SECTION 237414

CUSTOM CENTRAL-STATION AIR-HANDLING UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Outdoor, variable air volume, air-handling units.

1.3 PERFORMANCE REQUIREMENTS

A. Structural Performance: Casing panels shall be self-supporting and capable of withstanding +/- 10 inches water column without panels and joints exceeding a deflection of L/200 where "L" is the unsupported span length within completed casings.

B. Leakage Performance: Air handling unit casing and components shall meet ASHRAE 111 Class 6 leakage level up to +/-10 inches water column.

C. Seismic Performance: Air-handling units shall withstand the effects of earthquake motions determined according to ASCE/SEI 7 and Section 230548 “Vibration and Seismic Controls for HVAC Piping and Equipment.”

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

1.4 ACTION SUBMITTALS

A. Product Data: For each air-handling unit indicated.

1. Unit dimensions and weight.
2. Cabinet material, metal thickness, finishes, insulation, access doors and accessories.
3. Fans:

a. Certified fan-performance curves with system operating conditions indicated.
b. Certified fan-sound power ratings.
c. Fan construction and accessories.
d. Motor ratings, electrical characteristics, and motor accessories.

4. Certified coil-performance ratings with system operating conditions indicated.
5. Dampers, including housings, and linkages.
6. Filters including housings and racks.

7. Humidifier assemblies
8. UV light assemblies
9. Fan motor trolly beam

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Wiring Diagrams: Power, signal, and control wiring.
2. Anchoring requirements including locations and anchoring devices

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Layout and position of structural members including modifications to existing structural steel supports.
2. Anchoring requirements and layout coordinated with existing and new structural steel.
3. Coil piping routing and connections.

B. Seismic Qualification Certificates: For air handling units, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air-handling units to include operation and maintenance manuals.

1.7 QUALITY ASSURANCE

A. Factory Leak Testing: The unit manufacturer shall provide a witnessed factory leak test on unit. The cabinet shall be tested at the unit’s design static pressure of 10” water column for both the high and low pressure sides. Cabinet leakage shall no exceed a leakage class rating as defined by ANSI/ASHRAE Standard 111. All supply and return air openings shall be sealed. The air shall be pumped into the unit until the appropriate operating pressures are achieved. Air flow measurements shall be performed in compliance with AMCA Standard 210. The testing shall be performed at the factory. The manufacturer shall notify contractor prior to test. A written test report shall be prepared by the manufacturer and submitted for approval.

B. Factory Panel Deflection Testing: The unit manufacturer shall provide a factory deflection test on unit at design static pressure of 10” water column differential static pressure across the cabinet exterior walls. A deflection limit of L/200 shall be demonstrated at this time. "L" is the unsupported span length within completed casings. Deflection testing shall be at the same time

as Factory Leak Testing. A written test report shall be prepared by the manufacturer and submitted for approval.

C. Field Leak Testing: For units that are field assembled including units shipped in sections with shipping splits, the unit manufacturer shall provide a witnessed field leak test on unit. The cabinet shall be tested at the unit's design static pressure of 10" water column for both the high and low pressure sides. Cabinet leakage shall not exceed a leakage class rating as defined by ANSI/ASHRAE Standard 111. All supply and return air openings shall be sealed. The air shall be pumped into the unit until the appropriate operating pressures are achieved. Air flow measurements shall be performed in compliance with AMCA Standard 210. The testing shall be performed after the unit has been fully assembled. The contractor shall provide the Owner's Construction Administrator 2 days notice prior to the test. A written test report shall be prepared by the manufacturer and submitted for approval.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

E. NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of air-handling units and components.

F. ARI Certification:
1. Air-handling units and their components shall be factory tested according to ARI 430, "Central-Station Air-Handling Units," and shall be listed and labeled by ARI.
2. Standard 410 – Forced Circulation Air Cooling and Air Heating Coils. Coils shall bear the ARI seal.

