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## SECTION 238219 – HEATING AND COOLING TERMINAL UNITS

First Edition 5-16-2017

(Engineer shall edit specifications and blue text in header to meet project requirements. This includes but is not limited to updating Equipment and/or Material Model Numbers indicated in the specification and adding any additional specifications that may be required by the project. Also turn off all “Underlines”.)

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section and all other sections of Division 23.

#### 1.2 SUMMARY

- A. This section includes the requirements for heating and cooling terminal units as follows:
  - <Edit for the Project>
  - 1. Fan coil cooling units.
  - 2. Cabinet unit heaters.
  - 3. Unit heaters.
  - 4. Convertors.
  - 5. Finned tube radiation heaters.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each specified product, include manufacturers cut sheets, dimensional data, performance data, installation instructions, wirings diagrams, power requirements, specified options, and warranty information.
- B. LEED Submittals:
  - 1. Product Data for Credit EA 4: Documentation indicating that equipment and refrigerants comply.
  - 2. Product Data for Prerequisite IEQ 1: Documentation indicating that units comply with ASHRAE 62.1, Section 5 - "Systems and Equipment."
- C. Shop Drawings:
  - 1. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 2. Include diagrams for power, signal, and control wiring.
- D. Samples for Initial Selection: For units with factory-applied color finishes.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Seismic Qualification Certificates: For fan coil units, accessories, and components, from manufacturer.
- B. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
- C. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
- D. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- E. Field quality control reports.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: Include a copy of each approved submittal along with any applicable maintenance data in the project operation and maintenance manual.
  - 1. In addition to items specified in Section "Operation and Maintenance Data," include the following:
    - a. Maintenance schedules and repair part lists for motors, coils, integral controls, and filters.
- B. Maintenance Material Submittals: <Edit for project>
  - 1. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
    - a. Fan Coil Unit Filters: Furnish spare filters for each filter installed.
    - b. Cabinet heaters: Furnish spare filters for each filter installed.
    - c. Fan Belts: Furnish spare fan belts for each unit installed.
    - d. Fan Coil and Cabinet Unit Heater Filters: Furnish one (1) space filter for each filter installed.

#### 1.6 PERFORMANCE REQUIREMENTS

- A. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
- B. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

- C. Seismic Performance: Cabinet unit heaters shall withstand the effects of earthquake motions determined according to ASCE/SEI 7. <Edit for project>
1. The term "withstand" means "the unit will remain in place without separation of any parts when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

## 1.7 QUALITY ASSURANCE

- A. Comply with NFPA 70.
- B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
- C. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."
- D. 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.
- E. Factory-packaged and tested units rated according to AHRI 440, ASHRAE 33, and UL 1995

## 1.8 COORDINATION

- A. Coordinate layout and installation of heating and cooling terminal units and suspension system components with other construction that penetrates or is supported by ceilings, including light fixtures, HVAC equipment, fire suppression system components, and partition assemblies.

## 1.9 WARRANTY/GAURANTEE

- A. See Division 23 Specification Section "Basic Mechanical Requirements – HVAC" for warranty and guarantee requirements.

## PART 2 - PRODUCTS

### 2.1 GENERAL PRODUCT REQUIREMENTS

- A. Equipment Design and Selection: Heating and cooling and/or heating terminal units shall be designed and selected in accordance with the scheduled capacities on the drawings and the requirements of this specification.
- B. Basis of Design: The basis of design for heating and cooling and/or heating terminal units are units manufactured by Trane and/or Vulcan as follows: <Edit required for project>

1. Fan Coil Unit (FCU) - Trane Models 'B' and/or 'E'
  2. Cabinet Unit Heater (CUH) – Trane Model 'B', 'D', or 'E'
  3. Unit Heater (UH) - Trane Model 'S'
  4. Convector (CV) – Trane Models 'AK', 'SFK'
  5. Finn Tube Radiation (FTR) – Vulcan Linovector II 'LV' Series
- C. Other Acceptable Manufacturers: Subject to compliance with requirements, provide heating and cooling and/or heating terminal units by one (1) of the following: **<Edit required for project>**
1. FCU – Airtherm or Carrier
  2. CUH – Airtherm, Rittling or Modine
  3. UH – Airtherm, Rittling or Modine
  4. CV – Airtherm, Rittling or Modine
  5. FTR – Airtherm, Rittling or Modine

## 2.2 FAN COIL UNITS

- A. Coil Section Insulation: One half (1/2) inch thick, coated glass fiber complying with ASTM C 1071 and attached with adhesive complying with ASTM C 916.
1. Surface Burning Characteristics: Insulation and adhesive shall have a combined maximum flame spread index of twenty five (25) and smoke developed index of fifty (50) when tested according to ASTM E 84 by a qualified testing agency.
  2. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- B. Coil Section Insulation: Insulate coil section according to Division 23 Specification Section "Insulation for HVAC Pipe and Duct Systems."
1. Surface Burning Characteristics: Insulation and adhesive shall have a combined maximum flame spread index of twenty five (25) and smoke developed index of fifty (50) when tested according to ASTM E 84 by a qualified testing agency.
  2. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- C. Drain Pans: Stainless steel. Fabricate pans and drain connections to comply with ASHRAE 62.1.
- D. Chassis: Galvanized steel where exposed to moisture, with baked enamel finish and removable access panel. Floor mounting units shall have leveling screws.
- E. Cabinet: Steel with baked enamel finish in manufacturer's standard paint color as selected by Architect.

1. Vertical Unit Front Panels: Removable, steel, with steel discharge grille and channel formed edges, cam fasteners, and insulation on back of panel.
  2. Horizontal Unit Bottom Panels: Fastened to unit with cam fasteners and hinge and attached with safety chain; with cast aluminum discharge grilles.
  3. Stack Unit Discharge and Return Grille: Aluminum double deflection discharge grille, and louvered or panel type return grille; color as selected by Architect from manufacturer's standard colors. Return grille shall provide maintenance access to fan coil unit.
  4. Steel recessing flanges for recessing fan coil units into ceiling or wall.
- F. Filters: Minimum arrestance and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2 and all addendums.
1. MERV Rating: Six (6) when tested according to ASHRAE 52.2.
- G. Hydronic Coils: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch, rated for a minimum working pressure of 200 psig and a maximum entering water temperature of 220°F. Include manual air vent and drain valve.
- H. Fan and Motor Board: Removable.
1. Fan: Forward curved, double width, centrifugal; directly connected to motor. Thermoplastic or painted steel wheels, and aluminum, painted steel, or galvanized steel fan scrolls.
  2. Motor: Permanently lubricated, multispeed; resiliently mounted on motor board. Comply with requirements in Division 23 Specification Section "Motor Requirements for HVAC Equipment."
  3. Wiring Termination: Connect motor to chassis wiring with plug connection.
- I. Factory, Hydronic Piping Package: ASTM B 88, Type L copper tube with wrought copper fittings and brazed joints. Label piping to indicate service, inlet, and outlet.
- J. Control devices and operational sequences are specified in Division 23 Specification Sections for "Building Automation Systems."

## 2.3 CONVECTORS

### A. Hot Water Convectors:

1. Heating Elements: Seamless copper tubing mechanically expanded into evenly spaced aluminum fins and rolled into cast iron or brass headers with inlet/outlet and air vent; steel side plates and supports. Factory pressure test element at minimum 100 psig.

- a. Front and Top Panel: Minimum 0.0528 inch thick steel with exposed corners rounded; removable front panels with tamper resistant fasteners braced and reinforced for stiffness.
- b. Wall-Mounted Back and End Panels: Minimum 0.0428 inch thick steel.
- c. Floor-Mounted Pedestals: Conceal conduit for power and control wiring at maximum thirty six (36) inch spacing. Pedestal-mounted back panel shall be solid panel matching front panel.
- d. Support Brackets: Locate at maximum thirty six (36) inch spacing to support front panel and element.
- e. Insulation: One half (1/2) inch thick, fibrous glass on inside of the back of the enclosure.
- f. Finish: Baked enamel finish in manufacturer's standard color as selected by Architect.
- g. Access Doors: Factory made, permanently hinged with tamper resistant fastener, minimum size of six (6) inches by seven (7) inches, integral with enclosure.
- h. Enclosure Style: [Sloped] [Flat] top. <Edit for project>
  - 1) Front Inlet Grille: Punched louver; painted to match enclosure.
  - 2) Front Inlet Grille: Extruded aluminum linear bar grille; pencil proof bar spacing.
    - a) Mill-finish aluminum.
    - b) Anodized finish, color as selected by Architect from manufacturer's standard colors.
    - c) Painted to match enclosure.
  - 3) [Top] [Front] Outlet Grille: Punched louver; painted to match enclosure. <Edit for project>
  - 4) [Top] [Front] Outlet Grille: Extruded aluminum linear bar grille; pencil proof bar spacing.
    - a) Mill-finish aluminum.
    - b) Anodized finish, color as selected by Architect from manufacturer's standard colors.
    - c) Painted to match enclosure.

