

DIVISION 23 – HEATING VENTILATING AND AIR CONDITIONING

SECTION 23 73 00 – AIR HANDLING UNITS

PART 1: GENERAL

1.01 Related Documents

- A. Drawings and provisions of the Contract, including Uniform General Conditions and Supplementary Conditions, Division 1 Specification Sections and Component Special Conditions apply.

1.02 Summary

- A. Perform all work required to provide and install modular air handling units, including factory installed fans, dampers, coils, motors, and any specialty equipment as indicated in the Contract Documents with supplementary items necessary for proper installation.
- B. This section includes factory-assembled modular Air Handling Unit (AHU) that includes but is not limited to the following:
 - 1. Casing.
 - 2. Fans.
 - 3. Bearings and Drives.
 - 4. Coils.
 - 5. Filter Sections.
 - 6. Additional Sections
 - 7. AHU Dampers.
 - 8. Accessories.

1.03 References

- A. AFBMA9-Load Rating and Fatigue Life for Ball Bearings.
- B. AFBMA 11-Load Rating and Fatigue Life for Roller Bearings.
- C. AMCA 99-Standards Handbook.
- D. AMCA 210-Laboratory Methods for Testing Fans for Rating Purposes.
- E. AMCA 300-Test Code for Sound Rating Air Moving Devices.
- F. AMCA 301-Method of Publishing Sound Rating for Air Moving Devices.
- G. AMCA 500-Test Methods for Louver, Dampers, and Shutters.
- H. ARI 260-Sound Rating of Ducted Air Moving and Conditioning Equipment

- I. ARI 410-Forced-Circulation Air-Cooling and Air-Heating Coils
- J. ARI 430-Central-Station Air-Handling Units.
- K. ARI 435-Application of Central-Station Air-Handling Units.
- L. ARI 610-Central System Humidifiers
- M. NEMA MG1-Motors and Generators.
- N. NFPA 70-National Electrical Code
- O. SMACNA-HAVC Duct Construction Standards-Metal and Flexible.
- P. UL 900-Test Performance of Air Filter Units.
- Q. ANSI/ASHRAE/IES Standard 90.1 - (Current revision as approved by SECO) - Energy Standard for Buildings except Low-Rise Residential Buildings
- R. ANSI/ASHRAE/IES Standard 90.2 - (Current revision as approved by SECO) - Energy-Efficient Design of Low-Rise Residential Buildings
- S. ASHRAE STANDARD 135 - A Data Communication Protocol for Building Automation and Control Networks
- T. ASHRAE 68 – Laboratory Method of Testing to Determine the Sound Power in a Duct
ASHRAE 52.2 - Filter Testing and Specifications

1.04 Submittals

- A. See Uniform General Conditions, Division 1 Specifications, Component Special Conditions, and technical specification for submittal requirements.
- B. Shop Drawings:
 - 1. Contractor shall submit ¼ inch scale equipment layouts showing equipment in mechanical space. Indicate assembly, unit dimensions, weight loading, required clearances, construction details, field connection details, electrical characteristics, connection and requirements.
- C. Product Data:
 - 1. Provide literature that indicates dimensions, weights, capacities, rating, fan performance, duct air flow requirements to minimize restrictions in airflow into and out of the Air Handler, gages and finishes of materials, electrical characteristics and connection requirements. Refer to detailed listing of submittal data under Part 3 – Air Handling Unit Submittal Data.
 - 2. Provide data of filter media, filter performance data, filter assembly, and filter frames as tested and certified per ASHRAE standards.

3. Provide fan curves with specified operating point clearly plotted, as tested and certified per AMCA standards. Ratings shall include system effects. Fan ratings will not satisfy this requirement but shall be submitted for comparison purposes.
4. Submit sound power level data for both fan outlet and casing radiation at rated capacity, as tested and certified per AMCA and ARI 260 standards.
5. Provide data on all coils as tested and certified per ARI standards.
6. Submit electrical requirements for power supply wiring including wiring diagrams for interlock and control wiring, clearly indicating factory-installed and field-installed wiring.
7. All materials shall have NFPA-90 rating of 25/50 or better.

D. Base Rail Height Calculations

Provide calculations for required base rail heights to allow for proper condensate trapping.

E. Fan Performance Curves

Submit with specified operating point clearly plotted. Base performance curves on test in accordance with ARI standards. Conduct test in ARI-approved laboratory.

F. Sound Power Levels

Submit sound power levels in octave bands from 63 to 8,000 Hz for unit inlet, outlet and casing radiation at rated capacity. Base sound power levels on actual factory test data on fan sizes and accessories being furnished. Sound performance shall be rated per ARI Standard

260 and units shall bear the ARI 260 seal. The manufacturer shall factory sound test all units if they are not ARI 260 certified as manufactured. Submit factory sound test procedures with submittal for Owner's approval prior to release of equipment for production.

G. Manufacturer's Instructions

Provide start-up information and Operations and Maintenance Manuals.

- H. Submit cataloged coil moisture carryover curves. The curves shall be plotted at the coil operating point and shall show the maximum coil moisture carryover limits.

1.05 Operation and Maintenance Data

- A. Include instructions for lubrication, filter replacement, motor and drive replacement, spare parts lists, and wiring diagrams.
- B. Provide Operations and Maintenance manuals for all air handling units. In addition to a full set of manuals with close-out documentation, each unit shall ship with its own manual permanently mounted inside the unit casing fan section in a watertight enclosure, and in PDF Format on a USB Flash Drive.
- C. Permanently mount condensate trapping calculation instructions within the unit Operations and Maintenance manuals that illustrates the unit casing at the condensate drain connection.

1.06 Quality Assurance**A. Performance Ratings**

1. Conform to ARI Standards; bear ARI 430 certified rating seal. If unit is not ARI 430 rated, unit shall be tested in accordance with the standards to establish acceptability.

B. Sound Ratings

1. Test air handling unit in accordance with AMCA 300 (ASHRAE 68) and ARI 260 Guidelines.

C. Air Coils

1. Certify capacities, pressure drops, and selection procedures in accordance with ARI 410.

D. Manufacturer

1. Regularly engaged in production of components that issues complete catalog data on total product and has at least two years of manufacturing experience for the product specified.

E. Base performance on sea level conditions, unless otherwise scheduled.**F. Provide complete unit including components designed to operate within range of 35 degrees F to 135 degrees F ambient temperature, and 20 to 70 percent relative humidity, unless otherwise specified.****G. These specifications and drawings are based on the equipment scheduled. Contractor is advised that the use of equipment other than that scheduled may directly affect and require coordination with (but not limited to) the following items:**

1. Mechanical room sizes and building structural conditions, with required clearances, to include required clearances for proper airflow into and out of the Air Handlers, as well as adequate access to all pertinent maintenance areas of the Air Handler.
2. Electrical starter/disconnect switch, wire and conduit sizes; electrical clearances as per NEC.
3. Ductwork and piping layouts and return air opening sizes and locations.
4. Plumbing floor drain locations.

H. Units shall fit into the space available with adequate clearance for service as determined by the Engineer and approved by the Owner. Submitted units which do not meet these criteria shall be rejected. Do not assume that all of the manufacturers listed as acceptable manufacturers will provide a unit that will fit in the space allocated. Selection of acceptable manufacturers is not based on whether the manufacturer's standard stock unit will fit into every space allocated. A custom or semi- custom air-handling unit may be required to meet project space and performance requirements without exception. The dimensions shown on the drawing are not to be exceeded.**I. Basis of Design shall provide all demount points, section sizes, etc. for the ingress to the unit location.**

1.07 Delivery, Storage, and Handling

- A. Deliver, store, protect and handle products to site as required by the Contract Documents.
- B. Contractor to accept products on site in factory-fabricated protective containers or covered to protect from weather and construction debris, with factory-installed shipping skids and lifting lugs. Inspect for damage and make any necessary repairs at no expense to the Owner.
- C. Store in clean dry place and protect from weather and construction traffic. Handle carefully to avoid damage to components, enclosures, and finish. Replace damaged equipment, at no expense to the Owner.
- D. Protect coils from entry of dirt and debris with pipe caps or plugs.

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 shall be minimum and maximum capacities. Variations in the capacities of the scheduled equipment supplied under this contract will be permitted only with written direction of the Owner.
- B. Where installation instructions are not included in these Specifications or Drawings, the manufacturer's instruction shall be followed.

PART 2: PRODUCTS**2.01 Manufacturers**

- A. Provide custom air handlers as manufactured by **Temtrol** as a stand-alone base bid and the Engineer Basis of Design for hydronic-based systems. Hydronic based system will be the primary Basis of Design.
- B. Provide air handlers as manufactured by **AAON** as a stand-alone base bid and the Engineer Basis of Design for direct expansion-based package systems.
- C. Provide air handlers as manufactured by **LG** as a stand-alone base bid and the Engineer Basis of Design for direct expansion-based mini-split (ductless) systems.
- D. All air handling units will be integrated into the Texas State University Building Automation and Energy Management System via BACnet. Refer to Construction Standard 25 51 00 Integrated Automation Facilities Controls for integration guidelines.
- E. The manufacturers below will only be accepted as a voluntary alternate to the base bid above. These will only be accepted with a written pre-approval from the engineer of the record and the university within 14 days prior to bid date. Pre-approval letter to the engineer should include complete unit submittal (Including data sheets at back of specification filled out in entirety) to ensure that alternate units will meet performance criteria and dimensional requirements. A line-by-line compliance to specification, unit drawings and fans/coil performance data will be provided with any alternate price to aid the engineer and the

University in determining that the alternate manufacturer is complying with all plans and specifications. Contractors not presenting all of the information above when providing deductions will risk having mechanical bid disqualified.

1. Alternate Manufactures with approval of Owner:
 - a. Hydronic-based systems:
 - 1). Energy Labs
 - 2). Climate Craft
 - b. Direct Expansion-based package systems:
 - 1). Trane
 - 2). Carrier
 - c. Direct Expansion-based mini-split (ductless) systems:
 - 1). DAIKIN
 - 2). Mitsubishi (Trane)

2.02 Unit Construction Description

- A. General: Provide factory-fabricated air handling units with capacity as indicated on the schedule. Units shall have overall dimensions as indicated and fit into the space available with adequate clearance for service as determined by the Engineer, and the Owner. Units shall be completely assembled. Multiple sectioned units shall be shipped as a single factory assembled piece (except where shipping limitations prevent) and, if necessary, de-mounted into modular sections in the field by the contractor. Units shall be furnished with sufficient gasket and bolts for reassembly in the field by the contractor. Unit manufacturer shall provide certified ratings conforming to the latest edition of AMCA 210, 310, 500 and ARI 410. All electrical components and assemblies shall comply with NEMA standards. Unit internal insulation must have a flame spread rating not over 25 and smoke developed rating no higher than 50 complying with NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems." Units shall comply with NFPA 70, "National Electrical Code," as applicable for installation and electrical connections of ancillary electrical components of air handling units. Tags and decals to aid in service or indicate caution areas shall be provided. Electrical wiring diagrams shall be attached to the control panel access doors. Operation and maintenance manuals shall be furnished with each unit. Units shall be UL or ETL listed.
- B. Rigging Provision – Multiple Piece Units: Units shipped in multiple sections shall be engineered for field assembly. The base frame shall have integral lifting lugs. The lifting lugs shall be fabricated from structural steel with an appropriate rigging hole. Lifting lugs shall be located at the corner of each section (and along the sides if required) and sized to allow rigging and handling of the unit. All gasket and necessary assembly hardware shall ship loose with unit. Junction boxes with a factory supplied numbered terminal strip shall be supplied at each shipping split for reconnection of control wiring.

- C. **Unit Base - Floor:** Unit perimeter base shall be completely welded and fabricated using heavy gauge structural steel tubing. **(Note: bolted bases are not acceptable)** C-Channel cross supports shall be welded to perimeter base steel tubing and located on maximum 24" centers to provide support for internal components. Base rails shall include lifting lugs welded to perimeter base at the corner of the unit or each section if de-mounted. Entire base frame is to be painted with a phenolic coating for long term corrosion resistance. Internal walk-on floor shall be thermal break construction, 16-gauge galvanized steel with mechanically fastened and caulked seams. The outer sub-floor of the unit shall be made from 20-gauge galvanized metal. The floor cavity shall be spray foam insulated with floor seams gasketed for thermal break and sealed for airtight / watertight construction. Where access is provided to the unit interior, floor openings shall be covered with walk-on phenolic coated steel safety grating. Single wall floors with glued and pinned insulation and no sub floor are not acceptable. Base frame shall be attached to the unit at the factory.

2.03 Unit Casing

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

The exterior panel finish shall be: Painted with a polyester resin coating designed for long term corrosion resistance meeting or exceeding (ASTM B-117) Salt Spray Resistance at 95 degrees F. 1,000 hrs. and (ASTM D-2247) Humidity Resistance at 95 degrees F. 1,000 hrs. The color shall be sandstone.

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

- B. Double Wall Liner - Each unit shall have double wall construction with 20-gauge solid galvanized liner in the entire unit. The double wall interior panel shall be removable from the outside of the unit without affecting the structural integrity of the unit.
- C. Insulation - Entire unit to be insulated with a full 3" (R-19.5) thick closed cell foam insulation. Foam shall be ecomate 0- (Non VOC) UL 94HF1 rated. All insulation edges shall be encapsulated within the panel. All field penetrations must be completely sealed by installing contractor.

- D. Access/Inspection Doors - The unit shall be equipped with a solid double wall insulated (same as the unit casing), hinged access doors as shown on the plans. The doorframe shall be extruded aluminum, foam filled with a built-in thermal break barrier and full perimeter gasket. The door hinge assembly shall be completely adjustable die cast stainless steel. There shall be a minimum of two heavy duty handles per door. Provide ETL, UL 1995, and CAL- OSHA approved tool operated safety latch on all fan section access doors. Knife edge door seal shall be provided to ensure tightness of air seal.

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

1. Access doors in all sections shall be provided with a 10 x 10 dual thermal pane safety glass window.
 2. Access doors shall be 24" wide.
 3. Access doors shall be on both sides (no exceptions).
- E. Coil Casings - Construct coil section so coils can be removed without affecting structural integrity of casing. Completely enclose connections, coil headers, and return bends. Provide 304 stainless steel coil frame with intermediate casing supports as required. Return bends shall be replaceable.
- F. Drain Pans - IAQ style drain pans shall be provided under all cooling coils as shown on the drawings. The drain pan shall be fabricated from 16-gauge 304 stainless steel. All pans are to be triple pitched for complete drainage with no standing water in the unit. They shall be insulated minimum 3-inch "Double Bottom" construction with welded corners. Provide stainless steel, 1-1/4" MPT drain connection extended to the exterior of the unit base rail. All drain connections shall be piped and trapped separately for proper drainage. For suspended units, secondary drain pans provided by the installing contractor shall extend a minimum of 6" beyond all sides of the complete unit.

2.04 Fan Section with Fanwall Technology (FWT)

- A. For means of redundancy, reduced maintenance and energy savings, provide Fanwall Technology in fan section of Temtrol Air Handling unit.
- B. The multiple fan array systems shall include multiple, direct driven, arrangement 4 plenum fans constructed per AMCA requirements for the duty specified class III as required. Class I fans are not acceptable. Fans shall be rated in accordance with and certified by AMCA for performance. All fans shall be selected to deliver the specified airflow quantity at the specified operating Total Static Pressure and specified fan/motor speed. The fan array shall be selected to operate at a system Total Static Pressure that does not exceed 90% of the specified fan's peak static pressure producing capability at the specified fan/motor speed. Each fan/motor cube or cell shall include a minimum 10-gauge, G 90 Galvanized steel intake wall, 100 aluminum spun fan inlet funnel, and a 10-gauge G90 Galvanized steel motor support plate rail and structure. All motors shall be standard foot mounted type TEAO selected at the specified operating voltage, RPM, and efficiency as specified or as scheduled elsewhere. Motors shall meet the

requirements of NEMA MG-1 Part 30 and 31, section 4.4.2. Motors shall be as manufactured by Baldor, Siemens, or Toshiba for use in multiple fan arrays that operate at varying synchronous speeds as driven by an approved VFD. Motor HP shall not exceed the scheduled HP as indicated in the AHU equipment schedule(s). Steel cased motors and/or ODP motors are not acceptable. All motors shall include permanently sealed (L10-400,000 hr) bearings and AEGIS™ shaft grounding to protect the motor bearings from electrical discharge machining due to stray shaft currents. Each fan/motor assembly shall be dynamically balanced to meet AMCA standard 204-96, exceeding category BV-5, to meet or exceed an equivalent Grade G.55, producing a maximum rotational imbalance of .022” per second peak, filter in (.55mm per second peak, filter in). Fan and motor assemblies submitted for approval incorporating larger than 22” wheel size and 215 T frames size motors shall be balanced in three orthogonal planes to demonstrate compliance with the G.55 requirement with a maximum rotational imbalance of .022” per second peak filter in (.55 mm per second peak, filter in). Copies of the certified balancing reports shall be provided with the unit O&M manuals at the time of shipment. Submittals that do not include a statement of compliance with this requirement will be returned to the contractor without review.

