SECTION 23 7210

PACKAGED AIR HANDLING ENERGY RECOVERY UNITS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Manufactured custom rooftop energy recovery air handling units

B. Enthalpy energy recovery wheels

1.02 RELATED SECTIONS

A. Section 23 0510 - General Mechanical Requirements

B. Section 23 0513 - Motors for HVAC Equipment

C. Section 23 0514 - Variable Frequency Controllers

D. Section 23 4000 - HVAC Air Cleaning Devices

E. Section 23 0923 - Digital Control Equipment

F. Section 23 0800 - HVAC Commissioning Requirements

G. Section 26 2717 - Equipment Wiring: Electrical characteristics and wiring connections.

1.03 REFERENCES

A. ABMA STD 9 - Load Ratings and Fatigue Life for Ball Bearings; American Bearing Manufacturers Association, Inc.; 1990 (Reapproved 2008).

B. AHRI 1060 I-P - Performance Rating of Air-to-Air Heat Exchangers for Energy Recovery Ventilation Equipment; 2011.

C. ARI 410 - Standard for Forced-Circulation Air-Cooling and Air-Heating Coils; Air Conditioning and Refrigeration Institute; 2001.

D. ARI 430 - Standard for Central-Station Air-Handling Units; Air-Conditioning and Refrigeration Institute; 1999.

E. ARI Guideline D - Application and Installation of Central Station Air-Handling Units; Air-Conditioning and Refrigeration Institute; 1996.

F. ASHRAE Std 52.2 - Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size; 2012.

G. SMACNA (DCS) - HVAC Duct Construction Standards; Sheet Metal and Air Conditioning Contractors' National Association; 2005.

H. NEMA MG 1 - Motors and Generators; National Electrical Manufacturers Association; 1993 (and Revision 1,2,3).

I. NFPA 70 - National Electrical Code; National Fire Protection Association 2020.

1.04 PERFORMANCE REQUIREMENTS

A. Performance shall be certified in accordance with ASHRAE 84-78P and ARI-1060.

B. Wheels shall run dry to the touch at all design conditions with moisture transfer always in a vapor phase.

1.05 SUBMITTALS

A. Product Data:

1. Published Literature: Indicate dimensions, weights, capacities, ratings, fan performance data, gages and finishes of materials, and electrical characteristics and connection requirements.
2. Filters: Data for filter media, filter performance data, filter assembly, and filter frames; Refer to section 234000.
3. Electrical Requirements: Power supply wiring including wiring diagrams for interlock and control wiring, clearly indicating factory-installed and field-installed wiring.

B. Shop Drawings: Indicate assembly, unit dimensions, weight loading, required clearances, construction details, field connection details, and electrical characteristics and connection requirements.

C. Shop Drawings:
   1. Provide shop drawings showing rooftop equipment curb arrangement proposed by the contractor.
   2. If the contractor's proposed equipment results in an arrangement different than that shown, the contractor shall coordinate structural support members beneath unit with the Design Professional.

D. Filter Maintenance Data: Provide an itemized listing providing the filter description, the Air Filter part number and the quantity of filters required. Obtain certified letter from the manufacturer regarding this data and include in O & M manual. The contractor shall provide a tag for each air handling system affixed to the unit adjacent to the filter module with the following information:
   1. Filter identification
   2. Filter quantity
   3. Filter size

E. Certificate: Provide Manufacturer's Certificate in accordance with the General Conditions.

1.06 QUALITY ASSURANCE

A. Products Requiring Electrical Connection: Listed and classified by UL as suitable for the purpose specified and indicated.

1.07 DELIVERY, STORAGE, AND PROTECTION

A. Accept products on site in factory-fabricated protective containers, with factory-installed shipping skids and lifting lugs. Inspect for damage.

B. Store in clean, dry place and protect from weather and construction traffic. Handle carefully to avoid damage to components, enclosures, and finish.

C. Do not operate units until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

1.08 ENVIRONMENTAL REQUIREMENTS

A. Do not operate without filters at any time.

B. Do not operate when building construction activities create a dusty exterior environment.

1.09 WARRANTY

A. See Section 23 0510 - General HVAC Requirements for additional Warranty requirements.

B. Provide 10 year manufacturer's materials and labor warranty for the energy recovery wheels.

1.10 EXTRA MATERIALS

A. Provide one new set and one spare set of disposable panel filters at Material Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Layout basis: Seasons 4.

