SECTION 23 73 14 - CUSTOM PACKAGED CENTRAL STATION AIR HANDLING UNITS

PART 1 - GENERAL

1.1 DESCRIPTION:

A. This section of the work includes the design, fabrication, testing, cleaning and packaging, shipment and final assembly of custom built-up air handling units by the unit manufacturer in complete accordance with the following specification.

B. The details outlined and component manufacturers named in this specification may not be deviated from in the air handling unit manufacturer's preparation of the bid, even where techniques are required which are not considered standard by the manufacturer. The construction as described in this specification is considered essential, and any deviation from this specification must be specifically identified and bid as a Voluntary Alternate (add or deduct), but only after complying with the specification defined as the Base Bid.

1.2 SUBMITTALS:

A. WITH THE QUOTATION: Provide the following detailed information on the equipment proposed Unit manufacturer shall itemize all deviations from the specified requirements. If not so indicated, unit manufacturer will be required to furnish at no cost to the owner:

1. Information requested in the RFQ, including equipment data sheets, schedules and sketches.

2. Equipment drawings showing dimensions, weights (shipping & operating), configuration, major component locations, access door locations, duct connection sizes and locations, and shipping split locations.

3. Fan manufacturer and performance curves with the operating points clearly indicated. Motor sizes and types.

4. Coil selections with sizes, rows, fin spacing, face velocities, temperatures, flow rates, pressure drops, & connection sizes.

5. Proposed filters indicating size, efficiency, and pressure drop.

6. Materials of construction for housing and major components.

7. Airborne and transmitted sound power levels by octave band.

B. AFTER PURCHASE: Make submittals in accordance with requirements of conditions of purchase. Submittals shall show Buyer's purchase order number, equipment number and project number. Information shall include, as applicable, but not be limited to the following:

1. Information submitted with quotation, revised and expanded as required.

2. If applicable) Electrical data, wiring diagrams, and accessory panel layouts. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.

3. If applicable) Factory testing procedures for review and acceptance.

C. AFTER RECEIPT OF APPROVED DRAWINGS: Submit manuals with detailed description of installation, operation, and maintenance, including the following:

1. All approved "Certified for Construction" drawings.

2. Written recommendations for field storage, both indoors and outdoors.

3. Installation requirements including assembly instructions, lifting requirements and adjustments.

4. Manufacturer's literature describing each piece of equipment furnished including operation instructions including step by step preparation of starting, shutdown, and draining and maintenance instructions including lubrication.

1.3 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data

B. Include instructions for lubrication, filter replacement, motor and drive replacement, spare parts lists, and wiring diagrams.

1.4 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum five years documented experience, who issues complete catalog data on total product.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of Division 01 and Section 230001.

B. Accept products on site in factory-fabricated protective containers, with factory-installed shipping skids. Inspect for damage.

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

D. The entire unit shall be sealed with wrap and have water absorption desicant packs in each section to eliminate moisture during shipping.

1.6 ENVIRONMENTAL REQUIREMENTS

A. Do not operate units for any purpose, temporary or permanent, until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

1.7 EXTRA STOCK

A. Provide one complete set of extra disposable filters per air handling unit.

PART 2 - PRODUCTS

2.1 CUSTOM AIR HANDLING UNITS MANUFACTURERS

A. Manufacturers: Units shall be as manufactured by Trane Custom, Air Enterprises, Energy Labs Inc, TMI, Cambridgeport, and Buffalo.

2.2 CUSTOM AIR HANDLING UNIT

A. Custom built-up units shall be of the configuration, capacity and style as indicated on the drawings and Equipment Schedule and as specified herein. Through properly designed access; ease of maintenance, removability of components, and unit serviceability shall be assured.

B. General:

1. The unit manufacturer shall be responsible for provisions of fans, dampers and all other unit and plenum components as specified in this section or other sections of this division and performance characteristics as shown in schedules or on drawings. The unit manufacturer shall provide all field labor for assembly of enclosure and components.
2. Unit shall be factory-fabricated for shipping and field assembly by experienced manufacturer of large custom air handling units, that maintains engineering and production staff.
   a. Provide proof of credentials of manufacturer's staff as required by Owner and Architect.
3. Shop drawings shall be subject to approval of the Owner and Architect.
4. Certify conformance with performance requirements specified and shown on Drawings.
5. Provide necessary appurtenances to perform as specified, whether or not expressly required by Contract Documents mentioned herein in conformance with good trade practice, as determined by Architect.
6. Seal any casing penetrations made in field for piping, conduit, tubing and equipment installed under other sections. Manufacturer shall supply contractor with details for sealing casing. Manufacturer’s field service representative shall inspect and approve all casing penetrations

C. Testing:

1. Unit manufacturer shall provide (at no cost to owner) factory witness performance test for 4 people which includes contractor, engineer, and (2) owners.