1. Manufacturers not able to comply with this balance grade requirement must note an exception on their bid. The balance grade is critical as many classroom buildings are in sound sensitive environments.
- C. The fan array shall consist of multiple fan and motor “cubes” or “cells”, spaced in the air way tunnel cross section to provide a uniform air flow and velocity profile across the entire air way tunnel cross section and components contained therein. In order to assure uniform velocity profile in the AHU cross section, the fan cube dimensions must be variable, such that each fan rests in an identically sized cube or cell, and in a spacing that must be such that the submitted array dimensions fill a minimum of 90% of the cross sectional area of the AHU air way tunnel. There shall be no blank off plates or “spacers” between adjacent fan columns or rows to position the fans across the air way tunnel. The array shall produce a uniform air flow profile and velocity profile within the airway tunnel of the air handling unit to equal the specified cooling coil and/or filter bank face velocity by +/- 10% when measured at a point 36” from the intake side of the fan array intake plenum wall, and at a distance of 72” from the discharge side of the fan array intake plenum wall. Submittals for units providing less than the scheduled quantity of fans and/or spacing of the fans for multiple fan arrays shall submit CFD modeling of the air flow profile for pre-bid approval that indicates uniform velocity and flow across all internal components without increasing the length of the AHU unit or changing the aspect ratio of the unit casing as designed.
- D. Each fan motor shall be individually wired to a control panel containing a single VFD as the primary VFD and a backup VFD wired in bypass, as specified elsewhere. Each VFD shall be sized for the total connected HP for all fan motors contained in the fan array. Wire sizing shall be determined, and installed, in accordance with applicable NEC standards and local code requirements. When specified and scheduled, the multiple fan array electrical panel shall include system optimization controls to actively control fan speed and to enable and disable fans in the multiple fan array. The number of active fans in the array shall be automatically determined, and the speed of the enabled fans shall be adjusted to produce the required

coincidental flow and pressure at the perimeter boundary of the unit at substantially peak efficiency. The system optimization controls shall continuously monitor required flow and pressure and shall automatically optimize the operating array configuration and speed for peak efficiency. When specified, system optimization controls shall be provided that will interface with and be compatible with the BAS as specified elsewhere. It is the responsibility of the contractor to assure that the fan system optimization controls are compatible with the BAS system. System optimization controls shall be provided by the AHU manufacturer to assure single source responsibility for fan volume controls and shall require only an input control signal from the controls contractor for SP or flow for proper operation of the system optimization controls. When specified, the AHU unit manufacturer shall provide a single communication interface with the BAS and shall coordinate with the controls contractor to make sure that all necessary data points are communicated.

- E. Alternate AHU manufacturers above that are approved for bidding purposes only, other than the basis of design manufacturer, and that are submitting multiple fan arrays, shall test one or more of the submitted AHU's for flow, pressure, leakage, BHP and acoustics as submitted and approved, prior to shipment. The testing shall be witnessed by an owner's representative and approved by the engineer prior to shipment of any of the submitted AHU equipment. A test report shall be provided for each tested AHU unit and the report shall be included in the O&M manuals for the units. Costs for these tests including travel shall be covered by the AHU manufacturer.
- F. Each individual cube or cell in the multiple fan arrays shall be provided with an integral back flow prevention device that prohibits recirculation of air in the event a fan or multiple fans become disabled. The system effects for the back flow prevention device(s) shall be included in the criteria for TSP determination for fan selection purposes and shall be indicated as a separate line-item SP loss in the submittals. Submitted AHU performance that does not indicate allowance for system effects for the back flow prevention device(s) and the system effect for the fan and motor enclosure in which each fan is mounted, will be returned to the contractor disapproved and will need to be resubmitted with all of the requested information included for approval. Back Draft Damper performance data that is per AMCA ducted inlet and discharge arrangements will not be accepted. Damper data must be for the specific purpose of preventing back flow in any disabled fan cube and that is mounted directly at the inlet of each fan. Motorized dampers for this purpose are not acceptable. Submitted fan performance data which only reflect published performance for individual fans in AMCA arrangement "A" free inlet and discharge will not be accepted. Alternate AHU Manufacturers above that are approved for bidding that do not manufacture the fans being submitted on must provide certified performance data for fans as installed in the AHU unit with Back Draft damper effects included. These manufactures shall submit to a performance test which is witnessed by the engineer and/or the owner's representative. Costs for this trip will be covered by the AHU manufacturer.
- G. Each fan & motor assembly shall be removable through a 24" wide, free area, access door located on the discharge side of the fan wall array without removing the fan wheel from the motor. All fan/motor access doors shall open against pressure.
- H. Motor Circuit Protection (Factory Mounted)

