

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. Furnish and install laboratory controlled environment rooms complete with equipment, controls, accessories, hardware, electrical and mechanical systems, and all other work to provide a completely operational room and as shown on plans.
- B. Types:
 - 1. Controlled Environment Rooms to operate between [+1°C to +4°C] and between 50%RH to 90%RH.

1.2 REFERENCES

- A. Comply with requirements of general and supplementary conditions and Division 1 as part of this specification.
- B. Controlled Environment Rooms shall be constructed in accordance with National Sanitation Foundation (NSF) and Underwriters Laboratories (UL).
- C. Controlled Environment Rooms insulated panels shall comply with current EPA Regulations and the Clean Air Act.
- D. 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.

1.3 SUBMITTALS

- A. Submit as specified herein and under provisions of Division 1 "Submittal Requirements".
- B. Materials List/Product Data: Submit complete materials list, including catalog data, materials, equipment, and products.
- C. Shop Drawings: Submit complete shop fabrication and installation drawings, including plans, elevations, sections, details and schedules. Show relationship to adjoining materials and construction.
- D. Detailed anchorage and attachment Drawings and calculations provided by a licensed Structural Engineer complying with the California Administrative Code, Title 24 Seismic Restraint requirements.
- E. Photometric Lighting Calculations: Furnish calculations indicating illumination levels provided. Submittal shall include five plane photometric data for fixture to be furnished.
- F. Certification that the special tests have been performed and that products meet or exceed specified requirements.

- G. Manufacturer and Contractor qualifications as described in the "Quality Assurance" article below.
- H. 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.
- I. Certification and Testing: Acceptance testing shall be performed by the controlled environment room Contractor on completion of the installation and shall consist of demonstration of sustained operation for 24 hours at the minimum temperature, the maximum temperature and one intermediate temperature condition. The recorder charts will be provided to and retained by the University. Acceptance shall be provided upon completion of the acceptance test, as witnessed by the University's Representative and factory personnel.
 - 1. Provide written certification from the manufacturer that room performance complies with specified criteria; equipment is installed per applicable codes and standards, adjusted and ready for intended function.
 - 2. Certification and test results shall be provided prior to, and be a requirement for, Substantial Completion.

1.4 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Manufacturer of field erected Controlled Environment Rooms shall be single source supplier of 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.
 - 2. Installation of field erected Controlled Environment Rooms shall be the manufacturer or the manufacturer's approved sub-contractor with a minimum of five years installation experience and 10 similar rooms.

1.5 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. Controlled Environments Inc. (Convion)
 - 2. Percival
 - 3. Environmental Growth Chambers (EGC)
 - 4. Enconair Ecological Chambers Inc.
 - 5. Or equal.
- B. Room Performance Parameters
 - a. Control Sensitivity: Control sensitivity is defined as the temperature measured at the point where the room temperature control-sensing element is placed.
 - (1) The control sensitivity shall be ± 1.0 degrees C of the specified set point.

- b. Temperature Uniformity: Temperature Uniformity is defined as the actual allowable variation in temperature measured on a horizontal plane 40 inches above finished floor and within 12 inches of walls throughout the room.
 - (1) Temperature uniformity shall be ± 1.0 degree C of the specified set point.
 - (2) Uniformity shall be measured by a multipoint recorder utilizing a minimum of 12 thermocouples during a continuous 12-hour test period.
 - c. Temperature Gradient: Temperature Gradient is defined as the maximum temperature differential between any 2 points within the room.
 - (1) Gradient from floor to ceiling shall not be more than 2 degrees C.
 - d. Humidity control: Humidity shall be maintained between 50%RH and 90%RH $\pm 5\%$ RH and shall be controlled to avoid condensation on room surfaces under operating conditions.
 - e. Recovery: Room shall recover preset operating temperature within five minutes after door has been fully opened to 75°F (24°C) ambient for a period of one full minute.
- C. General Construction
- 1. All surfaces shall be designed for easy cleaning and maintenance.
 - 2. Wall, ceiling and [floor] sectional panels.
 - a. Maximum Exterior Dimensions: [9'6"W x 12'6"D x 10'H] or nearest standard dimensions offered by the manufacturer to match dimensions shown on plans.
 - b. Total Interior Area: 104 square feet or nearest standard area offered by the manufacturer.
 - c. 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.
 - d. 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.
 - e. The panels shall incorporate cam lock type fasteners as joining devices for tongue and groove panels.
 - f. Mechanical panel fasteners shall have wings with 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.
 - g. The panel edge shall have a gasket to provide a positive seal that meets NSF standards.
 - 3. [Floors]
 - a. Shall be minimum 4" thick, insulated galvanized steel floor with non-slip surface.
 - b. Floor sealer or epoxy floor finish shall meet NSF requirements for floor and cove base.
 - c. Removable exterior entrance ramp to be provided with a slope of 1:3.]
 - 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. Door 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. The interior assembly shall be complete with bump bar.
 - i. 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.
 - j. Provide adequate type and quantity of hinges with reinforcement to prevent the door from sagging.
 - k. Door observation window shall be three-pane tempered Sealed Insulating Glass Manufacturers Association (SIGMA) approved safety glass, with heated frames and heated glass. A light tight removable window cover shall cover entire observation window and be easily installed or removed.
 - l. 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. All light fixtures shall be surface mounted on the ceiling to maintain a light intensity of 70 foot-candles 40 inches above floor.
 - b. Lighting fixtures shall be sealed vapor-proof fixtures with LED source.
 - c. Locate light switch 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 of the room on the strike side of the door.
6. 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. Provide two duplex receptacles inside the room.
 - e. Personnel Emergency Alarm: Reset-type electronically powered personnel emergency alarm system powered from the room electrical input.
 - (1) 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 door jamb 12 inches above the floor.
 - (2) The system shall have audible and visual alarms affixed to the front exterior of the room.
 - (3) 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.
 - f. Provide plastic sleeves, sealed, and insulated at all panel penetrations and provide escutcheons on interior and exterior panel surface.
 - g. 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.
 - h. Both the evaporator and condensing unit shall be on dedicated circuits and shall have a disconnect switch for each unit with weatherproof labels identifying the appropriate circuit(s).
7. Refrigeration Systems
- a. Provide a factory assembled, air cooled condensing unit with a semi-hermetic or scroll compressor designed for industrial use and able to operate at 105 degree F ambient temperature. The unit shall be provided with low ambient controls including a crankcase heater and a condenser fan control. Provide hot gas by-pass for capacity control.
 - b. Placement of the condensing unit shall be installed to meet all service access clearances recommended by the manufacturer and as shown on the contract drawings.
 - c. 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.
 - d. Evaporators shall use electric defrost and be time initiated, incorporated with a time clock, and temperature terminated with built-in fail-safe.
 - e. System 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.
 - f. 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.
 - g. All refrigeration pressure relief lines shall be piped to a location outside the building 20 or more feet from any building outside air intake.
 - h. All pressure controls shall utilize flex hoses and not capillary tubes.