B. Acceptable Manufacturers:
   1. Airwise
   2. Climatecraft

2.02 GENERAL DESCRIPTION

A. Factory fabricated air handling unit with components scheduled, housed within modules for assembly into a complete energy recovery air handling system. Minimize shipping splits to keep field assembly to a minimum.

B. Maximum Unit Dimensions: Refer to floor plans.

C. Unit Layout: Refer to floor plans for exact location of SA and EA duct connections (out bottom of unit).

D. Configuration: Fabricate with fan modules plus scheduled sections and accessories, including:
   1. Fan sections - supply and exhaust.
   2. Hydronic cooling coil section.
   3. Face and bypass type pre-heat coil section.
   4. Filter sections.
   5. Service Access sections.
   6. Exhaust/Discharge plenum sections.
   7. Intake/Discharge plenum sections.
   8. Intake and exhaust dampers.
   9. Enthalpy wheel module.
   10. Pipe Chase.

E. Unit shall be assembled in a housing and mounted on a full perimeter type factory fabricated roof curb for flashing into the roof structure.

F. Fabrication: Conform to AMCA 99 and ARI 430.

2.03 UNIT HOUSING

A. The unit housing shall consist of structurally formed frame casing sections manufactured of min. 14 ga. galvanized steel or aluminum. The integral frame and panel design shall form flush internal surfaces to minimize pressure losses and to facilitate cleaning. Unit shall sit on a factory roof curb.

B. Unit sections shall be specifically designed for outdoor application with a fully weatherproof cabinet and pitched roof assembly. Provide with intake/exhaust hoods and birdscreen.

C. Roof assembly to overhang all unit walls or base rail to overhang curb to facilitate water runoff and prevent water intrusion into roof curb to base connection.

D. Insulation: Closed cell foam.
   1. Entire unit section to be insulated with (min.) nominal 2" thick injected foam insulation, R-6.75 per inch. The insulation foam material shall be (non VOC) UL 94HF1 rated. All insulation edges shall be encapsulated within the panel.
   2. Minimum 2-inch thick panels.
   3. Provide thermal breaks on casing, mating joints, structural forms, doors and door frames in all sections.

E. All panels shall consist of solid min. 20 ga. galvanized outer and inner wall construction. Exterior panel surface shall be cleaned and factory painted. All panels shall be easily removed from the outside of the unit and self-sealing without the use of caulking material. Casing with solid panels shall be designed for +/- 10" W.G. operating pressure. Leakage rates shall be less than 1% at design static pressure or 8" W.C. whichever is greater.

F. Bottom Inlet/Outlet Units: Provide steel or aluminum walking grate on structural supports to cover opening locations with minimal impact on pressure loss.

G. The units shall be furnished with lifting lugs at the top corners to facilitate rigging.

H. All components shall have provision for access through large 24 inch wide, hinged, tightly sealed access doors. Each door shall be provided with two handles to insure maximum sealing. Doors at fan sections shall have view window. Vapor proof LED service lights shall be provided in each section and wired to a single switch on the exterior of the unit.

I. Finish:
   1. Outdoor Units:
      a. Provide exterior, galvanized steel panels with painted polyester resin surface complying with ASTM B117.
      b. Color: Manufacturer's standard color.

J. Roof Mounting Curb:

1. Mounting frame shall be approved by the National Roofing Contractors Association and shall have curb-to-unit base gasket with air tight fit.
2. Minimum 14 inches high insulated galvanized steel, channel frame with gaskets, nailer strips.

2.04 AUTOMATIC DAMPERS

A. The outside air intake and exhaust air discharge damper assembly shall be constructed of extruded aluminum, hollow core, air foil blades with rubber edge seals and aluminum end seals. Damper blades shall be designed to have no more than 8 CFM of leakage per sq. ft. of damper area when subjected to 4 in. w.g. air pressure differential across the damper.

B. Damper motor shall be spring return to ensure closing of outdoor air damper during periods of unit shut down or power failure.

