

SECTION 230100 – GENERAL MECHANICAL REQUIREMENTS

PART 1 - GENERAL

1.01 BUY AMERICAN REQUIREMENTS

- A. Provide certificates to show that all products meet the following requirements.
 - 1. American Iron and Steel (AIS)
 - 2. Build America, Buy America Act
- B. See Supplementary Conditions for details.

1.02 SECTION INCLUDES

- A. Basic Mechanical Requirements specifically applicable to Division 21, 22, and 23 Sections as delineated in these specifications, in addition to Division 01 – General Requirements.

1.03 SCOPE

- A. Furnish all labor, materials, equipment, supervision of labor and performance of all operations required to completely install satisfactorily operating mechanical and plumbing systems as defined herein and on Drawings.
- B. Major items of work include, but are not limited to, the installation of the following systems:
 - 1. Plumbing systems.
 - 2. Heating, ventilation & air conditioning systems.
 - 3. Heat generation systems.
 - 4. Heat transfer systems.
 - 5. Air handling systems.
 - 6. Controls systems.
- C. Other Divisions of these Specifications apply to work generally defined by Division 21, 22, and Division 23 Specifications and/or shown on Mechanical Drawings. For additional details, refer to Drawings detailing work under other Divisions. All work shown on the "M" series Drawings, Division 22 and 23 Specifications, and referenced Division 21 Specifications is to be provided unless otherwise stated.
- D. The drawings and specifications are complementary to each other. What is shown on one is as binding as if called for in both. The mechanical drawings are generally diagrammatic and are intended to show mechanical details in a schematic fashion. Do not scale mechanical drawings. Exact locations are not shown unless so indicated or specifically dimensioned. Typical connection diagrams are schematic and do not show the actual physical arrangement of equipment. The plans do not necessarily show complete details of all the features that may affect the mechanical installations; however, it is the intent of the contract documents to provide a complete and satisfactorily working installation.
- E. Submit in writing to the Owner's Representative for review details of any necessary or proposed departures from these Contract Documents and reasons therefore, as soon as practicable within

30 days after the award of the contract. Make no such departure without prior written approval of the Owner's Representative.

- F. Coordination of the Work: Coordinate work under this Division with work of other trades to avoid conflicts, errors, and delays.
- G. Verify the approximate location of equipment and other mechanical system components shown on the Drawings and report any conflicts with openings, structural members, and components of other systems and equipment having fixed locations.
- H. During the course of accomplishing the work defined herein and on the Contract Drawings, the Contractor discovers major damage, defect or deterioration to existing equipment or systems indicated as existing to remain, and where such damage, defect or deterioration will or might effect the safe and proper operation of such equipment and systems, the Contractor shall immediately notify the Owner's Representative in writing.

1.04 REFERENCES

- A. Codes and Standards: All work and materials shall comply with the latest issues of the following:
 - 1. American Gas Association (AGA).
 - 2. Air Moving and Conditioning Association (AMCA).
 - 3. American National Standards Institute (ANSI).
 - 4. Air-Conditioning and Refrigeration Institute (ARI).
 - 5. American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE).
 - 6. American Society of Mechanical Engineers (ASME).
 - 7. American Society for Testing Materials (ASTM).
 - 8. American Water Works Association (AWWA).
 - 9. American Welding Society (AWS).
 - 10. Environmental Protection Agency (EPA).
 - 11. Hydraulic Institute (HI).
 - 12. International Building Code (IBC).
 - 13. International Fire Code (IFC).
 - 14. International Fuel Gas Code (IFGC).
 - 15. International Mechanical Code (IMC).
 - 16. National Bureau of Standards (NBS).
 - 17. National Environmental Balancing Bureau (NEBB).
 - 18. National Electrical Code (NEC).
 - 19. National Electrical Manufacturers Association (NEMA).
 - 20. National Fire Protection Association (NFPA).
 - 21. Occupational Safety and Health Administration (OSHA).
 - 22. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA).
 - 23. Underwriters Laboratories, Inc. (UL).
 - 24. Uniform Plumbing Code (UPC).
 - 25. All base materials shall comply with standards of ASTM and ANSI.