All motors in the FANWALL Array shall be provided with individual motor protection for thermal overload protection. All motor circuit protectors can be located in starting device enclosure or, if required by design, in a separate enclosure. Motor circuit protector enclosure must be located and mounted at a minimal distance from motors in a FANWALL array. Provide remote indication by means of current switches wired in **PARALLEL**. This means that the manufacturer shall provide a current switch **PER FAN** for BAS contractor to map back in fan status per fan to DDC. Provide multiple pilot lights (one per fan) cover mounted for local monitoring as well.

I. Fan Wall Technology with Redundant VFD frequency control (Field Mounted)

As required by system design, provide one ABB ACH550 VFD for normal operation and a second ABB ACH550 VFD for redundant backup operation. Provide control wiring and control circuitry to transfer from main VFD to redundant VFD when main drive has faulted. The VFD shall be sized accordingly to start and hold all motors in the FANWALL Array. Provide with factory mounted circuit breaker. Provide redundant drive package in Nema 1 cabinet configuration.

2.05 Multiple Fan Array Air Flow Measuring Systems

Refer to Construction Standard 25 51 00 Integrated Automation Facilities Controls sections 2.8.D. through 2.8.F as applicable.

2.06 Water Coils

- A. All coil assemblies shall be leak tested under water at 315 PSIG and PERFORMANCE is to be CERTIFIED under ARI Standard 410. Coils exceeding the range of ARI standard rating conditions shall be noted.
- B. Cooling coils shall be mounted on stainless steel support rack to permit coils to slide out individually from the unit. Provide intermediate drain pans on all stacked cooling coils. The intermediate pan shall drain to the main drain pan through a copper downspout. Water coils shall be constructed of seamless copper tubing mechanically expanded into fin collars. All fins shall be continuous within the coil casing to eliminate carryover inherent with a split fin design. Fins are die formed Plate type.
- C. Headers are to be seamless copper with die formed tube holes.
- D. Temperature Sensor shall be installed in the supply and return of all coils and will be tied back to the Building Automation System for monitoring.
- E. Connections shall be male pipe thread (MPT) Schedule 40 Red Brass with 1/8" vent and drain provided on coil header for coil drainage. All coil connections shall be extended to the exterior of the unit casing by the manufacturer. Coils shall be suitable for 250 PSIG working pressure. Intermediate tube supports shall be supplied on coils over 44" fin length with an additional support every 42" multiple thereafter.
- F. Water coils shall have the following construction:
 - 1. 5/8" o.d. x .020" wall copper tube with .028 return bends.
 - 2. 0.008" aluminum fins.

3. 16 gauge 304 Stainless Steel casing.

2.07 Filter Sections

A. General

Air shall not be allowed to bypass filters. Provision shall be made to positively lock filters in place to prevent shifting. Provide filter sections as scheduled or shown on the Drawings. Each filter bank shall be provided with Dwyer Series 2000 filter gauge.

Note: Some units may have multiple filter sections and multiple filter types. Some filter section types shown here may not be used.

B. Filter Section:

1. Provide 2" Merv 8 Filter for any pre-filter or standalone single filter.
2. Provide 12" Merv 13 Filter for any final filter

C. Provide for removal of profiler from upstream and final filter downstream.

D. Refer to schedule on drawings for filtering requirements

2.08 Additional Sections

A. All additional sections of the unit, including blank sections and turning sections require for proper unit operation, maintenance, and configuration, shall meet the unit casing requirements listed in this Section. Note: Some, all, or none of the additional sections listed maybe used. Refer to Drawings and Schedules.

B. Mixing Box Section:

1. Where specified or shown on the Drawings, provide with factory-mounted interconnected outside and return air dampers mounted in a galvanized frame. See AHU Dampers Section, below.

C. Access Section(s):

1. Provide access sections with door where specified or shown on Drawings. Floors of access section must be heavy-duty to accommodate maintenance personnel/equipment.

2.09 Accessories

A. "Marine-type" or fluorescent lights shall be installed in EACH section (no exceptions). Light shall be wired to a switch installed on the outside casing of the unit, with separate power connection from unit to allow maintenance during unit shutdown.

B. Where scheduled, ultraviolet (UV) lights will be installed in coil and filter sections (on upstream side of filter). Power source and wiring for the UV lights shall be separate from the motor power for maintenance purposes and shall be provided under Division 26 00 00.

C. Dual thermal pane windows shall be provided in all access doors. Minimum window dimensions shall be 10-inch x 10-inch.

PART 3: EXECUTION

3.01 Installation

- A. Install in accordance with manufacturer’s instructions.
- B. Make joints and connections fully gasketed and air-tight.
- C. Install filters.

A.	
General Data	
Air Handling Unit Manufacturer	
Maximum Exterior Dimensions (Assembled):	
Length (feet)	
Width (feet)	
Height (feet)	
Operating weight (lb.)	

B.	
Pre-filters	
Manufacturer	
Type	
Efficiency	
Quantity	
Pressure Drop	
Clean	
Dirty	

C.	
Preheat Coil	
Manufacturer	
Air Flow (CFM)	
Air Entering Temp (°F)	
Air Leaving	
Fins/Inch (8 maximum)	
Rows (2 maximum)	
Minimum Capacity	
Rated Capacity (Btuh)	
Steam Flow (lb./hr)	
Air Pressure Drop (Inches H2O)	

Sound Power	At AHU Inlet	At AHU Outlet
1 st Octave		
2 nd Octave		
3 rd Octave		
4 th Octave		
5 th Octave		
6 th Octave		
7 th Octave		
8 th Octave		

Fan BHP (at design CFM)	
Fan BHP (at design CFM)	
Motor HP	
Motor Efficiency (at design CFM)	
Motor Efficiency (at 50% of design)	
Motor Manufacturer and Model No.	
Bearing Manufacturer and Model No.	

- D. 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.

3.02 Air handling Unit submittal Data

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.

Attach Manufacturer’s Literature on:

- Fan
- Fan Curve at full RPM (Design CFM)
- Fan Curve at minimum recommended RPM Motor
- Fan Bearings Fan Drive Vibration Isolation
- CFM vs. Total Unit kW Curve with Clean Filers for Fan
- CFM vs. Total Unit kW Curve with Fully loaded Filers for Fan

D.	
Cooling Coil	
Manufacturer	
Air Flow (CFM)	
Air Entering Temp (°F)	
Dry Bulb	
Wet Bulb	
Air Leaving Temp (°F)	
Dry Bulb	
Wet Bulb	
Fins/Inch (8 maximum)	
Rows (6 maximum)	
Minimum Coil Capacity	
Rated Coil Capacity (Btuh)	
Entering Water GPM	
Leaving Water Temp. (°F)	
Water Pressure Drop (Feet H2O)	
Air Pressure Drop (wet) (Inches H2O)	
Water Velocity (ft/min)	
Number of Sections	

E.	
Heating Coil	
Manufacturer	
Air Flow (CFM)	
Air Entering Temp (°F)	
Air Leaving Temp (°F)	
Fins/Inch (8 maximum)	
Rows (2 maximum)	
Minimum Coil Capacity (Btuh)	
Entering Water GPM	
Leaving Water Temp. (°F)	
Water Pressure Drop (Feet H2O)	
Air Pressure Drop (Inches H2O)	
Water Velocity (ft/min)	
Number of Sections	
Dimensions of each Coil Section (inches)	
Weight of each Coil Section (lb.)	

F.	
Flow Element	
Type	

Certified Accuracy	
Pressure Drop	

3.03 EXTRA MATERIALS

- A. Furnish as required by the contract documents.

3.04 Test and Balance

- A. Testing and Balancing will be completed prior to beginning commissioning.
- B. All systems will be Tested and Balanced.
- C. Testing and Balance documents will be turned over to the Owner on both physical and digital media prior to begin of Commissioning.

3.05 Commissioning

- A. Systems will be Commissioned per the contract documents.
- B. Commissioning report will be turned over to the Owner on both physical and digital media prior to final acceptance and building occupancy.