SECTION 23 73 23 – custom air handling units

1. GENERAL
	* + 1. RELATED DOCUMENTS
				1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
				2. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.
				3. Related Specifications include but are not limited to the following:

Division 25 Controls

* + - 1. SUMMARY
				1. 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.
				2. This Specification applies to all air handling equipment for special applications as scheduled on the Drawings.
			2. REFERENCE STANDARDS
				1. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
				2. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.
				3. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the following references:

AFBMA 9 ‑ Load Ratings and Fatigue Life for Ball Bearings.

AFBMA 11 ‑ Load Ratings and Fatigue Life for Roller Bearings.

AMCA 99 ‑ Standards Handbook.

AMCA 210 ‑ Laboratory Methods of Testing Fans for Rating Purposes.

AMCA 300 ‑ Test Code for Sound Rating Air Moving Devices.

AMCA 301 ‑ Method of Publishing Sound Ratings for Air Moving Devices.

AMCA 500 ‑ Test Methods for Louver, Dampers, and Shutters.

ARI 410 ‑ Forced‑Circulation Air-Cooling and Air-Heating Coils.

ARI 610 ‑ Central System Humidifiers.

NEMA MG1 ‑ Motors and Generators.

NFPA 70 ‑ National Electrical Code.

NFPA 90A - Flame Spread and Smoke Ratings.

SMACNA ‑ HVAC Duct Construction Standards ‑ Metal and Flexible.

UL 900 ‑ Test Performance of Air Filter Units.

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

* + - 1. QUALITY ASSURANCE
				1. 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.
			2. SUBMITTALS
				1. Product Data Record Documents:

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.

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.

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.

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.

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.

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

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

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

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

* + - * 1. Operation and Maintenance Data:

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

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.

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

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

* + - 1. DELIVERY, STORAGE and HANDLING
				1. Deliver, store, protect and handle products to the Project Site under provisions of Division 01 and Division 20.
				2. Accept products on site in factory-fabricated protective containers, with factory-installed shipping skids and lifting lugs. Inspect for damage.
				3. Store in clean dry place and protect from weather and construction traffic. Handle carefully to avoid damage to components, enclosures, and finish.
				4. 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.
			2. Extra materials
				1. Provide additional set of specified fan belts, sheaves, and 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.
			3. schedules on drawings
				1. 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.
				2. Insofar as is possible, all items of the same type (i.e., coils, fans, etc.) shall be by the same manufacturer.
				3. Where installation instructions are not included in the Contract Documents, the manufacturer’s instructions shall be followed.
				4. 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.
1. PRODUCTS
	* + 1. GENERAL
				1. 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.
				2. Configuration: Fabricate with fan and coil sections plus accessories as indicated on the Drawings, including but not limited to:

Preheat coil.

Heating coil.

Mixing box section.

Applicable filter and final filter sections.

Cooling coil section.

Humidifier section.

Motors and variable frequency drives.

Access doors.

Dampers.

Silencer sections.

* + - * 1. Base performance on sea level conditions, unless otherwise scheduled.
				2. Fabrication: Conform to AMCA 99 in the absence of direction in this Specification.
				3. Performance: Refer to schedule in Drawings.
				4. 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.
				5. Dual duct units shall have separate hot deck and cold deck fans.
				6. Units shall have a draw-through configuration.
			1. manufacturers
				1. Equipment Procurement Procedure
			2. unit casing, frame, and general construction
				1. Unit Casing:

The casing shall consist of double wall panels, and also have reinforced construction with sufficient internal welded steel structure frame and bracing to prevent excessive deflection of the casing panels.

Exterior walls minimum 16-gage G-90 galvanized steel.

Internal insulation shall be minimum R-value of 12 and fire and fungus proof.

Protect all internal insulation with solid galvanized sheet metal inner panels of minimum 18-gage G-90 galvanized steel.

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.

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

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

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.

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

* + - * 1. Drain Pans:

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

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

Construct drain pan of Type 304 stainless steel; minimum 14-gage on 100 percent outside air handling units and minimum 16-gage on 30 percent and higher recirculation air handling units.

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.

Drain pan triple sloped to the drain connection to prevent accumulation of standing water to meet the requirements of ASHRAE 62.

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.

Provide an insulated intermediate drain pan for all coils above another coil, factory piped to main drain pan. Drain pans shall be triple 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.

* + - * 1. Base and Floor:

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

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

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

Base and structural members shall be G120 galvanized steel.

Unit floor shall be 14-gage, galvanized tread plate insulated with R-12 insulation. 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.

