

SECTION 23 73 80 – PACKAGED AIR HANDLING UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This section includes: constant-volume, blower coil type, air-handling units with coils, filters, and other accessories for indoor installations.
- B. Source Limitations: Obtain all Packaged Units through one source from a single manufacturer, regularly engaged in production of the units.

1.3 SUBMITTALS

- A. Product Data: For each air-handling unit provide the following:
 - 1. Unit dimensions and weight.
 - 2. Cabinet material, metal thickness, finishes, insulation, and accessories.
 - 3. Certified fan performance curves with system operating conditions indicated.
 - 4. Certified coil-performance ratings with system operating conditions indicated.
 - 5. Coil connection locations and sizes.
 - 6. Dampers, including housings, linkages, and operators.
 - 7. Filters with performance characteristics.
 - 8. Wiring diagrams detailing wiring for power and controls and differentiating between manufacturer-installed wiring and field-installed wiring.
- B. Provide Operation and Maintenance Data for all packaged air handling units.

1.4 QUALITY ASSURANCE

- A. Units to be designed and tested in compliance with AHRI 430 air delivery ratings per AHRI 430-2014.
- B. Units to be designed and tested in compliance with AHRI 260-2001.

1.5 COORDINATION

- A. Where required, coordinate sizes and locations of concrete bases with actual equipment provided.
- B. Coordinate sizes and locations of structural-steel support members, if any, with actual equipment provided.

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1.6 DELIVERY, STORAGE AND HANDLING

- A. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units. Units shall ship fully assembled up to practical shipping and rigging limitations. Units not shipped fully assembled shall have tags on each section to indicate location and orientation in direction of airflow. Each section shall have lifting points to allow for field rigging and final placement of section.
- B. Store units in a clean dry place and protect from weather and construction traffic. Handle carefully to avoid damage to components, enclosures, and finish.
- C. Deliver units to site with electronically commutated fan motors factory mounted in units. If these components are not completely assembled, contractor shall be responsible for all expenses associated with installation, testing, and vibration balancing of fan(s).

1.7 WARRANTY

- A. Indoor Units: provide written warranty indicating all packaged air handling units and components will be warranted for a period of 1 year from the date of substantial completion. The warranty will include all parts, materials, and labor for replacement of any of the unit's components that fail in materials and/or workmanship within the warranty period.
- B. Outdoor Condensing Units: provide a full five-year non-prorated warranty.

1.8 EXTRA MATERIALS

- A. In addition to the equipment and materials furnished with the air handling units, furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Filters: Two complete set for each air-handling unit.
 - 2. Fan Belts: One set for each belt-driven air-handling unit fan.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with requirements, provide Packaged Air Handling Units and Condensing Units manufactured by Carrier. Subject to review, equipment meeting the full requirements of the specifications and project installation limitations (i.e., size and weight) and manufactured by the following will be considered:
 - 1. The Trane Co.
 - 2. Johnson Controls.
- B. General Description: Provide factory assembled units, consisting of fans, motor and drive assembly, coils, damper, plenums, filters, drip pans, and mixing box with dampers. Unit manufacturer to provide vibration spring isolators required to hang horizontal units.

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2.2 UNIT CASING

- A. The entire air handler shall be constructed of galvanized steel. The removal of access panels shall not affect the structural integrity of the unit once the unit is installed. Contractor shall be responsible to provide connection flanges and all other framework that is needed to properly support the unit. Access panels shall be on both sides or front of the unit in all sections to allow easy access to drain pan, coil(s), motor, drive components and bearings for cleaning, inspection, and maintenance.
- B. Units shall ship as one or two modules completely factory-assembled including all coils, fans, motors, drives, dampers, and filters.
- C. Access Panels: Removable access panels shall be provided on both sides of the unit to facilitate service access to drain pans, motors, drive components and bearings. Panels shall be gasketed. Access panel for filter removal shall be provided on both sides of the unit.
- D. Cabinet: Casing shall be manufactured of heavy gauge galvanized steel. All removable panels shall be gasketed to minimize air leakage.
- E. Provide high density, matte-faced insulation on the interior surface of unit casing. Insulation shall have a minimum R-Value of 4 and shall be UL Listed. The insulation shall comply with NFPA-90A and B requirements.