## 2.4 FINNED TUBE RADIATION HEATERS

### A. Hot-Water Finned-Tube Radiation Heaters:

1. Performance Ratings: Rate finned-tube radiation heaters according to Hydronics Institute's "I=B=R Testing and Rating Standard for Finned Tube (Commercial) Radiation."

2. Heating Elements: Copper tubing mechanically expanded into flanged collars of evenly spaced aluminum fins resting on element supports. One (1) end of tube shall be belled.
  - a. Tube Diameter: [NPS 3/4] [NPS 1] [NPS 1-1/4] <Insert pipe size>. <Edit for project>
  - b. Fin Size: Three (3) inches by three (3) inches.
  - c. Fin Spacing: Forty (40) fins per foot.
  - d. Number of Tiers: <Insert number>. <Edit for project>
3. Element Supports: Ball-bearing cradle type to permit longitudinal movement on enclosure brackets.
4. Front Panel: Minimum 0.0428 inch thick steel.
5. Rust-Resistant Front Panel: Minimum 0.052 inches thick, ASTM A 653/A 653M, G60 galvanized steel.
6. Wall-Mounted Back Panel: Minimum 0.0329 inch thick steel, full height, with full length channel support for front panel without exposed fasteners.
7. Floor Mounted Pedestals: Conceal insulated piping at maximum thirty six (36) inch spacing. Pedestal mounted back panel shall be solid panel matching front panel. Provide stainless steel escutcheon for floor openings at pedestals.
8. Support Brackets: Locate at maximum thirty six (36) inch spacing to support front panel and element.
9. Finish: Baked enamel finish in manufacturer's standard color as selected by Architect.
10. Access Doors: Factory made, permanently hinged with tamper resistant fastener, minimum size of six (6) inches by seven (7) inches, integral with enclosure.
11. Enclosure Style: [Sloped] [Flat] top. <Edit for project>
  - a. Front Inlet Grille: Punched louver; painted to match enclosure.
  - b. Front Inlet Grille: Extruded aluminum linear bar grille; pencil proof bar spacing.
    - 1) Mill finish aluminum.
    - 2) Anodized finish, color as selected by Architect from manufacturer's [standard] [custom] colors.
    - 3) Painted to match enclosure.
  - c. [Top] [Front] Outlet Grille: Punched louver; painted to match enclosure. <Edit for project>
  - d. [Top] [Front] Outlet Grille: Extruded aluminum linear bar grille; pencil proof bar spacing. <Edit for project>
    - 1) Mill finish aluminum.
    - 2) Anodized finish, color as selected by Architect from manufacturer's standard colors.

3) Painted to match enclosure.

12. Accessories: Filler sections, corners, relay sections, and splice plates all matching the enclosure and grille finishes.

## 2.5 UNIT HEATERS

### A. Description:

1. Factory assembled and tested unit complying with AHRI 440.
2. 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.
3. Comply with UL 2021.

## 2.6 COIL SECTION INSULATION

### A. Insulation Materials: Comply with NFPA 90A or NFPA 90B. Unicellular polyethylene thermal plastic, preformed sheet insulation complying with ASTM C 534, Type II, except for density.

