SECTION 237343.16 - OUTDOOR, SEMI-CUSTOM AIR-HANDLING UNITS

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

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

This Section may include provisions for LEED 2009, LEED v4, ASHRAE 189.1, IgCC, and Green Globes. Note that some sustainable design requirements are either mandatory or optional requirements that may be inserted in the Section Text using the hypertext links. Other requirements that are associated with sustainable design, and may be considered "best practice" or retained even if a sustainable design standard is not a project requirement, are discussed in the Evaluations.

1. GENERAL
	* + 1. RELATED DOCUMENTS

Retain or delete this article in all Sections of Project Manual.

* + - * 1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
			1. SUMMARY
				1. Section includes outdoor, semi-custom air-handling units that are factory assembled using multiple section components; including:

Unit casings.

Fan, drive, and motor section.

Coil section.

Air filtration section.

Dampers.

Sound attenuators.

Humidifiers.

Air-to-air energy recovery units.

Air blenders.

Diffusers.

UV-C lamp systems.

Roof curbs.

Intake and relief air openings.

* + - 1. SUBMITTALS
				1. Submittals for this section are subject to the er-evaluation fee identified in Article 4 of the General Conditions.
				2. Manufacturer's installation instructions shall be provided along with product data.
				3. Submittals shall be provided in the order in which they are specified and tabbed (for combined submittals).
				4. Product Data: For each air-handling unit.

Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

Include unit dimensions and weight.

Include cabinet material, metal thickness, finishes, insulation, and accessories.

Fans:

Include certified fan-performance curves with system operating conditions indicated.

Include certified fan-sound power ratings.

Include fan construction and accessories.

Include motor ratings, electrical characteristics, and motor accessories.

Include certified coil-performance ratings with system operating conditions indicated.

Include certified coil-performance ratings with system operating conditions indicated.

Retain subparagraph below if items are furnished as parts of air-handling units.

Include dampers, including housings, linkages, and operators.

* + - * 1. Sustainable Design Submittals:
				2. Shop Drawings: For each outdoor, semi-custom air-handling unit.

Include plans, elevations, sections, and **[mounting] [attachment]** details.

Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

Detail fabrication and assembly of outdoor, semi-custom air-handling units, as well as procedure and diagrams.

Include diagrams for power, signal, and control wiring.

Retain "Coordination Drawings" paragraph below for situations where limited space necessitates maximum utilization for efficient installation of different components or if coordination is required for installation of products and materials by separate installers. Coordinate paragraph with other Sections specifying products listed below. Preparation of coordination drawings requires the participation of each trade involved in installations within the limited space.

* + - * 1. Coordination Drawings: Floor plans and other details, or BIM model, drawn to scale, showing the items described in this Section, and coordinated with all building trades.
				2. Sample Warranty: For manufacturer's warranty.

Retain "Seismic Qualification Data" paragraph below if required by seismic criteria applicable to Project. Coordinate with Section 230548 "Vibration and Seismic Controls for HVAC." See ASCE/SEI 7 for certification requirements for equipment and components.

* + - * 1. Seismic Qualification Data: Certificates for air-handling units, accessories, and components, from manufacturer.

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

Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

Restraint of internal components.

Retain "Product Certificates" paragraph below if required by wind design criteria applicable to Project.

* + - * 1. Product Certificates: Submit certification that specified equipment will withstand wind forces identified in "Performance Requirements" Article and in Section 230548 "Vibration and Seismic Controls for HVAC."

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

Dimensioned Outline Drawings of Equipment Unit: Identify center of wind force and locate and describe mounting and anchorage provisions.

Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

* + - * 1. Source quality-control reports.
				2. Startup service reports.

Retain "Field quality-control reports" paragraph below if Contractor is responsible for field quality-control testing and inspecting.

* + - * 1. Field quality-control reports.
			1. CLOSEOUT SUBMITTALS
				1. Operation and Maintenance Data: For air-handling units to include in emergency, operation, and maintenance manuals.
			2. MAINTENANCE MATERIAL SUBMITTALS
				1. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

Filters: **[One] <Insert number>** set(s) for each air-handling unit.

Gaskets: **[One] <Insert number>** set(s) for each access door.

Fan Belts: **[One] <Insert number>** set(s) for each air-handling unit fan.

* + - 1. WARRANTY

When warranties are required, verify with Director’s Representative that warranties stated in this article are not less than remedies available to Director’s Representative under prevailing local laws.

* + - * 1. Warranty: Manufacturer agrees to repair or replace components of outdoor, semi-custom, air-handling unit that fail in materials or workmanship within specified warranty period.

Verify available warranty periods for units and components. Warranty periods vary among manufacturers and unit sizes.

Warranty Period for Entire Unit: Manufacturer's standard but not less than **[one] <Insert number>** year(s) from date of Substantial Completion.

Warranty Period for Heat Wheels: Not less than **[five] <Insert number>** years from date of Substantial Completion.

1. PRODUCTS

Manufacturers and products listed in SpecAgent and MasterWorks Paragraph Builder are neither recommended nor endorsed by the AIA or Deltek. Before inserting names, verify that manufacturers and products listed there comply with requirements retained or revised in descriptions and are both available and suitable for the intended applications.

* + - 1. PERFORMANCE REQUIREMENTS
				1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
				2. NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of air-handling units and components.

"ASHRAE 62.1 Compliance" paragraph below may be required to comply with Project requirements or authorities having jurisdiction. Sustainable design may require 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, the availability of units with components and features that comply with these requirements.

* + - * 1. ASHRAE 62.1 Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

"ASHRAE/IES 90.1 Compliance" paragraph below may be required to comply with Project requirements or authorities having jurisdiction. Sustainable design may require minimum efficiency equal to requirements in ASHRAE/IES 90.1.

* + - * 1. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."
				2. Structural Performance:

Casing Panels: Self-supporting and capable of withstanding positive/negative **[8-inch wg] <Insert value>** internal static pressure, without exceeding a midpoint deflection of **[0.0042 inch/inch] <Insert dimensions>** of panel span.

Floor and Roof Panels: Self-supporting and capable of withstanding 300-lb static load at midspan, without exceeding a midpoint deflection of **[0.0042 inch/inch] <Insert dimensions>**.

Roof Panels: Self-supporting and capable of withstanding a static snow load of 30 lb/sq. ft., without exceeding a midpoint deflection of **[0.0042 inch/inch] <Insert dimensions>**.

* + - * 1. Casing Leakage Performance: ASHRAE 111, **[Class 6 leakage] <Insert leakage class>** or better at **[plus or minus 8-inch wg] <Insert pressure>**.

Retain "Seismic Performance" paragraph below with "Seismic Qualification Data" paragraph in "Informational Submittals" Article for projects requiring seismic design. Delete paragraph if performance requirements are indicated on Drawings. Model building codes and ASCE/SEI 7 establish criteria for buildings subject to earthquake motions. Coordinate requirements with Structural Engineer.

* + - * 1. Seismic Performance: Air-handling units shall withstand the effects of earthquake motions determined according to **[ASCE/SEI 7] <Insert requirement>**.

Retain first subparagraph 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. Option is used for essential facilities where equipment must operate immediately after an earthquake.

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]**."

For life-safety components required to function after an earthquake (such as fire-sprinkler systems, components that contain hazardous content, and storage racks in structures open to the public), the Component Importance Factor is 1.5. For other components, the Component Importance Factor is 1.0 unless the structure is in Seismic Use Group III and component is necessary for continued operation of facility or failure of component could impair continued operation of facility, in which case the Component Importance Factor is 1.5.

Component Importance Factor: **[1.5] [1.0]**.

See ASCE/SEI 7, Coefficients for Architectural Component Table and Seismic Coefficients for Mechanical and Electrical Components Table, for requirements to be inserted in subparagraph below.

**<Insert requirements for Component Amplification Factor and Component Response Modification Factor>**.

* + - 1. CAPACITIES AND CHARACTERISTICS

If Project has more than one type or configuration of air-handling unit, delete this article and schedule air-handling units on Drawings.

* + - * 1. Supply Fan:

Type: **[DWDI, backward-inclined centrifugal fan] [DWDI, forward-curved centrifugal fan] [DWDI, airfoil centrifugal fan] [SWSI, airfoil unhoused centrifugal fan] <Insert fan type>**.

Coordinate "Class" designation in first subparagraph below with fan performance requirements and fan class availability of manufacturers.

**[Class I] [Class II] [Class III]**: AMCA 99-2408.

Drive: **[V-belt] [Direct]**.

Number of Fan Wheels: **<Insert number>**.

Fan Diameter: **<Insert value>** inches.

Airflow: **<Insert value>** cfm.

Total Static Pressure: **<Insert value>** inches wg.

External Static Pressure: **<Insert value>** inches wg.

Speed: **<Insert rpm>**.

Maximum Outlet Velocity: **<Insert value>** fpm.

Motor:

Size: **<Insert horsepower>**.

Speed: **<Insert rpm>**.

Volts: **[208] [230] [460] <Insert value>** V.

Phase: **[Three] <Insert value>**.

Hertz: **[60] <Insert number>** Hz.

Full-Load Amperes: **<Insert value>** A.

Minimum Circuit Ampacity: **<Insert value>** A.

Maximum Overcurrent Protection: **<Insert amperage>** A.

Fan Discharge Sound Power, dB:

1st Octave: **<Insert value>**.

2nd Octave: **<Insert value>**.

3rd Octave: **<Insert value>**.

4th Octave: **<Insert value>**.

5th Octave: **<Insert value>**.

6th Octave: **<Insert value>**.

7th Octave: **<Insert value>**.

8th Octave: **<Insert value>**.

* + - * 1. **[Return] [Exhaust]** Fan:

Type: **[DWDI, backward-inclined centrifugal fan] [DWDI, forward-curved centrifugal fan] [DWDI, airfoil centrifugal fan] [SWSI, airfoil unhoused centrifugal plenum fan] <Insert fan type>**.

**[Class I] [Class II] [Class III]**: AMCA 99-2408.

Drive: **[V-belt] [Direct]**.

Number of Fan Wheels: **<Insert value>**.

Fan Diameter: **<Insert value>** inches.

Airflow: **<Insert value>** cfm.

Total Static Pressure: **<Insert value>** inches wg.

External Static Pressure: **<Insert value>** inches wg.

Speed: **<Insert rpm>**.

Maximum Outlet Velocity: **<Insert value>** fpm.

Motor:

Size: **<Insert value>** hp.

Speed: **<Insert value>** rpm.

Volts: **[208] [230] [460] <Insert value>** V.

Phase: **[Three] <Insert number>**.

Hertz: **[60] <Insert number>** Hz.

Full-Load Amperes: **<Insert value>** A.

Minimum Circuit Ampacity: **<Insert value>** A.

Maximum Overcurrent Protection: <Insert amperage> A.

Fan Inlet Sound Power, dB:

1st Octave: **<Insert value>**.

2nd Octave: **<Insert value>**.

3rd Octave: **<Insert value>**.

4th Octave: **<Insert value>**.

5th Octave: **<Insert value>**.

6th Octave: **<Insert value>**.

7th Octave: **<Insert value>**.

8th Octave: **<Insert value>**.

* + - * 1. Preheat Coil:

Heat-Transfer Rate: **<Insert value>** Btu/h.