2. Test to ensure structural integrity, design suitability under simulated operating conditions, systems operation and minimum vibration levels as specified. Certify that unit complies with design intent and Contract Documents.
3. Manufacturer shall be responsible for correcting any operating deficiencies found during the unit startup after installation.
4. Prior to shipping the following tests shall be performed:

    a. Pressure test water coils if coil manufacturer has not already performed pressure test, and piping.
    b. Energize electrical devices to ensure operational integrity prior to shipment. Replace non-functioning items.
    c. Submit housing panel acoustical, structural and physical properties performance test data before shipment from independently certified test laboratory.
    d. Performance Test:

        1) Perform a unit performance test in the factory. The performance test shall be done to determine unit flow rate, total static pressure across the fan, external static pressure available to overcome system losses, fan speed and input power to the fans. Filter losses shall be simulated to provide average filter loss [1/2(clean & dirty)]. Test results shall confirm the unit is able to produce the required CFM at the listed external static pressure drop on the drawing schedules. Fan brake horsepower shall not be greater than design power by more than 5 percent
        2) Unit Air Leakage Rate: Perform unit leak pressure test to meet air leakage rates not to exceed the following values at 1½ times the design static pressure (not to exceed 8 in. w.g.) Manufacturer shall be responsible for any corrections required to meet test criteria. Leak test shall be performed before any ductwork is connected. Factory to provide blank off of openings
            a) ½ of 1% of the Design Airflow

5. Provide the following field tests after unit assembly:

    a. Unit operation and vibration analysis. Operate fans at design RPM, set fan drive and conduct complete vibration spectrum as specified. Fan, motor, drive and base assembly, vibration shall be brought to within specified levels. Check motor and drive vibration with fan as a completed assembly. Vibration levels shall be measured in velocity (in/sec peak) in the horizontal, axial and vertical direction on the housing of both fan bearings while tuned to the fan running speed. A second reading based on the overall shall be made as a check on other possible vibration sources other than balance. The following is the acceptance criteria in velocity (in/sec peak):

ISOLATOR SUPPORTS

Direction	Radial	Axial
Filtered	0.16	0.32
Overall	0.40	0.40

D. Unit shall comprise of, but not limited to, sections shown on drawings and the following list:

1. Double wall aluminum outer cabinet. Construction shall employ 'no through metal' design.
2. Outside air intake section with minimum and economizer outside air dampers.
3. Pre-Filter
4. Final Filter
5. Discharge HEPA Filters (Discharge MERV 14 for AHU-148 ONLY)
6. Air Blender
7. Steam preheat coil
8. Chilled water cooling unit
9. Humidifier
10. Supply air fan section.
11. UV Lights at Cooling Coil
12. Discharge Air Plenum
13. Outdoor air and supply air flow stations. Outdoor air flow station transducer shall be by until manufacturer. ATC shall provide supply fan transducers.
14. Smoke Isolation Control dampers

E. Provide safing between internal components and unit casing to prevent air bypass. Safing material shall match unit interior. All seams or voids between safing, components and unit casing shall be caulked and sealed airtight.

F. Unit shall employ aluminum material wherever possible (panels, bases, supports, safing, etc).

2.3 AIR HANDLING UNIT BASE:

A. The unit shall be constructed on an all aluminum structural base. The base shall be designed to distribute loads properly to a suitable mounting surface and be braced to support internal components without sagging, pulsating or oil canning. The base sections for the field fabricated units shall be provided as complete prefabricated sections for field joining.

B. The entire unit base shall be fully welded and guaranteed waterproof; cooling coil condensate shall have a minimum 3" deep sump between structural members to serve as a drain pan to prevent building water damage from the unit. Sump to be 14 GA. stainless steel double-sloped towards units drains to positively remove condensate from the unit.

C. The base floor shall be minimum 3/16" thick aluminum tread plate bonded to the base floor so that there is no thru metal. The base floor shall be designed for a minimum live load of 100 pounds per square foot throughout the unit. The base floor is to be supported with adequate stiffening members to prevent oil canning. Unit base shall be provided with aluminum longitudinal base channels that provide adequate support to limit floor deflection to 1/200th of the span. The floor surface shall not be the source of strength for component and service personnel weight. Floors shall have a 2" turned up lip to form a waterproof surface.

D. The perimeter support members shall be a minimum of 6" welded structural member properly sized to support all major components and the housing during rigging, handling and operation of the unit.

E. The underneath side of the base pan and base perimeter shall be insulated with minimum 2" thick 1.5-pcf high density polyisocyanurate foam insulation covered with a plastic sheet to form a vapor barrier. Vapor barrier material is to be continuous with no seams. Vapor barrier is then protected by a .04" thick aluminum sheet.

F. Each section of the unit base shall contain a minimum 1" NPT drain to facilitate system washdown, maintenance and condensate removal. Areas in the base where potential standing water cannot be removed through drains or weep holes are not acceptable. Clean out drains shall be provided with removable caps of non-corrosive material.

G. All equipment within air handling unit shall be provided with a minimum 2" high base to raise equipment off unit floor for housekeeping. Equipment mounted directly on unit floor is unacceptable.

H. All unit base service openings shall be framed with a minimum 2" high water dam continuously welded to the floor.

I. Fastening to floor plate or joining of unit sections to be accomplished by bolting through gasketed joints above the floor line. Fasteners which penetrate base floor plate are not acceptable.