2.3 WATER COILS

- A. Install coils such that headers and return bends are enclosed by unit casing to ensure that if condensate forms on the header or return bends, it is captured by the drain pan under the coil. Coils shall be manufactured with plate fins to minimize water carryover and maximize airside thermal efficiency. Tubes shall be mechanically expanded and bonded to fin collars for maximum thermal conductivity. Use of soldering or tinning during the fin-to-tube bonding process is not acceptable due to the inherent thermal stress and possible loss of bonding at that joint.
- B. Construct coil casings of galvanized steel. End supports shall have belled tube holes to minimize wear of the tube wall during thermal expansion and contraction of the tube.
- C. Supply and return header connections shall be clearly labeled on outside of units such that direction of coil water-flow is counter to direction of unit air-flow. Coils shall be proof tested to 450 psig and leak tested to 300 psig air pressure under water. Headers shall be constructed of round copper pipe. If unit is provided with 1/2-inch O.D. coils, the minimum tube wall thickness shall be 0.016-inch-thick copper. If unit is provided with 3/8-inch O.D. coils, the minimum tube wall thickness shall be 0.014-inch-thick copper. All fins shall be aluminum.

2.4 DIRECT EXPANSION (DX) COILS

- A. DX coils are to be designed for use with refrigerant 410A and have 3/8" OD x 0.014" round seamless copper tubes expanded into full fin collars for permanent fin-tube bond. Provide three, four, or six row coils as required. Provide aluminum fins mechanically bonded to stainless copper tubes with 12 fins per inch fin spacing.
- B. The coil casing is 16-gauge galvanized steel. Provide a foam sealing strip between the casing (top and bottom) channels to eliminate air bypass and reduce potential water carryover. Coils to have round, seamless, copper pipe liquid lines and suction headers with male sweat connections. Suction headers to have bottom connections to aid drainage of any oil that may collect in the coil. Liquid line and suction connections are outside the unit casing (on the same side of the unit) to facilitate field piping. Connections

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to be labeled to ensure coils are piped correctly. Coils to have a venturi-type distributor assembly designed with a vertical downflow feed for low pressure drops.

- C. Coils to be proof tested at 715 psig and leak tested at 650 psig air-under-water. Coils are dehydrated and sealed with a dry air charge. Maximum standard operating conditions are 650 psig at 127°F with R-410A. Coils to be rated in accordance with ARI Standard 410.

2.5 DRAIN PAN

- A. Provide a drain pan fabricated of a noncorrosive material, either a polymer plastic or stainless steel, and double-sloped to allow condensate drainage. Coils to be mounted above the drain pan, not in the drain pan, to allow the drain pan to be fully inspected and cleaned. The drain pan is to be removable for cleaning. The drain connection is at the lowest point of the drain pan.

2.6 SUPPLY FANS

- A. Fans are forward curved, centrifugal blower type equipped with heavy-duty adjustable speed V-belt drive. The fan shaft is supported by heavy-duty, permanently sealed ball bearings. All fans are dynamically balanced.

2.7 MOTORS (PAH-1 thru 6)

- A. Provide variable speed, multiple voltage electrically commutated motor with a voltage range of +/- 10 percent. The motor to be an open type with permanently sealed ball bearings and internal overload protection. The motor is to be factory installed, programmed, and wired to the air handling unit control panel.
- B. All motors are brushless DC electronically commutated motors (ECM) factory- programmed and run-tested in assembled units. The motor controller is mounted in a touch-safe control box with a built-in integrated user interface and LED tachometer. If adjustments are needed, motor parameters can be adjusted through momentary contact switches on the motor control board accessible.
- C. Motors will soft-ramp between speeds to lessen the acoustics due to sudden speed changes. Motors can be operated at single speed, three speeds or with single zone VAV control. The motor will choose the highest speed if there are simultaneous/conflicting speed requests. All motors have integral thermal overload protection and are permanently lubricated. Single phase motors to have a maximum ambient operating temperature of 104°F and three-phase motors to have a maximum ambient operating temperature of 130°F. Motors are capable of operating at 90 percent of rated voltage on all speed settings. Motors can operate up to 10 percent over voltage.