Entering-Air Temperature: **<Insert value>** deg F.

Leaving-Air Temperature: **<Insert value>** deg F.

Face Area: **<Insert value>** sq. ft..

Maximum Face Velocity: **<Insert value>** fpm.

Maximum Air-Side, Static-Pressure Drop: **<Insert value>** inches wg.

Fin Spacing: Maximum **<Insert number>** fins per inch.

Minimum Number of Rows: **<Insert number>**.

Retain first subparagraph below for integral face-and-bypass dampers with water or steam preheat coils.

Integral Face-and-Bypass Dampers: **[Horizontal] [Vertical]**, opposed-blade, **[galvanized-steel] [aluminum] [extruded-aluminum]** dampers with **[zinc-plated**]steel operating rods rotating in sintered bronze or nylon bearings mounted in a single **[galvanized-steel] [aluminum] [extruded-aluminum]** frame, with operating rods connected with a common linkage. Meeting edges of blades shall have gaskets and edge seals, and blades shall be mechanically fastened.

Water:

Water Flow: **<Insert value>** gpm.

Maximum Water Pressure Drop: **<Insert value>** feet of head.

Entering-Water Temperature: **<Insert value>** deg F.

Leaving-Water Temperature: **<Insert value>** deg F.

Tube Velocity: **<Insert value>** fpm.

Steam:

Steam Flow: **<Insert value>** lb/h.

Inlet Steam Pressure: **<Insert value>** psig.

Outer-Tube Diameter: **<Insert value>** inches.

* + - * 1. Heating Coil:

Heat-Transfer Rate: **<Insert value>** Btu/h.

Entering-Air Temperature: **<Insert value>** deg F.

Leaving-Air Temperature: **<Insert value>** deg F.

Face Area: **<Insert value>** sq. ft..

Maximum Face Velocity: **<Insert value>** fpm.

Maximum Air-Side, Static-Pressure Drop: **<Insert value>** inches wg.

Number of Rows: **<Insert number>**.

Fin Spacing: Maximum **<Insert number>** fins per inch.

Water:

Water Flow: **<Insert value>** gpm.

Maximum Water Pressure Drop: **<Insert value>** feet of head.

Entering-Water Temperature: **<Insert value>** deg F.

Leaving-Water Temperature: **<Insert value>** deg F.

Tube Velocity: **<Insert value>** fpm.

Steam:

Steam Flow: **<Insert value>** lb/h.

Inlet Steam Pressure: **<Insert value>** psig.

* + - * 1. Electric Heating Coil:

Heat-Transfer Rate: **<Insert value>** Btu/h.

Input: **<Insert kilowatts>**.

Volts: **[120] [208] [230] <Insert value>** V.

Phase: **[Single] [Three]**.

Full-Load Amperes: **<Insert value>** A.

Number of Steps: **<Insert number>**.

* + - * 1. Cooling Coil:

Sensible Heat-Transfer Rate: **<Insert value>** Btu/h.

Total Heat-Transfer Rate: **<Insert value>** Btu/h.

Entering-Air, Dry-Bulb Temperature: **<Insert value>** deg F.

Entering-Air, Wet-Bulb Temperature: **<Insert value>** deg F.

Leaving-Air, Dry-Bulb Temperature: **<Insert value>** deg F.

Leaving-Air, Wet-Bulb Temperature: **<Insert value>** deg F.

Face Area: **<Insert value>** sq. ft..

Maximum Face Velocity: **<Insert value>** fpm.

Maximum Air-Side, Static-Pressure Drop: **<Insert value>** inches wg.

Number of Rows: **<Insert number>**.

Fin Spacing: Maximum **<Insert number>** fins per inch.

Water:

Water Flow: **<Insert value>** gpm.

Maximum Water Pressure Drop: **<Insert value>** feet of head.

Entering-Water Temperature: **<Insert value>** deg F.

Leaving-Water Temperature: **<Insert value>** deg F.

Tube Velocity: **<Insert value>** fpm.

Refrigerant:

Refrigerant Type: **<Insert refrigerant type>**.

* + - * 1. Prefilters:

Type: **<Insert type>**.

Face Dimensions, each: **<Insert value>** inches by inches.

Depth: **<Insert value>** inches.

Number of Filters, Wide by High: **<Insert number>**.

Access Location: **[Front] [Back] [Side] [Bottom]**.

Maximum or Rated Face Velocity: **<Insert value>** fpm.

Initial Resistance: **<Insert value>** inches wg.

Recommended Final Resistance: **<Insert value>** inches wg.

Retain "Minimum Efficiency Reporting Value and Average Arrestance" subparagraph below if requiring MERV 1, 2, 3, or 4.

Minimum Efficiency Reporting Value and Average Arrestance:

MERV Rating: **[MERV 1] [MERV 2] [MERV 3] [MERV 4]**, and corresponding average arrestance according to ASHRAE 52.2.

Retain "Minimum Efficiency Reporting Value" subparagraph below if inserting requirements for MERV 5 and higher. LEED 2009 IEQ Prerequisite 1 and LEED v4 EQ Prerequisite "Minimum Indoor Air Quality Performance" require compliance with ASHRAE 62.1 (2007 and 2010 versions, respectively), which require a MERV rating of 6 or higher for service to occupied spaces. LEED 2009 IEQ Credit 5 and LEED v4 EQ Credit "Enhanced Indoor Air Quality Strategies" require MERV 13 or higher. Insert values appropriate to Project sustainability goals.

Minimum Efficiency Reporting Value:

MERV Rating: **[MERV 6] [MERV 13] <Insert value>**, according to ASHRAE 52.2.

* + - * 1. Final Filters:

Type: **<Insert type>**.

Face Dimensions, each: **<Insert value>** inches by inches.

Depth: **<Insert value>** inches.

Number of Filters, Wide by High: **<Insert number>**.

Access Location: **[Front] [Back] [Side] [Bottom]**.

Maximum or Rated Face Velocity: **<Insert value>** fpm.

Initial Resistance: **<Insert value>** inches wg.

Recommended Final Resistance: **<Insert value>** inches wg.

Retain "Minimum Efficiency Reporting Value" subparagraph below if inserting requirements for MERV 5 and higher. LEED 2009 IEQ Prerequisite 1 and LEED v4 EQ Prerequisite "Minimum Indoor Air Quality Performance" requires compliance with ASHRAE 62.1 (2007 and 2010 versions, respectively), which require a MERV rating of 6 or higher for service to occupied spaces. LEED 2009 IEQ Credit 5 and LEED v4 EQ Credit "Enhanced Indoor Air Quality Strategies" require MERV 13 or higher. Insert values appropriate to Project sustainability goals.

Minimum Efficiency Reporting Value:

MERV Rating: **[MERV 6] [MERV 13] <Insert value>**, according to ASHRAE 52.2.

* + - * 1. Dampers: **[Zone] [Mixing dampers] [Face and bypass]**.
				2. Sound Attenuators:

Configuration: **[Straight] [Elbow]**.

Shape: **[Rectangular] [Round]**.

Attenuation Mechanism: **[Acoustic glass fiber] [Packless]**.

Maximum Pressure Drop: **<Insert value>** inches wg.

Length: **<Insert value>** inches.

Face Dimension: **<Insert value>** inches wide by **<Insert value>** inches high.

Face Velocity: **<Insert value>** fpm.

Dynamic Insertion Loss:

1st Octave: **<Insert dBa>**.

2nd Octave: **<Insert dBa>**.

3rd Octave: **<Insert dBa>**.

4th Octave: **<Insert dBa>**.

5th Octave: **<Insert dBa>**.

6th Octave: **<Insert dBa>**.

7th Octave: **<Insert dBa>**.

8th Octave: **<Insert dBa>**.

Generated Noise:

1st Octave: **<Insert dBa>**.

2nd Octave: **<Insert dBa>**.

3rd Octave: **<Insert dBa>**.

4th Octave: **<Insert dBa>**.

5th Octave: **<Insert dBa>**.

6th Octave: **<Insert dBa>**.

7th Octave: **<Insert dBa>**.

8th Octave: **<Insert dBa>**.

Consult retained air-handling unit manufacturers for humidifier type availability. Retain one of four humidifier types in "Steam Grid Humidifier," "Self-Contained Electric-Resistance Humidifier," "Self-Contained Gas-Fired Humidifier," and "Heat-Exchanger Humidifier" subparagraphs below.

* + - * 1. Steam Grid Humidifier:

Humidification Rate: **<Insert value>** lb/h.

Steam Supply Pressure: **<Insert value>** psig.

Dry-Bulb Air Temperature at Discharge: **<Insert value>** deg F.

Wet-Bulb Air Temperature at Discharge: **<Insert value>** deg F.

Maximum Absorption Distance: **<Insert value>** inches.

Retaining "Tubes" or "Manifolds" option in first subparagraph below relates to steam jacketed tubes versus distribution panel manifolds, respectively. See Section 238413.23 for more information. Coordinate with manufacturers.

Number of Distribution **[Tubes] [Manifolds]: <Insert number>**.

* + - * 1. Self-Contained Electric-Resistance Humidifier.

Humidification Rate: **<Insert value>** lb/h.

Dry-Bulb Air Temperature at Discharge: **<Insert value>** deg F.

Wet-Bulb Air Temperature at Discharge: **<Insert value>** deg F.

Maximum Absorption Distance: **<Insert value>** inches.

Minimum Makeup Water Supply Pressure: **<Insert value>** psig.

Electric-Resistance Evaporation Chamber:

Power Input per Chamber: **<Insert number>** kW.

Number of Chambers: **<Insert number>**.

* + - * 1. Self-Contained Gas-Fired Humidifier:

Humidification Rate: **<Insert value>** lb/h.

Dry-Bulb Air Temperature at Discharge: **<Insert value>** deg F.

Wet-Bulb Air Temperature at Discharge: **<Insert value>** deg F.

Maximum Absorption Distance: **<Insert value>** inches.

Minimum Makeup Water Supply Pressure: **<Insert value>** psig.

Gas-Fired Generator:

Fuel Input: **<Insert value>** Btu/h.

Fuel Pressure: **<Insert value>** inches wg.

Number of Distribution **[Tubes] [Manifolds]**: **<Insert number>**.

* + - * 1. Heat-Exchanger Humidifier:

Humidification Rate: **<Insert value>** lb/h.

Dry-Bulb Air Temperature at Discharge: **<Insert value>** deg F.

Wet-Bulb Air Temperature at Discharge: **<Insert value>** deg F.

Maximum Absorption Distance: **<Insert value>** inches.

Minimum Makeup Water Supply Pressure: **<Insert value>** psig.

Steam to Heat Exchanger:

Supply Pressure at Control Valve: **<Insert value>** psig.

Condensing Rate: **<Insert value>** lb/h.

* + - * 1. Air-to-Air Energy Recovery:

Type: **[Heat-wheel air-to-air energy recovery] [Fixed-plate air-to-air energy recovery]**.

Exhaust Air:

Airflow: **<Insert value>** cfm.

Face Velocity: **<Insert value>** fpm.

Summer:

Entering-Air Temperature, Dry Bulb: **<Insert value>** deg F.

Entering-Air Temperature, Wet Bulb: **<Insert value>** deg F.