2.4 AIR HANDLING UNIT CASING:

A. Air handling unit casing shall be built up from the unit base with panels. The unit manufacturer shall be the manufacturer of the panel system. Panels shall be load bearing and capable of forming the enclosure without additional structural members. Panels shall be joined together with independent joining member and fastened with stainless steel fasteners.

B. All panels shall be double wall all aluminum construction with minimum .040" aluminum exterior and .040" solid aluminum interior skin. Interior finish to be smooth mill finish, exterior to be a low reflective textured mill finished. Fan sections shall have acoustical absorptive panels. Acoustical absorptive panels shall not be used within 24" downstream of cooling coil. Each panel shall contain an integral frame or be properly supported by a structural framing system. Panel shall have continuous tight seal at the interior and exterior skins completely encapsulating the insulation.

1. The minimum panel thickness shall be 2" thick with 3-pcf high density polyisocyanurate foam insulation. Core material shall comply with NFPA 90A requirements. Housing insulation shall have a "U" valve greater than 0.07 BTU/Hr/Sq. Ft./ Deg. F.

C. Thickness of the panel skin, core density, rib structural frame spacing shall be regulated to eliminate panel pulsation and restrict the maximum deflection to 1/200 of any span at design load of 1-1/2 times the design positive or negative pressure plus snow and wind loading. Casings shall be built to exceed AMCA Class "C" requirements.

D. Casing system shall be guaranteed to assure the owner that system capacity, performance, and cleanliness standards specified are not compromised. All panel joints shall be sealed with gasket insulation. The gasketing shall be sealed to provide a full thermal and air leak free connection.

E. All casing walls shall be of panel construction, including the fan discharge walls and mixing section walls

F. Panel system shall incorporate an integral thermal break system throughout the unit such that there is no through metal path between the interior and exterior surface of the unit casing at all locations. Criteria to evaluate requirement for thermal break system shall be based upon scheduled unit performance and ambient conditions anticipated around the units. The preferred method for a thermal break shall consist of a minimum ½" structural epoxy bridge.

G. Any equipment flashing, internal partitions or other attachments to the casing shall be made in such a way as to ensure a permanent leak-tight connection. Attachments that are bolted, screwed, or welded to or through the casing creating air bypass, air leakage or rust propagation areas are not acceptable.

H. All ductwork penetrations through unit enclosure shall be provided with framed openings of size indicated on drawing. Openings to be provided with flanged duct connections of same material as casing interior extending a minimum of 4" from surface of unit casing. All piping and conduit penetrations shall be provided with sleeves sealed watertight to unit casing; pipe penetrations through the unit casings shall be by the unit manufacturer and be properly sealed prior to leaving the factory. Penetrations created by cutting through panels, compromising panel integrity, will not be acceptable. Penetrations made in the field shall be made under the supervision of the factory air handling units representative.

I. Provide minimum 24" wide access doors for access to all internal components. Access doors shall be installed to open against the greatest pressure relative to air pressure on each side of access door

1. Access doors shall be of the same construction as panels described above. Corners shall be seal welded for rigidity and air tightness. Mitered and caulked corners are unacceptable.

2. The access doors shall be guaranteed tight closing by the means of two continuous separate gasket seals around the entire periphery of the door or panel set at a beveled 45° angle to assure a true perpendicular, non-shearing compression fit. Gasket material shall be UV-resistant, closed cell neoprene; gaskets shall be attached by adhesive and not be mechanically held in place. Single gasket seals or 90º gasket configurations will not be accepted.
3. Each access door shall contain a thermopane tempered safety glass window (min. 10" square). Window assembly shall have a vacuum between panes to prevent condensation
4. Each access door shall have a built-in static pressure probe port with cap plug for ease of pressure readings across various internal components. Provide minimum 1" dia. test ports with screwed caps on casing upstream and downstream of all coils and filters for pressure and temperature measurement.
5. Each access door shall be mounted with stainless steel fully adjustable hinges, and shall have a least two (2) non-corrosive handles operable from either side. The door handles shall include self-locking nuts and stainless steel hardware to assure a long term proper door operation. Door handle striker plates shall be non-metallic high impact nylon with a notched "center position" to lock the handle in place. No moving parts shall contact the casing materials. Door tie backs shall be provided on all doors.
6. Removable access panels shall be provided as indicated on the drawings for service and maintenance. Access panels shall be of the same construction as panels described above. Removable access panels shall be designed and constructed such that removal and replacement may be accomplished without disturbing adjacent panels. Airtight integrity must be maintained.

2.5 AIR HANDLING UNIT ROOF CONSTRUCTION

A. The roof section shall be 2" thick double wall

B. The exterior skin of the roof shall be .04" thick aluminum, with .040" thick interior skin and internal channel supports

C. 2" injectable foam insulation, with an R-value of 6.2 per inch, shall be used over the entire roof. Insulation shall meet all NFPA 90A requirements

D. All panel seams shall be caulked with sealant.

E. When a unit is split into sections, 2" x 1/4" perimeter companion channel with ridge cap shall be provided.

2.6 MOTORS

A. REFER TO DIVISION 23 SECTION "COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT"

2.7 AIR HANDLING UNIT ELECTRICAL:

A. Provide non-corroding vaportight T-5 fluorescent light fixtures in each AHU compartment suitable for use in wet and damp locations.

