
SECTION 230000 – BASIC MECHANICAL REQUIREMENTS – HVAC

Latest Update 05-03-2023 See Underlined Text for Edits.

(Engineer shall edit specifications and blue text in header to meet project requirements. This includes but is not limited to updating Equipment and/or Material Model Numbers indicated in the specifications and adding any additional specifications that may be required by the project. Also turn off all “Underlines”.)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section and all other sections of Division 23.

1.2 SUMMARY

- A. This Section includes general administrative and procedural requirements, as well as the following basic mechanical materials and methods <Edit for particular project>:

1. Codes, organizations, standards, and abbreviations
2. Responsibility
3. Site visit
4. Outages
5. Submittals
6. Variances
7. Performance requirements
8. Material and equipment
9. Coordination, sequencing and scheduling
10. Demolition
11. Fire safe materials
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13. Warranty / Guarantee
14. Listed manufacturers
15. Approved equal equipment layouts
16. Coordination drawings
17. Construction record documents.
18. Operation and maintenance manuals
19. Concrete housekeeping pads
20. Grout
21. Combination motor starters, VFD, and controllers – HVAC equipment
22. General requirements - execution
23. Existing HVAC Systems
24. Equipment roughins
25. Mechanical installation - HVAC
26. Cutting and patching
27. Cutting, welding and burning
28. Painting and finishing

29. Concrete housekeeping pads
30. Erection of metal supports and anchorage
31. Demolition
32. Grouting
33. Penetration of water proof construction
34. Excavation and backfilling
35. Cleaning and Finishes
36. Lintels
37. Electrical requirements
38. Provisions for access
39. Operation of equipment
40. Temporary service and equipment use
41. Demonstration and instructions
42. Lubrication
43. Wall and floor penetrations
44. Equipment provided under another division and by others
45. Construction record drawings
46. Closeout procedures
47. Clean up
48. Project punchout

1.3 CODES, ORGANIZATIONS, STANDARDS AND ABBRIVIATIONS

- A. Codes: All material and equipment provided and installed as part of these construction documents shall be in compliance with the latest edition of the following codes as adapted by the State of Maryland for the following:

1. International Building Code (IBC)
2. International Mechanical Code (IMC)
3. International Plumbing Code (IPC)
4. National Electric Code (NEC)
5. Maryland State Health Department
6. Underwriters Laboratories (UL)
7. NFPA 90A: Standard for the Installation of Air Conditioning and Ventilation Systems
8. NFPA 90B: Standard for the Installation of Warm Air Heating and Air Conditioning Systems
9. NFPA 101: Life Safety Code

- B. Organizations and Standards: The following list of organizations and standards are referenced in the HVAC Specification Sections and are included here for reference:

1. AABC: Associated Air Balance Council
2. ADC: Air Diffusion Council
3. AEC: Architecture, Engineering and Construction
4. AGA: American Gas Association

5. AHRI: Air Conditioning, Heating and Refrigeration Institute
6. AMCA: Air Moving and Conditioning Association
7. ANSI: American National Standards Institute
8. API: American Petroleum Institute
9. ARI: Air Conditioning and Refrigeration Institute
10. ASCE: American Society of Civil Engineers
11. ASCE-SEI: American Society of Civil Engineers - Structural Engineering Institute
12. ASHRAE- American Society of Heating, Refrigerating and Air Conditioning Engineers
13. ASME: American Society of Mechanical Engineers
14. ASTM: American Society for Testing and Materials
15. AWS: American Welding Society
16. AWWA: American Water Works Association
17. BAS: Building Automation System
18. CFR: Code of Federal Regulations
19. CGA: Compressed Gas Association
20. CS: Commercial Standard
21. CSA: Canadian Standards Association
22. CSU: Coppin State University
23. CTI STD: Cooling Technology Institute - Standard
24. CTI ATC: Cooling Technology Institute – Acceptable Test Code
25. EJMA: Expansion Joint Manufacturers Association
26. EPA: Environmental Protection Agency
27. FM: Facilities Management
28. FMG: Factory Mutual Global
29. FSA: Fuel Sealing Association
30. FSA – NMEJ: Fuel Sealing Association - Non-Metallic Expansion Joint
31. IAPMO: International Association of Plumbing and Mechanical Officials
32. IBR: Institute of Boiler and Radiator Manufacturers
33. ICC: International Code Council
34. ICC–ES: International Conference on Computational & Experimental Engineering and Sciences
35. IEC: International Electrotechnical Commission
36. IEEE: Institute of Electrical and Electronics Engineers
37. IESNA: Illuminating Engineering Society of North America
38. ISO: International Organization for Standardization
39. ITT: International Telephone & Telegraph Corporation
40. MOSHA- Maryland Occupational Safety and Health Administration
41. MSHA: Mine Safety and Health Administration
42. MSS: Manufacturers Standardization Society
43. MSSP: Manufacturers Standards Society of the Valve and Fittings Industry
44. MSS SP: Manufacturers Standardization Society Standard Practice
45. NADCA: National Air Duct Cleaners Association
46. NAIMA: North American Insulation Manufacturers Association.
47. NAIMA – AH: North American Insulation Manufacturers Association – Air Handling

48. NEBB: National Environmental Balancing Bureau
49. NEC: National Electric Code
50. NEMA: National Electrical Manufacturers Association
51. NEMA – ICS: National Electrical Manufacturers Association – Industrial Control and Systems
52. NEMA – KS: National Electrical Manufacturers Association – Kansas
53. NEMA – MG: National Electrical Manufacturers Association – Motors & Generators
54. NFPA: National Fire Protection Association
55. NICET: National Institute for Certification in Engineering Technologies
56. NIOSH: National Institute for Occupational Safety and Health
57. OSHA - Occupational Safety and Health Administration
58. SE: System Engineering
59. SEI: Software Engineering Institute
60. SMACNA- Sheet Metal and Air Conditioning Contractors National Association
61. TEMA: Tubular Exchanger Manufacturers Association
62. TU: Towson University
63. UB: University of Baltimore
64. UL: Underwriters' Laboratories
65. ULC: Underwriters' Laboratories – Canada
66. UM: University of Maryland
67. UMB: University of Maryland, Baltimore
68. UMB-A/E: University of Maryland, Baltimore – Architect/Engineer
69. UMB-FM: University of Maryland, Baltimore – Facilities Management
70. UMB-PM: University of Maryland, Baltimore – Project Manager
71. UMBC: University of Maryland, Baltimore County

C. Abbreviations: The following list of abbreviations are referenced in the HVAC Specification Sections and are included here for reference:

1. A/C: Air Conditioning
2. ADA: American Disability Act
3. ASJ: All Service Jacket
4. ATC: Automatic temperature Control
5. BACnet: Building Automation and Control Networks
6. BACnet IP: Internet Protocol
7. BACnet MSTP: Master Slave Token Passing
8. BACnet TCP: Transmission Control Protocol
9. BAS: Building Automation System
10. BMS: Building Management System
11. BTU: British Thermal Unit
12. CAD: Computer Aided Design
13. CD-ROM: Compact Disk – Read Only Material
14. CFC: Chlorofluorocarbon
15. CFM: Cubic Feet per Minute
16. CM: Construction Manager

17. Corp: Corporation
18. CV: Coefficient of Variation, Constant Volume
19. CWP: Cold Working Pressure
20. °C: Degree Celsius
21. °F: Degree Fahrenheit
22. DDC: Direct Digital Control
23. DIA: Diameter
24. DOC: Document
25. DOP: Dispersed Oil Particle
26. DP: Differential Pressure
27. Dwg: Drawing
28. EEPROM: Electrically Erasable, Programmable Read-Only Memory
29. EMT: Electrical Metallic Tubing
30. EDPM: Ethylene Propylene Diene Terpolymer Rubber
31. FCU: Fan Coil Unit
32. FHETU: Fume Hood Exhaust Terminal Unit
33. FIT: Fast Installation Technique
34. FLN: Floor Local Network
35. FNPT: Female National Pipe Thread
36. FPM: Feet Per Minute
37. FRP: Fiberglass Reinforced Pipe
38. FSK: Foil Scrim Kraft
39. FTU: Fin Tube
40. Ft.²: Square Feet
41. GAL: Gallon(s)
42. GETU: General Exhaust Terminal Unit
43. GFI: Ground Fault Interrupter
44. GPM: Gallons Per Minute
45. HCFC: Hydrochlorofluorocarbons
46. HEPA: High Efficiency Particulate Absorption
47. Hr: Hour
48. H_g: Mercury
49. HP: Horse Power
50. HVAC: Heating Ventilation and Air Conditioning
51. Hz: Hertz
52. IBC: International Building Code
53. IEQ: Indoor Environmental Quality
54. Inc: Incorporated
55. ID: Inside Diameter
56. IN: Inches
57. Khz: Kilohertz
58. KVA: Kilo Volt Ampere
59. KVAR: Kilo Volt Amperes, Reactive
60. KVARH: Kilo Volt Amps Reactive Hours
61. kW: Kilowatt
62. LAN: Local Area Network

