

SECTION 15855

CUSTOM AIR HANDLING UNITS

PART 1 –DESIGN DIRECTIVE

1.1 QUALITY ASSURANCE

- A. NFPA Compliance: Custom air handling units and components shall be designed, fabricated, and installed in compliance with NFPA Standard 90A “Standard for the Installation of Air Conditioning and Ventilating Systems”.
- B. ARI Certification: Custom air handling units and their components shall be factory tested in accordance with the applicable portions of ARI 430 - Standard for Central-Station Air-Handling Units and shall be listed and bear the label of the Air-Conditioning and Refrigeration Institute.

1.2 DELIVERY, STORAGE, AND HANDLING

- A. Lift and support units with the manufacturer's designated lifting or supporting points. Disassemble and reassemble units as required for movement into the final location following manufacturer's written instructions.

1.3 SEQUENCING AND SCHEDULING

- A. Coordinate the size and location of concrete equipment pad.

1.4 EXTRA MATERIALS

- A. Furnish one additional complete set of pre and final filters for each custom air handling (AHU) unit.
- B. Furnish one additional complete set of belts for each custom air handling unit.
- C. Furnish one additional gasket for each sectional joint of each custom air handling unit.
- D. Provide one quart of spare paint for touch-up.

1.5 DESIGN CRITERIA

- A. Designer shall evaluate fan performance at both clean and dirty filter conditions. The AHU schedule shall indicate filter pressure drop change out.
- B. Designer shall coordinate the locations of AHUs with consideration to objectionable noise and access. Units located on other than slab on grade, shall be supported on materials that provide a sound deadening mass. Maximum structural deflection shall not exceed 1/4”.
- C. The space below roof top units shall be solid. Only duct, pipe, and conduit openings are allowed under the unit. Seal all openings with resilient type seal.
- D. When face and bypass dampers are needed, utilize integral type, face and bypass type coils.
- E. When variable airflows are required, use variable frequency drives, not inlet vanes. AHU manufacturers may offer starters and/or VFD’s as an option to the unit. These products may be

specified providing they comply with the requirements stated within this section and coordination between the mechanical and electrical designers takes place.

- F. Specify air blenders wherever the risk of air stratification can occur.
- G. Insure that the steam coil location will allow a minimum vertical drop of 12" from the discharge of the steam coil to the trap inlet. The discharge from the steam trap shall then be pitched away from the trap so it can drain by gravity. Vertical lifts are not allowed.
- H. Coordinate with the plumbing designer so that there is a floor drain in the immediate proximity of the AHU cooling coil. Arrange piping so that it does not create a trip hazard.
- I. All wiring shall conform the current enforced edition of the National Electric code. In addition, all wiring shall be in metallic raceway.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by:
 - 1. Buffalo Forge
 - 2. Conservatherm
 - 3. Temtrol
 - 4. Webco
 - 5. York Custom
 - 6. York Solution
- B. The design has been based on the manufacturer listed in the schedule. Variations in dimensions and connection sizes must be fully coordinated by the contractor with all trades and at no additional cost to the owner.

2.2 GENERAL

- A. AHUs shall be entirely of double wall galvanized steel construction. Galvanizing shall be hot dipped conforming to ASTM A525 and shall provide a minimum of 0.90 oz. of zinc per square foot (G90). Unit exterior shall be finish painted.
- B. The contractor and the AHU manufacturer shall be responsible for insuring that the unit will not exceed the allocated space and weight as shown on the drawings, including required clearances for service and future overhaul or removal of unit components.
- C. AHUs shall be fully assembled by the manufacturer in the factory in accordance with the arrangement shown on the drawings. The unit shall be assembled into the largest sections possible subject to shipping and rigging restrictions. The correct fit of all components and casing sections shall be verified in the factory for all units prior to shipment. Factory tested units shall be fully assembled, tested and then split to accommodate shipment and jobsite rigging. On units not shipped fully assembled, the manufacturer shall tag each section and include air flow direction to facilitate assembly at the jobsite. Lifting lugs or shipping skids shall be provided for each section to allow for field rigging and final placement of unit.
- D. Provide the necessary gasketing, caulking, and all screws, nuts, and bolts required for assembly. Clear instructions on how to assemble the unit shall be provided.
- E. All door and panel gaskets shall be high quality which seal air tight and retain their structural integrity and sealing capability after repeated assembly and disassembly of bolted panels and

opening and closing of hinged components. Bolted sections may use a more permanent gasketing method provided they are not disassembled.

