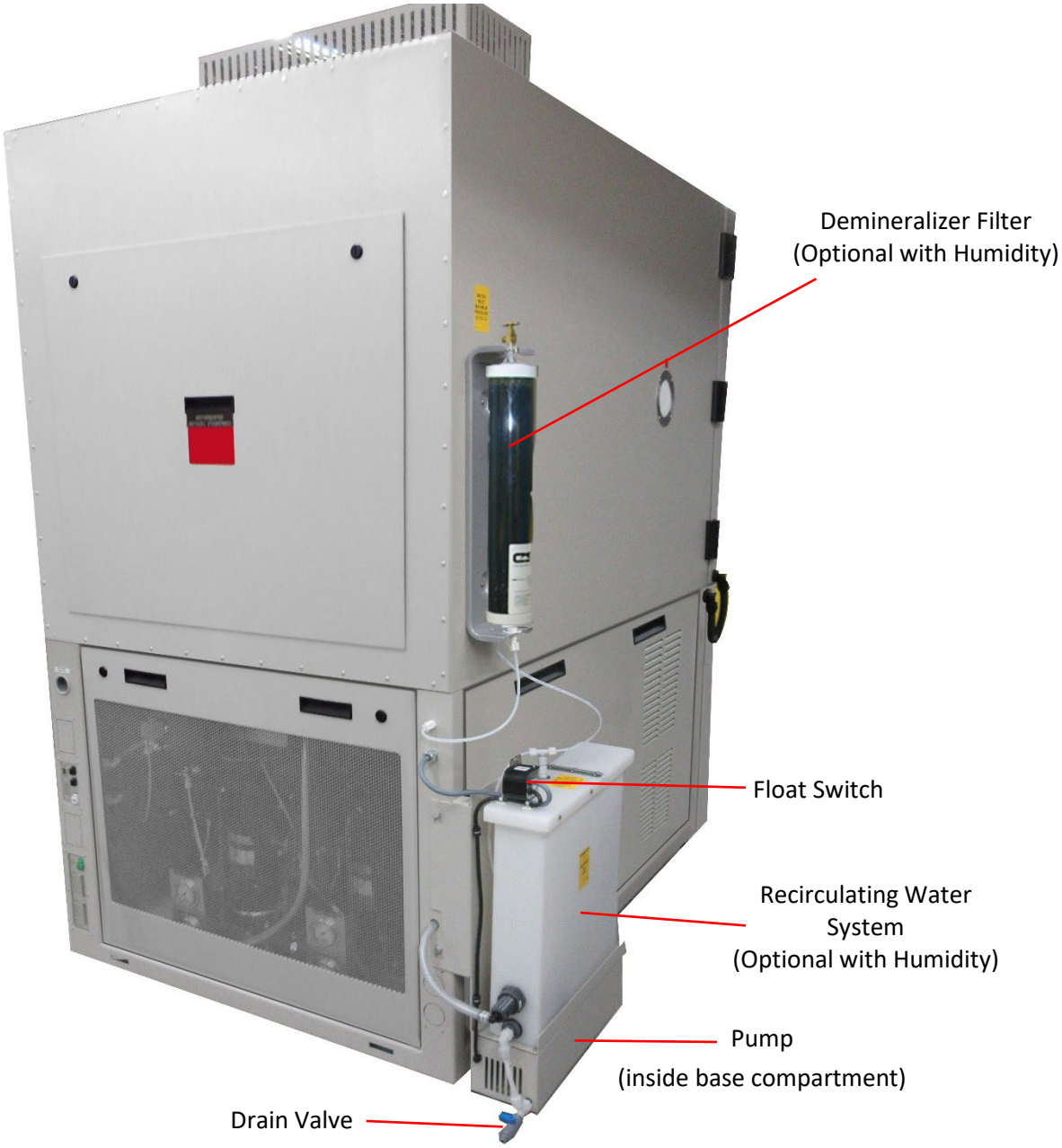



Figure 2-5: Optional Recirculating Water/ Demineralizer Filter

*Note: CSZ is continuously upgrading the components used in its equipment. Consequently, the physical appearance of certain components may vary from that shown.*

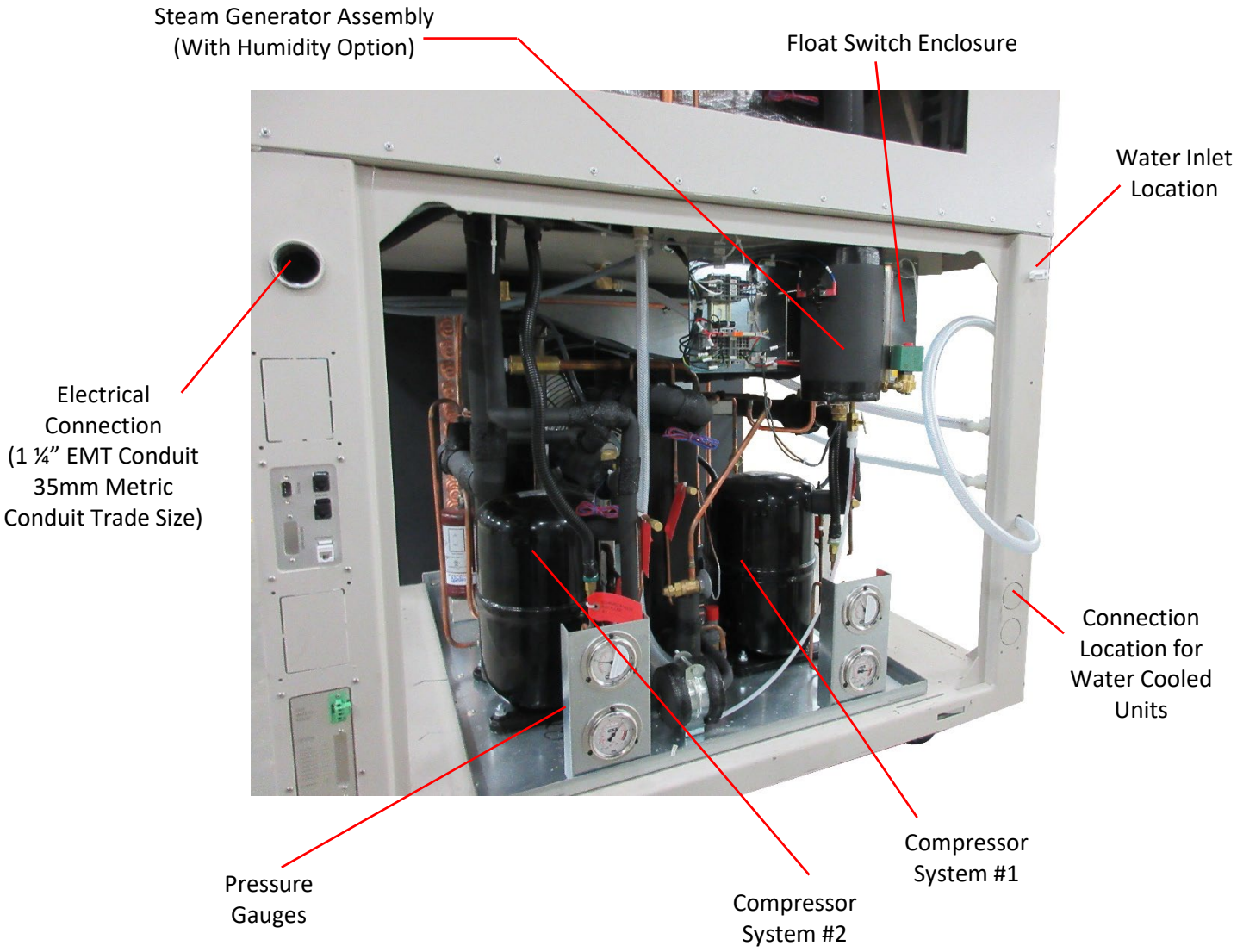



Figure 2-6: Humidity Panel Location & Components (Steam Generator System)

*Note: CSZ is continuously upgrading the components used in its equipment. Consequently, the physical appearance of certain components may vary from that shown.*

## HUMIDITY COMPONENTS (CONTINUED)

The chamber area contains the remaining components necessary to generate and maintain humidity levels within the work space. The following is a description of these components (see Figures 2-3 to 2-5).

A. Solid-State Humidity Sensor

**DO NOT RELOCATE.** It has been located at the factory for maximum performance.

This unit utilizes a solid-state relative humidity sensor which takes the place of the traditional wet bulb and dry bulb sensors. The solid-state sensor is a highly accurate, quick responding, direct RH measuring device. It feeds an electronic signal to the controller that in turn controls and displays direct relative humidity.

B. Atomizing Nozzle (Optional)

Water flows from the control solenoid at a very slow rate. Air is pumped into this nozzle and picks up water. The chamber is humidified by the air/water mixture.

C. Humidity Wet Coil

This coil is cooled by the R-404A (System 1) system and functions as a dehumidification coil. Dehumidification of the chamber air is accomplished by condensing water from the chamber air onto the refrigerated surface.

D. Wet Coil Pan

The wet coil pan is used to collect moisture from the wet coil and dispense it through the chamber drain.

E. Recirculating Water

The Recirculating Water Reservoir Option is a fully integrated accessory that requires only minor installation. Just fill the reservoir with water to the fill line, connect a drain line to the plastic ball valve located at the bottom rear of the unit and the system is ready to operate.

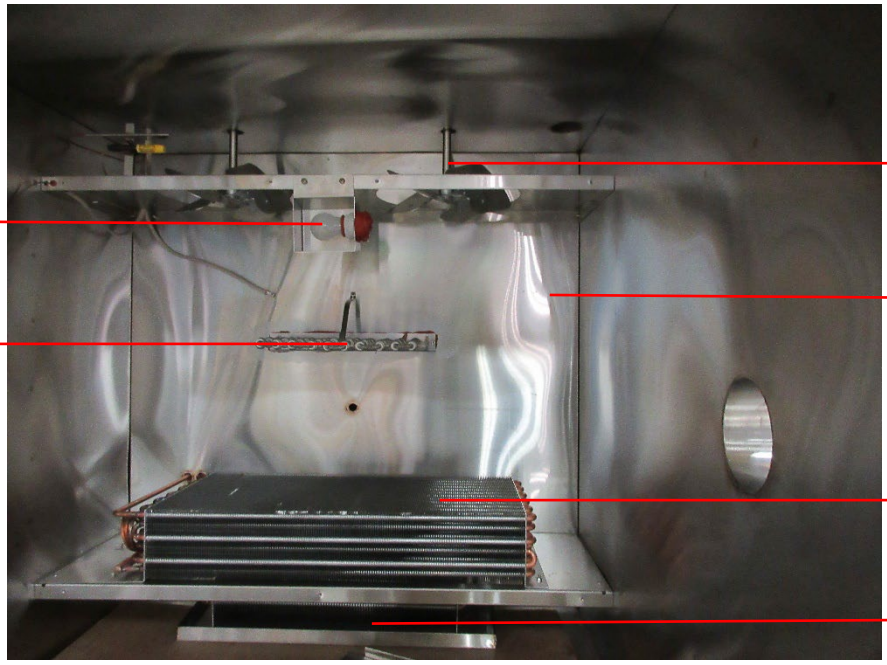
Typical System Operation:

- A water pump (located under the reservoir) turns on when the humidity function is turned on and pumps water from the reservoir to the boiler.
- The water vapor condenses into a liquid and runs down the chamber drain, back to the reservoir.
- This cycle is repeated over and over.
- The float switch (located on top of the reservoir) turns the pump off when the water level in the reservoir is too low and needs to be replenished, preventing damage to the pump.

Maintenance:

- Drain and clean the reservoir every 2 months or sooner as required by usage and water conditions.

**PLENUM COVER REMOVED**




**PLENUM COVER ON**

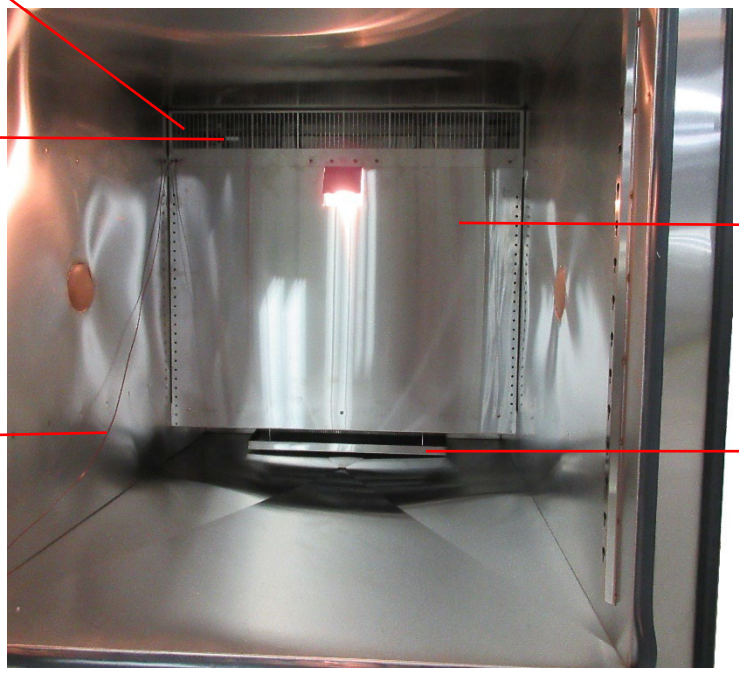



Figure 2-7: Chamber Interior

*Note: CSZ is continuously upgrading the components used in its equipment. Consequently, the physical appearance of certain components may vary from that shown.*

**CAUTION**

If any options are installed using a GFCI Receptacle, check the GCFI Receptacle(s) monthly.

## OPTIONS

Some options may be equipped with a GFCI Receptacle for power. If any options are installed in this manner, check the GCFI Receptacle(s) monthly.

### PEN RECORDERS (OPTIONAL)

The Circular Chart Recorder features fully programmable inputs, ranging, and linearization, with stepper motor, pen, and chart drive speed. This eliminates the need for range cards and chart speed change gears. Configuration is field programmable for flexibility to meet changing test requirements. Refer to the chart recorder manual on the digital media, or supplemental booklet, if applicable.

Replacement chart paper is available from the CSZ Service Department.

**NOTE**

The redundant high/low limit has a red LED display which displays a "SAFE" condition when temperature has returned to safe conditions, press the "RESET" button to reset the limit.

### REDUNDANT HIGH/LOW LIMIT CONTROL (OPTIONAL)

The High/Low Limit Control is designed with set-points for high and low temperatures. These can be precisely set at temperatures to permit safe operation. The Limit Control will shut down the chamber operation and product operation if the safe operating temperature limit of the product, either hot or cold, has been exceeded.

### IEEE-488 SYSTEM (OPTIONAL)

An optional IEEE communication interface can be provided on the chamber to allow the EZT-570 to communicator over the GPIB bus.

**WARNING**

Gaseous Nitrogen/CO2 vent **must** be ducted outdoors to prevent displacement of oxygen around the unit. Asphyxia can occur if this is not installed properly.

### LN2/CO2 BOOST COOLING SYSTEM (OPTIONAL)

In addition to the main refrigeration system, the chamber is equipped with an optional connection port for supplying boost cooling from an external source of cryogenic liquefied gas (either carbon dioxide or liquid nitrogen). The boost cooling gas is vented directly into the chamber by a controller under the conditions of sustained cooling demand.

Refer to the System Diagrams Chapter to see the schematic diagram for the boost cooling system when using LN2 as the boost cooling agent.

LN2 can be supplied in one of two ways, either by an LN2 Cylinder or with a central supply using vacuum jacketed lines.

**WARNING**

Wear appropriate PPE when handling LN2 connections.

When using an LN2 Cylinder, it must be connected with a well insulated line that is at least 3/8" inside diameter. The line length should be 5FT (152 cm) or less. The LN2 tank should have a maximum supply pressure of 25 PSIG (274 kPa) and be able to provide 0.60 gallons/min.

With a central supply using vacuum jacketed lines, there is no maximum line length.

**Mode:** Mechanical cooling with LN2 boost:
At temperatures above -94°F (-70°C) the refrigeration system operates normally. When the LN2 switch is turned "on" the LN2 cooling valve will open when there has been a call for cooling from the controller for more than 10 seconds. This will boost the cooling effect and reduce the temperature in the chamber faster.

The vent duct connected to top of the chamber to exhaust the gaseous nitrogen should be well insulated and 10 FT (3.0 meters) or less. If over 10 FT (3.0 meters), the duct size will have to be increased. Contact CSZ for sizing.

## PROGRAMMABLE DOOR LOCK (OPTIONAL)

The optional programmable door lock can be configured to automatically lock or unlock the chamber based on the desired configuration either at certain temperature setpoints, or in profile steps. See Chapter 4 of this manual for further details.

## GN2 PURGE SYSTEM (OPTIONAL)

**WARNING**

Gaseous Nitrogen/CO2 vent **must** be ducted outdoors to prevent displacement of oxygen around the unit. Asphyxia can occur if this is not installed properly.

The GN2Purge system must be vented outdoors to prevent displacement of oxygen around the unit. DO NOT enter the chamber while the boost/purge is turned on. The door must be left open to ventilate the chamber before entering. A GN2 Purge system reduces condensation within the test chamber and is used when low humidity is required. The purge system consists of a control solenoid and flow meter. GN2 has a dewpoint approaching -94°F (-70°C) that, when introduced into the chamber workspace, creates a slightly positive pressure within the chamber to minimize the migration of moist ambient air into the chamber. The system should have a maximum supply of 25 PSIG (172kPa).

## DRY AIR PURGE (OPTIONAL)

**NOTE**

Optional Dry Air Purge is NOT UL Approved.

A Dry Air Purge system can be provided to reduce condensation within the test chamber and for use when low humidity is required. Compressed air is dried to a dewpoint approximately -100°F (-73°C) then introduced into the chamber workspace, creating a slightly positive pressure within the chamber to minimize the migration of moist ambient air into the chamber. The system requires approximately 5 SCFM (142 std liters/minute) of compressed air at 90 PSIG (620 kPa) free of all oil and entrained water droplets. The system features a dropout filter and oil removal filter at the inlet. See Operating Instructions in Chapter 4 for more information regarding Dry Air Purge.

**NOTE**

A chamber equipped with sheath heaters may no longer possess a CE mark in accordance to IEC publication 610 10-1; 2000.

## LIMITED TEMPERATURE SHEATH HEATER (OPTIONAL)

Each heater has its own temperature controller and redundant high limit safety. The temperature controller is set to maintain the heater sheath temperature below 80% of the auto ignition temperature of the fluid or vapor in the chamber. The temperature high limit is set +10°C above the temperature controller as a safety.

Per section 501-10 of the N.E.C.:

"The heater shall not exceed 80 percent of the ignition temperature in degrees Celsius of the gas or vapor involved on any surface that is exposed to the gas or vapor when continuously energized at the maximum rated ambient temperature."

**WARNING**

**Check the Gas Monitor water filter daily.** Empty when full as required. Failure to follow this Procedure will result in damage to the Gas Monitor and is NOT covered under warranty.

## GAS MONITOR (OPTIONAL)

The optional gas monitoring system measures and detects hazardous gases. The gases monitored are specific to the application and determined based on what products will be tested in the environmental test chamber. The gas monitor uses a sampling hose for individual or multiple gases. Examples include carbon monoxide (CO), carbon dioxide (CO2), hydrocarbons (HC), and variations in oxygen (O2) content. When a gas is detected, the chamber will shut down and an alarm will be shown on the chamber display. The gas monitor also includes a stand-alone display which provides readings for the gases specified. The alarm setpoints can also be adjusted as needed.

For additional details on the use and care of the Gas Monitor system, see the manufacturer's manual found in the Accessories folder on the electronic media.

**WARNING**

Do not exceed the max temp of +149°C as the Firetrace tube will melt causing the CO2 to discharge.

## FIRETRACE FIRE SUPPRESSION SYSTEM (OPTIONAL)

Firetrace is a fire detection and fire suppression system specifically designed for small enclosures with a maximum Chamber High Temp of 149°C. It is an indirect release system where the red Firetrace tubing acts as both a fire detection system and a fire suppressant trigger. Once the heat hits the red tube and ruptures it, the tubing system drops in pressure and sends a signal back to the high-pressure CO2 fire suppression system to activate and put out the fire.

**WARNING**

If pressure gauge reads less than 195PSI please contact customer service 1-513-719-3300 for further instructions.

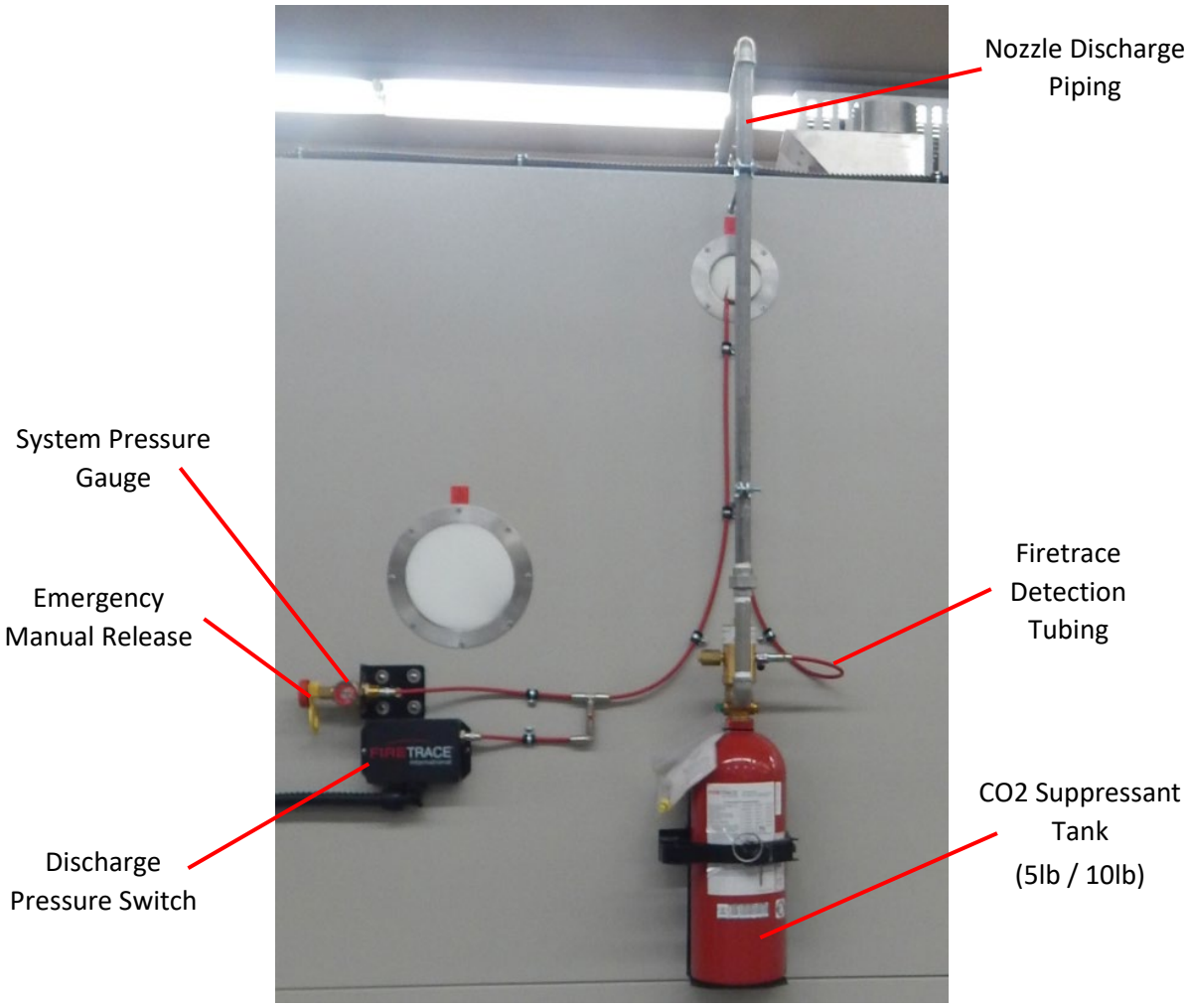



Figure 2-8: Fire Suppression System Components (external)

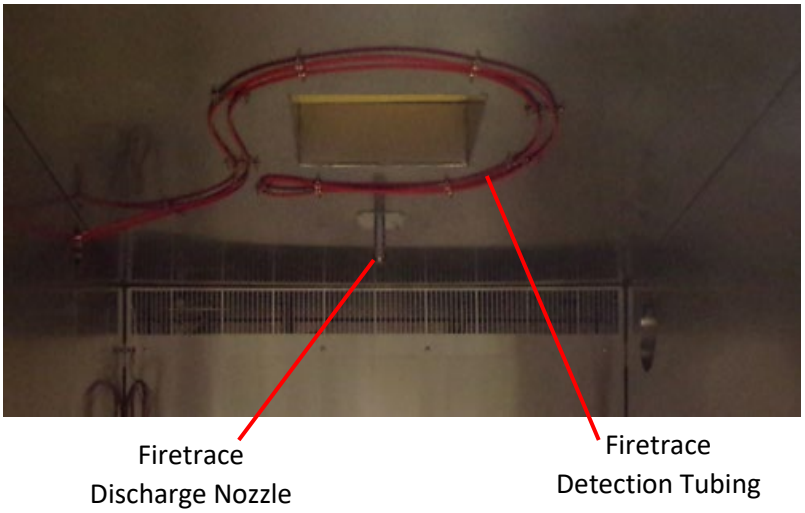


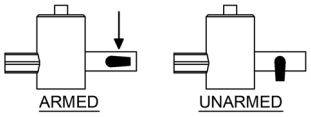

Figure 2-9: Fire Suppression System Components (internal)

**WARNING**

If pressure gauge reads less than 195 PSI, please contact customer service at 1-513-719-3300 for further instructions.

**WARNING**

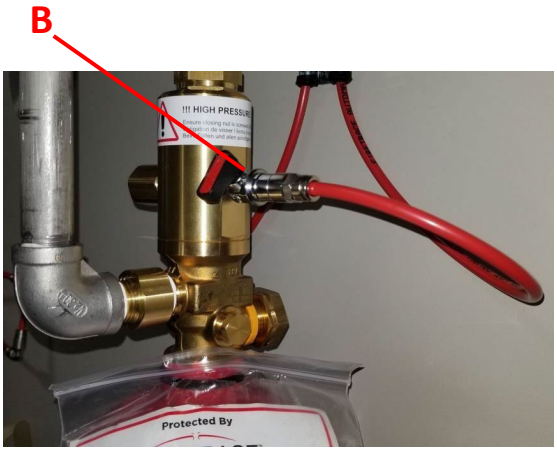
Valve must be in the "ON"/"ARMED" position at all times.




