SAM HOUSTON STATE UNIVERSITY
DESIGN AND CONSTRUCTION STANDARDS

DIVISION 23 00 00
MECHANICAL

23 00 00 GENERAL MECHANICAL

A. This standard is intended to provide useful information to the Professional Service Provider (PSP) to establish a basis of design. The responsibility of the engineer is to apply the principles of this section and the ones that follow so that the Sam Houston State University may achieve a level of quality and consistency in the mechanical design of their facilities. Deviations from these guidelines must be justified through LCC analysis and submitted to the University for approval.
B. Provide a full-sized set of MEP drawings in the main mechanical room following all new construction and major renovation projects.
C. For equipment providing critical services, provide N+1 redundancy. Definition of “critical services” to be evaluated during design with SHSU.
D. Roof-top HVAC equipment is not allowed without prior approval by SHSU.
E. Locate a wall or roof hydrant within 50-ft of all outdoor HVAC equipment including air handling units, condensing units, and air-cooled chillers to allow for coil cleaning.
F. Any exterior mounted louver used for mechanical purposes must meet and exceed AMCA 500-L Wind Driven Rain test procedures.

23 05 00 COMMON WORK RESULTS FOR HVAC

23 05 13 COMMON MOTOR AND CONTROLLER REQUIREMENTS

A. Motor Manufacturers:

23 05 17 SLEEVES & SLEEVE SEALS

A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
B. Where sleeves are installed in floors, provide with integral water stop.
C. Where sleeves are installed in floors of mechanical equipment areas or other wet areas, extend sleeve 2-inches above the finished floor.
D. Where sleeves are installed in exterior concrete walls, concrete slabs-on-grade, and other waterproofed membranes, provide a mechanical-type, water-tight modular sealing-element unit equal to GPT LINK-SEAL.

23 05 18 ESCUTCHEONS

A. Install one-piece, cast-brass, polished, chrome-plated finish escutcheons with setscrew fastener for piping passing through walls, ceilings, and finished floors in exposed spaces. Use deep-pattern escutcheons if required to conceal protruding fittings.

23 05 19 METERS & GAGES

A. City Domestic Water Metering:
   1. Installation of the building main domestic water meter should meet all requirements of the local jurisdiction including meter brand, calibration certification, and meter reading equipment. The City of Huntsville requires Badger Meter for domestic water.
   2. Include isolation valves on water meter inlet and outlet and a valved bypass around the meter unless prohibited by the local jurisdiction.
B. Campus Metering & Submetering:
   1. The following building utilities should be metered or submetered for billing purposes: chilled water, heating water, domestic cold water, domestic hot water, irrigation water, and natural gas.
   2. Metering instrumentation should be compatible with the current SHSU campus building automation system.
   3. For buildings with mixed occupancy (E&G and non-E&G), provide sub-metering to properly allocate utility costs between organizations. Coordinate sub-metering requirements with SHSU during design.
   4. For domestic hot water systems that require sub-metering, provide separate, isolated recirculation loops.
   5. Locate hydronic, domestic water, and irrigation water metering instrumentation within a building mechanical room.
   6. Provide isolation valves and a lockable bypass valve around building meters to allow for maintenance.
   7. Provide thermal-energy meters for chilled water systems comprised of an ultrasonic flow sensor, chilled water supply and return temperature sensors, transmitter, indicator, and required wiring.

23 05 23 VALVES

A.

2. Provide stainless steel hangers and supports in corrosive environments.
3. Provide coated or copper-plated steel for copper pipe and tube hangers.
4. The use of pipe hooks, chains, and perforated iron piping for support is prohibited.

B. Thermal-Hanger Shielded Inserts:
1. Insulation insert material for cold piping, use cellular glass or phenolic foam insulation with vapor barrier.
2. Insulation insert material for hot piping, use calcium silicate, cellular glass, or phenolic foam insulation with vapor barrier.
3. Pipe shield to be galvanized sheet steel and to extend 2-inches beyond each side of support. Secure shield with 2 bands at each end.
4. For trapeze or clamped systems, insert and shield should cover the entire circumference of the pipe.
5. For clevis or band hangers, insert and shield should cover lower 180 degrees of the pipe.
6. Insert length should extend 2-inches beyond sheet metal shield for piping below ambient air temperature.

23 05 30 ROOF ACCESSORIES

A. Roof curb requirements for roof-mounted equipment:
1. Height above roof: Minimum of 14-inches or higher as required to maintain roof warranty. Coordinate overall curb height with roof insulation thickness.
2. Material: Galvanized steel.
3. Style: Prefabricated, insulated with fully welded corners.
   a. Roof curb should be insulated with the same R-value as the roof, coordinate requirement with Architect and roofing subcontractor.

23 05 53 MECHANICAL IDENTIFICATION

A. Equipment Labels: Brass, stainless-steel, aluminum, or anodized-aluminum, or multi-layer plastic with black lettering and white background.
B. Pipe Labels: Plastic, preprinted, color-coded, lettering indicating service, flow direction, in accordance with ASME A13.1.
C. Valve Tags: Brass, stamped or engraved, lettering indicating piping system and valve number, predrilled or stamped holes, brass or stainless-steel chain. Include O&M requirements for a valve schedule on letter sized paper with valve number, piping system, system abbreviation used, location of valve, normal operating position, and any special use designation (emergency shut-off).
D. Ceiling Tacks: Color coded to identify above ceiling HVAC equipment, fire/smoke dampers, plumbing valves, and HVAC valves.
E. All exterior identification should be UV-resistant and specifically manufactured for exterior applications.

23 05 93 TESTING, ADJUSTING, & BALANCING

A. TAB specialist shall be an independent contractor, approved by the University, and certified by AABC, NEBB, or TABB.
1. TAB Field Supervisor: Employee of the TAB specialist and certified by AABC, NEBB, or TABB.
2. TAB Technician: Employee of the TAB specialist and certified by AABC, NEBB, or TABB as a TAB technician.

B. Instrumentation type, quantity, accuracy, and calibration shall comply with requirements in ASHRAE 111, Section 4.
C. Meet all applicable ASHRAE/IES 90.1, Section 6.7.2.3 – "System Balancing" requirements.

23 07 00 HVAC INSULATION

A. Insulation products that have contact with stainless steel shall have a leachable chloride content of less than 50 PPM when tested according to ASTM C871. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C795.
B. All insulation materials should have a maximum flame spread rating of 25 and a maximum smoke development rating of 50 per ASTM E 84. PVC products are NOT ALLOWED from use in plenums.
C. All required mastics, coatings, adhesives, and sealants should be compatible with insulation materials, jackets, and substrates.

23 07 13 DUCTWORK INSULATION

A. Materials by Location Type:
   1. Interior, concealed: Flexible, glass fiber duct wrap, ASTM C1290, Type III, factory-applied FSK jacket. This location type applies to conditioned, unoccupied spaces and return air plenums.
      a. Mesh and Mastic: 3" wide Chil-Glas #10 glass fiber reinforcing mesh, Childers CP-34 vapor-retarder mastic.
      b. FSK and FSP tapes are not allowed.
   2. Interior, exposed: Double wall insulated duct with metal inner lining, perforated or solid, by United McGill Acousti-K27 or equal. Duct should be paintable. This location type applies to conditioned occupied spaces.
   3. Interior, unconditioned: Closed-cell elastomeric foam duct wrap, ASTM C534, Type II. This location type applies to above ceiling spaces with ducted return, ventilated attics, crawl spaces, mechanical and electrical rooms.
   4. Exterior:
      a. Closed-cell elastomeric foam duct wrap with heavy duty silver UV-resistant laminate jacket, ASTM C534, Type II.
      b. Prefabricated exterior ductwork with interlocking connections (no metal flanges) by Thermaduct, AQC Q Duct, Spot PhenoliDuct, or equal.
B. Duct Liner:
   1. Duct liner may be used for through-wall return air transfer ducts.
   2. The use of sound attenuators or double wall insulated duct is preferred for noise reduction, however, duct liner *may* be considered in some cases for value engineering purposes.
   3. Duct liner may be used for noise reduction *only when approved by SHSU*, in ducts with velocities less than 1,500 FPM, and for a maximum of 10-FT length. Duct liner should NOT be used on duct connected to fan discharge or ducts in interior, unconditioned spaces or exterior ducts.
      a. Round Ductwork: Flexible duct liner, glass fiber, ASTM C1071, Type I.
      b. Rectangular Ductwork: Duct liner board, glass fiber, ASTM C1071, Type II.
C. General Installation Requirements:
   1. Insulate all interior, concealed return air ductwork. Exposed return air ductwork does not require insulation where the temperature difference is less than 15 degrees F.
   2. Insulate all interior, unconditioned outside air and boiler combustion air ductwork.
   3. Insulate general exhaust ductwork when exhausting humidified spaces.
   4. Insulate all interior, unconditioned and exterior exhaust ductwork. Extend insulation 2 feet inside of the conditioned space from exterior wall or roof.

5. Insulate kitchen grease exhaust ductwork as required by local codes.
6. Do not permanently insulate over duct access doors, including access doors in fire wrapped kitchen grease duct.
7. Install insulation with tight longitudinal seams and end joints. Bond ALL seams and joints with adhesive recommended by insulation material manufacturer.

23 07 16 EQUIPMENT INSULATION

A. Materials By System Operating Temperature:
   1. 34 deg. F and Below:
      a. 2-inch thickness, flexible elastomeric cellular, ASTM C534.
      b. 2-inch thickness, Cellular glass, ASTM C552, Type II, pure glass, vapor barrier required in unconditioned and exterior areas. FOAMGLAS by Owens Corning is not allowed.
   2. 35 to 60 deg. F:
      a. 1.5-inch thickness, flexible elastomeric cellular, ASTM C534.
      b. 1.5-inch thickness, Cellular glass, ASTM C552, Type II, pure glass, vapor barrier required in unconditioned and exterior areas. FOAMGLAS by Owens Corning is not allowed.
   3. 100 to 200 deg. F:
      a. 1.5-inch thickness, Glass fiber ASTM C547, rigid molded, noncombustible.
      b. 1.5-inch thickness, Calcium silicate, ASTM C533, Type I.

B. Insulation is required for, but not limited to the following types of equipment:
   1. Cold refrigeration equipment not factory insulated.
   2. Water pumps handling media at or below 60 deg. F
   3. Duct mounted coils
   4. Drip pans under equipment operating at or below 60 deg. F
   5. Air handling equipment not factory insulated.
   6. Heat exchangers
   7. Buffer and storage tanks
   8. Expansion and air separator tanks
   9. Water softeners
   10. Hot water generators

C. Do NOT insulate heating water pumps.

D. Do not insulate over nameplate or ASME stamps. Bevel and seal insulation around nameplates.

E. Field-applied jackets for equipment needing regular maintenance shall be removeable and reusable.

23 07 19 PIPING INSULATION

A. Materials by System Type:
   1. Chilled Water:
      a. 2-inch piping and smaller: Flexible elastomeric cellular, ASTM C534.
      b. 3-inch piping and larger:
         (i) Phenolic, CFC & HCFC-free, ASTM C1126, Grade 1, Type II and III, vapor barrier required in unconditioned and exterior areas. For 3-inch piping, use 3-lb density insulation. For 4-inch piping and larger, use 5-lb density insulation.
         (ii) Cellular glass insulation is not allowed.
   2. Condenser Water: Exterior piping only, flexible elastomeric cellular, ASTM C534.
   3. Heating Water:
      a. Interior:
         (i) Glass fiber ASTM C547, rigid molded, noncombustible.

8. HVAC Piping System Omissions: Omit insulation on hot piping within radiation enclosures or unit cabinets, on cold piping within unit cabinets provided piping is located over drain pan, on heating piping beyond control valve, located within heated space, on flexible connections, and expansion joints.

23 20 00 HVAC PIPING AND PUMPS

23 21 10 PIPES AND TUBES

A. Piping Material by System Type:
   1. Chilled and Heating Water:
      a. 2-inch piping and smaller:
         (i) Type L copper, hard drawn tubing, ASTM B88 with wrought copper fittings per ASME B16.22 with soldered joints (95% tin, 5% silver per ASTM B32).
         (ii) Standard weight carbon steel, ASTM A53, Grade B, Type E or S with Class 150 malleable iron fittings per ASTM A197, ASME B16.3 with threaded joints.
      b. 3-inch piping and larger: Standard weight carbon steel, ASTM A53, Grade B, Type E or S with standard weight carbon steel fittings per ASTM A105, ASME B16.5 with butt-welded joints per ASME B31.9. Flanges to be Class 150 carbon steel ASTM A105, ASME B16.5.
      c. Polypropylene piping (Aquatherm or equivalent) is to be considered an acceptable alternate.
   2. Condenser Water:
      a. 2-inch piping and smaller: Standard weight carbon steel, ASTM A53, Grade B, Type E or S with Class 150 malleable iron fittings per ASTM A197, ASME B16.3 with threaded joints.
      b. 3-inch piping and larger: Standard weight carbon steel, ASTM A53, Grade B, Type E or S with standard weight carbon steel fittings per ASTM A105, ASME B16.5 with butt-welded joints per ASME B31.9. Flanges to be Class 150 carbon steel ASTM A105, ASME B16.5.
   3. Refrigerant Piping: Type ACR copper tubing, ASTM B280, clean, dry, and capped with wrought copper fittings per ASME B16.22 with brazed fittings per AWS A5.8.
   4. Grooved joint fittings may be specified for carbon steel piping 3-inches and larger. Standard weight carbon steel fittings per ASTM A234, ASME B16.9 with grooved joint ductile iron couplings for standard weight carbon steel piping per ASTM A536 with Grade 65-45-12 EPDM gaskets.
      a. Install in strict accordance with manufacturer's instructions using manufacturer's pipe roll groove tools.
      b. Provide warranty on the grooved joint fittings AND installation. Warranty should include contractor training by the manufacturer and final inspection of every grooved joint by a manufacturer's representative.
   5. Direct Buried Chilled and Heating Water Piping: HDPE, NO EXCEPTIONS.
      a. Install tracer wire between supply and return piping to aid in buried pipe detection.
      b. Prevent corrosion to the metal pipe where the direct buried piping system connects to the building piping system due to a buildup of static electricity. Install a grounding system for the buried piping or a dielectric flange kit at the HDPE-to-metal joint.
   6. For main loop campus chilled water distribution piping, refer to Section 33 00 00.
B. General Installation Requirements:
   1. Piping shall be installed plumb and square with the structure and walls in a good workmanship manner. Use eccentric reducers to maintain top of pipe distance AFF.
   2. Install piping above accessible ceiling to allow sufficient space for ceiling panel removal.
   3. Install piping to permit valve and fitting servicing.

vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times the "SE" value in Appendix A in ASME B31.9, "Building Services Piping."

e. After hydrostatic test pressure has been app

1. Aurora.
2. Armstrong.
3. Goulds.
4. Peerless.
5. Taco.
6. Bell & Gossett, *preferred manufacturer*.
7. Paco, *preferred manufacturer*.

B. Pump Selection:
1. Evaluate the pump system conditions and select the optimum pump type and configuration based on efficiency and pump characteristics. Where feasible, provide pumps as follows:
   a. Up to 50 GPM - in-line circulating pumps or close-coupled end suction pumps
   b. Between 50 and 500 GPM - base-mounted end suction pumps
   c. More than 500 GPM - horizontal split case, double-suction pumps
   d. Larger in-line pumps may be considered for specific situations where floor space is limited. Larger vertical in-line pumps require approval.
2. Select pumps on the ascending side of the efficiency curve. All pump motors should be non-overloading to the end of the pump curve.
3. Size pumps at middle of the pump curve to allow for future load.
4. Select pumps that are sized for a critical speed of at least 115% operating speed at 60 Hz.
5. Select pumps that are free of flashing and cavitation at all flow rates between 25% and 125% of design flow under the suction conditions of the pump installation.
6. Select pumps that are designed to operate to 1,750 RPM unless directed otherwise.
7. Modulate water pumps 5 HP or greater with variable frequency drives.
8.

b. Install all ducts without dips and traps that may hold grease and sloped a minimum of 2 percent to drain grease back to the hood.
c. All joints should be welded and should be telescoping, bell, or flange joint as per NFPA 96.
d.

D. Duct Accessories:
   1. Provide balancing dampers with inspection ports at supply, return, and general exhaust branches when connected to larger ducts, as required, for air balancing.

23 34 00 HVAC FANS

A. Direct drive fans are required. Belt driven fans are not permissible.
B. Provide TEFC NEMA Premium Efficiency rated motor rated for compatibility with variable frequency drives where applicable. ODP motors are acceptable where TEFC is not required.
C. Select non-overloading motors at all points on the RPM operating curve.
D. Motors rated for compatibility with variable frequency drives shall be equipped with a conductive shaft grounding ring.
E. Provide all fans with factory supplied and mounted NEMA 1 disconnect switch. For roof-mounted equipment, provide NEMA 3R disconnect switch.
F.

23 64 00 WATER CHILLERS

A. Microchannel condenser and evaporator coils are NOT ALLOWED.
B. Water-cooled chillers:
   1. Preferred Manufacturers:
      a. Trane.
      b. York.
C. Air-cooled chillers:
   1. Preferred Manufacturers:
      a. Carrier, Aqua Snap.
      b. York.
D. Evaporator Tubes:
   1. Individually replaceable from either end and without damage to tube sheets and other tubes.
   2. Mechanically expanded into end sheets and physically attached to intermediate tube sheets such as with tube clips.
   3. Material: Copper or copper-nickel alloy.
   4. Nominal OD: ¾ inch or 1 inch.
   5. Minimum Wall Thickness Throughout Entire Tube Length: 0.025 inch.
   6. External Finish: Manufacturer's standard.
   7. Internal Finish: Enhanced.
E. Condenser Tubes:
   1. Individually replaceable from either end and without damage to tube sheets and other tubes.
   2. Mechanically expanded into end sheets and physically attached to intermediate tube sheets such as with tube clips.
   3. Material: Copper or copper-nickel alloy.
   4. Nominal OD: ¾ inch or 1 inch.
   5. Minimum Wall Thickness Throughout Entire Tube Length: 0.035 inch.
   6. External Finish: Manufacturer's standard.
   7. Internal Finish: Rifling or enhanced for service with cooling tower water. Enhanced for service with heating hot water system (heat pump chiller).

23 65 00 COOLING TOWERS

A. This section covers packaged cooling towers only. Field erected cooling towers with reinforced concrete structure will require custom specifications that are closely coordinated with and approved by SHSU.
B. Preferred Manufacturers:
   1. Marley/SPX Cooling Technologies
   2. Baltimore Aircoil Company
C. General Design Characteristics:
   1. Design Criteria: Ambient temperature of 98 deg. F dry-bulb and 90 deg. F wet-bulb, minimum condenser water delta T of 10 deg. F.
   2. Arrangement: Open-circuit, induced-draft, crossflow. Other arrangements may be allowed with prior approval by SHSU.
   3. Design for variable condenser water flow.
   4. Filter 5% of circulating flow using either sand filters or mechanical vortex filters.
   5. Design for N+1 redundancy for condenser water pumps and cooling tower cells.
   6. All internal components shall be stainless steel.

8. Daikin is not an acceptable manufacturer.
9. Trane is not an acceptable manufacturer.

B. General Design Characteristics:
   1. Mechanical rooms must be large enough to allow for manufacturer recommended clearances, coil pull space, filter replacement, UV lamp replacement, motor replacement, and any other manufacturer recommended routine maintenance or repairs. Clearance spaces should be noted on the drawings and should not require disassembly of the unit cabinet or modifications to any other

1. All hydronic coils should be self-draining, fin and tube type with aluminum fins mechanically bonded to seamless copper tubes and headers.
2. Aluminum tubes and headers are not allowed.
3. Chilled water coils should have a minimum 6-rows and maximum 10-FPI with 5/8-inch diameter copper tubes, 0.008-inch thick aluminum fins, and stainless steel casings.
4. Heating water coils should have a minimum 1-rows and maximum 10-FPI with 1/2-inch diameter copper tubes, 0.008-inch thick aluminum fins, and galvanized steel casings.
5. The maximum face velocity for a chilled water coil is 450-FPM.
6. The maximum face velocity for a heating water coil is 700-FPM.

F. Air Filtration:
1. Minimum filter efficiency should be MERV 13 for all airstreams, including recirculated or return air.
2. Filters should be standard size and locally stocked. Custom dimensioned filters are not allowed.
3. Filter media should be coated with an antimicrobial agent.
4. Install filter gauges at each filter bank for comparison with DDC instrumentation.
   a. Provide surface mounted pressure gauge, Dwyer Magnehelic, with integral leveling screw, graduated to read appropriate pressure range based on maximum dirty filter pressure loss.
   b. Provide static-pressure tips, tubing, gauge connections, and mounting bracket.

G. Dampers:
1. Factory-mounted modulating outside air, return air, and relief air dampers are preferred. Field installed modulating dampers are allowed where required for system arrangement.

H. Antimicrobial UV Lamp Systems:
1. Install UV-C lamps downstream of cooling coil section.
2. Provide inspection port in UV-C lamp section.
3. All components internal to air handling unit shall be rated for temperatures 34 to 158 deg. F, 100% relative humidity, at any velocity.
4. All components exposed to UV-C lamps shall be constructed of UV-resistant materials.
5. Provide quantity of UV-C lamps required for full coverage of cooling coil.
6. Provide mechanical interlock switch on access panels and doors to UV-C lamp section (or section within view of UV-C lamp system) to ensure system will be de-energized when accesses are opened.
7. Provide safety signage on access panels and doors to disconnect power source before servicing.

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4. Install the following coil return piping accessories: shutoff valve, strainer with blow-down valve, test port with extended neck for insulated piping, thermometer with thermowell, pressure gauge assembly with shutoff valve, control valve, balancing valve, and union or flanged connections.
5. Install pressure gauge at unit discharge for comparison with DDC instrumentation.
   a. Provide surface mounted pressure gauge, Dwyer Magnehelic, with integral leveling screw, graduated to read appropriate pressure range based on unit discharge static pressure.
   b. Provide static-pressure tips, tubing, gauge connections, and mounting bracket.

23 80 00 DECENTRALIZED HVAC EQUIPMENT

B. As of 2020, the EPA is developing a plan for the phasedown of HFC refrigerants. The PSP shall be responsible for selecting equipment that is in compliance with this plan. HFC refrigerants are expected to be slowly replaced by the next-generation of refrigerants, HFO's and HFO blends.
C. Microchannel condenser and evaporator coils are NOT ALLOWED.
D. Install auxiliary drain pans below all suspended, concealed fan coil units. Where applicable, extend drain pain 6-inches bew Qn

B. Design Phase Requirements:
   1. Refrigerant piping must be modeled in REVIT for appropriate space allocation and clash detection with other trades. Pipes may be modeled as a rectangular block in lieu of each pipe individually.
   2. Show access requirements for all equipment on drawings, including access for routine filter replacements. Where filters are to be replaced from below, coordinate auxiliary drain pan dimensions to maintain access.
   3. Concealed fan coil units that do not have integral filter racks should be modeled with filter rack accessory.
   4. Show access requirements for branch selector units.

C. Manufacturer Submittal Requirements:
   1. Include design calculations with corresponding diagram of refrigerant piping and tubing sizing.
   2. Include design calculations with corresponding floor plans indicating that refrigerant concentration limits are within allowable limits of ASHRAE 15 and governing codes.
   3. Include design calculations showing that maximum refrigerant piping and controls cabling horizontal and vertical distances are not exceeded.

D. Installation Requirements:
   1. Installation to be by a manufacturer certified technician. Installed must also have prior documented experience with the specific manufacturer of the VRF system.
   2. Engage a manufacturer's service representative to advise and assist installers, witness testing, and observe and inspect components, assemblies, and equipment installations, including controls and connections.
      a. Project specification should clearly outline the expectations of the manufacturer's service representative. These expectations should be reviewed with SHSU during the design phase. Expectations include but are not limited to the following:
         (i) Frequency of on-site visits during construction.
         (ii) Written field observation reports for each visit that should include deficiencies with photo documentation and recommended corrective action.
         (iii) Final inspection requirements which should include all system equipment and operating components regardless of project size.
         (iv) Test witnessing including leak testing, operational testing, and controls and safeties testing.
         (v) Startup supervision and Owner training.
      b. Kick-off Meeting:
         (i) Participants to include SHSU, design engineer, installer, manufacturer's service representative, and all other related trades.
         (ii) Review all relevant VRF system information including contract documents, specifications, drawings, submittals, and manufacturer requirements.
         (iii) Review expectations for manufacturer's service representative oversight.
      c. VRF system testing to include refrigerant tubing positive pressure testing, refrigerant tubing evacuation testing, and all other tests as recommended by the manufacturer.

23 82 10 FAN COIL UNITS

F. Manufacturers:
   1. Carrier.
   2. EMI.
   3. Johnson Controls.