Leaving-Air Temperature, Dry Bulb: **<Insert value>** deg F.

Leaving-Air Temperature, Wet Bulb: **<Insert value>** deg F.

Winter:

Entering-Air Temperature, Dry Bulb: **<Insert value>** deg F.

Entering-Air Temperature, Wet Bulb: **<Insert value>** deg F.

Leaving-Air Temperature, Dry Bulb: **<Insert value>** deg F.

Leaving-Air Temperature, Wet Bulb: **<Insert value>** deg F.

Air Pressure Drop: **<Insert value>** inches wg.

Supply Air:

Airflow: **<Insert value>** cfm.

Face Velocity: **<Insert value>** fpm.

Summer:

Entering-Air Temperature, Dry Bulb: **<Insert value>** deg F.

Entering-Air Temperature, Wet Bulb: **<Insert value>** deg F.

Leaving-Air Temperature, Dry Bulb: **<Insert value>** deg F.

Leaving-Air Temperature, Wet Bulb: **<Insert value>** deg F.

Winter:

Entering-Air Temperature, Dry Bulb: **<Insert value>** deg F.

Entering-Air Temperature, Wet Bulb: **<Insert value>** deg F.

Leaving-Air Temperature, Dry Bulb: **<Insert value>** deg F.

Leaving-Air Temperature, Wet Bulb: **<Insert value>** deg F.

Air Pressure Drop: <Insert value> inches wg.

Retain "Wheel Drive" subparagraph below for heat wheels.

Wheel Drive:

Motor Size: **<Insert horsepower>**.

Motor Electrical Characteristics:

Volts: **[120] [208] [230] <Insert value>** V.

Phase: **[Single] [Three]**.

Hertz: **[60] <Insert number>** Hz.

Effectiveness: **<Insert percentage>**.

Air Blender:

Airflow: **<Insert value>** cfm.

Minimum Velocity: **<Insert value>** fpm.

Air Pressure Drop: **<Insert value>** inches wg.

Diffuser:

Airflow: **<Insert value>** cfm.

Air Pressure Drop: **<Insert value>** inches wg.

* + - 1. MANUFACTURERS
				1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

Carrier Corporation.

Coil Company, LLC.

Daikin Applied.

Dunham-Bush, Inc.

Trane.

USA Coil & Air.

YORK; a Johnson Controls company.

Approved equivalent.

* + - * 1. Source Limitations: Obtain from single source from single manufacturer.
			1. UNIT CASINGS
				1. Frame: Modular and providing overall structural integrity without reliance on casing panels for structural support.
				2. Base Rail:

Material: **[Galvanized steel] [Welded structural steel] <Insert material>**.

Height: **[6 inches] <Insert dimension>**.

* + - * 1. Casing Joints: Hermetically sealed at each corner and around entire perimeter.
				2. Double-Wall Construction:

In "Outside Casing Wall" subparagraph below, not all options are available from all manufacturers; consult manufacturers.

Outside Casing Wall:

Retain "Material, Galvanized Steel"; "Material, Aluminum"; or "Material, Stainless Steel" subparagraph below.

Material, Galvanized Steel: Minimum **[18 gauge] [16 gauge] [14 gauge] <Insert value>** thick.

Material, Aluminum: Minimum **[16 gauge] [14 gauge] [12 gauge] <Insert value>** thick.

Material, Stainless Steel: Minimum **[18 gauge] [16 gauge] [14 gauge] <Insert value>** thick.

Factory Finish: Provide **[manufacturer's standard finish] [corrosion-resistant coating] <Insert special coating>**.

In "Inside Casing Wall" subparagraph below, not all options are available from all manufacturers; consult manufacturers.

Inside Casing Wall:

Retain "Material, Galvanized Steel"; "Material, Aluminum"; or "Material, Stainless Steel" subparagraph below.

Material, Galvanized Steel: **[Solid] [Perforated]**, minimum **[18 gauge] [16 gauge] <Insert value>** thick.

Material, Aluminum: **[Solid] [Perforated]**, minimum **[16 gauge] [14 gauge] <Insert value>** thick.

Material, Stainless Steel: **[Solid] [Perforated]**, minimum **[18 gauge] [16 gauge] <Insert value>** thick.

Antimicrobial Coating: Applied during the manufacturing process. **[EPA approved] [NSF approved] [FDA listed]**.

In "Floor Plate" paragraph below, not all options are available from all manufacturers; consult manufacturers.

* + - * 1. Floor Plate:

Material: Galvanized steel,**[ treadplate,] minimum [18 gauge] [16 gauge] [14 gauge] [12 gauge] [10 gauge] <Insert value>** thick.

Material: Aluminum,**[ treadplate,]** minimum **[18 gauge] [16 gauge] [14 gauge] [12 gauge] [10 gauge] <Insert value>** thick.

Material: Stainless steel,**[ treadplate,]** minimum **[18 gauge] [16 gauge] [14 gauge] [12 gauge] [10 gauge] <Insert value>** thick.

Antimicrobial Coating: Applied during the manufacturing process. **[EPA approved] [NSF approved] [FDA listed]**.

* + - * 1. Roof: Cross-broken and pitched with "C" caps over joints to provide watertight seal.
				2. Piping Vestibule: Insulated with same insulation and thickness as casing, **[18 inches] [24 inches] [30 inches] <Insert dimension>** deep by full width of piping connections.
				3. Casing Insulation:

For outdoor units, majority of manufacturers offer either fiberglass insulation or injected foam insulation. A few offer both options. Foam performs better thermally. Coordinate with manufacturers.

Materials: **[Glass-fiber blanket or board insulation, Type I or Type II ASTM C1071] [or] [injected polyurethane foam insulation]**.

Casing Panel R-Value: Minimum **[R-6.5] [R-11] [R-13] <Insert value>**.

Insulation Thickness: **[1 inches] [2 inches] <Insert dimension>**.

Thermal Break: Provide continuity of insulation with no through-casing metal in casing walls, floors, or roofs of air-handling unit.

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

* + - * 1. Airstream Surfaces: Surfaces in contact with airstream shall comply with requirements in ASHRAE 62.1.
				2. Static-Pressure Classifications:

For Unit Sections Upstream of Fans: Minus **[2-inch wg] [3-inch wg] [4-inch wg] [6-inch wg] <Insert value>**.

For Unit Sections Downstream and Including Fans: **[2-inch wg] [3-inch wg] [4-inch wg] [6-inch wg] <Insert value>**.

* + - * 1. Panels, Doors, and Windows:

Panels:

Fabrication: Formed and reinforced, double-wall and insulated panels of same materials and thicknesses as casing.

Fasteners: Two or more camlock type for panel lift-out operation. Arrangement shall allow panels to be opened against airflow

Gasket: Neoprene, applied around entire perimeters of panel frames.

Size: Large enough to allow unobstructed access for inspection and maintenance of air-handling unit's internal components. At least **[18 inches] [24 inches] <Insert dimension>** wide by full height of unit casing up to a maximum height of **[60 inches] [72 inches] <Insert dimension>**.

Doors:

Fabrication: Formed and reinforced, double-wall and insulated panels of same materials and thicknesses as casing.

Hinges: A minimum of two ball-bearing hinges or stainless-steel piano hinge and two wedge-lever latches, operable from inside and outside. Arrange doors to be opened against airflow. Provide safety latch retainers on doors so that doors do not open uncontrollably.

Gasket: Neoprene, applied around entire perimeters of panel frames.

Size: Large enough to allow for unobstructed access for inspection and maintenance of air-handling unit's internal components. At least **[18 inches] [24 inches] <Insert dimension>** wide by full height of unit casing up to a maximum height of **[60 inches] [72 inches] <Insert dimension>**.

Retain "Windows" subparagraph below to add windows in access panels and doors.

Windows:

Construction: Fabricate windows in access panels and doors of double-glazed, safety glass with an airspace between panes and sealed with interior and exterior rubber seals.

Size: Minimum **[6 inches] <Insert dimension>**, square or round.

In "Locations and Applications" subparagraph below, identify sections that are to include windows. ASHRAE 62.1, Section "Access for Inspection, Cleaning, and Maintenance," sets requirements for equipment access.

Locations and Applications:

Verify that sections listed below are large enough for access panels and doors.

Fan Section: Doors**[, with windows]**.

Coil Section: Panels.

Access Section: Doors**[, with windows]**.

Access Sections Immediately Upstream and Downstream of Coil Sections: Doors**[, with windows]**.

Damper Section: Doors**[, with windows]**.

Retain "Filter Section" subparagraph below if filter sections are served by side-access housings.

Filter Section: **[Doors] [Panels]** large enough to allow periodic removal and installation of filters.

Retain first subparagraph below for front- or back-access filter housings.

Access Sections Immediately **[Upstream] [and] [Downstream]** of Filter Sections: **[Doors] [Panels] [, with windows]**.

Mixing Section: **[Doors] [Panels] [, with windows]**.

Humidifier Section: **[Doors] [Panels] [, with windows]**.

Retain "Service Lights" subparagraph below to add service lights.

Service Lights: **<Insert number of watts> [LED] <Insert lamp type>** vaporproof luminaire with individual switched junction box located **[outside] [inside]**, adjacent to each access door and panel.

Locations: **[Each section accessed with door or panel] [Fan section] <Insert location>**.

Convenience Outlets: One 20-A duplex GFCI receptacle per location with junction box located on outside casing wall.

Locations: **[Each section accessed with a door or panel] [Fan section] <Insert location>**.

* + - * 1. Condensate Drain Pans:

Location: Each type of **[cooling coil] [heat wheel]**.

Construction:

Retain one of first two subparagraphs below.

Single-wall, **[galvanized-steel or noncorrosive polymer] [stainless-steel]** sheet.

Double-wall, **[galvanized-steel or noncorrosive polymer] [stainless-steel]** sheet with space between walls filled with foam insulation and moisture-tight seal.

Drain Connection:

Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on **[one end] [both ends]** of pan.

Minimum Connection Size: **[NPS 1] [NPS 2] <Insert pipe size>**.

Retain last option in "Slope" subparagraph below to comply with LEED 2009 IEQ Prerequisite 1 or LEED v4 EQ Prerequisite "Minimum Indoor Air Quality Performance" if required by Project requirements or authorities having jurisdiction.

Slope: Minimum **[0.125-in./ft.] <Insert value>** slope**[, to comply with ASHRAE 62.1,]** in at least two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and from humidifiers and to direct water toward drain connection.

Retain option in "Length" subparagraph below to comply with LEED 2009 IEQ Prerequisite 1 or LEED v4 EQ Prerequisite "Minimum Indoor Air Quality Performance" if required by Project requirements or authorities having jurisdiction.

Length: Extend drain pan downstream from leaving face **[for distance to comply with ASHRAE 62.1] <Insert distance>**.

Width: Entire width of water producing device.

Depth: A minimum of **[2 inches] <Insert dimension>** deep.

**[Formed sections] [Integral part of floor plating]**.

Retain first subparagraph below for galvanized-steel drain pans.

Pan-Top Surface Coating for Galvanized-Steel Drain Pans: Asphaltic waterproofing compound.

Units with stacked coils shall have an intermediate drain pan to collect condensate from top coil.

