C-36 - ENVIRONMENTAL CHAMBERS

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This section design guidelines for includes Environmental Chambers, in the form of: Walk-In Coolers, Freezers, Warm Rooms, and Incubators.

General Requirements

Condenser Cooling

Provide a process heat exchanger utilizing the campus chilled water system as primary cooling and provide single pass domestic water backup on the process side of the heat exchanger. Design the exchanger to serve all environmental chambers in the building. Provide single point change over for entire building. The domestic water backup supply shall include backflow prevention, as required by North Carolina Building Codes, and a pressure reducing valve. The domestic water return shall be discharged to a floor drain and shall utilize a modulating control valve to maintain return water temperatures at a maximum of 75 degF (resetable). Failure of the utility chilled water system will result in rising process chilled water temperatures necessitating use of the domestic water backup and alarming the UNC Energy Management Control System.

General Notes

Refer to Building Automation Design Guidelines for sequence of operation.

Noise levels inside the chamber may not exceed 80 dBA.

Specify environmental cold rooms furnished as a complete functional unit.

1. Assembly: All metal and other materials shall be shaped and sized as required with all angles sharp and true. All surfaces shall be finished smooth. Punching and shearing shall be neatly done. Permanent connections shall be riveted or bolted. All exposed welds shall be ground smooth and flush with adjacent surfaces. Welded connections in stainless steel shall be polished to match adjacent stainless steel.
2. Panel Construction: The room shall be constructed of prefabricated metal skinned urethane panels, with exterior surfaces constructed WHITE STUCCO GALVALUME, interior surfaces of stainless steel. The panels shall be constructed of high quality components with 100 percent of each panel exclusive of its metal supports as being comprised of urethane insulation. Panels shall have tongue and groove construction with vinyl stripping fitted on the exterior and interior of each panel to provide moisture and vapor tight gasketing. Each of the rooms corners shall be performed 90 degree angles. All construction shall comply with Factory Mutual Standard 4880 for insulated wall construction. Contractor shall furnish filler panels of matching metal to extend from the exterior of the chamber walls to the building walls and lay-in ceiling. Insulation in the panels shall be a minimum of 4 inch thick rigid, poured in place, urethane foam. Foam core of panels shall be Underwriters Laboratories certified as having a flame spread of 25 or lower when tested in accordance with ASTM E-84-76. Panels shall be approved by Factory Mutual as a Class-1 building type. They shall not use CFC, HCFC or HFC blowing agents. Insulation shall remain stable at an operating temperature range of –67 to 94 degrees C (non-humidified). Panels – including floor panels - must be constructed not using any wood materials and must be all metal panel and structural support.
3. Floor: The floor panels shall be clad in the interior with stainless steel and the exterior with GALVANIZED and utilize 4” thick urethane insulation. The floor panels shall be able to withstand loading to 600 pounds per square foot.
4. Door: The door shall be fitted flush with a minimum free span of 36 inches wide and 78 inches high with the same material finish and insulation as adjacent walls. Anti condensate heater wiring shall be concealed behind the (removable) metal edge of the door jamb on all four sides. Heaters shall be

connected to a temperature control to provide sufficient heat to prevent the formation of condensation and frost at various temperature and humidity conditions. The door shall utilize a minimum of two hinges of the spring loaded self closing type with plated steel pins and Delrin cam type bearings. Designer shall consider preference to have cam action rather than spring action. Hinges and latches shall be suitable high strength steel and not "pot metal.") The door latch shall be designed to open the door easily by breaking the force of the magnetic door gasket. The door shall be able to be opened with an easily accessible pull handle. The latch shall have a cylinder lock, keyed to match existing lockset, (PK 625 KEY number) and include provisions for padlocking. The latch shall also include an inside safety release handle. Door interior/exterior materials shall be equal to adjacent panel construction.

5. Observation Window: Provide a manufacturers standard, heated observation window. The window shall consist of three panes of glass with sealed vapor spaces between them. Window shall be 14" x 24"
6. Pressure Relief Port: Pressure relief ports shall be utilized for all chambers operating at -10 degrees C or lower.
7. Chamber Size: The exterior size of the chamber shall be as large as possible fitting in the free area of the building location. The Contractor shall verify the free space available after the completion of the site preparation by the University and General Contractor.
8. Painted Finish: Finish shall be factory applied baked on enamel/polyester. Paint shall be chemical resistant and odorless. Paint shall be sprayed on and not applied with a roller or a brush to achieve a uniform texture and appearance. Paint thickness shall be a minimum of 1 mil. Color shall be white.

