SECTION 237300

AIR HANDLING UNITS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Design, performance criteria, controls, and installation requirements for Custom Air Handling Units.

1.2 REFERENCES

A. AMCA Standard 99: Standards Handbook.

B. AMCA /ANSI Standard 204: Balance Quality and Vibration Levels for Fans.

C. AMCA Standard 210: Laboratory Methods of Testing Fans for Ratings.

D. AMCA Standard 300: Reverberant Room Method for Sound Testing of Fans.

E. AMCA Standard 500: Test Methods for Louvers, Dampers and Shutters.

F. ARI Standard 410: Forced-Circulation Air-Cooling and Air-Heating Coil.

G. ASHRAE Standard 52: Gravimetric and Dust Spot Procedures for Testing Air Cleaning Devices Used in General Ventilation for Removing Particulate Matter.

H. ASHRAE/ANSI Standard 111: Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-Conditioning and Refrigeration Systems.

I. UL Standard 1995: Heating and Cooling Equipment.

J. ASTM A-525: Specification for General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process.

1.3 SUBMITTALS

A. Submit shop drawings and product data in accordance with Division 01.

B. Submittals shall include the following:
   1. Dimensioned plan and elevation view drawings, including motor starter and control cabinets, required clearances, and location of all field connections.
   2. Summary of all auxiliary utility requirements such as: electricity, water, compressed air, etc. Summary shall indicate quality and quantity of each required utility.
   3. Ladder type schematic drawing of the power and ancillary utility field hookup requirements, indicating all items that are furnished.
   4. Manufacturer’s performance of each unit. Selection shall indicate, as a minimum, the following:
      a)Input data used for selection.
      b)Model number of the unit.
      c)Net capacity.
      d)Rated load amp draw.
      e)Noise levels produced by equipment.
      f) Fan curves.
      g)Approximate unit shipping weight.

1.4 OPERATION AND MAINTENANCE DATA

A. Include data on design, inspection and procedures related to preventative maintenance. Operation and Maintenance manuals shall be submitted at the time of unit shipment.

1.5 QUALIFICATIONS

A. The manufacturer shall be a company specializing in the design and manufacture of commercial/ industrial custom HVAC equipment. The manufacturer shall have been in production of custom HVAC equipment for a minimum of 5 years.

B. Each unit shall bear an ETL or UL label under UL Standard 1995 indicating the complete unit is listed as an assembly. ETL or UL listing of individual components, or control panels only, is not acceptable.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect, and handle products to site under the supervision of the owner.

1.7 SEQUENCING AND SCHEDULING

A. Coordinate work performed under this section with work performed under the separate installation contract.

1.8 WARRANTY

A. The complete unit shall be covered by a parts warranty issued by the manufacturer covering the first year of operation. This warranty period shall start upon receipt of start-up forms for the unit or eighteen months after the date of shipment, whichever occurs first.

B. The installation contractor shall provide a labor warranty during the unit’s first year of operation.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Provide custom outdoor air handling units manufactured by Temtrol as the basis-of-design. Equipment manufactured by Webco, Ventrol or Huntair shall be considered provided the construction specifications capacities and performance criteria are met.

2.2 GENERAL

A. Furnish and install where shown on the plans, mechanical frame style air handling units specifically designed for OUTDOOR application with construction features as specified below. The units shall be provided and installed in strict accordance with the specifications. All units shall be complete with all components and accessories as specified. Any exceptions must be clearly defined. The contractor shall be responsible for any additional expenses that may occur due to any exception made.

B. If unit manufacturer cannot provide “sole source” for major components: *(fans, coils, dampers)* they must list supplier and quote lead time for replacement parts on bid. If units are built outside the USA list country of origin on bid.

2.3 FACTORY TESTING AND QUALITY CONTROL

A. Standard Factory Tests: The fans shall be factory run tested to ensure structural integrity and proper RPM. All electrical circuits shall be tested to ensure correct operation before shipment of the unit. Units shall pass quality control and be thoroughly cleaned prior to shipment.