G. AMCA Standards:
1. Standard 99 – Standards Handbook
2. Standard 204 – Balance Quality and Vibration Levels for Fans
3. Standard 210 – Laboratory Methods of Testing Fans for Ratings. Fans shall bear the AMCA seal.
4. Standard 300 – Reverberant Room Method for Sound Testing of Fans
5. Standard 500 – Test Methods for Louvers, Dampers and Shutters

H. Equipment within unit shall be UL listed where applicable.

1.8 COORDINATION

A. Outdoor Units: Coordinate sizes and locations of structural steel bases with actual equipment provided.

B. Coordinate location of unit shipping breaks, unit disassembly capabilities and requirements to accommodate shipping, hoisting, rigging and moving unit into final location.

C. Electrical Distribution System: The electrical distribution system including wire size, conduit size, branch circuit protection, VFD size and components, etc., is designed based on fan type, fan number and motor sizes as shown and scheduled on drawings. Contractor shall provide for all electrical distribution modifications associated with contractor proposed and Design Engineer approved modifications including different supply fan types, numbers and motor sizes then what is depicted on the drawings including upsized wiring, conduit, branch circuit protection, VFD size and components, etc., consistent with specification requirements. All required electrical changes shall be subject to the approval of the Design Engineer.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Air Enterprises
   2. Climate Craft
   3. Governair
   4. MarCraft
   5. Temtrol
   6. Trane

2.2 OVERVIEW

A. Custom built-up unit shall be of the configuration, capacity and style as indicated and scheduled on the Drawings and as specified herein.

B. The unit shall be shipped in sections and components as required to accommodate shipping, hoisting, rigging and moving into place constraints. The contractor shall assemble unit in place providing a complete unit constructed in the same integrity, pressure rating, deflection rating, air leakage rating as if assembled at the factory.

C. Outdoor units to be provided with weatherproofing (roofing, guttering, etc.) as defined herein.

2.3 UNIT BASE

A. Fabrication Requirements for Unit Base
   1. Base Construction:
      a. Unit perimeter base shall be completely welded and fabricated using heavy gauge structural steel or aluminum tubing. Perimeter support members shall be a minimum of 6” structural member properly sized to support all major components and the housing during rigging, handling and operation of the unit.
      b. C-channel cross supports shall be welded to perimeter base steel tubing and located on maximum 24” centers to provided support for internal components.
      c. Base rails shall include lifting lugs welded to perimeter base at the corner of the unit or each section if divided into shipping / hoisting sections.
   2. Floor Construction:
      a. 12 gauge G90 galvanized steel or 10 gauge aluminum tread plate, continuously welded floor seams and turned up perimeter lip.
      b. Thermal break construction.
      c. Outer floor material: 14 gauge galvanized steel or aluminum
      d. Insulation: The floor cavity shall be spray polyurethane foam insulated with floor seams gasketed for thermal break and sealed for airtight / watertight construction.
      e. Floor openings shall be covered with walk on open steel grating suitable for free air passage.
   3. Floor Drains:
      a. Each section of the unit base shall contain a minimum 1” NPT drain to facilitate system washdown and maintenance piped to unit exterior with steel pipe. Provide threaded pipe cap at end of pipe in accessible location.
   4. All equipment within the unit shall be provided with a minimum 2” high base to raise equipment off the unit floor.

5. Base Finish:
    a. Entire base frame is to be painted with a phenolic coating for long term corrosion resistance.

2.4 UNIT CASINGS

A. Fabrication Requirements for Casings and Insulation:
1. Casing Construction:
    a. 3” to 4” solid double wall construction with no through metal, internal thermal break. All casing panels shall be removable from the unit exterior without affecting the unit’s structural integrity.
    b. Interior panel wall shall be 20 ga G90 galvanized steel solid liner or 18 ga aluminum solid liner.
    c. Exterior panel wall shall be 20 ga G90 galvanized steel solid liner, 20 ga steel solid liner painted with a polyester resin coating designed for long term corrosion resistance or 14 ga (0.063”) aluminum.
2. Pressure Rating: 10” W.C. positive or negative static pressure. Deflection up to 10” W.C. shall be no more than L/200 where "L" is the unsupported span length within completed casings.
3. Double Wall Liner:
    a. Each unit section (entire unit) shall have double wall construction with 20 ga G90 galvanized solid liner.
    b. Double wall interior panel shall be removable from the outside of the unit without affecting the structural integrity of the unit.
4. Insulation:
    a. Entire unit shall be insulated with a full wall thick, 3” to 4” thick closed cell foam insulation, expanded to completely fill panel cavities, minimum thermal resistance R value of 26 ft^2 h °F/BTU.
    b. Foam shall be 0-, 0- UL 94HF1 rated.
    c. All insulation edges shall be encapsulated within the panel.
5. Unit Casing Finish
    a. 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. Standard color.

B. Fabrication Requirements for Access Doors:
1. Access Doors:
    a. Solid 2 inch thick double wall construction with same insulation as unit casing.
    b. Door frame: extruded aluminum, foam filled with built in thermal break barrier and full perimeter gasket.
    c. Hinges: A minimum of two ball-bearing stainless steel hinges or stainless-steel piano hinge and two heavy duty wedge-lever-type latches, operable from inside and outside. Arrange doors to be opened against air-pressure differential.
    d. Gasket: Neoprene, applied around entire perimeters of panel frames.
    e. Access doors shall be provided with a 10 x 10 dual thermal pane safety glass window. UV resistant window shall be provided on access doors that view UV light section.
    f. Size: Minimum 24” width where modular section width allows if not indicated otherwise on drawings.
2. Locations and Applications:
    a. Access to entering air and leaving air side of each coil.
    b. Access to fan suction and discharge plenum.
    c. Access to fan motors and drives.
    d. Access to remove and install filters

e. Access to dampers
f. Access to humidifiers
g. As shown on Drawings.

C. Roof System (use for outdoor units)
1. Unit roofs for outdoor units are to be sloped a minimum of 1/4" per foot to assure positive run-off. Roof to (select) peak in center and drain off to both sides / on door side and drain away from door side. Unit shall be provided with a non-corrosive rain gutter system with downspouts to guide unit roof water run-off to the building roof. Units incorporating roof systems without controlled water run-off accommodations are not acceptable.

2.5 UNHOUSED DIRECT-DRIVE PLENUM TYPE FANS

A. Unit Fans: Fans shall be unhoused direct-drive plenum type and incorporate a non-overloading type backward inclined air foil blade wheel, heavy-gauge galvanized or painted steel frame and inlet frame. AMCA fan arrangement 4. All fans shall meet the air flow performance specified and shall not exceed the break horsepower or sound power levels specified or scheduled on the Drawings. Minimum wheel size and fan class shall be as scheduled on Drawings. Fans shall be balanced per ANSI/AMCA 204-5 standards.

B. Fan Assemblies: Fan assemblies including structural support frame, inlet plate, fan wheel and direct drive motor. Spring isolators shall be restrained vibration type isolators. Restrained isolators must meet seismic control requirements.

C. Motor Removal Trolly Beam: Provide a permantently installed and mounted motor removal trolly beam in fan section to facilitate replacement of fan motors.

D. Fan Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Chicago Blower Corporation. – Design 51Plenum
2. Loren Cook Company – Model PLC
3. Greenheck – Model QEP
4. New York Blower Company – Plenum
5. Twin City Fan and Blower Company – E-Series

E. Fan Frame and Panel:
1. Rugged industrial strength, heavy gauge steel angles and supports fully painted. Welded construction.
2. Inlet plates shall be heavy gauge galvanized or finish painted steel construction. The inlet plate incorporates a removal spun heavy gauge steel inlet cone designed for smooth airflow into the accompanying inlet retaining ring of the fan wheel.

F. Airfoil Wheels:
1. Air foil fan wheel mounted directly on motor shaft. Wheel has a high efficiency, non overloading, airfoil design.
2. Welded Steel or welded/extruded aluminum wheel/blades.
3. Continuous welded blades to back plate and inlet ring.
4. Wheel balanced per ANSI/AMCA 204-96.

G. Isolation: Each fan and motor assemblies in the fan section must be factory mounted on restrained vibration isolators that have a minimum 2 inches deflection. Restrained isolators must meet seismic control requirements. Plenum fan inlets shall be connected to the pressure-bulkhead panel with flexible duct to prevent transmission of vibration to the unit casing. Metal to

metal contact is not permitted between fixed and floating parts. Thrust restraints must be provided as required to limit horizontal movement of the fan assembly at design conditions.

H. Backdraft Damper: Each fan shall be equipped with a gravity backdraft damper. Dampers shall be constructed to withstand deadhead pressure of online fans.

I. Motor: Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."
   1. NEMA Premium (TM) efficient motors as defined in NEMA MG 1.
   2. Motor Sizes: Minimum size as indicated.
   3. Motors shall be designed for direct drive fan mounting.
   4. Motors shall be rated for variable frequency drive operation.
   5. Enclosure: TEFC Cast Iron frame and brackets.
   6. Grounding Ring: Provide AEGIS SGR shalt grounding ring for protection of the motor bearings from electrical discharge machining caused by capacitive induced shaft voltage discharging through the motor bearings. AEGIS SGR shaft grounding ring shall have 6061 aluminum frame with high conductivity micro fibers and 6061 aluminum mounting bracket. The grounding ring shall be factory mounted on the motor shaft external to the motor housing.

2.6 COIL SECTIONS

A. General Requirements for Coil Section:

   1. All coils shall be leak tested under water at 300 PSIG and performance shall be certified under ARI Standard 410. Coils shall have working pressure rating of 200 PSIG.
   2. All coils shall be mounted on steel support racks to permit coils to slide out individually from the unit. Steel support rack for cooling coils shall be stainless steel.
   3. All coils shall have removable coil access panels to facilitate coil removal and U-bend access.
   4. The units shall be provided with coils of the types and capacities scheduled. Cooling coil casing shall be Series 300 stainless steel, others shall be galvanized steel. Coils shall be constructed with no less than 5/8” diameter x .025” wall thickness copper tubes and .01” aluminum fins spaced not closer 8 fins per inch, and not more than 10 rows. Fins shall be permanently secured to the tubes by mechanical bonding or soldering and shall be plate type. Frame shall include intermediate tube supports to prevent sagging of the tubes.
   5. Water coil headers and “U” bends shall be arranged so that the entrained air is carried along with the flow of water through the coil to the high point on the leaving water header. High points in the coil shall be provided with vent connections and low points provided with drain connections. Multi-row coils shall be arranged for counterflow heat exchange between the air and water.
   6. Connections shall be male pipe thread MPT Schedule 40 red brass.
   7. Coils shall not act as structural component of unit.

B. Coil Bid Alternates:
   1. Deduct Alternate No. 1: Delete space for future heating coil.
   2. Deduct Alternate No. 2: Cooling coil shall utilize USA Coil Sentry Guard technology.

C. Condensate Drain Pans:

   1. Indoor air quality style drain pans shall be provided under all cooling coils, dual purpose heat reclaim/preheat coils and humidifiers. The drain pan shall be fabricated from 16

gauge 304 stainless steel. All pans shall be triple pitched for complete drainage with no standing water in the unit. Drain pans shall be double walled construction with minimum 3" insulation. Extend drain pan downstream from leaving face of cooling coil to comply with ASHRAE 62.1. Outlet shall be stainless steel, minimum 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.

2. Provide intermediate drain pans on all stacked cooling coils. The intermediate drain pans shall have a copper drain pipe extend to spill over the main drain pan.

2.7 FILTERS AND FILTER RACKS AND HOUSINGS

A. Filters and Filter Housing Manufactures: Subject to compliance with requirements, provide products by one of the following:
   1. AAF International.
   2. Camfil Farr.
   3. Flanders-Precisionair.
   4. Approved equal.

B. Pleated Panel Filters: Provide filters of the type scheduled on the Drawings.

   1. Face Dimensions: 24 inches x 24 inches.
   2. Thickness or Depth: 2 inches or 4 inches as scheduled on drawings
   3. Surface Area: 17.3 sq. ft. (2 inch thick) or 27.7 sq. ft. (4 inch thick) of effective media per 24" x 24" filters.
   4. Filter-media frames: Cardboard frame with perforated metal retainer sealed or bonded to the media.
   5. Number of Filters: See schedule on drawings.
   6. System Airflow: See schedule on drawings.
   7. Maximum or Rated Face Velocity: 500 fpm.
   8. Initial Resistance: 0.27-inch wg at 500 fpm.
   9. Recommended Final Resistance: 1.0 inch wg.
   10. MERV Rating: 8 when tested according to ASHRAE 52.2.

