

SECTION 23 00 00

GENERAL PROVISIONS FOR HEATING, VENTILATING AND AIR CONDITIONING WORK

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Work in this Section includes the providing of labor, materials, equipment and services necessary for a complete and safe installation in accordance with the contract documents and all applicable codes and authorities having jurisdiction for heating, ventilating and air conditioning work covered by all sections within Division 23 of the specifications (including but not limited to HVAC systems and equipment).
- B. Provide cutting and patching, except as noted in "AIA Document A210" and "Supplementary Conditions for Mechanical and Electrical Work."
- C. Provide piping extensions and connections from capped Plumbing terminations, for makeup water and other such services.
- D. Provide drainage from noted equipment to floor drains, roof, sink, or funnel drains.
- E. Provide piping connections to equipment, as required, for kitchens, sterilizers, kitchenettes, and as indicated.
- F. Provide 3/8" coordinated shop drawings with a sheetmetal construction drawing as the base drawing; and overlay plumbing, fire protection, and electrical systems for coordination.
- G. Related Work And Requirements
 - 1. Requirements of general conditions, supplementary conditions for mechanical and electrical work and Division No. 1.
 - 2. Requirements noted under other Divisions of Work

1.2 WORK NOT INCLUDED:

- 1. Providing temporary heat.
- 2. Providing finish painting.
- 3. Installing building construction access door filler.
- 4. Providing trench covers and frames.
- 5. Cutting and patching, except as noted in "AIA Document A201" and "Supplementary Conditions for Mechanical and Electrical Work."

6. Excavating and backfilling under building.
7. Excavating and backfilling.
8. Providing exterior louvers.
9. Providing undercut and louvers in doors.
10. Providing exterior wall louvers intake, screens and exterior attenuation panels.
11. Providing plenums other than sheet metal.
12. Providing flashing.
13. Providing shaft gratings.
14. Providing equipment platforms.

1.3 DESCRIPTION OF BID DOCUMENTS

- A. Specifications, in general, describe quality and character of materials and equipment.
- B. Drawings, in general are diagrammatic and indicate sizes, locations, connections to equipment and methods of installation. Provide additional offsets, fittings, hangers, supports, valves, drains as required for construction and coordination with work of other trades.
- C. Scaled and indicated dimensions are approximate and are for estimating purposes only. Before proceeding with work, check and verify all dimensions.
- D. Make adjustments that may be necessary or requested in order to resolve space problems, preserve headroom, and avoid architectural openings, structural members and work of other trades.
- E. Typical details, where shown on the drawings, apply to each and every item of the project where such items are applicable. Typical details are not repeated in full on the plans, and are diagrammatic only, but with the intention that such details shall be incorporated in full.
- F. If any part of Specifications or Drawings appears unclear or contradictory, consult Architect and/or Engineer for interpretation and decision as early as possible during bidding period. Do not proceed with work without the Architect's and/or Engineer's decision.

1.4 DEFINITIONS

- A. "Furnish" or "provide": to supply, install and make complete, safe, and operable, the particular work referred to unless specifically indicated otherwise.
- B. "Install": to erect, mount and make complete with all related accessories.

- C. "Supply": to purchase, procure, acquire, and deliver complete with related accessories.
- D. "Work": includes labor, materials, equipment, services, and all related accessories necessary for the proper and complete installation of complete systems.
- E. "Piping": includes pipe, tube, fittings, flanges, valves, controls, strainers, hangers, supports, unions, traps, drains, insulation, and all related accessories.
- F. "Wiring": includes raceway, fittings, wire, boxes, and all related accessories.
- G. "Concealed": not in view, installed in masonry or other construction, within furred spaces, double partitions, hung ceilings, trenches, crawl spaces, or enclosures.
- H. "Exposed": in view, not installed underground or "concealed" as defined above.
- I. "Indicated," "shown," or "noted": as indicated, shown or noted on drawings or specifications.
- J. "Similar" or "equal" of base bid manufacturer, equal in quality, materials, weight, size, performance, design and efficiency of specified product, conforming with "Base Bid Manufacturers."
- K. "Reviewed," "satisfactory," "accepted," or "directed" as reviewed, satisfactory, accepted, or directed by or to Architect and/or Engineer.
- L. "Motor Controllers": includes manual or magnetic starters with or without switches, individual pushbuttons or hand-off-automatic (HOA) switches controlling the operation of motors.
- M. "Control or Actuating Devices": includes automatic sensing and switching devices such as thermostats, pressure, float, flow, electro-pneumatic switches and electrodes controlling operation of equipment.