- F. Provide structural reinforcement when required by span or loading so that the deflection of the assembled structure shall not exceed $L/200$ of the span when the unit is operating at a minimum differential static pressure of 8" water gauge. In addition to all mechanical dead loads, exterior units shall be designed to a minimum of a simultaneous 50 psf roof live load and 20 psf wind load, or as required by code, whether or not the unit is operating. At the above stated design parameters, the unit air leakage rate shall be $<1\%$ of scheduled air flow @ 8" w.g. pressure.
- G. All piping connections for the unit shall be run to outside the casing from the factory. Grommets and other air seals shall be installed by the factory.

2.3 BASE

- A. Provide a heavy-duty base for supporting all AHU major components. Bases shall be constructed of a minimum 6" high wide-flange steel I-beams, channels, or minimum 3/16" wall tubular steel base members. Welded or bolted cross members shall be provided as required for lateral stability. Contractor shall provide supplemental steel supports as required to obtain proper operation heights for steam coil condensate and return trap.
- B. AHUs shall be completely self supporting for installation on structural steel support frame as appropriate.

2.4 CASING (including wall, floor and roof)

- A. AHU shall be designed and constructed such that removal of any panel shall not affect the structural integrity of the unit. Plug panels may be used to enhance structural stability provided access space is not reduced. Panels shall be removable to allow service access.
- B. Casing shall be double wall galvanized steel, minimum 2" thick, constructed of minimum 16 gauge outer skin and 20 gauge solid inner skin. Provide perforated inner skin in the fan, supply discharge section and the return air sections.
- C. Inner panel of floor shall be 16 gauge, with a 20 gauge insulation protector (below unit).
- D. Provide blank-offs where required to insure no air bypass between sections, through perforated panels or around coils or filters. Blank-offs shall be installed at each component of the AHU unit and also at the internal panels to prevent recirculation of the air through perforated panels. Seal any holes where bypass occurs.
- E. Manufacturer shall provide a written warranty stating the AHU casing shall not condense water on the exterior of the unit at design conditions. Through metal connections between inner and outer panels shall be kept to an absolute minimum. If tubular structural members are used inside of tube shall be insulated equal to casing.
- F. Provide adequate structural base members beneath floor in service access sections to support typical service foot traffic and to prevent damage to unit floor or internal insulation. Unit floors in casing sections which may contain water or condensate shall be watertight with drain pan.
- G. Exterior and interior panels shall be secured to the support channels with stainless steel or zinc-chromate plated screws and gaskets installed around the panel perimeter. Panels shall be completely removable to allow removal of fan, coils, and other internal components for maintenance, repair, or modifications.

- H. Casing construction and finish for outdoor units shall be suitable for exterior installation with no leakage or other weather penetration. Roofs shall be sloped to allow proper draining. Provide a ten year, non-prorated labor and material warranty protecting the owner for water leakage or material rusting.
- I. Provide sealed sleeves or grommets with metal or plastic escutcheons for penetrations through casing for pipes, wiring, and pneumatic tubing; coordinate number and location with electrical and temperature control subcontractors. Coordinate lights, switches, duplex outlets and disconnect switch location and mounting. All field penetrations shall be neatly performed by drilling or saw cutting, cutting by torches is not allowed. Neatly seal all openings airtight. All piping connections shall be outside the casing from the factory.
- J. Exterior of units shall be primed and painted color as directed by Owner/Owner's representative at time of purchase. Submit color chart.

2.5 ACCESS DOORS:

- A. Provide at access sections and at fan sections. Doors shall be a minimum of 2" thick with same double wall construction as the unit casing. Doors shall be gasketed, hinged, and latched to provide an airtight seal. Each door shall include a minimum 9" x 9" double thickness tempered glass window in a gasketed frame. Doors shall swing in where installed in positive pressure sections, out for negative pressure systems.
- B. Hinges shall be manufacturers standard, designed for door size, weight and pressure classifications. Hinges shall hold door completely rigid with minimum 100 pound weight hung on latch side of door.
- C. Latches shall be non-corrosive alloy construction, with interior and exterior operating levers with positive cam action. Doors that do not open against unit operating pressure shall be provided with safety "Ventlock" style latches that allow the door to open approximately three inches and then require approximately 45° further movement of the handle for complete opening. Latch shall be capable of restraining explosive opening of door with a force equal to a minimum of 12" of differential static pressure or 1-1/2 times operating differential pressure, whichever is greater. Latch motion shall not exceed 180° and shall seal and pull the unit snug to the frame.
- D. Gaskets shall be neoprene bulb-type, continuous around door, positioned for direct compression with no sliding action between the door and gasket. Secure with high quality mastic to eliminate possibility of gasket slipping or coming loose.

