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SECTION 238219 - FAN COIL UNITS

This Section includes requirements for the LEED Rating System. However, equipment specified in this Section may not qualify for LEED Rating System prerequisites and credits. Verify, with manufacturers, that the requirements for prerequisites and credits can be met. To achieve prerequisites and obtain credits, HVAC system design alternatives that do not include fan coil units may be required.

Revise this Section by deleting and inserting text to meet Project-specific requirements.

This Section uses the term "Architect." Change this term to match that used to identify the design professional as defined in the General and Supplementary Conditions.

Verify that Section titles referenced in this Section are correct for this Project's Specifications; Section titles may have changed.

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes fan-coil units and accessories.

1.3 DEFINITIONS

Retain abbreviation that remains after this Section has been edited.

- A. BAS: Building automation system.

1.4 ACTION SUBMITTALS

- A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories.
- B. LEED Submittals:

Coordinate "Product Data for Credit EA 4" Subparagraph below with requirements for refrigerants.

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: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
1. Wiring Diagrams: Power, signal, and control wiring.
- D. Samples for Initial Selection: For units with factory-applied color finishes.

Delete paragraph above if colors and other characteristics are preselected and specified or scheduled. Retain paragraph below with or without above.

- E. Samples for Verification: For each type of fan-coil unit indicated.

1.5 INFORMATIONAL SUBMITTALS

Retain first paragraph and subparagraphs below if Drawings do not include detailed plans or if Project involves unusual coordination requirements.

- A. Coordination Drawings: Floor plans, reflected ceiling plans, and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

Edit subparagraphs below to suit Project.

1. Ceiling suspension components.
2. Structural members to which fan-coil units will be attached.
3. Method of attaching hangers to building structure.
4. Size and location of initial access modules for acoustical tile.
5. Items penetrating finished ceiling, including the following:
 - a. Lighting fixtures.
 - b. Air outlets and inlets.
 - c. Speakers.
 - d. Sprinklers.
 - e. Access panels.
 - f. <Insert item.>
6. Perimeter moldings for exposed or partially exposed cabinets.

Retain paragraph and subparagraphs below if required by seismic criteria applicable to Project. Coordinate with Section 230548 "Vibration and Seismic Controls for HVAC Piping and Equipment."

- B. Manufacturer Seismic Qualification Certification: Submit certification that fan-coil units, accessories, and components will withstand seismic forces defined in Section 230548 "Vibration and Seismic Controls for HVAC Piping and Equipment." Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

Retain one of first two subparagraphs below to define the term "withstand" as it applies to this Project. Definition varies with type of building and occupancy and is critical to valid certification. Second definition is used for essential facilities where equipment must operate immediately after an earthquake.

- a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
 - b. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

Retain first paragraph below if Contractor is responsible for field quality-control testing.

- C. Field quality-control test reports.
- D. Warranty: Special warranty specified in this Section.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fan-coil units to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 1. Maintenance schedules and repair part lists for motors, coils, integral controls, and filters.

1.7 MAINTENANCE MATERIAL SUBMITTALS

Extra materials may not be allowed for publicly funded projects.

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Fan-Coil-Unit Filters: Furnish <Insert number> spare filters for each filter installed.

Retain subparagraph below only for fan-coil units with belt-driven fans.

2. Fan Belts: Furnish <Insert number> spare fan belts for each unit installed.

1.8 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

"ASHRAE Compliance" Paragraph below may be required to comply with Project requirements or authorities having jurisdiction. LEED Prerequisite IEQ 1 requires compliance with requirements in ASHRAE 62.1, including requirements for controls, surfaces in contact with the airstream, particulate and gaseous filtration, humidification and dehumidification, drain pan construction and connection, finned-tube coil selection and cleaning, and equipment access. Verify, with manufacturers, availability of units with components and features that comply with these requirements.

- B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

"ASHRAE/IESNA 90.1 Compliance" Paragraph below may be required to comply with Project requirements or authorities having jurisdiction. LEED Prerequisite EA 2 requires minimum efficiency equal to requirements in ASHRAE/IESNA 90.1.

- C. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

1.9 COORDINATION

Edit paragraph below to delete or add types of construction that penetrate or are supported by ceilings. Delete this Article if fan-coil units are wall or floor mounted.

- A. Coordinate layout and installation of fan-coil 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.

Retain paragraph below for units with outdoor air.

- B. Coordinate size and location of wall sleeves for outdoor-air intake.

1.10 WARRANTY

Delete this Article if remote condensing unit is not required.

When warranties are required, verify with Owner's counsel that special warranties stated in this Article are not less than remedies available to Owner under prevailing local laws. Coordinate with Section 016000 "Product Requirements."

Warranties vary among manufacturers from covering the whole unit for up to 4 years, to only the compressor for 5 to 10 years, or only the condenser coil for 5 years. Extended special warranties are limited to units in the 1- to 5-ton (3.5- to 17.6-kW) range, and then are usually restricted to residential applications.

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of condensing units that fail in materials or workmanship within specified warranty period.
1. Failures include, but are not limited to, the following:
 - a. Compressor failure.
 - b. Condenser coil leak.

Verify available warranties and insert number in subparagraphs below.

2. Warranty Period: **[Four]** **[Five]** **[10]** **<Insert number>** years from date of Substantial Completion.
3. Warranty Period (Compressor Only): **[Five]** **[10]** **<Insert number>** years from date of Substantial Completion.
4. Warranty Period (Condenser Coil Only): **[Five]** **<Insert number>** years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

See Editing Instruction No. 1 in the Evaluations for cautions about naming manufacturers and products.

Edit this Article with other Part 2 articles, or the Fan-Coil-Unit Schedule on Drawings, in which manufacturers and products, or manufacturers only, are named. See Section 016000 "Product Requirements" for an explanation of the terms "Available Manufacturers," "Manufacturers," and "Basis-of-Design Product" and the effect these terms have on "Comparable Product" and "Product Substitution" requirements.

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

Retain paragraph above if fan-coil units are described in this Section; retain paragraph below if fan-coil units are scheduled on Drawings. See sample schedule in the Evaluations.

- B. In the Fan-Coil-Unit Schedule where titles below are column or row headings that introduce lists, the following requirements apply to product selection:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
 2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
 3. Basis-of-Design Product: The design for each fan-coil unit is based on the product named. Subject to compliance with requirements, provide either the named product or a comparable product by one of the other manufacturers specified.

