

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and Divisions 00 and 01, apply to this Section.

1.2 SUMMARY

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

1.3 DEFINITIONS

- A. BAS: Building automation system.

1.4 SUBMITTALS

- A. General: See Section 23 05 00 for general requirements of Product Data, Shop Drawings, Reports and Certificates, and Operation and Maintenance data submittals.
- B. Product Data: Provide submittals of the following:
 - 1. Fan-coil units; include rated capacities, operating characteristics, furnished specialties, and accessories.
- 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. 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:
 - 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.
 - 6. Perimeter moldings for exposed or partially exposed cabinets.
- E. Samples for Verification: For each type of fan-coil unit indicated.

- F. **Manufacturer Seismic Qualification Certification:** Submit certification that fan-coil units, accessories, and components will withstand seismic forces defined in Division 23 Section "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.
 - 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.
- G. **Field quality-control test reports.**
- H. **Operation and Maintenance Data:** For fan-coil units to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
1. **Maintenance schedules and repair part lists** for motors, coils, integral controls, and filters.
- I. **Warranty:** Special warranty specified in this Section.

1.5 CODES AND STANDARDS

- A. **Codes and Standards** shall be the current version adopted by the Authority Having Jurisdiction.

1.6 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.

1.7 COORDINATION

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

1.8 WARRANTY

- 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.
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.

1.9 EXTRA MATERIALS

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

PART 2 – PRODUCTS

2.1 FAN-COIL UNITS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Airtherm; a Mestek Company.
 2. Carrier Corporation.
 3. Engineered Air Ltd.
 4. Environmental Technologies, Inc.
 5. First Co.
 6. International Environmental Corporation.
 7. Marlo Coil; Subsidiary of Engineered Support Systems, Inc.
 8. Marshall Engineered Products Co., LLC (MEPCO); Dunham-Bush, Inc.
 9. McQuay International.
 10. Rosemex.
 11. Trane.
 12. USA Coil & Air.
 13. YORK International Corporation.
 14. <Insert manufacturer's name.>
 15. Or Approved Equal.
- B. Description: Factory-packaged and -tested units rated according to ARI 440, ASHRAE 33, and UL 1995.
- C. Coil Section Insulation: [1/2-inch] [1-inch] <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.

- D. Main and Auxiliary Drain Pans: [Plastic] [Stainless steel] [Insulated galvanized steel with plastic liner] formed to slope from all directions to the drain connection as required by ASHRAE 62. [Drain pans shall be removable].
- E. Chassis: Galvanized steel where exposed to moisture. Floor-mounting units shall have leveling screws.
- F. 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.
 - 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.
- G. Outdoor-Air Wall Box: Minimum 0.1265-inch- 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 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.
- H. Outdoor-Air Damper: Galvanized-steel blades with edge and end seals and nylon bearings; with [electronic] [pneumatic], [two-position] [modulating] actuators.
- I. Filters: Minimum arrestance according to ASHRAE 52.1, and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.
 - 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.
- J. 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 deg F. Include manual air vent and drain valve.
- K. Steam Coils: Copper [distributing] tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch, rated for a minimum working pressure of 75 psig.
- 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. Terminate elements in stainless-steel machine-staked terminals secured with stainless-steel hardware.

- M. 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 Section "Common Motor Requirements for HVAC Equipment."
 3. Wiring Termination: Connect motor to chassis wiring with plug connection.
- N. Factory, Hydronic Piping Package: [ASTM B 88, Type L] [ASTM B 88, Type M] copper tube with wrought-copper fittings and brazed joints. Label piping to indicate service, inlet, and outlet.
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 working pressure, and operating temperatures from 33 to 211 deg F. Tag hose kits to equipment designations.
 - a. Length: [24 inches] [36 inches] <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 minimum CWP rating and blowout-proof stem.
 7. Calibrated-Orifice Balancing Valves: Bronze body, ball type; 125-psig working pressure, 250-deg F 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 working pressure at 250 deg F, 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.
 9. Y-Pattern Hydronic Strainers: Cast-iron body (ASTM A 126, Class B); 125-psig working pressure; with threaded connections, bolted cover, perforated stainless-steel basket, and bottom drain connection. Include minimum NPS 1/2 hose-end, full-port, ball-type blowdown valve in drain connection.
 10. Wrought-Copper Unions: ASME B16.22.
 11. Risers: [ASTM B 88, Type L] [ASTM B 88, Type M] copper pipe with hose and ball valve for system flushing.
- O. Control devices and operational sequences are specified in Division 23 Sections "Instrumentation and Control for HVAC" and "Sequence of Operations for HVAC Controls" and
- P. Basic Unit Controls:
1. Control voltage transformer.
 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.