2.6 INSULATION:

- A. The walls, roof and floor of the AHU shall be insulated. Insulation shall be held securely in position between the inner and outer skin of casing.
- B. Insulation shall completely fill the void of the AHU casing, 1-1/2 pound density for interior units, 3 pound density for exterior units, rigid glass fiber. Alternately, insulation may be 2" thick spray injected foam, minimum R value of 12.5 Btu/hr. Insulation shall meet ASTM 1071 requirements. Secure the insulation to prevent settling or separation.
- C. Materials shall meet NFPA 90A flame spread and smoke generation requirements:

Fire and smoke rating limits:	ASTM E84
Flame Spread:	25
Fuel Contributed:	15
Smoke Developed:	20

2.7 FAN SECTIONS:

- A. Supply fan shall be minimum Class II construction, double width, double inlet centrifugal, air-foil, or backward inclined type. Return fans shall be minimum Class II construction, vertical plenum fan. All fans shall be factory balanced and rated in accordance with AMCA 210.
- B. Provide self-aligning, pillow block, grease type ball-type bearings selected for a B(10) life of not less than 80,000 hours and an L(50) average fatigue life of 400,000 hours per AFBMA Standard 9. Extend bearing grease lines to motor and drive side of fan section. Fan shall be located in air stream to assure proper air flow.
- C. Allowable vibration tolerances for fan shall not exceed a self-excited vibration maximum velocity of 0.20" per second RMS, filter in, when measured with a vibration meter on bearing caps of machine in vertical, horizontal and axial directions or measured at equipment mounting feet if bearings are concealed. After field installation, compliance to this requirement shall be demonstrated with field test.
- D. Fan Motor, Drive and Mounting Assembly:
 1. Provide internally vibration isolated fan, motor and drive, mounted on a common integral bolted or welded structural steel base with adjustable motor slide rail with locking device. Provide flexible duct connections at fan discharge to completely isolate fan assembly.
 2. General requirements: In addition to the requirements of DC-Standards Section, "electrical requirements for mechanical systems", the following features are required:
 - a. Ball bearings with lube lines extended to accessible location.
 - b. Cast iron or steel base with provision for slide adjustment unless direct connected.
 - c. Conduit box with ample room for lead terminal connections.
 - d. Numbered leads of ample length for connection, terminating in the conduit box.
 - e. Permanently stamped nameplate, including motor efficiency.
 - f. Single speed, 1750 RPM.
 - g. Rated for continuous duty in ambient not exceeding 40°C.
 - h. Phase failure detection equal to SSAC WVM Series.
 - i. Size motor for 120% of brake horsepower requirement.
 - j. Motors shall be suitable for use with variable frequency drive.
 - k. Fan drive and belts shall be factory mounted with final alignment and belt adjustment to be made by the Contractor after installation. Unit manufacturer shall provide additional drive(s) if required during balancing, to achieve desired airflow.

2.8 INLET AND DISCHARGE SECTIONS:

- A. Opposed blade dampers shall be of low leak design with metal compressible bronze jamb seals and PVC coated fabric mechanically locked into the blade edge. Blades shall rotate on stainless steel sleeve bearings or bronze bushings. Leakage rate shall not exceed 8 cfm per square foot at 1" W.G. and 12 cfm per square foot at 4" W.G. Damper shall be furnished and mounted in an accessible and easily serviceable location by the air handling unit manufacturer at the factory. Damper operators shall be of same manufacturer as the automatic temperature controls.
- B. Provide aerodynamically designed framed discharge openings or spun bellmouth fittings terminating with the metal liner to minimize pressure loss.