2.2 FAN-COIL UNITS

Many additional features, which vary with each manufacturer, are available for this product. Include all features for fan-coil units that are required for Project, and identify additional features for specific units in the Fan-Coil-Unit Schedule on Drawings.

- A. Basis-of-Design Product: <Insert manufacturer's name; product name or designation> or a comparable product by one of the following:

Retain paragraph above or below. Retain "Available" in first paragraph below for nonproprietary and delete for semiproprietary specifications. Coordinate with Part 2 "Manufacturers" Article.

- B. [Available] \$L~Manufacturers~\$l~3615~L\$:

Retain list of manufacturers below with either paragraph above.

1. \$M~Airtherm; a Mestek Company~\$m~123456822377~M\$.
2. \$M~Carrier Corporation~\$m~123456813923~M\$.
3. \$M~Engineered Air Ltd~\$m~123456813924~M\$.
4. \$M~Environmental Technologies, Inc~\$m~123456813925~M\$.
5. \$M~First Co~\$m~123456813926~M\$.
6. \$M~International Environmental Corporation~\$m~123456813927~M\$.
7. \$M~Marlo Coil; Subsidiary of Engineered Support Systems, Inc~\$m~123456822381~M\$.
8. \$M~Marshall Engineered Products Co., LLC (MEPCO); Dunham-Bush, Inc~\$m~123456822384~M\$.
9. \$M~McQuay International~\$m~123456813928~M\$.
10. \$M~Rosemex~\$m~123456813929~M\$.
11. \$M~Trane~\$m~123456813930~M\$.
12. \$M~USA Coil & Air~\$m~123456813931~M\$.
13. \$M~YORK International Corporation~\$m~123456813932~M\$.
14. <Insert manufacturer's name.>

- C. Description: Factory-packaged and -tested units rated according to ARI 440, ASHRAE 33, and UL 1995.

Closed-cell insulation with foil or matt facing is provided by some manufacturers to reduce the possibility of fibers from glass-fiber insulation being introduced into the conditioned space.

- D. Coil Section Insulation: [1/2-inch (13-mm)] [1-inch (25-mm)] <Insert thickness> thick, [coated glass fiber] [foil-covered, closed-cell foam] [matte-finish, closed-cell foam] complying with ASTM C 1071 and attached with adhesive complying with ASTM C 916.

1. Fire-Hazard Classification: Insulation and adhesive shall have a combined maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM E 84.

"Airstream Surfaces" Subparagraph below may be required to comply with Project requirements or authorities having jurisdiction. Retain subparagraph to comply with LEED Prerequisite IEQ 1.

2. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

Removable drain pans are an extra feature with some manufacturers.

"Main and Auxiliary Drain Pans" Paragraph below may be required to comply with Project requirements or authorities having jurisdiction. LEED Prerequisite IEQ 1 requires compliance with ASHRAE 62.1.

- E. Main and Auxiliary Drain Pans: [**Plastic**] [**Stainless steel**] [**Insulated galvanized steel with plastic liner**]. Fabricate pans and drain connections to comply with ASHRAE 62.1. [**Drain pans shall be removable**].
- F. Chassis: Galvanized steel where exposed to moisture. Floor-mounting units shall have leveling screws.

Coordinate custom-color requirements in paragraph below with sample submittal requirements. Coordinate field painting with Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

- G. Cabinet: Steel with [**factory prime coating, ready for field painting**] [**baked-enamel finish in manufacturer's standard paint color as selected by Architect**] [**baked-enamel finish in manufacturer's custom paint color as selected by Architect**].
 1. Vertical Unit Front Panels: Removable, steel, with [**integral stamped**] [**polyethylene**] [**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 [**integral stamped**] [**cast-aluminum**] discharge grilles.

Retain first subparagraph below for stack-type fan-coil unit.

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**] [**custom**] colors. Return grille shall provide maintenance access to fan-coil unit.
4. Steel recessing flanges for recessing fan-coil units into ceiling or wall.

Retain paragraph and subparagraphs below for fan-coil units with outdoor-air intake.

- H. Outdoor-Air Wall Box: Minimum 0.1265-inch- (3.2-mm-) thick, aluminum, rain-resistant louver and box with integral eliminators and bird screen.
 1. Louver Configuration: [**Horizontal**] [**Vertical**], rain-resistant louver.
 2. Louver Material: [**Aluminum**] [**Steel**].
 3. Bird Screen: 1/2-inch (13-mm) mesh screen on interior side of louver.
 4. Decorative Grille: On outside of intake.
 5. Finish: [**Anodized aluminum**] [**Baked enamel**], color as selected by Architect from manufacturer's [**standard**] [**custom**] colors.

Outdoor-air dampers are furnished for wall-mounting, vertical, exposed units only.

- I. Outdoor-Air Damper: Galvanized-steel blades with edge and end seals and nylon bearings; with **[electronic]** **[pneumatic]**, **[two-position]** **[modulating]** actuators.

Verify available filter types with manufacturer. Indicate filter thickness in "Capacities and Characteristics" Paragraph or in the Fan-Coil-Unit Schedule on Drawings.

- J. Filters: Minimum arrestance according to ASHRAE 52.1, and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.

Retain one or more of three subparagraphs below. Indicate filter type in the Fan-Coil-Unit Schedule on Drawings. 2-inch- (50-mm-) thick washable foam is not available. Retain third subparagraph if applying for LEED certification. LEED Prerequisite IEQ 1 requires compliance with ASHRAE 62.1, which requires a MERV rating of 6 or higher.

1. Washable Foam: 70 percent arrestance and 3 MERV.
 2. Glass Fiber Treated with Adhesive: 80 percent arrestance and 5 MERV.
 3. Pleated Cotton-Polyester Media: 90 percent arrestance and 7 MERV.
- K. Hydronic Coils: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch (2.5 mm), rated for a minimum working pressure of 200 psig (1378 kPa) and a maximum entering-water temperature of 220 deg F (104 deg C). Include manual air vent and drain valve.
- L. Steam Coils: Copper **[distributing]** tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch (2.5 mm), rated for a minimum working pressure of 75 psig (517 kPa).
- M. Electric-Resistance Heating Coils: Nickel-chromium heating wire, free of expansion noise and hum, mounted in ceramic inserts in a galvanized-steel housing; with fuses in terminal box for overcurrent protection and limit controls for high-temperature protection. Terminate elements in stainless-steel machine-staked terminals secured with stainless-steel hardware.
- N. 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.