## WEISS TECHNIK COMMISSIONING PROCEDURE

This procedure is to be completed during the system commissioning at the customer's facility. The intent is to leave the suppression system armed.

1. Verify the tubing pressure gauge (A) reads at least 195 PSI.
2. If the tubing pressure is adequate, **SLOWLY** rotate the ball valve lever (B) counterclockwise to the "ON"/"ARMED" position. Opening the valve slowly allows the tube and valve pressure to equalize.
3. Fire suppression is not active until the procedure is complete.


**NOTE**

If other devices are used to take measurements within the chamber, the readings between the chamber controller and the other instruments will vary slightly due to the tolerances between the two devices and their individual sensing elements.

## CHAMBER PERFORMANCE

The performance of your chamber is significantly affected by the characteristics of your test sample. Such characteristics include size, material, shape, weight, and power dissipation if energized. The test sample should be placed in the chamber in a manner that allows proper ventilation. Air flow is taken in from the bottom of the plenum and exits from the top. Test samples should be placed on the shelves; not placed directly on the chamber floor. Multiple test samples should be distributed throughout the chamber to ensure proper airflow and to minimize temperature gradients.

Shelves with product can be slid out of the chamber (approximately halfway). The "C" channel shelf rails will prevent the shelf from tipping. There is NOT a mechanical stop to prevent the shelf from being pulled all of the way out. Shelves pulled out more than halfway can become unstable.

To relocate "C" channel rail, remove shelf, lift front of rail up and pull forward. To replace rail, place pin on rear of rail into the hole in the plenum and line up with slot on shelf rail. Push rail back and then down, locking rail into place.

## SHELF DESCRIPTION

**WARNING**

Test samples should be placed in the chamber in a manner that allows proper ventilation.

**WARNING**

Shelves pulled more than halfway out can become unstable.

**WARNING**

"C" channel shelf rail is not a mechanical stop to prevent the shelf from being pulled all the way out.

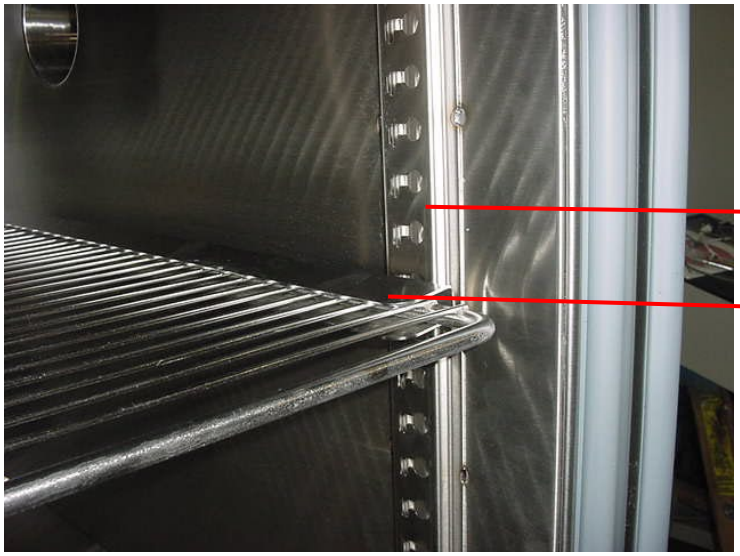



Figure 2-10: Shelf and Bracket

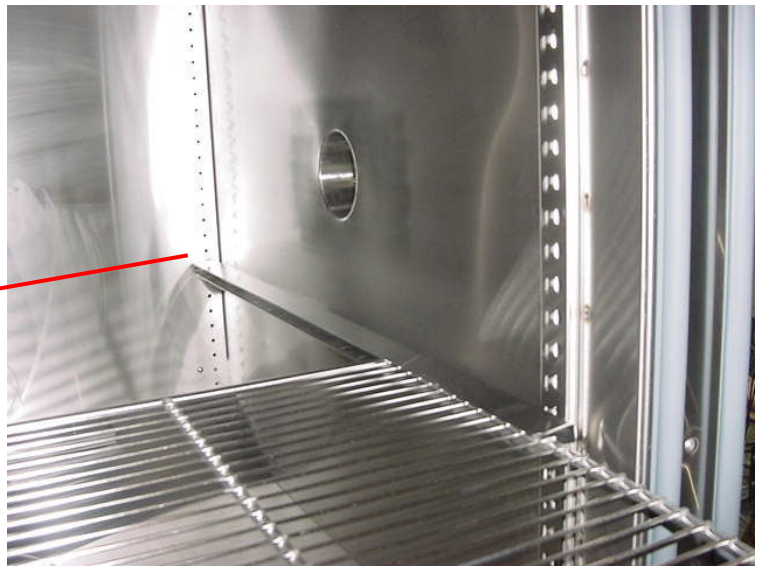



Figure 2-11: Shelf in Pulled Out Position

| | ZP(H) - 8 | ZP(H) - 16 | ZP(H) – 32 | ZP(H) - 44 | ZP(H) - 64 | ZP(H) - 80 | ZP(H) - 96 |
|---|---|---|---|---|---|---|---|
| **Workspace Volume** | 8 Cubic Ft (230 L) | 16 Cubic FT (450L) | 32 Cubic Ft (900 L) | 44 Cubic Ft (1,250) | 64 Cubic Ft (1,801L) | 80 Cubic Ft (2,265L) | 96 Cubic Ft (2,718 L) |
| **Exterior Dimensions (cm) W x D x H** | 36" x 57" x 76" (91 x 145 x 193) | 42" x 63" x 82" (107 x 160 x 208) | 50" x 71" x 91.5" (127 x 180 x 232) | 56.5" x 80.5" x 99.5" (144 x 204 x 253) | 60.5" x 80.5" x 101.5" (154 x 204 x 258) | 60.5" x 94" x 101.5" (154 x 238 x 258) | 60" x 105" x 101.5" (154 x 266 x 258) |
| **Workspace Dimensions (cm) W x D x H** | 24" x 24" x 24" (61 x 61 x 61) | 30" x 30" x 30" (76 x 76 x 76) | 38" x 38" x 38" (97 x 97 x 97) | 44" x 38" x 46" (112 x 97 x 117) | 48" x 48" x 48" (122 x 122 x 122) | 48" x 60" x 48" (122 x 152 x 122) | 48" x 72" x 48" (122 x 183 x 122) |
| **Temperature Ranges** | Single Stage: -34° C to +190° C (-30°F to 375°F)<br>Tundra®: -45° C to +190° C (-49°F to 375°F)<br>Cascade: -70° C to +190° C (-94°F to 375°F) | | | | | | |
| **Temperature Control Tolerance*** | +/- 0.5° C at steady state condition after stabilization | | | | | | |
| **Humidity Range Optional Range** | 10% TO 98% RH<br>5% TO 98% RH | | | | | | |
| ***Humidity Control Tolerance** | +/- 3% RH at steady state conditions after stabilization | | | | | | |
| **Distributed Shelf Load Capacity** | 110 lbs. | 110 lbs. | 100 lbs. | 100 lbs. | 100 lbs. | 100 lbs. | 100 lbs. |

Table 2-1: ZP(H) Specifications

* -Tolerances are based upon the full temperature range of the chamber. Better control will be achieved across a limited range.

| Single Stage -34° C to 190° C | | | | |
|---|---|---|---|---|
| | Live Load Capacity | | Electrical Power Requirements | |
| | Watts | | Full Load Amps | |
| **Model** | **-18° C** | **-34° C** | **208-230V, 1Phase** | **208-230V, 3Phase** |
| ZP-8-2-SC/AC | 1200 | 250 | 34 | 30 |
| ZP-16-2-SC/AC | 1200 | 250 | 34 | 30 |
| ZP-32-2-SC/AC | 1200 | 250 | 34 | 30 |
| ZP-44-2-SC/AC | 2000 | 300 | 43 | 38 |
| ZP-64-2-SC/AC | 2000 | 300 | 43 | 38 |

Table 2-2: ZP Load Capacity and Electrical Requirements

| Single Stage -34° C to 190° | | | | | |
|---|---|---|---|---|---|
| | Cooling Performance with Empty Chamber in Minutes from: | | Heating Performance with Empty Chamber in Minutes from: | | |
| | **24° C** | | **24° C** | | **-34° C** |
| **Model** | **-18° C** | **-34° C** | **93° C** | **190° C** | **24° C** |
| **ZP-8-2-SC/AC** | 6 | 18 | 10 | 30 | 10 |
| **ZP-16-2-SC/AC** | 8 | 22 | 15 | 50 | 12 |
| **ZP-32-2-SC/AC** | 10 | 28 | 20 | 72 | 15 |
| **ZP-44-2-SC/AC** | 15 | 401 | 20 | 60 | 15 |
| **ZP-64-2-SC/AC** | 20 | 50 | 25 | 75 | 20 |

Table 2-3: ZP Single Stage Specifications

| Cascade -70° C to 190° C | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Live Load Capacity Watts | | | | | Electrical Power Requirements Full Load Amps | | |
| Model | -18° C | -34° C | -40°C | -54°C | -68°C | 208/230V, 1Phase | 208/230V, 3Phase | 460V, 3Phase |
| ZP-8-2-2-SC/AC | - | - | 1200 | 900 | 600 | 49 | 36 | - |
| ZP-8-3.5-3.5-SC/AC | - | - | 1700 | 1200 | 750 | - | 48 | 29 |
| ZP-16-2-2-SC/AC | - | - | 1800 | 1200 | 600 | 49 | 36 | - |
| ZP-16-3.5-3.5-SC/AC | - | - | 2000 | 1600 | 1000 | - | 48 | 29 |
| ZP-16-6-6-SC/WC | - | - | 3000 | 2400 | 1500 | - | 65 | 29 |
| ZP-32-2-2-SC/AC | - | - | 1500 | 1100 | 600 | 49 | 36 | - |
| ZP-32-3.5-3.5-SC/AC | - | - | 2000 | 1600 | 1000 | - | 48 | 29 |
| ZP-32-6-6-SC/WC | - | - | 3000 | 2400 | 1500 | - | 65 | 29 |
| ZP-44-3.5-3.5-SC/AC | - | - | 1700 | 1300 | 700 | - | 48 | 29 |
| ZP-44-6-6-SC/WC | - | - | 2700 | 2100 | 1200 | - | 65 | 29 |
| ZP-44-10-10-SC/WC | - | - | 4500 | 3500 | 2000 | - | - | 45 |
| ZP-64-3.5-3.5-SC/AC | - | - | 1500 | 1100 | 500 | - | 48 | 29 |
| ZP-64-6-6-SC/WC | - | - | 2500 | 2100 | 1000 | - | 65 | 29 |
| ZP-64-10-10-SC/WC | - | - | 4500 | 3500 | 2000 | - | - | 45 |
| ZP-80-3.5-3.5-SC/WC | - | - | 1500 | 1100 | 500 | - | 48 | 29 |
| ZP-80-6-6-SC/WC | - | - | 2500 | 2100 | 1000 | - | 65 | 29 |
| ZP-80-10-10-SC/WC | - | - | 4500 | 3500 | 2000 | - | - | 45 |
| ZP-80-15-15-SC/WC | - | - | 5500 | 4500 | 3000 | - | - | 53 |
| ZP-96-3.5-3.5-SC/AC | - | - | 1500 | 1100 | 500 | - | 48 | 29 |
| ZP-96-6-6-SC/WC | - | - | 2500 | 2100 | 1000 | - | 65 | 29 |
| ZP-96-10-10-SC/WC | - | - | 4500 | 3500 | 2000 | - | - | 45 |
| ZP-96-15-15-SC/WC | - | - | 5500 | 4500 | 3000 | - | - | 53 |
| High Performance Models | Live Load Capacity Watts | | | | | Electrical Power Requirements Full Load Amps | | |
| ZP(HP)-8-6-6-SC/WC | - | - | 2000 | 1600 | 1000 | - | 65 | 29 |
| ZP(HP)-16-10-10-SC/WC | - | - | 3500 | 2600 | 1600 | - | - | 45 |
| ZP(HP)-32-10-10-SC/WC | - | - | 4500 | 3500 | 1700 | - | - | 45 |
| ZP(HP)-32-15-15-SC/WC | - | - | 5500 | 4500 | 2500 | - | - | 53 |
| ZP(HP)-32-20-20-S/WC | - | - | 10000 | 8000 | 5000 | - | - | 84 |
| ZP(HP)-44-15-15-SC/WC | - | - | 5500 | 4500 | 3000 | - | - | 53 |
| ZP(HP)-44-20-20-S/WC | - | - | 10000 | 8000 | 5000 | - | - | 84 |
| ZP(HP)S-44-30-30-S/WC | - | - | 15000 | 10000 | 8000 | - | - | 110 |
| ZP(HP)-64-15-15-SC/WC | - | - | 5500 | 4500 | 3000 | - | - | 53 |
| ZP(HP)-64-20-20-S/WC | - | - | 10000 | 8000 | 5000 | - | - | 84 |
| ZP(HP)S-64-30-30-S/WC | - | - | 15000 | 10000 | 8000 | - | - | 110 |
| ZP(HP)-80-20-20-S/WC | - | - | 10000 | 8000 | 5000 | - | - | 85 |
| ZP(HP)S-80-30-30-S/WC | - | - | 15000 | 10000 | 8000 | - | - | 110 |
| ZP(HP)-96-20-20-S/WC | - | - | 10000 | 8000 | 5000 | - | - | 84 |
| ZP(HP)S-96-30-30-S/WC | - | - | 15000 | 10000 | 8000 | - | - | 110 |

Table 2-4: ZP Load Capacity and Electrical Requirements

| Cascade -70° C to 190° | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Z-Plus Performance Models | Cooling Performance with Empty Chamber in Minutes from: | | | | | | Cooling Rate | Heating Performance with Empty Chamber in Minutes from: | | | |
| | 24° C | | | | | 85° C | ° C / min | 24° C | | -34° C | -68° C |
| Model | -18°C | -34°C | -40°C | -54°C | -68°C | -40°C | | 93°C | 190°C | 24°C | 24°C |
| ZP-8-2-2-SC/AC | 5 | 8 | 9 | 12 | 20 | 18 | 7.0 | 10 | 30 | 10 | 15 |
| ZP-8-3.5-3.5-SC/AC | 3 | 5 | 6 | 10 | 16 | 14 | 9.0 | 3.5 | 12 | 3.5 | 5 |
| ZP-16-2-2-SC/AC | 6 | 10 | 12 | 17 | 25 | 25 | 5.0 | 15 | 50 | 12 | 22 |
| ZP-16-3.5-3.5-SC/AC | 5 | 8 | 11 | 16 | 23 | 23 | 5.4 | 10 | 30 | 6 | 12 |
| ZP-16-6-6-SC/WC | 4 | 5 | 6 | 9 | 15 | 13 | 9.6 | 10 | 30 | 6 | 12 |
| ZP-32-2-2-SC/AC | 10 | 16 | 20 | 28 | 38 | 40 | 3.1 | 20 | 72 | 15 | 25 |
| ZP-32-3.5-3.5-SC/AC | 8 | 13 | 16 | 23 | 33 | 30 | 4.2 | 10 | 35 | 8 | 15 |
| ZP-32-6-6-SC/WC | 5 | 8 | 10 | 15 | 23 | 20 | 6.3 | 10 | 35 | 8 | 15 |
| ZP-44-3.5-3.5-SC/AC | 13 | 22 | 26 | 40 | 60 | 45 | 2.7 | 20 | 60 | 15 | 25 |
| ZP-44-6-6-SC/WC | 8 | 12 | 15 | 22 | 32 | 32 | 4.0 | 20 | 60 | 15 | 25 |
| ZP-44-10-10-SC/WC | 4 | 6 | 7 | 10 | 16 | 15 | 8.3 | 8 | 25 | 7 | 10 |
| ZP-64-3.5-3.5-SC/AC | 15 | 25 | 30 | 42 | 65 | 65 | 2.0 | 25 | 75 | 20 | 30 |
| ZP-64-6-6-SC/AC | 10 | 15 | 20 | 26 | 36 | 36 | 3.5 | 25 | 75 | 20 | 30 |
| ZP-64-10-10-SC/WC | 5 | 6 | 8 | 13 | 22 | 18 | 7.0 | 10 | 30 | 8 | 12 |
| ZP-80-3.5-3.5-SC/WC | 18 | 30 | 36 | 50 | 70 | 70 | 1.8 | 30 | 80 | 25 | 35 |
| ZP-80-6-6-SC/WC | 12 | 20 | 23 | 33 | 45 | 45 | 2.7 | 30 | 80 | 25 | 35 |
| ZP-80-10-10-SC/WC | 7 | 9 | 10 | 16 | 29 | 30 | 4.2 | 15 | 40 | 12 | 18 |
| ZP-80-15-15-SC/WC | 5 | 7 | 8 | 11 | 19 | 20 | 6.2 | 12 | 31 | 10 | 15 |
| ZP-96-3.5-3.5-SC/AC | 20 | 35 | 40 | 60 | 80 | 80 | 1.6 | 35 | 90 | 30 | 40 |
| ZP-96-6-6-SC/WC | 13 | 21 | 24 | 35 | 50 | 50 | 2.5 | 35 | 90 | 30 | 40 |
| ZP-96-10-10-SC/WC | 8 | 10 | 11 | 17 | 35 | 35 | 3.6 | 20 | 45 | 14 | 20 |
| ZP-96-15-15-SC/WC | 5.5 | 7.5 | 8.5 | 11.5 | 29.5 | 30.5 | 4.1 | 12.5 | 31.5 | 10.5 | 15.5 |
| High Performance Models | Cooling Performance with Empty Chamber in Minutes from: | | | | | | Cooling Rate | Heating Performance with Empty Chamber in Minutes from: | | | |
| | 24° C | | | | | 85° C | ° C / min | 24° C | | -34° C | -68° C |
| Model | -18°C | -34°C | -40°C | -54°C | -68°C | -40°C | | 93°C | 190°C | 24°C | 24°C |
| ZP(HP)-8-6-6-SC/WC | 2 | 3 | 4 | 6 | 10 | 8 | 15.6 | 3.5 | 12 | 3.5 | 5 |
| ZP(HP)-16-10-10-SC/WC | 1.5 | 2.5 | 3 | 5 | 10.5 | 8 | 15.6 | 4 | 11 | 3 | 5 |
| ZP(HP)-32-10-10-SC/WC | 3 | 5 | 6 | 8 | 12 | 10 | 12.5 | 7 | 20 | 6 | 10 |
| ZP(HP)-32-15-15-SC/WC | 2 | 3 | 4 | 6 | 10 | 8 | 15.6 | 6 | 16 | 5 | 8 |
| ZP(HP)-32-20-20-S/WC | 1.5 | 2.3 | 2.5 | 4 | 6 | 5 | 25.0 | 2 | 9 | 3 | 4.5 |
| ZP(HP)-44-15-15-SC/WC | 3 | 4 | 6 | 9 | 13 | 11 | 11.4 | 6 | 15 | 5 | 8 |
| ZP(HP)-44-20-20-S/WC | 2 | 3 | 4 | 6 | 8 | 8 | 17.9 | 3 | 12 | 3 | 4.5 |
| ZP(HP)S-44-30-30-S/WC | 1.5 | 2 | 3 | 5 | 7.5 | 5 | 25 | 2 | 8 | 2 | 4 |
| ZP(HP)-64-15-15-SC/WC | 4 | 5 | 6 | 9 | 16 | 12 | 10.4 | 8 | 20 | 6 | 10 |
| ZP(HP)-64-20-20-S/WC | 2.5 | 3.5 | 4.5 | 6.5 | 9 | 9 | 13.8 | 3.5 | 13 | 3.5 | 5 |
| ZP(HP)S-64-30-30-S/WC | 2 | 2.5 | 3.5 | 5.5 | 8.5 | 8 | 15.6 | 2.5 | 10 | 2.5 | 4 |
| ZP(HP)-80-20-20-S/WC | 3 | 4.5 | 5.5 | 7.5 | 11.5 | 12 | 10.4 | 5 | 17 | 6 | 10 |
| ZP(HP)S-80-30-30-S/WC | 2.2 | 3.5 | 4.5 | 6.5 | 11.5 | 10 | 12.5 | 4 | 16 | 5 | 9 |
| ZP(HP)-96-20-20-S/WC | 3.5 | 5 | 6 | 8 | 12.5 | 12.5 | 10 | 7 | 20 | 7 | 11 |
| ZP(HP)S-96-30-30-S/WC | 3 | 4 | 5 | 7 | 12 | 11 | 11.4 | 5 | 18 | 6 | 10 |

Table 2-5: ZP Cascade Specifications

| Tundra® -45°C to 190° | | | | | | |
|---|---|---|---|---|---|---|
| | Live Load Capacity Watts | | | Electrical Power Requirements Full Load AMPs | | |
| Model | -18° C | -34° C | -40°C | 208/230V, 1Ph | 208/230V, 3Ph | 460V, 3Ph |
| ZP-8-2-SCT/AC | 1800 | 950 | 725 | 31 | 27 | - |
| ZP-8-3.5-SCT/AC | 2110 | 1100 | 925 | - | 37 | 23 |
| ZP-8-6-SCT/WC | 2200 | 1500 | 1200 | - | 46 | 21 |
| ZP-16-3.5-SCT/AC | 3000 | 1700 | 1300 | - | 37 | 23 |
| ZP-16-6-SCT/WC | 3600 | 2300 | 1800 | - | 46 | 21 |
| ZP-16-10-SCT/WC | 4000 | 2500 | 2000 | - | - | 29 |
| ZP-32-3.5-SCT/AC | 3000 | 1700 | 1300 | - | 37 | 23 |
| ZP-32-6-SCT/WC | 3600 | 2300 | 1800 | - | 46 | 21 |
| ZP-32-10-SCT/WC | 6000 | 3500 | 2300 | - | - | 29 |
| ZP-32-15-SCT/WC | 8000 | 5000 | 3000 | - | - | 35 |
| ZP-44-3.5-SCT/AC | 2800 | 1500 | 1100 | - | 37 | 23 |
| ZP-44-6-SCT/WC | 3300 | 2000 | 1500 | - | 46 | 21 |
| ZP-44-10-SCT/WC | 6000 | 3500 | 2300 | - | - | 29 |
| ZP-44-15-SCT/WC | 8000 | 5000 | 3000 | - | - | 35 |
| ZP-64-3.5-SCT/AC | 2600 | 1300 | 800 | - | 37 | 23 |
| ZP-64-6-SCT/WC | 3100 | 1800 | 1300 | - | 46 | 21 |
| ZP-64-10-SCT/WC | 6000 | 3500 | 2300 | - | - | 29 |
| ZP-64-15-SCT/WC | 8000 | 5000 | 3000 | - | - | 35 |
| ZPS-80-3.5-SCT/AC | 2600 | 1300 | 800 | - | 37 | 23 |
| ZPS-80-6-SCT/WC | 3100 | 1800 | 1300 | - | 46 | 21 |
| ZPS-80-10-SCT/WC | 6000 | 3500 | 2300 | - | - | 29 |
| ZPS-80-15-SCT/WC | 8000 | 5000 | 3000 | - | - | 35 |
| ZP-96-3.5-SCT/AC | 2600 | 1300 | 800 | - | 37 | 23 |
| ZP-96-6-SCT/WC | 3100 | 1800 | 1300 | - | 46 | 21 |
| ZP-96-10-SCT/WC | 6000 | 3500 | 2300 | - | - | 29 |
| ZP-96-15-SCT/WC | 8000 | 5000 | 3000 | - | - | 35 |

Table 2-6: ZP Load Capacity and Electrical Requirements

**NOTE**

**The performance of your chamber is significantly affected by the characteristics of your test sample. Factors including size, material, shape, weight, and power dissipation if energized. The test sample should be placed in the chamber in a manner that allows proper ventilation. Air flow is from top to bottom in the chamber. Test samples should be placed on the shelves, not placed directly on the chamber floor.**

***Please reference your CSZ quotation as values may vary in specific chamber performance listed in each chart seen on pages 14 - 17.***

**Performance is based on 230V, 60 Hz. operation and a 24°C ambient. For 50 Hz operation, stated performance and air flow may be approximately 17% less. Specifications are subject to change.

**Electrical requirements on temperature only units. Amperage may increase on humidity models. See quotation for actual values.

| Tundra® -45°C to 190° | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Cooling Performance with Empty Chamber in Minutes from: | | | | Cooling Rate | Heating Performance with Empty Chamber in Minutes from: | | |
| | 24° C | | | 85° C | ° C / min | 24° C | | -34° C |
| Model | -18°C | -34°C | -40°C | -40°C | | 93°C | 190°C | 24°C |
| ZP-8-2-SCT/AC | 6 | 12 | 18 | 30 | 4.1 | 10 | 30 | 10 |
| ZP-8-3.5-SCT/AC | 4 | 8 | 12 | 22 | 5.6 | 3.5 | 12 | 3.5 |
| ZP-8-6-SCT/WC | 3 | 5 | 7 | 12 | 10.4 | 3.5 | 12 | 3.5 |
| ZP-16-3.5-SCT/AC | 5 | 10 | 15 | 25 | 5.0 | 10 | 30 | 6 |
| ZP-16-6-SCT/WC | 3 | 7 | 10 | 18 | 7.0 | 10 | 30 | 6 |
| ZP-16-10-SCT/WC | 2.5 | 5 | 7 | 12 | 10.4 | 4 | 11 | 3 |
| ZP-32-3.5-SCT/AC | 7 | 15 | 20 | 35 | 3.5 | 10 | 35 | 8 |
| ZP-32-6-SCT/WC | 4 | 9 | 12 | 22 | 5.6 | 10 | 35 | 8 |
| ZP-32-10-SCT/WC | 3 | 6 | 8 | 18 | 7.0 | 7 | 20 | 6 |
| ZP-32-15-SCT/WC | 2 | 4 | 6 | 11 | 11.3 | 6 | 16 | 5 |
| ZP-44-3.5-SCT/AC | 11 | 25 | 32 | 52 | 2.4 | 20 | 60 | 15 |
| ZP-44-6-SCT/WC | 5.5 | 15 | 20 | 30 | 4.1 | 20 | 60 | 15 |
| ZP-44-10-SCT/WC | 4 | 8 | 12 | 22 | 5.6 | 8 | 25 | 7 |
| ZP-44-15-SCT/WC | 3 | 7 | 10.5 | 14 | 9.0 | 6 | 15 | 5 |
| ZP-64-3.5-SCT/AC | 14 | 30 | 38 | 65 | 2.0 | 25 | 75 | 20 |
| ZP-64-6-SCT/WC | 7 | 17 | 22 | 38 | 3.2 | 25 | 75 | 20 |
| ZP-64-10-SCT/WC | 5 | 11 | 18 | 24 | 5.2 | 10 | 30 | 8 |
| ZP-64-15-SCT/WC | 4 | 9 | 14 | 18 | 7.0 | 8 | 20 | 6 |
| ZP-80-3.5-SCT/AC | 16 | 36 | 48 | 75 | 1.7 | 30 | 80 | 40 |
| ZP-80-6-SCT/WC | 12 | 24 | 30 | 50 | 2.5 | 30 | 80 | 40 |
| ZP-80-10-SCT/WC | 7 | 14 | 25 | 32 | 3.9 | 15 | 40 | 12 |
| ZP-80-15-SCT/WC | 5 | 12.5 | 19 | 24 | 5.2 | 12 | 31 | 10 |
| ZP-96-3.5-SCT/AC | 18 | 40 | 55 | 85 | 1.5 | 35 | 90 | 30 |
| ZP-96-6-SCT/WC | 14 | 25 | 35 | 55 | 2.3 | 35 | 90 | 30 |
| ZP-96-10-SCT/WC | 10 | 18 | 30 | 45 | 2.8 | 20 | 45 | 14 |
| ZP-96-15-SCT/WC | 7 | 15 | 25 | 40 | 3.1 | 12.5 | 31.5 | 10.5 |

Table 2-7: ZP Tundra Specifications

# SEQUENCE OF OPERATION

## CASCADE UNIT - SYSTEM 1 (R-404A) DESCRIPTION

(Refer to Refrigeration Diagram in Drawing Section)

**NOTE:** Pressure settings are approximate.

The compressor (item 101) will pump compressed R-404A vapor through the discharge line where the high pressure gauge (item 183) displays the high-pressure of the refrigerant.