- i. Replaceable liquid line driers or cores shall be included on all systems. Replaceable suction driers or cores shall be provided.
 - j. Hot gas bypass valves shall be installed with Schrader valve access and isolation ball valves.
 - k. An oil failure control shall be required on all semi hermetic compressors with an oil pump.
 - l. Refrigerant piping shall be pressure tested to 175 PSIG. Test pressure shall not exceed the maximum rating of the weakest component of the system.
 - m. 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.
 - n. 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.
8. Ventilation
- a. Furnish room with:
 - (1) An air inlet with adjustable slide damper positioned on the negative pressure side of the room air handling system.
 - (2) An air exhaust port with adjustable slide damper positioned in the ceiling at the opposite end of the room from the fan coil assembly (positive pressure side).
 - (3) Adjust the slide dampers to provide make-up air from the laboratory space at the rate of 0.25 CFM per square foot (4.57 m³/h per square meter).
9. Instruments and Control Systems
- a. Provide a control panel incorporating a key locked door, on left side of chamber face.
 - b. Temperature and Humidity controller shall have fully programmable microprocessor providing interface through a light emitting diode, vacuum florescent or a liquid crystal alphanumeric display. Dials, toggle switches, calibration via set point and non-alphanumeric controls are not acceptable.
 - c. The temperature controller shall have the ability of three modes of operation:
 - (1) manual
 - (2) automatic with local set point
 - (3) automatic with remote set point
 - d. Controller output algorithms shall have the capability to select the following output algorithms:
 - (1) on-off or time proportional
 - (2) on-off duplex
 - (3) three position step control
 - (4) time proportional duplex
 - (5) current proportional
 - (6) current proportional duplex
 - (7) current/time duplex
 - e. All set points shall be adjustable by the multifunction interface keypad.

- f. The specified controllers shall have replacement parts deliverable within 48 hours.
- g. Control panel components features shall include:
 - (1) Sensors with a repeatability of better than ± 0.07 degrees Celsius
 - (2) Room temperature display with selectable Fahrenheit or Celsius scale
- h. Temperature and personnel alarms shall be dedicated solely for their respective functions.
- i. 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.
- j. 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.
- k. System shall have a minimum of 2 digital inputs, 2 analog inputs, 2 digital outputs to allow for additional user selected operating devices.
- l. A complete wiring and control diagram shall be permanently affixed to the inside of each control panel.

10. Humidity Control Systems:

- a. General: Humidity shall be maintained at a level set by the user and to avoid condensation on room surfaces under operating conditions.
- b. Humidification: Provide atomized water spray or centrifugal atomizing unit with constant level water control, sized and controlled for the load conditions and operating specified parameters. Provide all wiring and controls incorporated into room control panel.
- c. Dehumidification: Provide automatic, continuous duty, desiccant drying system. Process air shall be removed from the room and the dehumidified air shall be reintroduced to the room in a manner so as not to affect room temperature uniformity. The drying system shall include a Honeycomb type desiccant dryer, insulated ductwork, blower, wiring, and controls incorporated into room control panel. Coordinate ventilation requirements with mechanical contractor in ensure sufficient dry reactivation air is available at the inlet to the dehumidifier.

11. Signage

- a. Signage must be applied to the entrance door or control panel of the room clearly stating the design operating temperature and humidity parameters.

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.

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 acceptance testing in the presence of a factory-trained representative, and University's Representative. Notify University's Representative in writing, prior to test.
- C. Contractor shall verify the prefabricated room operates correctly and meets the specified parameters. A copy of the documented test results shall be delivered to the University's Representative and to the room manufacturer.
- D. Provide equipment and labor for testing.
- E. Tests shall validate the room conditions conform to the requirements listed in paragraph 2.1/B Room Performance Parameters. Perform the following tests:
 - 1. Control Sensitivity
 - 2. Temperature Uniformity
 - 3. Temperature Gradient
 - 4. Humidity Control
 - 5. Recovery

3.3 Training

- A. Provide manufacturer's representative who shall demonstrate proper operation and train University's personnel in the proper operation and maintenance of this equipment.
- B. 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