1. Thickness: One half (1/2) inch.
2. Thermal Conductivity (k-Value): 0.24 Btu x in./h x sq. ft. at 75°F mean temperature.
3. Fire Hazard Classification: Maximum flame-spread index of twenty five (25) and smoke developed index of fifty (50) when tested according to ASTM C 411.
4. Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.
5. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

## 2.7 CABINETS

### A. Material: Steel with baked enamel finish with manufacturer's standard paint, in color selected by Architect.

1. Vertical Unit, Exposed Front Panels: Minimum 0.0528 inch thick galvanized sheet steel, removable panels with channel formed edges secured with tamperproof cam fasteners.
2. Horizontal Unit, Exposed Bottom Panels: Minimum 0.0528 inch thick galvanized sheet steel, removable panels secured with tamperproof cam fasteners and safety chain.
3. Recessed Flanges: Steel, finished to match cabinet.
4. Control Access Door: Key operated.
5. Base: Minimum 0.0528 inch thick steel, finished to match cabinet, six (6) inches high with leveling bolts.



6. Extended Piping Compartment: Eight (8) inches wide piping end pocket.
7. False Back: Minimum 0.0428 inch thick steel, finished to match cabinet.

## 2.8 COILS

- A. Hot Water Coil: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch and rated for a minimum working pressure of 200 psig and a maximum entering water temperature of 220°F. Include manual air vent and drain.

## 2.9 CONTROLS

- A. Fan and Motor Board: Removable.
  1. Fan: Forward curved, double width, centrifugal, directly connected to motor; thermoplastic or painted-steel wheels and aluminum, painted-steel, or galvanized-steel fan scrolls.
  2. Motor: Permanently lubricated, multispeed; resiliently mounted on motor board. Comply with requirements in Division 23 Specification Section "Motor Requirements for HVAC Equipment."
  3. Wiring Terminations: Connect motor to chassis wiring with plug connection.
- B. Factory, Hot Water Piping Package: ASTM B 88, Type L copper tube with wrought copper fittings and brazed joints. Label piping to indicate service, inlet, and outlet.
  1. Two-Piece, Ball Valves: Bronze body with full-port, stainless steel ball and stem; PTFE or TFE seats; and 600 psig minimum CWP rating and blowout proof stem. See Division 23 Specification Section "Valves for HVAC Piping Systems" for acceptable valve manufacturers.
  2. Calibrated-Orifice Balancing Valves: Bronze body, ball type, 125 psig working pressure, 250°F maximum operating temperature; with calibrated orifice or venture, connection for portable differential pressure meter with integral seals, threaded ends, and equipped with a memory stop to retain set position.
  3. Automatic Flow-Control Valve: Brass or ferrous metal body, 300 psig working pressure at 250°F, with removable, corrosion-resistant, tamperproof, self cleaning piston spring; factory set to maintain constant indicated flow within plus or minus 10% of differential pressure range of 2 psig to 80 psig.
  4. Y Pattern, Hot Water Strainers: Cast iron body (ASTM A 126, Class B); 125 psig minimum working pressure; with threaded connections, bolted cover, perforated stainless steel basket, and bottom drain connection. Include minimum NPS 1/2 threaded pipe and full port ball valve in strainer drain connection.
  5. Wrought-Copper Unions: ASME B16.22.
- C. Control devices and operational sequences are specified in Division 23 Specification Sections for "Building Automatic Systems".

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. With the installing contractor present examine the locations for each heating and cooling terminal unit for compliance with the requirements for installation tolerances and other conditions affecting performance of the work.
- B. Examine roughing in locations and verify the required mechanical and electrical connections have been completed and the surface areas are level and clean.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 INSTALLATION**

#### **A. Fan Coil Unit Installation:**

- 1. Install fan coil units to comply with NFPA 90A.
- 2. Install fan coil units level and plumb.
- 3. Suspend fan coil units from structure with elastomeric hangers. Vibration isolators are specified in Division 23 Specification Section "Vibration and Seismic Controls for HVAC Systems."
- 4. Verify locations of thermostats, and other exposed control sensors with Drawings and room details before installation. Install devices forty eight (48) inches above finished floor.
- 5. Install new filters in each fan coil unit within two (2) weeks after Substantial Completion.

#### **B. Cabinet Unit Heater Installation:**

- 1. Install cabinet unit heaters to comply with NFPA 90A.
- 2. Install cabinet unit heaters level and plumb.
- 3. Suspend horizontal cabinet unit heaters from structure with elastomeric hangers and seismic restraints. Vibration isolators and seismic restraints are specified in Division 23 Specification Section "Vibration and Seismic Controls for HVAC Systems."
- 4. Install wall mounted thermostats and switch controls in electrical outlet boxes at heights to match lighting controls. Verify location of thermostats and other exposed control sensors with Drawings and room details before installation.

