



EQUIPMENT SPECIFICATIONS

Commercial Temperature Altitude Chamber

TABLE OF CONTENTS

1.	SCOPE.....	6
1.1	EQUIPMENT SUMMARY	6
1.2	SAFETY STANDARDS	6
1.3	OPERATIONAL ENVIRONMENT	6
2.	PERFORMANCE SUMMARY	6
2.1	SENSOR LOCATION.....	6
2.2	STABILITY OF CONDITIONS.....	6
2.2.1	DEFINITION OF CHAMBER STABILIZATION.....	6
2.2.2	TEMPERATURE STABILITY	6
2.2.3	HUMIDITY STABILITY (CAH MODELS ONLY)	6
2.2.4	ALTITUDE STABILITY.....	6
3.	EQUIPMENT CONSTRUCTION.....	7
3.1	CABINET CONSTRUCTION.....	7
3.1.1	INTERNAL LINER.....	7
3.1.2	EXTERNAL FABRICATION.....	7
3.1.3	INSULATION.....	7
3.1.4	DOOR CONSTRUCTION	7
3.2	STANDARD CHAMBER ACCESSORIES	7
3.2.1	ACCESS PORT	7
3.2.2	SHELF SUPPORTS.....	7
3.3	CHAMBER OPTIONAL ACCESSORIES	7
3.3.1	CIRCULAR FEEDTHROUGH PORTS (OPTIONAL).....	7
3.3.2	INTERIOR LIGHT (OPTIONAL).....	8
3.3.3	ADDITIONAL LIGHTS (OPTIONAL).....	8
3.3.4	WINDOW (OPTIONAL).....	8
3.3.5	DRY AIR PURGE (OPTIONAL FOR TEMPERATURE OPERATION ONLY).....	8
3.3.6	SHELVES (OPTIONAL).....	8
4.	ELECTRICAL SYSTEM	8
4.1	OPERATING VOLTAGE	8
4.2	CONTROL CIRCUIT	8
4.3	HEATERS	8
4.4	ELECTRICAL SAFETY DEVICES	9
4.4.1	FUSIBLE LINK HEATER OVERTEMPERATURE PROTECTION	9
4.4.2	CHAMBER OVERTEMPERATURE LIMIT	9
4.4.3	MASTER HEATING CONTACTOR	9
4.4.4	HEATER/FAN INTERLOCK.....	9
4.4.5	APPLICABLE ELECTRICAL STANDARDS	9
4.5	ELECTRICAL SYSTEM OPTIONAL ACCESSORIES	9
4.5.1	MAIN POWER DISCONNECT SWITCH (OPTIONAL).....	9
5.	VACUUM SYSTEM.....	10
5.1	VACUUM PUMP	10
5.2	VACUUM VALVE	10



6.	AVAILABLE REFRIGERATION SYSTEMS	10
6.1	SINGLE STAGE REFRIGERATION SYSTEM.....	10
6.2	CASCADE REFRIGERATION SYSTEM.....	10
6.3	TUNDRA® REFRIGERATION SYSTEM – EXCLUSIVELY FROM CINCINNATI SUB-ZERO PRODUCTS, INC.	11
6.4	THERMOSTATIC EXPANSION VALVES	11
6.5	SEMI-HERMETIC REFRIGERATION COMPRESSORS	11
6.6	WATER COOLED REFRIGERANT CONDENSER	11
6.7	SYSTEM COMPONENTS.....	11
6.8	REFRIGERATION SAFETY DEVICES	11
6.8.1	RELIEF VALVES.....	11
6.8.2	PRESSURE SWITCHES	11
6.8.3	COMPRESSOR INJECTION COOLING	12
6.8.4	COMPRESSOR OVERLOAD PROTECTION	12
6.8.5	ENVIRONMENTALLY-SAFE REFRIGERANTS.....	12
6.8.6	CERTIFICATION OF PRESSURE VESSELS	12
6.8.7	OIL PRESSURE SWITCHES	12
6.9	REFRIGERATION SYSTEM STANDARD ACCESSORIES	12
6.9.1	REFRIGERATION SERVICE TAPS	12
6.9.2	BOOST COOLING SYSTEM (FOR TEMPERATURE OPERATION ONLY)	12
6.9.3	REFRIGERATION SOUND ABATEMENT PACKAGE.....	12
6.9.4	REFRIGERATION SERVICE VALVES.....	12
6.9.5	OPTIONAL AIR COOLED REFRIGERANT CONDENSERS	12
7.	HUMIDITY CONDITIONING SYSTEM (CAH MODELS ONLY)	13
7.1	HUMIDIFICATION SYSTEM.....	13
7.1.1	VAPOR GENERATING SYSTEM.....	13
7.2	DEHUMIDIFICATION SYSTEM.....	13
7.2.1	DEHUMIDIFICATION EVAPORATOR COIL.....	13
7.2.2	DEHUMIDIFICATION DRAIN	13
7.3	HUMIDITY SYSTEM ACCESSORIES	14
7.3.1	RELATIVE HUMIDITY MEASUREMENT SYSTEM	14
7.3.2	HUMIDITY WATER DEMINERALIZER	14
7.3.3	RECIRCULATING HUMIDITY WATER SYSTEM (OPTIONAL)	14
8.	AIR CONDITIONING SYSTEM	14
8.1	CHAMBER AIR MOVER	14
8.2	AIR MOVER MOTOR.....	14
8.3	AIR MOVER MOTOR OVERLOAD PROTECTION	14
8.4	AIR MOVER GUARD	14
8.5	AIR DISTRIBUTION BAFFLE - MIL-STD 810 (OPTIONAL).....	14
9.	CHAMBER CONTROLS AND INSTRUMENTS	15
9.1	CSZ EZT-560 TOUCH SCREEN CONTROLLER WITH THE FOLLOWING FEATURES:.....	15
9.1.1	WATVIEW RT SOFTWARE (OPTIONAL).....	16
9.2	OPTIONAL INSTRUMENTATION	16
9.2.1	REMOTE INSTRUMENT/CONTROL CONSOLE (OPTIONAL).....	16
9.2.2	DIGITAL DISPLAY TEMPERATURE LIMIT AND ALARM (OPTIONAL)	17
9.2.3	OPTIONAL TEMPERATURE RECORDERS	17
9.2.4	MODEL DR-5000 CHART RECORDER (OPTIONAL).....	17
10.	DESIGN MANUFACTURING AND TEST	18
10.1	DESIGN CONFIRMATION DRAWING	18
10.2	CHANGE IN WORK SCOPE.....	18
10.3	MANUFACTURING PROCESS REVIEW	18
10.4	EQUIPMENT PERFORMANCE VERIFICATION.....	18