1.5 QUALITY ASSURANCE

- A. All equipment and accessories shall be the product of manufacturers regularly engaged in their manufacture. All items of a given type shall be the products of the same manufacturer.
- B. Furnish all equipment and accessories new and free from defects.
- C. All electrical equipment shall be listed by Underwriters' Laboratories, Inc. (UL) or bear UL labels.
- D. Supply all equipment and accessories in complete compliance with and in accordance with the applicable standards listed in reference standards of this Section and with all applicable national, state and local codes.

1.6 JOB CONDITIONS

- A. Inspection of Site Conditions:

1. Before starting work, visit the site and examine the conditions under which the work has to be performed. Report in writing any conditions which might adversely affect the work.

B. Hazardous locations:

1. Provide required material, equipment and installation applicable for hazardous location defined by codes.
2. Provide material, equipment and installation as required for Class, Division and Group noted.

1.7 REFERENCE STANDARDS

A. Published specifications, standards tests, or recommended methods of trade, industry or governmental organizations apply to work in all Sections as noted below:

1. ASHRAE - American Society of Heating, Refrigerating and Air Conditioning engineers.
2. AABC - Associated Air Balance Controls.
3. AMCA - Air Moving and Conditioning Association.
4. ADC - Air Diffuser Council.
5. NEMA - National Electrical Manufacturers' Association.
6. ANSI - American National Standards Institute.
7. ASME - American Society of Mechanical Engineers.
8. ASTM - American Society for Testing and Materials.
9. NFPA - National Fire Protection Association.
10. ARI - Air-Conditioning and Refrigeration Institute.
11. UL - Underwriters' Laboratories, Inc.
12. OSHA - Occupational Safety and Health Administration Regulations.

B. Codes:

1. This installation is to abide by all applicable codes including, but not limited to:
 - a. International Building Code-2009/Maine State Building Code including all amendments

1.8 SUBMITTALS

- A. Submit shop drawings product data, samples and certificates of compliance required by contract documents, "AIA Document 201" and "SUPPLEMENTARY CONDITIONS FOR MECHANICAL AND ELECTRICAL WORK."
- B. Operating instructions, maintenance manuals and parts lists.
 - 1. Provide five sets of manufacturer's equipment brochures and service manuals consisting of the following:
 - a. Descriptive literature for equipment and components.
 - b. Model number and performance data.
 - c. Installation and operating instructions.
 - d. Maintenance and repair instructions.
 - e. Recommended spare parts lists.
 - 2. Assemble manufacturers' equipment manuals in chronological order following the specifications' numbering system using heavy duty three ring binders.
 - 3. Submit valve tag chart.
 - 4. Submit three sets of field test reports including instrument set points and normal operating valves.
- C. Submit to the Construction Manager all testing and certification documentation as required to comply in all respects with the U.S. Green Building Council/LEED®.

1.9 AS-BUILT DRAWINGS

- A. Provide as-built drawings of all work modified from the construction documents in the field during the construction phase.

1.10 CLEARANCE FROM ELECTRICAL EQUIPMENT

- A. Piping and ductwork is prohibited in electric and telephone rooms and closets, elevator machine rooms, and for installations over or within 5 ft of transformers, substations, switchboards, motor control centers, standby power plants, and motors.
- B. Branch piping to equipment is acceptable when installed over or within 5 ft of motors.

1.11 DRIP PANS

- A. Provide drip pans under piping when installation over or within 5 ft of electrical apparatus is unavoidable or in rooms containing electrical equipment. Pan shall be reinforced, properly supported and made watertight. Provide enclosed type for

pressure piping. Extend 1-1/4 in. drain pipe from pan to spill over nearest floor drain, janitors sink or as indicated.

1. Construction shall be 18 gauge galvanized sheet steel. Pans shall be constructed to retain 3 inches of water minimum.
2. BMS Contractor shall install a waterflow detector for BMS alarm in case of a water leak.

1.12 PRODUCT, DELIVERY, HANDLING AND STORAGE

- A. Ship materials and equipment in crated sections of sizes to permit passing through available space, where required
- B. Deliver equipment with protective crating and shrink-wrapped covering.
- C. Receive and accept materials and equipment at the site, properly handle, house, and protect them from damage and the weather until installation. Replace equipment damaged in the course of handling without additional charge.
- D. Store to prevent damage and protect from weather, dirt, fumes, water, and construction debris in clean dry space
- E. Arrange for and provide storage space or area at the job site for all materials and equipment to be received and/or installed in this project
- F. All exposed openings of equipment, piping and ductwork are to be covered nightly and/or when no work is anticipated for more than 4 hours.
- G. Handle according to manufacturer's written rigging and installation instructions for unloading, transporting, and setting in final location
- H. Protect units from physical damage. Leave factory shipping covers in place until installation

1.13 TEMPORARY HEAT

- A. Temporary heat will be provided under General Construction Work.