#### **C. Unit Heater Installation:**

- 1. Install unit heaters to comply with NFPA 90A.
- 2. Install unit heaters level and plumb.

3. Suspend unit heaters from structure with elastomeric hangers and seismic restraints. Vibration isolators and seismic restraints are specified in Division 23 Specification Section "Vibration and Seismic Controls for HVAC Systems."
4. Install wall mounted thermostats and switch controls in electrical outlet boxes at heights to match lighting controls. Verify location of thermostats and other exposed control sensors with Drawings and room details before installation.

D. Convector Unit Installation:

1. Install convector units to comply with NFPA 90A.
2. Install convector units level and plumb.
3. Install wall mounted thermostats and switch controls in electrical outlet boxes at heights to match lighting controls. Verify location of thermostats and other exposed control sensors with Drawings and room details before installation.

E. Finned Tube Radiation (FTR) Unit Installation:

1. Install FTR unit's level and plumb.
2. Install enclosure continuously around corners, using outside and inside corner fittings.
3. Join sections with splice plates and filler pieces to provide continuous enclosure.
4. Install access doors for access to valves.
5. Install enclosure continuously from wall to wall.
6. Terminate enclosures with manufacturer's end caps except where enclosures are indicated to extend to adjoining walls.
7. Install valves within reach of access door provided in enclosure.
8. Install air seal gasket between wall and recessed flanges or front cover of fully recessed unit.
9. Install piping within pedestals for freestanding units.

### 3.3 CONNECTIONS

A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties. Specific connection requirements are as follows:

1. Install piping adjacent to machine to allow service and maintenance.
2. Connect piping to fan coil unit factory hydronic piping package. Install piping package if shipped loose.
3. Connect condensate drain to indirect waste.
  - a. Install condensate trap of adequate depth to seal against fan pressure. Install cleanouts in piping at changes of direction.

- B. Connect supply air and return air ducts to fan coil units with flexible duct connectors specified in Division 23 Specification Section "HVAC Duct Systems and Accessories." Comply with safety requirements in UL 1995 for duct connections.
- C. Ground equipment according to Division 26 Specification Section "Grounding and Bonding for Electrical Systems."
- D. Connect wiring according to Division 26 Specification Section "Low Voltage Electrical Power Conductors and Cables."
- E. Piping installation requirements are specified in Division 23 Specification Section "HVAC Piping Systems and Specialties." Drawings indicate general arrangement of piping, fittings, and specialties.
- F. Connect hot water convectors and components to piping according to Division 23 Specification Section "HVAC Piping Systems and Specialties."
  - 1. Install shutoff valves on inlet and outlet, and balancing valve on outlet.
- G. Piping installation requirements are specified in Division 23 Specification Section "HVAC Piping Systems and Specialties." Drawings indicate general arrangement of piping, fittings, and specialties.
- H. Connect hot water finned tube radiation heaters and components to piping according to Division 23 Specification Section "HVAC Piping Systems and Specialties."
  - 1. Install shutoff valves on inlet and outlet, and balancing valve on outlet.

### 3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- B. Perform the following tests and inspections with the assistance of a factory authorized service representative:
  - 1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
  - 2. Operate electric heating elements through each stage to verify proper operation and electrical connections.
  - 3. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.
  - 4. Record temperatures entering and leaving energy recovery wheel when outdoor-air temperature is a minimum of 15°F higher, or 20°F lower, than room temperature.

- C. Remove and replace malfunctioning units and retest as specified above.
- D. Prepare test and inspection reports.

### 3.5 ADJUSTING

- A. Adjust initial temperature set points.
- B. Occupancy Adjustments: When requested within twelve (12) months from the date of Substantial Completion, provide onsite assistance in adjusting system to suit actual occupied conditions. Provide up to two (2) visits to Project during other than normal occupancy hours for this purpose.

### 3.6 DEMONSTRATION

- A. Engage a factory authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fan coil units.

END OF SECTION 238219