1.05 QUALITY ASSURANCE

- A. All work and materials shall be in accordance with applicable codes, standards and ordinances, rules and regulations of the Fire Marshal and of the utility companies. Nothing in the Drawings and Specifications shall be construed as requiring or permitting work in violation of such codes.
- B. Rulings and interpretations of the agencies having jurisdiction shall be considered as part of the codes and regulations if commonly known to the trade prior to bidding.
- C. Whenever the Drawings and Specifications require higher standards than the codes and regulations, the Drawings and Specifications shall govern.
- D. Only craftsmen skilled in their trade shall be employed.
- E. Fan Requirements:
 - 1. Performance Ratings: Conform to AMCA 210 and bear AMCA Certified Rating Seal.
 - 2. Sound Ratings: AMCA 301, tested to AMCA 300 and bear AMCA Certified Sound Rating Seal.
 - 3. UL Compliance: UL listed and labeled, designed, manufactured, and tested in accordance with UL 705.
 - 4. Balance Quality: Conform to AMCA 204.

1.06 QUALIFICATIONS

- A. Manufacturers: Company specializing in manufacturing products specified in subsequent sections shall have a minimum three years of experience.
- B. Installers: Company specializing in performing Work of this section with a minimum three years of experience.

1.07 SUBMITTALS

- A. Submit shop drawings, product data, material data sheets, manufacturers' literature, and all other items as specified in Division 01 and the individual sections of Divisions 21, 22, and 23. Incomplete or partial Division 21, 22, and 23 submittals will be returned without review.
- B. Shop Drawings and Manufacturer's Literature:
 - 1. Submit large scale dimensioned shop drawings certified by manufacturer of major equipment and other equipment as may be directed by the Owner's Representative.
 - 2. Coordination Drawings: Submit shop drawings for work in congested areas, indicating solutions to space problems and coordination with work by other trades and specification divisions. As the coordination drawings provide the means to resolve space conflicts and issues, likewise they will serve as the vehicle to sequence work. Space and scheduling will have been resolved prior to the start of work. Do not proceed without obtaining prior approval of shop drawings from the Department. These drawings must indicate work by other trades including, but not limited to:
 - a. Mechanical equipment.

- b. Ductwork.
 - c. Plumbing piping and equipment.
 - d. Heating and piping.
 - e. Electrical work including, but not limited to:
 - 1) Panels, transfer switches.
 - 2) Disconnects, motor starters, VFDs.
 - 3) Conduits 3 inches and larger.
 - 4) Banks of conduits larger than a total width of 12 inches.
 - 5) Junction or pull boxes greater than 12 inches by 12 inches.
 - 6) Cable trays.
 - 7) Busways.
 - 8) Indicate on the drawings the associated NEC clearances for the above items.
 - f. Structural members.
 - g. Architectural features including door swings.
3. Shop drawings for the various systems shall be at a minimum scale of 1/2 inch = 1 foot, shall be completely dimensioned, and shall clearly show the following:
- a. Legend and abbreviation table.
 - b. Fittings.
 - c. Offsets and transitions.
 - d. Sizes.
 - e. Mounting heights and basis of given height (e.g., bottom of duct).
 - f. Duct turning vanes and air extractors.
 - g. Fire and smoke dampers.
 - h. Volume dampers (different symbols to be used for manual verses remote linkage dampers).
 - i. Duct lining.
 - j. Valve types and locations.
 - k. Drains and vents.
 - l. Insulation.
 - m. Sound traps.
 - n. Access doors.
 - o. Building access panels.
 - p. Flexible connections.
 - q. Duct and pipe sizes.
 - r. Duct gage, construction, reinforcement, and material.
 - s. Duct hangers and supports.
 - t. Duct sealing methods and requirements.
 - u. Fire and smoke damper installation details.
 - v. Exterior wall and roof penetration details.
 - w. Sleeve details.
- C. Submit shop drawings of any product that is not the standard catalog product of an established manufacturer and is fabricated by the Contractor.
- D. Submit shop drawings and other items as specified in the individual Sections.
- E. Include with shop drawings of fabricated items the basis of design and design calculations.

1.08 CLOSEOUT SUBMITTALS

- A. Submit all required certifications and testing reports as specified in Division 01 and as follows:
1. Upon completion of instruction, submit a certification that instruction in the maintenance and operation of all mechanical systems and equipment, as specified herein, has been provided to designated personnel.
 2. The certification shall:
 - a. List systems and equipment which were the subject of instruction,
 - b. List the names personnel instructed the dates of instruction,
 - c. List the names of the personnel providing instruction,
 - d. List the appropriate areas of instruction,
 - e. List the dates of classroom and on-site instructional session, and
 - f. Be signed by all individuals participating in the instruction (both instructor and instructed).
- B. Operating and Maintenance Data:
1. Provide six (6) sets of each type of instruction bound together in D-ring metal-ringed hardcover binders with removable pages, with a typewritten index indicating location of items in the work. Any information not pertinent to this work shall be deleted or neatly and completely lined out. Binders shall be of capacity to allow a minimum of 20 percent expansion.
 2. The following components of the mechanical portion of the maintenance manual shall be printed so as not to fade, be permanently framed, glass or plexiglass covered and mounted in a convenient location in the respective mechanical room where the equipment and/or systems are located:
 - a. Pipe and duct identification schedules.
 - b. Valve directory.
 - c. Equipment nameplate directory.
 - d. System schematic drawings.
 - e. Master maintenance schedule.
 3. Operating and maintenance data must be provided for Owner's Representative approval at least thirty (30) days prior to Substantial Completion. If approved operation and maintenance instructions are not on hand at the time of Substantial Completion and/or occupancy, the Contractor, at his own expense, shall make all repairs, replacements and installation of any components that may be destroyed or damaged due to the absence of specified instructions, and shall hold the Owner harmless.
- C. Submit mechanical HVAC system start-up, testing, commissioning, and demonstration plans.
- D. Submit controls system start-up and demonstration plans.
- E. Submit a mechanical system operating instruction training schedule complete with class outline lesson plan that includes training topics and durations.
- F. Project Record Documents: Record actual locations of components and tag numbering. Record actual locations and deviations of piping from drawings. Indicate drain and test locations.

- G. Operation and Maintenance Data: Submit spare parts lists.

1.09 PROJECT CONDITIONS

- A. Site Visit: It is advised that the Contractor visit the site and verify the exact conditions relating to his work and obtain such information as may be necessary to provide an intelligent and conclusive bid. No allowance will be made on behalf of the Contractor for any extra expense due to failure on his part to make such a visit.
- B. Protection: Protect surrounding areas and surfaces to preclude damage due to the installation of any material or equipment. Unfinished work shall be temporarily protected from unsafe conditions and damage.
- C. Sequencing and Scheduling: Coordinate the scheduling of equipment and material installations with all other affected trades to avoid conflicts. If, during the course of construction, conditions are discovered which adversely affect the mechanical work, immediately notify the Owner's Representative before proceeding. Advise other trades of openings required in their work for the subsequent installation of mechanical work or equipment.

1.10 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.11 INSPECTION

- A. All work and materials shall be subject at all times to inspection by the Owner's Representative and by the agencies having jurisdiction.
- B. Any work or materials found to be damaged or defective or not conforming to the requirements of the Drawings or Specifications, or to the approved finish aesthetic appearance of the job, shall be removed and replaced as directed by the Owner's Representative.

1.12 ELECTRICAL REQUIREMENTS

- A. All electrical work, equipment, wiring, devices, and components shall comply with the requirements of local and national electrical codes and with Division 24, 25, 26.
- B. All electrical equipment, devices, and components that are tested by Underwriters Laboratories, Inc. shall be UL listed and shall bear a UL label.

- C. Unless otherwise indicated on the electrical drawings, all mechanical equipment motors and controls shall be furnished, set in place, and wired in accordance with the following schedule. (Carefully coordinate all work with Divisions 24, 25, and 26.) Refer to Divisions 24, 25, and 26 for motor characteristics and motor controls.

	FURNISHED UNDER DIVISION	SET IN PLACE BY DIVISION	LINE VOLTAGE POWER UNDER DIVISION	MECH CONTROL
Equipment Motors	21,22,23	21,22,23	26	21,22,23
VFD Starters:				
a. Automatically controlled	26	26	26	21,22,23
b. In packaged equipment	21,22,23	21,22,23	26	21,22,23
Magnetic Motor Starters:				
a. Automatically controlled	26	26	26	21,22,23
b. Manually controlled	26	26	26	21,22,23
c. In packaged equipment	21,22,23	21,22,23	26	21,22,23
d. Disconnect switches, manual motor starters, thermal overload switches not provided with starter	26	26	26	--
e. Control relays, transformers, time clocks, thermostats, motor valves, float controls, damper motors, EP and PE switches and other miscellaneous Division 22 and 23 controls	21,22,23	21,22,23	26	21,22,23

- D. Where Drawings clearly and explicitly differ from preceding paragraphs, Drawings have precedence.
- E. Factory wired assemblies and panels shall be prewired to numbered terminal strips for connection to field wiring.

1.13 USE OF HEATING SYSTEMS DURING CONSTRUCTION

- A. The Contractor is free to use or operate the heating system, provided the operation is approved in writing by the Owner's Representative. Operation of the air delivery system during construction shall only be done with specified filters properly installed.
- B. When construction is complete, the Contractor shall install new filters at no additional expense to the Owner. The Contractor shall pay for all energy used until acceptance of the building.

1.14 GUARANTEE

- A. Neither the final certificate of payment, nor any provision in the Contract Documents, nor partial or entire occupancy of the premises by the Owner shall constitute an acceptance of work not done in accordance with the Contract Documents or relieve the Contractor of liability in respect to any express warranties or responsibilities for faulty materials or workmanship.

- B. The Contractor shall remedy any defects in the work and pay for any damage to other work resulting therefrom which shall appear within a period one year from the date of final acceptance of work, unless a longer period is specified. The Owner's Representative will give notice of observed defects with reasonable promptness.

1.15 OPERATING AND MAINTENANCE DATA

- A. The Contractor shall prepare operating and maintenance instructions containing information to operate, prolong service life or replace parts of the work. Operating and maintenance data shall specifically include:
1. List of all contractors' and subcontractors' names, addresses, and telephone numbers.
 2. List of all equipment and material manufacturers' local representatives and suppliers and their addresses and telephone numbers.
 3. Pipe and duct identification schedules.
 4. Nameplate directory with a list of all equipment indicating designation, location of equipment, manufacturers' name, model number, serial number, electrical characteristics, primary control switch location and normal position of switch.
 5. Valve directory indicating valve number, size, location, function, service, type, and normal position.
 6. Boiler factory start-up testing report.
 7. Air and hydronic test and balance report.
- B. Equipment Literature: For all equipment, fixtures, devices, valves and specialties, provide the following:
1. Manufacturer's data sheets and cut sheets.
 2. Model and serial numbers.
 3. Capacity curves, charts and calculations.
 4. Electrical characteristics.
 5. Replacement parts list.
 6. As-built equipment piping diagrams.
 7. As-built equipment wiring diagrams.
 8. Manufacturer's instructions for operation and maintenance.
 9. Completely mark out on all literature sheets all non-applicable items.
 10. Where piping and wiring diagrams are not available from the manufacturer, they shall be produced by the Contractor.
 11. Literature shall be grouped together by system, i.e., plumbing, heat generation, etc. For each system section, the Contractor shall produce and include a basic system written narrative description. Each narrative shall be comprised of the following:
 - a. Brief system description, including sequence of operation.
 - b. Basic system function discussion, including any interaction with other systems or components.
 - c. Primary system preventive maintenance procedures.
 - d. How to isolate all major components.
 - e. How to drain, fill, and vent liquid system.
 - f. How to drain, clean, and refill all tanks, pumps, and tube bundles.
 - g. How to clean coils and change air filters for air systems.
 - h. Emergency shutdown procedures.

C. System Schematic Drawings:

1. The Contractor shall produce and include in the maintenance manuals, simplified schematic drawings of the mechanical systems, specifically including, but not necessarily restricted to, the following systems:
 - a. Hydronic heating systems.
 - b. Ventilation and exhaust systems.
 - c. Domestic water systems.
 - d. HVAC controls systems.
2. Schematic drawings shall: Show in simplified form, major equipment and equipment components, control dampers, control valves and valves or devices used during normal system operation, maintenance work or emergency functions.
 - a. Show the primary flow paths for air and hydronic systems.
 - b. Reference all shown equipment, devices, ducts, zones, controls devices, piping and valves by the designations and identification tags listed in the valve directory, nameplate directory, duct schedule and pipe coding schedules.

- D. Master Maintenance Schedule: List each item of equipment requiring inspection and maintenance, showing component maintenance required and the intervals when such inspection and maintenance shall be performed (daily, weekly, monthly, semi-annually, etc.). For each item, reference the page within the maintenance manual where detailed manufacturer's maintenance instructions can be found.

PART 2 - PRODUCTS

2.01 MATERIALS AND EQUIPMENT

- A. Materials and equipment shall be those of major and reputable manufacturers with ability to render competent and thorough service through local organizations and expeditiously to provide spare parts.
- B. In addition to material and equipment specified, also provide incidental materials required to effect complete installation. Such incidental materials include solders, tapes, caulking, mastics, gaskets, etc.
- C. Mixes, Compounds, Dopes, Tapes and Fluxes: All mixes, compounds, dopes, tapes and fluxes shall be fresh, highest quality, free of contaminants, of the type and grade suitable for the intended use in each case. Where more than one type of mix, etc. is specified for the same service, select one type; however, state which type is proposed for use in the submittal material and in no case more than one type is to be used in a specific mechanical system. Where two or more units of the same mix, etc., are required, provide products of a single manufacturer. Provide mixes, etc., bearing approval stamps wherever standards have been established. Comply with governing regulations and industry standards for selections, and with manufacturers' recommendations where applicable.

- D. Valves, piping specialties, and escutcheons and access panels to be of same manufacturer throughout installation even though they may be specified in different Divisions of these specifications.
- E. All materials and equipment shall be free of asbestos. Mixes, fluxes, and solders shall be free of lead. Submit certification no asbestos or lead based materials have been used or installed.
- F. Provide all special tools and extra materials required for maintenance of installed equipment as follows:
 - 1. Supply two 12-ounce containers of packing lubricant and cartridge style grease gun such as controls system tools and grease guns.
 - 2. Furnish two packing kits for each size valve, two loose keys for outside hose bibs and two[pump seals for each pump model.
 - 3. Furnish two sets of belts for each fan.
 - 4. Furnish one additional set of filters for each unit.
 - 5. Furnish one set of wrenches for disassembly of plate type heat exchangers.
 - 6. Furnish 1 container of lithium bromide and inhibitors or ammonia.

2.02 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. All materials shall be new, unused, and delivered to the job site packed in their original containers.
- B. All materials shall be delivered free of damage or defects.
- C. Provide adequate storage facilities at the job site to protect materials from damage or corrosion.
- D. Protect material, equipment, and apparatus provided under this Division from damage, water, dust, etc., both in storage and installed until final completion has been filed. Materials, equipment, or apparatus damaged because of improper storage or protection will be rejected and must be removed from site.
- E. Piping, ductwork and all similar equipment shall be capped or protected during storage and installation to protect from construction debris and dust contamination.

PART 3 - EXECUTION

3.01 PREPARATION

- A. The Contractor shall lay out all work in advance of construction and shall determine the correct location and placement of all material and equipment.
- B. Schedule all work in coordination with that of other trades in order to avoid delays in construction and unnecessary cutting and patching.

3.02 INSTALLATION

- A. All work shall be installed neatly and in accordance with the best practices in the trade.
- B. Workmanship must be of highest quality, done by persons especially skilled at assigned tasks, resulting in neat, clean, and well-done installations consistent with best practices of trades.
- C. Repair or replace materials and parts of premises that become damaged as a result of installation of work of this Division. Remove replaced parts from the premises.
- D. Ensure installation is performed per the manufacturer's instructions.

3.03 OPERATING AND MAINTENANCE INSTRUCTION

- A. Mechanical Instruction: The Contractor shall provide a minimum of 80 hours of instruction on the operation and maintenance of all mechanical systems to maintenance personnel.
- B. Instruction shall be performed by a qualified technician.
- C. Instruction of major pieces of equipment shall be given by a factory certified representative.
- D. The instruction shall consist of both a "classroom" period and a "field" period.
- E. The classroom portion shall consist of a brief discussion of each piece of equipment, using the maintenance manual as a guide, and a general preventive maintenance discussion of system as a whole; e.g., discuss procedure for maintaining proper glycol heat transfer solution mixture, etc.
- F. The field portion shall consist of a building walk-through to physically locate and examine each piece of equipment previously discussed. At that time, the main points discussed during the classroom portion shall be recovered while pointing out the specific grease fitting or valve, etc.
- G. Certification: The Contractor shall submit, prior to or at the time of Substantial Completion and before the Owner will accept responsibility for maintenance and operation of the facility, certification that instructions of maintenance and operation procedures have been given to the Owner's Representative responsible for the maintenance and operation of the facility.
 - 1. The certification shall indicate the name and be affixed with the signature(s) of the person(s) receiving the instructions, the dates of instruction, and the names of the Contractor or subcontractor giving the instructions, and shall list the appropriate areas of instruction. Until these requirements are met, the Contractor shall provide at least one maintenance mechanic, acceptable to the Owner's Representative, to operate and maintain the facility's system(s).

3.04 STARTUP / DEMONSTRATION (as specified in Division 01):

- A. Provide the services of a factory trained technician for the start-up and testing of the following equipment:
 - 1. Ventilation fans.
 - 2. HVAC building controls.

- B. Prepare and submit complete startup testing and demonstration plans 30 days prior to schedule test, startup, or demonstration date. All mechanical systems shall be demonstrated for proper operation. The demonstration plan shall clearly identify each system and piece of equipment and the proposed demonstration.
- C. Following successful testing and startup, submit certifications that the equipment and/or systems are operating properly.

END OF SECTION