* + - 1. FAN, DRIVE, AND MOTOR SECTION
				1. Fan and Drive Assemblies: Statically and dynamically balanced and designed for continuous operation at maximum-rated fan speed and motor horsepower.
				2. Fans: Centrifugal, rated according to AMCA 210; galvanized steel; mounted on solid-steel shaft.

Shafts: With field-adjustable alignment.

Turned, ground, and polished hot-rolled steel with keyway.

Shaft Bearings:

Retain "Prelubricated and Sealed, Ball Bearings"; "Grease-Lubricated, Tapered-Roller Bearings"; or "Grease-Lubricated Bearings" subparagraph below. Other bearing types may be available; those specified below may not be available from all manufacturers.

Prelubricated and Sealed, Ball Bearings: Self-aligning, pillow-block type with an **[L-50] <Insert bearing life rating>** rated life of **[200,000] <Insert number>** hours according to ABMA 9.

Grease-Lubricated, Tapered-Roller Bearings: Self-aligning, pillow-block type with double-locking collars and two-piece, cast-iron housing**[ with grease lines extended to outside unit]** and an **[L-50] <Insert bearing life rating>** rated life of **[200,000] <Insert number>** hours according to ABMA 11.

Grease-Lubricated Bearings: Self-aligning, pillow-block-type, ball or roller bearings with adapter mount and two-piece, cast-iron housing**[ with grease lines extended to outside unit]** and an **[L-50] <Insert bearing life rating>** rated life of **[200,000] <Insert number>**.

Housings: Formed- and reinforced-steel panels to form curved scroll housings with shaped cutoff and spun-metal inlet bell.

Bracing: Steel angle or channel supports for mounting and supporting fan scroll, wheel, motor, and accessories.

Housings, Plenum Fans: Steel frame and panel; fabricated without fan scroll and volute housing. Provide inlet screens for Type SWSI fans.

In "Plenum Fan Arrays" subparagraph below, retain one of first two options. These are AHRI 430 terminology. Contained fan arrays have uniform partitioning enclosures between the sides of fans, and, as a result, fans do not aerodynamically interact. Uncontained fan arrays do not have partitioning enclosures between the sides of fans, and, as a result, fans do aerodynamically interact. Coordinate selection with manufacturers.

Plenum Fan Arrays: **[Contained] [Uncontained]** as defined in AHRI 430. Steel or aluminum frame with inlet cone and structural framing around each fan built into an array of multiple fans. Provide **[backdraft] [motorized]** dampers at each fan to prevent short circuiting of flow if one fan is not operating.

Retain "Backward-Inclined, Centrifugal Fan Wheels"; Forward-Curved, Centrifugal Fan Wheels"; or "Airfoil, Centrifugal Fan Wheels (Plenum Fan Wheels)" subparagraph below if these fan wheels are retained as options in "Capacities and Characteristics" Article.

Backward-Inclined, Centrifugal Fan Wheels: Construction with curved inlet flange, backplate, backward-inclined blades welded or riveted to flange and backplate; **[steel] [aluminum]** hub riveted to backplate and fastened to shaft with setscrews.

Forward-Curved, Centrifugal Fan Wheels: Inlet flange, backplate, and shallow blades with inlet and tip curved forward in direction of airflow and mechanically fastened to flange and backplate; **[steel] [aluminum]** hub swaged to backplate and fastened to shaft with setscrews.

Airfoil, Centrifugal Fan Wheels (Plenum Fan Wheels): Smooth-curved inlet flange, backplate, and hollow die-formed airfoil-shaped blades continuously welded at tip flange and backplate; steel hub riveted to backplate and fastened to shaft with setscrews.

Mounting: For internal vibration isolation**[ and seismic control]**. Factory-mount fans with manufacturer's standard[ restrained] vibration isolation mounting devices having a minimum static deflection of **[1 inch] [2 inches] <Insert dimension>**.

Shaft Lubrication Lines: Extended to a location outside the casing.

In "Flexible Connector" subparagraph below, select metal compatible with casing material option selected.

Flexible Connector: Factory fabricated with a fabric strip minimum **[3-1/2 inches] [5-3/4 inches] <Insert dimension>** wide, attached to two strips of minimum **[2-3/4-inch-wide] <Insert width>** by **[0.028-inch- thick, galvanized-steel sheet] [0.032-inch- thick, aluminum sheets]**.

Flexible Connector Fabric: Glass fabric, double coated with neoprene. Fabrics, coatings, and adhesives shall comply with UL 181, Class 1.

Fabric Minimum Weight: 26 oz./sq. yd..

Fabric Minimum Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.

Fabric Minimum Service Temperature Range: Minus 40 to plus 200 deg F.

* + - * 1. Drive, Direct: Factory-mounted, direct drive.
				2. Drive, Belt: Factory-mounted, V-belt drive, with adjustable alignment and belt tensioning, and with **[1.5] [1.25]** service factor based on fan motor.

Pulleys: Cast iron or cast steel with split, tapered bushing, dynamically balanced at the factory.

Belts: Oil resistant, non-sparking and nonstatic; in matched sets for multiple-belt drives.

Belt Guards: Comply with requirements specified by OSHA and fabricate according to SMACNA's "HVAC Duct Construction Standards"; **[0.146-inch-] <Insert dimension>** thick, **[3/4-inch] <Insert dimension>** diamond-mesh wire screen, welded to steel angle frame; prime coated.

* + - * 1. Motors:

Retain first subparagraph below if motor characteristics are specified in Section 230513 "Common Motor Requirements for HVAC Equipment." If different characteristics are required, insert paragraphs to suit Project.

Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

Verify enclosure types with manufacturer of specified equipment.

Enclosure Type: **[Open, dripproof] [Totally enclosed, fan cooled] <Insert type>**.

Retain "Enclosure Materials," "Motor Bearings," "Unusual Service Conditions," "Efficiency," and "NEMA Design" subparagraphs below if options are available from equipment manufacturers and are different from default requirements specified in Section 230513 "Common Motor Requirements for HVAC Equipment." Consider each subparagraph and retain only those that vary from default requirements.

Enclosure Materials: **[Cast iron] <Insert material>**.

Motor Bearings: **<Insert requirements>**.

Unusual Service Conditions:

Ambient Temperature: **<Insert deg C>**.

Altitude: **<Insert feet>** above sea level.

High humidity.

**<Insert conditions>**.

Efficiency: Premium efficient as defined in NEMA MG 1.

NEMA Design: **<Insert designation>**.

5-hp limit in "Motor Pulleys" subparagraph below is standard with many manufacturers but is a designer's choice.

Motor Pulleys: Adjustable pitch for use with **[5] <Insert number>**-hp motors and smaller; fixed pitch for use with motors larger than **[5] <Insert number>** hp. Select pulley size so pitch adjustment is at the middle of adjustment range at fan design conditions.

Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in electrical Sections.

If unique characteristics are required for motors in this Section, insert subparagraphs below.

**<Insert unique motor characteristics>**.

Retain subparagraph below to require that disconnect switches be supplied with unit.

Mount unit-mounted disconnect switches on **[exterior] [interior]** of unit.

First paragraph below is an example of variable-frequency controllers. Retain features and attributes to suit Project, and verify their availability with manufacturers.

Retain one of two "Variable-Frequency Motor Controller" paragraphs below. First paragraph coordinates with electrical variable-frequency motor-control specification. Second paragraph describes basic features of variable-frequency motor controllers and can be used when variable-frequency motor controller is not on a schedule on Drawings or is different from that specified in variable-frequency motor-controller specification. Coordinate either option with electrical engineer and manufacturers. A few manufacturers do not offer variable-frequency controllers with outdoor units. Consult manufacturers.

* + - * 1. Variable-Frequency Motor Controller: Comply with Section 262923 "Variable-Frequency Motor Controllers."
				2. Variable-Frequency Motor Controller: Serving [**each fan individually**] [**all fans combined**] in fan array.

Manufactured Units: Pulse-width modulated; **[constant torque] [and] [variable torque]** **<Insert application> for [Design A and Design B] [inverter-duty]** motors.

Output Rating: Three phase; 10 to **[60 Hz, with voltage proportional to frequency throughout voltage range] [66 Hz, with torque constant as speed changes]**; maximum voltage equals input voltage.

Unit Operating Requirements:

Internal Adjustability:

Minimum Speed: 5 to 25 percent of maximum rpm.

Maximum Speed: 80 to 100 percent of maximum rpm.

Acceleration: **[0.1 to 999.9] <Insert range>** seconds.

Deceleration: **[0.1 to 999.9] <Insert range>** seconds.

Current Limit: 30 to minimum of 150 percent of maximum rating.

Self-Protection and Reliability Features:

Surge suppression.

Loss of input signal protection.

Under- and overvoltage trips.

Variable-frequency motor controller and motor-overload/overtemperature protection.

Critical frequency rejection.

Loss-of-phase protection.

Reverse-phase protection.

Motor-overtemperature fault.

Bidirectional autospeed search.

Torque boost.

Motor temperature compensation at slow speeds.

Panel-mounted operator station.

Historical logging information and displays.

Digital indicating devices.

Control Signal Interface: Electric.

Proportional Integral Directive (PID) control interface.

DDC system for HVAC Protocols for Network Communications: **[ASHRAE 135] <Insert protocol type>**.

Line Conditioning:

Input line conditioning.

Output filtering.

EMI/RFI filtering.

Bypass is not available from all manufacturers; consult manufacturers.

Bypass Systems:

Bypass Mode: **[Manual operation only] [Field-selectable automatic or manual]**.

Retain one of two "Bypass Controller" subparagraphs below. Bypass is not available from all manufacturers; consult manufacturers.

Bypass Controller: Two-contactor style, with bypass and output isolating contactors**[ and isolating switch]**.

Bypass Controller: Three-contactor style, with bypass and input and output isolating contactors**[ and isolating switch]**.

Bypass Contactor Configuration: **[Full-voltage (across the line)] [Reduced-voltage (autotransformer)] <Insert type>** type.

* + - 1. COIL SECTION
				1. General Requirements for Coil Section:

Comply with AHRI 410.

Fabricate coil section to allow removal and replacement of coil for maintenance and to allow in-place access for service and maintenance of coil(s).

For multizone units, provide air deflectors and air baffles to balance airflow across coils.

Coils shall not act as structural component of unit.

* + - * 1. Preheat Coils:

Retain preheat coil types from subparagraphs below. Electric coils are not available in outdoor units from all manufacturers; consult manufacturers.

Electrical Coils, Controls, and Accessories: Comply with UL 1995.

Casing Assembly: **[Slip-in] [Flanged]** type with galvanized-steel frame.

Lack of manufacturer availability of sheathed type; therefore, sheathed type was not included as an option.

Open Heating Elements: Resistance wire of 80 percent nickel and 20 percent chromium supported and insulated by floating ceramic bushings recessed into casing openings, fastened to supporting brackets, and mounted in galvanized-steel frame.

Overtemperature Protection: Disk-type, automatically resetting, thermal-cutout, safety device; serviceable through terminal box without removing heater from coil section.

Secondary Protection: Load-carrying, manually resetting or manually replaceable, thermal cutouts; factory wired in series with each heater stage.

Control Panel: **[Unit] [Remote]** mounted with disconnecting means and overcurrent protection.

**[Magnetic] [Mercury]** contactor.

Solid-state, stepless pulse controller.

