

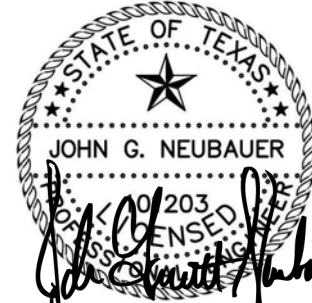
Addendum

Distribution	<input checked="" type="checkbox"/> Owner	<input type="checkbox"/> Consultants	<input checked="" type="checkbox"/> Bidders	<input type="checkbox"/> Other (describe)
From	Scott L. Tucker, Principal Page Southerland Page, Inc. 1100 Louisiana, Suite One Houston, TX 77002		Owner	MD Anderson Cancer Center Facilities Planning, Design and Construction 6900 Fannin Street, 10th Floor Houston, TX 77037
Project	MDACC CRB Cold Rooms Access Issues MDA Clinical Research Building 6767 Bertner Street Houston, TX 77005		Architect's Project No.	417008.02
Date of Issue	April 30, 2018		Addendum No.	01
Contract For	For Bids Due			

Seals



04/30/2018



4/30/2018

Revised Drawing List

This addendum includes drawing sheets that have been added or revised as of **April 30, 2018**. Please replace any prints from the original issue set with those below marked "R" and ADD sheets marked "A" to your bidding documents.

Sheet No.	Rev. Date	Status	Drawing Title
(none)			

This Addendum 01 is hereby incorporated into the Contract Documents for the Project referenced above, modifying and superseding any previously issued Contract Documents.

This Addendum includes the following changes to the Work:

Section No.	Rev. Date	Status	Section Title
00 00 02	04/30/2018	R	Table of Contents
13 21 00	04/30/2018	R	Controlled Environmental Rooms

This Addendum 01 is hereby incorporated into the Contract Documents for the Project referenced above, modifying and superseding any previously issued Contract Documents.

Table of Contents Generated by MasterWorks: 12/4/2017

Division	Section Title	Pages
----------	---------------	-------

	2013 Uniform General Conditions for University of Texas System Building Construction Contracts	-49
--	---	----------------

PROCUREMENT AND CONTRACTING DOCUMENTS GROUP

DIVISION 00 - PROCUREMENT AND CONTRACTING REQUIREMENTS

00 25 00	OWNER'S SPECIAL CONDITIONS	17
00 25 00A	OWNER'S SPECIAL CONDITIONS – ATTACHMENT A – MINIMUM WAGE DETERMINATION	2
00 25 00B	OWNER'S SPECIAL CONDITIONS – ATTACHMENT B – FACILITIES PLANNED UTILITY OUTAGES POLICY	6
00 25 00C	OWNER'S SPECIAL CONDITIONS – ATTACHMENT C – PROJECT SIGN LAYOUT	1

SPECIFICATIONS GROUP

General Requirements Subgroup

DIVISION 01 - GENERAL REQUIREMENTS

01 31 00	PROJECT ADMINISTRATION	20
01 32 00	PROJECT PLANNING AND SCHEDULING	10
01 35 16	ALTERATION PROJECT PROCEDURES	9
01 35 25	OWNER SAFETY REQUIREMENTS	31
01 45 00	PROJECT QUALITY CONTROL	7
01 77 00	PROJECT CLOSEOUT PROCEDURES	11
01 78 39	PROJECT RECORD DOCUMENTS	5
01 78 46	MAINTENANCE MATERIALS	8
01 79 00	DEMONSTRATION AND TRAINING	9
01 91 00	GENERAL COMMISSIONING REQUIREMENTS	20
01 89 23	SITE HVAC UTILITIES PERFORMANCE REQUIREMENTS	4

***THE UNIFORM GENERAL CONDITIONS FOR UNIVERSITY OF TEXAS SYSTEM BUILDING CONSTRUCTION CONTRACTS AND THE DIVISION 00 AND 01 SPECIFICATION SECTIONS ARE INCLUDED AS EXHIBITS TO THE AGREEMENT BETWEEN OWNER AND CONTRACTOR.**

Facility Construction Subgroup

DIVISION 07 - THERMAL AND MOISTURE PROTECTION

07 84 13	PENETRATION FIRESTOPPING	3
07 90 05	JOINT SEALANTS	5

DIVISION 09 - FINISHES

09 51 00	ACOUSTICAL CEILINGS	7
----------	---------------------	---

DIVISION 13 - SPECIAL CONSTRUCTION

13 21 00	CONTROLLED ENVIRONMENTAL ROOMS	16
----------	--------------------------------	----

Facility Services Subgroup

DIVISION 23 - HEATING, VENTILATING, AND AIR CONDITIONING (HVAC)