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- 63. Lb: Pound
 - 64. Lbf/inch: Pound Force per Inch
 - 65. Lbs: Pounds
 - 66. LCD: Liquid Crystal Display
 - 67. LED: Light Emitting Diode
 - 68. mA: Milli Ampere
 - 69. mL: Milli Liter
 - 70. MAX: Maximum
 - 71. MERV: Minimum Efficiency Rating Value
 - 72. MIN: Minimum
 - 73. MPa: Megapascal
 - 74. N/A: Not Applicable
 - 75. NBR: Nitrile Butadiene Rubber
 - 76. NEC: National Electric Code
 - 77. NG: Natural Gas
 - 78. NMEJ: Non-Metallic Expansion Joint
 - 79. No.: Number
 - 80. NOM: Nominal
 - 81. NPS: Nominal Pipe Size
 - 82. NPT: National Pipe Thread
 - 83. NRC: Noise Reduction Coefficient
 - 84. OC: On Center
 - 85. OD: Outside Diameter
 - 86. ODP: Open Drip Proof
 - 87. OZ: Ounce
 - 88. PD: Pressure Drop
 - 89. Pdf: Portable Document Format
 - 90. pH: Potassium Hydrogen
 - 91. PPM: Parts per Million
 - 92. PPS: Plastic Pipe Systems
 - 93. PSI: Pounds per Square Inch
 - 94. PSIG: Pounds per Square Inch Gage
 - 95. P/T: Pressure/Temperature
 - 96. PTFE: Polytetraflouroethylene
 - 97. PVC: Polyvinyl Chloride
 - 98. RO: Reverse Osmosis
 - 99. RO/DI: Reverse Osmosis/Distilled Water
 - 100. RPM: Revolutions per Minute
 - 101. RPTFE: Reinforced PolyTetraFluoroEthylene
 - 102. S/S: Stainless Steel
 - 103. STC: Sound Transmission Class
 - 104. STU: Supply Terminal Unit
 - 105. Sq.yd.: Square Yard
 - 106. TAB: Testing, Adjusting, and Balancing
 - 107. TEAO: Totally Enclosed Air Over Enclosure
 - 108. TEC: Terminal Equipment Controller

- 109. TENV: Totally Enclosed Non Ventilating Enclosure
- 110. TFE: Tetrafluoroethylene, Trifluoroethanol?
- 111. TORR: Unit of Pressure Equal to 1/760 Atmosphere
- 112. TRU: Terminal Reheat Unit
- 113. TSS: Total Suspended Solids
- 114. UH: Unit Heater
- 115. US: United States
- 116. USA: United States of America
- 117. USB: Universal Serial Bus
- 118. UPS: Uninterrupted Power Supply
- 119. UV: Ultraviolet
- 120. V: Volt
- 121. VAV: Variable Air Volume
- 122. VOC: Volatile Organic Compounds
- 123. VSD: Variable Speed Drive
- 124. WG: Water Gage

1.4 RESPONSIBILITY

- A. The Construction Manager/General Contractor (CM/GC) shall be responsible for all work included in Division 23. The delegation of work to the contractors shall not relieve him of this responsibility. Contractors who perform work under this Division shall be responsible to the CM/GC.

1.5 SITE VISIT

- A. Prior to preparing the bid, the HVAC mechanical subcontractor shall visit the site and become familiar with all existing conditions. Make all necessary investigations as to locations of utilities and all other matters which can affect the work. No additional compensation will be made to the contractor as a result of his failure to familiarize himself with the existing conditions under which the work must be performed.

1.6 OUTAGES

- A. For all work requiring an outage, the HVAC mechanical subcontractor shall submit an outage request to the UMB Project Manager, using the UMB Standard Request for Outage Form which is available through the UMB Design and Construction Web Site at <https://www.umaryland.edu/designandconstruction/design-and-construction-documents/umb-standard-project-forms---current-editions/>
- B. The existing HVAC system shall remain operational unless turned off by University personnel during the construction of the project.
- C. Unless otherwise specified, outages of any services required for the performance of this contract and affecting areas other than the immediate work area shall be scheduled at least ten business days (10) days in advance with the UMB Design and Construction

Department. Outages shall be performed during normal duty hours. If necessary some outage work may be performed outside normal hours if approved by UMB.

- D. All HVAC outages which will interfere with the normal use of the building in any manner shall be done at such times as shall be mutually agreed upon by the contractor and the UMB Design and Construction Department.
- E. The HVAC contractor shall include in his price the cost of all premium time required for outages and other work which interferes with the normal use of the building, which will be performed, in most cases, during other than normal work time and at the convenience of the University.
- F. The operation of HVAC valves or switches; required to achieve an outage must be operated by University personnel only. Unauthorized operation of HVAC valves, power switches, by contractors and their personnel will result in extremely serious consequences for which the contractor will be held accountable.

1.7 SUBMITTALS

- A. General: For general requirements see Architectural Specification Division 01 Section "Submittal Procedures".
- B. HVAC Submittals: Provide submittals for all material, equipment and/or supports as specified in Division 23 and where indicated on the drawings and details. For material and product data submission requirements see Division 23 Specification Sections. At a minimum the following submittals shall be provided as required by the project unless otherwise noted:
 - 1. Pipe, fittings and accessories for each system.
 - 2. Valves, strainers and unions for each system.
 - 3. Insulation (pipe, duct and equipment).
 - 4. Hangers and supports.
 - 5. AHU's.
 - 6. Heat exchangers.
 - 7. Energy recovery equipment.
 - 8. Terminal heating units (FCU, UH, FTU).
 - 9. Chillers.
 - 10. Cooling towers.
 - 11. Water treatment.
 - 12. HVAC pumps.
 - 13. Air terminal units (STU, GETU, FHETU).
 - 14. Air Devices.
 - 15. Duct systems.
 - 16. Building automation system.
 - 17. Identification (labels, tags valve schedule).
 - 18. Equipment supports.

19. Coordinated drawings.
20. Warranties and maintenance instructions shall be included in the O & M Manual only. Do not include this data in the Product Submittals.
21. <Add additional items or delete items per project requirements>

C. Submittal File Format: File formats for each submittal shall be electronically as follows:

1. Product Data File: “pdf” file format.
2. Drawings: “pdf” and “dwg” formats.
3. Coordinated Drawings: “pdf” or “dwg” file formats.
4. Schedules: “xl” file format.