**System 1 – Description (2 HP – 6 HP Systems)**

The high pressure switch (item 195) senses the discharge refrigerant pressure and will open a contact in the event that discharge pressure exceeds 400 PSIG (27.6 bar(g)). This contact opening will serve to shut down the unit and will automatically reset when the pressure drops to 300 PSIG (20.7 bar(g)).

**System 1 – Description (10 HP – 20 HP Systems)**

The high pressure switch (item 195) senses the discharge refrigerant pressure and will open a contact in the event that discharge pressure exceeds 350 PSIG (24.1 bar(g)). This contact opening will serve to shut down the unit and must be manually reset.

The discharge refrigerant vapor passes a tee which diverts some of the refrigerant to the bypass loop (see bypass description) and enters the condenser.

**Air Cooled Condensing Option (2 HP – 6 HP systems)**

The condenser (item 105) cools the high pressure R-404A vapor and condenses it into a high pressure liquid. The condenser fan motor (item 196) will be energized anytime the compressor (item 101) is running.

The high pressure liquid leaves the condenser and flows through a filter drier (item 108) and sight glass (item 109) then passes a tee which diverts some of the liquid refrigerant to the bypass loop (see bypass description)

**Water Cooled Condensing Option (3.5 HP – 20 HP systems)**

The condenser (item 105) cools the high pressure R-404A vapor and condenses it into a high pressure liquid. The pressure actuated water valve (item 107) will maintain the discharge pressure at approximately 210 PSIG (14.5 bar(g)).

The high pressure liquid leaves the condenser and flows through a receiver (item 122), filter drier (item 108) and sight glass (item 109) then passes a tell which diverts some of the liquid refrigerant to the bypass loop (see bypass description).

**Cascade Cooling (2 HP – 3.5 HP systems)**

After passing the bypass tee, the liquid refrigerant flows through the thermostatic expansion valve (item 111) where it changes to a low pressure, two phase refrigerant. The two phase refrigerant is cold due to the flashing of refrigerant. It enters the cascade condenser (item 113) where the heat from system 2 boils the rest of the R-404A refrigerant into a vapor. The cascade condenser serves as the evaporator for system 1. If dehumidification is called for, some of the R-404A refrigerant is diverted to the humidity loop prior to entering the thermostatic expansion valve (see Humidity Loop section).

Superheated R-404A vapor exits the cascade condenser and moves through the system 1 suction line. A suction service valve (item 115) is located near the compressor.

**Cascade Cooling (6 HP – 20 HP systems)**

After passing the bypass tee, the liquid refrigerant flows through the maximum liquid line solenoid (item 110) and into the maximum thermostatic expansion valve (item 111) where it changes to a low pressure, two phase refrigerant. In parallel with maximum valves, liquid refrigerant flows through a minimum liquid line solenoid (item 119) and into the minimum thermostatic expansion valve (item 120) where it also changes to a low pressure, two phase refrigerant. The two phase refrigerant is cold due to the flashing of refrigerant. The two phase refrigerant enters the cascade condenser (item 113) where the heat from System 2 boils the rest of the R-404A refrigerant into a vapor. The cascade condenser serves as the evaporator for System 1. If dehumidification is called for, some of the R-404A refrigerant is diverted to the humidity loop (see Humidity Loop section).

Superheated R-404A vapor exits the cascade condenser and moves through the System 1 suction line. A suction service valve (item 115) is located near the compressor.

**Humidity Loop (Optional Equipment)**

When dehumidification or dry bulb cooling is called for while in humidity mode, the unit will operate in single stage mode and not as a cascade unit. High pressure liquid refrigerant from the condenser, is diverted into two separate paths.

The first path is to the liquid line solenoid (item H149) and into the capillary tube (item H150) where it changes to a low pressure, two phase refrigerant. The two phase refrigerant is cold due to the flashing of refrigerant. The two phase refrigerant enters the evaporator coil (item H113) and leaves as a superheated vapor. Superheated R-404A vapor exits the evaporator coil and moves through the System 1 suction line.

The second path is to the wet coil humidity solenoid (item H127) and into the capillary tube (item H123). Two phase refrigerant exits the capillary tube and enters the evaporator (item H125). The wet coil is cold enough to attract moisture from the chamber air, but not cold enough to freeze the moisture on the evaporator. The temperature of the evaporator is regulated by an evaporator pressure regulator valve (item H126) E.P.R. for short. This valve is intended to flood the coil to keep pressure higher than the suction pressure. The E.P.R. valve is set at 68 PSIG (4.7 bar(g)), which corresponds to a 29°F (-1.6°C) evaporator temperature. The warm chamber air keeps the moisture from freezing on the evaporator, and keeps the refrigerant from migrating to the evaporator when the humidity mode is inactive. The refrigerant leaves the evaporator and passes through a check valve (item H128) and enters the suction line, where it remixes with rest of the refrigerant from the first path.

If the chamber is equipped with a Low RH package, the following description applies. When dehumidification is called for, some of the liquid refrigerant is diverted to the humidity loop. The refrigerant passes through a solenoid valve (item H131) and a Low RH thermostatic expansion valve (item H130). Two phase refrigerant exits the thermostatic expansion valve and enters the evaporator (item H125). The evaporator temperature is cold enough to freeze water out of the air where it collects and freezes on the surface of the evaporator. The temperature of the evaporator is able to drop below freezing temperature due to the suction bypass solenoid (item H129) where it allows the suction vapor to bypass the evaporator pressure regulator valve (item H126) this allows the chamber to achieve low temperature dew points limited as previously discussed in this manual.

## CASCADE UNIT - SYSTEM 2 (R-508B) DESCRIPTION

**System 2 – Description (2 HP – 6 HP Systems)**

The compressor (item 201) will pump compressed R-508B/R23 vapor through the discharge line where the high pressure gauge (item 283) senses and displays the pressure of the refrigerant. The high pressure switch (item 295) senses the discharge refrigerant pressure and will open a contact in the event that discharge pressure exceeds 350 PSIG (24.1 bar(g)). This contact opening will serve to shut down the unit, and will automatically reset when the pressure drops to 250 PSIG (17.2 bar(g)).

The discharge gas then enters the oil separator (item 245). The oil separator removes 90% of the oil in the refrigerant vapor. It collects the oil and drains it back to the compressor crankcase. This prevents oil logging in the evaporator.

The discharge refrigerant vapor passes a tee which diverts some of the refrigerant to the bypass loop (see Bypass Loop description).

The residual discharge refrigerant vapor passes through the discharge desuperheater (item 244). The discharge refrigerant vapor passes a tee, in the event that discharge pressure exceeds a range of 270 PSIG (18.6 bar(g)) to 300 PSIG (20.7 bar(g)), see unit specific refrigeration flow diagram for setting. Some of the discharge refrigerant vapor will be diverted to the high pressure dump valves (item 253), and will flow to the vapor tank (item 255) where the gas is siphoned back into the suction line to maintain proper flow of the refrigerant. The residual discharge refrigerant vapor then enters the cascade condenser.

The cascade condenser (item 113) cools the high pressure R-508B/R23 vapor, and condenses it into a high pressure liquid. A relief valve (item 281) is mounted near the condenser and will relieve at 400 PSIG.

High pressure liquid refrigerant exits the cascade condenser. The liquid flows through a filter drier (item 208) and enters a tee. The tee will divert some of the liquid refrigerant to be used in the bypass circuit (see Bypass Loop description).

**System 2 – Description (10 HP – 20 HP Systems)**

The high pressure switch (item 295) senses the discharge refrigerant pressure and will open a contact in the event that discharge pressure exceeds 350 PSIG (24.1 bar(g)). This contact opening will serve to shut down the unit and must be manually reset.

The discharge gas then enters the oil separator (item 245). The oil separator removes 90% of the oil in the refrigerant vapor. It collects the oil and drains it back to the compressor crankcase. This prevents oil logging in the evaporator.

The discharge refrigerant vapor passes a tee, which diverts some of the refrigerant to the bypass loop (see Bypass Loop description).

The residual discharge refrigerant vapor passes through the discharge desuperheater (item 244). The discharge refrigerant vapor passes a tee. In the event that discharge pressure exceeds a range of 270 PSIG (18.6 bar(g)) to 300 PSIG (20.7 bar(g)), see unit specific refrigeration flow diagram for setting. Some of the discharge refrigerant vapor will be diverted to the high pressure dump valves (item 253), and will flow to the vapor tank (item 255) where the gas is siphoned back into the suction line to maintain proper flow of the refrigerant. The residual discharge refrigerant vapor then enters the cascade condenser.

The cascade condenser (item 113) cools the high pressure R-508B/R23 vapor, and condenses it into a high pressure liquid. A relief valve (item 281) is mounted near the condenser and will relieve at 400 PSIG.

High pressure liquid refrigerant exits the cascade condenser. The liquid flows through a filter drier (item 208), and enters a tee. The tee will divert some of the liquid refrigerant to be used in the bypass circuit (see Bypass Loop description).

**Chamber Cooling (2 HP – 6 HP Systems)**

After passing the bypass tee, the liquid refrigerant flows through the liquid line solenoid (item 210) and into the thermostatic expansion valve (item 211) where it changes to a low pressure, two phase refrigerant. The two phase refrigerant is cold due to the flashing of refrigerant. The two phase refrigerant enters the distributor (item 212) where the refrigerant is evenly distributed to evaporator circuits. The evaporator (item 213) serves to boil the rest of the R-508B/R-23 into a vapor. The boiling action cools the chamber. Superheated R-508B/R23 refrigerant vapor exits the evaporator and moves through the suction line. A suction service valve (item 215) is located near the compressor.

**(6 HP systems)** The low pressure switch (item 298) senses the pressure of the vapor. If the pressure is below 10“ hg vacuum, it will open a contact and shut the system down. It will automatically reset when the pressure rises to an acceptable level. A low pressure gauge (item 282) indicates the pressure in the line. A suction service valve (item 215) is located near the compressor.

**Chamber Cooling (10 HP – 20 HP Systems)**

After passing the bypass tee, the liquid refrigerant flows through the maximum liquid line solenoid (item 210) and into the maximum thermostatic expansion valve (item 211) where it changes to a low pressure, two phase refrigerant. In parallel with maximum valve, liquid refrigerant flows through a minimum liquid line solenoid (item 219) and into the minimum thermostatic expansion valve (item 220) where it also changes to low pressure, two phase refrigerant. The two phase refrigerant is cold due to the flashing refrigerant. The two phase refrigerant enters the distributor (item 212) where the refrigerant is evenly distributed to evaporator circuits. The evaporator (item 213) serves to boil the rest of the R-508B/R-23 into a vapor. The boiling action cools the chamber. Superheated R-508B/R23 refrigerant vapor exits the evaporator and moves through the suction line. A suction service valve (item 215) is located near the compressor.

**Bypass Loop (R508B Systems)**

The discharge refrigerant vapor passes a tee where some of the vapor is diverted to the suction line through a hot gas bypass regulator valve (item 263). The hot gas bypass regulator valve will allow hot discharge refrigerant vapor to flow directly to the suction line. This is done as a means to control cooling capacity or to “unload” the system. The liquid injection thermostatic expansion valve (item 261) will sense the temperature of the suction gas, and automatically open to feed liquid refrigerant into the suction line. This will provide cooling for the hot gas that is being fed into the suction line. The cooling effect keeps the compressor from overheating. There is also a discharge temperature control valve (item 278), which prevents the compressor from overheating and results in no loss of capacity or mass flow.

**Bypass Loop (R23 Systems 3.5 HP – 15 HP)**

The discharge refrigerant vapor passes a tee, where some of the vapor is diverted to the suction line. The discharge vapor passes through the hot gas bypass solenoid (item 262), and through a hot gas bypass regulator valve (item 263). The hot gas bypass solenoid valve (item 262) will open and close opposite of the liquid line solenoid valve (item 210). The hot gas bypass regulator valve will allow hot discharge refrigerant vapor to flow directly to the suction line. This is done as a means to control cooling capacity or to "unload" the system. The liquid injection thermostatic expansion valve (item 261) will sense the temperature of the suction gas and automatically open to feed liquid refrigerant into the suction line. This will provide cooling for the hot gas that is being fed into the suction line. The cooling effect keeps the compressor from overheating. These systems also come equipped with a discharge temperature control loop. The control loop consists of a liquid solenoid valve (item 277) and a discharge temperature control valve (item 278). The liquid line solenoid is energized when the compressor is running.

**Bypass Loop (R23 Systems 20 HP)**

The discharge refrigerant vapor passes a tee where some of the vapor is diverted to the suction line. The discharge vapor passes through the hot gas bypass solenoid (item 262), and through a hot gas bypass regulator valve (item 263). The hot gas bypass solenoid valve (item 262) will open and close opposite of the liquid line solenoid valve (item 210). The hot gas bypass regulator valve will allow hot discharge refrigerant vapor to flow directly to the suction line. This is done as a means to control cooling capacity or to "unload" the system. The liquid injection thermostatic expansion valve (item 261) will sense the temperature of the suction gas and automatically open to feed liquid refrigerant into the suction line. This will provide cooling for the hot gas that is being fed into the suction line. The cooling effect keeps the compressor from overheating. These systems also come equipped with a discharge temperature control loop. The control loop consists of a liquid solenoid valve (item 277), and a hand expansion valve (item 278). This valve is set at the factory. The liquid line solenoid is controlled by a discharge temperature monitor and will open at a factory preset temperature.

## CASCADE CONTROL SYSTEM

(Refer to Refrigeration Diagram in Drawing Section)

**Mode: Normal cooling/heating (2 HP – 3.5 HP)**

When there is a call for cooling, the R-508B/R-23 liquid line solenoid (202-SOL) and the R-404A compressor turns on. Thirty seconds later, the R-508B/R-23 compressor turns on. The high pressure switch (101-PS and 204-PS) will turn the compressor off if a high discharge pressure event is reached. Contact Cincinnati Sub-Zero's service department if this occurs. The high pressure switch will automatically reset. When there is call for cooling, (202-SOL) is energized. When the chamber is near the set point, the controller begins to cycle (202-SOL) on and off. If the chamber does not call for cooling for ninety seconds, the refrigeration system will turn off.

When there is a call for heating, (202-SOL) will deenergize, and the heaters will energize.

**Mode: Normal cooling (6 HP)**

When there is a call for cooling, the R-508B/R-23 liquid line solenoid (202-SOL), and the R-404A maximum liquid line solenoid (101-SOL) energize, and the R-404A minimum liquid line solenoid (107-SOL) and the R-404A compressor turn on. Thirty seconds later, the R-508B/R-23 compressor turns on. The high pressure switch (101-PS and 204-PS) will turn the compressor off if a high discharge pressure event is reached. Contact Cincinnati Sub-Zero's service department if this occurs. The high pressure switch will automatically reset. When there is call for cooling, (202-SOL) is energized. When the chamber is near the set point, the controller begins to cycle (202-SOL) on and off. If the chamber does not call for cooling for ninety seconds, the refrigeration system will turn off.

When there is a call for heating, (202-SOL) will deenergize, and the heaters will energize.

**Mode: Normal cooling (10 HP – 20 HP)**

When there is a call for cooling, the R-508B/R-23 maximum liquid line solenoid (202-SOL), the R-508B/R-23 minimum liquid line solenoid (203-SOL), and the R-404A maximum liquid line solenoid (101-SOL) energize. The R-404A minimum liquid line solenoid (107-SOL) and the R-404A compressor turn on. Thirty seconds later, the R-508B/R-23 compressor turns on. The high pressure switch (101-PS and 204-PS) will turn the compressor off if a high discharge pressure event is reached. Contact Cincinnati Sub-Zero's service department if this occurs. The high pressure switch will automatically reset. When there is call for cooling, (202-SOL & 203-SOL) is energized. When the chamber output drops below 90% cooling, the controller will deenergize the maximum liquid line solenoid (202-SOL). When the chamber is near the set point, the controller begins to cycle (203-SOL) on and off. If the chamber does not call for cooling for ninety seconds, the refrigeration system will turn off.

When there is a call for heating, (202-SOL & 203-SOL) will deenergize, and the heaters will energize.

**Mode: Humidity (Optional Equipment)**

In humidity mode, the unit runs as a single stage system. The R-404A compressor turns on. A high pressure switch (1-PS) will turn the compressor off if a high discharge pressure is reached. Contact Cincinnati Sub-Zero's service department if this occurs.

When dehumidification is called for, the wet coil solenoid valve (H111-SOL) is energized. This allows refrigerant to flow to the dehumidification evaporator (item H125).

When humidity is called for, the wet coil solenoid valve (H111-SOL) is deenergized.

For Dry Bulb Temperature cooling in humidity mode, the liquid line solenoid valve (H101-SOL) is energized. This allows refrigerant to flow through the R-404A dry bulb thermostatic expansion valve which enables the chamber to have tighter temperature control.

For Dry Bulb Temperature heating, the liquid line solenoid valve (H101-SOL) is deenergized, and the heaters are energized.

**Mode: Pumpdown (10 HP – 15 HP)**

When the conditioning system is turned off, the refrigeration system will go into pumpdown mode. In pumpdown mode, the compressor will automatically turn on when the pressure in the suction line is above 50 PSIG (3.4 bar(g)). The compressor turns off when the suction line pressure is reduced to 10 PSIG (0.7 bar(g)). Pressure switch (107-PS) will monitor the suction line pressure and control the operation of the compressor in pumpdown mode. The maximum liquid line solenoid (101-SOL), the minimum liquid line solenoid (107-SOL), and the hot gas bypass solenoid (104-SOL) will be deenergized. Pumpdown forces most of the refrigerant into the high side of the system. The refrigerant will be in the liquid line, filter drier, sight glass, receiver, condenser, and discharge line. Pumpdown serves to protect the compressor on startup. If there was no pumpdown, a slug of liquid refrigerant could exit the evaporator coil and damage the compressor.

## TUNDRA® DESCRIPTION

(Refer to Refrigeration Diagram in Drawing Section)

The compressor (item 101) will pump compressed R-410A vapor through the discharge line, where the high-pressure gauge (item 183) display the pressure of the refrigerant. The high pressure switch (item 195) senses the discharge refrigerant pressure and will open a contact in the event that discharge pressure exceeds 400 PSIG (27.6 bar(g)). This contact opening will serve to shut down the unit, and will automatically reset when the pressure drops to 300 PSIG (20.7 bar(g)). The discharge refrigerant vapor passes a tee which diverts some of the refrigerant to the bypass loop (see bypass description), and enters the condenser. A relief valve (item 181) is installed near the condenser and will relieve at 450 PSIG (31.0 bar(g)).

**Air Cooled Condensing Option (2 HP – 6 HP systems)**

The condenser (item 105) cools the high pressure R-410A vapor and condenses it into a high pressure liquid. The condenser fan motor (item 196) will be energized anytime the compressor (item 101) is running.

The high pressure liquid leaves the condenser and flows through a filter drier (item 108) and sight glass (item 109), then passes a tee which diverts some of the liquid refrigerant to the bypass loop (see bypass description).

**Water Cooled Condensing Option (6 HP – 15 HP systems)**

The condenser (item 105) cools the high pressure R-410A vapor and condenses it into a high pressure liquid. The pressure actuated water valve (item 107) will maintain the discharge pressure at approximately 230 PSIG (15.9 bar(g)).

The high pressure liquid leaves the condenser and flows through a receiver (item 122), filter drier (item 108) and sight glass (item 109), and then passes a tee which diverts some of the liquid refrigerant to the bypass loop (see bypass description).

**Chamber Cooling (2 HP – 3.5 HP systems)**

After passing the bypass tee, the liquid refrigerant flows through the liquid line solenoid (item 110), and into the thermostatic expansion valve (item 111) where it changes to a low pressure, two phase refrigerant. The two phase refrigerant is cold due to the flashing of refrigerant. The two phase refrigerant enters the distributor (item 112) where the refrigerant is evenly distributed to evaporator circuits. The evaporator (item 113) serves to boil the rest of the R-410A into a vapor. This boiling action cools the chamber. If dehumidification is called for, some of the R-410A refrigerant is diverted to the humidity loop prior to entering the thermostatic expansion valve (see Humidity Loop section).

Superheated refrigerant vapor exits the evaporator and moves through the suction line. (3.5 HP units) A crankcase pressure regulator is located close to the compressor to keep the compressor suction from rising above a preset factory pressure. A suction service valve (item 115) is located near the compressor.

**Chamber Cooling (6 HP – 15 HP systems)**

After passing the bypass tee, the liquid refrigerant flows through the maximum liquid line solenoid (item 110), and into the maximum thermostatic expansion valve (item 111) where it changes to a low-pressure two phase refrigerant. In parallel with the maximum valve, liquid refrigerant flows through a minimum liquid line solenoid (item 119), and into the minimum thermostatic expansion valve (item 120) where it also changes to a low pressure, two phase refrigerant. The two phase refrigerant is cold due to the flashing of refrigerant. The two phase refrigerant enters the distributor (item 112) where the refrigerant is evenly distributed to evaporator circuits. The evaporator (item 113) serves to boil the rest of the R-410A into a vapor. This boiling action cools the chamber. If dehumidification is called for, some of the R-410A refrigerant is diverted to the humidity loop prior to entering the thermostatic expansion valve (see Humidity Loop section).

Superheated refrigerant vapor exits the evaporator and moves through the suction line. A crankcase pressure regulator is located close to the compressor to keep the compressor suction from rising above a preset factory pressure. A suction service valve (item 115) is located near the compressor.

**Humidity Loop (Optional Equipment)**

When dehumidification is called for while in humidity mode, some of the liquid refrigerant is diverted to the humidity loop. The refrigerant passes through the wet coil solenoid valve (item H127) and a wet coil capillary tube (item H123). Two phase refrigerant exits the capillary tube and enters the evaporator (item H125). The evaporator is cold enough to attract moisture from the chamber air, but not cold enough to freeze water on the evaporator. The temperature of the evaporator is regulated by an evaporator pressure regulator valve (item H126) E.P.R. for short. This valve is intended to flood the coil to keep pressure higher than the suction pressure. The warm chamber air keeps the moisture from freezing on the coil. After the refrigerant leaves the wet coil, it enters the suction line and returns to the compressor.

If the chamber is equipped with a Low RH package, the following description applies. When dehumidification is called for, some of the liquid refrigerant is diverted to the humidity loop. The refrigerant passes through a solenoid valve (item H131), and a Low RH thermostatic expansion valve (item H130). Two phase refrigerant exits the thermostatic expansion valve and enters the evaporator (item H125). The evaporator temperature is cold enough to freeze water out of the air where it collects and freezes on the surface of the evaporator. The temperature of the evaporator is able to drop below freezing temperature due to the suction bypass solenoid (item H129) where it allows the suction vapor to bypass the evaporator pressure regulator valve (item H126). This allows the chamber to achieve low temperature dew points limited, as previously discussed in this manual.

**Bypass Loop**

The bypass circuit is composed of two lines in parallel: the hot gas bypass line, and the liquid injection line. The hot gas bypass line consists of a solenoid valve (item 117) and a hot gas bypass regulator valve (item 118). The liquid injection line consists of a liquid injection solenoid valve (item 121) and liquid injection thermostatic expansion valve (item 123). The hot gas bypass solenoid valve (item 117) will open and close opposite of the liquid line solenoid valve (item 110) (2 HP – 3.5 HP). The hot gas bypass solenoid valve (item 117) will open and close opposite of the liquid line solenoid valve (item 119) (6 HP – 15 HP). The valve will allow hot discharge refrigerant vapor to flow directly to the suction line. This is done as a means to control cooling capacity or to “unload” the system. The liquid injection thermostatic expansion valve will sense the temperature of the suction gas and will automatically open to feed liquid refrigerant into the suction line. This will provide cooling for the hot gas that is being fed into the suction line. The cooling effect keeps the compressor from overheating. There is also a discharge temperature control valve (item 178). This prevents the compressor from overheating and results in no loss of capacity or mass flow.

## TUNDRA® CONTROL SYSTEM

Refer to Refrigeration Diagram in Drawing Section.

**Mode: Normal cooling/heating (2 HP – 3.5 HP systems)**

When there is a call for cooling, the R-410A liquid line solenoid (101-SOL), and the liquid injection solenoid (108-SOL) energize. The R-410A compressor turns on (2 HP – 3.5 HP). The high pressure switch (101-PS) will turn the compressor off if a high discharge pressure event is reached. Contact Cincinnati Sub-Zero’s service department if this occurs. The high pressure switch will automatically reset. When there is call for cooling, (101-SOL) is energized. When the chamber is near the set point, the controller begins to cycle (101-SOL) on and off. At the same time, the R-410A hot gas bypass solenoid (109-SOL) cycles on and off opposite of (101-SOL). If the chamber does not call for cooling for ninety seconds, the refrigeration system will turn off.

When there is a call for heating, (101-SOL) will de-energize and the heaters will energize.

