

SECTION 23 7313
MODULAR CENTRAL-STATION AIR-HANDLING UNITS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Casing construction.
- B. Fan section.
- C. Coil section.
- D. Integral face and bypass coil section.
- E. Humidifier section.
- F. Filter and air cleaner section.
- G. Damper section.
- H. Airflow measurement.
- I. Air blender section.
- J. Diffuser section.
- K. Turning and discharge plenum section.
- L. Controls.

1.02 RELATED REQUIREMENTS

- A. Section 21 0719 - Fire Suppression Piping Insulation.
- B. Section 22 0513 - Common Motor Requirements for Plumbing Equipment.
- C. Section 22 0719 - Plumbing Piping Insulation.
- D. Section 22 1005 - Plumbing Piping: Equipment drains.
- E. Section 23 0513 - Common Motor Requirements for HVAC Equipment.
- F. Section 23 0548 - Vibration and Seismic Controls for HVAC Piping and Equipment.
- G. Section 23 0593 - Testing, Adjusting, and Balancing for HVAC.
- H. Section 23 0719 - HVAC Piping Insulation.
- I. Section 23 3300 - Air Duct Accessories: Flexible duct connections.
- J. Section 23 3413 - Axial HVAC Fans.
- K. Section 23 8200 - Convection Heating and Cooling Units: Air coils.
- L. Section 23 8415 - Steam Humidifiers.
- M. Section 26 2923 - Variable-Frequency Motor Controllers.

1.03 REFERENCE STANDARDS

- A. AHRI 410 - Standard for Forced-Circulation Air-Cooling and Air-Heating Coils; 2001 (R2011).
- B. AHRI 430 (I-P) - Performance Rating of Central Station Air-Handling Units; 2014.
- C. AHRI 610 (I-P) - Performance Rating Of Central System Humidifiers for Residential Applications; 2014.
- D. AMCA (DIR) - [Directory of] Products Licensed Under AMCA International Certified Ratings Program; <http://www.amca.org/certified/search/company.aspx>.
- E. AMCA 99 - Standards Handbook; 2010.
- F. AMCA 210 - Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating; 2007.
- G. AMCA 300 - Reverberant Room Method for Sound Testing of Fans; 2014.
- H. AMCA 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data; 2014.

- I. AMCA 500-D - Laboratory Methods of Testing Dampers for Rating; 2012.
- J. AMCA 500-L - Laboratory Methods of Testing Louvers for Rating; 2012.
- K. AMCA 611 - Certified Ratings Program for Airflow Measurement Stations; 2010.
- L. ASHRAE Std 52.2 - Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size; 2012, with 2015 amendments.
- M. ASHRAE Std 62.1 - Laboratory Method of Testing to Determine the Sound Power in a Duct; 2013.
- N. ASHRAE Std 90.1 - Energy Standard for Buildings Except Low-Rise Residential Buildings; 2013, Including All Addenda.
- O. ASTM B177/B177M - Standard Guide for Engineering Chromium Electroplating; 2011.
- P. NEMA MG 1 - Motors and Generators; 2014.
- Q. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2015.
- R. UL (DIR) - Online Certifications Directory; current listings at database.ul.com.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate the installation of _____ with size, location and installation of service utilities.
- B. Coordinate the work with other trades for installation of roof mounted air handling units on roof curbs.
- C. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.
- D. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

1.05 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data:
 - 1. Published Literature: Indicate dimensions, weights, capacities, ratings, gages and finishes of materials, and electrical characteristics and connection requirements.
 - 2. Filters: Data for filter media, filter performance data, filter assembly, and filter frames.
 - 3. Fans: Performance and fan curves with specified operating point clearly plotted, power, RPM.
 - 4. Sound Power Level Data: Fan outlet and casing radiation at rated capacity.
 - 5. Electrical Requirements: Power supply wiring including wiring diagrams for interlock and control wiring, clearly indicating factory-installed and field-installed wiring.
- C. Sustainable Design Documentation: Submit manufacturer's product data on refrigerant used, showing compliance with specified requirements.
- D. Shop Drawings: Indicate assembly, unit dimensions, weight loading, required clearances, construction details, field connection details, and electrical characteristics and connection requirements.
- E. Specimen Warranty: Submit sample of manufacturer's warranty.
- F. Executed Warranty: Submit documentation of final executed warranty completed in Owner's name and registered with manufacturer.
- G. Manufacturer's Instructions: Include installation instructions.
- H. Maintenance Data: Include instructions for lubrication, filter replacement, motor and drive replacement, spare parts lists, and wiring diagrams.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

1.07 REGULATORY REQUIREMENTS

- A. Products Requiring Electrical Connection: Listed and classified by UL (DIR) as suitable for the purpose specified and indicated.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Accept products on site in factory-fabricated protective containers, with factory-installed shipping skids and lifting lugs. Inspect for damage.
- B. Store in clean dry place and protect from weather and construction traffic. Handle carefully to avoid damage to components, enclosures, and finish.
- C. Do not operate units until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

1.09 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Carrier Corporation; _____: www.carrier.com.
- B. Airflow Equipment; _____: www.airflowequipment.com.
- C. Trane Inc; _____: www.trane.com.
- D. York International Corporation / Johnson Controls Inc; _____: www.york.com.
- E. Substitutions: See Section 01 6000 - Product Requirements.

2.02 CASING CONSTRUCTION

- A. Full Perimeter Base Rail:
 - 1. Construct of galvanized steel.
 - 2. Provide base rail of sufficient height to raise unit for external trapping of condensate drain pans.
- B. Casing:
 - 1. Construct of one piece, insulated, double wall panels.
 - 2. Provide mid-span, no through metal, internal thermal break.
 - 3. Construct outer panels of galvanized steel and inner panels of galvanized steel.
 - 4. Casing Air Pressure Performance Requirements:
 - a. Able to withstand up to 8 inches w.g. positive or negative static pressure.
 - b. Not to exceed 0.0042 inches per inch deflection at 1.5 times design static pressure up to a maximum of plus 8 inches w.g. in positive pressure sections and minus 8 inches w.g. in negative pressure sections.
- C. Access Doors:
 - 1. Construction, thermal and air pressure performance same as casing.
 - 2. Provide surface mounted handles on hinged, swing doors.
 - 3. Provide shatterproof viewing window designed to withstand operating pressures.
- D. Outdoor Unit Roof:
 - 1. Factory install single layer outer roof above inner roof.
 - 2. Slope at a minimum of 0.125 inches per foot from one side of unit to the other side, or from center to sides of unit.
 - 3. Roof assembly to overhang each unit wall or base rail to overhang curb to facilitate water runoff and prevent water intrusion into roof curb to base connection.
- E. Outside Air and Exhaust Air Weather Hood:
 - 1. Fabricate from same material as casing outer panel.
 - 2. Extend hood past perimeter of unit casing opening so as not to obstruct airflow path.
 - 3. Paint hoods with same finish as external surface of outdoor units.

4. Provide inlet hood for each fresh air damper with a sine wave moisture eliminator to prevent entrainment of water into the unit from outside air.
 5. Provide exhaust hoods for each exhaust air opening.
 6. Size each hood for 100 percent of nominal fresh air damper capacities.
 7. Protect each hood with bird screen to prevent nesting at intake or exhaust air flow paths.
- F. Unit Flooring: Construct with sufficient strength to support expected people and equipment loads associated with maintenance activities.
- G. Casing Leakage: Seal joints and provide airtight access doors so that air leakage does not exceed one percent of design flow at the specified casing pressure.
- H. Insulation:
1. Provide minimum thermal thickness of 12 R throughout.
 2. Completely fill panel cavities in each direction to prevent voids and settling.
 3. Comply with NFPA 90A.
- I. Drain Pan Construction:
1. Provide cooling coil and humidifier sections with an insulated, double wall, stainless steel drain pan complying with ASHRAE Std 62.1 for indoor air quality and sufficiently sized to collect all condensate.
 2. Slope in two planes to promote positive drainage and eliminate stagnate water conditions.
 3. Locate outlet of sufficient diameter at lowest point of pan to prevent overflow at normal operating conditions.
 4. Provide threaded drain connections constructed of drain pan material, extended sufficient distance beyond the base to accommodate field installed, condensate drain trapping.
- J. Bottom Inlet Units: Provide steel or aluminum walking grate on structural supports.
- K. Louvers: Stationary, of galvanized steel, 4 inch deep with plenum, nylon bearings, 1/2 inch mesh, 0.04 inch galvanized wire bird screen in aluminum frame, and bearing AMCA Certified Ratings Seal in accordance with AMCA 500-L. Furnish adjustable louvers with hollow vinyl bulb edging on blades and foam side stops to limit leakage to maximum 2 percent at 4 inch wg differential pressure when sized for 2000 fpm face velocity.
- L. Marine Lights:
1. Provide factory mounted, water and dust resistant LED fixture(s) where shown on the Drawings with the following characteristics:
 - a. Non-ferrous metal housing.
 - b. Glass or polycarbonate lens.
 - c. Factory wired to a single switch within factory provided service module.
 - d. Instant on LED white light with minimum 50,000 hour service life.
 2. Provide factory installed service module including GFCI receptacle independent from load side; designed to receive power from field supplied 120 volt source.
- M. Finish:
1. Outdoor Units:
 - a. Coat external surface of unit casing with primer and minimum 1.5 mil, enamel paint finish.
 - b. Comply with salt spray test in accordance with ASTM B177/B177M.
 - c. Color: Manufacturer's standard color.
 2. Indoor Units:
 - a. Provide exterior, galvanized steel panels without paint.
 - b. Color: Manufacturer's standard color.

2.03 FAN SECTION

- A. Type: Backward inclined, double width, double inlet, centrifugal plug type fan, conforming to AMCA 99. Refer to Section 23 3413.
- B. Performance Ratings: Determined in accordance with AMCA 210 and labeled with AMCA Certified Rating Seal.

- C. Sound Ratings: AMCA 301; tested to AMCA 300 and label with AMCA Certified Sound Rating Seal.
- D. Bearings: Self-aligning, grease lubricated, with lubrication fittings extended to exterior of casing with plastic tube and grease fitting rigidly attached to casing.
- E. Mounting:
 - 1. Locate fan and motor internally on welded steel base coated with corrosion resistant paint.
 - 2. Factory mount motor on slide rails.
 - 3. Provide access to motor, drive, and bearings through removable casing panels or hinged access doors.
 - 4. Mount base on vibration isolators.
- F. External Motor Junction Box: Factory mount NEMA 4 external junction box and connect to extended motor leads from internally mounted motors.
- G. Motor Wiring Conduit: Factory wire fan motor wiring to the unit mounted starter-disconnect, variable frequency drive, external motor junction box, and _____.
- H. Fan Accessories:
 - 1. Variable inlet vanes.
 - 2. Discharge dampers.
 - 3. Damper operator.
- I. Flexible Duct Connections:
 - 1. For separating fan, coil, and adjacent sections.
 - 2. Refer to Section 23 3300.
- J. Supply Fan Performance Conforming to AHRI 430 (I-P):
 - 1. Air Flow: _____ cfm.
 - 2. External Static Pressure: _____ inch wg external static pressure.
 - 3. Motor: _____ hp.
 - a. Type: NEMA MG 1.
- K. Return Fan Performance Conforming to AHRI 430 (I-P):
 - 1. Air Flow: _____ cfm.
 - 2. External Static Pressure: _____ inch wg external static pressure.
 - 3. Motor: _____ hp.
 - a. Type: NEMA MG 1.
- L. Direct Drives and Motors:
 - 1. Provide fans of type and class as specified on the schedule. Fan shafts shall be solid steel, coated with a rust-inhibiting coating, and properly designed so that fan shaft does not pass through first critical speed as unit comes up to rated RPM. All fans shall be statically and dynamically tested by the manufacturer for vibration and alignment as an assembly at the operating RPM to meet design specifications. Fans controlled by variable frequency drives shall be statically and dynamically tested for vibration and alignment at speeds between 25% and 100% of design RPM. Fan wheels shall be keyed to fan shafts to prevent slipping.
 - 2. Fans shall be mounted on spring isolation bases. Internally-mounted motor shall be on the same isolation base. Fan and motor shall be internally isolated with spring isolators. Unit sizes up to nominal 4,000 cfm shall have 1-inch springs. Unit sizes larger than nominal 4,000 cfm shall have 2-inch spring isolators. A flexible connection (e.g. canvas duct) shall be installed between fan and unit casing to ensure complete isolation. Flexible connection shall comply with NFPA 90A and UL 181 requirements. If fans and motors are not internally isolated, then the entire unit shall be externally isolated from the building, including supply and return duct work, piping, and electrical connections. External isolation shall be furnished by the installing contractor in order to avoid transmission of noise and vibration through the ductwork and building structure.
 - 3. Fan sections containing multiple fans shall be provided as indicated on the schedule and drawings. Each fan shall operate in parallel to each other fan in the array. The fans shall

- be SWSI plenum type with high efficient AF blades. Fans shall be direct-driven. Fan wheels shall be aluminum. The Hp characteristic of the fans shall be non-overloading.
4. Fan sections containing multiple fans shall be controlled using a common control signal, such as the duct static control signal, to modulate the fan speed.
 5. Fan airflow measurement systems shall be provided to measure fan airflow directly or to measure differential pressure that can be used to calculate airflow. The accuracy of the devices shall be no worse than +/- 5 percent when operating within stable fan operating conditions. Devices shall not affect the submitted fan performance and acoustical levels. Devices that obstruct the fan inlet or outlet shall not be acceptable. Devices shall be connected to transducers with a 2-10 VDC output. Signal shall be proportional to air velocity.
 6. All motors and drives shall be factory-installed and run tested. All motors shall be installed on a slide base to permit adjustment of belt tension. Slide base shall be designed to accept all motor sizes offered by the air-handler manufacturer for that fan size to allow a motor change in the future, should airflow requirements change.
 7. Motors shall meet or exceed all NEMA Standards Publication MG 1 – 2006 requirements and comply with NEMA Premium efficiency levels when applicable. Motors shall comply with applicable requirements of NEC and shall be UL Listed.
 8. Fan Motors shall be heavy duty, NEMA Premium efficient ODP, operable at 460/60/3, exceeding the EPC efficiency requirements.
 9. Direct-driven fan sections shall use 4-pole (1800 rpm) motors, NEMA Design B, with Class B insulation to operate continuously at 104°F (40°C) ambient without tripping of overloads. Multiple fan selections utilizing alternate rpm motors are unacceptable due to motor inefficiency, cost, and replacement lead times.
 10. Motors shall have a +/- 10 percent voltage utilization range to protect against voltage variation.

2.04 COIL SECTION

- A. Casing: Provide access to both sides of coils. Enclose coils with headers and return bends exposed outside casing. Slide coils into casing through removable end panel with blank off sheets and sealing collars at connection penetrations.
- B. Drain Pans: 24 inch downstream of coil and down spouts for cooling coil banks more than one coil high. Stainless Steel construction.
- C. Eliminators: Three break of galvanized steel, mounted over drain pan.
- D. Air Coils:
 1. Certify capacities, pressure drops, and selection procedures in accordance with AHRI 410.
 2. Refer to Section 23 8200.
- E. Fabrication:
 1. Tubes: 5/8 inch OD seamless copper expanded into fins, brazed joints.
 2. Fins: Aluminum.
 3. Casing: Die formed channel frame of galvanized steel.
- F. Water Heating Coils:
 1. Headers: Cast iron, seamless copper tube, or prime coated steel pipe with brazed joints.
 2. Configuration: Drainable, with threaded plugs for drain and vent; serpentine type with return bends on smaller sizes and return headers on larger sizes.
- G. Water Cooling Coils:
 1. Headers: Cast iron, seamless copper tube, or prime coated steel pipe with brazed joints.
 2. Configuration: Drainable, with threaded plugs for drain and vent; threaded plugs in return bends and in headers opposite each tube.
- H. Hot Water Heating Coil:
- I. Water Cooling Coil:

2.05 INTEGRAL FACE AND BYPASS COIL SECTION

- A. Provide horizontal, vertical, or _____ tube, integral face and bypass, steam coil certified in accordance with AHRI 410.
- B. Enclose headers and return bends within unit casing.
- C. Assembly to consist of finned heating elements and bypasses with interlocked dampers.
- D. Provide factory damper actuator.
- E. Hot Water Heating Coil:

2.06 HUMIDIFIER SECTION

- A. General: Capacities and selection in accordance with AHRI 610 (I-P).
- B. Steam Grid Humidifier:
 - 1. Stainless steel distribution tube with evenly spaced orifices extended full width of unit, factory mounted in plenum with drain pan for draw-through units.
 - 2. Refer to Section 23 8415.

2.07 FILTER AND AIR CLEANER SECTION

- A. General: Provide filter sections with filter racks, minimum of one access door for filter removal, and filter block-offs to prevent air bypass. To be installed so filters are pulled toward frame by airflow. Design for airflow velocity less than 400 FPM.
- B. Pleated Media Pre Filters:
 - 1. Media: 4 inch, 100 percent synthetic fibers, continuously laminated to a grid with water repellent adhesive, and capable of operating up to a maximum of 625 fpm without loss of efficiency and holding capacity.
 - 2. Frame: Steel wire grid.
 - 3. Minimum Efficiency Reporting Value: 5 MERV when tested in accordance with ASHRAE Std 52.2.
- C. HEPA Filters:
 - 1. Media: Continuously pleated, waterproof, micro-fiberglass; enclosed in a galvanized, steel frame with neoprene rubber seal applied to leaving air side, and capable of operating up to a maximum of 625 fpm without loss of efficiency and holding capacity.
 - 2. Frame: Continuously welded, gasketed, front loaded filter frames, mounted inside section casing along with filter holding clips, requiring tooling to tighten and hold filter cells.
 - 3. Minimum Efficiency: Not less than: 99.97 percent when tested in accordance with ASHRAE Std 52.2.
 - 4. Refer to Section 23 4000.
- D. Differential Pressure Gage:
 - 1. Provide factory installed dial type differential pressure gage, flush mounted with casing outer wall, and fully piped to both sides of each filter to indicate status.
 - 2. Maintain plus/minus 5 percent accuracy within operating limits of 20 degrees F to 120 degrees F.

2.08 DAMPER SECTION

- A. Mixing Section: Provide a functional section to support the damper assembly for modulating the volume of outdoor, return, exhaust, and _____ air.
- B. Damper Blades:
 - 1. Double-skin airfoil design with metal, compressible jamb seals and extruded-vinyl blade-edge seals on each blade.
 - 2. Self-lubricating stainless steel or synthetic sleeve bearings.
 - 3. Comply with ASHRAE Std 90.1 for rated maximum leakage rate.
 - 4. Provide leakage testing and pressure ratings in compliance with AMCA 500-D test methods.
 - 5. Arrange in parallel or opposed-blade configuration.

- C. Barometric Relief Dampers:
 - 1. Frame: Roll formed galvanized steel.
 - 2. Blades: Roll formed galvanized steel with nylon or teflon bushed hinge pins.
 - 3. Blade Seals: Extruded vinyl, mechanically attached to the blade edge.
 - 4. Material:
 - a. Galvanized steel, single tie bar linkage for damper sections up to 24 inches wide.

2.09 AIRFLOW MEASUREMENT

- A. Air Flow Measurement Station:
 - 1. Provide factory installed, airflow measurement station tested in accordance with AMCA 611 and bearing the AMCA Ratings Seal for Airflow Measurement Performance.
 - 2. Station Location: Install in outdoor, return, and _____ opening to measure airflow.
 - 3. Damper Blades:
 - a. Galvanized steel or extruded aluminum construction.
 - b. Housed in galvanized steel or extruded aluminum frame and mechanically fastened to a rotating axle rod.
 - c. Comply with ASHRAE Std 90.1 for rated maximum leakage rate.
 - 4. Measurement Range: Minimum of 15 percent to 100 percent of unit nominal flow.
 - 5. Operation: Provide low voltage signal corresponding to actual airflow for controlling and documenting airflow.
 - 6. Accuracy: Plus/minus 5 percent.

2.10 CONTROLS

- A. Combination Starter-Disconnects:
- B. Combination VFD - Disconnects:
 - 1. Provide factory mounted, combination VFD - disconnect for each fan motor.
 - a. Provide in accordance with Section 26 2923.
 - 2. Factory mount in full metal enclosure and wire to fan motor.
 - 3. Mount VFD-disconnect on fan section externally in a NEMA 1 enclosure within a dedicated controls section or housed fan section.
 - a. Internal Enclosure Construction Characteristics:
 - 1) Integral part of unit casing to allow for thermal venting to casing interior.
 - 2) Accessible from unit exterior via access door.
 - 3) Construction of access doors same throughout unit.
 - 4. Include circuit breaker disconnect with through-the-door interlocking handle for externally mounted starters, spring loaded, and designed to rest only in the full and lockable ON or OFF state.
 - 5. Allow enclosure entry via a concealed defeater mechanism when the handle is in the ON position.
 - 6. Include control transformer with sufficient capacity to support the following items:
 - a. VFD and controls.
 - b. Binary output on-off wiring.
 - c. Analog output speed-signal wiring.
 - d. Wires that interface between VFD and direct digital controller.
 - 7. Mount starter on fan section externally in a NEMA 1 enclosure within a dedicated controls section or housed fan section.
 - a. Internal Enclosure Construction Characteristics:
 - 1) Integral part of unit casing to allow for thermal venting to casing interior.
 - 2) Accessible from unit exterior via access door.
 - 3) Construction of access doors same throughout unit.
 - 8. Provide bypass relays and bypass circuitry with VFD-OFF-BYPASS selector switch.
- C. Factory Installed Direct Digital Control (DDC) System:
 - 1. Factory engineer and test each component.

2. Provide fully functional control system to operate in either stand-alone mode or as part of the building automation system (BAS) via single pair of twisted wires tie-in.
3. DDC Controller:
 - a. Dedicated, field programmable DDC controller with appropriate point capabilities.
 - b. Portable Screen and Keypad Capabilities:
 - 1) Local monitoring.
 - 2) Troubleshooting.
 - 3) Setpoint adjustments.
 - 4) Physical plugging compatibility into other factory-configured controllers by same manufacturer.
4. Control Options:
 - a. Electronic End Devices:
 - 1) Accommodate integration into existing building systems.
 - 2) Wire to standard point locations of unit mounted DDC controller or terminal block for remote controller.
 - b. Mixing Section Spring Return Damper Actuators:
 - 1) Outdoor Air Damper: Normally closed.
 - 2) Return Air Damper: Normally open.
 - c. Air Flow Measurement Stations: 2 to 10 VDC signal corresponding to CFM for controlling and documenting airflow.
 - d. Fan Discharge Temperature and Temperature Averaging Sensors: Suitable for integration into the BAS system.
 - e. Low Limit Switches:
 - 1) Factory wire to momentary push-button reset circuit.
 - 2) Provide separate low limit for each coil in a coil stack.
 - f. Airflow Switches: Pipe to both filter sides to indicate fan status.
 - g. Dirty Filter Switches: Pipe to both filter sides to indicate filter status.
 - h. Provide Relays for each Binary Output of Controller for User Interface of the following:
 - 1) Motor starters for supply, return, and exhaust fans.
 - 2) Relief dampers.
 - 3) Pumps.
 - 4) Condensing units.
- D. Factory Provided Controls for Field Installation:
 1. Control valves.
 2. Space and outdoor air temperature sensors.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Bolt sections together with gaskets.
- C. Install flexible duct connections between fan inlet and discharge ductwork and air handling unit sections. Ensure that metal bands of connectors are parallel with minimum one inch flex between ductwork and fan while running.
- D. Make connections to coils with unions or flanges.
- E. Hydronic Coils:
 1. Hydronic Coils: Connect water supply to leaving air side of coil (counterflow arrangement).
 2. Provide shut-off valve on supply line and lockshield balancing valve with memory stop on return line.
 3. Locate water supply at bottom of supply header and return water connection at top.
 4. Provide manual air vents at high points complete with stop valve.
 5. Ensure water coils are drainable and provide drain connection at low points.
- F. Cooling Coils:
 1. Pipe drain and overflow to nearest floor drain.

2. Refer to Section 22 1005.
- G. Connect Humidifiers to Water Supply:
 1. Provide gate valve on water supply line.
 2. Provide 3/4 inch hose bibb accessible from interior.
 3. Pipe drain and overflow to nearest floor drain.

3.02 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.

3.03 SYSTEM STARTUP

- A. Provide manufacturer's field representative to perform systems startup.
- B. Prepare and start equipment and systems in accordance with manufacturers' instructions and recommendations.
- C. Adjust for proper operation within manufacturer's published tolerances.

3.04 CLOSEOUT ACTIVITIES

- A. See Section 01 7800 - Closeout Submittals, for closeout submittals.
- B. See Section 01 7900 - Demonstration and Training, for additional requirements.
- C. Demonstrate proper operation of equipment to Owner's designated representative.
- D. Demonstration: Demonstrate operation of system to Owner's personnel.
 1. Use operation and maintenance data as reference during demonstration.
 2. Conduct walking tour of project.
 3. Briefly describe function, operation, and maintenance of each component.
- E. Training: Train Owner's personnel on operation and maintenance of system.
 1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
 2. Provide minimum of two hours of training.
 3. Location: At project site.

END OF SECTION 23 7313