BuildingName
The Description of the Project
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SPECIFICATION DIVISION 23

NUMBER SECTION DESCRIPTION

DIVISION 23 HEATING, VENTILATING AND AIR CONDITIONING (HVAC)
SECTION 238200 - TERMINAL HEATING UNITS (TU'S) HOT WATER

END OF CONTENTS TABLE

DIVISION 23 HEATING, VENTILATING AND AIR CONDITIONING (HVAC)
SECTION 238200 - TERMINAL HEATING UNITS (HOT WATER)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, Standard General and Supplementary General Conditions, Division 1 Specification Sections, and other applicable Specification Sections including the Related Sections listed below, apply to this Section.

B. Related Sections:

1. Section 221113: Piping Materials and Methods.
2. Section 220523: Valves.
3. Section 220513: Motors.
4. Section 220719: Mechanical Systems Insulation.
5. Section 232116: Hydronic Piping Specialties.
6. Section 230900: Mechanical Systems Controls.
7. Division 26: Electrical.

1.2 SUMMARY

A. Section Includes

1. Fan Powered
   a. Unit Heaters.
   b. Cabinet Heaters.
2. Fin-tube Radiation.
3. Flat-Pipe Panel Radiators

1.3 SUBMITTALS

A. Product Data: Include manufacturer, catalog number, catalog illustrations, rated capacities, performance characteristics, weights, conductor insulation and jacket dimensions, component sizes, rough-in requirements, piping and wiring diagrams and details, materials of construction, accessories, operating and maintenance clearance requirements. Wiring diagrams shall be project specific, and differentiate between factory wiring and field wiring. Include shop drawings and fabrication drawings for equipment indicating piping connections, power and utility requirements, rigging, installation and support details and instructions. Include written sequence of operations for all controls. Additionally include:

B. Submit the following product data for approval:

1. Coil total and sensible heat transfer capacity, entering and leaving water temperatures, water flow rate, water pressure drop, and air pressure drop.
2. Air filter type, MERV rating and method of replacement.
3. Details of equipment assemblies indicating dimensions, weights, required clearances, component locations, and location and size of each field connection. Include cabinet construction details: panel gauge, removal method for access panel, mounting or hanging method, and filter and fan motor removal method.

4. Details of motor including type, manufacturer and electrical characteristics.
5. Wiring Diagrams: Power, disconnect switch, controls, transformer and fan speed control.
6. Detailed information on fan speed control, including control signal interface.
7. Octave band and A-weighted sound power data for each unit type at rated capacity, tested per AHRI Standard 350.
8. Evidence of UL or ETL listing and labeling.

C. Equipment schedule with the following information for each unit type:

1. Equipment tag.
2. Model number.
3. Manufacturer's size designation.
4. Configuration (floor mount, wall mount, ceiling mount, recessed, suspended).
5. Number of coils, number of rows for each coil, fin spacing for each coil, airflow rate and motor watts at each fan speed.

D. Maintenance schedules and repair part numbers and manufacturer of motors, coils, integral controls, relay board, control transformer, and air filters.

E. Warranty Documentation: Submit warranty documentation according to requirements of Contract Documents.

F. Fabrication and Shop Drawings

G. Installation, Operation and Maintenance Manuals

1.4 COORDINATION

A. Coordinate dimensions and arrangement of cabinet unit heaters and fin tube enclosures with building elements including floor finish, pipe entry location, and wall construction.

1.5 QUALITY ASSURANCE

A. Manufacturers and Products: The products and manufacturers specified in this Section establish the standard of quality for the Work. Subject to compliance with all requirements, provide specified products from the manufacturers named in Part 2.

B. Reference Standards: Products in this section shall be built, tested, and installed in compliance with the following quality assurance standards; latest editions, unless noted otherwise.

1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. National Fire Protection Association (NFPA):
   a. 90A Standard for the Installation of Air Conditioning and Ventilating Systems.
   b. National Electrical Code
3. Underwriters Laboratories, Inc. (UL)
4. AHRI 210 Standard for Unitary Air-Conditioning Equipment
5. AHRI 410 Standard for Forced-Circulation Air-Cooling and Air-Heating Coils

6. AMCA Standard 99-0401, "Classification for Spark Resistant Construction".
7. ANSI/AMCA Standard 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data."

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store materials and equipment raised off the floor on pallets and protected with coverings to prevent damage due to weather and construction activities. Store in areas that prevent damage due to freezing and extreme temperatures or sunlight. Arrange coverings to provide air circulation to avoid damage from condensation or chemical build-up. Protect from damage, dirt and debris at all times.

B. Shipping and Handling Requirements

C. Packaging and Protection

D. On-site Storage & Staging

E. Packaging Waste Management

1.7 WARRANTY

A. Provide a complete parts and labor warranty for a minimum of one year from the date of Substantial Completion.

PART 2 - PRODUCTS

2.1 UNIT HEATERS (HOT WATER)

A. Construct casing of minimum 20 gauge die-formed steel. Casing shall be corrosion resistant, electrostatically applied baked enamel finish. Paint finish shall be lead free and chromate free.

B. Coil elements and headers are heavy wall drawn seamless copper tubing. Element tubes are brazed into extruded header junctions. Aluminum fins shall have drawn collars to assure permanent bond with expanded element tubes (and exact spacing. Copper tubes shall have minimum (.035") wall thickness. All Element Assemblies shall be submersion tested at factory at minimum 200 psig at 220°F. All coils shall be provided with a manual air vent fitting to allow for coil venting.

C. Fans shall be aluminum blade, hub type, factory balanced.

D. Provide hanging brackets to allow unit to be suspended from threaded rod.

E. Fan guards shall be welded steel, zinc plated or painted, and meet CSA and OSHA requirements. Provide OSHA belt guards with belt driven fans.

F. Provide unit mounted manual starter toggle switch with thermal overload protection for on/off control of fan.

NOTE TO SPEC WRITER. SELECT ANY REQUIRED FIELD INSTALLED ACCESSORIES BELOW.

G. Provide the following accessories:

1. Provide adjustable horizontal and vertical discharge louvers for units with horizontal discharge.
2. Provide an adjustable cone diffuser for projection units with vertical discharge.
3. Provide remote mounted 115v thermostat
4. Provide remote mounted 24v thermostat and unit mounted step down transformer.
5. Provide wire thermostat guard.

NOTE TO SPEC WRITER PROVIDE EXPLOSION PROOF MOTOR BELOW IF REQUIRED.

H. Provide explosion proof motor.

I. Manufacturers: Dunham-Bush, McQuay, Modine, Reznor, Rittling, Sterling, Trane, Wing, Vulcan Radiator.

2.2 CABINET UNIT HEATERS (HOT WATER)

A. Construct front panel of minimum 16 gauge steel and all other panels of minimum 18 gauge steel, fully welded construction. All panels shall be made rigid using formed channels or other strengthening method. Cabinets will be thermally insulated with minimum 1/2" thick closed cell insulation. Provide sound dampening insulation on all front panels. Unit chassis shall be minimum G-60 galvanized or A-40 galvanealed. Casing shall be primed and painted with baked on enamel or polyester powder coated standard finish. All unpainted steel shall be galvanized. Provide ample sized pockets on both sides of cabinet for piping and electrical connections.

B. Base or legs: Form all vertical surfaces of solid sheet metal, including sides facing the air stream (facing the return air/air filter opening); open construction is not permissible.

C. Provide closed cell insulation on all surfaces exposed to air stream.

D. For all concealed and recessed horizontal cabinets with vertical air discharge, provide hinged access panel flush with front panel, with tamperproof fasteners and safety chain.

E. Provide centrifugal, forward-curved, and double width aluminum fan wheels sized to meet scheduled airflow requirements. Fan housing shall be constructed of galvanized sheet metal. Fan assembly and motor shall be easily removed from unit.

F. Motors shall be direct drive, ECM (electronically commutated motor) with manual speed adjustment, integral thermal overload protection with a maximum ambient operating temperature of 104 F and are permanently lubricated. Motors shall be capable of starting at 78 percent of rated voltage and operating at 90 percent of rated voltage on all speed settings. Motors shall be able to operate up to 10 percent over voltage.

G. Provide heating coils as scheduled. Heating coils shall be suitable for 200 PSI working pressure with 220°F water. Copper tubes shall have minimum (.035") wall thickness. Coil tube and u-bends shall be copper. Aluminum fins shall be mechanically expanded to the copper tubes. Stub out connections shall be copper. All water coils shall be provided with a manual air vent fitting to allow for coil venting. Provide 1" throwaway pleated filters.

H. Control sequence

Coordinate controls requirements for cabinet unit heaters with the Mechanical Systems Controls Drawings and Specifications.

NOTE TO SPEC WRITER. SELECT ANY REQUIRED FIELD INSTALLED ACCESSORIES BELOW.

I. Provide the following accessories:

1. Electrical Options
   a. High Static Motor. Used to overcome up to 0.4"W.C. external static pressure.
   b. Plug-In Motor. Allows removal of motor(s) or fan board without unwiring unit.
   c. Disconnect Switch. On-Off DPST toggle switch to disconnect electric power (hot and neutral lines) to unit.
   d. Unit Mounted Return Air Thermostat. Temperature sensing bulb is located in return air stream. Temperature set point range 55° to 90°F. Not for use with inverted air flow arrangements. Normally used with a control.
2. Piping Options
   a. 2, 3 & 4 Row High Capacity Coil, for use with water only.
   b. Right Hand Piping, Left Hand Electrical.
3. Access Door Options
   a. Access Doors for Model WCC. Two doors per unit.
   b. Front Panel Tamper Proof Fasteners with Tool.
   c. Key Locks on Access Doors. Two locks per unit. Especially valuable for units located in public place, these key locks make unit controls tamperproof.
   d. Key Locks on Front Panel. Two locks per unit. Especially located in public place, these key locks make unit controls tamperproof.
4. Air Inlet Options
   a. Aluminum Bar Grille. Grille replaces louvers. 12 gauge extruded aluminum.
   b. Arrangement 9 (inverted) where it is located at the top inlet.
5. Air Outlet Options
   a. Aluminum Bar Grille. Grille replaces louvers. 12 gauge extruded aluminum.
   b. Two Way Adjustable Air Deflector Louvers. Cannot be ordered with 2 Row High Capacity Coil.
   c. 100% Air Outlet Duct Collar. Collar width is 1” and is located at top outlet or bottom outlet on inverted models. Model WCC only.
6. Miscellaneous Options
   a. Provide manufacturers color chart for custom color selection by architect.

J. Manufacturers: Dunham-Bush, McQuay, Modine, Reznor, Rittling, Sterling, Trane, Vulcan Radiator.

2.3 FIN-TUBE RADIATION (HOT WATER)

A. Provide fin-tube radiation type, size and capacity as scheduled.

B. Heating Element:

1. Seamless copper tubing mechanically expanded into the fins.
2. Fins shall be constructed of aluminum.
3. Tube ends shall be designed to accept standard domestic copper fittings.
4. Fin-tube shall be rated for not less than 200 psi at 220 deg.

C. Fin-Tube Enclosures:

1. Provide seamless enclosure of type, style and length scheduled.
2. Enclosure shall be constructed of 16 gauge steel, unless otherwise scheduled, with maximum 10'-0" long sections. Provide slip joint type connectors and clips, of 16 gauge, welded to panel, to minimize the appearance of joints on the exterior of the enclosures. Provide sponge air seal gasket on back of enclosure for wall mounted enclosures.
3. Provide all required enclosure hangers and supports, minimum 16 gauge steel as required for proper installation. Provide stiffening angles where required for reinforcement at all enclosure joints. Provide fin-tube element support brackets, with ball bearing slide cradle, that allows for 2-1/2" lateral movement.
4. Provide all required accessories, valve compartments, end caps, corner bends and end enclosures. Coordinate with construction documents to provide a complete system. Provide a removable section of the enclosure, not less than 12" long and not more than 24" long, at all valve locations for access.
5. Enclosures shall be treated for corrosion resistance and painted with baked on enamel or polyester powder coated standard finish. All unpainted steel shall be galvanized.

Spec Editor Standard stamped grille implied, revised below options as required.

6. Provide stamped pencil proof stationary grilles on enclosures inlets and outlets. All access panels shall be tamperproof.
7. Provide manually operated damper with visible dial operator where indicated.
8. Provide manufacturers color chart for custom color selection by architect.

D. Manufacturers: Dunham-Bush, Rittling, Slantfin, Sterling Radiator, Trane, Vulcan Radiator.

2.4 FLAT-PIPE PANEL RADIATORS

A. Description: Provide steel panel radiator elements of lengths and in locations as indicated, and of capacities, style and having accessories as scheduled.

One-piece all-welded steel construction, consisting of flattened water tubes welded to headers at each end. Headers are square with 0.109" minimum wall thickness. Provide headers with supply/return connections of ½" NPT tapered thread (¾" when indicated). Provide header with 1/8" NPT tapered thread vent connection. Provide internal baffling where required for proper water flow. Provide lengths from 2'-0" to 20'-0" minimum in two inch even increments without the need for splicing.

B. Pressure Rating:

STANDARD: Working pressure-56 PSI max, Test Pressure-74 PSI max

MEDIUM: Working pressure-85 PSI max, Test Pressure-110 PSI max

HIGH: Working pressure-128 PSI max, Test Pressure 184 PSI max

C. Fins: When style is indicated as finned type the radiator shall include an integral heavy gauge (0.09" minimum) all-welded perforated top grille (omit for curved radiators) and steel corrugated fins spot-welded to the rear side of the water tubes. There shall be no less than 32 fins per foot. Fins shall start within 3" of the headers.

D. Finish: Gloss powdered coat finish of 2 mils thickness minimum. Provide standard white unless custom color is indicated. Submit color sample.

E. Warranty: 5 years

F. Accessories: Provide pipe covers and end caps of same finish. Provide wall mount brackets or floor mount supports based on application.

G. Manufacturers: Jaga, Runtal Radiator, Sterling, Vulcan Radiator

PART 3 - EXECUTION

3.1 EXAMINATION AND PREPARATION

A. Review and examine conditions affecting work. Proceed with installation only after unsatisfactory conditions have been corrected.

B. Commissioning: Review and perform required commissioning activities in the pre-construction phases.

3.2 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.
2. Test unit operation with thermostat in all modes of operation.
3. Remove and replace malfunctioning units and retest as specified above.

Engineer shall verify that the Mechanical Systems Controls SPECIFICATION DESCRIBES controls start-up for terminal units.

B. Coordinate controls start-up for terminal units with the Mechanical Systems Controls Specifications.

3.3 HANGER AND SUPPORT INSTALLATION

A. Comply with applicable SMACNA HVAC Duct Construction Standards and Hanger and Support construction standards, and applicable Division 23 Sections.

B. Support TU’s independently from adjacent ductwork. Ensure supports do not interfere with accessibility of other equipment, e.g., access to TU DDC control enclosure. Do not hang TUs from piping, other ducts or equipment.

3.4 TERMINAL UNIT INSTALLATION

A. Install TUs in accordance with manufacturer recommendations, Contract Drawings, and reviewed submittals.

B. Label unit according to the applicable detail.

C. Position terminal unit, unit-mounted controller and reheat coil to comply with clearance requirements and for ease of maintenance.

3.5 COMMISSIONING

A. Perform the commissioning activities as outlined in the Division 01 Section Commissioning and other requirements of the Contract Documents.

3.6 SYSTEM START-UP

A. After start-up and operation, coils, sensors and controllers shall be cleaned.

3.7 ADJUSTING, CLEANING, PROTECTION

A. Protect TU's throughout the entire construction period, until Commissioning and Substantial Completion.

3.8 OWNER TRAINING

A. In cooperation with the Commissioning Agent, train Owner’s personnel on basic unit maintenance by demonstrating the following: location of control devices, removal of access panel, filter replacement, relay replacement, and motor replacement.

END OF SECTION 238200