1. Lights shall have 120V cold weather ballasts with emergency backup power pack and shall comply with UL Standard #1570 and shall carry the UL label.
2. Wiring shall be #12 copper type THHN in liquid tight conduct. Wire to cast watertight switch boxes with 60 minute timer switch, and trim plate on exterior of casing at each access door. Each timer switch shall energize lights in adjoining section of casing.
3. Conduit and wiring to light fixtures and convenience outlets shall be brought back to a single NEMA 3R junction box at the exterior of the air handling unit for single source power connection. Provide circuiting per NEC (1600 watts max per circuit).
4. Provide two (2) 1 ¼" liquid tight raceways along the entire top length of each unit section. Provide an internal junction box and conduit connection to allow for routing of temperature controls wiring and tubing through air handling unit.

B. Provide duplex 120V, GFI, service outlet (outdoor use) in all accessible sections. Conduit and wiring to outlets shall be brought back to a single junction box (not same as lighting) for single source power connection.

C. Extend motor leads to an external NEMA 1 service fused disconnect switch for each fan.

D. The AHUs shall be wired 100% by manufacturer for connection by electrical contractor with separate main junction boxes for 120v and 460v power feeds for each VFD/fan motor. Electric work shall be in accordance with National Electrical Code and requirements of Section 26000.

2.8 PLUG/PLENUM FANS (SUPPLY AND RETURN)

A. Fan shall be a single width, single inlet backward inclined centrifugal airfoil, direct driven plenum blowers as specified.

B. The fans shall be of bolted and welded construction utilizing corrosion resistant fasteners. The inlet panel shall be constructed from minimum 10-gauge steel with a spun aluminum inlet cone. Bearings shall be supported on a welded assembly constructed of minimum ¼' x 2 ½" steel. The inlet panel and bearing support structure shall be attached to a frame constructed of 2"x2"x ¼: steel tubing with continuously welded joints

C. Wheel shall be aluminum, non-overloading, centrifugal backward inclined, airfoil type. Blades on all sizes shall be continuously welded to the backplate and deep spun inlet shroud. All sizes shall be securely keyed to the fan shaft. Wheel shall overlap an aerodynamic aluminum inlet cone to provide maximum performance and efficiency. Wheel shall be factory balanced in accordance with AMCA standard 204-96, Balance Quality and Vibration Levels for Fans after the fan and motor have been mounted on the factory provided inertia pads.

D. Blower shaft shall be AISI C-1045 hot rolled and accurately turned, ground and polished. Shafting shall be sized for a critical speed of at least 125% of maximum RPM.

E. Provide OSHA screened enclosures for plenum fans

F. Plenum fans shall be as manufacturer by Twin Cities and include Piezometer air flow monitoring stations. Pneumatic lines from air flow stations shall extend through unit casing for use by ATC

G. All fans shall be mounted on spring isolators. The base shall be of sufficient size and thickness for the fan and motor size as scheduled.

H. Bearings are to be heavy duty, grease lubricated, anti-friction ball or roller self aligning, pillow block type and selected for minimum average bearing life (AFBMA L-50) in excess of 200,000 hours at the maximum class RPM. All bearings shall be equipped with re-greasable Zerk fittings. Grease fittings shall be at the fan and not extended to the exterior casing.

I. The unit manufacturer shall provide flexible connection between fan and fan wall. Fan assembly shall be provided with thrust arrestors as required to prevent damage to the flex connection. Flex connection shall be flame retardant fabric suitable for intended use meeting the requirements of NFPA 90A.

2.9 FILTER SECTIONS:

A. Provide all prefilters and final filters of number, size and capacity as required for air handling system indicated on drawings and as stated in these specifications

B. Filters shall have nominal rating of 500 fpm. Each cell shall be 24" x 24", or 12” x 24”. Initial pressure drop shall not exceed that indicated. Filter media efficiency will be tested in accordance with ASHRAE Test Standard 52-76. Filters will be listed by Underwriters Laboratory (UL) as Class 2.

C. Media shall be approved and listed as Underwriters Laboratories Class 2 when tested according to UL Standard 900 and as described below:

1. Filters (MERV 8 Prefilter):

a. Shall be UL Class 2, 2" thick MERV 8 pleated fabric filter for supply filters.
b. Filter shall have welded steel wire grid support
c. Filters shall not unload or collapse under high velocity or static pressure.
d. Efficiency shall be MERV 8 as measured by ASHRAE Test Standard 52-76.
e. Initial pressure drop shall be more than 0.28" at a velocity of 500 fpm. Filters shall be designed to operate at up to 500 fpm for the 2" thick filter.
f. Provide 2 sets of prefilters
g. Filters shall be Farr 30/30 or equivalent by AAF or Aerostar

2. Final Filters: 12” rigid mini V pleat type, 60-65% (per ASHRAE Test Standard 52-76), rigid disposable filters.

a. Filter media shall be of ultra-fine fiberglass formed into a thin paper-like mat with a water repellant binder. Construction shall be dual density, consisting of coarser fibers on the air entering side and finer fibers on the air leaving side, to enhance full depth particle collection. The rigid media pack shall consist of media pleats, structurally bonded one to the other, in order to maximize media area while minimizing pack depth. Corrugated media separators or wire media support grids shall not be required. The eight mini-pleats shall be arranged in a series of four Vs, with an overall filter depth of 12".
b. The media pack shall be contained within the frame of rigid polystyrene plastic or galvanized steel for high wet strength and moisture resistance. The pack shall be bonded inside the double wall frame on all four edges to prevent leakage and increased rigidity.

3. Final HEPA filters (downstream of supply fan section) AHU-146 & 147 only: 12” rigid separator style pleated filter.

a. HEPA filters shall be extended media separator type filters with a minimum efficiency of 99.97% on 0.30 micrometer particles.
b. Filters shall be UL900 Class 2.
c. The separator style filter pack shall be constructed by pleating a continuous sheet of non-woven water resistant fiberglass media around hemmed-edge corrugated aluminum separators.
d. The filter pack shall be sealed into a galvanized frame with a fire retardant sealant

4. Final filters (Downstream of supply fan section) AHU-148 only; 12” rigid mini pleat type MERV 14 rigid disposable filter.

a. Filter media shall be of ultra-fine fiberglass formed into a thin paper-like mat with a water repellant binder. Construction shall be dual density, consisting of coarser fibers on the air entering side and finer fibers on the air leaving side, to enhance full depth particle collection. The rigid media pack shall consist of media pleats, structurally bonded one to the other, in order to maximize media area while minimizing pack depth. Corrugated media separators or wire media support grids shall not be required. The eight mini-pleats shall be arranged in a series of four Vs, with an overall filter depth of 12"
b. The media pack shall be contained within the frame of rigid polystyrene plastic or galvanized steel for high wet strength and moisture resistance. The pack shall be bonded inside the double wall frame on all four edges to prevent leakage and increased rigidity

D. Filters shall be upstream removable.

E. Filter frames shall be aluminum or stainless steel construction with associated clips required to hold filter cells. Pre filter and final filter frames to be provided with closed cell neoprene gasketing.

F. Filter holding frames shall be installed and individually sealed to prevent leakage around frames. Filter banks shall be reinforced with vertical stiffeners to assure rigidity. Unit manufacturer shall provide flashing between filter banks and unit casings to prevent air leakage or bypass around the frames. Installation techniques, sealing methods, and structural reinforcement eliminate unfiltered air bypass and assure system cleanliness based on filter efficiencies specified.

G. For the HEPA filter frames, provide 11 gauge welded filter racks, using swing arm bolts to secure filters.

H. Provide filter gauges for each filter as follows:

1. Dwyer Magnahelic Type 2002 AF dry air filter gauge, with scale of 0 to 2" across filter, with appropriate static pressure tips, vent valves, and tubing with flag suitably marked to indicate need to change filter for prefilters and final filters.

2.10 AIR BLENDER UNITS

A. Acceptable Manufacturers: Blender Products, Inc. -Series IV AIR BLENDER® static mixer

B. Static mixing devices shall be installed where shown on plans to enhance the mixing of outside air with return air to a mixing effectiveness required to eliminate Freeze stat trips, minimize sensor error and enhance outdoor air distribution. Furthermore the air mixing device shall provide even airflow across filters, coils and control sensors.

C. The pressure drop rating for static air mixers shall include the pressure loss due to the mixer design and the mixer-to- plenum area ratio.

D. Detailed documentation of performance testing shall be made available upon request

E. Static air mixers shall be geometrically scaled to ensure consistent performance across full range of sizes offered. Mixers that are not geometrically scaled are not acceptable. Mixers shall be of counter rotational design.

F. Construction: Static air mixers shall be welded and mechanically fastened .080” or .125” thk. Aluminum. Static air mixers shall have Bare finish.

G. Installation: Installation shall be in accordance with the manufacturer’s written installation instructions and SMACNA plenum construction guidelines. If necessary, provide reinforcing in plenum where the Mixing Device Is Installed To Eliminate Excess Vibration or Deflection Of Blank Off Plenum.

2.11 AIR CONTROL DAMPERS

A. Dampers shall be low leakage, opposed blade design capable of withstanding 8” wg differential pressure at 2,000 fpm approach velocity. Leakage rate not to exceed 6 CFM per $ft.^2$ at 4” wg differential pressure and 2,000 fpm approach velocity.

B. Damper frames shall be made of extruded aluminum. Damper blades shall be extruded aluminum airfoil shape to withstand high velocities and static pressures. Leakage not to exceed 8 cfm per square foot through a 36 inch by 36 inch damper at 4" w.g. pressure differential

1. Frames: .080" extruded aluminum. Damper frame is 4 inches deep and is insulated with polystyrofoam. Frame is assembled using type 316 stainless steel screws.
2. Blades: Airfoil shaped extruded aluminum, maximum 48 inches long. Blades shall be insulated with polyurethane foam and thermally broken.
3. Bearings: Celcon inner bearing fixed to a 7/16 inch aluminum hexagon blade pin, rotating with a polycarbonate outer bearing inserted in the frame.
4. Blade Seals: Extruded silicone secured in an integral slot within the aluminum extrusions
5. Damper shall be selected on the basis of the pressure class. Linkage hardware is installed in the frame side. All aluminum linkage hardware parts are clear anodized. All non-aluminum linkage hardware parts are type 316 stainless steel.
6. All dampers shall be provided with jack shafts
7. Control actuators shall be provided by ATC contractor