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

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

* + - * 1. Access Doors:

Provide access doors to allow access to both sides (upstream and downstream) of the filter racks, both sides of the fan section, and both sides of all coils. Access doors shall be capable of opening full 90 degree swing with allowance to preclude the door from opening into and causing damage to coil, filter bank, etc, or opening out and interfering and causing damage to insulation on the piping connection to a coil.

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

Door size shall 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.

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

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

Doors shall be 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.

All access doors shall open against air pressure, unless approved by the Owner in writing.

* + - * 1. Rigging Performance Requirements:

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

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

Indicate physical balance point on unit bases.

* + - 1. Fans and related components
				1. Fans and Motors:

Airfoil Fan (AF) DWDI Minimum Class II Housed Fans: double width double inlet as indicated on the Drawings. Fan blades shall be hollow airfoil in shape, welded to the center and wheel side plates. Fan housing shall be heavy gage, continuously welded, steel construction. Inlet cones shall be precision spun and aerodynamically matched.

Plug Fan (PF) SWSI Minimum Class II Fans: single width single inlet arrangement 1 or 4 plenum fan as indicated on the Drawings. The fan wheel shall have a minimum of 9 blades shall be hollow airfoil in shape, welded to the center and wheel side plates. Inlet cone shall be precision spun.

Fans shall be both dynamically and statically balanced. Dynamic fan balancing shall be conducted from 16 Hz to 60Hz 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 and sheaves shall be keyed to the shaft. Fans shall be rated in accordance with AMCA 210 for performance and AMCA 300 for sound.

Housed fans shall be equipped with quick opening access doors in the fan scroll.

Motors shall be premium efficiency types per Section 20 05 13.

The motor mounting for each unit shall be an integral part of the fan support frame.

The fan/motor unit shall be mounted on spring isolators, minimum 2-inch deflection, within the air handler casing.

Housed fans shall have a fabric duct vibration isolator installed within the air handler casing. The unit shall be supplied with a factory installed and sealed flange for connection to ductwork.

* + - * 1. Sheaves and Belts:

Design V‑belts and drives for minimum of 50 percent overload. Where more than one belt is required, belts shall be of matched sets and factory pre-tensioned for normal operation. Furnish all belt drives with belt guards.

For belt drive units, provide adjustable sheaves on motors 15 horsepower and under.

* + - * 1. Bearings:

Antifriction type, either ball or roller, within a split pillow block housing for shafts 2-1/2 inches in diameter and larger, and with a single piece pillow block below 2-1/2 inches in diameter. Bearings shall be lubricated at the factory and equipped with means for lubrication on the outside of the bearing housing.

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

L-10 minimum life of 200,000 hours.

[Note to Engineer: For applications with larger bearings, use oil bath lubricated bearings. Engineer should determine if grease or oil bath is appropriate and delete non applicable paragraph].

[Furnish pillow block bearing with thermocoupler port and oil vent port, bearing end plug, and oiler to provide a constant level of lubrication in the bearing housing.]

[Where oil bath lubricated bearings are not available, grease fittings for bearings shall be remotely mounted within line of sight of the bearing, where possible. Where not feasible, then the fitting shall be mounted where it is most easily accessible for service. The tubing used for removing the fitting shall be stainless steel, installed with a strain relief pigtail approximately four (4) inches long and terminated at the exterior of the air handling unit panel for all units.]

* + - 1. Coil section
				1. Coil Casing:

Coil casing shall comply with requirements for general construction.

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.

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.

Coils shall be completely enclosed within the coil casing.

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

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

* + - * 1. Steam Coils:

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.

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

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.

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

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

* + - * 1. Chilled and Hot Water Coils:

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 425 fpm for constant volume applications and 450 fpm for variable volume applications. FPM. Maximum water pressure drop through coil shall not exceed 20 feet and maximum velocity in tubes shall not exceed 8 feet per second.

Chilled Water Coils:

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.

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.

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.

Hot Water Coils:

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.

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.

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.

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.

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.

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.

* + - 1. Filter Section
				1. Refer to Section 23 40 00 – Filters, and Drawings for additional requirements.
				2. Filters shall have a maximum width of 24 inches.
				3. Side Access Housings:

Fabricate of not less than 16-gage galvanized steel.

Each filter section shall 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.

The filter section 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.

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.

Filter sections 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.

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

* + - * 1. 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.
				2. Filter sections 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.
				3. Frames for filters with efficiencies greater than 95 percent shall be constructed of not less than 14-gage galvanized 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.
			1. Dampers
				1. Mixing Box Section:

Factory built, field mounted, outside air of Type 304 stainless steel and edge seals in stainless steel frame, with stainless steel axles in self‑lubricating synthetic bearings. Return air dampers of extruded aluminum airfoil shape blade design with seals in an extruded aluminum frame, with galvanized plated hex steel axles in self-lubricating synthetic bearings.

Opposed blade arrangement with damper blades positioned across short air opening dimension. Parallel blade arrangement should be used if outside air dampers are used for isolation purposes only.

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

* + - * 1. Damper Leakage:

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

Dampers shall be sized for maximum 2000 FPM face velocity.

* + - 1. dual duct section
				1. Diffuser Section: Arrange baffles and diffuser plates to provide maximum recovery of fan discharge velocity head and to ensure uniform diffusion of airflow over the faces of the coils.

Balancing Plates: Provide perforated balancing plates as required to ensure balanced airway resistance between hot and cold air circuits within the unit.

Integral Air Passages:

Construct air passages and ducts so as to direct air streams from the heating and cooling coils separately to mixing dampers with minimum friction loss.

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

Supply Air Damper Section:

Provide dampers of extruded aluminum airfoil shape blade design in an extruded aluminum frame, with galvanized plated hex steel axles in self-lubricating synthetic bearings.

Face areas of damper sets will be in proportion to the indicated air flow quantities

**[Note to Engineer if supply air isolation damper needs to be a tight shut off type of damper then specify:]**

Provide dampers of galvanized steel airfoil shape blade design with seals in an galvanized steel frame, with galvanized plated hex steel axles in stainless steel sleeve bearings.

Face areas of damper sets will be in proportion to the indicated air flow quantities

Damper Leakage:

Maximum 4.0 cfm per square foot at 6-inches w.g. differential pressure.

Dampers shall be sized for maximum 2000 FPM face velocity.

* + - 1. Air handling unit specialties
				1. 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.  **[Note to engineer, if humidifier option is not listed on the design then remove this humidifier requirement specialty item.]**
				2. Variable Speed Drives (VSD):

Refer to Section 23 05 13.

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.

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

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

* + - * 1. Ultra Violet Germicidal Irradiation Systems:

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.

UV lamps shall be located:

Downstream of cooling coils.

Above condensate drain pans.

Up-stream of final filtration sections.

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

Lighting systems shall be moisture resistant with electronic ballasts and shall be wired using moisture resistant conduit.

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

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

Lamps shall be installed on a stainless steel grid using stainless steel fasteners in accordance with the manufacturer’s installation instructions.

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

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

* + - 1. sound characteristics
				1. Conduct sound tests at the unit manufacturer’s test facility under AMCA Guidelines and Conditions.
				2. Provide sound power level test procedures and data for each unit under scheduled operating pressures.
				3. The air handling unit sound power levels must not exceed the following criteria. Sound power levels scheduled on Drawings shall supersede the values below:
				4. [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 |
| 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 |
|  |  |  |  |  |  |  |  |  |  |

* + - 1. Electrical provisions
				1. 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. Specification 20 05 13 refers to the NEMA standards and publications relevant to applications and use of both EMT and liquid tight flexible conduit.
				2. 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.
				3. Provide water-proof, two-lamp linear fluorescent light fixtures with electronic ballasts manufactured by Lithonia DM 232 M Volt or equivalent, 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 section shall be 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.
				4. All wiring shall be 600V rated type MTW/THWN #12 stranded copper in EMT or liquid tight 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 water tight type.
				5. Provide liquid tight flexible connection to motor; 36-inch maximum length.
				6. Conduit penetrations shall not represent through-metal contact. Penetrations shall be made and sealed before unit factory testing.
1. EXECUTION
	* + 1. INSTALLATION
				1. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.
				2. All installation shall be in accordance with manufacturer’s published recommendations.
				3. Install in conformance with ARI 435.
				4. Install factory assembled unit on vibration isolators, where fans are not internally isolated. Refer to Section 20 05 48.
				5. 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).
				6. 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.).
				7. Arrange fans and surrounding components in such a way that poor fan performance does not result.
				8. It is the Engineer’s responsibility to verify opening dimensions and Contractors responsibility to verify installation methods to ensure unit sections and components can be physically installed into the designated space.

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.

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

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

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

All internal coil piping shall be extended to casing walls.

The unit manufacturer shall provide a written acceptance letter to BJC HEALTHCARE stating the unit was assembled and complies with manufacturer’s assembly requirements.

* + - * 1. 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.
				2. Protect coils to prevent damage to fins and flanges. Comb out bent fins.
				3. Install cleanable tube coils with 1:50 pitch.
				4. Make connections to coils with unions and flanges.
				5. 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.
				6. On water heating coils and chilled water-cooling coils, connect water supply to leaving airside of coil (counterflow arrangement).
				7. 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.
				8. Insulate headers located outside airflow as specified for piping. Refer to Section 20 07 19.
				9. Ensure sufficient space between coil sections for installation of control devices.
			1. TESTING
				1. 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.
				2. 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.
				3. 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.
				4. After assembly, fan and motor shall be given an electronic vibration analysis along with the variable frequency drive either at the air handling unit or VSD manufacturer's factory, while operating over the entire speed range.
				5. Vibration amplitude and frequency shall be recorded in the horizontal, vertical and axial planes.

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.

Each bearing shall be tested.

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

"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.

* + - 1. Air handling unit submittal data
				1. 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.
				2. General Data:

Air Handling Unit Manufacturer

Maximum Exterior Dimensions (Assembled)

Length (feet)

Width (feet)

Height (feet)

(Attach general arrangement drawing.)

Operating weight (pounds)

* + - * 1. Filters:

Manufacturer

Type

Efficiency (percent)

Quantity

Pressure Drop

Clean

Dirty

(Attach manufacturer's literature.)

* + - * 1. Final Filters:

Manufacturer

Type

Efficiency (percent)

Quantity

Pressure Drop

Clean

Dirty

(Attach manufacturer's literature.)

* + - * 1. Preheat Coil:

Manufacturer

Air Flow (cfm)

Face Velocity

Air Entering Temperature (degrees F)

Air Leaving Temperature (degrees F)

Fins per Inch (9 maximum)

Rows (2 maximum)

Minimum Capacity (Btuh)

Rated Capacity (Btuh)

Steam Flow (lb./hr)

Air Pressure Drop (Inches w.g.)

Tube Diameter (Inches)

Tube Material

Fin Height

Fin Material

Tube Wall Thickness

Coil Section Dimensions (Inches)

Coil Weight

Frame Material

1. Fan Sound Power at AHU at AHU

 (at design cfm) Inlet Outlet

 1st Octave

 2nd Octave

 3rd Octave

 4th Octave

 5th Octave

 6th Octave

 7th Octave

 8th Octave

Fan BHP (at design cfm)

(with clean filters)

Fan BHP (at design cfm)

(with fully loaded filters)

Motor Horsepower

Motor Efficiency (at design cfm)

Motor Efficiency (at 50 percent of design)

Motor Manufacturer and Model Number

Bearing Manufacturer and Model Number

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 Filters for Fan

cfm vs. Total Unit kW Curve with Fully Loaded Filters for Fan

* + - * 1. Cooling Coil:

Manufacturer

Air Flow (cfm)

Face Velocity

Air Entering Temperature (degrees F)

Dry Bulb

Wet Bulb

Air Leaving Temperature (degrees F)

Dry Bulb

Wet Bulb

Fins per Inch (8 maximum)

Rows (6 maximum)

Minimum Coil Capacity Sensible/Total (Btuh)

Rated Coil Capacity (Btuh)

Entering Water (gpm)

Entering Water Temperature (degrees F)

Leaving Water Temperature (degrees F)

Water Side Pressure Drop (Feet w.g.)

Air Side Pressure Drop (wet) (Inches w.g.)

Water Velocity (ft/min)

Number of Sections

Tube Diameter (Inches)

Tube Material

Fin Height

Fin Material

Tube Wall Thickness

Coil Section Dimensions (Inches)

Coil Weight

Frame Material

Finish

* + - * 1. Heating Coil:

Manufacturer

Air Flow (cfm)

Face Velocity

Air Entering Temperature (degrees F)

Air Leaving Temperature (degrees F)

Fins per Inch (8 maximum)

Rows (2 maximum)

Minimum Coil Capacity Sensible/Total (Btuh)

Rated Coil Capacity (Btuh)

Entering Water (gpm)

Entering Water Temperature (degrees F)

Leaving Water Temperature (degrees F)

Water Side Pressure Drop (Feet w.g.)

Air Side Pressure Drop (wet) (Inches w.g.)

Water Velocity (ft/min)

Number of Sections

Tube Diameter (Inches)

Tube Material

Fin Height

Fin Material

Tube Wall Thickness

Coil Section Dimensions (Inches)

Coil Weight

Frame Material

Finish

END OF SECTION 23 73 23