Motor characteristics such as NEMA designation, temperature rating, service factor, enclosure type, and efficiency are specified in Section 230513 "Common Motor Requirements for HVAC Equipment." If different characteristics are required, add subparagraphs below to suit Project.

2. Motor: Permanently lubricated, multispeed; resiliently mounted on motor board. Comply with requirements in Section 230513 "Common Motor Requirements for HVAC Equipment."
3. Wiring Termination: Connect motor to chassis wiring with plug connection.

Retain first paragraph and applicable subparagraphs below to suit Project. Delete if factory piping package is not required.

- O. Factory, Hydronic Piping Package: [ASTM B 88, Type L (ASTM B 88M, Type B)] [ASTM B 88, Type M (ASTM B 88M Type C)] copper tube with wrought-copper fittings and brazed joints. Label piping to indicate service, inlet, and outlet.

Retain one or more of first four subparagraphs below.

1. [Two] [Three]-way, [two-position] [modulating] control valve for dual-temperature coil.
2. [Two] [Three]-way, [two-position] [modulating] control valve for chilled-water coil.
3. [Two] [Three]-way, [two-position] [modulating] control valve for heating coil.
4. [Two] [Three]-way [two-position] [modulating] control valve for hot-water reheat coil.
5. Hose Kits: Minimum 400-psig (2758-kPa) working pressure, and operating temperatures from 33 to 211 deg F (0.5 to 99 deg C). Tag hose kits to equipment designations.
 - a. Length: [24 inches (600 mm)] [36 inches (900 mm)] <Insert dimension>.
 - b. Minimum Diameter: Equal to fan-coil-unit connection size.
6. Two-Piece Ball Valves: Bronze body with full-port, chrome-plated bronze ball; PTFE or TFE seats; and 600-psig (4140-kPa) minimum CWP rating and blowout-proof stem.
7. Calibrated-Orifice Balancing Valves: Bronze body, ball type; 125-psig (860-kPa) working pressure, 250-deg F (121-deg C) maximum operating temperature; with calibrated orifice or venturi, connections for portable differential pressure meter with integral seals, threaded ends, and equipped with a memory stop to retain set position.
8. Automatic Flow-Control Valve: Brass or ferrous-metal body; 300-psig (2070-kPa) working pressure at 250 deg F (121 deg C), with removable, corrosion-resistant, tamperproof, self-cleaning piston spring; factory set to maintain constant indicated flow with plus or minus 10 percent over differential pressure range of 2 to 80 psig (13.8 to 552 kPa).
9. Y-Pattern Hydronic Strainers: Cast-iron body (ASTM A 126, Class B); 125-psig (860-kPa) working pressure; with threaded connections, bolted cover, perforated stainless-steel basket, and bottom drain connection. Include minimum NPS 1/2 (DN 15) hose-end, full-port, ball-type blowdown valve in drain connection.
10. Wrought-Copper Unions: ASME B16.22.

Retain subparagraph below for stack-type units with hydronic coils.

11. Risers: [ASTM B 88, Type L (ASTM B 88M, Type B)] [ASTM B 88, Type M (ASTM B 88M Type C)] copper pipe with hose and ball valve for system flushing.

- P. Control devices and operational sequences are specified in Section 230900 "Instrumentation and Control for HVAC" and Section 230993 "Sequence and Operations for HVAC Controls."

Retain paragraph above and delete paragraph and subparagraphs below if controls are part of overall temperature-control system.

- Q. Basic Unit Controls:

1. Control voltage transformer.

Verify control features with manufacturer.

2. [Wall-mounting] [Unit-mounted] thermostat with the following features:

- a. Heat-cool-off switch.
- b. Fan on-auto switch.

Retain first subparagraph below if multispeed motors are specified.

- c. Fan-speed switch.
 - d. **[Manual]** **[Automatic]** changeover.
 - e. Adjustable deadband.
 - f. **[Concealed]** **[Exposed]** set point.
 - g. **[Concealed]** **[Exposed]** indication.
 - h. **[Degree F]** **[Degree C]** indication.
- 3. **[Wall-mounting]** **[Unit-mounted]** humidistat.
 - a. **[Concealed]** **[Exposed]** set point.
 - b. **[Concealed]** **[Exposed]** indication.
 - 4. **[Wall-mounting]** **[Unit-mounted]** temperature sensor.
 - 5. Unoccupied-period-override push button.
 - 6. Data entry and access port.
 - a. Input data includes room temperature, and humidity set points and occupied and unoccupied periods.
 - b. Output data includes room temperature and humidity, supply-air temperature, entering-water temperature, operating mode, and status.

Retain first paragraph and subparagraphs below and coordinate with "Basic Unit Controls" Paragraph and subparagraphs above or with control devices specified in Section 230900 "Instrumentation and Control for HVAC."

R. **[DDC]** Terminal Controller:

- 1. Scheduled Operation: Occupied and unoccupied periods on seven-day clock with a minimum of four programmable periods per day.
- 2. Unoccupied Period Override Operation: **[Two]** **<Insert number>** hours.
- 3. Unit Supply-Air Fan Operation:
 - a. Occupied Periods: Fan runs continuously.
 - b. Unoccupied Periods: Fan cycles to maintain room setback temperature.
- 4. Hydronic-Cooling-Coil Operation:
 - a. Occupied Periods: **[Open]** **[Modulate]** control valve to maintain room temperature.
 - b. Unoccupied Periods: Close control valve.
- 5. Heating-Coil Operation:
 - a. Occupied Periods: **[Open control valve]** **[Modulate control valve]** **[Energize electric-resistance coil]** to provide heating if room temperature falls below thermostat set point.

- b. Unoccupied Periods: Start fan and **[open control valve] [modulate control valve] [energize electric-resistance coil]** if room temperature falls below setback temperature.
6. Dual-Temperature Hydronic-Coil Operation:
- a. Occupied Periods: When chilled water is available, **[open] [modulate]** control valve if room temperature exceeds thermostat set point. When hot water is available, open control valve if temperature falls below thermostat set point.
 - b. Unoccupied Periods: When chilled water is available, close control valve. When hot water is available, **[open] [modulate]** control valve if room temperature falls below thermostat setback temperature.
7. Reheat-Coil Operation:

Retain two subparagraphs and associated subparagraph below if reheat coil provides reheat only.