C. Acceptable dampers: TAMCO Series 9000 thermally insulated series.

2.12 INJECTION TYPE HUMIDIFIER PANELS:

A. Each panel shall consist of a steam supply header/separator, a condensate collection header and a bank of closely spaced steam dispersion tubes spanning the distance between the two headers. Each steam outlet in tubes shall contain a steam orifice sized for its required steam capacity. The humidifier shall provide absorption characteristics that preclude water accumulation on any in-duct surface within 36″ downstream of the humidifier tube panel while maintaining conditions of 90% (maximum) relative humidity at a minimum temperature of 55°F in the duct air stream. Air pressure loss across humidifier panel shall not exceed 0.10″ W.C. at a duct air velocity of 500 FPM. Humidifiers in air handling units shall have assemblies sized to match the unit's cooling coil casing size. Humidifiers shall be Ultra-Sorb by Dri-Steem. Humidifiers shall be purchased locally.

B. Each packaged humidifier panel assembly of tubes and headers shall be contained within a stainless steel metal casing to allow convenient duct mounting or to facilitate the stacking of and/or the end-to-end mounting of multiple panels in ducts or air handler casings.

C. All tubes and headers shall be of 304 stainless steel and joints shall be heli-arc welded. Tubes shall be joined to headers with slip fit couplers.

D. Insulated dispersion tubes. Dispersion tubes shall be insulated with a plenum−approved insulating material for in−duct installation and have an R−value not less than 0.5 at a thickness not more than 0.125" (3.2 mm), for minimal increase in dispersion tube diameter.

1. Airstream heat gain shall not exceed the values as scheduled; the values shall be supported by the manufacturer's published data.

2. Insulating material shall meet the following criteria at 0.125" (3.2 mm) thickness:

   a. Fire/smoke index shall be 0/0 per any of the following test procedures: – UL 723 fire/smoke index (Test for Surface Burning Characteristics of Building Materials) – NFPA 255 (Standard Method of Test of Surface Burning Characteristics of Building Materials) – ASTM E84 (Surface Burning Characteristics for Materials Used in Plenums).
   b. Stable up to 300 °F (148 °C) continuous – to prevent material degradation, hardening, or crumbling at high temperatures
   c. Closed–cell construction does not absorb water or support microbial growth – to negate the need for vapor barriers and jackets
   d. Non–toxic and pure as documented in manufacturer's data – to prevent off–gassing and to facilitate use in clean rooms, pharmaceutical applications, and food industries
   e. Will not degrade when exposed to UVC light – to negate the need for UV wraps
   f. Continuous, seam–welded, and held in place without bands or clamps – to minimize surfaces for the accumulation of particulate matter

2.13 MOTORIZED CONTROL AND SMOKE DAMPERS

A. Dampers shall be UL555S rates as manufactured by Ruskin Inc. or approved equal.

B. Leakage characteristics shall be based upon test procedures per AMCA Standard 500 that shows air leakage at 6 cfm per sq. ft at 4" wg differential pressure. Dampers shall be suitable for 9" w.c. static pressure and 6000 FPM free velocities.

C. Frames and blades to be minimum 12 ga. (.081") extruded aluminum. Blades to be of single unit design.

D. Provide overlapping blades and seals (not just overlap seals) to assure minimum air leakage. Provide extruded silicone seals fit into a ribbed groove insert in blades with a formed stainless steel, spring steel at the jamb.

E. Rod bearings shall be designed so that there shall be no metal-to-metal or metal-to-bearing riding surfaces. Interconnecting linkage to have separate Celcon bearing to eliminate friction in linkage.

F. Blade linkage hardware shall be of non-corrosive reinforced material or cadmium plated steel.

G. All dampers shall be parallel blade type.

2.14 STEAM TUBE IN TUBE PREHEAT COILS

A. Acceptable manufacturers subject to compliance with the specifications shall be as follows:

   1. Aerofin

2. Heat Craft
3. Marlo

B. Fins shall be continuous aluminum configured plate fin type, with full fin collars for accurate spacing and maximum fin tube contact with a maximum fins per inch. as scheduled. Minimum fin thickness shall be 0.010".

C. Tubes shall be copper expanded into fin collars for permanent fin tube bond and expanded into header for leak tight joint at 300 psig air pressure under water. Headers shall be gray cast iron, hydrostatically tested to 400 psi before assembly. All standard coils shall be proof tested at 300 psig and leak tested at 200 psig air under water. Tubing and return bends shall be constructed from UNS 12200 seamless copper conforming to ASTM B75 and ASTM B251 for standard pressure applications. The 5/8″ OD inner steam distributing tubes are centered in the outer 1 1/8″ OD condensing tube. The inner tube has proportionally spaced directional steam jet orifices that direct the condensate flow to the outlet. Coils shall be suitable for 50 psig steam pressure.