Chamber Accessories

Electrical Receptacles: Receptacles shall be corrosion resistant track type. (must be Hospital grade and have gasketed covers) Receptacles shall be 8 inches above bench surface and shall be on 12 inch centers along the entire length of the bench. Receptacles shall be fed by TWO separate 20 amp, 120 volt circuits each feeding every other receptacle, with two circuits per side of enclosure, connecting to panel indicated on the drawings.

1. Sleeves/Pass-throughs Ports: Sleeves for service piping, refrigerant lines, cables and drain water lines shall be cylindrical in cross section, formed of 1/8 inch or 3/16 inch PVC and sealed to chamber from both ends with silicone sealant. The void between the service line and the sleeve inside and out shall be sealed with a sealant that remains flexible. Caps shall be provided to seal pass-throughs used for equipment line passage when not in use. Provide flange on both sides of pass-through for cap to slide onto.
2. Ceiling Grid: Lay in ceiling grid shall be provided on a 2 foot by 2 foot perforated Lexan lay in ceiling grid supported by 1.5 inch by 1.5 inch anodized aluminum tees to form a positive pressure plenum at the chamber roof with return air duct or plenum below the ceiling grid to the chamber floor area.

<u>Submittals</u>

The designer shall coordinate design with UNC Refrigeration Shops. Designer shall provide one set of submittals to UNC Refrigeration Shop during preconstruction and incorporate the Shops' comments prior to returning submittals to the contractor.

Environmental Controls and Instruments

Control Console

Provide a control console incorporating a key locked door (pk 625 keyed) with a clear acrylic for viewing and protecting the settable controls. The console shall be mounted on the chamber exterior adjacent to the door if possible. The console shall include all instruments, controls, switches, pilot lights, alarm contacts and recorders including the process alarm card. This card shall provide several useful features including; the independent selection of 0-15 minute delay of each alarm action, maintained SPDT contacts for connection to remote alarm panels, defrost timer with time or temperature termination, evaporator fan delay, RH disable during defrost and user adjustable audible alarm silence timer. The control panel as an assembled unit will be labeled/listed by a certified National Testing Laboratory such as ETL, UL or MET, etc. Each control panel will provide:

1. Single point electrical connection with lockable overcurrent protection and disconnection means.
2. Automatic main power overcurrent protection and independent overcurrent protection for the fans, heaters control circuits, steam heaters dryers and receptacles.
3. All control and switch functions clearly labeled with non-fading polycarbonate labels and thus no stamping of silkscreen markings that wear off. Panel labels shall be logically organized for ease of operation.
4. Removable laminate covered side panels for protection of main control panel housing. Access panels shall be color coordinated with building color scheme and shall be replaceable if damaged.
5. Durable non painted brushed stainless-steel fronts for impact resistance and durability. These panels shall be lockable and hinged for convenient access when servicing the control panel
6. Lockable acrylic view window to prevent unauthorized to control and alarm set points.
7. Anodized aluminum interior construction with offset mounting rails to produce a natural cooling plenum behind the control panel for heat dissipation.
8. Low power level switching and indication for longevity of switches and indicators.
9. Accurate and NIST traceable temperature sensing hermetically glass sealed platinum Resistance Temperature Detectors (RTD).
10. Central wiring location and grouping for efficient trouble shooting.
11. Plug-in components where feasible.
12. Specify control panel mounting height of 72” maximum to top of panel. Mount on the latch side of the door to prevent damage from door openings.

Temperature Controller

Temperature controller shall be through a solid-state microprocessor based digital controller with RTD sensing. Sensitivity of the sensor will not be less than .01° C over the entire range of the chamber. The sensor shall be located to detect the average temperature of the chamber (and not directly in the air flow path of the evaporator discharge nor should they be mounted in the return air plenum). The control components shall control the capacity of the fully proportional refrigeration/conditioning system and shall be designed to meet the performance criteria of the chamber specified in the Project Outline. The chamber’s set point shall be set through the digital control and LED readout in degrees Centigrade (°C). The controller shall simultaneously display both the chamber set point and the actual chamber temperature. If the controller is a programmed controller contractor shall furnish any software needed to perform maintenance or repair with the chamber.

High/Low Temperature Safety Alarms

Provide the necessary sensing devices and circuits to takeover control, initiate corrective action and activate an audible and visual signal device in the event of deviation of more than 2° C from the main operating temperature set point and adjustable to match the main controller's range. The signal shall be uninterrupted until the chamber is restored to the set temperature or until silenced by an operator. Separate alarms for high and low operating temperatures shall be provided. The alarm setpoint shall be digital and shall be in °C. Provide independent maintained dry contacts for connection to the building alarm system for each alarm point. The contacts shall switch either on a loss of chamber power or an alarm condition. Each alarm shall have an adjustable 0–60-minute delay before alarm action will occur. The alarm switching power shall be low voltage and low current to prolong the life of the alarm contacts. The remote alarm contacts shall be brought out to a removable connector for ease of hook-up to the remote alarm system. The remote alarm contacts shall be plug-in replaceable and shall have both NC and NO contacts available.

Defrost Control

On chambers operating below 7°C, provide a defrost control system settable for a minimum of 6 defrost operations in a 24-hourperiod. The defrost control shall be time initiated and time or temperature terminated. The defrost system shall have the capability to accept an input from a chamber temperature sensor that will automatically disable the defrost system when the chamber is operated higher than 7° C. The defrost system duration shall be adjustable from 2-30 minutes in one-minute increments. The defrost system shall provide for an adjustable fan delay at the end of the defrost cycle to allow for precooling of the evaporator coil after the defrost period. This precooling action shall prevent the warm air in and around the evaporator coil from being introduced to the working area of the chamber at the termination of the defrost cycle. This fan delay action shall only occur at the termination of a defrost cycle and not each time the refrigeration system is started. A manual defrost timer by-pass shall be provided to defeat the defrost action when not required. A defrost test switch shall be provided which will initiate a defrost cycle on demand. This switch shall allow for additional defrost operations as required and shall facilitate a service mechanic in the check-out and service of the defrost system. Provide a pilot light on the control panel which shall remain illuminated during the duration of the defrost cycle. This pilot light shall be labeled "DEFROST".

Recorder

Provide a solid state temperature recorder with a switch selectable 8 hour-24 hour-7 day chart movement. The recorder shall utilize a 10 or 12" circular chart (12"chart recorder is preferred) and shall be mounted in the control panel and furnished with 90 day supply of charts. Chambers provided with relative humidity control shall be provided with a second pen for the recording of relative humidity levels within the chamber. The temperature channel shall be calibrated to a minimum of 10% above and below the operating range (not start-up set point) of the chamber and the hygrometer shall be calibrated over the range of 10% to 98%. Recorder accuracy shall be +/- 1% of full scale.

Humidity Control

Refrigerated dehumidification is preferred though the following manner is acceptable.

1. Provide refrigerated dehumidification integrated into the pressurized supply air plenum. Electric reheat dehumidification will NOT be accepted. Capable of maintaining chamber relative humidity at 60% when operated at 4°C with accuracy of +/- 1%. Humidification during high temperature operation shall not be required. The system shall control humidity through a microprocessor based digital controller with readout in percent RH. The RH sensor shall be a variable capacitance sensor or a hygroscopic plastic foil sensor, temperature –compensated and calibrated over the entire range of the chamber. The sensor shall be located within the chambers airflow to provide maximum sensitivity and

fast response to changes within the chamber. Wet bulb/dry bulb, lithium chloride, gold grid, bulk resistance or similar sensors shall not be acceptable.

Refrigeration

Condensing Unit General
Unit and all system components shall be designed for operation on 134A Refrigerant for coolers designed for 0-10degC and 404A for operating below 0 degC. Unit shall be designed for operation on building electrical power. A single 120 volt power supply shall supply power to the control console, the chamber receptacles, lighting.

Locate condensing units behind or beside the chamber in a chase or mechanical room providing sufficient access on all sides, to facilitate maintenance. DO NOT LOCATE CONDENSING UNITS ON TOP OF CHAMBER. The preferred location is 28" above the floor unless there is room for maintenance and repair and approved by UNC's Refrigeration Shop.

Compressor/Condensing Unit
The compressor/condensing unit shall be water cooled and shall be appropriately sized for the specified operating range. The compressor/condensing unit shall provide safe operation in its specified location remote from the chamber. All components of the condensing unit shall be designed for the greater of 300PSIG working pressure or 150% of maximum operating pressure. The semi- hermetic compressor unit shall have a minimum of a high/low pressure safety control, receiver with fusible plug, low oil pressure safety, liquid line dryer with sight glass, crankcase pressure regulator, accumulator, vibration eliminators and thermal protection. Cycling solenoids shall not be acceptable for capacity control but shall be furnished to provide for pump-down only.

A fully proportional modulating refrigerant valve on the hot gas line shall be used for capacity control

The condensing unit shall be designed for continuous operation to maximize compressor life, eliminate on/off cycling and minimize RF interference. False loading of the compressor to cause continued operation will NOT be allowed. Unit shall be provided with a modulating water flow valve to regulate head pressure. Provide cleanable shell and tube heat exchanger.

Provide service lighting and 120V receptacle for service and repair of condensing unit outlet located on the same level and within 10 ft of the condensing unit.