2.9 BLENDERS

- A. Blenders shall be integrated into the overall unit design to maximize the performance of the downstream components. The blenders shall be fixed devices with no moving parts.

2.10 HUMIDIFIER SECTION:

- A. Provide factory fabricated humidifier section of the same construction and finish as the AHU casing including humidifier supports, and hinged double wall access doors.
- B. Provide stainless steel distribution manifold with provision to return condensate to steam trap. Construct with steam nozzles designed to provide even steam distribution over entire length, from 0 to 100% capacity. Provide stainless steel mounting plate for duct attachment and mounting flange for separator attachment.
- C. Subject to compliance with requirements, provide jacketed dry steam humidifiers of one of the following:
 - 1. DRI-STEEM Humidifier Co.
 - 2. Nortec Industries, Inc.

2.11 FILTER SECTION:

- A. Filter section cabinet material and finish shall match the AHU cabinet Section shall have access doors on both sides of the unit. Provide filter holding frames of extruded aluminum suitable for filters as specified. Filter frames shall be provided with neoprene gasketing on the leaving side of the air filter for pressure sealing. Filter frames shall be made of hot dipped galvanized steel and be built as part of the unit.
- B. Manufacturer shall supply magnehelic gauge to read pressure drop across the filter bank for scheduling filter replacement. Gauge shall be recessed into the cabinet to minimize chances for damage during shipment and installation.
- C. Pre-Filters shall be pleated panel type replaceable air filters with holding frames, 2" thick, with UL Class 2 throwaway media material. Filters shall be 30% efficient based on ASHRAE 52-76 test procedures.
- D. Final-Filters components to consist of glass media, crimped aluminum separators, glass packing sealant and fire retardant, 12" thick, and water resistant hard board cell sides. Cells to be UL 900 Class 1 construction. Flanges and gasketing to permit installation in holding frames providing a non-leaking seal. Filters to have an average efficiency rating of 90% as measured by ASHRAE Standard 52-68. Initial resistance not greater than 0.65" of W.G. at 500 feet per minute face velocity.

- E. Manufacturers:
 - 1. American Air Filter
 - 2. Environmental Air Filter Co.
 - 3. Farr Co.

2.12 COILS:

- A. Cooling and heating coils shall be factory tested for rating in accordance with ARI 410-Standard for Forced-Circulation Air-Cooling and Air-Heating Coils. Coils shall be designed for a working pressure of 200 psi and tested at 250 psi under water.
- B. Coils shall be mounted on hot dipped galvanized steel 16 gage casing to assure proper anchoring of coil and future maintenance. If the unit is a 100 % outside air unit, cooling coil casing shall be made of 304 stainless steel. Coils shall be side removable for future replacement through the access doors or removable panels. Each coil shall be removable without disturbing adjacent coil. Cooling coils shall be designed and installed to insure no condensate carry over. Provide factory installed extended supply, return, drain and vent piping connections.
- C. Cooling coils shall have aluminum fins, constructed from flat plate with belled collars for tubes. Fins shall be bonded to tubes by mechanically expanding copper tubes. Steam coils may have maximum fin spacing shall not exceed 12 fins per inch.
- D. Seamless copper tubes, 5/8" OD with 0.035" wall.
- E. Provide double wall insulated 304 stainless steel condensate pans, and intermediate pans on coils over 48" high. All pans shall be tapered in all directions with a single low point and drain connection for full drainage.
- F. Steam coil headers shall be steel, copper or cast iron, with connections for drain valve and air vent and piping connections.
- G. Vertical tube steam coil with integral face and bypass dampers:
 - 1. Each preheat system coil to consist of built-in series of finned heating elements and bypasses with interlocked dampers controlled by damper motor and air-stream thermostat. Dampers shall be arranged to completely enclose and isolate the heating coil passes when temperature rise is not required. While maintaining full steam pressure, each coil shall be capable of maintaining a constant discharge air temperature regardless of variations in entering air temperatures.
 - 2. Proportioning of the air shall be such that the temperature at any point in a plane parallel to the face of the coil three feet downstream from the leaving side shall not vary more than 5°F from the average discharge air stream temperature.
 - 3. Dampers shall be 16 gauge roll-formed cold-rolled steel with baked enamel finish with blade gaskets and edge seals.
 - 4. Casing shall be 14 gauge steel, galvanized and painted, with rigid framework.
 - 5. Finned heating elements shall be fabricated of seamless straight, vertical copper tubes with rectangular aluminum fins spaced not closer than 11 fins per inch. Each tube shall be individually secured to the steam and return headers by brazed joint with provision for individual tube expansion and contraction.
 - 6. Finned elements shall be factory tested at 100 psig steam and 500 lbs. hydrostatic pressure.

