SECTION 237300 - INDOOR CENTRAL-STATION AIR-HANDLING UNITS

This Section includes air handling units packaged by manufacturer in modular form for use in interior applications. Units can be constructed with heating coils, mixing boxes, combination filter/mixing box section, filter section, face and bypass damper section, multi-zone damper section, cooling coil section, and humidifier.

Manufacturers found in SpecAgent for this Section were identified as representative and not as an endorsement for meeting the requirements of this specification.

This Section includes performance, proprietary, and descriptive type specifications. Edit to avoid conflicting requirements.

This Section includes the term Architect/Engineer. "Architect" is used in AIA contract documents; "Engineer" is used in EJCDC contract documents. Retain appropriate term.

See the Drawing Coordination Considerations for information needed to coordinate this specification Section with the Drawings.

1. GENERAL
	* + 1. SUMMARY
				1. Section includes modular factory fabricated air-handling units and accessories.
				2. Related Sections:

Section 033000 - Cast-In-Place Concrete: Execution requirements for housekeeping pads specified by this section.

Section 230513 - Common Motor Requirements for HVAC Equipment: Product requirements for electric motors for placement by this section.

Section 230548 - Vibration and Seismic Controls for HVAC Piping and Equipment: Product requirements for vibration isolators for placement by this section.

Section 230700 - HVAC Insulation: Product requirements for insulation for placement by this section.

Section 230923 - Direct-Digital Control System for HVAC: Controls remote from unit.

Section 230953 - Pneumatic and Electric Control System for HVAC: Product requirements for pneumatic controls to interface with air handling units.

Section 230993 - Sequence of Operations for HVAC Controls: Sequences of operation applying to units in this section.

Section 232113 - Hydronic Piping: Product requirements for chilled water and hot water piping connections to air handling units.

Section 232116 - Hydronic Piping Specialties: Product requirements for hydronic piping specialties for placement by this section.

Section 232213 - Steam and Condensate Heating Piping: Product requirements for steam supply and steam condensate piping connections to air handling units.

Section 232216 - Steam and Condensate Piping Specialties: Product requirements for steam supply and steam condensate piping specialties for placement by this section.

Section 232300 - Refrigerant Piping: Product requirements for refrigerant piping connections to air handling units.

Section 233300 - Air Duct Accessories: Product requirements for flexible duct connections for placement by this section.

Section 238400 - Humidity Control Equipment: Product requirements for humidifiers and dehumidifiers for placement by this section.

Section 262923 - Variable-Frequency Motor Controllers: Variable frequency controllers.

* + - 1. REFERENCES

List reference standards included within text of this section. Edit the following for Project conditions.

* + - * 1. American Bearing Manufacturers Association:

ABMA 9 - Load Ratings and Fatigue Life for Ball Bearings.

ABMA 11 - Load Ratings and Fatigue Life for Roller Bearings.

* + - * 1. Air Movement and Control Association International, Inc.:

AMCA 99 - Standards Handbook.

AMCA 210 - Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.

AMCA 300 - Reverberant Room Method for Sound Testing of Fans.

AMCA 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data.

AMCA 500 - Test Methods for Louvers, Dampers, and Shutters.

* + - * 1. Air-Conditioning and Refrigeration Institute:

ARI 410 - Forced-Circulation Air-Cooling and Air-Heating Coils.

ARI 430 - Central-Station Air-Handling Units.

ARI 610 - Central System Humidifiers for Residential Applications.

* + - * 1. National Electrical Manufacturers Association:

NEMA MG 1 - Motors and Generators.

* + - * 1. Sheet Metal and Air Conditioning Contractors:

SMACNA - HVAC Duct Construction Standard - Metal and Flexible.

* + - * 1. Underwriters Laboratories Inc.:

UL 900 - Air Filter Units.

UL - Fire Resistance Directory.

* + - 1. SUBMITTALS
				1. Submittals for this section are subject to the re-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).

Only request submittals needed to verify compliance with Project requirements.

* + - * 1. Section 013300 - Submittal Procedures: Submittal procedures.
				2. Shop Drawings: Indicate assembly, unit dimensions, weight loading, required clearances, construction details, field connection details, and electrical characteristics and connection requirements.
				3. Product Data, Submit the following:

Published Literature: Indicate capacities, ratings, gages and finishes of materials, and electrical characteristics and connection requirements.

Filters: Data for filter media, filter performance data, filter assembly, and filter frames.

Fans: Performance and fan curves with specified operating point plotted, power, RPM.

Sound Power Level Data: Fan outlet and casing radiation at rated capacity.

Dampers: Include leakage, pressure drop, and sample calibration curves. Indicate materials, construction, dimensions, and installation details.

Electrical Requirements: Power supply wiring including wiring diagrams for interlock and control wiring. Indicate factory installed and field installed wiring.

* + - * 1. Manufacturer's Installation Instructions: Submit **[detailed instructions on installation requirements, including storage and handling procedures] <\_\_\_\_\_\_\_\_>**.
				2. Manufacturer's Certificate: Certify products meet or exceed specified requirements.
			1. CLOSEOUT SUBMITTALS
				1. Section 017716 – Contract Closeout
				2. Operation and Maintenance Data: Submit instructions for lubrication, filter replacement, motor and drive replacement, spare parts lists, and wiring diagrams.
			2. QUALITY ASSURANCE
				1. **[Outside Air]** Damper Leakage: Test in accordance with AMCA 500 “Test Methods for Louvers, Dampers, and Shutters”.

Include the following paragraph only when cost of acquiring specified standards is justified.