11.	SHIPMENT.....	18
11.1	DELIVERY	19
11.2	EQUIPMENT PACKAGING	19
11.3	FREIGHT CHARGES AND F.O.B. POINT	19
11.4	SHIPPING DAMAGE CLAIMS	19
12.	INSTALLATION AND ASSISTANCE.....	19
12.1	PURCHASER'S RESPONSIBILITY	19
12.2	START-UP ASSISTANCE (OPTIONAL).....	19
13.	WARRANTY/TESTING.....	20
14.	DOCUMENTATION AND MANUALS	20
14.1	START-UP INSTRUCTIONS	20
14.2	MANUALS.....	20
15.	EQUIPMENT SUPPORT	21
15.1	FIELD SERVICE	21
15.2	SPARE PARTS	21
15.3	PREVENATIVE MAINTENANCE PROGRAM	21
15.4	CALIBRATION SERVICES	21
16.	QUOTATION CONDITIONS AND CERTIFICATIONS.....	21
16.1	DAMAGES	21
16.2	PRICE CERTIFICATION.....	21
16.3	MOST FAVORED CUSTOMER.....	21
16.4	QUOTATION VALIDATION	21
17.	INVOICE TERMS AND CONDITIONS	22
18.	EQUIPMENT FOR EXPORT	22
18.1	PAYMENT TERMS	22
18.2	WARRANTY.....	23
19.	CANCELLATION AND TERMINATION OF WORK	23

1. SCOPE

1.1 EQUIPMENT SUMMARY

This document is to define equipment to be built by Cincinnati Sub-Zero, Inc.

This equipment is classified as a commercial temperature altitude chamber. While its use is primarily for general purpose environmental testing, the chamber incorporates some features based on military test standards. For example, the airflow volume through the workspace is designed such that the chamber can easily be modified with the addition of a simple air distribution baffle to meet airflow requirements such as are required by MIL-STD 810.

1.2 SAFETY STANDARDS

The equipment described herein will comply with all OSHA safety standards in effect on the date of manufacture.

1.3 OPERATIONAL ENVIRONMENT

The equipment will be designed to operate in a commercial environment, i.e. temperature of +23°C, ±10°C (+75°F, ±18°F) and maximum relative humidity of 95% noncondensing.

2. PERFORMANCE SUMMARY

The quoted performance for the equipment described herein is based on conditions of +23°C (+75°F), 50% Relative Humidity, and +29°C (+85°F) cooling water (where applicable). Addition of certain accessories may affect specified performance.

2.1 SENSOR LOCATION

Measurement of performance shall be at the control sensor located in the conditioned air inlet to the chamber workspace.

2.2 STABILITY OF CONDITIONS

2.2.1 DEFINITION OF CHAMBER STABILIZATION

Chamber is stabilized when the temperature of the most massive component of the test item changes temperature at a rate of no more than 2°C (3.6°F) per hour.

2.2.2 TEMPERATURE STABILITY

±1°C (±1.8°F) under steady state conditions after chamber stabilization.

2.2.3 HUMIDITY STABILITY (CAH MODELS ONLY)

±4% relative humidity under steady state conditions after chamber stabilization.

2.2.4 ALTITUDE STABILITY

±500 feet under steady state conditions after chamber stabilization

3. EQUIPMENT CONSTRUCTION

3.1 CABINET CONSTRUCTION

3.1.1 INTERNAL LINER

The internal liner will be fabricated of series 304, high nickel content, non-magnetic, stainless steel. All liner seams are continuously heliarc welded to insure a hermetic seal. The chamber interior acts as the vacuum pressure member and is constructed of heavy gauge steel plate reinforced with structural steel on the interior to withstand any pressure below ambient.

3.1.2 EXTERNAL FABRICATION

The exterior chamber liner will be fabricated from galvanized coated steel. The chamber base is fabricated of structural angle framework with sheet steel panels for easy access to system components requiring periodic service. The entire chamber exterior is cleaned, primed and finished with a polyurethane enamel finish. Standard color is Nitro Blue. Optional colors and for paint materials are available at additional cost.

3.1.3 INSULATION

Thermal insulation is installed between the internal pressure member and cabinet exterior. Fiberglass insulation is used with a high temperature binder for temperatures to +260°C (+500°F). Equalization vents are provided between the chamber workspace and the insulation space to equalize pressure differentials during altitude transitions.

3.1.4 DOOR CONSTRUCTION

One hinged, full opening door provides access to the chamber workspace. The door is part of the chamber, which is part of the pressure member and is constructed of welded steel plate with reinforcing. Double gasketing assures both a tight vacuum seal and a thermal barrier. Heavy-duty self-adjusting hinges allow the door to float as the vacuum gasket is compressed as the chamber is evacuated. The door is hinged on the left hand side as viewed from in front of and facing the chamber. A heavy-duty hand wheel latch clamps the door.

3.2 STANDARD CHAMBER ACCESSORIES

3.2.1 ACCESS PORT

One access port, 70 mm (2.875") diameter is provided in the left hand chamber wall, centered in the workspace. The port sleeve is stainless steel and is welded to the interior liner and outside panel to form a hermetic unit. An insulated sponge is provided. A blank flange is provided for customer access.