7. Volume of air passing through the coil shall not vary more than $\pm 5\%$, regardless of the position of the internal dampers.
8. As manufactured by LJ Wing or approved equal.

2.13 ELECTRICAL AND LIGHTING: (For unit Sections and Service Vestibule).

- A. Vapor-proof lights using cast aluminum base style with glass globe and cast aluminum guard and 60 watt lamp, shall be installed in each section where there is access for maintenance. A switch shall control the lights in each compartment with pilot light mounted outside the respective compartment access door. All wiring shall run in neatly installed electrical conduits and terminate in a junction box for two, 115 volt field connections to the building system. Wiring and equipment specifications shall conform to DC Standards 16, Electrical.
- B. Provide a factory wired convenience GFI duplex outlet next to the light fixture. Outlets shall be on a different circuit than the AHU lighting circuit.
- C. Provide factory penetrations to allow field installation of power to motors. Coordinate with Electrical Specifications and with installation of starters.
- D. Each roof top unit shall be equipped with a single point motor starter panel serving the fan motors. Panel shall include fused disconnects and all required electrical appurtenances.
 1. The panel and all associated components shall be UL listed. All wiring shall conform with the applicable sections of the National Electric Code and the requirements of DC Standards 16.
 2. The single point motor starter panel shall be housed in a NEMA 4 enclosure. The enclosure shall be located on the exterior of the unit near the entry door. Refer to DC Standards, "electrical requirements for mechanical equipment".

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances, housekeeping pads, and other conditions.

3.2 INSTALLATION, GENERAL

- A. Install custom air handling units level and plumb, on structural steel equipment bases or concrete housekeeping pad ~~in accordance with manufacturer's written instructions~~. *Steel sub base or concrete pad shall be level in all directions to within 1/16" and shall as measured with laser instrumentation. Adjust concrete base via non-shrink grout. Structural steel shall be shimmed at the steel connection points, not AHU connection points, to provide a continuously level platform.*
- B. Arrange installation of units to provide access space around air-handling units for service and maintenance. Coordinate with owner to verify proper access.
- C. Install seismic bracing as required in DC standards "SEISMIC RESTRAINTS FOR MECHANICAL SYSTEMS AND EQUIPMENT".
- D. Refer to DC Standards, "BASIC MECHANICAL MATERIALS AND METHODS" for filter installation requirements.

3.3 ADJUSTING, CLEANING, AND PROTECTING

- A. Adjust damper linkages for proper damper operation.
- B. Clean unit cabinet interiors to remove foreign material and construction dirt and dust. Vacuum clean fan wheel, fan cabinet, and coils entering air face. Comb all coil fins so they are straight and parallel.

3.4 MANUFACTURER'S FIELD SERVICE

- A. The contractor shall arrange and pay for a factory-authorized service representative to perform the requirements of this section.
- B. Inspect the field assembly of components and installation of custom air-handling units including piping, ductwork, and electrical connections.
- C. Prepare a written report on findings and recommended corrective actions. Copy of the report shall be left on the site for the contractor to share with the owner.
- D. Demonstrate procedures and schedules related to start-up and shut down, troubleshooting, servicing, preventative maintenance, and how to obtain replacement parts.
- E. Schedule training with at least 7 days' advance notice.

3.5 FIELD TESTING

- A. Provide field test to confirm that fan operates within the allowable vibration tolerances as described in this section. Test must be performed by qualified technicians with a full written report submitted to the engineer.
- B. Provide a field pressure test at 1.5 times the scheduled pressure in all air conveying sections. The maximum allowable leak rate is 2% of the airflow. This will be measured by comparing inlet and outlet airflows. If the leak rate is uncertain, testing will be performed by sealing the unit and pumping in a measured air quantity into the unit under maximum design pressure.
- C. Notify owner and engineer 7 days in advance of testing. Notice shall include a full schedule of tests with test procedures described.

END OF SECTION 15855