B. Factory Leak Testing: The unit manufacturer shall provide a witnessed factory leak test on one selected unit or obtain written approval from engineer prior to bid time for acceptance of prior satisfactory testing history. The cabinet shall be tested at the unit's design operating 8" static pressure for both the high- and low-pressure sides. Cabinet leakage shall not exceed a Leakage Class rating as defined by ANSI/ASHRAE Standard 111. All supply and return air openings shall be sealed. The air shall then be pumped into the unit until the appropriate operating pressures are achieved. Air flow measurements shall be performed in compliance with AMCA Standard 210. The testing shall be performed at the factory. The manufacturer shall notify contractor and/or owner 10 days prior to test for witnessing. (Travel expenses are not part of this contract). A written test report shall be prepared by the manufacturer and issued to the Owner's representative.

C. Factory Panel Deflection Testing: The unit manufacturer shall provide a factory deflection test on one unit at design 8" total static pressure or obtain written approval from engineer prior to bid time for acceptance of prior satisfactory testing history. A deflection limit of L/200 will be demonstrated at this time. "L" is defined as the height of panel on the side of the unit. Measurements shall be at mid-point of "L" along the vertical seam of the largest panel on one side.

Height of panel = H x (.005) = inches deflection allowed

The manufacturer shall notify contractor and/or owner 10 days prior to test for witnessing. (Travel expenses are not part of this contract). A written test report shall be prepared by the manufacturer and issued to the Owner's representative.

D. Factory Sound Testing: The equipment manufacturer shall furnish calculations showing the estimated sound power levels at the supply and return connections for each air conditioning unit. Calculations shall be based on fan sound power levels which were determined in accordance with AMCA Standard 300 and 301. Sound power levels shall be determined for each octave band:

2.4 UNIT CONSTRUCTION DESCRIPTION

A. General: Provide factory-fabricated air handling units with capacity as indicated on the schedule. Units shall have overall dimensions as indicated and fit into the space available with adequate clearance for service as determined by the Engineer. Units shall be completely assembled. Multiple sectioned units shall be shipped as a single factory assembled piece (except where shipping limitations prevent) de-mounted into modular sections in the field by the contractor. Units shall be furnished with sufficient gasket and bolts for reassembly in the field by the contractor. Unit manufacturer shall provide certified ratings conforming to the latest edition of AMCA 210, 310, 500 and ARI 410. All electrical components and assemblies shall comply with NEMA standards. Unit internal insulation must have a flame spread rating not over 25 and smoke developed rating no higher than 50 complying with NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems." Units shall comply with NFPA 70, "National Electrical Code," as applicable for installation and electrical connections of ancillary electrical components of air handling units. Tags and decals to aid in service or indicate caution areas shall be provided. Electrical wiring diagrams shall be attached to the control panel access doors. Operation and maintenance manuals shall be furnished with each unit. Units shall be UL or ETL listed.

B. Rigging Provision – Multiple Piece Units: Units shipped in multiple sections shall be engineered for field assembly. The base frame shall have integral lifting lugs. The lifting lugs shall be fabricated from structural steel with an appropriate rigging hole. Lifting lugs shall be located at the corner of each section (and along the sides if required) and sized to allow rigging and handling of the unit. All gasket and necessary assembly hardware shall ship loose with unit. Junction boxes with a factory supplied numbered terminal strip shall be supplied at each shipping split for reconnection of control wiring.

C. Unit Base - Floor: Unit perimeter base shall be completely welded and fabricated using heavy gauge structural steel tubing. (Note: bolted bases are not acceptable) C-Channel cross supports shall be welded to perimeter base steel tubing and located on maximum 24" centers to provide support for internal components. Base rails shall include lifting lugs welded to perimeter base at the corner of the unit or each section if de-mounted. The entire base frame is to be painted with a phenolic coating for long term corrosion resistance. The internal walk-on floor shall be .188 aluminum treadplate. The outer sub-floor of the unit shall be made from 20-gauge galvanized steel. The floor cavity shall be spraying foam insulated with floor seams gasketed for thermal break and sealed for airtight / watertight construction. Where access is provided to the unit interior, floor openings shall be covered with walk on phenolic coated steel safety grating. Single wall floors with glued and pined insulation and no sub floor are not acceptable. Base frame shall be attached to the unit at the factory.