1.8 VARIANCES

- A. Where variances occur between the drawings and specifications or within either document itself, the item or arrangement of better quality, greater quantity or higher cost shall be included in the contract price. The Engineer shall decide on the item and manner in which the work shall be provided.

1.9 PERFORMANCE REQUIREMENTS

- A. Contract drawings are generally diagrammatic and do not indicate all offsets, fittings, transitions, access panels and other specialties required.
- B. Arrange HVAC piping, ductwork, equipment and other work generally as shown on the contract drawings, providing proper clearances and access.
- C. Where departures are proposed because of field conditions or other causes, prepare and submit detailed shop drawing submittal for approval in accordance with Submittals specified below.
- D. The Architect may make reasonable changes in location of equipment piping and ductwork up to the time of rough-in or fabrication.

1.10 MATERIALS AND EQUIPMENT

- A. The contract drawings and system performances have been designed on the basis of using the particular manufacturer’s products specified or scheduled on the contract drawings.
- B. Products of other manufacturer’s listed in the specification shall be permitted provided as follows:
 1. Products meet all of the requirements of the specifications.
 2. Make, without additional cost to the Owner, all adjustments for deviations, such that the final installation is complete and functions as the basis of design product is intended.

- C. Products with dimensions or other characteristics different from the basis of design product that render their use impractical or cause functional fit, access, or connection problems, shall not be acceptable.

1.11 COORDINATION, SEQUENCING AND SCHEDULING

- A. Coordinate HVAC systems, equipment, and materials installation with other building components.
- B. Utilities: Coordinate connection of HVAC systems with exterior underground services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies.
- C. Chases: Arrange for chases, slots, and openings in building structure during progress of construction to allow for mechanical installations.
- D. Sleeves: Coordinate the installation of required supporting devices and set sleeves in poured in place concrete and other structural components as they are constructed.
- E. Sequencing: Sequence, coordinate, and integrate installations of HVAC materials and equipment for efficient flow of the Work. Give particular attention to large equipment requiring positioning prior to closing in the building.
- F. Electrical Services: Coordinate connection of electrical services.
- G. Access: Coordinate requirements for access panels and doors where HVAC items requiring access are concealed behind finished surfaces. Access panels and doors are specified in Architectural Specification Section "Access Doors."
- H. Scheduling: Schedule and coordinate the delivery of material and equipment with other trades to avoid delivery conflicts.

1.12 DEMOLITION <Delete if not required>

- A. HVAC Demolition: Cut, remove and legally dispose of selected HVAC equipment, components, and materials as indicated, including but not limited to removal of HVAC piping, HVAC equipment, ductwork, plumbing fixtures and trim, and other HVAC items made obsolete by the new work.

1.13 FIRE SAFE MATERIALS

- A. Unless otherwise indicated, materials shall conform to UL, NFPA or ASTM standards for fire safety with smoke and fire hazard rating not exceeding flame spread of twenty five (25) and smoke developed of fifty (50).

1.14 UNDERWRITER’S LABORATORY (UL) REQUIREMENTS

- A. All equipment containing electrical components and provided as part of the mechanical specifications shall bear the Underwriter’s Laboratory (UL) label, as a complete packaged system.
 - 1. Equipment not provided with a UL label shall be tested in the field, certified and provided with a UL label at the installer’s expense.
 - 2. Field testing shall be performed by a testing agency approved by the authority having jurisdiction.

1.15 WARRANTY/GUARANTEE

- A. All materials, equipment, etc. provided by the general contractor and/or his subcontractors shall be warranted and guaranteed to be free from defects in workmanship and materials for a period of two (2) years from the date of substantial completion and acceptance of work by UMB. Any defects in workmanship, materials, or performance which appear within the guarantee period shall be corrected by the contractor without cost to the owner, within a reasonable time, to be specified by UMB. In default thereof, owner may have such work done and charge the cost of same to the contractor. In addition to the above statement the Warranty/Guarantee Period shall also include all labor cost related to all warranty work. For compressorized equipment include an additional three (3) year Warranty/Guarantee Period.

PART 2 – PRODUCTS

2.1 LISTED MANUFACTURERS

- A. Listed Manufacturers: The manufacturers indicated in Part 2 represent the basis for design and identify the minimum level of quality for materials and equipment, specified in this Division, that are acceptable to UMB. Unless “or equal” is included as an option, substitutions are not allowed, except under the following condition. During bid phase, contractors may submit material and equipment by non-listed manufacturers provided said submittals meet the requirements of these specifications. All submitted materials and equipment are subject to approval by the A/E and UMB. Reference: Division 1 Substitution Section.