Q. [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:

- 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].
 - 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.
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.
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.
- R. 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.
- S. Electrical Connection: Factory wire motors and controls for a single electrical connection.
- T. Capacities and Characteristics:
- 1. Fan:
 - a. Airflow: <Insert cfm.>
 - b. External Static Pressure: <Insert inches wg.>
 - c. Fan Speed: <Insert rpm.>
 - d. Motor Speed: <Insert rpm.>
 - e. Motor Horsepower: <Insert horsepower.>
 - 2. Cooling Capacity:
 - a. Total: <Insert Btu/h.>
 - b. Sensible: <Insert Btu/h.>
 - c. Entering-Air Dry-Bulb Temperature: <Insert deg F.>
 - d. Entering-Air Wet-Bulb Temperature: <Insert deg F.>
 - 3. Chilled-Water Coil:
 - a. Water Flow: <Insert gpm.>
 - b. Water-Side Pressure Loss: <Insert feet wg.>
 - c. Entering-Water Temperature: <Insert deg F.>
 - 4. Heating Capacity:
 - a. Output: <Insert Btu/h.>
 - b. Entering-Air Temperature: <Insert deg F.>
 - c. Air-Temperature Rise: <Insert deg F.>
 - 5. Hot-Water Heating Coil:
 - a. Water Flow: <Insert gpm.>
 - b. Water-Side Pressure Loss: <Insert feet wg.>
 - c. Entering-Water Temperature: <Insert deg F.>
 - 6. Steam Heating Coil:
 - a. Inlet Steam Pressure: <Insert psig.>
 - b. Condensing Capacity: <Insert lb/h.>
 - 7. Electric-Resistance Heating Coil:
 - a. Capacity: <Insert kW.>
 - b. Number of Steps: <Indicate value.>
 - 8. Reheat Capacity:
 - a. Output: <Insert Btu/h.>
 - b. Entering-Air Temperature: <Insert deg F.>

- c. Air-Temperature Rise: <Insert deg F.>
- 9. Hot-Water Reheat Coil:
 - a. Water Flow: <Insert gpm.>
 - b. Water-Side Pressure Loss: <Insert feet wg.>
 - c. Entering-Water Temperature (during Cooling): <Insert deg F.>
- 10. Steam Reheat Coil:
 - a. Inlet Steam Pressure: <Insert psig.>
 - b. Condensing Rate: <Insert lb/h.>
- 11. Electric-Resistance Reheat Coil:
 - a. Capacity: <Insert kW.>
 - b. Number of Steps: <Insert number.>
- 12. Filters:
 - a. Face Area: <Insert sq. ft.>
 - b. Thickness: [1 inch] [2 inches] <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.>

2.2 DUCTED FAN-COIL UNITS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Carrier Corporation.
 - 2. Engineered Air Ltd.
 - 3. Environmental Technologies, Inc.
 - 4. First Co.
 - 5. International Environmental Corporation.
 - 6. Marlo Coil; Subsidiary of Engineered Support Systems, Inc.
 - 7. Marshall Engineered Products Co., LLC (MEPCO); Dunham-Bush, Inc.
 - 8. McQuay International.
 - 9. Rosemex.
 - 10. Trane.
 - 11. USA Coil & Air.
 - 12. YORK International Corporation.
 - 13. <Insert manufacturer's name.>
 - 14. Or Approved Equal.
- B. Description: Factory-packaged and -tested units rated according to ARI 440, ASHRAE 33, and UL 1995.

- C. Coil Section Insulation: [1/2-inch] [1-inch] <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.
- D. Drain Pans: [Plastic] [Stainless steel] [Insulated galvanized steel with plastic liner] formed to slope from all directions to the drain connection as required by ASHRAE 62.
- E. Chassis: Galvanized steel where exposed to moisture, with baked-enamel finish and removable access panels.
- F. 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.
 - 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.
- G. Filters: Minimum arrestance according to ASHRAE 52.1, and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.
 - 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.
- H. 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 deg F. Include manual air vent and drain.
- I. Indoor Refrigerant Coils: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch, and brazed joints at fittings. Comply with ARI 210/240, and leak test to minimum 450 psig for a minimum 300-psig working pressure. Include thermal expansion valve.
- J. Steam Coils: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch, rated for a minimum working pressure of 75 psig.
- K. 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.
- L. 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.

- M. 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.
1. Motors: Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."
- N. Factory, Hydronic Piping Package: [ASTM B 88, Type L] [ASTM B 88, Type M] copper tube with wrought-copper fittings and brazed joints. Label piping to indicate service, inlet, and outlet.
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 working pressure, and operating temperatures from 33 to 211 deg F. Tag hose kits to equipment designations.
 - a. Length: [24 inches] [36 inches] <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 minimum CWP rating and blowout-proof stem.
 7. Calibrated-Orifice Balancing Valves: Bronze body, ball type; 125-psig working pressure, 250 deg F 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 working pressure at 250 deg F; 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.
 9. Y-Pattern Hydronic Strainers: Cast-iron body (ASTM A 126, Class B); 125-psig working pressure, with threaded connections, bolted cover, perforated stainless-steel basket, and bottom drain connection. Include minimum NPS 1/2 hose-end, full-port, ball-type blowdown valve in drain connection.
 10. Wrought-Copper Unions: ASME B16.22.
- O. Remote condensing units are specified in Division 23 Section "Packaged Compressor and Condenser Units."
- P. 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.

3. Compressor Motor: Start capacitor, relay, and contactor. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."
 4. Refrigerant Piping Materials: ASTM B 743 copper tube with wrought-copper fittings and brazed joints.
 5. Charge: [R-22] [R-407C] [R-410A] refrigerant.
 6. Low ambient controls to permit operation down to 45 deg F.
 7. Crankcase heater.
 8. Charging and service fittings on exterior of casing.
 9. Filter dryer.
 10. 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.
 11. Hot-gas-bypass, constant-pressure expansion valve and controls to maintain continuous refrigeration system operation at 10 percent of full load.
 12. Condenser: Copper-tube, aluminum-fin coil, with liquid subcooler.
 13. Condenser Fan: Direct-drive, aluminum propeller fan.
 - a. Motor: Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."
 14. Accessories: Polyethylene mounting base to provide a permanent foundation.
- Q. Control devices and operational sequence are specified in Division 23 Sections "Instrumentation and Control for HVAC" and "Sequence of Operations for HVAC Controls."
- R. Basic Unit Controls:
1. Control voltage transformer.
 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.
- S. [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] <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:
 - 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].
 - 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.
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.
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.
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.
- T. 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.

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

- V. Capacities and Characteristics:
 - 1. Fan:
 - a. Airflow: <Insert cfm.>
 - b. Static Pressure: <Insert inches wg.>
 - 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.>
 - b. Sensible: <Insert Btu/h.>
 - c. Entering-Air Dry-Bulb Temperature: <Insert deg F.>
 - d. Entering-Air Wet-Bulb Temperature: <Insert deg F.>

 - 3. Chilled-Water Coil:
 - a. Water Flow: <Insert gpm.>
 - b. Water-Side Pressure Loss: <Insert feet wg.>
 - c. Air-Side Pressure Drop: <Insert inches wg.>
 - d. Entering-Water Temperature: <Insert deg F.>

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

 - 5. Condensing Unit:
 - a. Compressor Power Input: <Insert kW.>
 - b. Energy-Efficiency Ratio: <Insert value.>
 - c. Seasonal Energy-Efficiency Ratio: <Insert value.>
 - d. 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.>
 - b. Entering-Air Temperature: <Insert deg F.>
 - c. Air-Temperature Rise: <Insert deg F.>

 - 7. Hot-Water Heating Coil:

- a. Water Flow: <Insert gpm.>
 - b. Water-Side Pressure Loss: <Insert feet wg.>
 - c. Air-Side Pressure Drop: <Insert inches wg.>
 - d. Entering-Water Temperature: <Insert deg F.>
8. Steam Heating Coil:
- a. Air-Side Pressure Drop: <Insert inches wg.>
 - b. Inlet Steam Pressure: <Insert psig.>
 - c. Condensing Capacity: <Insert lb/h.>
9. Electric-Resistance Heating Coil:
- a. Capacity: <Insert kW.>
 - b. Number of Steps: <Insert number.>
10. Reheat Capacity:
- a. Output: <Insert Btu/h.>
 - b. Entering-Air Temperature: <Insert deg F.>
 - c. Air-Temperature Rise: <Insert deg F.>
11. Hot-Water Reheat Coil:
- a. Water Flow: <Insert gpm.>
 - b. Water-Side Pressure Loss: <Insert feet wg.>
 - c. Air-Side Pressure Drop: <Insert inches wg.>
 - d. Entering-Water Temperature (during Cooling): <Insert deg F.>
12. Steam Reheat Coil:
- a. Air-Side Pressure Drop: <Insert inches wg.>
 - b. Inlet Steam Pressure: <Insert psig.>
 - c. Condensing Rate: <Insert lb/h.>
13. Electric-Resistance Reheat Coil:
- a. Capacity: <Insert kW.>
 - b. Number of Steps: <Insert number.>
14. Filters:
- a. Face Area: <Insert sq. ft.>
 - b. Thickness: [1 inch] [2 inches] <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.>

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.
- C. Suspend fan-coil units from structure with elastomeric hangers. Vibration isolators are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."
- D. Verify locations of thermostats, humidistats, and other exposed control sensors with Drawings and room details before installation. Install devices [48 inches] [60 inches] <Insert dimension> above finished floor.
- E. Install new filters in each fan-coil unit within two weeks after Substantial Completion.

3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Division 23 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 the pressure of fan. Install cleanouts in piping at changes of direction.
- B. Connect supply and return ducts to fan-coil units with flexible duct connectors specified in Division 23 Section "Air Duct Accessories." Comply with safety requirements in UL 1995 for duct connections.
- C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

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

3.5 ADJUSTING

- 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

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fan-coil units. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION