
SECTION 23 00 00

HVAC SYSTEMS

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

- A. Conform to General and Supplementary Conditions, the modifications thereto and Division 1 General Requirements for all work in Division 23.
- B. Plans take precedence. Where conflict between specifications and plans, plans shall take precedence.

1.2 SCOPE OF WORK

- A. Provide labor, materials and appliances and satisfactory installation of HVAC work ready to operate in accordance with these specifications. Work includes, but is not limited to, that as delineated in this specification section and on the architectural, civil, landscape, and structural drawings.
- B. Coordination:
 - 1. Coordinate with other trades.
 - 2. Coordinate motor starter requirements with other trades.
 - 3. Where required by code and as indicated on plans, provide duct smoke detectors with shutoff for equipment.
- C. Project Closeout Requirements:
 - 1. Complete HVAC controls and schedule according to owner's setpoints and schedule requirements.
 - 2. Testing and balancing all of equipment.
 - 3. Reseal fans as necessary to achieve proper fan balancing.

1.3 PROPOSAL

- A. Proposals shall contain, but not be limited to, the following data:
 - 1. Basic contract price for systems described herein.
 - 2. Adjustments to contract price for alternates.
- B. Contractors are invited and encouraged to develop and submit for consideration alternates to the basic systems and sub systems. Contractor shall include costs for redesign, plan revisions and permit resubmittal in their alternate pricing.

1.4 CODES AND STANDARDS

- A. If any conflict occurs between legally adopted codes and this specification, the codes are to prevail; this shall not be construed as relieving the Contractor from complying with any

requirements of the plans or specifications which may be in excess of code requirements and not contrary to same.

- B. Conform to code and agency requirements having jurisdictional authority over installation as indicated on plans.

1.5 FINAL CONSTRUCTION APPROVAL

- A. Completion and approval of the following is required for final approval of systems.
 1. Execution of Architect's and Engineer's final observation reports.
 2. Operation and maintenance instruction.
 3. Operation and maintenance manuals submitted.
 4. Equipment cleaning.
 5. Record drawings submitted.
 6. Testing & Balancing Report submitted.
 7. Preliminary Commissioning Report submitted.
 8. Final Commissioning Report submitted.

1.6 DOCUMENTATION

- A. Product Submittals: Within thirty (30) calendar days (or as required by Division 1) after contractor's receipt of Owner's Notice to Proceed, submit in PDF format:
 1. Organized PDF electronic file that includes relevant catalog data for all equipment, insulation, hanger systems, parts and accessories in accord with Division 1.
 2. Unless otherwise indicated, material and equipment to be submitted includes all items specified in Part 2 (Products) in each section of Division 23 and as listed on equipment schedules on drawings, and/or necessary to complete the work.
 3. Clearly indicate on each page the equipment schedule designation, as applicable, and model intended for use.
 4. Do no fabrication or manufacture any products until return of approved submittals.
- B. Provide shop drawings for all products, systems, system components, and special supports which are not a standard catalog product and which may be fabricated for the Contractor or by the Contractor. Lay out drawings to scale and show dimensions where accuracy of location is necessary for coordination or communication purposes.
- C. The word "provide" in the drawings and specifications shall be understood to mean "furnish and install complete and operational".
- D. Permits: Submitted for, paid for, and obtained by Contractor. Submit copies of signed, approved permits to the Architect. See Supplementary Conditions.
- E. Record Drawings: See Division 1. Provide two sets of record drawings. Show location of equipment and size of piping and ductwork. Indicate locations of all valves, dampers, and similar equipment. One set of mark-up record drawings shall be located on site and maintained up-to-date with red pen. Mark-up record drawings shall be available to Engineer upon site visits.

- F. Operating and Maintenance Manuals: Furnish three (3) copies of operating and maintenance manuals. Manual shall be hard-cover loose-leaf with index and tabbed Sections. Manual shall include the following:
 - 1. Manufacturers, suppliers, and subcontractors' names, address, and phone numbers.
 - 2. Schedule and description of routine maintenance for each component to include oiling, lubrication and greasing data, and belt sizes, types and lengths.
 - 3. Balancing and test data.
 - 4. Part numbers of all replaceable items.
 - 5. Control diagrams and sequence of operating.
 - 6. Written guarantees.
 - 7. Record drawings corrected and completed.
 - 8. Copies of manufacturer's warranties on equipment.
 - 9. Equipment submittals.
 - 10. Completed equipment start-up forms.
- G. Operation Instruction Period: Conducted by Contractor during minimum four (4) hour period. Deliver and post all operation and maintenance instructions at this time.

1.7 ELECTRICAL

- A. Power Wiring: By Electrical Contractor.
- B. Control Wiring for HVAC: By Division 23. If line voltage control wiring is required, provide an allowance for same.
- C. Owner will not entertain additional cost requests due to lack of coordination between Division 23 and Electrical Contractor.

1.8 WARRANTY

- A. Warrant materials and workmanship for one year in accord with the General and Supplementary Conditions. Provide written guarantees which exceed one year. Submit with Maintenance and Operating Manual. Warranty period to extend from date of substantial completion.

1.9 EMERGENCY SERVICE

- A. The subcontractor shall provide a twenty-four (24) hour emergency telephone number for all warranty work related to their contract. The subcontractor shall complete all emergency service work with the same day of notice.

1.10 COORDINATION OF WORK

- A. Coordinate installation to preclude interference between trades. Conflicts shall be brought to the attention of the Architect prior to installation.
- B. Insure proper "rough-in" on all equipment to which connections are made.

1.11 LUBRICATION

- A. Lubricate all moving parts per manufacturer's recommendation. Replace ruptured seals caused by excessive lubrication. Attach service record label with space for future service to all major equipment.

1.12 CUTTING AND PATCHING

- A. Provide all cutting and patching necessary to install work not otherwise coordinated with other trades prior to installation. Patching shall match adjacent surfaces.

1.13 TESTING AND BALANCING

- A. Provide completed start-up forms and checklists.
- B. Work shall be performed by independent Air Testing and Balance Agency specializing in testing and balancing or heating, ventilating, and cooling systems to balance, adjust, and test air moving equipment, air distribution, and exhaust systems.
- C. Perform testing and balancing in accordance with Associated Air Balance Council (AABC) or National Environmental Balancing Bureau (NEBB). All work shall be supervised. Calibrate instruments used for testing and balancing within a period of six months of start of work.
- D. Mechanical Contractor shall assist Balancing Agency in testing and balancing or mechanical equipment.
- E. Provide replacement sheaves, pulleys, and belts when necessary to achieve proper air balance. Air balance shall not be accomplished with excessive damper closure when fan speed adjustment is an option.
- F. Provide three (3) copies of typed and bound report to be included in Preliminary and final Commissioning Report.
- G. Report shall consist of test sheets similar to AABC Forms as follows:
 - 1. Form 12666 Diffusers and Grilles
 - 2. Form 12766 Air Handling Equipment
 - 3. Form 12866 Exhaust Fans
 - 4. Additional Reports as Required
- H. Report shall include the following:
 - 1. Preface suggesting abnormalities and problems encountered.
 - 2. Instrumentation List including type, model, manufacturer, serial number, and calibration dates.
 - 3. System Identification reporting location of equipment, zones, supply, return, and exhaust openings.
 - 4. Record following for each piece of air handling equipment:
 - a. Manufacturer, model number, and serial number.
 - b. Design and manufacturer rated data.

- c. Actual CFM.
- d. Suction and discharge static pressure of each fan.
- e. Outside-air and Return-air total CFM.
- f. Actual operating current, voltage, and brake horsepower of each fan motor.
- g. Final RPM of each motor.
- h. Static pressure controls final operating set points.

1.14 COMMISSIONING

- A. Submit three (3) copies of the preliminary commissioning report as required by Energy Code and as outlined on drawing commissioning notes. This report is an execution and fulfillment of the commissioning plan. This report shall be completed before the building is issued a certificate of occupancy. At a minimum, this report shall include:
 - 1. Test and balance report.
 - 2. Complete equipment startup checklist.
 - 3. Functional test reports.
 - 4. Sequence test reports.
 - 5. O&M materials.
 - 6. Record drawings.
 - 7. Owner training documentation.
 - 8. Note any discrepancies observed during testing and any corrective actions taken or date when corrective action will be taken.
 - 9. Note any test which could not be performed due to weather conditions.
- B. After receiving review comments from the preliminary commission plan, make corrections indicated and submit three (3) copies of the final commissioning report. At a minimum this report shall include the information from the preliminary commission report and the Corrective Measures taken in response to preliminary report or field observation report.

PART 2 - PRODUCTS

2.1 PROGRAMMABLE THERMOSTATS

- A. Guestroom Thermostats: Electronic programmable thermostats compatible with guestroom mechanical system and applicable energy code and central control systems where applicable.
- B. Corridor Programmable Thermostat: Similar to "A", but with remote sensor and thermostat located in a locked closet nearby.

2.2 DUCT-MOUNTED SMOKE DETECTORS

- A. Duct-mounted smoke detectors shall be UL listed for use in air handling systems. Detectors shall comply with NFPA 90A. They shall contain a detector which samples the width of the air duct.

2.3 ELECTRIC ACTUATORS

- A. Manufacturers: Belimo or approved equal. Proportional, spring-return to open or closed as appropriate. Direct mount.

2.4 REFRIGERANT PIPING

- A. Provide refrigerant piping from indoor to outdoor unit. Piping shall be type "ACR" copper, sized and installed per manufacturer's recommendations. Pipe shall be sized per "long line" standards to minimize capacity loss in lines. Verify routing with Architect prior to installation.

2.5 METAL DUCTWORK

- A. Standards: Comply with most stringent requirements and recommendations of International Mechanical Code, or SMACNA (Sheet Metal and Air Conditioning Contractors National Association) Low Pressure Duct Construction Standards for fabrication, construction and sealant of duct, fittings and accessories.
- B. Materials:
 1. Galvanized Steel Ducts: ASTM A653 galvanized steel sheet, lock-forming quality, having G60 zinc coating in conformance with ASTM A90.
 2. Steel Ducts; ASTM A1008.
 3. Aluminum Ducts: ASTM B209; aluminum sheet, alloy 3003-H14.
 4. Aluminum Connectors and Bar Stock: Alloy 6061-T6 or of equivalent strength.
 5. Stainless Steel Ducts: ASTM A167, Type 304.
 6. Fasteners: Rivets, bolts, or sheet metal screws.
 7. Hanger Rod: ASTM A36; steel, galvanized; threaded both ends, threaded one end, or continuously threaded.

2.6 DUCTWORK

- A. Ductwork, hangers, and supports in compliance with SMACNA and Mechanical Code, requirements and recommendations.
- B. Insulated Flexible Ducts:
 1. Thermaflex M-KC or approved equal.
 2. Product Description: Insulated assembly with inner duct of woven and coated fiberglass permanently bonded to coated steel wire helix, 1 inch fiberglass insulation, and vapor barrier jacket of fiberglass reinforced metallized film laminate, UL 181 Class 1 complying with NFPA 90A & 90B.
- C. Single Wall Spiral Round Ducts
 1. Manufacturers: McGill AirFlow, Semco or approved equal.
 2. Product Description: UL 181, Class 1, round spiral lockseam duct constructed of galvanized steel.
 3. Elbows: Smooth radius or 5 section, 1.5D.

4. Application: Required for all exposed round ductwork; all round ductwork 12 inch diameter and larger; all round ductwork with static pressure over 1 inch w.g. Optional for all round ductwork.
- D. Single Wall Spiral Flat Oval Ducts
1. Manufacturers: McGill AirFlow, Semco or approved equivalent.
 2. Product Description: Machine made from round spiral lockseam duct construction of galvanized steel; rated for 10 inches w.g pressure.
 3. Joints: Either fully welded or bolted flange with gasket material.
 4. Application: All flat oval ducts.
- E. Single Wall Round Ducts
1. Manufacturers: Ductmate GreenSeam+ or approved equal.
 2. Product Description: Snap lock round duct with self-sealing butyl rubber longitudinal seam and polyurethane gasket transverse seam. No external sealant. No VOCs.
 3. Application: Only allowed for low pressure ductwork with static pressure of 1 inch w.g. or less, less than 10 inches diameter and concealed. Not for use exposed.
- 2.7 DRYER BOX
- A. Manufacturers: Guy Gray, In-O-Vate Technologies or approved equal.
 - B. 22 gauge aluminized steel manufactured wall recessed dryer vent hose receptacle with opening for 4 inch diameter duct. UL Classified for one hour wall.
- 2.8 CLOTHES DRYER EXHAUST DUCTWORK
- A. Rigid galvanized sheet metal of minimum 26 gauge with smooth interior finish.
- 2.9 FIRE/SMOKE DAMPERS
- A. Provide fire and fire/smoke dampers where required to preserve fire-rated assemblies. Coordinate with Architect to establish all locations as required by building code and/or local jurisdiction.
- 2.10 CEILING AND CABINET FANS
- A. Provide as scheduled on plans.
- 2.11 ROUND DIFFUSERS
- A. Manufacturers: Titus, Price, Krueger or approved equal.
 - B. Product Description: Type: Round, adjustable pattern, stamped or spun, multi-core diffuser to discharge air in 360 degree pattern.
 - C. Fabrication: Steel.

2.12 RECTANGULAR CEILING DIFFUSERS

- A. Manufacturers: Titus, Price, Krueger, or approved equal.
- B. Type: Square, stamped, multi-core, adjustable pattern diffuser.
- C. Frame: Surface mount with flat frame or T-bar lay-in.
- D. Fabrication: Steel.

2.13 SUPPLY REGISTERS

- A. Manufacturers: Titus, Price, Krueger, or approved equal.
- B. Type: Contoured and individually adjustable blades, 3/4 inch blade spacing, two-way deflection.
- C. Frame: 1-1/4 inch margin with countersunk screw mounting and gasket.
- D. Fabrication: Steel.

2.14 EXHAUST/RETURN GRILLES

- A. Manufacturers: Titus, Price, Krueger, or approved equal.
- B. Type: Curved blades, 1/2 inch blade spacing, with blades set at 30 degrees.
- C. Frame: 1-1/4 inch margin with countersunk screw mounting.
- D. Fabrication: Steel with 20 gauge minimum frames and 22 gauge minimum blades.

2.15 CEILING GRID CORE EXHAUST AND RETURN GRILLES

- A. Manufacturers: Titus, Price, Krueger, or approved equal.
- B. Type: Fixed grilles of 1/2 x 1/2 inch aluminum core.
- C. Frame: 1-1/4 inch margin with countersunk screw mounting or channel lay-in frame for suspended grid ceilings.
- D. Fabrication: Aluminum.

2.16 LOUVERS

- A. Manufacturers: Greenheck, Ruskin, or approved equal.
- B. Product Description: Stationary, drainable blade. AMCA certified.
- C. Type: 4 inch deep with blades on 45 degree slope, heavy channel frame. Minimum initial point of water penetration of 900 fpm.

- D. Fabrication: 12 gauge thick extruded aluminum, welded assembly, with factory Kynar finish.
- E. Bird Screen: Aluminum bird screen.

2.17 CORRIDOR SUPPLY PACKAGED ROOFTOP AIR HANDLING UNITS

- A. Provide as scheduled on plans.

2.18 SPLIT-SYSTEM DUCTLESS AIR CONDITIONING, VARIABLE REFRIGERANT FLOW SYSTEMS AND HEAT PUMP UNITS

- A. Provide as scheduled on plans.

PART 3 - EXECUTION**3.1 ACCESS**

- A. Install equipment with associated ductwork and piping to permit access to doors and panels as required for periodic maintenance (e.g. filter servicing).

3.2 INSTALLATION

- A. Install equipment in accord with manufacturer's recommendations. Bring conflicts between such recommendations and drawings to immediate attention of Architect/Engineer.

3.3 DUCTWORK

- A. Ductwork, hangers, and supports in compliance with SMACNA and Mechanical Code, requirements and recommendations.

3.4 CLOTHES DRYER DUCT INSTALLATION

- A. Ducts shall terminate outside the building and be equipped with a backdraft damper. No screens shall be used at termination.
- B. Ducts shall not be constructed with sheet metal screws or other fasteners that enter the airstream. Ductwork shall be metal with smooth interior finish. The male end of duct joints shall extend in the direction of airflow.
- C. Dryer ducts which penetrate a wall or ceiling membrane shall be fire caulked.
- D. Dryer ducts shall be supported at minimum 4 foot intervals and secured in place.
- E. Provide protective shield plates where duct is in concealed locations within framing. Plates shall be 16 gauge steel and cover the duct area plus 2 inches. Shields may be omitted if duct is more than 1-1/2 inches from nearest edge of structural member.

3.5 FILTERS

- A. Provide two complete sets of filters: one for use during construction and one initial operating set.

3.6 FIRE AND FIRE/SMOKE DAMPERS

- A. Provide fire and fire/smoke dampers where required to preserve fire-rated assemblies. Coordinate with Architect to establish all locations as required by building code and/or local jurisdiction.

3.7 DUCT MOUNTED SMOKE DETECTORS

- A. Duct-mounted smoke detectors shall be UL listed for use in air handling systems and shall comply with NFPA 90A. They shall contain a detector which samples the width of the air duct and contacts for interface with the fire alarm system.

3.8 CONTROLS INSTALLATION

- A. Furnish all control products to accomplish the specified sequence of operation, except those products specifically furnished under other sections.
- B. Install all control products and connections, except where already installed by the equipment manufacturer.
- C. General:
 - 1. Install controls by mechanics skilled in erection of control systems under supervision of control manufacturer's representative.
 - 2. Mount control equipment and devices as recommended by manufacturers and as shown on drawings; in case of conflicts between manufacturer's instructions and the drawings, consult the Project Manager for direction.
 - 3. Fasten all equipment securely to structure. Install equipment and exposed piping and conduit runs parallel to building lines, plumb and level.
- D. Wiring: All wiring shall be the responsibility of the Division 23 contractor.
- E. Install thermostats, space temperature sensors, and other exposed control sensors after locations are coordinated with other Work.
- F. Mount thermostats and other human interface devices at 48 inch centerline above finished floor to comply with ADA accessibility per ANSI A117.1. Align thermostats and devices with light switches and other controls.
- G. Coordinate wall location of thermostats and other wall mount devices with light switches and controls provided by others. All devices in the same vicinity should be grouped at a common elevation with regular horizontal spacing intervals.
- H. After completion of installation, start-up, test, and adjust each system. Submit data showing set points, final adjustments of controls and compliance with sequence of operations.

- I. Work in close coordination with testing and balancing Agency to set up control devices, set damper flow rates, and provide control system in perfect operating order.
- J. Demonstrate complete operation of systems to Owner, including sequence of operation, prior to Date of Substantial Completion.

3.9 OUTDOOR AIR HANDLING UNIT INSTALLATION

A. Examination

- 1. Verify roof curbs are installed and dimensions are as shown on shop drawings.
- 2. Verify piping rough-in is at correct location.
- 3. Verify electrical rough-in is at correct location.

B. Installation

- 1. Install in accordance with ARI 430.
- 2. Roof Curb: Assemble roof curb. Install roof curb level. Coordinate curb installation and flashing. Install units on roof curb providing watertight enclosure to protect ductwork and utility service. Install gasket material between unit base and roof curb.
- 3. Provide seismic anchorage of equipment to curb and curb to structure.
- 4. Install flexible connections between unit and inlet and discharge ductwork. Install metal bands of connectors parallel with minimum one inch flex between ductwork and fan while running.
- 5. Install assembled units with vibration isolators. Install isolated fans with resilient mountings and flexible electrical leads.
- 6. Install condensate piping with trap and route from drain pan to splash block on roof.
- 7. Provide fixed sheaves required for final air balance.
- 8. Install components furnished loose for field mounting.
- 9. Install electrical devices furnished loose for field mounting.
- 10. Install control wiring between unit and field installed accessories.

END OF SECTION