C. 30 inch Bag Filters: Provide filters of the type scheduled on the Drawings.
   1. Face Dimensions: 24 inches x 24 inches.
   2. Thickness or Depth: 30 inches
   3. Filter-media frames: Plastic, ABS
   4. Number of Filters: See schedule on drawings.
   5. System Airflow: See schedule on drawings.
   6. Maximum or Rated Face Velocity: 500 fpm.
   7. Initial Resistance: 0.53-inch wg at 500 fpm.
   8. Recommended Final Resistance: 1.25 inch wg.
   9. MERV Rating: 13 when tested according to ASHRAE 52.2.
   10. Filter make: Camfil HI-FLO-ES, no exceptions

D. Filter Housing: Provide factory fabricated unit filter sections. Configuration shall be as shown on Drawings.
   1. Face Loaded Filter Racks:
      a. Filter Rack Type: Face loaded, Camfil Farr Type 8 or equivalent.
      b. Filter racks over 72" in length shall require an angle center reinforcement support.
      c. Provide internal blank-offs to prevent air bypass around filters.
      d. Provide required springs, clips, etc. to secure filters to rack.

E. Filter Accessories:
   1. Filter Gauge: Provide for each filter rack, Dwyer Series 2000 filter gauge or equal.

2.8 DAMPERS

A. Dampers Manufactures: Subject to compliance with requirements, provide products by one of the following:
   1. Arrow United Industries; a division of Mestek, Inc.
   2. Nailor Industries Inc.
   3. NCA Manufacturing, Inc.
   4. Ruskin Company.

B. Frames:
   1. Steel channel.
   2. 14 ga. galvanized sheet steel.
   3. Welded channel corners.

C. Blades:
   1. Air foil shape multiple blade with maximum blade width of 5 to 8 inches.
   2. Opposed-blade design.
   3. Galvanized-steel.
   4. 16 ga. thick dual skin air foil design.
   5. Blade Edging: EPDM blade seals.
   6. Jamb Seals: Compressible flexible metal.

D. Blade Axles: 1/2-inch- diameter; plated steel; blade-linkage hardware of zinc-plated steel and brass; ends sealed against blade bearings. Provide shaft length at actuator mounting for two tandem electronic actuators.

E. Operating Temperature Range: From 250 deg F.

F. Bearings:
   1. Stainless-steel sleeve.
   2. Thrust bearings at each end of every blade.

G. Performance:
   1. 10” w.c. maximum pressure at 48” damper width.
   2. 4000 feet per minute maximum velocity.
   3. 4 cfm/sq. ft. leakage 1” w.c. differential pressure.

2.9 LOUVERS

A. Approved manufacturers: Ruskin or equal.

B. Louver frames and blade material shall be constructed of aluminum. Louvers shall have a minimum of 45% free area. Louvers shall be painted with the same paint requirements identified for the external casing herein.

C. Intake louver frames shall be 6” deep. Intake louvers shall be drainable with stationary blades, front flanges, and bird screens. The intake louver shall be sized for no more than 0.1" w.g. pressure drop.

D. The louvers for intake shall be equal to Ruskin Model EME, wind driven rain louver.

2.10 ANTIMICROBIAL UV-C LAMP SYSTEMS

A. Description: UV-C lamp system mounted inside HVAC equipment consisting of power supply, power supply housing, wiring, UV lamp(s), and lamp holder. Include non-corrosive aluminum housing and cover with Titanium Dioxide coated stainless steel mesh tube.

1. Provide UV-C lamp system that can be installed without cutting hole for lamp entry in HVAC unit cabinet, and without using waterproof or watertight housing.