- a. Humidity Control for Occupied Periods:
 - 1) Humidistat **[opens control valve] [modulates control valve] [energizes electric-resistance coil]** to provide heating. As space temperature rises above the set point, cooling coil valve **[opens] [modulates]** to maintain room temperature.
- b. Humidity Control for Unoccupied Periods: **[Close control valve] [De-energize]**.

Retain two subparagraphs and associated subparagraphs below if reheat coil provides heating and reheat.

- c. Occupied Periods:
 - 1) Heating Operations: **[Open control valve] [Modulate control valve] [Energize electric-resistance coil]** to provide heating if room temperature falls below thermostat set point.
 - 2) Humidity-Control Operations: Humidistat **[opens control valve] [modulates control valve] [energizes electric-resistance coil]** to provide heating. As space temperature rises above the set point, cooling coil valve **[opens] [modulates]** to maintain room temperature.
- d. Unoccupied Periods: Start fan and **[open control valve] [modulate control valve] [energize electric-resistance coil]** if room temperature falls below setback temperature. Humidity control is not available.

Retain subparagraph and associated subparagraphs below for fixed, minimum outdoor-air intake.

8. Outdoor-Air Damper Operation:
- a. Occupied Periods: Open damper to fixed position for **[25] <Insert percent>** percent outdoor air.
 - b. Unoccupied periods: Close damper.

Retain first subparagraph and associated subparagraphs below for outdoor-air economizer cycle.

9. Outdoor-Air Damper Operation:
 - a. Occupied Periods:
 - 1) Outdoor-Air Temperature below Room Temperature: If room temperature is above thermostat set point, modulate outdoor-air damper to maintain room temperature (outdoor-air economizer). If room temperature is below thermostat set point, position damper to fixed minimum position.
 - 2) Outdoor-Air Temperature above Room Temperature: Position damper to fixed minimum position for [25] <Insert percent> percent outdoor air.
 - b. Unoccupied Periods: Close damper.
10. Controller shall have volatile-memory backup.

S. BAS Interface Requirements:

1. Interface relay for scheduled operation.
2. Interface relay to provide indication of fault at the central workstation.
3. Provide [BACnet] [or] [LonWorks] interface for central BAS workstation for the following functions:
 - a. Adjust set points.
 - b. Fan-coil-unit start, stop, and operating status.
 - c. Data inquiry, including [outdoor-air damper position,]supply- and room-air temperature[and humidity].
 - d. Occupied and unoccupied schedules.

- T. Electrical Connection: Factory wire motors and controls for a single electrical connection.

If Project has more than one type or configuration of fan-coil unit, delete paragraph and subparagraphs below and schedule fan-coil units on Drawings.

U. Capacities and Characteristics:

1. Fan:
 - a. Airflow: <Insert cfm (L/s).>
 - b. External Static Pressure: <Insert inches wg (kPa).>
 - c. Fan Speed: <Insert rpm.>
 - d. Motor Speed: <Insert rpm.>
 - e. Motor Horsepower: <Insert horsepower.>
2. Cooling Capacity:
 - a. Total: <Insert Btu/h (kW).>
 - b. Sensible: <Insert Btu/h (kW).>
 - c. Entering-Air Dry-Bulb Temperature: <Insert deg F (deg C).>
 - d. Entering-Air Wet-Bulb Temperature: <Insert deg F (deg C).>
3. Chilled-Water Coil:

- a. Water Flow: <Insert gpm (L/s).>
 - b. Water-Side Pressure Loss: <Insert feet wg (kPa).>
 - c. Entering-Water Temperature: <Insert deg F (deg C).>
4. Heating Capacity:
- a. Output: <Insert Btu/h (kW).>
 - b. Entering-Air Temperature: <Insert deg F (deg C).>
 - c. Air-Temperature Rise: <Insert deg F (deg C).>
5. Hot-Water Heating Coil:
- a. Water Flow: <Insert gpm (L/s).>
 - b. Water-Side Pressure Loss: <Insert feet wg (kPa).>
 - c. Entering-Water Temperature: <Insert deg F (deg C).>
6. Steam Heating Coil:
- a. Inlet Steam Pressure: <Insert psig (kPa).>
 - b. Condensing Capacity: <Insert lb/h (g/s).>
7. Electric-Resistance Heating Coil:
- a. Capacity: <Insert kW.>
 - b. Number of Steps: <Indicate value.>
8. Reheat Capacity:
- a. Output: <Insert Btu/h (kW).>
 - b. Entering-Air Temperature: <Insert deg F (deg C).>
 - c. Air-Temperature Rise: <Insert deg F (deg C).>
9. Hot-Water Reheat Coil:
- a. Water Flow: <Insert gpm (L/s).>
 - b. Water-Side Pressure Loss: <Insert feet wg (kPa).>
 - c. Entering-Water Temperature (during Cooling): <Insert deg F (deg C).>
10. Steam Reheat Coil:
- a. Inlet Steam Pressure: <Insert psig (kPa).>
 - b. Condensing Rate: <Insert lb/h (g/s).>
11. Electric-Resistance Reheat Coil:
- a. Capacity: <Insert kW.>
 - b. Number of Steps: <Insert number.>
12. Filters:
- a. Face Area: <Insert sq. ft. (sq. m).>
 - b. Thickness: [1 inch (25 mm)] [2 inches (50 mm)] <Insert thickness>.

13. Electrical Characteristics for Single-Point Connection:

- a. Voltage/Phase/Hertz: <Insert values.>
- b. Full-Load Amperes: <Insert value.>
- c. Maximum Circuit Amperes: <Insert value.>
- d. Maximum Overcurrent Protection: <Insert value.>

2.3 DUCTED FAN-COIL UNITS

Many additional features, which vary with each manufacturer, are available for this product. Include all features for fan-coil units that are required for Project, and identify additional features for specific units in the Fan-Coil-Unit Schedule on Drawings.

- A. Basis-of-Design Product: <Insert manufacturer's name; product name or designation> or a comparable product by one of the following:

Retain paragraph above or below. Retain "Available" in first paragraph below for nonproprietary and delete for semiproprietary specifications. Coordinate with Part 2 "Manufacturers" Article.

- B. [Available] \$L~Manufacturers~\$1~3616~L\$:

Retain list of manufacturers below with either paragraph above.

1. \$M~Carrier Corporation~\$m~123456822388~M\$.
2. \$M~Engineered Air Ltd~\$m~123456813934~M\$.
3. \$M~Environmental Technologies, Inc~\$m~123456813935~M\$.
4. \$M~First Co~\$m~123456813936~M\$.
5. \$M~International Environmental Corporation~\$m~123456813937~M\$.
6. \$M~Marlo Coil; Subsidiary of Engineered Support Systems, Inc~\$m~123456822390~M\$.
7. \$M~Marshall Engineered Products Co., LLC (MEPCO); Dunham-Bush, Inc~\$m~123456822392~M\$.
8. \$M~McQuay International~\$m~123456813938~M\$.
9. \$M~Rosemex~\$m~123456813939~M\$.
10. \$M~Trane~\$m~123456813940~M\$.
11. \$M~USA Coil & Air~\$m~123456813941~M\$.
12. \$M~YORK International Corporation~\$m~123456813942~M\$.
13. <Insert manufacturer's name.>

- C. Description: Factory-packaged and -tested units rated according to ARI 440, ASHRAE 33, and UL 1995.

- D. Coil Section Insulation: [1/2-inch (13-mm)] [1-inch (25-mm)] <Insert thickness> thick [coated] [foil-faced] glass fiber complying with ASTM C 1071 and attached with adhesive complying with ASTM C 916.

1. Fire-Hazard Classification: Insulation and adhesive shall have a combined maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM E 84.

"Airstream Surfaces" Subparagraph below may be required to comply with Project requirements or authorities having jurisdiction. Retain subparagraph to comply with LEED Prerequisite IEQ 1.

2. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

"Drain Pans" Paragraph below may be required to comply with Project requirements or authorities having jurisdiction. LEED Prerequisite IEQ 1 requires compliance with ASHRAE 62.1.

- E. Drain Pans: [**Plastic**] [**Stainless steel**] [**Insulated galvanized steel with plastic liner**]. Fabricate pans and drain connections to comply with ASHRAE 62.1.
- F. Chassis: Galvanized steel where exposed to moisture, with baked-enamel finish and removable access panels.
- G. Cabinets: Steel with baked-enamel finish in manufacturer's standard paint color.
 1. Supply-Air Plenum: Sheet metal plenum finished and insulated to match the chassis[**with mill-finish, aluminum, double-deflection grille**].
 2. Return-Air Plenum: Sheet metal plenum finished to match the chassis.

Retain subparagraph above or first subparagraph below.

3. Mixing Plenum: Sheet metal plenum finished and insulated to match the chassis with outdoor- and return-air, formed-steel dampers.
4. Dampers: Galvanized steel with extruded-vinyl blade seals, flexible-metal jamb seals, and interlocking linkage.

Verify available filters with fan-coil-unit manufacturer. Indicate filter thickness in "Capacities and Characteristics" Paragraph or in the Fan-Coil-Unit Schedule on Drawings.

- H. Filters: Minimum arrestance according to ASHRAE 52.1, and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.

Retain one or more of three subparagraphs below. Indicate filter type in the Fan-Coil-Unit Schedule on Drawings. 2-inch- (50-mm-) thick washable foam is not available. Retain third subparagraph if applying for LEED certification. LEED Prerequisite IEQ 1 requires compliance with ASHRAE 62.1, which requires a MERV rating of 6 or higher.

1. Washable Foam: 70 percent arrestance and 3 MERV.
 2. Glass Fiber Treated with Adhesive: 80 percent arrestance and 5 MERV.
 3. Pleated Cotton-Polyester Media: 90 percent arrestance and 7 MERV.
- I. Hydronic Coils: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch (2.5 mm), rated for a minimum working pressure of 200 psig (1378 kPa) and a maximum entering-water temperature of 220 deg F (104 deg C). Include manual air vent and drain.
 - J. Indoor Refrigerant Coils: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch (2.5 mm), and brazed joints at fittings. Comply with ARI 210/240, and leak test to minimum 450 psig (3105 kPa) for a minimum 300-psig (2070-kPa) working pressure. Include thermal expansion valve.

- K. Steam Coils: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch (2.5 mm), rated for a minimum working pressure of 75 psig (517 kPa).
- L. Electric-Resistance Heating Coils: Nickel-chromium heating wire, free of expansion noise and hum, mounted in ceramic inserts in a galvanized-steel housing; with fuses in terminal box for overcurrent protection and limit controls for high-temperature protection of heaters. Terminate elements in stainless-steel machine-staked terminals secured with stainless-steel hardware.
- M. Direct-Driven Fans: Double width, forward curved, centrifugal; with permanently lubricated, multispeed motor resiliently mounted in the fan inlet. Aluminum or painted-steel wheels, and painted-steel or galvanized-steel fan scrolls.

Retain paragraph above or below. Retain both if multiple-type units are required. If retaining both, indicate fan type in the Fan-Coil-Unit Schedule on Drawings.

- N. Belt-Driven Fans: Double width, forward curved, centrifugal; with permanently lubricated, single-speed motor installed on an adjustable fan base resiliently mounted in the cabinet. Aluminum or painted-steel wheels, and painted-steel or galvanized-steel fan scrolls.

Motor characteristics such as NEMA designation, temperature rating, service factor, enclosure type, and efficiency are specified in Section 230513 "Common Motor Requirements for HVAC Equipment." If different characteristics are required, add subparagraphs below to suit Project. Permanently lubricated ball bearings are available for motors up through 5 hp. Larger motors have grease-lubricated ball bearings.

Retain subparagraph below with either of last two paragraphs above.

- 1. Motors: Comply with requirements in Section 230513 "Common Motor Requirements for HVAC Equipment."

Retain first paragraph and applicable subparagraphs below to suit Project. Delete if factory piping package is not required.

- O. Factory, Hydronic Piping Package: [ASTM B 88, Type L (ASTM B 88M, Type B)] [ASTM B 88, Type M (ASTM B 88M Type C)] copper tube with wrought-copper fittings and brazed joints. Label piping to indicate service, inlet, and outlet.

Retain one or more of first four subparagraphs below.

- 1. [Two] [Three]-way, [two-position] [modulating] control valve for chilled-water coil.
- 2. [Two] [Three]-way, [two-position] [modulating] control valve for heating coil.
- 3. [Two] [Three]-way, [two-position] [modulating] control valve for dual-temperature coil.
- 4. [Two] [Three]-way, [two-position] [modulating] control valve for reheat coil.
- 5. Hose Kits: Minimum 400-psig (2758-kPa) working pressure, and operating temperatures from 33 to 211 deg F (0.5 to 99 deg C). Tag hose kits to equipment designations.
 - a. Length: [24 inches (600 mm)] [36 inches (900 mm)] <Insert dimension>.
 - b. Minimum Diameter: Equal to fan-coil-unit connection size.