1.14 ACCESSIBILITY

- A. Install all work so that parts requiring periodic inspection, operation, maintenance, and repair are readily accessible. Minor deviations from the drawings may be made to accomplish this, but changes of substantial magnitude shall not be made without written approval.
- B. Group concealed valves, expansion joints, controls, dampers, and equipment requiring access, so as to be freely accessible through access doors.

1.15 SPECIAL TOOLS

- A. Provide one set of any special tools required to operate, adjust, dismantle or repair equipment furnished under this Division for the Owner's use at the completion of the work.
- B. Provide one pressure grease gun with adapters for each type of grease required.
- C. Provide one suitable tool case for special tools.

1.16 CUTTING AND PATCHING

- A. Provide all carpentry, cutting and patching required for proper installation of materials and equipment specified. Do not cut or drill structural members without review by Architect and Structural Engineer.

1.17 PROTECTION OF MATERIALS

- A. Protect from damage, water, dust, etc., materials, equipment and apparatus provided under this trade, both in storage and installed

1.18 SUBSTITUTIONS

- A. No substitute material or manufacturer of equipment shall be permitted without a formal written submittal to the Construction Manager and Architect which includes all dimensional, performance and material specifications and is approved in writing by the engineer. Any changes in layout or design brought about by the use of a substitution shall be submitted to the Construction Manager and Architect fully designed for review in conjunction with the submittal of the alternate. Any substitution must be submitted with an explanation why a substitution is being proposed. If the substitute is being proposed for financial reasons, the associated credit must be simultaneously submitted. Final acceptance or rejection of any substitution is subject to the owner's review.

1.19 STANDARDS:

- A. If any item in the specification, as furnished by the contractor, is manufactured in a location which does not certify ASME/ANSI standards, the contractor is to pay the Construction Manager/Owner for ALL expenses incurred by the Construction Manager/Owner for an outside testing company to confirm such compliance.

1.20 COORDINATION

- A. Arrange for pipe spaces, duct spaces, space for equipment, chases, slots, and openings in building structure during progress of construction, to allow for mechanical installations.
- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- C. Coordinate requirements for access panels and doors for mechanical items requiring access that are concealed behind finished surfaces.

- D. Provide coordination drawing for all areas of the work. The drawings shall have the following qualities:
1. Minimum 3/8" scale
 2. Clearly show all the work for each trade including, but not limited to hangers, valves, dampers, actuators, access doors and service access requirements for all items.
 3. Indicate bottom elevations of all ductwork, electrical conduit, raceways, cable trays, control wiring and piping.
 4. Ductwork, piping, and conduit 3 inches and smaller may be shown in single line.
 5. Ductwork, piping, and conduit greater than 3 inches shall be shown in double line.
 6. Color scheme:
 - a. Architectural and structural background: Light grey.
 - b. Ductwork: Black.
 - c. Equipment and pads: Purple.
 - d. HVAC piping and equipment: Green.
 - e. Electrical conduits and equipment: Blue.
 - f. Plumbing: Orange.
 - g. Fire protection: Red.
 - h. Control wiring: Pink.

1.21 GUARANTEE

- A. In accordance with General Conditions (AIA Document 201) & Supplementary Conditions for Mechanical & Electrical Work.
- B. The Contractor shall furnish a written guarantee to replace or repair promptly and assume responsibility for all expenses incurred for any workmanship and equipment in which defects develop within one year from the date of final certificate for payment and/or from date of actual use of equipment or occupancy of spaces by Owner included under the various parts of work, whichever date is earlier. This work shall be done as directed by the Owner. This guarantee shall also provide that where defects occur, the Contractor will assume responsibility for all expenses incurred in repairing and replacing work of other trades affected by defects, repairs or replacements in equipment supplied by the Contractor.

1.22 PERMITS AND FEES

- A. In accordance with General Conditions (AIA Document 201) & Supplementary Conditions for Mechanical & Electrical Work.
- B. The Contractor shall give necessary notice, file drawings and specifications with the department having jurisdiction, obtain permits or licenses necessary to carry out this work and pay all fees therefore. The Contractor shall arrange for inspection and test of any or all parts of the work if so required by authorities and pay all charges for same. The Contractor shall pay all costs for, furnish to the Owner before final billing, all certificates necessary as evidence that the work installed conforms with all regulations where they apply to this work.

1.23 RIGGING

- A. This contractor shall provide all required rigging, hoisting and bracing to install the equipment as indicated on the plans. This work shall be performed by an insured certified licensed rigging company that is experienced in rigging equipment of the type indicated for the areas shown on the construction documents. This contractor shall submit rigging plans for approval prior to proceeding with the work.
- B. All permits required from the authorities and agencies involved to perform the rigging are the responsibilities of this contractor.
- C. All structural supports, modifications or additions are to be submitted to the structural engineer for approval prior to proceeding with the work. All supplemental structural supports, elevator charges /modifications, bracing and protection required for the rig is the responsibility of this contractor
- D. The rigging contractor shall hire and pay for all charges and services of the building elevator contractor for the rigging of the equipment

1.24 COMMISSIONING

- A. Provisions Included
 - 1. Include Division 00 and applicable parts of Division 01 for conditions and requirements which may affect the work of this Section.
 - 2. Examine all other Sections of the specifications for requirements which affect work under this Section whether or not such work is specifically mentioned in this Section.
 - 3. Coordinate work with that of all other Trades affecting, or affected by work of this Section. Cooperate with such Trades to ensure the steady progress of all work under the Contract.
 - 4. This scope is not all inclusive of the overall effort necessary to fully commission this project but rather serves as a guide. Refer to the Commissioning Plane and Section provided by the Construction Manager for further details. Refer to Sections 019100- Commissioning and Section

230800- Commissioning of HVAC for further scope and responsibility required.

B. Commissioning Effort

1. The Construction Manager shall be the prime contractor which is responsible for the overall commissioning program.
2. The Construction Manager and all Contractors/Subcontractors shall completely assist the Commissioning Agent in establishing and maintaining the schedule of commissioning events, as developed for the complete check out of each individual mechanical and electrical sub-system and the integration of all building systems.
3. The Contractor, BMS Contractor and TAB Contractor responsible for all work, installation, testing, balancing and controls under this Division shall be responsible to provide all set up, testing and services required in the commissioning of the systems under this Division.

C. Commissioning Team

1. A representative of each of the following parties shall be designated as a member of the Commissioning Team.
2. Each member must attend weekly "schedule of events" meetings, in accordance with the Commissioning Agent's schedule.
3. Each member must be closely associated with this design project to accommodate the actual scheduling of events upon mechanical and electrical systems which have been "completed" and thus in proper operation to be commissioned.
4. Commissioning Team
5. Commissioning Agent
 - a. Construction Manager
 - b. HVAC Contractor
 - c. BMS Contractor
 - d. Testing and Balancing Contractor (TAB)
 - e. Plumbing Contractor
 - f. Fire Protection Contractor
 - g. Electrical Contractor
 - h. Selective Equipment Manufacturers
 - i. Owners Designated Representative

D. Substantial Completion

1. The Construction Manager shall submit written notice that the project is substantially complete. Provide a detailed punch list of items not yet in conformance with the contract documents which require attention.
2. Submit preliminary copies of the Operation and Maintenance Manuals.

3. Submit the as-built drawings.
4. Submit warranties, workmanship/maintenance bonds, maintenance agreements, final certifications, and similar documents.
5. Obtain and submit releases enabling Owner's full and unrestricted use of the work and access to services and utilities, including occupancy permits, operating certifications, and similar releases.
6. The Contractor shall have completed all commissioning requirements in Division 21, 22, 23 and 26 except Functional Performance Testing of systems.
7. The Contractor shall have completed all training required for Owner's staff.
8. Submit a letter to the Architect requesting inspection and the Certificate of Substantial Completion, which will be signed and submitted to the Owner.

E. Functional Completion

1. The Construction Manager shall submit commissioning acceptance procedures test check-off sheets, signed by the Commissioning Agent, and the Commissioning Agent's letter recommending Functional Completion.
2. Formal records of all test procedures and results shall be included, as specified, in binders organized for convenient future reference by the Owner's operations staff.
3. The Commissioning Agent will submit a final commissioning report recommending Function Completion when all requirements have been met and when the final report is accepted by the Client. The Commissioning Agent's report will be a comprehensive summary regarding the commissioning program, which shall also include formal records and data accumulated by the Commissioning Agent during the commissioning process.
4. All Contractors shall participate in assisting the commissioning agent in indicating system compliance by performance ALL system tests to the satisfaction of the commissioning agent.

F. Final Completion And Final Acceptance

1. Final Completion occurs when the work is fully and finally completed in accordance with the Contract Documents and all deficiencies have been corrected. Final Acceptance is the written acceptance issued to the Contractor by the Construction Manager and Owner after the Contractor has achieved Final Completion. The specific requirements are:
 - a. Submit "Consent of Surety to Final Payment". This letter is to be completed by the surety and mailed to the Owner.
 - b. Submit final payment request with final releases and supporting documentation not previously submitted or accepted.

- c. Submit a copy of the Architect's final punch list of itemized work to be completed or corrected, stating that each item is complete (or otherwise resolved) for acceptance, endorsed and dated by the Architect.
- d. Deliver tools, spare parts, extra stock of materials, and similar physical items to the Owner.
- e. Make the final change-over of locks and transmit the new keys to the Owner. Return any loaned construction access keys. Advise Owner's personnel regarding change-over in security provisions.
- f. Discontinue and remove from the project site temporary facilities and services, along with construction tools and facilities, mock-ups, and similar elements.
- g. Complete final cleaning requirements, including touch-up of marred surfaces, and repair, restore and touch-up exposed finishes.
- h. Submit a letter to the Architect requesting inspection and the Certificate of Final Acceptance, which will be signed and submitted to the Owner.

G. Commissioning Schedule

1. The Construction Managers schedule for construction, control implementation and completion, start, and point-by-point checkout must be complete for Owner occupancy, in accordance with the Construction Managers schedule.

H. Responsibilities

1. The Contractors shall cooperate with the Construction Manager and Commissioning Agent to accomplish the following tasks:
 - a. Review and approve all functional performance tests, results, and documentation required by the contract documents, for all equipment and systems, as performed by subcontractors, vendors, etc.
 - b. Develop schedules for all testing, integrate testing into the master construction activity schedule and coordinate all subcontractor testing as required.
 - c. Assist and participate in all equipment tests, system functional tests, and cross system functional tests. Test procedures shall be in accordance with equipment manufacturer's recommendations, where applicable. Test procedures shall fully describe system configuration and steps required for each test, appropriately documented so that another party can repeat the tests with virtually identical results.
 - d. Submit test procedure schedule, procedures, forms and other documentation to the Construction Manager and Owner for approval three months prior to starting any testing required and stipulated by the construction Manager.
 - e. Coordinate directly with subcontractor on the project specific to their responsibilities and contractual obligations.
 - f. Provide qualified personnel for participation in commissioning tests, including seasonal testing required after the initial commissioning.
 - g. Provide engineering and technical expertise to oversee and direct the correction of deficiencies found during the commissioning process.

- h. Provide all start-up and initial testing of all systems and equipment by the Contractor and subcontractors, and then all final tests of equipment and systems in accordance with the Commissioning Agent procedures.
- i. Manage all cross system testing such as HVAC, building fire alarm, emergency power, life safety, elevators, etc.
- j. Note any inconsistencies or deficiencies in system operations and enforce system compliance or recommend to the Architect modifications to system design which will enhance system performance.
 - 1) Coordinate with the Commissioning Agent and Construction Manager the required A/E and Owner testing participation and approval procedures, after verifying that pretests have been satisfactorily conducted and final tests are ready to be performed.
 - 2) In the event that a functional test fails, the cause of failure shall be determined and rectified as soon as possible, and then retested. If more than three functional tests of the same system(s) are required, the Contractor shall reimburse all associated costs for the extraordinary participation of the A/E, Commissioning Agent, Construction Manager and Owner's staff, as required by the particular test being performed.
 - 3) Review operation and maintenance information and as-built drawings provided by the various subcontractors and vendors for verification, organization and distribution.
 - 4) Obtain all documentation from tests and assemble a final test report to be submitted to the Construction Manager, Commissioning Agent, Architect and the Owner for approval.
 - 5) Oversee and/or provide training for the systems specified in the Division with coordination by the Division 23 Subcontractors.

I. Related Work

- 1. All start-up and testing procedures and documentation requirements specified within Divisions 21, 22, 23 and 26.
- 2. The Test, Adjust and Balance (TAB) firm shall provide the following:
 - a. Allow sufficient time before final commissioning dates so that testing, adjusting and balancing can be accomplished.
 - b. Put all heating, ventilating and air conditioning equipment and systems into full operation and continue the operation during each working day of testing, adjusting and balancing and commissioning so they are fully functional. This includes the complete installation of all equipment, materials, pipe, duct, wire, insulation, controls, etc., per the contract documents and related directives, clarifications, change orders, etc.
- 3. A commissioning plan will be developed by the Commissioning Agent. Divisions, 21, 22, 23 and 26 are obligated to assist the Commissioning Agent in preparing the commissioning plan by providing all necessary information pertaining to the actual equipment and installation. If system modifications/clarifications are in the contractual requirements of this and

related sections of work, they will be made at no additional cost to the Owner. If Contractor initiated system changes have been made that alter the commissioning process, the Test Engineer will notify the Commissioning Agent and Owner's Representative for approval.

4. Normal start-up services required to bring each system into a fully operational state. This includes cleaning, filling, purging, leak testing, motor rotation check, control sequences of operation, full and part load performance, etc. The TAB firm will not begin the TAB work until each system is complete, including normal contractor start-up. The Commissioning Agent will not begin the commissioning process until each system is complete, including normal contractor start-up and the TAB work has been completed.
5. Provide labor and material to make corrections when required, without undue delay.
6. The HVAC Contractor shall include the cost of exchanged sheaves and belts as may be required by the TAB firm.
7. Provide test holes in ducts and plenums where directed or necessary for pitot tubes to take air measurements and to balance the air systems. Test holes shall be provided with an approved removable plug or seal. At each location where ducts or plenums are insulated, test holes shall be provided with an approved extension with plug fitting.
8. Provide pressure and temperature taps as indicated on construction documents in locations as required by the TAB firm to adequately test and/or balance the hydronic systems.
9. The Contractor shall include a minimum of two week "flush out" period, in which the air handling systems are sequenced into a 100% outside air mode, to assist in the removal of any construction material off-gasing, in accordance with LEEDS.

J. Test Equipment

1. Provide test equipment as necessary for start-up and commissioning of the mechanical equipment and systems. The TAB firm will provide the test equipment required to perform their service.

K. Test Equipment - Proprietary

1. Proprietary test equipment required by the manufacturer, whether specified or not, shall be provided by the manufacturer of the equipment. Manufacturer shall provide the test equipment, demonstrate its use, and assist the Commissioning Test Engineer in the commissioning process. Proprietary test equipment shall become the property of the Owner upon completion of commissioning.
2. Identify the proprietary test equipment required in the test procedures submittals and in a separate list of equipment to be included in the operations and maintenance manuals.

L. Work Prior To Commissioning

1. Complete all phases of work so the system can be started, tested, adjusted, balanced, controlled and otherwise commissioned. Divisions 21, 22, 23 and 26 have primary start-up responsibilities with obligations to complete systems, including all sub-systems completion will not relieve these Divisions from completing those systems as per the Construction and Commissioning schedule.

M. Work To Resolve Deficiencies

1. In some systems, mis-adjustments, misapplied equipment and/or deficient performance under varying loads will result in additional work being required by the Contractors to commission the systems. This work will be completed under the direction of the Construction Manager, Architect and Owner's Representative, with input from the Contractor, equipment supplier, and Commissioning Agent. Whereas all members will have input and the opportunity to discuss the work and resolve problems, the Architect will have final jurisdiction on the necessary work to be done to achieve performance.
2. Corrective work shall be completed in a timely fashion to permit timely completion of the commissioning process. Experimentation to render system performance will be permitted. If the Commissioning Agent deems the experimentation work to be ineffective or untimely as it relates to the commissioning process, the Commissioning Agent will notify the Owner indicating the nature of the problem, expected steps to be taken, and the deadline for completion of activities. If deadlines pass without resolution of the problem, the Owner reserves the right to obtain supplementary services and/or equipment to resolve the problem. Costs incurred to solve the problems in an expeditious manner will be the Contractor's responsibility.

N. Seasonal Commissioning And Occupancy Variations

1. Seasonal commissioning pertains to testing under full-load conditions during peak heating and peak cooling seasons, as well as part-load conditions in the spring and fall. Initial commissioning will be done as soon as contract work is completed regardless of season. Subsequent commissioning may be undertaken at any time thereafter to ascertain adequate performance during the different seasons.
2. All equipment and systems will be tested and commissioned in a peak season to observe full-load performance. Heating equipment will be tested during winter design extremes. Cooling equipment will be tested during summer design extremes, with a fully occupied building. Each Contractor and supplier will be responsible to participate in the initial and the alternate peak season test of the systems required to demonstrate performance, as scheduled by the Commission Agent, with three day (minimum) advance notification.
3. Subsequent commissioning may be required under conditions of minimum and/or maximum occupancy or use. All equipment and systems affected by occupancy variations will be tested and commissioned at the minimum and peak loads to observe system performance. The Contractor will be

responsible to participate in the occupancy sensitive testing of systems to provide verification of adequate performance.

O. Recommissioning

1. Upon notification by the Commissioning Agent of successful system/equipment performance/checkout test, the Owner shall witness Test No. 1. If any system/equipment/component/device fails to perform correctly during Test No. 1, the Contractor and/or equipment supplier must correct any systems/wiring deficiencies, and must incur any travel/airfares/food/hotel expenses of the designated Agent, to be available for the Retest No. 1.

P. Training

1. Participate in the training of the Owner's engineering and maintenance staff, as required in Divisions 01, 21, 22, 23 and 26, on each system and related components. Training, in part, will be conducted in a classroom setting, with system and component documentation, and suitable classroom training aids.
2. Training will be conducted jointly by the Commissioning Agent, the Contractor, and the equipment vendors. The Test Engineer will be responsible for highlighting system peculiarities specific to this project.

Q. Systems Documentation

1. In addition to the requirements of Division 01, The Contractor shall update contract documents to incorporate field changes and revisions to system designs to account for actual constructed configurations. All drawings shall be red-lined on two sets. Divisions 21, 22, 23 and 26 as-built drawings shall include architectural floor plans, elevations, and details, and the individual mechanical or electrical systems in relation to actual building layout.
2. Maintain as-built red-lines as required by Division 01. Given the size and complexity of this project, red-line drawings at completion of construction, based on memory of key personnel, is not satisfactory. Continuous and regular red-lining of drawings is considered essential and mandatory.

R. Miscellaneous Support

1. Divisions 21, 22, 23 and 26 shall remove and replace covers of mechanical equipment, open access panels, etc., to permit the Commissioning Agent, Architect and Owner's representative to observe equipment and controllers provided. Furnish ladders and flashlights as necessary.

S. Systems To Be Commissioned

1. HVAC
 - a. Each exhaust fan.
 - b. Each supply fan.
 - c. Each return fan.

- d. Each supply air unit including verification of all air and water flows at each coil and filter.
 - e. Each air flow station.
 - f. Each Variable Frequency Drive
 - g. Verify the final accuracy of the air and water test and balancing report.
 - h. BMS functional and operational control sequences.
2. Electrical
 - a. Circuit breaker trip setting verification.
 - b. Fire alarm interface to HVAC/ATC.
 - c. Emergency Power
- T. Post Occupancy Commissioning
1. This Contractor shall fully cooperate in all regards with this phase of commissioning.
 2. The Commissioning Agent will prepare a complete building operations review within ten (10) months after substantial completion with the owners operating personnel and note in the report any outstanding construction and/or operational deficiencies that are identified during this post occupancy review. This report shall be provided to the owner, Construction Manager and A/E. This Post-Occupancy deficiency list shall be corrected by the Construction Manager under the one year guarantee/warranty period and shall be submitted as being completed by the Contractor and Equipment Suppliers. The Commissioning Agent shall also procure all equipment manufacturer test data verifying post-occupancy equipment efficiencies and compare all such data to the information published by the manufacturer. This data shall be used to verify overall equipment efficiency against the contract specifications.
 3. Divisions 21, 22, 23 and 26 shall correct any and all system deficiencies noted by the Commissioning Agent during the first one year after substantial completion and as noted by the Commissioning Agent during the 10th month building operating review.

PART 2 - PRODUCTS

2.1 BASE BID MANUFACTURERS

- A. Base bid on materials or equipment are specified by name of manufacturer, brand or trade name and catalog reference.
- B. The choice will be optional with bidder where two or more manufacturers are named.
- C. The following are base bid manufacturers for items under this Section:
 1. Access doors: Karp Associates, Inc., Higgins Mfg. Co., Milcor Steel Co., and Walsh-Spencer Co.
 2. Inserts: F and S Mfg Co., Fee and Mason and Grinnell.

3. Hangers and supports: I.T.T. Grinnell, Carpenter and Patterson, Inc., and Fee & Mason.
4. Paint: Sherwin-Williams, Pittsburgh Paint Co., Pratt and Lambert, and Rust-Oleum.
5. Gratings: Irving Grating IKG Industries and Ryerson - Inland Steel Co.

2.2 INSERTS AND SUPPORTS

- A. Support all HVAC work from building construction by providing inserts, beam clamps, steel fishplates (in concrete fill only), and acceptable brackets. Submit all methods for review.
- B. Provide trapeze hangers of bolted angles or channels for grouped lines and services.
- C. Provide additional framing where building construction is inadequate. Submit for review.
- D. Inserts shall be steel, slotted type and factory-painted.
 1. Single rod shall be similar to Grinnell Fig. 281.
 2. Multi-rod shall be similar to Fee & Mason Series 9000 with end caps and closure strips.
 3. Clip form nails flush with inserts.
 4. Maximum loading including pipe, contents and covering shall not exceed 75 percent of rated insert capability.
- E. Supports from steel decks:
 1. Pipes:
 - a. Sizes up to 3" diameter maximum hanger spacing: 10' centers maximum.
 - b. Beyond 3" diameter provide support steel, hanger spacing: 10' centers.
 2. Ductwork:
 - a. Hangers spacing: maximum 10' centers and/or every change in direction.

2.3 SUPPLEMENTARY STEEL, CHANNELS AND SUPPORTS:

- A. Furnish supplementary steel, channels and supports required for proper installation, mounting and support of all HVAC work.
- B. Connect supplementary steel and channels firmly to building construction in an acceptable manner.

- C. Determine type and size of supporting channels and supplementary steel. Supplementary steel and channels shall be of sufficient strength and size to allow only a minimum deflection in conformance with manufacturer's requirements of loading.
- D. Install supplementary steel and channels in a neat and workmanlike manner parallel to walls, floors, and ceiling construction.
- E. All supplementary steel, channels, supports shall be submitted to Structural Engineer for review.

2.4 EXPANSION ANCHORS

- A. Provide smooth wall, non-self-drilling internal plug expansion type anchors constructed of AISC 12L14 steel and zinc plated in accordance with Fed. Spec. QQ-A-325 Type 1, Class 3.
- B. Do not exceed 1/4 of average values for a specific anchor size using 2000 psig (13,800 kpa) concrete only, for maximum working load.
- C. Provide spacing and install anchors in accordance with manufacturer's recommendations.

2.5 ACCESS DOORS

- A. This contractor shall submit to the architect for approval a plan indicating the size (minimum 18" x 18") and location of all building construction access doors required for operation and maintenance of all concealed equipment, devices, valves, dampers and controls. Contractor shall arrange for furnishing of all access doors in finished construction and include costs in the bid.
- B. Flush type access doors shall be similar to Karp Type DSC-211 with No. 13 USSG steel doors and trim and No. 16 USSG steel frame, metal wings for keying into construction, concealed hinges and screwdriver operated stainless steel cam lock. Provide lift off type access doors, similar to Karp Type DSC-212, where door cannot swing open.
- C. In acoustic tile ceilings, factory finished white access doors shall be similar to Karp Type DSC-210, with No. 13 USSG steel frame, No. 16 USSG steel pan door suitable for receiving tile thickness and hinges that are not visible when door is closed. Access door shall have screwdriver operated stainless steel cam locks finishing flush with tile with a minimum of 2 per door.
- D. In plaster ceilings recessed access doors shall be similar to Karp DSC-210-PL, with recess to receive plaster.
- E. In fire rated construction provide fire rated access doors, similar to Karp KRP-150-FR, in accordance with applicable code requirements.
- F. Access doors shall have one coat of shop-painted zinc chromate primer.

2.6 ACCESS TILE IDENTIFICATION:

- A. In removable ceiling tiles, provide buttons, tabs, and markers to identify location of concealed work. Submit for review.

2.7 EQUIPMENT PLATFORMS

- A. Equipment platforms will be provided under General Construction Work.

2.8 LADDERS

- A. Ladders will be provided under General Construction Work except those inside air handling units which shall be provided as an integral part of the unit.

2.9 SHAFT GRATINGS

- A. Shaft gratings will be provided under General Construction Work.

2.10 TAGS:

- A. Provide 2 in. round valve tags on all valves and controls of No. 18 BS gauge aluminum with stamped numbers and letters filled in with black paint.
- B. Indicate identifying number and system letter on tags, and fasten by heavy aluminum or brass "S" hooks or chains.
- C. Tags shall be similar to Seton Name Plate Corporation.

2.11 CHARTS

- A. Provide valve tag chart indicating valve number, system, type, size, location and function for all valves.
- B. Mount in aluminum frame and glass.
- C. Letter and number valves and controls to correspond with designations on metal tags.
- D. Fasten charts permanently in locations, as directed, with four brass screws.

2.12 NAMEPLATES

- A. Provide nameplates with inscriptions, subject to review, indicating building abbreviations, equipment number and capacity (CFM and/or GPM). Fasten with epoxy cement or chrome plated screws. Nameplate shall be black Lamicoid sheet with white lettering.

PART 3 - EXECUTION

3.1 MECHANICAL IDENTIFICATION

- A. Refer to identification Section.

3.2 FOUNDATIONS

- A. Foundations and concrete will be provided under General Construction Work.
- B. Coordinate foundations for:
 - 1. Air handling units and floor mounted plenums.
 - 2. Floor mounted control panels.
 - 3. Motor controllers; VFD's, Disconnect Switches, etc.
 - 4. Control Panels.

3.3 WATERPROOFING

- A. Waterproofing will be provided under General Construction Work.

3.4 FIELD QUALITY CONTROL

- A. Perform tests as noted, and in the presence of Architect and/or Construction Manager, Engineer and authorities having jurisdiction.
- B. Provide required labor, material, equipment, and connections necessary for tests and submit results for review.
- C. Repair or replace defective work and pay for restoring or replacing damaged work due to tests, as directed.

3.5 CLEANING

- A. Brush and clean work prior to concealing, painting and acceptance. Perform in stages if directed.
- B. Clean and repair painted exposed work, soiled or damaged, to match adjoining work before final acceptance.
- C. Remove debris from inside and outside of material and equipment.

End Of Section