2.8 MOTORS (PAH-7 and 8)

- A. All motors and drives shall be factory-installed and run tested.
- B. Direct-driven fan sections shall use 2-pole (3600 rpm), 4-pole (1800 rpm), or 6-pole (1200 rpm) motors, NEMA Design B, with Class B insulation to operate continuously at 104°F (40°C) ambient without tripping of overloads. Multiple fan selections utilizing 8-pole (900 rpm) motors are unacceptable due to motor inefficiency, cost, and replacement lead times.
- C. Motors shall have a +/- 10 percent voltage utilization range to protect against voltage variation.

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- D. Motors shall meet or exceed all NEMA Standards Publication MG 1 – 2006 requirements and comply with NEMA premium efficiency levels when applicable. Motors shall comply with applicable requirements of NEC and shall be UL Listed.

2.9 VARIABLE FREQUENCY DRIVES (VFD)

- A. Where indicated on the drawings variable frequency drives shall be provided. Refer to specification section 238900 for VFD requirements. Variable frequency drives shall NOT be supplied with bypass capabilities on air handling units that serve systems with variable air volume terminal units.

2.10 ANGLE FILTER MIXING BOX

- A. Where indicated, provide mixing boxes. Mixing boxes are to be constructed of heavy-gauge galvanized steel complete with two low-leak parallel blade dampers that are factory-linked together. Provide 1/2" extendible drive rod that can be used for actuator connection, either internally or externally. Damper blades are to be extruded aluminum having interlocked PVC extruded edge seals. Damper frame seals are PVC extruded forms interlocked to the damper frame and provided with a continuous edge seal to the blades. Damper seals are stable in the temperature range of -50°F to 230°F. Mixing boxes also include two side access panels as standard to provide access to the unit's internal components.
- B. Provide 2" thick MERV 13 throwaway filters.

2.11 FILTER SECTION

- A. Where indicated provide filter section with MERV 13 filters. Units have a standard flat filter rack that is sized for less than 500 feet per minute at nominal airflow.
- B. Where indicated provide filter section with MERV 8 and MERV 13 filters. Units have a standard flat filter rack that is sized for less than 500 feet per minute at nominal airflow.

2.12 CONDENSATE OVERFLOW PROTECTION SYSTEM

- A. Provide condensate overflow protection for the units. The system can be factory supplied with the unit(s) or field installed. Provide a float switch installed in the primary drain pan to detect a high condensate water level. Should the condensate level rise in the primary drain pan the float switch will sense the high-water level and stop the supply fan and close the heating control valve and outdoor air damper where applicable. The float switch shall have manual reset.

2.13 OUTDOOR CONDENSING UNITS

- A. General Description: Condensing unit shall include compressors, air-cooled condenser coils, condenser fans, suction and liquid connection valves, and unit controls. Unit shall be factory assembled and tested including leak testing of the coil and run testing of the completed unit.
- B. Unit shall be completely factory assembled, piped, wired, and shipped in one section. Condenser coils shall be mechanically protected from physical damage by painted galvanized steel louvers (wire grille) covering the full area of the coil. Access to condenser coils, condenser fans, compressors, and electrical and controls components shall be through hinged access doors with quarter turn, zinc cast, lockable handles. Exterior paint finish shall be capable of withstanding at least 1,000 hours, with no visible corrosive effects, when tested in a salt spray and fog atmosphere in accordance with ASTM B 117-95 test procedure.