3.2.2 SHELF SUPPORTS

Stainless steel shelf supports are provided on the interior chamber walls. Supports will accept clips adjustable in 12 mm (0.5") increments to support optional shelves or customer supplied test fixture.

3.3 CHAMBER OPTIONAL ACCESSORIES

3.3.1 CIRCULAR FEEDTHROUGH PORTS (OPTIONAL)

A stainless steel sleeve type port can be installed in the chamber cabinet for a routing cable, etc. to the test item. The sleeve is welded to both the internal chamber liner and a weld neck flange is provided on the external cabinet to insure the hermetic integrity of the wall insulation space. A foam insulating plug is provided.

3.3.2 INTERIOR LIGHT (OPTIONAL)

An interior light is available for illumination of the chamber interior. The light fixture does not intrude on the chamber workspace and is positioned to minimize glare experienced by the viewer.

3.3.3 ADDITIONAL LIGHTS (OPTIONAL)

Additional interior chamber lights can be provided for additional illumination within the chamber interior. The light fixtures can be located in the chamber ceiling, walls or door to suit the application.

3.3.4 WINDOW (OPTIONAL)

A multi-pane window assembly is available in the door of the chamber to allow viewing of the chamber interior during operation. The window is constructed of tempered glass panels and is sealed with an aerospace silicone sealant to form a hermetic assembly.

3.3.5 DRY AIR PURGE (OPTIONAL FOR TEMPERATURE OPERATION ONLY)

A dry air purge system can be provided to reduce condensation within the chamber and on the test item during temperature cycling testing. The system consists of a heatless automatic regenerating desiccant type compressed air dryer, control solenoid, and flow meter. Compressed air is dried to a dew point approaching -73°C (-100°F) and then introduced into the chamber workspace creating a slight positive pressure within the chamber to minimize the migration of moist ambient air into the chamber. The system requires approximately 142 standard liters/minute (5 scfm) of compressed air at 720 kpa (90 psig), free of all oil and entrained water droplets.

3.3.6 SHELVES (OPTIONAL)

Adjustable shelves can be provided as an option. Shelf supports are stainless steel. Support clips are adjustable in 12 mm (0.5 in) increments. Shelves are of stainless steel welded wire construction.

4. ELECTRICAL SYSTEM

4.1 OPERATING VOLTAGE

One 460 volt, 3 phase, 60 Hz power source is required to operate the entire chamber. All system loads are distributed to provide a balanced load.

4.2 CONTROL CIRCUIT

115-volt power for the chamber control circuit is provided from the main input voltage by a step-down transformer. All electrical components are mounted on sub-panel located inside the electrical enclosure. All wiring is color coded and identified on both ends with numbered labels corresponding to the wire numbers shown on the system schematics. All wiring between the electrical panel and the various components passes through a terminal strip to facilitate service and troubleshooting. All chamber switches and lights are identified on the switch panel as to function.

4.3 HEATERS

Chamber heating is accomplished by open coil, nichrome resistant heating elements. The elements are held in porcelain insulators attached to a stainless steel support frame. The heaters are located so as not to radiate heat directly to the chamber workspace or test items. The heaters are positioned in the main chamber airflow loop such that they normally operate in the black heat range to assure long life. Power input to the heaters is controlled upon instrument demand by time-proportioned duty cycling of the heater input power. Power switching is accomplished by long life solid-state relays.

4.4 ELECTRICAL SAFETY DEVICES

4.4.1 FUSIBLE LINK HEATER OVERTEMPERATURE PROTECTION

Fusible link over temperature protectors are installed in the heater power supply leads to provide heater over temperature protection. These devices are designed to interrupt the heater power if the temperature reaches +240°C (+464°F).

4.4.2 CHAMBER OVERTEMPERATURE LIMIT

In addition to the fusible link primary heater over temperature limit, an additional limit is provided for chamber over temperature protection. This device has a fixed trip point at the maximum chamber operating temperature and is intended for chamber over temperature protection only. If the intended test items generate heat while in the chamber, additional interlocking of the test item power to the High/Low Temperature Limit and Alarm unit to de-energize the test item is recommended.

4.4.3 MASTER HEATING CONTACTOR

All power to the chamber heaters passes through a non-cycling power contactor. This contactor is controlled by the chamber over temperature limit Hi/Lo test item limit and is de-engaged if either a chamber over temperature or test item over temperature condition occurs.

4.4.4 HEATER/FAN INTERLOCK

The heater and fan control circuits are interlocked such that the heaters cannot be energized until the air circulator is turned on.

4.4.5 APPLICABLE ELECTRICAL STANDARDS

Cincinnati Sub-Zero Products, Inc. electrical systems are manufactured to National Electrical Code NEMA-1 standards.

4.5 ELECTRICAL SYSTEM OPTIONAL ACCESSORIES

4.5.1 MAIN POWER DISCONNECT SWITCH (OPTIONAL)

The chamber can be provided with a fused main disconnect switch for the main chamber power input. This switch is interlocked via a through-the-door handle mechanism such that the electrical enclosure door cannot be opened without first throwing the disconnect switch to the off position.

5. VACUUM SYSTEM

5.1 VACUUM PUMP

One (1) Stokes Model No. V-005-2 (or equivalent) two-stage rotary vane pump with a capacity of 7 CFM. Pump will provide a ramp rate of 2,000 feet altitude per minute minimum. Features include positive internal oil circulation system, gas ballast valve, anti-suckback valve, gas purge port, and KF flanges on inlet and outlet connections. The pump is driven by a 230 volt ($\pm 5\%$) 3-phase, 60 Hz or 460 volt ($\pm 5\%$), 3-phase, 60 Hz 1/2 HP totally enclosed fan cooled (TEFC) motor and is arranged for general applications. Pump will be provided with a charge of .53 gallons of V-Lube-J oil.