2.05 FILTERS

A. Pleated Filters (EAPF): 2-inch thick disposable extended area throwaway type and High Efficiency Mini-Pleat (ESHF) 4-inch thick type filters. Cartridges shall be provided to fit the filter frames provided with the air handling unit. Provide blank-off plates to prevent bypassing air around filters. Refer to Section 23 4000.

B. Provide EAPF and ESHF filters for outside air intake and EAPF filters only for exhaust air streams.

C. Filter Gauges: Provide for each filter module.
   1. Manufacturers:
      a. Dwyer Instruments Inc.
      b. H.O. Trerice Co..
      c. Weiss Instruments.
   2. Direct Reading Dial: 3-1/2 inch diameter diaphragm actuated dial in metal case, vent valves, black figures on white background, front recalibration adjustment, 2 percent of full scale accuracy.
   3. Accessories: Static pressure tips with integral compression fittings, 1/4 inch aluminum tubing, 2-way or 3-way vent valves.
   4. Filter Sizes: Minimize filter sizes required per unit (single filter size preferred), maximum two filter sizes per unit.

2.06 FAN ARRAY ASSEMBLY

A. The fan arrays shall consist of two (minimum), direct driven, arrangement plenum fans constructed per AMCA requirements for the duty specified. All fans shall be selected to deliver the specified airflow quantity at the specified operating Total Static Pressure and specified fan/motor speed. Number of fans in array shall be greater or equal to the number scheduled. The array shall be selected to operate at a system Total Static Pressure that does not exceed 60% of the specified fan peak static pressure producing capability at the specified fan/motor speed. Each fan/motor cartridge shall be dynamically balanced to meet AMCA Standard 204-05, category BV-3, to meet or exceed Grade G6.3 residual unbalance. Manufacturer shall provide sound data for the entire fan array system. Fan data for individual fans is not acceptable.

B. The fan array shall consist of multiple fan and motor "cubes" or steel frame with isolated fan assembly, spaced in the air way plenum cross section to provide a uniform air flow and velocity profile across the entire air way plenum cross section and components contained therein. Each fan cube shall be individually wired to a factory installed MCP (motor circuit protector) panel. The control panel will contain individual motor circuit protectors with auxiliary contacts (BAS contacts), pilot light per fan to indicate fan on-off operation. Variable frequency drives shall be furnished by the manufacturer and field installed and wired by the contractor.

C. Each fan/motor “cube” shall be provided with an individual low-leakage back-draft damper in the event of a fan failure, or be provided with a fan blank-off plate. If blank-off plates are utilized, each fan assembly shall be pre-drilled to accept plates. Provide a fan blank-off plate for each air handling unit.

2.07 FANS

A. General: All fans shall meet the airflow performance specified and shall not exceed the motor horsepower specified in the schedule. Fan framing assemblies shall be fabricated from structural steel. Fan assemblies shall be independently isolated with factory spring vibration isolators. Vibration isolators shall be mounted to a structural angle on the fan base assembly. Fans shall be selected for the altitude at which the fan will be located.

B. Type: Plenum type fan(s), backward inclined, or Airfoil as scheduled. Fans shall be constructed of galvanized steel components.

C. Performance Ratings: Determined in accordance with AMCA 210 and labeled with AMCA Certified Rating Seal.

D. Sound Ratings: AMCA 301; tested to AMCA 300 and label with AMCA Certified Sound Rating Seal.

E. All motors shall be standard pedestal mounted type, ODP.

2.08 BEARINGS AND DRIVES

A. Motors: Refer to section 23 0513.

B. Bearings: Heavy duty pillow block type, self-aligning, grease-lubricated ball bearings, with ABMA 9 L-50 life at 100,000 hours.

C. Shafts: Solid, hot rolled steel, ground and polished, with key-way, and protectively coated with lubricating oil.

D. Belt Guard/Inlet Screen: Fabricate to SMACNA HVAC Duct Construction Standards - Metal and Flexible; 0.106 inch thick, 3/4 inch 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.

2.09 MOTORS

A. Motors shall be premium efficiency, IEEE inverter duty rated with appropriate winding insulation to meet NEMA MG 31, part 1 requirements. All motors shall be furnished with integral shaft grounding rings.

B. Motors: Refer to Section 23 0513.

2.10 ENTHALPY WHEEL MODULE

A. Wheel Manufacturers:
   1. Acceptable Manufacturers: Klingenburg USA,Thermotech Enterprises Thermowheel, Seibu Giken Wheel.

B. Performance Requirements:
   1. Performance shall be certified in accordance with ASHRAE 84-1991 and ARI-1060.
   2. Wheels shall run dry to the touch at all design conditions with moisture transfer always in a vapor phase.
   3. Wheel performance and leakage/purge shall be confirmed with manufacturer for project design fan locations and accommodated in fan selections.

C. Wheel Housing:
   1. Structural framework to limit deflection of rotor due to air pressure differentials to less than.031 inch.
   2. Unit casing shall be constructed of not less than 12 gauge steel with side panels removable to provide access to internal parts.
   3. Finish: Baked enamel or epoxy.
   4. Strength: Provide structure to brace casings for suction pressure of 6 inch wg positive and 4 inch wg negative, with maximum deflection of 1 in 200.

D. Enthalpy Wheel Rotor Media:
   1. The media shall transfer both moisture and temperature at equal efficiencies.

2. Media transfer surface shall be coated aluminum and in accordance with NFPA ruling pass UL900 Flame and Smoke Tests.
3. Media shall be honeycombed shaped wheel impregnated with a molecular sieve desiccant providing selective coating of water vapor only. The media shall pass solids up to 800 microns.
4. Wheel shall be true in roundness and flatness to +1/16 inch.
5. Media shall be cleanable with hot water and detergent without degradation.

E. Purge Section:
1. A built-in purge section with adjustable neoprene seals shall limit cross contamination to not exceed 0.04%. Wheel manufacturer to adjust calculations for project fan configuration as indicated on drawings.

F. Rotor Seals:
1. Casing seals shall be neoprene, adjustable, provided on periphery of the wheel, duct dividers, and purge section.

G. Bearings and Drive System:
1. Motor: Refer to Section 23 0513.
2. The rotor shall be driven by a self-adjusting urethane belt.
3. Bearings: Heavy duty pillow block type, self-aligning, grease-lubricated ball bearings, with ABMA 9 L-50 life at 100,000 hours. Bearings shall be located in an accessible location.
4. Shafts: Solid, hot rolled steel, ground and polished, with key-way, and protectively coated with lubricating oil.
5. Sheave: Fixed pitch, cast iron or steel sheaves, dynamically balanced, bored to fit shafts, and keyed. Provide so required rpm is obtained with sheave set at mid-position. Provide drive rated as recommended by manufacturer or minimum 1.5 times nameplate rating of the motor.
6. Provide drive rated as recommended by manufacturer or minimum 1.5 times nameplate rating of the motor.

2.11 SERVICE LIGHTS AND RECEPTACLES

A. Each compartment shall be provided with lighting arranged for safety and servicing of unit.

B. Provide conduit and conductors for lights in accordance with Division 26.

C. Lighting fixtures shall be an enclosed and gasketed, vapor-tight, LED type with glass or acrylic lens and lens guards.

D. Provide a single light switch for each tunnel at an associated access door.

E. Surface mount light switch in type FS box with weather-proof cover.

F. Receptacles: Provide two prewired GFI protected 120v power receptacles. Locate one on each side of air unit, below light switches.

2.12 ELECTRICAL CONTROL CABINET

A. General:
1. All equipment provided with unit shall be electrically-self-contained. All electrical and controls components necessary for proper operation shall be furnished, installed, wired and ready for operation.
2. Equipment shipped loose or removed for shipping shall be noted accordingly on approved installation wiring diagrams shipped with the unit. Wiring connections that must be reconnected at shipping splits shall be noted accordingly on approved installation wiring diagrams shipped with the unit.
3. Incoming power to the unit shall be made at a single point electrical connection in the unit mounted electrical control panel. The control panel shall be the single point power connection for the entire unit.
4. Provide an auxiliary interlock contact for each electrical power disconnect switch.
5. In addition to any internal functionality requirements of the manufacturer, the main system controls shall comply with the sequence of operation as specified.

6. Provide single point power connection for 480V circuit and single point power connection for 120V circuit. Refer to Electrical drawings.
    a. Any deviation from single point power connections shall be coordinated with electrical prior to bid so all additional costs are accommodated.

B. Electrical Raceways and Wiring:
1. All wiring shall be routed in conduit raceway. Exposed wiring is not allowed.
2. Conduit and conduit fittings shall be EMT both inside and outside the unit and be provide with compression fittings. All conduit clamps, hangers, fasteners and hardware shall be galvanized steel.
3. Flexible conduit connections to devices or instruments shall be made using Liquidtight flexible non-metallic conduit and non-metallic fittings. The maximum length shall be 36”.
4. All conduit connections shall be made with watertight hubs through the sides or bottom of boxes and panels. No conduit connections through the top of boxes and panels.
5. All wiring shall be stranded type with 600 volt insulation. The minimum wire sizes shall be as follows: #12 for all power wiring, #14 for field wiring to control devices, #16 for internal cabinet wiring and for all 24 volt control wiring.
6. All wiring shall terminate at a wiring terminal.
7. Provide labeling of terminated wires and terminal blocks with wire number to match wiring diagrams.

C. Unit Mounted Electrical Control Panel:
1. Provide a NEMA 3R UL Listed and Labeled control panel mounted to the unit for main incoming power from the VFD serving each fan with motor circuit protectors, terminal strips for all wiring originating or terminating at the panel.
2. The panel enclosure shall include indicator lights on panel face for each individual fan to indicate if fan is on or off, and auxiliary contacts on each motor circuit protector, wired in series to a single point to allow for interface with the Building Automation System (BAS) to indicate fan status. Enclosures shall be field wired to variable frequency drives serving the supply/exhaust fans.
3. Provide control power transformer of suitable rating to satisfy the appropriate control power voltage requirements. Control circuits shall not exceed 120 volts.

D. Receptacle and Lighting Services:
1. Power for receptacles and lighting shall be provided by separate 120 volt services wired to unit mounted junction boxes and unit mounted switches.

E. Fan Variable Frequency Controllers:
1. Provide Variable Frequency Drive Controllers to start and run fan motors.
2. Drives shall be factory installed and wired.
3. Drives shall meet the equipment and installation requirements of Section 23 0514 - Variable Frequency Controllers.
4. All Variable Frequency Controllers used on project shall be by same manufacturer.

F. Enthalpy Wheel Controls:
1. Control Cabinet
    a. Provide a NEMA 3R enclosure, UL listed, with piano hinged door, grounding lug, terminal strip, and fusible control circuit transformer.
    b. Provide variable frequency controller for the enthalpy wheel.
    c. 'Auto-Off' switch.
    d. Provide frost prevention sensor mounted in the exhaust air stream.
    e. Provide wheel rotation detector with dry auxiliary contactor for tie in to BAS.
2. Variable Speed Wheel Controller.
    a. Provide in accordance with Section 23 0514.
    b. All Variable Frequency Controllers used on project shall be by same manufacturer.

G. Operating Controls:
1. The BAS vendor shall provide all other operating controls for the unit.
2. Sequences: Refer to SECTION 23 0994.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Mount unit on factory built roof mounting curb with spring isolation providing watertight enclosure to protect ductwork and utility services. Install roof mounting curb level.

C. Field installed piping and associated hydronic valves shall be installed in factory pipe chase with full service space of piping appurtenances and associated coils. Installation shall be coordinated to minimize exhaust airstream obstruction.

D. Mount unit on factory built roof curb, providing watertight enclosure to protect ductwork and utility services.

E. Route condensate drain to nearest roof drain; Refer to detail.

F. Mount roof mounting curb level.

G. No variable frequency drives serving fan motors and enthalpy wheel shall be mounted inside the air unit cabinet downstream of any cooling coils.

3.02 STARTING EQUIPMENT AND SYSTEMS

A. Start no equipment or systems until all prefunctional checklists have been completed, signed, and sent to the CxA for approval.

B. Provide manufacturer's field representative to prepare and start equipment.

C. Adjust for proper operation within manufacturer's published tolerances.

D. Demonstrate proper operation of equipment to Owner 's designated representative.

E. Provide start-up certificate as prescribed in the General Conditions.

3.03 ADJUSTING

A. Adjust belts and seals for smooth operation.

3.04 COMMISSIONING TESTS

A. Provide assistance to the Commissioning Authority (CxA) for scheduling and witnessing of testing (2 days).

B. Review the Prefunctional and Functional test procedures to ensure feasibility, safety, and equipment protection.

END OF SECTION