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- C. Electrical: Unit shall be provided with standard power block for connecting power to the unit. Control circuit transformer and wiring shall provide 24 VAC control voltage from the line voltage provided to the unit.
- D. Refrigeration System: Compressors shall be scroll type with thermal overload protection and circuited. Provide two-step compressors shall include 2 stages of capacity control, 65% and 100%. Each compressor shall include a crankcase heater. Compressors shall be mounted in an isolated service compartment which can be accessed without affecting unit operation. Lockable hinged access doors shall provide access to the compressors. Compressors shall be isolated from the base pan with the compressor manufacturer's recommended rubber vibration isolators, to reduce any transmission of noise from the compressors into the building area. Each refrigeration circuit shall be equipped with automatic reset low pressure and manual reset high pressure refrigerant safety controls, Schrader type service fittings on both the high pressure and low-pressure sides, and service valves for liquid and suction connections. Liquid line filter driers shall be factory provided. Finished field installed refrigerant circuits shall include the low side cooling components, refrigerant, thermal expansion valve, liquid line and insulated suction line. Unit shall include a factory holding charge of R-410A refrigerant and oil. Each compressor shall be equipped with a 5 minute off, delay timer to prevent compressor short cycling. The unit shall be capable of stable cooling operation to a minimum of 35°F outdoor temperature.
- E. Air-Cooled Condenser: Condenser fans shall be axial flow, direct drive fans. Fan motor shall be weather protected, single phase, direct drive, and open drip proof with inherent overload protection. Coils shall be designed for use with R-410A refrigerant and constructed of copper tubes with aluminum (copper) fins mechanically bonded to the tubes and aluminum end casings. Fin design shall be sine wave rippled. Coils shall be designed for a minimum of 10°F of refrigerant sub-cooling and shall be leak tested.

2.14 REFRIGERANT PIPING

- A. Drawn-Temper Copper Tube: ASTM B 280, Type ACR, ASTM B 88, Type L.
- B. Wrought-Copper Fittings: ASME B16.22.
- C. Wrought-Copper Unions: ASME B16.22.
- D. Brazing Filler Metals: AWS A5.8, Classification BAg-1 (silver), BAg-2 (silver)
- E. Flexible Connectors: 500-psig (3450-kPa) minimum operating pressure; seamless tin-bronze core, high-tensile bronze-braid covering, and solder-joint end connections; dehydrated, pressure tested, minimum 7 inches long.
- F. Provide all refrigerant accessories, as required by the unit manufacturer, for a complete a working system.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the work. Examine roughing-in for hydronic, and condensate drainage piping systems and electrical services to verify actual locations of connections before installation. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install packaged air-handling units level and plumb, in accordance with manufacturer's written instructions.
- B. Install units with adequate clearance for service and maintenance.
- C. Where units are to be supported from the structure provide the required number of spring vibration isolation hangers with threaded rod. Verify number of connection points with the unit manufacture.
- D. When required provide all necessary controls for a condensate overflow protection system.
- E. Install roof-mounted condensing units on equipment support curbs. Anchor units to supports per the manufacturer's installation instructions.
- F. At the direction of the Owner's Representative the contractor shall remove and dispose of filters from the respective units and install a new filter obtained from the Extra Materials required in Part 1 of this specification. If additional filter installation is not required, forward filters to the owner as extra stock, at the completion of the project.

3.3 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties. Install piping adjacent to the unit to allow service and maintenance. Connect piping to air-handling units mounted on vibration isolators with flexible connectors.
- B. Hot- and Chilled-Water Piping: Install shutoff valve and union or flange at each coil supply connection. Refer to contract drawings for piping connection details.
- C. Refrigerant Piping: Refrigerant Piping: Provide all required refrigeration piping and accessories. Install piping per the manufacturer's installation instructions.
- D. Coordinate duct installations and specialty arrangements with schematics on Drawings and with requirements specified in Section 233113 "Metal Ducts" and Section 233300 "Air Duct Accessories."
- E. Connect duct to air-handling units with flexible connections.
- F. Provide duct mounted motor operated dampers, where indicated on the drawings.

3.4 STARTUP SERVICE

- A. Provide all factory recommended startup service.
- B. Do not operate units for any purpose, temporary or permanent, until ductwork is clean, filters in place, bearings lubricated (if applicable), condensate properly trapped, piping connections verified and leak-tested, belts aligned and tensioned, all shipping braces removed, bearing set screws torqued, and fan has been test run under observation.

3.5 CLEANING

- A. After completing system installation and testing, adjusting, and balancing air-handling unit and air-distribution systems and after completing startup service, clean units internally to remove foreign material

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and construction dirt and dust. Clean fan wheels, cabinets, dampers, coils, and filter housings, and install new, clean filters.

3.6 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain air-handling units.

END OF SECTION 23 73 80