**Mode: Normal cooling/heating (6 HP system)**

When there is a call for cooling, the R-410A maximum liquid line solenoid (101-SOL), minimum liquid line solenoid (107-SOL), and the liquid injection solenoid (108-SOL) energize. The R-410A compressor turns on. The high pressure switch (101-PS) will turn the compressor off if a high discharge pressure event is reached. Contact Cincinnati Sub-Zero's service department if this occurs. The high pressure switch will automatically reset. When there is call for cooling, (101-SOL) and (107-SOL) is energized. Once the chamber has reached a preset factory chamber temperature, the maximum liquid line solenoid (101-SOL) will deenergize. When the chamber is near the set point, the controller begins to cycle (107-SOL) on and off. At the same time, the R-410A hot gas bypass solenoid (109-SOL) cycles on and off opposite of (101-SOL). If the chamber does not call for cooling for ninety seconds, the refrigeration system will turn off.

When there is a call for heating, 101-SOL will de-energize and the heaters will energize.

**Mode: Normal cooling/heating (10 HP - 15 HP systems)**

When there is a call for cooling, the R-410A maximum liquid line solenoid (101-SOL), minimum liquid line solenoid (107-SOL), and the liquid injection solenoid (108-SOL) energize. The R-410A compressor turns on. The high pressure switch (101-PS) will turn the compressor off if a high discharge pressure event is reached. Contact Cincinnati Sub-Zero's service department if this occurs. The high pressure switch has to be manually reset. When there is call for cooling, (101-SOL) and (107-SOL) are energized. Once the chamber has reached a preset factory chamber temperature, the maximum liquid line solenoid (101-SOL) will deenergize. When the chamber is near the set point, the controller begins to cycle (107-SOL) on and off. At the same time, the R-410A hot gas bypass solenoid (109-SOL) cycles on and off opposite of (101-SOL). If the chamber does not call for cooling for ninety seconds, the refrigeration system will turn off.

When there is a call for heating, 101-SOL will deenergize, and the heaters will energize.

**Mode: Humidity (Optional Equipment)**

In humidity mode, the system starts in the same manner as above with the following differences:

When dehumidification is called for, the wet coil solenoid valve (H111-SOL) is energized. This allows refrigerant to flow to the dehumidification evaporator (item H125).

When humidity is called for, the wet coil solenoid valve (H111-SOL) is deenergized.

For Dry Bulb Temperature cooling in humidity mode, the liquid line solenoid valve (101-SOL) is energized. This allows refrigerant to flow through the R-410A dry bulb thermostatic expansion to reduce the temperature of the chamber.

For Dry Bulb Temperature heating, the liquid line solenoid valve (101-SOL) is deenergized, and the heaters are energized.

**Mode: Pumpdown (10 HP - 15 HP systems)**

When the conditioning system is turned off, the refrigeration system will go into pumpdown mode. In pumpdown mode, the compressor will automatically turn on when the pressure in the suction line is above 50 PSIG (3.4 bar(g)). The compressor turns off when the suction line pressure is reduced to 5 PSIG (0.3 bar(g)). Pressure switch (107-PS) will monitor the suction line pressure and control the operation of the compressor in pumpdown mode. The maximum liquid line solenoid (101-SOL), the minimum liquid line solenoid (107-SOL), and the hot gas bypass solenoid (109-SOL) will be deenergized. Pumpdown forces most of the refrigerant into the high side of the system. The refrigerant will be in the liquid line, filter-drier, sight glass, receiver, condenser, and discharge line. Pumpdown serves to protect the compressor on startup. If there was no pumpdown, a slug of liquid refrigerant could exit the evaporator coil and damage the compressor.

## SINGLE STAGE - SYSTEM 1 (R-404A) DESCRIPTION

(Refer to Refrigeration Diagram in Drawing Section.)

The compressor (item 101) will pump compressed R-404A vapor through the discharge line where the high pressure gauge (item 183) displays the pressure of the refrigerant. The high pressure switch (item 195) senses the discharge refrigerant pressure and will open a contact in the event that discharge pressure exceeds 350 PSIG (24.1 bar(g)). This contact opening will serve to shut down the unit and will automatically reset when the pressure drops to 250 PSIG (17.2 bar(g)). The discharge refrigerant vapor passes a tee which diverts some of the refrigerant to the bypass loop (see bypass description), and enters the condenser.

**Air Cooled Condensing Option**

The condenser (item 105) cools the high pressure R-404A vapor and condenses it into a high pressure liquid. The condenser fan motor (item 196) will be energized anytime the compressor (item 101) is running.

The high pressure liquid leaves the condenser and flows through a filter drier (item 108) and sight glass (item 109), then passes a tee which diverts some of the liquid refrigerant to the bypass loop (see bypass description).

**Water Cooled Condensing Option**

The condenser (item 105) cools the high pressure R-404A vapor and condenses it into a high pressure liquid. The pressure actuated water valve (item 107) will maintain the discharge pressure at approximately 210 PSIG (14.5 bar(g)).

The high pressure liquid leaves the condenser and flows through a receiver (item 122), filter drier (item 108), and sight glass (item 109), then passes a tee which diverts some of the liquid refrigerant to the bypass loop (see bypass description).

**Chamber Cooling**

After passing the bypass tee, the liquid refrigerant flows through the liquid line solenoid (item 110) and into the thermostatic expansion valve (item 111) where it changes to a low pressure, two phase refrigerant. The two phase refrigerant is cold due to the flashing of refrigerant. The two-phase refrigerant enters the distributor (item 112), where the refrigerant is evenly distributed to evaporator circuits. The evaporator (item 113) serves to boil the rest of the R-404A into a vapor. This boiling action cools the chamber. If dehumidification is called for, some of the R-404A refrigerant is diverted to the humidity loop prior to entering the thermostatic expansion valve (see humidity description).

**Humidity Loop (Optional Equipment)**

When dehumidification is called for, some of the liquid refrigerant is diverted to the humidity loop. The refrigerant passes through the wet coil solenoid valve (item H127) and a wet coil capillary tube (item H123). Two phase refrigerant exits the capillary tube and enters the evaporator (item H125). The evaporator is cold enough to attract moisture from the chamber air, but not cold enough to freeze water on the evaporator. The temperature of the evaporator is regulated by an evaporator pressure regulator valve (E.P.R) (item H126) and is intended to be a flooded coil by design. The warm chamber air keeps the moisture from freezing on the coil. After the refrigerant leaves the wet coil, it enters the suction line and returns to the compressor.

If the chamber is equipped with a Low RH package, the following description applies. When dehumidification is called for, some of the liquid refrigerant is diverted to the humidity loop. The refrigerant passes through a solenoid valve (item H131) and a Low RH thermostatic expansion valve (item H130). Two phase refrigerant exits the thermostatic expansion valve and enters the evaporator (item H125). The evaporator temperature is cold enough to freeze water out of the air where it collects and freezes on the surface of the evaporator. The temperature of the evaporator is able to drop below freezing temperature due to the suction bypass solenoid (item H129) where it allows the suction vapor to bypass the evaporator pressure regulator valve (item H126). This allows the chamber to achieve low temperature dew points limited, as previously discussed in this manual.

**Bypass Loop**

The bypass circuit is composed of two lines in parallel: the hot gas bypass line, and the liquid injection line. The hot gas bypass line consists of a solenoid valve (item 117) and the hot gas bypass regulator valve (item 118). The liquid inject line consists of a liquid injection solenoid valve (item 121) and liquid injection thermostatic expansion valve (item 123). The hot gas bypass solenoid valve (item 117) will open and close opposite of the liquid line solenoid valve (item 110). The valve will allow hot discharge refrigerant vapor to flow directly to the suction line. This is done as a means to control cooling capacity or to “unload” the system. The liquid injection thermostatic expansion valve will sense the temperature of the suction gas, and will open automatically to feed liquid refrigerant into the suction line. This will provide cooling for the hot gas that is being fed into the suction line. The cooling effect keeps the compressor from overheating.

## SINGLE STAGE CONTROL SYSTEM

(Refer to Refrigeration Diagram in Drawing Section).

**Mode: Normal cooling/heating**

When there is a call for cooling, the R-404A Liquid Line Solenoid (101-SOL), and the liquid injection solenoid (108-SOL) energize. The R-404A compressor turns on. The high pressure switch (101-PS) will turn off the compressor if a high discharge pressure event is reached. Contact Cincinnati Sub-Zero's service department if this occurs. The high-pressure switch will automatically reset. When there is call for cooling, 101-SOL is energized. When the chamber is near the set point, the controller begins to cycle 101-SOL on and off. At the same time, the R-404A hot gas bypass solenoid 109-SOL is cycling on and off opposite of 101-SOL. If the chamber does not call for cooling for ninety seconds, the refrigeration system will turn off.

When there is a call for heating, 101-SOL will deenergize and the heaters will energize.

**Mode: Humidity**

In humidity mode, the system starts in the same manner as above with the following differences:

When dehumidification is called for, the wet coil solenoid valve H111-SOL is energized. This allows refrigerant to flow to the dehumidification evaporator (item H125).

When humidity is called for, the wet coil solenoid valve H111-SOL is deenergized.

For Dry Bulb Temperature cooling in humidity mode, the liquid line solenoid valve (101-SOL) is energized. This allows refrigerant to flow through the R-410A dry bulb thermostatic expansion to reduce the temperature of the chamber.

For Dry Bulb Temperature heating, the liquid line solenoid valve (101-SOL) is deenergized, and the heaters are energized.

# CHAPTER 3: OPERATION

## STARTUP INSTRUCTION SUMMARY (EZT-570S/L CONTROLLER)

**NOTE**

Humidity performance will be affected if live loads are placed in the chamber when trying to achieve certain humidity levels.

**NOTE**

When running at high humidity levels for an extended period of time, the tip of the humidity sensor can become saturated, resulting in erroneous readings. To correct this condition, it is recommended that the tip be dried out by turning the humidity system off and raising the temperature to 250°F (121.1°C) high temp for 10 minutes. The sensor accuracy will be restored by evaporating the water out of the porous cover over the sensing element.

**NOTE**

Any changes to the CSZ configurations programmed in the temperature controller or safety limit without prior authorization by CSZ could void warranty. Related issues and costs associated from the changing of these configuration settings could be deemed customers responsibility. Call factory prior to changing these configurations.

The control section, illustrated in Figure 3-1, is composed of a CSZ EZT-570S/L Controller. Specifications for the Controller may be found in the EZT-570S/L User's manuals, located on the digital media included in this binder.

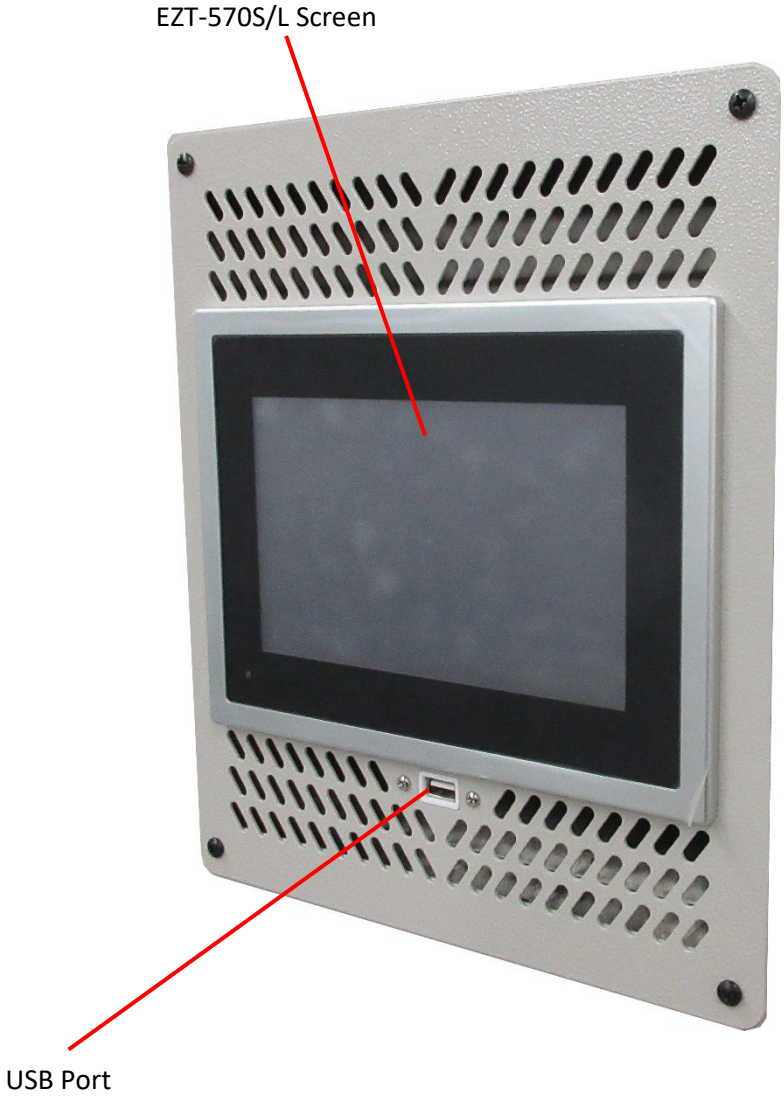



Figure 3-1: CSZ EZT – 570S/L Controller

*Note: CSZ is continuously upgrading the components used in its equipment. Consequently, the physical appearance of certain components may vary from that shown.*

## PUMPDOWN

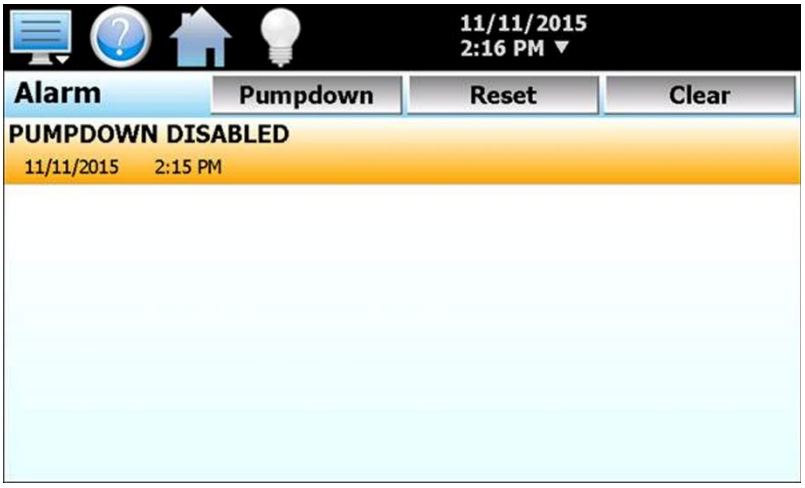
Chambers with large horsepower refrigeration systems have an automatic mode of operation called “pumpdown”. The refrigeration system is in this mode whenever it is not running to cool or dehumidify the chamber. In pumpdown mode, the System 1 compressor will automatically turn on and off at preset pressures in order to force refrigerant into the high side of the system. This serves as a means to protect the compressor on startup.

If pumpdown was not used, refrigerant could migrate throughout the system and accumulate, typically in the coldest location; like the compressor crankcase. On startup, this refrigerant could then enter the compressor as a liquid and cause permanent damage to the compressor. In addition, a crankcase heater is installed on the compressor in order to heat the oil in the crankcase of the compressor. This helps boil out any refrigerant, so that it can be pumped into the high side of the system.

If the chamber is equipped with the pumpdown mode of operation, the “Pumpdown” button will be provided on the Alarm Monitor screen. This provides a manual way to reset pumpdown mode. Pumpdown will be automatically disabled if main power is off for more than 30 minutes. This is due to the fact that without main power, the crankcase heater will be off and cannot warm the compressor. Depending on the temperature of the compressor, this could allow refrigerant to accumulate in the compressor causing a potentially damaging startup.

**NOTE**

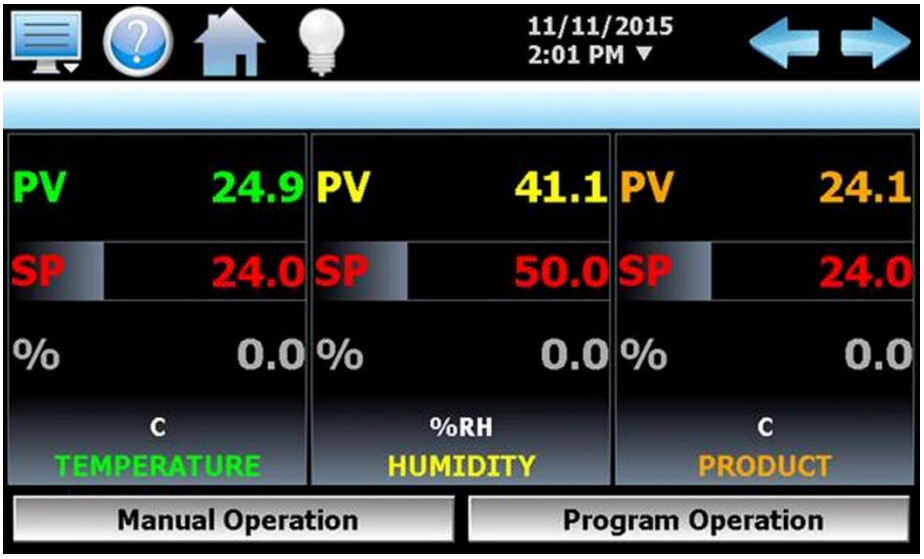
Prior to starting the four (4) hour pumpdown cycle, please confirm that the scroll compressors are operating in the proper rotation.




The “Pumpdown Disabled” alarm will notify the operator of this condition. The chamber will not operate when pumpdown is disabled. Pumpdown will automatically reset after the main power has been on for a period of 4 hours, or it can be reset at any time by pressing the “Pumpdown” button.

***If your chamber is equipped with pumpdown, main power should remain on at all times. If power is removed for extended periods of non use, DO NOT reset pumpdown after power is applied to the unit. Only silence the alarm. Allow for the 4 hour warm-up period prior to use or damage to the compressor may result.***

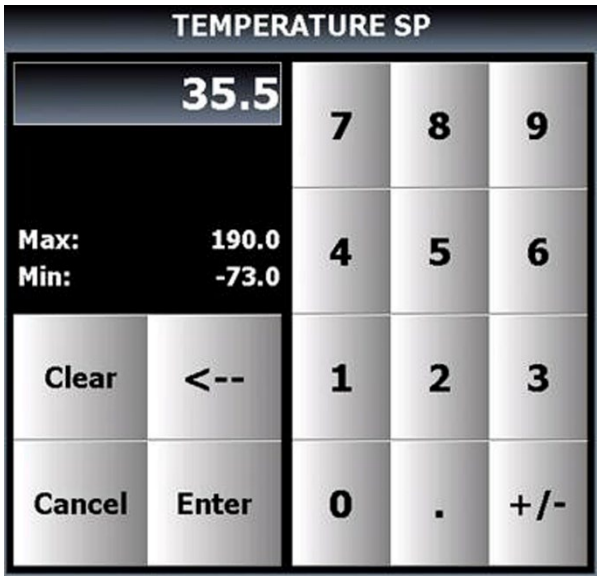
## SINGLE SET POINT OPERATION




To adjust the setpoint:

1. Select one of the loop views from the main View menu.
2. Input the set point temperature.

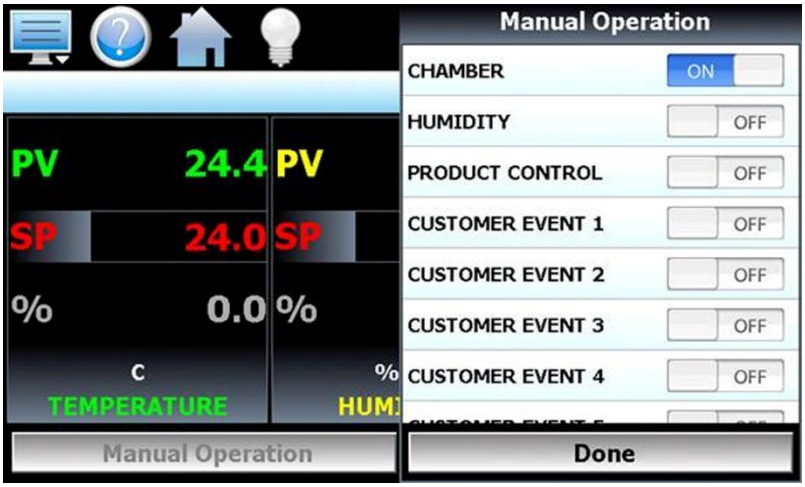
Press the numeric display for the setpoint (SP) for temperature. The setpoint adjust keypad will be shown on the screen. Enter the desired setpoint value and press the "Enter" button.




3. Turn the Chamber event on to start the chamber, see manual event control.

## MANUAL EVENT CONTROL (TURNING THE CHAMBER ON/OFF)

Events are the “switches” used to turn the chamber, its related functions, and optional systems on and off. These events can be manually turned on and off as well as programmed into profiles so that they can be turned on and off at set time intervals.




To turn the chamber and optional events on/off:

1. Select “Manual Operation” from the main View menu.
2. To turn the events on or off, touch the slide switch.

## PROFILE OPERATION

To create and run programs on the EZT570S/L, see Chapter 4 of the EZT-570S/L User Manual

Sample profiles have been provided by CSZ, preloaded on the EZT-570S/L controller in order to provide an example of a completed profile.

**NOTE**

The following start-up instructions are written for the F4 controller. For optional controller, please refer to Specific Instructions in your controller manual.

**NOTE**

Switch must be on manual mode for single set point operation.

**NOTE**

Humidity performance will be affected if live loads are placed in the chamber when trying to achieve certain humidity levels.

**NOTE**

When running at high humidity levels for an extended period of time, the tip of the humidity sensor can become saturated, resulting in erroneous readings. To correct this condition, it is recommended that the tip be dried out by turning the humidity system off and raising the temperature to 250°F (121.1°C) high temp for 10 minutes. The sensor accuracy will be restored by evaporating the water out of the porous cover over the sensing element.

## STARTUP INSTRUCTION SUMMARY (WATLOW F4 CONTROLLER)

The control section, illustrated in Figure 3-2, is composed of a Watlow F4 Controller. Specifications for the Controller may be found in the Watlow F4 User's manuals located on the digital media included in this binder.

1. Turn the power switch **ON**.
2. Load your test sample into the chamber.
3. Enter the Single Set Point Operation Temperature.
4. Enter the Single Set Point Operation Humidity if applicable.

## SUMMARY FOR STEP BY STEP SET POINT OPERATION

These instructions will enable the operator to use the Watlow F4 Programmer/Controller in a single set point operation. The User's Manual for the Watlow F4 Programmer/Controller should be reviewed for more detailed operation.

### Single Set Point Operation - Temperature

1. When Turning the Main Power Switch ON
   a. This will supply power to the Watlow F4 Controller, Product Hi/Low Limit and chamber light. The Watlow F4 controller will perform a 5-10 second startup self test. The upper display will be blank, and the lower display will show Watlow F4 and current software revision. Wait for the completion of the self-test.
2. When operating the chamber, the PGM/OFF/ON switch determines if event No. 1 must be on to run the chamber.
   a. **ON**
      The PGM/OFF/ON switch should be set in this position when running single set points or when operating in a program mode without using events to turn on-off option features.
   b. **PGM**
      The PGM/OFF/ON switch must be set in this position when running a program profile where events are used to turn features on and off.
3. Use the arrow keys to navigate through the lower display and place the arrow cursor on setpoint 1.
   a. Use the ▶ right arrow key to enter the setpoint field.
   b. Use the ▲ up and ▼ down arrow keys to change the setpoint
   c. Use the ◀ left or ▶ right arrow keys to exit the setpoint field.

**Single Set Point Operation - Humidity (Optional)**

1. Turn the humidity system **ON**.
2. Use the arrow keys to navigate through the lower display and place the arrow cursor on setpoint 2.
   a. Use the ▶ right arrow key to enter the setpoint field.
   b. Use the ▲ up and ▼ down arrow keys to change the setpoint.
   c. Use the ◀ left or ▶ arrow keys to exit the setpoint field.
3. When returning to temperature only operation, turn the humidity system off. Failure to do this will result in the unit not reaching low temperatures.
4. Verify that the demineralizer cartridge is fresh. The color of the cartridge should be dark.

**NOTE**

**Dry Air Purge Units Only**

During humidity operation, the dry air purge system must be turned off.

## WATLOW F4 CONTROLLER OUTPUTS

**Control Outputs**

Output 1A: Heating output. Cycles chamber heaters when heating is called for.

Output 1B: Cooling output. Cycles refrigeration valves when cooling is called for.

The compressors will run as long as cooling is called for before the time-out period has expired. If cooling is not called for within the preset time-out period, the compressors shut off. They will turn back on when cooling is called for.

Output 2A: Humidify output. Cycles boiler heater or atomizing nozzle of humidity system when humidity is called for.

Output 2B: Dehumidify output. Cycles refrigeration valves when dehumidification is called for.

The compressors will run as long as dehumidification is called for before the time-out period is expired. If dehumidification is not called for within the preset time-out period, the compressors will shut off. The compressors will turn back on when dehumidification is called for.


Figure 3-2: Watlow F4 Controller Outputs

**Event Outputs**

| | |
|---|---|
| Event # 1: | Conditioning system. Turns on refrigeration system components. |
| Event # 2: | Humidity system. Turns on humidity system components. |
| Event # 3: | Auxiliary cooling system. Turns on LN2 or CO2 boost cooling components. |
| Event # 4: | Dry air purge system. Turns on GN2 and/or air dryer components. |
| Event # 5: | Turns on Frozen Coil for low RH mode |
| Event # 6-8: | User defined event. Can be used to turn on test equipment, initiate a test cycle, etc. |

*Note: CSZ is continuously upgrading the components used in its equipment. Consequently, the physical appearance of certain components may vary from that shown.*

**NOTE**

During humidity operation, the dry air purge system must be turned off.

**NOTE**

Switch must be on manual mode for single set-point operation.

**NOTE**

CLEAN AND OIL-FREE AIR SHOULD BE USED TO SUPPLY THE DRY AIR PURGE SYSTEM.
The Hose inside the dry air purge package must be run to a drain. Both oil and water will be drained through this line.

**CAUTION**

Do not expose the bowl or sight glass to materials such as carbon tetrachloride, trichlorethylene, acetone, paint thinner, or other similar materials as they can also cause a chemical reaction with the plastic and can cause it to rupture.

## DRY AIR PURGE

In normal operation, the dryer towers will switch every 30 seconds. Each tower purges with an audible exhaust. Do not plug or restrict the purge air exhausts. If operating conditions change, different purge orifices may be required. If orifices are replaced, they should be replaced in matched pairs.