6. Two-Piece Ball Valves: Bronze body with full-port, chrome-plated bronze ball; PTFE or TFE seats; and 600-psig (4140-kPa) minimum CWP rating and blowout-proof stem.
7. Calibrated-Orifice Balancing Valves: Bronze body, ball type; 125-psig (860-kPa) working pressure, 250 deg F (121 deg C) maximum operating temperature; with calibrated orifice or venturi, connections for portable differential pressure meter with integral seals, threaded ends, and equipped with a memory stop to retain set position.
8. Automatic Flow-Control Valve: Brass or ferrous-metal body; 300-psig (2070-kPa) working pressure at 250 deg F (121 deg C); with removable, corrosion-resistant, tamperproof, self-cleaning piston spring; factory set to maintain constant indicated flow with plus or minus 10 percent over differential pressure range of 2 to 80 psig (13.8 to 552 kPa).
9. Y-Pattern Hydronic Strainers: Cast-iron body (ASTM A 126, Class B); 125-psig (860-kPa) working pressure, with threaded connections, bolted cover, perforated stainless-steel basket, and bottom drain connection. Include minimum NPS 1/2 (DN 15) hose-end, full-port, ball-type blowdown valve in drain connection.
10. Wrought-Copper Unions: ASME B16.22.

- P. Remote condensing units are specified in Section 236200 "Packaged Compressor and Condenser Units."

Retain paragraph above or first paragraph and subparagraphs below. Retain below for condensing units packaged with fan-coil units by fan-coil-unit manufacturer.

- Q. Remote Condensing Units: Factory assembled and tested, consisting of compressors, condenser coils, fans, motors, refrigerant receiver, and operating controls. Construct, test, and rate condensing units according to ARI 210/240 and ASHRAE 15.
1. Casing: Steel with baked-enamel finish, removable panels for access to controls, weep holes for water drainage, and mounting holes in base.
 2. Compressor: Hermetic, **[scroll]** **[reciprocating]** type; internally isolated for vibration with factory-installed safety devices as follows:
 - a. Antirecycle timer.
 - b. High-pressure cutout.
 - c. Low-pressure cutout or loss-of-charge switch.
 - d. Internal thermal-overload protection.
 - e. Current and voltage sensitive safety devices.

Motor characteristics such as NEMA designation, temperature rating, service factor, enclosure type, and efficiency are specified in Section 230513 "Common Motor Requirements for HVAC Equipment." If different characteristics are required, add subparagraphs below to suit Project.

3. Compressor Motor: Start capacitor, relay, and contactor. Comply with requirements in Section 230513 "Common Motor Requirements for HVAC Equipment."

Retain first subparagraph below if applying for LEED certification or if required by Project requirements or authorities having jurisdiction. LEED Prerequisite EA 2 requires minimum efficiency equal to requirements in ASHRAE/IESNA 90.1.

4. Energy Efficiency: Equal to or greater than prescribed by ASHRAE/IESNA 90.1, "Energy Standard for Buildings except Low-Rise Residential Buildings."

5. Refrigerant Piping Materials: ASTM B 743 copper tube with wrought-copper fittings and brazed joints.

Retain one of first two subparagraphs below to require a specific refrigerant type; delete both if any refrigerant type is acceptable. LEED-NC, LEED-CS, and LEED for Schools Credit EA 4 award a single point if all HVAC&R equipment meets requirements for enhanced refrigerant management. Retain second or third option in first subparagraph or retain second subparagraph to comply with Credit EA 4.

6. Refrigerant: **[R-22] [R-407C] [R-410A]**.
7. Refrigerant: R-407C or R-410A.
8. Low ambient controls to permit operation down to 45 deg F (7 deg C).
9. Crankcase heater.
10. Charging and service fittings on exterior of casing.
11. Filter dryer.

Retain subparagraph below for air-to-air heat pump.

12. Air-to-Air Heat Pump: Pilot-operated, sliding-type reversing valve with replaceable magnetic coil, and controls for air-to-air heat pump operation with supplemental heat operation.

Retain first subparagraph below for hot-gas bypass.

13. Hot-gas-bypass, constant-pressure expansion valve and controls to maintain continuous refrigeration system operation at 10 percent of full load.
14. Condenser: Copper-tube, aluminum-fin coil, with liquid subcooler.
15. Condenser Fan: Direct-drive, aluminum propeller fan.

Motor characteristics such as NEMA designation, temperature rating, service factor, enclosure type, and efficiency are specified in Section 230513 "Common Motor Requirements for HVAC Equipment." If different characteristics are required, add subparagraphs below to suit Project.

- a. Motor: Comply with requirements in Section 230513 "Common Motor Requirements for HVAC Equipment."
16. Accessories: Polyethylene mounting base to provide a permanent foundation.
- R. Control devices and operational sequence are specified in Section 230548 "Vibration and Seismic Controls for HVAC Piping and Equipment."

Retain paragraph above and delete first paragraph and subparagraphs below if controls are part of overall temperature-control system.

- S. Basic Unit Controls:
1. Control voltage transformer.

Verify control features with manufacturer.

2. **[Wall-mounting] [Unit-mounted]** thermostat with the following features.
 - a. Heat-cool-off switch.
 - b. Fan on-auto switch.
 - c. Fan-speed switch.

- d. [Manual] [Automatic] changeover.
 - e. Adjustable deadband.
 - f. [Concealed] [Exposed] set point.
 - g. [Concealed] [Exposed] indication.
 - h. [Degree F] [Degree C] indication.
3. [Wall-mounting] [Unit-mounted] humidistat.
 - a. [Concealed] [Exposed] set point.
 - b. [Concealed] [Exposed] indication.
 4. [Wall-mounting] [Unit-mounted] temperature sensor.
 5. Unoccupied-period-override push button.
 6. Data entry and access port.
 - a. Input data includes room temperature, and humidity set points and occupied and unoccupied periods.
 - b. Output data includes room temperature and humidity, supply-air temperature, entering-water temperature, operating mode, and status.

T. [DDC]Terminal Controller:

1. Scheduled Operation: Occupied and unoccupied periods on seven-day clock with a minimum of four programmable periods per day.
2. Unoccupied Period Override Operation: [Two] <Insert number> hours.
3. Unit Supply-Air Fan Operation:
 - a. Occupied Periods: Fan runs continuously.
 - b. Unoccupied Periods: Fan cycles to maintain room setback temperature.
4. Hydronic-Cooling-Coil Operation:
 - a. Occupied Periods: [Open] [Modulate] control valve to maintain room temperature.
 - b. Unoccupied Periods: Close control valve.
5. Refrigerant-Coil Operation:
 - a. Occupied Periods: Start compressor to maintain room temperature or humidistat set point.
 - b. Unoccupied Periods: Stop compressor cooling and cycle compressor for heating to maintain setback temperature.
6. [Supplemental] Heating-Coil Operation:
 - a. Occupied Periods: [Open control valve] [Modulate control valve] [Energize electric-resistance coil] to provide heating if room temperature falls below thermostat set point.
 - b. Unoccupied Periods: Start fan and [open control valve] [modulate control valve] [energize electric-resistance coil] if room temperature falls below setback temperature.

- c. Switch refrigerant-reversing valve to operate supplemental coil for heating when outdoor temperature is below **[25 deg F (4 deg C)] <Insert temperature>**.
7. Dual-Temperature Hydronic-Coil Operation:
- a. Occupied Periods: When chilled water is available, **[open] [modulate]** control valve if room temperature exceeds thermostat set point. When hot water is available, **[open] [modulate]** control valve if temperature falls below thermostat set point.
 - b. Unoccupied Periods: When chilled water is available, close valve. When hot water is available, **[open] [modulate]** control valve if room temperature falls below thermostat setback temperature.
8. Reheat-Coil Operation:

Retain two subparagraphs below if reheat coil provides reheat only.

- a. Humidity Control for Occupied Periods: Humidistat **[opens control valve] [modulates control valve] [energizes electric-resistance coil]** to provide heating. As room temperature rises above the set point, cooling coil valve **[opens] [modulates]** to maintain room temperature.
- b. Humidity Control for Unoccupied Periods: **[Close control valve] [De-energize]**.

Retain two subparagraphs and associated subparagraphs below if reheat coil provides heating and reheat.

- c. Occupied Periods:
 - 1) Heating Operations: **[Open control valve] [Modulate control valve] [Energize electric-resistance coil]** to provide heating if room temperature falls below thermostat set point.
 - 2) Humidity-Control Operations: Humidistat **[opens control valve] [modulates control valve] [energizes electric-resistance coil]** to provide heating. As room temperature rises above the set point, cooling coil valve **[opens] [modulates]** to maintain room temperature.
- d. Unoccupied Periods: Start fan and **[open control valve] [modulate control valve] [energize electric-resistance coil]** if room temperature falls below setback temperature. Humidity control is not available.

Retain subparagraph and associated subparagraphs below for fixed, minimum outdoor-air intake.

9. Outdoor-Air Damper Operation:
- a. Occupied Periods: Open damper to fixed position for **[25] <Insert percent>** percent outdoor air.
 - b. Unoccupied Periods: Close damper.

Retain subparagraph and associated subparagraphs below for outdoor-air economizer cycle based on temperature.

10. Outdoor-Air Damper Operation:

- a. Occupied Periods:
 - 1) Outdoor-Air Temperature below Room Temperature: If room temperature is above room-temperature set point, modulate outdoor- and return-air dampers to maintain room-temperature set point (outdoor-air economizer). If room temperature is below set point, position damper to fixed minimum setting.
 - 2) Outdoor-Air Temperature above Room Temperature: Position damper to fixed minimum position for [25] <Insert percent> percent outdoor air.
- b. Unoccupied Periods: Close outdoor-air damper and open return-air damper.

Retain first subparagraph and associated subparagraphs below for outdoor-air economizer cycle based on enthalpy.

11. Outdoor-Air Damper Operation:

- a. Occupied Periods:
 - 1) Outdoor-Air Enthalpy below Room Enthalpy: If room temperature is above room-temperature set point, modulate outdoor-air damper to maintain room temperature (outdoor-air economizer). If room temperature is below set point, position damper to fixed minimum position for [25] <Insert percent> percent outdoor air.
 - 2) Outdoor-Air Enthalpy above Room Enthalpy: Position damper to fixed minimum position for [25] <Insert percent> percent outdoor air.
- b. Unoccupied Periods: Close outdoor-air damper and open return-air damper.

12. Controller shall have volatile-memory backup.

U. BAS Interface Requirements:

- 1. Interface relay for scheduled operation.
- 2. Interface relay to provide indication of fault at the central workstation.
- 3. Provide [BACnet] [or] [LonWorks] interface for central BAS workstation for the following functions:
 - a. Adjust set points.
 - b. Fan-coil-unit start, stop, and operating status.
 - c. Data inquiry including [outdoor-air damper position,]supply- and room-air temperature[and humidity].
 - d. Occupied and unoccupied schedules.

V. Electrical Connection: Factory wire motors and controls for a single electrical connection.

If Project has more than one type or configuration of fan-coil unit, delete paragraph and subparagraphs below and schedule fan-coil units on Drawings.

W. Capacities and Characteristics:

1. Fan:
 - a. Airflow: **<Insert cfm (L/s).>**
 - b. Static Pressure: **<Insert inches wg (kPa).>**
 - c. Fan Speed: **<Insert rpm.>**
 - d. Motor Speed: **<Insert rpm.>**
 - e. Motor Horsepower: **<Insert horsepower.>**
 - f. Drive: **[Direct] [Belt].**

2. Cooling Capacity:
 - a. Total: **<Insert Btu/h (kW).>**
 - b. Sensible: **<Insert Btu/h (kW).>**
 - c. Entering-Air Dry-Bulb Temperature: **<Insert deg F (deg C).>**
 - d. Entering-Air Wet-Bulb Temperature: **<Insert deg F (deg C).>**

3. Chilled-Water Coil:
 - a. Water Flow: **<Insert gpm (L/s).>**
 - b. Water-Side Pressure Loss: **<Insert feet wg (kPa).>**
 - c. Air-Side Pressure Drop: **<Insert inches wg (kPa).>**
 - d. Entering-Water Temperature: **<Insert deg F (deg C).>**

4. Refrigerant Coil:
 - a. Air-Side Pressure Loss: **<Insert inches wg (kPa).>**
 - b. Suction Temperature: **<Insert deg F (deg C).>**

5. Condensing Unit:
 - a. Compressor Power Input: **<Insert kW.>**
 - b. Energy-Efficiency Ratio: **<Insert value.>**

LEED Prerequisite EA 2 requires minimum efficiency equal to requirements in ASHRAE/IESNA 90.1. If applying for LEED certification, efficiency must be equal to or greater than minimum efficiency required by ASHRAE/IESNA 90.1, Tables 6.8.1A and 6.8.1B, "Air Conditioners and Condensing Units" for cooling only equipment and "Electrically Operated Unitary and Applied Heat Pumps - Minimum Efficiency Requirements" for heat pump applications.

