

PROJECT MANUAL

**MMC Library
Renovation
Portland, Maine**

Project No: 11022

**"Construction Documents"
Issued May 10, 2012**

Prepared By:

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TABLE OF CONTENTS

SECTIONS	PAGES
DIVISION 01 - GENERAL REQUIREMENTS	
SECTION 011000 - SUMMARY	3
SECTION 012500 - SUBSTITUTION PROCEDURES	3
SECTION 012600 - CONTRACT MODIFICATION PROCEDURES	2
SECTION 012900 - PAYMENT PROCEDURES	4
SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION	7
SECTION 013200 - CONSTRUCTION PROGRESS DOCUMENTATION	4
SECTION 013300 - SUBMITTAL PROCEDURES	9
SECTION 014000 - QUALITY REQUIREMENTS	7
SECTION 014200 - REFERENCES	3
SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS	4
SECTION 017419 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL	5
SECTION 017700 - CLOSEOUT PROCEDURES	5
SECTION 017823 - OPERATION AND MAINTENANCE DATA	5
SECTION 017839 - PROJECT RECORD DOCUMENTS	3
DIVISION 02 - EXISTING CONDITIONS	
SECTION 024119 - SELECTIVE STRUCTURE DEMOLITION	5
DIVISION 03 - 05	
NOT USED	
DIVISION 06 - WOOD, PLASTICS, AND COMPOSITES	
SECTION 061000 - ROUGH CARPENTRY	4
SECTION 064023 - INTERIOR ARCHITECTURAL WOODWORK	5
DIVISION 07 - THERMAL AND MOISTURE PROTECTION	
SECTION 078413 - PENETRATION FIRESTOPPING	3
SECTION 078446 - FIRE-RESISTIVE JOINT SYSTEMS	3
SECTION 079200 - JOINT SEALANTS	6
DIVISION 08 - OPENINGS	
SECTION 081113 - HOLLOW METAL FRAMES	4
SECTION 081416 - FLUSH WOOD DOORS	3
SECTION 083113 - ACCESS DOORS AND FRAMES	3
SECTION 087100 - FINISH HARDWARE	11
SECTION 088000 - GLAZING	5
SECTION 088113 - DECORATIVE GLASS GLAZING	3
DIVISION 09 - FINISHES	
SECTION 092216 - NON-STRUCTURAL METAL FRAMING	4
SECTION 092900 - GYPSUM BOARD	3
SECTION 095113 - SUSPENDED ACOUSTICAL PANEL CEILINGS	3
SECTION 096513 - RESILIENT BASE AND ACCESSORIES	3
SECTION 096813 - TILE CARPETING	4
SECTION 096816 - SHEET CARPETING	4

SECTION 099123 - INTERIOR PAINTING	4
DIVISION 10 - SPECIALTIES	
SECTION 101100 - VISUAL DISPLAY SURFACES	4
SECTION 104413 - FIRE EXTINGUISHER CABINETS	3
SECTION 104416 - FIRE EXTINGUISHERS	2
DIVISION 11 - 14	
NOT USED	
DIVISION 21 - FIRE SUPPRESSION	
SECTION 210000 - FIRE PROTECTION	11
DIVISION 22 - PLUMBING	
NOT USED	
DIVISION 23 - HEATING, VENTILATING, AND AIR CONDITIONING	
SECTION 230000 - HEATING, VENTILATION, AND AIR CONDITIONING	88
DIVISION 24-25	
NOT USED	
DIVISION 26 - ELECTRICAL	
SECTION 260000 - ELECTRICAL	59
DIVISION 27-33	
NOT USED	

SECTION 011000 - SUMMARY

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Project information.
2. Work covered by Contract Documents.
3. Access to site.
4. Work restrictions.
5. Specification and drawing conventions.

B. Related Section:

1. Division 01 Section "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.

1.2 PROJECT INFORMATION

A. Project Identification: Maine Medical Center Library Renovation, Project No. 11022.

1. Project Location: Maine Medical Center, Portland, Maine.

B. Owner: Maine Medical Center.

C. Architect: Canal 5 Studio.

1. Address: One Canal Plaza, Portland, Maine 04101.
2. Telephone: 207-553-2115.

D. Construction Manager: Hebert Construction.

1.3 WORK COVERED BY CONTRACT DOCUMENTS

A. The Work of the Project is defined by the Contract Documents and consists of the following:

1. Project involves renovation to approximately 5,000 s. f. of library space at Maine Medical Center 5th floor. Scope of Work includes new partitions to enclose office, meeting, study, and conference rooms, and new finishes, including flooring and ceiling, throughout. Upgrades and modifications to building systems, such as mechanical, electrical, sprinkler, and life safety are included.

B. Type of Contract:

1. Project will be constructed under a single prime contract.

1.4 ACCESS TO SITE

- A. General: Contractor shall have full use of Project site for construction operations during construction period. Contractor's use of Project site is limited only by Owner's right to perform work or to retain other contractors on portions of Project.

1.5 WORK RESTRICTIONS

- A. Work Restrictions, General: Comply with restrictions on construction operations.
 1. Comply with limitations on use of public streets and other requirements of authorities having jurisdiction.
- B. On-Site Work Hours: Limit work in the existing building to normal business working hours of 7:00 a.m. to 5:00 p.m., Monday through Friday, except as otherwise indicated.
- C. 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 Architect not less than two days in advance of proposed disruptive operations.
- D. Nonsmoking Building: Smoking is not permitted within the building or within 25 feet of entrances, operable windows, or outdoor air intakes.
- E. Controlled Substances: Use of tobacco products and other controlled substances on the Project site is not permitted.

1.6 SPECIFICATION AND DRAWING CONVENTIONS

- A. 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. Imperative mood and streamlined language are generally used in the Specifications. 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.
 2. Where "Owner" is indicated in this manual, "Owner" shall refer to the Owner as listed in Section 011000 Article 1.2 B.
 3. Specification requirements are to be performed by Contractor unless specifically stated otherwise.
- B. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.

- C. Drawing Coordination: Requirements for materials and products identified on the Drawings are described in detail in the Specifications. One or more of the following are used on the 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.
 3. Keynoting: Materials and products are identified by reference keynotes referencing Specification Section numbers found in this Project Manual.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 011000

Issued for Construction

MMC Library Renovation
Portland, Maine
Project No.: 11022

SECTION 012500 - SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for substitutions.

1.2 DEFINITIONS

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

1.3 ACTION SUBMITTALS

- A. 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 product or fabrication or installation cannot be provided, if applicable.
 - b. Coordination information, including a list of changes or revisions 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. Include annotated copy of applicable Specification Section. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.
 - d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
 - e. Samples, where applicable or requested.
 - f. Certificates and qualification data, where applicable or requested.
 - g. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners.
 - h. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
 - i. Research reports evidencing compliance with building code in effect for Project, from ICC-ES.
 - j. 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 date of receipt of purchase order, lack of availability, or delays in delivery.

- k. Cost information, including a proposal of change, if any, in the Contract Sum.
 - l. Contractor's certification that proposed substitution complies with requirements in the Contract Documents except as indicated in substitution request, is compatible with related materials, and is appropriate for applications indicated.
 - m. 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. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within seven days of receipt of a request for substitution. Architect will notify Contractor of acceptance or rejection of proposed substitution within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.
- a. Forms of Acceptance: Change Order, Construction Change Directive, or Architect's Supplemental Instructions for minor changes in the Work.
 - b. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.

1.4 QUALITY ASSURANCE

- A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage a qualified testing agency to perform compatibility tests recommended by manufacturers.

PART 2 - PRODUCTS

2.1 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: Architect will consider Contractor's request for substitution when the following conditions are satisfied:
 - 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. Requested substitution will not adversely affect Contractor's construction schedule.

- d. Requested substitution has received necessary approvals of authorities having jurisdiction.
- e. Requested substitution is compatible with other portions of the Work.
- f. Requested substitution has been coordinated with other portions of the Work.
- g. Requested substitution provides specified warranty.
- h. 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.

PART 3 - EXECUTION (Not Used)

END OF SECTION 012500

Issued for Construction

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Portland, Maine
Project No.: 11022

SECTION 012600 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for handling and processing Contract modifications.

1.2 MINOR CHANGES IN THE WORK

- A. Architect 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, "Architect's Supplemental Instructions."

1.3 PROPOSAL REQUESTS

- A. Owner-Initiated Proposal Requests: Architect 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 Architect are not instructions either to stop work in progress or to execute the proposed change.
 - 2. Within time specified in Proposal Request or 20 days, when not otherwise specified, after receipt of Proposal Request, submit a quotation 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.
 - e. Quotation Form: Use forms acceptable to Architect.
- B. Contractor-Initiated Proposals: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to Architect.
 - 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 "Substitution Procedures" if the proposed change requires substitution of one product or system for product or system specified.
 7. Proposal Request Form: Use form acceptable to Architect.

1.4 CHANGE ORDER PROCEDURES

- A. On Owner's approval of a Proposal Request, Architect will issue a Change Order for signatures of Owner and Contractor on AIA Document G701.

1.5 CONSTRUCTION CHANGE DIRECTIVE

- A. Construction Change Directive: Architect 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

1.1 SUMMARY

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

1.2 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. Submittal schedule.
 - c. Items required to be indicated as separate activities in Contractor's construction schedule.
 - 2. Submit the schedule of values to Architect 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.
 - 1. Identification: Include the following Project identification on the schedule of values:
 - a. Project name and location.
 - b. Name of Architect.
 - c. Architect's project number.
 - d. Contractor's name and address.
 - e. Date of submittal.
 - 2. Arrange schedule of values consistent with format of AIA Document G703.
 - 3. 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 multiple line items for principal subcontract amounts in excess of five percent of Contract Sum.
 - a. Include separate line items under Contractor and principal subcontracts for project closeout requirements in an amount totaling five percent of the Contract Sum and subcontract amount.

4. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
5. 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.
6. 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.
7. Allowances: Provide a separate line item in the schedule of values for each allowance. Show line-item value of unit-cost allowances, as a product of the unit cost, multiplied by measured quantity. Use information indicated in the Contract Documents to determine quantities.
8. 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.
9. 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.

1.3 APPLICATIONS FOR PAYMENT

- A. Each Application for Payment shall be consistent with previous applications and payments as certified by Architect 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: Progress payments shall be submitted to Architect by the tenth of the month. The period covered by each Application for Payment is one month, ending on the last day of the month.
- C. Application for Payment Forms: Use AIA Document G702 and AIA Document G703 as form for Applications for Payment.
- D. Application for Payment Forms: Use forms provided by Owner for Applications for Payment. Sample copies are included in the Project Manual.
- E. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Architect 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.