The heat of absorption and the solenoid valves will cause the unit to become warm. This is normal and does not indicate a malfunction. The temperature rise is more pronounced in a dryer operating at a low flow rate.

During operation, there may be a faint fume from the solenoid valves. This is caused by the AC voltage on the coil. It does not indicate a malfunction.

The highest ambient temperature at which a heatless dryer can be operated is 125°F (52°C). The maximum air temperature at the inlet which the instrument should handle is 125°F (52°C).

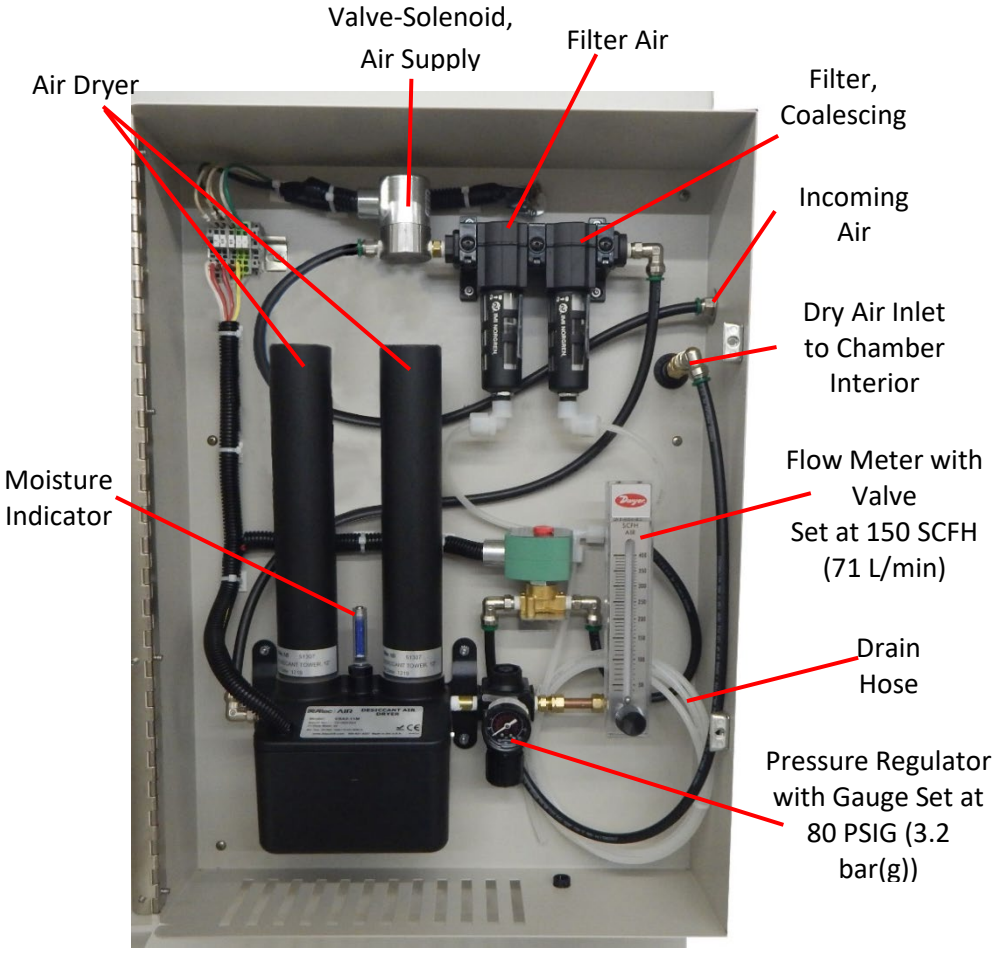



Figure 3-3: Dry Air Purge System Components Location (5SCFM Unit)

*Note: CSZ is continuously upgrading the components used in its equipment.*
*Consequently, the physical appearance of certain components may vary from that shown.*

**NOTE**

Since the F4 transmits and receives binary data, it is not possible for the converter to sense the end of the F4's message, since an EOM character could be part of the message. Therefore, it is necessary to set the number of bytes to be read from the converter when it is addressed to talk. Since the packet structure is fixed, the number of bytes will remain a set value.

# IEEE 488 - F4 CONTROLLER

The ICS GPIB to Serial Converter is used to convert the information on the GPIB bus into serial data to communicate with the F4. The F4 is set to use its RS-232 interface with the ICS converter. The F4 and converter are set up at the factory. The F4 settings are the default values for the serial interface. The ICS converter settings have been modified from their default values as listed below to interface with the F4.

| F4 Settings: | |
|---|---|
| Address | 1 |
| Baud Rate | 9600 |

| ICS Converter Settings: | |
|---|---|
| SYST:MODE | G |
| STAT:QUES:ENAB | 0 |
| SYST:COMM:SER:EOI | 0 |
| STAT:OPER:ENAB | 512 |
| *SRE | 128 |

The converter address is set to four (4). For a more detailed explanation on the ICS converter settings and how to change the address, see Section 3, " Operating from the GPIB Bus", of the IEEE manual located in the Accessories folder on the digital media.

**SENDING/RECEIVING DATA**

The F4 uses Modbus protocol for its communications. This requires that all data being sent to, and all data being received from the F4 be hexadecimal characters formatted into packets. It is recommended that the user become familiar with this format before any attempt is made to communicate with the F4. Watlow provides a very useful and well-documented manual on how to perform Modbus communications with the F4. This manual is available on Watlow's web site and is called the Data Communications Reference Electronic User's Manual. The manual explains how to format the data strings, what commands are available, and how to create subroutines to generate checksums.

The commands and format used to communicate over the GPIB bus will be identical to those explained in the manual. The only difference will be that a line feed (LF) terminator will have to be appended to the data string when it is sent, so the GPIB converter can sense the end of the message. The data will be sent to the F4, which will then send a response back to the converter. When addressed to talk, the converter will send the data string from the F4 with a line feed (LF) terminator appended to it.

*Example:*

*Read Register 0 (model number) of controller at address 0:*

*Send:* *010300000001840A*

*Received:* *01030203DCB92D*

*NOTE: All data is in HEX format. The bus controller must address device number four (4), the GPIB converter, when sending and receiving the data. Line feed terminators are used to signal end of transmission; however, it is necessary for the bus controller to transmit the number of bytes to be read when addressing the converter to talk. In the above example, the byte count would be seven (7).*

## HIGH/LOW LIMIT CONTROL

If the chamber is operated with a live load (heat dissipating product), protection should be provided. Provisions must be made to remove power from the product being tested and from the chamber in the event the chamber temperature exceeds safe limits for the product being tested. When testing a dead load (non-heat dissipating product), protection need only remove power from the chamber.

The High/Low Limit Control shuts down the chamber and product under test operation if the preset temperature limits are exceeded. Should the temperature go beyond these limits, an audible alarm sounds and the chamber shuts down. The Limit Control is a high and low limit control. It accepts an input from a single Type "T" thermocouple to sense process temperature. An LED display provides process temperature or limit set point information. Discrete LEDs tell the operator the status of the unit. High and low limit set points are user selectable at the front of the panel. The output device is a six amp mechanical relay.

The High/Low Limit Control incorporates auto power reset. In a non-limit condition, auto power reset will automatically energize the output relay and silence the audible alarm when power is applied. If a limit condition exists, the output relay will latch in a de-energized state and the audible alarm will sound.
The output relay can be re-energized, and the audible alarm silenced by the front panel "Reset" switch being depressed one time only when the limit condition no longer exists. The "Reset" should be depressed a second time to reset the alarm.

**WARNING**

A two-amp alarm relay contact is provided for customer's use. It is the customer's responsibility to interlock this control to the test product power source to de-energize the product during an alarm condition. The High/Low Limit Control will also provide protection from a malfunctioning temperature control unit and associated device.

**NOTE**

If the door lock is for one specific application (i.e. lock when blower is on), it will not have these programmable options.

The limit has three alarms that must be set up the same to energize all alarm contacts at the same conditions. Alarm 1 shuts down the chamber. Alarm 2 sounds the audible alarm. Alarm 3 is used to deenergize the test product. Proper operation of the High/Low Limit should be checked every three (3) months.

## VAISALA HMT337 HUMIDITY AND TEMPERATURE TRANSMITTER (IF EQUIPPED)

The Vaisala HMT337 humidity transmitter is equipped with the “Warmed Probe” and “Chemical Purge” options. The “Warmed Probe” feature prevents condensation from occurring on the probe. The “Chemical Purge” feature helps maintain measurement accuracy between calibration intervals. For more information about the “Warmed Probe” feature, or the “Chemical Purge” feature; please reference the HMT330 series user’s guide. **This information is not applicable to the Vaisala HMM100 series or any other humidity sensor.**

## PROGRAMMABLE DOOR LOCK (IF EQUIPPED)

The programmable door lock can be configured to lock the chamber door at certain temperature setpoints or in profile steps. The setpoint values that trigger the door to lock can be adjusted in the Settings Menu under Alarm Settings. The “Setpoints” button in Alarm Settings provides a field to adjust the low and high setpoints. These are the setpoints that will cause the door to lock. The user can also modify if the alarm is silent or if it shuts down the chamber. The “Door Lock” event can also be turned on or off within specific profile steps like any other chamber event.

## START-UP INSTRUCTION SUMMARY - REMOTE SENSOR (ZPRC UNITS)

Enabling the “RC Blower” Event energizes the remote conditioning blower, delivering conditioned air to the
remote hood. Temperature (and optional humidity) control is automatically transitioned from local in the
chamber’s plenum to remote at the hood.
Connections for both the remote temperature and humidity sensors are located on the Remote Sensors
interface plate at the rear of unit.

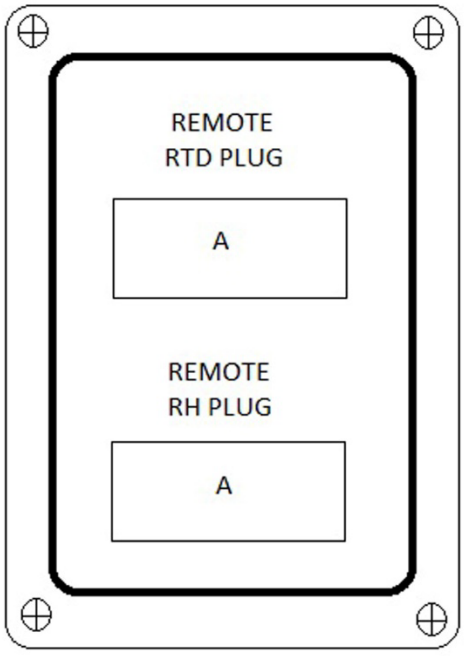



Figure 3-4: Controller Panel

*Note: CSZ is continuously upgrading the components used in its equipment. Consequently, the physical appearance of certain components may vary from that shown.*

## AIR SUPPLY DAMPER (ZPRC UNITS)

This device regulates the flow of supplied air to the chamber. To change the flow of air, loosen the wing nut and rotate the handle located on the top left corner of the chamber. Once the handle is adjusted, tighten the wing nut so your settings will hold.

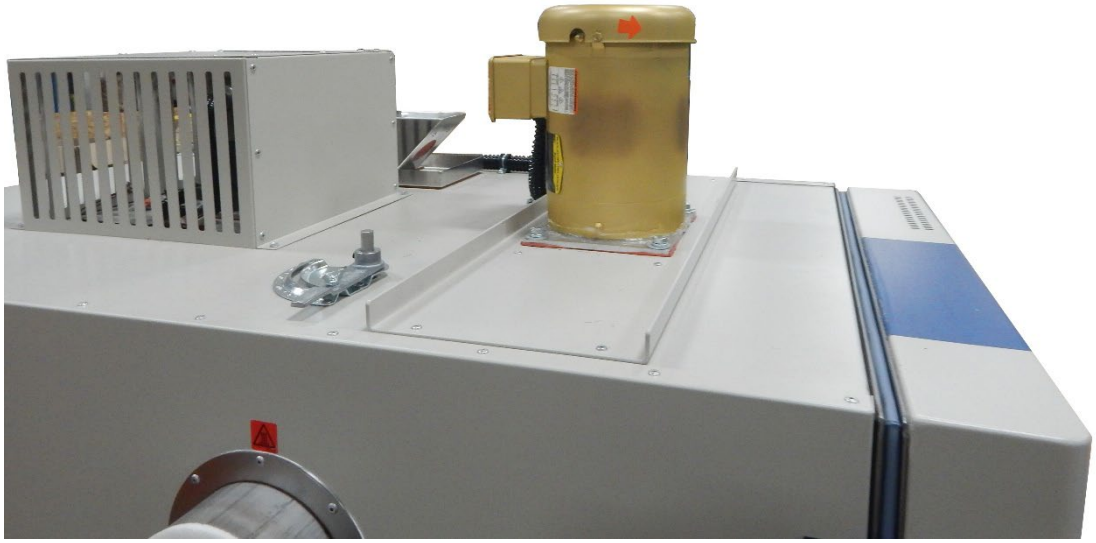


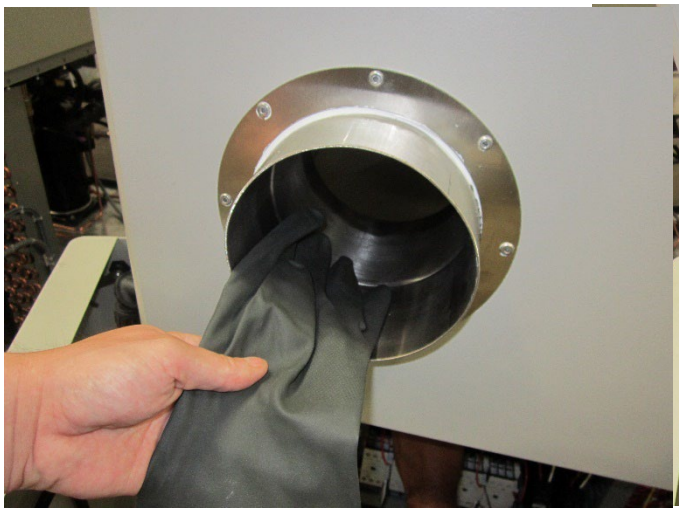
Figure 3-5: Air Supply Damper

*Note: CSZ is continuously upgrading the components used in its equipment. Consequently, the physical appearance of certain components may vary from that shown.*

## ATTACHING GLOVES (GLOVE PORT OPTION)

Procedure:

1. Slide the left hand glove into the left port. Leave approximately 3” (8cm) of the glove outside the port.



2. Pull the end of the glove over the port, all the way to the port collar.

3. Secure the glove with a 6” (15.25 cm) worm clamp. Over-tightening can cause clamp to cut rubber glove.

4. Repeat all steps for right glove.

*Note: CSZ is continuously upgrading the components used in its equipment. Consequently, the physical appearance of certain components may vary from that shown.*

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**WARNING**

Only **qualified maintenance personnel** should be permitted to perform any maintenance or installation procedures.

**WARNING**

Do not locate system in an area near flammable or toxic material. Failure to follow these instructions may result in serious personal injury.

**CAUTION**

In moving or relocating the chamber, never tip the unit more than 45 degrees without instructions from Cincinnati Sub-Zero.

**WARNING**

Maximum water inlet pressure is 10 PSI (69kPa) for an atomizer and 25 PSI (172 kPa) for a boiler. Exceeding this pressure may cause catastrophic failure of the filter housing.
For optimal use of the atomizer and boiler systems, inlet water pressure should not fall below 10 PSI (69 kPa) for both boilers and atomizers.

**NOTE**

Results may not be immediate, please wait several hours before continuing adjustments.

# CHAPTER 4: INSTALLATION

## PREPARATION FOR USE

1. Inspect all equipment for damage that may have occurred during shipment. **Contact Cincinnati Sub-Zero immediately if any shipping damage is noticed.**
2. Ensure that all packing materials have been removed from all parts.
3. Read this manual in its entirety.
4. Select a suitable location for chamber.
    a. A minimum clearance of 12” (31 cm) must be maintained for proper ventilation around the sides of the chamber. The rear of the chamber must have at least 30” (70 cm) of clearance for ventilation. If the unit has the optional up-blast enclosure, no additional clearance is required behind the unit. Water and electrical connections should be flexible and be at least 3 ft (92 cm) long so the unit can be serviced easily.
    b. The chamber must be installed in an environment of 75°F ±10°F (+23°C±6°C) with a maximum relative humidity of 95% for proper operation and a maximum elevation of 5000 ft (609.6m).
    c. Units give off between 6,000 (1.76 kw) and 50,000 BTU/HR (14.65 kw) of heat to the room, depending on the unit. There must be a means of removing this heat to keep the chamber environment within spec.
    d. Select a suitable location for the chamber. The location must be smooth and level with a maximum slope in any direction of 1/8” (3 mm) x 10’ (3 m).
    e. Unit lifting points are designated with forklift labels.
    f. Forks should extend passed the other side of the chamber to prevent damage.
    g. When transporting the chamber, it should be 2”-3” off the floor.
    h. The rear of the chamber is heavier than the front due to the location of the refrigeration compressors.
5. To Level Unit:
    a. Leveling feet have been provided at the front of the unit. A 1/2” (13 mm) open end wrench can be used to extend the leveling feet. The unit must be level or slightly tilted to the rear for proper water drainage in the chamber.
    b. If the door is binding, the hinge-side leveling foot must be extended approximately 1/4” (13 mm) higher than the latch-side leveling foot.

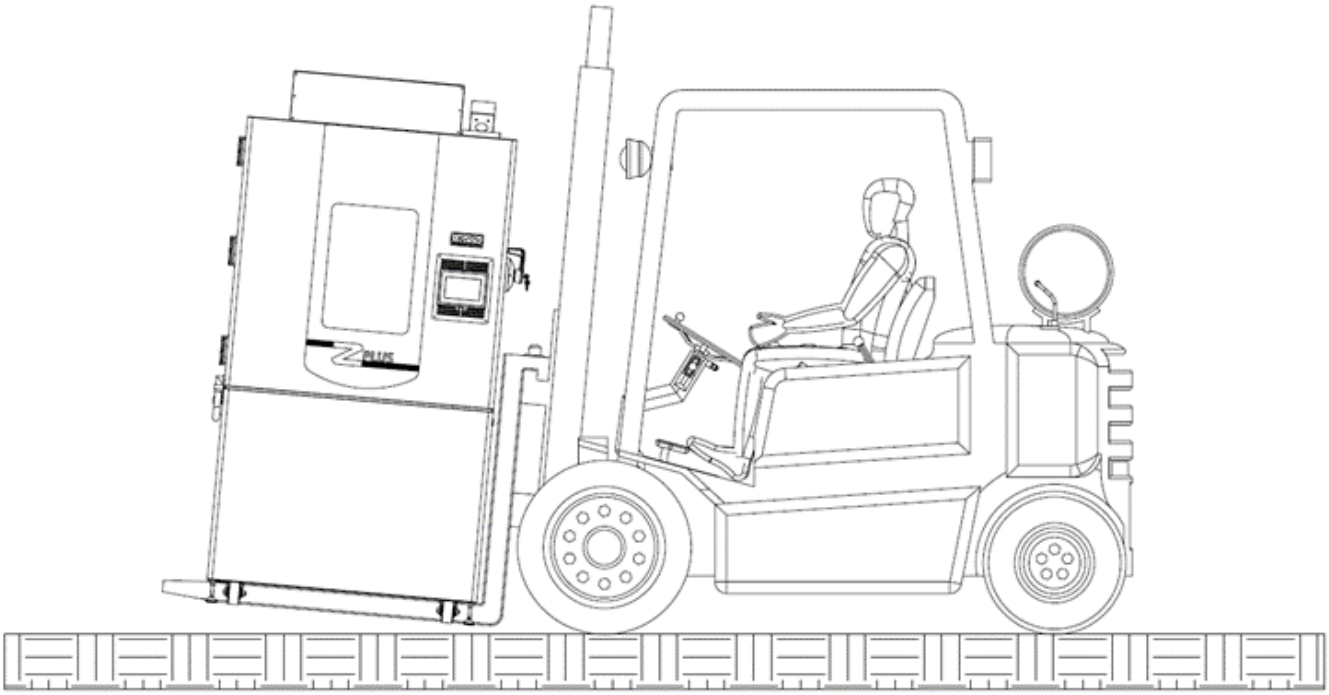

Figure 4-1: Transporting a Chamber

**NOTE**

Drawing above is for illustration purposes only. Not drawn to scale.

## MAIN POWER CONNECTION

**NOTE**

Electrical connections are terminated in the electrical panel. Route incoming power wires through the conduit located at the rear of the unit.

1. **Connect to the power source per electrical schematic.**
   The main power wiring must be connected per the NEC, CEC, and any applicable local and national codes or regulations. For installation, the chamber is a measurable category III piece of equipment. The unit can be cord connected or hard wired.

   A main power disconnect must be provided with a time delay fused switch or circuit breaker with ampere rating specified on the electrical schematic for the particular unit being connected. The switch or circuit breaker must remove power from all ungrounded conductors. (See GENERAL DESCRIPTION Tables 4-2 to 4-4 for ZP(H) live load Capacities) The main power disconnect must be suitably located and easily reached. Main power disconnects must be located near the chamber. The main power disconnect must be marked as the disconnecting device for the equipment. Please see electrical schematic for appropriate rating of your chamber model.

**WARNING**

If a main power disconnect is not provided, a suitably rated switch or circuit breaker must be included in the installation.

2. **Cord Connected**
   ZP(H) Units
   Use SO type cord sized appropriately for the load rating of the chamber. It should be installed with a cord grip and integral strain relief. For Non-CE marked chambers, it is recommended that the power plug be a twist-lock device to insure a solid electrical connection. For CE marked equipment, a suitably rated IEC60309 plug must be fitted to the cord.

3. **Hard Wired**
   ZP(H) Units
   Use a liquid tight metallic or nonmetallic flexible conduit. Power wires should be sized appropriately for the load rating of the chamber and rated at a minimum of 75°C. The 1/4 EMT conduit (35 mm metric conduit trade size) is equipped on the chamber as a conduit for power lines.

**WARNING**

All applicable local and national codes must be followed when providing power and protective earthing to your chamber.

4. **Grounding**
   Protective earth conductor must be sized appropriately and connected to the protective conductor terminal on the chamber's electrical sub panel. If main power disconnect is provided with the chamber, the protective conductor will connect to the provided terminal inside the main power disconnect. See your electrical schematic for information regarding earth connections.

   To change between 208V and 230V, locate the jumper between TB-1 terminals H3, 2L4 and H5. For 208V, place jumper between H3 and 2L4. For 230V operation, place jumper between 2L4 and H5. For more information, refer to note 1 on the electrical schematic located in the "Drawings" section of this manual.

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**CAUTION**

Do not make final connection to water inlet fitting on the chamber until any newly installed line has been flushed thoroughly to remove any pipe compound, metal chips, or foreign matter.

**NOTE**

A strainer (20 mesh) is recommended in the supply line for water cooled units.

## VOLTAGE CHANGE ON ZP CHAMBERS

Your chamber was configured prior to shipment for the particular voltage that was specified at the time of order. If applicable, these instructions should be used to change the input voltage from one configuration to another.

ZP-Series chambers with 1HP-2HP refrigeration systems can be set to run off 208V or 230V, 60 Hz., and 1 phase or 3 phase power. The change between 1 to 3 phase supply requires jumper changes on TB-1(main power terminal block) on the electrical sub-panel. The voltage change requires a jumper to be changed for the control transformer's primary voltage tap. The chambers come pre-configured for the voltage and phase specified upon order.

**1HP - 2HP 208-230V, 60 Hz Only**

**To switch from single phase to three phase power:** Remove the jumpers be-tween terminals 1L1, 1L3 and 1L2, 1L4 on TB-1. Place one jumper between terminals 1L3, 1L2. Connect main power leads as shown in Figure 1 for 3 phase connection.

**To switch from three phase to single phase power:** Remove the jumper between terminals 1L3, 1L2 on TB-1. Place one jumper between terminals 1L1, 1L3 and 1L2, 1L4. Connect main power leads as shown in Figure 2 and for single connection.

## REFRIGERATION SYSTEM PRESSURES

Check the system pressures using the refrigeration system pressure gauges.

If the R-508B (System 2) static pressure is more than 30 PSI (2 bar(g)) lower than that specified on the data plate, contact the CSZ Service Department. **DO NOT START.** If the R-404A (System 1 or Tundra) pressure is less than 100 PSI (6.9 bar(g)), contact the CSZ Service Department. **DO NOT START**.

## WATER COOLED UNITS (OPTIONAL)

If water cooled, provide and connect water supply and return lines to the inlet and outlet for the condenser. The line size should be equal to or larger than the inlet fitting provided on the chamber (See Water Usage Table).