D. Unit Casing – The construction of the air handling unit shall consist of a (1" x 2") steel frame with formed 16 gauge galvanized painted exterior casing panels. The exterior casing panels shall be attached to the gasketed (1 x 2) steel frame with corrosion resistant fasteners. All casing panels shall be completely removable from the unit exterior without affecting the unit's structural integrity. (Units without framed type of construction shall be considered, provided the exterior casing panels are made from 14-gauge galvanized steel, maximum panel center lines are less than 20 inches and deflection is less than L/200 @ 9" positive pressure). The air handling unit casing shall be of the "no-through-metal" design. The casing shall incorporate insulating thermal breaks as required so that, when fully assembled, there's no path of continuous unbroken metal to metal conduction from inner to outer surfaces. Provide necessary support to limit casing deflection to L/200 of the narrowest panel dimension. If panels cannot meet this deflection, additional internal reinforcing is required. All panel seams shall be caulked and sealed for an airtight unit. Leakage rates shall be less than 1% at design static pressure or 9" W.C. whichever is greater. The exterior panel finish shall be: Painted with a polyester resin coating designed for long term corrosion resistance meeting or exceeding (ASTM B-117) Salt Spray Resistance at 95 degrees F. 2500 hrs. and (ASTM D-2247) Humidity Resistance at 95 degrees F. 2500 hrs. The color shall be sandstone.

Note: If manufacturer cannot provide thermal break (no through metal) and or removable exterior panel construction it must be noted as an exception on the bid.

E. Double Wall Liner - Each unit shall have double wall construction with 20-gauge solid galvanized liner with polyurethane foam insulation except for the following listed sections which will have 22 gauge perforated galvanized liner with HD faced fiberglass insulation with R12.5; intake plenum, fan sections, discharge plenum. The double wall interior panel shall be removable from the outside of the unit without affecting the structural integrity of the unit.

F. All insulation edges shall be encapsulated within the panel. All field penetrations must be completely sealed by the installation contractor.

Note: Non-UL 94HF1 rated foam is not allowed.

G. Access Doors - The unit shall be equipped with a solid double wall insulated (same as the unit casing), hinged access doors as shown on the plans. The doorframe shall be extruded aluminum, foam filled with a built-in thermal break barrier and full perimeter gasket. The door hinge assembly shall be completely adjustable die cast stainless steel. There shall be a minimum of two heavy duty handles per door. Provide ETL, UL 1995, and CAL-OSHA approved tool operated safety latch on all fan section access doors.
   1. Access doors in the fan sections shall be provided with a 10 x 10 dual thermal pane safety glass window.

      Note: If the manufacturer cannot provide thermal break door design it must be noted as an exception on the bid.