* + - * 1. Maintain one copy of each document on site.
			1. QUALIFICATIONS
				1. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years' **[documented]** experience.
				2. Installer: Company specializing in performing Work of this section with minimum three years' **[documented]** experience **[approved by manufacturer]**.
			2. PRE-INSTALLATION MEETINGS
				1. Section 013000 - Administrative Requirements: Pre-installation meeting.
				2. Convene minimum **[one] <\_\_\_\_\_\_\_\_>** week prior to commencing work of this section.
			3. DELIVERY, STORAGE, AND HANDLING
				1. Section 016500 – Materials and Equipment
				2. Accept units and components on site in factory protective containers, with factory shipping skids and lifting lugs. Inspect for damage.
				3. Protect units from weather and construction traffic by storing in dry, roofed location.
			4. WARRANTY
				1. Section 017716 – Contract Closeout
				2. Furnish **[five] <\_\_\_\_\_\_\_\_>**-year manufacturer's warranty for air handling units.
			5. EXTRA MATERIALS
				1. Section 017716 – Contract Closeout

Extra filters are normally provided to ensure completely clean set of filter media is available at Project completion. Initial set is used for testing and trial use and may not be replaced at Project completion.

* + - * 1. Furnish **[one set] <\_\_\_\_\_\_\_\_>** of **[fan belts] <\_\_\_\_\_\_\_\_>** for each unit.
				2. Furnish **[one set] <\_\_\_\_\_\_\_\_>** of **[filters] <\_\_\_\_\_\_\_\_>** for each unit.
1. PRODUCTS
	* + 1. AIR HANDLING UNITS

In this article, list manufacturers acceptable for this Project.

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

Airtherm; a Mestek company.

Buffalo Air Handling.

Carrier Corporation.

Daikin Applied.

Dunham-Bush, Inc.

ENVIRO-TEC; by Johnson Controls, Inc.

Titus, a division of Air System Components; Johnson Controls, Inc.

Trane.

YORK; a Johnson Controls company.

Approved equivalent.

Edit the following descriptive specifications to identify Project requirements and to eliminate conflicts with manufacturers specified above.

Repeat paragraphs where Project has units configured differently.

* + - * 1. Configuration: Fan section **[fan and coil section]** plus accessories, including:

Cooling coil section.

Heating coil.

Humidifier.

Filter section.

Combination filter/mixing box section.

Mixing box section.

Face and bypass damper section.

Multi-zone damper section.

* + - * 1. Performance Base: **[Sea level] <\_\_\_\_\_\_\_\_>** pressure or altitude.
				2. Fabrication: Conform to AMCA 99 “Standards Handbook” **[and ARI 430.]**
			1. CASING
				1. Channel base [and drain pan] of welded steel. Assemble sections with gaskets and bolts.
				2. Outside Casing:

Aluminum: **[0.063] <\_\_\_\_\_\_\_\_>**inch thick.

Steel: **[0.06] <\_\_\_\_\_\_\_\_>**inch thick.

Galvanized Steel: **[0.0516] [0.0635] <\_\_\_\_\_\_\_\_>** inch.

Stainless Steel: **[0.0625] <\_\_\_\_\_\_\_\_>** thick.

* + - * 1. Inside Casing:

Aluminum: **[Solid] [Perforated] [0.32] <\_\_\_\_\_\_\_\_>** inch thick.

Galvanized Steel: **[Solid] [Perforated], [0.0276]** inch thick.

Stainless Steel: **[Solid] [Perforated], [0.025] <\_\_\_\_\_\_\_\_>** inch thick.

* + - * 1. Floor Plate:

Galvanized Steel: **[1.382] <\_\_\_\_\_\_\_\_>** inch thick.

Stainless Steel: **[0.1406] <\_\_\_\_\_\_\_\_>** inch thick.

The 1 inch thick, 1-1/2 lb/cu ft (24 kg/cu m) or 3 lb/cu ft (48 kg/cu m) density insulation may be applied with or without weld pins. Thicker insulation requires weld pins.

* + - * 1. Insulation: Neoprene coated, glass fiber, applied to internal surfaces with adhesive **[and weld pins]** with exposed edges of insulation coated with adhesive.

'K' factor at 75 degrees F: Maximum 0.26 Btuh inch/ sq ft/ degrees F.

Density: **[1] [1-1/2] [2]** inch thick, **[1-1/2]**lbs/cu ft.

* + - * 1. Finish: **[Baked enamel] [Zinc chromate, iron oxide, phenolic resin paint] [Asphalt base coating formulated to protect surfaces, to seal seams and joints, and to provide insulation and sound deadening] [Three coat system of epoxy applied over shot-blasted surface, to total thickness of 5-6 mils] [Finish: Manufacturers standard [paint] on exterior]**.
				2. Inspection Doors: **[10 x 10] <\_\_\_\_\_\_\_\_>** inch of galvanized steel for flush mounting, with gasket, latch, and handle assembly **[and 1/4 inch thick Plexiglas inspection window]**. **[Furnish welded channel frame to set door out from casing to permit external insulation.]**

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

* + - * 1. Inspection Doors: **[18 x 22] <\_\_\_\_\_\_\_\_>** inch of galvanized steel for flush mounting, with gasket, latch, and handle assemblies and 12 x 12 inch inspection window of 1/4 inch thick Plexiglas. **[Furnish welded channel frame to set door out from casing to permit external insulation.]**
				2. Walk-in Access Doors: **[18 x 40] [24 x 48] [24 x 60] [30 x 60] [30 x 72] <\_\_\_\_\_\_\_\_>** inch Galvanized steel insulated sandwich construction, for flush mounting, with hinges, gasket, latch, and handle assemblies **[, and 12 x 12 inch inspection window of 1/4 inch thick Plexiglas]**. **[Furnish welded channel frame to set door out from casing to permit external insulation.]**
				3. Lights: Located in accessible sections suitable for damp locations with wire guards, factory wired to **[weatherproof]** switch **[and pilot light] [and duplex outlet]** mounted on casing exterior. In humidifier sections, furnish lights suitable for wet locations.
				4. Drain Pans: **[Single] [Double]** thickness galvanized steel **[with insulation between layers]** with welded corners. Cross break and pitch to drain connection. Furnish drain pans under **[fan section]** **[heating coil section] [cooling coil section] [mixing section] [humidifier section] [plenum sections] [with asphalt base coating]**.
				5. Bottom Inlet Units: Furnish steel or aluminum walking grate on structural supports.
				6. Strength: Furnish structure to brace casings for suction pressure of **[2.5] <\_\_\_\_\_\_\_\_>** inch wg, with maximum deflection of 1 in 200.
			1. FANS
				1. Type: **[Forward curved,] [Backward inclined,] [Air foil,] [single width, single inlet, centrifugal] [double width, double inlet, centrifugal] [Vane axial] [plug]** type fan.
				2. Performance Ratings: Conform to AMCA 210 “Laboratory Methods of Testing Fans for Aerodynamic Performance Rating” **[and label with AMCA Certified Rating Seal]**.
				3. Sound Ratings: AMCA 301 “Methods for Calculating Fan Sound Ratings from Laboratory Test Data”, tested to AMCA 300 “Reverberant Room Method for Sound Testing of Fans” **[and label with AMCA Certified Sound Rating Seal]**.
				4. Bearings: Self-aligning, grease lubricated, ball or roller bearings with lubrication fittings extended to exterior of casing with **[plastic] [aluminum] [copper]** tube and grease fitting rigidly attached to casing.