2.2 APPROVED EQUAL EQUIPMENT LAYOUTS

- A. Approved Equal Equipment Layouts: The equipment layouts and the related mechanical and electrical service connections, access space and supports indicated on the construction documents represent equipment provided by the specified basis of design manufacturer and model number. When the successful bidder chooses to provide “or approved equal” equipment by one (1) of the other listed manufacturers in the specifications, the bidder shall be responsible for providing all adjustments and modifications to the services necessary to make connections to the equipment, the bidder shall be responsible for

installing the equipment such that all required clear access space is maintained, and the bidder shall be responsible for providing all adjustments and modifications to the equipment mounting and supports. All adjustments and modifications shall be provided by the bidder and appropriate subcontractors at no additional cost to the project.

2.3 COORDINATION DRAWINGS <Delete if size of project does not warrant.>

- A. General: When required participate in the preparation of the coordinated drawing effort for the project. See Specification Division 01 for General Requirements.
- B. Coordination Drawings: In addition to the requirements of the Specification Division 01 prepare the HVAC part for the coordination drawing effort. Work with the other trades to ensure the material and equipment installed as part on the HVAC system will not be in conflict with the installation of material and equipment by the other trade contractors. Unless otherwise indicated the coordination drawings, including plans, sections, and elevations shall be prepared at a scale of not less than 1/4 inch = 1 foot- 0 inches. At a minimum, prepare coordination drawings for all mechanical rooms, electrical rooms and substation rooms.
- C. File Format: Coordination drawings shall be in a layered structure form as CAD Files or PDF Files for each floor with searchable text as follows:
 - 1. File Structure: The “pdf” or “dwg” files shall have separate layered structure for:
 - a. Building Elements: Indicate each building element on separate layers, such as:
 - 1) Walls.
 - 2) Reflected ceiling plan.
 - 3) Room numbers.
 - b. Systems and Sub Systems: Indicate each system or sub system as warranted by congestion or complexity on separate layers such as:
 - 1) Examples of Systems:
 - a) Hot Water Heating System.
 - b) Chilled Water System.
 - c) Air Distribution System.
 - 2) Examples of Sub Systems:
 - a) Perimeter Heat System.
 - b) Process Cooling Water System.
 - c) General Exhaust System.

2. The layered electronic files shall allow building elements, building systems and sub systems to be viewed in isolation or in combinations that are user selectable when the drawing files are being displayed.

D. Coordination Effort: This coordination effort shall include detailing major elements, components, and systems of mechanical equipment and materials in relationship with other systems, installations, and building components. Indicate locations where space is limited for installation and access and where sequencing and coordination of installations are of importance to the efficient flow of the work, including (but not necessarily limited to) the following

1. Indicate the proposed locations of HVAC system piping, valves, equipment, and materials. Include the following:
 - a. Clearances for servicing and maintaining equipment, including, the space for equipment disassembly required for periodic maintenance.
 - b. Exterior wall and foundation penetrations.
 - c. Sizes and location of required concrete pads and bases.
 - d. Size and location of pipe hangers and other components for pipe supports.
 - e. All HVAC system roughins for equipment.
 - f. Access doors.
2. Indicate scheduling, sequencing, movement, and positioning of large equipment into the building during construction.
3. Prepare floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations. Show all wall mounted access doors for mechanical devices.
4. Prepare reflected ceiling plans to coordinate and integrate installations, air outlets and inlets, light fixtures, communication systems components, cable trays, sprinklers, access doors and other ceiling mounted items.

2.4 CONSTRUCTION RECORD DOCUMENTS

- A. The mechanical contractor shall maintain a set of construction record documents during the construction period in accordance with Specification Division 01 Section “Project Closeout”.

2.5 PROJECT OPERATION AND MAINTENANCE MANUAL – ELECTRONIC FILES

- A. Project O & M Manual File: The project OM Manual shall include one (1) electronic copy of each approved submittal and any manufacturer’s maintenance manuals, and all warranty certificates included in this Division. Also include the address, phone number and contact person for each supplier. Using the UMB Standard O&M Manual Template referenced in Division 01 Closeout Procedures insert the submittal files include both a book mark and tree structure for accessing each submittal file in the manual.

2.6 CONCRETE HOUSEKEEPING PADS

- A. Provide concrete required for housekeeping pads under Division 23 unless otherwise noted.
- B. Concrete shall be 3,500 psi twenty-eight (28) day compressive strength concrete and reinforcement bars as specified in the architectural specifications.

2.7 GROUT

- A. Grout shall be non-shrink, high strength type, free of iron or chlorides and suitable for use in contact with all metals, without caps or other protective finishes complying with ASTM C 1107, Grade B and the following:
 - 1. Characteristics: Post hardening, volume adjusting, dry, hydraulic cement grout, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 - 2. Design Mix: 5,000-psi (34.50MPa), twenty eight (28) day compressive strength.
 - 3. Packaging: Premixed and factory-packaged.

2.8 COMBINATION MOTOR STARTERS, VFD'S, AND CONTROLLERS – HVAC EQUIPMENT

- A. Combination motor starters, VFD's and/or controllers shall be provided for all motors serving HVAC equipment as follows:
 - 1. Skid Mounted Equipment: Combination motor starters, VFD's and/or controllers shall be provided by the equipment manufacturer as part of Division 23.
 - 2. Non Skid Mounted Equipment: Combination motor starters, VFD's and/or controllers shall be provided as part of Division 26.

PART 3 – EXECUTION

3.1 GENERAL REQUIREMENTS – EXECUTION

- A. All construction work that creates excessive noise will not be permitted during normal business hours. See Division 01 Specification Section “Cutting and Patching” for requirements.

3.2 EXISTING HVAC SYSTEMS <Delete if not required>

- A. Building: In no case shall the buildings HVAC systems be placed out of service for any period of time unless it is in an emergency condition as directed by the University.
- B. Project Area: The sections of the HVAC systems serving the project area can be placed out of service for the construction period as approved by UMB. When the construction is

completed the section of the HVAC system serving the project area shall be placed back in service.

3.3 EQUIPMENT ROUGH INS

- A. Verify final locations for rough ins with field measurements and with the requirements of the actual equipment to be connected.
- B. Refer to equipment specifications included in the architectural, mechanical, and electrical specifications for equipment rough in requirements.

3.4 MECHANICAL INSTALLATIONS - HVAC

- A. Verify all dimensions by field measurements.
- B. Where HVAC systems, materials and equipment are intended for overhead installation, and where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible. Notify UMB - PM prior to installation of HVAC components when headroom is less than seven (7) feet- six (6) inches and/or where existing system components will be below the new finished ceiling height. Notification shall be through the “RFI” process.
- C. Install HVAC systems, materials, and equipment to conform with approved submittal data, including coordination drawings, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the Work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, identify the conflict and submit and “RFI” for each conflict to the Architect.
- D. Install HVAC systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components.
- E. Install HVAC equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations. Extend grease fittings to an accessible location.
- F. Install access panel or doors where units are concealed behind finished surfaces. Access panels and doors are specified in the Architectural Specifications.
- G. Install HVAC systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.
- H. The contractor shall confirm that all pressure vessels are installed in full compliance with the requirements of the State Inspector’s Office for Boilers and Pressure Vessels. Refer to “Closeout Procedures” in this Section for additional requirements.

3.5 CUTTING AND PATCHING

- A. General: Perform cutting and patching in accordance with Specification Division 01 Section "Cutting and Patching" In addition to the requirements specified in Specification Division 01, the following requirements apply:
 - 1. Patch Materials: Patch finished surfaces and building components using new materials specified for the original installation and using experienced Installers. Installers' qualifications refer to the materials and methods required for the surface and building components being patched.

3.6 CUTTING, WELDING, BURNING

- A. Before the contractor and/or any sub-contractor commences any cutting, welding, burning or other type of hot work at UMB, the contractor shall contact the UMB Fire Marshal's Office on the First Floor of the Pine Street Station located @ 214 N. Pine Street, or by phone @ 1-410-706-3494 to obtain a hot work permit. Office Hours are Monday – Friday.
- B. The hot work permit copy shall remain on the job site at the hot work location until such work is completed at which time the permit shall be returned to the UMB Fire Marshal.

3.7 PAINTING AND FINISHING <Add painting section if project requires field painting>

- A. Refer to Architectural Specification Section "Painting" for field painting requirements.
- B. Damage and Touch Up: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.
- C. Do not paint manufacturer's labels or tags.

3.8 CONCRETE HOUSEKEEPING PADS

- A. General: Construct concrete housekeeping pads to support mechanical equipment were indicated and as detailed on the drawings and as specified herein. Engage the services of the Structural or General Contractor, and pay for them, to provide the concrete housekeeping pads. Follow supported equipment manufacturer's setting templates for anchor bolt and tie locations.
- B. Housekeeping Pads: Except for AHU's set all floor-mounted equipment on four (4) inch high concrete housekeeping pads, unless otherwise shown or specified. For floor mounted AHU's set units on six (6) inch high concrete housekeeping pads.
 - 1. Housekeeping Pads: Pads shall be minimum of four (4) inches wider and longer than vibration isolation base or structural base of equipment being set on pad.
 - 2. Chillers: Comply with equipment manufacturer's installation requirements for extent of housekeeping pads.

3.9 ERECTION OF METAL SUPPORTS AND ANCHORAGE

- A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.
- B. Field Welding: Comply with AWS D1.1 "Structural Welding Code Steel."

3.10 DEMOLITION <Delete if project does not include removal work>

- A. Disconnect, demolish, and remove work specified as part of the HVAC specifications and as indicated. Remove pipes and ducts back to the active pipe and duct to remain and cap.
- B. Where pipe, ductwork, insulation, or equipment to remain is damaged or disturbed, remove damaged portions and install new products of equal capacity and quality.
- C. Accessible Work: Remove indicated exposed pipe and ductwork in its entirety.
- D. Abandoned Work: Cut and remove buried pipe abandoned in place, two (2) inches (50 mm) beyond the face of adjacent construction. Cap and patch surface to match existing finish.
- E. Removal: Remove indicated equipment from the Project site.
- F. Temporary Disconnection: Remove, store, clean, reinstall, reconnect, and make operational equipment indicated for relocation.

3.11 GROUTING

- A. Install nonmetallic nonshrink grout for HVAC equipment base bearing surfaces, pump and other equipment base plates, and anchors. Mix grout according to manufacturer's printed instructions.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms for placement of grout, as required.
- D. Avoid air entrapment when placing grout.
- E. Place grout to completely fill equipment bases.
- F. Place grout on concrete bases to provide a smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout according to manufacturer's printed instructions.

3.12 PENETRATION OF WATERPROOF CONSTRUCTION

- A. Coordinate the work to minimize penetration of waterproof construction, including roofs, exterior walls and interior waterproof construction.
- B. Furnish and install drains, curbs, vent assemblies, sleeves, flashing, etc. specifically designed for application to the particular construction. Install system in accordance with the roofing manufacturer's instructions.

3.13 EXCAVATION AND BACKFILLING

- A. General: Perform all necessary excavation and backfilling necessary for the installation of underground HVAC services as part of Division 23 in accordance with the architectural specifications.

3.14 CLEANING AND FINISHES

- A. Clean surfaces prior to application of insulation, adhesives, coating, and paint.
- B. Provide factory applied finish where specified.
- C. Protect all finishes and restore all finishes to their original condition if damaged as a result of work installed as part of the mechanical specifications.
- D. Remove all construction marking and writing from exposed equipment, ductwork, piping and building surfaces.

3.15 LINTELS

- A. Lintels shall be provided for openings in masonry, brick, concrete, etc. walls to accommodate work of this division.
 - 1. Lintels shall be provided under this division when not being provided under other divisions. Lintels shall be approved by the Architect.

3.16 ELECTRICAL REQUIREMENTS

- A. Unless otherwise indicated, furnish and install control and interlock wiring for the equipment furnished under this division. In general, power wiring and motor starting equipment will be provided as specified in the electrical specifications.
 - 1. Where the electrical requirements of the equipment furnished differ from the provisions made in the electrical specifications, make the necessary allowances as part of the mechanical specifications.
 - 2. Where no electrical provisions are included in the electrical specifications, include all necessary electrical work as part of the mechanical specifications.

- B. All electrical work performed as part of the mechanical specifications shall be provided in accordance with the electrical specifications.

3.17 PROVISIONS FOR ACCESS

- A. Furnish and install adequate access to all HVAC and plumbing components. The following list shall be used as a guide only:

1. Equipment
2. Valves
3. Dampers and operators
4. Filters
5. Heating and air conditioning units
6. Controls
7. ATC panels
8. Heating and cooling coils
9. Water Source Heat Pump Units
10. Low point drains

- B. Access shall be adequate as determined by the Architect.
- C. Refer to contract drawings where access panels have been specifically located.
- D. Provide additional access panels for adequate access as indicated in paragraph 'A' above.
- E. Where access is by means of lift out ceiling tiles or panels mark each access panel using small color coded or numbered tabs. Provide an index chart for identification. Place markers in corner of tile.

3.18 OPERATION OF EQUIPMENT

- A. Clean all systems and equipment prior to initial operation for testing and balancing.
- B. Do not operate equipment unless all proper safety devices or controls are operational.
- C. Provide all maintenance and service for equipment which is operated during construction.
- D. Where specified and otherwise required, provide the services of a manufacturer's factory trained service organization to start the equipment.

3.19 TEMPORARY SERVICE AND EQUIPMENT USE

- A. Temporary Service: Unless temporary services are required as part of the project, do not use HVAC systems for temporary services during construction unless authorized in writing by the Architect and/or UMB.

- B. Equipment Use: Where such authorization is granted, temporary use of new and or existing equipment shall not limit or otherwise affect warranties or guarantees covering new equipment. Where equipment is used by the contractor the contractor shall perform all required preventive maintenance on the equipment during the construction period. Upon completion of work, clean and restore all new and/or existing equipment to new condition and replace all filters as necessary.

3.20 DEMONSTRATION AND INSTRUCTIONS

- A. Demonstrate operation and maintenance of equipment and systems to Owner's personnel a minimum two (2) weeks prior to date of final inspection.
 - 1. For equipment requiring seasonal operation, perform instructions for other seasons at the same time.
 - 2. Training period shall be performed within one (1), two (2) week period.
- B. Use operation and maintenance manuals and video as basis of instruction. Review contents of manual and video with personnel in detail to explain all aspects of operation and maintenance.
- C. Demonstrate the following:
 - 1. Start up.
 - 2. Operation.
 - 3. Control.
 - 4. Adjustment.
 - 5. Trouble shooting.
 - 6. Servicing.
 - 7. Maintenance.
 - 8. Shutdown.
- D. Provide at least forty (40) hours straight time instruction to the operating personnel.
 - 1. This instruction period shall consist of not less than five (5) eight (8) hour days.
 - 2. Time of instruction shall be designated by the Owner.
 - 3. This instruction shall be in addition to instructional requirements of specific equipment specified elsewhere in the mechanical specifications.

3.21 LUBRICATION

- A. All bearings, motors and all equipment requiring lubrication shall be provided with accessible fittings.
- B. Before turning over the equipment to the Owner, the Installer shall provide the following:

1. Fully lubricate each item of equipment.
2. Provide one (1) year's supply of lubricant for each type of lubricant.
3. Provide complete written lubricating instructions, together with diagram locating the points requiring lubrication.

C. Motors and equipment shall be provided with grease lubricated roller or ball bearings with Alemite or equal extended grease fittings and drain plugs.

3.22 WALL AND FLOOR PENETRATIONS

A. All penetrations of partitions, walls and floors by ducts, piping or conduit under Specification Division 23 shall be sealed and caulked. Provide UL listed fire stopping systems at penetrations through fire walls as specified in the architectural specifications.

3.23 EQUIPMENT PROVIDED UNDER ANOTHER DIVISION AND BY OTHERS

A. The Installer of products under Specification Division 23 shall make all system connections required to equipment furnished and installed under another division and by others.

B. It shall be the responsibility of the Installer to obtain all necessary data from the equipment supplied under other Divisions.

3.24 CONSTRUCTION RECORD DRAWINGS

A. As the work progresses, the contractor shall record on one (1) set of prints, the installed locations, sizes, and depths of pipes, services, equipment, etc. which may differ from the approved contract drawings.

B. Upon completion of the HVAC installations, the installer shall deliver to the Architect construction manager one (1) complete set of marked-up blueprints of the HVAC contract drawings. The construction manager shall compile the mark up prints into a composite set and transmit the set the architect who shall incorporate the mark ups into the record drawing electronic file.

1. The mark-ups shall be legibly marked in red pencil to show all changes and departures of the installation as compared with the original design.

C. At a minimum include the following installed conditions:

1. Location of all shut off valves, drain valves, and balancing valves with assigned valve tag numbers.
2. Show the location of concealed material and/or equipment requiring service such as strainers, traps, localized A/C units, control valves and/or expansion compensators.

3. Actual entering/leaving invert elevations for steam, and chilled water services for the building.

3.25 CLOSEOUT PROCEDURES

- A. Operating and Maintenance Instructions: Submit Complete Package At Least **Two (2) Months** Prior To Substantial Completion. Arrange for each installer of equipment that requires regular maintenance to meet with the Owner's personnel to provide instruction in proper operation and maintenance. If installers are not experienced in procedures, provide instruction by manufacturer's representatives. Include a detailed review of the following items: **<Coordinate with UMB and Edit Time for Project >**

1. Maintenance manuals, including a customized list of preventive maintenance items and annual schedule for maintenance.
2. Record documents.
3. Complete inventory of spare parts and materials.
4. Tools.
5. Lubricants.
6. Fuels.
7. Identification systems.
8. Control sequences.
9. Hazards.
10. Cleaning.
11. Warranties and bonds.
12. Maintenance agreements and similar continuing commitments.

- B. As part of instruction for operating equipment, demonstrate the following procedures:

1. Start up.
2. Shut down.
3. Emergency operations.
4. Noise and vibration adjustments.
5. Safety procedures.
6. Economy and efficiency adjustments.
7. Effective energy utilization.

- C. Pressure Vessel Inspections by the State of Maryland: For the purpose of obtaining and having UM buildings insured by any commercial insurance carrier, the contractor shall arrange for the inspection of all pressure vessels installed during construction. The contractor shall contact the Office of Boiler and Pressure Vessel Inspections of the Department of Labor, Licensing and Regulations (DLLR), State of Maryland, and arrange for the inspections. The DLLR shall be notified at least thirty (30) days prior to installation. After such inspections are carried out by the State Inspector's office, Certificates of Compliance will be issued to the contractor of record to be turned over to the Owner's representative for compliance with current insurance regulations as part of the Project Documents. Examples of pressure vessels include boilers, heat exchangers,

converters, expansion tanks, water heaters, hot water generators and storage tanks. Chillers are excluded and are covered under ASHRAE Guidelines.

3.26 CLEAN UP

- A. Excessive debris and dirt, such as occurs from cutting through masonry or plaster walls shall be cleaned up from the equipment and removed immediately after the work of cutting through the walls.
- B. Debris shall be removed from UMB property.
- C. Ceiling panels shall be replaced as soon as work is finished in the area, and shall be kept free of dirty finger prints. Where work is being done in corridors used by patients and ceiling panels shall be replaced at the close of the day's work even if work is at the particular location is incomplete.
- D. All areas shall be left broom-clean at the end of the work period.
- E. Remove all mechanical clipping, wiring, nuts, bolts, etc. left on top of ceilings and ceiling tiles.

3.27 PROJECT PUNCH OUT

- A. Architect/Engineer will perform punch out reviews and will provide the Contractor with a list of punch list items to be completed before contract close out. Each and every punch list item shall be initialed and dated by the Contractor when the work is complete. The Architect/ Engineer will not perform any punch list verification until all items have been completed, initialed, dated and the list returned to the Architect/Engineer. If any items have been initialed as being completed by the Contractor and the Architect/Engineer determines that the work is not complete, the Architect/Engineer shall be reimbursed by the Contractor at his regular hourly rate for any and all items requiring revisiting of the site by the Architect/Engineer. Reimbursement shall be made by deducting the Architect/Engineer fee from the Contractor's final payment.

END OF SECTION 230000