SECTION 23 73 24 – CUSTOM FAN WALL AIR HANDLING UNITS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.02 SUMMARY

A. Perform all Work required to provide and install factory assembled, custom-built air handling units, including factory installed fans, dampers, filters, coils, motors and any specialty equipment as indicated by the Contract Documents with supplementary items necessary for proper installation.

B. This Specification applies to all air handling equipment scheduled with over 20,000 cfm capacity and for special applications as scheduled on the Drawings.

1.03 REFERENCE STANDARDS

A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

C. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the following references:

1. AFBMA 9 - Load Ratings and Fatigue Life for Ball Bearings.
2. AFBMA 11 - Load Ratings and Fatigue Life for Roller Bearings.
3. AMCA 99 - Standards Handbook.
4. AMCA 210 - Laboratory Methods of Testing Fans for Rating Purposes.
5. AMCA 300 - Test Code for Sound Rating Air Moving Devices.
6. AMCA 301 - Method of Publishing Sound Ratings for Air Moving Devices.
7. AMCA 500 - Test Methods for Louver, Dampers, and Shutters.
8. ARI 410 - Forced-Circulation Air-Cooling and Air-Heating Coils.
9. ARI 610 - Central System Humidifiers.
10. NEMA MG1 - Motors and Generators.
11. NFPA 70 - National Electrical Code.
12. NFPA 90A - Flame Spread and Smoke Ratings.

13. SMACNA - HVAC Duct Construction Standards - Metal and Flexible.

14. UL 900 - Test Performance of Air Filter Units.

15. ANSI/ASHRAE/IESNA Standard 90.1 – Energy Standard for Buildings Except Low Rise Residential Buildings.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this Section with minimum three (3) years documented experience, who issues complete catalog data on total product.

1.05 SUBMITTALS

A. Product Data Record Documents:

1. Provide literature that indicates dimensions, weights, capacities, ratings, fan performance, gages and finishes of materials, electrical characteristics and connection requirements. Refer to detailed list of submittal data in this Section.

2. Provide data of filter media, filter performance data, filter assembly and filter frames as tested and certified per ASHRAE and NFPA 90 flame spread and smoke rating standards.

3. Provide fan curves with specified operating point clearly plotted, as tested and certified per AMCA standards. Ratings to include system effects. Bare fan ratings will not satisfy this requirement but shall be submitted for comparison purposes. All fan data shall be generated from specified testing. The fan shall compare favorably with the scheduled data listed in the Drawings. Where two fans are operated in parallel, provide Hagen's Line plots on fan curves to prove that fans will not be operating in the unstable region.

4. Submit sound power level data for both fan outlet and casing radiation at rated capacity, as tested and certified per AMCA standards. All fan data shall be generated from specified testing. The fan shall compare favorably with the scheduled data listed in the construction drawings. The selected unit will not exceed the scheduled sound power data.

5. Unit manufacturer shall submit full sound performance data to the Project sound consultant for evaluation. Unit shall be finally configured so as not to exceed sound levels as scheduled on Contract Documents.

6. Provide data on all coils as tested and certified per ARI standards.

7. Submit electrical requirements for power supply wiring including wiring diagrams for interlock and control wiring, clearly indicating factory-installed and field-installed wiring.

8. All materials shall have NFPA 90 rating of 25/50 or better.

9. Base Rail Height Calculations: Provide calculations for required base rail heights to allow for proper condensate trapping per condensate drain details.

B. Operation and Maintenance Data:

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

2. Provide Operating and Maintenance (O&M) Manuals for air handling units. In addition to a full set of manuals with closeout documentation, each unit shall ship with its own manual permanently mounted inside the unit casing fan section in a watertight enclosure.

3. Permanently mount condensate trapping calculation instructions within the unit O&M Manual that illustrates the unit casing at the condensate drain connection.

4. Manufacturer's Instructions: Provide Start-up information and maintenance required prior to Start-up.

1.06 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, protect and handle products to the Project Site under provisions of Division 01 and Division 20.

B. Accept products on site in factory-fabricated protective containers, with factory-installed shipping skids and lifting lugs. 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. Protect openings in casing and seal them with plastic wrap to keep dirt and debris, also protect coils from entry of dirt and debris with pipe caps or plugs.

1.07 EXTRA MATERIALS

A. Provide [one] ~~[two]~~ additional sets of specified filters for each unit, packaged for storage after each unit has been tested and operated for final acceptance by Owner. Tag products to identify associated unit.

1.08 SCHEDULES ON DRAWINGS

A. In general, all capacities of equipment and motor and starter characteristics are shown in schedules on the Drawings. Reference shall be made to the schedules for such information. The capacities shown are minimum capacities. Variations in the capacities of the scheduled equipment supplied under this contract will be permitted only with the written direction of the Owner.

B. Insofar as is possible, all items of the same type (i.e., coils, fans, etc.) shall be by the same manufacturer.

C. Where installation instructions are not included in the Contract Documents, the manufacturer’s instructions shall be followed.

D. Motor and wheel diameters shown on the AHU schedules are the minimum. If a larger wheel diameter or horsepower is required, it shall be so quoted and noted on evaluation forms in this section.

PART 2 - PRODUCTS

2.01 GENERAL

A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

B. Configuration: Fabricate with fan and coil sections plus accessories as indicated on the Drawings, including but not limited to:

1. Preheat coil.
2. Heating coil.
3. Mixing box section.
4. Applicable filter and final filter sections.
5. Cooling coil section.
6. Humidifier section.
7. Motors and variable speed drives.
8. Access doors.
9. Dampers.
10. Silencer sections.