Note: Faster altitude change rates can be provided as an option.

5.2 VACUUM VALVE

MKS Model 263A-20-40-01 (or equivalent) full throttling valve, (0-100%), with an accuracy of 0.5%, and an analog input signal of 0-5 VDC will be provided.

6. AVAILABLE REFRIGERATION SYSTEMS

6.1 SINGLE STAGE REFRIGERATION SYSTEM

For low temperatures down to -30°F (-34.4°C), a single stage refrigeration system is used.

The system has one refrigeration compressor using refrigerant HFC-404A. The HFC-404A system removes heat directly from the chamber interior via a thermodynamically engineered fin coil (evaporator) in which the HFC-404A evaporates absorbing heat from the chamber. The HFC-404A compressor compresses the resulting HFC-404A vapor raising its temperature and pressure. The HFC-404A vapor is then condensed back to a liquid in the HFC-404A condenser and finally rejecting the chamber heat to the surroundings.

6.2 CASCADE REFRIGERATION SYSTEM

For ultimate low temperatures down to -100°F (-73°C), a cascade refrigeration system is used.

The system has two refrigeration compressors, one using refrigerant HFC-404A and one using refrigerant R-508B. The R-508B system removes heat directly from the chamber interior via a thermodynamically engineered fin coil (evaporator) in which the R-508B evaporates absorbing heat from the chamber. The R-508B compressor compresses the resulting R-508B vapor raising its temperature and pressure. The heat of compression is removed by a desuperheater heat exchanger. The R-508B vapor is then condensed back into a liquid giving up the heat picked up from the chamber. This takes place in a heat exchanger called the "cascade" which acts as the condenser for the R-508B refrigerant and the evaporator for the HFC-404A refrigerant. In the cascade, the HFC-404A evaporates picking up the heat given up by the condensing R-508B. The HFC-404A compressor raising its temperature and pressure then compresses the HFC-404A vapor. The HFC-404A vapor is then condensed back to liquid in the HFC-404A condenser and finally rejecting the chamber heat to the surroundings.

An R-508B expansion tank is included in the system to prevent system pressure buildup in a standby condition.

6.3 TUNDRA® REFRIGERATION SYSTEM – Exclusively from Cincinnati Sub-Zero Products, Inc.

For applications that require testing at -40°C , the Tundra® refrigeration system is recommended. The Revolutionary patent-pending Tundra® refrigeration system breaks the boundaries of conventional single-stage refrigeration systems. Unlike conventional single stage systems that can only reach -34°C , the new Tundra system provides reliable and efficient cooling down to the low temperature of -45°C . A cascade refrigeration system is no longer needed to reach this low temperature. Cincinnati Sub-Zero Products, Inc. is the only chamber manufacturer approved by Copeland to utilize scroll technology in this unique refrigeration system. Scroll compressors use only four moving parts as opposed to the traditional compressor that uses 16 moving parts, ultimately making the system more reliable and easier to service. Not only is the Tundra system more reliable and easier to service, but it also allows for rapid transition rates and offers greater capacity compared to the equivalent cascade system.

6.4 THERMOSTATIC EXPANSION VALVES

Refrigerant flow control within the systems is accomplished by thermostatic expansion valves (TEV's). No fixed capillary tube flow control devices are used in the systems. A TEV modulates refrigerant flow in response to system load, whereas a fixed capillary provides optimum flow control at only one load condition, generally minimum load at minimum temperature to prevent refrigerant "floodback" and compressor damage. This severely limits system performance under higher load conditions. TEV's match refrigerant flow to load optimizing system performance under varying conditions giving improved performance over capillary systems.

6.5 SEMI-HERMETIC REFRIGERATION COMPRESSORS

The refrigeration compressors will be of the heavy-duty semi-hermetic type, which are spring mounted to reduce vibration in the system.

6.6 WATER COOLED REFRIGERANT CONDENSER

The refrigeration system will be equipped with a water cooled HFC-404A refrigerant condenser designed for a maximum $+14^{\circ}\text{C}$ ($+25^{\circ}\text{F}$) temperature differential between the cooling water temperature and the refrigerant condensing temperature at maximum system load to give maximum system efficiency. The condenser is equipped with an automatically modulating water flow control valve, which supplies only the amount of water required and shuts off when the refrigeration compressor(s) are not running.

6.7 SYSTEM COMPONENTS

The components used in the system have been carefully selected and balanced to assure the total refrigeration system is operating in an optimum condition. All refrigeration components used are commercially available from local refrigeration wholesalers or may be purchased as spare or replacement parts directly from Cincinnati Sub-Zero Products, Inc.

6.8 REFRIGERATION SAFETY DEVICES

6.8.1 RELIEF VALVES

Relief valves are provided to protect against overpressure in the systems.

6.8.2 PRESSURE SWITCHES

System pressure switches assure that the refrigeration system is not operated beyond the compressor manufacturer's stated design operating conditions.

6.8.3 COMPRESSOR INJECTION COOLING

To protect the R-508B compressor from damage from hot returning refrigerant gases during pull down from elevated temperature, liquid injection compressor cooling is employed. A thermostatic expansion valve senses the temperature of the returning refrigerant and injects additional refrigerant liquid to cool the returning gas within safe limits.

6.8.4 COMPRESSOR OVERLOAD PROTECTION

All compressors have inherent electrical overload protection, which will shut down the compressor in the event of an electrical overload.

6.8.5 ENVIRONMENTALLY-SAFE REFRIGERANTS

All Cincinnati Sub-Zero refrigeration systems use refrigerants, which are **environmentally safe**, non-flammable, non-explosive, and have a zero Ozone Depletion Potential (ODP).

6.8.6 CERTIFICATION OF PRESSURE VESSELS

All purchased pressure vessels used in the system are either ASME certified or U.L. listed for operation at the maximum pressures expected in the system.

6.8.7 OIL PRESSURE SWITCHES

Each refrigeration compressor having a pressurized lubrication system is protected against loss of lubrication by a differential oil pressure switch, which is piped to measure the differential between the compressor crankcase and the oil pump discharge pressure. Insufficient oil pressure will cause the pressure switch to shut down the compressor.

6.9 REFRIGERATION SYSTEM STANDARD ACCESSORIES

6.9.1 REFRIGERATION SERVICE TAPS

All compressors in the refrigeration system are equipped with service taps in both the high and low side of the system for convenient connection of a service gauge set and system refrigerant charging.

6.9.2 BOOST COOLING SYSTEM (FOR TEMPERATURE OPERATION ONLY)

In addition to the main refrigeration system, the chamber can be equipped with boost cooling system for more rapid cool down rates via direct injection of a cryogenic liquefied gas (carbon dioxide or nitrogen) into the chamber. The boost cooling control system consists of a control solenoid that is operated upon demand from the chamber temperature controller in conjunction with a delay timer to permit boost cooling only under conditions of sustained cooling demand. Maximum operating pressure is 100 P.S.I., for higher pressures consult factory.

6.9.3 REFRIGERATION SOUND ABATEMENT PACKAGE

On chambers having water-cooled or remotely air-cooled compressors, a refrigeration sound abatement package is available as an option. The package consists of sound barrier materials applied to the refrigeration compressor enclosure to reduce emitted refrigeration compressor noise to a level of 80 db (A scale) or less.

6.9.4 REFRIGERATION SERVICE VALVES

All compressors in the refrigeration system are equipped with service valves in both the high and low side of the system for convenient connection of a service gauge set and system refrigerant charging.

6.9.5 OPTIONAL AIR COOLED REFRIGERANT CONDENSERS

For chamber operation in locations where an adequate cooling water supply is not economical or readily available, the chamber can be equipped with an air-cooled refrigerant condenser. The

condenser is multi-circuited to serve as both the HFC-404A condenser and as the R-508B desuperheater.

6.9.5.1 AIR COOLED CONDENSER - REMOTE (OPTIONAL)

The optional air-cooled condenser can be located remotely from the chamber. The condenser may be located within the building for heat recovery in the heating season or outdoors to reduce building cooling loads. Low heat pressure controls are included to permit operation under low wintertime ambient temperature conditions.

6.9.5.2 AIR COOLED CONDENSER - INTEGRAL (OPTIONAL)

The optional air-cooled condenser can be located in the chamber base along with the other refrigeration components and will discharge its heat directly to the surrounding area. Heat rejection to the surrounding area can be estimated by multiplying the HFC-404A compressor horsepower by 4,500 watts/hp (15,000 btu/hr).

7. HUMIDITY CONDITIONING SYSTEM (CAH MODELS ONLY)

7.1 HUMIDIFICATION SYSTEM

7.1.1 VAPOR GENERATING SYSTEM

A heated vapor generator generates water vapor humidification of the chamber interior. Migration of water vapor from the generator to the chamber interior is dependent on the temperature of the water within the generator. As the temperature of the water is increased as controlled by the chamber humidity controller, the water vapor pressure within the generator increases causing vapor to migrate into the chamber interior increasing the relative humidity there. This process continues until the vapor pressure in the chamber equals the vapor pressure in the generator and equilibrium is established. Cincinnati Sub-Zero utilizes humidity vapor generators with the minimum practical water volume to reduce system control response time and improve humidity control tolerance.

7.2 DEHUMIDIFICATION SYSTEM

7.2.1 DEHUMIDIFICATION EVAPORATOR COIL

Dehumidification of the chamber air is accomplished by condensing water from the chamber air onto a refrigerated surface. As water vapor is removed from the air, the overall relative humidity level is reduced. The dehumidification coil is cooled in conjunction with the chamber refrigeration system. The dehumidification coil has a wide fin spacing, which enables it to tolerate a small amount of frost buildup, which may occur at low dew point conditions.

7.2.2 DEHUMIDIFICATION DRAIN

The chamber is provided with a ½ inch diameter condensate drain to remove water resulting from the dehumidification process and any condensation, which may form in the chamber workspace as a result of the humidity test. This condensate drain must be equipped with a "P" Trap and connected to an open (non-pressurized) drain.

7.3 HUMIDITY SYSTEM ACCESSORIES

7.3.1 RELATIVE HUMIDITY MEASUREMENT SYSTEM

A solid-state humidity measurement and sensing system is provided to measure humidity. The sensor is a solid-state "humicap" type, which unlike hygroscopic salt sensors, has a wide operating temperature range and is not easily damaged by condensation. The sensor includes an electronic signal transmitter which conditions the sensor signal and provides a 4-20 mA analog signal corresponding to 0 to 100% relative humidity to the Programmable Controller.

7.3.2 HUMIDITY WATER DEMINERALIZER

One replaceable cartridge type demineralizer will be supplied to provide demineralized water for humidity system operation. The system uses a general-purpose mixed bed water treatment cartridge. In addition, pretreatment of the water is recommended to maximize the efficiency of the demineralizer and extend the life of the cartridge. The purchaser is encouraged to obtain a local water analysis to determine the nature and extent of water treatment required. Replacement cartridges are available at additional cost.

7.3.3 RECIRCULATING HUMIDITY WATER SYSTEM (OPTIONAL)

A recirculating humidity water system is available which collects the condensate from the chamber, passes it through a filter and demineralizer, and stores it in a reservoir for reuse. The system includes a pump, sediment filter, and a five-gallon reservoir.

8. AIR CONDITIONING SYSTEM

The airflow within the chamber will be sufficient to minimize temperature gradients within the chamber workspace. The airflow will also be of sufficient velocity and volume to optimize the heat transfer efficiency of the refrigeration evaporator fin coil. The chamber air circulator shaft will utilize a rotary carbon to metal shaft seal for positive leak free operation and long life.

8.1 CHAMBER AIR MOVER

A propeller type fan will generate recirculating air movement within the chamber workspace. The air mover will be dynamically balanced to minimize vibrations transmitted to the chamber.

8.2 AIR MOVER MOTOR

The air mover is driven by an externally mounted totally enclosed fan cooled (TEFC) electric motor with a stainless steel shaft. The motor bearings are not exposed to the temperature of the chamber interior.

8.3 AIR MOVER MOTOR OVERLOAD PROTECTION

The air mover motor is provided with thermal protection to protect against overload.

8.4 AIR MOVER GUARD

The air mover is equipped with a guard to prevent personnel contact with the rotating impeller.

8.5 AIR DISTRIBUTION BAFFLE - MIL-STD 810 (OPTIONAL)

The chamber can be equipped with a ceiling air baffle to distribute the air within the chamber for uniform velocity per the requirements of MIL-STD 810. The baffle will reduce the chamber workspace height by approximately 150 mm (6").

9. CHAMBER CONTROLS AND INSTRUMENTS

All Cincinnati Sub-Zero CA and CAH Series Chambers feature the CSZ EZT-560 Touch Screen Controller with Product Monitor. The controls are mounted on the chamber door at an ergonomic height for ease of programming. The controller is fully insulated and vented.

9.1 CSZ EZT-560 Touch Screen Controller with the following features:

- 6" Color touch screen
- Windows-based Menu Navigation
- On-line help provides menu specific information
- Real time & historical trend graphs with the drag-n-zoom feature provides the ability to touch and zoom into specific areas of the graph
- Print real time and historical trend graphs directly to a printer (HP Deskjet 6540 driver)
- Unlimited profiles with up to 99 steps each
- Enhanced profile entry allows user to enter time in HH:MM:SS
- Profile status view provides detailed information on the running profile including the stop date and time.
- Profile Autostart and "Wait For" functions
- Data Logging capabilities with user-selectable features
- Easily download profiles, alarm files, audit trail files and data files to removable I-stick via USB port
Also import profiles via removable I-Stick for easy transfer among multiple chambers
- Fully configurable alarm settings for all inputs with ability to assign alarms to control optional customer event outputs (relays)
- Access alarm history files and view detail for troubleshooting
- System monitor displays run time and cycles of all major components
- Configurable maintenance messages and audible alarms alert the user when chamber systems are due to be maintained
- Full System Security allows up to 30 different users with three different levels of security.
Audit trail tracks changes in settings by each user.
- "Adapt-a-Tune Technology" provides the ultimate in chamber performance and control stability.
- Product control feature accelerates temperature cycling of the device under test
- Product high/low limit protects your device under test
- Selectable power failure/recovery options in the event of a power failure
- Monitor option provides up to 8 inputs for monitoring with individual alarms, displays, and data logging for each input
- Wireless compatibility using web-enabled, hand-held devices.

- Computer Interface
 - EIA-232/485 Serial Communications (standard)
 - Ethernet Compatibility
 - GPIB (IEEE-488) Optional

- Featured Software
 - Monitor and control up to 20 chambers from any location with CSZ EZ-View Software

9.1.1 WATVIEW RT SOFTWARE (OPTIONAL)

The main features of Watview RT Software are:

- Control up to 32 Watlow controllers for simultaneous communications
- Easy to use, built-in setup screens or spreadsheet views can be used for entering environmental test specifications
- Create a library of user-defined test specifications (recipes) that are chamber independent
- Continuous data-logging of chosen parameters that can be exported or view up to 20 data items on a trend plot graph
- Pre-defined professional looking output of test data from any Windows compatible printer
- On-line and context sensitive Windows help system to guide operators
- Maintains a log of alarms and allows users to clear and acknowledge alarms while the chamber is running

Watview RT Software requires the following minimum configuration:

- Microprocessor – Pentium® 200 MHz processor
- RAM - 32MB minimum
- Monitor 800 x 600 screen resolution
- Mouse or trackball
- High-density floppy drive
- Hard Disk – 200 MB
- CD-ROM drive
- Operating System - Windows® 95 or 98, or NT 4.0

Watview RT supports the following communications standards with the F4: EIA-232 and EIA-485.

9.2 OPTIONAL INSTRUMENTATION

9.2.1 REMOTE INSTRUMENT/CONTROL CONSOLE (OPTIONAL)

Free standing relay rack console for remote mounting of any of above instruments. Includes ten feet (three meters) umbilical cable for connection to chamber, and labor to install and wire any of the above instruments into console.

9.2.2 DIGITAL DISPLAY TEMPERATURE LIMIT AND ALARM (OPTIONAL)

The optional Digital Display Temperature Limit and Alarm provides independent failsafe redundant over/under temperature limit and alarm protection. The unit utilizes a thermocouple sensor completely independent of the chamber temperature control sensor. Sufficient sensor wire is provided to permit location of the sensor anywhere in the chamber. In this way, the sensor can be placed on or in the test item providing maximum thermal protection for valuable "one-of-a-kind" test items. A 2-ampere SPDT alarm relay contact is provided for customer use. It is the customer's responsibility to interlock this contact to the test item power source to de-energize the test item upon an alarm condition.

Set points:	Independent high and low tamper resistant setpoint adjustments.
Display:	LED, °F/°C jumper selectable.
Sensor:	Type "T" thermocouple with upscale break protection.
Failsafe:	Instrument control form is failsafe to de-energize equipment on and out of tolerance condition or chamber power failure.
Alarms:	Both audible (with silence) and visual, require manual reset after limit.
Alarm Relay:	2 ampere DPDT. One pole used by chamber circuits, one pole available for interlock to customer's test item power or remote alarm system.
Accuracy:	0.25% of calibrated span
Package:	¼ DIN

9.2.3 OPTIONAL TEMPERATURE RECORDERS

Temperature recorders will be mounted in the door of the Instrumentation/ Electrical enclosure on the right hand side of the chamber cabinet.

9.2.4 MODEL DR-5000 CHART RECORDER (OPTIONAL)

The DR-5000 recorder features all essential recording capabilities including built in self test, thermocouple burn out protection, one or two pen ink recording or auto. thermal printing.

Accuracy:	0.5% of span
Inputs:	J.K. and T: Type Thermocouples; 100 ohm RTD 4-20 MA, 0-5 Vdc
Chart Size:	10" Circular
Chart Speed:	Field Configurable
Range:	Field Configurable/Over 150 preprinted charts available.

10. DESIGN MANUFACTURING AND TEST

10.1 DESIGN CONFIRMATION DRAWING

After receipt of order, Cincinnati Sub-Zero Products will submit for the purchaser's review an overall drawing of equipment as ordered, showing equipment configuration, overall size, required service access, utility requirements, and installed accessories. Manufacturing will begin ten working days from issuance of this confirmation drawing.

10.2 CHANGE IN WORK SCOPE

Upon commencement of manufacturing, the design for the equipment described on the design confirmation drawing will be considered frozen. Subsequent changes in design and/or specification requested by the purchaser may result in additional work, may change delivery date, and may require additional funding.

10.3 MANUFACTURING PROCESS REVIEW

The purchaser, at his or her discretion, may make periodic visits to our manufacturing facility to review the manufacturing progress for the equipment ordered. The purchaser is encouraged to do so to become familiarized with the design and operation of the equipment.

10.4 EQUIPMENT PERFORMANCE VERIFICATION

Prior to shipment, the equipment, complete with controls, will be cycled and run in our plant to verify that the equipment meets the performance requirements of this specification. The purchaser may, if desired, witness this final testing.

11. SHIPMENT

Shipment has been quoted using typical lead times. Consult factory for specific ship dates. Delivery dates are not guaranteed and are reasonable and accurate estimates based on situations at the time of the issuance of the quotation. All efforts will be made to uphold, or improve quoted delivery, but Cincinnati Sub-Zero Products cannot be responsible for circumstances beyond our control.

Unless otherwise notified, we will arrange for pick-up and shipment of the equipment via the routing of its choice giving consideration to cost and timeliness of delivery. If a specific routing is preferred, routing instructions should be included in the purchase order instructions.

11.1 DELIVERY

When equipment delivery shipment is delayed at the customer's request beyond the Cincinnati Sub-Zero Products, Inc. advised shipment date for a period longer than ten (10) business days, Cincinnati Sub-Zero Products, Inc. may at its option (1) require that you arrange for the equipment to be stored in a commercial warehouse with all transportation, storage, handling, and other charges to be billed to you and (2) invoice you the entire unpaid balance on the purchase price of the equipment with payment terms of net 30 days.

11.2 EQUIPMENT PACKAGING

Upon completion of manufacture and in-plant testing, the equipment will be prepared for shipment. Crating will be in accordance with standard practices for shipment by common carrier motor freight.

11.3 FREIGHT CHARGES AND F.O.B. POINT

All equipment is shipped F.O.B. Cincinnati Sub-Zero Products' plant, freight collect. Freight charges can be prepaid and added to the invoice upon request with proper credit approval.

11.4 SHIPPING DAMAGE CLAIMS

Cincinnati Sub-Zero Products cannot be responsible for damage in transit to equipment properly packaged and in good condition when given to the carrier. Any shipping damage must be noted on the receiver and appropriate action taken by the purchaser in filing claims with the carrier.

12. INSTALLATION AND ASSISTANCE

12.1 PURCHASER'S RESPONSIBILITY

Unloading, moving into place, including remote and roof mounted devices (if applicable), floor modifications for mounting and leveling, installation of power sources, and all utility plumbing to the equipment and remote devices are the responsibility of the purchaser.

12.2 START-UP ASSISTANCE (OPTIONAL)

Cincinnati Sub-Zero Products can provide, at additional cost, qualified personnel at the purchaser's facility to supervise the purchaser's personnel during equipment installation, to check out the equipment after installation, start-up the equipment, and instruct the operators in its proper operation.

The equipment quoted is of custom design to meet specific applications. All systems are 100% tested for functionality to meet the customer's test specifications at the factory. Since the performance of the unit may depend on such factors as cooling water temperature and flow, ambient conditions, customer loads, or other variables, Cincinnati Sub-Zero Products strongly recommends the purchase of supervision of installation and start-up performed by Cincinnati Sub-Zero Products, Inc. authorized service companies in your area, or by factory personnel.

13. WARRANTY/TESTING

A ninety (90) day labor and one (1) year parts warranty is included. This unit will be fully assembled and tested prior to shipping. Company representatives from your firm are invited to be present during testing and validation.

Claims under the warranty must be made directly to Cincinnati Sub-Zero Products' Field Service Department, directly specifying the defect claimed, the length of service of part involved, and if known, the purchase order or contract number under which the part was procured. Cincinnati Sub-Zero Products reserves the right of access to the equipment at the purchaser's facility for the purpose of determining the nature and extent of the defect claimed. **No material may be returned without written approval from Cincinnati Sub-Zero Products, Inc. No returns of material will be honored without prior written approval.** No claims for damages or missing merchandise will be considered if made more than fifteen (15) days after the date of shipment.

Extended product warranties are available. Please consult factory for additional details.

14. DOCUMENTATION AND MANUALS

14.1 START-UP INSTRUCTIONS

Cincinnati Sub-Zero Products, Inc. will furnish basic set-up and start-up instructions including electrical and refrigeration schematics for the equipment at the time it is shipped.

14.2 MANUALS

One complete manual including maintenance, service, and operating instructions will be forwarded no later than thirty days after the equipment is shipped.

