PROJECT MANUAL AND SPECIFICATIONS

CITY OF WORCESTER

WORCESTER LIBRARY
BOILER REPLACEMENT
3 SALEM STREET
WORCESTER, MA 01608

ENGINEER
FITZEMEYER & TOCCI ASSOCIATES, INC.
300 UNICORN PARK DRIVE, 5TH FLOOR
WOBURN, MA 01801

ISSUED FOR BID
June 22, 2026

PROJECT MANUAL AND SPECIFICATIONS

TABLE OF CONTENTS

DIVISION 01 - GENERAL REQUIREMENTS

011000 SUMMARY
012600 CONTRACT MODIFICATION PROCEDURES
012900 PAYMENT PROCEDURES
013100 PROJECT MANAGEMENT AND COORDINATION
013200 CONSTRUCTION PROGRESS DOCUMENTATION
013300 SUBMITTAL PROCEDURES
014000 QUALITY REQUIREMENTS
014200 REFERENCES
016000 PRODUCT REQUIREMENTS
017300 EXECUTION
017329 CUTTING AND PATCHING
017700 CLOSEOUT PROCEDURES
017823 OPERATION AND MAINTENANCE DATA
017839 PROJECT RECORD DOCUMENTS
017900 DEMONSTRATION AND TRAINING

DIVISION 23 – HEATING VENTILATION AND COOLING

220000 HEATING VENTILATION AND COOLING

DIVISION 26 – ELECTRICAL

260000 ELECTRICAL

SECTION 011000 – SUMMARY

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings, general provisions of the Contract, including General and Supplementary Conditions and Division 01 General Requirements, are a part of this Section and shall be binding on all Contractors and Subcontractors who perform this work.

1.02 SUMMARY

A. This Section includes the following:

1. Project information.
2. Work covered by Contract Documents.
3. Access to site.
4. Coordination with occupants.
5. Work restrictions.
6. Specification and drawing conventions.
7. Miscellaneous provisions.

1.03 PROJECT INFORMATION

A. Project Identification: City of Worcester – Worcester Library Boiler Replacement

1. Project Location: 3 Salem St, Worcester, MA 01608

B. Owner: City of Worcester.

1. Owner's Representative: Jim McDermott

C. Engineer: The Contract Documents were prepared for the Project by: Fitzemeyer & Tocci Associates, Inc.

1.04 WORK COVERED BY CONTRACT DOCUMENTS

A. The project consists of the following:

1. Removal and Replacement of one Boiler while second boiler is to remain functioning during new install. New boiler will need to communicate with existing building controls.

1.05 TYPE OF CONTRACT

A. Project will be constructed under a single contract.

1.06 SCHEDULE

A. General: The Contractor shall prepare a detailed construction schedule, to be submitted to the Owner, Engineer, and Owner’s Representative for review and approval. The schedule must clearly demonstrate the proper sequencing of construction activities.

1.07 USE OF PREMISES

A. General: Each Contractor shall have limited use of premises for construction operations as determined by the Owner.

B. Use of Site: Limit use of premises to areas determined by the Owner's Representative. Do not disturb portions of Project site beyond areas in which the Work is indicated.

1. Confine the parking of workmen's and construction vehicles, and the storage of construction materials to a designated staging area determined by the Owner.
2. Owner Occupancy: Allow for Owner occupancy of Project site.
3. Driveways and Entrances: Keep driveways and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or storage of materials.
   a. Schedule deliveries to minimize use of driveways and entrances.
   b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.

C. Use of Existing Building: Maintain existing building in a weathertight condition throughout construction period. Repair damage caused by construction operations. Protect building and its occupants during construction period. Maintain the existing fire alarm and sprinkler system throughout construction.

1.08 COORDINATION WITH OCCUPANTS

A. Partial Owner Occupancy: Owner will occupy the premises during entire construction period, with the exception of areas under construction during working hours. Owner will occupy entire building at the end of each working day. Structure shall be made safe for all affected parties at the end of this working day. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner's operations. Maintain existing exits, unless otherwise indicated.

1. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from Owner and authorities having jurisdiction.
2. Provide not less than 72 hours' notice to Owner of activities that will affect Owner's operations.

1.09 WORK RESTRICTIONS

A. Work Restrictions, General: Comply with restrictions on construction operations.

1. Comply with limitations on use of public streets and with other requirements of authorities having jurisdiction.

B. On-Site Work Hours: Work shall be generally performed inside the building during normal business working hours of 8:00 a.m. to 5:00 p.m., Monday through Friday, except otherwise indicated.

1. Living Quarters: Coordinate with Owner.
2. Weekend Hours: Coordinate with Owner.
3. Hours for Utility Shutdowns: Coordinate with Owner.

C. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify Owner not less than two days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without Owner's written permission.

D. Noise, Vibration, and Odors: Coordinate operations that may result in high levels of noise and vibration, odors, or other disruption to Owner occupancy with Owner.

1. Notify Engineer and Owner not less than two days in advance of proposed disruptive operations.
2. Obtain Engineer's and Owner’s written permission before proceeding with disruptive operations.

E. Nonsmoking Building: Smoking is not permitted within the building or within 25 feet of entrances, operable windows, or outdoor-air intakes.

F. Employee Identification: Provide identification tags for Contractor personnel working on Project site. Require personnel to use identification tags at all times.

1.10 SPECIFICATION FORMATS AND CONVENTIONS

A. Specification Format: The Specifications are organized into Divisions and Sections using the 48-division format and CSI/CSC's "MasterFormat" numbering system.

1. Section Identification: The Specifications use Section numbers and titles to help cross-referencing in the Contract Documents. Sections in the Project Manual are in numeric sequence; however, the sequence is incomplete because all available Section numbers are not used. Consult the table of contents at the beginning of the Project Manual to determine numbers and names of Sections in the Contract Documents.

B. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.

C. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:

1. Abbreviated Language: Language used in the Specifications and other Contract Documents is abbreviated. Words and meanings shall be interpreted as appropriate. Words implied, but not stated, shall be inferred as the sense requires. Singular words shall be interpreted as plural, and plural words shall be interpreted as singular where applicable as the context of the Contract Documents indicates.
2. Imperative mood and streamlined language are generally used in the Specifications. Requirements expressed in the imperative mood are to be performed by Contractor. Occasionally, the indicative or subjunctive mood may be used in the Section Text for clarity to describe responsibilities that must be fulfilled indirectly by Contractor or by others when so noted.

   a. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.

D. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. One or more of the following are used on Drawings to identify materials and products:

1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
2. Abbreviations: Materials and products are identified by abbreviations published as part of the U.S. National CAD Standard and scheduled on Drawings.

E. In general, the Specifications will describe the quality of the work and the Drawings, the extent of the work. The Drawings and Specifications are cooperative and supplementary; however, each item of the work is not necessarily mentioned in both the Drawings and the Specifications. All work necessary to complete the project, so described, is to be included in this Contract.

F. In case of disagreement between the Drawings and Specifications, or within either document itself, the Engineer shall interpret the Documents to require the better quality or greater quantity of work for the Owner that can reasonably be construed therefrom. Any work performed by the Contractor without consulting the Engineer, when the same requires a decision, shall be performed at the Contractor's risk.

1.11 CODES, STANDARDS AND PERMITS

A. All work under this contract shall conform to all codes and standards in effect as of the date of receipt of Bids which are applicable to this Project. All work shall also conform to specific requirements and interpretations of local authorities having jurisdiction over the Project. These Codes, standards, and authorities are referred to collectively as "the governing codes and authorities" and similar terms throughout the Specifications. Determination of applicable codes and standards and requirements of the authorities having jurisdiction shall be the responsibility of the Contractor; as shall be the analysis of all such codes and standards in regard to their applicability to the Project for the purposes of determining necessary construction to conform to such code requirements, for securing all approvals and permits necessary to proceed with construction, and to obtain all permits necessary for the Owner to occupy the facility for their intended use. In the case of conflicts between the requirements of different codes and standards, the most restrictive or stringent requirements shall be met.

B. The codes that were used in the design of this Project are as follows:

1. Commonwealth of Massachusetts State Building Code, 780 CMR Ninth Edition, including all referenced standards.
   a. 2015 International Building Code.
   b. 2015 International Existing Building Code.
2. 2015 International Mechanical Code.
3. 2015 International Energy Conservation Code & Stretch Energy Code.
4. 527 CMR: Massachusetts Fire Prevention Regulations, including M.G.L. Chapter 148 Section 26G – Sprinkler Protection.
5. 527 CMR 12.00: Massachusetts Electrical Code (2017 National Electrical Code).
6. 248 CMR: Massachusetts Plumbing Code.
7. 521 CMR: Massachusetts Architectural Access Board (AAB).
8. Title II of the Americans with Disabilities Act (ADA) including the 2010 ADA Standards for Accessible Design.

C. Code Enforcement and Approvals: Secure and pay for the general building permit for the work, and conform to all conditions and requirements of the permit and code enforcement authorities.

D. Identify all permits (other than general building permit) required from authorities having jurisdiction over the Project for the construction and occupancy of the work. Prepare the necessary applications and submit required plans and documents to obtain such permits in a timely manner. Permit fees to be paid by the Contractor.

1. Display all permit cards as required by the authorities, and deliver legible photocopies of all permits to the Owner promptly upon their receipt.
2. Arrange for all inspections, testing and approvals required for all permits. Notify the Owner and Engineer at least three business days in advance, so they may arrange to observe.
3. Comply with all conditions and provide all notices required by all permits.
4. Perform and/or arrange for and pay for all testing and inspections required by the governing codes and authorities, other than those provided by the Owner, and notify the Owner and Engineer of such inspections at least three business days in advance, so they may arrange to observe.
5. Where inspecting authorities require corrective work in conjunction with applicable codes and authorities, promptly comply with such requirements, except in cases where such requirements clearly exceed the requirements of the Contract Documents, in which case proceed in accordance with the procedures for modifications to the Work established in the Contract Documents.

E. OCCUPATIONAL SAFETY AND HEALTH ACT: The Contractor and each Subcontractor shall comply with the requirements of the Occupational Safety and Health Act of 1970 and the Construction Safety Act of 1969, including all standards and regulations which have been promulgated by the Governmental Authorities which administer such Acts. Said requirements, standards and regulations are incorporated herein by reference.

1. The Contractor and each Subcontractor shall comply with M.G.L. Chapter 306 of the Acts of 2004 which requires that all employees on the Project site complete a course in construction safety and health approved by the U.S. Occupational Safety and Health Administration (OSHA), known as the “OSHA 10-hour course.”

F. The Contractor and each Subcontractor shall comply with said regulations, requirements and standards and require and be directly responsible for compliance therewith on the part of his agents, employees material men and Subcontractors; and shall directly receive and be responsible for all citations, assessments, fines or penalties which may be incurred by reason of his agents, employees, material men or Subcontractors failing to so comply.

1.12 DRAWING LIST

A. The drawings included in the design of this Project are as follows:

Sheet Number	Sheet Name
M000	Mechanical Legend
M120	Mechanical Basement Level Duct & Piping Plans
M700	Mechanical Schedules
M900	Mechanical Details
E000	Electrical Legend
E001	Electrical Legend, Notes, and Abbreviations

E120	Electrical Basement Level Power Plan
E700	Electrical Schedules and Details

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 011000

SECTION 012600 -CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. The Contractor, Subcontractors, and/or suppliers providing goods or services referenced in or related to this Section shall also be bound by the Documents identified in Division 01 Section “Summary”, Paragraph 1.1A, entitled “Related Documents.”

1.02 SUMMARY

A. This Section specifies administrative and procedural requirements for handling and processing Contract modifications.

B. Related Sections include the following:

1. Division 01 Section "Product Requirements" for administrative procedures for handling requests for substitutions made after Contract award.

1.03 MINOR CHANGES IN THE WORK

A. Engineer will issue supplemental instructions authorizing Minor Changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on AIA Document G710, "Engineer's Supplemental Instructions” or similar form prepared by Engineer.

1.04 PROPOSAL REQUESTS

A. Owner-Initiated Proposal Requests: Engineer will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.

1. Proposal Requests issued by Engineer are for information only. Do not consider them instructions either to stop work in progress or to execute the proposed change.
2. Within 10 days after receipt of Proposal Request, submit a quotation to the Engineer, estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
   a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
   b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
   c. Include costs of labor and supervision directly attributable to the change.
   d. Include an updated Contractor's Construction Schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.

B. Contractor-Initiated Proposals: If latent or unforeseen conditions require modifications to the Contract, Contractor may propose changes by first submitting a “Request for Information” to the Engineer. This request will be responded to by the Engineer, wherein the Contractor may submit a Change Order Proposal.

1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
4. Include costs of labor and supervision directly attributable to the change.
5. Include an updated Contractor's Construction Schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
6. Comply with requirements in Division 01 Section "Product Requirements" if the proposed change requires substitution of one product or system for product or system specified.

1.05 ADMINISTRATIVE CHANGE ORDERS

A. Allowance Adjustment: To adjust allowance amounts, base each Change Order proposal on the difference between purchase amount and the allowance, multiplied by final measurement of work-in-place. If applicable, include reasonable allowances for cutting losses, tolerances, mixing wastes, normal product imperfections, and similar margins.

1. Include installation costs in purchase amount only where indicated as part of the allowance.
2. If requested, prepare explanation and documentation to substantiate distribution of overhead costs and other margins claimed.
3. Submit substantiation of a change in scope of work, if any, claimed in Change Orders related to unit-cost allowances.
4. Owner reserves the right to establish the quantity of work-in-place by independent quantity survey, measure, or count.

B. Submit claims for increased costs because of a change in scope or nature of the allowance described in the Contract Documents, whether for the Purchase Order amount or Contractor's handling, labor, installation, overhead, and profit. Submit claims within 21 days of receipt of the Change Order or Construction Change Directive authorizing work to proceed. Owner will reject claims submitted later than 21 days after such authorization.

1. Do not include Contractor's or subcontractor's indirect expense in the Change Order cost amount unless it is clearly shown that the nature or extent of work has changed from what could have been foreseen from information in the Contract Documents.
2. No change to Contractor's indirect expense is permitted for selection of higher-or lower-priced materials or systems of the same scope and nature as originally indicated.

C. Unit-Price Adjustment: See Division 01 Section "Unit Prices" for administrative procedures for preparation of Change Order Proposal for adjusting the Contract Sum to reflect measured scope of unit-price work.

1.06 CHANGE ORDER PROCEDURES

A. On Owner's approval of a Proposal Request, the Engineer will issue a Change Order for signatures of Owner and Contractor on AIA Document G701 or similar form.

1.07 CONSTRUCTION CHANGE DIRECTIVE

A. Construction Change Directive: Engineer may issue a Construction Change Directive on AIA Document G714. Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.

   1. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.

B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.

   1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 012600

SECTION 012900 -PAYMENT PROCEDURES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. The Contractor, Subcontractors, and/or suppliers providing goods or services referenced in or related to this Section shall also be bound by the Documents identified in Division 01 Section “Summary”, Paragraph 1.1A, entitled “Related Documents.”

1.02 SUMMARY

A. This Section specifies administrative and procedural requirements necessary to prepare and process Applications for Payment.

B. Related Sections include the following:

1. Division 01 Section "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.
2. Division 01 Section "Construction Progress Documentation" for administrative requirements governing preparation and submittal of Contractor's Construction Schedule.

1.03 DEFINITIONS

A. Schedule of Values: A statement furnished by Contractor allocating portions of the Contract Sum to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

1.04 SCHEDULE OF VALUES

A. Coordination: Coordinate preparation of the Schedule of Values with preparation of Contractor's Construction Schedule.

1. Correlate line items in the Schedule of Values with other required administrative forms and schedules, including the following:
   a. Application for Payment forms with Continuation Sheets.
   b. Submittals Schedule.
   c. Contractor's Construction Schedule.

2. Submit the Schedule of Values to the Engineer at earliest possible date but no later than seven days before the date scheduled for submittal of initial Applications for Payment.

B. Format and Content: Use the Project Manual table of contents as a guide to establish line items for the Schedule of Values. Provide at least one line item for each Specification Section. For major trades with line item values greater than $25,000, provide a separate line item for units of work within each trade with a value not exceeding $25,000.

1. Identification: Include the following Project identification on the Schedule of Values:
   a. Project name and location.
   b. Name of Engineer.
   c. Engineer's project number.
   d. Contractor's name and address.
   e. Date of submittal.

2. Submit draft of AIA Document G702 and AIA Document G703 Continuation Sheets.

3. Arrange the Schedule of Values in tabular form with separate columns to indicate the following for each item listed:

    a. Related Specification Section or Division.
    b. Description of the Work.
    c. Name of subcontractor.
    d. Name of manufacturer or fabricator.
    e. Name of supplier.
    f. Change Orders (numbers) that affect value.
    g. Dollar value.

4. Percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent.

5. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with the Project Manual table of contents. Provide several line items for principal subcontract amounts, where appropriate.
    a. Include the following mandatory line items:
        1) Mobilization.
        2) Demobilization
        3) Builders Risk Insurance.
        4) Bonds.
        5) Scheduling.
        6) Commissioning.
        7) Project record documents
        8) Operation and Maintenance manuals.
        9) Field Engineering.
        10) Daily Building Cleanup.
        11) Safety Program.
        12) NFPA 241 Compliance Plan.
        13) Full-Time Project Manager.
        14) Full-Time Project Superintendent.
        15) Field Offices.
        16) Dumpsters
        17) Cold Weather Protection.
        18) Temporary Heat.
6. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
7. Provide a separate line item in the Schedule of Values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
    a. Differentiate between items stored on-site and items stored off-site. If specified, include evidence of insurance or bonded warehousing.
8. Provide separate line items in the Schedule of Values for initial cost of materials, for each subsequent stage of completion, and for total installed value of that part of the Work.
9. Each item in the Schedule of Values and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item.
    a. Temporary facilities and other major cost items that are not direct cost of actual work-in-place may be shown either as separate line items in the Schedule of Values or distributed as general overhead expense, at Contractor's option.

10. Schedule Updating: Update and resubmit the Schedule of Values before the next Applications for Payment when Change Orders or Construction Change Directives result in a change in the Contract Sum.
11. Prevailing Wage Rates: The prevailing wage rates of MGL, Chapter 149, are applicable to this Project. Wage rates are as determined by the Massachusetts Department of Workforce Development. Certified payrolls must be submitted with each Application for Payment.

1.05 APPLICATIONS FOR PAYMENT

A. Each Application for Payment shall be consistent with previous applications and payments as certified by Engineer and paid for by Owner.

   1. Initial Application for Payment, Application for Payment at time of Substantial Completion, and final Application for Payment involve additional requirements.

B. Payment Application Times: The date for each progress payment is indicated in the Agreement between Owner and Contractor. The period of construction Work covered by each Application for Payment is the period indicated in the Agreement.

   1. Prepare a draft of each Application for Payment and review with the Engineer prior to submission of final Application. The draft copy shall be typewritten and include the application number and date.

C. Payment Application Forms: Use AIA Document G702 and AIA Document G703 Continuation Sheets as form for Applications for Payment.

D. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Engineer will return incomplete applications without action.

   1. Entries shall match data on the Schedule of Values and Contractor's Construction Schedule. Use updated schedules if revisions were made.
   2. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.

E. Stored Materials: Include in Application for Payment amounts applied for materials or equipment purchased or fabricated and stored, but not yet installed. Differentiate between items stored on-site and items stored off-site.

   1. Provide certificate of insurance, evidence of transfer of title to Owner, and consent of surety to payment, for stored materials.
   2. Provide supporting documentation that verifies amount requested, such as paid invoices. Match amount requested with amounts indicated on documentation; do not include overhead and profit on stored materials.
   3. Provide summary documentation for stored materials indicating the following:
      a. Value of materials previously stored and remaining stored as of date of previous Applications for Payment.
      b. Value of previously stored materials put in place after date of previous Application for Payment and on or before date of current Application for Payment.
      c. Value of materials stored since date of previous Application for Payment and remaining stored as of date of current Application for Payment.

F. Transmittal: Submit three (3) signed and notarized original copies of each Application for Payment to Engineer by a method ensuring receipt within 24 hours. One copy shall include waivers of lien and similar attachments if required.

G. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's lien from every entity who is lawfully entitled to file a mechanic's lien arising out of the Contract and related to the Work covered by the payment.

1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
2. When an application shows completion of an item, submit final or full waivers.
3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
4. Waiver Forms: Submit waivers of lien on forms, executed in a manner acceptable to Owner.

H. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:

1. List of subcontractors.
2. Schedule of values.
3. Contractor's construction schedule (preliminary if not final).
4. Combined Contractor's construction schedule (preliminary if not final) incorporating Work of multiple contracts, with indication of acceptance of schedule by each Contractor.
5. Products list (preliminary if not final).
6. Schedule of unit prices.
7. Submittal schedule (preliminary if not final).
8. List of Contractor's staff assignments.
9. List of Contractor's principal consultants.
10. Copies of building permits.
11. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
12. Initial progress report.
13. Report of preconstruction conference.
14. Certificates of insurance and insurance policies.
15. Performance and payment bonds.
16. Data needed to acquire Owner's insurance.
17. Certified payrolls.
18. OSHA training certificates.
19. Application for Payment at Substantial Completion: After issuing the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.
20. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
21. This application shall reflect Certificates of Partial Substantial Completion issued previously for Owner occupancy of designated portions of the Work.

I. Final Payment Application: Submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:

1. Evidence of completion of Project closeout requirements.

2. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
3. Updated final statement, accounting for final changes to the Contract Sum.
4. AIA Document G706, "Contractor's Affidavit of Payment of Debts and Claims."
5. AIA Document G706A, "Contractor's Affidavit of Release of Liens."
6. AIA Document G707, "Consent of Surety to Final Payment."
7. Evidence that claims have been settled.
8. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 012900

SECTION 013100 -PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. The Contractor, Subcontractors, and/or suppliers providing goods or services referenced in or related to this Section shall also be bound by the Documents identified in Division 01 Section “Summary”, Paragraph 1.1A, entitled “Related Documents.”

1.02 SUMMARY

A. This Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:

1. General coordination procedures.
2. Requests for Information (RFIs).
3. Project meetings.

B. The Contractor and each Subcontractor shall participate in coordination requirements.

C. Related Sections include the following:

1. Division 01 Section "Construction Progress Documentation" for preparing and submitting Contractor's Construction Schedule.
2. Division 01 Section "Execution" for procedures for coordinating general installation and field-engineering services.
3. Division 01 Section "Closeout Procedures" for coordinating closeout of the Contract.

1.03 DEFINITIONS

A. RFI: Request from Contractor seeking interpretation or clarification of the Contract Documents.

1.04 INFORMATIONAL SUBMITTALS

A. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:

1. Name, address, and telephone number of entity performing subcontract or supplying products.
2. Number and title of related Specification Section(s) covered by subcontract.
3. Drawing number and detail references, as appropriate, covered by subcontract.

B. Key Personnel Names: Within 10 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including home and office telephone numbers. Provide names, addresses, and telephone numbers of individuals assigned as standbys in the absence of individuals assigned to Project.

1. Keep list current at all times, resubmit upon update.

1.05 GENERAL COORDINATION PROCEDURES

A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations, included in different Sections, that depend on each other for proper installation, connection, and operation.

1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
2. Coordinate installation of different components with other contractors to ensure maximum accessibility for required maintenance, service, and repair.
3. Make adequate provisions to accommodate items scheduled for later installation.
4. Where availability of space is limited, coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair of all components, including mechanical and electrical.
5. No claim for additional compensation or extension of Contract Time will be permitted for conditions resulting from lack of coordination.

B. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.

1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.

C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities and activities of other contractors to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:

1. Preparation of Contractor's Construction Schedule.
2. Preparation of the Schedule of Values.
3. Installation and removal of temporary facilities and controls.
4. Delivery and processing of submittals.
5. Preinstallation conferences.
6. Progress meetings.
7. Startup and adjustment of systems.
8. Project closeout activities.

D. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials.

1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. Refer to other Sections for disposition of salvaged materials that are designated as Owner's property.

1.06 ADMINISTRATIVE AND SUPERVISORY PERSONNEL

A. General: In addition to Project superintendent, provide other administrative and supervisory personnel as required for proper performance of the Work.

1.07 REQUESTS FOR INFORMATION (RFIS)

A. Procedure: Immediately on discovery of the need for interpretation of the Contract Documents, and if not possible to request interpretation at Project meeting, prepare and submit an RFI, to the Engineer, in the form specified.

1. RFIs shall originate with Contractor or Subcontractor. RFIs submitted by entities other than the Contractor will be returned with no response.
2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.

B. Content of the RFI: Include a detailed, legible description of item needing interpretation and the following:

1. Project name.
2. Date.
3. Name of Subcontractor.
4. Name of Engineer.
5. RFI number, numbered sequentially.
6. Specification Section number and title and related paragraphs, as appropriate.
7. Drawing number and detail references, as appropriate.
8. Field dimensions and conditions, as appropriate.
9. Contractor's suggested solution(s). If Contractor's solution(s) impact the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
10. Contractor's signature.
11. Attachments: Include drawings, descriptions, measurements, photos, Product Data, Shop Drawings, and other information necessary to fully describe items needing interpretation.

    a. Supplementary drawings prepared by Contractor shall include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments.

C. Hard-Copy RFIs:

1. Identify each page of attachments with the RFI number and sequential page number.

D. Software-Generated RFIs: Software-generated form with substantially the same content as indicated above.

1. Attachments shall be electronic files in Adobe Acrobat PDF format.

E. Engineer's Action: Engineer will review each RFI, determine action required, and return it. Allow five working days for Engineer's response for each RFI. RFIs received after 1:00 p.m. will be considered as received the following working day.

1. The following Contractor-generated RFIs will be returned without action:
    a. Requests for approval of submittals.
    b. Requests for approval of substitutions.
    c. Requests for approval of Contractor's means and methods.
    d. Requests for coordination information already indicated in the Contract Documents.
    e. Requests for adjustments in the Contract Time or the Contract Sum.
    f. Requests for interpretation of Engineer's actions on submittals.
    g. Incomplete RFIs or RFIs with numerous errors.

2. Engineer's action may include a request for additional information, in which case Engineer's time for response will start again.
3. Engineer's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Division 01 Section "Contract Modification Procedures."

    a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Engineer in writing within 10 days of receipt of the RFI response.

F. On receipt of Engineer's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Engineer within five days if Contractor disagrees with response.

G. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log biweekly. Include the following:

1. Project name.
2. Name and address of Engineer.
3. RFI number including RFIs that were dropped and not submitted.
4. RFI description.
5. Date the RFI was submitted.
6. Date Engineer's response was received.
7. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.

1.08 PROJECT MEETINGS

A. General: Schedule and conduct meetings and conferences at Project site, unless otherwise indicated.

1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify the Owner and Engineer of scheduled meeting dates and times.
2. Agenda: Prepare the meeting agenda and distribute the agenda to all invited attendees.
3. Minutes: Record significant discussions and agreements achieved and distribute the meeting minutes to everyone concerned, including Owner and Engineer, within three days of the meeting.

B. Preconstruction Conference: Schedule a preconstruction conference before starting construction, at a time convenient to Owner and Engineer, but no later than 15 days after execution of the Agreement. Hold the conference at Project site or another convenient location. Conduct the meeting to review responsibilities and personnel assignments.

1. Attendees: Authorized representatives of Owner, Engineer, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
2. Agenda: Discuss items of significance that could affect progress, including the following:
    a. Tentative construction schedule.
    b. Critical work sequencing and long-lead items.
    c. Designation of key personnel and their duties.
    d. Procedures for processing field decisions and Change Orders.
    e. Procedures for RFIs.

f. Procedures for testing and inspecting.
g. Procedures for processing Applications for Payment.
h. Distribution of the Contract Documents.
i. Submittal procedures.
j. Preparation of Record Documents.
k. Use of the premises.
l. Work restrictions.
m. Owner's occupancy requirements.
n. Responsibility for temporary facilities and controls.
o. Construction waste management and recycling.
p. Parking availability.
q. Office, work, and storage areas.
r. Equipment deliveries and priorities.
s. First aid.
t. Security.
u. Progress cleaning.
v. Working hours.

3. Minutes: The Engineer will record and distribute meeting minutes.

C. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity that requires coordination with other construction.

1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Engineer of scheduled meeting dates.
2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:
   a. The Contract Documents.
   b. Options.
   c. Related RFIs.
   d. Related Change Orders.
   e. Purchases.
   f. Deliveries.
   g. Submittals.
   h. Possible conflicts.
   i. Compatibility problems.
   j. Time schedules.
   k. Weather limitations.
   l. Manufacturer's written recommendations.
   m. Warranty requirements.
   n. Compatibility of materials.
   o. Acceptability of substrates.
   p. Temporary facilities and controls.
   q. Space and access limitations.
   r. Regulations of authorities having jurisdiction.
   s. Testing and inspecting requirements.
   t. Installation procedures.
   u. Coordination with other work.
   v. Required performance results.
   w. Protection of adjacent work.
   x. Protection of construction and personnel.

3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
4. Reporting: The Engineer will distribute minutes of the meeting to each party present and to parties who should have been present.
5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.

D. Progress Meetings: Attend progress meetings at interval determined by the Engineer. Dates of meetings may coincide with preparation of payment requests.

1. Attendees: In addition to representatives of Owner and Engineer, each Subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
2. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.

    a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's Construction Schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
        1) Review schedule for next period.
    b. Review present and future needs of each entity present, including the following:
        1) Interface requirements.
        2) Sequence of operations.
        3) Deliveries.
        4) Access.
        5) Site utilization.
        6) Temporary facilities and controls.
        7) Work hours.
        8) Hazards and risks.
        9) Progress cleaning.
        10) Quality and work standards.
        11) Status of correction of deficient items.
        12) Field observations.
        13) RFIs.
        14) Status of proposal requests.
        15) Pending changes.
        16) Status of Change Orders.
        17) Pending claims and disputes.
        18) Documentation of information for payment requests.

3. Minutes: The Engineer will record and distribute the meeting minutes.
4. Reporting: The Engineer will distribute minutes of the meeting to each party present and to parties who should have been present.

a. Schedule Updating: Revise Contractor's Construction Schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 013100

SECTION 013200 -CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. The Contractor, Subcontractors, and/or suppliers providing goods or services referenced in or related to this Section shall also be bound by the Documents identified in Division 01 Section “Summary”, Paragraph 1.1A, entitled “Related Documents.”

1.02 SUMMARY

A. This Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:

1. Contractor's Construction Schedule.
2. Daily construction reports.
3. Field condition reports.
4. Special reports.
5. Certified payroll records.

B. Related Sections include the following:

1. Division 01 Section "Payment Procedures" for submitting the Schedule of Values.
2. Division 01 Section "Project Management and Coordination" for submitting and distributing meeting and conference minutes.
3. Division 01 Section "Submittal Procedures" for submitting schedules and reports.
4. Division 01 Section "Quality Requirements" for submitting a schedule of tests and inspections.

1.03 INFORMATIONAL SUBMITTALS

A. Contractor's Construction Schedule: Submit two opaque copies of initial schedule, large enough to show entire schedule for entire construction period.

1. Submit an electronic copy of schedule, using software indicated, on CD-R, and labeled to comply with requirements for submittals. Include type of schedule (Initial or Updated) and date on label.

B. Daily Construction Reports: Submit two copies at weekly intervals, to the Owner’s Representative.

C. Field Condition Reports: Submit two copies at time of discovery of differing conditions, to the Engineer.

D. Special Reports: Submit two copies at time of unusual event, to the Engineer.

E. Certified Payroll Records: Submit two copies at weekly intervals to Owner.

1.04 QUALITY ASSURANCE

A. Prescheduling Conference: Conduct a conference at Project site with Engineer to comply with requirements in Division 01 Section "Project Management and Coordination." Review

methods and procedures related to the Contractor's Construction Schedule, including, but not limited to, the following:

1. Review delivery dates for Owner-furnished products.
2. Review schedule for work of Owner's separate contracts.
3. Review time required for review of submittals and resubmittals.
4. Review requirements for tests and inspections by independent testing and inspecting agencies.
5. Review time required for completion and startup procedures.
6. Review and finalize list of construction activities to be included in schedule.
7. Review submittal requirements and procedures.
8. Review procedures for updating schedule.
9. Establish mandatory milestone dates and finish dates within each phase.

B. Review and approval of the Contractor’s Construction Schedule is advisory only and does not relieve the Contractor of the responsibility for completing the work within the Contract time.

1.05 COORDINATION

A. Coordinate preparation and processing of schedules and reports with performance of construction activities and with scheduling and reporting of separate contractors.

B. Coordinate Contractor's Construction Schedule with the Schedule of Values, list of subcontracts, Submittals Schedule, progress reports, payment requests, and other required schedules and reports.

1. Secure time commitments for performing critical elements of the Work from parties involved.
2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

C. Calendar: Compile a project calendar for use in scheduling. Incorporate all limitations on working days and working hours, including the following:

1. Legal Holidays.
2. Other Holidays observed by the Owner.
3. Other non-working days determined by the Contractor.
4. Optional working days determined by the Contractor.

PART 2 - PRODUCTS

2.01 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

A. Time Frame: Extend schedule from date established for commencement of the Work to date of Substantial Completion.

1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.

B. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.

1. Work Restrictions: Show the effect of the following items on the schedule:

a. Coordination with existing construction.
b. Limitations of continued occupancies.
c. Uninterruptible services.
d. Partial occupancy before Substantial Completion.
e. Use of premises restrictions.
f. Provisions for future construction.
g. Seasonal variations.
h. Environmental control.

2. Work Stages: Indicate important stages of construction for each major portion of the Work, including, but not limited to, the following:
   a. Subcontract awards.
   b. Submittals.
   c. Purchases.
   d. Mockups.
   e. Fabrication.
   f. Sample testing.
   g. Deliveries.
   h. Installation.
   i. Tests and inspections.
   j. Adjusting.
   k. Curing.
   l. Startup and placement into final use and operation.

3. Other Constraints: Include the following specific activities in each trade in each phase.
   a. Interface between Contractor and Subcontractor.
   b. Electrical connections to each piece of equipment.
   c. Mechanical connections to each piece of equipment.
   d. Concrete finishing.
   e. Site work constraints on other activities.

C. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and Final Completion.

2.02 CONTRACTOR'S CONSTRUCTION SCHEDULE (GANTT CHART)

A. Gantt-Chart Schedule: Submit a comprehensive, fully developed, horizontal, Gantt-chart-type, Contractor's construction schedule within 14 days of date established for the Notice to Proceed.

B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line.

2.03 REPORTS

A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:

1. List of subcontractors at Project site.
2. List of separate contractors at Project site.
3. Approximate count of personnel at Project site.
4. Equipment at Project site.
5. Material deliveries.
6. High and low temperatures and general weather conditions.

7. Accidents.
8. Meetings and significant decisions.
9. Unusual events (refer to special reports).
10. Stoppages, delays, shortages, and losses.
11. Meter readings and similar recordings.
12. Emergency procedures.
13. Orders and requests of authorities having jurisdiction.
14. Change Orders received and implemented.
15. Construction Change Directives received and implemented.
16. Services connected and disconnected.
17. Equipment or system tests and startups.
18. Partial Completions and occupancies.
19. Substantial Completions authorized.

B. Field Condition Reports: Immediately on discovery of a difference between field conditions and the Contract Documents, prepare and submit a detailed report. Submit with a request for interpretation. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

2.04 SPECIAL REPORTS

A. General: Submit special reports directly to Owner within one day of an occurrence. Distribute copies of report to parties affected by the occurrence.

B. Reporting Unusual Events: When an event of an unusual and significant nature occurs at Project site, whether or not related directly to the Work, prepare and submit a special report. List chain of events, persons participating, response by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner in advance when these events are known or predictable.

2.05 CERTIFIED PAYROLL RECORDS

A. In compliance with MGL Chapter 149, the Contractor and each Subcontractor is required to submit a certified payroll with a statement of compliance on a weekly basis.

1. Certified Payroll: Submit Massachusetts Department of Labor and Workforce Development “Weekly Payroll Report”, typewritten.
2. Certificate of Compliance: Submit Massachusetts Department of Labor and Workforce Development “Weekly Payroll Records Report and Statement of Compliance” form, typewritten.

B. The Owner has the authority to verify payroll reports by checking employees’ pay stubs and personal identification.

C. The Owner may withhold a portion of the Application for Payment if payroll reports have not been submitted for a portion of the Work.

PART 3 - EXECUTION

3.01 CONTRACTOR'S CONSTRUCTION SCHEDULE

A. Scheduling Consultant: Engage a consultant to provide planning, evaluation, and reporting using CPM scheduling.

1. In-House Option: Owner may waive the requirement to retain a consultant if Contractor employs skilled personnel with experience in CPM scheduling and reporting techniques. Submit qualifications.
2. Meetings: Scheduling consultant shall attend all meetings related to Project progress, alleged delays, and time impact.

B. Contractor's Construction Schedule Updating: At bi-weekly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one week before submission of Application for Payment.

1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
3. As the Work progresses, indicate Actual Completion percentage for each activity.
4. Evaluate progress of the work jointly with the Owner and Owner’s Representative at the end of each week to show progress and identify conflicts.

C. Distribution: Distribute two copies each of approved schedule to Engineer, Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.

D. Post copies in Project meeting rooms and temporary field offices.

E. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

END OF SECTION 013200

SECTION 013300 -SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. The Contractor, Subcontractors, and/or suppliers providing goods or services referenced in or related to this Section shall also be bound by the Documents identified in Division 01 Section “Summary”, Paragraph 1.1A, entitled “Related Documents.”

1.02 SUMMARY

A. This Section includes administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.

B. Related Sections include the following:

1. Division 01 Section "Payment Procedures" for submitting Applications for Payment and the Schedule of Values.
2. Division 01 Section "Project Management and Coordination" for submitting and distributing meeting and conference minutes and for submitting Coordination Drawings.
3. Division 01 Section "Construction Progress Documentation" for submitting schedules and reports, including Contractor's Construction Schedule.
4. Division 01 Section "Quality Requirements" for submitting test and inspection reports and for mockup requirements.
5. Division 01 Section "Closeout Procedures" for submitting warranties.
6. Division 01 Section "Operation and Maintenance Data" for submitting operation and maintenance manuals.
7. Division 01 Section "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
8. Division 01 Section "Demonstration and Training" for submitting videotapes of demonstration of equipment and training of Owner's personnel.
9. Divisions 02 through 33 Sections for specific requirements for submittals in those Sections.

1.03 DEFINITIONS

A. Action Submittals: Written and graphic information that requires Engineer's responsive action.

B. Informational Submittals: Written information that does not require Engineer's responsive action. Submittals may be rejected for not complying with requirements.

C. Portable Document Format (PDF): An open standard file format licensed by Adobe Systems used for representing documents in a device-independent and display resolution-independent fixed-layout document format.

1.04 ACTION SUBMITTALS

A. Submittal Schedule: Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Engineer and additional time for handling and reviewing submittals required by those corrections.

1. Coordinate Submittals Schedule with list of subcontracts, the Schedule of Values, and Contractor's Construction Schedule.
2. Initial Submittal: Submit concurrently with preliminary network diagram. Include submittals required during the first 60 days of construction. List those required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.
3. Final Submittal: Submit concurrently with the first complete submittal of Contractor's Construction Schedule.
4. Update the submittals schedule periodically as the work progresses. Submit concurrently with each Application for payment.
5. Utilize a computerized program for tracking submittals. Submit the following reports bi-weekly:
   a. Complete list of reviewed submittals.
   b. Listing of submittals to date.
   c. Listing of approved submittals.
   d. Listing of rejected submittals.
   e. Listing of submittals returned for correction.
   f. List of outstanding submittals.
   6. At the request of the Engineer provide reports capable of being sorted by the following criteria:
   a. Approved status.
   b. Subcontractor/Supplier.
   c. Submission date.
   d. Number of days late for return.
   e. Number of days under review.