Select one of next two paragraphs. First is for units with internally mounted motors, second for externally mounted motors.

* + - * 1. Mounting: Locate fan and motor internally on welded steel base coated with corrosion resistant paint. Factory mount motor on slide rails. Furnish access to motor, drive, and bearings through removable casing panels or hinged access doors. **[Furnish built-in inertia base of welded steel with bottom sheet and reinforcing grid for concrete ballast.]** Mount base on vibration isolators.

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

* + - * 1. Mounting: Locate motor, drive, and belt guard on integral casing framework on exterior of casing. **[Furnish ventilated weather cover of galvanized steel completely enclosing motor and drive with tachometer opening.]** Mount casing on vibration isolators.
				2. Fan Modulation: **[Variable inlet vanes] [Discharge dampers]**.

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

* + - * 1. Fan Modulation: Variable Frequency Drive. Refer to Section 262923.
				2. Flexible Connection: Separate unit from connecting ductwork.
			1. MOTORS
				1. Refer to Section 230513 for motor requirements.
			2. BEARINGS AND DRIVES

Bearing life means at rated hours percent failure is anticipated; i.e., L-10 life at 50,000 hours means 10 percent of bearings may be expected to have failed at 50,000 hours.

* + - * 1. Bearings: Pillow block type, self-aligning, grease-lubricated **[ball bearings, with ABMA 9 [L-10 life at 50,000 hours] [L-50 life at 100,000 hours]] [roller bearings, or ABMA 11, [L-10 life at 120,000 hours] [L-50 life at 400,000 hours]]**.
				2. Shafts: Solid, hot rolled steel, ground and polished, with key-way, and protectively coated with lubricating oil.
				3. V-Belt Drive: Cast iron or steel sheaves, dynamically balanced, bored to fit shafts, and keyed. Variable and adjustable pitch sheaves for motors 15 hp and under selected so required rpm is obtained with sheaves set at mid-position; fixed sheave for 20 hp and over, matched belts, and drive rated as recommended by manufacturer or minimum 1.5 times nameplate rating of motor.
				4. Belt Guard: Fabricate to SMACNA “HVAC Duct Construction Standard - Metal and Flexible” Standard; 0.106 inch thick, 3/4 inch diamond mesh wire screen welded to steel angle frame or equivalent, prime coated. Secure to fan or fan supports without short circuiting vibration isolation, with provision for adjustment of belt tension, lubrication, and use of tachometer with guard in place.
			1. COILS
				1. Casing with access to both sides of coils. Enclose coils with headers and return bends **[exposed outside] [fully contained within]** casing. Slide coils into casing through removable end panel **[with blank off sheets and sealing collars at connection penetrations]**.
				2. Drain Pans: 24 inch downstream of coil and down spouts for cooling coil banks more than one coil high.
				3. Eliminators: Three break of **[galvanized steel,] [Type 304 stainless steel,] [PVC,]** mounted over drain pan.
				4. Air Coils: Certify capacities, pressure drops, and selection procedures in accordance with ARI 410 “Forced-Circulation Air-Cooling and Air-Heating Coils”.
				5. Fabrication:

Tubes: 5/8 inch OD seamless copper expanded into fins, brazed joints.

Fins: Aluminum.

Casing: Die formed channel frame of galvanized steel.

* + - * 1. Water Heating Coils:

Headers: Cast iron, seamless copper tube, or prime coated steel pipe with brazed joints.

Configuration: Drainable, with threaded plugs for drain and vent; serpentine type with return bends on smaller sizes and return headers on larger sizes.

* + - * 1. Steam Heating Coils:

Headers: Cast iron with tubes expanded into header, seamless copper tube with silver brazed joints, or prime coated steel pipe with brazed joints.

Configuration: Drainable, with threaded plugs for drain and vent, threaded plugs in return bends and in headers opposite each tube, sloped within frame to condensate connection.

* + - * 1. Steam Distribution Heating Coils:

Headers: Cast iron or prime coated steel pipe with brazed joints.

Tubes: **[5/8] [3/8]** inch OD steam distribution tubes located within **[one] [5/8]** inch OD condensing tubes.

Configuration: Drainable, with threaded plugs for drain and vent; with **[same end] [opposite end] [double steam] [double pass]** connections.

* + - * 1. Water Cooling Coils:

Headers: Cast iron, seamless copper tube, or prime coated steel pipe with brazed joints.

Configuration: Drainable, with threaded plugs for drain and vent; threaded plugs in return bends and in headers opposite each tube.

* + - * 1. Refrigerant Coils:

Headers: Seamless copper tubes with silver brazed joints.

Liquid Distributors: Brass or copper venturi distributor with seamless copper distributor tubes.

Configuration: Down feed with bottom suction.

* + - * 1. Electric Coils:

Assembly: UL 1096 “Standard for Safety Electric Central Air Heating Equipment” listed and labeled, with terminal control box and **[hinged]** cover, splice box, coil, casing, and controls.

Coil: **[Enclosed copper tube, aluminum finned element] [Exposed helical coil]**.

Casing: Die formed channel frame of galvanized steel.