The compressor/condensing unit shall be linked to a matching evaporator designed to maintain the specified operating conditions. The condensing unit shall have a single point electrical connection point and shall be connected to an appropriate disconnect switch provided by the Chamber contractor.

Evaporator/Horizontal Ceiling Plenum
The chamber shall be provided with a custom stainless steel ceiling plenum with internal motor driven blowers and copper coils. Modified stainless steel unit coolers or commercial evaporators shall not be acceptable. The ceiling plenum shall contain evaporator coil ,copper tube/ copper fins with stainless steel end plates to prevent corrosion, an insulated condensate drain pan and dehumidification inlet/outlet. The plenum shall force conditioned air continuously across the ceiling and down over the work surface through a perforated prismatic

Lexan ceiling grid system. Drainage during operation and during defrost shall be collected in the insulated drain pan and run through a trapped ⅞" copper drain line to the casework within the chamber or to a specified drain point outside of the chamber within 10'. The drain piping shall be easily removable from the drain pan for pan access. All metal surfaces and hardware shall be stainless steel to resist corrosion. Air returns shall be equipped with removable, cleanable mesh air filters to protect the evaporator coil surface. The exposed surfaces of the ceiling plenum shall be 304 stainless steel with No. 3 finish. All access shall be through the drain pan allowing all walls to remain free of disturbance during access. Fans shall be direct drive centrifugal blowers with forward curved blades.

1. Sub Assembly Quality Control: The above mentioned sub-assemblies: condensing unit, evaporator, and plenums, shall be evacuated to <500 microns and held for > 5 hours prior to pre-charging with 150 PSIG of dry nitrogen. The unit shall be tagged with the dry nitrogen charge pressure, ambient temperature, date and the testing technician's initials. Units shall be shipped with the test charge in tact and pressures evaluated after installation. Upon start-up, unit shall be evacuated of nitrogen and charged with the proper refrigerant charge. Evacuation shall be witnessed by UNC Refrigeration Shop.
2. Chamber Dehumidification: Chamber shall be equipped with dehumidification capabilities which utilize a refrigerated dehumidification coil designed as an integral part of the evaporator plenum. This dedicated coil will be housed inside of the evaporator plenum for condensate removal to a double wall stainless steel drain pan system. The dehumidification coils will be provided with specific valving to obtain the temperatures necessary to maintain the required humidity levels for the chamber. The control shall be through a separate solid-state microprocessor based digital controller mounted on the control panel. Dehumidification by desiccant or refrigeration and reheat shall not be acceptable.

Refrigerant Piping
Piping shall consist of Type "ACR" hard copper tubing and fittings. Joints shall be made with a high pressure silver bearing solder with a silver content of =>15 %, (Harris Stay-Silv 15 or equivalent). 95-5 solder or stabrite will not be acceptable. Refrigerant piping shall be sized in accordance with the ASHRAE Handbook, (1998 Refrigeration Volume, Chapter 2). Suction line shall be insulated with closed cell pipe insulation. Insulation shall have a flame spread rating of less than 25 and a smoke density rating of less than 50 as certified by ASTM E-84 tunnel testing. Adhesives used in the application of pipe insulation shall be designed for use with that product and maintain fire ratings. All penetrations in the insulation shall be sealed to maintain a moisture tight barrier. Insulation shall be sealed to the tubing at termination points.

<u>Performance</u>

Temperature Fluctuation
Room temperature swing during normal operation with the door remaining closed shall be less than ½° C.

Temperature Range
All chambers shall be designed to operate AND PERFORM AS ABOVE at any setting between 0 to 10° C.

Uniformity
Room temperature shall remain uniform within +/-2 degree C. for 24 hours and tested with a multi port recorder with at least 12 sensors over the entire range of operation (0-10 degrees C.) Specify that test

results are to be submitted to the University.

Capacity
The refrigeration system and all related components shall be capable of maintaining the temperature within the specified limits without operation at full capacity more than 80 percent of the time.

Humidity Control
The chamber shall be designed to be capable of lowering the relative humidity to 65% during low temperature operation. Humidification during high temperature operation is not required.

Training:
The manufacturer shall provide 1-day (8-HRS) of on-site training for the preventive maintenance, calibration, repair and operation of the chambers. The manufacturer shall also include at least one seat in their factory training school for each chamber supplied to the university at no charge. To be used as university workload permits.

Warranty
The room enclosure and its fixtures and components shall be guaranteed for a period of five years one year unconditionally and four for parts. The compressor and refrigeration circuit shall be guaranteed for a period of five years one year unconditionally and four years for parts. Repair and/or replacement of warranty components shall be performed at no cost to the Owner. The manufacturer must have factory trained service technicians on call to respond to emergency service 24-7, 365 days a year, with a maximum response time of 4 hrs.