Note: Water cooled systems can require up to a 40 PSI (275 kPa) differential pressure (supply pressure minus return pressure) on the water system (See PSID on chart). The water temperature provided to the unit will determine the flow rate. Some water-cooled units have strainers at the inlet connection. These should be cleaned periodically. On systems using a closed loop cooling water system with a pressurized return, supply pressure must be at least 40 PSI (275 kPa) (refer to chart) greater than return pressure. Maximum water pressure = 60 PSI (515 kPa).

| WATER TEMPERATURE | | | | 2-2-SC/WC | | 3.5-3.5-SC/WC | | 6-6-SC/WC | | REQUIRED FLUID PRESSURE DIFFERENTIAL | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | WATER FLOW RATE | | WATER FLOW RATE | | WATER FLOW RATE | | | |
| INLET | | OUTLET | | | | | | | | | |
| °F | °C | °F | °C | GPM | LPH | GPM | LPH | GPM | LPH | PSID | bar |
| 85.00 | 29.44 | 95.00 | 35.00 | 5.68 | 1,290.53 | 9.79 | 2,223.59 | 16.63 | 3,777.00 | 40.00 | 2.76 |
| 80.00 | 26.67 | | | 3.79 | 860.35 | 6.53 | 1,482.39 | 11.09 | 2,518.00 | 37.50 | 2.59 |
| 75.00 | 23.89 | | | 2.84 | 645.26 | 4.90 | 1,111.80 | 8.31 | 1,888.50 | 35.00 | 2.41 |
| 70.00 | 21.11 | | | 2.27 | 516.21 | 3.92 | 889.44 | 6.65 | 1,510.80 | 32.50 | 2.24 |
| 65.00 | 18.33 | | | 1.89 | 430.18 | 3.26 | 741.20 | 5.54 | 1,259.00 | 30.00 | 2.07 |
| 60.00 | 15.56 | | | 1.62 | 368.72 | 2.80 | 635.31 | 4.75 | 1,079.14 | 27.50 | 1.90 |
| 55.00 | 12.78 | | | 1.42 | 322.63 | 2.45 | 555.90 | 4.16 | 944.25 | 25.00 | 1.72 |
| 50.00 | 10.00 | | | 1.26 | 286.78 | 2.18 | 494.13 | 3.70 | 839.33 | 22.50 | 1.55 |
| 45.00 | 7.22 | | | 1.14 | 258.11 | 1.96 | 444.72 | 3.33 | 755.40 | 20.00 | 1.38 |
| **WATER HEAT LOAD (BTU/hr)** | | | | **28,450.50** | | **49,020.40** | | **83,266.30** | | | |
| **WATER CONNECTION (NPT)** | | | | **0.75"** | | **0.75"** | | **0.75"** | | | |

| WATER TEMPERATURE | | | | 10-10-SC/WC | | 15-15-SC/WC | | 17-17-SC/WC | | REQUIRED FLUID PRESSURE DIFFERENTIAL | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | WATER FLOW RATE | | WATER FLOW RATE | | WATER FLOW RATE | | | |
| INLET | | OUTLET | | | | | | | | | |
| °F | °C | °F | °C | GPM | LPH | GPM | LPH | GPM | LPH | PSID | bar |
| 85.00 | 29.44 | 95.00 | 35.00 | 26.64 | 6,050.72 | 41.10 | 9,334.21 | 55.91 | 12,698.32 | 40.00 | 2.76 |
| 80.00 | 26.67 | | | 17.76 | 4,033.81 | 27.40 | 6,222.81 | 37.27 | 8,465.54 | 37.50 | 2.59 |
| 75.00 | 23.89 | | | 13.32 | 3,025.36 | 20.55 | 4,667.10 | 27.95 | 6,349.16 | 35.00 | 2.41 |
| 70.00 | 21.11 | | | 10.66 | 2,420.29 | 16.44 | 3,733.68 | 22.36 | 5,079.33 | 32.50 | 2.24 |
| 65.00 | 18.33 | | | 8.88 | 2,016.91 | 13.70 | 3,111.40 | 18.64 | 4,232.77 | 30.00 | 2.07 |
| 60.00 | 15.56 | | | 7.61 | 1,728.78 | 11.74 | 2,666.92 | 15.97 | 3,628.09 | 27.50 | 1.90 |
| 55.00 | 12.78 | | | 6.66 | 1,512.68 | 10.27 | 2,333.55 | 13.98 | 3,174.58 | 25.00 | 1.72 |
| 50.00 | 10.00 | | | 5.92 | 1,344.60 | 9.13 | 2,074.27 | 12.42 | 2,821.85 | 22.50 | 1.55 |
| 45.00 | 7.22 | | | 5.33 | 1,210.14 | 8.22 | 1,866.84 | 11.18 | 2,539.66 | 20.00 | 1.38 |
| **WATER HEAT LOAD (BTU/hr)** | | | | **133,391.70** | | **205,778.30** | | **279,942.11** | | | |
| **WATER CONNECTION (NPT)** | | | | **1.00"** | | **1.00"** | | **1.00"** | | | |

Table 4-1: Cascade Water Usage

| WATER TEMPERATURE | | | | 20-20-S/WC | | 30-30-S/WC | | 40-40-S/WC | | REQUIRED FLUID PRESSURE DIFFERENTIAL | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| INLET | | OUTLET | | WATER FLOW RATE | | WATER FLOW RATE | | WATER FLOW RATE | | | |
| °F | °C | °F | °C | GPM | LPH | GPM | LPH | GPM | LPH | PSID | bar |
| 85.00 | 29.44 | 95.00 | 35.00 | 70.32 | 15,970.60 | 99.79 | 22,663.96 | 127.50 | 28,957.86 | 40.00 | 2.76 |
| 80.00 | 26.67 | | | 46.88 | 10,647.07 | 66.52 | 15,109.30 | 85.00 | 19,305.24 | 37.50 | 2.59 |
| 75.00 | 23.89 | | | 35.16 | 7,985.30 | 49.89 | 11,331.98 | 63.75 | 14,478.93 | 35.00 | 2.41 |
| 70.00 | 21.11 | | | 28.13 | 6,388.24 | 39.91 | 9,065.58 | 51.00 | 11,583.14 | 32.50 | 2.24 |
| 65.00 | 18.33 | | | 23.44 | 5,323.53 | 33.26 | 7,554.65 | 42.50 | 9,652.62 | 30.00 | 2.07 |
| 60.00 | 15.56 | | | 20.09 | 4,563.03 | 28.51 | 6,475.42 | 36.43 | 8,273.67 | 27.50 | 1.90 |
| 55.00 | 12.78 | | | 17.58 | 3,992.65 | 24.95 | 5,665.99 | 31.87 | 7,239.46 | 25.00 | 1.72 |
| 50.00 | 10.00 | | | 15.63 | 3,549.02 | 22.17 | 5,036.43 | 28.33 | 6,435.08 | 22.50 | 1.55 |
| 45.00 | 7.22 | | | 14.06 | 3,194.12 | 19.96 | 4,532.79 | 25.50 | 5,791.57 | 20.00 | 1.38 |
| **WATER HEAT LOAD (BTU/hr)** | | | | **352,081.60** | | **499,640.70** | | **638,393.60** | | | |
| **WATER CONNECTION (NPT)** | | | | **1.25"** | | **1.50"** | | **1.50"** | | | |

Table 4-1: Cascade Water Usage (Continued)

| WATER TEMPERATURE | | | | 2-SC/WC | | REQUIRED FLUID PRESSURE DIFFERENTIAL | |
|---|---|---|---|---|---|---|---|
| INLET | | OUTLET | | WATER FLOW RATE | | | |
| °F | °C | °F | °C | GPM | LPH | PSID | bar |
| 85.00 | 29.44 | 95.00 | 35.00 | 4.69 | 1,065.62 | 40.00 | 2.76 |
| 80.00 | 26.67 | | | 3.13 | 710.42 | 37.50 | 2.59 |
| 75.00 | 23.89 | | | 2.35 | 532.81 | 35.00 | 2.41 |
| 70.00 | 21.11 | | | 1.88 | 426.25 | 32.50 | 2.24 |
| 65.00 | 18.33 | | | 1.56 | 355.21 | 30.00 | 2.07 |
| 60.00 | 15.56 | | | 1.34 | 304.46 | 27.50 | 1.90 |
| 55.00 | 12.78 | | | 1.17 | 266.41 | 25.00 | 1.72 |
| 50.00 | 10.00 | | | 1.04 | 236.81 | 22.50 | 1.55 |
| 45.00 | 7.22 | | | 0.94 | 213.12 | 20.00 | 1.38 |
| **WATER HEAT LOAD (BTU/hr)** | | | | **23,492.30** | | | |
| **WATER CONNECTION (NPT)** | | | | **0.75"** | | | |

Table 4-2: Single Stage Water Usage

| WATER TEMPERATURE | | | | 2-SCT/WC | | 3.5-SCT/WC | | 6-SCT/WC | | REQUIRED FLUID PRESSURE DIFFERENTIAL | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| INLET | | OUTLET | | WATER FLOW RATE | | WATER FLOW RATE | | WATER FLOW RATE | | | |
| °F | °C | °F | °C | GPM | LPH | GPM | LPH | GPM | LPH | PSID | bar |
| 85.00 | 29.44 | 95.00 | 35.00 | 5.04 | 1,144.58 | 8.53 | 1,936.88 | 13.94 | 3,166.09 | 40.00 | 2.76 |
| 80.00 | 26.67 | | | 3.36 | 763.05 | 5.69 | 1,291.26 | 9.29 | 2,110.72 | 37.50 | 2.59 |
| 75.00 | 23.89 | | | 2.52 | 572.29 | 4.26 | 968.44 | 6.97 | 1,583.04 | 35.00 | 2.41 |
| 70.00 | 21.11 | | | 2.02 | 457.83 | 3.41 | 774.75 | 5.58 | 1,266.43 | 32.50 | 2.24 |
| 65.00 | 18.33 | | | 1.68 | 381.53 | 2.84 | 645.63 | 4.65 | 1,055.36 | 30.00 | 2.07 |
| 60.00 | 15.56 | | | 1.44 | 327.02 | 2.44 | 553.40 | 3.98 | 904.60 | 27.50 | 1.90 |
| 55.00 | 12.78 | | | 1.26 | 286.15 | 2.13 | 484.22 | 3.48 | 791.52 | 25.00 | 1.72 |
| 50.00 | 10.00 | | | 1.12 | 254.35 | 1.90 | 430.42 | 3.10 | 703.57 | 22.50 | 1.55 |
| 45.00 | 7.22 | | | 1.01 | 228.92 | 1.71 | 387.38 | 2.79 | 633.22 | 20.00 | 1.38 |
| **WATER HEAT LOAD (BTU/hr)** | | | | **25,233.00** | | **42,699.80** | | **69,798.30** | | | |
| **WATER CONNECTION (NPT)** | | | | **0.75"** | | **0.75"** | | **0.75"** | | | |

| WATER TEMPERATURE | | | | 10-SCT/WC | | 15-SCT/WC | | 17-SCT/WC | | REQUIRED FLUID PRESSURE DIFFERENTIAL | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| INLET | | OUTLET | | WATER FLOW RATE | | WATER FLOW RATE | | 80/20 WATER GLYCOL SOLUTION FLOW RATE | | | |
| °F | °C | °F | °C | GPM | LPH | GPM | LPH | GPM | LPH | PSID | bar |
| 85.00 | 29.44 | 95.00 | 35.00 | 20.71 | 4,704.46 | 33.03 | 7,502.82 | 46.74 | 10,615.20 | 40.00 | 2.76 |
| 80.00 | 26.67 | | | 13.81 | 3,136.31 | 22.02 | 5,001.88 | 31.16 | 7,076.80 | 37.50 | 2.59 |
| 75.00 | 23.89 | | | 10.36 | 2,352.23 | 16.52 | 3,751.41 | 23.37 | 5,307.60 | 35.00 | 2.41 |
| 70.00 | 21.11 | | | 8.29 | 1,881.78 | 13.21 | 3,001.13 | 18.69 | 4,246.08 | 32.50 | 2.24 |
| 65.00 | 18.33 | | | 6.90 | 1,568.15 | 11.01 | 2,500.94 | 15.58 | 3,538.40 | 30.00 | 2.07 |
| 60.00 | 15.56 | | | 5.92 | 1,344.13 | 9.44 | 2,143.66 | 13.35 | 3,032.91 | 27.50 | 1.90 |
| 55.00 | 12.78 | | | 5.18 | 1,176.12 | 8.26 | 1,875.70 | 11.68 | 2,653.80 | 25.00 | 1.72 |
| 50.00 | 10.00 | | | 4.60 | 1,045.44 | 7.34 | 1,667.29 | 10.39 | 2,358.93 | 22.50 | 1.55 |
| 45.00 | 7.22 | | | 4.14 | 940.89 | 6.61 | 1,500.56 | 9.35 | 2,123.04 | 20.00 | 1.38 |
| **WATER HEAT LOAD (BTU/hr)** | | | | **103,712.70** | | **165,404.20** | | **234,018.55** | | | |
| **WATER CONNECTION (NPT)** | | | | **1.00"** | | **1.00"** | | **1.00"** | | | |

Table 4-3: Tundra Water Usage

Cincinnati Sub-Zero

**CAUTION**

3.5 HP and larger scroll compressors are equipped with crank-case heaters. After connecting the power, the unit must sit 4 hours before start-up to properly heat-up.

**NOTE**

Do not connect the steam generator or cooling tower water to this system. These types of water have additives and will deplete the demineralizer in a short period. Use the purest water available.

**NOTE**

Humidity performance will be affected if live loads are placed in the chamber when trying to achieve certain humidity levels.

**WARNING**

Maximum water inlet pressure is 10 PSI (69kPa) for an atomizer and 25 PSI (172 kPa) for a boiler. Exceeding this pressure may cause catastrophic failure of the filter housing. For optimal use of the atomizer and boiler systems, inlet water pressure should not fall below 10 PSI (69 kPa) for both boilers and atomizers.

## SCROLL COMPRESSORS ONLY

Three phase scroll compressors (3.5, 6, 10 & 15HP) are rotation dependent. A phase monitor is installed on these units. If the phase monitor alarms, reverse any two leads on the incoming three phase power.

## HUMIDITY SYSTEM (OPTIONAL)

Prior to operating the humidity system check the following:

1. Unit is connected to proper voltage.
2. Water supply has been connected to the rear of the unit. Humidity water pressure should not exceed 10 PSI (69 kPa) for an atomizer and 25 PSI (172 kPa) for a boiler. For optimal use of the atomizer and boiler systems, inlet water pressure should not fall below 10 PSI (69 kPa) for both boilers and atomizers.

   Water has a resistance level of 0.05 to 2 Mega Ohms and <2mg/L of free chlorine. If not, the optional Demineralizer must be installed.
3. The chamber drain hose located in the compressor area should be drained to an external drain.
4. Water line compression fittings on humidity panel should be secure.
5. When starting up unit, the boiler will have to fill with water. Depending on the water pressure and flow rate, the low boiler water alarm could be tripped during this process. If so, reset to continue filling. If alarm continues to go off, call Cincinnati Sub-Zero.

## GN2 SYSTEM (OPTIONAL)

The GN2Purge system must be vented outdoors to prevent displacement of oxygen around the unit. Connect 4” cuff pressure relief vent to ventilation system. This is required for all units equipped with LN2/GN2 to prevent the displacement of oxygen around the unit. The GN2 Purge system should have a maximum supply of 25 PSIG.

**CAUTION**

Make sure that the rubber gaskets at each end are properly oriented before tightening the locking ring.

**WARNING**

Failure to maintain cartridge may result in chloride corrosion of stainless steel interior surfaces which is not covered under warranty.

## SEMI HERMETIC SPRING MOUNTED COMPRESSORS

If the unit has Semi-Hermetic spring mounted compressors, follow the following instructions prior to operating unit:

1. Loosen the upper nuts and washers until compressor floats on springs.
2. Discard the shipping spacers.
3. Allow 1/16 inch space between the upper mounting nut and rubber spacer. See Figure 4-2 below.

This should be the last step before startup so that the compressors remain protected until the chamber location is finalized, and installation is otherwise completed.

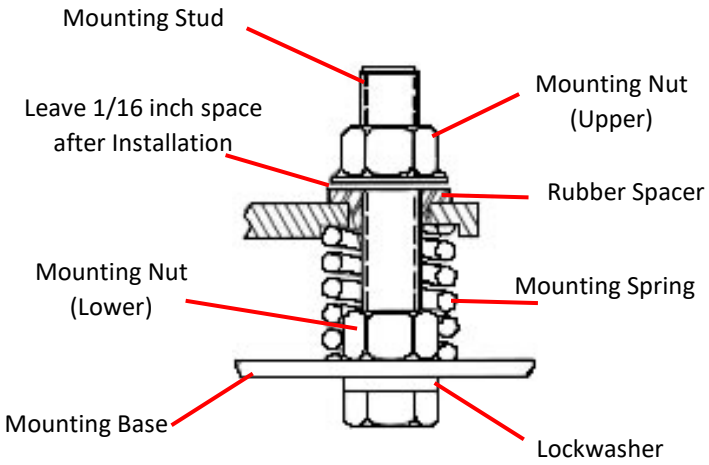


Figure 4-2: Semi Hermetic Spring Mounted Compressor

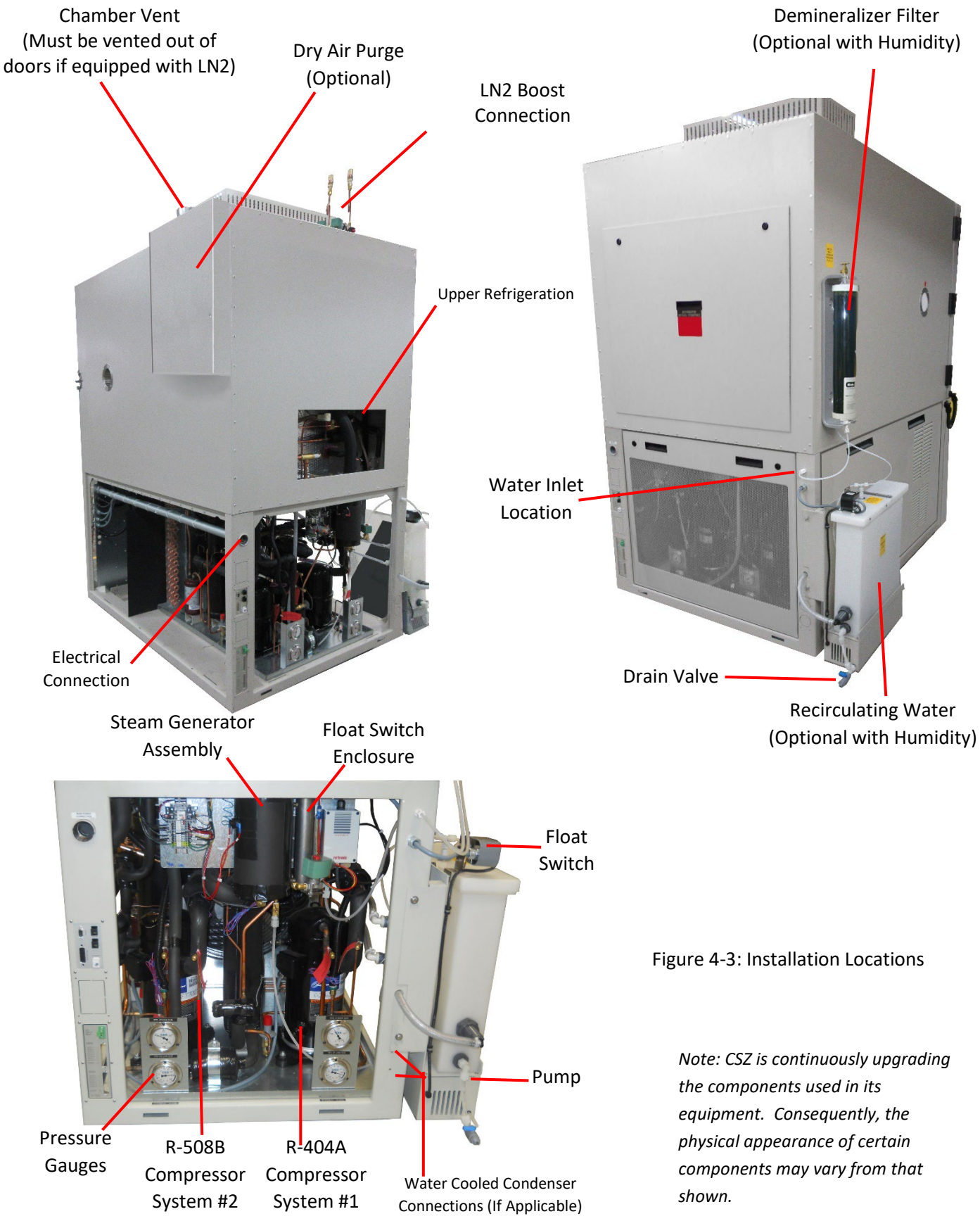


Figure 4-3: Installation Locations

*Note: CSZ is continuously upgrading the components used in its equipment. Consequently, the physical appearance of certain components may vary from that shown.*

# CHAPTER 5: MAINTENANCE WITH Q & A

**WARNING**

Only **qualified maintenance personnel** should be permitted to perform any maintenance or installation procedures.

**WARNING**

All loads must be removed from the chamber prior to transport and/or before maintenance and servicing.

## GENERAL MAINTENANCE

This chapter contains only general maintenance instructions that can be performed outside the factory. More detailed maintenance instructions may be found in the supplemental manuals included on the digital media in the manual binder that shipped with your unit, (and, if applicable, the booklets in the rear pocket). You may also contact the factory for instructions.

**WARNING: Only qualified maintenance personnel should be permitted to perform any maintenance procedures.**

## TEST EQUIPMENT REQUIRED

Table 5-1 is a list of the test equipment required to test and maintain the chamber. Equivalent equipment may be used.

| NOMENCLATURE | USE |
|---|---|
| Precision millivolt source | Millivolt source for use in calibrating analog inputs |
| Type "T" reference table | Reference table used for calibrating temperature inputs |
| Digital voltmeter | Measures voltage |
| Ammeter | Measures current |
| Two sets of manifold refrigeration gauges with charging hoses | Monitoring refrigeration system pressures and connecting purge/charge equipment to refrigeration system |
| One tank of HFC-404A (If Applicable) | Charging refrigeration system |
| One tank of R-410A (If Applicable) | Charging refrigeration system |
| One tank of R-508B (If Applicable) | Charging refrigeration system |
| One tank of R-23 (If Applicable) | Charging refrigeration system |
| Leak detector | Detecting leaks in refrigeration system |
| Ohmmeter | Continuity and resistance tests |
| Digital Clamp-on Ammeter | Reads current draw of electrical components including heaters, compressors, etc |

Table 5-1: Test Equipment Required

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**NOTE**

If any of the following scheduled inspections require maintenance, contact a qualified service technician or CSZ's Service department.

## INSPECTION SCHEDULE

In the daily operation of this equipment, you will become aware of certain levels of noise, vibration, temperature. and pressure. If you encounter any significant changes in these levels, investigate them immediately.

An inspection program should be developed for this equipment. To assist in your development of this program, Cincinnati Sub-Zero has prepared a list of routine inspections. While this list is not all inclusive, it will serve as a good base on which to build your own custom program. The establishment of such a program will add significantly to the life of the equipment and will reduce unscheduled down time on the equipment.

| INSPECT | DAILY | WEEKLY | MONTHLY | ANNUALLY |
|---|---|---|---|---|
| 1. Interior & Exterior Cleaning | X | | | |
| 2. Fluid Levels (If Applicable) | X | | | |
| 3. Gas Monitor (Optional Equipment) Water Filter | X | | | |
| 4. R-404A Charge (If Applicable) | | X | | |
| 5. R-410A Charge (If Applicable) | | X | | |
| 6. R-508B Stand-By Pressure (If Applicable) | | X | | |
| 7. R-23 Stand-By Pressure (If Applicable) | | X | | |
| 8. Compressor Oil Level | | X | | |
| 9. Humidity Demineralizer Filter (Optional Equipment) | | | X | |
| 10. Air Cooled Condenser (If Applicable) | | | X | |
| 11. Electrical Panel | | | X | |
| 12. Operating Currents | | | X | |
| 13. Check GFCI Receptacle (If Applicable) | | | X | |
| 14. Tubing Abrasion | | | X | |
| 15. Oil Pressure (Semi-Hermetic Compressors Only) | | | X | |
| 16. Humidity Sensor (If Applicable) | | | X | |
| 17. Product High/Low Limit | | | X | |
| 18. Water Strainer | | | | X |
| 19. Water Cooled Condenser (If Applicable) | | | | X |
| 20. Chamber Controller Calibration/Verification | | | | X |
| 21. Diaphragm, Air Compressor (Atomizer, Optional Equipment) | | | | X |
| 22. Lubricate Motors | | | | X |

Table 5-2: Inspection Schedule

**DAILY**

1. **Interior and Exterior Cleaning**
   a. Wipe or vacuum out all debris.
   b. Clean interior surfaces with a damp cloth, mild detergent, or stainless steel cleaner. Avoid cleaners that are abrasive or leave a residue. DO NOT use steel wool.
   c. Clean the chamber exterior and door gaskets with a damp cloth or a mild detergent. If a detergent is used, test a small area to make sure it does not damage the finish.

**WARNING**

Follow all OSHA and any other applicable legal, national and local codes, regulations, and guidelines for lockout/tagout when servicing the equipment. This includes a lockable disconnect switch. Failure to adhere to these guidelines may result in severe injury and/or death.

2. **Fluid Levels (If Applicable)**
   Check the fluid levels daily.
3. **Gas Monitor (Optional Equipment) Water Filter**
   If the chamber is equipped with a Gas Monitor, check the water accumulation levels daily. Empty when full as required. Failure to follow this procedure will result in damage to the Gas Monitor and is NOT covered under warranty.

**WEEKLY**

4. **R-404A Charge (If Applicable)**
   Check the sight glass for bubbles every 7 to 14 days. If bubbles are present, the unit is low on refrigerant. Call a qualified service technician to add refrigerant.

**WARNING**

Failure to empty the Gas Monitor Filter will damage the Gas Monitor and if NOT covered under warranty.

5. **R-410A Charge (If Applicable)**
   Check the sight glass for bubbles every 7 to 14 days. If bubbles are present, the unit is low on refrigerant. Call a qualified service technician to add refrigerant.
6. **System 2 (R-508B) Stand-By Pressure (If Applicable)**
   Check the pressure in the controller prior to starting the conditioning system. A discharge pressure reading lower than the standby pressure on the data plate could indicate a leak in the system. DO NOT START. To check the stand-by pressure, power off the unit. Let the unit stand for 24 hours (this will allow for full equalization). Check pressure reading on the gauges.
7. **System 2 (R-23) Stand-By Pressure (If Applicable)**
   Check the pressure in the controller prior to starting the conditioning system. A discharge pressure reading lower than the standby pressure on the data plate could indicate a leak in the system. DO NOT START. To check the stand-by pressure, power off the unit. Let the unit stand for 24 hours (this will allow for full equalization). Check pressure reading on the gauges.

**CAUTION**

Mineral Oil (3GS) does not mix with the P.O.E. oils. Therefore, any oil that is added to the compressors must be P.O.E. This oil attracts moisture much worse than mineral oil. Care should be taken to keep the oil enclosed at all times.

8. **Compressor Oil Level**
   There is an oil level indicator on scrolls and semi-hermetic compressors. The compressors are factory charged and the level should be checked periodically. Polyol Ester Oil (P.O.E.) is used in the R-404A, R-410A and R-508B/R-23 compressors. The brand name is Mobil EAL22. This oil was developed for the use with the new refrigerants.

9. **Humidity Demineralizer Filter (Optional Equipment)**
   The demineralizer filter should be replaced when the color change reaches 3" from the bottom of the filter. Damage will occur if the filter is not replaced when the color changes from dark blue to orange brown.

**MONTHLY**

10. **Air-Cooled Condenser (If Applicable)**
    Should be cleaned monthly with a vacuum. This period may be extended if operating conditions warrant. A dirty, clogged condenser can lead to excessive head pressure in the R-404A/R-410A system and can result in a loss of system efficiency and premature failure.

**WARNING**

**Voltages dangerous to life are present in this equipment.** Electrical service must be performed by qualified electricians only. Failure to follow these instructions may result in personal injury and/or loss of life.