Controls: Automatic reset thermal cutout, built-in **[magnetic] [mercury]** contactors **[, control circuit transformer and fuse] [, manual reset thermal cutout] [, air flow proving device] [, fused disconnect] [, non-fused disconnect] [, load fuses]**.

* + - 1. HUMIDIFIER

Use the following article when humidifiers are integral to the air handling unit.

In this article, list manufacturers acceptable for this Project.

* + - * 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

Armstrong International, Inc.

Carel USA, LLC.

DRI-STEEM Humidifier Company.

Hygromatik; Spirax Sarco.

Neptronic; National Environmental Products, Inc.

Nortec Industries Inc.

Pure Humidifier Company.

Approved equivalent.

Edit the following descriptive specifications to identify Project requirements and to eliminate conflicts with manufacturers specified above.

* + - * 1. Humidifiers: Capacities and selection in accordance with ARI 610 “Central System Humidifiers for Residential Applications”.
				2. Steam Grid Humidifier: Stainless steel distribution tube with evenly spaced orifices extended full width of unit, factory mounted **[in plenum with drain pan for draw-through units] [in diffuser section of blow-through units]**.
				3. Wet Glass Cell Washer Section:

3 inch deep cells with random packed, glass fiber media in **[galvanized] [stainless]** steel frames.

Access Door: Watertight with brass fittings, **[wire glass window,]** and locking handles.

Spray Tree Assembly: **[Brass] [Stainless steel]** nozzles and **[galvanized] [stainless]** steel piping.

Eliminator: **[Galvanized] [Stainless]** steel plates.

Tank: Welded **[stainless]** steel **[with interior and exterior surfaces blasted and painted with zinc chromate paint]**; copper suction screen, drain, overflow, and suction connections; make-up connection with **[brass]** float valve, and quick-fill connection; insulate exterior with duct insulation and mount on 2 inch thick rigid insulation board.

* + - * 1. Evaporative Humidifier Section:

Access Door: Watertight [cast iron] with brass fittings, wire glass window, and locking handles.

Spray Tree Assembly: Brass nozzles and galvanized piping, **[galvanized eliminator plates with flooding nozzles and header, and galvanized anti-splash baffles] [cross-fluted cellulose media]**.

Tank: Welded steel tank with interior and exterior surfaces blasted and painted with zinc chromate paint; copper suction screen, drain, overflow, and suction connections; make-up connection with **[brass]** float valve, and quick-fill connection.

Insulation: Duct insulation on exterior and mount on 2 inches thick rigid insulation board.

* + - 1. FILTERS
				1. Filter Box: Section with filter guides, access doors from both sides, for **[side] [face]** loading with gaskets and blank-off plates.
				2. Filter Media: UL 900 “Air Filter Units” listed, Class I [Class II]
				3. **[Flat] [Angle] [High Capacity]**: **[2 inches] [44 inches]** deep **[washable permanent panel filters.] [disposable panel filters.] [disposable, extended area panel filters.]**
				4. Renewable Media: **[Horizontal] [Vertical]** filters with **[manual] [automatic]** control and auxiliary frame for extended surface **[retained media filters] [non-supported media filters]**. Motor: **<\_\_\_\_\_\_\_\_>** hp.
				5. Extended Surface: Filter box with holding frames and blank-off sheets, extended surface **[retained] [non-supported] [high efficiency]** media filters with **[30] [50] [80] [90] [95]** percent dust spot efficiency.
				6. Filter Gauges: **[3-1/2 inch diameter diaphragm actuated dial in metal case,] [2 inch diameter diaphragm actuated dial in metal case,] [One piece molded plastic inclined manometer,]** with static pressure tips.
			2. ECONOMIZER
				1. Provide economizer components and controls in accordance with ICC IECC.
			3. DAMPERS
				1. Mixing Boxes: Section with factory mounted outside and return air dampers of galvanized steel **[with vinyl bulb edging] [and edge seals]** in galvanized frame, with galvanized steel axles in self-lubricating **[nylon] [brass]** bearings, in **[parallel] [opposed]** blade arrangement **[with damper blades positioned across short air opening dimension.] [Furnish removable, full width support for freeze-protection thermostat, with removable end panel to permit support removal.]**

International Energy Conservation Code requires outside air dampers to have the following maximum air leakage.

* + - * 1. Outside Air Damper Leakage: Maximum **[3.0] <\_\_\_\_\_\_\_\_>** cfm per square foot at **[1.0] <\_\_\_\_\_\_\_\_>** inches wg pressure differential.

Leakage rates for other dampers in air systems could be specified using one of the following two paragraphs.

* + - * 1. Damper Leakage: Maximum **[2] <\_\_\_\_\_\_\_\_>** percent at 4 inch wg differential pressure when sized for 2000 fpm face velocity.

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

* + - * 1. Damper Leakage: Maximum **<\_\_\_\_\_\_\_\_>** cfm per square foot at **[1.0] <\_\_\_\_\_\_\_\_>** inches wg pressure differential.
				2. Face and Bypass Dampers: Factory mount in casing with access doors, of galvanized steel blades, **[with vinyl bulb edging] [and edge seals]**, galvanized steel frame, and axles in self-lubricating nylon bearings. Arrange to match coil face with **[bottom] [top]** bypass, blank-off and division sheets, **[internal] [external]** linkage, access doors, and **[adjustable]** resistance plate.
				3. Multi-Zone Dampers: Factory mount in casing with service door, of galvanized steel blades **[with vinyl bulb edging] [and edge seals]** and frame with 1/2 inch diameter stainless steel shaft in oil impregnated bronze bearings, with end stops in frame. Arrange for **[parallel] [opposed]** blade operation, with **[adjustable]** resistance plates, hand quadrants, and sheet metal clips for duct connections.
				4. Damper Actuators: Furnish factory installed **[electric] [pneumatic] [electronic]** damper actuators for **[outside air, return air, and exhaust air dampers] [face and bypass dampers] [multi-zone dampers]**.
			1. OUTSIDE AIR MEASURING AND MODULATION DEVICE

Use the following device to maintain constant outside air quantity when air handling units are used in variable air volume systems.

* + - * 1. Factory mounted in **[outside air] [return air] [outside air and return air openings]**.
				2. Damper and airflow measurement assembly sized to accommodate **[minimum] [economizer] outside airflow [as indicated on Drawings]**.
				3. Construction:

Frame: Extruded aluminum.

Blades:

Modulating Air Control:

Style: Airfoil-shaped, single-piece.

Action: Parallel.

Orientation: Horizontal.

Material: Heavy gage 6063-T5 extruded aluminum.

Width: Maximum 5 inches.

Stationary Sensing:

Style: Airfoil-shaped, single-piece.

Orientation: Horizontal.

Material: Heavy gage 6063-T5 extruded aluminum.

Width: Maximum 5-1/4 inches.

Finish: Anodized.

Bearings: Self-lubricating molded synthetic sleeve, turning in extruded hole in frame.

Seals:

Blade: Extruded rubber. Mechanically attached to blade edge.

Jamb: Stainless steel, flexible metal compression type.

Linkage: Concealed in frame.

Axles: Minimum 1/2 inch diameter plated steel, hex-shaped, mechanically attached to blade.

Mounting: Vertical.

Electric Actuator: 24 V, 60 Hz, modulating, with position feedback.

Digital Controller: Application specific controller. Programming logic and calibration in nonvolatile EPROM. Controller uses generic 0 - 10 vdc inputs and outputs for interface to building automation system.

Air Straightener Section: 3 inches deep section contained in 5 inch long sleeve attached to damper-airflow monitor frame.

Finish: Mill aluminum.

* + - * 1. Performance Data:

Temperature Rating: Withstand -40 to 140 degrees F.

Accuracy: Plus or minus 5 percent.

Leakage: Maximum of **[2.0] [3.0] <\_\_\_\_\_\_\_\_>** cfm per square foot at **[1.0] <\_\_\_\_\_\_\_\_>** inches wg pressure differential.

Measures from 15 percent to 100 percent of unit nominal air flow.

Adjusts air flow for temperature variations.

Provides 2 to 10 volt DC signal corresponding to actual air flow.

* + - * 1. Accessories:

Actuator Heater: Allow actuator operation in ambient temperatures to -40 degrees F.

* + - 1. CONTROLS
				1. Controls: Refer to Section **[230923] [230953]**. **[Refer to Section 230993 for sequence of operation.]**
			2. CAPACITY

Insert capacity requirements essential to Project. Use the following for one or identical units. When specifying units of different sizes, use schedule at end of this section.

* + - * 1. Supply Fan Performance:

Air Flow: **<\_\_\_\_\_\_\_\_>** cfm.

[Minimum] Outside Air Flow: **<\_\_\_\_\_\_\_\_>** cfm.

External Static Pressure: **<\_\_\_\_\_\_\_\_>** inch wg.

Motor: **<\_\_\_\_\_\_\_\_>** hp. **[Open drip proof] [TEFC] [NEMA MG1, <\_\_\_\_\_\_\_\_>.]**

* + - * 1. Return Fan Performance:

Air Flow: **<\_\_\_\_\_\_\_\_>** cfm.

External Static Pressure: **<\_\_\_\_\_\_\_\_>** inch wg.

Motor: **<\_\_\_\_\_\_\_\_>** hp. **[Open drip proof] [TEFC] [NEMA MG1, <\_\_\_\_\_\_\_\_>.]**

* + - * 1. Hot Water Heating Coil:

Rows: **<\_\_\_\_\_\_\_\_>**.

Capacity: **<\_\_\_\_\_\_\_\_>** Btuh.

Face Velocity: **<\_\_\_\_\_\_\_\_>** fpm.

Entering Air Temperature: **<\_\_\_\_\_\_\_\_>** degrees F.

Leaving Air Temperature: **<\_\_\_\_\_\_\_\_>** degrees.

Water Flow Rate: **<\_\_\_\_\_\_\_\_>** gpm.

Entering Water Temperature: **<\_\_\_\_\_\_\_\_>** degrees F.

Leaving Water Temperature: **<\_\_\_\_\_\_\_\_>** degrees F.

Water Pressure Drop: **<\_\_\_\_\_\_\_\_>** ft head.

* + - * 1. Steam Heating Coil:

Rows: **<\_\_\_\_\_\_\_\_>**.

Capacity: **<\_\_\_\_\_\_\_\_>** Btuh.

Face Velocity: **<\_\_\_\_\_\_\_\_>** fpm.

Entering Air Temperature: **<\_\_\_\_\_\_\_\_>** degrees F.

Leaving Air Temperature: **<\_\_\_\_\_\_\_\_>** degrees F.

Steam Flow Rate: **<\_\_\_\_\_\_\_\_>** lb/hr.

Entering Steam Pressure: **<\_\_\_\_\_\_\_\_>** psi.

* + - * 1. Water Cooling Coil:

Rows: **<\_\_\_\_\_\_\_\_>**.

Capacity: **<\_\_\_\_\_\_\_\_>** Btuh.

Face Velocity: **<\_\_\_\_\_\_\_\_>** fpm.

Entering Air Temperature:

Dry Bulb: **<\_\_\_\_\_\_\_\_>** degrees F.

Wet Bulb: **<\_\_\_\_\_\_\_\_>** degrees F.

Leaving Air Temperature:

Dry Bulb: **<\_\_\_\_\_\_\_\_>** degrees F.

Wet Bulb: **<\_\_\_\_\_\_\_\_>** degrees F.

Water Flow Rate: **<\_\_\_\_\_\_\_\_>** gpm.

Entering Water Temperature: **<\_\_\_\_\_\_\_\_>** degrees F.

Leaving Water Temperature: **<\_\_\_\_\_\_\_\_>** degrees F.

Water Pressure Drop: **<\_\_\_\_\_\_\_\_>** ft.

* + - * 1. Refrigerant Cooling Coil:

Rows: **<\_\_\_\_\_\_\_\_>**.

Capacity: **<\_\_\_\_\_\_\_\_>** Btuh.

Face Velocity: **<\_\_\_\_\_\_\_\_>** fpm.

Entering Air Temperature:

Dry Bulb: **<\_\_\_\_\_\_\_\_>** degrees F.

Wet Bulb: **<\_\_\_\_\_\_\_\_>** degrees F.

Leaving Air Temperature:

Dry Bulb: **<\_\_\_\_\_\_\_\_>** degrees F.

Wet Bulb: **<\_\_\_\_\_\_\_\_>** degrees F.

Refrigerant Saturated Suction Temperature: **<\_\_\_\_\_\_\_\_>** degrees F.

* + - * 1. Electric Coil:

Capacity: **<\_\_\_\_\_\_\_\_>** Btuh.

Face Velocity: **<\_\_\_\_\_\_\_\_>** fpm.

Entering Air Temperature: **<\_\_\_\_\_\_\_\_>** degrees F.

Leaving Air Temperature: **<\_\_\_\_\_\_\_\_>** degrees F.

Power Input: **<\_\_\_\_\_\_\_\_>** kW.

* + - * 1. Humidifier:

Select appropriate capacity information based on humidifier type.

Evaporation capacity: **<\_\_\_\_\_\_\_\_>** lbs/hr.

Coil water temperature: **<\_\_\_\_\_\_\_\_>** degrees F.

Coil steam temperature: **<\_\_\_\_\_\_\_\_>** degrees F.

Electrical heat input: **<\_\_\_\_\_\_\_\_>** kW.

Air Pressure Drop: Maximum **<\_\_\_\_\_\_\_\_>** inch wg.

Saturation Efficiency: Minimum **<\_\_\_\_\_\_\_\_>** percent.

Steam Flow Rate: **<\_\_\_\_\_\_\_\_>** lb/hr.

Entering Steam Pressure: **<\_\_\_\_\_\_\_\_>** psi.

* + - 1. ELECTRICAL CHARACTERISTICS AND COMPONENTS

Select one or more of the following subparagraphs appropriate to equipment requirements.

* + - * 1. Electrical Characteristics: In accordance with Section 260503 and the following:

**[<\_\_\_\_\_\_\_\_>hp.]** **[<\_\_\_\_\_\_\_\_> rated load amperes.]**

**<\_\_\_\_\_\_\_\_>** volts, **[single] [three]** phase, 60 Hz.

**<\_\_\_\_\_\_\_\_>** amperes maximum **[fuse size] [circuit breaker size] [overcurrent protection]**.

**<\_\_\_\_\_\_\_\_>** minimum circuit ampacity.

**<\_\_\_\_\_\_\_\_>** percent minimum power factor at rated load.

* + - * 1. Disconnect Switch: Factory mount **[in control panel] [on equipment]**.
1. EXECUTION
	* + 1. INSTALLATION
				1. Install in accordance with ARI 430 “Central-Station Air-Handling Units”.
				2. Install flexible connections between unit and inlet and discharge ductwork. Install metal bands of connectors parallel with minimum 1 inch flex between ductwork and fan while running. Refer to Section 233300.
				3. Install assembled units with vibration isolators. Install isolated fans with resilient mountings and flexible electrical leads. Install restraining snubbers as **[indicated] [required]**. Adjust snubbers to prevent tension in flexible connectors when fan is operating. Refer to Section 230548.
				4. Install floor mounted units on concrete housekeeping pads at least 3-1/2 inches high and 6 inches wider than unit. Refer to Section 033000.
				5. Provide **[fixed]** sheaves required for final air balance.
				6. Insulate coil headers located outside airflow as specified for piping. Refer to Section 230700.
				7. Connect humidifiers to water supply. Install gate valve on water supply piping. Install 3/4 inch hose bibb accessible from interior. Pipe drain and overflow to nearest floor drain.
				8. Install condensate piping with trap and route from drain pan to **[nearest floor drain.] [condensate drainage system.] <\_\_\_\_\_\_\_\_.>** Refer to Section 232113.

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

* + - * 1. Install Work in accordance with **[State] [Municipality]** of **<\_\_\_\_\_\_\_\_> [Highways] [Public Work's]** standard.
			1. INSTALLATION – REFRIGERANT COILS
				1. Install sight glass in liquid line within 12 inches of coil. Refer to Section 232300.
				2. Install piping specialties in accordance with Section 232300.
			2. INSTALLATIONN CHILLED WATER COOLING COIL

Edit the following based on project conditions.

* + - * 1. Make connections to coils with unions or flanges.
				2. Connect water supply to leaving airside of coil (counter flow arrangement).
				3. Locate water supply at bottom of supply header and return water connection at top.
				4. Install water coils to allow draining and install drain connection at low points.
				5. Install the following piping accessories on chilled water piping connections. Refer to Section 232116 and Section 232113.

On supply:

Thermometer well and thermometer.

Well for **[control system]** temperature sensor.

Shutoff valve.

Strainer.

Control valve.

Pressure gage.

On return:

Thermometer well and thermometer.

Well for **[control system]** temperature sensor.

Pressure gage.

Shutoff valve.

**[Balancing valve] [Flow control valve]**.

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

* + - * 1. Install valves and piping specialties in accordance with details as indicated on Drawings.
				2. Install **[manual] [automatic]** air vents at high points complete with shutoff valve. Refer to Section 232113.
			1. INSTALLATION HOT WATER HEATING COIL

Edit the following based on project conditions.

* + - * 1. Make connections to coils with unions or flanges.
				2. Connect water supply to leaving airside of coil (counter flow arrangement).
				3. Locate water supply at bottom of supply header and return water connection at top.
				4. Install water coils to allow draining and install drain connection at low points.
				5. Install the following piping accessories on hot water piping connections. Refer to Section 232116 and Section 232113.

On supply:

Thermometer well and thermometer.

Well for **[control system]** temperature sensor.

Shutoff valve.

Strainer.

Control valve.

Pressure gage.

On return:

Thermometer well and thermometer.

Well for **[control system]** temperature sensor.

Pressure gage.

Shutoff valve.

**[Balancing valve] [Flow control valve]**.

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

* + - * 1. Install valves and piping specialties in accordance with details as indicated on Drawings.
				2. Install **[manual] [automatic]** air vents at high points complete with shutoff valve. Refer to Section 232113.
			1. INSTALLATION – STEAM HEATING COIL

Edit the following based on project conditions.

* + - * 1. Make connections to coils with unions or flanges.
				2. Install steam traps with outlet minimum 12 inches below coil return connection.
				3. Install the following piping accessories on steam piping connections. Refer to Section 232216 and Section 232213.

On supply:

Shutoff valve.

Strainer.

Control valve.

Pressure gage.

Air vent.

On return:

Vacuum breaker.

Steam trap.

Shutoff valve.

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

* + - * 1. Install valves and piping specialties in accordance with details as indicated on Drawings.
			1. MANUFACTURER’S FIELD SERVICES

Include the following based on Project conditions.

* + - * 1. Furnish initial start-up and shutdown during first year of operation, including routine servicing and checkout.

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

* + - * 1. Furnish services of factory trained representative for minimum of **[one] <\_\_\_\_\_\_\_\_>** days to leak test, refrigerant pressure test, evacuate, dehydrate, charge, start-up, calibrate controls, and instruct Facility’s maintenance personnel on operation and maintenance.
			1. CLEANING
				1. Section 017716 – Contract Closeout
				2. Vacuum clean coils and inside of unit cabinet.
				3. Install new throwaway filters in units at Substantial Completion.

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

* + - * 1. Install temporary filters during construction period. Replace with permanent filters at Substantial Completion.
			1. DEMONSTRATION
				1. Section 017716 – Contract Closeout
				2. Demonstrate unit operation and maintenance.

Include the following based on Project conditions.

* + - * 1. Furnish services of manufacturer's technical representative for **[one] <\_\_\_\_\_\_\_\_> [8] <\_\_\_\_\_\_\_\_>** hour day to instruct Facility’s personnel in operation and maintenance of units. Schedule training with Director’s Representative, provide at least 7 days notice to **[Director’s Representative] <\_\_\_\_\_\_\_\_>** of training date.
			1. PROTECTION OF FINISHED WORK
				1. Section 017716 – Contract Closeout
				2. Do not operate units until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.
			2. SCHEDULES

Include schedule when more than one different size of unit is specified. Complete in conjunction with identification method used on drawings, or provide schedule on drawing. Coordinate equipment tags and abbreviations with project specific requirements.

Complete schedule in conjunction with identification method used on Drawings, or provide schedule on Drawings. No units of measurement are indicated; these may be added to schedule legend or included within each insert.

Consider the following examples when developing Project schedule.

* + - * 1. Air Handling Units Schedule:

Equipment Tag: <AHU-1>:

**[Manufacturer: <\_\_\_\_\_\_\_\_>.]**

**[Model: <\_\_\_\_\_\_\_\_>.]**

Fan Capacity: **<\_\_\_\_\_\_\_\_>**.

Air Flow Rate: **<\_\_\_\_\_\_\_\_>**.

External Static Pressure: **<\_\_\_\_\_\_\_\_>**.

Motor Power: **<\_\_\_\_\_\_\_\_>**.

[Minimum] Outside Air Flow Rate: **<\_\_\_\_\_\_\_\_>**.

Heating Coil:

Capacity: **<\_\_\_\_\_\_\_\_>**.

Entering Air Temperature: **<\_\_\_\_\_\_\_\_>**.

Leaving Air Temperature: **<\_\_\_\_\_\_\_\_>**.

Entering Water Temperature: **<\_\_\_\_\_\_\_\_>**.

Leaving Water Temperature: **<\_\_\_\_\_\_\_\_>**.

Water Pressure Drop: **<\_\_\_\_\_\_\_\_>**.

\*\*\*\*\* (OR) \*\*\*\*\*

Steam Capacity: **<\_\_\_\_\_\_\_\_>**.

Entering Steam Pressure: **<\_\_\_\_\_\_\_\_>**.

\*\*\*\*\* (OR) \*\*\*\*\*

Electrical Input: **<\_\_\_\_\_\_\_\_>**.

Maximum Face Velocity: **<\_\_\_\_\_\_\_\_>**.

Fin Spacing: **<\_\_\_\_\_\_\_\_>**.

Rows: **<\_\_\_\_\_\_\_\_>**.

Cooling Coil:

Capacity: **<\_\_\_\_\_\_\_\_>**.

Entering Air Temperature:

Dry Bulb: **<\_\_\_\_\_\_\_\_>**.

Wet Bulb: **<\_\_\_\_\_\_\_\_>**.

Leaving Air Temperature:

Dry Bulb: **<\_\_\_\_\_\_\_\_>**.

Wet Bulb: **<\_\_\_\_\_\_\_\_>**.

Water Flow Rate: **<\_\_\_\_\_\_\_\_>**.

Entering Water Temperature: **<\_\_\_\_\_\_\_\_>**.

Leaving Water Temperature: **<\_\_\_\_\_\_\_\_>**.

Pressure Drop: **<\_\_\_\_\_\_\_\_>**.

\*\*\*\*\* (OR) \*\*\*\*\*

Saturated Suction Temperature: **<\_\_\_\_\_\_\_\_>**.

Maximum Face Velocity: **<\_\_\_\_\_\_\_\_>**.

Fin Spacing: **<\_\_\_\_\_\_\_\_>**.

Rows: **<\_\_\_\_\_\_\_\_>**.

Humidifier:

Select appropriate capacity information based on humidifier type.

Evaporation Capacity: **<\_\_\_\_\_\_\_\_>**.

Coil Water Temperature: **<\_\_\_\_\_\_\_\_>**.

Coil Steam Temperature: **<\_\_\_\_\_\_\_\_>**.

Electrical Heat Input: **<\_\_\_\_\_\_\_\_>**.

Air Pressure Drop: **<\_\_\_\_\_\_\_\_>**.

Minimum Saturation Efficiency: **<\_\_\_\_\_\_\_\_>**.

Steam Flow Rate: **<\_\_\_\_\_\_\_\_>**.

Entering Steam Pressure: **<\_\_\_\_\_\_\_\_>**.

Sound Power - Fan Discharge:

1st Octave: **<\_\_\_\_\_\_\_\_>**.

2nd Octave: **<\_\_\_\_\_\_\_\_>**.

3rd Octave: **<\_\_\_\_\_\_\_\_>**.

4th Octave: **<\_\_\_\_\_\_\_\_>**.

5th Octave: **<\_\_\_\_\_\_\_\_>**.

6th Octave: **<\_\_\_\_\_\_\_\_>**.

7th Octave: **<\_\_\_\_\_\_\_\_>**.

8th Octave: **<\_\_\_\_\_\_\_\_>**.

Sound Power - Casing Radiated:

1st Octave: **<\_\_\_\_\_\_\_\_>**.

2nd Octave: **<\_\_\_\_\_\_\_\_>**.

3rd Octave: **<\_\_\_\_\_\_\_\_>**.

4th Octave: **<\_\_\_\_\_\_\_\_>**.

5th Octave: **<\_\_\_\_\_\_\_\_>**.

6th Octave: **<\_\_\_\_\_\_\_\_>**.

7th Octave: **<\_\_\_\_\_\_\_\_>**.

8th Octave: **<\_\_\_\_\_\_\_\_>**.

Accessories: **<\_\_\_\_\_\_\_\_>**.

Equipment Tag: **<AHU-2>**:

**[Manufacturer: <\_\_\_\_\_\_\_\_>.]**

**[Model: <\_\_\_\_\_\_\_\_>.]**

Fan Capacity: **<\_\_\_\_\_\_\_\_>**.

Air Flow Rate: **<\_\_\_\_\_\_\_\_>**.

External Static Pressure: **<\_\_\_\_\_\_\_\_>**.

Motor Power: **<\_\_\_\_\_\_\_\_>**.

**[Minimum]** Outside Air Flow Rate: **<\_\_\_\_\_\_\_\_>**.

Heating Coil:

Capacity: **<\_\_\_\_\_\_\_\_>**.

Entering Air Temperature: **<\_\_\_\_\_\_\_\_>**.

Leaving Air Temperature: **<\_\_\_\_\_\_\_\_>**.

Entering Water Temperature: **<\_\_\_\_\_\_\_\_>**.

Leaving Water Temperature: **<\_\_\_\_\_\_\_\_>**.

Water Pressure Drop: **<\_\_\_\_\_\_\_\_>**.

\*\*\*\*\* (OR) \*\*\*\*\*

Steam Capacity: **<\_\_\_\_\_\_\_\_>**.

Entering Steam Pressure: **<\_\_\_\_\_\_\_\_>**.

\*\*\*\*\* (OR) \*\*\*\*\*

Electrical Input: **<\_\_\_\_\_\_\_\_>**.

Maximum Face Velocity: **<\_\_\_\_\_\_\_\_>**.

Fin Spacing: **<\_\_\_\_\_\_\_\_>**.

Rows: **<\_\_\_\_\_\_\_\_>**.

Cooling Coil:

Capacity: **<\_\_\_\_\_\_\_\_>**.

Entering Air Temperature:

Dry Bulb: **<\_\_\_\_\_\_\_\_>**.

Wet Bulb: **<\_\_\_\_\_\_\_\_>**.

Leaving Air Temperature:

Dry Bulb: **<\_\_\_\_\_\_\_\_>**.

Wet Bulb: **<\_\_\_\_\_\_\_\_>**.

Water Flow Rate: **<\_\_\_\_\_\_\_\_>**.

Entering Water Temperature: **<\_\_\_\_\_\_\_\_>**.

Leaving Water Temperature: **<\_\_\_\_\_\_\_\_>**.

Pressure Drop: **<\_\_\_\_\_\_\_\_>**.

\*\*\*\*\* (OR) \*\*\*\*\*

Saturated Suction Temperature: **<\_\_\_\_\_\_\_\_>**.

Maximum Face Velocity: **<\_\_\_\_\_\_\_\_>**.

Fin Spacing: **<\_\_\_\_\_\_\_\_>**.

Rows: **<\_\_\_\_\_\_\_\_>**.

Humidifier:

Select appropriate capacity information based on humidifier type.

Evaporation Capacity: **<\_\_\_\_\_\_\_\_>**.

Coil Water Temperature: **<\_\_\_\_\_\_\_\_>**.

Coil Steam Temperature: **<\_\_\_\_\_\_\_\_>**.

Electrical Heat Input: **<\_\_\_\_\_\_\_\_>**.

Air Pressure Drop: **<\_\_\_\_\_\_\_\_>**.

Minimum Saturation Efficiency: **<\_\_\_\_\_\_\_\_>**.

Steam Flow Rate: **<\_\_\_\_\_\_\_\_>**.

Entering Steam Pressure: **<\_\_\_\_\_\_\_\_>**.

Sound Power - Fan Discharge:

1st Octave: **<\_\_\_\_\_\_\_\_>**.

2nd Octave: **<\_\_\_\_\_\_\_\_>**.

3rd Octave: **<\_\_\_\_\_\_\_\_>**.

4th Octave: **<\_\_\_\_\_\_\_\_>**.

5th Octave: **<\_\_\_\_\_\_\_\_>**.

6th Octave: **<\_\_\_\_\_\_\_\_>**.

7th Octave: **<\_\_\_\_\_\_\_\_>**.

8th Octave: **<\_\_\_\_\_\_\_\_>**.

Sound Power - Casing Radiated:

1st Octave: **<\_\_\_\_\_\_\_\_>**.

2nd Octave: **<\_\_\_\_\_\_\_\_>**.

3rd Octave: **<\_\_\_\_\_\_\_\_>**.

4th Octave: **<\_\_\_\_\_\_\_\_>**.

5th Octave: **<\_\_\_\_\_\_\_\_>**.

6th Octave: **<\_\_\_\_\_\_\_\_>**.

7th Octave: **<\_\_\_\_\_\_\_\_>**.

8th Octave: **<\_\_\_\_\_\_\_\_>**.

Accessories: **<\_\_\_\_\_\_\_\_>**.

END OF SECTION 237300