Toggle switches, one per step.

Step controller.

Time-delay relay.

Pilot lights, one per step.

Airflow proving switch.

In "Hot-Water Coils" subparagraph below, coordinate type with manufacturers.

Hot-Water Coils; **[Continuous circuit] [Self-draining] [Cleanable]**.

Piping Connections: **[Threaded] [Flanged], [same end] [opposite ends]** of coil.

Tube Material: **[Copper] <Insert material>**.

Fin Type: Plate.

Fin Material: **[Aluminum] [Copper] <Insert material>**.

Fin Spacing: Maximum **[10] [12] <Insert spacing>** fins per inch.

Fin Thickness: **<Insert value>** inches.

Fin and Tube Joint: **[Mechanical bond] [Silver brazed]**.

Headers:

Cast iron with**[ cleaning plugs and] drain and air vent tappings[ extended to exterior of unit]**.

Seamless copper tube with brazed joints, prime coated.

Fabricated steel, with brazed joints, prime coated.

Provide insulated cover to conceal exposed outside casings of headers.

Frames: Channel frame, **[0.052-inch- thick, galvanized steel] [0.064-inch- thick, galvanized steel] [0.079-inch- thick, galvanized steel] [0.0625-inch- thick, galvanized steel] [0.0625-inch- thick, stainless steel] <Insert thickness> <Insert material>**.

Pressure and temperature ratings in "Coil Working-Pressure Ratings" subparagraph below are standard for most copper tube coils. Other materials have different ratings.

Coil Working-Pressure Ratings: **[200 psig, 325 deg F] <Insert value and temperature>**.

Coating: **[None] [Corrosion-resistant coating]**.

Retain first subparagraph below for integral face-and-bypass dampers on water or steam coils.

Integral Face-and-Bypass Dampers: **[Horizontal] [Vertical]**, opposed-blade, **[galvanized-steel] [aluminum] [extruded-aluminum]** dampers with **[zinc-plated ]**steel operating rods rotating in sintered bronze or nylon bearings mounted in a single **[galvanized-steel] [aluminum] [extruded-aluminum]** frame, with operating rods connected with a common linkage. Meeting edges of blades shall have gaskets and edge seals, and blades shall be mechanically fastened.

Steam Coils: **[Distributed] [Single tube]**.

Steam Outer-Tube Diameter: **<Insert value>** inches.

Piping Connections: **[Threaded] [Flanged], [same end] [opposite ends]** of coil.

Tube Material: **[Copper] <Insert material>**.

Fin Type: Plate.

Fin Material: **[Aluminum] [Copper] <Insert material>**.

Fin Spacing: Maximum **[8] [10] [12] <Insert spacing>** fins per inch.

Fin Thickness: **<Insert value>** inches.

Fin and Tube Joint: **[Mechanical bond] [Silver brazed]**.

Headers:

Cast iron with**[ cleaning plugs and]** drain and air vent tappings **[ extended to exterior of unit]**.

Seamless copper tube with brazed joints, prime coated.

Fabricated steel, with brazed joints, prime coated.

Provide insulated cover to conceal exposed outside casings of headers.

Frames: Channel frame, **[**0.052-inch- **thick, galvanized steel] [**0.064-inch- **thick, galvanized steel] [**0.079-inch- **thick, galvanized steel] [**0.0625-inch- **thick, galvanized steel] [**0.0625-inch- **thick, stainless steel] <Insert thickness> <Insert material>**.

Pressure and temperature ratings in "Coil Working-Pressure Ratings" subparagraph below are standard for most copper tube coils. Other materials have different ratings.

Coil Working-Pressure Ratings: **[200 psig, 325 deg F] <Insert value and temperature>**.

Coating: **[None] [Corrosion-resistant coating]**.

Retain subparagraph below for integral face-and-bypass dampers on water or steam coils.

Integral Face-and-Bypass Dampers: **[Horizontal] [Vertical]**, opposed-blade, **[galvanized-steel] [aluminum] [extruded-aluminum]** dampers with **[zinc-plated ]**steel operating rods rotating in sintered bronze or nylon bearings mounted in a single **[galvanized-steel] [aluminum] [extruded-aluminum]** frame, with operating rods connected with a common linkage. Meeting edges of blades shall have gaskets and edge seals, and blades shall be mechanically fastened.

* + - * 1. Heating Coils:

Electrical Coils, Controls, and Accessories: Comply with UL 1995.

Casing Assembly: **[Slip-in] [Flanged]** type with galvanized-steel frame.

Lack of manufacturer availability for sheathed type; therefore, sheathed type was not included as an option.

Open Heating Elements: Resistance wire of 80 percent nickel and 20 percent chromium supported and insulated by floating ceramic bushings recessed into casing openings, fastened to supporting brackets, and mounted in galvanized-steel frame.

Overtemperature Protection: Disk-type, automatically resetting, thermal-cutout, safety device; serviceable through terminal box without removing heater from coil section.

Secondary Protection: Load-carrying, manually resetting or manually replaceable, thermal cutouts; factory wired in series with each heater stage.

Control Panel: **[Unit] [Remote]** mounted with disconnecting means and overcurrent protection.

**[Magnetic] [Mercury]** contactor.

Solid-state, stepless pulse controller.

Toggle switches, one per step.

Step controller.

Time-delay relay.

Pilot lights, one per step.

Airflow proving switch.

In "Hot-Water Coils" subparagraph below, coordinate type with manufacturers.

Hot-Water Coils: **[Continuous circuit] [Self-draining] [Cleaning]**.

Piping Connections: **[Threaded] [Flanged], [same end] [opposite ends]** of coil.

Tube Material: **[Copper] <Insert material>**.

Fin Type: Plate.

Fin Material: **[Aluminum] [Copper] <Insert material>**.

Fin Spacing: Maximum **[10] [12] <Insert spacing>** fins per inch.

Fin Thickness: **<Insert value>** inches.

Fin and Tube Joint: **[Mechanical bond] [Silver brazed]**.

Headers:

Cast iron with**[ cleaning plugs and]** drain and air vent tappings **[ extended to exterior of unit]**.

Seamless copper tube with brazed joints, prime coated.

Fabricated steel, with brazed joints, prime coated.

Provide insulated cover to conceal exposed outside casings of headers.

Frames: Channel frame, **[0.052-inch- thick, galvanized steel] [0.064-inch- thick, galvanized steel] [0.079-inch- thick, galvanized steel] [0.0625-inch- thick, galvanized steel] [0.0625-inch- thick, stainless steel] <Insert thickness> <Insert material>**.

Pressure and temperature ratings in "Coil Working-Pressure Ratings" subparagraph below are standard for most copper tube coils. Other materials have different ratings.

Coil Working-Pressure Ratings: **[200 psig, 325 deg F] <Insert value and temperature>**.

Coating: **[None] [Corrosion-resistant coating]**.

In "Steam Coils" subparagraph below, coordinate type with manufacturers.

Steam Coils: **[Distributed] [Single tube]**.

Steam Outer-Tube Diameter: **<Insert value>** inches.

Piping Connections: **[Threaded] [Flanged], [same end] [opposite ends]** of coil.

Tube Material: **[Copper] <Insert material>**.

Fin Type: Plate.

Fin Material: **[Aluminum] [Copper] <Insert material>**.

Fin Spacing: Maximum **[10] [12] <Insert spacing>** fins per inch.

Fin Thickness: **<Insert value>** inches.

Fin and Tube Joint: **[Mechanical bond] [Silver brazed]**.

Headers:

Cast iron with**[ cleaning plugs and]** drain and air vent tappings **[ extended to exterior of unit]**.

Seamless copper tube with brazed joints, prime coated.

Fabricated steel, with brazed joints, prime coated.

Provide insulated cover to conceal exposed outside casings of headers.

Frames: Channel frame, **[0.052-inch- thick, galvanized steel] [0.064-inch- thick, galvanized steel] [0.079-inch- thick, galvanized steel] [0.0625-inch- thick, galvanized steel] [0.0625-inch- thick, stainless steel] <Insert thickness> <Insert material>**.

Pressure and temperature ratings in "Coil Working-Pressure Ratings" subparagraph below are standard for most copper tube coils. Other materials have different ratings.

Coil Working-Pressure Ratings: **[200 psig, 325 deg F] <Insert value and temperature>**.

Coating: **[None] [Corrosion-resistant coating]**.

* + - * 1. Cooling Coils:

Retain "Chilled-Water Coil" or "Refrigerant Coil" subparagraph below.

Chilled-Water Coil: **[Continuous circuit] [Self-draining] [Cleanable]**.

Retain third option in "Piping Connections" subparagraph below for freeze protection.

Piping Connections: **[Threaded] [Flanged]**, **[same end] [opposite ends]** of coil.

Tube Material: **[Copper] <Insert material>**.

Tube Thickness: **<Insert value>** inches.

Fin Type: Plate.

Fin Material: **[Aluminum] [Copper] <Insert material>**.

Fin Spacing: **[0.125 inch] [0.091 inch] [0.071 inch] [0.067 inch] [0.056 inch] [0.0075 inch] <Insert fins per inch>**.

Fin Thickness: **<Insert value>** inches.

Fin and Tube Joint: **[Mechanical bond] [Silver brazed]**.

Headers:

Cast iron with**[ cleaning plugs and]** drain and air vent tappings**[ extended to exterior of unit]**.

Seamless copper tube with brazed joints, prime coated.

Fabricated steel, with brazed joints, prime coated.

Provide insulated cover to conceal exposed outside casings of headers.

Frames: Channel frame, **[0.052-inch- thick, galvanized steel] [0.064-inch- thick, galvanized steel] [0.079-inch- thick, galvanized steel] [0.0625-inch- thick, galvanized steel] [0.0625-inch- thick, stainless steel].**

**Coatings: [None] [Corrosion-resistant coating]**.

Pressure and temperature ratings in "Working-Pressure Ratings" subparagraph below are standard for most copper tube coils. Other materials have different ratings.

Working-Pressure Ratings: **[200 psig, 325 deg F] <Insert value and temperature>**.

Refrigerant Coil:

Tubes: **[Copper] <Insert material>**.

Fins:

Material: **[Aluminum] [Copper] <Insert material>**.

Fin Spacing: Maximum **[12] [10] [8] <Insert spacing>** fins per inch.

Fin and Tube Joints: Mechanical bond.

Headers: **[Seamless-copper headers with brazed connections] <Insert material and connections>**.

Frames: **[Galvanized steel] [Stainless steel] <Insert material frame>**.

Coatings: **[None] [Corrosion-resistant coating]**.

Ratings: Designed, tested, and rated according to ASHRAE 33 and AHRI 410.

Working Pressure: Minimum 300 psig.

* + - 1. AIR FILTRATION SECTION

Retain one or more of first three paragraphs below to require that filters be provided under other filter Sections, and retain appropriate mounting frame or side-access housings to be provided by air-handling manufacturer. Retain applicable filter paragraphs to require that filters be provided by air-handling unit manufacturer. Most air-handling manufacturers do not offer gas-phase filters as part of air-handling unit. Confirm availability with manufacturers.