2.5 UNIT COMPONENT DESCRIPTION

A. MUTIPLE DIRECT DRIVE FAN CUBES
   1. The multiple fan array systems shall include multiple, direct driven, arrangement 4 plenum fans constructed per AMCA requirements for the duty specified class III as required. Class I fans are not acceptable. Fans shall be rated in accordance with and certified by AMCA for performance. All fans shall be selected to deliver the specified airflow quantity at the specified operating Total Static Pressure and specified fan/motor speed. The fan array shall be selected to operate at a system Total Static Pressure that does not exceed 90% of the specified fan's peak static pressure producing capability at the specified fan/motor speed. Each fan/motor cube or cell shall include a minimum of 10-gauge, G 90 Galvanized steel intake wall, .100 aluminum spun fan inlet funnel, and a 7-gauge HR steel (painted) motor support plate rail and structure. All motors shall be standard foot mounted type TEAO selected at the specified operating voltage, RPM, and efficiency as specified or as scheduled elsewhere. Motors shall meet the requirements of NEMA MG-1 Part 30 and 31, section 4.4.2. Motors shall be manufactured by Baldor, Siemens, or Toshiba for use in multiple fan arrays that operate at varying synchronous speeds as driven by an approved VFD. Motor HP shall not exceed the scheduled HP as indicated in the AHU equipment schedule(s). Steel cased motors and/or ODP motors are not acceptable. All motors shall include permanently sealed (L10-400,000 hr.) bearings and AEGIS™ shaft grounding to protect the motor bearings from electrical discharge machining due to stray shaft currents. Each fan/motor assembly shall be dynamically balanced to meet AMCA standard 204-96, exceeding category BV-5, to meet or exceed an equivalent Grade G.55, producing a maximum rotational imbalance of .03" per second peak, filter in (.55mm per second peak, filter in). Fan and motor assemblies submitted for approval incorporating larger than 22" wheel size and 215 T frames size motors shall be balanced in three orthogonal planes to demonstrate compliance with the G.55 requirement with a maximum rotational imbalance of .03" per second peak filter in (.55 mm per second peak, filter in). Copies of the certified balancing reports shall be provided with the unit O&M manuals at the time of shipment. Submittals that do not include a statement of compliance with this requirement will be returned to the contractor without review.
   2. The fan array shall consist of multiple fan and motor "cubes" or "cells", spaced in the air way tunnel cross section to provide a uniform air flow and velocity profile across the entire air way tunnel cross section and components contained therein. In order to assure uniform velocity profile in the AHU cross section, the fan cube dimensions must be variable, such that each fan rests in an identically sized cube or cell, and in a spacing that must be such that the submitted array dimensions fill a minimum of 90% of the cross-sectional area of the AHU air way tunnel. There shall be no blank off plates or "spacers" between adjacent fan columns or rows to position the fans across the air way tunnel. The array shall produce a uniform air flow profile and velocity profile within the airway tunnel of the air handling unit to equal the specified cooling coil and/or filter bank face velocity by +/- 10% when measured at a point 36" from the intake side of the fan array intake plenum wall, and at a distance of 72" from the discharge side of the fan array intake

plenum wall. Submittals for units providing less than the scheduled quantity of fans and/or spacing of the fans for multiple fan arrays shall submit CFD modeling of the air flow profile for pre-bid approval that indicates uniform velocity and flow across all internal components without increasing the length of the AHU unit or changing the aspect ratio of the unit casing as designed.