Documentation will cover all electronic, electrical, electromechanical, mechanical, and pneumatic components of the system. Documentation packages will include, but are not limited to the following:

- a. Circuit schematics of the total system.
- b. System preventative maintenance schedules.
- c. Procedures and schematics for the calibration of the system and any special circuitry.
- d. Recommended spare parts list and procurement details.
- e. Information on electrical drives, motors, blower, fans, vacuum pumps, etc.
- f. Computer interfacing documentation.

All documentation will follow standard industrial guidelines for component identification, signal paths, document numbers, etc., and will be in an indexed manual.

15. EQUIPMENT SUPPORT

15.1 FIELD SERVICE

Cincinnati Sub-Zero Products, Inc. has a fully qualified Field Service Department, which can provide service for our equipment (in most cases, within a 24-hour period). This service, other than that covered under warranty, when requested by authorized purchaser's personnel, will be charged at Cincinnati Sub-Zero Products' standard field service rates. A cost estimate for repairs will be provided before the technician departs from our facility.

15.2 SPARE PARTS

To minimize equipment downtime and facilitate repairs, Cincinnati Sub-Zero Products recommends that the purchaser procure the recommended spare parts listed in the equipment manual. For the purpose of budgetary planning, it is recommended that a minimum of 10% of the total system price be set aside for spare parts procurement.

15.3 PREVENTATIVE MAINTENANCE PROGRAM

Cincinnati Sub-Zero Products, Inc. provides preventative maintenance agreements that include routine maintenance on all aspects of your chamber systems. Maintenance agreements may be customized to meet your needs.

15.4 CALIBRATION SERVICES

Cincinnati Sub-Zero Products, Inc. offers NIST traceable calibration services.

16. QUOTATION CONDITIONS AND CERTIFICATIONS

16.1 DAMAGES

Cincinnati Sub-Zero Products cannot be responsible for any misapplied product, nor for consequential damages arising from the use of its products.

16.2 PRICE CERTIFICATION

Cincinnati Sub-Zero Products certifies that the prices quoted herein have been independently prepared in accordance with the terms of the Certificate of Independent Price Determination contained in the Federal Acquisition Regulation. Cincinnati Sub-Zero Products, Inc. reserves the right to revise prices and specifications detailed within this proposal after the stated, lapsed date. Quoted prices do not include Federal, State, or local taxes. Taxes, whenever applicable, shall be brought to the attention of Cincinnati Sub-Zero Products prior to the issuance of invoice for inclusion, and as a separate charge, to be paid by the buyer.

16.3 MOST FAVORED CUSTOMER

Cincinnati Sub-Zero Products certifies that the prices quoted herein do not exceed the current selling price or prices for the same or substantially the same articles or service that are sold to the government or another purchaser, taking into account the quantity under consideration.

16.4 QUOTATION VALIDATION

Prices quoted herein shall remain valid for 60 days. Quoted prices are in U.S. funds. Quoted prices are for domestic purchase and use only. Accessories that are added after the order is placed will require a 15% surcharge.

17. INVOICE TERMS AND CONDITIONS

Net 30, on orders with a total value of \$80,000.00 or less, (with credit approval). The total order amount will be invoiced at shipment of equipment, due net 30 days from date of invoice. On orders with a total value greater than \$80,000.00, Cincinnati Sub-Zero Products requires the following milestone payments:

- 20% with receipt of order
- 30% on receipt of major materials at our plant, sign-off of approval drawings, due upon receipt of invoice.
- 40% on shipment of equipment, due on receipt from date of invoice. *
- 10% payment upon receipt of invoice after start-up/installation not to exceed 30 days from shipment.

* If no scheduled start-up, then final payment to be 50% on shipment of equipment.

Note: A service charge of 1.5% per month (18% per annum) or the maximum permitted by law, whichever is less, shall be added to past due balances.

18. EQUIPMENT FOR EXPORT

18.1 PAYMENT TERMS

Normal shipping trade terms are FCA (Free Carrier) Origin Cincinnati, Ohio. IPPC Labeled/ISPM 15 compliant Heat Treated Wood Crating will be used for crating at an additional cost to the buyer.

All equipment for shipment outside of the U.S.A., Canada & Mexico is subject to **full payment in advance or advised irrevocable letter of credit** payable at sight drawn in favor of Cincinnati Sub-Zero Products, Inc. as shown below before the equipment can be released for shipment. **Detailed letter of credit instructions are provided separate from this document.**

Check Payments (US Payments only):	Wires/ACH Payments:	Letters of Credit:
Cincinnati Sub-Zero Products, Inc. 1898 Paysphere Circle Chicago, Illinois 60674 USA	Beneficiary: Cincinnati Sub-Zero Products, Inc. LaSalle Bank Chicago, Illinois USA SWIFT: LASLUS44XXX ABA: 071000505 Account No: 5801017020	LaSalle Bank ABN AMRO Plaza 540 West Madison, 26 th Floor Chicago, IL 60661 SWIFT (LaSalle Bank) or SWIFT (ABN AMRO) ABNAUS33

When other payment and trade terms are agreed upon by CSZ, charges forwarding, storage, insurance, inland freight or other special charges as a result of change from normal trade and payment terms will be the responsibility of the buyer. All price quotes are in U.S. funds. Shipping costs, insurance, banking charges, custom clearance charges, legalization of documents for import purposes, import duties, taxes and import license are the responsibility of the buyer.

18.2 WARRANTY

Warranty for all equipment for export outside the U.S. or Canada will be covered under the terms of Cincinnati Sub-Zero Products, Inc.'s domestic warranty, EXCEPT the purchaser will be responsible for all labor costs for on-site repairs or parts installation. All replacement parts provided under warranty by Cincinnati Sub-Zero Products, Inc. are shipped F.O.B. our plant (Title Transfer Point), Cincinnati, Ohio Freight Collect.

19. CANCELLATION AND TERMINATION OF WORK

Order may be cancelled by purchaser only upon payment of reasonable charges for Cincinnati Sub-Zero Products' expenses already incurred, commitments made, and other expenses arising out of termination of the work.