23 05 90	CONTRACTOR COORDINATION WITH TESTING, ADJUSTING, AND BALANCING	4
23 05 93	SYSTEM TESTING, ADJUSTING AND BALANCING	14
23 21 13	HYDRONIC PIPING	21
23 21 30	HYDRONIC SPECIALTIES	8

DIVISION 25 - INTEGRATED AUTOMATION

25 11 10	BAS BASIC MATERIALS, INTERFACE DEVICES, AND SENSORS - RETROFIT	34
----------	---	----

DIVISION 26 - ELECTRICAL

26 01 00	BASIC ELECTRICAL REQUIREMENTS	8
26 05 19	CABLE, WIRE AND CONNECTORS, 600 VOLT	5
26 05 26	GROUNDING	11
26 05 29	HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS	7
26 05 33	RACEWAYS AND BOXES	12

END OF TABLE OF CONTENTS

SECTION 13 21 00 – CONTROLLED ENVIRONMENTAL ROOMS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and General Provisions of the Contract, including General Conditions and Division 01 Specification Sections, apply to this Section.
- B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.02 SUMMARY

- A. Furnish all labor, materials, equipment and services necessary to complete fabrication and installation of Controlled Environmental Rooms (CER). CER types included here are Cold Rooms, Incubator Rooms, and Wide-Range Rooms.
- B. All major components shall have applicable UL, AMCA, NEMA, ASME, ANSI and AHRI certifications which include motors, compressors, evaporator fan and evaporator coils, water-cooled condensers and control panel assemblies.
- C. Deliver CER components to their final location, and complete assembly of CER in place by factory trained technician.
- D. Furnish and install refrigeration piping, electrical power wiring, control wiring and connections to all devices which are an integral part of the CER.
- E. Provide freestanding stainless steel wire shelving and wall mounted perforated (15 to 25 percent) stainless steel shelving as shown on construction drawings (including in-wall backing).
- F. Start-up and field performance testing of CER shall be performed by factory trained technical personnel.

1.03 REFERENCE STANDARDS

- A. The latest published edition and applicable addenda of a reference shall be applicable to this Project unless identified by a specific edition date:
 - 1. ANSI/ASHRAE Standard 15 Safety Standard for Refrigeration Systems.
 - 2. ANSI/ASHRAE Standard 90.1 Energy Standard for Buildings Except Low-Rise Residential Buildings.
 - 3. ANSI/AHRI - 420 Performances Rating of Forced-Circulation Free-Delivery Unit Coolers for Refrigeration.
 - 4. ANSI/AHRI - 540 Standard for Performance Rating of Positive Displacement Refrigerant Compressors and Compressor Units.
 - 5. ANSI - B9.1 Safety Code for Mechanical Refrigeration.
 - 6. UL – 723 Test for Surface Burning Characteristics of Building Materials.
 - 7. NFPA - 70 National Electric Code.
 - 8. NFPA - 79 Electrical Standard for Industrial Machinery.

- B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.
- C. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the following references:
 - 1. All joints to be tongue and groove for structural strength and to provide vapor barrier to prevent heat loss and moisture infiltration in accordance with ASTM E-283.
 - 2. Foam insulation is to be of a non flammable, non flame supporting grade with a "K" value of 0.118 BTU / hour / foot squared / degrees Fahrenheit / inch in accordance with ASTM C518.
 - 3. Insulation shall have a 97% closed cell structure and "R" factor shall be 32 or greater in a thickness of 4 inches – values in accordance with ASTM C-236/C-1363 methods.
 - 4. The noise level in the environmental enclosure during steady state control conditions shall fall below an NC-65 curve over the audible frequency range as measured by standard ASA methods, when the external ambient sound pressure level is 85 decibels or less.

1.04 SYSTEM DESCRIPTION

A. General Description:

- 1. The Contractor shall be responsible for the complete design and engineering required to meet the specified performance requirements established in this section. The CER design and installation shall conform to applicable codes, ordinances and regulations.
- 2. The Drawings and Specifications are an outline of the criteria and performance requirements for the systems. The requirements shown are intended to establish basic aspects of the systems. Within these parameters the Contractor is responsible for whatever modifications or additions are required to meet the specified requirements and maintain the building design.
- 3. The Contractor shall design the systems with sufficient capacity to simultaneously and continuously meet all load performance requirements, including heat transmission from external sources, ventilation load, and internal heat gain from equipment, lighting, and people. The scheduled voltage and amperage represents power allocated by the building electrical system design for each CER. If additional power in excess of the amount scheduled is required to maintain specified environmental condition requirements, the Contractor shall coordinate with the Architect / Engineer and Electrical Contractor.

B. Room Control and Performance Parameters:

- 1. Temperature Ranges:
 - a. Cold Room: 4° C +/- 0.5° C.
- 2. Humidity Range:
 - a. 50% RH +/- 5% (Cold Room, or Wide-Range Room cold setting only) adjustable.
- 3. Ventilation:
 - a. Minimum outside air ventilation rate is to be 15 CFM +5/-0 CFM. The CER pressure should not be negative with respect to the adjacent areas.

- C. Specific Requirements: CER shall be prefabricated, all metal clad construction, furnished and installed as a complete self-contained unit and system, with all controls, balanced air circulation, and all other equipment necessary to reach and record the environmental conditions specified herein.

1. Structural Requirements:

- a. Floor panels shall be of same construction as the ceiling and wall panels except that the interior skin shall be 14 gage unfinished galvanized steel, and rated to support a distributed weight load of 600 pounds per square foot.

1.05 QUALITY ASSURANCE

A. Component Manufacturer/Qualifications:

1. The CER covered by this specification shall be a product of an established manufacturer for this type equipment. Manufacturer/supplier shall have not less than five (5) years successful and regular production of components/equipment used for this Project.
2. CER systems shall have been in satisfactory operation on at least five (5) installations similar to this project for not less than two (2) years. Submit list of installations; include names and addresses of facilities and representatives.

B. Subcontractor's Qualifications:

1. The Subcontractor, as the installer, shall be a division, or part of the supplying equipment manufacturer. Subcontractor's for work of this section shall be an established organization and factory with not less than five (5) years of documented experience, with production facilities specializing in the type of equipment specified, and have an experienced engineering department with an established history of similar installations of equal scope and complexity. Each bidder shall have the demonstrated ability to produce the specified equipment of the required quality and a proven capacity to complete an installation of this size and type within the required time limits. When requested by the Owner, the approved manufacturer shall demonstrate financial stability.
2. Subcontractor shall be a Texas licensed HVACR Contractor with Refrigeration Qualification, trained and capable of providing a 100 percent performance bond. Out of state manufacturers shall partner with a Texas licensed HVACR Contractor.
3. The Subcontractor shall be capable of providing service on a 4 hour notification during normal business hours Monday through Friday. After- hours and weekends response time shall be a maximum of 6 hours upon notification. All after- hours/weekend time will be treated as overtime service.

C. Any deviations from the specification, including type of finishes as set forth herein, shall be listed in detail, separate from product data submissions described above, and such that the Architect/Engineer does not have to expend unnecessary time during evaluation.

D. The Subcontractor for Work in this Section shall be responsible for fabrication to the point of mechanical, electrical and plumbing service connections and for the cost of any alteration to such service connection which is necessary to accommodate the manufacturer's product requirements if different from those specified herein, or as shown on the Drawings. No extra charge shall be permitted for any required service alterations. The mechanical, electrical and plumbing contractors are responsible for making final connection to respective building services.

E. The CER design and installation shall conform to the referenced standards in this section and also conform to applicable codes, ordinances and regulations governing the use and safety of refrigerant gases. In addition, the CER enclosure must be approved by National Sanitation Foundation.

- F. The Subcontractor shall inventory factory parts for a minimum of five (5) years and have experienced refrigeration service technicians and mechanics in Subcontractor's direct employ to assure the Owner of a having a reliable service.

1.06 SUBMITTALS

- A. Submit manufacturer's literature indicating compliance with specification for each component, device and product of the system.
- B. Provide roughing-in requirements for mechanical and electrical services and assure they are compatible with utilities shown in construction documents.
- C. Shop Drawings shall be supplied prior to the commencement of manufacture per Division 01. Shop Drawings shall be verified by the Contractor to assure clearances, utilities, and other interfaces. The Drawings shall include enclosure layout, elevations, dimensions, thicknesses, types and locations of connections and openings, and other pertinent construction and erection details including the routing and diameter of refrigeration tubing and coil condensate drain and fresh air connection.
- D. Indicate the room's structural (floor, columns, etc.) architectural (walls, ceilings, etc.) mechanical (duct, equipment, etc.) and electrical (panels, conduits, etc.) components that are immediately adjacent to the CER.
- E. Indicate performance requirements, which include, as a minimum, cooling, heating and humidification/ dehumidification parameters and capacities. Provide refrigeration piping schematic showing all components and their respective size or capacity, air schematic and written sequence.
- F. Provide electrical plan showing all power connections to lighting and equipment, the voltage, amperage, and kW load for each circuit, and control and power wiring schematic.
- G. Certification: Submit manufacturer's certification stating that each CER complies with specifications.
- H. Functional Performance Test / Report: Submit written report which includes the findings from the system performance test made on site; state the test was performed in accordance with the specified test requirements; state the test design requirements and results attained; state the system complies with the specified operational requirements; and indicate whether the system has passed, or reason why the system failed the test.
- I. A complete comprehensive instruction and maintenance manual shall be provided with each CER. The manual shall include sequential operating instructions, routine preventative maintenance instructions, and complete schematics.
 - 1. The data shall include, but is not limited to the following:
 - a. Shop Drawings revised to reflect the final constructed condition.
 - b. System components and parts descriptions.
 - c. Operating sequences, procedures, instructions, and/or theory of operation.
 - d. Specific maintenance and troubleshooting instructions.
 - e. Recommended service schedule for adjustment, lubrication, and inspection. The submitted information shall include maintenance schedules for each component part of the systems furnished in this section. Include information on frequency of, and

detailed instruction for, maintenance procedures and the parts required for each maintenance activity.

- f. Recommended complete spare parts inventory.
 - g. Name and address of service branch.
- J. Submit one sample of wall mounted control panel, if product not manufactured by one of the CER manufacturers listed in Part 2, Products

1.07 DELIVERY, STORAGE AND HANDLING

- A. Coordinate with other trades affecting, or affected by this work, to assure the steady progress of all work performed under the contract. Closely coordinate the delivery and installation of this work with the Contractor's schedule.
- B. Replace any panels or components damaged during shipment, storage, or handling with new identical factory-supplied components.
- C. Protect finishes from physical damage by leaving factory packing cases in place before installation and providing temporary protective covers after installation with on-going construction within the Project area.

1.08 WARRANTY

- A. Manufacturers and suppliers written warranties shall be provided covering defects in material, workmanship and performance for the following lengths of time. Warranties are to cover total cost of repair or replacement of parts without cost to the Owner. All of these warranties shall be in addition to, and not in lieu of, other liabilities which the Contractor may have by law or the provision of the Contract Documents.
 - 1. Evaporator: One year warranty.
 - 2. Compressor: Five year warranty. Four year extended warranty shall be purchased in addition to the manufacturer's one year warranty.
 - 3. Control Panel: Five year warranty. Lifetime support and availability for access to repair/replacement of any "Plug and Play" PC boards and components not available from local parts supply vendors.
 - 4. All other Parts and labor for a period of one year upon Owner acceptance of certifications and passing functional test or final completion of the building, whichever is later.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Environmental Growth Chambers, (800) 321-6854, Chagrin Falls, OH
- B. ~~EMCOR/ Bahnson Environmental Specialties, LUWA Environmental Specialties, LLC~~, (919) 829-9300, Raleigh, NC
- C. Harris Environmental Systems, (978) 470-8600, Andover, MA 01810
- D. ~~Reliant Sales, 936-582-1160, Montgomery, TX 77356~~

2.02 GENERAL

- A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.
- B. Examine all Drawings and all other sections of the specifications for requirement therein affecting the work of this trade.

2.03 CONSTRUCTION

A. Wall and Ceiling Panels:

- 1. Modular panel sections, 4 inches thick, consisting of foamed in place urethane insulation with interior and exterior metal surfaces. Provide panels in standard size increments, fully interchangeable, and in a configuration that meets the specified dimensions. Structural metal, wood, or fiberglass material shall not be used between interior and exterior surfaces.
- 2. Interior and Exterior Surfaces: Stucco embossed 22 GA. galvanized steel. Additionally, all interior and exposed exterior surfaces are to be provided with baked white enamel finish.
- 3. Insulation: Foamed in-place urethane having a thermal conductivity ("K" Factor) not exceeding 0.118 BTU/hour/square foot/degree Fahrenheit/inch of thickness (R-32) for 4 inch thick walls. Foam insulation shall be 97 percent closed cell, impervious to moisture. Insulation shall bond the panel and have a minimum compressive strength of 28 pounds per square inch.
- 4. Fire Resistance: Certified as having flame spread of 25 or lower and smoke generation of 450 or lower, as tested in accordance with UL-723.

2.04 INTERIORS

A. Conditioning Module:

- 1. Room air shall be temperature conditioned utilizing ceiling mounted low profile evaporator (s) with air circulating fans, heat strips (if required), and drain pan(s) with fittings for connection of waste line for the removal of condensate.

B. Raceways:

- 1. Provide where shown on the Drawings.
- 2. Provide horizontally oriented back boxes and vertically oriented conduit within walls, and conduit seal fittings above walls, as required to install electrical devices indicated.
- 3. Within CER, provide and install hospital grade 20 amp GFCI receptacles, including weatherproof type device covers. Receptacles connected to emergency power shall be red in color. Identify each circuit and receptacle with the complete circuit number.
- 4. All CER penetrations shall be filled with expanding foam insulation, and then sealed externally and internally with silicone sealant. All trades requiring penetration of the CER are to coordinate penetrations with CER vendor, who is responsible for satisfactory completion of the work.

2.05 REFRIGERATION SYSTEM

A. Design:

- 1. Provide complete 100% redundant lead-lag integrated refrigeration systems consisting of conditioning modules, compressors/condenser units, interconnecting wiring,

interconnecting piping, and controls designed for continuous system operation. The refrigeration systems shall be designed utilizing hot gas by-pass with liquid refrigerant injection. Pump down control is not acceptable. Each individual system shall include encapsulated high/low pressure controls, encapsulated fan cycle switches, receiver accumulators, liquid line and suction line filters, and all necessary components for a complete system to achieve the specified performance. Fan cycle switches shall be pilot duty to fan contactor.

2. Each of the redundant refrigeration systems shall have sufficient capacity to simultaneously and continuously meet all loads, from 0 to 100 percent, including heat transmission from external sources, ventilation load, and internal heat gain from equipment, lighting, and people. The redundant lead-lag refrigeration systems shall also operate in parallel to bring the CER temperature to the controlled set-point within a short time period after the room has been opened for an extended period of time. The control panel shall start the lag system if the lead system is unable to achieve set-point in a predetermined (adjustable) amount of time.
3. Refrigerant: R-404A for rooms 2 degrees C and above.
4. Ventilation shall be provided from building air supply and exhaust system as shown on Drawings. Air flow shall be controlled to 15 CFM +/- 0 CFM via manual dampers located on both the supply and exhaust (and possibly by-pass) ductwork to be supplied and installed by HVAC Contractor. Rooms shall maintain temperature and humidity control and uniformity with ventilation continuously present. Connecting ductwork shall be rigid (spiral is acceptable) and insulated per Division 23. PVC and Flex duct are not allowed.

B. Fan-Coil Module:

1. Evaporator Coil: Factory interlaced copper tube, aluminum fin coil with aluminum housing for which replacement is readily available – such as manufactured by BOHN, or approved equal. Coil shall be selected with a maximum face velocity no greater than 450 fpm. Coil shall have a maximum of 7 fins per inch, and be a minimum 4 rows deep. Each refrigerant circuit shall be connected to an independent refrigeration system. The drain pan shall be an integral component of the housing.
2. Fan Motor: ECM low energy type, permanently lubricated, ball bearing design, isolation mounted, and thermally protected.
3. Electric Coil: In rooms that require a heat source, provide a coil manufactured with defrost heaters integrated by the manufacturer. Upon written approval from Owner, an optional provision is for finned tube heating elements, made with 80/20 nickel/chromium inner coil centered in copper plated steel tube.
4. Drip Pan: Provide evaporator drip pan with sloped drain.
5. Condensate Drain Piping: Provide 7/8 inch or greater, Type L copper tubing from evaporator drain pan to the building sanitary waste system. In rooms with sinks, unless shown differently on the Drawings, drain piping shall be connected to the sink drain on the house side of the trap. In rooms without sinks, drain piping shall terminate 2 inches above the floor sink or floor drain outside the room. Rigidly support piping at walls, 3 feet on center with 1 inch clear space between the wall and the drain line. Provide cleanout tee near the drain pan. Where piping passes through wall of room, provide chrome-plated escutcheons on both faces of the wall and a trap seal at the outside surface of the wall. Drain lines inside rooms which operate below 2 degrees C shall have heat tracing and insulation. All condensate drain lines shall have traps and be insulated outside the room per Division 22.

C. Condenser Unit/Compressor:

1. Condenser: Water cooled, serviceable unit sized to maintain temperature conditions per scheduled application, with air cooled backup. Redundant air cooled condenser shall assume the conditioning load if the water supply is interrupted or is too warm to effectively manage the heat load from the compressor. The control package for the air cooled backup system shall be fully automatic with an override switch to manually determine if air cooled operation is desired. The condenser fan shall only run when necessary. Phenolic labels with system name and room location shall be affixed to each condenser with stainless steel screws. For refrigeration piping runs of 50 feet or more, provide an oil separator to ensure refrigerant oil stays in the condensing unit.
2. Water cooled condenser shall have a maximum allowable pressure loss no greater than 8 feet of water between the water inlet and outlet connections. The condenser shall be designed to permit access and passage of a tube brush to clean the water side of the tubes.
3. Compressor: The system compressor shall be a Copeland hermetic or Semi hermetic, industrial unit with integral suction and discharge service valves, factory installed motor protection, a crankcase oil sight glass, and vibration absorbers.
4. All components of the unit shall be designed for 400 psig working pressure or 150% of maximum operating pressure, whichever is greater. The refrigerant circuit shall have a high/low pressure safety control, refrigerant receiver with fusible plug, liquid line drier with integral sight glass, and accumulator.
5. Reference Drawings for the location of the condensing unit(s).
6. Condenser units and compressors are to be labeled with room number and refrigerant type using phenolic labels secured with screws.

D. Automatic Defrost System:

1. For rooms with set point temperature below 2 degrees Celsius provide hot gas bypass defrost with timer and fan delay switch. Set defrost initiation time and duration so that room temperature increase is minimized while achieving complete removal of accumulated frost.

E. Refrigerant Piping:

1. ACR type, hard drawn, cleaned and capped copper tubing soldered with silver solder. All piping shall be installed to allow for linear expansion of copper after start-up. All soldering shall be done in the presence of dry nitrogen flowing through copper lines.
2. Suction Piping: Size for velocity of 500-700 fpm on horizontal runs with a slight pitch toward condensing unit. When condensing unit is located above evaporator, size vertical runs for velocity of 1000 to 1500 fpm and install proper traps spaced not more than 10 feet apart on all tubing risers.
3. Hot Gas Piping: When hot gas piping is field installed remote from compressor, size at same velocities and with same trap requirements as specified above for suction lines.
4. Liquid Piping: Size all liquid piping for maximum 2 psig pressure drop.
5. Hangers: Provide with appropriate isolating tubing clamps to support liquid, suction, and other associated refrigeration lines individually with a minimum of 1-inch interspacing.
6. Refrigerant Testing: Pressurize and leak test entire system with dry nitrogen at not less than 100 psig for 24 hours. Clean and dehydrate by achieving a vacuum of a minimum 100 microns, then blank off and test for a 10 minute period. Vacuum at the end of this test period is not to exceed 400 microns. Add required charge of refrigerant and test entire system for performance. The R-404A refrigerant shall be used in accordance with State and Local Codes. Mark each system clearly as to refrigerant used. All pre-functional performance pressure testing and vacuum testing shall be scheduled with, and witnessed by, the Owner's representative.

7. All service line penetrations through the CER wall(s) shall have insulation voids filled with foam insulation and be properly sealed with silicone caulking.

F. Refrigerant Piping Insulation:

1. Suction and hot gas refrigeration lines shall be insulated with closed cell foam insulation. The material shall be tubular in form, 1-inch thick, and sized according to the pipe size. Joints shall be thoroughly sealed to form a complete vapor barrier. Whenever the insulation terminates, the edges shall be sealed to the pipe with sealant.

2.06 VENTILATION SYSTEM

- A. Ventilation supply and exhaust shall be provided on a continuous basis from the building ventilation system. Manually adjustable damper air valves on the supply and exhaust to each environmental room shall be supplied by HVAC Contractor. A fresh air exchange of 15 CFM +5/-0 CFM shall be set by the TAB contractor. Rooms must maintain specified uniform temperature and humidity control with ventilation load being continuously present.
- B. Provide a 4 inch diameter insulated exhaust duct collar for connection to the building laboratory exhaust air system by HVAC Contractor. Termination of the exhaust air duct through the roof of the CER shall be at a location sufficiently separated from the supply air duct as to mitigate short-circuiting of fresh air directly to exhaust.
- C. Provide a 4 inch diameter insulated supply duct collar on process air inlet ductwork of any dehumidifier for connection to the building laboratory supply air system by HVAC Contractor. Termination of the supply air duct from the dehumidifier through the ceiling of the room shall be evenly distributed at the warm side of the evaporator.

2.07 INSTRUMENTS AND CONTROL SYSTEMS

- A. Locate all instruments and controls in a TAS/ADA compliant, all stainless steel control panel mounted on the outside of the room, or in one fabricated of steel or aluminum having a baked enamel finish. Controls shall be mounted approximately 60-inches above finished floor. Control panel faceplate shall have full-length stainless steel piano type hinge to allow easy service access to control panel components. Provide panel with a clear acrylic window, lockable cover and six (6) keys.
- B. Control Panel: Provide UL-Listed solid state microprocessor type control panel with secondary power distribution, temperature control and humidity control, incorporating a separate chart recorder into the same enclosure. Control panel shall have "plug and play" components. Single source or proprietary repair components are not allowed. All replacement parts shall be available from local supply vendors. Control panel shall provide the following:
 1. Main power circuit breaker shall disconnect entire room and accessories from building power. Condenser units shall not be powered from the control panel.
 2. All sub-circuits shall be protected circuit breakers sized in accordance with NEC requirements. Fuses are not acceptable.
 3. Digital thermometer calibrated in degrees C with resolution to 0.1 degrees C and absolute accuracy within one half degree (verifiable against a NBS or NIST, standard thermometer.)
 4. Adjustable audio/visual high and low alarms. Horn shall have push-to-silence switch and light to indicate that the horn has been silenced. Silencing of alarm shall not deactivate the alarm condition light. Only correction to the alarm condition shall deactivate the alarm.

5. Mechanical failure alarm indicating failure of compressor and/or loss of power to condensing unit.
6. Provide one set of dry contacts as may be required to relay any alarm condition to the building automation system. Contacts shall be fail-safe to the open position in case of control panel power failure. Connection to BAS shall be by others.
7. Adjustable temperature control with capability to control room to desired temperature within +/- 0.5 degrees C. Controllers shall be capable of scale changes which will allow for expanded temperature ranges.
8. Manual "change-over" switch inside control panel shall allow the control panel operation to be switched to an electronic thermostat, in the event of a controller failure, until repairs or replacements can be obtained.
9. Defrost status "on" indicator light.
10. Adjustable humidity control function (Cold Rooms and Wide-Range Rooms only) to regulate and control humidity within +/- 5 percent at 4 degrees C room temperature and 50 percent RH.
11. Chart Recorder: Honeywell Series #DR45AR-1100 with Platinum RTD or Partlow MRC5000 recorder. Recorder shall be circular 10 inch with temperature and humidity data recording capability and stainless steel doorframe, or one fabricated of steel or aluminum having a baked enamel finish, with Plexiglas window and lock. Door shall have full-length stainless steel piano type hinge. Provide one (1) box of charts.
12. Alarms shall be programmed such that alarm conditions report by means of power loss (circuit interruption) rather than by application of power, so as to report problem on loss of power.
13. Reference respective Electrical Drawings for the quantity, locations and requirements of power outlets to be installed in the CER.
14. All operating modes and functions shall be clearly indicated on the controller by appropriate symbols and LEDs.
15. Control panel shall be UL approved and have a UL sticker attached.
16. Facilitate installation of independent thermal sensor connected to the building automation system and installed inside room by controls contractor. Coordinate location for the room sensor and provide conduit with seal for control cable to pass through to the sensor location.

2.08 PERSONNEL EMERGENCY ALARM

- A. Provide room with a reset type, electrically powered Personnel Emergency Alarm System. The system shall consist of an actuator switch within the room and audible and visual alarms affixed to the front exterior of the room. Provide additional dry contacts as may be required for connection to the building automation system by others.
- B. The alarm system actuator shall be a heavy duty, oil tight lighted switch, equipped with a red button marked, "EMERGENCY ALARM – PULL TO RESET." The alarm activation switch shall be mounted on the interior wall of the room adjacent to the door jamb 18 inches above the finish floor.
- C. The audible alarm shall be of a type that provides a high decibel level of sound output at a frequency distinct from room parameter alarms. The visual alarm shall be red in color and mounted in an area providing no vision interference and shall be prominently labeled "PERSONNEL EMERGENCY" using a phenolic label secured with screws. The alarm shall only be silenced by resetting the red switch inside the room.

- D. Provide an Oxygen Detection System, GfG Instrumentation 4121-1 Single Point Oxygen Monitoring System, with ZD-21 Oxygen Transmitter outside the room and a red strobe and horn assembly inside the room. These are locally available from Scientific Resources Southwest. This alarm has dry contacts for connection to the building automation system by others. Alarm 1 is to activate strobes at 19.5% oxygen in air. Alarm 2 is to activate horns and signal alarm to the building automation alarm system at 17% oxygen in air.

2.09 FIRE ALARMS

- A. The audible alarm and visual alarm for fire shall be supplied and installed under Division 28. In-wall back-boxes, conduit and seals are to be provided to facilitate alarm installation.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Roof panels shall match without distortion. Electrical work shall be coordinated with electrical contractor, who is responsible for:
 - 1. High voltage electrical work to connect CER control panels and condenser units to electrical circuits located outside of the rooms and provided under Division 26. (Note: Division 26 shall provide power to points of service i.e., control panel disconnect and condensing unit disconnect.)
 - 2. Verify that all light fixtures installed by CER vendor are properly operating and that design illumination is provided at 36 inches above finished floor. Commission and test room lighting occupancy sensor for proper sensitivity, time delay, and operation.
- B. Electrical integration work is to be completed by CER vendor, who is responsible to:
 - 1. Connect interlocking low voltage control wiring between control panel, remote compressor(s), and sensors.
 - 2. Provide a dry contact, for use by building automation system, that will close when any of the operating controls fail or when any of the safety devices prevent operation of conditioning equipment. Connection of dry contacts to BAS is by controls contractor.
 - 3. Install power receptacles for use inside the CER and identify the supporting electrical circuit on each device with label tape having red letters on white tape.
- C. Mechanical: Service line penetrations into rooms shall be properly insulated with foam insulation and sealed with silicone caulking.
- D. Confirm operation of all systems and adjust to desired parameters.
- E. Operate the CER for a minimum of 24 hours prior to field quality control testing and certification.

3.02 PREPARATION

- A. It shall be the responsibility of the CER manufacturer to demonstrate the proper operation of all systems. The CER manufacturer shall completely field check all equipment prior to final acceptance. All tests, adjustments of controls, and operational instruction shall be performed by an experienced factory technician.

- B. The CER manufacturer shall provide all equipment for testing and perform all tests. Testing shall consist of a demonstration of sustained operation at a minimum, maximum, and one intermediate environmental (temperature and humidity) conditions. Performance test shall be conducted with all applicable shelving, benches, and casework installed within the room. Final acceptance shall be provided upon successful completion of the performance test, as witnessed by the Owner's representative and factory personnel.
- C. Notify the Owner's representative in writing at least 48 hours prior to commencing with the performance test. Owner's representative shall be given the option of witnessing and confirming the test results.

3.03 TESTING

- A. Pre-Functional Test: After System Start-up Operational Test Run, and prior to a formal system performance test, perform preliminary tests verifying components are properly connected and are operational.
 - 1. The Owner's Representatives shall be given the option of witnessing all tests (pre-functional, Start-up, Operational testing) and confirming results. Notify Owner's Representative prior to test in writing.
- B. System Functional Performance Test Requirements:
 - 1. Provide written notification to the Architect/Engineer and Owner fourteen (14) days in advance of the scheduled system performance test.
 - 2. The Owner's Representatives shall be given the option of witnessing and confirming test results.
 - 3. Provide all technicians, equipment, and instruments required for the performance test.
 - 4. System test shall be conducted by a trained and competent technician, possessing complete knowledge of the system operation, and using an NIST certified recorder with a sampling rate not to exceed 1-minute.
 - 5. The Functional Performance Test shall verify temperature control to set point, plus or minus 0.5 degrees C, which is the temperature at the sensing bulb. Testing for control to set point shall be in addition to the temperature uniformity test as noted below.
 - 6. Temperature uniformity of plus or minus 0.5 degrees C refers to the temperature as measured on a horizontal plane 40 inches above floor and within 12 inches of walls throughout the entire room. Uniformity shall be measured by a multipoint chart recorder utilizing a minimum of ten (10) thermocouples, distributed evenly around the room during a continuous test period of not less than 24 hours on each refrigeration system. Use NIST or ANSI/NCSS Z540 traceable DIGITAL multipoint recorder similar to Agilent model# 34970A or Kaye Valadater. All sensors shall be placed in an ice bath to determine uniformity prior to testing. Record results. Upon completion of each refrigeration system certification test, place all sensors in ice bath to confirm uniformity. Gradient from floor to ceiling shall be 1 degree C or less.
 - 7. Recovery Test: Open door of the CER to 75 degrees F ambient air for one (1) minute; close door to confirm that room returns to operating temperature within 5 minutes. All test results shall be recorded.
 - 8. Internal Load Test: Each room shall maintain low set point temperature control, plus or minus 0.5 degrees C, for a period of one hour when room is operating with the amount of ventilation, and equivalent internal heat load of equipment as shown in Contract Documents.
- C. Adjustments:

1. Provide service representatives for the four-week period immediately prior to the occupancy of the facility to adjust and repair any part of the system, to ensure proper start-up, smooth operation, and correction of any mechanical failure.
- D. Install all components plumb and straight as required by the manufacturer's instructions. Install all refrigerant service lines at right angles with walls or floors except where the refrigerant lines are required to be pitched for oil return back to the compressor or to install a refrigerant oil trap per the manufacturer's instructions.
- E. All CER installations shall be in strict accordance with manufacturer's printed instructions and approved shop drawings, and in close coordination and cooperation with the mechanical and electrical trades providing services to the rooms and with surrounding work of other trades.. This responsibility shall include connection of all refrigerant piping and electrical wiring which is integral to the rooms, including the refrigeration piping from the room to the condensing unit. All electrical connections integral to the rooms shall be the responsibility of the Contractor who is installing the CER.
- F. Majority of penetrating openings through the insulated panels shall be performed at the factory, and properly sealed. All field penetrations through, and fastenings into, the panels shall be per the manufacturer's approval, and shall be sealed per the manufacturer's instructions to assure that vapor barrier or insulation is not compromised.
- G. Provide and install filler panels to close off spaces between tops of the CER and the building ceiling. Colors of the filler panels shall match the room panels as specified by the Architect/Engineer.

3.04 TRAINING

- A. Operational and Maintenance Training: Provide instruction by Technician and certified personnel for a minimum of six (6) Owner's personnel for a period of not less than 4 hours. The training shall be given at a location designated by the Owner, in addition to any necessary on-site orientation and training. Provide bound copies of training materials for each attendee plus additional copies as required by the contract close-out. The Contractor shall submit a training proposal with program, materials, instructors' qualifications, and proposed schedule, a minimum of 60 days prior to the training session. The Owner reserves the right of approval of any training course, material, instructor, and schedule.
- B. The manufacturer shall provide an operations and instruction manual to the Owner's authorized representative. The manual shall contain information about the panel equipment components, operating sequences, all pertinent controls and their respective data sheets or manuals, all warranties, refrigeration drawings, power wiring drawings, and panel control wiring schematics. The operations and instruction manual shall also contain pertinent information about approved sealants, replacement parts for equipment components, and door and shelving hardware, and shall include panel and door assembly drawings.

END OF SECTION 13 21 00