11. **Electrical Panel**
    Check for components and wires which may vibrate loose during operation. Check for signs of contactor or relay arcing. Check to see that power and ground connections remain secure.

12. **Operating Current**
    Check the operating current of the compressors, heaters, circulator, and other components with an Ammeter. Maximum operating values are shown on the electrical schematic.

13. **Check GFCI Receptacle(s) (If Applicable)**
    Check per instructions on the receptacle. Location of the receptacle(s) is indicated on the electrical schematic.

14. **Tubing Abrasion**
    Check for evidence of friction wear on all refrigeration lines. Particular care should be taken in inspecting capillary tubes to pressure gauges/transducers. Check lines any time the system is shut down.

15. **Oil Pressure (Semi-Hermetic Compressors Only)**
    The oil pressure should run from 15 to 50 PSIG above the suction pressure of the compressor. A reading below 15 PSIG should be investigated immediately.

16. **Humidity Sensor**
    It is recommended to perform this routine maintenance monthly to avoid inaccurate readings. If you are having trouble achieving levels or if you can see dirt, sensor must be replaced. Do not attempt to clean the humidity sensor, as it can damage the product.

    Depending on the conditions of measurement, the dust filter should be checked from time to time. Corroded, discolored, or clogged filters should be replaced.

17. **Product High Limit (Check every 3 months)**
    Check for proper operation by lowering the setpoint and tripping the safety.

18. **Water Strainer (Water Cooled Units)**
    Check/Clean the water strainer (if equipped).

**ANNUALLY**

19. **Water-Cooled Condenser (If Applicable)**
    Annually check the condenser for buildup of scale on the condensing surface. This interval may need to be shortened if the buildup is of a substantial amount.

20. **Chamber Controller Calibration/Verification**
    Calibrate/Verify the chamber controller settings if all instruments in your facility are periodically calibrated to one device (metrology), or if a measurement system component fails. The calibration/verification procedure is located in the Controller Manual which accompanied your unit.

21. **Diaphragm, Air Compressor (Atomizer)**
    If chamber is equipped with an atomizer, the diaphragm in the air compressor should be checked for wear annually. If chamber runs high temperature (above 60°C) and high humidity levels (over 60%) the diaphragm may need to be replaced more frequently.

22. **Lubricate Motors (If Applicable)**
    If any of the motors have an oil or grease fitting, the proper lubricant should be applied. Contact the motor manufacturer or CSZ for the correct lubricant.

**NOTE**

Disassemble unit only to the extent required for inspection, repair, or testing.

## VISUAL INSPECTION

Visually inspect the chamber according to inspection procedures in Table 5-3.

| ITEM | INSPECT FOR |
|---|---|
| Chassis | Deformation, dents, punctures, badly worn surfaces, damaged connectors, damaged fastener, worn door gasket, devices, or damaged handles. Inspect for corrosion and damage to finish. |
| Electrical panel | Cracked, broken, or charred terminal insulation; case damage; body damage; loose, broken, or corroded terminal studs, lugs, or leads; lose, broken, or poorly soldered connections. Inspect for physical damage to forms and adjustment screws. |
| Port plugs | Check for port plugs sealing the port. |
| Metal Parts | Physical damage to mounting plates, chassis, brackets, nuts, bolts, screws, washers, handles, fasteners, and hardware. |
| Plastic parts | Signs of cracked or charred insulation, and loose or missing mounting hardware on plastic parts such as terminal boards, mounting blocks, and insulating members. Inspect for other abnormalities that might indicate future breakdown. |
| Wiring | Physical damage and charring on open and laced wiring of chassis, terminal boards, and parts of equipment, by checking insulation. Inspect wires for breakage and for improper dress. |

Table 5-3: Inspection Procedures

## TROUBLESHOOTING PROCEDURES

The corrective action procedures in this chapter should be performed if normal indications are not obtained. Before attempting any corrective action or troubleshooting procedures, always check cable connections for looseness or damage. Check test equipment switches for proper settings. Follow the corrective action steps suggested until the problem is corrected or determined to be non-repairable at your level. Contact Customer Service at (513)719-3300 between 7:30AM and 4:30PM Eastern Standard time, Monday through Friday for instructions if you are unable to repair the unit.

## SYSTEM TROUBLESHOOTING

When experiencing problems with system or unit operation, refer to the following tables for possible diagnoses and corrective actions. These tables are not intended to be all inclusive; however, they provide troubleshooting procedures for common problems with the unit. Refer to the manuals found in the Accessories folder on the digital media for further troubleshooting procedures not found here.

## GENERAL TROUBLESHOOTING PROCEDURES

| PROBLEM | PROBABLE CAUSE | CORRECTIVE ACTION |
|---|---|---|
| Compressor will not run | Conditioning system OFF | Turn ON conditioning system |
| | No electrical power | Check facility circuit breaker |
| | Wrong voltage applied to unit | Check voltage and correct |
| | Compressor internal overload tripped | Will automatically reset when cooled |
| | High/Low Limit tripped | Correct cause of limit condition, repair and reset |
| | Control alarm energized | |
| | Motor failure | Check winding resistance and lead to ground resistance |
| | Motor shorted | Replace compressor |
| | Circuit breaker may be tripped | Refer to section on Resetting a Circuit Breaker |
| Unit short cycles continuously | Gain setting too high | Decrease gain setting |
| | Proportional band setting to low | Increase proportional band setting |
| | Compressor low on refrigerant | Check refrigerant and charge if necessary |
| Compressor difficult to start | Wrong voltage applied to unit | Connect correct voltage |
| | Defective run/start capacitor(s) | Replace capacitor(s) |
| | Defective start relay | Replace start relay |
| | Refrigeration overcharge | Recover and recharge |
| High load amps | Low voltage | Check supply circuit |
| | Electrical malfunctions | Check for proper wiring and correct compressor capacitor<br><br>Check for grounds and measure winding resistance |
| | Defective start relay | Check and replace |
| Low Amps | Low refrigerant | Check for leaks; charge system |
| Insufficient cooling effect | Refrigerant shortage | Repair leak and recharge |
| | Frosted coil | Defrost and dry coil |
| | Low air circulation | Check fan blade and shaft. Blade may have come off |
| | Exceeding rated live load capacity (See data sheets) | Reduce live load |
| | Cooling coils obstructed | Remove obstruction or defrost |
| | TXV defective | Replace valve |
| | Solenoid coil burned out | Replace coil |
| | Solenoid valve bad | Replace valve |
| | Dirty condenser | Clean condenser |
| | R-404A compressor frosting | Possible leak in R-508B/R-23. Check ambient pressures |
| R-508B/R-23 Head Pressure too high | Refrigerant overcharge | Recover excess refrigerant |
| | Exceeding rated live load capacity (See data sheets) | Reduce live load |
| | Air in system | Recover, evacuate, and recharge. |
| | R-404A system short of gas | Repair leak and recharge |

Table 5-4: General Troubleshooting Procedures

## GENERAL TROUBLESHOOTING PROCEDURES

| PROBLEM | PROBABLE CAUSE | CORRECTIVE ACTION |
|---|---|---|
| R-508B/R-23 head pressure too low | Refrigerant shortage | Repair leak and recharge |
| R-404A head pressure too high | Condensing air too warm | Maximum condenser inlet air = 80°F |
| | Restricted air cooled condenser | Clean condenser |
| | Air in system | Recover, evacuate, and recharge |
| R-404A head pressure too low | Condensing air too cold | Location may need to be changed |
| | Low refrigerant charge | Repair leak and recharge |
| Noisy unit | Insufficient compressor oil | Consult Cincinnati Sub Zero |
| | Fan | Check blades |
| | Tubing rattle | Bend tubes away from contact |
| | Compressor mounting loose | Tighten |

Table 5-4: General Troubleshooting Procedures (Continued)

## HUMIDITY TROUBLESHOOTING PROCEDURES (OPTIONAL ATOMIZER)

| PROBLEM | PROBABLE CAUSE | CORRECTIVE ACTION |
|---|---|---|
| Humidity NOT reaching desired level<br><br>*Applies only to units with an atomizing humidity system. | Heater failure | Check heater and replace as required |
| | *Atomizing nozzle clogged | Remove and clean. Replace demineralizer filter if necessary |
| | Air pump not functioning | Check air pump |
| | *Filter/Strainer Clogged | Remove and clean |
| | Water is not connected to unit | Connect water |
| | Water control solenoid not energized | Check coil - replace if burned |
| | Dispersion tube is clogged | Remove and clean |
| | Chamber fan not functioning | Check fan circuit check fan blade for tightness on shaft |
| | Humidity switch not on | Turn switch on |
| | Demineralizer cartridge clogged internally | Replace cartridge |
| | Solid state sensor defective | Replace sensor unit |
| | *Water metering valve not adjusting properly | Adjust to 20.25 cubic centimeters |
| | Circuit breaker tripped | Reset breaker |
| | Defective heating element | Replace element |
| | Defective float switch | Replace float unit |
| | Dirty humidity sensor | See corresponding manufacturers manual in the Accessories folder for information |

Table 5-5: Humidity System Troubleshooting Procedures

## DRY AIR PURGE TROUBLESHOOTING PROCEDURES (OPTIONAL EQUIPMENT)

| PROBLEM | PROBABLE CAUSE | CORRECTIVE ACTION |
|---|---|---|
| Unit delivers moist air | Improper operating conditions | Change temperature and RH setpoint to be within recommended operating range for Dry Air Purge. |
| Moisture indicator is pink | Solenoid core spring not seated properly or is broken | Remove solenoid valve. Spring should be seated on core and not broken. Replace if necessary. |
| | Purge orifice plugged | Remove, inspect, and clean orifice. Use air gun to clean. Do not force wires through critically drilled holes. |
| | Solenoid coil burned out | Remove cover, place iron or steel material (screwdriver or nail) on exposed end of solenoid base to feel the magnetic effect indicating proper operation. Each coil should be energized for 30 seconds. Depress switch lever by hand and listen for clicking contact. Switch should click when depressed and when released. Replace if necessary. |
| | Improper cycle timer operation | Check the power supply. If the correct voltage is not present between L1 and both of the L2 terminals, check the wiring and protective device supplying power to the dryer. |
| | | Dryers with DC solenoid valves should alternately have DC voltage between L2 and DC1 and between L2 and DC2. Replace the timer if voltage is present at either DC terminal continuously or not at all. |
| | | Timer Input 120VAC/Timer Output 53 VDC |
| | | Timer Input 240 VAC/Timer Output 106 VDC |
| | | Timers P-06521-F1 and F2 are the standard timers used on the HF200, HF300A and HF300B air driers. The timers permit simultaneous switching of the solenoid valves every 30 seconds. |
| | Desiccant attrition or contamination | Inspect outlet air line for indication of excessive oil. |
| | | Check operation of dropout filter. |
| | | Remove chamber from manifold and depress perforated disc at open end of chamber. If it can be depressed more than 1/4" from the retaining ring, replace chamber. |
| | Water in Customer air supply lines | Find and correct problem |

Table 5-6: Dry Air Purge Troubleshooting Procedures

## DRY AIR PURGE TROUBLESHOOTING PROCEDURES (OPTIONAL EQUIPMENT)

| PROBLEM | PROBABLE CAUSE | CORRECTIVE ACTION |
|---|---|---|
| Excessive drop in outlet pressure | Improper operating conditions | Correct operating conditions |
| | Solenoid coil burned out | Remove cover, place iron or steel material (screwdriver or nail) on exposed end of solenoid base to feel the magnetic effect indicating proper operation. Each coil should be energized for 30 seconds. Depress switch lever by hand and listen for clicking contact. Switch should click when depressed and when released. Replace if necessary. |
| | Improper cycle timer operation | Check the power supply. If the correct voltage is not present between L1 and both of the L2 terminals, check the wiring and protective device supplying power to the dryer. |
| | | Dryers with DC solenoid valves should alternately have DC voltage between L2 and DC1 and between L2 and DC2. Replace the timer if voltage is present at either DC terminal continuously or not at all. |
| | | Timer Input 120VAC/Timer Output 53 VDC |
| | | Timer Input 240 VAC/Timer Output 106 VDC |
| | | Timers P-06521-F1 and F2 are the standard timers used on the HF200, HF300A and HF300B air driers. The timers permit simultaneous switching of the solenoid valves every 30 seconds. |
| | Check valve balls for proper seating | Remove check balls and springs and inspect for excessive wear or damage. Replace if necessary |
| | Plugged air passages | Check inlet and outlet air passages and piping for blockage. Correct if necessary. |
| | Desiccant attrition or contamination | Inspect outlet air line for indication of excessive oil. |
| | | Check operation of dropout filter. |
| | | Remove chamber from manifold and depress perforated disc at open end of chamber. If it can be depressed more than 1/4" from the retaining ring, replace chamber. |
| Solenoid valve chatter | Solenoid valve defective | Replace solenoid valve core assembly and solenoid base. |

Table 5-6: Dry Air Purge Troubleshooting Procedures (Continued)

## LN2 BOOST COOLING TROUBLESHOOTING PROCEDURES (OPTIONAL EQUIPMENT)

| PROBLEM | PROBABLE CAUSE | CORRECTIVE ACTION |
|---|---|---|
| No LN2 Flow | Check LN2 Supply | Is the LN2 Supply tank empty? |
| | Check solenoid valves | Are the solenoid valves opening? |
| | | Do the solenoid coils have power? They should have 120 VAC applied to the coil. |

Table 5-7: LN2 System Troubleshooting Procedures

**WARNING**

GN2/LN2 can displace oxygen and become a hazard in an enclosed area.

## GN2 SYSTEM TROUBLESHOOTING PROCEDURES (OPTIONAL EQUIPMENT)

| PROBLEM | PROBABLE CAUSE | CORRECTIVE ACTION |
|---|---|---|
| Unit doesn't reach low humidity setpoint | Solenoid core spring not seated properly or is broken | Remove solenoid valve. Spring should be seated on core and not broken. Replace if necessary. |
| | Solenoid coil burned out | Remove cover, place iron or steel material (screwdriver or nail) on exposed end of solenoid base to feel the magnetic effect indicating proper operation. Each coil should be energized for 30 seconds. Depress switch lever by hand and listen for clicking contact. Switch should click when depressed and when released. Replace if necessary. |
| Excessive drop in outlet pressure | Solenoid coil burned out | Remove cover, place iron or steel material (screwdriver or nail) on exposed end of solenoid base to feel the magnetic effect indicating proper operation. Each coil should be energized for 30 seconds. Depress switch lever by hand and listen for clicking contact. Switch should click when depressed and when released. Replace if necessary. |
| Solenoid valve chatter | Solenoid valve defective | Replace solenoid valve core assembly and solenoid base. |

Table 5-8: GN2 Troubleshooting Procedures

## FROZEN COIL TROUBLESHOOTING PROCEDURES (OPTIONAL EQUIPMENT)

| PROBLEM | PROBABLE CAUSE | CORRECTIVE ACTION |
|---|---|---|
| Coil not freezing water | Frozen Coil Mode not engaged | Dewpoint not low enough, let wet coil remove moisture before unit enters frozen coil mode |
| | Solenoid valve not working | Check liquid line solenoid (Frozen Coil) |
| | | Check EPR bypass solenoid. Do they have power? |
| | Frozen Coil T.E.V. out of adjustment | Adjust T.E.V. to increase superheat |
| | | Verify Frozen Coil is turned on by the event and/or switch on the control panel |

Table 5-9: Frozen Coil Troubleshooting Procedures

## HIGH/LOW LIMIT CONTROL TROUBLESHOOTING PROCEDURES

| PROBLEM | PROBABLE CAUSE | CORRECTIVE ACTION |
|---|---|---|
| No display on control panel | AC unit is not connected, or is connected improperly | Check AC input connections and correct if necessary. If connections are correct and the there is still no display, contact CSZ's Service Department. |
| Display indicates "- . . ." and yellow LO LIMIT LED is ON. | Solenoid coil burned out | Repair or replace the thermocouple |
| Display error | Sensor is connected improperly | Check sensor locations, connections, and sensing element. Repair or replace sensor as required |
| | | Place jumper wire across thermocouple terminals. Indicator is functioning properly if display indicates room temperature |
| Display indicates "-000" and flashes | Jumper W8 for °F/°C selection is not installed or is installed improperly | Install Jumper W8 in desired location for °F or °C |
| Control is in a LO or HI LIMIT condition and cannot be reset | Actual temperature is below low limit setpoint or above high limit setpoint | Check low limit and high limit setpoints. If actual temperature is not between low and high limit setpoints, it cannot be reset, though alarm can be silenced |
| | | If external reset switch is used, check wiring of external reset switch |
| LO or HI LIMIT temperature does not appear accurate | Calibration adjustments incorrect | Perform field calibration procedure. |

Table 5-10: High/Low Limit Control Troubleshooting Procedures

| SATURATED TEMPERATURE/PRESSURE CHART | | | | |
|---|---|---|---|---|
| TEMP. | GAUGE PRESSURE (P.S.I.G.) | | | |
| °F | R-404A | R-410A | R-23 | R-508B |
| -130 | 28.0* | - | 11.4* | 3.8* |
| -125 | 27.5* | - | 7.9* | 0.4 |
| -120 | 27.0* | - | 3.9* | 2.9 |
| -115 | 26.1* | - | 0.3* | 5.9 |
| -110 | 25.5* | - | 2.9 | 9.2 |
| -105 | 24.6* | - | 5.7 | 12.8 |
| -100 | 23.5* | - | 9.0 | 16.8 |
| -95 | 22.3* | - | 12.7 | 21.4 |
| -90 | 20.9* | - | 16.7 | 26.3 |
| -85 | 19.2* | - | 21.3 | 31.8 |
| -80 | 17.5* | 12.0* | 26.3 | 37.8 |
| -75 | 15.2* | 10.2* | 32.0 | 44.3 |
| -70 | 12.8* | 7.0* | 38.0 | 51.5 |
| -65 | 10.1* | 3.4* | 44.7 | 59.3 |
| -60 | 7.0* | 0.3 | 52.0 | 67.7 |
| -55 | 3.6* | 2.5 | 60.0 | 76.9 |
| -50 | 0.2 | 5.0 | 68.7 | 86.8 |
| -45 | 2.2 | 7.8 | 78.1 | 97.5 |
| -40 | 4.5 | 10.8 | 88.3 | 109.0 |
| -35 | 7.0 | 14.2 | 99.4 | 121.3 |
| -30 | 9.8 | 17.8 | 111.3 | 134.6 |
| -25 | 12.9 | 21.9 | 124.0 | 148.8 |
| -20 | 16.2 | 26.3 | 137.8 | 164.0 |
| -15 | 19.9 | 31.2 | 152.5 | 180.2 |
| -10 | 23.8 | 36.4 | 168.2 | 197.5 |
| -5 | 28.1 | 42.2 | 185.1 | 215.8 |
| 0 | 32.8 | 48.2 | 202.9 | 235.3 |
| 5 | 37.8 | 55.1 | 221.1 | 256.0 |
| 10 | 43.3 | 62.1 | 242.4 | 277.9 |
| 15 | 49.1 | 70.1 | 264.0 | 301.2 |
| 20 | 55.4 | 78.2 | 286.9 | 325.7 |
| 25 | 62.2 | 87.5 | 311.3 | 351.6 |
| 30 | 69.4 | 96.8 | 337.1 | 378.9 |
| 35 | 77.2 | 107.5 | 364.5 | 407.7 |
| 40 | 85.5 | 118.0 | 393.6 | 438.0 |
| 45 | 94.3 | 130.2 | 424.4 | 469.9 |
| 50 | 113.7 | 142.0 | 457.1 | 503.5 |
| 55 | 115.7 | 156.0 | 491.7 | 538.7 |
| 60 | 124.3 | 170.0 | 528.5 | Critical |
| 65 | 135.6 | 185.2 | 567.5 | Pressure |
| 70 | 147.5 | 200.0 | 608.9 | |
| 75 | 160.1 | 218.0 | 652.9 | |
| 80 | 173.5 | 235.0 | Critical | |
| 85 | 187.6 | 254.0 | Pressure | |
| 90 | 202.4 | 274.0 | | |
| 95 | 218.1 | 295.0 | | |
| 100 | 234.6 | 317.0 | | |
| 105 | 252.0 | 340.0 | | |
| 110 | 270.3 | 364.0 | | |
| 115 | 289.5 | 390.0 | | |
| 120 | 309.6 | 417.0 | | |
| 125 | 330.8 | 445.0 | | |
| 130 | 352.9 | 475.0 | | |
| 135 | 376.1 | 506.0 | | |
| 140 | 400.5 | 538.0 | | |

*inches of mercury below one atmosphere

Cincinnati Sub-Zero

| SATURATED TEMPERATURE/PRESSURE CHART | | | | |
|---|---|---|---|---|
| TEMP. | GAUGE PRESSURE (P.S.I.G.) | | | |
| °C | HFC | HFC | HFC | HFC/PFC |
| | R-404A | R-410A | R-23 | R-508B |
| -90.0 | - | - | 11.5* | 3.9* |
| -87.2 | - | - | 8.0* | 0.0 |
| -84.4 | - | - | 4.0* | 0.2 |
| -81.7 | - | - | 0.0 | 0.4 |
| -78.9 | - | - | 0.2 | 0.6 |
| -76.1 | - | - | 0.4 | 0.9 |
| -73.3 | - | - | 0.6 | 1.1 |
| -70.6 | - | - | 0.9 | 1.5 |
| -67.8 | - | - | 1.2 | 1.8 |
| -65.0 | - | - | 1.5 | 2.2 |
| -62.2 | 16.9* | 13.2* | 1.8 | 2.6 |
| -59.4 | 14.8* | 10.4* | 2.2 | 3.0 |
| -56.7 | 12.3* | 7.2* | 2.6 | 3.5 |
| -53.9 | 9.5* | 3.5* | 3.1 | 4.1 |
| -51.1 | 6.4* | 0.0 | 3.6 | 4.6 |
| -48.3 | 2.9* | 0.2 | 4.1 | 5.3 |
| -45.6 | 0.0 | 0.3 | 4.7 | 6.0 |
| -42.8 | 0.2 | 0.5 | 5.4 | 6.7 |
| -40.0 | 0.3 | 0.7 | 6.1 | 7.5 |
| -37.2 | 0.5 | 1.0 | 6.8 | 8.4 |
| -34.4 | 0.7 | 1.2 | 7.6 | 9.3 |
| -31.7 | 0.9 | 1.5 | 8.5 | 10.3 |
| -28.9 | 1.2 | 1.8 | 9.4 | 11.3 |
| -26.1 | 1.4 | 2.2 | 10.5 | 12.5 |
| -23.3 | 1.7 | 2.5 | 11.5 | 13.7 |
| -20.6 | 2.0 | 2.9 | 12.7 | 14.9 |
| -17.8 | 2.3 | 3.3 | 13.9 | 16.3 |
| -15.0 | 2.7 | 3.8 | 15.3 | 17.8 |
| -12.2 | 3.1 | 4.3 | 16.7 | 19.3 |
| -9.4 | 3.5 | 4.8 | 18.2 | 20.9 |
| -6.7 | 3.9 | 5.4 | 19.7 | 22.7 |
| -3.9 | 4.4 | 6.0 | 21.4 | 24.5 |
| -1.1 | 4.9 | 6.7 | 23.2 | 26.5 |
| 1.7 | 5.4 | 7.4 | 25.1 | 28.5 |
| 4.4 | 6.0 | 8.2 | 27.1 | 30.7 |
| 7.2 | 6.6 | 9.0 | 29.2 | 33.1 |
| 10.0 | 7.3 | 9.9 | 31.4 | 35.6 |
| 12.8 | 8.0 | 10.8 | 33.8 | 36.7 |
| 15.6 | 8.7 | 11.8 | 36.3 | Critical |
| 18.3 | 9.5 | 12.8 | 38.9 | Pressure |
| 21.1 | 10.3 | 13.9 | 41.7 | |
| 23.9 | 11.2 | 15.1 | 44.7 | |
| 26.7 | 12.1 | 16.3 | Critical | |
| 29.4 | 13.1 | 17.6 | Pressure | |
| 32.2 | 14.1 | 19.0 | | |
| 35.0 | 15.2 | 20.4 | | |
| 37.8 | 16.3 | 22.0 | | |
| 40.6 | 17.5 | 23.6 | | |
| 43.3 | 18.8 | 25.3 | | |
| 46.1 | 20.1 | 27.1 | | |
| 48.9 | 21.5 | 28.9 | | |
| 51.7 | 23.0 | 30.9 | | |
| 54.4 | 24.5 | 33.0 | | |
| 57.2 | 26.1 | 35.1 | | |
| 60.0 | 27.8 | 37.4 | | |
| *inches of mercury below one atmosphere | | | | |

## PFC REFRIGERANTS

**(Only applicable to chambers using refrigerant R-508B)**

This equipment contains the refrigerant SUVA® 95 (R-508B) in the low side system. SUVA® 95 is chlorine-free and meets all EPA regulations for ozone-safe refrigerants. It has also been established that SUVA® 95, a PFC, has a long atmospheric lifetime and therefore, emissions of this refrigerant should be minimized. Cincinnati Sub-Zero Products, LLC recommends that SUVA® 95 should never be discharged to the atmosphere, and that servicing of your equipment should be performed by those persons certified to work on this type of refrigerant system.

Specifically, we recommend the following maintenance instructions:

1. Implement practices to recover, reclaim, recycle, or destroy the PFC refrigerants during equipment servicing and upon the retirement of the equipment.
2. Reduce or contain to a minimum the emission of PFC refrigerant during normal operation, maintenance, manufacture, or installation of systems; and ensure that the annual leakage from systems containing PFC refrigerants will not exceed 25% of the system charge in the previous year. On July 1, 1997, the maximum allowable annual leakage will be reduced to 20%.

   If you have any questions about refrigerants, please call Cincinnati Sub Zero and speak with our Manager of Application Engineering.

## RESETTING A CIRCUIT BREAKER

If the unit fails to operate properly, or fan or compressors do not operate, a circuit breaker may have opened due to an overload condition. To reset the breaker, disconnect main power from the unit and access the electrical sub-panel by removing the cover on the front of the unit. The circuit breakers are labeled as shown on the electrical schematic. Switch the circuit breaker to the off position and then turn it back on. The cause of the trip should be investigated so further trips are avoided.

CAUTION

The demineralizer filter should be replaced when the color change reaches 3" from the bottom of the cartridge. Damage will occur if the cartridge is not replaced when the color changes from dark blue to orange-brown.

CAUTION

Make sure that the rubber gaskets at each end are properly oriented before tightening the locking ring.