D. Casings shall be 16 gauge, continuous coated galvanized steel with fins recessed into channels to minimize air bypass, with 3/8" holes on 3" centers in top and bottom channels for mounting.

2.15 COOLING COILS.

A. Acceptable manufacturers subject to compliance with the specification shall be as follows:

1. Aerofin
2. Heat Craft
3. Marlo
4. Energy Labs
5. Trane

B. Primary surface shall be round seamless 0.025" thick, 5/8” o.d. copper tubes on 1 1/2" centers, staggered in the direction of airflow. All joints shall be brazed. Tube bends shall be 0.035 thick.

C. Secondary surface shall consist of aluminum plate type fins for higher capacity and structural strength. Fins shall have a minimum thickness of 0.0095" with full drawn collars to provide a continuous surface cover over the entire tube for maximum heat transfer with a maximum (10) fins per inch. Bare copper tube shall not be visible between fins. Fins shall have no openings punched in them so as to accumulate lint and dirt. Tubes shall be mechanically expanded into fins to provide a continuous primary to secondary compression bond over the entire finned length for maximum heat transfer rates. Tubes that have been expanded through the use of hydraulic expansion methods will not be acceptable.

D. Casing and tube supports shall be constructed of stainless steel with 3/8" diameter bolt holes for mounting on 8" centers. Casing shall be a minimum of 16 gauge, 304 stainless steel, reinforced flange of a minimum of 1½" deep flange.

E. Coil header shall be of copper materials using seamless copper tubing with intruded tube holes to permit expansion and contraction without creating undue stress or strain. Coil size shall be determined by coil manufacturer based upon the most efficient coil circuiting. Vent connections at the highest point to ensure proper venting and drain connections shall be provided at the lowest point to ensure complete drainage and prevent freeze-up.

F. Coils shall have foam sealing strip located between casing channels and fins along top and bottom to arrest air bypass and water carryover.

G. The complete coil core shall be pressure tested with 315 lbs. air pressure under warm water and shall be suitable for operation at 250 psig working pressure. Individual tube test and core tests before installation of headers will not be considered acceptable. Cooling coils shall be circuited for drainability and for service without removing individual plugs from each tube. Use of internal restrictive devices to obtain turbulent flow will not be acceptable since they prevent complete draining of the coil.

H. The manufacturer shall furnish coil capacities as outlined in the tabulation. Capacities shall be verified with an ARI approved computer selection method.

I. The unit manufacturer shall provide separate drains from pan under each coil section. Drains from multiple, stacked coil pans shall be routed individually to drain outlet, not cascaded from one coil pan to the next lower pan.

J. Cooling coils shall be mounted to allow removal of any coil individually without disturbing any other coils, and shall be bolted off for removal.

K. Drain pans and support members shall be stainless steel. Coil drain pans shall allow for condensate removal 3 inch upstream and 24 inch downstream of all coils.

L. Each individual coil module shall have a limited height of up to 36".

M. Coils shall be fully drainable

2.16 UVC EMITTERS

A. General:

1. Acceptable Manufacturers:

a. Steril-Aire, Inc. Model DE Series as shown on Schedule or Drawings.
b. Substitutions: (10) day prior approval is required and is to include documentation by a recognized Industry Independent Testing Lab on UVC Emitter performances. Performance results must meet or exceed the performance for Emitters in an HVAC environment as detailed in Paragraphs A, 2.b, Paragraph B, Item 2, and Paragraph C, Items 3, 4 and 5.

2. Quality Assurance:

a. Qualifications: Each component and product is to be inbound and outbound tested before shipment under Mil Standard 105E and ANSI/ASQCZ 1.4

b. Output Verification: When tested in accordance with the general provisions of IES Lighting Handbook, 1981 Applications Volume, total output per one inch arc length shall not be less than 10 μW/cm2, at one meter, in a 400 fpm airstream of 45° F

3. Warranty:

a. Fixture and Emitter shall be warranted to be free from defects for a period of one year

B. Design Requirements:

1. Irradiation - Emitters and fixtures are to be installed in sufficient quantity and in such an arrangement so as to provide an equal distribution of UVC energy on the coil and in the drain pan. To maintain energy efficiency, the UVC energy produced shall be of the lowest possible reflected and shadowed losses.
2. Intensity - The minimal UVC energy striking the leading edge of all the coil fins shall not be less than 1400 μW/cm2. This sets the quantity of fixtures to be installed and their placement.
3. Installation - Emitters and fixtures shall be installed downstream of the cooling coil at right angles to the coil fins, such that UVC energy bathes all surfaces of the coil and drain pan

C. Equipment:

1. Units shall be high output, HVAC-type, germicidal UVC light sources, factory assembled and tested. Components shall include a housing, reflector, high efficiency electronic power source, Emitter sockets and boots, and Emitter tube, all constructed to withstand HVAC environments.
2. DE Unit housings shall be made of 304 stainless steel, with DE Units having electrical connectors on both ends to simplify gang wiring and wiring to power. They shall include mounting holes to assist in securing the fixtures.
3. DE reflectors shall be constructed of high spectral finished aluminum alloy with a minimum 85% reflectance of 254-nm UVC energy.
4. High efficiency electronic power sources shall be 115 Vac/60/1. They shall be UL listed to comply with UL Standard 1995 and capable of igniting each Emitter at temperatures from 35 - 170° F in airflow velocities to 1000 fpm. They shall be equipped with RF and line noise suppression.
5. Emitter tube shall be of the high output, hot cathode, T5 (15mm) diameter, and medium bi-pin type. They shall produce 95% of their energy at 254 nm and be capable of producing the specified output at airflow velocities to 1000 fpm at temperatures of 35 - 170° F. UVC Emitters shall produce no ozone or other secondary contamination.