* + - * 1. Particulate air filtration is specified in Section 234100 "Particulate Air Filtration."
				2. High-efficiency particulate air (HEPA) filtration is specified in Section 234133 "High-Efficiency Particulate Air Filtration."
				3. Gas-phase air filtration is specified in Section 234200 "Gas-Phase Air Filtration."
				4. Panel Filters:

Description: **[Flat, non-pleated] [Pleated]** factory-fabricated, self-supported, disposable air filters with holding frames.

Filter Unit Class: UL 900.

Media: Interlaced glass, synthetic, or cotton fibers coated with nonflammable adhesive.

Filter-Media Frame: **[Beverage board] <Insert material>** with perforated metal retainer, or metal grid, on outlet side.

* + - * 1. Bag Filters:

Description: Factory-fabricated, dry, extended-surface, self-supporting filters with holding frames in steel, basket-type retainers.

Filter Unit Class: UL 900.

Media: Fibrous material, coated with antimicrobial agent, constructed so individual pockets are maintained in tapered form by flexible internal supports under rated-airflow conditions.

Filter-Media Frame: **[Galvanized steel] <Insert material>**.

* + - * 1. Cartridge Filters:

Description: Factory-fabricated, **[adhesive-coated ]**disposable, packaged air filters with media perpendicular to airflow, and with holding frames.

Filter Unit Class: UL 900.

Media: Fibrous material, coated with antimicrobial agent, constructed so individual pleats are maintained in pleated form under rater-airflow conditions by corrugated aluminum separators.

Filter Media Frame: **[Galvanized steel] <Insert material>**.

Retain "Adhesive, Sustainability Projects" paragraph below if required for sustainability.

* + - * 1. Adhesive, Sustainability Projects: As recommended by air-filter manufacturer and with a VOC content of 80 g/L or less.

Retain "Adhesive, LEED for Schools Projects" paragraph below if required for sustainability.

* + - * 1. Adhesive, LEED for Schools Projects: As recommended by air-filter manufacturer and that complies with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

Retain "(Front-) (or) (Back-)Access Filter Mounting Frames" or "Side-Access Filter Mounting Frames" paragraph below to reflect type of filter access desired.

* + - * 1. **[Front-] [or] [Back-]**Access Filter Mounting Frames:

Retain one or more of three subparagraphs below to match filter types.

Particulate Air Filter Frames: **[Galvanized-steel] [Aluminum]** framing members with access for filter servicing, cut to size and prepunched for assembly into modules. Vertically support filters to prevent deflection of horizontal members without interfering with either filter installation or operation.

Prefilters: Incorporate a separate **[2-inch-] <Insert dimension>** thick track[ with spring clips], with same access as primary filter.

Sealing: Full periphery foam gaskets.

Not all manufacturers offer "HEPA Filter Frames" for outdoor units; consult manufacturers.

HEPA Filter Frames: **[Aluminum] [Stainless-steel]** framing members, cut to size and prepunched for assembly into modules. Vertically support filters to prevent deflection of horizontal members without interfering with either filter installation operation. Bolted filter-sealing mechanism shall mount and continuously seal each individual filter.

Prefilters: Incorporate a separate **[2-inch-] [4-inch-] <Insert dimension>** thick track**[ with spring clips]** with same access as primary filter.

Sealing: **[Gasketed] [or] [gel]**, hand-crank locking mechanism to provide positive-sealing for each filter to ensure seal between filter elements to prevent bypass of unfiltered air.

Retain "Gas-Phase Air Filter Frames" subparagraph below for front or back access of gas-phase air filters. Not all manufacturers offer "Gas Phase Air Filter Frames" for outdoor units; consult manufacturers.

Gas-Phase Air Filter Frames: **[Galvanized-steel] [Aluminum]** framing members with access for filter servicing, cut to size and prepunched for assembly into modules. Vertically support filters to prevent deflection of horizontal members without interfering with either filter installation or operation.

Prefilters: Incorporate a separate **[2-inch-] <Insert dimension>** thick track**[ with spring clips]**.

Sealing: **[Full periphery foam gaskets] [Positive-sealing-device for each row of filters to ensure seal between gasketed filter elements to prevent bypass of unfiltered air]**.

* + - * 1. Side-Access Filter Mounting Frames:

Retain one or more of three subparagraphs below to match filter types.

Particulate Air Filter Frames: Match inner casing and outer casing material, and insulation thickness. **[Galvanized steel] [Aluminum]** track.

Prefilters: Incorporate an integral **[2-inch-] <Insert dimension>** thick track with same access as primary filter.

Sealing: Incorporate positive-sealing device to ensure seal between gasketed material on channels to seal top and bottom of filter cartridge frames to prevent bypass of unfiltered air.

Not all manufacturers offer "HEPA Filter Frames" for outdoor units; consult manufacturers.

HEPA Filter Frames:

Frames: Match inner casing and outer casing material, and insulation thickness. **[Aluminum] [Stainless steel]** track.

Prefilters: Incorporate an integral **[2-inch-] [4-inch-] <Insert dimension>** thick track,

Sealing: Incorporate positive-sealing clamping device on each filter between **[gasket] [gel]** seal on all sides of filter cartridge frames to prevent bypass of unfiltered air.

Gas-Phase Air Filter Frames:

Frames: Matching inner casing and outer casing material, and insulation thickness. **[Galvanized-steel] [Aluminum]** track.

Prefilters: Incorporate an integral **[2-inch-] <Insert dimension>** thick track.

Sealing: Incorporate positive-sealing gasket material on channels to seal top and bottom of filter cartridge frames to prevent bypass of unfiltered air.

* + - 1. DAMPERS

Retain "Dampers" paragraph below if dampers are specified in Section 230923.12 "Control Dampers." Retain "Outdoor- and Return-Air Dampers," "Face-and-Bypass Dampers," and "Zone Dampers" paragraphs if dampers are to be provided by unit manufacturer. Not all manufacturers offer this option; consult manufacturers.

* + - * 1. Dampers: Comply with requirements in Section 230923.12 "Control Dampers."

Low-leakage dampers in "Outdoor- and Return-Air Dampers" paragraph below are available from most manufacturers and from manufacturers of temperature-control equipment. ASHRAE/IES 90.1 limits maximum damper leakage based on climate zone, number of stories, damper function (intake, exhaust/relief), and damper type (motorized, non-motorized). The most restrictive across all climate zones, number of stories, damper function, and damper type is 4 cfm/sq. ft. (20 L/s per sq. m) at 1-inch wg (250 Pa). This is the maximum leakage cited in paragraph.

* + - * 1. Outdoor- and Return-Air Dampers: Low-leakage, double-skin, airfoil-blade, **[galvanized-steel] [aluminum] [extruded-aluminum] <Insert material>** dampers with compressible jamb seals and extruded-vinyl blade edge seals in **[opposed] [parallel]**-blade arrangement with **[zinc-replated ]**steel operating rods rotating in **[stainless steel sleeve] [sintered bronze or nylon] <Insert material>** bearings mounted in a single **[galvanized-steel] [aluminum] [extruded-aluminum] <Insert material>** frame, and with operating rods connected with a common linkage. Leakage rate shall not exceed **[4 cfm/sq. ft. at 1-inch wg and 8 cfm/sq. ft. at 4-inch wg] <Insert requirement>**.
				2. Face-and-Bypass Dampers: Opposed-blade, **[galvanized-steel] [aluminum] [extruded-aluminum]** dampers with **[zinc-plated ]**steel operating rods rotating in sintered bronze or nylon bearings mounted in a single **[galvanized-steel] [aluminum] [extruded-aluminum]** frame and with operating rods connected with a common linkage. Provide blade gaskets and edge seals, and mechanically fasten blades to operating rod.
				3. Zone Dampers: Two single-blade, **[galvanized-steel] [aluminum] [extruded-aluminum] <Insert materials>** dampers offset 90 degrees from each other on **[zinc-plated ]**steel operating rod rotating in sintered bronze or nylon bearings mounted in a single **[galvanized-steel]** **[aluminum] [extruded-aluminum] <Insert material>** frame. Provide blade gaskets and edge seals, and mechanically fasten blades to operating rod.

Retain "Damper Operators" paragraph below if damper operators are specified in Section 230923.12 "Control Dampers." Retain "Electronic Damper Operators" paragraph to require that damper operators be provided by air-handling unit manufacturer. If retaining second paragraph, coordinate with Division 23 controls Sections for electrical service to devices.

* + - * 1. Damper Operators: Comply with requirements in Section 230923.12 "Control Dampers."
				2. Electronic Damper Operators:

Direct-coupled type designed for minimum 60,000 full-stroke cycles at rated torque.

Electronic damper position indicator shall have visual scale indicating percent of travel and 2- to 10-V dc, feedback signal.

Default motor characteristics are specified in Section 230513 "Common Motor Requirements for HVAC Equipment." Insert subparagraphs to suit Project if different characteristics are required.

Operator Motors:

Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

Size to operate with sufficient reserve power to provide smooth modulating action or two-position action.

Permanent Split-Capacitor or Shaded-Pole Type: Gear trains completely oil immersed and sealed. Equip spring-return motors with integral spiral-spring mechanism in housings designed for easy removal for service or adjustment of limit switches, auxiliary switches, or feedback potentiometer.

Nonspring-Return Motors for Dampers Larger Than 25 Sq. Ft.: Size for running torque of 150 in. x lbf and breakaway torque of 300 in. x lbf.

Spring-Return Motors for Dampers Larger Than 25 Sq. Ft.: Size for running and breakaway torque of 150 in. x lbf.

Size dampers for running torque calculated as follows:

Parallel-Blade Damper with Edge Seals: 7 inch-lb/sq. ft. of damper.

Opposed-Blade Damper with Edge Seals: 5 inch-lb/sq. ft. of damper.

Parallel-Blade Damper without Edge Seals: 4 inch-lb/sq. ft of damper.

Opposed-Blade Damper without Edge Seals: 3 inch-lb/sq. ft. of damper.

Dampers with 2- to 3-Inch wg of Pressure Drop or Face Velocities of 1000 to 2500 fpm: Increase running torque by 1.5.

Dampers with 3- to 4-Inch wg of Pressure Drop or Face Velocities of 2500 to 3000 fpm: Increase running torque by 2.0.

Coupling: V-bolt and V-shaped, toothed cradle.

Overload Protection: Electronic overload or digital rotation-sensing circuitry.

Fail-Safe Operation: Mechanical, spring-return mechanism with external, manual gear release on nonspring-return actuators.

Coordinate first two subparagraphs and "Proportional Signal" subparagraph below with Division 23 controls Sections.

Power Requirements (Two-Position Spring Return): **[24 V dc] [120 V ac] [230 V ac]**.

Power Requirements (Modulating): Maximum 10 VA at 24 V ac or 8 W at 24 V dc.

Proportional Signal: 2 to 10 V dc or 4 to 20 mA, and 2- to 10-V dc position feedback signal.

Temperature Rating: **[Minus 22 to plus 122 deg F] [40 to 104 deg F]**.

Run Time: **[12 seconds open, 5 seconds closed] [30 seconds] [60 seconds] [120 seconds]**.

* + - * 1. Mixing Section: Multiple-blade, air-mixer assembly located immediately downstream of mixing section.
				2. Combination Filter and Mixing Section:

Cabinet support members shall hold **[2-inch-] <Insert dimension>** thick, pleated, flat, permanent or throwaway filters.

Multiple-blade, air-mixer assembly shall mix air to prevent stratification, located immediately downstream of mixing box.

* + - 1. SOUND ATTENUATORS

Sound attenuators are available from several, but not all, manufacturers; consult manufacturers.

* + - * 1. General Requirements:

Factory fabricated.

Fire-Performance Characteristics: Adhesives, sealants, packing materials, and accessory materials with flame-spread index not exceeding 25 and smoke-developed index not exceeding 50; ASTM E84.

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

* + - * 1. Shape: **[Rectangular, straight] [Round, straight] [Rectangular, elbow] [Round, elbow]**.
				2. Rectangular Silencer Outer Casing: **[Galvanized steel] <Insert material>**.
				3. Round Silencer Outer Casing: **[Galvanized steel] <Insert material>**.
				4. Inner Casing and Baffles: **[Galvanized steel] <Insert material>**.
				5. Principal Sound-Absorbing Mechanism:

Retain "Packless Type" or "Dissipative Type" subparagraph below. Packless types use controlled impedance to reduce sound with no absorptive fill. They are used in sensitive applications where no airstream contact to absorptive material is desired. Film-lined option of dissipative type can provide some protection against direct contact between absorptive material and the airstream.

Packless Type: Controlled impedance membranes and broadly tuned resonators without adsorptive media.

Dissipative Type: **[Polymer film-lined ]**absorptive fill material.

Fill Material: **[Inert and vermin-proof fibrous material] <Insert material type>**.

Joints: Lock formed and sealed, continuously welded or flanged.

* + - 1. HUMIDIFIERS

Retain this article to require that humidifiers be provided by air-handling unit manufacturer and to reference applicable humidifier Section. If only certain humidifier features are desired, cut and paste from one of the three humidifier Sections into this article. Not all manufacturers offer each type of humidifier. Confirm availability of specific type of humidifier with manufacturers.

* + - * 1. Direct-steam-injection humidifiers are specified in Section 238413.23 "Direct-Steam-Injection Humidifiers."
				2. Self-contained humidifiers are specified in Section 238413.29 "Self-Contained Humidifiers."
				3. Heat-exchanger humidifiers are specified in Section 238413.36 "Heat Exchanger Humidifiers."
			1. AIR-TO-AIR ENERGY RECOVERY UNITS

Retain this article to require that air-to-air energy recovery units be provided by air-handling unit manufacturer; delete if air-to-air energy recovery units are specified in Section 237213 "Heat-Wheel Air-to-Air Energy Recovery Equipment," Section 237216 "Heat-Pipe Air-to-Air Energy Recovery Units," and Section 237219 "Fixed-Plate Air-to-Air Energy Recovery Units." Not all manufacturers offer energy recovery options and not all manufacturers offer each combination of materials and coatings; consult manufacturers.

* + - * 1. Heat Wheels:

Casing:

Galvanized steel, stainless steel, or aluminum with manufacturer's standard factory finish.

Integral purge section limiting carryover of exhaust air to between **[0.05 percent at 1.6-inch wg and 0.20 percent at 4-inch wg] <Insert values>** differential pressure.

Casing seals on periphery of rotor, on duct divider, and on purge section.

Support vertical rotors on grease-lubricated ball bearings with extended grease fittings. Mount horizontal rotors on tapered roller bearing.

Retain "Rotor, Aluminum or Polymer" or "Rotor - Aluminum, Metallic, or Polymer" subparagraph below. Not all manufacturers offer each combination of materials and coatings. Consult manufacturers.

Rotor, Aluminum or Polymer: Segmented wheel, strengthened with radial spokes**[, with nontoxic, noncorrosive, silica-gel desiccant coating]**.

Rotor - Aluminum, Metallic, or Polymer: Segmented wheel, strengthened with radial spokes impregnated with nonmigrating, water-selective, 3-angstrom molecular-sieve desiccant coating.

Drive: Fractional horsepower motor and gear reducer**[, with speed changed by variable-frequency controller]**. Permanently lubricated wheel bearings with an **[L-10] <Insert bearing life> [400,000 hours] <Insert hours>**.

Retain "Controls" subparagraph below to require that controls be an integral part of air-handling unit; delete if controls are specified in Section 230923 "Direct Digital Control System for HVAC."

Controls:

Starting relay, factory mounted and wired, and manual motor starter for field wiring.

Retain one of first three subparagraphs below.

Variable-frequency controller, factory mounted and wired, permitting input of field connected 4- to 20-mA or 1- to 10-V control signal.

Variable-frequency controller, factory mounted and wired, with exhaust-air sensor to vary rotor speed and maintain exhaust temperature above freezing.

Variable-frequency controller, factory mounted and wired, with exhaust- and outdoor-air sensors, automatic changeover thermostat and set-point adjuster, to vary rotor speed and maintain **[exhaust temperature above freezing and ]**air differential temperature above set point. Provide maximum rotor speed when exhaust-air temperature is less than outdoor-air temperature.

Pilot-Light Indicator: Display rotor rotation and speed.

Speed Settings: Adjustable settings for maximum and minimum rotor speed limits.

* + - * 1. Fixed-Plate Sensible Heat Exchangers:

Casing: **[Aluminum] [Galvanized steel] <Insert material>**.

Plates: Evenly spaced and sealed and arranged for **[counter] [cross]** airflow.

Plate Material: **[Embossed aluminum] [Stainless steel] [High-density plastic]**.

Coatings are available for aluminum plates in corrosive atmospheres.

Plate Coating: **[Epoxy] <Insert coating>**.

Bypass: Plenum within casing, with gasketed face-and-bypass dampers that have operating rods extended outside casing.

Heat-Exchanger Prefilters:

Thickness: **[1 inch thick, disposable] [2 inches thick, disposable] <Insert type>**.

MERV Rating: **[MERV 6] <Insert MERV rating>**.

* + - 1. AIR BLENDERS

Not all manufacturers offer air blenders or each material option; consult manufacturers.

* + - * 1. Description: Static air mixer device to provide mixing of two airstreams to within **[plus/minus 6 deg F] <Insert mixing differential>**.
				2. Material: **[Galvanized steel] [Aluminum] <Insert material>**.
				3. Coating: **[None] [Corrosion-resistant coating]**.
			1. DIFFUSERS

Retain this article if specifying Type DWDI centrifugal fans. Delete if specifying plenum fans. Not all manufacturers offer diffusers and not all manufacturers offer each material option; consult manufacturers.

* + - * 1. Description: Velocity profile equalizer device for providing equalized airflow profile downstream of Type DWDI fans.
				2. Material: **[Galvanized steel] [Aluminum] <Insert material>**.
			1. UV-C LAMP SYSTEMS

Not all manufacturers offer UV-C lamp systems as a factory-installed option; consult manufacturers.

* + - * 1. Description:

UV-C lamp system consisting of power supply, power supply housing, wiring, UV lamp(s), lamp plug, lamp plug protector, encapsulated lamp, and lamp holder used for UV germicidal irradiation of cooling coil and condensate drain pan.

Factory installed and pre-engineered.

* + - * 1. Standard: UL Category Code ABQK, HVAC accessories, air-duct mounted.
				2. Lamps: High output, hot cathode.
				3. Lamp-Holder Construction:

UV- and moisture-resistant materials and designed to connect the lamp to the plug.

Adjustable positioning.

* + - * 1. Lamp-Clamp Construction:

UV- and moisture-resistant materials, water-tight connection.

* + - * 1. Adjustable positioning.
				2. Lamp Protection: Hermetically sealed to provide protection against lamp breakage and to ensure lamp contents from a broken lamp are contained.
				3. Lamp Output: UV-C energy, primarily at the 254-nm wavelength with a 360-degree energy distribution.
				4. Access Door Interlocks: Automatic disconnect on all access doors into UV-installed casing sections to shield servicing personnel from contact with light.
				5. Power Supply: UL-listed, single-point electrical connection**[ with service disconnect]**.
				6. Power Consumption: Maximum of **[15 W/sq. ft.] <Insert value>**.
			1. ROOF CURBS

Retain one of first two paragraphs below. Retain first for curbs with vibration isolation and seismic or wind restraints; retain second for curbs provided by outdoor air-handling unit manufacturer without vibration isolation and seismic or wind restraints. Not all manufacturers offer this option; consult manufacturers.

* + - * 1. Roof curbs with vibration isolators and wind or seismic restraints are specified in Section 230548 "Vibration and Seismic Controls for HVAC."
				2. Materials: Galvanized steel with corrosion-resistant coating, watertight gaskets, and factory-installed wood nailer; complying with NRCA standards.

Curb Insulation and Adhesive: Comply with NFPA 90A or NFPA 90B.

Materials: ASTM C1071, Type I or II.

Thickness: **[1 inch] [1-1/2 inches] [2 inches] <Insert dimension>**.

Application: Factory applied with adhesive and mechanical fasteners to the internal surface of curb.

Liner Adhesive: Comply with ASTM C916, Type I.

Mechanical Fasteners: Galvanized steel, suitable for adhesive attachment, mechanical attachment, or welding attachment to duct without damaging liner when applied as recommended by manufacturer and without causing leakage in cabinet.

Liner materials applied in this location shall have airstream surface coated with a temperature-resistant coating or faced with a plain or coated fibrous mat or fabric depending on service air velocity.

Liner Adhesive: Comply with ASTM C916, Type I.

For healthcare occupancies, ASHRAE 170 and most healthcare authorities having jurisdiction require the outside air intake opening for roof-mounted equipment to be a minimum of 36 inches (910 mm) above the roof. Coordinate outside air intake opening elevation with curb height in order to comply with requirement.

* + - * 1. Curb Dimensions: Height of **[14 inches] [24 inches] [36 inches] <Insert dimension>.[ Adaptable horizontal dimensions as required for existing roof openings.]**
				2. Wind and Seismic Restraints: Metal brackets compatible with the curb and casing, painted to match unit, used to anchor unit to the curb, and designed for loads at Project site. Comply with requirements in Section 230548 "Vibration and Seismic Controls for HVAC" for wind-load requirements.
			1. INTAKE AND RELIEF AIR OPENINGS
				1. Provide hood, including moisture eliminator, over all unit intake and relief openings. Match material and finish of casing exterior.
			2. MATERIALS
				1. Steel:

ASTM A36/A36M for carbon structural steel.

ASTM A568/A568M for steel sheet.

* + - * 1. Stainless Steel:

Manufacturer's standard grade for casing.

Manufacturer's standard type, ASTM A240 for bare steel exposed to airstream or moisture.

* + - * 1. Galvanized Steel: ASTM A653.
				2. Aluminum: ASTM B209.

Retain first paragraph below if corrosion-resistant coating is specified in Section 230546 "Coatings for HVAC." Retain "Corrosion-Resistant Coating" paragraph below if corrosion-resistant coating options are cited in "Casings," "Preheat Coils," "Heating Coils," or "Cooling Coils" paragraph in "Coil Section" Article and if corrosion-resistant coating is specified in this Section. Determine availability with air-handling unit manufacturers.

* + - * 1. Comply with Section 230546 "Coatings for HVAC" for corrosion-resistant coating.
				2. Corrosion-Resistant Coating: Coat with a corrosion-resistant coating capable of withstanding a **[3000] <Insert time>**-hour salt-spray test according to ASTM B117.