NOTE

Water Pressure should not exceed 10 PSI when unit is equipped with an atomizer. For optimal operation of the atomizer system, inlet water pressure should not fall below 10PSI (69 kPa).

CAUTION

Do not over-tighten compression fittings

# HUMIDITY SYSTEM MAINTENANCE

1. The standard steam generator requires no maintenance under normal use.

2. The outer casing of the demineralizer filter is transparent, and the crystals are visible. A new cartridge is violet or dark blue when water flows through it. A spent cartridge will turn brown, orange, yellow, or white. The cartridge should be changed before it completely changes color. Spare cartridges are available through the Cincinnati Sub-Zero Service Department.

## CHANGING THE CARTRIDGE

1. To change the demineralizer filter cartridge, close the valve, and loosen the large, white-locking ring on the bottom of the cartridge and rack. This will reduce the pressure on the cartridge. Push the cartridge straight up and pull the lower part of the cartridge out. Reverse the operation when replacing the cartridge. SEE CAUTION.

2. Check the compression fittings on the humidity panel periodically for tightness.

## REMOVING THE ATOMIZING NOZZLE (FLUID CAP)

## (If Equipped with Atomizer System Option)

1. Turn off the unit power.
2. Disconnect the recirculating water.
3. Open the humidity side pack cover.
4. Locate square plate with two compression fittings.
5. Remove the plate with the nozzle assembly attached.
6. Remove the retainer ring at the end of the nozzle assembly.
7. Gently pull the air cap from the fluid cap.
8. Remove the fluid cap from the body of the nozzle.

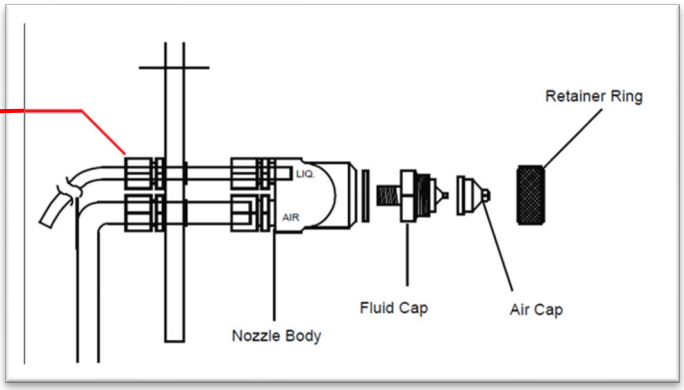


Figure 5-1: Atomizing Nozzle Components

**NOTE**

On humidity units, a water atomizing nozzle is used to create humidity. With clean water, the nozzle and filter should be cleaned every three months or 500 hours of use, whichever comes first. If clean water is not available, please install a pre-filter (40 micron) at the inlet. Please refer to the cleaning procedure described above.

**NOTE**

On units with a recirculating water option, drain and clean reservoir every two months or sooner as required by usage and water conditions.

**NOTE**

When using a separate handheld humidity sensor for checking humidity readings in the chamber, the probe must be given at least 1 hour to stabilize within the chamber after insertion. Also be aware that the error of the chamber probe and error of the handheld must be taken into consideration when comparing readings. If the chamber probe has an accuracy of + or - 3% and the handheld has an accuracy of + or - 2%, the reading can be off by as much as 5% and still be accurate.

## CLEANING THE ATOMIZING NOZZLE (FLUID CAP)

1. To clean, you will need a 12" (31 cm) piece of stranded electrical wire.
2. Strip back 4" (11 cm) of the wire at one end and 1" (3 cm) of the wire at the opposite end.
3. Use the 4" (11 cm) section of the wire and separate one strand to clean the end of the fluid cap.
4. Use the 1" (3 cm) section of the wire to clean the other end of the fluid cap.
5. Blow out the fluid cap with compressed air and reassemble.

## MAINTAINING THE HUMIDITY SENSOR

Please refer to the Vaisala manufacturer's manual for maintenance and calibration information regarding the humidity sensor and its components.

Be aware that there is an allowable tolerance for humidity readings:

1. < 90% + or -2% and > 90% + or -3% for the sensors within the chambers.
2. Handheld accuracy is typically + or -2% for quality instruments.

   The recommended interval for calibration is at least once a year. It is also recommended to calibrate the sensor if it is not operating within its stated accuracy limits.

**CAUTION**

The filter on the end of the humidity sensor must be in place for the sensor to operate properly. Operating the sensor without the filter will damage the instrument.

Cincinnati Sub-Zero

**CAUTION**

Water specification 0.05 to 2 Mega OHMS in addition to <2mg/L of free chlorine.

## WATER QUALITY

Purified water is recommended for use with our humidity systems. Water should be provided within 0.05 to 2M (.25 to 10ppm) DI and <2mg/L of free chlorine, Distilled water or Reverse Osmosis (RO) water outside of these limits may cause either corrosion or scaling. Tap water may be used with our optional Demineralizer Filtration System. A Recirculation Humidity Water Supply System is also available. Inlet water pressure should not exceed 10 PSI for use with an atomizer or 25 PSI for use with a boiler. For optimal use of the atomizer and boiler systems, inlet water pressure should not fall below 10 PSI (69 kPa) for both boilers and atomizers. A Water Pressure Regulator must be used.

**WARNING**

Maximum water inlet pressure is 10 PSI (69kPa) for an atomizer and 25 PSI (172 kPa) for a boiler. Exceeding this pressure may cause catastrophic failure of the filter housing.

For optimal use of the atomizer and boiler systems, inlet water pressure should not fall below 10 PSI (69 kPa) for both boilers and atomizers.

**WARNING**

Failure to maintain cartridge may result in chloride corrosion of stainless steel interior surfaces, which is not covered under warranty.

## QUESTIONS & ANSWERS

**The input voltage label says 230 VAC (or 208 VAC). I thought I had 220 VAC. Is that OK?**

208V and 230V are NOT the same. 220V is a misnomer in the United States—there is no such standard as nominal 220V in the United States though 220V does exist in Europe. You must verify the exact type of electrical service you have. If there is any doubt, you must consult with a qualified electrician who is familiar with industrial plant wiring. In addition, the input line voltage should be measured while the chamber is operating in the COOL mode to ensure that the expected nominal voltage of either 208V ±5% or 230V ±5% is present.

**Why doesn't the chamber come with a power cord and plug?**

Most local and national electrical codes require permanent wiring for this type of equipment. If used as a portable device, a flexible wire with a plug may be acceptable, but local and national codes may limit the length to 6 feet. Cincinnati Sub-Zero recommends that the appropriate method for your installation be determined by a qualified electrician who is familiar with industrial plant wiring.

**Why does my chamber heat or cool slower than the published specifications?**

Performance is significantly affected by the characteristics of your test sample. Factors include size, weight, material, shape, and power dissipation if energized. The test sample should be placed in the chamber in a manner that allows for air circulation. You should not place the test sample directly on the chamber floor. It should be placed on the shelf. Multiple test samples should be distributed throughout the chamber to ensure even airflow and minimize temperature gradients. If necessary, additional shelves should be used to evenly distribute the load.

**How can I modify the chamber to cool faster?**

Unfortunately, there is little you can do to improve upon the designed-in performance. Cincinnati Sub-Zero does offer an LN2 boost package that can be installed in the field to increase cooling performance.

**Why is there water/ice/snow in the chamber?**

Any time the ambient air is subjected to temperatures below the dewpoint, moisture will condense out of the air. The effect is ice or frost during low temperature operation. When the chamber is heated above 0°C, the ice or frost will turn into water. To avoid moisture condensation, make sure the port plugs are inserted at all times. Also, avoid opening the chamber door while the chamber is operating at temperatures below room ambient. When a low temperature test is completed, warm the chamber to at least room ambient before opening the chamber door and before removing your test sample.

**How accurate is the chamber?**
That's a loaded question! There is no "chamber accuracy" specification as such. The answer requires an understanding of several performance parameters.

> **Control Tolerance** – The control sensor is located in the discharge airflow. Control tolerance is a measure of how much the temperature varies after stabilization at the control sensor. It is a measure of the relative variations, NOT the absolute accuracy of the readout. The control tolerance specification for this chamber is ±0.5°C, or a total of 1°C. For example, the temperature set point may be -65.0°C. The actual temperature varies between -64.5°C and -65.5°C. These specifications are for an empty chamber. The addition of a test sample may affect the control variations. In some instances, the test sample will reduce these variations.
>
> **Uniformity** – Also known as Gradients. This is a measure of variations in temperature at different locations throughout the chamber interior, at the same time, after stabilization. The uniformity specification can vary for each chamber. These specifications are for an empty chamber. The addition of a test sample may affect the temperature uniformity. For example, an energized test sample will produce a higher temperature near the sample. For more specific uniformity information, please contact CSZ.

**Why do I smell something when I operate the chamber for the first time at high temperatures?**
Cincinnati Sub-Zero chambers are cleaned and polished before leaving the factory. Stainless steel polish can give off an odor while at elevated temperatures. This is a temporary condition and is non-toxic.

**I'm not going to use the chamber for a while. Is there anything I should do before storage?**
Perform ALL the steps in the Preventive Maintenance Schedule before placing the chamber into storage. This will ensure that the chamber will be ready to operate when taken out of storage. If the chamber has a problem and is still under warranty, these problems should be resolved before being placed into storage, since the warranty period starts from the date of shipment. The chamber should be stored in a conditioned environment. Do not store it outside or where it will be subjected to dirt or excessive moisture.

**I haven't used the chamber in a while. Is there anything I should do before operation?**
Perform ALL the steps in the Preventive Maintenance Schedule before placing the chamber back into service. This will ensure that nothing has been damaged and that a leak has not developed.

**Can the person who services our air conditioning also service the chamber?**
Probably not. Most air conditioning mechanics are not familiar with low-temperature cascade refrigeration systems. While this chamber is relatively easy to maintain and repair, most air conditioning mechanics do not have the necessary refrigerants and may not be familiar with the microprocessor-based controls. This chamber should only be serviced by a qualified mechanic that is familiar with low-temperature cascade refrigeration systems. Call Cincinnati Sub-Zero to recommend one in your area, or to check if the one you would like to use is qualified.

**I need to send the chamber to Europe/Asia. Will it work with their power?**
Europe and Asia generally have 50 Hz power. Standard voltages in Europe are typically 220V to 240V, while parts of Asia may be 200V. Operation at 220V to 240V/ 50 Hz requires bucking transformers to lower the voltage to the compressors to 200V. These transformers are available from Cincinnati Sub-Zero for a reasonable cost and are easy to install in the field. Note that the cooling performance will be slightly reduced at 50 Hz. Please call Cincinnati Sub-Zero for details on re-configuring for 50 Hz. operation.

**How often should I charge the refrigeration system?**
This chamber uses a closed-loop refrigeration system. Just like your refrigerator at home, it does not need periodic charging. If the charge is low, this means that there is a leak. Leaks should be repaired before recharging.

**What kind of Freon does the chamber use?**
The word Freon® is a DuPont registered trade name for their CFC-based refrigerants and is incorrectly used as a generic term for refrigerants. Cincinnati Sub-Zero chambers do not use CFC-based refrigerants. The high-stage system uses R-404A, which is also known as DuPont Suva® HP62. The low-stage system uses R-508B, which is also known as DuPont Suva® 95. Tundra units use R-410A, also known as Puron and Suva® 9100.

**My static pressure is lower than the data plate specification. Is this an indication of a leak in my refrigeration system?**
This does not always mean that there is a leak. Ozone friendly refrigerants use P.O.E. oil, which has the ability to absorb refrigerant to the point of actually causing a lower pressure reading. A decrease in the chamber's performance along with lower pressure readings is a possible indicator of a leak. (Please contact Cincinnati Sub-Zero if this occurs).

**What is the hissing and clicking sound when my unit is at or approaching set point?**
This is normal. The sounds are caused by the solenoid valves alternating between cooling and bypass modes.

**Sometimes I see bubbles in the 404A sight glass. Does this mean my chamber has a leak in it or is undercharged?**
This does not necessarily mean that the unit is undercharged or has a leak. Under certain conditions, it is possible to see bubbles in the sight glass. Contact Cincinnati Sub-Zero if you have any questions.

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## HOW TO CONTACT CSZ

Cincinnati Sub-Zero Products
12011 Mosteller Road
Cincinnati, OH 45241

| | |
|---|---|
| Telephone (Main) | 1-513-326-5252 |
| Toll Free (North America) | 1-877-233-9871 |
| Service & Parts | 1-513-719-3300 |
| Fax | 1-513-326-5258 |
| Internet | http://www.cszproducts.com |

## HOW TO OBTAIN REPLACEMENT PARTS / PARTS ORDERING PROCEDURE

If a part fails and must be returned to Cincinnati Sub-Zero Products for repair or replacement under the terms of the warranty, follow the procedure below.

1. Contact our **Service Department at (513) 719-3300** from 7:30 AM to 5:30 PM (Eastern Time Zone).

   For overnight shipments, the Service Department must be contacted ***BEFORE*** 2:00 PM (Eastern Time Zone).

   You may submit your request online at: http://www.cszindustrial.com/Contact/Service-Request.aspx

2. To order the replacement part, please provide the following information:
   a. A purchase order number or credit card number.
   b. The complete Cincinnati Sub-Zero Part number.
   c. The model number and serial number of the chamber for requiring the replacement part.
   d. The specific complaint regarding the failed part.

NOTE: CSZ provides a list of parts for all chambers in a Bill of Materials which is included in the manual. The recommended spare parts for your chamber have an asterisk (*) on the left-hand margin.

3. The Parts Department will authorize the return of the failed material and issue an RMA (Return Material Authorization) number.

4. Any part replaced under terms of the warranty is invoiced at the current price. Upon receipt of the defective material Cincinnati Sub-Zero Products will issue a credit for the amount billed less any prepaid freight charges.

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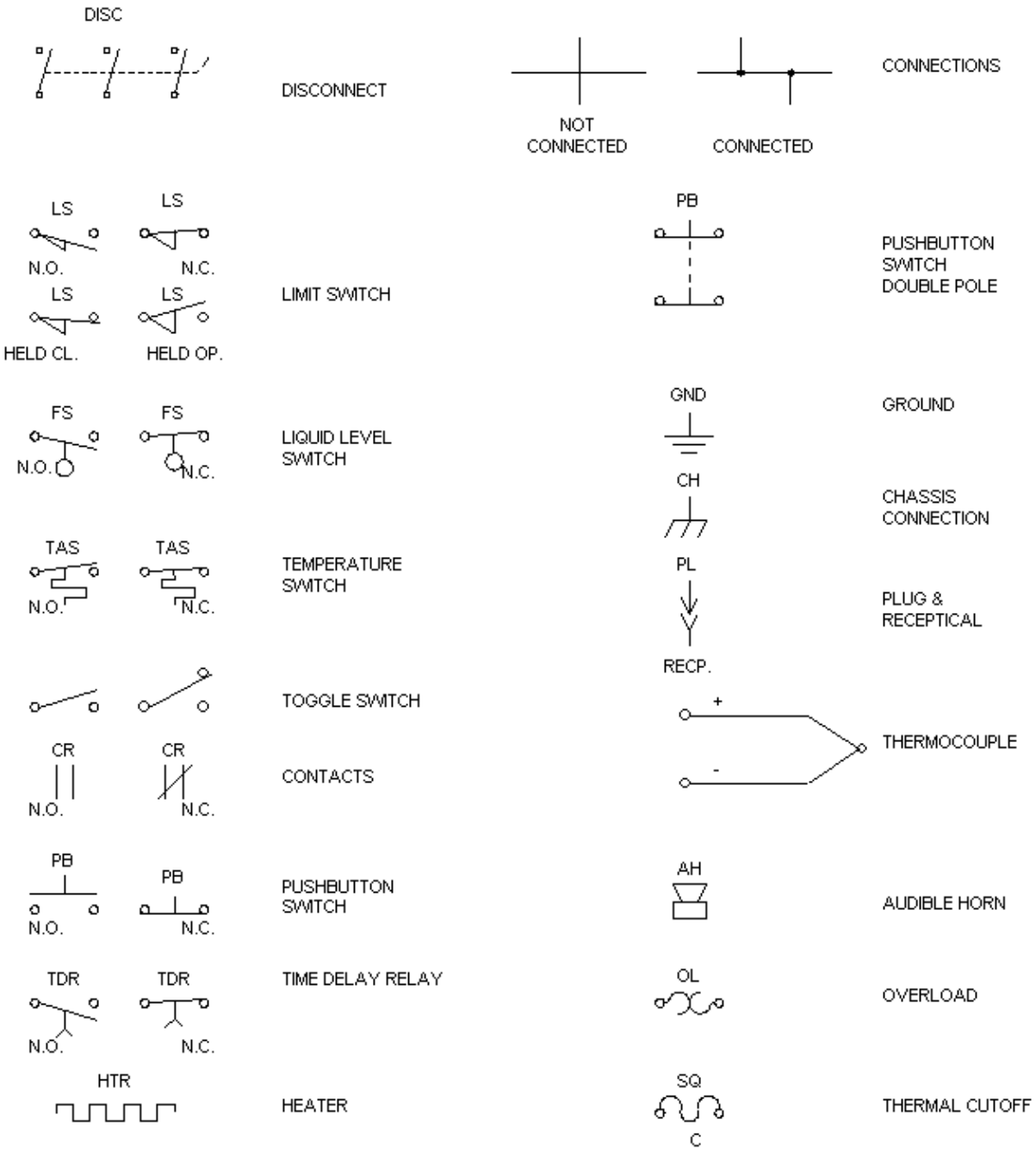
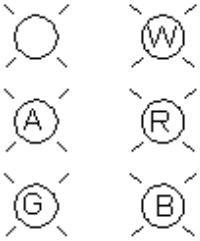
# ELECTRICAL SCHEMATIC SYMBOLS



Cincinnati Sub-Zero

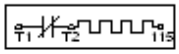
## ELECTRICAL SCHEMATIC SYMBOLS




LIGHTS - WHITE

AMBER, RED

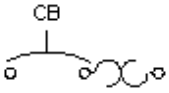
GREEN, BLUE




OIL PRESSURE CONTROL


CONTROL RELAY

RUN CAP.




CIRCUIT BREAKER

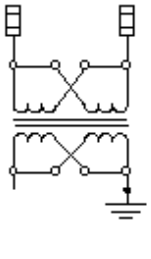

FUSE


VARISTOR

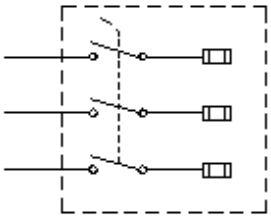

SOLENOID


RESISTOR

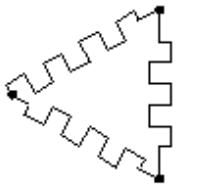
RELAYS, CONTACTORS, COILS



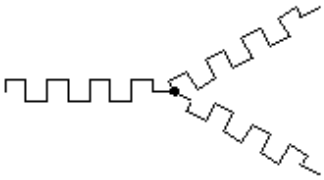
TRANSFORMER



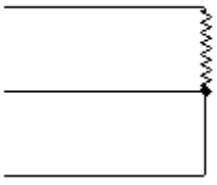
FUSED DISCONNECT TO BE SUPPLIED BY CUSTOMER



DELTA HEATER



"Y" HEATER



RTD

## SYSTEM DIAGRAMS

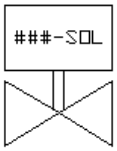
# REFRIGERATION SCHEMATIC SYMBOLS

HIGH-PRESSURE GAUGE

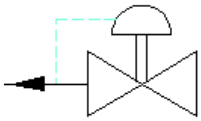
LOW-PRESSURE GAUGE

BALL VALVE WITH SERVICE ACCESS VALVE

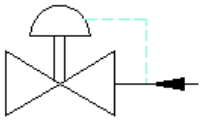
REFRIGERATION SERVICE ACCESS VALVE




SOLENOID VALVE



DOWNSTREAM PRESSURE REGULATING VALVE
(HOT GAS BYPASS)



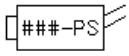
UPSTREAM PRESSURE REGULATING VALVE
(HIGH-PRESSURE DUMP VALVE,
EVAPORATOR PRESSURE REGULATOR)

CHECK VALVE

FILTER DRIER

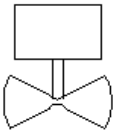
SIGHT GLASS

PRESSURE RELIEF VALVE

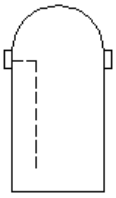



PRESSURE SWITCH (HIGH, LOW, ETC..)

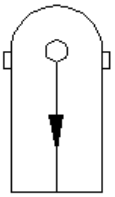
CAPILLARY TUBE EXPANSION DEVICE



FAN AND MOTOR ASSEMBLY



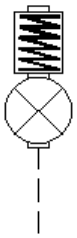
RECEIVER
VERTICAL LIQUID REFRIGERANT



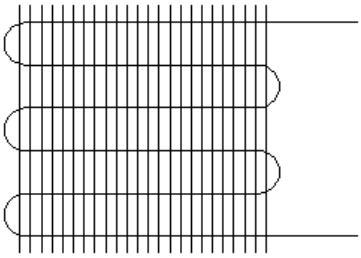
OIL SEPARATOR

Cincinnati Sub-Zero

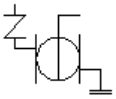
# REFRIGERATION SCHEMATIC SYMBOLS



WATER REGULATING VALVE
HIGH-PRESSURE REFRIGERANT ACTUATED

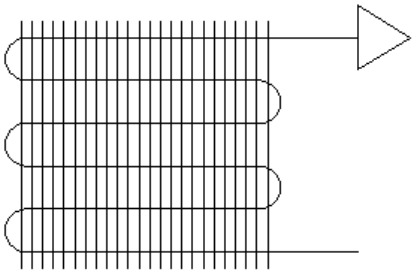


HEAT EXCHANGER REFRIGERANT EVAPORATOR



COMPRESSOR SERVICE VALVE

VIBRATION ELIMINATOR



HEAT EXCHANGER REFRIGERANT EVAPORATOR
WITH DISTRIBUTOR


PIPING CONTINUATION ARROW


TEMPERATURE MONITORING
THERMOCOUPLE

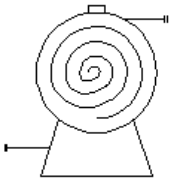
BALL VALVE

HEATER
(CRANKCASE HEATER, RECEIVER HEATER)

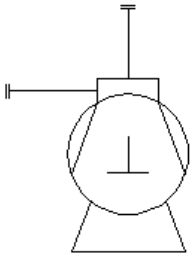
STRAINER (WATER INLET)

# SYSTEM DIAGRAMS

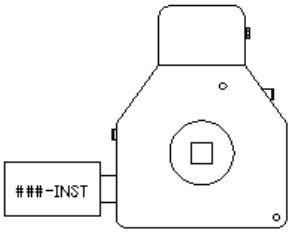
# REFRIGERATION SCHEMATIC SYMBOLS



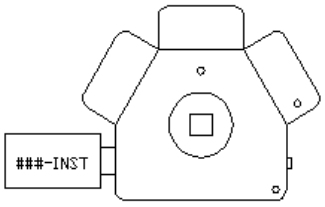
HERMETIC SCROLL COMPRESSOR - K4 SERIES



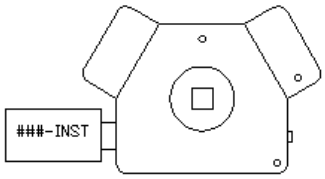
HERMETIC RECIPROCATING COMPRESSOR




SEMI-HERMETIC RECIPROCATING
COMPRESSOR
(2-3 CYLINDERS)



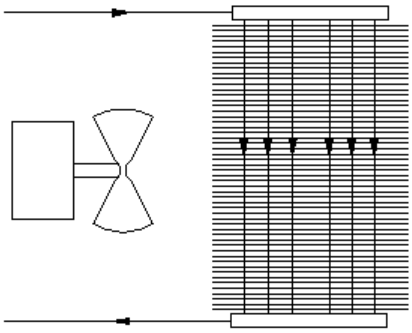

SEMI-HERMETIC RECIPROCATING COMPRESSOR
(6 CYLINDERS)



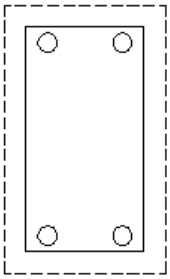

SEMI-HERMETIC RECIPROCATING
COMPRESSOR
(4 CYLINDERS)

Cincinnati Sub-Zero

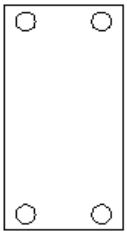
# REFRIGERATION SCHEMATIC SYMBOLS



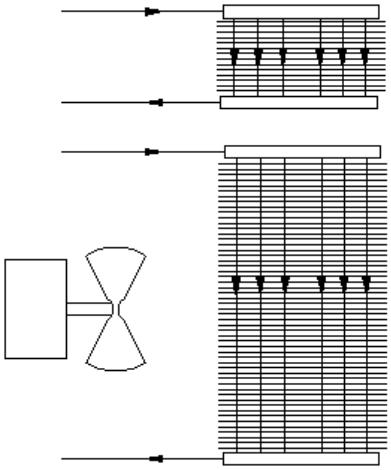
HEAT EXCHANGER AIR COOLED CONDENSER
WITH FAN AND MOTOR ASSEMBLY
(SINGLE STAGE & TUNDRA)



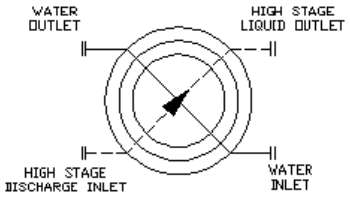
BRAZED PLATE HEAT EXCHANGER
(CASCADE CONDENSER WITH INSULATION KIT)



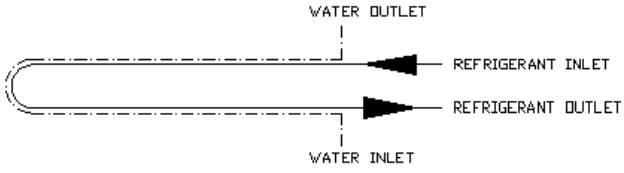
BRAZED PLATE HEAT EXCHANGER
(WATER COOLED CONDENSER, DESUPERHEATER, ETC..)



HEAT EXCHANGER AIR COOLED CONDENSER
WITH SEPARATE DESUPERHEATER CIRCUIT,
FAN AND MOTOR ASSEMBLY
(CASCADE SYSTEMS)




COAXIAL HEAT EXCHANGER
(WATER COOLED CONDENSER)




U-TUBE HEAT EXCHANGER TUBE IN TUBE
(WATER COOLED DESUPERHEATER)

# SYSTEM DIAGRAMS