

The following standard specification is intended to be edited according to the specifics of the project. Brackets [ ] and areas shaded in gray [e.g. format] indicate requirements that are optional depending upon the type of system being provided or per instructions associated with the [ ] and project requirements. Consult with University's Representative and campus stakeholders.

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## SECTION 13 21 00 CONTROLLED ENVIRONMENT ROOMS

### PART 1 - GENERAL

#### 1.1 GENERAL REQUIREMENTS

- A. Factory assembled self-contained [refrigeration] [and heating] system rooms shall include modular metal clad construction with all the essential controls and equipment, benches, shelving, interior electrical power distribution and light fixtures, controls and instrumentation, refrigeration piping, electrical power connections, inter-wiring and all other work to provide a complete operational room.

#### 1.2 REFERENCES

- A. Controlled temperature rooms shall be constructed in accordance with National Sanitation Foundation (NSF) and Underwriters Laboratories (UL).
- B. Controlled temperature room insulated panels shall comply with current EPA Regulations and the Clean Air Act.
- C. Construction shall conform, as applicable, to the requirements of the National Sanitation Foundation Testing Laboratory, Underwriters Laboratories, and Class One Building Type construction of Factory Mutual Approval Standard #4880 for insulated wall construction and shall be listed on panels for environmental rooms, cold rooms, freezer applications and warm rooms.

#### 1.3 SUBMITTALS

- A. Contractor shall submit certification that the special tests have been performed and that products meet or exceed specified requirements.
- B. Operation and Maintenance Manuals: Instructions for sequential operation, start-up and shutdown, with pertinent control data including any programming or operating software, and schematics, room arrangement, and component parts list to provide sufficient information for the University's personnel to operate, maintain, and repair all equipment.

#### 1.4 WARRANTY

- A. Minimum of 15 year insulated panel warranty.
- B. Minimum of 5 year compressor warranty.

### PART 2 - PRODUCTS

#### 2.1 MATERIALS

- A. Manufacturers

1. Conviron, EGC, Enconair or equal.
2. Manufacturer of Growth Chambers shall be an ISO 9001 registered company specializing in the manufacture of complete packaged prefabricated controlled temperature rooms.
3. Only single source suppliers will be acceptable supplying all components, with satisfactory installations of similar equipment, in operation for at least 5 years. A minimum of 100 rooms shall have been installed within the past 5 years.

B. General Construction

1. All surfaces shall be designed for easy cleaning and maintenance.
2. Wall, ceiling and [floor] sectional panels.
  - a. Shall be prefabricated modular construction consisting of 100 percent foamed in place urethane insulation 4 inch thick, bonded by an adhesive to interior and exterior metal pan skins and heat cured for life long stability.
  - b. Panels shall have widths of 6 inch increments, with a minimum width of 6 inches and a maximum width of 48 inches and bear the UL and NSF label.
  - c. The panels shall incorporate cam lock type fasteners as joining devices for tongue and groove panels.
  - d. Mechanical panel fasteners shall have wings, which provide the necessary strength to support the cam action of the locking mechanism when the panels are drawn together. Access holes to the locking mechanism shall be cleared of foam and concealed with NSF listed synthetic plug buttons to provide a sanitary seal.
  - e. The panel edge shall have a gasket, which provides a positive seal that meets NSF standards.
3. [Floors]
  - a. If controlled temperature rooms are floor-less rooms they shall be supplied with PVC extruded floor channels with semi-flexible edges, which seal to building floor without the use of exposed fasteners.
  - b. Floor sealer or epoxy floor finish shall meet NSF requirements for floor and cove base.]
4. Doors
  - a. Entrance door shall be in-fitting, flush design with a minimum opening of 36 inches width by 78 inches height, mounted within a panel.
  - b. The door section shall provide 4 inches of polyurethane insulation; construction and finish shall be the same as the adjoining wall panels. Incorporate a heavy-duty, molded ABS breaker strip, permanently foamed-in-place.
  - c. Bottom of door shall seal with an adjustable double sweep gasket.
  - d. Door frame shall be a fully coved, extruded, welded, structural anodized aluminum, rigid frame design for easy cleaning and maintenance.
  - e. Threshold plate provided shall be extruded aluminum.
  - f. Rooms operating at or below 0 degrees Celsius shall have an anti-sweat heater wire around the entire perimeter of the door opening and under the threshold to provide enough heat to prevent condensation. Heater wire shall be provided in an electrically safe housing and be easily replaceable without the need for clips or special tools. All conduits for the inner wiring of the door panel shall be totally concealed in the polyurethane foam panel; exposed conduit is not acceptable. Door shall be field wired to surface mounted junction box on the interior door panel.
  - g. Door hardware shall be high-pressure die-cast zinc with polished chrome finish. Hardware shall include a hydraulic piston driven door closer, cam lift hinges, and handle with bumpers and inside safety release. All hardware shall be attached to extra large 1/2 inch thick, non-conducting synthetic tapping plates.
  - h. Provide lock, field selectable to allow for keyless entry or automatically lock each time. A 6 pin, full face, mortise cylinder lock shall incorporate a removable core compatible with [DP to State System Selected for Project]. University will provide and install final core cylinder and keying.

- i. The interior assembly shall be complete with bump bar.
  - j. Exterior shall be free of bolts and shall have a large aluminum handle mounted by means of through bolts to a 1/4 inch aluminum faceplate.
  - k. Provide adequate type and quantity of hinges with reinforcement to prevent the door from sagging.
  - l. Door observation window shall be three-pane tempered Sealed Insulating Glass Manufacturers Association (SIGMA) approved safety glass. Rooms operating below 0 degrees Celsius shall have heated frames and heated glass. A light tight removable window cover shall cover entire observation window and be easily installed or removed.
  - m. Factory install a kick plate, 16 gauge stainless steel or 1/8 inch aluminum diamond tread, to the interior and exterior of door, and frame surface and shall extend 36 inches above the floor.
5. Lighting [Note to Specifier: Items listed are a minimum. Identify lighting specific to use with the University's Representative.]
- a. Cool white, 4 foot fluorescent, 115 VAC lamps. Lamps and low temperature ballasts, designed for use in damp and wet locations.
  - b. Rooms operating below freezing shall utilize vapor-proof gasket equipped UL listed light fixtures, made of cast aluminum with Lexan, or equal globes.
  - c. All light fixtures shall be surface mounted on the ceiling to maintain a light intensity of 70 foot-candles 40 inches above floor.
  - d. Locate light switch(s) with pilot light adjacent to each door with all inner wiring in rigid conduit concealed inside the door section and terminated at a surface mounted junction box on the interior and exterior door frame.
6. Instruments and Control Systems
- a. A control panel incorporating a key locked door.
  - b. Temperature controller shall have fully programmable microprocessor providing interface through a light emitting diode, vacuum fluorescent or a liquid crystal alphanumeric display. Dials, toggle switches, calibration via set point and non-alphanumeric controls are not acceptable. The temperature controller shall have the ability of 3 modes of operation, manual, automatic with local set point, automatic with remote set point. Controller output algorithms shall have the feature to select the following output algorithms, on-off or time proportional, on-off duplex, three position step control, or time proportional duplex, current proportional, current proportional duplex, current/time duplex. Single or double setpoint controllers are acceptable when the environmental room merits static temperature control conditions. All set points shall be adjustable by the multifunction interface keypad. Process Logic Controllers shall not be used for temperature or humidity control. If defrost cycle control logic resides in PLC, provisions shall be integrated with real time clock functionality. IE: External time clock utilizes a digital input into PLC to initiate defrost cycle. The specified controllers shall have replacement parts deliverable within 48 hours. Control panel components features shall include: Sensors with a repeatability of better than  $\pm 0.07$  degrees Celsius; room temperature display shall be selectable for Fahrenheit or Celsius scale. Temperature and personnel alarms shall be dedicated solely for their respective functions.
  - c. Temperature high/low alarm sensors shall be independent of temperature/humidity controller sensors. Alarm control shall have an audible and visual indicator. The alarms shall feature the option of user adjustable time and temperature/humidity limits. Audible alarms shall offer an alarm silence feature. Power failure alarm shall auto reset after power interruption.
  - d. System shall be expandable for the addition of a real time clock, RS422/RS485 serial communication interface with capabilities for operator or monitoring of the entire system via host computer.
  - e. System shall have a minimum of 2 digital inputs, 2 analog inputs, 2 digital outputs to allow for additional user selected operating devices.
  - f. Provide temperature recorder. [If required – DP to delete if not]. The chart recorder shall be stand alone with its own same process variable sensor. The recorder shall be a

- minimum 10 inch circular chart recorder with 7 day 24 hour pre-formatted charts. Its input shall be capable of accepting Thermocouple, RTD, 4/20 MA, MV and voltage input signals. Circular chart recorder shall have an accuracy of at least +/- 0.35 percent, and a scan rate of 330 MS. It shall have a built-in self-testing feature be able to have minimum of 2 inputs and dip switch configuration. Models shall be Underwriters Laboratories, Canadian Standard Association, CE (UL/CSA/CE) approved. Honeywell, Wattlow, or equal.
- g. Humidity Controller/Recorder: [If required – DP to delete if not]. Same as Temperature controller.
  - h. A complete wiring and control diagram shall be permanently affixed to the inside of each control panel.
7. [Note to Design Professional: Process Logic Controllers (PLC) controllers are . If PLC's are to be specified, refer to the following:] Process Logic Controllers (PLC): Provide all software, programming and hardware for a complete and fully functioning PLC package.
- a. Manufacturers: Allen-Bradley, G.E., Siemens, or equal.
  - b. Licensing: If applicable
    - (i) Include licensing for all project-specific software and programming at all required servers and workstations and their operating systems.
    - (ii) Provide licensing and original software copies for each specified server or workstation.
    - (iii) Licenses for remote workstations shall allow for access and shall not be restricted.
  - c. Software Functionality and Completeness: The Contractor shall furnish and install all software and programming necessary to provide a complete and functioning system as specified. The Contractor shall include all software and programming not specifically itemized in these Specifications which is necessary to implement, maintain, operate, and diagnose the system in compliance with these Specifications.
  - d. System Management and Supervision: The system software shall allow centralized overall system supervision, operator interface, management report generation, alarm annunciation, and communication with control units. It shall allow system operators to perform the following functions from the Operator Interface, Portable Operator's Terminal, and Hand Held Operator's Terminal.
    - (i) Monitor and supervise control of all points.
    - (ii) Add new points and edit the system database.
    - (iii) Change control setpoint, timing parameters, and loop-tuning constants in all control units.
    - (iv) Enter programmed start/stop time schedules.
    - (v) View alarms and messages.
    - (vi) Modify existing control programs in all control units
    - (vii) Upload/Download programs, database, etc. as specified.
  - e. Control Unit Software: Primary Control Unit Software Residency: Each Primary Control Unit shall be capable of control and monitoring of all points physically connected to it. All software including the following shall reside and execute at the Primary Control Unit.
    - (i) Real Time Operating System software
    - (ii) Real Time Clock/Calendar and network time synchronization
    - (iii) Primary Control Unit diagnostic software
    - (iv) LAN Communication software
    - (v) Direct Digital Control software
    - (vi) Alarm Processing and Buffering software
    - (vii) Energy Management software
    - (viii) Data Trending, Reporting, and Buffering software
  - f. Control Unit Programming Method
    - (i) Application software shall be user programmable.

- (ii) This specification generally requires a programming convention that is logical, easy to learn, use, and diagnose. Application programming shall be provided by the following conventions:
      - (iii) Database Creation: provide templates customized for point type, to support input of individual point information.
      - (iv) The method of programming must be able to accomplish sequences as specified. Both line-type programming and graphic block programming are acceptable, provided that programming can be annotated and follow standards that are consistent and supported by manufacturer's operational literature and training. The programming can be formatted using line-by-line text or graphical block representation.
      - (v) Line-byline Text Programming: Programs shall contain comment lines that can exist without affecting the processing and command outputs of the programming. Provide a utility to compile programming language and indicate faults with the usage of the programming protocol. Line-type programming which uses text programming in a language similar to BASIC is acceptable.
    - g. Contractor may provide a means for testing and debugging customized programming. However, no debugging program shall substitute for actual live verification of the program's ability to provide actual on-line control. Commissioning checklists shall be utilized to determine the final effectiveness of programming to meet the intent of the Specifications and its sequences.
- 8. Refrigeration Systems
  - a. Shall include high/low pressure controls, receiver, sight glass, liquid line filter dryer, suction accumulator, vibration eliminators, expansion valves, evaporator mounting kit, and other equipment required to achieve the performance specified.
  - b. Provide an air cooled or water cooled condensing unit in Condensing unit shall feature a semi-hermetic or scroll compressor designed for industrial use.
  - c. The condensing unit shall be factory assembled.
  - d. Compressor shall be designed to perform in the ambient conditions of its location.
  - e. Placement of the condensing unit shall be installed to meet all service access clearances recommended by the manufacturer.
  - f. Evaporator Coil: Copper tube, aluminum fin. Evaporators shall be forced air type designed for ceiling installation. Fan motors, guards, multi-fin and tube-type coil shall be housed in heavy gauge aluminum housing. Unit shall have drain pan with suitable drainpipe connection.
  - g. Evaporators for use at or below 0 degrees Celsius shall use electric defrost and be time initiated, incorporated with a time clock, and temperature terminated with built-in fail-safe.
  - h. Rooms requiring heaters to maintain specified temperature shall have strip heaters mounted to unit cooler housing. Strip heaters shall have chrome steel sheath with large finned area.
  - i. Pre-charged refrigeration systems, shall be furnished to match refrigeration equipment and shall be factory assembled and pre-charged ready for field installation using quick connect fittings and interconnecting wiring harness for single point electrical connections.
  - j. Provide hot gas by-pass for capacity control.
  - k. All refrigeration pressure relief lines shall be piped to a location outside the building 20 or more feet from any building outside air intake.
  - l. All pressure controls shall utilize flex hoses and not capillary tubes.
  - m. Replaceable liquid line driers or cores shall be included on all systems. Replaceable suction driers or cores shall be provided.
  - n. All systems with outdoor condensers or condensing units shall be provided with low ambient controls including a crankcase heater and a condenser fan control.
  - o. Air cooled condensers shall be designed for a 105 degree ambient temperature.
  - p. Hot gas bypass valves shall be installed with Schrader valve access and isolation ball valves.
  - q. An oil failure control shall be required on all semi hermetic compressors with an oil pump.

- r. Refrigerant piping shall be pressure tested to 175 PSIG. Test pressure shall not exceed the maximum rating of the weakest component of the system.
  - s. Each system upon completion of the pressure test shall be evacuated to a minimum of 500 microns. The system shall hold 500 microns for twenty minutes without deviation of more than 10 percent.
  - t. Signage must be applied to the entrance door or control panel of all custom designed or engineered conditioned rooms or spaces, clearly stating the designed operating temperature and/or humidity parameters.
9. Electrical Systems
- a. All components shall be UL listed or recognized with interior wiring practices for use in damp or wet locations, in accordance with UL and the National Electrical Code. Conductors shall conform to Article 310 and motors to Article 410 of the NEC.
  - b. All panels requiring 115V/60Hz/1 Phase electrical shall be provided with concealed through panel electrical conduit stubbed to junction box on the exterior ceiling and ready for final connection.
  - c. Exposed conduit on the interior or exterior of the refrigerated room is not acceptable.
  - d. Personnel Emergency Alarm: Reset type electronically powered personnel emergency alarm system powered from the room electrical input. The system shall consist of a heavy-duty actuator with a red button marked, "EMERGENCY ALARM - PULL TO RESET" mounted on the interior wall of the room adjacent to the doorjamb 12 inches above the floor. The system shall have audible and visual alarms affixed to the front exterior of the room. The audible alarm shall provide a high decibel level of sound output at a frequency different from room parameter alarms. The visual alarm shall be prominently labeled "PERSONNEL EMERGENCY." Alarm shall also include a set of dry contacts for user connection to a remote alarm station.
  - e. Provide plastic sleeves, sealed, and insulated at all panel penetrations and provide escutcheons on interior and exterior panel surface.
  - f. Seal or otherwise ensure that fastenings do not compromise vapor barriers or insulation. Seal all service penetrations for piping and sleeves. Seal all electrical conduits to prevent condensation from accumulating in light fixtures and junction boxes.
  - g. Both the evaporator and condensing unit shall be on dedicated circuits and shall have a disconnect switch for each unit with weather proof labels identifying the appropriate circuit(s).

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

[To be specified by Design Professional]

- A. Mechanical refrigeration or any other related equipment or components shall not be located such that penetration of the cooler structure is required.
- B. Service access shall not require entry through the cooler to service related equipment.
- C. Manufacturer's recommended service clearances shall be adhered to if mechanical equipment is mounted on cooler roof.
- D. If water cooled, a secondary pan shall be positioned to capture and drain water away, preventing damage to any surrounding equipment or structure.

#### 3.2 TESTING & INSPECTION

- A. Major components shall be factory tested prior to delivery and include leak tests of the entire refrigeration circuits or devices, and a run test of fans, motors and compressors.
- B. Provide equipment and labor for testing. Tests shall confirm that rooms conform to the following requirements:

1. After operating temperature is reached, door shall be fully opened to 24 degrees Celsius ambient for one minute. Room shall recover to operating temperature within 5 minutes after closing door.
2. Control Sensitivity: Control sensitivity is defined as the temperature measured at the point where the prefabricated room temperature control-sensing element is placed. The control sensitivity is to be  $\pm 1.0$  degrees C of the specified set point.
3. Temperature Control: Temperature control of  $\pm 1.0$  degrees C in controlled environmental rooms shall be temperature at the sensor and shall be the total variation in the temperature control of the room.
4. Gradient: Maximum temperature differential between any 2 points within the environmental room. Gradient from floor to ceiling shall not be more than 2 degrees C.
5. Uniformity: The actual allowable variation in temperature measured on a horizontal plane 40 inches above finished floor (AFF) and within 12 inches of walls throughout the room.
  - a. Temperature uniformity of 1.0 degrees C refers to the maximum allowable variation in temperature as measured on a horizontal plane 40 inches AFF and within 12 inches of walls throughout the entire room.
  - b. Uniformity shall be measured by a multipoint recorder utilizing a minimum of 12 thermocouples during a continuous 12-hour test period.
6. University's Representative shall witness and confirm test results. Notify University's Representative in writing, prior to test.
7. Provide acceptance testing in the presence of a factory-trained representative, and University's Representative. Contractor shall verify that the prefabricated rooms operate and meet the specified parameters. A copy of this document shall be delivered to the University's Representative and to the room manufacturer.

#### C. Training

1. Provide manufacturer's representative who shall demonstrate proper operation and train University's personnel in the proper operation and maintenance of this equipment.
2. Schedule training with University's Representative at least 10 business days in advance to allow coordination with University staff schedules and shifts.

END OF SECTION 13 21 00