1.05 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

A. Engineer's Digital Data Files: Electronic digital data files of the Contract Drawings will not be provided by Engineer for Contractor's use in preparing submittals.

B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.

1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
4. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.

   a. Engineer reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

C. Processing Time: Allow enough time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Engineer's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.

5. Initial Review: Allow two weeks for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Engineer will advise Subcontractor when a submittal being processed must be delayed for coordination.
6. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
7. Resubmittal Review: Allow two weeks for review of each resubmittal.
8. Resubmittals will be reviewed no more than two times at the Owner's expense. Resubmittals which fail to comply with Contract requirements will be reviewed at the Contractor's expense, based on an hourly rate of $75 per hour, not to exceed $600 for each subsequent submittal.
9. The Owner reserves the right to deduct said reimbursement from the Contractor's application for payment on a monthly basis.
10. Concurrent Consultant Review: Submittals may be transmitted simultaneously to Engineer and to Engineer's consultants, as required. Allow two weeks for review of each submittal. Consultant will return submittal to Engineer before being returned to Contractor.

D. Paper Submittals: Place a permanent label or title block on each submittal item for identification.

1. Indicate name of firm or entity that prepared each submittal on label or title block.
2. Provide a space approximately 6 by 8 inches on label or beside title block to record Subcontractor's review and approval markings and action taken by Engineer**.**
3. Include the following information on label for processing and recording action taken:
   a. Project name.
   b. Date.
   c. Name and address of Engineer
   d. Name and address of Subcontractor.
   e. Name and address of supplier.
   f. Name of manufacturer.
   g. Submittal number or other unique identifier, including revision identifier.

      1) Submittal number shall use Specification Section number followed by a decimal point and then a sequential number (e.g., 055000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., 055000.01.A).

   h. Number and title of appropriate Specification Section.
   i. Drawing number and detail references, as appropriate.
   j. Location(s) where product is to be installed, as appropriate.
   k. Other necessary identification.

4. Additional Copies: Unless additional copies are required for final submittal, and unless Engineer observes noncompliance with provisions in the Contract Documents, initial submittal may serve as final submittal.
   a. Submit one copy of submittal to concurrent reviewer in addition to specified number of copies to Engineer.
5. Transmittal for Paper Submittals: Package each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form. Engineer will return submittals, without review, received from sources other than Contractor.
   a. Transmittal Form: Provide locations on form for the following information:
      1) Project name.
      2) Date.
      3) Destination (To:).

4) Source (From:).
5) Names of subcontractor, manufacturer, and supplier.
6) Category and type of submittal.
7) Submittal purpose and description.
8) Specification Section number and title.
9) Drawing number and detail references, as appropriate.
10) Transmittal number, numbered consecutively.
11) Submittal and transmittal distribution record.
12) Remarks.
13) Signature of transmitter.

E. Electronic Submittals: Identify and incorporate information in each electronic submittal file as follows:

1. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
2. Name file with submittal number or other unique identifier, including revision identifier.
3. a. File name shall use project identifier and Specification Section number followed by a decimal point and then a sequential number (e.g., LNHS-061000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., LNHS-061000.01.A).
4. Provide means for insertion to permanently record Contractor's review and approval markings and action taken by Engineer.
5. Transmittal Form for Electronic Submittals: Use electronic form acceptable to Engineer, containing the following information:
   a. Project name.
   b. Date.
   c. Name and address of Engineer.
   d. Name of Contractor.
   e. Name of firm or entity that prepared submittal.
   f. Names of subcontractor, manufacturer, and supplier.
   g. Category and type of submittal.
   h. Submittal purpose and description.
   i. Specification Section number and title.
   j. Specification paragraph number or drawing designation and generic name for each of multiple items.
   k. Drawing number and detail references, as appropriate.
   l. Location(s) where product is to be installed, as appropriate.
   m. Related physical samples submitted directly.
   n. Indication of full or partial submittal.
   o. Transmittal number, numbered consecutively.
   p. Submittal and transmittal distribution record.
   q. Other necessary identification.
   r. Remarks.
6. Metadata: Include the following information as keywords in the electronic submittal file metadata:
   a. Project name.
   b. Number and title of appropriate Specification Section.
   c. Manufacturer name.
   d. Product name.

F. Options: Identify options requiring selection by Engineer.

G. Deviations and Additional Information: On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Engineer on previous submittals, and deviations from requirements in the Contract Documents, including minor variations and limitations. Include same identification information as related submittal.

H. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.

1. Note date and content of previous submittal.
2. Note date and content of revision in label or title block and clearly indicate extent of revision.
3. Resubmit submittals until they are marked “Approved” or “Approved as Corrected.”

I. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.

J. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Engineer's action stamp.

PART 2 - PRODUCTS

2.01 SUBMITTAL PROCEDURES

A. General Submittal Procedure Requirements: Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.

1. Submit electronic submittals via email as PDF electronic files.
   a. Engineer will return annotated file. Annotate and retain one copy of file as an electronic Project record document file.
2. Action Submittals: Submit three paper copies of each submittal unless otherwise indicated. Engineer will return two copies.
3. Informational Submittals: Submit two paper copies of each submittal unless otherwise indicated. Engineer will not return copies.
4. Certificates and Certifications Submittals: Provide a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.
   a. Provide a digital signature with digital certificate on electronically submitted certificates and certifications where indicated.
   b. Provide a notarized statement on original paper copy certificates and certifications where indicated.

B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.

1. If information must be specially prepared for submittal because standard printed data are not suitable for use, submit as Shop Drawings, not as Product Data.
2. Mark each copy of each submittal to show which products and options are applicable.
3. Include the following information, as applicable:
   a. Manufacturer's written recommendations.
   b. Manufacturer's product specifications.
   c. Manufacturer's installation instructions.
   d. Standard color charts.

e. Manufacturer's catalog cuts.
f. Wiring diagrams showing factory-installed wiring.
g. Printed performance curves.
h. Operational range diagrams.
i. Mill reports.
j. Standard product operation and maintenance manuals.
k. Compliance with specified referenced standards.
l. Testing by recognized testing agency.
m. Application of testing agency labels and seals.
n. Notation of coordination requirements.

4. For equipment, include the following in addition to the above, as applicable:
   a. Wiring diagrams showing factory-installed wiring.
   b. Printed performance curves.
   c. Operational range diagrams.
   d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
5. Submit Product Data before or concurrent with Samples.
6. Submit Product Data in the following format: PDF electronic file. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
   a. Dimensions.
   b. Identification of products.
   c. Fabrication and installation drawings.
   d. Roughing-in and setting diagrams.
   e. Wiring diagrams showing field-installed wiring, including power, signal, and control wiring.
   f. Shopwork manufacturing instructions.
   g. Templates and patterns.
   h. Schedules.
   i. Design calculations.
   j. Compliance with specified standards.
   k. Notation of coordination requirements.
   l. Notation of dimensions established by field measurement.
   m. Relationship to adjoining construction clearly indicated.
   n. Seal and signature of professional engineer if specified.
   o. Wiring Diagrams: Differentiate between manufacturer-installed and field-installed wiring.

7. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches but no larger than 30 by 42 inches.
8. Number of Copies: Submit five copies of each submittal, unless copies are required for operation and maintenance manuals. Submit six copies where copies are required for operation and maintenance manuals. Engineer will retain two copies; remainder will be returned. Mark up and retain one returned copy as a Project Record Drawing.

C. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.

1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.

2. Identification: Attach label on unexposed side of Samples that includes the following:
   a. Generic description of Sample.
   b. Product name and name of manufacturer.
   c. Sample source.
   d. Number and title of appropriate Specification Section.
3. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
   a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
   b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
4. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.
   a. Number of Samples: Submit two full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Engineer will return submittal with options selected.
5. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.

   a. Number of Samples: Submit three sets of Samples. Engineer will retain two Sample sets; remainder will be returned. Mark up and retain one returned Sample set as a Project Record Sample.
      1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
      2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.

D. Product Schedule or List: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:

1. Type of product. Include unique identifier for each product.
2. Number and name of room or space.
3. Location within room or space.
4. Number of Copies: Submit five copies of product schedule or list, unless otherwise indicated. Engineer will return four copies.
5. Mark up and retain one returned copy as a Project Record Document.

E. Contractor's Construction Schedule: Comply with requirements specified in Division 01 Section "Construction Progress Documentation."

F. Application for Payment: Comply with requirements specified in Division 01 Section "Payment Procedures."

G. Schedule of Values: Comply with requirements specified in Division 01 Section "Payment Procedures."

H. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:

1. Name, address, and telephone number of entity performing subcontract or supplying products.
2. Number and title of related Specification Section(s) covered by subcontract.
3. Drawing number and detail references, as appropriate, covered by subcontract.
4. Number of Copies: Submit five copies of subcontractor list, unless otherwise indicated. Engineer will return four copies.
   a. Mark up and retain one returned copy as a Project Record Document.

I. Contractor's Construction Schedule: Comply with requirements specified in Division 01 Section "Construction Progress Documentation."

J. Application for Payment and Schedule of Values: Comply with requirements specified in Division 01 Section "Payment Procedures."

K. Test and Inspection Reports and Schedule of Tests and Inspections Submittals: Comply with requirements specified in Division 01 Section "Quality Requirements."

L. Closeout Submittals and Maintenance Material Submittals: Comply with requirements specified in Division 01 Section "Closeout Procedures."

M. Maintenance Data: Comply with requirements specified in Division 01 Section "Operation and Maintenance Data."

N. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, names and addresses of Engineers and owners, and other information specified.

O. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification (WPS) and Procedure Qualification Record (PQR) on AWS forms. Include names of firms and personnel certified.

P. Installer Certificates: Prepare written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.

Q. Manufacturer Certificates: Prepare written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.

R. Product Certificates: Prepare written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.

S. Material Certificates: Prepare written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.

T. Material Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.

U. Product Test Reports: Prepare written reports indicating current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.

V. Research/Evaluation Reports: Prepare written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:

1. Name of evaluation organization.
2. Date of evaluation.
3. Time period when report is in effect.
4. Product and manufacturers' names.
5. Description of product.
6. Test procedures and results.
7. Limitations of use.

W. Preconstruction Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.

X. Compatibility Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.

Y. Field Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.

Z. Design Data: Prepare written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.

AA. Manufacturer's Instructions: Prepare written or published information that documents manufacturer's recommendations, guidelines, and procedures for installing or operating a product or equipment. Include name of product and name, address, and telephone number of manufacturer. Include the following, as applicable:

1. Preparation of substrates.
2. Required substrate tolerances.
3. Sequence of installation or erection.
4. Required installation tolerances.
5. Required adjustments.
6. Recommendations for cleaning and protection.

BB. Manufacturer's Field Reports: Prepare written information documenting factory-authorized service representative's tests and inspections. Include the following, as applicable:

1. Name, address, and telephone number of factory-authorized service representative making report.
2. Statement on condition of substrates and their acceptability for installation of product.
3. Statement that products at Project site comply with requirements.
4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
6. Statement whether conditions, products, and installation will affect warranty.
7. Other required items indicated in individual Specification Sections.

CC. Insurance Certificates and Bonds: Prepare written information indicating current status of insurance or bonding coverage. Include name of entity covered by insurance or bond, limits of coverage, amounts of deductibles, if any, and term of the coverage.

DD. Material Safety Data Sheets (MSDSs): Submit information directly to Owner; do not submit to Engineer.

1. Engineer will not review submittals that include MSDSs and will return the entire submittal for resubmittal.

2.02 DELEGATED DESIGN

A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.

1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Engineer.

B. Delegated-Design Submittal: In addition to Shop Drawings, Product Data, and other required submittals, submit five copies of a statement, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.

1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

PART 3 - EXECUTION

3.01 CONTRACTOR'S REVIEW

A. Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Engineer.

B. Project Closeout and Maintenance Material Submittals: See requirements in Division 01 Section "Closeout Procedures."

C. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

3.02 ENGINEER'S ACTION

A. General: Engineer will not review submittals that do not bear Contractor's approval stamp and will return them without action.

B. Action Submittals: Engineer will review each submittal, make marks to indicate corrections or modifications required, and return it. Engineer will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action taken, as follows:

1. “No Exceptions Taken”: The portion of Work covered by the submittal may proceed provided it complies with the Contract Documents.
2. “No Exceptions Taken Comments Below”: The portion of Work covered by the submittal may proceed provided it complies with notations or corrections on the submittal, and with the Contract Documents.
3. “Not Approved” or “Revise and Resubmit”: Revise or prepare a new submittal in accordance with notations; resubmit. Do not proceed with that portion of the Work covered by the submittal.

C. Informational Submittals: Engineer will review each submittal and will not return it,or will return it if it does not comply with requirements. Engineer will forward each submittal to appropriate party.

D. Partial submittals are not acceptable, will be considered nonresponsive, and will be returned without review.

E. Submittals not required by the Contract Documents may not be reviewed and may be discarded.

END OF SECTION 013300

SECTION 014000 -QUALITY REQUIREMENTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. The Contractor, Subcontractors, and/or suppliers providing goods or services referenced in or related to this Section shall also be bound by the Documents identified in Division 01 Section “Summary”, Paragraph 1.1A, entitled “Related Documents.”

1.02 SUMMARY

A. This Section includes administrative and procedural requirements for quality assurance and quality control.

B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.

1. Specific quality-assurance and -control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and -control procedures that facilitate compliance with the Contract Document requirements.
3. Requirements for Contractor to provide quality-assurance and -control services required by Engineer, Owner, or authorities having jurisdiction are not limited by provisions of this Section.

C. Related Sections include the following:

4. Division 01 Section "Construction Progress Documentation" for developing a schedule of required tests and inspections.
5. Division 01 Section "Cutting and Patching" for repair and restoration of construction disturbed by testing and inspecting activities.
6. Divisions 02 through 33 Sections for specific test and inspection requirements.

1.03 DEFINITIONS

A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.

B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Services do not include contract enforcement activities performed by Engineer.

C. Mockups: Full-size, physical assemblies that are constructed on-site. Mockups are used to verify selections made under sample submittals, to demonstrate aesthetic effects and, where indicated, qualities of materials and execution, and to review construction, coordination, testing, or operation; they are not Samples. Approved mockups establish the standard by which the Work will be judged.

1. Laboratory Mockups: Full-size physical assemblies constructed at testing facility to verify performance characteristics.

D. Preconstruction Testing: Tests and inspections that are performed specifically for the Project before products and materials are incorporated into the Work to verify performance or compliance with specified criteria.

E. Product Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with industry standards.

F. Source Quality-Control Testing: Tests and inspections that are performed at the source, i.e., plant, mill, factory, or shop.

G. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.

H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.

I. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.

1. Using a term such as "carpentry" does not imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as "carpenter." It also does not imply that requirements specified apply exclusively to tradespeople of the corresponding generic name.

J. Experienced: When used with an entity, "experienced" means having successfully completed a minimum of five previous projects similar in size and scope to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

1.04 CONFLICTING REQUIREMENTS

A. Referenced Standards: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer conflicting requirements that are different, but apparently equal, to Engineer for a decision before proceeding.

B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Engineer for a decision before proceeding.

1.05 INFORMATIONAL SUBMITTALS

A. Contractor's Quality-Control Plan: For quality-assurance and quality-control activities and responsibilities.

B. Qualification Data: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.

C. Schedule of Tests and Inspections: Prepare in tabular form and include the following:

1. Specification Section number and title.
2. Description of test and inspection.
3. Identification of applicable standards.
4. Identification of test and inspection methods.
5. Number of tests and inspections required.
6. Time schedule or time span for tests and inspections.
7. Entity responsible for performing tests and inspections.
8. Requirements for obtaining samples.
9. Unique characteristics of each quality-control service.

D. Reports: Prepare and submit certified written reports that include the following:

1. Date of issue.
2. Project title and number.
3. Name, address, and telephone number of testing agency.
4. Dates and locations of samples and tests or inspections.
5. Names of individuals making tests and inspections.
6. Description of the Work and test and inspection method.
7. Identification of product and Specification Section.
8. Complete test or inspection data.
9. Test and inspection results and an interpretation of test results.
10. Record of temperature and weather conditions at time of sample taking and testing and inspecting.
11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
12. Name and signature of laboratory inspector.
13. Recommendations on retesting and reinspecting.

E. Permits, Licenses, and Certificates: For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

1.06 QUALITY ASSURANCE

A. General: Qualifications paragraphs in this Article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.

B. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.

C. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

D. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in the Commonwealth of Massachusetts and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar to those indicated for this Project in material, design, and extent.

F. Specialists: Certain sections of the Specifications require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.

1. Requirement for specialists shall not supersede building codes and regulations governing the Work.

G. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 548; and with additional qualifications specified in individual Sections; and where required by authorities having jurisdiction, that is acceptable to authorities.

1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.

H. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

I. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:

1. Contractor responsibilities include the following:
   a. Provide test specimens representative of proposed products and construction.
   b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
   c. Provide sizes and configurations of test assemblies, mockups, and laboratory mockups to adequately demonstrate capability of products to comply with performance requirements.
   d. Build site-assembled test assemblies and mockups using installers who will perform same tasks for Project.
   e. Build laboratory mockups at testing facility using personnel, products, and methods of construction indicated for the completed Work.
   f. When testing is complete, remove test specimens, assemblies, mockups, and laboratory mockups; do not reuse products on Project.

2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Engineer with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.

J. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:

1. Build mockups in location and of size indicated or, if not indicated, as directed by Engineer.
2. Notify Engineer seven days in advance of dates and times when mockups will be constructed.
3. Demonstrate the proposed range of aesthetic effects and workmanship.
4. Obtain Engineer's approval of mockups before starting work, fabrication, or construction.
   a. Allow seven days for initial review and each re-review of each mockup.
5. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
6. Demolish and remove mockups when directed by the Engineer, unless otherwise indicated.

K. Laboratory Mockups: Comply with requirements of preconstruction testing and those specified in individual Sections in Divisions 02 through 33.

1.07 QUALITY CONTROL

A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.

1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspecting they are engaged to perform.
2. Payment for these services will be made by the Owner.
3. Costs for retesting and reinspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor, and the Contract Sum will be adjusted by Change Order.

B. Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.

1. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.
   a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.
2. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting will be performed.
3. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
4. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
5. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.

C. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Division 01 Section "Submittal Procedures."

D. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.

E. Testing Agency Responsibilities: Cooperate with Engineer and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.

1. Notify Engineer and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
2. Determine the location from which test samples will be taken and in which in-situ tests are conducted.
3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
6. Do not perform any duties of Contractor.

F. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:

1. Access to the Work.
2. Incidental labor and facilities necessary to facilitate tests and inspections.
3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
4. Facilities for storage and field curing of test samples.
5. Delivery of samples to testing agencies.
6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
7. Security and protection for samples and for testing and inspecting equipment at Project site.

G. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.

1. Schedule times for tests, inspections, obtaining samples, and similar activities.

H. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents. Submit schedule within 30 days of date established for commencement of the Work.

1. Distribution: Distribute schedule to Owner, Engineer, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

1.08 SPECIAL TESTS AND INSPECTIONS

A. Special Tests and Inspections: Owner will engage a qualified testing agency and special inspector to conduct special tests and inspections required by the Massachusetts State Building Code and by authorities having jurisdiction as the responsibility of Owner, and as follows:

1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures and reviewing the completeness and adequacy of those procedures to perform the Work.
2. Notifying Engineer and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
3. Submitting a certified written report of each test, inspection, and similar quality-control service to Engineer with copy to Contractor and to authorities having jurisdiction.
4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
5. Interpreting tests and inspections and stating in each report whether tested and inspected work complies with or deviates from the Contract Documents.
6. Retesting and reinspecting corrected work.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 TEST AND INSPECTION LOG

A. Prepare a record of tests and inspections. Include the following:

1. Date test or inspection was conducted.
2. Description of the Work tested or inspected.
3. Date test or inspection results were transmitted to Engineer.
4. Identification of testing agency or special inspector conducting test or inspection.

B. Maintain log at Project site. Post changes and modifications as they occur. Provide access to test and inspection log for Engineer's reference during normal working hours.

3.02 REPAIR AND PROTECTION

A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.

1. Provide materials and comply with installation requirements specified in other Specification Sections. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible.
2. Comply with the Contract Document requirements for Division 01 Section "Cutting and Patching."

B. Protect construction exposed by or for quality-control service activities.

C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 014000

SECTION 014200 -REFERENCES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. The Contractor, Subcontractors, and/or suppliers providing goods or services referenced in or related to this Section shall also be bound by the Documents identified in Division 01 Section “Summary”, Paragraph 1.1A, entitled “Related Documents.”

1.02 DEFINITIONS

A. General: Basic Contract definitions are included in the Conditions of the Contract.

B. "Approved": When used to convey Engineer's action on Contractor's submittals, applications, and requests, "approved" is limited to Engineer's duties and responsibilities as stated in the Conditions of the Contract.

C. "Directed": A command or instruction by Engineer. Other terms including "requested," "authorized," "selected," "required," and "permitted" have the same meaning as "directed."

D. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."

E. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.

F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.

G. "Install": Operations at Project site including unloading, temporarily storing, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.

H. "Provide": Furnish and install, complete and ready for the intended use.

I. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

1.03 INDUSTRY STANDARDS

A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.

B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.

C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.

   1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.

D. Abbreviations and Acronyms for Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the organizations responsible for the standards and regulations.

1.04 ABBREVIATIONS AND ACRONYMS

A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities indicated in Thomson Gale's "Encyclopedia of Associations" or in Columbia Books' "National Trade & Professional Associations of the U.S."

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 014200

SECTION 016000 -PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. The Contractor, Subcontractors, and/or suppliers providing goods or services referenced in or related to this Section shall also be bound by the Documents identified in Division 01 Section “Summary”, Paragraph 1.1A, entitled “Related Documents.”

1.02 SUMMARY

A. This Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; product substitutions; and comparable products.

B. Related Sections include the following:

1. Division 01 Section "References" for applicable industry standards for products specified.
2. Division 01 Section "Closeout Procedures" for submitting warranties for Contract closeout.
3. Divisions 02 through 33 Sections for specific requirements for warranties on products and installations specified to be warranted.

1.03 DEFINITIONS

A. Products: Items purchased for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.

1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature, that is current as of date of the Contract Documents.
2. New Products: Items that have not previously been incorporated into another project or facility, except that products consisting of recycled-content materials are allowed, unless explicitly stated otherwise.
   a. Products salvaged or recycled from other projects are not considered new products.
   b. Products manufactured and stored for more than one year prior to the start date of this project are not considered new products.
3. Comparable Product: Product that is demonstrated and approved through submittal process, or where indicated as a product substitution, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.
4. “Or Equal” Product: Product that is demonstrated and approved through submittal process, or where indicated as a product substitution, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

   a. An item equal to that named or described in the specifications may be furnished; and an item shall be considered equal to the item so named or described if, in the opinion of the awarding authority: (1) it is at least equal in quality, durability, appearance, strength and design, (2) it will perform at least equally the function imposed by the general design for the public work being contracted for or the

material being purchased, and (3) it conforms substantially, even with deviations, to the detailed requirements for the item in the said specifications.

B. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.

1. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
2. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required in order to meet other Project requirements but may offer advantage to Contractor or Owner.

C. Basis-of-Design Product Specification: A specification in which a specific manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of additional manufacturers named in the specification, or for purposes of evaluating “or equal” products.

1.04 SUBMITTALS

A. Product List: Submit a list, in tabular from, showing specified products. Include generic names of products required. Include manufacturer's name and proprietary product names for each product.

1. Coordinate product list with Contractor's Construction Schedule and the Submittals Schedule.
2. Form: Tabulate information for each product under the following column headings:
   a. Specification Section number and title.
   b. Generic name used in the Contract Documents.
   c. Proprietary name, model number, and similar designations.
   d. Manufacturer's name and address.
   e. Supplier's name and address.
   f. Installer's name and address.
   g. Projected delivery date or time span of delivery period.
   h. Identification of items that require early submittal approval for scheduled delivery date.
3. Initial Submittal: Within 30 days after date of commencement of the Work, submit 3 copies of initial product list. Include a written explanation for omissions of data and for variations from Contract requirements.
   a. At Contractor's option, initial submittal may be limited to product selections and designations that must be established early in Contract period.
4. Completed List: Within 90 days after date of commencement of the Work, submit 3 copies of completed product list. Include a written explanation for omissions of data and for variations from Contract requirements.
5. Engineer's Action: Engineer will respond in writing to Contractor within 15 days of receipt of completed product list. Engineer's response will include a list of unacceptable product selections and a brief explanation of reasons for this action. Engineer's response, or lack of response, does not constitute a waiver of requirement to comply with the Contract Documents.

B. Substitution Requests: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.

1. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
   a. Statement indicating why specified material or product cannot be provided.
   b. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by Owner and separate contractors, that will be necessary to accommodate proposed substitution.
   c. Detailed comparison of significant qualities of proposed substitution with those of the Work specified. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
   d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
   e. Samples, where applicable or requested.
   f. List of similar installations for completed projects with project names and addresses and names and addresses of Engineers and owners.
   g. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
   h. Research/evaluation reports evidencing compliance with building code in effect for Project, from a model code organization acceptable to authorities having jurisdiction.
   i. Detailed comparison of Contractor's Construction Schedule using proposed substitution with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating lack of availability or delays in delivery.
   j. Cost information, including a proposal of change, if any, in the Contract Sum.
   k. Contractor's certification that proposed substitution complies with requirements in the Contract Documents and is appropriate for applications indicated.
   l. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.

2. Engineer's Action: If necessary, Engineer will request additional information or documentation for evaluation within 7 days of receipt of a request for substitution. Engineer will notify Contractor of acceptance or rejection of proposed substitution within 15 days of receipt of request, or 7 days of receipt of additional information or documentation, whichever is later.
   a. Form of Acceptance: Change Order.
   b. Use product specified if Engineer cannot make a decision on use of a proposed substitution within time allocated.

C. Comparable Product Requests: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.

1. Engineer's Action: If necessary, Engineer will request additional information or documentation for evaluation within one week of receipt of a comparable product request. Engineer will notify Contractor of approval or rejection of proposed comparable product request within 15 days of receipt of request, or 7 days of receipt of additional information or documentation, whichever is later.
   a. Form of Approval: As specified in Division 01 Section "Submittal Procedures."
   b. Use product specified if Engineer cannot make a decision on use of a comparable product request within time allocated.

D. Basis-of-Design Product Specification Submittal: Comply with requirements in Division 01 Section "Submittal Procedures." Show compliance with requirements.

1.05 QUALITY ASSURANCE

A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, product selected shall be compatible with products previously selected, even if previously selected products were also options.

1. Each contractor is responsible for providing products and construction methods compatible with products and construction methods of other contractors.
2. If a dispute arises between contractors over concurrently selectable but incompatible products, Engineer will determine which products shall be used.

1.06 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft. Comply with manufacturer's written instructions.

B. Delivery and Handling:

1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
4. Inspect products on delivery to ensure compliance with the Contract Documents and to ensure that products are undamaged and properly protected.

C. Storage:

1. Store products to allow for inspection and measurement of quantity or counting of units.
2. Store materials in a manner that will not endanger Project structure.
3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
4. Store cementitious products and materials on elevated platforms.
5. Store foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
6. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
7. Protect stored products from damage and liquids from freezing.
8. Provide a secure location and enclosure at Project site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner.

1.07 PRODUCT WARRANTIES

A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.

1. Manufacturer's Warranty: Preprinted written warranty published by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
2. Special Warranty: Written warranty required by or incorporated into the Contract Documents, either to extend time limit provided by manufacturer's warranty or to provide more rights for Owner.

B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution. Submit a draft for approval before final execution.

3. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
4. Specified Form: When specified forms are included with the Specifications, prepare a written document using appropriate form properly executed.
5. Refer to Divisions 02 through 33 Sections for specific content requirements and particular requirements for submitting special warranties.

C. Submittal Time: Comply with requirements in Division 01 Section "Closeout Procedures."

PART 2 - PRODUCTS

2.01 PRODUCT SELECTION PROCEDURES

A. General Product Requirements: Provide products that comply with the Contract Documents, that are undamaged and, unless otherwise indicated, that are new at time of installation.

1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
4. Where products are accompanied by the term "as selected," Engineer will make selection.
5. Where products are accompanied by the term "match sample," sample to be matched is Engineer's.
6. Descriptive, performance, and reference standard requirements in the Specifications establish "salient characteristics" of products.
7. Or Equal: Where products are specified by name and accompanied by the term "or equal" or "or approved equal" or "or approved," comply with provisions in Part 2 "Comparable Products" Article to obtain approval for use of an unnamed product.

B. Product Selection Procedures:

1. Products:
   a. Nonrestricted List: Where Specifications include a list of names of both available manufacturers and products, provide one of the products listed, or an unnamed equal product, that complies with requirements. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product.
2. Manufacturers:
   a. Nonrestricted List: Where Specifications include a list of available manufacturers, provide a product by one of the manufacturers listed, or a product by an unnamed equal manufacturer, that complies with requirements. Comply with requirements in

"Comparable Products" Article for consideration of an unnamed manufacturer's product.

3. Product Options: Where Specifications indicate that sizes, profiles, and dimensional requirements on Drawings are based on a specific product or system, provide the specified product or system. Comply with provisions in Part 2 "Product Substitutions" Article for consideration of an unnamed product or system.
4. Basis-of-Design Product: Where Specifications name a product and include a list of manufacturers, provide the specified product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with provisions in Part 2 "Comparable Products" Article for consideration of an unnamed product by the other named manufacturers.
5. Visual Matching Specification: Where Specifications require matching an established Sample, select a product that complies with requirements and matches Engineer's sample. Engineer's decision will be final on whether a proposed product matches.
   a. If no product available within specified category matches and complies with other specified requirements, comply with provisions in Part 2 "Product Substitutions" Article for proposal of product.
6. Visual Selection Specification: Where Specifications include the phrase "as selected from manufacturer's colors, patterns, textures" or a similar phrase, select a product that complies with other specified requirements.
   a. Standard Range: Where Specifications include the phrase "standard range of colors, patterns, textures" or similar phrase, Engineer will select color, pattern, density, or texture from manufacturer's product line that does not include premium items.
   b. Full Range: Where Specifications include the phrase "full range of colors, patterns, textures" or similar phrase, Engineer will select color, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

2.02 PRODUCT SUBSTITUTIONS

A. Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than 15 days prior to time required for preparation and review of related submittals.

1. Conditions: Engineer will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Engineer will return requests without action, except to record noncompliance with these requirements:
   a. Requested substitution is consistent with the Contract Documents and will produce indicated results.
   b. Requested substitution provides sustainable design characteristics that specified product provided.
   c. Substitution request is fully documented and properly submitted.
   d. Requested substitution will not adversely affect Contractor's construction schedule.
   e. Requested substitution has received necessary approvals of authorities having jurisdiction.
   f. Requested substitution is compatible with other portions of the Work.
   g. Requested substitution has been coordinated with other portions of the Work.
   h. Requested substitution provides specified warranty.
   i. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

B. Substitutions for Convenience: Engineer will consider requests for substitution if received within 60 days after the Notice to Proceed. Requests received after that time may be considered or rejected at discretion of Engineer.

1. Conditions: Engineer will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Engineer will return requests without action, except to record noncompliance with these requirements:
   a. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Engineer for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
   b. Requested substitution does not require extensive revisions to the Contract Documents.
   c. Requested substitution is consistent with the Contract Documents and will produce indicated results.
   d. Requested substitution provides sustainable design characteristics that specified product provided.
   e. Substitution request is fully documented and properly submitted.
   f. Requested substitution will not adversely affect Contractor's construction schedule.
   g. Requested substitution has received necessary approvals of authorities having jurisdiction.
   h. Requested substitution is compatible with other portions of the Work.
   i. Requested substitution has been coordinated with other portions of the Work.
   j. Requested substitution provides specified warranty.
   k. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

2.03 COMPARABLE PRODUCTS

A. Conditions: Engineer will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Engineer will return requests without action, except to record noncompliance with these requirements:

1. Evidence that the proposed product does not require extensive revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
3. Evidence that proposed product provides specified warranty.
4. List of similar installations for completed projects with project names and addresses and names and addresses of Engineers and owners, if requested.
5. Samples, if requested.
6. Compliance with requirements of M.G.L. Chapter 30, Section 39M.

PART 3 - EXECUTION (NOT USED)

END OF SECTION 016000

SECTION 017300 -EXECUTION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. The Contractor, Subcontractors, and/or suppliers providing goods or services referenced in or related to this Section shall also be bound by the Documents identified in Division 01 Section “Summary”, Paragraph 1.1A, entitled “Related Documents.”

1.02 SUMMARY

A. This Section includes general procedural requirements governing execution of the Work including, but not limited to, the following:

1. Construction layout.
2. Field engineering and surveying.
3. General installation of products.
4. Progress cleaning.
5. Starting and adjusting.
6. Protection of installed construction.
7. Correction of the Work.

B. Related Sections include the following:

1. Division 01 Section "Project Management and Coordination" for procedures for coordinating field engineering with other construction activities.
2. Division 01 Section "Submittal Procedures" for submitting surveys.
3. Division 01 Section "Cutting and Patching" for procedural requirements for cutting and patching necessary for the installation or performance of other components of the Work.
4. Division 01 Section "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, and final cleaning.

1.03 INFORMATIONAL SUBMITTALS

A. Qualification Data: For land surveyor.

B. Certificates: Submit certificate signed by land surveyor certifying that location and elevation of improvements comply with requirements.

C. Certified Surveys: Submit two copies signed by land surveyor.

D. Final Property Survey: Submit 10 copies showing the Work performed and record survey data.

1.04 QUALITY ASSURANCE

A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in the Commonwealth of Massachusetts and who is experienced in providing land-surveying services of the kind indicated.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 EXAMINATION

A. Existing Conditions: The existence and location of site improvements, utilities, and other construction indicated as existing are not guaranteed. Before beginning work, investigate and verify the existence and location of mechanical and electrical systems and other construction affecting the Work.

1. Before construction, verify the location and points of connection of utility services.

B. Existing Utilities: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities and other construction affecting the Work.

1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; and underground electrical services.
2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.

C. Examination and Acceptance of Conditions: Examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.

1. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
2. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
3. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
4. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

D. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:

1. Description of the Work.
2. List of detrimental conditions, including substrates.
3. List of unacceptable installation tolerances.
4. Recommended corrections.

3.02 PREPARATION

A. Existing Utility Information: Furnish information to Owner that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.

B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.

D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to Engineer. Include a detailed description of problem encountered, together with recommendations for changing the Contract Documents.

3.03 CONSTRUCTION LAYOUT

A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Engineer promptly.

B. General: Engage a land surveyor to lay out the Work using accepted surveying practices.

1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
2. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
3. Inform installers of lines and levels to which they must comply.
4. Check the location, level and plumb, of every major element as the Work progresses.
5. Notify Engineer when deviations from required lines and levels exceed allowable tolerances.
6. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.

C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and invert elevations.

D. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Engineer.

3.04 FIELD ENGINEERING

A. Identification: Owner will identify existing benchmarks, control points, and property corners.

B. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.

1. Do not change or relocate existing benchmarks or control points without prior written approval of Engineer. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Engineer before proceeding.
2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.

C. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.

1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.

D. Certified Survey: On completion of foundation walls, major site improvements, and other work requiring field-engineering services, prepare a certified survey showing dimensions, locations, angles, and elevations of construction and sitework.

3.05 INSTALLATION

A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.

1. Make vertical work plumb and make horizontal work level.
2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
3. Conceal pipes, ducts, and wiring in finished areas, unless otherwise indicated.
4. Maintain minimum headroom clearance of 7’-6” in spaces without a suspended ceiling.

B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.

C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.

D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.

E. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.

F. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.

G. Anchors and Fasteners: Provide anchors and fasteners as required to anchor each component securely in place, accurately located and aligned with other portions of the Work.

1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Engineer.
2. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

H. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.

I. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

3.06 PROGRESS CLEANING

A. General: Clean Project site and work areas daily, including common areas. Coordinate progress cleaning for joint-use areas where more than one installer has worked. Enforce requirements strictly. Dispose of materials lawfully.

1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
2. Do not hold materials more than 7 days during normal weather or 3 days if the temperature is expected to rise above 80 deg F.
3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.

B. Site: Maintain Project site free of waste materials and debris.

C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.

1. Remove liquid spills promptly.
2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.

D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.

E. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

F. Waste Disposal: Burying or burning waste materials on-site will not be permitted. Washing waste materials down sewers or into waterways will not be permitted.

G. G. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.

H. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

I. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.07 STARTING AND ADJUSTING

A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.

B. Adjust operating components for proper operation without binding. Adjust equipment for proper operation.

C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Manufacturer's Field Service: If a factory-authorized service representative is required to inspect field-assembled components and equipment installation, comply with qualification requirements in Division 01 Section "Quality Requirements."

3.08 PROTECTION OF INSTALLED CONSTRUCTION

A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.

B. Comply with manufacturer's written instructions for temperature and relative humidity.

3.09 CORRECTION OF THE WORK

A. Repair or remove and replace defective construction. Restore damaged substrates and finishes. Comply with requirements in Division 01 Section "Cutting and Patching."

1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.

B. Restore permanent facilities used during construction to their specified condition.

C. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.

D. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.

E. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

END OF SECTION 017300

SECTION 017329 -CUTTING AND PATCHING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. The Contractor, Subcontractors, and/or suppliers providing goods or services referenced in or related to this Section shall also be bound by the Documents identified in Division 01 Section "Summary", Paragraph 1.1A, entitled "Related Documents."

1.02 SUMMARY

A. This Section includes procedural requirements for cutting and patching.

B. Related Sections include the following:

1. Divisions 02 through 33 Sections for specific requirements and limitations applicable to cutting and patching individual parts of the Work.

1.03 DEFINITIONS

A. Cutting: Penetration of in-place construction necessary to permit installation or performance of other Work, including the removal of debris.

B. Patching: Fitting and repair work required to restore surfaces to original conditions after installation of other Work.

1.04 SUBMITTALS

A. Cutting and Patching Proposal: Submit a proposal describing procedures at least 10 days before the time cutting and patching will be performed, requesting approval to proceed. Include the following information:

1. Extent: Describe cutting and patching, show how they will be performed, and indicate why they cannot be avoided.
2. Changes to In-Place Construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in building's appearance and other significant visual elements.
3. Products: List products to be used and firms or entities that will perform the Work.
4. Dates: Indicate when cutting and patching will be performed.
5. Utility Services and Mechanical/Electrical Systems: List services/systems that cutting and patching procedures will disturb or affect. List services/systems that will be relocated and those that will be temporarily out of service. Indicate how long services/systems will be disrupted.
6. Structural Elements: Where cutting and patching involve adding reinforcement to structural elements, submit details and engineering calculations showing integration of reinforcement with original structure.
7. Engineer's Approval: Obtain approval of cutting and patching proposal before cutting and patching. Approval does not waive right to later require removal and replacement of unsatisfactory work.

1.05 QUALITY ASSURANCE

A. Structural Elements: Do not cut and patch structural elements in a manner that could change their load-carrying capacity or load-deflection ratio. Structural elements include, but are not limited to the following:

1. Concrete foundation construction.
2. Bearing and retaining walls.
3. Lintels.
4. Structural decking.
5. Miscellaneous structural metals.
6. Interior and/or exterior load bearing masonry wall construction.

B. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety. Operating elements include the following:

1. Primary operational systems and equipment.
2. Air or smoke barriers.
3. Fire-suppression systems.
4. Mechanical systems piping and ducts.
5. Control systems.
6. Communication systems.
7. Conveying systems.
8. Electrical wiring systems.

C. Miscellaneous Elements: Do not cut and patch miscellaneous elements or related components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety. Miscellaneous elements include the following:

1. Water, moisture, or vapor barriers.
2. Membranes and flashings.
3. Piping, ductwork, vessels, and equipment.
4. Noise-and vibration-control elements and systems.
5. Roofing systems.

D. Visual Requirements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch construction exposed on the exterior or in occupied spaces in a manner that would, in Engineer's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

E. Cutting and Patching Conference: Before proceeding, meet at Project site with parties involved in cutting and patching, including mechanical and electrical trades. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

PART 2 - PRODUCTS

2.01 MATERIALS

A. General: Comply with requirements specified in other Sections.

B. In-Place Materials: Use materials identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.

1. If identical materials are unavailable or cannot be used, use materials that, when installed, will match the visual and functional performance of in-place materials.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine surfaces to be cut and patched and conditions under which cutting and patching are to be performed.

1. Compatibility: Before patching, verify compatibility with and suitability of substrates, including compatibility with in-place finishes or primers.
2. Proceed with installation only after unsafe or unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Temporary Support: Provide temporary support of Work to be cut.

B. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.

C. Adjoining Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.

D. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to minimize interruption to occupied areas.

3.03 PERFORMANCE

A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.

1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.

B. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.

1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.

4. Excavating and Backfilling: Comply with requirements in applicable Division 2 Sections where required by cutting and patching operations.
5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
6. Proceed with patching after construction operations requiring cutting are complete.

C. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections.

1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.
2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
   a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
   b. Restore damaged pipe covering to its original condition.
3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
   a. Where patching occurs in a painted surface, apply primer and intermediate paint coats over the patch and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.
4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition.

D. Cleaning: Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortar, oils, putty, and similar materials.

END OF SECTION 017329

SECTION 017700 -CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. The Contractor, Subcontractors, and/or suppliers providing goods or services referenced in or related to this Section shall also be bound by the Documents identified in Division 01 Section “Summary”, Paragraph 1.1A, entitled “Related Documents.”

1.02 SUMMARY

A. This Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:

1. Substantial Completion procedures.
2. Final completion procedures.
3. Warranties.
4. Final cleaning.
5. Repair of the Work.

B. Related Sections include the following:

1. Division 01 Section "Payment Procedures" for requirements for Applications for Payment for Substantial and Final Completion.
2. Division 01 Section "Execution" for progress cleaning of Project site.
3. Division 01 Section "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
4. Division 01 Section "Operation and Maintenance Data" for operation and maintenance manual requirements.
5. Division 01 Section "Demonstration and Training" for requirements for instructing Owner's personnel.
6. Divisions 02 through 33 Sections for specific closeout and special cleaning requirements for the Work in those Sections.

1.03 ACTION SUBMITTALS

A. Product Data: For cleaning agents.

B. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.

C. Certified List of Incomplete Items: Final submittal at Final Completion.

1.04 CLOSEOUT SUBMITTALS

A. Certificates of Release: From authorities having jurisdiction.

B. Certificate of Insurance: For continuing coverage.

1.05 MAINTENANCE MATERIAL SUBMITTALS

A. Schedule of Maintenance Material Items: For maintenance material submittal items specified in other Sections.

1.06 SUBSTANTIAL COMPLETION PROCEDURES

A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's punch list), indicating the value of each item on the list and reasons why the Work is incomplete.

B. Submittals Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.

1. Prepare a list of items to be completed and corrected (punch list), the value of items on the list, and reasons why the Work is not complete.
2. Advise Owner of pending insurance changeover requirements.
3. Submit specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
4. Certificates of Release: Obtain and submit releases from authorities having jurisdiction permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
5. Submit closeout submittals specified in other Division 01 Sections, including project record documents, operation and maintenance manuals, damage or settlement surveys, property surveys, and similar final record information.
6. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
7. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Engineer. Label with manufacturer's name and model number where applicable.
   a. Schedule of Maintenance Material Items: Prepare and submit schedule of maintenance material submittal items, including name and quantity of each item and name and number of related Specification Section. Obtain Engineer's signature for receipt of submittals.
8. Submit test/adjust/balance records.
9. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.

C. Procedures Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.

1. Advise Owner of pending insurance changeover requirements.
2. Complete startup and testing of systems and equipment.
3. Perform preventive maintenance on equipment used prior to Substantial Completion.
4. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings specified in Division 01 Section "Demonstration and Training."
5. Advise Owner of changeover in utilities.
6. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
7. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
8. Complete final cleaning requirements, including touchup painting.
9. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.

D. Inspection: Submit a written request for inspection for Substantial Completion. On receipt of request, Engineer will either proceed with inspection or notify Contractor of unfulfilled requirements. Engineer will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Engineer, that must be completed or corrected before certificate will be issued.

1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
2. Results of completed inspection will form the basis of requirements for Final Completion.

1.07 FINAL COMPLETION

A. Preliminary Procedures: Before requesting final inspection for determining date of Final Completion, complete the following:

1. Submit a final Application for Payment according to Division 01 Section "Payment Procedures."
2. Submit certified copy of Engineer's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Engineer. The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
3. Submit evidence of final, continuing insurance coverage complying with insurance requirements.
4. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training videotapes.

B. Inspection: Submit a written request for final inspection for acceptance. On receipt of request, Engineer will either proceed with inspection or notify Contractor of unfulfilled requirements. Engineer will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.

1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.08 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

A. Preparation: Submit three copies of list. Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.

1. Organize list of spaces in sequential order.
2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
3. Include the following information at the top of each page:
   a. Project name.
   b. Date.
   c. Name of Engineer.
   d. Name of Contractor.
   e. Page number.

1.09 SUBMITTAL OF PROJECT WARRANTIES

A. Submittal Time: Submit written warranties on request of Engineer for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated.

B. Partial Occupancy: Submit properly executed warranties within 15 days of completion of designated portions of the Work that are completed and occupied or used by Owner during construction period by separate agreement with Contractor.

C. Organize warranty documents into an orderly sequence based on the table of contents of the Project Manual.

1. Bind warranties and bonds in heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper.
2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.

D. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

PART 3 - EXECUTION

3.01 FINAL CLEANING

A. General: Provide final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.

B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.

1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a portion of Project:
   a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
   b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
   c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
   d. Remove tools, construction equipment, machinery, and surplus material from Project site.

e. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
f. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
g. Sweep concrete floors broom clean in unoccupied spaces.
h. Vacuum carpet and similar soft surfaces, removing debris and excess nap; shampoo if visible soil or stains remain.
i. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.
j. Remove labels that are not permanent.
k. Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.

    1) Do not paint over "UL" and similar labels, including mechanical and electrical nameplates.

l. Wipe surfaces of mechanical and electrical equipment, elevator equipment and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
m. Replace parts subject to unusual operating conditions.
n. Leave Project clean and ready for occupancy.

C. Comply with safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on Owner's property. Do not discharge volatile, harmful, or dangerous materials into drainage systems. Remove waste materials from Project site and dispose of lawfully.

3.02 REPAIR OF THE WORK

A. Complete repair and restoration operations before requesting inspection for determination of Substantial Completion.

B. Repair or remove and replace defective construction. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment. Where damaged or worn items cannot be repaired or restored, provide replacements. Remove and replace operating components that cannot be repaired.

C. Restore damaged construction and permanent facilities used during construction to specified condition.

1. Remove and replace chipped, scratched, and broken glass, reflective surfaces, and other damaged transparent materials.
2. Touch up and otherwise repair and restore marred or exposed finishes and surfaces. Replace finishes and surfaces that that already show evidence of repair or restoration.
    a. Do not paint over "UL" and other required labels and identification, including mechanical and electrical nameplates. Remove paint applied to required labels and identification.
3. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.

4. Replace burned-out bulbs, bulbs noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.

END OF SECTION 017700

SECTION 017823 -OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. The Contractor, Subcontractors, and/or suppliers providing goods or services referenced in or related to this Section shall also be bound by the Documents identified in Division 01 Section “Summary”, Paragraph 1.1A, entitled “Related Documents.”

1.02 SUMMARY

A. This Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:

1. Operation and maintenance documentation directory.
2. Emergency manuals.
3. Operation manuals for systems, subsystems, and equipment.
4. Maintenance manuals for the care and maintenance of products, materials, and finishes, systems and equipment.

B. Related Sections include the following:

1. Division 01 Section "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.
2. Division 01 Section "Closeout Procedures" for submitting operation and maintenance manuals.
3. Division 01 Section "Project Record Documents" for preparing Record Drawings for operation and maintenance manuals.
4. Divisions 02 through 33 Sections for specific operation and maintenance manual requirements for the Work in those Sections.

1.03 DEFINITIONS

A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.

B. Subsystem: A portion of a system with characteristics similar to a system.

1.04 CLOSEOUT SUBMITTALS

A. Manual Content: Operations and maintenance manual content is specified in individual Specification Sections to be reviewed at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.

1. Engineer will comment on whether content of operations and maintenance submittals are acceptable.
2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.

B. Format: Submit operations and maintenance manuals in the following format:

1. PDF electronic file. Assemble each manual into a composite electronically indexed file. Submit on digital media acceptable to Engineer.

a. Name each indexed document file in composite electronic index with applicable item name. Include a complete electronically linked operation and maintenance directory.
b. Enable inserted reviewer comments on draft submittals.

2. Three paper copies. Include a complete operation and maintenance directory. Enclose title pages and directories in clear plastic sleeves. Engineer will return two copies.

C. Initial Manual Submittal: Submit draft copy of each manual at least 30 days before commencing demonstration and training. Engineer will comment on whether general scope and content of manual are acceptable.

D. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. Engineer will return copy with comments.

1. Correct or revise each manual to comply with Engineer's comments. Submit copies of each corrected manual within 15 days of receipt of Engineer's comments and prior to commencing demonstration and training.

1.05 COORDINATION

A. Where operation and maintenance documentation includes information on installations by more than one factory-authorized service representative, assemble and coordinate information furnished by representatives and prepare manuals.

PART 2 - PRODUCTS

2.01 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY

A. Organization: Include a section in the directory for each of the following:

1. List of documents.
2. List of systems.
3. List of equipment.
4. Table of contents.

B. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.

C. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.

D. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.

E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

2.02 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

A. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:

1. Title page.
2. Table of contents.
3. Manual contents.

B. Title Page: Enclose title page in transparent plastic sleeve. Include the following information:

1. Subject matter included in manual.
2. Name and address of Project.
3. Name and address of Owner.
4. Date of submittal.
5. Name, address, and telephone number of Contractor.
6. Name and address of Engineer.
7. Cross-reference to related systems in other operation and maintenance manuals.

C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.

1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.

D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.

1. Binders: Heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
   a. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary to provide essential information for proper operation or maintenance of equipment or system.
   b. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents. Indicate volume number for multiple-volume sets.

2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software diskettes for computerized electronic equipment.
4. Supplementary Text: Prepared on 8-1/2-by-11-inch white bond paper.
5. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
   a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
   b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

2.03 EMERGENCY MANUALS

A. Content: Organize manual into a separate section for each of the following:

1. Type of emergency.
2. Emergency instructions.
3. Emergency procedures.

B. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:

1. Fire.
2. Flood.
3. Gas leak.
4. Water leak.
5. Power failure.
6. Water outage.
7. System, subsystem, or equipment failure.
8. Chemical release or spill.

C. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.

D. Emergency Procedures: Include the following, as applicable:

1. Instructions on stopping.
2. Shutdown instructions for each type of emergency.
3. Operating instructions for conditions outside normal operating limits.
4. Required sequences for electric or electronic systems.
5. Special operating instructions and procedures.

2.04 OPERATION MANUALS

A. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:

1. System, subsystem, and equipment descriptions.
2. Performance and design criteria if Contractor is delegated design responsibility.
3. Operating standards.
4. Operating procedures.
5. Operating logs.
6. Wiring diagrams.
7. Control diagrams.
8. Piped system diagrams.
9. Precautions against improper use.
10. License requirements including inspection and renewal dates.

B. Descriptions: Include the following:

1. Product name and model number.
2. Manufacturer's name.
3. Equipment identification with serial number of each component.
4. Equipment function.
5. Operating characteristics.
6. Limiting conditions.
7. Performance curves.
8. Engineering data and tests.
9. Complete nomenclature and number of replacement parts.

C. Operating Procedures: Include the following, as applicable:

1. Startup procedures.
2. Equipment or system break-in procedures.
3. Routine and normal operating instructions.
4. Regulation and control procedures.
5. Instructions on stopping.
6. Normal shutdown instructions.
7. Seasonal and weekend operating instructions.
8. Required sequences for electric or electronic systems.
9. Special operating instructions and procedures.

D. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.

E. Piped Systems: Diagram piping as installed, and identify color-coding where required for identification.

2.05 PRODUCT MAINTENANCE MANUAL

A. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.

B. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.

C. Product Information: Include the following, as applicable:

1. Product name and model number.
2. Manufacturer's name.
3. Color, pattern, and texture.
4. Material and chemical composition.
5. Reordering information for specially manufactured products.

D. Maintenance Procedures: Include manufacturer's written recommendations and the following:

1. Inspection procedures.
2. Types of cleaning agents to be used and methods of cleaning.
3. List of cleaning agents and methods of cleaning detrimental to product.
4. Schedule for routine cleaning and maintenance.
5. Repair instructions.

E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.

F. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

1. Include procedures to follow and required notifications for warranty claims.

2.06 SYSTEMS AND EQUIPMENT MAINTENANCE MANUAL

A. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.

B. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.

C. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including the following information for each component part or piece of equipment:

1. Standard printed maintenance instructions and bulletins.
2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
3. Identification and nomenclature of parts and components.
4. List of items recommended to be stocked as spare parts.

D. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:

1. Test and inspection instructions.
2. Troubleshooting guide.
3. Precautions against improper maintenance.
4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
5. Aligning, adjusting, and checking instructions.
6. Demonstration and training videotape, if available.

E. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.

1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.

F. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.

G. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.

H. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

1. Include procedures to follow and required notifications for warranty claims.

PART 3 - EXECUTION

3.01 MANUAL PREPARATION

A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals.

B. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.

C. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.

D. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.

1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.

E. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.

1. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.

F. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in Record Drawings to ensure correct illustration of completed installation.

   1. Do not use original Project Record Documents as part of operation and maintenance manuals.

G. Comply with Division 01 Section "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

END OF SECTION 017823

SECTION 017839 -PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. The Contractor, Subcontractors, and/or suppliers providing goods or services referenced in or related to this Section shall also be bound by the Documents identified in Division 01 Section “Summary”, Paragraph 1.1A, entitled “Related Documents.”

1.02 SUMMARY

A. This Section includes administrative and procedural requirements for Project Record Documents, including the following:

1. Record Drawings.
2. Record Specifications.
3. Record Product Data.
4. Miscellaneous record submittals.

B. Related Sections include the following:

1. Division 01 Section "Closeout Procedures" for general closeout procedures.
2. Division 01 Section "Operation and Maintenance Data" for operation and maintenance manual requirements.
3. Divisions 02 through 33 Sections for specific requirements for Project Record Documents of the Work in those Sections.

1.03 CLOSEOUT SUBMITTALS

A. Record Drawings: Comply with the following:

1. Number of Copies: Submit copies of record Drawings as follows:
   a. Initial Submittal:
      1) Submit one paper-copy set of marked-up record prints.
      2) Submit PDF electronic files of scanned record prints and one of file prints.
      3) Submit record digital data files and one set of plots.
      4) Engineer will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.
   b. Final Submittal:
      1) Submit three paper-copy sets of marked-up record prints.
      2) Submit PDF electronic files of scanned record prints and three sets of prints.
      3) Print each drawing, whether or not changes and additional information were recorded.

B. Record Specifications: Submit one copy of Project's Specifications, including addenda and contract modifications.

C. Record Product Data: Submit one copy of each Product Data submittal.

1. Where Record Product Data is required as part of operation and maintenance manuals, submit marked-up Product Data as an insert in manual instead of submittal as Record Product Data.

D. Miscellaneous Record Submittals: See other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Submit one paper copy of each submittal.

PART 2 - PRODUCTS

2.01 RECORD DRAWINGS

A. Record Prints: Maintain one set of black-line white prints of the Contract Drawings and Shop Drawings.

1. Preparation: Mark Record Prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to prepare the marked-up Record Prints.
   a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
   b. Accurately record information in an understandable drawing technique.
   c. Record data as soon as possible after obtaining it. Record and check the markup before enclosing concealed installations.

2. Content: Types of items requiring marking include, but are not limited to, the following:
   a. Dimensional changes to Drawings.
   b. Revisions to details shown on Drawings.
   c. Depths of foundations below first floor.
   d. Locations and depths of underground utilities.
   e. Revisions to routing of piping and conduits.
   f. Revisions to electrical circuitry.
   g. Actual equipment locations.
   h. Duct size and routing.
   i. Locations of concealed internal utilities.
   j. Changes made by Change Order or Construction Change Directive.
   k. Changes made following Engineer's written orders.
   l. Details not on the original Contract Drawings.
   m. Field records for variable and concealed conditions.
   n. Record information on the Work that is shown only schematically.

3. Mark the Contract Drawings or Shop Drawings, whichever is most capable of showing actual physical conditions, completely and accurately. If Shop Drawings are marked, show cross-reference on the Contract Drawings.
4. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
5. Mark important additional information that was either shown schematically or omitted from original Drawings.
6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.

B. Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked-up record prints with Engineer. When authorized, prepare a full set of corrected digital data files of the Contract Drawings, as follows:

1. Format: Annotated PDF electronic file with comment function enabled.
2. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.

3. Refer instances of uncertainty to Engineer for resolution.
4. Engineer will furnish Contractor one set of digital data files of the Contract Drawings for use in recording information.
   a. See Division 01 Section "Submittal Procedures" for requirements related to use of Engineer's digital data files.
   b. Engineer will provide data file layer information. Record markups in separate layers.

C. Newly Prepared Record Drawings: Prepare new Drawings instead of preparing record Drawings where Engineer determines that neither the original Contract Drawings nor Shop Drawings are suitable to show actual installation.

1. New Drawings may be required when a Change Order is issued as a result of accepting an alternate, substitution, or other modification.
2. Consult Engineer for proper scale and scope of detailing and notations required to record the actual physical installation and its relation to other construction. Integrate newly prepared record Drawings into record Drawing sets; comply with procedures for formatting, organizing, copying, binding, and submitting.

D. Format: Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.

1. Record Prints: Organize Record Prints into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
2. Format: Annotated PDF electronic file with comment function enabled.
3. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.
4. Identification: As follows:
   a. Project name.
   b. Date.
   c. Designation "PROJECT RECORD DRAWINGS."
   d. Name of Engineer.

2.02 RECORD SPECIFICATIONS

A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
3. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
4. For each principal product, indicate whether Record Product Data has been submitted in operation and maintenance manuals instead of submitted as Record Product Data.
5. Note related Change Orders, Record Product Data, and Record Drawings where applicable.

B. Format: Submit record Specifications as annotated PDF electronic file or scanned PDF electronic file(s) of marked-up paper copy of Specifications as required.

2.03 RECORD PRODUCT DATA

A. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
3. Note related Change Orders, Record Specifications, and Record Drawings where applicable.

B. Format: Submit record Product Data as annotated PDF electronic file or scanned PDF electronic file(s) of marked-up paper copy of Product Data.

1. Include record Product Data directory organized by Specification Section number and title, electronically linked to each item of record Product Data.

2.04 MISCELLANEOUS RECORD SUBMITTALS

A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.

B. Format: Submit miscellaneous record submittals as PDF electronic file or scanned PDF electronic file(s) of marked-up miscellaneous record submittals as required.

1. Include miscellaneous record submittals directory organized by Specification Section number and title, electronically linked to each item of miscellaneous record submittals.

PART 3 - EXECUTION

3.01 RECORDING AND MAINTENANCE

A. Recording: Maintain one copy of each submittal during the construction period for Project Record Document purposes. Post changes and modifications to Project Record Documents as they occur; do not wait until the end of Project.

B. Maintenance of Record Documents and Samples: Store Record Documents and Samples in the field office apart from the Contract Documents used for construction. Do not use Project Record Documents for construction purposes. Maintain Record Documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to Project Record Documents for Engineer's reference during normal working hours.

END OF SECTION 017839

SECTION 017900 -DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. The Contractor, Subcontractors, and/or suppliers providing goods or services referenced in or related to this Section shall also be bound by the Documents identified in Division 01 Section “Summary”, Paragraph 1.1A, entitled “Related Documents.”

1.02 SUMMARY

A. This Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:

1. Demonstration of operation of systems, subsystems, and equipment.

B. Related Sections include the following:

1. Division 01 Section "Project Management and Coordination" for requirements for preinstruction conferences.
2. Divisions 02 through 22 Sections for specific requirements for demonstration and training for products in those Sections.

1.03 QUALITY ASSURANCE

A. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.

B. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Division 01 Section "Quality Requirements," experienced in operation and maintenance procedures and training.

C. Videographer Qualifications: A professional videographer who is experienced photographing demonstration and training events similar to those required.

D. Preinstruction Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination." Review methods and procedures related to demonstration and training including, but not limited to, the following:

1. Inspect and discuss locations and other facilities required for instruction.
2. Review and finalize instruction schedule and verify availability of educational materials, instructors' personnel, audiovisual equipment, and facilities needed to avoid delays.
3. Review required content of instruction.
4. For instruction that must occur outside, review weather and forecasted weather conditions and procedures to follow if conditions are unfavorable.

1.04 COORDINATION

A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations.

B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.

C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data has been reviewed and approved by Engineer.

PART 2 - PRODUCTS

2.01 INSTRUCTION PROGRAM

A. Program Structure: Develop an instruction program that includes individual training modules for each system and equipment not part of a system, as required by individual Specification Sections, and as follows:

B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following:

1. Basis of System Design, Operational Requirements, and Criteria: Include the following:
   a. System, subsystem, and equipment descriptions.
   b. Performance and design criteria if Contractor is delegated design responsibility.
   c. Operating standards.
   d. Regulatory requirements.
   e. Equipment function.
   f. Operating characteristics.
   g. Limiting conditions.
   h. Performance curves.

2. Documentation: Review the following items in detail:
   a. Emergency manuals.
   b. Operations manuals.
   c. Maintenance manuals.
   d. Project Record Documents.
   e. Identification systems.
   f. Warranties and bonds.
   g. Maintenance service agreements and similar continuing commitments.

3. Emergencies: Include the following, as applicable:
   a. Instructions on meaning of warnings, trouble indications, and error messages.
   b. Instructions on stopping.
   c. Shutdown instructions for each type of emergency.
   d. Operating instructions for conditions outside of normal operating limits.
   e. Sequences for electric or electronic systems.
   f. Special operating instructions and procedures.

4. Operations: Include the following, as applicable:
   a. Startup procedures.
   b. Equipment or system break-in procedures.
   c. Routine and normal operating instructions.
   d. Regulation and control procedures.
   e. Control sequences.
   f. Safety procedures.
   g. Instructions on stopping.

h. Normal shutdown instructions.
i. Operating procedures for emergencies.
j. Operating procedures for system, subsystem, or equipment failure.
k. Seasonal and weekend operating instructions.
l. Required sequences for electric or electronic systems.
m. Special operating instructions and procedures.

5. Adjustments: Include the following:
   a. Alignments.
   b. Checking adjustments.
   c. Noise and vibration adjustments.
   d. Economy and efficiency adjustments.

6. Troubleshooting: Include the following:
   a. Diagnostic instructions.
   b. Test and inspection procedures.

7. Maintenance: Include the following:
   a. Inspection procedures.
   b. Types of cleaning agents to be used and methods of cleaning.
   c. List of cleaning agents and methods of cleaning detrimental to product.
   d. Procedures for routine cleaning
   e. Procedures for preventive maintenance.
   f. Procedures for routine maintenance.
   g. Instruction on use of special tools.

8. Repairs: Include the following:
   a. Diagnosis instructions.
   b. Repair instructions.
   c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
   d. Instructions for identifying parts and components.
   e. Review of spare parts needed for operation and maintenance.

PART 3 - EXECUTION

3.01 PREPARATION

A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a combined training manual.

B. Set up instructional equipment at instruction location.

3.02 INSTRUCTION

A. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.

   1. Owner will furnish Contractor with names and positions of participants.

B. Scheduling: Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.

1. Schedule training with Owner with at least seven days' advance notice.

C. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of a demonstration performance-based test.

D. Cleanup: Collect used and leftover educational materials and give to Owner. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

END OF SECTION 017900

CITY OF WORCESTER
455 MAIN STREET, WORCESTER, MA 01608

PROJECT MANUAL

WORCESTER LIBRARY BOILER REPLACEMENT

3 SALEM STREET

WORCESTER, MA 01608

DIVISIONS 23 & 26

JUNE 2026

SET NUMBER

DIVISION 23 – HEATING VENTILATION AND COOLING

22 00 00 – Heating Ventilation and Cooling June 2026

DIVISION 24 – THROUGH DIVISION 25

NO WORK IN THESE DIVISIONS

DIVISION 26 – ELECTRICAL *

26 00 00 - Electrical June 2026

DIVISION 27 THROUGH DIVISION 33

NO WORK IN THESE DIVISIONS

END OF SECTION

* Filed Sub-Bid Sections

SECTION 00 01 15

COVER SHEET

MECHANICAL

M000 Mechanical Legend
M120 Mechanical Basement Level Duct & Piping Plans
M700 Mechanical Schedules
M900 Mechanical Details

ELECTRICAL

E000 Electrical Legend
E001 Electrical Legend, Notes and Abbreviations
E120 Electrical Basement Level Power Plan
E700 Electrical Schedules and Details

END OF SECTION

DIVISION 23 – HEATING, VENTILATION AND AIR-CONDITIONING 1

PART 1 - GENERAL 1

1.1 GENERAL REQUIREMENTS 1
1.2 WORK INCLUDED 1
1.3 RELATED WORK 2
1.4 INTENT 3
1.5 STANDARD OF MATERIALS AND WORKMANSHIP 3
1.6 ABBREVIATIONS AND DEFINITIONS 4
1.7 EXAMINATION 4
1.8 REFERENCES 4
1.9 DRAWINGS 6
1.10 FABRICATION OF MATERIALS 6
1.11 PERMITS, FEES, INSPECTION CERTIFICATES 6
1.12 RECORD DRAWINGS 7
1.13 OPERATION AND MAINTENANCE DATA 7
1.14 SUBMITTALS 8
1.15 STANDARD REPORTING REQUIREMENTS 11
1.16 COORDINATION DRAWINGS 11
1.17 REQUESTS FOR INTERPRETATION (RFIs) 12
1.18 TEMPORARY SERVICES 12
1.19 IDENTIFICATION OF MECHANICAL SERVICES 13
1.20 PROTECTION 13
1.21 COORDINATION 14
1.22 GUARANTEE 15
1.23 DRAIN PANS OVER ELECTRIC EQUIPMENT AND MOTORS 15
1.24 CONNECTIONS TO EQUIPMENT 15
1.25 SEISMIC DESIGN 16
1.26 HVAC BASIS OF DESIGN 17
1.27 IAQ PROCEDURES FOR OCCUPIED BUILDINGS UNDER CONSTRUCTION 18
1.28 MANUFACTURERS REPRESENTATIVE 18
1.29 HVAC SYSTEM DEMONSTRATION 19
1.30 ALTERNATES 19
1.31 APPROVED EQUALS 19
1.32 RELATED DOCUMENTS 20

PART 2 - PRODUCTS 20

2.1 PIPE AND FITTINGS 20
2.2 PIPE EXPANSION FITTINGS AND LOOPS 21
2.3 VIBRATION ISOLATION, SUPPORTS AND SEISMIC RESTRAINT 22
2.4 MOTORS AND MOTOR STARTERS 24
2.5 VARIABLE SPEED DRIVES 27
2.6 METERS AND GAUGES 28
2.7 VALVES 29
2.8 HANGERS AND SUPPORTS 31
2.9 MECHANICAL IDENTIFICATION 32
2.10 PIPING INSULATION 33
2.11 AUTOMATIC TEMPERATURE CONTROLS – FACILITIES MANAGEMENT SYSTEM 34
2.12 IN-LINE CENTRIFUGAL PUMPS 46
2.13 PRE-MANUFACTURED DUCTWORK AND FLUE SYSTEMS 47
2.14 DUCTWORK ACCESSORIES 47
2.15 CAST IRON SECTIONAL HOT WATER BOILERS 48

PART 3 - EXECUTION 49

3.1 PROTECTION 49
3.2 INSTALLATION OF EQUIPMENT - GENERAL 50
3.3 CUTTING, PATCHING AND CORE DRILLING 50
3.4 WIRING 50
3.5 PAINTING 51
3.6 STEEL 51
3.7 INSTALLATION OF HYDRONIC PIPE AND PIPE FITTINGS 51
3.8 INSTALLATION OF VIBRATION ISOLATION, SUPPORTS & SEISMIC RESTRAINT 55
3.9 INSTALLATION OF MOTORS AND MOTOR STARTERS 59
3.10 INSTALLATION OF VARIABLE SPEED DRIVES 59
3.11 INSTALLATION OF METERS AND GAUGES 60
3.12 INSTALLATION OF PIPING SPECIALTIES 61
3.13 INSTALLATION OF VALVES 61
3.14 INSTALLATION OF HANGERS AND SUPPORTS 62
3.15 INSTALLATION OF MECHANICAL IDENTIFICATION 62
3.16 INSTALLATION OF PIPE INSULATION 64
3.17 INSTALLATION OF EQUIPMENT INSULATION 66
3.18 INSTALLATION OF HYDRONIC SPECIALTIES 67
3.19 INSTALLATION OF PUMPS 68
3.20 INSTALLATION OF PRE-MANUFACTURED DUCTWORK AND FLUE SYSTEMS 68
3.21 INSTALLATION OF BOILERS 69
3.22 TESTING, ADJUSTING AND BALANCING 70
3.23 SELECTIVE DEMOLITION 73
3.24 TRIAL USAGE 74
3.25 INSTRUCTIONS TO OWNER 75

DIVISION 23 – HEATING, VENTILATION AND AIR-CONDITIONING

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. Conditions of the Contract and Division 1, General Requirements, shall be made part of this Section.

B. Refer to the drawings for further definition of location, extent, and details of the work described herein.

C. Cooperate and coordinate with all trades in execution of the work described in this Section and so as to provide clearance for equipment maintenance operation.

D. Where referred to, standard specifications of technical Societies, Manufacturer's Associations, and Federal Agencies shall include all amendments current as the date of issue of these Specifications.

E. It is intended, for the guidance of the bidders, that the Manufacturer's name used first throughout this Section of the Specification, is that used in the design of the HVAC system. All material submitted shall be equal in all respects to that used in the design.

F. The Subcontractor for work of this Section shall become familiar with other Sections of the Specifications to determine the type and extent of work there under which affects the work of this trade, whether or not such work is specifically mentioned in this Section.

1.2 WORK INCLUDED

A. The scope of the work under this Division, without limiting the generality thereof, consists of furnishing all labor, material, equipment, scaffolding, power, tools and rigging, except as otherwise specified, and performing all work as necessary to fully complete the HVAC work indicated. Note that the Drawings and the Specifications are complementary. Provide work drawn, but not specified, and work specified, but not drawn, as if explicitly indicated in both ways.

B. Examine all Drawings and other Divisions of the Specifications for requirements affecting work under this Division.

C. The HVAC work shall include but not be limited to the following:
1. Selective Demolition
2. Hoisting and rigging for equipment and materials specified herein.
3. Core drilling, cutting and channeling for holes six (6) inches and smaller in diameter.
4. Fire watch, as required.
5. Furnishing and maintenance, in safe and adequate condition, of all staging and scaffolding required for work under this Division.
6. Maintenance of proper building indoor air quality during construction.
7. Proper protection of all stored and partially installed equipment, piping, ductwork and accessories.
8. Submittals and coordination drawings.
9. Equipment and Systems:

a. HVAC motors, starters and interlocking device.
b. HVAC variable frequency drives.
c. HVAC vibration isolation and seismic restraint.
d. Hot water hydronic piping system.
e. Pumps.
f. Piping, ductwork and / or equipment insulation.
g. Piping, ductwork and / or equipment identification.
h. Boilers.
i. Automatic temperature controls and monitoring.

10. Hydronic system cleaning, flushing, chemical treatment and water quality report.
11. Testing, adjusting and balancing of all air and / or water systems.
12. System demonstration / Start-up / Manufacturer representation.
13. Operations and maintenance manual(s).
14. Record drawings
15. Multiple Phase Project: The project is intended for multiple phases. The contractor shall treat each phase as a separate project requiring equipment start-up, testing, adjusting and balancing, reports, system flushing and testing, submittals, coordination drawings, punch lists, etc.
16. Premium Time: The project requires work to be completed on premium time (outside normal business hours).

1.3 RELATED WORK

A. Examine all other sections of the Specifications and all drawings for the relationship of the work under this Section and the work of other trades. Cooperate with all trades and coordinate all work under this section therewith. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. The following related items are included under sections listed below:

1. Except as specified herein, cutting shall be the responsibility of the mechanial Contractor and patching shall be performed by the respective trades. Refer to the respective sections.
2. The HVAC Subcontractor shall provide all hoisting and rigging for equipment and materials specified herein.
3. Core drilling, cutting and channeling for HVAC equipment for holes six (6) inches and less in diameter.
4. Furnish and maintain in safe and adequate condition, all staging and scaffolding that is required for work of this section.
5. City water piping and fittings including insulation and backflow prevention on plumbing piping systems connecting to HVAC equipment. DIVISION 22 - PLUMBING.
6. In general, all wiring required for equipment provided by the HVAC Contractor that requires Automatic Controls and all interlock wiring and accessories for this HVAC equipment that is not shown or indicated on the Electrical Drawings of DIVISION 26 - ELECTRICAL, shall be provided under DIVISION 23 – HEATING, VENTILATION, AND AIR CONDITIONING.
7. HVAC Motor Starters, Disconnects and Variable Frequency Drives provided under this section shall be installed under DIVISION 26 – ELECTRICAL.
8. Natural Gas piping systems provided under DIVISION 22 – PLUMBING and shall be coordinated with the work of this section.
9. Permitting for the installation of Gas Boilers and Gas Equipment – DIVISION 22 – PLUMBING. The licensed plumber or gasfitter who secures the gas fitting permit shall be responsible for and supervise the installation of the gas boiler and gas equipment venting provided under this section. The gas fitting permit holder shall review and approve products and execution.

10. Gas-fired boiler shutdown switches and wiring to be provided under DIVISION 26 – ELECTRICAL.
11. Gas vent piping for the boiler gas train shall be provided under DIVISION 22 -PLUMBING and shall be coordinated with the work of this section.
12. HVAC Commissioning: DIVISION 23 - HVAC COMMISSIONING, DIVISION 1– HVAC COMMISIONING REQUIREMENTS.
13. Plumbing Equipment and Building Management System (BMS) Interface: All Plumbing equipment will be provided and installed under DIVISION 22 – PLUMBING. For equipment interface within the BMS, the wiring shall be done under this Section.

C. Furnish the following materials to be installed under other specification sections.
1. Access Doors and Panels to be installed under applicable sections.

1.4 INTENT

A. Description in the Specifications, or the indication on the Drawings of equipment, materials, operation and methods, required that such items shall be of the quantity required, and the systems complete in every respect.

B. The Specifications shall be considered an integral part of the accompanying Drawings. Any item or subject omitted from one or the other, but which is either mentioned or reasonably implied, shall be considered as properly and sufficiently specified. In the case of a conflict, the more demanding item shall apply.

C. The HVAC Contractor shall be completely responsible for the acceptable condition and operation of all systems, equipment and components forming part of the installation or directly associated with it. The HVAC Contractor shall provide fully qualified personnel to fulfill this requirement. The HVAC Contractor shall be responsible for prompt replacement of defective materials, equipment and parts of equipment and related damages.

1.5 STANDARD OF MATERIALS AND WORKMANSHIP

A. Refer to Part A and Division 1 of Part B for general instructions and, in addition, adhere to the following:
1. Workmanship and installation methods shall conform to the highest standard practice. Work shall be performed by skilled tradesmen under the direct supervision of fully qualified personnel.
2. Install equipment in strict accordance with manufacturer’s published recommendations.
3. When requested, submit samples of materials proposed for review before proceeding with the work.
4. Install equipment and materials to present a neat appearance. Install piping, ducts and conduit parallel with or perpendicular to building planes.
5. Conceal piping, ducts and conduit in finished areas. Install work so as to require a minimum amount of furring.
6. Make provisions for neat insulation finish around equipment and materials. Do not mount piping or equipment within insulation depth.
7. Equipment, materials and work shall comply with the requirements of generally recognized agencies, including, but not limited to, agencies listed under DIVISION 23 – HEATING VENTILATION AND AIR-CONDTIONING Article STANDARDS- REFRENCES and shall conform to and be installed in strict accordance with Federal, State and Town requirements and shall meet all of the requirements of all authorities having jurisdiction.

1.6 ABBREVIATIONS AND DEFINITIONS

A. "HVAC" or "HV" or "AC" as mentioned herein means specifically "Heating, Ventilating and Air Conditioning" or "Heating and Ventilating" or "Air Conditioning" respectively, when used in conjunction with contractor, equipment, work or articles within this specification.

B. A.T.C. as mentioned herein means specifically Automatic Temperature Control as it refers to the manufacturer or description of work and equipment

C. "Provide" may be used in place of "furnish and install" and where used shall mean to deliver, furnish, erect, and connect up complete in readiness for regular operation, the particular work or equipment referred to, unless otherwise specified.

D. "Concealed" shall be defined as areas where piping or ducts are located in chases, shafts, and above ceilings whether furred or lay-in type.
   1. All other ductwork and piping shall be considered "exposed".

E. The term "Applicable Section Contractor" or "A.S.C." shall be understood to refer to a contractor or contractors other than the HVAC Contractor or any HVAC Subcontractor or HVAC Sub-subcontractor.

1.7 EXAMINATION

A. Before submitting bid, visit and examine the site where work is to be carried out and become familiar with all features and characteristics which affect the work of this SECTION.

B. Examine the Specifications and Drawings, including the Specifications and Drawings of other DIVISIONS before bid.

C. Report in writing, any discrepancies or deficiencies which may adversely affect the work, at least six days prior to close of bid.

D. No allowance will be made for any difficulties encountered due to any features of the building, site or surrounding public and private property which existed up to the time of bid.

1.8 REFERENCES

A. All material and workmanship shall comply with all applicable codes, local and state ordinances, industry standards, and utility company regulations.

B. All materials, equipment and apparatus shall be Underwriters Listed or Labeled for all components where such listing or label are available. Items which are not UL Listed or Labeled are not acceptable if labeled or listed equipment can be obtained from another acceptable manufacturer. Assemblies or components not labeled or listed shall be furnished with certification by the manufacturer that the wiring complies with UL safety requirements.

C. STANDARDS: Except as modified by governing codes or this specification, applicable standards (latest editions regardless of years listed below) produced by the following organizations shall apply to materials, equipment and installation of components and systems furnished and / or installed as part of this Section:
   1. ASHRAE – American Society of Heating, Refrigeration and Air-conditioning Engineers
      a. Special Attention is required for:

1) ASHRAE Standard 15-2010: Safety Code for Mechanical Refrigeration.
2) ASHRAE Standard 62.1-2010: Ventilation for Acceptable Indoor Air Quality.
3) ASHRAE Standard 111-2008: Practices for Measurement, Testing, Adjusting and balancing of Building Heating, Ventilation, Air-Conditioning, and Refrigeration Systems.
4) ASHRAE Standard 90.1-2010: Energy Standard for Buildings Except Low-Rise Residential Builidings

2. NFPA – National Fire Protection Association
   a. Special Attention is required for:
      1) NFPA 31: Installation of Oil Burning Equipment.
      2) NFPA 37: Installation and Use of Stationary Combustion Engines and Gas Turbines.
      3) NFPA 45: Laboratories Using Chemicals.
      4) NFPA 54: National Fuel Gas Code.
      5) NFPA 90A: Installation of Air Conditioning and Ventilation Systems.
      6) NFPA 90B: Installation of Warm Air Heating and Air-Conditioning Systems
      7) NFPA 91: Blower and Exhaust Systems.
      8) NFPA 96: Ventilation, Control, and Fire Protection of Commercial Cooking Operations.
      9) NFPA 99: Standard for Health Care Facilities
3. SMACNA – Sheet Metal and Air Condition Contractors Nation Association, Inc.
   a. Special Attention is required for:
      1) SMACNA Duct Construction Standards Metal and Flexible.
      2) SMACNA Fire, Smoke, Radiation, Damper Installation Guide for HVAC Systems.
      3) SMACNA Ducted Electric Heat Guide for Air Handling Systems.
      4) SMACNA Air Duct Leakage Test Manual.
      5) SMACNA IAQ Guidelines for Occupied Buildings Under Design and Construction
      6) SMACNA Duct cleanliness for New Construction Guidelines
      7) SMACNA HVAC Systems Testing, Adjusting & Balancing
4. OSHA – Occupational Safety & Health Administration
5. UL – Underwriter's Laboratory
6. EPA – Environmental Protection agency
7. AIA – American Institute of Architects
8. AGA - American Gas Association
9. ANSI – American Nation Standards Institute
10. ASME – American Society of Mechanical Engineers
    a. Special Attention is required for:
       1) ASME B31.9, "Building Services Piping," for materials, products, and installation. Safety valves and pressure vessels shall bear appropriate ASME label.
11. AWWA – American Water Works Association
12. ARI – American Air Conditioning and Refrigeration Institute
13. IEEE- Institute of Electrical and Electronics Engineers
14. IPCEA – Insulated Power Cable Engineers Association
15. ADA –American Standards Association
16. FM – Factory Mutual Engineering Division
17. CS – Commercial Standard of NBS (US Department of Commerce)
18. NADCA - National Air Duct Cleaners Association – ACR 2006
19. NEMA – National Electrical Manufacturers Association
20. ASTM – American Society of Testing and Materials
21. AMCA – Air Moving and Conditioning Association
22. ADC – American Diffuser Council
1. Massachusetts State Building Code, 780 CMR, 9th Edition

2. Massachusetts State Fuel and Gas Code, 248 CMR
3. Massachusetts State Electrical Code, 527 CMR

1.9 DRAWINGS

A. The Drawings are schematic in nature and are intended to show approximate locations of apparatus, fixtures, piping and duct runs in diagrammatic form. The Drawings are not intended to show Architectural and Structural details.

B. Do not scale drawings. Obtain any information requiring accurate dimensions from Architectural and Structural Drawings or from site measurements. Check locations and elevations before proceeding with work.

C. At no additional cost to the Owner, make all changes or additions to materials and/or equipment necessary to accommodate structural and architectural conditions.

D. Leave areas clear and unobstructed where space is indicated as reserved for future equipment.

E. Whether shown on the Drawings or not, provide adequate space and provision for servicing of equipment and removal and reinstallation of replaceable items such as motors, coils, filters and tubes.

F. Provide all ceiling mounted components, including air terminals, access doors and panels, in strict accordance with reflected ceiling plans.

1.10 FABRICATION OF MATERIALS

A. Before prefabricating ductwork or piping for installation, make certain that such items can be installed as shown on the coordination drawings without interfering with the structure or the work of other trades. Any problems that cannot be solved in agreement with other trades affected, shall be submitted for decision.

B. If ductwork or piping is prefabricated prior to the investigation and reaching of a solution to possible interference problems, necessary changes in such prefabricated items shall be made at no extra cost to the Owner.

C. In case of any discrepancies between the Specifications and Drawings, or where the Specifications or Drawings are not clear or definite, the subject shall be referred to or decided by the Architect whose decision shall be final. Otherwise, make adjustments at no expense to the Owner.

1.11 PERMITS, FEES, INSPECTION CERTIFICATES

A. Apply for, obtain and pay for all permits, inspections and fees required.

B. Be fully acquainted with and obey all Federal, State, and Municipal laws, by-laws, codes and regulations, and all authorities having jurisdiction. Provide fire dampers and smoke dampers in air handling systems as described herein.

C. Before starting any work, submit the required specifications and Drawings to the Governing Authorities for their approval. Comply with any requested changes as part of the Contract, and give any notification immediately of such changes.

D. Where the Specifications, Instructions, or the Governing Authorities require any work to be tested, inspected or approved, give sufficient notice of its readiness for inspection, and, if the inspection is by a Governing Authority, of the date and time set for such inspection.

E. Inspection will be made promptly. If any work is covered up without consent, it shall, if required, be uncovered for examination and the required corrections made at not extra cost to the Owner.

F. Furnish any certificates necessary as evidence that the work conforms to the requirements of all authorities having jurisdiction.

G. Make changes, if required, to make the work conform to all laws, bylaws, codes, and regulations, as part of this SECTION work.

1.12 RECORD DRAWINGS

A. Refer to DIVISION 1 – GENERAL REQUIREMENTS and DIVISION 1 - PROJECT CLOSEOUT.

B. All costs for Record Drawings shall be borne by the HVAC Subcontractor.

C. Purchase and maintain at the job site at all times, a complete set of blackline prints of the HVAC drawings. As the work progresses, mark all changes made, whether resulting from addenda, formal change orders or other instructions issued by the Architect. Color in the various ductwork, piping, equipment, apparatus and associated appurtenances exactly as they are erected.

D. The accurate location, depth, size and type of all concealed items shall be recorded before concealment to ensure accurate and direct future access doors and panels. Show inverts of all services at key points within the building, or buried items, and entering and leaving the building. Show dimensions from building grid lines.

E. The record drawings will be reviewed at regular intervals by the Architect and will be taken into consideration when reviewing the monthly applications for payment submitted by the HVAC Subcontractor.

F. When this procedure has been accomplished to the satisfaction of the Architect, the Record Drawing information shall be transferred to a set of CAD drawings by this Subcontractor and printed to PDF file format. The CAD file(s), in format .DWG 2004, and PDF file shall be submitted to the Architect, as directed in DIVISION 1, PROJECT CLOSEOUT. Electronic files shall be included with Mechanical System Operation and Maintenance Data as submitted to the Owner.

1.13 OPERATION AND MAINTENANCE DATA

A. Refer to DIVISION 1 - PROJECT CLOSEOUT

B. Assemble three copies of indexed hard cover manuals entitled “Operating and Maintenance Instructions for Mechanical System”.

C. Submit one copy for review at least two months before instructions to Owner are commenced. Instruct the Owner for one week (40 hours) as to the Operation-Maintenance of the System. This,

and all instructional sessions, shall be videotaped and three (3) copies made and submitted to the Architect. Refer to DIVISION 1, PROJECT CLOSEOUT.

D. Ensure that the terminology used in various sections of the manual is consistent.

E. Refer to PART 1 – STANDARD REPORTING REQUIREMENTS, this document, for general information. Each manual shall contain the following:
1. Description of each system, with description of each major component of the system.
2. Complete sets of approved page-size equipment shop drawings including temperature control drawings.
3. A lubrication schedule of all specified equipment.
4. Spare parts list.
5. Equipment identification list with serial numbers.
6. Page-size valve tag schedule and flow diagrams.
7. Final balancing reports.
8. Water treatment procedure and tests.
9. Names and telephone numbers of all equipment parts suppliers.
10. Control commissioning report
11. Equipment start-up reports
12. Two (2) “snap-shots” of the DDC points of the Automatic Temperature Control system. This data shall be compiled and recorded with the system in the “occupied” and “unoccupied” modes of each zone. Also include the schedule for these modes as established by the Owner.
13. CAD and PDF drawings in electronic format as described in DIVISION 23, RECORD DRAWINGS

1.14 SUBMITTALS

A. Refer to DIVISION 1 - SUBMITTAL PROCEDURES and specifications for submittal requirements. Without limiting the generality thereof, the HVAC Subcontractor shall also submit the additional information noted herein.

B. Present, not later than three (3) weeks after award of the Contract, a list of submittals to be submitted with the name of each manufacturer and supplier. Failure to submit this list will result in the necessity for the Contractor to use that equipment which is scheduled.

C. Submittals for equipment furnished under this Section shall include, but not be limited to all items listed in DIVISION 23 – HEATING VENTILATION AND AIR-CONDITIONING Article - WORK INCLUDED and listed within this specification. Refer to each article of this section for additional specific submittal requirements.

D. Do not manufacture, deliver or install equipment and materials until final review of Shop Drawings has been completed.

E. Separate submittals based on trade and equipment (specification section and sub-section or sub-sections). Do not combine various disparate products together under one submittal title.

F. Submit a minimum of seven (7) copies of certified submittals of all equipment, materials, equipment wiring, diagrams, motors, starters, controls and schedules. Ensure that submittals have adequate clear space for all stamps. When requested, resubmit promptly.
1. If submitting electronically, provide email notification to ftconadmin@f-t.com with submittal file(s) attached in industry standard “.pdf” file format. If the submittal file(s) are too large

for email transfer, provide hyperlink to files allowing both download and upload of files over internet connection without requiring use of usernames or passwords.

G. Identification: In addition to the information required by DIVISION 1 - SUBMITTAL PROCEDURES indicate:
1. Name and address of supplier.
2. Name of manufacturer.
3. Reference specification section number, article number, article name and page number (e.g. 23 00 00 - 2.10 - VIBRATION ISOLATION AND SIESMIC RESTRAINT – Page 23 00 00 - 14)
4. Identify if submittal is a resubmission of previous reviewed equipment.
5. Distribution list of all Trade subcontractors and manufacturers who will receive the Engineer's reviewed comments.

H. Do not manufacture, deliver or install equipment and materials until final review of Submittals has been completed.

I. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.

1. If information must be specially prepared for submittal because standard printed data are not suitable for use, submit as Shop Drawings, not as Product Data.
2. Mark each copy of each submittal to show which products and options are applicable.
3. Include the following information, as applicable:
   a. Manufacturer's written recommendations.
   b. Manufacturer's product specifications.
   c. Manufacturer's installation instructions.
   d. Dimensions and Required clearances
   e. Equipment Shipping and Operating weights and Structural Loads.
   f. Components required for field installation.
   g. Method of field assembly, components, and location and size of each field connection.
   h. Field electrical and mechanical connection requirements.
   i. Notation of coordination requirements.
   j. Wiring diagrams showing field-installed wiring, including power, signal, and control wiring
   k. Material gages and finishes.
   l. Standard color charts.
   m. Manufacturer's catalog cuts.
   n. Wiring diagrams showing factory-installed wiring.
   o. Certified performance curves for each fan, air handling unit and pump, showing duty and horsepower with design operating points over the components entire range indicated clearly.
   p. Certified performance ratings with system operating conditions indicated.
   q. Certified compliance with specified referenced standards. Testing by recognized testing agency.
   r. Motor ratings, electrical characteristics, and motor accessories.
   s. Filters with performance characteristics.
   t. Equipment Manufacturer supplied Dampers, housings, linkages, and operators.
   u. Equipment Manufacturer supplied valves and operators.
   v. All available specialties, options and accessories. Clearly indicated furnished specialties, options and accessories.
   w. Standard product operation and maintenance manuals.
   x. Notation of coordination requirements.
   y. Submit certified discharge and radiated sound power levels for:

1) Air terminal units
2) Air moving equipment – fans, air handlers, roof top units, etc.
3) Equipment with compressors
4) Boilers/burners
5) Water moving equipment – pumps
6) Steam pressure reducing stations.

J. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data. Prepare shop drawings for all custom equipment such as boilers, pumps.

K. Testing Plans and Reports:
1. Submit a report template with representative sheets for each test to be included in the project. Template report shall include the design and or specification data per the documents.
2. Submit preliminary testing field reports.
3. Submit final testing field reports. Incorporate engineers' review comments.

L. Compliance with specified standards. Be responsible for presenting the processing of submittals to suit manufacturing schedule of equipment and construction schedule of building.

M. Be responsible for the accuracy of equipment dimensions relative to available space, the performance and the electrical characteristics. When required, submit a complete comparison between accepted alternative equipment and materials, and that which is specified.

N. Each submittal shall indicate clearly the correct name and address of the project, the intended use and location of the equipment, and the specified and/or scheduled designation tag/number.

O. Upon receipt of approved Submittals, distribute copies to all trades and manufacturers affected. Submit approved Submittals to authorities having jurisdiction when requested.

P. Keep one set of reviewed Submittals on the site at all times.

Q. Bind one set of the corrected, reviewed and approved Submittals in each Operation and Maintenance Instructions Manual. Refer to DIVISION 1 - SUBMITTALS, DIVISION 1 - PROJECT CLOSEOUT and DIVISION 23 - HEATING VENTILATION AND AIR CONDITIONING article – OPERATION AND MAINTENANCE DATA.

R. Prior to submission of Submittals, the HVAC Subcontractor shall thoroughly check each shop drawing to ascertain that it complies with the Contract requirements; that the electrical characteristics are correct; and that the dimensions of work submitted fit the available space. Any deviations from the Contract requirements shall be clearly noted on the submittals. The HVAC Subcontractor shall stamp each submittal with his firm's name, date and approval, thereby representing that the above has been complied with. Shop Drawings not so checked and stamped, shall be returned without being examined. Review of the Shop Drawings shall not relieve the HVAC Subcontractor from the responsibility for departures from the Contract Documents. Errors in shop drawings shall be the sole responsibility of the HVAC Subcontractor whether the drawings are reviewed or not.

S. The HVAC Subcontractor shall submit to the General Contractor, for transmittal to the Owner, any samples requested by the Owner. Submittal, review, and approval of samples shall be in accordance with the Conditions of the Contract.

T. Drawings not stamped by the General Contractor shall be returned without being examined.

1.15 STANDARD REPORTING REQUIREMENTS

A. All reports shall be submitted in electronic and hardcopy format.
   1. Electronic reports shall be provided in PDF format.
   2. All reports must provide the following general information, at a minimum. Refer to individual specification paragraphs for additional reporting requirements.
      a. Project Location
      b. Date of report completion.
      c. Personnel involved in completing reports.

1.16 COORDINATION DRAWINGS

A. Prepare Coordination Drawings in accordance to the requirements of DIVISION 1 - SUBMITTAL PROCEDURES. Before work progresses, in addition to the shop drawings listed herein, coordination drawings shall be created and prepared by the HVAC and Sheetmetal Subcontractors in AutoCAD DWG electronic format. The Coordination Drawings once completed by the HVAC and Sheetmetal contractors shall be delivered to the Plumbing Contractor, Fire Protection Contractor and lastly the Electrical Contractor for inclusion of their respective equipment and systems. Provide drawings in electronic format, one 3/8 inch scale reproducible and one 3/8 inch scale blue print of coordination drawings.

B. Prepare Coordination Drawings in accordance to Division 1 and, in addition, adhere to the following:
   1. Indicate temporary relocation, phasing, sequencing and moving of large equipment in the building during construction.
   2. Floor plans and details, including the following:
      a. HVAC Coordination Drawings shall include, as a minimum, all supply, return and exhaust ductwork, VAV Boxes, air-handlers, fans, piping, pumps, isolation valves, thermostats and other similar controls and sensors, and all other equipment installed under this Section showing the adjoining work of the other trades at all floors, Mechanical Rooms and duct shafts. Refer to articles throughout this SECTION for additional coordination requirements.
      b. HVAC Sub-contractor shall note apparent conflicts and suggest alternate solutions.
      c. Composite systems coordination drawings showing how HVAC systems are to be installed where conflicts with the work of other trades may occur.
      d. Access Door and Panel Coordination: Show sizes and locations of all access panels and doors on coordination drawings.

C. The Contractor, before transmittal of the Coordination Drawings to the Owner for approval, may require the HVAC and Sheetmetal Subcontractors to revise the composite coordination drawings and shop drawings and to make reasonable modifications in the layout of the HVAC work, so that the HVAC work may be properly accommodated without the interference with work of other trades. The HVAC and Sheetmetal Subcontractors shall make such revisions to composite systems coordination drawings, when requested, without extra charge. For example, note that ductwork aspect ratio changes (up to a maximum of 5 to 1 width to height ratio) shall be considered reasonable changes and therefore made at no cost to the owner.

D. The HVAC Contractor shall be responsible for the cost for changes in the HVAC and adjoining work where an approved substitution of the HVAC equipment requires such changes in the HVAC work or in the adjoining work of any other trade. Provide coordination drawings showing all changes.

E. Sheetmetal ductwork installed in floor areas which may be in conflict with ceiling system. The Ceiling Contractor and the Sheetmetal Contractor shall coordinate the method of support and access for the ceiling. In no case shall the ductwork be used to support the ceiling construction nor shall it fall on the grid or its cross points unless the specific areas of conflict are allowed by the Architect/Engineer.

F. The Contractor, before transmittal of the Coordination Drawings to the Owner for approval, shall review with and obtain sign-off from the following contractors indicating that the work of their trade is fully coordinated:
1. General Contractor
2. HVAC contractor
3. Sheetmetal Contractor
4. ATC Contractor
5. Testing and Balancing Contractor
6. Air Duct and System Cleaning Contractor
7. Plumbing Contractor
8. Electrical Contractor
9. Low voltage wiring contractor
10. Fire Protection Contractor

1.17 REQUESTS FOR INTERPRETATION (RFIs)

A. Prepare Requests for Interpretation (RFIs) in accordance to Division 1 and, in addition, adhere to the following:
1. RFIs shall originate with the Contractor. RFIs submitted directly by sub-contractors will be returned with no response. RFIs sent directly to engineer will be returned with no response. Incomplete RFIs will not be reviewed and will be returned for additional information.
2. If email RFI submissions are allowed by Division 1 then the RFI and Attachment(s) shall be in Adobe Acrobat PDF format.
3. Submit RFIs in format specified and in addition include:
   a. Specification Section number and title and related paragraphs, as appropriate.
   b. Drawing number, room name, structural grid coordinates and detail references, as appropriate.
   c. Field dimensions and conditions, as appropriate.
   d. Contractor's suggested solution(s). If Contractor's solution(s) impact the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
   e. Attachments: Include 8 ½” x 11” copies of construction documents highlighting areas requiring interpretation. Include drawings, descriptions, measurements, photos, Product Data, Shop Drawings, and other information necessary to fully describe items needing interpretation and suggested solution(s).
   f. Supplementary drawings prepared by Contractor shall be to scale and shall include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments.

1.18 TEMPORARY SERVICES

A. Refer to DIVISION 1 - TEMPORARY FACILITIES AND CONTROLS.

B. Operations necessary for checking, testing and balancing shall be done after written approval is given to start up systems. Before then, ensure that care is taken to protect equipment from damage, and to prevent distribution of dust through duct systems. Cap and seal ducts and cap pipes as required to prevent construction debris from entering.

C. Permanent heating or air conditioning systems shall not be used for temporary heating, except with written permission of the Architect. It is intended that the HVAC Subcontractor shall schedule his work so as to be able to utilize the permanent heating system for temporary heat when the building is totally enclosed. When the permanent heating system is utilized for temporary heat, the boiler plant shall be operated as designed with all accessory equipment and systems operative. Upon completion of the temporary heating phase, the equipment shall be inspected and cleaned as required to bring it to as new condition. Under no circumstances shall the boilers, air handlers, or any permanent equipment be operated without feed water, chemical treatment or air filters.

D. Where air systems are used the associated Ductwork System shall be protected with return air filters at all duct openings or air inlets. Prior to balancing the system for permanent use replace air filters, and clean and test the air system including but not limited to ductwork, air handler, air terminals. Refer to AIR DUCT AND SYSTEM CLEANING for cleaning and testing requirements.

1.19 IDENTIFICATION OF MECHANICAL SERVICES

A. After finish painting complete, identify all mechanical services. Use terminology consistent with the Drawings and Specifications. Refer to Division 1. A line item on the schedule of values for equipment identification shall be included.

B. Prepare flow diagrams (same size as record documents) of piping systems to identify equipment and valves. Include these diagrams in record drawings.
   1. Insert page-size copies of diagrams into each Operating and Maintenance Manual.
   2. Install schematic piping flow diagrams, framed under glass, on equipment room walls. Final location shall be as directed on site by Owner. All valves shall be identified in these diagrams.
   3. A line item in the schedule of values shall be dedicated to flow diagrams of mechanical services.

C. Provide typewritten master lists in Operating and Maintenance Instruction Manuals; and shop equipment numbers on Record Prints and sepias.

D. Identification shall be consistent with Owner’s standard methods of identification.

1.20 PROTECTION

A. Protect all mechanical work from damage. Keep all equipment dry and clean at all times.

B. Cover openings in equipment, and pipes, with caps or heavy gauge plastic sheeting until final connections are made.

C. Correct at no cost to the Owner, any damage caused by improper storage, handling, or installation of equipment and materials.

D. Protect equipment, piping and temporary services installed within this SECTION from weather damage.

E. Ductwork systems:
   1. Contractor shall maintain duct cleanliness to the “Intermediate level” as defined by the SMACNA, “Duct cleanliness for New Construction Guidelines.” This level of cleanliness shall include, but not be limited to, providing duct sections in plastic wrap from the

manufacturer, and maintaining the wrapped sections in storage in good condition until installed. At the end of each day after installation, the ends of installed ductwork shall be capped.

2. Owner will obtain independent NADCA ACR 2006 Vacuum testing at their discretion to ensure the duct cleanliness is maintained. To be considered clean by the NADCA Vacuum Test, the net weight of the debris collected on the filter media must not exceed 0.75 mg/100 cm^2. If the installed systems do not meet the specified cleanliness then the HVAC contractor shall hire a NADCA certified independent duct cleaning contractor at no cost to the owner. Duct cleaning contractor shall clean ductwork and verify specified cleanliness level is obtained.

F. Provide temporary sheetmetal caps on all ductwork, air terminals and sound attenuators delivered, stored and partially installed at the site.

1.21 COORDINATION

A. Fully coordinate with other trades to ensure that work is carried out in the best interests of all concerned. Install work in proper sequence to conserve headroom and space.

B. Coordinate work with other trades to provide maximum accessibility for maintenance and operation of all equipment installed by all trades.

C. Give notices of requirements for holes, recessed openings, pits and chases before structure is to be erected.

D. Furnish all items to be built-in, in ample time to allow schedules progress of work.

E. Refer to the Coordination Drawing Section of Specification for Coordination drawing process.

F. Provide the Electrical contractor and Plumbing Contractor with all requirements within Two (2) weeks from date of Contract to allow proper coordination of trades by the Contractor.

G. Verify with the Electrical contractor available electrical characteristics before ordering any equipment.

H. Verify with the Plumbing contractor available natural gas pressure before ordering any equipment.

I. Verify Smoke and Smoke/Damper actuator requirements with Fire Alarm and/or electrical contractor before ordering any equipment.

J. Verify Smoke detector and Fire Alarm interlock requirements before ordering any equipment.

K. Furnish to the Electrical Contractor all starters, control devices, relays, pilot lights, accessories, contactors, wiring diagrams, and the like required for proper operation, connection and control of motorized equipment, as specified and/or shown on the drawings.

L. Electrical Contractor shall be responsible for the following:
   1. Mount and connect starters, controllers and disconnects, except where specified to be factory wired and mounted on the equipment.
   2. Provide all required power connections for all motor driven equipment.
   3. Provide power wiring to control transformers and control panels.

M. HVAC contractor provides low and line voltage control wiring to all equipment requiring control unless specifically called for on the Electrical Drawings or Specifications.

N. General contractor shall provide all roof openings. Roof openings shall be the minimum size required for duct and/or pipe penetrations. Roof openings for roof curbs shall be the minimum allowable for duct and pipe passage. Under no circumstances shall the roof opening be as large as the roof curb. Openings shall be sealed tight to duct or piping penetrating the roof or roof structure. Roof openings shall not be cut until show drawings are approved.

1.22 GUARANTEE

A. Conform to the requirements of DIVISION 1 - Project Close-out.

B. All equipment, material and workmanship shall be unconditionally guaranteed, as set forth in the Contract, or for longer periods when stated in the Specifications. Extensions to the standard equipment warranty periods shall be arranged by the HVAC Subcontractor to enable the period to commence upon beneficial usage by the Owner.

C. If any equipment or material does not match the manufacturer's published data or specifically supplied rating schedules during performance tests, replace without delay the defective equipment or materials. Bear all associated costs and adjust all components at no charge to the Owner and adjust all components to achieve the proper rating.

D. Correct defects and deficiencies, and pay for resulting damage to Mechanical or other work, and to property and person, which appear or originate during the guaranteed period

E. The Owner shall give notice of observed defects promptly in writing.

1.23 DRAIN PANS OVER ELECTRIC EQUIPMENT AND MOTORS

A. Wherever piping runs above motor control centers, panels or other electrical equipment due to field conditions or coordination process, a copper drip pan with drain outlet shall be provided.

B. Indicate on coordination drawings the locations where piping passes over motors and electric panels.

C. Drip pans shall have lips 2 inch high, stiffened and braced, supported to prevent sagging, and shall be pitched to a ¼" per foot toward the drain outlet. Drain outlet shall be piped, with approved piping, to nearest floor drain or other indirect waste connection. Width of pan shall extend 6 inches beyond piping, but shall not be less than 18 inches wide. All seams shall be soldered and watertight.

1.24 CONNECTIONS TO EQUIPMENT

A. The HVAC Subcontractor shall provide all duct and/or pipe connections to equipment provided under other sections of the specifications as shown on the contract documents and herein specified including final connections to equipment to result in a complete system, fully operational. Coordinate the locations of all equipment with Architect. Obtain installation diagrams and methods of installation of all equipment from manufacturers. Follow instructions strictly.

1.25 SEISMIC DESIGN

A. DESCRIPTION
1. General
a. This section provides vibration isolation, wind restraint and seismic restraint provisions for mechanical components and distributed systems.
2. Intent
a. It is the intent of the seismic and wind restraint portion of this specification to provide restraint of non-structural building components. Seismic restraints shall be provided per code and specification. Wind restraints are required for all components located on the roof or outside of the building structure.
b. All connections between components and structure must be positive, frictional forces due to the weight of the component are not acceptable.
c. Any supplementary supports must be capable of transferring the seismic and/or wind loads to the structure without failure.
d. Screening walls or obstructions do not reduce the code required wind load on components.
3. The work in this section includes the following:
a. Vibration isolation elements for equipment and distributed systems.
b. Equipment isolation bases, support stands and rails.
c. Pipe flex connectors.
d. Seismic and wind restraint for distributed systems, isolated and non-isolated equipment.
e. Certification of seismic and wind restraint designs, installation supervision as required.
4. Definitions.
a. The word component will be used throughout this specification and shall include all non-structural HVAC equipment AND distributed systems such as piping and duct.
b. Components buried underground are excluded but entry of services through the foundation wall is included.
c. IBC: International Building Code
d. Life safety systems:
1) All components involving fire protection.
2) All components connected to an emergency power supply.
3) All medical and life support components.
4) Fresh air relief systems.
e. Positive attachment.
1) Welded, steel bolted, through bolted and concrete anchored connections.
2) Double sided beam clamps loaded perpendicular to the beam.
5. The work in this section includes the following:
a. Vibration isolation elements for equipment.
b. Equipment isolation bases.
c. Pipe and Duct Supports.
d. Piping flexible connectors.
e. Seismic restraints for isolated equipment.
f. Seismic restraints for non-isolated equipment.
g. Certification of seismic restraint designs and installation supervision.
h. Equipment support stands, bases or rails.
i. Structural design of all vibration isolation, supports and seismic restraints.
j. .

B. MANUFACTURER'S RESPONSIBILITY
1. Manufacturer of vibrations isolation, wind, seismic & thermal control equipment shall have the following responsibilities:

a. Determine vibration isolation, seismic, thermal and wind support/anchorage requirements for all components.
b. Vibration isolation shall be provided as specified in the applications section of this document. In the event of conflict between specification and contract drawing the stricter requirements will drive design unless otherwise allowed in writing by the mechanical engineer of record for the project.
c. Manufacturer to guarantee submitted isolation systems meet specified deflection requirements.
d. Manufatcurer to provide installer with detailed installation instructions, drawings and, if required, field supervision/field training to insure installation and performance of all submitted systems.

C. RELATED WORK
1. Housekeeping Pads
a. Housekeeping pad attachment to structure design shall be by the project structural engineer. Material and labor required for attachment and construction shall be by the concrete section contractor.
b. Housekeeping pads shall be coordinated with the Restraint Supplier and sized to provide the detailed minimum edge distance required to achieve full anchor ratings.
2. Supplemental Support Steel
a. Contractor shall supply supplementary support steel and connections for all equipment, piping, ductwork, etc. Including roof mounted equipment, as required or specified.
b. Where support for equipment requires stands, bases, rails, etc. these devices shall be designed and fabricated by Restraint Supplier to ensure the seismic capability of the entire installation.
c. Contractor may be required to provide educational experience, welding certifications or training experience for workers involved in seismic restraint installations.

D. NON CODE REQUIRED SEISMIC DESIGN
1. Although not required by code, it is a project requirement that the following types of buildings or occupancies within buildings shall have all non-structural HVAC components seismically braced:
a. Data centers
b. Elective outpatient surgery centers
c. Inpatient hospitals
d. Smoke evacuation and stairwell pressurization systems
2. Any HVAC system that serves occupancies with different seismic design categories shall be designed to the more stringent category.

1.26 HVAC BASIS OF DESIGN

A. For major pieces of HVAC equipment, including but not limited to, boilers, the engineers basis of design is the unit shown on the plans and listed in the schedules. The contractor may submit an alternate unit from the list of approved manufacturers in this specification IF he ensures that such unit has thermal and acoustical performance equal or better than the scheduled unit and IF he ensures that the unit fits within the allotted mechanical space.

B. Electrical characteristics of submitted equipment must match those of scheduled equipment. This means that voltages, phases and hertz of submitted equipment must be the same as scheduled equipment and that current draws (amperage) must be equal or less than scheduled equipment.

1.27 IAQ PROCEDURES FOR OCCUPIED BUILDINGS UNDER CONSTRUCTION

A. For renovation work taking place in occupied buildings the mechanical contractor shall designate an individual to be indoor air quality coordinator. This individual shall be available at the job site during working hours and he or she shall be thoroughly familiar with the procedures for maintaining indoor air quality detailed in the SMACNA publication "IAQ Guidelines for Occupied Buildings Under Construction." On commencement of the project the contractor shall provide the name of this individual to the Architect and Engineer.

B. Before commencing any work in an occupied building, including demolition work the mechanical contractor shall submit to the Architect and Engineer for review, a plan for maintaining indoor air quality in the occupied space. The plan shall be based on the procedures in Chapter 3 of the SMACNA IAQ manual referenced above. At a minimum the plan shall address the specifics of how the following procedures are to be carried out (or if they are not to be implemented - why not):
1. Keeping the construction area under negative pressure. State specific balancing procedures to be followed.
2. Keeping the occupied area under positive pressure. State specific balancing procedures to be followed.
3. Erecting barriers between the construction area and the occupied area. State type of barrier and sealing method.
4. Exhausting the construction area. State where exhaust is directed to and whether filtration on exhaust is to be provided
5. Sealing of ductwork openings.
6. Protection of sheetmetal sections not yet installed from dust and water.
7. Protection of equipment not yet installed from dust and water.
8. Cleaning of ductwork and terminal boxes after construction is complete.
9. Provision of temporary filters on return air systems. State efficiency of filters.
10. Provision of fan powered air cleaners.
11. Any other procedure not listed above which the contractor is implementing to maintain adequate levels of indoor air quantity.

1.28 MANUFACTURERS REPRESENTATIVE

A. Provide, at the appropriate time and/or as directed by Architect, the services of a competent factory-trained Engineer of each piece of equipment. Manufacture representative shall inspect, adjust, troubleshoot and place in proper operating condition any and all items of the manufacturer.

B. No additional compensation will be allowed Contractor for such services.

C. Refer to the individual specification paragraphs for additional Manufacturer representative requirements.

D. Site visits and Field/Startup Reports
1. Refer to PART 1 – STANDARD REPORTING REQUIREMENTS, this document, for general information.
2. Prepare field/startup reports in accordance to Division 1 and, in addition, adhere to the following:
   a. Provide field report as for each site visit.
   b. Manufacturer shall check-in with owner or project representative at each field visit.
   c. Report shall include at a minimum:
      1) Date, Time and weather conditions
      2) Present during visit

3) Reason for visit
4) Standard manufacturer's startup forms/checklists
5) Results of visit
6) Any deficiencies requiring repair/replacement
7) Follow-up actions required

3. Submit reports for approval.
4. Include approved reports in close out documents.

1.29 HVAC SYSTEM DEMONSTRATION

A. At completion of the HVAC system installation, testing and balancing and start up, the mechanical contractor shall demonstrate to the owner and to the engineer the proper operation of all major HVAC systems. This shall include but not be limited to temperature controls, boilers, pumps an associated equipment. Allow minimum of one full day (8 hours) for this demonstration.

B. Provide owner and engineer at least one week notice before demonstration is to begin. Mechanical contractor shall ensure the presence of personnel from local manufacturer's representative for the specific pieces of equipment involved as well as for the automatic temperature controls contractor who shall be present throughout the entire procedure.

C. If a piece of equipment has an occupied/unoccupied cycle or otherwise has two speed operations all control cycles and speeds are to be demonstrated.

D. If any piece of equipment or control cycle does not operate as specified then this contractor shall remedy the deficiency and repeat the demonstration in the owner's and engineers presence.

1.30 ALTERNATES

A. Examine DIVISION 1 - ALTERNATES for scope of work which may affect the work of this section and include any deletions or additions in the form for sub bid under the appropriate alternate.

1.31 APPROVED EQUALS

A. For projects bid under the Commonwealth of Massachusetts Public Bid Laws Only.
1. Proprietary: Where items are listed as proprietary the owner has demonstrated that it is in the owner's best interest to use the specified product without any substitutes.
2. Items not listed as proprietary: Massachusetts General Law - Chapter 30, Section 39m requires that public bid projects allow for additional manufacturers beyond the listed acceptable manufacturers/installers/technicians.
3. The mechanical contractor may submit manufacturers and sub-contractors which differ from the Acceptable manufacturers/installers listed in these specification sections as "Approved Equals".
4. Documentation must be submitted showing that the proposed equipment and/or installer meets the following (1) it is at least equal in quality, durability, appearance, strength and design, (2) it will perform at least equally the function imposed by the general design for the work being contracted for or the material being purchased, and (3) it conforms substantially, even with deviations, to the detailed requirements of the specifications
5. The Engineer shall have sole discretion to determine whether the substitution is in fact equal to the specified manufacturer's product. The Engineers determination shall be final.

1.32 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

PART 2 - PRODUCTS

2.1 PIPE AND FITTINGS

A. ACCEPTABLE MANUFACTURERS
1. Anvil
2. Charlotte
3. Atlas

B. GENERAL:
1. Comply with ASME B31.9, “Building Services Piping,” and ASME B31.1 “Power Piping” for materials and products.

C. SUBMITTALS:
1. Schedule indicating the type of pipe and joining method by size and system.
2. General product data for each type of pipe, fittings and joining materials.
3. Welding Qualifications.
4. Pressure testing reports. Refer to “Piping Tests” in INSTALLATION OF PIPE AND PIPE FITTINGS in these specifications.

D. QUALITY ASSURANCE:
1. Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code: Section IX.
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

E. PIPE AND TUBE
1. Black Steel Pipe: ASTM A53/A, 53M black steel with plain ends, welded (type E) and seamless (type S), Grade B. Schedule as specified in Part 3.
2. Copper Tube: ASTM B 88, Type L, seamless. Type K when buried in concrete.
3. ACR Copper Tube: ASTM B 280.

F. FITTINGS
1. Cast Iron Flanged Fittings: ANSI B 16.1, including bolting.
2. Cast Iron Threaded Fittings: ANSI B 16.4.
3. Malleable Iron Threaded Fittings: ANSI B 16.3.
4. Malleable Iron Threaded Unions: ANSI B 16.39
5. Wrought Steel Weld Fittings: ASTM A 234/A 234M, wall thickness to match adjoining pipe.
6. Wrought Cast and Forged Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts and gaskets of the following material group, end connections and facings:
   a. Material Group: 1.1
   b. End Connections: Butt welding
   c. Facings: Rasised face
7. Wrought Copper Solder Joint Fittings: ANSI B 16.22.
8. Steel Pipe Nipples: ASTM A 733, made of same materials and wall thicknesses as piping in which they are installed.

G. UNIONS AND COUPLINGS
1. Wrought Copper: ASME B16.22
2. Malleable-Iron Unions: ASME B16.39

H. JOINING MATERIALS
1. Welding Filler Materials: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel being welded.
2. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813
3. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus allows for joining copper with copper. BAg-1, silver alloy for joining copper with bronze or steel.
4. Gaskets for Flanged Joints: ANSI B 16.21; full faced for cast iron flanges; raised faced for steel flanges, unless otherwise indicated.
5. Flange Bolts and Nus: ASME B18.2.1, carbon steel, unless otherwise indicated.
6. Joint Compound and Tape: Suitable for pipe, system, fluid within system and associated chemical treatment.

I. MECHANICAL PRESS PIPING PRODUCTS
1. Basis of Design: Viega Propress
2. General Requirements: Mechanical press piping products shall be considered equal to the other products as described in this paragraph “PIPE AND FITTINGS”. These products shall only be used on hydronic piping sizes **4”** and under.
3. Copper and copper alloy press fittings shall conform to material requirements of ASME B16.18 or ASME B16.22 and performance criteria of IAPMO PS 117. Sealing elements for press fittings shall be EPDM. Sealing elements shall be factory installed. Press ends shall have feature designed to assure leakage of liquids and/or gases from inside the system past the sealing element of an unpressed connection.
4. Installer shall be a qualified installer, licensed within the jurisdiction, and familiar with the installation of copper press joint systems.
5. Copper and copper alloy press connections shall be made in accordance with the manufacturer’s installation instructions. The tubing shall be fully inserted in the fitting and the tubing marked at the shoulder of the fitting. The fitting alignment shall be checked against the mark on the tubing to assure the tubing is fully engaged (inserted) in the fitting. The joints shall be pressed using the tool(s) approved by the manufacturer.

2.2 PIPE EXPANSION FITTINGS AND LOOPS

A. ACCEPTABLE MANUFACTURERS
1. Metraflex
2. Novia
3. Flexonics

B. GENERAL
1. Coordinate provision of all expansion compensation devices with the seismic restraints portion of this specification. Expansion compensation devices provided shall not compromise the ability of the piping system to resist seismic loads.
2. Project specific expansion compensation calculations and product selections shall be provided by expansion compensation supplier for final review and approval by the Engineer. Calculations and product incorporation design shall be performed by a registered mechanical or structural engineer licensed in to the state of the project work. See submittals section below for shop drawing requirements of design.
3. Final approved expansion compensation design shall be incorporated into project Coordination Drawing process.

C. SUBMITTALS
6. Product Data: For each type of pipe expansion joint and alignment guide indicated.
1. Shop Drawings
a. Expansion compensation calculations and equipment location shop drawing. Provide registered engineer stamped expansion compensation calculations and proposed equipment design including products, product performance requirements, and product locations for the following systems:
1) Hydronic heating systems
2) Heating glycol systems
3) Low pressure steam systems
b. Anchor Details: Detail fabrication of each anchor indicated. Show dimensions and methods of assembly and attachment to building structure.
c. Alignment Guide Details: Detail field assembly and attachment to building structure.

D. SCHEDULE:
1. Indicate type, manufacturer's number, size, material, pressure rating, end connections, and location for each expansion joint. Show pipe expansion fittings loops, anchors, and alignment guides on Coordination drawings. Refer to “COORDINATION DRAWINGS” this SECTION. Refer to detail sheet for valves, vents and other hydronic components not called for by this section of the specification but required for proper installation.

E. BELLOWS EXPANSION JOINTS
1. Basis of Design: Metraflex, Inc. model HP.
2. Stainless Steel Bellows Type:
a. Pressure Rating: 200 psig and 250 degrees F.
b. Maximum Compression: 3 inch.
c. Maximum Extension: 1/4 inch.
d. Joint: As specified for pipe joints.
e. Size: Use pipe sized units
f. Application: Steel piping 3 inch and under.
3. External Ring Controlled Stainless Steel Bellows Type:
a. Pressure Rating: 200 psig and 250 degrees F.
b. Maximum Compression: 1-1/4 inch.
c. Maximum Extension: 3/8 inch.
d. Maximum Offset: 5/16 inch.
e. Joint: Flanged
f. Size: Use pipe sized units
g. Accessories: Internal flow liner.
h. Application: Steel piping over 3 inch.

2.3 VIBRATION ISOLATION, SUPPORTS AND SEISMIC RESTRAINT

A. ACCEPTABLE MANUFACTURERS
1. Novia Associates, Inc.
2. Mason Industries Inc.
3. Vibration Mountings and Controls, Inc.

B. GENERAL
1. All vibration isolation, supports and seismic devices described in this section shall be the product of a single supplier. NAI (Novia Associates, Inc.) is the Basis of Design of these specifications; products of other suppliers may be acceptable provided their systems strictly comply with intent, structural design, performance and deflections of the Basis of Design.

2. It is the intent of the seismic restraint portion of this specification to provide restraint of non-structural building components. Restraint systems are intended to withstand the stipulated seismic accelerations applied through the component's center of gravity.
3. Each and every support attachment to the structure of equipment that meets the requirements of this specification must be positive, including equipment that may be excluded from auxiliary seismic bracing as noted in Part 3.

C. SUBMITTALS
1. General
   a. Provide an itemized schedule listing the tags and quantities of all components included in the submittal package.
   b. Schedule shall indicate vibration isolation type and deflection for all isolated components.
   c. Schedule shall indicate calculations and tie down details for all components subject to wind or seismic loading regardless of whether the component is isolated or not.
   d. Submittal shall include detailed cut sheets on all vibration isolation devices including component tag, rated deflections, rated loads dimensions and material finish.
   e. For equipment requiring seismic or wind restraint the submittal shall include detailed calculations indicating equipment tag, wind loads and/or seismic loads, applicable load combinations and calculations indicating minimum tie down requirements.
   f. Submittal shall include tie down details as required.
   g. Similar equipment may be grouped into a "worst case" calculation.
2. Shop Drawings
   a. For all supplemental steel bases, rails and supports the submittal shall include drawings indicating the component tag, dimensions, structural member sizes and support point locations.
   b. Provide specific details for all seismic and/or wind restraint devices and anchors including minimum quantity, size and location for each piece of equipment.
   c. Provide coordinated or contract drawings marked up with all distributed system seismic restraints including type, size and orientation.
      1) Provide minimum braced and unbraced rod lengths for each restraint location.
      2) Assigned load at each location shall be clearly identified.
      3) Minimum elevation view installation angle 30 degrees from vertical.
   d. All ceiling suspended equipment requiring seismic restraint shall include details in the restraint type and size.
      1) Provide minimum braced and unbraced rod lengths for each piece of equipment.
      2) Assigned seismic load must be clearly indicated.
      3) Minimum elevation view installation angle of 30 degrees from vertical.
      4) Similar equipment may be grouped into a "worst case" calculation.
   e. Calculate thrust for fan heads. Provide thrust restraints for any situation where the fan thrust exceeds 10% of the fan weight, the fan and duct are flexibly connected and either the fan, duct or both are not restrained from movement.
   f. For equipment subject to seismic loads and for all outdoor equipment provide seismic and/or wind load restraint details including anchor quantity, size type and location.

D. RELATED WORK
1. Housekeeping Pads
   a. Housekeeping pad attachment to structure design shall be by the project structural engineer. Material and labor required for attachment and construction shall be by the concrete section contractor.
   b. Housekeeping pads shall be coordinated with the Seismic Restraint Supplier and sized to provide a minimum edge distance of 13 bolt diameters of clearance all around the outermost anchor bolt to allow for the use of full anchor ratings.

2. Supplementary Support Steel
   a. Contractor shall supply supplementary support steel and connections for all equipment, piping, ductwork, etc. Including roof mounted equipment, as required or specified.
   b. Where support for equipment requires stands, bases, rails, etc. these devices shall be designed and fabricated by Seismic Restraint Supplier to ensure the seismic capability of the entire installation.
3. Attachments
   a. Contractor shall provide restraint attachment plates cast into housekeeping pads, concrete inserts, double sided beam clamps, etc. as directed by the Seismic Restraint Supplier.

E. FLEXIBLE CONNECTORS
1. All connectors shall be installed on the equipment side of shutoff valves; horizontal and parallel to equipment shafts whenever possible. Piping shall be supported and/or anchored to resist pipe movement beyond the allowable movement of the flexible connector. Installations must include check valves and/or other design and installation precautions to reduce the threat to life safety when subjected to the specified seismic accelerations.
2. TYPE FC-1: Spherical Elastomer connector
   a. Manufactured of EPDM.
   b. Sizes 2" and larger shall have two spheres reinforced with an external ring between spheres. Bolted-on strap type reinforcing is not acceptable. Sizes 16" to 24" may be single sphere.
   c. Threaded one piece bolted flange assemblies with female threaded ends for sizes 3/4" to 1-1/2".
   d. Rated at 250 psi up to 1700 F, with a uniform drop in allowable pressure to 170 psi at 2500 F for sizes through 14". 16" through 24" single sphere minimum ratings are 180 psi at 1700 F and 130 psi at 2500 F.
   e. Connectors shall be installed in piping gaps equal to the length of the connector under pressure.
   f. Control rods are required in unanchored installations where the installation exceeds the pressure limitation without control rods.
      1) Control rods shall have ½" thick Neoprene washer bushings large enough in diameter to take the thrust at 1,000 psi maximum on the washer area.
   g. Connectors bolted to Victaulic type coupling or gate, butterfly or check valves to have a minimum 5/8" flange spacer (by others) installed between the connector and the coupling flange. Connectors must mate to a flat-faced flange in all instances.
3. TYPE FC-2: Flexible Stainless Steel Hose
   a. Stainless steel hose and braid rated with 3:1 safety factor.
   b. 2" diameter and smaller with male nipples, 2-1/2" and larger with fixed flat faced steel flanges.
      1) Lengths shall be: 9" for 2-1/2" to 4", 11" for 5" and 6", 12" for 8", 13" for 10", 14" for 12" to 16".
4. TYPE FC-3: Unbraided Exhaust Hose
   a. Low pressure Stainless steel annularly corrugated with flanged ends.
   b. Maximum temperature of 1500 degrees F.
5. TYPE FC-4: Wire Braid Reinforced Flexible Metal Hose
   a. Metal hose and braid rated with a minimum 3:1 safety factor. (Minimum 150 PSI)
   b. Copper tube ends.

2.4 MOTORS AND MOTOR STARTERS

A. MOTOR ACCEPTABLE MANUFACTURERS
1. General Electric

2. Baldor
3. Lincoln

B. GENERAL CONSTRUCTION AND REQUIREMENTS
1. Motors Less Than 250 Watts, for Intermittent Service: Equipment manufacturer's standard and need not conform to these specifications.
2. Single Phase Motors: PSC where available.
3. Electrical Service:
4. Refer to DIVISION 26 – ELECTRICAL for required electrical characteristics.
5. Open drip-proof type except where specifically noted otherwise.
6. Design for continuous operation in 40 degrees C environment.
7. Design for temperature rise in accordance with NEMA MG 1 limits for insulation class, service factor, and motor enclosure type.
8. Motors connected to variable frequency drives shall meet requirements of NEMA MG-11, Part 31 and stated as frequency drive compatible. Motors shall be suitable for use with repeated voltage peaks of 1600 volts with rise time of 0.1 microseconds or greater.
9. Explosion-Proof Motors: UL approved for hazard classification.
10. Visible Nameplate: Indicating manufacturer's name and model number, motor horsepower, RPM, frame size, voltage, phase, cycles, full load amps, insulation system class, service factor, maximum ambient temperature, temperature rise at rated horsepower, minimum efficiency.
11. Wiring Terminations:
    a. Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70, threaded for conduit.
    b. For fractional horsepower motors where connection is made directly, provide threaded conduit connection in end frame.

C. SINGLE PHASE POWER - SPLIT PHASE MOTORS
1. Starting Torque: Less than 150 percent of full load torque.
2. Starting Current: Up to seven times full load current.
3. Breakdown Torque: Approximately 200 percent of full load torque.
4. Drip-proof Enclosure: Class A (50 degrees C temperature rise) insulation, NEMA Service Factor, prelubricated sleeve or ball bearings.
5. Enclosed Motors: Class A (50 degrees C temperature rise) insulation, 1.0 Service Factor, prelubricated ball bearings.

D. SINGLE PHASE POWER - PERMANENT-SPLIT CAPACITOR MOTORS
1. Starting Torque: Exceeding one fourth of full load torque.
2. Starting Current: Up to six times full load current.
3. Multiple Speed: Through tapped windings.
4. Open Drip-proof or Enclosed Air Over Enclosure: Class A (50 degrees C temperature rise) insulation, minimum 1.0 Service Factor, prelubricated sleeve or ball bearings, automatic reset overload protector.

E. SINGLE PHASE – ELECTRONICALLY COMMUTATED MOTORS (ECM)
1. Variable speed, constant torque brushless DC motor
2. Motor shall be provided with potentiometer to vary speed.
3. UL and CSA compliant
4. NEMA enclosure

F. SINGLE PHASE POWER - CAPACITOR START MOTORS
1. Starting Torque: Three times full load torque.
2. Starting Current: Less than five times full load current.
3. Pull-up Torque: Up to 350 percent of full load torque.

4. Breakdown Torque: Approximately 250 percent of full load torque.
5. Motors: Capacitor in series with starting winding; provide capacitor-start/capacitor-run motors with two capacitors in parallel with run capacitor remaining in circuit at operating speeds.
6. Drip-proof Enclosure: Class A (50 degrees C temperature rise) insulation, NEMA Service Factor, prelubricated sleeve ball bearings.
7. Enclosed Motors: Class A (50 degrees C temperature rise) insulation, 1.0 Service Factor, prelubricated ball bearings.

G. THREE PHASE POWER - SQUIRREL-CAGE MOTORS
1. Starting Torque: Between 1 and 1-1/2 times full load torque.
2. Starting Current: Six times full load current.
3. Power Output, Locked Rotor Torque, Breakdown or Pull Out Torque: NEMA Design B characteristics.
4. Design, Construction, Testing, and Performance: Conform to NEMA MG 1 for Design B energy efficient motors.
5. Insulation System: NEMA Class B or better.
6. Motor Frames: NEMA Standard T-Frames of steel, aluminum, or cast iron with end brackets of cast iron or aluminum with steel inserts.
7. Thermistor System (Motor Frame Sizes 254T and Larger): Three PTC thermistors embedded in motor windings and epoxy encapsulated solid state control relay with wiring to terminal box.
8. Bearings: Grease lubricated anti-friction ball bearings with housings equipped with plugged provision for relubrication, rated for minimum AFBMA 9, L-10 life of 200,000 hours. Calculate bearing load with NEMA minimum V-belt pulley with belt centre line at end of NEMA standard shaft extension. Stamp bearing sizes on nameplate.
9. Sound Power Levels: To NEMA MG 1.
10. Part Winding Start Where Indicated: Use part of winding to reduce locked rotor starting current to approximately 60 percent of full winding locked rotor current while providing approximately 50 percent of full winding locked rotor torque.
11. Weatherproof Epoxy Sealed or Treated Motors: Epoxy seal windings using vacuum and pressure to coat windings with rotor and starter surfaces protected with epoxy enamel; bearings double shielded with waterproof non-washing grease.
12. Nominal Efficiency: Unless noted otherwise, all motors provided under this project shall be premium efficient meeting the requirements of NEMA MG-1 Table 12-12 and Table 12-11 as well the Independence and Security Act of 2007.

Efficiency (Open Motor)

HP	2 Pole (1200 RPM)	4 Pole (1800 RPM)	6 Pole (3600 RPM)
1	82.5	85.5	77
1.5	86.5	86.5	84
2	87.5	86.5	85.5
3	88.5	89.5	85.5
5	89.5	89.5	86.5
7.5	90.2	91	88.5
10	91.7	91.7	89.5
15	91.7	93	90.2
20	92.4	93	91
25	93	93.6	91.7
30	93.6	94.1	91.7

40	94.1	94.1	92.4
50	94.1	94.5	93
60	94.5	95	93.6
75	94.5	95	93.6
100	95	95.4	93.6

2.5 VARIABLE SPEED DRIVES

A. ACCEPTABLE MANUFACTURERS
1. ABB
2. Allen Bradley
3. Danfoss
4. Square D

B. VARIABLE MOTOR SPEED DRIVES
1. Provide adjustable frequency motor drives consisting of pulse width modulation inverter for use on standard NEMA induction motors.
2. Provide ventilated enclosure for installation as free standing or wall mounted unit.
3. Logic shall be microprocessor based.
4. Power factor shall be not less than 0.95 through full range of frequencies.
5. Input: Refer to drawings for VAC and phase, plus or minus 10%.
6. Output: Refer to drawings for VAC and phase, 6 - 60 Hz.
7. Digital Displays:
   a. Out frequency, voltage and amps.
   b. Overcurrent - OC.
   c. Overvoltage - OV.
   d. Current Limit - CL.
   e. Voltage Limit - VL.
   f. IIT Protection - MT.
   g. Ground Fault - GF.
   h. Improper Input Voltage Selected - LO-V, HI-V.
   i. Minimum and Maximum Speed Improper Selection - MNMX.
   j. Overtemperature - OT.
8. Field setable adjustments, controls and outputs:
   a. Adjustable Current Limit (60-110% of drive's rated current).
   b. Adjustable volts per hertz (V/Hz) +10%, -10%.
   c. Adjustable Acceleration Rate.
   d. Adjustable Deceleration Rate.
   e. Speed-adjustment by face-mounted potentiometer with Software Lockout.
   f. Adjustable Maximum Speed 0 to 100%.
   g. Adjustable Minimum Speed 0 to 100%.
   h. Adjustable Speed Input Gain 1:1 to 10:1.
   i. Adjustable Speed Input Offset 0 - 50%.
   j. Speed Command Inverting Switch.
   k. Adjustable Analog Output of 0-1 to 0-10 VAC proportional to volts amps or hertz.
   l. Digital Output of 12 VDC.
   m. Adjustable Output Boost.
   n. Adjustable Thermal overload protection 60% to 100% of drive rating.
   o. Three sets of single pole double throw contacts indicating run, trip and current limit.
   p. Automatic restart after a fault to a maximum of 5 attempts.
   q. Set point mode of operation from a transducer input signal.

r. RS232 Port Communication Capacity.

9. Acceptable Inputs:
   a. DC voltage 0-10 VDC.
   b. DC current 0-50 MaDC.
10. Acceptable Start/Stop Commands:
   a. Closure of contact or switch.
11. Enclosures:
   a. Enclosure shall be designed to maintain operation at 50 degrees C.
   b. Outdoor: NEMA 250, Type 3R,
   c. Indoor: NEMA 250, Type 12K.
   d. If VFD is to be located in a kitchen area, other wet or damp space, or hazardous location, refer to electrical specification for appropriate enclosure requirements.
12. Options to be provided:
   a. Prewired H-O-A switch.
   b. Manual transfer to line power via contactors and including motor thermal overload and fuse protection while in bypass operation.
   c. Service switch which provides ability to service controller (electrically isolated) while in bypass operation without having to remove power to the motor.
   d. 5% line reactor
   e. Provide output reactor if electrical feed to the motor is greater than manufacturer's recommendations.

2.6 METERS AND GAUGES

A. ACCEPTABLE MANUFACTURERS
1. Weiss
2. Trerice
3. Ashcroft

B. PRESSURE GAGES
1. Gage: ASME B40.1, with bourdon tube, rotary brass movement, brass socket, front recalibration adjustment, black scale on white background.
   a. Case: Steel
   b. Bourdon Tube: Brass.
   c. Dial Size: 2 inch.
   d. Mid-Scale Accuracy: One percent.
   e. Scale: Psi.
   f. Provide pulsation damper for all pressure gauges
   g. All pump and other vibration areas shall utilize liquid filled gauges
   h. All steam piping pressure gauges shall be provided with coil siphons

C. STEM TYPE THERMOMETERS
1. Thermometer: ASTM E1, blue organic liquid, lens front tube, cast aluminum case with enamel finish.
   a. Size: 7 inch scale.
   b. Window: Clear glass.
   c. Stem: Brass, 3/4 inch NPT, 3-1/2 inch long.
   d. Accuracy: ASTM E77 2 percent.
   e. Calibration: Degrees F.
   f. Scale shall be 30 – 240 deg. with 2 deg. F. divisions for hot water and 30-180 deg. with 2 deg F divisions for chilled water.

D. TEST PLUGS

1. Test Plug:
   a. 1/4 inch NPT or 1/2 inch NPT brass stainless steel fitting and cap for receiving 1/8 inch outside diameter pressure or temperature probe with:
   b. Neoprene core for temperatures up to 200 degrees F.
   c. Test Kit:
      1) Carrying case, internally padded and fitted containing:
      2) One 2 inch diameter pressure gages.
      3) Two gage adapters with 1/8 inch probes.
      4) Two one inch 1-1/2 inch dial thermometers.

E. STATIC PRESSURE GAGES
1. Dial Gages:
   a. 3-1/2 inch diameter dial in metal case, diaphragm actuated black figures on white background, front recalibration adjustment, 2 percent of full scale accuracy.
   b. Accessories: Static pressure tips with compression fittings for bulkhead mounting, 1/4 inch diameter tubing.

2.7 VALVES

A. ACCEPTABLE MANUFACTURERS
1. Stockham
2. Crane
3. Milwaukee
4. High-Performance Butterfly Valves
   a. Bray
   b. Approved equal

B. SUBMITTALS
1. Product Data: For each type of valve indicated. Include body, seating, and trim materials; valve design; pressure and temperature classifications; end connections; arrangement; dimensions; and required clearances. Include list indicating valve and its application. Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories.
2. Shop Drawing: Show valves on Coordination drawings. Refer to ‘COORDINATION DRAWINGS” this SECTION.

C. GENERAL
1. Provide valves of same manufacturer throughout where possible.
2. Where a single acceptable manufacturer does not produce all valve types required, multiple manufacturers may be used, but in no case shall the same type valve be provided by different manufacturers.
3. Valve manufacturers and their valve numbers indicated herein are meant to describe type and quality only.
4. ASME Compliance: ASME B31.9 for building services piping valves.
5. ASME Compliance for Ferrous Valves: ASME B16.10 and ASME B16.34 for dimension and design criteria.

D. GATE VALVES
1. Type GV2: Bronze, non-rising stem, inside screw, solid wedge, screwed ends, Class 150, (Stockham Fig.B-128).
2. Type GV3: Bronze, Rising stem, inside screw, solid wedge, screwed ends, Class 150, (Stockham Fig. B-122).

3. Type GV4: Iron body, bronze trim, OS&Y, solid wedge, rising stem, flanged ends, Class 125, (Stockham Fig. G-623).
4. Type GV5: Iron body, bronze trim, OS&Y, solid wedge, rising stem, flanged ends, Class 250, (Stockham Fig. F667).
5. Type GV6: Bronze, non-rising stem, inside screw, solid wedge, screwed ends, screw-in bonnet, Class 300, (Stockham Fig. B-147).
6. Type GV7: Cast steel body, steel trim, OS&Y, flexible wedge, rising stem, flanged ends, Class 150, (Stockham Fig. 15-OF-U).
7. Type GV8: Cast steel body, steel trim, OS&Y, flexible wedge, rising stem, flanged ends, Class 300, (Stockham Fig. 30-OF-U).

E. BALL VALVES
1. Type BLV1: Bronze body and retainer, reinforced Teflon seats and packing, chromium plated ball, soldered ends, full port (Apollo 77-200).
2. Type BLV2: Bronze body and retainer, reinforced Teflon seats and packing, chromium plated ball, screwed ends, full port (Apollo 77-100).
3. Provide extended stems for all valves in insulated piping systems. Stems shall extend to length necessary for full handle exposure outside of insulation system.

F. BUTTERFLY VALVES
1. Type BFV1: High performance, carbon steel lug body, stainless steel disc, all-metal seat, combination metal and PTFE seal, stainless steel stem, class 150, -20 to 500 deg. F. (Bray Series 40).
2. Grooved End: Ductile iron body and disc. Seat tested to MSS-SP-67, Bubble tight, bi-directional dead end service to 300 psi. The disc coating shall be suitable for intended service. Valves shall be Victaulic Series 300 or equivalents by Stockham and Grinnell.
3. Unless otherwise indicated provide lever operators for valves 6" and less and gear operators for valves 8" and larger.

G. CHECK VALVES
1. Type SCV1: Swing check valve, bronze body, regrinding bronze disc, soldered ends, 300 psi, (Stockham Fig. B-321).
2. Type SCV2: Swing check valve, bronze body, regrinding bronze disc, screwed ends, Class 300, (Stockham Fig. B375).
3. Type SCV3: Swing check valve, iron body, regrind-renew bronze disc and seat ring, flanged ends, Class 125, (Stockham Fig. G931).
4. Type SCV4: Swing check valve, iron body, regrind-renew bronze disc and seat ring, flanged ends, 250 psi, (Stockham Fig. F947).
5. Type LCV1: Lift check valve, bronze body, bronze disc, spring loaded, screw over cap, screwed ends, Class 150 (Stockham Fig. B-322T).
6. Type WCV1: Wafer check valve, iron body, bronze trim, bronze disc, stainless steel spring, (Stockham Fig. WG-961).

H. DRAIN VALVES
1. Type DV1: Ball or gate valve with hose end, bronze cap and chain.

I. PLUG VALVES
1. Type PV1: Semi-steel, bolt gland type, (Rockwell Fig. 142 or 143).

J. VALVES FOR HYDRONIC SYSTEMS
1. Valves for hydronic systems shall be as follows:
   a. BALL VALVES:
      1) 2" and Less (Soldered Ends); Type BLV1.
      2) 2" and Less (Screwed Ends); Type BLV2.
   b. BUTTERFLY VALVES

1) 2-1/2" and Larger; BFV1.

c. GLOBE VALVES – For use on control valve bypass lines only.
   1) 2” and Less (Screwed Ends): Type GLV2
   2) 2-1/2” and Larger (Flanged Ends): Type GLV3

d. SWING CHECK VALVES
   1) 2" and Less (Soldered Ends); Type SCV1.
   2) 2" and Less (Screwed Ends); Type SCV2.
   3) 2-1/2" and Larger (Flanged Ends Pressure under 125 PSI); SCV3.
   4) 2-1/2" and Larger (Flanged Ends Pressure over 125 PSI); SCV4.

e. LIFT CHECK VALVES:
   1) 2" and Less; Type LCV1.

f. WAFER CHECK VALVES (For Use on Pump Discharge Services):
   1) All Sizes; WCV1.

g. DRAIN VALVES:
   1) Type DV1.

h. PLUG VALVES:
   1) Type PV1

2.8 HANGERS AND SUPPORTS

A. ACCEPTABLE MANUFACTURERS
   1. Carpenter and Patterson, Inc.
   2. Elcen Metal Products Co.
   3. ITT Grinnell Corp.

B. GENERAL:
   1. MSS: Manufacturers Standardization Society for The Valve and Fittings Industry Inc.
   2. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."
   3. Coordinate provision of all Hangers and Supports with the seismic restraints portion of this specification. Hangers and Supports provided shall not compromise the ability of the piping system to resist seismic loads.

C. PIPE HANGERS AND SUPPORTS
   1. Hangers for Pipe Sizes 1/2 Inch to 1-1/2 Inch: Adjustable steel band hanger; MSS Type 7.
   2. Hangers for Pipe Sizes 2 Inch to 3 Inch: Carbon steel, adjustable, clevis; MSS Type 1.
   3. Hangers for Pipe Sizes 4 Inch to 5 Inch: Steel adjustable, cast iron roll, single hanger; MSS Type 43.
   4. Hangers for Pipe Sizes 6 Inch and Over: Single cast iron pipe roll, double hangers; MSS Type 41.
   5. Shields for insulated all cold piping and insulated hot piping size 3 inch and less: Galvanized steel shield over insulation in 180 deg. segments, minimum 12 inch long at pipe supports.
   6. Shield for all hot piping 4 inch and larger: Steel pipe covering protection saddle; MSS Type 39. Fill void with insulating cement.
   7. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods; cast iron roll and stand for hot pipe sizes 6" and over.
   8. Wall Support for Pipe Sizes 4 Inch and Over: Welded steel bracket and wrought steel clamp; adjustable steel yoke and cast iron roll for hot pipe sizes 6 inch and over.
   9. Vertical Support: Steel riser clamp.
   10. Floor Support for Pipe Sizes to 4 Inch and All Cold Pipe Sizes: Cast iron adjustable pipe saddle, locknut nipple, floor flange, and concrete pier or steel support.
   11. Floor Support for Pipe Sizes to 6 Inch and Over: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.

12. Provide copper plated hangers and supports for copper piping systems.
13. Shields for Vertical Copper Pipe Risers: Sheet lead.
14. Manufactured Piping Systems: Provide hangers and supports per manufacturer's recommendations for press-fit and grooved mechanical fitting piping systems (if allowable).

D. HANGER RODS
1. Steel Hanger rods: Continuous threaded.

E. INSERTS AND BUILDING ATTACHMENTS
1. Inserts: Malleable iron case of steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.
2. Provide: Provide steel beam clamps, C-clamps, and steel brackets as required to accept threaded rods.

2.9 MECHANICAL IDENTIFICATION

A. ACCEPTABLE MANUFACTURERS
1. Allen Systems, Inc.
2. Brady (W.H.) Co.; Signmark Div.
3. Seton Name Plate Corp.

B. SUBMITTALS
1. Product Data: For each type of product indicated.
2. Valve numbering scheme.
3. Valve Schedules: For each piping system. Furnish extra copies (in addition to mounted copies) to include in maintenance manuals.

C. GENERAL
1. Identification shall be consistent with Owner's standard methods of identification.
2. Labeling of new systems added to existing systems shall be consistent with the existing numbering system and terminology. Do not use valve numbers that have already been used.
3. Provide typewritten valve tag list in Operating and Maintenance Instruction Manuals.
   a. List shall be printed on 8.5x11 letter size paper.
   b. Provide one aluminum framed plastic shielded copy for mounting in the main mechanical room.
   c. List shall indicate each valve number, service, size and location
4. Flow arrows shall be solid black. Arrows shall be six (6) inches long by two (2) inches wide.

D. MATERIALS
1. Unless specified otherwise, comply with ASME A13.1, "Scheme for the Identification of Piping Systems," for letter size, length of color field, colors, and viewing angles of identification devices for piping.
2. Plastic Nameplates: Laminated three-layer plastic with engraved black letters on light contrasting background.
3. Brass Valve Tags: Brass with stamped letters; tag size minimum 1-1/2-inch diameter with smooth edges; four-inch brass chain.
4. Valve Tag Chart: Aluminum frame sized for 8.5x11 for chart, plastic lens.
5. Plastic Pipe Markers: Factory fabricated, flexible, semi rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and fluid being conveyed.

a. On piping diameters (including insulation) up to 2-1/4", use 0.75 inch high capital letters.
b. On piping diameters (including insulation) between 2-1/2" and 6", use 1.5 inch high capital letters.
c. On piping diameters (including insulation) between 7" and 10", use 2.5 inch high capital letters.
d. On piping diameters (including insulation) above 10", use 3.5 inch high capital letters.

6. Plastic Tape Duct Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings. On ductwork (including insulation) lettering shall be two (2) inches high capitals.
7. Underground Plastic Pipe Markers: Bright colored continuously printed plastic ribbon tape of not less than 6 inch wide by 4 mil thick, manufactured for direct burial service.
8. Equipment Nameplates: Metal, with data engraved or stamped, for permanent attachment on equipment. Provided by equipment manufacturers.
   a. Data:
      1) Manufacturer, product name, model number, and serial number.
      2) Capacity, operating and power characteristics, and essential data.
      3) Labels of tested compliances.
   b. Location: Accessible and visible.
   c. Size: Manufacturers standard
   d. Fasteners: As required to mount on equipment.
9. Equipment Markers: Engraved, 1 1/6" thick color-coded engraved phenolic. Include contact-type, permanent adhesive.
   a. Terminology: Match schedules as closely as possible.
   b. Data:
      1) Name and plan number.
      2) Equipment service.
   c. Location: Accessible and visible.
   d. Size: 2-1/2 by 4 inches (64 by 100 mm) for control devices, dampers, and valves; 4-1/2 by 6 inches (115 by 150 mm) for equipment or as required to be secured to equipment.
   e. Letter Size: Minimum 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances.
10. Warning Tags: Preprinted or partially preprinted, accident-prevention tags; of plasticized card stock with matte finish suitable for writing.
    a. Size: Approximately 4 by 7 inches (100 by 178 mm).
    b. Fasteners: Reinforced grommet and wire or string.
    c. Nomenclature: Large-size primary caption such as DANGER, CAUTION, or DO NOT OPERATE.
    d. Color: Yellow background with black lettering.
11. Ceiling Grid Markers: White plastic with adhesive backing and min ½-inch tall lettering for attachment to ceiling t-bar grid.
12. Access Panel and Door Markers: 1/16-inch- thick, engraved laminated plastic, with abbreviated terms and numbers corresponding to identification. Provide 1/8-inch center hole for attachment. Self-tapping, stainless-steel screws or contact-type, permanent adhesive.

2.10 PIPING INSULATION

A. GLASS FIBER

1. Acceptable Manufacturers:
   a. Knauf / Manson

b. Manville.
c. Certainteed.
2. Insulation: ASTM C795; rigid, noncombustible, end grain adhered to jacket.
a. 'K' value: ASTM C177, 0.24 at 75 degrees F.
b. Maximum service temperature: 650 degrees F.
c. Maximum moisture absorption: 0.2 percent by volume.
d. All fittings shall also be rigid, conformed pieces with integral vapor barrier; basis of design shall be Hamfab insert product.
3. Vapor Barrier Jacket:
a. ASTM C921, White kraft paper with glass fiber yarn, bonded to aluminized film.
b. Moisture vapor transmission: ASTM E96; 0.02 perm-inches.
4. Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.
5. Vapor Barrier Lap Adhesive:
a. Compatible with insulation.
6. Insulating Cement/Mastic:
a. ASTM C195; hydraulic setting on mineral wool.
7. Fibrous Glass Fabric:
a. Cloth: Untreated; 9 oz/sq yd weight.
b. Blanket: 1.0 lb/cu ft density.
c. Weave: 5x5 10x10 10x20.
8. Indoor Vapor Barrier Finish:
a. Cloth: Untreated; 9 oz/sq yd weight.
b. Vinyl emulsion type acrylic, compatible with insulation.

B. JACKETS
1. General: ASTM C 921, Type 1, unless otherwise indicated
2. PVC Plastic.
a. PVC Jacket: High-impact, ultraviolet-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; PVC; 20 mils thick; roll stock ready for shop or field cutting and forming.
b. Adhesive: As recommended by insulation jacket material manufacturer.
c. PVC Jacket Color: Off-White and Color-code jackets based on system. Color shall be as specified in "INSTALLATION OF MECHANICAL IDENTIFICATION" of these specifications.
d. Standard PVC Fitting Covers
1) Factory-fabricated fitting covers manufactured from 20-mil-thick, high-impact, ultraviolet-resistant PVC to match jacket if available; otherwise, field fabricate.
2) Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, traps, mechanical joints, and P-traps.

C. ACCESSORIES
1. Insulating Cement: ASTM C195; hydraulic setting mineral wool.
2. Adhesives, Sealers, and Protective Finishes: As recommended by insulation manufacturer for applications indicated.
3. Staples, Bands, Wires, and Cement: As recommended by insulation manufacturer for applications indicated.

2.11 AUTOMATIC TEMPERATURE CONTROLS – FACILITIES MANAGEMENT SYSTEM

A. ACCEPTABLE MANUFACTURERS
1. Trane, or equal.

B. EXTENSION OF EXISTING BUILDING AUTOMATION SYSTEM

1. The work shall be an extension of the existing facilities management system. Provide all necessary components for a complete operational system.
2. Contractor shall become familiar with existing FMS sequences and shall coordinate all new sequences with the Owner's existing FMS protocol.
3. Provide new or updated graphics and User Interface software as necessary to control the new components from the existing User Interface.
4. Extend the existing Local Area Network as necessary.

C. GENERAL
1. The Automatic Temperature Control (ATC) Contractor shall be the primary manufacturer-owned branch office that is regularly engaged in the engineering, programming, installation and service of total integrated Facilities Management Systems (FMS) of similar size, scope and complexity to the FMS specified in this Contract.
2. The ATC Contractor shall be a recognized national manufacturer, installer and service provider of FMS. Distributors, manufacturer's representatives and wholesalers will not be acceptable.
3. The ATC Contractor shall have a branch facility within a 50-mile radius of the job site supplying complete maintenance and support services on a 24 hour, 7-day-a-week basis. This branch facility shall provide the work for this project. This support facility shall have spare parts and all necessary test and diagnostic equipment required to install, commission and service the specified FMS.
4. As evidence and assurance of the contractor's ability to support the Owner's system with service and parts, the contractor must have been in the ATC business for at least the last ten (10) years and have successfully completed total projects of at least 10 times the value of this contract in each of the preceding five years.
5. The FMS architecture shall consist of the products of a manufacturer regularly engaged in the production of Facility Management Systems, and shall be the manufacturer's latest standard of design at the time of bid.
6. FMS Manufacturers system shall be Direct Digital Control (DDC) BACNET compatible. Comply with ASHRAE 135 for FMS control components.

D. SYSTEM DESCRIPTION
1. The Basis of Design Is **Trane**
2. The FMS shall be a complete **proprietary** Direct Digital Control (DDC) system designed for use on Intranets and the Internet. This functionality shall extend into the equipment rooms. Primary nodes located in equipment rooms and similar shall be fully IT compatible devices that mount and communicate directly on the IT infrastructure.
3. All points of user interface shall be on standard PCs that do not require the purchase of any special software from the ATC manufacturer for use as a building operations terminal. The primary point of interface on these PCs will be a standard Web Browser such as Internet Explorer.
4. The ATC work shall consist of the provision of all labor, materials, tools, equipment, software, software licenses, software configurations and database entries, interfaces, wiring, tubing, installation, labeling, engineering, calibration, documentation, samples, submittals, testing, verification, training services, permits and licenses, transportation, shipping, handling, administration, supervision, management, insurance, temporary protection, cleaning, cutting and patching, warranties, services, and items as Specified in these Division documents which are required for the complete, fully functional and commissioned system.
   a. The ATC contractor shall field-install all components requiring field installation. All items required for a complete operating system, not provided by the manufacturer shall be by this contractor. The ATC contractor shall fully coordinate all control components, sequences and requirements with the manufacturer before submitting his shop drawings.

b. The ATC contractor shall provide all interlock wiring and controls between the energy recovery units and their associated air cooled condensing units.

5. Provide a complete, neat and workmanlike installation. Use only manufacturer employees who are skilled, experienced, trained, and familiar with the specific equipment, software and configurations to be provided for this Project.
6. Manage and coordinate the ATC work in a timely manner in consideration of the Project schedules. Coordinate cooperatively with the associated work of other trades so as to assist the progress and not impede or delay the work of associated trades.
7. The FMS as provided shall incorporate, at minimum, the following integrated features, functions and services:
   a. Operator information, alarm management and control functions at User Interface without the need to purchase special software from the ATC manufacturer for those consoles.
   b. Enterprise-level information and control functions.
   c. Information management including monitoring, transmission, archiving, retrieval, and reporting functions.
   d. Diagnostic monitoring and reporting of FMS functions.
   e. Offsite monitoring and management
   f. Energy management
8. The FMS shall be designed entirely for use on intranets and internets. All networking technology used at the Tier 1 level shall be off the shelf, industry standard technology fully compatible with other owner provided networks in the facility.
9. All aspects of the user interface shall be via browsers. Any PCs used as User Interface points shall not require any more than the software indicated under User Interface in order to provide the complete user interface as described throughout this section.
10. The user interface will be complete as described herein, providing complete tool sets, operational features, multi- panel displays, and other display features. Systems which merely provide HTML based web pages as the User Interface will not be acceptable.
11. The primary components of the system will be the Control Units located at the highest level of the network architecture.
12. The FMS shall consist of a number of control units and associated equipment connected by industry standard network practices. All communication between control units shall be by digital means only.
13. The FMS network shall at minimum comprise of the following:
    a. Network processing, data storage and communication equipment.
    b. Routers, bridges, switches, hubs, modems and like communications equipment.
    c. Active processing Nodes including field panels.
    d. Intelligent and addressable elements and end devices.
    e. Third-party equipment interfaces.
    f. Other components required for a complete and working FMS.
14. All FMS features shall be accessible via Enterprise Intranet and Internet browser with equivalent FMS access control for user access.
15. The FMS shall support auto-dial/auto-answer communications to allow FMS nodes to communicate with other remote FMS Nodes via standard telephone lines - DSL or voice grade.
16. Provide licenses for all software residing in the FMS and transfer these licenses to the Owner prior to completion.
17. Power Fail / Auto Restart
    a. Provide for the automatic orderly and predefined shutdown of parts or all of the FMS following total loss of power to parts or all of the FMS.
    b. Provide for the automatic orderly and predefined startup of all parts of the FMS following total loss of power to those parts or all of the FMS. Archive and annunciate time and details of restoration.

c. Provide for the orderly and predefined scheduling of controlled return to normal, automatically time scheduled, operation of controlled equipment as a result of the auto restart processes.
d. Maintain the FMS real-time clock operation during periods of power outage for a minimum of 72 hours.

18. Downloading And Uploading
    a. Provide the capability to generate FMS software-based sequences, database items and associated operational definition information and user-required revisions to same at the User Interface, and the means to download same to the associated control units.

E. SUBMITTALS
1. Shop Drawings, Product Data, and Samples
2. The ATC Contractor shall submit a list of all shop drawings with submittal dates within 30 days of contract award.
3. Submittals shall be in defined packages. Each package shall be complete and shall only reference itself and previously submitted packages. The packages shall be as approved by the Architect for Contract compliance.
7. Organize FMS submittal within the following three basic sections: 1. Component factory data sheets, component-specific diagrams, and component schedules; 2. Systems sequences, and system diagrams; and 3. Graphic User Interface (GUI) screen graphics. Provide full table of contents indicating specific page-number or drawing-number location of each component type, component schedule, system sequence, system diagram, and each GUI screen graphic.
4. Equipment and systems requiring approval of local authorities must comply with such regulations and be approved. Filing shall be at the expense of the ATC Contractor where filing is necessary. Provide a copy of all related correspondence and permits to the Architect.
5. At a minimum, submit the following:
    a. FMS network architecture diagrams including all nodes and interconnections.
    b. Detailed coordinated controls submittal including any packaged factory supplied controls and the ATC contractor supplied controls.
    c. Thermostat and other controls and sensor locations shall be indicated on the project coordination drawing submittal.
    d. Schematics and flow diagrams.
    e. Sequences of Operation
        1) The specific sequences described below in “SEQUENCE OF OPERATION” are provided only to indicate the design intent. The ATC contractor shall use these as the basis for development of full, narrative style, system logic based control sequences by the automatic temperature controls (ATC) contractor.
        2) Final sequences written by the ATC contractor shall specifically reference actual sensor names and point designations within the provided enterprise system. Sequence language shall follow system logic and include all criteria included in specific sequence listed below.
    f. Copying and pasting of the engineers sequence of operations is prohibited and shall result in rejection of the submittal.
    g. Points schedule for each real point in the FMS, including: Tag, Point Type, System Name and Display Units. <Node Type, Address, Cable Destination, Module Type, Terminal ID, Panel, Slot Number, Reference Drawing, and Cable Number.>
    h. Samples of Graphic Display screen types and associated menu penetrations to show hierarchy and functional interrelationships.
    i. Detailed Bill of Material list for each Node, identifying quantity, part number, description, and optional features.
    j. Control Damper Schedule including a separate line for each damper and a column for each of the damper attributes, including: Code Number, Fail Position, Damper

Type, Damper Operator, Blade Type, Bearing Type, Seals, Duct Size, Damper Size, Mounting, and Actuator Type.

k. Control Valve Schedules including a separate line for each valve and a column for each of the valve attributes: Code Number, Configuration, Fail Position, Pipe Size, Valve Size, Body Configuration, Close off Pressure, Capacity, Valve CV, Calculated CV, Design Pressure, Actual Pressure, and Actuator Type.

l. Room Schedule including a separate line for each VAV box and terminal unit indicating minimum/maximum cfm, pickup gain, box area, and bias setting.

m. Details of all FMS interfaces and connections to the work of other trades.

n. Product data sheets for all products including software.

o. Training provided, including outlines for each session.

F. RECORD DOCUMENTATION

1. Operation and Maintenance Manuals shall be provided to the Owner's Representative upon completion of the project. The entire Operation and Maintenance Manual shall be furnished on Compact Disc media, and include the following for the FMS provided:
   a. Table of contents.
   b. As-built system record drawings. Computer Aided Drawings (CAD) record drawings shall represent the as-built condition of the system and incorporate all information supplied with the approved submittal. Include locations of all thermostats and other controls and sensors.
   c. Manufacturers product data sheets for all products including software.
   d. System Operator’s manuals.
   e. Archive copy of all site-specific databases and sequences.
   f. network diagrams.
   g. Wiring termination schedules.
   h. Interfaces to all third-party products and work by other trades.
2. The Operation and Maintenance Manual CD shall be self-contained, and include all necessary software required to access the project record drawings and data sheets. A logically organized table of contents shall provide dynamic links to view and print all project record drawings and product data sheets. Viewer software shall provide the ability to display, zoom, and search all documents. The CD-ROM(s) shall contain adequate space for future system updates.
3. On-line Documentation: After completion of all the tests and adjustments listed above, the contractor shall install the following information on the FMS:
   a. "AS BUILT" drawing files
   b. Detailed catalog data on all installed system components with address and phone number of factory repair service.

G. WARRANTY

1. Provide a one-year labor and material warranty on the FMS.
2. If within twelve (12) months from the date of acceptance of product, upon written notice from the owner, it is found to be defective in operation, workmanship or materials, it shall be replaced, repaired or adjusted at the option of the ATC Contractor at the cost of the ATC Contractor.
3. Maintain an adequate supply of materials within 100 miles of the Project site such that replacement of key parts and labor support, including programming. Warranty work shall be done during ATC Contractor’s normal business hours.
4. Maintain an on-site record of all work done, all items removed from site, all items returned to site, all new replacement items installed and all remedial programming and database entry work undertaken including software revisions installed. Maintain a record of all re-calibrations required as a result of Warranty service.

H. COMMISSIONING

1. Refer to PART 1 – STANDARD REPORTING REQUIREMENTS, this document, for general information.
2. Fully commission all aspects of the Facility Management System work.
3. Acceptance Check Sheet
   a. Prepare a check sheet that includes all points for all functions of the FMS
   b. Submit the check sheet to the Engineer for approval one month prior to testing.
   c. Complete the check sheet for all items and functions of the FMS and initial each entry with time/date as record of having fully calibrated and tested the FMS. Submit to Engineer.
4. The Engineer will use the check sheet as the basis for acceptance testing with the ATC Contractor.
5. VAV box performance verification and documentation:
   a. The ATC Contractor shall test each VAV box for where the dampers in one half of a group of boxes are stepped towards full open while the other half are stepped towards full closed. At each step, after a settling time, box air flows and damper positions will be sampled. Following the cycle, a pass/fail report indicating results shall be produced. Possible results are Pass, No change in flow between full open and full close, Reverse operation or Maximum flow not achieved. The report shall be submitted as documentation of the installation.
   b. The ATC Contractor shall issue a report based on a sampling of the VAV calculated loop performance metrics. The report shall indicate performance criteria, include the count of conforming and non-conforming boxes, list the non-conforming boxes along with their performance data, and shall also include graphical representations of performance. The sampling shall take place after completion of Test and Balance, when design cooling and heating media have been available and occupied conditions approximated for five consecutive days.
6. Provide all necessary specialist labor, materials and tools to demonstrate to the Engineer that the FMS has been commissioned and is operating in compliance with the contract. Prepare a list of noted deficiencies signed by both the Engineer and the ATC Contractor.
7. Promptly rectify all listed deficiencies and submit to the Engineer that this has been done.

I. CONTROL UNITS
1. Units: Modular in design and consisting of processor board with programmable RAM memory, local operator access and integral interface equipment.
2. Memory shall be backed up with non-volatile EEPROM.
3. Control Units Functions:
   a. Monitor or control each input/output point.
   b. Completely independent with hardware clock/calendar and software to maintain control independently.
   c. Acquire, process, and transfer information to User Interface or other control units on network.
   d. Accept, process, and execute commands from other control unit's or devices or User Interface.
   e. Access both data base and control functions simultaneously.
   f. Record, evaluate, and report changes of state or value that occur among associated points. Continue to perform associated control functions regardless of status of network.
   g. Perform in stand-alone mode:
      1) Start/stop.
      2) Duty cycling.
      3) Automatic Temperature Control.
      4) Demand control via a sliding window, predictive algorithm.
      5) Event initiated control.
      6) Calculated point.
      7) Scanning and alarm processing.

8) Full direct digital control.
9) Trend logging.
10) Global communications.
11) Maintenance scheduling.

4. Global Communications:
   a. Broadcast point data onto network, making that information available to all other system control units.
   b. Transmit any or all input/output points onto network for use by other control units and utilize data from other control units.
5. Input/Output Capability:
   a. Discrete/digital input (contact status).
   b. Discrete/digital output.
   c. Analog input.
   d. Analog output.
   e. Pulse input (5 pulses/second).
   f. Pulse output (0-655 seconds in duration with 0.01 second resolution).
6. Monitor, control, or address data points. Mix shall include analog inputs, analog outputs, pulse inputs, pulse outputs and discrete inputs/outputs, as required. Install control unit's with minimum 30 percent spare capacity.
7. Point Scanning: Set scan or execution speed of each point to operator selected time from 1 to 250 seconds.
8. Upload/Download Capability: Download from or upload to using the User Interface. Upload/Download time for entire control unit database maximum 10 seconds on hard wired LAN, or 60 seconds over voice grade phone lines.
9. Test Mode Operation: Place input/output points in test mode to allow testing and developing of control algorithms on line without disrupting field hardware and controlled environment. In test mode:
   a. Inhibit scanning and calculation of input points. Issue manual control to input points (set analog or digital input point to operator determined test value) from work station.
   b. Control output points but change only data base state or value; leave external field hardware unchanged.
   c. Enable control actions on output points but change only data base state or value.
10. Local display and adjustment panel: **<Portable> <or> <Integral to>** control unit, containing digital display, and numerical keyboard. Display and adjust:
    a. Input/output point information and status.
    b. Controller set points.
    c. Controller tuning constants.
    d. Program execution times.
    e. High and low limit values.
    f. Limit differential.
    g. Set/display date and time.
    h. Control outputs connected to the network.
    i. Automatic control outputs.
    j. Perform control unit diagnostic testing.
    k. Points in "Test" mode.
11. Uninterruptible power supply (UPS):
    a. Each Control unit shall be equipped with the necessary UPS such that it will not cease operation during minor power outages, including those that occur upon transfer to emergency generator or other local power source not provided by the utility.

J. PROGRAMMING APPLICATION FEATURES
1. Trend Point:
   a. Sample up to 500 points, real or computed, with each point capable of collecting samples at intervals specified in minutes, hours, days, or month.

b. Output trend logs as line graphs or bar graphs. Output graphic on terminal, with each point for line and bar graphs designated with a unique **<pattern> <color>**, vertical scale either actual values or percent of range, and horizontal scale time base. Print trend logs up to 12 columns of one point/column.

2. Alarm Messages:
   a. Allow definition of messages.
   b. Assign alarm messages to system messages including point's alarm condition, point's off-normal condition, totalized point's warning limit, hardware elements advisories.
   c. Output assigned alarm with "message requiring acknowledgement".
   d. Operator commands include define, modify, or delete; output summary listing current alarms and assignments; output summary defining assigned points.
3. Weekly Scheduling:
   a. Automatically initiate equipment or system commands, based on preselected time schedule for points specified.
   b. Provide program times for each day of week, per point, with one minute resolution.
   c. Automatically generate alarm output for points not responding to command.
   d. Provide for holidays, minimum of 366 consecutive holidays.
   e. Operator commands:
      1) System logs and summaries.
      2) Start of stop point.
      3) Lock or unlock control or alarm input.
      4) Add, delete, or modify analog limits and differentials.
      5) Adjust point operation position.
      6) Change point operational mode.
      7) Open or close point.
      8) Enable/disable, lock/unlock, or execute interlock sequence or computation profile.
      9) Begin or end point totalization.
      10) Modify totalization values and limits.
      11) Access or secure point.
      12) Begin or end HVAC or load control system.
      13) Modify load parameter.
      14) Modify demand limiting and duty cycle targets.
   f. Output summary: Listing of programmed function points, associated program times, and respective day of week programmed points by software groups or time of day.
4. Interlocking:
   a. Permit events to occur, based on changing condition of one or more associated master points.
   b. Binary contact, high/low limit of analog point or computed point shall be capable of being utilized as master. Same master may monitor or command multiple slaves.
   c. Operator commands:
      1) Define single master/multiple master interlock process.
      2) Define logic interlock process.
      3) Lock/unlock program.
      4) Enable/disable interlock process.
      5) Execute terminate interlock process.
      6) Request interlock type summary.

K. PRESSURE INDEPENDENT AUTOMATIC CONTROL VALVES:
1. All control valves shall be pressure independent, combining the functionality of a control valve and pressure regulating valve, providing constant flow at a given position regardless of pressure variations within the system. The valves shall be quiet in operation and fail-safe in either normally open or normally closed position in the event of power failure. All valves shall be capable of operation in sequence when required by the sequence of

operation. All control valves shall be sized by the control manufacturer and shall be guaranteed to meet the heating loads as specified. All control valves shall be suitable for the pressure conditions involved. Valve operators shall be of the electronic actuating type and be fully modulating or two position type as indicated under the sequence of operation. Body pressure rating and connection type (screwed or flanged) shall conform to pipe schedule in this specification.

a. All valves sequenced with other valves, or control devices, shall be equipped with pilot positioners.
b. Hot water control valves shall be single-seated type with equal percentage flow characteristics. The valve discs shall be composition type with bronze trim.

L. VALVE OPERATORS:
1. ACCEPTABLE MANUFACTURERS:
   a. Belimo
   b. FMS system manufacturer
2. Valve operator shall be electronic actuator type, fully-modulating or two-position type as indicated in the sequences of operation. Floating point control shall not be acceptable.
3. Direct-mount, spring return, bi-directional
4. Operating conditions -40 deg. F to 131 deg. F.
5. NEMA 2 aluminum enclosure.
6. 24V / 60 Hz power, unless noted otherwise on electrical drawings.
7. Locking manual override with auto release and crank storage.
8. Proportional actuators shall accept a 0 to 10 VDC or 0 to 20 mA control input and provide a 2 to 10 VDC or 4 to 20 mA operating range. An actuator capable of accepting a pulse width modulating control signal and providing full proportional operation of the valve is acceptable. All actuators shall provide a 2 to 10 VDC position feedback signal.
9. All 24 VAC/VDC actuators shall operate on Class 2 wiring and shall not require more than 10 VA for AC or more than 8 watts for DC applications. Actuators operating on 120 VAC power shall not require more than 10 VA. Actuators operating on 230 VAC power shall not require more than 11 VA.
10. Actuators shall be Underwriters Laboratories Standard 873 listed and Canadian Standards Association Class 4813 02 certified as meeting correct safety requirements and recognized industry standards.
11. Actuators shall be designed for a minimum of 60,000 full stroke cycles at the actuator's rated torque and shall have a 2-year manufacturer's warranty, starting from the date of installation. Manufacturer shall be ISO9001 certified.
12. ACCESSORIES
    a. Shaft Clamp
    b. Provide with linkage bars where indicated in the documents or where required in the field to facilitate 3-way valve operation.
    c. Electronic overload or digital rotation sensing circuitry to prevent damage throughout the entire actuator rotation. End switch and magnetic clutch are not acceptable.

M. DAMPERS:
1. The mechanical contractor shall coordinate with the ATC contractor which equipment is being provided with automatic control dampers and actuators. Any equipment not provided with automatic control dampers or actuators by the manufacturer, but requiring them per the sequence of operation, shall be provided by the ATC contractor.
2. Automatic dampers, furnished by the Control Contractor shall be single or multiple blade as required. Dampers are to be installed by the sheetmetal contractor under the supervision of the temperature control contractor. All blank-off plates and conversions necessary to install smaller than duct size dampers are the responsibility of the sheetmetal contractor.
   a. All damper frames are to be constructed of 13 gauge galvanized sheetmetal and shall have flanges for duct mounting.

b. Damper blades shall not exceed 6" in width. All blades are to be of corrugated type construction, fabricated from two (2) sheets of 22 galvanized sheet steel, spot welded together. Blades are to be suitable for high velocity performance.
c. When damper assemblies (damper, accessories and hardware) are required in stainless ductwork, provide assembly with all stainless construction.
d. All damper bearings are to be made of nylon. Bushings that turn in the bearings are to be oil-impregnated sintered metal.
e. Replaceable butyl rubber seals are to be provided with the damper. Seals are to be installed along the top, bottom and sides of the frame and along each blade edge. Seals shall provide a tight-closing, low-leakage damper. Leakage and flow characteristic charts must be submitted to the engineer prior to approval of dampers.
f. All dampers serving openings integral to the building envelope shall be Class I motorized, leakage rated dampers with a maximum leakage of 4 CFM per square foot at 1.0 in. w.g. when tested in accordance with AMCA 500D
g. Gravity dampers shall be permitted in buildings less than three stories in height above grade

N. DAMPER OPERATORS:
1. Electronic direct-coupled actuation shall be provided.
2. The actuator shall be direct-coupled over the shaft, enabling it to be mounted directly to the damper shaft without the need for connecting linkage. The fastening clamp assembly shall be of a “V” bolt design with associated “V” shaped toothed cradle attaching to the shaft for maximum strength and eliminating slippage. Spring return actuators shall have a “V” clamp assembly of sufficient size to be directly mounted to an integral jackshaft of up to 1.05 inches when the damper is constructed in this manner. Single bolt or set screw type fasteners are not acceptable.
3. The actuator shall have electronic overload or digital rotation sensing circuitry to prevent damage to the actuator throughout the entire rotation of the actuator. Mechanical end switches or magnetic clutch to deactivate the actuator at the end of rotation are not acceptable.
4. For power-failure/safety applications, an internal mechanical spring return mechanism shall be built into the actuator housing. Non-mechanical forms of fail-safe operation are not acceptable.
5. All spring return actuators shall be capable of both clockwise or counterclockwise spring return operation by simply changing the mounting orientation.
6. Proportional actuators shall accept a 0 to 10 VDC or 0 to 20 mA control input and provide a 2 to 10 VDC or 4 to 20 mA operating range. An actuator capable of accepting a pulse width modulating control signal and providing full proportional operation of the damper is acceptable. All actuators shall provide a 2 to 10 VDC position feedback signal.
7. All 24 VAC/VDC actuators shall operate on Class 2 wiring and shall not require more than 10 VA for AC or more than 8 watts for DC applications. Actuators operating on 120 VAC power shall not require more than 10 VA. Actuators operating on 230 VAC power shall not require more than 11 VA.
8. All non-spring return actuators shall have an external manual gear release to allow manual positioning of the damper when the actuator is not powered. Spring return actuators with more than 60 in-lb torque capacity shall have a manual crank for this purpose.
9. All modulating actuators shall have an external, built-in switch to allow the reversing of direction of rotation.
10. Actuators shall be provided with a conduit fitting and a minimum three-foot electrical cable and shall be pre-wired to eliminate the necessity of opening the actuator housing to make electrical connections.
11. Actuators shall be Underwriters Laboratories Standard 873 listed and Canadian Standards Association Class 4813 02 certified as meeting correct safety requirements and recognized industry standards.

12. Actuators shall be designed for a minimum of 60,000 full stroke cycles at the actuator's rated torque and shall have a 2-year manufacturer's warranty, starting from the date of installation. Manufacturer shall be ISO9001 certified.
13. BOILER INTERLOCKS:
    a. A manually operated boiler shutdown switch shall be interlocked with the boilers.
        1) The shutdown switch shall be located just outside the boiler room door.
        2) If the boiler room door is on the building exterior, the shutdown switch shall be located just inside the door.
        3) If there is more than one door to the boiler room, there shall be a switch located at each door.
    b. Activation of the boiler shutdown switch shall immediately shut off the fuel or energy supply.
14. BOILER PLANT CONTROLS
    a. The ATC contractor shall be responsible for the implementation of all controls, monitored points and alarmed points required by this section. System shall be a combination of manufacturer-furnished packaged boiler controls and controls provided by the ATC contractor. The ATC contractor shall install all controls furnished by the boiler manufacturer. The ATC contractor shall coordinate as required with unit manufacturer to ensure all monitored points and alarmed points indicated in this section are provided at FMS graphic user interface. Accessibility of any required points only via local unit controller is not acceptable.
    b. Hot water supply temperature set point: Set point shall be reset on a linear schedule based on outside air temperature. Provide control functions as required. Set point shall be 140°F (adj.) at 0°F (adj.) outdoor air temperature, and 120°F (adj.) at 60°F (adj.).
    c. Where drawings indicate primary and variable secondary pumping systems or systems with 3-way mixing valves where it is possible to thermally shock the boilers, provide temperature sensors at each boiler inlet and outlet and prevent the temperature across the boilers from exceeding 25 dg F by reducing the flow of cold return water back to the boilers.
    d. Hot Water Distribution Pumping Operation:
        1) The FMS shall start lead pump(s) if:
            a) the ambient temperature is below 60°F (adj.) or;
            b) there is a call for heat at any air handler control valve(s) or;
            c) there is a call for heat at any of DDC monitoring sensor(s).
        2) Differential pressure sensor across hydronic supply and return main shall modulate hot water distribution pump speed as required, via individual variable frequency drives, to maintain set point. Initial set point shall be 5 PSI (adj.).
        3) Pumps shall have automated lead / stand-by operation, on a weekly rotation, to equalize run time of each pump. In systems of three or more pumps in parallel under normal operation, one shall be designated stand-by and all others shall be designed "lead" and are intended to operate in unison.
        4) On the failure of one pump the stand-by pump shall be started automatically.
        5) Minimum pump flow shall be maintained via **a** differential pressure by-pass valve
        6) Pump speed equalization sequence (to be used, in systems of three or more pumps in parallel under normal operation, at status re-assignment or upon pump failure):
            a) With the initial lead pump(s) at 100% speed, when system differential pressure falls below set point for 5 minutes (adj.) or longer, the secondary lead pump shall start at minimum speed.
            b) While maintaining the initial lead pump(s) at 100% speed, increase secondary lead pump at a rate of +10% / 2 minutes (adj.) until the system differential pressure set point is satisfied.

e. Carbon monoxide monitor shall be interlocked with gas-fired boilers and domestic hot water heaters. Provide local alarm and alarm at FMS graphic user interface. Initiate alarm at Warning condition, initial setpoint of 100 parts per million (ppm) (adj.). Initiate alarm and shut down all gas-fired appliances at High Limit condition, initial setpoint of 400 ppm (adj.).

f. Combustion Air Controls
   1) Provide one normally closed automatic temperature control damper for combustion air inlet for the boiler and for the hot water heater. When the boiler or hot water heater operates the ACD shall be open. Otherwise the dampers shall be closed. Interlock dampers with Boiler and domestic hot water heater. Boiler and hot water heater shall not fire if dampers are not proven open.

g. The ATC contractor shall provide all sensors and programming to indicate the following on operator's Graphic User Interface display:
   1) System graphic.
   2) Outside air temperature.
   3) Boiler status (each boiler).
   4) Hot water supply temperature.
   5) Hot water supply temperature set point.
   6) Hot water return temperature.
   7) Hot water distribution pump status (each pump).
   8) Hot water distribution pump speed (each pump).
   9) Hot water distribution pump speed set point (each pump).
   10) Expansion tank pressure indication.
   11) System differential pressure.
   12) System differential pressure set point.
   13) Boiler control valve position (each valve).
   14) Boiler control valve position (each valve) set point.
   15) Hot water flow rate through boiler (each boiler).
   16) Hot water flow rate through distribution loop.
   17) Hot water flow rate through distribution loop differential pressure bypass.

h. Alarms / Safeties:
   1) The control system shall initiate alarms in accordance with any of the conditions below, indicate and describe any alarm at the FMS' graphic user interface, and further address any alarm as indicated in the SYSTEM DESCRIPTION and OPERATING SYSTEM SOFTWARE paragraphs above.
      a) Any pump is commanded to run and run status is not sensed via current transformer after a start-up delay of 15 seconds (adj.). Register as a pump failure and start stand-by pump.
      b) Hot water supply temperature varies more than 5°F (adj.) above or below set point for 5 minutes (adj.) or longer.
      c) System differential pressure varies more than 2 PSI (adj.) above set point for 5 minutes (adj.) or longer.
      d) On a call for boiler operation, combustion air damper open status is not sensed via end switch.
      e) On a call for boiler operation, run status is not sensed via current transformer at the boiler room **< supply > < exhaust >** fan(s).
      f) Carbon monoxide sensor reaches "Warning" level.
      g) Carbon monoxide sensor reading reaches "High Limit". Register as CO alarm and shut down all gas-fired boilers and water heaters.
   2) Whenever a unit is shut down because of one of the safeties, the control system shall retain in memory the reading and set point of each device to help the operator in isolating the reason for the problem.
   3) All control system sensors shall have a high and low software alarm limit to indicate temperature problems or a faulty sensor.

i. All setpoints and time periods indicated above shall be user-adjustable from the FMS' graphic user interface.
j. The ATC contractor shall field-install all components requiring field installation. All items required for a complete operating system, but not provided by the equipment manufacturer, shall be by this contractor. The ATC contractor shall fully coordinate all control components and sequences with the manufacturer's requirements before submitting shop drawings.

2.12 IN-LINE CENTRIFUGAL PUMPS

A. ACCEPTABLE MANUFACTURERS:
1. Bell & Gossett,
2. Armstrong Pump
3. Taco

B. GENERAL
1. Factory-assembled and -tested, centrifugal, overhung-impeller, close-coupled, in-line pump; designed for installation with pump and motor shafts mounted horizontally or vertically. Rate pump for 175-psig minimum working pressure and a continuous water temperature of 250 deg F
2. Pump and motor combination shall be non-overloading over the full operating range.

C. SUBMITTALS
1. Product summary sheet with motor size, RPM, voltage and phase, brake horsepower at design conditions, non-overload horsepower, design flow and head.
2. Performance curve with design operating point indicated.
3. Dimensional drawings.

D. GENERAL
1. Casing shall be ASTM A48 class 30 cast iron with replaceable bronze wear rings, ¼" threaded taps at inlet and outlet for pressure gauges and flanged connections.
2. Body and flanges shall be Class 125 rated to 250°F
3. Pump Shaft: Stainless steel.
4. Impeller: ASTM B 584, cast bronze or ASTM A351 stainless steel; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. Trim impeller to match specified performance.
5. Pump Bearings: Permanently lubricated.
6. Mechanical Seal: Carbon rotating ring against a ceramic seat held by a stainless-steel spring, and EPT bellows and gasket. Provide with flush line and slinger.

E. SPLIT-COUPLED
1. Coupling: High tensile aluminum alloy, split style.
2. OSHA coupling guard.
3. Design shall permit removal of shaft seal without disturbing pump or motor.

F. MOTOR:
1. Premium efficient.
2. Type: Induction EC
3. Enclosure: Totally enclosed, fan cooled
4. Motor bearings: re-greaseable ball bearings.
5. Provide with integral variable frequency drive.
6.

2.13 PRE-MANUFACTURED DUCTWORK AND FLUE SYSTEMS

A. SUBMITTALS
1. Ductwork construction standards.
2. Product Data Sheets: for each type of pre-manufactured system.
3. System drawing showing all ductwork system components, including all fittings, elbows, connections and termination (i.e. weather-head type, etc.), as well as all supports and guides. The drawing shall include a component list, which includes quantities, with tag marks indicating placement within the system. All mechanical trades must position equipment, electrical wiring and water and gas piping so as to accommodate the vent system design.
4. System sizing calculations.
5. Refer to “COORDINATION DRAWINGS”, PART 1.

B. DOUBLE WALL DUCT
1. General
   a. Where indicated on the drawings, double wall, acoustically insulated round duct shall be supplied.
2. Materials and Construction
   a. Double wall duct shall be constructed of an outer shell, a 1" thick layer of fiberglass insulation, and an inner metal liner. The inner metal liner for all spiral and longitudinal seam duct shall be perforated metal.
   b. All fittings from fan discharge to a point where 35 linear feet of spiral duct has been used shall have a perforated metal liner.
   c. All other fittings shall have a solid metal liner which may be one even gauge lighter than that shown for perforated liners.
   d. Insulation shall have a thermal conductivity "K" factor of .26 BTU/hr/sq. ft./° or less.
3. Acceptable Manufacturers
   a. Semco
   b. Approved Equal.

2.14 DUCTWORK ACCESSORIES

A. SUBMITTALS
1. Product Data Sheets: For each type of Ductwork Accessories indicated.
2. Shop Drawings: Show all ductwork accessories on Coordination drawings. Refer to “COORDINATION DRAWINGS” this SECTION.

B. ACCEPTABLE MANUFACTURERS
1. Greenheck
2. Ruskin
3. Nailor
4. Pottorff

C. VOLUME DAMPERS
1. Fabricate in accordance with SMACNA Duct Construction Standards.
2. Fabricate splitter dampers of double thickness sheetmetal to streamlined shape. Secure blades with continuous hinge or rod. Operate with min. 1/4 inch diameter rod in self aligning, universal joint action flanged bushing with set screw.
3. Single Blade Dampers
   a. Fabricate single blade dampers for rectangular duct sizes up to 12" x 30". Damper shall be 22 gauge sheet steel for widths up to 18” and 18 gauge sheet steel for widths 19 through 30”

b. Fabricate single blade dampers for round duct sizes up to 20” with 24 gauge sheet steel.
c. Except in round ductwork 12 inches and smaller, provide end bearings.

4. Multi Blade Dampers
   a. Fabricate multi blade dampers for rectangular duct sizes larger than 12” x 30”. Damper shall be opposed V blade type with 16 gauge galvanized steel frame and bronze or oil-impregnated nylon bearings. Provide damper with manual locking quadrant. Greenheck model MBD-15 or equal.
   b. Fabricate multi blade dampers for round duct sizes larger than 20”. Damper shall be opposed V blade type with 16 gauge galvanized steel frame and bronze or oil impregnated nylon bearings. Provide damper with manual locking quadrant. Greenheck model VCDRM-50 or equal.
5. Remote Volume Dampers
   a. Provide remote volume dampers where noted on the darwings.
   b. Dampers shall consist of a 3 ½” deep 22 gauge galvanized steel frame with 20 gauge galvanized steel blades and ½” diameter steel axles.
   c. Provide a single wall plate with ports for each room or as noted on drawing, number of ports commensurate with damper quantity. Contractor shall label port and associated diffuser or device served with engraved label. Finish shall be white.
   d. Provide with all cables and connectors for a complete system.
   e. Provide with one (1) battery operated hand held remote.
   f. Greenheck RBD or equal.
6. Provide locking, indicating quadrant regulators on single and multi-blade dampers.
7. On insulated ducts mount quadrant regulators on stand off mounting bracket, bases or adapters.
8. Damper material shall match duct system material in which it is installed.
9. Damper pressure and leakage rating shall meet or exceed minimum rating for system installed. Refer to “INSTALLATION OF DUCTWORK” this section for duct system pressure classifications.

2.15 CAST IRON SECTIONAL HOT WATER BOILERS

A. MANUFACTURERS
   1. Weil McClain
   2. H.B. Smith
   3. Burnham

B. MANUFACTURED UNITS
   1. Hot Water Boilers: Suitable for natural draft with insulated jacket, sectional cast iron heat exchanger, gasburning system, refractory, controls, and boiler trim including circulator
   2. Provide water wall design consisting of water backed combustion area with water circulating around firebox. Refractory chamber or separate base not required.
   3. Disconnect Switch: Provide disconnect switch meeting manufacturers requirements and code requirements.

C. ELECTRICAL CHARACTERISTICS:
   1. Provide with NEMA 3R Non fused with thermal overload disconnect.

D. FABRICATION
   1. Assembly: Cast iron sections with 30 psig water ASME Boilers and Pressure Vessels Code rating, assembled with push nipples or gaskets and draw rods.
   2. Access: To flue passages for cleaning and flame observation ports.

3. Structural Base: Aluminized steel lined with high temperature mineral fiber insulating panels.
4. Jacket: Glass fiber insulated steel jacket, finished with factory applied baked enamel.

E. HOT WATER BOILER TRIM
1. ASME rated pressure relief valve.
2. Combination water pressure and temperature gage.
3. Low water cut-off to prevent burner operation when boiler water falls below safe level.
4. Electronic operating temperature controller:
   a. NEMA 250 Type 1 enclosure with full cover for wall mounting.
   b. Ambient temperature range - 30 to 150 degrees F.
   c. Adjustable reset ratio of outside air temperature change to discharge control point change 1:2 to 100:1.
   d. Integral set point adjustment 80 to 230 degrees F.
   e. Electronic primary and outdoor sensors.
   f. Suitable for on-off switching of pilot duty single throw double pole relays.
5. High limit temperature controller with manual reset for burner to prevent boiler water temperature from exceeding safe system temperature.
6. Boiler air vent.

F. FUEL BURNING SYSTEM
1. Acceptable Manufacturers
   a. Industrial Combustion
   b. Powerflame
   c. Webster
2. Burner Operation: Fully modulating with low fire position for ignition.
3. Gas Burner: Power type for natural gas adjustable combustion air supply, pressure regulator, gas valves, manual shut-off, intermittent spark or glow coil ignition, flame sensing device, and automatic 100 percent shut-off. Gas train shall be as required by the owner's insurer or by the town requirements. Carefully coordinate requirements for gas train venting requirements with the Plumbing section of this specification. Gas Burner Safety Controls: Energize ignition, limit time for establishment of flame, prevent opening of gas valve until pilot flame is proven, stop gas flow on ignition failure, energize blower motor, and after air flow proven and slight delay, allow gas valve to open.
4. Controls: Pre-wired, factory assembled electronic controls in control cabinet with flame scanner or detector, programming control, relays, and switches. Provide pre-purge and post-purge ignition and shut-down of burner in event of ignition pilot and main flame failure with manual reset.
5. Provide Fire Eye 110 Flame Monitor.

G. PERFORMANCE
1. Performance rating shall be in accordance with HI - Testing and Rating Standard for Cast Iron and Steel Heating Boilers.

PART 3 - EXECUTION

3.1 PROTECTION

A. Be responsible for the care and protection of all work included in this Section until it has been tested and accepted.

B. After delivery and before, during and after installation, protect all equipment, materials and systems from injury or damage of all causes, as well as from theft. Such loss or damage shall be made good without expense to the Owner.

C. Wherever factory finishes of paint, lacquer, baked enamel, etc., have been damaged or deteriorated during construction, use factory furnished painting materials and refinish or touch up the damage or deterioration, to the satisfaction of the Architect. Application shall be by skilled workers experienced in painting and finishing.

3.2 INSTALLATION OF EQUIPMENT - GENERAL

A. Install all equipment and products furnished and make system connections to such equipment in accordance with the manufacturer's instructions.

B. Provide adequate clearances around equipment to permit replacement, normal servicing and maintenance.

C. Install electrical devices furnished by manufacturer but not specified to be factory mounted.

D. Ground equipment: Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

E. Install with required clearance for service and maintenance.

F. Locate all roof mounted equipment a minimum of 10’-0” from the edge of the roof to the service clearance requirement. Equipment can be located near to edge of roof if equipment screen, guard rail or parapet of code required height is provided.

G. Install piping and ductwork adjacent to machine to allow service and maintenance.

3.3 CUTTING, PATCHING AND CORE DRILLING

A. This contractor shall perform all cutting, channeling and coring up to six (6) inches in diameter required for the work of this section.

B. Provide timely notification to other trades of openings required for mechanical work. Supply accurate details of location and size.

C. Obtain written approval of structural engineer before cutting through structural members.

3.4 WIRING

A. Where the mechanical contractor is to provide wiring including but not limited to wiring provided under the Automatic temperature controls paragraph of this specification, the wiring including conduit and materials, shall conform to the requirements of the National Electrical Code and DIVISION 26.

B. For interface between DIVISION 220000 PLUMBING and DIVISION 210000 equipment and the Building Management System (BMS), the wiring between the equipment and the BMS is to be under this Section.

3.5 PAINTING

A. Supply ferrous metal work, except piping and galvanized steel ductwork, with at least one factory prime coat, or paint one prime coat on the job.

B. Paint all galvanized exterior ductwork that is not insulated or jacketed. Comply with ASTM D6386.

C. Clean and steel brush surfaces of welds. Then prime coat all steel supports and brackets.

D. On uninsulated piping, steel brush and prime coat welds.

E. Touch-up or repaint all surfaces damaged during shipment or installation and prepare surface for finish painting.

F. Paint with flat black, all surfaces visible behind air diffusers and grilles, including surfaces behind grilles provided by others to which sheetmetal connects.

G. Prime coat material and finish painting shall conform to the PAINTING paragraph of the architectural specifications.

H. Paint all exterior piping, supports, accessories, etc. that are not galvanized or stainless, with corrosion prevention coating system. Refer to Division 9. Apply per manufacturers recommendations. Coordinate color with Architect.

3.6 STEEL

A. Steel which is required for the work of this section, and is not shown on the structural or architectural drawings, shall be furnished and installed by this contractor under the requirements of the appropriate sections of the architectural specifications.

B. Steel shall have adequate strength to support equipment and materials during testing and under all operating conditions.

C. Support suspended equipment from the bottom or from manufacturer’s designated suspension points. Tanks and similar equipment with adequate beam strength shall be supported by saddles with a curvature to exactly match the equipment. Other equipment shall be supported continuously.

D. Steel supports exposed to weather or in contact with water or otherwise in a humid atmosphere shall be either galvanized after fabrication or fabricated from materials having approved corrosion resistance. Welds shall be brushed clean and a coat of rust inhibiting paint applied.

E. This contractor shall ensure that equipment is sufficiently rigid for point support by isolators specified in the VIBRATION ISOLATION paragraph of these specifications. Coordinate with supplier of vibration isolation and provide auxiliary structural support if required.

3.7 INSTALLATION OF HYDRONIC PIPE AND PIPE FITTINGS

A. GENERAL
1. Hold piping close to walls, overhead construction, columns and other structural and permanent enclosure elements of building. Limit clearance to 2" where furring is shown for

enclosure or concealment of piping, but allow for insulation thickness, if any. Where possible, locate insulated piping for 1" clearance outside insulation.

2. Install each run with minimum joints and couplings, but with adequate and accessible unions for disassembly and maintenance/replacement of valves and equipment.
3. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
4. Anchor piping for proper direction of expansion and contraction.
5. Align piping accurately at connections, within 1/16" misalignment tolerance.
6. Comply with ASME B31.9, “Building Services Piping,” and ASME B31.1 “Power Piping” for installation.
7. Fire and/or Smoke Barrier Penetrations: Maintain indicated fire/smoke rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials.
8. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
9. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
10. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
11. Install piping at indicated slopes.
12. Install piping free of sags and bends.
13. Install fittings for changes in direction and branch connections.
14. Install escutcheons for penetrations of walls, ceilings, and floors.
15. **If grooved piping systems are allowed by associated Piping and Fittings Section of Part 2, Products, then grooved piping and fittings may be installed if in strict adherence to manufacturer’s recommendations.**
16. **If compressed fitting piping systems are allowed by associated Piping and Fittings Section of Part 2, Products, then compressed fittings and piping may be installed if in strict adherence to manufacturer’s recommendations.**

B. THREADED JOINTS

1. Thread pipe in accordance with ANSI B1.20.1; cut threads full and clean using sharp dies. Ream threaded ends to remove burrs and restore full inside diameter. Apply pipe joint compound, or pipe joint tape (Teflon) on male threads at each joint and tighten joint to leave not less than 3 threads exposed.

C. SOLDERED JOINTS

1. Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32. Wipe excess solder from joint before it hardens.

D. BRAZED JOINTS

1. Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8/A5.8M.

E. WELDED JOINTS

1. Construct joints according to AWS D10.12M/D10.12 using qualified processes and welding operators.

F. FLANGED JOINTS

1. Match flanges within piping system, and at connections with valves and equipment. Clean flange faces and install gaskets. Tighten bolts to provide uniform compression of gaskets.

G. CLEANING, FLUSHING, INSPECTING

1. Clean exterior surfaces of installed piping systems of superfluous materials, and prepare for application of specified coating (if any).
2. Fill system with fresh water and add liquid alkaline compound with emulsifying agents and detergents to remove grease and petroleum products from piping. Circulate solution for a minimum of 24 hours. Drain, clean strainer screens, and refill with fresh water.
3. Inspect each run of each system for completion of joints, supports and accessory items.

H. PIPING TESTS
1. Test pressure piping in accordance with ASME B 31. Utilize water as the test medium. If water is not available or practical, a pneumatic test may be performed only with written consent from the engineer and only on systems that do not contain plastic or cast iron pipe.
2. General Procedures
   a. Test piping with all joints visible and before installation of insulation.
3. Water Test
   a. Fill system with water. Provide temporary equipment for testing, including pump and gages. Test piping systems before insulation is installed and remove control devices before testing. Test each natural section of each piping system independently but do not use piping system valves to isolate sections where test pressure exceeds valve pressure rating.
   b. Required test period is 2 hours.
   c. Test each piping system at 150% of operating pressure indicated, but not less than 25 psi test pressure.
   d. Observe each test section for leakage at end of test period. Test fails if leakage is observed or if pressure drops exceeds 5% of test pressure.
   e. Repair piping systems sections that fail required test, by disassembly and reinstallation, using new materials to the extent required to overcome leakage. Do not use chemicals, stop-leak compounds, mastics, or other temporary repair methods.
   f. Drain test water from systems after testing and repair work has been completed.
4. Pneumatic Test
   a. Pressurize system to 10 PSIG to reveal major leaks.
   b. Once intital test is complete and major leaks have been sealed, raise pressure in 25% increments up to full test pressure of 125%. Allow pressure to stabilize between increments.
   c. Once full test pressure is achieved, hold system at pressure for 30 minutes.

I. HYDRONIC PIPING SYSTEMS
1. General
   a. Install eccentric reducers where pipe is reduced in size in direction of flow, with tops of both pipes and reducer flush.
   b. Install piping at a uniform grade of 0.2 percent upward in direction of flow.
   c. Unless otherwise indicated, install branch connections to mains using tee fittings in main pipe, with the takeoff coming out the bottom of the main pipe. For up-feed risers, install the takeoff coming out the top of the main pipe.
   d. Install drains, consisting of a tee fitting, NPS ¾ ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.
   e. Reduce pipe sizes using eccentric reducer fitting installed with level side up.
   f. Install strainers on supply side of each control valve, pressure-reducing valve, solenoid valve, in-line pump, and elsewhere as indicated. Install NPS 3/4 nipple and ball valve in blow-down connection of strainers NPS 2 and larger. Match size of strainer blow-off connection for strainers smaller than NPS 2.
   g. Install manual air vents at the system high points to allow bleeding off air.
2. Valves:
   a. Unless otherwise indicated install valves as listed below and elsewhere as indicated.

b. Isolation: ball and butterfly valves.
c. Throttling: ball and butterfly valves
d. Combination balancing and shut-off: Refer to “HYDRONIC SPECIALTIES” elsewhere in these specifications.
e. Provide isolation valves at each hydronic terminal, coil and equipment and elsewhere as indicated.
f. Provide balance cock at the by-pass port of each 3-way control.
g. Provide drain valves on each mechanical equipment item located to completely drain equipment; at base of each isolated riser and elsewhere as indicated or required to completely drain hydronic piping system.

3. Equipment Connections:
   a. Connect hydronic terminal, coil and equipment to the hydronic piping system in accordance to equipment manufacturer's instructions. Installation shall allow easy repair, cleaning, removal and replacement of hydronic terminal, coil and equipment.
   b. Size for supply and return piping connections shall be same as for equipment connections.
   c. Install control valves in accessible locations close to connected equipment.
   d. For control valve 1 1/4” and greater install bypass piping with globe valve around control valve. If multiple, parallel control valves are installed, only one bypass is required.
   e. Install ports for pressure and temperature gages at terminal, coil and equipment inlet and outlet connections.
4. Application

Piping Application Table

WC = Wrought Copper	WS = Wrought Steel	MI = Malleable Iron

System	Pipe Size	Pipe	Fittings	Joint
Hot Water	NPS 2 and smaller	Sch 40 Type E Type L Copper	Class 150 MI WC	Solder, Threaded
	NPS 2 ½ and larger	Sch 40 Type E	Class 150 WS	Welded
Condenser Water Chilled Water	NPS 2 and smaller	Sch 40 Type E Type L Copper	Class 150 MI WC	Solder, Threaded **<Press Fit>**
	NPS 2 ½ and larger	Sch 40 Type E	Class 150 WS	Welded **<Grooved>**
Pipe Embedded in Concrete	NPS 2 and smaller	Type K Copper	None allowed within concrete, WC outside	None allowed within concrete, solder outside

J. VALVES: Unless otherwise indicated provide valves as listed in the "VALVES" paragraphs of this specification.

3.8 INSTALLATION OF VIBRATION ISOLATION, SUPPORTS & SEISMIC RESTRAINT

A. GENERAL
1. Isolation, support and seismic restraint systems must be installed in strict accordance with the manufacturer's submittal data.
2. Vibration isolators shall not cause any change of position of equipment resulting in stress on equipment connections.

B. EQUIPMENT INSTALLATION
1. Equipment shall be isolated as indicated in TABLE A at the end of this section.
2. Additional Requirements:
   a. The minimum operating clearance under all bases shall be 1".
   b. All bases shall be placed in position and supported temporarily by blocks or shims prior to the installation of the equipment, isolators and restraints.
   c. Spring isolators shall be installed after all equipment is installed without changing equipment elevations.
   d. After the entire installation is complete and under full operational load, the spring isolators shall be adjusted so that the load is transferred from the blocks to the isolators.
   e. Remove all debris from beneath the equipment and verify that there are no short circuits of the isolation. The equipment shall be free in all directions.
   f. Install equipment with flexibility in wiring.
   g. Thrust restraints shall be installed on all cabinet fan heads, axial or centrifugal fans whose thrust exceeds 10% of unit weight.
   h. Housekeeping pads for equipment in this section must be properly doweled or bolted, using wedge type expansion bolts to meet the acceleration criteria. Anchor equipment or isolators to housekeeping pads.

C. PIPING and DUCTWORK ISOLATION
1. Installation:
   a. General
      1) Hanger isolators shall be installed with the hanger box hung as close as possible to the structure. (Without touching)
      2) Hanger rods shall not short-circuit the hanger box.
   b. All piping in mechanical equipment room(s) attached to rotating or reciprocating equipment shall be isolated as follows:
      1) Water and steam piping.
         a) Water piping 1-1/4" to 2" and all steam piping larger than 1" shall be hung with TYPE E isolators with 0.25" deflection.
         b) Water pipe larger than 2" shall be hung with TYPE F isolators with 0.75" deflection.
         c) Horizontal floor or roof mounted water piping 1-1/4" to 2" and all steam piping larger than 1" shall be supported by TYPE P isolators with 0.3" deflection.
         d) Water pipe larger than 2" shall be supported by TYPE B isolators with 0.75" deflection.
      2) Control air piping piping from compressor discharge to receiver shall be suspended by TYPE E isolators with 0.25" deflection or supported by TYPE P isolators with 0.3" deflection.
   c. All ductwork over four square feet face area located within 50' from air moving equipment shall be hung with TYPE C hangers with 0.75" deflection.
   d. Emergency generator exhaust shall be isolated with TYPE C isolators with 0.75" deflection (all neoprene components shall be omitted).
   e. Vertical riser supports for water & steam pipe 4" diameter and larger shall be isolated from the structure using TYPE K guides and anchors.

f. Install TYPE FC-1 flexible connectors at all connections of pipe to externally isolated equipment.

g. Install FC-2 or 4 type connectors only at locations which exceed temperature limitations of FC-1 or service requires stainless steel or bronze construction flex. (Such as; spaces without floor drains, or pipes carrying gas, fuel oil, steam or Freon)

D. INSPECTION

1. If in the opinion of the project engineer the seismic restraint installation does not meet with the project requirements, an outside consultant will be retained to inspect, verify and submit corrective measures to be taken. The consultant's fees and all work associated with such a review shall be borne by the contractor.

TABLE A VIBRATION ISOLATION & SEISMIC RESTRAINT REQUIREMENTS FOR **HVAC** EQUIPMENT				EQUIPMENT INSTALLATION ATTACHMENT POINT								
EQUIPMENT				**ON GRADE**			**ABOVE GRADE**			**ROOF**		
		SIZE (5) (8)	**MOUNTING**	**ISO L**	**DEFL**	**BASE**	**ISO L**	**DEFL**	**BASE**	**ISO L**	**DEFL**	**BASE**
AIR HANDLING UNITS AIR CONDITIONING UNITS CABINET TYPE FANS HEAT RECOVERY UNITS		TO 10 H.P.	FLOOR	D	0.3	(1)	B	0.75	(1)	- -	- -	- -
			CEILING	- -	- -	- -	F			- -	- -	- -
		OVER 10 H.P.	FLOOR	D	0.3	(1)	B	(2)		- -	- -	- -
			CEILING	- -	- -	(1)	F	(2)		- -	- -	- -
AIR OR REFRIGERANT COMPRESSORS	TANK	TO 10 H.P.	FLOOR	D	0.3	- -	B	0.75	- -	- -	- -	- -
		OVER 10 H.P.		B	0.75	- -		1.5	B-2	- -	- -	- -
	UNITARY	TO 10 H.P.		D	0.3	- -		0.75	B-2 (3)	- -	- -	- -
		OVER 10 H.P.		B	0.75	- -		1.5		- -	- -	- -
AIR COOLED CONDENSERS & DRY COOLERS		TO 1 H.P.	ROOF	- -	- -	- -	- -	- -	- -	- -	.75	B-6
		OVER 1 H.P.		- -	- -	- -	- -	- -	- -	- -	1.5	B-4
AXIAL FANS		TO 15 H.P.	FLOOR/ ROOF	D	0.3	B-1	B	(2)	B-1	- -	(2)	B-3 OR 4
			CEILING	F	0.75	- -	F		- -	- -		- -
		OVER 15 H.P.	FLOOR/ ROOF	B	0.75	B-1	B		B-1	- -		B-3 OR 4
			CEILING	F	0.75	- -	F		- -	- -		- -
BOILERS & STEAM GENERATORS		OIL OR GAS	FLOOR	- -	- -	- -	B	0.75 (1)	- -	- -	- -	- -
		ELECTRIC		- -	- -	- -	G	0.1	- -	- -	- -	- -
CENTRIFUGAL FANS	ARRG'T 1 & 3	ALL	FLOOR/ ROOF	B	0.75	B-1	B	(2)(6)	B-1 (4)	B	(2) (6)	B-1 (4)
			CEILING	F	0.75	- -	F			- -		- -
	ARRG'T 4,9 & 10		FLOOR/ ROOF	D	0.3	- -	B		- -	- -		B-4
			CEILING	F	0.75	- -	F		- -	- -		- -
CHILLERS & CONDENSING UNITS	ABSORB. & CENTRIF.	ALL	FLOOR	G	0.1	- -	B	0.75	- -	- -	1.5	B-4
	RECIPR. & ROTARY	To 5 TONS	FLOOR / ROOF	D	0.25	- -	D	.25	- -	- -	.75	B-6
		6-20 TONS		B	1.0	- -	B	1.5	- -	- -	1.5	B-4
		OVER 20 TONS						2.5	- -	- -	2.5	
COMPUTER ROOM UNITS		ALL	CEILING	- -	- -	- -	F	0.75	- -	- -	- -	- -
			FLOOR	- -	- -	B-9	B	0.75	B-9	- -	- -	- -
COOLING TOWERS		TO 200 TONS	FLOOR OR ROOF	G	0.10	- -	B	1.5	- -	B	1.5	B-1
		OVER 200				- -		2.5	- -		2.5	
CURB MOUNTED ROOF EXHAUSTERS		ALL (7)	ROOF	- -	- -	- -	- -	- -	- -	- -	- -	B-5
EXTERIOR DUCT SUPPORT SYSTEM		ALL	SLAB / ROOF	- -	- -	B-10	- -	- -	- -	- -	- -	B-10
EXTERIOR PIPE SUPPORT SYSTEM		ALL	SLAB / ROOF	- -	- -	B-11	- -	- -	- -	- -	- -	B-11
FAN COIL UNITS FAN POWERED BOXES CABINET UNIT HEATERS UNIT VENTILATORS HEAT PUMPS		ALL	CEILING	- -	- -	- -	F	0.75	- -	- -	- -	- -
PUMPS	BASE MOUNTED	TO 10 H.P.	FLOOR	-	-	-	B	0.75	B-2	- -	- -	- -
		10-30 H.P.		B	0.75	B-2				- -	- -	- -

TABLE A VIBRATION ISOLATION & SEISMIC RESTRAINT REQUIREMENTS FOR **HVAC** EQUIPMENT				EQUIPMENT INSTALLATION ATTACHMENT POINT								
		OVER 30 H.P.				B-2		1.5		- -	- -	- -
	INLINE	ALL	FLOOR	B	0.75	B-2	D	0.3	- -	- -	- -	- -
			CEILING	F	0.75	- -	F	0.75	- -	- -	- -	- -
	CONDEN-SATE		FLOOR	D	0.3	- -	D	0.3	- -	- -	- -	- -
	BOILER FEED					- -			- -	- -	- -	- -
DX ROOF TOP UNITS AIR HANDLING UNITS AIR CONDITIONING UNITS MAKE UP AIR UNITS HEAT RECOVERY UNITS H&V UNITS (10)		TO 3,000 CFM	CURB MOUNT-ED	- -	- -	- -	- -	- -	- -	- -	0.75	B-3
		3,001 TO 5,000 CFM		- -	- -	- -	- -	- -	- -	- -	1.50	B-3
		OVER 5,000 CFM		- -	- -	- -	- -	- -	- -	- -	2.50	B-3
		TO 5000 CFM	POINT SUPPORT -ED	- -	- -	- -	- -	- -	- -	B	1.5	B-1
		OVER 5000 CFM		- -	- -	- -	- -	- -	- -		2.5	B-1
UNIT HEATERS		ALL	CEILING	- -	- -	- -	E	0.3	- -	- -	- -	- -

E. Where applicable and for high rise buildings, the seismic restraint design and construction requirements for equipment and piping incorporated as part of Life Safety Systems shall be such that these systems will remain in place and be functional following a major earthquake, and that the design shall consider lateral drifts between stories as specified by code.

a
TABLE A NOTES:

GENERAL: **ISOL** = Isolator, **DEFL.** = Deflection, All deflections indicated are in inches.

(1) Units may not be capable of point support. Refer to separate equipment specification section, if base is not provided by that section and external isolation is required, provide Type B-1 base by this section for entire unit.
(2) Static deflection shall be determined on the deflection guide. Deflections indicated are minimums at actual load and shall be selected from manufacturer's nominal 4", 3", 2" and 1" deflection spring series. **R.P.M. is defined as the slowest operating speed of the equipment.**
(3) Single stroke compressors may require inertia bases with thickness greater than 12" max. As described for base B-2. Inertia base mass shall be sufficient to maintain double amplitude of 1/8".
(4) For floor mounted fans substitute base TYPE B-2 for class 2 or 3 or any class fan with static pressure over 5".
(5) Equipment with less than 1/3 H.P. is excluded from vibration requirements. (Seismic requirements still apply)
(6) Utility sets with wheel diameters less than 15" need not have deflections greater than 0.75".
(7) Curb mounted fans with curb area less than nine (9) square feet are excluded.
(8) For equipment with multiple motors, H.P. Classification applies to largest single motor.
(9) Exclude B-2 base for skid mounted pump sets.
(10) Based on Supply Air CFM.

DEFLECTION GUIDE	
R.P.M.	**DEFLECTION**
LESS THAN 400	3.50"
401 TO 600	2.50"
601 TO 900	1.50"
OVER 900	0.75"

TABLE B SEISMIC BRACING TABLE		
EQUIPMENT	**ON CENTER SPACING**	
	TRANSVERSE	**LONGITUDINAL**

DUCT	**30 Feet**	**60 Feet**
PIPE	**40 Feet**	**80 Feet**
Boiler Breeching	**30 Feet**	**60 Feet**
Chimneys & Stacks	**30 Feet**	**60 Feet**

NOTE WELL

Projects that contain large pipe may require that the allowable spacing shown in this Table be reduced to minimize structural loading. All associated costs shall be the responsibility of the contractor. Close coordination and approval by the structural engineer is mandatory for all seismic point loads exceeding 2,000 lbs.

3.9 INSTALLATION OF MOTORS AND MOTOR STARTERS

A. GENERAL
1. Install motors and accessories according to manufacturer's instructions.
2. Install securely on firm foundation. Mount ball bearing motors with shaft in any position.
3. Provide electrical service, devices, and connections in accordance with Division 26, Electrical, and as shown on the contract documents.
4. Provide engraved plastic nameplates

B. Motor starters shall be furnished for all fans that do not have a variable speed drive or electronically commutated (EC) motor.

C. Motor starters shall be furnished for all pumps that do not have a variable speed drive.

3.10 INSTALLATION OF VARIABLE SPEED DRIVES

A. Install in accordance with NEMA ICS 3.1.

B. Tighten accessible connections and mechanical fasteners after placing controller.

C. Provide fuses in fusible switches; refer to DIVISION 26 – ELECTRICAL for product requirements.

D. Select and install overload heater elements in motor controllers to match installed motor characteristics.

E. Provide engraved plastic nameplates

F. Neatly type label inside each motor controller door identifying motor served, nameplate horsepower, full load amperes, code letter, service factor, and voltage/phase rating. Place in clear plastic holder.

G. Prepare and start systems.

H. Make final adjustments to installed controller to assure proper operation of load system. Obtain performance requirements from installer of driven loads.

I. Manufacturer's Field Services
1. Prepare, calibrate and start systems.

2. Start-up Variable Frequency Drive in presence of and instruct Owners operating personnel.

3.11 INSTALLATION OF METERS AND GAUGES

A. Install one pressure gage per pump, with taps before strainers and on suction and discharge of pump; pipe to gage.

B. GENERAL
1. Install gage taps in piping.
2. Install pressure gages with pulsation dampers. Provide needle valve or ball valve to isolate each gage. Extend nipples and siphons to allow clearance from insulation.
3. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2-1/2 inches for installation of thermometer sockets. Ensure sockets allow clearance from insulation.
4. Install thermometers in air duct systems on flanges.
5. Locate duct mounted thermometers minimum 10 feet downstream of mixing dampers, coils, or other devices causing air turbulence.
6. Coil and conceal excess capillary on remote element instruments.
7. Install static pressure gages to measure across filters and filter banks, (inlet to outlet). On multiple banks, provide manifold and single gage.
8. Provide instruments with scale ranges selected according to service with largest appropriate scale.
9. Install gages and thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.
10. Adjust gages and thermometers to final angle, clean windows and lenses, and calibrate to zero.

C. SCHEDULES
1. Pressure Gages.
   a. Pumps.
      1) Location: Install one compound pressure gage per pump, with taps before suction diffuser or strainer and on suction and discharge of pump; pipe to gage with pet cock at each tap. Use pump body taps when available.
      2) Scale range: 0 - 100 psi.
   b. Expansion tanks.
      1) Location: Inlet and Outlet
      2) Scale range: 0 - 100 psi
   c. Shot Feeders.
      1) Location: Shot Feeder
      2) Scale range: 0 - 100 psi
   d. Expansion Tanks.
      1) Location: Inlet
      2) Scale range: 0 - 100 psi
   e. Air Handler Coils.
      1) Location: Inlet and Outlet
      2) Scale range: 0 - 100 psi
   f. Make-up Water.
      1) Location: Regulator valve inlet and outlet
      2) Scale range: 0 - 100 psi
   g. Boilers.
      1) Location: Hot water inlet and Outlet
      2) Scale range: 0 - 100 psi
2. Stem Type Thermometers:
   a. Chilled water Headers to central equipment.

1) Location: Inlet and Outlet
2) Scale range: 0 - 100 F

b. Hot water Headers to central equipment.
1) Location: Inlet and Outlet
2) Scale range: 0 - 212 F

3. Test Plug Location:.
a. Control valves 3/4 inch & larger - inlets and outlets.
b. Boiler - inlets and outlets.
c. Reheat coils - inlets and outlets.

4. Static Pressure and Filter Gages.
a. Built up filter banks.
1) Location: Across Filters
2) Scale range: 0 - 8” W.C.

b. Static pressure controllers
1) Location: At static pressure controller
2) Scale range: 0 - 8” W.C.

c. Packaged unit filter sections.
1) Location: Across Filters
2) Scale range: 0 - 8” W.C.

3.12 INSTALLATION OF PIPING SPECIALTIES

A. PIPE ESCUTCHEONS: Install on each pipe penetration through floors, walls partitions and ceilings where penetration is exposed to view or where noted on details.

B. Y-TYPE STRAINERS: Install full size of pipe line, install pipe nipple and blow-down valve except for strainers 2" and smaller ahead of control valves feeding individual terminals.

C. DIELECTRIC UNIONS: Install at each piping joint between ferrous and non-ferrous piping.

D. MECHANICAL SLEEVE SEALS: Loosely assembly rubber links around pipe with bolts and pressure plates located under each bolt head and nut. Push into sleeve and center. Tighten bolts until links have expanded to form watertight seal.
1. Install at all exterior concrete wall and slab-on-grade service piping penetrations into building

E. FIRE BARRIER PENETRATION SEALS: Fill entire opening with sealing compound.

F. PIPE SLEEVES: Install of type indicated where piping passes through walls, floors, ceilings, and roofs. Install sleeves accurately centered on pipe runs. Size sleeves so that piping and insulation (if any) will have free movement. Install length of sleeve equal to thickness of construction penetrated, and finish flush to surface; except for floor sleeves. Extend floor sleeves 1/4" above level finish floor or as indicated.
1. Install sheetmetal sleeves at interior partitions and ceilings other than suspended ceilings.
2. Install steel pipe iron pipe sleeves at exterior penetrations; both above and below grade.
3. Install steel or plastic sleeves except as otherwise indicated.

G. SLEEVES SEALS
1. Fill and pack annular space between sleeve and pipe with approved fire caulk on both sides.

3.13 INSTALLATION OF VALVES

A. Locate valves so as to be accessible and so that separate support can be provided when necessary.

B. Install valves with stems pointed up, in vertical position where possible, but in no case with stems pointed downward from horizontal plane unless unavoidable. Install valve drains with hose-end adapter for each valve that must be installed with stem below horizontal plane.

C. Where insulation is indicated, install extended stem valves, arranged to receive insulation.

D. Mechanical Actuators: Install mechanical actuators with chain operators where indicated. Extend chains to about 5' above floor and hook to clips to clear aisle passage.

E. Install swing check valves in horizontal position with hinge pin horizontally perpendicular to center line of pipe.

F. Install wafer check valves between 2 flanges in horizontal or vertical position.

G. Install lift check valves in piping line with stem vertically upward.

H. Valve Adjustment: After piping systems have been tested and put into service, but before final testing, adjusting, and balancing, inspect each valve for possible leaks, replace valve if leak persists.

I. Cleaning: Clean factory finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

3.14 INSTALLATION OF HANGERS AND SUPPORTS

A. INSERTS
1. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
2. Where concrete forms finished ceiling, provide inserts to be flush with slab surface.
3. Where inserts are omitted, drill through from below and provide through bolts with recessed steel plate and nut flush with slab.

A. PIPE HANGERS AND SUPPORTS
1. Support horizontal piping as follows:

PIPE SIZE	MAX. SPACING	ROD DIA.
1/2 to 1-1/4"	6'-6"	3/8"
1-1/2 to 2"	10'-0"	3/8"
2-1/2 to 3"	10'-0"	1/2"
4 to 6"	10'-0"	5/8"
8 to 12"	14'-0"	7/8"
14 & over	20'-0"	1"

2. Install hangers to provide minimum 2 inch space between finished covering and adjacent work.
3. Place hanger within 12 inches of each horizontal elbow.
4. Support vertical piping at every floor.
5. Where several pipes can be installed in parallel and at same elevation, provide trapeze or multiple hangers.

3.15 INSTALLATION OF MECHANICAL IDENTIFICATION

A. PREPARATION
1. Degrease and clean surfaces to receive adhesive for identification materials.

B. INSTALLATION
1. Plastic Nameplates: Install with corrosive resistant mechanical fasteners, or adhesive.
2. Metal Tags: Install with corrosive resistant chains.
3. Plastic Pipe Markers: Install in accordance with manufacturer's instructions.
4. Plastic Tape Duct Markers: Install in accordance with manufacturer's instructions.
5. Underground Plastic Pipe Markers: Install 6 to 8 inches below finished grade, directly above buried pipe.
6. Ceiling Gird Markers: Apply directly to ceiling t-grid below equipment being marked.

C. APPLICATION
1. EQUIPMENT NAMEPLATES: Equipment manufacturers shall install and permanently fasten equipment nameplates on each major item of mechanical equipment.
   a. Include markers for the following general categories of equipment:
      1) Boilers
      2) Pumps
2. EQUIPMENT MARKERS: Install equipment markers with permanent adhesive on or near each major item of mechanical equipment.
   a. Include markers for the following general categories of equipment:
      1) Automatic temperature control cabinets
      2) Boilers
      3) Pumps
3. WARNING-TAG INSTALLATION: Print required message on, and attach warning tags to, equipment and other items where required.
   a. Include markers for the following general categories of equipment:
      1) Steam or refrigerant safety relief vents
      2) Warning lights, strobes an/or horns
      3) MRI quench vents
      4) Hazardous exhaust (Patient Isolation, toxic fume, etc)
4. ACCESS PANELS: Identify all access doors and panels.
5. BALANCING DAMPERS:
   a. Identify balancing dampers with a 12 to 18” length of 1” width neon orange ribbon. Secure ribbon to damper handle and allow other end to hang free.
6. VALVES:
   a. Identify valves, except valves within heating or cooling terminals, with metal tags. Install valve tags at each valve.
   b. Attach to valves with four (4) inch brass chains.
   c. Prepare valve tag charts. Provide typewritten list of valves with service and corresponding tag number. Install in location as directed by facility owner.
7. PIPING
   a. Identify piping, concealed or exposed (including underground), with plastic pipe markers. Identify service and flow direction. Install in clear view and align with axis of piping. Locate identification not to exceed 20 feet on straight runs including risers and drops, adjacent to each valve and "T", at each side of penetration of structure or enclosure, and at each obstruction.
   b. On vertical pipes approximately seven feet above floor.
   c. Behind each access door and panel.
   d. At each change of direction of piping.
   e. On each piping branch close to point of connection to main piping.
   f. At valves.
   g. At no greater than intervals of 50 feet on straight runs of piping, and on both sides of walls.

h. Piping shall be colored and labeled in accordance with the Owner's standards and approval. If there is no Owner standard, piping shall be colored and labeled in accordance with the modified ANSI/ASME A13.1 – 2007 Standard for the Identification of Pipes, as follows:

Service Type	Pipe/Jacket Color	Background Color	Lettering Color
Chilled Water	Blue	Green	White
Condenser Water	Green	Yellow	Black
Domestic Cold Water	White	Green	White
Domestic Hot Water	White	Green	White
Dual Temperature	White	Yellow	Black
Fuel Oil	Orange	Yellow	Black
Heat Pump	Teal	Green	White
Hot Water	Red	Green	White
Steam	Mocha Tan	Yellow	Black
Condensate	Mocha Tan	Green	Black
Humidifier Condensate	White	Black	White
AC Condensate	White	Black	White
Natural Gas	Yellow	Green	Black

B. DUCTWORK

1. Locate Ductwork identification and flow arrows as follows:
   a. Identify ductwork with plastic tape duct markers. Identify as to air handling unit number. Locate at air handling unit, at each side of penetration of structure or enclosure, and at each obstruction.
   b. On vertical ductwork approximately seven feet above floor.
   c. Behind each access door and panel.
   d. At each change of direction of ductwork.
   e. On each ductwork branch close to point of connection to main ductwork.
   f. At no greater than intervals of 25 feet on straight runs of ductwork, and on both sides of walls.

3.16 INSTALLATION OF PIPE INSULATION

A. GENERAL

1. Install materials after piping has been tested and approved.
2. Install materials in accordance with manufacturer's instructions.
3. Continue insulation with vapor barrier through penetrations.
4. On insulated piping systems with vapor barrier, insulate fittings, valves, unions, flanges, strainers, PT plugs, drains, flexible connections and expansion joints. All cold piping surfaces shall be insulated. Balancing valves and PT plugs shall have insulation which is removable and reattachable.
5. On insulated piping systems without vapor barriers and piping conveying fluids 140 deg. F. or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation at such locations.
6. Provide an insert, not less than 6 inches long, of same thickness and contour as adjoining insulation, between support shield and piping, but under the finish jacket, on piping 2 inch diameter and larger, to prevent insulation from sagging at support points. Inserts shall be cork or other heavy density insulating material suitable for the planned temperature range. Factory fabricated inserts may be used.
7. Neatly finish insulation at supports, protrusions, and interruptions.
8. Exterior Applications: Provide indicated jacket with seams located on the bottom of horizontal piping. Insulate fitting, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor barrier cement.

9. INSULATION OMITTED: Omit insulation on hot piping within radiation enclosures or unit cabinets; on cold piping within unit cabinets providing piping is located over drain pan; on condensate piping between steam trap and union; and on unions, flanges, strainers flexible connections, and expansion joints.

B. APPLICATION

Pipe Insulation Application Schedule						
FG=Fiberglass		RT=Rubber Tube		C=Cellular		
Piping System	Insulation Type	Pipe Size				
		<1”	1” to <1.5”	1.5” to <4”	4” to 8”	8” and larger
Hot Water	FG	1.5	1.5	2	2	2
Hot Water w/ Glycol	FG	1.5	1.5	2	2	2
Chilled Water	C **<FG>**	0.5	0.5	1	1	1
Chilled Water w/ Heat Trace (Exterior)	C <FG>	1	1.5	1.5	1.5	1.5
Chilled Water w/ Glycol (Exterior)	C <FG>	0.5	0.5	1	1	1
Condenser Water w/ Heat Trace (Exterior)	C <FG>	1	1.5	1.5	1.5	1.5
AC Condensate	FG	0.5	0.5	1	1	1
Steam (b)	FG	2.5	2.5	2.5	3	3
Steam Condensate	FG	2.5	2.5	2.5	3	3
Boiler Feed	FG	1.5	1.5	2	2	2
Heat Recovery (Interior)	FG	0.5	0.5	1	1	1
Heat Recovery w/ Heat Trace (Exterior)	FG	1	1.5	1.5	1.5	1.5
Heat Recovery w/ Glycol (Exterior)	FG	0.5	0.5	1	1	1
Refrigerant Liquid	RT	0.5	1	1	-	-
Refrigerant Suction	RT	0.5	1	1	-	-
Refrigerant Hot Gas	RT	0.5	1	1	-	-
Refrigerant VRV	RT	1.5	1.5	1.5	-	-

(a) Contractor is responsible to meet thickness of insulation listed or local code requirement as a minimum. The more stringent requirement shall take precedence.

(b) Includes steam piping from humidifier generators to distribution grid

(c)

C. INDOOR, PIPE INSULATION JACKET APPLICATION

1. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket. On vapor-barrier piping systems, continue the vapor barrier under all fitting covers.
2. Piping, Concealed:
   a. None.
3. Piping, Exposed:

a. PVC, Color-Coded by System. Coordinate with Owner / Architect to match any existing system already in place.
b. If no existing system is in place, comply with “INSTALLATION OF MECHANICAL IDENTIFICATION” of these specifications.

3.17 INSTALLATION OF EQUIPMENT INSULATION

A. GENERAL

1. Apply insulation materials, accessories, and finishes according to the manufacturer's written instructions; with smooth, straight, and even surfaces; and free of voids throughout the length of equipment.
2. Do not insulate factory insulated equipment.
3. Apply insulation as close as possible to equipment by grooving, scoring, beveling insulation, if necessary. Secure insulation to equipment with studs, pins, clips, adhesive, wires, or bands.
4. Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface. On cold equipment, use vapor barrier cement.
5. Cover Rigid Fiberglass and Calcium Silicate insulation with metal mesh finish and finish with heavy coat of insulating cement.
6. Do not insulate over nameplates or testing agency labels and stamps. Bevel and seal insulation around such.
7. When equipment with insulation requires periodical opening for maintenance, repair, or cleaning, install insulation in such a manner that it can be easily removed and replaced without damage.
8. Use accessories compatible with insulation materials and suitable for the service. Use accessories that do not corrode, soften, or otherwise attack insulation or jacket in either the wet or dry state.
9. Apply multiple layers of insulation with longitudinal and end seams staggered.
10. Keep insulation materials dry during application and finishing.
11. Apply insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by the insulation material manufacturer.
12. Apply insulation with the least number of joints practical.
13. Apply insulation over fittings and specialties, with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
14. Hangers and Anchors: Where vapor retarder is indicated, seal penetrations in insulation at hangers, supports, anchors, and other projections with vapor-retarder mastic. Apply insulation continuously through hangers and around anchor attachments.
15. Insulation Terminations: For insulation application where vapor retarders are indicated, seal ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.
16. Cut insulation according to manufacturer's written instructions to prevent compressing insulation to less than 75 percent of its nominal thickness.
17. Install vapor-retarder mastic on equipment scheduled to receive vapor retarders. Overlap insulation facing at seams and seal with vapor-retarder mastic and pressure-sensitive tape having same facing as insulation. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-retarder seal.

B. APPLICATION

1. Insulate the following equipment:
   a. Insulate heat exchangers with 2" thick Rigid Fiberglass equipment insulation.
   b. Insulate boiler breechings with 3" Calcium Silicate equipment insulation only if a double wall vent system is not shown on the drawings or called for by this specification.
   c. Insulate chilled water pump bodies with 1" thick Rubber Sheet equipment insulation.

d. Insulate Chilled-water compression tanks with 2" thick Rigid Fiberglass equipment insulation.
e. Insulate air separators with 2" thick Rigid Fiberglass equipment insulation.
f. Insulate steel steam condensate receiver tanks with 2" thick Rigid Fiberglass equipment insulation.
g. Insulate steam flash tanks with 2" thick Rigid Fiberglass equipment insulation.
h. Insulate indoor kitchen exhaust fans and other fans serving systems requiring 2 hour protection with two layers of 1 ½” ceramic fire wrap
i. Condensate receivers, not factory insulated.
j. Deaerators, not factory insulated.
k. Insulate top of radiant ceiling panels with 2” thick Flexible Fiberglass equipment insulation.

C. Omit insulation from the following:
1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Manholes.
5. Handholes.
6. Cleanouts.

3.18 INSTALLATION OF HYDRONIC SPECIALTIES

A. Install specialties in accordance with manufacturer's instructions.

B. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.

C. Install only automatic air vents in mechanical equipment rooms only. Install at high points of system piping, at heat-transfer equipment and coils, and elsewhere as required for system air venting. Provide vent tubing to nearest drain. Where large air quantities can accumulate, provide enlarged air collection standpipes.

D. Install in-line air separators in pump suction lines. Install piping to compression tank with a 2 percent upward slope toward tank. Install drain valve on units NPS 2 and larger.

E. Install bypass chemical shot feeders in each hydronic system, in upright position with top of funnel not more than 36 inches above floor. Install feeder in bypass line, off main, using globe valves on each side of feeder and in the main between bypass connections. Pipe drain, with ball valve, to nearest equipment drain.

F. Install expansion tanks on floor. Vent and purge air from hydronic system, and ensure tank is properly charged with air to suit system design requirements. Provide anti-thermosyphon loop to prevent gravity heating in tank. Install automatic air vent at top of loop and drain at bottom. Size expansion line per manufacturers installation.

G. Provide valved drain and hose connection on strainer blow down connection.

H. Remove temporary strainers after cleaning systems.

I. Support pump fittings with floor mounted pipe and flange supports.

J. Select system relief valve capacity so that it is greater than make-up pressure reducing valve capacity. Select equipment relief valve capacity to exceed rating of connected equipment.

K. Pipe relief valve outlet to nearest floor drain.

L. Where one line vents several relief valves, make cross sectional area equal to sum of individual vent areas.

M. Clean and flush glycol system before adding glycol solution. Feed glycol solution to system through make-up line with pressure regulator, venting system high points. Perform tests determining strength of glycol and water solution and submit written test results.

3.19 INSTALLATION OF PUMPS

A. Install in accordance with manufacturer's instructions.

B. Provide access space around pumps for service. Provide no less than minimum as recommended by manufacturer.

C. Decrease from line size with long radius reducing elbows or reducers. Support piping adjacent to pump such that no weight is carried on pump casings. For close coupled or base mounted pumps, provide supports under elbows on pump suction and discharge line sizes 4 inches and over

D. Provide line sized shut-off valve and strainer pump suction fitting on pump suction, and line sized soft seat check valve, isolation valve and balancing valve on pump discharge.

E. Provide air cock and drain connection on horizontal pump casings.

F. Provide drains for bases and seals, piped to and discharging into floor drains.

G. Check, align, and certify alignment of base mounted pumps prior to start-up.

H. Install base mounted pumps on concrete housekeeping base, with anchor bolts, set and level, and grout in place.

I. Lubricate pumps before start-up.

J. Provide Type FC-1 flexible connectors.

3.20 INSTALLATION OF PRE-MANUFACTURED DUCTWORK AND FLUE SYSTEMS

A. Install in accordance with manufacturer's instructions.

B. Install in accordance with NFPA 54.

C. Install breechings with minimum of joints. Align accurately at connections, with internal surfaces smooth.

D. Support breechings from building structure, rigidly with suitable ties, braces, hangers and anchors to hold to shape and prevent buckling. Support vertical breechings, chimneys, and stacks at 12

foot spacing, to adjacent structural surfaces, or at floor penetrations. Refer to SMACNA HVAC Duct Construction Standards - Metal and Flexible for equivalent duct support configuration and size.

E. Install concrete inserts for support of breechings, chimneys, and stacks in coordination with formwork.

F. Pitch breechings with positive slope up from fuel-fired equipment to chimney or stack.

G. Coordinate installation of dampers

H. For Type B double wall gas vents, maintain UL listed minimum clearances from combustibles. Assemble pipe and accessories as required for complete installation.

I. Install vent dampers, locating close to draft hood collar, and secured to breeching.

J. Assemble and install stack sections in accordance with NFPA 82, industry practices, and in compliance with UL listing. Join sections with acid-resistant joint cement to ASTM C105. Connect base section to foundation using anchor lugs.

K. Level and plumb chimney and stacks.

L. Clean breechings, chimneys, and stacks during installation, removing dust and debris.

M. At appliances, provide slip joints permitting removal of appliances without removal or dismantling of breechings, breeching insulation, chimneys, or stacks

3.21 INSTALLATION OF BOILERS

A. Install in accordance with manufacturer's instructions.

B. Install in accordance with NFPA 54 and/or NFPA 31.

C. Provide disconnect to electrical contractor for wiring.

D. Provide relief valve piped to floor drain (water boilers) or atmosphere (steam boilers).

E. Provide shut off valves and pressure gauges on inlet and outlet piping.
   1. Provide temperature gauges on inlet and outlet piping for water boilers.

F. In accordance with CE-110(a) of CSD-1, a manually operated boiler shutdown switch shall be interlocked with the boilers.
   1. Shutdown switch location:
      a. The shutdown switch shall be located just outside the boiler room door.
      b. If the boiler room door is on the building exterior, the shutdown switch shall be located just inside the door.
      c. If there is more than one door to the boiler room, there shall be a shutdown switch located at each door.
   2. Activation of the boiler shutdown switch shall immediately shut off the fuel or energy supply.

G. MANUFACTURER'S FIELD SERVICES
   1. Prepare and start systems.
   2. Instruct operating personnel in operation and maintenance of units.

3.22 TESTING, ADJUSTING AND BALANCING

A. ACCEPTABLE BALANCERS
1. TAB contractors that may be engaged include, but are not limited to, the following. Contractors not listed shall demonstrate compliance with section B QUALITY ASSURANCE as part of the bid package for review by the design team.
   a. E.L. Barrett
   b. J.F. Coffey
   c. Thomas Young
   d. Leonhardt
   e. Advantage Engineering

B. QUALITY ASSURANCE
1. Testing, Adjusting and Balancing shall be performed by a AABC, NEBB or TABB certified company.
   a. TAB field supervisor and technician shall be certified.
2. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."
3. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6.7.2.3 - "System Balancing."

C. SUBMITTALS
1. Pre-Award:
   a. List of past 10 jobs including a brief description of the scope.
   b. Applicable agency certification copies.
   c. Letter of recommendation.
2. Construction Phase:
   a. Refer to PART 1 – STANDARD REPORTING REQUIREMENTS, this document, for general information.
   b. Prior to the commencement of testing, adjusting and balancing submit to the engineer for review a template report with test sheets for each equipment, air terminal or system type included in the project. The template report shall include the design test data. Do not begin testing until receipt of approved review from engineer. Comply with REPORT FORMS of this section.
   c. Submit preliminary testing field reports. Report defects and deficiencies noted during performance of services which prevent system balance.
   d. Submit final testing field reports. Make corrections or address items indicated in engineers review of preliminary testing field report. Report defects and deficiencies noted during performance of services which prevent system balance.

D. EXAMINATION
1. Verify that systems are complete and operable before commencing work. Ensure the following conditions:
   a. Systems are started and operating in a safe and normal condition.
   b. Temperature control systems are installed complete and operable.
   c. Proper thermal overload protection is in place for electrical equipment.
   d. Final filters are clean and in place. If required, install temporary media in addition to final filters.
   e. Duct systems are clean of debris.
   f. Fans are rotating correctly.
   g. Fire and volume dampers are in place and open.
   h. Air coil fins are cleaned and combed.
   i. Access doors are closed and duct end caps are in place.
   j. Registers, Grilles and Diffusers are installed and connected.
   k. Duct system leakage is minimized.

l. Hydronic systems are flushed, filled, and vented.
m. Pumps are rotating correctly.
n. Proper strainer baskets are clean and in place. Strainers shall have been blown down by HVAC.
o. Service and balance valves are open.

2. Submit field reports. Report defects and deficiencies noted during performance of services which prevent system balance. Refer to PART 1 – STANDARD REPORTING REQUIREMENTS, this document, for general information.

E. Beginning of work means acceptance of existing conditions.

F. PREPARATION

1. Coordinate atleast two balancing meetings, as follows:
   a. For renovation projects, at the first construction kick off meeting, coordinate a preconstruction balancing meeting which will ensure the provision of preconstruction balancing per paragraph H, “Renovation Pre-construction Testing,” of this section.
   b. Following a construction meeting, prior to post-construction balancing work associated with to this section, when the commissioning agent and engineer are scheduled for attendance, provide a post-construction balancing meeting. Provide anticipated balancing report format, and troubleshoot in advance any obstacles that could prevent the balancing process from being completed as required.
2. Provide instruments required for testing, adjusting, and balancing operations. Make instruments available to Architect/Engineer to facilitate spot checks during testing.
3. Provide additional balancing devices as required.
4. The testing, adjusting and balancing contractor shall review system installation at 50%, 75% and 100% construction completion milestones. The Owner and/or Engineer reserve the right to ask for the TAB contractor to provide a written confirmation that systems were inspected at those times.

G. INSTALLATION TOLERANCES

1. Air Handling Systems: Adjust to within plus or minus 5 percent of design for supply systems and plus or minus 10 percent of design for return and exhaust systems.
2. Registers, Grilles and Diffusers: Adjust total to within plus 10 percent and minus 5 percent of design to space. Adjust outlets and inlets in space to within plus or minus 10 percent of design.
3. Hydronic Systems: Adjust to within plus or minus 10 percent of design.

H. ADJUSTING

1. Ensure recorded data represents actual measured or observed conditions.
2. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.
3. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.
4. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.
5. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by the Owner.
6. Check and adjust systems approximately six months after final acceptance and submit report. Refer to PART 1 – STANDARD REPORTING REQUIREMENTS, this document, for general information.
7. Balancing contractor shall be responsible for any rebalance of air devices (i.e. VAV boxes, diffusers and grilles) post building occupancy. Balancing contractor shall carry a 25% cost allowance for any rebalance of these devices.

I. RENOVATION PRE-CONSTRUCTION TESTING

1. Prior to commencing testing coordinate with owner to ensure the all equipment is operational and spaces are accessible.
2. Prepare a pre-construction balancing report prior to demolition and/or new construction.
   a. Measure and record sound and vibration within spaces being renovated.
   b. Measure and record airflow at all main supply, return and exhaust air ducts at limit of demolition.
   c. Test all associated heating and cooling generation and transfer equipment serving the renovated spaces. Testing technician shall record the physical condition of all equipment being tested. Note condition, maintenance or repairs required.
   d. In addition to renovation area and service equipment testing; pre-renovation measurement of all main riser (or trunk) take-offs for multi-floor (area) systems shall be conducted. The intent of this testing is to document the existing supply, return, and exhaust air flows to all floors or areas outside the renovation area that are served by air handler and/or fan(s) serving the space to be renovated. Balancer shall coordinate with Engineer and Owner regarding locations of riser testing; as-built drawings (to the extent available) will be made available to the pre-construction testing contractor at no cost.
   e. The report is intended to record all air and water flows within the spaces being renovated and all associated equipment supplying, exhausting, or returning air or water from the spaces being renovated.
3. Submit pre-construction testing report for review and approval prior to commencement of demolition.

J. PHASED CONSTUCTION
1. Where project is intended to be constructed in multiple phases perform testing, balancing and submit balancing reports at the completion of each phase.
2. At the completion of the project submit a complete balancing report of all phases.
3. Test and adjust systems making provisions for .Measure and prepare a balancing report prior to demolition and/or new construction.
4. Make provisions for temporary balancing or reduce flows as required.

K. WATER SYSTEM PROCEDURE
1. Balance systems in accordance with latest edition of the SMACNA HVAC Systems Testing, Adjusting & Balancing.
2. Adjust water systems to provide required or design quantities.
3. Use calibrated Venturi tubes, orifices, or other metered fittings and pressure gauges to determine flow rates for system balance. Where flow metering devices are not installed, base flow balance on temperature difference across various heat transfer elements in the system.
4. Adjust systems to provide specified pressure drops and flows through heat transfer elements prior to thermal testing. Perform balancing by measurement of temperature differential in conjunction with air balancing.
5. Effect system balance with automatic control valves fully open to heat transfer elements.
6. Effect adjustment of water distribution systems by means of balancing cocks, valves, and fittings. Do not use service or shut-off valves for balancing unless indexed for balance point.
7. Where available pump capacity is less than total flow requirements or individual system parts, full flow in one part may be simulated by temporary restriction of flow to other parts.

L. SCHEDULES
1. Equipment requiring sound level, Air, Water, and vibration - testing, Adjusting, and Balancing:
   a. HVAC Pumps
   b. Boilers

2. Sound levels shall be taken at all motor driven equipment greater than 3/4 motor horsepower. Test sound levels at the equipment and in spaces above, below and/or adjacent to the equipment.
3. Provide sound level testing of all acoustically sensitive spaces such as:
   a. patient rooms
   b. treatment rooms
   c. operating rooms
   d. Waiting rooms.

3.23 SELECTIVE DEMOLITION

A. The extent of the demolition work is shown on the drawings or described in this specification.

B. Refer to DIVISION 1 Sections "CUTTING AND PATCHING" and "SELECTIVE DEMOLITION" for general demolition requirements and procedures.

C. Disconnect, demolish, and remove mechanical systems, equipment, and components indicated to be removed.
   1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
   2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
   3. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
   4. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.
   5. Equipment to Be Removed: Disconnect and cap services and remove equipment.
   6. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
   7. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
   8. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.
   9. Controls to Be Removed: Remove control panels, devices, wiring and tubing that have been abandoned or serve equipment which has been demolished. When removing wiring and tubing demolish back to nearest active branch and plug or cap.

D. RELATED WORK
   1. GENERAL CONTRACTOR
      a. Cuts wall and surfaces to provide access to elements to be removed or disconnected.
   2. ELECTRICAL CONTRACTOR
      a. Disconnects live wiring to all equipment or systems to be removed.
   3. PLUMBING CONTRACTOR
      a. Disconnects live plumbing and domestic water to all equipment to be removed.

E. CODES, ORDINANCES AND REGULATORY REQUIREMENTS
   1. Comply with all state and local codes as to removal and disposal of equipment removed from the site.
   2. Comply with governing EPA notification regulations before beginning selective demolition.
   3. Comply with hauling and disposal regulations of authorities having jurisdiction.

4. Comply with ANSI A10.6 and NFPA 241.

F. PERMITS
1. Give all required notices, file all required plans and Specifications relating to the work of this Section with the proper authorities and pay for any required permits.

G. SITE EXAMINATION
1. Visit site prior to submitting bid to become familiar with the existing conditions which may affect the removal of systems or products provided as part of the work of this Section.
2. Extra payment or compensation for work required by this Section due to existing conditions that would have been observed during the site examination will not be made.

H. REFRIGERANT RECOVERY
1. All Air-conditioning equipment and systems shall be removed demolished without releasing refrigerants.
2. Refrigerant recovery is to be performed by a Refrigerant Recovery Technician Certified by an EPA-approved certification program.

I. REMOVAL AND DISPOSAL
1. All equipment and systems to be removed or demolished under this Section shall become the property of the contractor. The contractor shall remove all such equipment from the site promptly after detachment from building structure.
2. Storage or sale of removed items or materials on-site is not permitted.
3. Contractor is responsible for all removal and disposal of hazardous / controlled items, such as, but not limited to refrigerant and glycol (including solution).

J. COORDINATION
1. Coordinate the work of this Section with all other project contractors.
2. Provide any special information or requirements needed for the proper and safe removal of equipment.

K. HAZARDOUS MATERIALS
1. It is unknown whether hazardous materials will be encountered in the Work.
2. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Architect and Owner.

L. UTILITY SERVICE
1. Maintain existing Mechanical/Electrical utilities/services indicated to remain in service and protect them against damage during selective demolition operations.
2. Maintain fire-protection facilities in service during selective demolition operations.
3. If services/systems are required to be removed, relocated, or abandoned, before proceeding with selective demolition provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.

M. EXISTING WARRANTIES
1. Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials so as not to void existing warranties.

3.24 TRIAL USAGE

A. The owner shall be permitted trial usage of systems or parts of systems for the purpose of testing and learning operational procedures.

B. Trial usage shall not be construed as acceptance.

C. Trial usage shall be carried out with the express knowledge and under supervision of the HVAC Subcontractor, who shall not waive any responsibility because of trial usage.

3.25 INSTRUCTIONS TO OWNER

A. Submit to the Owner, lists for each system or piece of equipment indicating that all components have been checked and are complete prior to the instruction period.

B. Thoroughly instruct the Owner's authorized representative in the safe operation of the systems and equipment. This instructional procedure shall be videotaped by this contractor and three copies of the tape submitted to the Architect.

C. Arrange and pay for the services of qualified manufacturer's representatives to instruct Owner on specialized portions of the installation. This shall include 6 hours of instruction in the operation of the water treatment system, 8 hours in the operation of packaged equipment, 24 hours in the operation of built-up custom and semi-custom equipment and 40 hours of operation of the automatic temperature control system. Instruction shall take place on-site at time agreed to by Owner.

D. Submit a complete record of instructions given to the Owner. For each instruction period, supply the following data:
   1. Date.
   2. Duration.
   3. System or equipment involved.
   4. Names of persons giving instructions.
   5. Other people present.

E. Instructional period shall be carried out during a continuous period of five days.

END OF SECTION 23 00 00

DIVISION 26 – ELECTRICAL

PART 1 - GENERAL

1.1 TIME, MANNER AND REQUIREMENTS FOR SUBMITTING SUB-BIDS

A. Sub-bids shall be submitted in accordance with the provisions of the General Laws (Ter. Ed.), Chapter 149, SECTIONS 44A TO 44L, inclusive, as set forth under INSTRUCTIONS TO BIDDERS.

B. Each sub-bid filed with the Awarding Authority must be accompanied by a BID BOND, CASH or CERTIFIED CHECK, or a TREASURER'S CHECK, or a CASHIER'S CHECK issued by a responsible bank or trust company, payable to the Town of XXXXXX, XX, in the amount stipulated in the INSTRUCTIONS TO BIDDERS. A sub-bid accompanied by any other form of bid deposit than those specified will be rejected.

C. Each sub-bid submitted for the work under the SECTION, shall be on a form furnished by the Awarding Authority, as required by SECTION 44F of Chapter 149 of the General Laws, as amended.

D. The work to be done under this Section is shown on the following drawings numbered: E000, E001, E120, E700.

E. The Filed Sub-bidder for work under this Section shall list in paragraph E of the FORM FOR SUB-BID the names of each person, firm or corporation whom he proposes to use to perform the following classes of work or part thereof and the bid price thereof:
   1. CLASSES OF WORK
      a. Lighting Protection
      b. Communications

F. In any case in which the Sub-bidder intends to perform with persons on his own staff, the class of work listed above, he must, nevertheless, list his own name under paragraph E of the FORM FOR SUB-BID.

1.2 GENERAL REQUIREMENTS

A. Definitions

1. "Electrical Contractor", "This contractor" – The party or parties have been duly awarded the contract for and are thereby made responsible for the electrical work as described herein.
2. "This Contract", "The Contract" – The agreement covering the work to be performed by "this Contractor".
3. "Approved", "Equal", "Satisfactory", "Accepted", "Acceptable", "Equivalent" – Acceptable for use on the project, as determined by the engineer based on documents presented for such determination.
4. "These Specifications", "this section, part, division" (of the specification) – The document specifying the work to be performed by "this contractor".
5. "The Electrical Work", "This Work" – All labor materials equipment, apparatus, controls, accessories, and other items required for a proper and complete installation by the Electrical Contractor.
6. "Architect", "Engineer", "Owner's Representative" – The party or parties responsible for interpreting, accepting and otherwise ruling on the performance under this contract.
7. "Furnish" – Purchase and deliver to the project site complete with every necessary appurtenance and support, all as part of the electrical work.

8. "Install" – Unload at the delivery point at the site and perform every operation necessary to establish secure mounting installation and correct operation at the proper location in the project, all as part of the electrical work.
9. "Provide" - "Furnish" and "Install".
10. "New" – Manufactured within the past two years and never used before.
11. "Relocate" – Move existing equipment/devices/fixture and all accessories as required, including the extension of existing or providing new circuit/conductors/wiring as required.
12. “Concealed”: Areas where equipment or systems are located in chases, shafts, walls or ceilings, whether hard or lay-in type.
13. “Exposed”: Equipment or systems not considered concealed.

B. Codes, Standards, and Guidelines:

1. All work shall comply with the requirements of all applicable state and local codes including the National Electrical Code (NEC) and all authorities having jurisdiction in the city of Worcester, MA building code, industry standards and utility company regulations.
2. All materials and equipment shall be Underwriters’ Laboratories Inc. (UL) listed or labeled, where available.
3. The contractor shall inform the Engineer, Architect, Owner, and Building Management of any existing work or materials which violate any of the above laws and regulations.
4. This contractor shall be responsible for prompt replacement or repair and expenses incurred for any workmanship, equipment or material in which violates any of the above references.

C. Site Verification

1. Before submitting bid, this contactor shall visit and examine the project site and become familiar with all field conditions as related to the electrical work. Any discrepancies which may affect this work shall be reported in writing prior to the bid, and if not resolved to satisfaction, shall be included as a written qualification of the bid.
2. Submission of a bid shall be evidence site verification has been performed as described above.
3. No allowance will be made for difficulties encountered due to any field condition which existed up to the time of bid.

D. Contract Documents:

1. Prior to submission of a formal bid, this contractor shall review all drawings of the entire project including general construction, demolition, architectural, mechanical, plumbing and sprinkler and he shall notify the construction manager of work required in the bid which is indicated or implied in other sections of the work.
2. Drawings are diagrammatic and indicate general arrangement of work and approximate location of equipment. Refer to architectural drawings for all dimensions and coordinate final locations of switches light fixtures, receptacles etc. Work shall be coordinated with other trades to avoid conflicts.
3. If a conflict occurs in the specifications and/or on the drawings that has not been addressed before the bid, or the documents are unclear, the more stringent situation shall apply.
4. Any equipment, supports, parts, materials, accessories, or labor that is necessary for proper performance of the electrical work, although not specifically mentioned herein or shown on the drawings, shall be furnished and installed as if called for in detail without additional cost.
5. Provide all ceiling mounted equipment in strict accordance with architectural reflected ceiling plans.

E. Prepare Requests for Interpretation (RFI’s) in accordance with industry standards and project requirements.

1. RFIs shall originate with the General Contractor. RFIs submitted directly by sub-contractors will be returned with no response. RFIs sent directly to Engineer will be

returned with no response. Incomplete RFIs will not be reviewed and will be returned for additional information.

2. Provide email notification to ftconadmin@f-t.com with RFI file(s) attached in industry standard ".pdf" file format. If the RFI file(s) are too large for email transfer, provide hyperlink to files allowing both download and upload of files over internet connection without requiring use of usernames or passwords. When requested, resubmit promptly incorporating design team comments.
3. Submit RFIs in format specified and in addition include:
   a. Specification Division number and title and related paragraphs, as appropriate.
   b. Drawing number, room name, structural grid coordinates and detail references, as appropriate.
   c. Field dimensions and conditions, as appropriate.
   d. Contractor's suggested solution(s). If Contractor's solution(s) impact the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
   e. Attachments: Include 8 ½" x 11" copies of construction documents highlighting areas requiring interpretation. Include drawings, descriptions, measurements, photos, Product Data, Shop Drawings, and other information necessary to fully describe items needing interpretation and suggested solution(s).
      1) Supplementary drawings prepared by Contractor shall be to scale and shall include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments.

F. This Contractor shall be responsible for Temporary Services in accordance with industry standards and project requirements.

   1. Provide temporary power to facilitate construction as required.

G. This contractor shall be responsible for applying for, obtaining and paying for all permits, inspections, and fees required, and complying with all prerequisites for and post-issuance requirements of such permits and inspection documentation.

H. Guarantee

   1. All equipment, materials, and workmanship shall be guaranteed for a period of one year from date of final acceptance of this work. Final acceptance shall be defined as the time at which the electrical work is taken over and accepted by the owner, and is under care, custody, and control of the owner. Extensions to standard equipment warranty periods shall be arranged by this Contractor such that the guarantee period commences upon beneficial usage by the Owner.
   2. Engage the services of various manufacturers supplying the equipment for the proper startup and operation of all systems installed. Instruct the owner's personnel in the proper operation and servicing of the equipment.
   3. The contractor shall provide as a requirement of the bid submission a guarantee for prompt replacement or repair and assume responsibility for all expenses incurred for any workmanship and equipment in which defects develop within the guarantee period. This work shall be done as directed by the owner. This guarantee shall also provide that where defects occur, the contractor will assume responsibility and pay for all expenses incurred in repairing and replacing work of other trades affected by defects, repairs or replacements in equipment supplied by this contractor.
   4. This contractor is responsible for the maintenance and operation of all systems until the final acceptance of the work.

I. Provide, at the appropriate time and / or as directed by Architect, the services of a manufacturer's representative to inspect, adjust, troubleshoot and place in proper operating condition any and all applicable manufacturer's equipment and provide site visit and start-up report documentation.

J. This contractor is responsible for demonstration of the proper operation of all major equipment, to the Owner and the Engineer, at the completion of installation, including but not limited to generator(s), lighting and lighting controls, and ATS(s).

1.3 SCOPE OF WORK:

A. Provide all labor, materials, equipment, and contractor's services necessary for complete, safe installation of all electrical work as indicated in the contract documents.

B. The electrical work shall include but not be limited to the following:

1. Demolition as indicated on the plans.
2. Core drilling, cutting and channeling for holes five (5) inches and less in diameter.
3. Installation of all Equipment and Systems indicated in the contract documents, including, but not limited to:
   a. Wall switches, receptacles, voice/data outlets, etc.
   b. Raceway and conductors for lighting and power.
   c. Variable frequency drives and motor starters.
   d. Addition or modification of existing electrical distribution equipment including panelboards, distribution panelboards, switchboards, MCC(s), etc.
   e. Installation of mechanical power wiring and final connections to mechanical equipment.
   f. Installation of conduit, junction boxes, pull boxes, etc.
   g. Grounding of all equipment as required by code and as specified.
   h. Maintenance and proper operation of existing base building systems within the contract area in accordance with the requirements of the Owner and building management.
4. Cutting, channeling and chasing required to accommodate the electrical installation and rough patching.
5. Fire stopping.
6. Temporary light and power during construction.
7. Testing of electrical systems and equipment including ATS's, lighting controls, and generators in accordance with NFPA 110 and manufacturer recommendations.
8. As-Built drawings.

C. Install all new work in a neat workmanlike manner readily accessible for operation, maintenance and repair.

D. Contractor Coordination

1. Refer to drawings for VFD's, motor starters / controllers, and disconnects provided by Mechanical Contractor to be installed by the Electrical Contractor.

1.4 COORDINATION WITH OWNER

A. This contractor is responsible for the maintenance and proper operation of existing base building systems within the contract area in accordance with the requirements of the Owner and Building Management.

B. For the purpose of the contractor's bid assume any noisy work (e.g. chopping, core drilling etc.) and base building system interruptions performed outside normal business hours. The contractor is responsible for determining the requirements and extent of premium time and phasing work.

C. This contractor is responsible for adhering to the building owner's rules and regulations. Any discrepancies between the contract documents and the building rules and regulations shall be submitted to the Architect/Engineer for review, with bid submission.

D. Coordinate any service interruption of existing systems with building manager with a minimum of two (2) days prior to any work.

1.5 SUBMITTALS AND SHOP DRAWINGS:

A. Provide email notification to ftconadmin@f-t.com with submittal file(s) attached in industry standard ".pdf" file format. If the submittal file(s) are too large for email transfer, provide hyperlink to files allowing both download and upload of files over internet connection without requiring use

of usernames or passwords. When requested, resubmit promptly incorporating design team comments.

B. The Electrical Contractor is responsible for thorough review of all submittals and shop drawings for compliance with the contract requirements and coordination with all other trades. This contractor shall submit to the general contractor for compliance with the project requirements.

C. Include the following information, as applicable:

1. Name and address of project.
2. Name and address of supplier.
3. Name of manufacturer.
4. Reference specification section number, article number and article name.
5. Intended use and location and scheduled designation tag.
6. Identification of whether submittal is a resubmittal of previously reviewed equipment.
7. Review comments distribution list.
8. Product Submittal Data:
   a. Notation on each submittal for which products and options are applicable.
   b. Manufacturer’s catalog information.
   c. Manufacturer's product and material specifications and compliance with referenced standards.
   d. Manufacturer’s installation instructions and recommendations.
   e. Notation of coordination requirements.
   f. Certified performance ratings with system operating conditions indicated.
   g. Wiring diagrams showing field-installed wiring, including power, signal, and control wiring
   h. Dimensions, required clearances, operating weights and structural loading points.
   i. Compliance with referenced standards.
   j. Standard product operation and maintenance manuals.
   k. Manufacturer-included specialties, options and accessories.
9. Shop Drawings (where differing from the submittal requirements above):
   a. Project-specific information, drawn accurately to scale.
   b. Rough-in information.
   c. Design calculations.

D. Required submittals to Engineer for Review:

1. Collect information into a single submittal for each element of construction and type of product or equipment. Submittals and shop drawings submitted shall include the following:
   a. All Electrical equipment as scheduled on the drawings.
   b. Variable frequency drives, motor starters, and controllers.
   c. As-built drawings (refer to applicable Section, this Part).
   d. Operation and maintenance (O&M) manuals (refer to applicable Section, this Part).
2. A product submittal or shop drawing is required if the contractor is proposing use of an item not specified herein as acceptable or basis of design.
3. Keep one (1) set of reviewed Submittals on site at all times.

E. Submittals not requiring engineering review:

1. Shop drawings and product submittals are not required for products and equipment unless listed above in paragraph D, provided that the product or equipment being furnished is not deviating from the basis of design, performance requirements or approved manufacturers listed on the drawings or specified herein.

1.6 PERMITTING AND UTILITY COMPANY CHARGES

A. Apply for, obtain and pay for all permits, inspections and fees required.

B. Be fully acquainted with and obey all Federal, State, and Municipal laws, by-laws, codes and regulations, and all authorities having jurisdiction.

C. Before starting any work, submit the required specifications and Drawings to the Governing Authorities for their approval. Comply with any requested changes as part of the Contract, and give any notification immediately of such changes.

D. Where the Specifications, Instructions, or the Governing Authorities require any work to be tested, inspected or approved, give sufficient notice of its readiness for inspection, and, if the inspection is by a Governing Authority, of the date and time set for such inspection.

E. Inspection will be made promptly. If any work is covered up without consent, it shall, if required, be uncovered for examination and the required corrections made at no extra cost to the Owner.

F. Furnish any certificates necessary as evidence that the work conforms to the requirements of all authorities having jurisdiction.

G. Make changes, if required, to make the work conform to all laws, bylaws, codes, and regulations, as part of DIVISION 26 work.

H. Electrical Contractor shall give all necessary notices, file and obtain all permits, pay all governmental taxes and fees. Contractor shall also obtain all required Certificates of Inspection for his respective work and deliver same to Architect or Owner's Representative before request for acceptance of his portion of work is made and before final payment.

1.7 SEISMIC DESIGN

A. Provide seismic-restraint devices having load testing and analysis performed according to the Office of Statewide Health Planning & Development for the State of California (OSHPD) and bearing anchorage preapproval "R" number, from OSHPD or another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings.

B. Submit Shop Drawings and Product Data signed and sealed by a qualified professional engineer, including design calculations, riser supports, vibration isolation base details, seismic restraint details, and snubber load deflection.

C. Where applicable and for high rise buildings, the seismic restraint design and construction requirements for equipment and piping incorporated as part of Life Safety Systems shall be such that these systems will remain in place and be functional following a major earthquake, and that the design shall consider lateral drifts between stories as specified by code.

1.8 RECORD DOCUMENTS

A. This Contractor shall maintain a complete set of Electrical drawing prints at the project site and record, at time of occurrence, deviations from the contract documents due to addenda, bulletins, field coordination or any other instruction by the Architect or Engineer. Accurate location, depth, size and type of all concealed items, inverts of services at key points and buried locations shall be shown, referenced with building grid lines.

B. Contractor shall revise shop drawings to conform to record drawings and submit as-built condition (devices, equipment, circuitry, etc.) drawings upon completion of the project. Final submission of as-built drawings are to be signed and certified by installing contractor that this is the as-built condition of the work.

C. At project completion, as-built information shall be transferred to CAD (.dwg 2004) and printed to PDF. Electronic files shall be included with the O&M manuals at project closeout.

1.9 OPERATION AND MAINTENANCE (O&M) DATA

A. Assemble three copies of indexed hard cover manuals entitled "Operating and Maintenance Instructions for Electrical Systems".

B. Documentation shall include the following:

1. O&M information for all systems and major components, including panelboards, distribution panelboards, transformers, lighting fixtures and controls, ATS(s), VFD(s), and generators.
2. All accepted equipment submittals and shop drawings, including lighting drawings and sequences.
3. All accepted testing reports, including generator load test performed in accordance with NFPA 110 requirements and acceptance test.
4. CAD and PDF electronic format drawings, refer to RECORD DRAWINGS, this Section.

1.10 STANDARD REPORTING REQUIREMENTS

A. All reports shall be submitted in electronic ".pdf" file format.

B. Reports shall include project general information, at a minimum, including location, date, and personnel.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Equipment and systems scheduled on the drawings may not be intended to be additionally specified herein. In these cases, provide as scheduled, using the indicated manufacturer's specifications to inform any substitution request / submittal.

2.2 DISCONNECT SWITCHES

A. Unless otherwise noted, disconnect switches shall be "quick-make, quick-break" heavy duty type in NEMA 1 enclosures fused or unfused as indicated on the drawings. Provide all fuses as required provide weatherproof NEMA 3R rated disconnect switches where installed outdoors or as indicated on drawings.

B. Acceptable Manufacturers: Square "D", GE, Cutler-Hammer, Siemens.

2.3 CIRCUIT BREAKERS

A. For panelboard applications, circuit breakers shall be bolted to the panelboard bus bars. Where circuit breakers are installed in existing panelboard breakers shall be of the same manufacturer and be compatible with existing panelboard. For stand-alone applications, circuit breakers shall be in a NEMA 1 enclosure.

B. Circuit breakers shall be "thermal magnetic" type, quick-make, quick-break with non-welding contacts compensated for ambient temperatures and shall have a minimum short circuit rating of 10,000 amperes symmetrical for 208/120V panelboards and 14,000 amperes symmetrical for 480/277V panelboards or higher where noted. Breakers feeding mechanical equipment shall be HACR rated.

C. Any circuit breakers made available due to demolition shall be designated as spare on panelboard directories.

D. Acceptable Manufacturers: Match existing distribution equipment they are to be installed. Square "D", GE, Cutler-Hammer, Siemens for individually mounted circuit breakers.

2.4 FUSES

A. Fuses shall be current limiting type with an interrupting capacity of 200,000 RMS amperes and of the continuous current ratings as shown on the drawings.

B. They shall have average melting time-current characteristics to meet the UL requirements for "Class K" 0-600 Amp fuses and "Class L" over 600 Amp fuses.

C. Acceptable manufacturers: Cooper Bussman, Mersen, Ferraz Shawmut.

2.5 RACEWAYS

A. All wires shall be run in conduit as specified hereinafter, and each length of conduit shall bear the maker's trademark or stamp. The plans indicate the general location of outlet boxes and circuiting. The conduit runs for these circuits may be modified at the time of installation to adapt same to building construction.

B. For all sizes of conduit larger than 1 1/2", use standard elbow; in smaller sizes, field bends will be permitted instead of using manufactured elbows, but care must be taken not to damage the conduit. The radius of the inner curve of any bend shall not be any less than that permitted by code.

C. Conduit shall be securely fastened in place and hangers, supports or fastenings shall be provided at each elbow and at each end of each straight run terminated at a box or cabinet. Where riser conduits pierce floor slabs, they shall rest on each floor with approved beam clamps, pipe straps or heavy iron ties wired to the structural members supporting equipment. Size and type of anchor shall be based on the combined weights of conduit, hanger and cables. All hangers and rods shall be painted with one coat of enamel.

D. Install conduit expansion fittings in each conduit run wherever it crosses an expansion joint and wherever the conduit length exceeds 200 feet.

E. Lay out and install all conduit runs to avoid proximity to steam and hot water pipes. Do not run conduit within three inches of such pipes except where crossings are unavoidable, then the conduit shall be kept at least 1 inch from the covering of the pipe crossing.

F. Unless otherwise indicated or specified, all wiring shall be installed concealed in ceilings, walls, slabs, pipe chases, and furred spaces whenever possible.

G. Feeders and branch circuitry above hung ceiling and in partitions shall be run in electrical metallic tubing (EMT) unless otherwise noted. Final connections to motors, light fixtures, etc. May be done with flexible metallic conduit (no longer than six feet).

H. All conduit in mechanical rooms, electrical closets shall be EMT and where concealed in concrete shall be rigid threaded regardless of size.

I. Electric metallic tubing shall be industry standard thin wall conduit, EMT shall be hot dipped galvanized steel only. It shall not be less than 3/4" trade size unless otherwise noted. It shall be used for trade size up to 4" unless otherwise noted.

J. Flexible metallic conduit shall be of the grounding type. It shall consist of galvanized steel tape formed into an industry standard interlocking coil. It shall not be less than 3/4" trade size unless otherwise noted.

K. Rigid metal conduit shall be industry standard steel conduit. It shall not be less than 3/4" trade size unless otherwise noted. Rigid metal conduit shall be hot dipped galvanized. It shall not be used for trade size greater than 4" unless otherwise noted.

L. Threaded fittings shall be used with rigid conduit. Compression fittings shall be used with EMT up to 1 1/2" and set screw 2" and larger.

M. Empty conduit for new communication and data outlets in partitions shall be 1" thin wall run concealed in walls, terminated and bushed 6" into accessible hung ceiling and directed towards particular communication / data room or closet. Electrified furniture shall receive 1 1/4" conduit. Provide pull string in each conduit.

N. All metal conduit terminating in a metal enclosure shall have an insulated bushing. Provide "grounding" type bushing where required.

O. Acceptable Manufacturers: Wheatland, Triangle, Republic.

2.6 WIRE AND CABLE

A. Metal clad (type MC) for concealed branch circuitry may be used when written approval is given to the contractor from the building owner. It shall only be installed where permitted by code and accepted by the AHJ.

B. All conductors shall be soft 98% minimum conductivity properly refined copper, type THHN/THWN insulated. All conductors shall have 600 volt rated insulation unless otherwise noted.

C. The minimum wire size for branch circuits shall be no. 12 AWG. Refer to drawing notes for additional requirements.

D. Recessed lighting fixtures for hung ceiling applications shall be supplied with type THHN insulated wire in flexible metallic conduit, in length not to exceed 6 feet from adjacent junction boxes.

E. Connection to recessed ceiling fixtures supplied with pigtails shall be arranged so that up to four such fixtures may be connected into a single outlet box. No fixture shall be supplied from an outlet in another room.

F. Unless specified otherwise, all wires #10 AWG and smaller shall be solid, conductors #8 AWG and larger shall be stranded.

G. Color coding shall be building standard. Where no building standard exists, factory color coding shall be as follows:

1. 208/120 Volt system: Phase 'A' - black, Phase 'B' - red, Phase 'C' - blue, Neutral - grey, Equipment Ground - green.
2. 480/277 Volt system: Phase 'A' - brown, Phase 'B' - orange, Phase 'C' - yellow, Neutral - white, Equipment Ground - green.

H. Install and connect up complete conductors for all circuits and wiring systems

I. No conductors shall be pulled into any conduit run before all conduit joints are made up tightly, and the entire run is secured in place. When required to ease the pulling of wires into conduit, use powdered soapstone, Minerallac #100 or approved equal by Thomas & Betts.

J. Tag all feeders in all pull boxes, gutter spaces, and wireways through which they pass.

K. Terminate stranded conductors #6 AWG and larger at switchboards, transformers, ups systems with compression type connectors. At panelboards terminate with mechanical lugs.

L. Join or tap stranded conductors (#6 AWG and larger) with pressure indent type connectors - Burndy.

M. Acceptable Manufacturers: Southwire, Okonite. (AFC for Metal Clad)

2.7 WIRING DEVICES

A. Wiring devices shall be specification grade unless otherwise noted. All devices shall be flush mounted unless otherwise noted. Refer to symbol list.

B. Standard receptacles shall be 120 Volt, 20 Amp, 2 pole grounding type. Mount with ground or neutral pin oriented up.

C. Switch and receptacle plates shall be plumb and shall fit flat against the wall.

D. Multiple devices at a common location shall be installed in a common multi-gang box with a common faceplate.

E. Acceptable Manufacturers for Receptacles: Hubbell, Lutron, Pass & Seymour, Cooper Wiring Devices.

2.8 SUPPORTS AND FASTENINGS

A. All supports and fastenings necessary for the support of electrical equipment shall be in accordance with the best industry practice and as specified herein.

B. Furnish and install all steel supporting members, hangers, brackets or other special details required and necessary for the proper installation of electric equipment.

C. Support less than 2-inch trade size, vertically run conduit at intervals no greater than 8 feet. Support such conduits 2-inch trade size or larger, at intervals no greater than the story height, or 15 ft. Whichever is smaller.

D. Where they are not embedded in concrete, support less than 1" trade size, horizontally run conduits at intervals no greater than 7 ft. Support such conduits, 1" trade size or larger, at intervals no greater than 10 ft.

E. Include supporting frames or racks extending from slab to slab for work indicated as being supported from walls where the walls are incapable of supporting the weight.

F. Include supporting frames or racks for equipment, intended for vertical surface mounting, which is required in a free-standing position.

G. Except for branch circuitry install all conduit in hung ceiling space on acceptable hangers and inserts. Conduit or metal clad cable for branch circuitry shall be supported by clamps or pipe straps secured to the ceiling support system (black iron), from structural members or from the deck. Support from ceiling tees, cross tees or support wires is prohibited.

2.9 GROUNDING

A. Provide a green ground conductor in all circuits.

B. Provide supplementary ground bonding where metallic conduits terminate at metal clad equipment (or at the metal pull box of equipment) for which a ground bus is specified. Accomplish this by equipping the conduits with a bushing of the grounding type connected individually to ground bus.

C. All ground wires shall be suitably protected from mechanical injury.

D. Acceptable Manufacturers: Erico, Burndy, Thomas & Betts.

2.10 MOTOR STARTERS

A. Each motor, except as noted on floor plans, shall be provided with a Full Voltage Non-reversing (FVNR) magnetic starter. Coordinate requirements with the mechanical contractor. For each starter unit, furnish hand off auto (HOA) selector switches, control power transformer, motor circuit protector, thermal overload protection sized for motor, and (2) normally open (NO) and (2) normally closed (NC) contacts. Provide red and green indicating lights for each starter.

B. Furnish manually operated motor starters of the proper size for all motors less than 1/2 HP. Starters for motors 175 Watts or less shall consist of a snap switch with thermal overload protection where such protection is not an integral part of the motor.

C. All starters shall be assembled and internally wired with all devices in conformance with NEMA standards.

D. Disconnect switches are provided by the electrical contractor if not integral with equipment.

PART 3 - EXECUTION

3.1 GENERAL

A. All control wiring associated with mechanical equipment is the responsibility of the mechanical contractor.

B. All data/voice/communication wiring and devices shall be installed by other contractors and is not included in this contract.

C. Openings around electrical penetrations through fire resistance rated walls, partitions, floors, or ceilings shall be fire stopped using approved methods.

D. Provide danger labeling at all equipment and junction/pull boxes per code.

E. All panelboard covers shall be replaced at the completion of each day's work.

F. Provide a typewritten panelboard schedule that clearly indicates all loads supplied by each branch circuit installed on the new and existing panelboard schedule. This includes providing an updated panelboard schedule for existing panelboards when branch circuits are modified or added as part of the scope of work. The list shall be mounted in a steel frame under a plastic cover window. Each panelboard shall be externally tagged with permanent plate indicating panelboard identification, voltage, and the distribution equipment feeding the panelboard.

G. Maintain ground continuity throughout all systems.

H. The contractor shall remove and/or relocate any existing electrical work which interferes with the new installation. All exposed abandoned conduit and wiring shall be removed. The contractor shall cut back all abandoned conduit and wiring to floor, or demising wall of the space. This work may not be represented on the drawings but should be taken into account by the contractor in their proposal.

I. Electrical contractor shall maintain continuity of circuitry for existing equipment and devices that are to remain. Where outlets are removed and are not at the circuit dead end, extend circuitry as required to maintain integrity of original circuit. Where a wiring device is to be removed and that wall is to remain the electrical contractor shall remove branch circuitry from its source and fill-in outlet box. Blank plates will not be permitted.

J. Prior to any chasing, chopping, or core drilling being performed, the contractor shall field investigate conditions and coordinate with all appropriate trades to ensure that work will be in harmony with other work and not affect any existing building systems. This work must be approved by Building Management prior to proceeding.

K. At the completion of the life safety system installation the contractor shall test all emergency lighting devices and submit a report to the Engineer verifying that the systems are fully operational.

L. Furnish and install wiring for adequate light and small tools power for the project. This shall include stringers, lamps, outlets, breakers, and fusing, as is necessary.

M. Mounting heights: Disconnect switches or enclosed CB's: 6'-6" to handle. Panelboards: 6'-6" to MCB or top circuit breaker (if no MCB) transformers: (where hung) - as close as possible to slab above but no less than manufacturers clearance requirements.

N. Where panelboards, switches, circuit breakers, transformers, etc. Are existing to be reused the contractor shall clean and refurbish the equipment. This shall include tightening all connections, replacing defective mechanisms, exercising mechanisms and providing any miscellaneous components so the equipment is in first class working order.

O. Provide seismic restraints for all equipment, including all structural steel members, inserts, anchors, wires and the required assembly thereof. All seismic restraints shall be designed and constructed in accordance with all local codes and ordinances having jurisdiction.

P. Provide labeling at each outlet, disconnect switch, and hardwired equipment indicating panelboard number and circuit number. Use "Brother P-Touch" or similar.