- c. Cooling Energy Efficiency [(EER)] [(SEER)]: **<Insert value.>**

Retain first subparagraph below for heat pump applications.

- d. Heating Coefficient of Performance: **<Insert value.>**
 - e. Voltage/Phase/Hertz: **<Insert values.>**
 - f. Full-Load Amperes: **<Insert value.>**
 - g. Maximum Circuit Amperes: **<Insert value.>**
 - h. Maximum Overcurrent Protection: **<Insert value.>**
6. Heating Capacity:
 - a. Output: **<Insert Btu/h (kW).>**
 - b. Entering-Air Temperature: **<Insert deg F (deg C).>**

- c. Air-Temperature Rise: **<Insert deg F (deg C).>**
7. Hot-Water Heating Coil:
 - a. Water Flow: **<Insert gpm (L/s).>**
 - b. Water-Side Pressure Loss: **<Insert feet wg (kPa).>**
 - c. Air-Side Pressure Drop: **<Insert inches wg (kPa).>**
 - d. Entering-Water Temperature: **<Insert deg F (deg C).>**
8. Steam Heating Coil:
 - a. Air-Side Pressure Drop: **<Insert inches wg (kPa).>**
 - b. Inlet Steam Pressure: **<Insert psig (kPa).>**
 - c. Condensing Capacity: **<Insert lb/h (g/s).>**
9. Electric-Resistance Heating Coil:
 - a. Capacity: **<Insert kW.>**
 - b. Number of Steps: **<Insert number.>**
10. Reheat Capacity:
 - a. Output: **<Insert Btu/h (kW).>**
 - b. Entering-Air Temperature: **<Insert deg F (deg C).>**
 - c. Air-Temperature Rise: **<Insert deg F (deg C).>**
11. Hot-Water Reheat Coil:
 - a. Water Flow: **<Insert gpm (L/s).>**
 - b. Water-Side Pressure Loss: **<Insert feet wg (kPa).>**
 - c. Air-Side Pressure Drop: **<Insert inches wg (kPa).>**
 - d. Entering-Water Temperature (during Cooling): **<Insert deg F (deg C).>**
12. Steam Reheat Coil:
 - a. Air-Side Pressure Drop: **<Insert inches wg (kPa).>**
 - b. Inlet Steam Pressure: **<Insert psig (kPa).>**
 - c. Condensing Rate: **<Insert lb/h (g/s).>**
13. Electric-Resistance Reheat Coil:
 - a. Capacity: **<Insert kW.>**
 - b. Number of Steps: **<Insert number.>**
14. Filters:
 - a. Face Area: **<Insert sq. ft. (sq. m).>**
 - b. Thickness: **[1 inch (25 mm)] [2 inches (50 mm)] <Insert thickness>.**
15. Electrical Characteristics for Single-Point Connection:
 - a. Voltage/Phase/Hertz: **<Insert values.>**

- b. Full-Load Amperes: <Insert values.>
- c. Maximum Circuit Amperes: <Insert values.>
- d. Maximum Overcurrent Protection: <Insert values.>

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive fan-coil units for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine roughing-in for piping and electrical connections to verify actual locations before fan-coil-unit installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install fan-coil units level and plumb.
- B. Install fan-coil units to comply with NFPA 90A.

Retain paragraph below for horizontal, suspended units.

- C. Suspend fan-coil units from structure with elastomeric hangers. Vibration isolators are specified in Section 230548 "Vibration and Seismic Controls for HVAC Piping and Equipment."

Verify mounting height in first paragraph below with authorities having jurisdiction to comply with requirements of the Americans with Disabilities Act.

- D. Verify locations of thermostats, humidistats, and other exposed control sensors with Drawings and room details before installation. Install devices [**48 inches (1220 mm)**] [**60 inches (1525 mm)**] <Insert dimension> above finished floor.
- E. Install new filters in each fan-coil unit within two weeks after Substantial Completion.

3.3 CONNECTIONS

Coordinate piping installations and specialty arrangements with schematics on Drawings and with requirements specified in piping systems. If Drawings are explicit enough, these requirements may be reduced or omitted.

- 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.

Retain subparagraph below for concealed and ducted fan-coil units.

- a. Install condensate trap of adequate depth to seal against the pressure of fan. Install cleanouts in piping at changes of direction.

Retain first paragraph below for ducted fan-coil units. Coordinate duct installation requirements with Drawings and with requirements specified in Section 233113 "Metal Ducts," Section 233116 "Nonmetal Ducts," and Section 233300 "Air Duct Accessories."

- B. Connect supply and return ducts to fan-coil units with flexible duct connectors specified in Section 233300 "Air Duct Accessories." Comply with safety requirements in UL 1995 for duct connections.
- C. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- D. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

Retain first paragraph below to require a factory-authorized service representative to perform, or assist Contractor with, field inspections, tests, and adjustments. Retain one of two options to suit Project; delete both to require only an inspection before field testing.

- A. **Manufacturer's Field Service:** Engage a factory-authorized service representative to inspect[, **test, and adjust**] field-assembled components and equipment installation, including connections[, **and to assist in field testing**]. Report results in writing.
- B. Perform the following field tests and inspections and prepare test reports:

Retain subparagraphs below with last paragraph above. Edit to suit Project. Delete subparagraphs if testing will be performed by Owner-engaged testing and inspecting agency.

1. **Operational Test:** After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

Delete first subparagraph below if units do not have electric heat.

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.
- C. Remove and replace malfunctioning units and retest as specified above.

3.5 ADJUSTING

Retain this Article if control devices are specified in this Section; delete if they are specified in Section 230900 "Instrumentation and Control for HVAC" and Section 230993 "Sequence and Operations for HVAC Controls."

- A. Adjust initial temperature and humidity set points.
- B. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to [two] <Insert number> visits to Project during other than normal occupancy hours for this purpose.

3.6 DEMONSTRATION

Delete this Article if factory-authorized service representative is not required.

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fan-coil units. Refer to Section 017900 "Demonstration and Training."

END OF SECTION 238219