D. Installation of UVC Emitters

1. Emitters shall be installed and wired at the AHU manufacturer using an aluminum framing system provided by Steril-Aire.
2. Provide an interlock switch on the access to the UVC Emitters to turn the lights off when the access is opened.
3. Install provided Caution Labels on all accesses to the Emitters

2.17 OUTSIDE AIR MONITOR

A. The monitor/controller shall be capable of direct measurement of airflow through an outside air inlet and provide an input to the building automation system that is linear to the measured airflow rate.

B. The monitor/controller shall measure inlet airflow with an accuracy of ±0.5% of reading over a range of and within ± 5% for operating ranges as low as 100 fpm.

C. The monitor/controller shall interface with existing building management systems, accepting inputs for fan system start, economizer mode operation, and an external controller setpoint, and provide flow deviation alarm outputs.

D. The sensors shall be constructed of materials that resist corrosion due to the presence of salt or chemicals in the air; all non-painted surfaces shall be constructed of stainless steel. The electronics enclosure shall be NEMA 1.

E. The airflow measurement system shall be tested in accordance with AMCA Standard 610-06, Figure 4 and AMCA Standards 611-06 Certified Ratings program. The airflow measurement system shall bear the AMCA International certified ratings seal for airflow measurement station performance.

2.18 UNIT DISCHARGE SECTION

A. Discharge section with exit velocities exceeding 1500 fpm shall be complete with aerodynamically designed framed discharge openings or spun bellmouth fittings in order to reduce overall system static pressures.

B. Bellmouth fittings shall have minimum radius equal to 20% of the diameter (round or oval) or shortest side (rectangular) to provide optimum performance. Bellmouths with radius less than 2” are not acceptable. Bellmouth to be mounted flush with unit interior edge to minimize exit loss.

C. Openings shall conform to the size and configuration of the ductwork where shown

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of AHUs.

B. Examine roughing-in for AHUs to verify actual locations of piping and duct connections before equipment installation

C. Proceed with installation only after unsatisfactory conditions have been corrected

3.2 CONNECTIONS

A. Install condensate drain, minimum connection size, with trap and indirect connection to nearest roof drain or area drain.

B. Install piping adjacent to RTU's to allow service and maintenance.

C. Duct installation requirements are specified in other Division 15 Sections. Drawings indicate the general arrangement of ducts. The following are specific connection requirements

1. Remove roof decking only as required for passage of ducts.
2. Connect supply ducts to RTUs with flexible duct connectors

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.

B. Perform tests and inspections and prepare test reports

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. Report results in writing.

C. Tests and Inspections:

1. After installing AHUs and after electrical circuitry has been energized, test units for compliance with requirements.
2. Inspect for and remove shipping bolts, blocks, and tie-down straps.
3. 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

D. Remove and replace malfunctioning units and retest as specified above.

3.4 STARTUP SERVICE

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

B. Complete installation and startup checks according to manufacturer's written instructions and do the following:

1. Inspect for visible damage to unit casing.
2. Inspect for visible damage to compressor, coils, and fans.
3. Inspect internal insulation.
4. Verify that labels are clearly visible.
5. Verify that clearances have been provided for servicing.
6. Verify that controls are connected and operable.
7. Verify that filters are installed.
8. Remove packing from vibration isolators.
9. Retain first subparagraph below for barometric relief dampers

10. Verify lubrication on fan and motor bearings.
11. Inspect fan-wheel rotation for movement in correct direction without vibration and binding.
12. Start unit according to manufacturer's written instructions

    a. Complete startup sheets and attach copy with Contractor's startup report.

13. Inspect and record performance of interlocks and protective devices; verify sequences.
14. Operate unit for an initial period as recommended or required by manufacturer.
15. Calibrate thermostats.
16. Adjust and inspect high-temperature limits.
17. Inspect outdoor-air dampers for proper stroke and interlock with return-air dampers.
18. Inspect controls for correct sequencing of heating, dampers, cooling, and normal and emergency shutdown.
19. Measure and record the following minimum and maximum airflows. Plot fan volumes on fan curve

    a. Supply-air volume, return air volume.

20. Verify operation of remote panel including pilot-light operation and failure modes. Inspect the following:

    a. Low-temperature safety operation.
    b. Filter high-pressure differential alarm.
    c. Smoke and firestat alarms.

21. After startup and performance testing and prior to Substantial Completion, replace existing filters with new filters

3.5 CLEANING AND ADJUSTING

A. After completing system installation and testing, adjusting, and balancing AHU and air-distribution systems, clean filter housings and install new filters.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain AHUs. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION