

DIVISION 23 MECHANICAL SPECIFICATIONS

PART 1: GENERAL - MECHANICAL

1-1 SCOPE OF WORK

The contractor shall provide all labor, equipment, materials, supervision and facilities to upgrade the HVAC systems in Keith Wiess Geology. Work includes but is not limited to the followings:

- Remove and dispose of eight existing rooftop fume hood exhaust fans as shown.
- Furnish and install eight new rooftop fume hood exhaust fans as shown. (replace in kind)
- Remove and dispose of one existing rooftop outdoor air handling unit.
- Furnish and install one new rooftop outdoor air handling unit.
- Remove and dispose of one exist outdoor air handling unit located in the basement.
- Furnish and install one new outdoor air handling unit to be located in the basement.
- Coordinate with the Owner's Representative for the construction schedule and system's shutdown coordination for the implementation of this project. Refer to Section 1-2 below for more details.
- Start up, check out and commission the new units and demonstrate to the Owner's Representative.

1-2 PROJECT SPECIAL CONDITIONS

The contractor shall thoroughly familiarize himself with the existing job conditions and all conditions therein. All proposals shall take into consideration all such conditions as may affect work under this contract.

In specific, the following construction issues shall be considered for the implementation and construction of this project:

- Phasing of work for this project will be critical to its success.
 - All University system outages must be scheduled and approved more than two weeks in advance.
 - Fume hood exhaust fans will be limited to weekend shutdowns. Each fan replaced shall be started and completed during a single shutdown.
 - The rooftop outdoor air handling unit will be limited to a weekend shutdown. The unit replacement shall be started and completed during a single shutdown.
 - The basement outdoor air handling unit shall require at least 4 weeks notices. The outage request for this unit shall include the following:

- A day by plan of tasks to be completed
 - A day by day list of services that will be shutdown and/or impacted.
 - A schedule of hours to be worked
- Contractor will provide a detail schedule of activities and provide weekly progress reports to the Owner's Representative, except for the Basement Air unit which will require daily reports during the outage.
- A "Hot Works" Permit is required from the Owner's Representative for the duration of the construction. All fume hood exhaust ductwork should be washed or sprayed down with water prior to cutting/welding as required by Rice University Environmental Health and Safety Dept.
- Provide lead times for equipment arrival.
- All equipment, components and materials will be on-site prior to start construction. This may be broken into phases with University Project Manager Approval.
- The Elevator can be used to move small equipment and materials. It is the contractor's responsibility to provide protection for the elevator. Any damage to the elevator car will be repaired or replaced to the owner satisfaction at the contractor expense.
- For air handlers, insulation should be removed prior to shutdown and can be re-installed after the system is back on-line, thus reducing the shutdown time.
- For the Basement Air handler, the removed VFD shall be turned over to the Universities electrical shop at a location on campus to be determined by the shop.
- The contractor is responsible for maintaining a safe working area, keeping the mechanical room clean, and removal of all construction debris from the mechanical room at the end of the construction
- At the end of construction all work areas are to be swept clean, the contractor shall be responsible to remove all scrap material, trash and debris, etc.

1-3 PERMITS AND FEES

The contractor shall secure and pay for all permits, inspections, legal fees and charges involved for this portion of the work. Furnish without additional charge, a certificate of acceptance from the inspection departments having jurisdiction over the work.

1-4 APPLICABLE STANDARDS

All work shall comply with the following latest adopted standards:

- ASHRAE American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc.
- AABC Associated Air Balance Council
- UPC Uniform Plumbing Code
- UL Underwriters Laboratories, Inc.
- TFIC Texas Fire Insurance Commission
- ASTM American Society for Testing and Materials
- ANSI American National Standards Institute

- ASME American Society of Mechanical Engineers
- OSHA Standards
- Rice University General Conditions, Safety Rules and Regulations
- Federal, State and Local City Ordinances and All Other Authorities having jurisdiction wherein the work shall apply.

Should any work shown on the drawings or herein specified be construed as contrary to said regulations, the same shall be executed in strict accordance with the regulations.

In case where Contract requirements are in excess of Code requirements and are permitted under code, then in such instances Contract provisions shall govern. Report all changes to Rice Project Manager immediately.

1-5 SUBMITTALS

The contractor shall provide four sets of shop drawings and submittals on all mechanical equipment, electrical equipment, insulation, air devices, ductwork (flexible and rigid), piping and specialties, control instrument. Any deviations from the specified items shall be listed on the cover sheet and clearly itemized for all deviations. The contractor shall provide four (4) sets of operation and maintenance manuals upon completion of the work.

1-6 WARRANTY

The contractor shall warrant the work for a period of one year beyond date of final acceptance. During that period, the contractor shall repair or replace, at his own expense, any faults or imperfections that may arise due to defects in material and workmanship, including the loss of refrigerant and/or oil due to leaks. Defects shall include but not limited to, noisy operation, loose or missing parts, or noticeable deterioration of finish.

1-7 WORKMANSHIP AND MATERIALS

All materials and equipment furnished and installed shall be new, free of defects and of preferred manufacturer and quality specified or accepted as equal by Rice Project Manager. Make the installation in a manner that will comply with applicable Codes and laws.

Where the requirements of the Contract Documents exceed Codes requirements, comply with Contract Documents.

1-8 WORKING HOUR AND SECURITY ACCESS

All work under this scope of work and specifications shall be done according to the construction schedule provided by Rice Project Manager.

Contractor shall notify Rice Project Manager at least 24 hours prior starting work to obtain proper security access and work permits for the working area.

1-9 INSPECTION, CLEAN UP AND MOVE OFF

Contractor shall have the prime responsibility for quality control. All stages of construction, including off-site fabrication, shall be subject to inspection by Rice Project Manager or assigned representative. Defective materials and workmanship will be rejected and replacement shall be made by the contractor at his own expense.

It shall be the contractor's responsibility to leave the job site and any area used by him in a clean and orderly condition at the end of each working day, and at the conclusion of the project.

The job site shall be inspected by Rice Project Manager when informed by the contractor that he has completed the work. Final acceptance of the work will not be granted until the final clean up work is complete to the satisfaction of Rice Project Manager.

Due to this work being performed in an operating facility, clean up not performed at the end of each working day will be done by the owner and charged back to the contractor.

1-10 SAFETY

The contractor will be required to comply with all Rice University General Conditions, Safety Rules and Regulations, and OSHA Standards.

PART 2: PRODUCTS - MECHANICAL

2-1 ROOF MOUNTED FUME EXHAUST FANS

Acceptable manufacturers:

1. PennBarry
2. Cook
3. Greenheck,
4. University approved equal

Use fan size, class, type, arrangement, and capacity as scheduled on construction drawings.

Furnish complete with motors, wheels, drive assemblies, bearings, vibration isolation devices, and accessories required for specified performance and proper operation. All single-phase motors to have inherent thermal overload protection.

2-2 FUME HOOD EXHAUST DUCTWORK

All fume hood exhaust ductwork shall be shop fabricated of minimum 20 gauge 304L Stainless Steel sheet metal in accordance with the latest edition of SMACNA Duct Construction Standards for welded negative pressure up to 10" w.g.

2-2 OUTDOOR AIR HANDLING UNITS

Acceptable manufacturers:

1. T temptrol
2. York
3. Trane
4. McQuay
5. Carrier
6. University approved equal

UNIT CONSTRUCTION

1. Interior Unit Construction: Draw-Thru Thru with mixing box, filters, coils, access sections, Dual Direct Drive Fans, pre-filters, discharge plenum with factory cut openings, 6" minimum high base rails and a note that the design TSP "WG must be coordinated with base rail concrete housekeeping pad and unit duct connections, and overall height of unit within indoor space.
2. Exterior Unit Construction: With mixing box, filters, coils, access sections, fans, pre filters, discharge plenum, weather tight piping vestibules for each exterior piping connection e.g., pre-heat, cooling or reheat coil and/or humidifier connections as scheduled, 14"high insulated roof curb, weatherized construction with sloped roof and drip lip edges, rain tight doors, OA intake hood with bird screen, mist eliminators, modulating dampers, weatherproof electrical components

- and conduit, Unless Noted Otherwise; Specification notes for interior units apply to exterior units.
3. Outdoor design temperature shall be most recent edition of ASHRAE weather data for Hobby Airport with 99% heating and 1% cooling categories used. Indoor temperature shall be per 01 05 00 Environmental Standards.
 4. New building construction shall be configured to allow for replacing the entire central station air handlers (in section break) without major demolition and new work.
 5. Use variable flow rate systems. If special circumstances warrant constant flow, then attain Rice Project Manager's approval prior to the initiation of design work.
 - a. Variable flow shall be attained through the use of variable frequency drives on the fan motors.
 6. Fusible disconnect switches shall not be used on any system or unit. Circuit breaker only.
 7. Casing should be supported by structural steel rails.
 8. Units shall be double walled, 3" thick with painted 16 GA external casing metal gauge. G-90 Galvanized, 20 GA internal casing metal gauge (solid panel). Perforated finish 22 GA in Fan sections for attenuation.
 - a. Internally insulated air units shall have fully cleanable internal surfaces.
 - b. All casing penetrations must be factory cut. No field cut penetrations allowed.
 9. Cooling and Heating Coils
 - a. All Coil tubes shall be seamless copper, 5/8" nominal OD with 0.035" wall thickness minimum.
 - b. Cooling Coil Construction:
 - i. Casing - 16 GA, 304 stainless steel
 - ii. Fins – 0.0008" fin thickness, aluminum (max of 8 FPI)
 - c. Heating Coil Construction:
 - i. Casing – 16 GA Galvanized Steel
 - ii. Fins – 0.0008" fin thickness, aluminum (max of 8 FPI)
 - d. Where multiple coils are used in air units, ensure that 24" minimum access section is employed between coils. Each side of coils will be accessible through hinged doors.
 10. Air Quality
 - a. Units shall have stainless steel drain pans, coil housings and filter racks.
 - b. UVC lights are required. 1 Manual switch on exterior of unit in addition to door interlocks
 11. Floor units wider than sixty inches should be reinforced for "walk-in" accessibility.
 - a. Access space between coils should be increased based on unit width. "True walk-in" units should have internal LED lights.
 - b. Walking surface to be aluminum diamond plating.
 12. Unit structure must be un-effected when the coil or modular section is removed.
 13. Air units designed for exterior or ventilated mechanical room applications must have "no through metal" design to prevent condensation on unit exterior.
 14. Outside air handling units must have
 - a. Freeze stats with alarming to BMS

- b. method to assure freeze protection
 - i. Non-lab buildings - automated inlet dampers which are hardwired to the freeze thermostat and motor starter. Dampers will provide feedback proof of open to start fan
 - ii. Lab Buildings – control to cause full flow to preheat and/or chilled water coils.
15. Central station air handlers will have temperature sensors prior to the first coil and after every subsequent coil and on the discharge.
16. Drain Pans
- a. Drain pans to be provided in filter sections (only required for Outside Air Handlers. This shall be a “Wash Down” floor with up-turned edges and shall have a “floor drain”), heating coil and cooling coils.
 - b. Minimum drain pan gauge: 16 GA
 - c. Galvanized drain pans for heating coils only, 304 Stainless Steel drain pans in all cooling coil sections.
 - d. Provide overflow switch in pan connected to alarm in BMS
17. Fans
- a. Shall be direct drive, draw-thru type plenum fans. Minimum two fans per unit. Fan wheels shall be Class 3, aluminum construction with welded blades.
 - b. Fan redundancy shall be N+1 with one fan off, the remaining fan or fans shall produce at least 70% of design air flow at the reduced static pressure per “fan laws”.
 - c. Fan isolation shall include rubber isolation pads and fan balance to AMCA 204-96 Category BV-5.
 - d. Fan Accessories: Backdraft Dampers (Two Position motorized or net-zero system effect) except on fans with vertical inlets which will require standard electrically operated dampers and actuators. Spare fan/wheel assembly per unit size, integral fan discharge silencer, Air Flow Monitoring Station in Fan Inlet (single probe), tapered hub connection to motor shaft (set screws are not acceptable) and powder coated or aluminum fan inlet cones (no galvanized or painted metal.)
 - e. Fan Wall systems acceptable upon Rice approval.
18. VFDs BAS Communication Card (BACnet) Compatible to Siemens Building Automation System.
- a. Line Filters
 - b. Single VFD per Fan Array
 - c. Factory Mounted and Wired with start-up service and 1-year labor warranty.
 - d. Current sensors with remote output signal.
19. Motors Shall be premium efficiency (inverter duty), class “F” insulation or better, VFD rated and Totally Enclosed Air-Over (TEAO), or Totally Enclosed Fan-Cooled (TEFC)
- a. Shaft grounding system factory installed with full-size independent ground wire for each motor run to motor overload panel.
 - b. All motors to be factory wired to J-Box or motor overload panel on exterior of unit.

20. Access Doors. Installed on all sections (one side only)
 - a. Min 24" door with 20" clear opening. 72" high or full height of unit.
 - b. Min 10"x10" viewing window with UV rated safety glass.
 - c. Double gaskets on all doors, adjustable stainless-steel hinges (3 planes). No piano hinges allowed.
 - d. Stainless steel latches with operable internal handles.
21. Motor bearing lube lines shall be copper and extended to exterior of units.

2-1 SUPPLY AND RETURN AIR DUCTWORK

All supply air ductwork shall be shop fabricated of minimum 20-gauge Galvanized Steel sheet metal in accordance with the latest edition of SMACNA Duct Construction Standards.

External Duct Wrap and Aluminum Jacketing:

All external duct wrap shall be 1-1/2" thick, 1 lb. density minimum, and is required on all outside and supply air duct that is not internally insulated.

Fasten all longitudinal and circumferential laps with outward clinching staples 3" on center. On rectangular ducts over 24" width, apply as above and hold insulation in place on bottom side with mechanical pins and clips on 12" centers.

Seal all joints, fastener penetrations and other breaks in vapor barrier with 3" wide strips of the same facing materials with factory applied vapor barrier adhesive, or 3" wide strips of white glass fabric embedded between two coats of a vapor barrier mastic, Childers CP-30 or equivalent.

Provide aluminum jacketing to match existing installation.

Duct Hangers and Supports:

All ductwork shall be properly suspended and supported from the building structure. Hangers and supports for all ductwork shall be in accordance with SMACNA Duct Construction Standards. Space hangers as required to support ducts from sagging.

2-2 PIPING

HEATING HOT WATER

2" and Smaller: ASTM A53, standard weight (schedule 40) black steel pipe with ASTM A126/ANSI B16.4, class 125, standard weight cast iron threaded fittings.

2-1/2" and Larger: ASTM A53, standard weight (schedule 40) black steel pipe with ASTM A234 grade WPB/ANSI B16.9 standard weight, seamless, carbon steel weld fittings.

CHILLED WATER

2" and Smaller: ASTM A53, type F, standard weight (schedule 40) black steel pipe with ASTM A126/ANSI B16.4, class 125, standard weight cast iron threaded fittings.

2-1/2" and Larger: ASTM A53, standard weight (schedule 40) black steel pipe with ASTM A234 grade WPB/ANSI B16.9 standard weight, seamless, carbon steel weld fittings.

COOLING COIL CONDENSATE

ASTM B88, type L hard temper copper tubing with ASTM B145/ANSI B16.23 cast red bronze or ASTM B75/ANSI B16.29 wrought solder-type drainage fittings.

2-2 PIPE INSULATION

PHENOLIC INSULATION:

All Insulated Piping - Rigid closed cell, minimum nominal density of 2.2 lbs. per cu. ft., thermal conductivity of not more than 0.13 at 75 degrees F mean temperature, rated for service temperature range of -290 degrees F to 250 degrees F.

ALL SERVICE JACKETS (ASJ):

All Insulated Piping - Heavy duty, fire retardant material with polymer coated white kraft reinforced foil vapor retarder jacket, factory applied to insulation with a self-sealing pressure sensitive adhesive lap.

PROTECTIVE METAL JACKETS (PMJ):

All Insulated Piping installed less than 8' above finished floor. 0.016 inch thick aluminum or 0.010 inch thick stainless steel with safety edge for indoor installations and 0.024 inch thick aluminum or 0.016 inch thick stainless steel with safety edge for outdoor installations.

2-4 CONTROLS

All controls for new work will be Siemens.

At the completion of this project, the control subcontractor shall demonstrate to the Owner's representative the operation of each and every new damper. The actuators shall drive the dampers open and close freely and smoothly to full open and close positions. Controls subcontractor shall be Siemens Controls.