3. Each individual cube or cell in the multiple fan arrays shall be provided with an integral back flow prevention device that prohibits recirculation of air in the event a fan or multiple fans become disabled. The system effects for the back flow prevention device(s) shall be included in the criteria for TSP determination for fan selection purposes and shall be indicated as a separate line-item SP loss in the submittals. Submitted AHU performance that does not indicate allowance for system effects for the back flow prevention device(s) and the system effect for the fan and motor enclosure in which each fan is mounted , will be returned to the contractor disapproved and will need to be resubmitted with all of the requested information included for approval. Back Draft Damper performance data that is per AMCA ducted inlet and discharge arrangements will not be accepted. Damper data must be for the specific purpose of preventing back flow in any disabled fan cube and that is mounted directly at the inlet of each fan. Motorized dampers for this purpose are not acceptable. Submitted fan performance data which only reflect published performance for individual fans in AMCA arrangement “A” free inlet and discharge will not be accepted. AHU Manufacturers that do not manufacture the fans being submitted on must provide certified performance data for fans as installed in the AHU unit with Back Draft damper effects included. At the sole discretion of the engineer, such performance testing may be witnessed by the engineer and/or the owner’s representative.
4. Each fan motor shall be individually wired to a control panel containing a single VFD as the primary VFD and a backup VFD wired in bypass, as specified elsewhere. Each VFD shall be sized for the total connected HP for all fan motors contained in the fan array. Wire sizing shall be determined, and installed, in accordance with applicable NEC standards and local code requirements.
5. At the sole discretion of the engineer, AHU manufacturers that are approved for bidding purposes only, other than the basis of design manufacturer, and that are submitting multiple fan arrays, shall test one or more of the submitted AHUs for flow, pressure, leakage, BHP and acoustics as submitted and approved, prior to shipment. The testing shall be witnessed by the owner’s representative and approved by the engineer prior to shipment of any of the submitted AHU equipment. A test report shall be provided for each tested AHU unit and the report shall be included in the O&M manuals for the units.
6. Each fan & motor assembly shall be removable through a 24” wide, free area, access door located on the discharge side of the fan wall array without removing the fan wheel from the motor. All fan/motor access doors shall open against pressure.
7. All motors in the fan Array shall be provided with individual Motor Protection for thermal overload protection. All motor circuit protectors can be located in starting device enclosure or in a separate enclosure. Motor circuit protector enclosure must be located and mounted at a minimal distance from motors in the fan Array. Provide remote indication by means of aux contacts wired in series and a single cover mounted pilot light for local monitoring. As required by system design, provide a single Yaskawa E7 Variable Frequency Drive to start and run all motors in the FANWALL Array. The Variable Frequency Drive shall be sized accordingly to start and hold all motors in the Fan Wall. Provide service disconnect with fuses or circuit breaker.
8. Each fan assembly shall be equipped with airflow monitoring probes, Huntair Flow-Cone. The flow measuring system shall consist of a flow measuring station with two static pressures taps and two total pressure tubes located at the throat of the fan inlet cone. The flow measuring station shall not obstruct the inlet of the fan and shall have no effect on fan performance (flow or static) or sound power levels. A surface mounted indicator shall provide an output control signal transmitter (4-20mA) (0-10 volt) for use in BAS as specified elsewhere.

B. Heat Transfer Coils – Water Coil
    1. All coil assemblies shall be leak tested underwater at 315 PSIG and PERFORMANCE is to be CERTIFIED under ARI Standard 410. Coils exceeding the range of ARI standard rating conditions shall be noted.
    2. Cooling coils shall be mounted on stainless steel support rack to permit coils to slide out individually from the unit. Provide intermediate drain pans on all stacked cooling coils. The intermediate pan shall drain to the main drain pan through a copper downspout. Water coils shall be constructed of seamless copper tubing mechanically expanded into fin collars. All fins shall be continuous within the coil casing to eliminate carryover inherent with a split fin design. Fins die formed Plate type.
    3. Headers are to be seamless copper with die formed tube holes.
    4. Connections shall be male pipe thread (MPT) Schedule 40 Red Brass with 1/8" vent and drain provided on coil header for coil drainage. All coil connections shall be extended to the exterior of the unit casing by the manufacturer. Coils shall be suitable for 250 PSIG working pressure. Intermediate tube supports shall be supplied on coils over 44" fin length with an additional support every 42" multiple thereafter.
    5. Water coils shall have the following construction:

        5/8" o.d. x .020" wall copper tube with .028 return bends.
        .008" aluminum fins
        16-gauge 304 stainless steel casing

C. Condensate/Drain Pans - IAQ style drain pans shall be provided under all cooling coils as shown on the drawings. The drain pan shall be fabricated from 16-gauge 304 stainless steel. All pans are to be triple pitched for complete drainage with no standing water in the unit. They shall be insulated with a minimum 3-inch "Double Bottom" construction with welded corners. Provide stainless steel, 1-1/4” MPT drain connection extended to the exterior of the unit base rail. Units in excess of 159 inches shall have drain connections on both sides. All drain connections shall be piped and trapped separately for proper drainage.