C. Base performance on sea level conditions, unless otherwise scheduled.

D. Fabrication: Conform to AMCA 99 in the absence of direction in this Specification.

E. Performance: Refer to schedule in Drawings.

F. Provide a unit with a total footprint size (length and width) that will not exceed the one shown on the Drawings, including the height of individual unit components.

G. Dual duct units shall have separate hot deck and cold deck fans.

H. Units shall have a draw-through configuration.

2.02 MANUFACTURERS

A. Huntair / Temtrol (Basis of Design)

B. Or accepted substitution.

C. Equipment as supplied by any of the acceptable manufacturers or an approved equivalent shall comply with all provisions of the specification.

2.03 UNIT CASING, FRAME, AND GENERAL CONSTRUCTION

A. Unit Casing:

1. Panels shall be double wall, reinforced construction with sufficient internal bracing to prevent excessive deflection of the panels.
2. Exterior walls minimum 16-gage G-90 galvanized steel.
3. Internal insulation shall be minimum R-value of 12 and fire and fungus proof.
4. Protect all internal insulation with solid galvanized sheet metal inner panels of minimum 18-gage G-90 galvanized steel.
5. All sheet metal joints throughout the air-handling unit and between panelized sections shall be gasketed with closed cell, soft rubber gaskets, fabricated from neoprene, EPDM or other approved material.

6. Where the air unit casing encloses the building columns, provide airtight enclosure. Leakage rate will not exceed that allowed for the unit casing.

7. Maximum deflection at any point on the unit casing shall be limited to 1/200th of the overall panel width or height.

8. Provide a thermal break between exterior panel and frame to ensure an air-tight fit. Configure casing assembly to eliminate all through-metal portions of the unit so that there will be no external condensation.

9. Panel surfaces shall be non-condensing per ASTM D 4230, Measuring Humidity with Cooled Surface Condensation.

B. Drain Pans:

1. Provide IAQ style drain pan under the entire cooling coil section, which is in compliance with ASHRAE Standard 62.

2. Drain pan shall extend minimum 24 inches downstream of the cooling coil section.

3. Construct drain pan of Type 304 stainless steel; minimum 14-gage on 100 percent outside air handling units and minimum 16-gage on recirculating units.

4. Insulate the under side of the entire drain pan with two part sprayed on polyurethane closed cell foam with a minimum of R-14 insulation value. Insulation shall be water impervious rigid type, after curing, and shall occupy all voids and areas between drain pan and outer wall to prevent the occurrence of trapped water, condensation, and microbial growth. Install and seal insulation as is appropriate for the equipment construction.

5. Slope drain pan in all planes to the drain connection to prevent accumulation of standing water. On units over ten (10) feet in width, slope pan to drain on both sides of the unit.

6. Condensate from drain pans shall be piped as indicated on the Drawings. The pipe size shall be 1-inch minimum diameter, insulated as specified for chilled water piping. A trap as required to prevent the escape or entry of air through the drain piping shall be provided as indicated on the Drawings.

7. Provide an insulated intermediate drain pan for all coils above another coil, factory piped to main drain pan. Drain pans shall be sloped and constructed of 16 gage Type 304 stainless steel to match the main drain pan and shall be extended 6 inches from the coil face.

C. Base and Floor:

1. Construct each unit section on a structural base that supports all major components (i.e., fans, coils, etc.). Support with structural steel members.

2. Complete perimeter channel base shall be minimum 6 inches galvanized steel. Select base rail size appropriate to the drain trap depth.

3. Fabricate base of electrically welded structural steel members. Use welding procedures and welders certified for structural steel welding according to AWS D1.1.

4. Base and structural members shall be G120 galvanized steel.

5. Unit floor material thickness is 14-gage, galvanized tread plate insulated with foam insulation equivalent to R-12 or greater. The flooring shall be welded to structural members below. No penetrations through the floor skin shall be acceptable. Welds shall be below the floor and spaced no greater than 6 inches on center.

6. A 20-gage galvanized sheet shall enclose the insulation on the bottom of the unit.

7. All points of contact between the floor, vapor barrier and structure shall be thermally isolated with closed-cell soft rubber or EPDM.

D. Access Doors:

1. Provide access doors to allow access to both sides (upstream and downstream) of filters support frames. Provided air lock access both the (upstream and downstream) of the fan section, and cooling coil section. The air lock must be large enough to allow for the exchange of fan assemblies and components while preventing the infiltration of unconditioned air or the loss of supply air flow to the respective air conditioned spaces.

2. Each fan/motor cube is designed for quick replacement of the fan/motor assembly, and capable of passing through a minimum 30 inch wide, access door located on the discharge side of the fan wall array.

3. Access doors are double wall, insulated the same as wall panels, and the opening framed with thermal break construction.

4. Door size must be at least 18 inches wide and full panel height up to 72-inch tall units. For units above 72 inches tall, provide, 72-inch high doors. For panels over 36 inches wide, provide 36-inch wide doors.

5. Access door construction shall equal or exceed the quality of air handler casing materials as specified herein.

6. Each door has a minimum 8-inch by 6-inch double glazed view window, capable of withstanding the total developed pressure of the unit.

7. Doors are hinged using either heavy-duty adjustable stainless steel butt hinges or a continuous adjustable stainless steel piano hinge, extending along the entire edge of the door, except for a maximum of 2-inches at each end. If butt hinges are used, provide two (2) per door for up to 36-inch high doors and three (3) per door for taller doors. Provide minimum of two (2) latches on doors taller than 18 inches and three (3) latches on doors over 36 inches long. Latches shall be Ventlok 310, heavy-duty latch.

8. All access doors open against positive air pressure, unless they are the outer doors of the air lock entrances or approved by the Owner in writing.

E. Rigging Performance Requirements:

1. Provide units that include lifting lugs and are suitable for rigging without requiring additional support frames or rails.

2. Provide units that may be lifted without permanent deformation to the housing, base or internal components.

3. Indicate physical balance point on unit bases.

2.04 FANS AND RELATED COMPONENTS

A. Fans and Motors:

1. Fan Wall System: The fall wall system shall consist of multiple, direct driven, arrangement 4 plenum fan constructed per AMCA requirements for the duty specified, (Class I, II or III). All fans shall be selected to deliver the specified airflow quantity at the specified operating total static pressure and specified motor speed. The fan wall 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" shall include an 11 gage; A60 galvanized steel motor support plate and structure. The fan intake wall, inlet funnel, and motor support structure shall be powered coated for corrosion resistance. All motors are standard T-frame pedestal mounted type, (TEFC), selected at the specified operating voltage, rpm, and efficiency as specified or as scheduled elsewhere. All motors are to be compatible for inverter duty, and include isolated bearing or shaft grounding. To ease the replacement of the assembled fan/motor, the motor must not to exceed the nominal rating of 10 horsepower.

    a. The fan wall array shall be provided with acoustical silencers to reduce the bare fan noise by a minimum 14 db re 10^-12 watts through the eight octave bands with center frequencies of 125, 250, 500, 1000, 2000, 4000 and 8000 hz when compared to same unit without silencers. The silencers shall not increase fan static pressure, nor shall it increase the airway length of the air handling unit.

    b. Alternate manufacturers must submit acoustical data for review and approval prior to bid indicating the proposed alternate equipment can meet all specified performance requirements. Proposals submitted which indicate a higher connected fan horsepower than specified or scheduled will not be accepted.

2. Multiple Fan/Motor VFD Control: The fan array shall consist of multiple fan and motor "cubes", spaced in the air way tunnel cross section to provide uniform airflow and velocity profile across the entire airway tunnel section and components contained therein. Each fan cube shall be individually wired to a control panel containing power lock-disconnects for individual motor(s) and VFD(s) controlling respective fan motors in the fan array. Each VFD shall be driven by a "master/slave" control scheme and shall be provided with a redundant VFD in the event of a "master" VFD failure. The manufacturer furnishes a spare VFD of the same make and model as the VFD(s) being used to power the array of fans. The VFD(s) and one spare VFD shall be furnished by the AHU manufacturer and shall be protected though a hard wired interlock to allow only one VFD to be energized at a time. Refer to Specification Section 23 05 13 – "Variable Frequency Drives" for requirements. Circuitries for VFD fault /failures, VFD "master" enable, VFD "slave" enable, single fan failure or trip conditions are provided by the manufacturer for connecting with the Owner's building automated system (BAS) for control and monitoring purposes. Connection to the Owner's existing BAS shall be accomplished though hard wire inputs and outputs. Gateway / Interfaces are not allowed. See Fan Array component panel requirements.

3. The fan wall array shall produce a uniform airflow and velocity profile within the airway tunnel of the air handling unit not to exceed the specified cooling coil and filter bank face velocity when measured 12 inches from the intake side of the fan wall array intake plenum wall and at a distance of 48 inches from the discharge side of the fan wall intake plenum wall.

4. Each fan/motor cube is equipped with a metal grating fan outlet guard.

5. Each fan wall array shall also include motor removal rail located on the discharge side of the fan wall array. The rail shall span the full internal width of the unit. A blanked off panel to isolate the inlet side of the fan/motor assembly that is being removed from the fan wall array.

6. Each fan array shall include at least one fan assembly with a complete airflow measuring station to indicate airflow in CFM. The flow measuring system shall consist of a flow measuring station with static pressure taps and total pressure tubes located at the fan inlet cone. The flow measuring station shall provide an analog to digital CFM readout using a 4-20ma or 0-10 volt output control signal for use in the BAS.

7. The manufacturer shall provide a complete spare fan wall fan/motor assembly with each respective air handler.

8. Plug Fan (PF) SWSI Minimum Class II Fans: single width single inlet arrangement 4 as indicated on the Drawings. Fan wheel has a minimum of 12 blades made from extruded aluminum as a hollow airfoil in shape, and welded to the center and wheel side plates. The fan Inlet cone is made from spun aluminum material.

9. Fans shall be both dynamically and statically balanced. Dynamic fan balancing shall be conducted from 16 Hz to 66Hz to identify and eliminate critical speeds to ensure stable operation through the entire operating range of the fan and drive assembly. Fan shaft shall be turned, ground and polished solid steel rated at maximum RPM below critical speed. Fan wheel shall be keyed to the shaft. Fans shall be rated in accordance with AMCA 210 for performance and AMCA 300 for sound.

10. Fan motors are premium efficiency and compatible for inverter duty per Section 20 05 13.

B. Bearings:

1. Antifriction type, either ball or roller, lubricated at the factory and extended lubrication lines where necessary to achieve bearing lubrication or solid silicon nitride (ceramic) bearings.

2. Catalogued type as manufactured by Fafnir, SKF, NTN or Sealmaster; bearings shall be stocked locally.

3. L-10 minimum life of 200,000 hours (direct drive application).

4. Grease fittings for bearings shall be remotely mounted within line of sight of the bearing, where possible. Where line of sight is not feasible, then the fitting shall be mounted with an extended lubrication where it is most easily accessible for service. Stainless steel tubing is used for the remote grease fitting. If the motors are equipped with more efficient solid silicon nitride (ceramic) ball bearings, then lubrication lines are not required.

2.05 COIL SECTION

A. Coil Casing:

1. Coil casing shall comply with requirements for general construction.

2. Coil casing reinforcements shall be furnished so that the unsupported casing length is not over 60 inches. Reinforcements shall be of the same material as coil casing.

3. Coils shall be individually removable by means of a coil rack. The coil support rack shall not be used to provide structural stability for the coil casing. Coil support racks for chilled water coils are to be made of Type 304 stainless steel materials. Coil support racks for hot water coils are to be made of A-36 carbon steel materials. The assembled carbon steel frames are to be coated with hot dipped galvanized material.

4. Coils shall be completely enclosed within the coil casing.

5. All penetrations of the coil casing shall be neatly sealed at the factory using a resilient sealant appropriate for the service temperature.

6. Access doors as specified herein shall be provided for each space between coils, filters, and other components.

B. Steam Coils:

1. All steam coils shall be steam-distributing type non-freeze 1-inch outside diameter seamless copper outer tubes having 0.035-inch minimum wall thickness.

2. Inner tube shall be 5/8 inch outside diameter seamless copper tubes having 0.025-inch minimum wall thickness.

3. Coil shall have 0.008-inch thick aluminum fins suitable for use with steam at a maximum temperature of 400 degrees F and a maximum pressure of 200 psig.

4. Coil headers shall be cast iron or I.P.S. brass or as specified hereinafter for chilled water coils.

5. Coils shall have a maximum of two (2) rows and a maximum of eight (8) fins per inch.

C. Chilled and Hot Water Coils:

1. Water coil capacities, pressure drops and selection procedures shall be certified for the capacity scheduled in accordance with ARI Standard 410-87. Non-certified coils will not be accepted. The cooling coil face velocity shall not exceed 500 FPM. Maximum water pressure drop through coil shall not exceed 20 feet and maximum velocity in tubes shall not exceed 8 feet per second.

2. Chilled Water Coils:

a. Extended surface type meeting all conditions and having the minimum face area and pressure drops scheduled on the Drawings. Same-end supply and return connections unless otherwise indicated.

b. Coils shall be constructed of copper tubes 5/8-inch [1/2-inch] outside diameter with 0.035-inch thick minimum wall thickness and copper fins permanently bonded to the tubes by mechanical expansion.

c. Coils shall have a maximum of eight (8) fins per inch and a maximum of six (6) rows. If additional capacity is necessary, provide an additional coil, with a separate access section between the coils. The coils shall be piped in series, counterflow to the direction of airflow. Copper fins on plate coils shall be 0.006 inch thick.

3. Hot Water Coils:

a. Extended surface type meeting all conditions and having the minimum face area and pressure drops scheduled on the Drawings. Same-end supply and return connections unless otherwise indicated.

b. Coils shall be constructed of copper tubes 5/8-inch outside diameter with 0.035-inch thick minimum wall thickness and aluminum fins permanently bonded to the tubes by mechanical expansion.

c. Coils shall have a maximum of eight (8) fins per inch and a maximum of six (6) rows. If additional capacity is necessary, provide an additional coil with a separate access section between the coils. The coils shall be piped in series, counterflow to the direction of airflow.

4. Coil headers and connections shall be of I.P.S. brass or heavy gage seamless hard drawn copper tubing with penetrations for connection of core tubing by die-formed intrusion process with resulting contact depth between the header wall and core tubing of not less than 0.090 inches. Joints between core tubing and header shall be of recess swage design to allow a large mating area for build up of brazing materials to give increased strength to the joint. Supply and return connection of brass or copper shall be terminated with brass flange connections.

5. Each coil section shall be provided with a Type 304 stainless steel frame/casing, including tube sheets, minimum 16-gage. Frame members shall extend over the ends and edges of the coils and shall be constructed with formed holes for tubes, permitting free expansion and contraction of coil sections while supported by an extended surface of the frame. Intermediate tube support sheets of Type 304 stainless steel shall be provided in all coils having tube lengths in excess of 48 inches. On long coil sections the spacing of coil supports shall not exceed 48 inches. All intermediate supports shall be welded to coil frame members and fabricated with formed tube holes to support the penetrating tubes.

6. Coils shall be leak tested with air pressure under water at 325 psig, and shall be designed for operation at pressures indicated on the Drawings. Maximum working pressure classification is 300 psig. Submit certification of leak test and certification that coils are suitable for testing at pressures of 450 psig at 100 degrees F. Provide stainless steel nameplate on each coil indicating: manufacturer, model number, coil designation, coil medium, coil test pressure, coil maximum operating temperature and pressure.

2.06 FILTER HOUSING

A. Refer to Section 23 40 00 – Filters, and Drawings for additional requirements.

B. Filters shall have a maximum width of 24 inches.

C. Side Access Housings:

1. Fabricate of not less than 16-gage galvanized steel.

2. Housings shall each be equipped with hinged access doors at both ends, provision for receiving filters of any manufacturer without alteration to the housings and extruded aluminum channels capable of receiving both the after filters and 2-inch deep panel type prefilters.

3. Housings shall incorporate a permanent provision for sealing filters against leakage around the entire perimeter of each filter, eliminating the need to purchase replacement filters with factory applied gasket strips.

4. Replaceable woven pile seals shall be an integral component of the downstream flange of each extrusion so that the seals are compressed by the pressure drop across the filters, preventing bypass of unfiltered air.

5. Housings shall not exceed 21 inches in direction of airflow and shall be of all welded construction with factory prepunched standing flanges for ease of attachment to adjacent equipment and/or ductwork.

6. Doors are to be fitted with positive sealing, heavy duty multiple latches and with sponge neoprene gaskets.

D. Unitary front access holding frames shall be fabricated of not less than 16-gage galvanized steel with holes prepunched for convenient assembly into banks. Frames shall be a minimum of 2-5/8 inches deep for maximum structural strength and resistance to racking. All joints in the field-assembled banks of frames shall be thoroughly caulked to prevent bypass of unfiltered air between frames and surrounding ductwork or plenum chambers. Frames shall each be fitted with polyurethane foam gaskets, held in place by long lasting adhesive and with a minimum of four heavy-duty spring type fasteners. Fasteners shall attach to the frames without requiring tools and shall be capable of withstanding 25 pounds of pressure without deflection.

E. Housing for disposable carbon panels shall be of modular design with each module designed to hold four (4) carbon panels and four (4) 1-inch type “C” filters in “V” shape. Each module shall also be designed to accommodate one 4-inch Type “C” filter downstream of the four carbon panels and the four Type “C” filters. Housing shall include all necessary hardware to mount panels and filters.

F. Frames for filters with efficiencies greater than 95 percent shall be constructed of not less than 14-gage stainless steel channel and shall be of all-welded construction, factory fabricated and assembled. Where the size of the filter bank is larger than can be fabricated in a single unit, the manufacturer shall provide modules to minimize the number of field joints.

2.07 DAMPERS

A. Mixing Box Section:

1. Factory built, field mounted, outside air and return air dampers of Type 304 stainless steel and edge seals in stainless steel frame, with stainless steel axles in self-lubricating nylon bearings.

2. Opposed blade arrangement with damper blades positioned across short air opening dimension.

3. Provide removable, full width rack for supporting freeze protection thermostat, with removable end panel to permit rack removal.

B. Damper Leakage:

1. Maximum 4.0 cfm per square foot at 4-inches w.g. differential pressure.

2. Dampers shall be sized for maximum 2000 FPM face velocity.

2.08 VAV DUAL DUCT SECTION

A. Cold and Hot Decks: Arrange the cold and hot decks to provide maximum recovery of fan discharge velocity head and to ensure uniform airflow across the faces of the cooling and heating coils.

1. Balancing Plates: If required provide perforated balancing plates as required to ensure balanced airway resistance between hot and cold air pathways within the unit.

2. Integral Air Passages:

    a. Construct air passages and ducts so as to direct air streams from the heating and cooling coils separately with minimum friction loss as possible within the constraints of the allowable dimensions of the air handling unit's casing.

    b. Insulate partitions common to both hot and cold air passages and seal the partition airtight.

3. Damper Section:

    a. Provide opposed-blade, interlocking dampers of heavy gage steel, pivoted on their longitudinal axes in nylon bearings.

    b. Arrange hot and cold air dampers for opposed action and secure to shafts.

    c. Face areas of damper sets will be in proportion to the indicated zone air quantities.

2.09 AIR HANDLING UNIT SPECIALTIES

A. Steam Grid Humidifiers: Refer to Section 23 84 13. The humidifier section shall be designed and constructed to meet the same criteria as the rest of the air handling unit sections. The humidifier section length shall be as specified on Drawings.

B. Variable Speed Drives (VSD):

1. Refer to Section 23 04 10.

2. Where indicated on Drawings, furnish as a part of the unit assembly, with drive matched to motor without noise or vibration over the entire operating range.

3. All motors with VSDs shall be compatible with VSD and tested at the factory.

4. Drives shall be erected on wall where shown on Drawings with support from floor.

C. Ultra Violet Germicidal Irradiation Systems:

1. Where scheduled on the Drawings, provide factory installed Ultra Violet (UV) Germicidal Irradiation lamps. Lamps shall provide a minimum irradiance of 9 Watts per square foot or 96.54 Joules per square meter at the cooling coil surface and at the coil leaving air temperature scheduled on the Drawings.

2. UV lamps shall be located:

    a. Downstream of cooling coils.

    b. Above condensate drain pans.

    c. Up-stream of final filtration sections.

3. Lamps shall be UL listed for application in air handling systems.

4. Lighting systems shall be vapor proof with electronic ballasts and shall be wired.

5. UV Light fixtures shall be capable of being switched on and off at the respective AHU section access door.

6. Lamps shall be interlocked with access door position limit switches such that they are de-energize when the doors open.

7. Lamps shall be installed on a stainless steel grid in accordance with the manufacturer's installation instructions.

8. Units with view ports from which the lamps can be seen shall be labeled to warn of possible eye damage.

9. Replacement lamps for UV systems shall be standard types which are not proprietary and are available from multiple sources.

2.10 SOUND CHARACTERISTICS

A. Conduct sound tests at the unit manufacturer's test facility under AMCA Guidelines and Conditions.

B. Provide sound power level test procedures and data for each unit under scheduled operating pressures.

C. The air handling unit sound power levels must not exceed the following criteria. Sound power levels scheduled on Drawings shall supercede the values below:

D. [Note to Engineer: The sound power levels provided in the following table must be carefully examined for each unit on each project. This table represents a starting point only for coordination between the acoustics specialist and the unit manufacturer.]

Location	Average	63 HZ	125 HZ	250 HZ	500 HZ	1K HZ	2K HZ	4K HZ	8K HZ
Units from 10,000-15,000 cfm (Where specifically applicable)									
Inlet	84	83	81	81	79	78	77	75	73
Outlet	91	91	84	92	88	86	80	76	72
Casing	71	85	77	77	66	60	54	51	48
Units from 15,001-25,000 cfm (Where specifically applicable)									
Inlet	85	84	86	80	80	81	78	74	67
Outlet	93	94	90	92	92	89	82	79	74
Casing	72	84	81	78	68	62	56	53	48
Units from 25,001-35,000 cfm									
Inlet	87	84	92	87	83	81	78	77	73
Outlet	94	92	95	97	92	87	82	79	74
Casing	73	83	85	78	66	59	54	52	48
Units from 35,001-45,000 cfm									
Inlet	93	94	96	90	89	89	82	76	72
Outlet	95	97	95	96	95	89	82	80	75
Casing	78	92	88	83	73	66	57	53	49
Units from 45,001-55,000 cfm									
Inlet	84	101	97	83	77	75	68	65	64
Outlet	95	98	98	95	94	89	80	76	92
Casing	77	94	90	80	68	60	55	53	49
Units from 55,001-65,000 cfm									
Inlet	89	92	97	88	87	84	77	71	68

Location	Average	63 HZ	125 HZ	250 HZ	500 HZ	1K HZ	2K HZ	4K HZ	8K HZ
Outlet	98	103	103	98	96	92	90	78	74
Casing	78	93	92	81	71	64	59	49	46
Units from 65,001-75,000 cfm									
Inlet	95	100	102	95	93	89	86	83	78
Outlet	95	100	102	95	93	89	86	83	78
Casing	77	96	91	78	66	59	55	53	49
Units from 75,001-larger cfm									
Inlet	87	105	99	85	81	78	70	68	68
Outlet	96	102	103	97	94	90	86	84	79
Casing	79	99	92	79	67	60	55	54	50

2.11 FAN WALL COMPONENT PANEL REQUIREMENTS

A. The AHU component panel shall be designed and constructed to meet the functional intent as follows:

1. Design of the Component Panel General:

a. Compliance with all applicable codes and regulations.

b. DDC or PLC controllers shall not be utilized.

c. Short circuit and over current protection shall be manually reset.

d. All safeties, relays, and field wiring shall be fail-safe.

e. Provide electrical disconnect means for each fan in the fan array.

f. Current sensors shall be split core with LED indicator and field adjustable per fan.

g. Plug in pin relays with status LED shall be provided.

h. Provide “Push to Test” lamp push button.

i. Panduit or equivalent shall be utilized for panel wiring.

j. Termination strips, contactors, relays, current sensors, switches, and any other apparatus shall be labeled in approved manner as deemed by the Owner.

2. Design of the Component Panel VFD:

a. The variable frequency drive LCD displays and H-O-A switch(es) and shall be readily accessible.

b. The variable frequency drive H-O-A switches in the Hand position shall activate all required HVAC apparatus (e.g. outside air damper, isolation damper, etc) The VFD shall start the fan array after apparatus position indications and safeties are in an acceptable state.

c. The variable frequency drive H-O-A switch(es) on the VFD in the Auto position shall start and stop the VFD through the BAS. The VFD shall activate all required HVAC apparatus (e.g. outside air damper, isolation damper, etc) The VFD shall start the fan array after apparatus position indications and safeties are in an acceptable state.

3. Design of the Component Panel Termination Strip:

    a. A termination strip shall be provided for Division 26 life safety field wiring. This termination strip shall have an AHU shutdown, supply smoke, and return smoke input terminals. The life safety shutdown relay shall be wired in series to theses terminals. Division 26 shall supply, install, and wire field devices including installing a jumper wire for any life safety terminals not utilized in the project. An indication light mounted in the component panel door shall display the life safety relay status.

    b. A termination strip shall be provided for Division 25 HVAC safety field wiring. This termination strip shall have a high static pressure and coil freeze protection safety input terminals. The equipment safety shutdown relay shall be wired in series to theses terminals. Division 25 shall supply, install, and wire the high static safety and freeze protection devices to the terminal strip, including installing a jumper wire for any HVAC safety terminals not utilized in the project. An indication light mounted in the component panel door shall display the HVAC safety relay status. High static safety and freeze protection status outputs shall be provided in the component panel for the BAS.

    c. A termination strip shall be provided for Division 25 BAS field control wiring. This termination strip shall have but not limited to a VFD Start/stop input, VFD speed input, VFD speed feedback output, VFD fault output, VFD control apparatus outputs and inputs. Division 25 shall supply, install and wire to the terminal strip the VFD control apparatus outputs and inputs (e.g. damper end switches, actuators and dampers not supplied with the AHU).

    d. Each fan in the fan array shall have a current sensor wired to the BAS field wiring terminal strip. Division 25 shall series all current sensor at the termination strip to create one BAS fan status input or series specific fans as necessary to comply with the sequence of operation.

4. Functional Intent of the Component Panel

    a. The component panel functional intent is manual operation of the fan array which is independent from the building automation system and automated control for the VFD by the building automation system. The component panel shall provide all life safety and HVAC equipment safeties AHU shutdown interlocks wired to termination blocks. The component panel shall be designed using only ladder logic hard wired methods and shall not execute any programmed logic specified in the sequence of operation which cannot be submitted in a ladder wiring diagram. The component panel shall provide all relevant inputs and outputs necessary for the building automation system to execute the specified sequence of operation.

    b. Coordinate component panel design with Division 25. Submit best design for owner approval prior to construction of component panel. Laminate final approved as-built ladder wiring diagram and mount inside component panel door.

2.12 ELECTRICAL PROVISIONS

A. Fan motors shall be factory mounted and wired to an external disconnect switch within sight of the motor access door. Fan motors shall be interlocked with fan access door to shut down fan when door is opened.

B. Disconnect switches and starters shall be mounted independent of the unit to allow for maintenance access and access to AHU components. Locate disconnect switches within close proximity and sight of the electrical component. Interlock fan motor starters with a position limit switch located at the fan section access door. The limit switch shall de-energize the fan motor or other electrical components when the access door is opened.

C. Provide vapor-proof, two-lamp linear fluorescent light fixtures with electronic ballasts, and water proof GFI convenience outlets inside sections before and after coil; before filter, at fan and before silencer compartments. Light fixtures in each air handling unit compartment shall be independently switched. Wire lights and outlets to two external 120V, 20A power connections (one for each service) for connection by Division 26. Fixtures and lamps shall comply with Division 26 requirements.

D. All wiring shall be 600V rated type MTW/THWN #12 stranded copper in EMT or LiquidTite conduit (maximum three feet). All junction boxes shall be UL approved and gasketed. All conduits installed on the floor inside air handling units shall be rigid steel with steel fittings and diecast boxes. All EMT conduit and fittings on unit walls and ceiling shall be steel, watertight type.

E. Provide flexible connection to motor; 36-inch maximum length.

F. Conduit penetrations shall not represent through-metal contact. Penetrations shall be made and sealed before unit factory testing.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

B. All installation shall be in accordance with manufacturer’s published recommendations.

C. Install in conformance with ARI 435.

D. Install factory assembled unit on vibration isolators, where fans are not internally isolated. Refer to Section 20 05 48.

E. Do not operate units for any purpose, temporary or permanent, until ductwork is clean, filters are in place, bearings have been lubricated, and fan has been test run under observation of the Owner's representative(s).

F. Provide the minimum access space sections for maintenance of individual components such as fans, filters, coils, humidifiers, etc., as scheduled or shown on the Drawings. Arrange these components in a manner that allows for ease of replacement. Provide a plenum section downstream of the cooling coil with sufficient width to contain all the moisture carryover from the cooling coils, before it reaches the next air handler component (such as filters, sound attenuators, etc.).

G. Arrange fans and surrounding components in such a way that poor fan performance does not result.

H. It is the manufacturer's responsibility to verify opening dimensions and installation methods to ensure unit sections and components can be physically installed into the designated space.

1. The manufacturer has the responsibility to transport sections to the Project Site and to supervise reassembling the sections together for all air handlers. Unload and hoist the sections onto the designated floor space.

2. Reassemble the sections together for all air handlers in their footprint under the direction of the manufacturer.

3. Additional unit section or component splits required for installation during construction shall be the responsibility of the manufacturer without additional cost to the Owner.

4. Units must be bolted together for reassembly. Drive screw construction at unit splits is unacceptable.

5. All internal coil piping shall be extended to casing walls.

6. The unit manufacturer shall provide a written acceptance letter to MDACC stating the unit was assembled and complies with manufacturer's assembly requirements.

I. Support coil sections independent of piping on steel channel or double angle frames and secure to casings. Provide frames for maximum three coil sections. Arrange supports to avoid piercing drain pains. Provide airtight seal between coil and duct or casing.

J. Protect coils to prevent damage to fins and flanges. Comb out bent fins.

K. Install cleanable tube coils with 1:50 pitch.

L. Make connections to coils with unions and flanges.

M. On water coils, provide shut-off valve on supply line and lockshield balancing valve on return line. Locate water supply at bottom of supply header and return water connection at top. Provide float operated automatic air vents at high points complete with stop valve. Ensure water coils are drainable and provide drain connection at low points.

N. On water heating coils and chilled water-cooling coils, connect water supply to leaving airside of coil (counterflow arrangement).

O. In steam coils, install vacuum breaker in steam line at header. Install steam traps with outlet minimum 12 inches below coil return connection. Install dirt leg in steam supply.

P. Insulate headers located outside airflow as specified for piping. Refer to Section 20 07 19.

Q. Ensure sufficient space between coil sections for installation of control devices.

3.02 TESTING

A. Units with cabinet mounted fans shall be tested and certified at rated conditions using AMCA test procedures with fan mounted in the cabinet. Bare fan data will not be accepted.

B. With unit set in place, leveled and ready to receive ductwork connections, unit shall be tested for casing leakage by sealing all openings and pressurizing to 2 inches w.g. above unit rating or the rating of attached ductwork or a maximum of 12 inches w.g. Maximum allowable leakage rate is 1 percent of design airflow.

C. Test shall be performed by the manufacturer using certified flow measurement devices and shall be witnessed by a representative of the Test and Balance Firm. Demonstrate deflection limit of 1/200th and confirm fan/motor vibration limits. The cost of testing shall be borne by the manufacturer.

D. After assembly, fan and motor shall be given an electronic vibration analysis along with the variable speed drive (if applicable), either at the air handling unit or VSD manufacturer's factory, while operating over the entire speed range.

E. Vibration amplitude and frequency shall be recorded in the horizontal, vertical and axial planes.

1. Maximum allowable variation amplitude is 1.0 mil. Full range of frequencies (500 to 50,000 cycles per minute) shall be scanned to detect misalignment, bearing defects, mechanical looseness or foundation weakness.

2. Each bearing shall be tested.

3. Fans with VSDs shall be checked from 15 percent to 100 percent of the rated speed.

4. "Lock-out" ranges may be used to correct up to two ranges of excess vibration. The span of each "lock-out" range shall be limited to an effective fan speed of 50 RPM. Any "lock-out" ranges used shall be clearly identified in the test report and shall be prominently displayed on a typed, laminated legend mounted inside the VSD controller cabinet.

3.03 AIR HANDLING UNIT SUBMITTAL DATA

A. The information for each item listed below must be furnished as part of these shop drawing submittals. Additional data may be submitted on separate sheets. Submit the requested data on the forms provided. Provide data for the air-handling units noted on the Drawings.

B. General Data:

1. Air Handling Unit Manufacturer

2. Maximum Exterior Dimensions (Assembled)

a. Length (feet)

b. Width (feet)

c. Height (feet)

d. (Attach general arrangement drawing.)

3. Operating weight (pounds)

C. Filters:

1. Manufacturer

2. Type

3. Efficiency (percent)

4. Quantity

5. Pressure Drop

a. Clean

b. Dirty

6. (Attach manufacturer's literature.)

D. Final Filters:

1. Manufacturer
2. Type
3. Efficiency (percent)
4. Quantity
5. Pressure Drop
    a. Clean
    b. Dirty
6. (Attach manufacturer's literature.)

E. Preheat Coil:

1. Manufacturer
2. Air Flow (cfm)
3. Face Velocity
4. Air Entering Temperature (degrees F)
5. Air Leaving Temperature (degrees F)
6. Fins per Inch (9 maximum)
7. Rows (2 maximum)
8. Minimum Capacity (Btuh)
9. Rated Capacity (Btuh)
10. Steam Flow (lb./hr)
11. Air Pressure Drop (Inches w.g.)
12. Tube Diameter (Inches)
13. Tube Material
14. Fin Height
15. Fin Material
16. Tube Wall Thickness
17. Coil Section Dimensions (Inches)
18. Coil Weight
19. Frame Material

E. Fan Sound Power (at design cfm)

	at AHU Inlet	at AHU Outlet
1st Octave	_____	_____
2nd Octave	_____	_____
3rd Octave	_____	_____
4th Octave	_____	_____
5th Octave	_____	_____
6th Octave	_____	_____
7th Octave	_____	_____
8th Octave	_____	_____

20. Fan BHP (at design cfm)
    a. (with clean filters)
21. Fan BHP (at design cfm)
    a. (with fully loaded filters)
22. Motor Horsepower
23. Motor Efficiency (at design cfm)
24. Motor Efficiency (at 50 percent of design)
25. Motor Manufacturer and Model Number
26. Bearing Manufacturer and Model Number
27. Attach Manufacturer's Literature on:
    a. Fan
    b. Fan Curve at full RPM (design cfm)
    c. Fan Curve at minimum recommended RPM
    d. Motor
    e. Fan Bearings
    f. Fan Drive
    g. Vibration Isolation
    h. cfm vs. Total Unit kW Curve with Clean Filters for Fan
    i. cfm vs. Total Unit kW Curve with Fully Loaded Filters for Fan

F. Cooling Coil:
1. Manufacturer
2. Air Flow (cfm)
3. Face Velocity

4. Air Entering Temperature (degrees F)
    a. Dry Bulb
    b. Wet Bulb
5. Air Leaving Temperature (degrees F)
    a. Dry Bulb
    b. Wet Bulb
6. Fins per Inch (8 maximum)
7. Rows (6 maximum)
8. Minimum Coil Capacity Sensible/Total (Btuh)
9. Rated Coil Capacity (Btuh)
10. Entering Water (gpm)
11. Entering Water Temperature (degrees F)
12. Leaving Water Temperature (degrees F)
13. Water Side Pressure Drop (Feet w.g.)
14. Air Side Pressure Drop (wet) (Inches w.g.)
15. Water Velocity (ft/min)
16. Number of Sections
17. Tube Diameter (Inches)
18. Tube Material
19. Fin Height
20. Fin Material
21. Tube Wall Thickness
22. Coil Section Dimensions (Inches)
23. Coil Weight
24. Frame Material
25. Finish

G. Heating Coil:
    1. Manufacturer
    2. Air Flow (cfm)
    3. Face Velocity

4. Air Entering Temperature (degrees F)
5. Air Leaving Temperature (degrees F)
6. Fins per Inch (8 maximum)
7. Rows (2 maximum)
8. Minimum Coil Capacity Sensible/Total (Btuh)
9. Rated Coil Capacity (Btuh)
10. Entering Water (gpm)
11. Entering Water Temperature (degrees F)
12. Leaving Water Temperature (degrees F)
13. Water Side Pressure Drop (Feet w.g.)
14. Air Side Pressure Drop (wet) (Inches w.g.)
15. Water Velocity (ft/min)
16. Number of Sections
17. Tube Diameter (Inches)
18. Tube Material
19. Fin Height
20. Fin Material
21. Tube Wall Thickness
22. Coil Section Dimensions (Inches)
23. Coil Weight
24. Frame Material
25. Finish

H. Flow Element:

1. Type
2. Certified Accuracy
3. Pressure Drop

END OF SECTION 23 73 23