B. Power Supply: UL/ETL listed, single phase, 120 V 60 Hz, with programmed rapid start.

1. For HVAC Applications, provide self-regulating fixtures for power sources between 120 V and 240 V.
2. Operating Temperature: From 34 to 194 deg F
3. Wiring Harness: Hard-wired power cable.
4. Electrical Connection: Single electrical connection with service disconnect in waterproof housing.

a. Provide waterproof, 3-pin, push-in/screw-in, quick-connectors suitable for use with flexible conduit to interconnect fixtures and lamp bars to power source.
b. Connect fixtures with liquid tight flexible metal conduit
1) Lamp units having connectors rated below 120 V are not acceptable.
c. Service disconnect shall be 20amp rated 125VAC single-pole toggle switch per Section 262726 “Wiring Devices”.

C. UV-C Lamps: Provide lamps, with lamp wattage and model number visibly printed on each lamp, with less than 5.0 mg of mercury in each lamp, and with lamps that do not produce or release ozone.

1. Provide non-proprietary lamps manufactured to work with non-proprietary sockets and bases, and available through commercial lamp distributors.

a. Proprietary lamps made for use with proprietary sockets, or bases are not acceptable.
2. Provide high-output-rated lamps suitable for application inside equipment with cold, moving airstreams, without reduction of intensity.

a. Encapsulated lamps, and lamps not rated for high output are not acceptable.
3. Output: UV-C energy, primarily at the 253.7-nm wavelength with 260 degree energy distribution.
4. Operating Temperature: From 34 to 158 deg F, 100 percent relative humidity, at any velocity.
5. Lamp Life: Minimum of 9000 hours with greater than 85 percent of initial output at end of lamp life.

D. Housing: Non-corrosive aluminum, for installation inside packaged rooftop units or plenums. Painted, coated, plated, and galvanized materials are not acceptable.

E. Wiring Loom: UV-C-resistant jacket materials with internal aluminum/Mylar shield.

1. Conduit: Loom covered with UL liquid-tight flexible metal conduit.

F. Lamp Plug, Holder, and Lamp Clamp: Four-pin type accommodates a single-ended high output lamp.

1. Provide non-proprietary lamp plug, holder, and lamp clamp, available from manufacturers not affiliated with lamp manufacturer, suitable to accept non-proprietary germicidal lamps by multiple manufacturers.
2. Lamp Plug and Holder Construction: UV-resistant materials designed to connect lamp to the plug.
3. Underwriter Listing: Listed and labeled to UL requirements.
4. Lamp Clamp Construction: Provide lamp clamp with UV-resistant materials suitable for installation in damp locations, and suitable to prevent electrical shock, connection shorts, and lamp or power supply failure, from lamp pin oxidation or arcing.
5. Position: Provide fixtures with non-adjustable lamp-holder position.

    a. Fixtures with adjustable positioning of lamp holder and lamp clamp are not acceptable.

G. Install UV-C lamp systems in accordance with manufacturer's installation manual and drawings unless otherwise indicated.

H. Install UV lamps in each UV-C lamp system.

I. Install UV-C lamp systems in locations that are accessible and that will permit servicing and maintenance.

J. Provide sufficient length of wiring loom to facilitate lamp connection to a remotely located power receptacle or power supply housing, such that lamp and loom can be mounted anywhere in the system.

K. Intensity, Coil Disinfection Applications: UV-C lamp system modeling shall be included in submittal and must contain necessary calculations to demonstrate minimum of 6 W/sq. ft. (64.6 W/sq. m) of coil surface area to achieve minimum of 100 microwatts/sq. cm, equally distributed on target surface as recommended by ASHRAE.

L. Housing Installation: Power supply housing can be installed inside or outside HVAC units or plenums.

M. UV Lamp Installation: Mount UV lamp to irradiate surfaces, as well as the available line of sight airstream, through proper lamp placement, and incident angle reflection.

N. Safety: Comply with requirements in UL 1995, "Standard of Safety for Heating and Cooling Equipment." Provide mechanical interlock switch on access panels and doors to UV lamp systems, or within view of UV lamp systems, to ensure that UV-C lamp systems will be de-energized when these accesses are opened. Warning signs and labels are specified in Section 230553 "Identification for HVAC Piping and Equipment."

O. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

1. Warranty Period, System: Five years from date of Substantial Completion.
2. Warranty Period, Lamp for Coil Cleaning System: Two year(s) from date of Substantial Completion.

2.11 ELECTRICAL POWER AND LIGHTS

A. General Requirements: Al electrical work shall be installed in full compliance with NEC and local codes and requirements. Where applicable, components shall be UL approved. All wiring

and components inside air handling plenums shall be weatherproof and rated for such use. All equipment shall contain a grounding conductor.

B. Conduit and Wire: 600 volt rated, type #12 THHN copper (minimum size). Conduit aluminum rigid, compression type fittings. All conduit penetrations in the unit housing and penetrations across the cooing coil sections shall be internally sealed with foam sealant to prevent the migration of water vapor in the conduit.

C. Lights and Outlets: Provide a 4 foot vapor proof LED light fixture for service for each unit section. Lights shall be controlled by one light switch mounted adjacent to the supply fan access door. Provide 120 volt, GFI duplex convenience outlet on the exterior of the unit in waterproof housing. Outlet shall be located near supply fan access door.

2.12 SOURCE QUALITY CONTROL

A. Fan Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Fans shall bear AMCA-certified sound ratings seal.

B. Fan Performance Rating: Factory test fan performance for airflow, pressure, power, air density, rotation speed, and efficiency. Rate performance according to AMCA 210, "Laboratory Methods of Testing Fans for Aerodynamic Performance Rating."

C. Water Coils: Factory tested to 300 psig according to ARI 410 and ASHRAE 33.

PART 3 - EXECUTION

3.1 EXAMINATION

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

B. Examine casing insulation materials and filter media before air-handling unit installation. Reject insulation materials and filter media that are wet, moisture damaged, or mold damaged.

C. Examine roughing-in for hydronic, and condensate drainage piping systems and electrical services to verify actual locations of connections before installation.

D. Examine structural steel support structure to verify that locations of support elements are correct to meet support requirements for the air handling unit.

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

3.2 INSTALLATION

A. If air handling unit is shipped in segments, contractor shall assemble unit in place providing a complete unit constructed in the same integrity as if assembled at the factory.

B. Equipment Mounting: Install air-handling unit on structural steel support system or concrete base as depicted on drawings. Secure unit with anchor bolts bolted through structural steel elements or secure units with anchor bolts installed in concrete bases.

C. If air handling unit is shipped in segments, is site built, or electrical components shipped loose, contractor shall provide for the installation of all electrical components and wiring including, but not limited to, lights, outlets, switches, wiring, raceway system, etc.

3.3 CONNECTIONS

A. Comply with requirements for piping specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to air-handling unit to allow service, maintenance and the removal of coils.

3.4 FIELD QUALITY CONTROL

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

B. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

C. Tests and Inspections:
1. Field Leak Test (Casing Pressure Testing): After installation, perform testing.
2. Leak Test: After installation, fill with water and test coils and connections for leaks.
3. Fan Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.5 STARTUP SERVICE

A. Perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Verify that shipping, blocking, and bracing are removed.
3. Verify that unit is secure on mountings and supporting devices and that connections to piping, ducts, and electrical systems are complete. Verify that proper thermal-overload protection is installed in motors, controllers, and switches.
4. Verify proper motor rotation direction, free fan wheel rotation, and smooth bearing operations.
5. Verify that bearings and other moving parts are lubricated with factory-recommended lubricants.
6. Verify that outdoor dampers open and close, and maintain minimum outdoor-air setting.
7. Verify proper rotation of heat wheel and position of air seals.
8. Comb coil fins for parallel orientation.
9. Install new, clean filters.
10. Verify that manual and automatic volume control and fire dampers in connected duct systems are in fully open position.

B. Starting procedures for air-handling units include the following:

1. Energize motor; verify proper operation of motor, drive system, and fan wheel.
2. Measure and record motor electrical values for voltage and amperage.
3. Manually operate dampers from fully closed to fully open position and record fan performance.

3.6 ADJUSTING

A. Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for air-handling system testing, adjusting, and balancing.

3.7 CLEANING

A. After completing system installation and testing, adjusting, and balancing air-handling unit and air-distribution systems and after completing startup service, clean air-handling units internally to remove foreign material and construction dirt and dust. Clean fan wheels, cabinets, dampers, coils, and filter housings.

END OF SECTION 237313