D. Filters - Provide filters of the type indicated on the schedule. Factory fabricated filter sections shall be of the same construction and finish as the unit. Face loaded pre and final filters shall have Type 8 frames as manufactured by BLC, FARR or equal. Filter racks over 72" in length shall require an angle center reinforcement support. Side service filter racks shall be fabricated from no less than 16-gauge galvanized steel and include hinged access doors on both sides of the unit or as indicated on unit drawings. Internal blank-offs shall be provided by the air unit manufacturer as required to prevent air bypass around the filters.
    1. Filter Gauge: Each Filter bank shall be furnished with a Dwyer Series 2000 filter gauge or equal.
    2. Medium Efficiency MERV 8 Pleated filters – Provide (2” or 4”) filters as specified on filter schedule. The filters shall be manufactured by AAF, FARR or equal. Filters shall be in compliance with ANSI/UL 900 – Test Performance of Air Filters. Provide 2 total sets of media.
    3. High Efficiency MERV 12 filters - Provide filters as specified on the filter schedule. The filters shall be listed as Class II under UL Standard 900. The filters shall be manufactured by AAF, FARR or equal. Filters shall be in compliance with ANSI/UL 900 – Test Performance of Air Filters. Provide 2 total sets of media.

E. Dampers – Temtrol TD-6, Ruskin CD-50 or approved equal. Provide Class 1 rated, ultra-low leak dampers (less than 3 cfm/sq ft. @ 1-inch-w.g.) as indicated on the unit drawings. Low leakage dampers shall have extruded aluminum airfoil blades. Flat or formed metal blades are not acceptable. The damper blade shall incorporate santoprene rubber edge seals and zinc plated or stainless-steel tubular steel shaft for a non-slip operation. Shaft bearings shall be spherical – noncorrosive nylon to eliminate friction and any metal-to-metal contact. Damper jamb seals shall be UV rated, nylon glass reinforced, or stainless-steel spring arcs designed for a minimum air leakage and smooth operation. Damper linkage shall be concealed within a 16-gauge galvanized steel frame. (Operator furnished and installed by controls section.

F. Louvers:
   1. Exhaust Air applications - Provide extruded aluminum stationary louvers, drainable type with built in downspouts and birdscreen. Blades shall be housed inside a 16 ga. galvanized steel frame mounted to the unit exterior. Louver finish to match exterior unit finish.
   2. Outside Air applications - RUSKIN EME6625D extruded aluminum louvers shall be used at O/A location. Louvers shall be stationary, drainable type with built in downspouts and furnished with birdscreen. Blades shall be vertical and housed inside an aluminum frame mounted to the unit exterior. Louver finish to match exterior unit finish.

G. Humidifier – Refer to separate section. Distribution manifolds to be stainless steel and insulated and factory installed. The humidifier capacity shall meet or exceed the capacity specified in the mechanical schedule. The size and number of distribution manifolds shall be sized so all steam is absorbed by the air before reaching the next component in the air stream. Gas fired steam generators to ship loose for field piping to unit manifold.

2.6 ELECTRICAL POWER AND CONTROLS

A. All electrical and automatic control devices not previously called out or listed below are to be furnished and installed in the field by OTHERS.

B. All wiring shall be (75°C) Insulated copper wires.

C. The unit shall feature a mounted permanent nameplate displaying at a minimum the manufacturer, serial number, model number and current and amps voltage. The unit must have an ETL or UL Listing and bear the appropriate mark.

D. Conduit shall consist of a combination of EMT, or flexible metal conduit as required. Liquidtite flexible metal conduit may be used outside the air tunnel for wet locations.

E. The fan motors shall be wired to a junction box mounted on unit exterior.

F. Unit Convenience Features
   1. Each section (specified sections) shall be equipped with a vapor- proof 100-watt service light with guard.
   2. Lights shall be controlled by one light switch mounted adjacent to the supply air fan access door.
   3. Furnish a 120-volt GFI duplex convenience outlet on the exterior of the unit as indicated on the unit drawing.

END OF SECTION