

SECTION 237313 - MODULAR INDOOR CENTRAL-STATION 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. Section Includes:
 - 1. Air-handling units.

1.3 SUBMITTALS

- A. Product Data: For each air-handling unit indicated.
 - 1. Unit dimensions and weight.
 - 2. Cabinet material, metal thickness, finishes, insulation, and accessories.
 - 3. Fans:
 - a. Certified fan-performance curves with system operating conditions indicated.
 - b. Certified fan-sound power ratings.
 - c. Fan construction and accessories.
 - d. Motor ratings, electrical characteristics, and motor accessories.
 - 4. Certified coil-performance ratings with system operating conditions indicated.
 - 5. Dampers, including housings, linkages, and operators.
 - 6. Filters with performance characteristics.
- B. LEED Submittal:
 - 1. Product Data for Prerequisite EQ 1: Documentation indicating that units comply with ASHRAE 62.1-2004, Section 5 - "Systems and Equipment."
- C. Source quality-control reports.
- D. Field quality-control reports.
- E. Operation and Maintenance Data: For air-handling units to include in emergency, operation, and maintenance manuals.

1.4 QUALITY ASSURANCE

- A. 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.
- B. NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of air-handling units and components.

Units from manufacturers that do not participate in ARI's certification program might comply with requirements in this Section; delete first paragraph below if not required.

- C. ARI Certification: Air-handling units and their components shall be factory tested according to ARI 430, "Central-Station Air-Handling Units," and shall be listed and labeled by ARI.

LEED-NC Prerequisite EQ 1 requires compliance with requirements in ASHRAE 62.1-2004, 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.

- D. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1-2004, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

LEED-NC Prerequisite EA 2 requires minimum efficiency equal to requirements in ASHRAE/IESNA 90.1-2004.

- E. ASHRAE/IESNA 90.1-2004 Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2004, Section 6 - "Heating, Ventilating, and Air-Conditioning."
- F. Comply with NFPA 70.

1.5 COORDINATION

- A. 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.

1.6 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Filters: Provide three (3) sets of unit filters for each air handling unit: (1) for use during construction, (1) for replacement at acceptance and (1) for replacement at the end of warranty.
 - 2. Fan Belts: One set(s) for each air-handling unit fan.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Carrier Corporation; a member of the United Technologies Corporation Family.
2. Daikin-McQuay.
3. Trane; Ingersoll-Rand Inc.
4. YORK International Corporation.
5. Ingenia Technologies
6. Temtrol

2.2 UNIT CASINGS

- A. General Fabrication Requirements for Casings:

1. Removable panels - removal of panels will not affect the structural integrity of units.
2. Double wall, 2" insulated panels for walls, roof and floor.
3. Panel deflection will not exceed L/240 at +/- 8" static pressure differential across casing.
4. Casing: leakage shall not exceed 1% of design cfm @ +/- 6" static pressure differential across casing.
5. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

- B. Casing Insulation and Adhesive:

In first subparagraph below, Type I is blanket and Type II is board insulation.

1. Materials: ASTM C 1071, Type II.
2. Location and Application: Unit casing shall be insulated with spray injected foam to achieve thermal resistance of R-13.

LEED-NC Prerequisite EQ 1 requires compliance with ASHRAE 62.1-2004, in which Section 5.14 - "Access for Inspection, Cleaning, and Maintenance" sets requirements for equipment access. If applying for LEED certification, comply with requirements in ASHRAE 62.1-2004.

- C. Inspection and Access Panels and Access Doors:

1. Panel and Door Fabrication: Formed and reinforced, double-wall and insulated panels of same materials and thicknesses as casing.
2. Inspection and Access Panels:
 - a. Fasteners: Two or more camlock type or screws for panel lift-out operation. Arrangement shall allow panels to be opened against air-pressure differential.
 - b. Gasket: Neoprene, applied around entire perimeters of panel frames.
 - c. Size: Large enough to allow inspection and maintenance of air-handling unit's internal components.

3. Access Doors:
 - a. Hinges: A minimum of two hinges or piano hinges and two wedge-lever-type latches sealed to meet design pressure classification for safety purposes, operable from inside and outside. Arrange doors to be opened against air-pressure differential. If opening against pressure is not feasible, discuss with Owner.
 - b. Gasket: Neoprene, applied around entire perimeters of panel frames.
 - c. Fabricate windows in fan section doors of double-glazed, safety glass or plexiglass with an air space between panes and sealed with interior and exterior rubber seals to meet design pressure classification of casing.
4. Locations and Applications:
 - a. Fan Section: Doors with windows and lights.
 - b. Access Section: Doors and lights.
 - c. Coil Section: Inspection and access panel.
 - d. Damper Section: Doors and lights.
 - e. Filter Section: Doors large enough to allow periodic removal and installation of filters.
 - f. Mixing Section: Doors and lights.
 - g. Humidifier Section: Doors with windows and lights.
5. Service Light: 100-W vapor-proof fixture with switched junction box located inside adjacent to door.
 - a. Locations: as noted above.

In addition to the primary condensate removal system, provide auxiliary drain pan with separate drain, separate overflow drain line, or auxiliary drain pan with water-level detection device to the AHUs located above ceilings or sensitive equipment as required by MMC.

D. Condensate Drain Pans:

1. Fabricated with minimum one percent slope 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.
 - a. Length: Extend drain pan downstream from leaving face to comply with ASHRAE 62.1-2004.
 - b. Depth: A minimum of 2 inches deep pitched towards the drain connections.
2. Double-wall, stainless-steel sheet with space between walls filled with foam insulation and moisture-tight seal.
3. Drain Connection: Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on one end of pan.
 - a. Minimum Connection Size: NPS 1 ¼.
4. Units with stacked coils shall have an intermediate drain pan to collect condensate from top coil.

- E. Air-Handling-Unit Mounting Frame: Formed galvanized-steel channel or structural channel supports, designed for low deflection, welded with lifting lugs. Assemble or disassemble to the minimum module size in accordance with shipping or jobsite requirements.

Specify base rail height for project taking into consideration the condensate trap height.

2.3 FAN, DRIVE, AND MOTOR SECTION

LEED-NC Prerequisite EA 2 requires compliance with ASHRAE/IESNA 90.1-2004, in which Section 6.5.3 - "Air System Design and Control" sets requirements for fans and fan controls. If applying for LEED certification, comply with requirements in ASHRAE/IESNA 90.1-2004.

- A. Fan and Drive Assemblies: Statically and dynamically balanced and designed for continuous operation at maximum-rated fan speed and motor horsepower. Fan and motor assembly shall be internally isolated from unit casing with spring isolators.
1. Shafts: Designed for continuous operation at maximum-rated fan speed and motor horsepower, and with field-adjustable alignment.
 - a. Turned, ground, and polished hot-rolled steel with keyway. Ship with a protective coating of lubricating oil.
 - b. Designed to operate at no more than 70 percent of first critical speed at top of fan's speed range.
- B. Centrifugal Fan Housings: Formed- and reinforced-steel panels to form curved scroll housings with shaped cutoff and spun-metal inlet bell.
1. Bracing: Steel angle or channel supports for mounting and supporting fan scroll, wheel, motor, and accessories.
 2. Housing for Supply Fan: Attach housing to fan-section casing with metal-edged flexible duct connector.
 3. Flexible Connector: Factory fabricated with a fabric strip 3-1/2 inches (89 mm) wide attached to 2 strips of 2-3/4-inch- (70-mm-) wide, 0.028-inch- (0.7-mm-) thick, galvanized-steel sheet or 0.032-inch- (0.8-mm-) thick aluminum sheets; select metal compatible with casing.
 - a. Flexible Connector Fabric: Glass fabric, double coated with neoprene. Fabrics, coatings, and adhesives shall comply with UL 181, Class 1.
 - 1) Fabric Minimum Weight: 26 oz./sq. yd. (880 g/sq. m).
 - 2) Fabric Tensile Strength: 480 lbf/inch (84 N/mm) in the warp and 360 lbf/inch (63 N/mm) in the filling.
 - 3) Fabric Service Temperature: Minus 40 to plus 200 deg F (Minus 40 to plus 93 deg C).
- C. Plenum Fan Housings: Steel frame and panel; fabricated without fan scroll and volute housing.

Retain one of first three paragraphs below. Select fan type, size and speed for stable operation and optimum energy efficiency.

Cast-steel hub is common on AMCA 99-2408, Class III fans.

- D. Backward-Inclined, Centrifugal Fan Wheels: Single-width-single-inlet and double-width-double-inlet construction with curved inlet flange, backplate, backward-inclined blades welded or riveted to flange and backplate; cast-iron or cast-steel hub riveted to backplate and fastened to shaft with set screws.
- E. 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; cast-steel hub swaged to backplate and fastened to shaft with set screws.
- F. Airfoil, Centrifugal Fan Wheels: Smooth-curved inlet flange, backplate, and hollow die-formed airfoil-shaped blades continuously welded at tip flange and backplate; cast-iron or cast-steel hub riveted to backplate and fastened to shaft with set screws.
- G. Fan Shaft Bearings:
 - 1. Grease-Lubricated Bearings: Self-aligning with eccentric locking collars and a rated life of L50 at 200,000 hours according to ABMA 11.
- H. Belt Drives: Factory mounted, with adjustable alignment and belt tensioning, and with 1.5 service factor based on fan motor.
 - 1. Fan Pulleys: Cast iron or cast steel dynamically balanced at factory; multiple v-belt style with fixed pitch. Do not use small diameter sheaves (nothing smaller than 4") and notched belts. Approved manufacturers are Browning, Dodge, and Woods.
 - 2. Motor Pulleys: Adjustable pitch for use with 5-hp motors and smaller; fixed pitch for use with motors larger than 5 hp. Select pulley size so pitch adjustment is at the middle of adjustment range at fan design conditions.
 - 3. Belts: Oil resistant, nonsparking, and nonstatic; in matched sets for multiple-belt drives.
 - 4. Belt Guards: Comply with requirements specified by OSHA and fabricate according to SMACNA's "HVAC Duct Construction Standards"; 0.1046-inch- (2.7-mm-) thick, 3/4-inch (20-mm) diamond-mesh wire screen, welded to steel angle frame; prime coated.
- I. Internal Vibration Isolation: Fans shall be factory mounted with manufacturer's standard vibration isolation mounting devices having a minimum static deflection of 1 inch (25 mm).
- J. Motor: Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."
 - 1. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 26 Sections.
 - 2. Unit disconnect to be field mounted.
- K. Variable Frequency Controllers: Comply with requirements specified in Division 26 Section "Variable Frequency Motor Controllers."

2.4 COIL SECTION

LEED-NC Prerequisite EQ 1 requires compliance with ASHRAE 62.1-2004, in which Section 5.12 - "Finned-Tube Coils and Heat Exchangers" sets requirements for coils. If applying for LEED certification, comply with requirements in ASHRAE 62.1-2004.

- A. General Requirements for Coil Section:
 - 1. Comply with ARI 410.
 - 2. 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).
 - 3. Coils shall not act as structural component of unit.
- B. Coils: Comply with requirements specified in Division 23 Section "Air Coils."

2.5 AIR FILTRATION SECTION

LEED-NC Prerequisite EQ 1 requires compliance with ASHRAE 62.1-2004, which requires a MERV rating of 6 or higher.

- A. General Requirements for Air Filtration Section:
 - 1. Comply with NFPA 90A.
 - 2. Provide minimum arrestance according to ASHRAE 52.1, and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.
 - 3. Air filter module: Consist of bag filters, 2 inch thick throwaway prefilters and side access filter rack capable of holding bag filters and prefilters. Provide hinged, gasketed access doors for service from either side.
- B. Filters: Comply with requirements specified in Division 23 Section "Particulate Air Filtration."
- C. Filter Gage:
 - 1. 3-1/2-inch- (90-mm-) diameter, diaphragm-actuated dial in metal case.
 - 2. Vent valves.
 - 3. Black figures on white background.
 - 4. Front recalibration adjustment.
 - 5. 2 percent of full-scale accuracy.
 - 6. Range: 0- to 120% full pressure drop in inch wg.
 - 7. Accessories: Static-pressure tips with integral compression fittings, 1/4-inch (6-mm) aluminum tubing, and 2- or 3-way vent valves.

2.6 DAMPERS

- A. General Requirements for Dampers: Leakage rate, according to AMCA 500, "Laboratory Methods for Testing Dampers for Rating," shall not exceed 2 percent of air quantity at 2000-fpm face velocity through damper and 4-inch wg pressure differential. Provide all necessary mounting hardware, linkage, jackshafts, and supports. Dampers are specified in Division 23 Section "Instrumentation and Control for HVAC."

- B. Damper Operators: Comply with requirements in Division 23 Section "Instrumentation and Control for HVAC." Supplied and mounted by Temperature Controls Contractor.
- C. Outdoor- and Return-Air Dampers: Low-leakage, double-skin, airfoil-blade, galvanized-steel or extruded-aluminum dampers with compressible jamb seals and extruded-vinyl blade edge seals in opposed-blade arrangement (for outside and exhaust air control) or parallel-blade arrangement (for return air control) with cadmium-plated steel operating rods rotating in stainless-steel sleeve or sintered bronze or nylon bearings mounted in a single galvanized-steel or extruded-aluminum frame, and with operating rods connected with a common linkage. Leakage rate shall not exceed 5 cfm/sq. ft. (0.22 L/s per sq. m) at 1-inch wg (250 Pa) and 9 cfm/sq. ft. (0.4 L/s per sq. m) at 4-inch wg (1.0 MPa).
- D. Mixing Section: Multiple-blade, air-mixer assembly located immediately downstream of mixing section.
- E. Combination Filter and Mixing Section:
 - 1. Cabinet support members shall hold 2-inch-thick, pleated, flat, and permanent or throwaway filters.
 - 2. Multiple-blade, air-mixer assembly shall mix air to prevent stratification, located immediately downstream of mixing box.
- F. Humidifiers: Comply with requirements specified in Division 23 Section "Humidifiers."

2.7 SOURCE QUALITY CONTROL

- A. 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.
- B. 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."
- C. Water Coils: Factory tested to 300 psig according to ARI 410 and ASHRAE 33.
- D. Steam Coils: Factory tested to 300 psig and to 200 psig underwater according to ARI 410 and ASHRAE 33.
- E. Refrigerant Coils: Factory tested to 450 psig according to ARI 410 and ASHRAE 33.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

- B. 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.
- C. Examine roughing-in for steam, hydronic, and condensate drainage piping systems and electrical services to verify actual locations of connections before installation.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. **Equipment Mounting:** Install air-handling units on concrete bases without vibration isolation devices. Secure units to anchor bolts installed in concrete bases. Comply with requirements for concrete bases specified in Division 03 Section "Cast-in-Place Concrete." Comply with requirements for vibration isolation devices specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."
- B. Structure steel support frame or concrete pad shall be high enough for an installation of properly sized condensate and steam condensate traps. Minimum concrete pad height is 4".
- C. Arrange installation of units to provide access space around air-handling units for service and maintenance.

LEED-NC Credit EQ 3.1 requires filters with a minimum MERV 13 rating for the air delivered to the occupied space. Air-handling units should not be used for temporary heating and ventilating unless expressly approved by Owner. If used during construction, see SMACNA's "IAQ Guidelines for Occupied Buildings under Construction" for procedures to protect HVAC system.

- D. Do not operate fan system until filters (temporary or permanent) are in place. Provide filters to be used during construction and replace with new, clean filters at acceptance. Provide first replacement set of filters.
- E. Install filter-gage, static-pressure taps upstream and downstream of filters. Mount filter gages on outside of filter housing or filter plenum in accessible position. Provide filter gages on filter banks, installed with separate static-pressure taps upstream and downstream of filters.

3.3 CONNECTIONS

- A. Comply with requirements for piping specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to air-handling unit to allow service and maintenance.
- C. Connect condensate drain pans using NPS 1-1/4, ASTM B 88, Type M copper tubing. Extend to nearest equipment or floor drain. Avoid elbow and tee in drain line. Construct deep trap at connection to drain pan and install cleanouts at changes in direction.
- D. **Hot- and Chilled-Water Piping:** Comply with applicable requirements in Division 23 Section "Hydronic Piping." Install shutoff valve and union or flange at each coil supply connection. Install balancing valve and union or flange at each coil return connection.

- E. Steam and Condensate Piping: Comply with applicable requirements in Division 23 Section "Steam and Condensate Heating Piping." 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. Install vacuum breakers in the top of the steam supply headers, after the automatic control valves.
- F. Refrigerant Piping: Comply with applicable requirements in Division 23 Section "Refrigerant Piping." Install shutoff valve and union or flange at each supply and return connection.
- G. Connect duct to air-handling units with flexible connections. Comply with requirements in Division 23 Section "Air Duct Accessories." External vibration isolators and flexible duct connectors are not required for modular air handling units which have internal vibration isolation.
- H. Chilled water cooling coils: Install as recommended by the manufacturer to permit complete drainage. Properly pitch and trap coils as required to provide positive drainage.
- I. Steam Heating Coils: Provide connections to both ends of coils over 6 feet in length. Properly size condensate traps to ensure proper drainage.

3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Tests and Inspections:
 - 1. Leak Test: After installation, fill water and steam coils with water, and test coils and connections for leaks.
 - 2. Charge refrigerant coils with refrigerant and test for leaks.
 - 3. Fan Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Air-handling unit or components will be considered defective if unit or components do not pass tests and inspections.
- D. Prepare test and inspection reports.

3.5 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Verify that shipping, blocking, and bracing are removed.
3. 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.
4. Verify proper motor rotation direction, free fan wheel rotation, and smooth bearing operations. Reconnect fan drive system, align belts, and install belt guards.
5. Verify that bearings, pulleys, belts, and other moving parts are lubricated with factory-recommended lubricants.
6. Verify that zone dampers fully open and close for each zone.
7. Verify that face-and-bypass dampers provide full face flow.
8. Verify that outdoor- and return-air mixing dampers open and close, and maintain minimum outdoor-air setting.
9. Comb coil fins for parallel orientation.
10. Verify that proper thermal-overload protection is installed for electric coils.
11. Install new, clean filters.
12. Verify that manual and automatic volume control and fire and smoke dampers in connected duct systems are in fully open position.

B. Starting procedures for air-handling units include the following:

1. 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.
2. Measure and record motor electrical values for voltage and amperage.
3. Manually operate dampers from fully closed to fully open position and record fan performance.

3.6 ADJUSTING

- A. Adjust damper linkages for proper damper operation.
- B. Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for air-handling system testing, adjusting, and balancing.

3.7 CLEANING

- A. 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.

3.8 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain air-handling units.

END OF SECTION 237313