Standards:

ASTM B117 for salt spray.

ASTM D2794 for minimum impact resistance of 100 in-lb.

ASTM B3359 for cross-hatch adhesion of 5B.

Application: **[Immersion] [Spray]**.

Thickness: **[1 mil] <Insert value>**.

Gloss: Minimum gloss of 60 on a 60-degree meter.

* + - 1. SOURCE QUALITY CONTROL

The majority of listed manufacturers are AHRI 430 certified, but a few are not. Consult manufacturers. Note that AHRI 430 requires fan performance to be in compliance with AMCA 210.

* + - * 1. AHRI 430 Certification: Air-handling units and their components shall be factory tested according to AHRI 430 and shall be listed and labeled by AHRI.

Retain "AHRI 1060 Certification" paragraph below if retaining "Air-to-Air Energy Recovery" Article and if AHRI certification is desired. Not all manufacturers offer energy recovery options and not all offer this certification; consult manufacturers.

* + - * 1. AHRI 1060 Certification: Air-handling units that include air-to-air energy recovery devices shall be factory tested according to AHRI 1060 and shall be listed and labeled by AHRI.

Retain "AMCA 301 or AHRI 260" paragraph below when specifying maximum sound levels.

* + - * 1. AMCA 301 or AHRI 260: Air-handling unit fan sound ratings shall comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data," or AHRI 260, "Sound Rating of Ducted Air Moving and Conditioning Equipment."
				2. Fan Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Fans shall bear AMCA-certified sound ratings seal.
				3. Fan Performance Rating: Factory test fan performance for airflow, pressure, power, air density, rotation speed, and efficiency. Rate performance according to AMCA 210, "Laboratory Methods of Testing Fans for Aerodynamic Performance Rating."
				4. Water Coils: Factory tested to 300 psig according to AHRI 410 and ASHRAE 33.
				5. Steam Coils: Factory tested to 300 and 200 psig underwater according to AHRI 410 and ASHRAE 33.
				6. Refrigerant Coils: Factory tested to minimum 450-psig internal pressure and to minimum 300-psig internal pressure while underwater, according to AHRI 410 and ASHRAE 33.
				7. Witnessed Casing Leakage Tests:

Pay for all expenses, for one representative designated by Director’s Representative, to travel to the factory to witness cabinet air-leakage testing on the specific assembled unit(s) prior to release for delivery to Project site.

If the unit(s) does not meet specified leakage requirements, perform factory modifications and retest. Do not release unit for shipment until tested leakage is measured to be within specified leakage and leakage testing report has been accepted by Director’s Representative.

1. EXECUTION
	* + 1. EXAMINATION
				1. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
				2. Examine casing insulation materials and filter media before air-handling unit installation. Reject insulation materials and filter media that are wet, moisture damaged, or mold damaged.
				3. Examine roughing-in for steam, hydronic, and condensate drainage piping systems and electrical services to verify actual locations of connections before installation.
				4. Proceed with installation only after unsatisfactory conditions have been corrected.
			2. INSTALLATION, GENERAL

Retain "Roof Curb" paragraph below if curbs are provided by outdoor air-handling unit manufacturer.

* + - * 1. Roof Curb: Install on roof structure or concrete base, level and secure, according to **[NRCA's "NRCA Roofing Manual: Membrane Roof Systems."] [AHRI Guideline B.]** Install units on curbs and coordinate roof penetrations and flashing with roof construction specified in Section 077200 "Roof Accessories." Secure units to upper curb rail, and secure curb base to roof framing or concrete base with anchor bolts. Coordinate sizes and locations of roof curbs with actual equipment provided.

Retain "Unit Support" paragraph below if unit is installed on field-fabricated curbs or steel supports.

* + - * 1. Unit Support: Install unit level on structural **[curbs] [steel supports]**. Coordinate roof penetrations and flashing with roof construction. Secure units to structural support with anchor bolts. Coordinate sizes and locations of **[curbs] [steel supports]** with actual equipment provided.

Retain one of two subparagraphs below. Retain first for projects in seismic areas; retain second for projects not in seismic areas. Indicate vibration isolation and seismic-control device types and minimum deflection in supported equipment schedule on Drawings.

Comply with requirements for vibration isolation and seismic-control devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."

Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."

* + - * 1. Arrange installation of units to provide access space around air-handling units for service and maintenance.

Sustainable design systems require filters with a minimum MERV 13 rating for air delivered to the occupied space. Air-handling units should not be used for temporary heating and ventilating unless expressly approved by Director’s Representative. If used during construction, see SMACNA's "IAQ Guidelines for Occupied Buildings under Construction" for procedures to protect HVAC system.

* + - * 1. Do not operate fan system until filters (temporary or permanent) are in place. Replace temporary filters used during construction and testing, with new, clean filters.
				2. Install filter-gauge, static-pressure taps upstream and downstream of filters. Mount filter gauges on outside of filter housing or filter plenum in accessible position. Provide filter gauges on filter banks, installed with separate static-pressure taps upstream and downstream of filters.

Coordinate duct installations and specialty arrangements with Drawings and with requirements specified in Section 233113 "Metal Ducts" and Section 233300 "Air Duct Accessories."

* + - * 1. Connect duct to air-handling units with flexible connections. Comply with requirements in Section 233300 "Air Duct Accessories."
			1. PIPING CONNECTIONS

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

* + - * 1. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
				2. Where installing piping adjacent to air-handling unit, allow space for service and maintenance.
				3. Connect piping to air-handling units mounted on vibration isolators with flexible connectors.

Verify condensate drainage requirements of authorities having jurisdiction.

* + - * 1. Connect condensate drain pans using **[NPS 1-1/4] <Insert pipe size>**, ASTM B88, Type M copper tubing. Extend to nearest equipment or roof drain. Construct deep trap at connection to drain pan and install cleanouts at changes in direction.
				2. Hot- and Chilled-Water Piping: Comply with applicable requirements in Section 232113 "Hydronic Piping" and Section 232116 "Hydronic Piping Specialties." Install shutoff valve and union or flange at each coil supply connection. Install balancing valve and union or flange at each coil return connection.
				3. Steam and Condensate Piping: Comply with applicable requirements in Section 232213 "Steam and Condensate Heating Piping" and Section 232216 "Steam and Condensate Heating Piping Specialties." Install shutoff valve at steam supply connections, float and thermostatic trap, and union or flange at each coil return connection. Install gate valve and inlet strainer at supply connection of dry steam humidifiers, and inverted bucket steam trap to condensate return connection.
				4. Refrigerant Piping: Comply with applicable requirements in Section 232300 "Refrigerant Piping." Install shutoff valve and union or flange at each supply and return connection.
			1. ELECTRICAL CONNECTIONS
				1. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
				2. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
				3. Install electrical devices furnished by manufacturer, but not factory mounted, according to NFPA 70 and NECA 1.
				4. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.

Retain one of two subparagraphs below. First subparagraph cross-references Section 260553 "Identification for Electrical Systems" and should be retained for consistent electrical identification. Second subparagraph is an abbreviated version of the product specified in Section 260553 "Identification for Electrical Systems."

Nameplate shall be laminated acrylic or melamine plastic signs, as specified in Section 260553 "Identification for Electrical Systems."

Nameplate shall be laminated acrylic or melamine plastic signs with a black background and engraved white letters at least 1/2 inch high.

* + - 1. CONTROL CONNECTIONS
				1. Install control and electrical power wiring to field-mounted control devices.
				2. Connect control wiring according to Section 260523 "Control-Voltage Electrical Power Cables."
			2. STARTUP SERVICE
				1. **[Engage a Company Field Advisor per OGS Spec Section 014216 to perform] [Perform]** startup service.

Complete installation and startup checks according to manufacturer's written instructions.

Verify that shipping, blocking, and bracing are removed.

Verify that unit is secure on mountings and supporting devices and that connections to piping, ducts, and electrical systems are complete. Verify that proper thermal-overload protection is installed in motors, controllers, and switches.

Verify proper motor rotation direction, free fan wheel rotation, and smooth bearing operations. Reconnect fan drive system, align belts, and install belt guards.

Verify that bearings, pulleys, belts, and other moving parts are lubricated with factory-recommended lubricants.

Verify that zone dampers fully open and close for each zone.

Verify that face-and-bypass dampers provide full face flow.

Verify that outdoor- and return-air mixing dampers open and close, and maintain minimum outdoor-air setting.

Comb coil fins for parallel orientation.

Verify that proper thermal-overload protection is installed for electric coils.

Install new, clean filters.

Verify that manual and automatic volume control and fire and smoke dampers in connected duct systems are in fully open position.

* + - * 1. Starting procedures for air-handling units include the following:

Energize motor; verify proper operation of motor, drive system, and fan wheel. Adjust fan to indicated rpm.**[ Replace fan and motor pulleys as required to achieve design conditions.]**

Measure and record motor electrical values for voltage and amperage.

Manually operate dampers from fully closed to fully open position and record fan performance.

* + - 1. ADJUSTING
				1. Adjust damper linkages for proper damper operation.
				2. Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC" for air-handling system testing, adjusting, and balancing.
				3. Occupancy Adjustments: When requested within **[12] <Insert number>** months from 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.
			2. CLEANING
				1. After completing system installation and testing, adjusting, and balancing air-handling unit and air-distribution systems and after completing startup service, clean air-handling units internally to remove foreign material and construction dirt and dust. Clean fan wheels, cabinets, dampers, coils, and filter housings, and install new, clean filters.
			3. FIELD QUALITY CONTROL

Retain one of first three paragraphs below.

Retain "Testing Agency" paragraph below to require Contractor to hire an independent testing agency.

* + - * 1. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

Retain "Manufacturer's Field Service" paragraph below to require a Company Field Advisor to perform tests and inspections.

* + - * 1. Manufacturer's Field Service: Engage a Company Field Advisor per OGS Spec Section 014216 to test and inspect components, assemblies, and equipment installations, including connections.

Retain "Perform the following tests and inspections" paragraph below to require Contractor to perform tests and inspections and retain option to require Contractor to arrange for the assistance of a Company Field Advisor.

* + - * 1. Perform the following tests and inspections**[ with the assistance of a Company Field Advisor per OGS Spec Section 014216]**:

Leak Test: After installation, fill water and steam coils with water, and test coils and connections for leaks.

Charge refrigerant coils with refrigerant and test for leaks.

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

Retain one of first two subparagraphs below for HEPA filters. Second subparagraph is for critical applications per ASME AG-1.

HEPA Filters: Pressurize housing to a minimum of 3-inch wg or to designed operating pressure, whichever is higher; test housing joints, door seals, and sealing edges of filter with soapy water to check for air leaks.

HEPA Filters: Pressurize housing to a minimum of 3-inch wg or to designed operating pressure, whichever is higher; test housing joints, door seals, and sealing edges of filter for air leaks according to ASME AG-1, pressure-decay method.

Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

* + - * 1. Air-handling unit and components will be considered defective if unit or components do not pass tests and inspections.
				2. Prepare test and inspection reports.
			1. DEMONSTRATION
				1. **[Engage a Company Field Advisor per OGS Spec Section 014216 to train] [Train]** Facility’s maintenance personnel to adjust, operate, and maintain air-handling units.

END OF SECTION 237343.16