- F. Transmittal: Submit three signed and notarized original copies of each Application for Payment to Architect by a method ensuring receipt within 24 hours. One copy shall include waivers of lien and similar attachments if required.
1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.
- G. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's lien from entities 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 conditional 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. Schedule of unit prices.
 5. Submittal schedule (preliminary if not final).
 6. List of Contractor's staff assignments.
 7. List of Contractor's principal consultants.
 8. Copies of building permits.
 9. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
 10. Initial progress report.
 11. Report of preconstruction conference.
 12. Certificates of insurance and insurance policies.
- I. 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.
1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
 2. This application shall reflect Certificates of Partial Substantial Completion issued previously for Owner occupancy of designated portions of the Work.
- J. 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 G706-1994, "Contractor's Affidavit of Payment of Debts and Claims."
5. AIA Document G706A-1994, "Contractor's Affidavit of Release of Liens."
6. AIA Document G707-1994, "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.
9. Final liquidated damages settlement statement.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012900

SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
 - 1. Coordination drawings.
 - 2. Requests for Information (RFIs).
 - 3. Project meetings.

1.2 DEFINITIONS

- A. RFI: Request from Owner, Architect, or Contractor seeking information from each other during construction.

1.3 COORDINATION

- 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 to ensure maximum performance and accessibility for required maintenance, service, and repair.
 - 3. Make adequate provisions to accommodate items scheduled for later installation.
- 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 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. Progress meetings.
6. Preinstallation conferences.
7. Startup and adjustment of systems.
8. Project closeout activities.

1.4 COORDINATION DRAWINGS

- A. Coordination Drawings, General: Prepare coordination drawings in accordance with requirements in individual Sections, where installation is not completely shown on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.
1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:
 - a. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
 - b. Indicate dimensions shown on the Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Architect indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.
- B. Coordination Drawing Organization: Organize coordination drawings as follows:
1. Floor Plans and Reflected Ceiling Plans: Show architectural and structural elements, and mechanical, plumbing, fire protection, fire alarm, and electrical Work. Show locations of visible ceiling-mounted devices relative to acoustical ceiling grid.
 2. Structural Penetrations: Indicate penetrations and openings required for all disciplines.
 3. Slab Edge and Embedded Items: Indicate slab edge locations and sizes and locations of embedded items for metal fabrications, sleeves, anchor bolts, bearing plates, angles, door floor closers, slab depressions for floor finishes, curbs and housekeeping pads, and similar items.
 4. Review: Architect will review coordination drawings to confirm that the Work is being coordinated, but not for the details of the coordination, which are the Contractor's responsibility.

1.5 REQUESTS FOR INFORMATION (RFIs)

- A. General: Immediately on discovery of the need for additional information or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.

1. Architect will return RFIs submitted to Architect by other entities controlled by Contractor 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 information or interpretation and the following:
1. Project name.
 2. Project number.
 3. Date.
 4. Name of Contractor.
 5. Name of Architect.
 6. RFI number, numbered sequentially.
 7. RFI subject.
 8. Specification Section number and title and related paragraphs, as appropriate.
 9. Drawing number and detail references, as appropriate.
 10. Field dimensions and conditions, as appropriate.
 11. Contractor's suggested resolution. If Contractor's solution(s) impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
 12. Contractor's signature.
 13. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.
- C. RFI Forms: AIA Document G716.
- D. Architect's Action: Architect will review each RFI, determine action required, and respond. Allow seven working days for Architect's response for each RFI. RFIs received by Architect after 1:00 p.m. will be considered as received the following working day.
1. The following RFIs will be returned without action:
 - a. Requests for approval of submittals.
 - b. Requests for approval of substitutions.
 - c. Requests for coordination information already indicated in the Contract Documents.
 - d. Requests for adjustments in the Contract Time or the Contract Sum.
 - e. Requests for interpretation of Architect's actions on submittals.
 - f. Incomplete RFIs or inaccurately prepared RFIs.
 2. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt of additional information.
 3. Architect'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 Architect in writing within 10 days of receipt of the RFI

response.

- E. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect within seven days if Contractor disagrees with response.
- F. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly. Use CSI Log Form 13.2B.
 - 1. Project name.
 - 2. Name and address of Contractor.
 - 3. Name and address of Architect.
 - 4. RFI number including RFIs that were dropped and not submitted.
 - 5. RFI description.
 - 6. Date the RFI was submitted.
 - 7. Date Architect's response was received.
 - 8. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.
 - 9. Identification of related Field Order, Work Change Directive, and Proposal Request, as appropriate.

1.6 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 Owner and Architect of scheduled meeting dates and times.
 - 2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
 - 3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Architect, within three days of the meeting.
- B. Preconstruction Conference: Schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than 15 days after execution of the Agreement.
 - 1. Attendees: Authorized representatives of Owner, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. 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. Phasing.
 - c. Critical work sequencing and long-lead items.

- d. Designation of key personnel and their duties.
 - e. Procedures for processing field decisions and Change Orders.
 - f. Procedures for RFIs.
 - g. Procedures for testing and inspecting.
 - h. Procedures for processing Applications for Payment.
 - i. Distribution of the Contract Documents.
 - j. Submittal procedures.
 - k. Sustainable design requirements.
 - l. Preparation of record documents.
 - m. Use of the premises.
 - n. Work restrictions.
 - o. Working hours.
 - p. Owner's occupancy requirements.
 - q. Responsibility for temporary facilities and controls.
 - r. Procedures for moisture and mold control.
 - s. Procedures for disruptions and shutdowns.
 - t. Construction waste management and recycling.
 - u. Parking availability.
 - v. Office, work, and storage areas.
 - w. Equipment deliveries and priorities.
 - x. First aid.
 - y. Security.
 - z. Progress cleaning.
3. Minutes: Entity responsible for conducting meeting 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 Architect 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. Contract Documents.
 - b. Options.
 - c. Related RFIs.
 - d. Related Change Orders.
 - e. Purchases.
 - f. Deliveries.
 - g. Submittals.
 - h. Review of mockups.
 - i. Possible conflicts.
 - j. Compatibility problems.
 - k. Time schedules.
 - l. Weather limitations.

- m. Manufacturer's written recommendations.
 - n. Warranty requirements.
 - o. Compatibility of materials.
 - p. Acceptability of substrates.
 - q. Temporary facilities and controls.
 - r. Space and access limitations.
 - s. Regulations of authorities having jurisdiction.
 - t. Testing and inspecting requirements.
 - u. Installation procedures.
 - v. Coordination with other work.
 - w. Required performance results.
 - x. Protection of adjacent work.
 - y. Protection of construction and personnel.
3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
 4. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.
 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: Progress meetings at monthly intervals.

1. Attendees: In addition to representatives of Owner and Architect, each Contractor, 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 meeting 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) Status of submittals.
 - 4) Deliveries.
 - 5) Off-site fabrication.

- 6) Access.
 - 7) Site utilization.
 - 8) Temporary facilities and controls.
 - 9) Progress cleaning.
 - 10) Quality and work standards.
 - 11) Status of correction of deficient items.
 - 12) Field observations.
 - 13) Status of 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: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.
- 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

Issued for Construction

MMC Library Renovation
Portland, Maine
Project No.: 11022

SECTION 013200 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 SUMMARY

- A. 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.

1.2 DEFINITIONS

- A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction project. Activities included in a construction schedule consume time and resources.
 - 1. Critical Activity: An activity on the critical path that must start and finish on the planned early start and finish times.
 - 2. Predecessor Activity: An activity that precedes another activity in the network.
 - 3. Successor Activity: An activity that follows another activity in the network.

1.3 INFORMATIONAL SUBMITTALS

- A. Format for Submittals: Submit required submittals in the following format:
 - 1. PDF electronic file.
- B. Start-up Network Diagram: Of size required to display entire network for entire construction period. Show logic ties for activities.
- C. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.
 - 1. Submit a working electronic copy of schedule, using software indicated, and labeled to comply with requirements for submittals. Include type of schedule (initial or updated) and date on label.
- D. Daily Construction Reports: Submit at monthly intervals.
- E. Field Condition Reports: Submit at time of discovery of differing conditions.

1.4 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, submittal schedule, progress reports, payment requests, and other required schedules and reports.
 - 1. Secure time commitments for performing critical elements of the Work from entities involved.
 - 2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

PART 2 - PRODUCTS

2.1 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

- A. Time Frame: Extend schedule from date established for the Notice to Proceed 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. Activities: Treat each story or separate area as a separate numbered activity for each principal element of the Work. Comply with the following:
 - 1. Activity Duration: Define activities so no activity is longer than 20 days, unless specifically allowed by Architect.
 - 2. Procurement Activities: Include procurement process activities for the following long lead items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
 - 3. Submittal Review Time: Include review and resubmittal times indicated in Division 01 Section "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's construction schedule with submittal schedule.
 - 4. Startup and Testing Time: Include not less than 15 days for startup and testing.
 - 5. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Architect's administrative procedures necessary for certification of Substantial Completion.
 - 6. Punch List and Final Completion: Include not more than 30 days for punch list and final completion.
- C. 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.
- D. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and final completion.
- E. Upcoming Work Summary: Prepare summary report indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:
1. Unresolved issues.
 2. Unanswered RFIs.
 3. Rejected or unreturned submittals.
 4. Notations on returned submittals.
- F. Recovery Schedule: When periodic update indicates the Work is 14 or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule.
- 2.2 CONTRACTOR'S CONSTRUCTION SCHEDULE (GANTT CHART)
- A. Gantt-Chart Schedule: Submit a comprehensive, fully developed, horizontal Gantt-chart-type, Contractor's construction schedule within 30 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.
1. For construction activities that require three months or longer to complete, indicate an estimated completion percentage in 10 percent increments within time bar.
- 2.3 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, including presence of rain or snow.
 7. Accidents.
 8. Meetings and significant decisions.
 9. Unusual events.
 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 Information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

PART 3 - EXECUTION

3.1 CONTRACTOR'S CONSTRUCTION SCHEDULE

- A. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one week before each regularly scheduled progress meeting.
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 final completion percentage for each activity.
- B. Distribution: Distribute copies of approved schedule to Architect, Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.

1. Post copies in Project meeting rooms and temporary field offices.
2. 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

Issued for Construction

MMC Library Renovation
Portland, Maine
Project No.: 11022

SECTION 013300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes requirements for the submittal schedule and administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.
- B. Related Sections:
 - 1. Division 01 Section "Construction Progress Documentation" for submitting schedules and reports, including Contractor's construction schedule.
 - 2. Division 01 Section "Operation and Maintenance Data" for submitting operation and maintenance manuals.
 - 3. Division 01 Section "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.

1.2 DEFINITIONS

- A. Action Submittals: Written and graphic information and physical samples that require Architect's responsive action.
- B. Informational Submittals: Written and graphic information and physical samples that do not require Architect's responsive action. Submittals may be rejected for not complying with requirements.

1.3 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 modifications to submittals noted by the Architect and additional time for handling and reviewing submittals required by those corrections.

1.4 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

- A. Architect's Digital Data Files: Electronic copies of CAD Drawings of the Contract Drawings will be provided by Architect for Contractor's use in preparing submittals.
 - 1. Architect will furnish Contractor one set of digital data drawing files of the Contract Drawings for use in preparing Shop Drawings and Project record drawings.

- a. Architect makes no representations as to the accuracy or completeness of digital data drawing files as they relate to the Contract Drawings.
 - b. Contractor shall execute a data licensing agreement in the form of AIA Document C106, Digital Data Licensing Agreement.
- 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. 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. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
- C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect'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.
1. Initial Review: Allow 15 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
 2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
 3. Resubmittal Review: Allow 15 days for review of each resubmittal.
- D. Identification and Information: Place a permanent label or title block on each paper copy 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 Contractor's review and approval markings and action taken by Architect.
 3. Include the following information for processing and recording action taken:
 - a. Project name.
 - b. Date.
 - c. Name of Architect.
 - d. Name of Construction Manager.
 - e. Name of Contractor.
 - f. Name of subcontractor.
 - g. Name of supplier.
 - h. Name of manufacturer.
 - i. 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., 061000.01).

Resubmittals shall include an alphabetic suffix after another decimal point (e.g., 061000.01.A).

- j. Number and title of appropriate Specification Section.
 - k. Drawing number and detail references, as appropriate.
 - l. Location(s) where product is to be installed, as appropriate.
 - m. Other necessary identification.
- E. Identification and Information: Identify and incorporate information in each electronic submittal file as follows:
- 1. Assemble complete submittal package into a single indexed file with links enabling navigation to each item.
 - 2. Name file with submittal number or other unique identifier, including revision identifier.
 - 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).
 - 3. Provide means for insertion to permanently record Contractor's review and approval markings and action taken by Architect.
 - 4. Include the following information on an inserted cover sheet:
 - a. Project name.
 - b. Date.
 - c. Name and address of Architect.
 - d. Name of Construction Manager.
 - e. Name of Contractor.
 - f. Name of firm or entity that prepared submittal.
 - g. Name of subcontractor.
 - h. Name of supplier.
 - i. Name of manufacturer.
 - j. Number and title of appropriate Specification Section.
 - 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. Other necessary identification.
- F. Options: Identify options requiring selection by the Architect.
- G. Deviations: Identify deviations from the Contract Documents on submittals.
- H. Additional Paper Copies: Unless additional copies are required for final submittal, and unless Architect observes noncompliance with provisions in the Contract Documents, initial submittal may serve as final submittal.
- 1. Submit one copy of submittal to concurrent reviewer in addition to specified number of copies to Architect.

- I. Transmittal: Assemble each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form. Architect will return submittals, without review, received from sources other than Contractor.
 - 1. Transmittal Form: Use AIA Document G810.
 - 2. On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Architect on previous submittals, and deviations from requirements in the Contract Documents, including minor variations and limitations. Include same identification information as related submittal.
- J. 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 with approval notation from Architect's action stamp.
- K. 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.
- L. Use for Construction: Use only final submittals that are marked with approval notation from Architect's action stamp.

PART 2 - PRODUCTS

2.1 SUBMITTAL PROCEDURES

- A. General Submittal Procedure Requirements:
 - 1. Post electronic submittals as PDF electronic files directly to Architect's FTP site specifically established for Project.
 - a. Architect will return annotated file. Annotate and retain one copy of file as an electronic Project record document file.
 - 2. Submit electronic submittals via email as PDF electronic files.
 - a. Architect will return annotated file. Annotate and retain one copy of file as an electronic Project record document file.
 - 3. Closeout Submittals and Maintenance Material Submittals: Comply with requirements specified in Division 01 Section "Closeout Procedures."
 - 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.
5. Test and Inspection Reports Submittals: Comply with requirements specified in Division 01 Section "Quality Requirements."
- 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 published 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 catalog cuts.
 - b. Manufacturer's product specifications.
 - c. Standard color charts.
 - d. Statement of compliance with specified referenced standards.
 - e. Testing by recognized testing agency.
 - f. Application of testing agency labels and seals.
 - g. Notation of coordination requirements.
 - h. Availability and delivery time information.
 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:
 - a. PDF electronic file.
- C. 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, unless submittal based upon Architect's digital data drawing files is otherwise permitted.
1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
 - a. Identification of products.
 - b. Schedules.
 - c. Compliance with specified standards.

- d. Notation of coordination requirements.
 - e. Notation of dimensions established by field measurement.
 - f. Relationship and attachment to adjoining construction clearly indicated.
 - g. Seal and signature of professional engineer if specified.
2. Submit Shop Drawings in the following format:
 - a. PDF electronic file.
- D. 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 applicable 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 one full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect 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 sets of Samples. Architect will retain two Sample

sets; remainder will be returned. Mark up and retain one returned Sample set as a Project record sample.

1) 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.

- E. Product Schedule: 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. Submit product schedule in the following format:
 - a. PDF electronic file.
- F. Contractor's Construction Schedule: Comply with requirements specified in Division 01 Section "Construction Progress Documentation."
- G. Application for Payment: Comply with requirements specified in Division 01 Section "Payment Procedures."
- H. Schedule of Values: Comply with requirements specified in Division 01 Section "Payment Procedures."
- I. 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. Use CSI Form 1.5A.
 - 1. Submit subcontract list in the following format:
 - a. PDF electronic file.
- J. Coordination Drawings: Comply with requirements specified in Division 01 Section "Project Management and Coordination."
- K. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.
- L. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification and Procedure Qualification Record on American Welding Society (AWS) forms. Include names of firms and personnel certified.
- M. Installer Certificates: Submit 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.
- N. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying

that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.

- O. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
- P. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
- Q. Material Test Reports: Submit 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.
- R. Product Test Reports: Submit 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.
- S. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project.
- T. Schedule of Tests and Inspections: Comply with requirements specified in Division 01 Section "Quality Requirements."
- U. Preconstruction Test Reports: Submit 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.
- V. Compatibility Test Reports: Submit 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.
- W. Field Test Reports: Submit reports 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.
- X. Maintenance Data: Comply with requirements specified in Division 01 Section "Operation and Maintenance Data."
- Y. Design Data: Prepare and submit 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.

2.2 DELEGATED-DESIGN SERVICES

- 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 Architect.
- B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally-signed PDF electronic file and three paper copies of certificate, 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

3.1 CONTRACTOR'S REVIEW

- A. Action and Informational Submittals: 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 Architect.
- B. Project Closeout and Maintenance/Material Submittals: Refer to 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.

3.2 ARCHITECT'S ACTION

- A. General: Architect will not review submittals that do not bear Contractor's approval stamp and will return them without action.
- B. Action Submittals: Architect will review each submittal, make marks to indicate corrections or modifications required, and return it. Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action.
- C. Informational Submittals: Architect will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.

- D. Incomplete 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

1.1 SUMMARY

- A. 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. 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.
 - 2. Requirements for Contractor to provide quality-assurance and -control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.

1.2 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 Architect.
- C. Mockups: Full size physical assemblies that are constructed on-site. Mockups are constructed to verify selections made under sample submittals; to demonstrate aesthetic effects and, where indicated, qualities of materials and execution; to review coordination, testing, or operation; to show interface between dissimilar materials; and to demonstrate compliance with specified installation tolerances. Mockups are not Samples. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged.
- D. Preconstruction Testing: Tests and inspections 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 specified requirements.

- 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. Use of trade-specific terminology in referring to a trade or entity does not require that certain construction activities be performed by accredited or unionized individuals, or that requirements specified apply exclusively to specific trade or trades.
- J. Experienced: When used with an entity or individual, "experienced" means having successfully completed a minimum of five previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

1.3 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 Architect 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 Architect for a decision before proceeding.

1.4 INFORMATIONAL SUBMITTALS

- A. Testing Agency Qualifications: 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.

1.5 REPORTS AND DOCUMENTS

- A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. 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.

B. Manufacturer's Field Reports: Prepare written information documenting tests and inspections specified in other Sections. Include the following:

1. Name, address, and telephone number of representative making report.
2. Statement on condition of substrates and their acceptability for installation of product.
3. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
4. Results of operational and other tests and a statement of whether observed performance complies with requirements.
5. Other required items indicated in individual Specification Sections.

C. 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.

1.6 QUALITY ASSURANCE

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

B. 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.

C. 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.

D. 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.

- E. **Professional Engineer Qualifications:** A professional engineer who is legally qualified to practice in jurisdiction where Project is located 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 Specification Sections 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. Requirements of authorities having jurisdiction shall supersede requirements for specialists.
- 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 329; 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. **Manufacturer's Representative Qualifications:** An authorized representative of manufacturer who is trained and approved by manufacturer to observe and 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. Build laboratory mockups at testing facility using personnel, products, and methods of construction indicated for the completed Work.
 - d. When testing is complete, remove test specimens, assemblies, 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 Architect, 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 Architect.
2. Notify Architect 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 Architect'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, unless otherwise indicated.

1.7 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. 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.
- B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities required to verify that the Work complies with requirements, 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 manufacturer's representative to observe and inspect the Work. Manufacturer's representative's services include examination of substrates and conditions, verification of materials, inspection of completed portions of the Work, and submittal of written reports.

- 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 Architect and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
1. Notify Architect 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. Preliminary design mix proposed for use for material mixes that require control by testing agency.
 6. 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.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 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 or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible.
- 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

Issued for Construction

MMC Library Renovation
Portland, Maine
Project No.: 11022

SECTION 014200 - REFERENCES

PART 1 - GENERAL

1.1 DEFINITIONS

- A. General: Basic Contract definitions are included in the Conditions of the Contract.
- B. "Approved": When used to convey Architect's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.
- C. "Directed": A command or instruction by Architect. 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.

1.2 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.

1.3 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 in the following list.

AA	Aluminum Association, Inc. (The)
AAMA	American Architectural Manufacturers Association
AF&PA	American Forest & Paper Association
AGC	Associated General Contractors of America (The)
AIA	American Institute of Architects (The)
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
ALSC	American Lumber Standard Committee, Incorporated
ANSI	American National Standards Institute
APA	APA - The Engineered Wood Association
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers
ASME	American Society of Mechanical Engineers International
ASTM	American Society for Testing and Materials International
AWI	Architectural Woodwork Institute
AWPA	American Wood Protection Association
AWS	American Welding Society
BHMA	Builders Hardware Manufacturers Association
CPA	Composite Panel Association
CRI	Carpet and Rug Institute (The)
CSI	Construction Specifications Institute (The)
DHI	Door and Hardware Institute
GA	Gypsum Association
GANA	Glass Association of North America
HPVA	Hardwood Plywood & Veneer Association
IGCC	Insulating Glass Certification Council
IGMA	Insulating Glass Manufacturers Alliance
MFMA	Metal Framing Manufacturers Association, Inc.
MPI	Master Painters Institute
NAAMM	National Association of Architectural Metal Manufacturers
NECA	National Electrical Contractors Association
NeLMA	Northeastern Lumber Manufacturers' Association
NEMA	National Electrical Manufacturers Association
NFPA	NFPA (National Fire Protection Association)
NGA	National Glass Association
NHLA	National Hardwood Lumber Association
NLGA	National Lumber Grades Authority
PDCA	Painting & Decorating Contractors of America
SDI	Steel Door Institute
SEI/ASCE	Structural Engineering Institute/American Society of Civil Engineers
SGCC	Safety Glazing Certification Council
SMACNA	Sheet Metal and Air Conditioning Contractors' National Association
SPIB	Southern Pine Inspection Bureau (The)

SSPC	SSPC: The Society for Protective Coatings
TCNA	Tile Council of North America, Inc.
UL	Underwriters Laboratories Inc.
WDMA	Window & Door Manufacturers Association
WMMPA	Wood Moulding & Millwork Producers Association

- B. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list.

IAPMO	International Association of Plumbing and Mechanical Officials
IBC	International Building Code
ICC	International Code Council
ICC-ES	ICC Evaluation Service, Inc.

- C. Federal Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list.

CPSC	Consumer Product Safety Commission
DOE	Department of Energy
EPA	Environmental Protection Agency
LBL	Lawrence Berkeley National Laboratory
NIST	National Institute of Standards and Technology
OSHA	Occupational Safety & Health Administration
ADAAG	Americans with Disabilities Act (ADA) Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities
CFR	Code of Federal Regulations
UFAS	Uniform Federal Accessibility Standards

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 014200

Issued for Construction

MMC Library Renovation
Portland, Maine
Project No.: 11022

SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes requirements for security and protection facilities, and moisture and mold control.

1.2 USE CHARGES

- A. General: Installation and removal of and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities to use temporary services and facilities without cost, including, but not limited to, Architect, testing agencies, and authorities having jurisdiction.
- B. Water and Sewer Service from Existing System: Water from Owner's existing water system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.

1.3 QUALITY ASSURANCE

- A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.
- B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.
- C. Accessible Temporary Egress: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1.

1.4 PROJECT CONDITIONS

- A. Temporary Use of Permanent Facilities: Engage installer of each permanent service to assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.
- B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.2 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.
- B. Temporary Partitions: Provide floor-to-ceiling dustproof partitions to limit dust and dirt migration and to separate areas occupied by Owner and tenants from fumes and noise.
 - 1. Construct dustproof partitions with gypsum wallboard with joints taped on occupied side, and fire-retardant plywood on construction operations side.
 - 2. Construct dustproof partitions with two layers of 6-mil polyethylene sheet on each side. Cover floor with two layers of 6-mil polyethylene sheet, extending sheets 18 inches up the sidewalls. Overlap and tape full length of joints. Cover floor with fire-retardant treated plywood.
 - a. Construct vestibule and airlock at each entrance through temporary partition with not less than 48 inches between doors. Maintain water-dampened foot mats in vestibule.
 - 3. Where fire-resistance-rated temporary partitions are indicated or are required by authorities having jurisdiction, construct partitions according to the rated assemblies.
 - 4. Insulate partitions to control noise transmission to occupied areas.
 - 5. Seal joints and perimeter. Equip partitions with gasketed dustproof doors and security locks where openings are required.
 - 6. Protect air-handling equipment.
 - 7. Provide walk-off mats at each entrance through temporary partition.
- C. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241.
 - 1. Prohibit smoking in construction areas.

2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.
3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.
4. Provide temporary standpipes and hoses for fire protection. Hang hoses with a warning sign stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.

3.3 MOISTURE AND MOLD CONTROL

- A. Contractor's Moisture Protection Plan: Avoid trapping water in finished work. Document visible signs of mold that may appear during construction.
- B. Partially Enclosed Construction Phase: After installation of weather barriers but before full enclosure and conditioning of building, when installed materials are still subject to infiltration of moisture and ambient mold spores, protect as follows:
 1. Do not load or install drywall or other porous materials or components, or items with high organic content, into partially enclosed building.
 2. Keep interior spaces reasonably clean and protected from water damage.
 3. Discard or replace water-damaged and wet material.
 4. Discard, replace or clean stored or installed material that begins to grow mold.
 5. Perform work in a sequence that allows any wet materials adequate time to dry before enclosing the material in drywall or other interior finishes.
- C. Controlled Construction Phase of Construction: After completing and sealing of the building enclosure but prior to the full operation of permanent HVAC systems, maintain as follows:
 1. Control moisture and humidity inside building by maintaining effective dry-in conditions.
 2. Remove materials that cannot be completely restored to their manufactured moisture level within 48 hours.

3.4 OPERATION, TERMINATION, AND REMOVAL

- A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.
- B. Maintenance: Maintain facilities in good operating condition until removal.
 1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.
- C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.

- D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
 2. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Division 01 Section "Closeout Procedures."

END OF SECTION 015000

SECTION 017419 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for the following:
 - 1. Salvaging nonhazardous demolition and construction waste.
 - 2. Recycling nonhazardous demolition and construction waste.
 - 3. Disposing of nonhazardous demolition and construction waste.
- B. Related Sections:
 - 1. Division 02 Section "Selective Structure Demolition" for disposition of waste resulting from partial demolition of buildings and structures.

1.2 DEFINITIONS

- A. Construction Waste: Building and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.
- B. Demolition Waste: Building and site improvement materials resulting from demolition or selective demolition operations.
- C. Disposal: Removal off-site of demolition and construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator acceptable to authorities having jurisdiction.
- D. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.
- E. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.
- F. Salvage and Reuse: Recovery of demolition or construction waste and subsequent incorporation into the Work.

1.3 INFORMATIONAL SUBMITTALS

- A. Recycling and Processing Facility Records: Indicate receipt and acceptance of recyclable waste by recycling and processing facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

- B. Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills and incinerator facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.
- C. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.

1.4 QUALITY ASSURANCE

- A. Refrigerant Recovery Technician Qualifications: Certified by EPA-approved certification program.
- B. Waste Management Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

1.5 WASTE MANAGEMENT PLAN

- A. General: Develop a waste management plan according to ASTM E 1609 and requirements of this Section. Plan shall consist of waste identification, waste reduction work plan, and cost/revenue analysis. Distinguish between demolition and construction waste. Indicate quantities by weight or volume, but use same units of measure throughout waste management plan.
- B. Waste Identification: Indicate anticipated types and quantities of demolition and construction waste generated by the Work. Include estimated quantities and assumptions for estimates.
- C. Waste Reduction Work Plan: List each type of waste and whether it will be salvaged, recycled, or disposed of in landfill or incinerator. Include points of waste generation, total quantity of each type of waste, quantity for each means of recovery, and handling and transportation procedures.
 - 1. Recycled Materials: Include list of local receivers and processors and type of recycled materials each will accept. Include names, addresses, and telephone numbers.
 - 2. Disposed Materials: Indicate how and where materials will be disposed of. Include name, address, and telephone number of each landfill and incinerator facility.
 - 3. Handling and Transportation Procedures: Include method that will be used for separating recyclable waste including sizes of containers, container labeling, and designated location on Project site where materials separation will be located.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 PLAN IMPLEMENTATION

- A. General: Implement approved waste management plan. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.
- B. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
 - 1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged, recycled, reused, donated, and sold.
 - 2. Comply with Division 01 Section "Temporary Facilities and Controls" for controlling dust and dirt, environmental protection, and noise control.

3.2 RECYCLING DEMOLITION AND CONSTRUCTION WASTE, GENERAL

- A. General: Recycle paper and beverage containers used by on-site workers.
- B. Recycling Incentives: Revenues, savings, rebates, tax credits, and other incentives received for recycling waste materials shall be shared equally by Owner and Contractor.
- C. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical according to approved construction waste management plan.
 - 1. Provide appropriately marked containers or bins for controlling recyclable waste until they are removed from Project site. Include list of acceptable and unacceptable materials at each container and bin.
 - a. Inspect containers and bins for contamination and remove contaminated materials if found.
 - 2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
 - 3. Stockpile materials away from construction area. Do not store within drip line of remaining trees.
 - 4. Store components off the ground and protect from the weather.
 - 5. Remove recyclable waste off Owner's property and transport to recycling receiver or processor.

3.3 RECYCLING DEMOLITION WASTE

- A. Wood Materials: Sort and stack members according to size, type, and length. Separate lumber, engineered wood products, panel products, and treated wood materials.
- B. Metals: Separate metals by type.
 - 1. Structural Steel: Stack members according to size, type of member, and length.
 - 2. Remove and dispose of bolts, nuts, washers, and other rough hardware.
- C. Gypsum Board: Stack large clean pieces on wood pallets or in container and store in a dry location. Remove edge trim and sort with other metals. Remove and dispose of fasteners.
- D. Acoustical Ceiling Panels and Tile: Stack large clean pieces on wood pallets and store in a dry location.
- E. Metal Suspension System: Separate metal members including trim, and other metals from acoustical panels and tile and sort with other metals.
- F. Carpet and Pad: Roll large pieces tightly after removing debris, trash, adhesive, and tack strips.
 - 1. Store clean, dry carpet and pad in a closed container or trailer provided by Carpet Reclamation Agency or carpet recycler.
- G. Piping: Reduce piping to straight lengths and store by type and size. Separate supports, hangers, valves, sprinklers, and other components by type and size.
- H. Conduit: Reduce conduit to straight lengths and store by type and size.

3.4 RECYCLING CONSTRUCTION WASTE

- A. Packaging:
 - 1. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location.
 - 2. Polystyrene Packaging: Separate and bag materials.
 - 3. Pallets: As much as possible, require deliveries using pallets to remove pallets from Project site. For pallets that remain on-site, break down pallets into component wood pieces and comply with requirements for recycling wood.
 - 4. Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.
- B. Wood Materials:
 - 1. Clean Cut-Offs of Lumber: Grind or chip into small pieces.
 - 2. Clean Sawdust: Bag sawdust that does not contain painted or treated wood.
- C. Gypsum Board: Stack large clean pieces on wood pallets or in container and store in a dry

location.

3.5 DISPOSAL OF WASTE

- A. General: Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.
 - 1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
 - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- B. Burning: Do not burn waste materials.
- C. Disposal: Transport waste materials off Owner's property and legally dispose of them.

END OF SECTION 017419

Issued for Construction

MMC Library Renovation
Portland, Maine
Project No.: 11022

SECTION 017700 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. 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.
- B. Related Sections:
 - 1. Division 01 Section "Operation and Maintenance Data" for operation and maintenance manual requirements.
 - 2. Division 01 Section "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.

1.2 SUBSTANTIAL COMPLETION

- A. Preliminary Procedures: Before requesting inspection for determining date of Substantial Completion, complete the following. List items below that are incomplete with 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. Obtain and submit releases permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
 - 5. Prepare and submit Project Record Documents, operation and maintenance manuals, final completion construction photographic documentation, damage or settlement surveys, property surveys, and similar final record information.
 - 6. Deliver tools, spare parts, extra materials, and similar items to location designated by Owner. Label with manufacturer's name and model number where applicable.
 - 7. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
 - 8. Complete startup testing of systems.
 - 9. Submit test/adjust/balance records.
 - 10. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.

11. Advise Owner of changeover in heat and other utilities.
12. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
13. Complete final cleaning requirements, including touchup painting.
14. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.

B. Inspection: Submit a written request for inspection for Substantial Completion. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect 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 Architect, 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.

1.3 FINAL COMPLETION

A. Preliminary Procedures: Before requesting final inspection for determining final completion, complete the following:

1. Submit a final Application for Payment according to Division 01 Section "Payment Procedures."
2. Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. 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. Submit pest-control final inspection report and warranty.
5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings.

B. Inspection: Submit a written request for final inspection for acceptance. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect 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.

1.4 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

A. Organization 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 items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
2. Submit list of incomplete items in the following format:
 - a. PDF electronic file.

1.5 WARRANTIES

- A. **Submittal Time:** Submit written warranties on request of Architect for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated.
- B. 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.
 4. Scan warranties and bonds and assemble complete warranty and bond submittal package into a single indexed electronic PDF file with links enabling navigation to each item. Provide table of contents at beginning of document.
- C. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 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

3.1 FINAL CLEANING

- A. General: Perform 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. Remove snow and ice to provide safe access to building.
 - f. 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.
 - g. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
 - h. Sweep concrete floors broom clean in unoccupied spaces.
 - i. Vacuum carpet and similar soft surfaces, removing debris and excess nap; shampoo if visible soil or stains remain.
 - j. 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.
 - k. Remove labels that are not permanent.
 - l. 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 other required labels and identification, including mechanical and electrical nameplates.
 - m. Wipe surfaces of mechanical and electrical equipment and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign

- substances.
- n. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.
 - o. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
 - p. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
 - q. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency. Replace burned-out bulbs, and those noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.
 - r. Leave Project clean and ready for occupancy.

END OF SECTION 017700

Issued for Construction

MMC Library Renovation
Portland, Maine
Project No.: 11022

SECTION 017823 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
1. Operation and maintenance documentation directory.
 2. Product maintenance manuals.
 3. Systems and equipment maintenance manuals.

1.2 CLOSEOUT SUBMITTALS

- A. 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 Architect.
 - 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. Architect will return two copies.
- B. 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. Architect will return copy with comments.
1. Correct or modify each manual to comply with Architect's comments. Submit copies of each corrected manual within 15 days of receipt of Architect's comments and prior to commencing demonstration and training.

PART 2 - PRODUCTS

2.1 REQUIREMENTS FOR 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: 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 and contact information for Contractor.
 6. Name and contact information for Construction Manager.
 7. Name and contact information for Architect.
 8. Name and contact information for Commissioning Agent.
 9. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
 10. 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.
- 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.
- E. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.
1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
 2. File Names and Bookmarks: Enable bookmarking of individual documents based upon file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel upon opening file.
- F. Manuals, Paper Copy: Submit manuals in the form of hard copy, bound and labeled volumes.
1. Binders: Heavy-duty, three-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. 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 of the manual. 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 storage media for computerized electronic equipment.
4. 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.

2.2 PRODUCT MAINTENANCE MANUALS

- 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.

2.3 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

- 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 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 video recording, 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.
- 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.

PART 3 - EXECUTION

3.1 MANUAL PREPARATION

- A. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.
- B. 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.
- C. 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.
- D. 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.
- E. Comply with Division 01 Section "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

END OF SECTION 017823

Issued for Construction

MMC Library Renovation
Portland, Maine
Project No.: 11022

SECTION 017839 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for project record documents, including the following:
 - 1. Record Drawings.
 - 2. Record Specifications.
 - 3. Record Product Data.
- B. Related Sections:
 - 1. Division 01 Section "Operation and Maintenance Data" for operation and maintenance manual requirements.

1.2 CLOSEOUT SUBMITTALS

- A. Record Drawings: Comply with the following:
 - 1. Number of Copies: Submit one set(s) of marked-up record prints.
- B. Record Specifications: Submit one copy of Project's Specifications, including addenda and contract modifications.
- C. Record Product Data: Submit one copy of each submittal.

PART 2 - PRODUCTS

2.1 RECORD DRAWINGS

- A. Record Prints: Maintain one set of marked-up paper copies 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 provide information for preparation of corresponding 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. Record data as soon as possible after obtaining it.

- c. Record and check the markup before enclosing concealed installations.
 2. Mark the Contract Drawings and Shop Drawings completely and accurately. Utilize personnel proficient at recording graphic information in production of marked-up record prints.
 3. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
 4. 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 Architect. When authorized, prepare a full set of corrected digital data files of the Contract Drawings, as follows:
1. Format: Same digital data software program, version, and operating system as the original Contract Drawings.
 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 Architect for resolution.
 4. Architect will furnish Contractor one set of digital data files of the Contract Drawings for use in recording information.
- C. Format: Identify and date each record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
1. Record Prints: Organize record prints and newly prepared record Drawings 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 Architect.
 - e. Name of Contractor.

2.2 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. Note related Change Orders, record Product Data, and record Drawings where applicable.

2.3 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 and record Drawings where applicable.

2.4 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.

PART 3 - EXECUTION

3.1 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 Architect's reference during normal working hours.

END OF SECTION 017839

Issued for Construction

MMC Library Renovation
Portland, Maine
Project No.: 11022

SECTION 024119 - SELECTIVE STRUCTURE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Demolition and removal of selected portions of building or structure.
2. Salvage of existing items to be reused or recycled.

1.2 DEFINITIONS

- A. Remove: Detach items from existing construction and legally dispose of them off-site unless indicated to be removed and salvaged or removed and reinstalled.
- B. Remove and Salvage: Carefully detach from existing construction, in a manner to prevent damage, and deliver to Owner ready for reuse.
- C. Remove and Reinstall: Detach items from existing construction, prepare for reuse, and reinstall where indicated.
- D. Existing to Remain: Existing items of construction that are not to be permanently removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.3 PREINSTALLATION MEETINGS

- A. Predemolition Conference: Conduct conference at Project site.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For refrigerant recovery technician.
- B. Predemolition Photographs or Video: Submit before Work begins.
- C. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician.

1.5 CLOSEOUT SUBMITTALS

- A. Landfill Records: Indicate receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.

1.6 QUALITY ASSURANCE

- A. Refrigerant Recovery Technician Qualifications: Certified by an EPA-approved certification program.

1.7 FIELD CONDITIONS

- A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.
- B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
- C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- D. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
 - 1. Maintain fire-protection facilities in service during selective demolition operations.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- B. Standards: Comply with ANSI/ASSE A10.6 and NFPA 241.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped before starting selective demolition operations.
- B. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.
- C. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Architect.

- D. Perform an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective building demolition operations.
- E. Survey of Existing Conditions: Record existing conditions by use of measured drawings and preconstruction photographs.

3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

- A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.
- B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off indicated utility services and mechanical/electrical systems serving areas to be selectively demolished.
 - 1. Arrange to shut off indicated utilities with utility companies.
 - 2. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
 - 3. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated to be removed.
 - a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 - b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
 - c. Equipment to Be Removed: Disconnect and cap services and remove equipment.
 - d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
 - e. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
 - f. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
 - g. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.
- C. Refrigerant: Remove refrigerant from mechanical equipment to be selectively demolished according to 40 CFR 82 and regulations of authorities having jurisdiction.

3.3 PREPARATION

- A. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

- B. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
- C. Temporary Shoring: Provide and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.

3.4 SELECTIVE DEMOLITION, GENERAL

- A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
 - 1. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.
 - 2. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
 - 3. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain fire watch and portable fire-suppression devices during flame-cutting operations.
 - 4. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
 - 5. Dispose of demolished items and materials promptly. Comply with requirements in Division 01 Section "Construction Waste Management and Disposal."
- B. Removed and Salvaged Items:
 - 1. Clean salvaged items.
 - 2. Pack or crate items after cleaning. Identify contents of containers.
 - 3. Store items in a secure area until delivery to Owner.
 - 4. Transport items to Owner's storage area designated by Owner.
 - 5. Protect items from damage during transport and storage.
- C. Removed and Reinstalled Items:
 - 1. Clean and repair items to functional condition adequate for intended reuse.
 - 2. Pack or crate items after cleaning and repairing. Identify contents of containers.
 - 3. Protect items from damage during transport and storage.
 - 4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.
- D. Existing Items to Remain: Protect construction indicated to remain against damage and soiling

during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

3.5 DISPOSAL OF DEMOLISHED MATERIALS

- A. General: Except for items or materials indicated to be recycled, reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, remove demolished materials from Project site and legally dispose of them in an EPA-approved landfill.
 - 1. Do not allow demolished materials to accumulate on-site.
 - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
 - 3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
 - 4. Comply with requirements specified in Division 01 Section "Construction Waste Management and Disposal."
- B. Burning: Do not burn demolished materials.
- C. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

3.6 CLEANING

- A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

END OF SECTION 024119

Issued for Construction

MMC Library Renovation
Portland, Maine
Project No.: 11022

SECTION 061000 - ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Wood blocking and nailers.
2. Wood furring and grounds.
3. Blocking for construction, accessories, and Owner-furnished items.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product.

1.3 INFORMATIONAL SUBMITTALS

- A. Evaluation Reports: For the following, from ICC-ES:

1. Fire-retardant-treated wood.
2. Power-driven fasteners.
3. Powder-actuated fasteners.
4. Expansion anchors.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

- A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.

1. Factory mark each piece of lumber with grade stamp of grading agency.
2. Provide dressed lumber, S4S, unless otherwise indicated.

- B. Maximum Moisture Content of Lumber: 19 percent unless otherwise indicated.

2.2 FIRE-RETARDANT-TREATED MATERIALS

- A. General: Where fire-retardant-treated materials are indicated, use materials complying with

requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.

- B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet beyond the Centerline of the burners at any time during the test.
 - 1. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D 3201 at 92 percent relative humidity. Use where exterior type is not indicated.
- C. Kilndry lumber after treatment to a maximum moisture content of 19 percent. Kilndry plywood after treatment to a maximum moisture content of 15 percent.
- D. Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency.
- E. Application: Treat items indicated on Drawings, and the following:
 - 1. Concealed blocking.

2.3 MISCELLANEOUS LUMBER

- A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
 - 1. Blocking.
 - 2. Nailers.
 - 3. Furring.
- B. For concealed boards, provide lumber with 15 percent maximum moisture content and the following species and grades:
 - 1. Northern species; No. 2 Common grade; NLGA.
- C. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.

2.4 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
- B. Power-Driven Fasteners: NES NER-272.

- C. Bolts: Steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers.
- D. Nails, Brads, and Staples: ASTM F 1667.
- E. Power-Driven Fasteners: NES NER-272.
- F. Wood Screws: ASME B18.6.1.
- G. Lag Bolts: ASME B18.2.1.
- H. Bolts: Steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers.
- I. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry assemblies and equal to four times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing and inspecting agency.
 - 1. Material: Carbonsteel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry to other construction; scribe and cope as needed for accurate fit. Locate furring, nailers, blocking, and similar supports to comply with requirements for attaching other construction.
- B. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.
- C. Sort and select lumber so that natural characteristics will not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
- D. Do not use panel materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
- E. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction, unless otherwise indicated.
- F. Securely attach rough carpentry work to Substrate by anchoring and fastening as indicated.

- G. Use steel common nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless otherwise indicated.

3.2 WOOD BLOCKING AND NAILER INSTALLATION

- A. Install where indicated and where required for attaching other work. Install wood blocking and nailers to support construction and fixtures, including, but not limited to equipment services, casework, shelving, building specialties, countertop supports, owner-furnished items, miscellaneous items, and construction. Provide 1/2-inch thick blocking, minimum, for door stops. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.
 - 1. Provide concealed wood blocking behind gypsum wallboard where door stops are to be installed.
- B. Attach items to Substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.

END OF SECTION 061000

SECTION 064023 - INTERIOR ARCHITECTURAL WOODWORK

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Wood cabinets.
 - 2. Closet and utility shelving.
 - 3. Plastic-laminate countertops.
 - 4. Solid-surfacing-material countertops.
 - 5. Shop finishing of woodwork.
- B. Interior architectural woodwork includes wood furring, blocking, shims, and hanging strips unless concealed within other construction before woodwork installation.

1.2 ACTION SUBMITTALS

- A. Product Data: For cabinet hardware and accessories, and finishing materials and processes.
- B. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.
- C. Samples:
 - 1. Lumber and panel products for transparent finish, for each species and cut, finished on one side and one edge.
 - 2. Plastic-laminates, for each type, color, pattern, and surface finish.
 - 3. Thermoset decorative panels, for each type, color, pattern, and surface finish.
 - 4. Shelving materials.
 - 5. Solid-surfacing materials.

1.3 INFORMATIONAL SUBMITTALS

- A. Woodwork Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Fabricator of woodwork.
- B. Quality Standard: Unless otherwise indicated, comply with AWI's "Architectural Woodwork Quality Standards."

1.5 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install woodwork until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Wood Species for Transparent Finish: As indicated on Drawings.
- B. Wood Products:
 - 1. Hardboard: AHA A135.4.
 - 2. Medium-Density Fiberboard: ANSI A208.2, Grade MD.
 - 3. Particleboard: ANSI A208.1, Grade M-2.
 - 4. Softwood Plywood: DOC PS 1.
 - 5. Veneer-Faced Panel Products (Hardwood Plywood): HPVA HP-1.
- C. Closet and Utility Adjustable Shelving: Provide the number of shelves indicated as follows:
 - 1. Shelves: Melamine-faced particleboard with applied 3 mm PVC front edge, matching face and 1 mm PVC applied to back edge and both ends; 3/4 inch thick.
 - 2. Adjustable shelf standards and supports: twin slotted, heavy duty, steel shelf standards and U-shaped, double-prong, heavy-duty steel brackets, powder coat finish, color as selected by Architect.
- D. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or, if not indicated, as required by woodwork quality standard.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Wilsonart International; Div. of Premark International, Inc.
 - b. Or approved equal.
- E. Solid-Surfacing Material: Homogeneous solid sheets of filled plastic resin complying with ISSFA-2.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. E. I. du Pont de Nemours and Company; Corian.
 - b. Or approved equal.

2.2 CABINET HARDWARE AND ACCESSORIES

- A. General: Provide cabinet hardware and accessory materials associated with architectural woodwork, except for items specified in Division 08 Section "Door Hardware."
- B. Frameless Concealed Hinges (European Type): BHMA A156.9, B01602, 135 degrees of opening, self-closing.
- C. Wire Pulls: Back mounted, solid metal.
- D. Catches: Magnetic catches, BHMA A156.9, B03141.
- E. Drawer Slides: BHMA A156.9, B05091.
 - 1. Heavy Duty (Grade 1HD-100 and Grade 1HD-200): Side mounted; full-extension type; zinc-plated steel ball-bearing slides.
- F. Door Locks: BHMA A156.11, E07121.
- G. Drawer Locks: BHMA A156.11, E07041.
- H. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.

2.3 MISCELLANEOUS MATERIALS

- A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln-dried to less than 15 percent moisture content.
- B. Adhesives, General: Adhesives shall not contain urea formaldehyde.

2.4 FABRICATION

- A. General: Complete fabrication to maximum extent possible before shipment to Project site. Where necessary for fitting at site, provide allowance for scribing, trimming, and fitting.
 - 1. Interior Woodwork Grade: Premium.
 - 2. Shop cut openings to maximum extent possible. Sand edges of cutouts to remove splinters and burrs. Seal edges of openings in countertops with a coat of varnish.
- B. Wood Cabinets for Transparent Finish:
 - 1. AWI Type of Cabinet Construction: Flush overlay.
 - 2. Matching of Veneer Leaves: Book match.
 - 3. Semiexposed Surfaces Other Than Drawer Bodies: Same species and cut indicated for exposed surfaces.
 - 4. Drawer Sides and Backs: Solid-hardwood lumber, same species indicated for exposed surfaces.
 - 5. Drawer Bottoms: Hardwood plywood.

- C. Closet and Utility Shelving:
 - 1. Thickness: 3/4 inch thick.
 - 2. Shelf Cleats: 3/4-by-3-1/2-inch boards hardwood lumber trim.
- D. Plastic-Laminate Countertops:
 - 1. High-Pressure Decorative Laminate Grade: HGS.
 - 2. Colors, Patterns, and Finishes: Match Architect's sample.
 - 3. Edge Treatment: As indicated.
 - 4. Core Material at Sinks: Particleboard made with exterior glue.
- E. Solid-Surfacing-Material Countertops:
 - 1. Solid-Surfacing-Material Thickness: As indicated on Drawings.
 - 2. Colors, Patterns, and Finishes: Match Architect's sample.
 - 3. Comply with solid-surfacing-material manufacturer's written recommendations for adhesives, sealers, fabrication, and finishing.

2.5 SHOP FINISHING

- A. Finish architectural woodwork at fabrication shop. Defer only final touchup, cleaning, and polishing until after installation.
- B. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of woodwork. Apply two coats to back of paneling.
- C. Transparent Finish:
 - 1. Grade: Premium.
 - 2. AWI Finish System: Conversion varnish.
 - 3. Staining and Sheen: Match approved sample.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Before installation, condition woodwork to average prevailing humidity conditions in installation areas. Examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming.
- B. Grade: Install woodwork to comply with requirements for the same grade specified in Part 2 for fabrication of type of woodwork involved.
- C. Install woodwork level, plumb, true, and straight to a tolerance of 1/8 inch in 96 inches. Shim as required with concealed shims.
- D. Scribe and cut woodwork to fit adjoining work, refinish cut surfaces, and repair damaged finish

at cuts.

- E. Anchor woodwork to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing as required for complete installation. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork and matching final finish if transparent finish is indicated.
- F. Cabinets: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation.
 - 1. Fasten wall cabinets through back, near top and bottom, at ends and not more than 16 inches o.c. with No. 10 wafer-head screws sized for 1-inch penetration into wood framing, blocking, or hanging strips.
- G. Countertops: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop. Calk space between backsplash and wall with sealant.
- H. Closet and Utility Shelving: Cut shelf cleats at ends of shelves about 1/2 inch less than width of shelves and sand exposed ends smooth. Install shelf cleats by fastening to framing or backing with finish nails or trim screws, set below face and filled. Space fasteners not more than 16 inches o.c. Cut shelves to neatly fit openings with only enough gap to allow shelves to be removed and reinstalled. Install shelves, fully seated on cleats, brackets, and supports.

END OF SECTION 064023

Issued for Construction

MMC Library Renovation
Portland, Maine
Project No.: 11022

SECTION 078413 - PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Penetrations in fire-resistance-rated walls.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Product Schedule: For each penetration firestopping system. Include location and design designation of qualified testing and inspecting agency.

1. Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping condition, submit illustration, with modifications marked, approved by penetration firestopping manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.

1.3 INFORMATIONAL SUBMITTALS

A. Installer Certificates: From Installer indicating penetration firestopping has been installed in compliance with requirements and manufacturer's written recommendations.

B. Product test reports.

1.4 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: Penetration firestopping shall comply with the following requirements:

1. Penetration firestopping tests are performed by UL.
2. Penetration firestopping is identical to those tested per testing standard referenced in "Penetration Firestopping" Article. Provide rated systems bearing marking of qualified testing and inspection agency.

B. Preinstallation Conference: Conduct conference at Project site.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. A/D Fire Protection Systems Inc.
 2. Grace Construction Products.
 3. Hilti, Inc.
 4. Johns Manville.
 5. Nelson Firestop Products.
 6. Specified Technologies Inc.
 7. 3M Fire Protection Products.
 8. Tremco, Inc.; Tremco Fire Protection Systems Group.
 9. USG Corporation.

2.2 PENETRATION FIRESTOPPING

- A. Provide penetration firestopping that is produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.
- B. Penetrations in Fire-Resistance-Rated Walls: Ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.
1. F-Rating: Not less than the fire-resistance rating of constructions penetrated.
- C. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping manufacturer and approved by qualified testing and inspecting agency for firestopping indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of the Work.
- B. Install penetration firestopping to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.

- C. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
 - 1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of firestopping.
- D. Install fill materials for firestopping by proven techniques to produce the following results:
 - 1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.
 - 2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
 - 3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.2 FIELD QUALITY CONTROL

- A. Where deficiencies are found or penetration firestopping is damaged or removed because of testing, repair or replace penetration firestopping to comply with requirements.
- B. Proceed with enclosing penetration firestopping with other construction only after inspection reports are issued and installations comply with requirements.

END OF SECTION 078413

Issued for Construction

MMC Library Renovation
Portland, Maine
Project No.: 11022

SECTION 078446 - FIRE-RESISTIVE JOINT SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Joints in or between fire-resistance-rated constructions.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Product Schedule: For each fire-resistive joint system. Include location and design designation of qualified testing agency.

1. Where Project conditions require modification to a qualified testing agency's illustration for a particular fire-resistive joint system condition, submit illustration, with modifications marked, approved by fire-resistive joint system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.

1.3 INFORMATIONAL SUBMITTALS

A. Installer Certificates: From Installer indicating fire-resistive joint systems have been installed in compliance with requirements and manufacturer's written recommendations.

B. Product test reports.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: A firm that has been approved by FM Global according to FM Global 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with UL's "Qualified Firestop Contractor Program Requirements."

B. Fire-Test-Response Characteristics: Fire-resistive joint systems shall comply with the following requirements:

1. Fire-resistive joint system tests are performed by UL.

C. Preinstallation Conference: Conduct conference at Project site.

PART 2 - PRODUCTS

2.1 FIRE-RESISTIVE JOINT SYSTEMS

- A. Where required, provide fire-resistive joint systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of assemblies in or between which fire-resistive joint systems are installed. Fire-resistive joint systems shall accommodate building movements without impairing their ability to resist the passage of fire and hot gases.
- B. Joints in or between Fire-Resistance-Rated Construction: Ratings determined per ASTM E 1966 or UL 2079:
 - 1. Fire-Resistance Rating: Equal to or exceeding the fire-resistance rating of construction they will join.
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. A/D Fire Protection Systems Inc.
 - b. Fire Trak Corp.
 - c. Grace Construction Products.
 - d. Hilti, Inc.
 - e. Johns Manville.
 - f. Nelson Firestop Products.
 - g. Specified Technologies Inc.
 - h. 3M Fire Protection Products.
 - i. Tremco, Inc.; Tremco Fire Protection Systems Group.
 - j. USG Corporation.
- C. Accessories: Provide components of fire-resistive joint systems, including primers and forming materials, that are needed to install fill materials and to maintain ratings required. Use only components specified by fire-resistive joint system manufacturer and approved by the qualified testing agency for systems indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for joint configurations, substrates, and other conditions affecting performance of the Work.
- B. Install fire-resistive joint systems to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.
- C. Install forming materials and other accessories of types required to support fill materials during their application and in position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.

1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of fire-resistive joint system.
- D. Install fill materials for fire-resistive joint systems by proven techniques to produce the following results:
1. Fill voids and cavities formed by joints and forming materials as required to achieve fire-resistance ratings indicated.
 2. Apply fill materials so they contact and adhere to substrates formed by joints.
 3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.2 FIELD QUALITY CONTROL

- A. Where deficiencies are found or fire-resistive joint systems are damaged or removed due to testing, repair or replace fire-resistive joint systems so they comply with requirements.
- B. Proceed with enclosing fire-resistive joint systems with other construction only after inspection reports are issued and installations comply with requirements.

END OF SECTION 078446

Issued for Construction

MMC Library Renovation
Portland, Maine
Project No.: 11022

SECTION 079200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Silicone joint sealants.
 - 2. Latex joint sealants.
 - 3. Acoustical joint sealants.

1.2 PRECONSTRUCTION TESTING

- A. Preconstruction Field-Adhesion Testing: Before installing sealants, field test their adhesion to Project joint substrates. Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.

1.3 ACTION SUBMITTALS

- A. Product Data: For each joint-sealant product indicated.
- B. Samples: For each kind and color of joint sealant required.
- C. Joint-Sealant Schedule: Include the following information:
 - 1. Joint-sealant application, joint location, and designation.
 - 2. Joint-sealant manufacturer and product name.
 - 3. Joint-sealant formulation.
 - 4. Joint-sealant color.

1.4 INFORMATIONAL SUBMITTALS

- A. Product test reports.
- B. Preconstruction field-adhesion test reports.
- C. Warranties.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to ASTM C 1021 to conduct the testing indicated.

1.6 WARRANTY

- A. Special Installer's Warranty: Manufacturer's standard form in which Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 - 1. Warranty Period: Two years from date of Substantial Completion.
- B. Special Manufacturer's Warranty: Manufacturer's standard form in which joint-sealant manufacturer agrees to furnish joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Liquid-Applied Joint Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied joint sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.
 - 1. Suitability for Immersion in Liquids. Where sealants are indicated for Use I for joints that will be continuously immersed in liquids, provide products that have undergone testing according to ASTM C 1247. Liquid used for testing sealants is deionized water, unless otherwise indicated.
- B. Stain-Test-Response Characteristics: Where sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.
- C. Suitability for Contact with Food: Where sealants are indicated for joints that will come in repeated contact with food, provide products that comply with 21 CFR 177.2600.

2.2 SILICONE JOINT SEALANTS

- A. Mildew-Resistant Silicone Joint Sealant: ASTM C 920.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. BASF Building Systems.
 - b. Dow Corning Corporation.
 - c. GE Advanced Materials - Silicones.
 - d. May National Associates, Inc.
 - e. Pecora Corporation.
 - f. Polymeric Systems, Inc.
 - g. Schnee-Morehead, Inc.
 - h. Sika Corporation; Construction Products Division.

- i. Tremco Incorporated.
2. Type: Single component (S) or multicomponent (M).
3. Grade: Pourable (P) or nonsag (NS).
4. Class: 100/50.
5. Uses Related to Exposure: Traffic (T) Nontraffic (NT).

2.3 LATEX JOINT SEALANTS

- A. Latex Joint Sealant: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. BASF Building Systems.
 - b. Bostik, Inc.
 - c. May National Associates, Inc.
 - d. Pecora Corporation.
 - e. Schnee-Morehead, Inc.
 - f. Tremco Incorporated.

2.4 ACOUSTICAL JOINT SEALANTS

- A. Acoustical Joint Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Pecora Corporation.
 - b. USG Corporation.

2.5 JOINT SEALANT BACKING

- A. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin) Type O (open-cell material) Type B (bicellular material with a surface skin) or any of the preceding types, as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
- B. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer.

2.6 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions.
 - 1. Remove laitance and form-release agents from concrete.
 - 2. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.
- B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.2 INSTALLATION

- A. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- B. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
 - 1. Do not leave gaps between ends of sealant backings.
 - 2. Do not stretch, twist, puncture, or tear sealant backings.
 - 3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.

- C. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- D. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
 - 1. Place sealants so they directly contact and fully wet joint substrates.
 - 2. Completely fill recesses in each joint configuration.
 - 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- E. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
 - 1. Remove excess sealant from surfaces adjacent to joints.
 - 2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
 - 3. Provide concave joint profile per Figure 8A in ASTM C 1193, unless otherwise indicated.
- F. Acoustical Sealant Installation: Comply with ASTM C 919 and with manufacturer's written recommendations.
- G. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.3 JOINT-SEALANT SCHEDULE

- A. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces.
 - 1. Joint Locations:
 - a. Control and expansion joints on exposed interior surfaces of exterior walls.
 - b. Perimeter joints of exterior openings where indicated.
 - c. Perimeter joints between interior wall surfaces and frames of interior doors and windows.
 - d. Other joints as indicated.
 - 2. Joint Sealant: Latex.
 - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- B. Joint-Sealant Application: Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces.
 - 1. Joint Sealant Location:
 - a. Joints between plumbing fixtures and adjoining walls, floors, and counters.

- b. Other joints as indicated.
 - 2. Joint Sealant: Silicone.
 - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- C. Joint-Sealant Application: Interior acoustical joints in vertical surfaces and horizontal nontraffic surfaces.
- 1. Joint Location:
 - a. Acoustical joints where indicated.
 - b. Other joints as indicated.
 - 2. Joint Sealant: Acoustical.
 - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range.

END OF SECTION 079200

SECTION 081113 - HOLLOW METAL FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Standard hollow metal frames.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Include elevations, frame profiles, metal thicknesses, preparations for hardware, and other details.

C. Samples for Verification: For each type of exposed finish required.

D. Schedule: Prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Amweld Building Products, LLC.
2. Ceco Door Products; an Assa Abloy Group company.
3. Curries Company; an Assa Abloy Group company.
4. Pioneer Industries, Inc.
5. Steelcraft; an Ingersoll-Rand company.
6. Windsor Republic Doors.

2.2 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, CS, Type B; suitable for exposed applications.

B. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, CS, Type B.

C. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with

minimum A40 metallic coating.

- D. Frame Anchors: ASTM A 591/A 591M, Commercial Steel (CS), 40Z coating designation; mill phosphatized.
- E. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.

2.3 STANDARD HOLLOW METAL FRAMES

- A. General: Comply with ANSI/SDI A250.8.
- B. Interior Frames: Fabricated from cold-rolled steel sheet unless metallic-coated sheet is indicated.
 - 1. Fabricate frames with mitered or coped corners.
 - 2. Fabricate frames as full profile welded unless otherwise indicated.
 - 3. Frames for Wood Doors: 0.042-inch-thick steel sheet.
- C. Hardware Reinforcement: ANSI/SDI A250.6.

2.4 FRAME ANCHORS

- A. Jamb Anchors:
 - 1. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch (1.0 mm) thick.
- B. Floor Anchors: Formed from same material as frames, not less than 0.042 inch thick, and as follows:
 - 1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.

2.5 FABRICATION

- A. Tolerances: Fabricate hollow metal work to tolerances indicated in SDI 117.
- B. Hollow Metal Frames: Where frames are fabricated in sections, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
 - 1. Welded Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible.
 - 2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
 - 3. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
 - 4. Jamb Anchors: Provide number and spacing of anchors as follows:
 - a. Stud-Wall Type: Locate anchors not more than 18 inches from top and bottom of

frame. Space anchors not more than 32 inches o.c. and as follows:

- 1) Four anchors per jamb from 60 to 90 inches high.

C. Hardware Preparation: Factory prepare hollow metal work to receive templated mortised hardware according to the Door Hardware Schedule and templates furnished.

1. Locate hardware as indicated, or if not indicated, according to ANSI/SDI A250.8.
2. Reinforce frames to receive nontemplated, mortised and surface-mounted door hardware.
3. Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for preparation of hollow metal work for hardware.

2.6 STEEL FINISHES

A. Prime Finish: Apply manufacturer's standard primer immediately after cleaning and pretreating.

1. Shop Primer: ANSI/SDI A250.10.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Hollow Metal Frames: Comply with ANSI/SDI A250.11.

1. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
 - a. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
 - b. Remove temporary braces necessary for installation only after frames have been properly set and secured.
 - c. Check plumbness, squareness, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.
 - a. Floor anchors may be set with powder-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
3. In-Place Gypsum Board Partitions: Secure frames in place with postinstalled expansion anchors through floor anchors at each jamb. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
4. Installation Tolerances: Adjust hollow metal door frames for squareness, alignment, twist, and plumb to the following tolerances:

- a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
- b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
- c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
- d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.

3.2 ADJUSTING AND CLEANING

- A. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.

END OF SECTION 081113

SECTION 081416 - FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Solid-core doors with wood-veneer faces.
2. Factory finishing flush wood doors.
3. Factory fitting flush wood doors to frames and factory machining for hardware.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of door indicated. Include factory-finishing specifications.

B. Shop Drawings: Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; location and extent of hardware blocking; and other pertinent data.

1. Indicate dimensions and locations of mortises and holes for hardware.
2. Indicate dimensions and locations of cutouts.
3. Indicate requirements for veneer matching.
4. Indicate doors to be factory finished and finish requirements.

1.3 QUALITY ASSURANCE

A. Quality Standard: In addition to requirements specified, comply with AWI's "Architectural Woodwork Quality Standards Illustrated."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Algoma Hardwoods, Inc.
2. Buell Door Company Inc.
3. Eggers Industries.
4. Graham; an Assa Abloy Group company.
5. Ideal Architectural Doors & Plywood.
6. Mohawk Flush Doors, Inc.; a Masonite company.
7. VT Industries Inc.

2.2 DOOR CONSTRUCTION, GENERAL

A. Particleboard-Core Doors:

1. Particleboard: ANSI A208.1, Grade LD-1 or Grade LD-2.
2. Blocking: Provide wood blocking in particleboard-core doors as needed to eliminate through-bolting hardware.
3. Provide doors with either glued-wood-stave or structural-composite-lumber cores instead of particleboard cores for doors indicated to receive exit devices.

2.3 VENEERED-FACED DOORS FOR TRANSPARENT FINISH

A. Interior Solid-Core Doors:

1. Grade: Premium, with Grade A faces.
2. Species: White oak.
3. Match between Veneer Leaves: Book match.
4. Assembly of Veneer Leaves on Door Faces: Running match.
5. Core: Particleboard or either glued wood stave or structural composite lumber.
6. Construction: Five or seven plies. Stiles and rails are bonded to core, then entire unit abrasive planed before veneering.

2.4 FABRICATION

A. Factory fit doors to suit frame-opening sizes indicated. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.

B. Openings: Cut and trim openings through doors in factory.

1. Light Openings: Trim openings with moldings of material and profile indicated.

2.5 FACTORY FINISHING

A. Transparent Finish:

1. Grade: Premium.
2. Finish: AWI catalyzed polyurethane system.
3. Staining and Sheen: Match Architect's sample.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Hardware: For installation, see Division 08 Section "Door Hardware."

B. Installation Instructions: Install doors to comply with manufacturer's written instructions and

the referenced quality standard, and as indicated.

- C. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.
- D. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

END OF SECTION 081416

Issued for Construction

MMC Library Renovation
Portland, Maine
Project No.: 11022

SECTION 083113 - ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Access doors and frames for walls and ceilings.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
- C. Samples: For each door face material.

PART 2 - PRODUCTS

2.1 ACCESS DOORS AND FRAMES FOR WALLS AND CEILINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Babcock-Davis.
 - 2. J. L. Industries, Inc.; Div. of Activar Construction Products Group.
 - 3. Karp Associates, Inc.
 - 4. Larsen's Manufacturing Company.
 - 5. Milcor Inc.
 - 6. Nystrom, Inc.
- B. Source Limitations: Obtain each type of access door and frame from single source from single manufacturer.
- C. Flush Access Doors with Concealed Flanges:
 - 1. Assembly Description: Fabricate door to fit flush to frame. Provide frame with gypsum board beads for concealed flange installation.
 - 2. Locations: Wall and ceiling.
 - 3. Uncoated Steel Sheet for Door: Nominal 0.060 inch, 16 gage.
 - a. Finish: Factory prime.
 - 4. Frame Material: Same material and thickness as door.

5. Hinges: Manufacturer's standard.
6. Hardware: Cam latch.

2.2 MATERIALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- B. Steel Sheet: Uncoated or electrolytic zinc coated, ASTM A 879/A 879M, with cold-rolled steel sheet substrate complying with ASTM A 1008/A 1008M, Commercial Steel (CS), exposed.
- C. Frame Anchors: Same type as door face.
- D. Inserts, Bolts, and Anchor Fasteners: Hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329.

2.3 FABRICATION

- A. General: Provide access door and frame assemblies manufactured as integral units ready for installation.
- B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.
- C. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access doors to types of supports indicated.
- D. Latching Mechanisms: Furnish number required to hold doors in flush, smooth plane when closed.

2.4 FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- D. Steel and Metallic-Coated-Steel Finishes:
 1. Factory Prime: Apply manufacturer's standard, fast-curing, lead- and chromate-free, universal primer immediately after surface preparation and pretreatment.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with manufacturer's written instructions for installing access doors and frames.
- B. Install doors flush with adjacent finish surfaces or recessed to receive finish material.

3.2 ADJUSTING

- A. Adjust doors and hardware, after installation, for proper operation.
- B. Remove and replace doors and frames that are warped, bowed, or otherwise damaged.

END OF SECTION 083113

Issued for Construction

MMC Library Renovation
Portland, Maine
Project No.: 11022

SECTION 087100 – FINISH HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. All of the Contract Documents, including General and Supplementary Conditions and Division 01 General Requirements, apply to the work of this section.

1.2 DESCRIPTION OF WORK

- A. The work of this section includes, but is not limited to, the following:
 1. Providing hardware for all doors, except doors provided with their own hardware.
 2. Providing lock cylinders for all work requiring cylinders.
 3. Providing the services of a qualified hardware consultant to prepare detailed schedules of hardware required for the project.

1.3 RELATED WORK

- A. Carefully examine all of the Contract Documents for requirements which affect the work of this section. Other specifications sections which directly relate to the work of this section include, but are not limited to, the following:
 1. Division 08 Section "Hollow Metal Frames"; work requiring template coordination, metal astragals for fire-rated doors.
 2. Division 08 Section "Flush Wood Doors"; work requiring template coordination, metal astragals for fire-rated doors.
 3. Division 26 – Electrical conduit and raceways.

1.4 INTENT

- A. A major intent of the work of this section is to provide hardware for every door in the project, except as indicated, so that each door functions correctly for its intended use. Provide only hardware that complies with applicable codes and requirements of authorities having jurisdiction including requirements for barrier-free accessibility.

1.5 QUALITY ASSURANCE

- A. Hardware supplier shall have in his employ one or more members of the Door and Hardware Institute to include at least one Certified Architectural Hardware Consultant in good standing, who shall be responsible for preparation of the Finish Hardware Schedule. This Consultant shall be acceptable to the Architect and is to ensure that the intent requirement of this specification is

fulfilled, and certify that the work of this section meets or exceeds the requirements specified in this section and the requirements of authorities having jurisdiction.

- B. Hardware supplier shall warrant and guarantee, in writing, that hardware supplied is free of defective material and workmanship. Supplier shall further warrant and guarantee for a period of one year from Owner's Use and Occupancy that the hardware shall function in a satisfactory manner without binding, collapse, or dislodging of its parts, provide the installation is made to the manufacturer's recommendations.
- C. The hardware supplier shall repair or remedy, without charge, any defect of workmanship or material for which he is responsible hereunder.

1.6 SUBMITTALS

- A. Submit the following in accordance with Division 01 Section "Submittals Procedures":
 - 1. Schedule: Submit to the Architect six (6) copies of the complete hardware schedule within the fourteen (14) days after receipt of contract award. Submit therewith complete catalog cuts and descriptive data of all products specifically scheduled therein. No materials shall be ordered or templates issued until the hardware schedule has been approved by the Architect. Form and detail of hardware schedule shall be in vertical format in conformance to the door and hardware industry standards. All hardware sets shall be clearly cross-referenced to the hardware set numbers listed in the specifications.
 - 2. Samples: If requested, submit to the Architect for approval, a complete line of samples as directed. Samples shall be plainly marked giving hardware number used in this specification, the manufacturer's numbers, types and sizes. The Architect will deliver approved samples to the project site to be stored. Samples will remain with the Architect until delivery of all hardware to the project is complete, after which time they will be turned over to the General Contractor for incorporation into the work.
 - 3. Keying System Submission: Before cylinders are ordered, submit a complete proposed keying system for approval. This should be done after a keying meeting has been held with the owner's representative.

1.7 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Delivery of hardware shall be made to the project by the Hardware Supplier in accordance with the instructions of the General Contractor.
- B. The finish hardware shall be delivered to the jobsite and received there by the General Contractor. The General Contractor shall prepare a locked storage room with adequate shelving, for all hardware. The storage room shall be in a dry, secure area, and shall not include storage of other products by other trades.
- C. The General Contractor shall furnish the Hardware Supplier with receipts for all hardware and accessory items received, and shall send copies of these receipts to the Architect, if requested.

1.8 REGULATORY REQUIREMENTS

- A. Conform to all applicable codes. Provide all throws, projections, coatings, knurling, opening and closing forces, and other special functions required by State and Local Building Codes, and all applicable Handicap Code requirements.
- B. For fire rated openings, provide hardware complying with NFPA 80 and NFPA 101 without exception. Provide only hardware tested by UL for the type and size of door installed and fire resistance rating required.

1.9 SPECIAL REQUIREMENTS

- A. Hardware Supplier shall determine conditions and materials of all doors and frames for proper application of hardware.
- B. The Hardware Schedule shall list the actual product series numbers. Bidders are required to follow the manufacturers' catalog requirement for the actual size of door closers, brackets and holders. All door opening sizes are as noted on the Door Schedule and all hardware shall be in strict accordance with requirements of height, width, and thickness.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

Hinges	McKinney Stanley	Scranton, PA New Britain, CT
Locksets	Sargent (No Substitutions)	New Haven, CT
Door Closers	LCN (No Substitutions)	Princeton, IL
Door Stop	Glynn Johnson Ives	Indianapolis, IN New Haven, CT
Rockwood	Rockwood, PA	
Push/Pulls	Rockwood Burns Ives	Rockwood, PA Erie, PA New Haven, CT
Protective Plates	Rockwood Burns Ives	Rockwood, PA Erie, PA New Haven, CT

Silencers	Ives Glynn Johnson Rockwood	New Haven, CT Indianapolis, IN Rockwood, PA
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2.2 MATERIALS AND QUALITY

- A. All hardware shall be of the best grade of solid metal entirely free from imperfections manufacturer and finish.
- B. Qualities, weights, and sizes given herein are the minimum that will be accepted. It is the responsibility of the Hardware Supplier to supply the specified size and weight of hardware and the proper function of hardware in each case and to provide UL approved hardware at all fire rated doors.
- C. Provide, as far as possible, locks of one lock manufacturer and hinges of one hinge manufacturer. Modifications to hardware that are necessary to conform to construction shown or specified shall be provided as required for the specified operation and functional features.

2.3 HARDWARE DESIGNATIONS

- A. All items of hardware are referenced by manufacturer's names and numbers. The manufacturer's names and numbers are used to define the function, design, and the quality of the material to be supplied.
 - 1. Substitution of products other than those listed shall be submitted to the Architect at least ten (10) days PRIOR to the bid date. The Architect shall be the sole judge of any proposed substitution.

2.4 TEMPLATES

- A. Hardware supplier shall immediately, but not later than three (3) days after approval of his Schedule by the Architect, furnish the General Contractor with complete template information necessary for the fabrication of doors, frames, etc. No templates shall be furnished prior to the approval of the hardware schedule.

2.5 HARDWARE FOR LABELED FIRE DOORS, EXIT DEVICES AND SMOKE DOORS

- A. Hardware shall conform to requirements of NFPA 80 for labeled fire doors and to NFPA 101 for exit doors, as well as to other requirements specified. Labeling and listing by UL Building Materials Directory, for class of door being used will be accepted as evidence of conformance to these requirements. Install minimum latch throw as specified on label of individual doors. Provide hardware listed by UL except where heavier materials, larger sizes, or better grades are specified herein under paragraph entitled "Hardware Sets". In lieu of UL labeling and listing, test reports from a nationally recognized testing agency may be submitted showing that hardware has been tested in accordance with UL test methods and that it conforms to NFPA

requirements. Specific hardware requirements of door or frame manufacturers which exceed sized or weights of hardware herein listed shall be provided with no additional charge.

2.6 KEYS AND KEYING

- A. The hardware supplier shall review the specific hardware functions with the Architect and owner at the time of the keying review, to assure the appropriateness of each of the hardware functions. Failure to make this review does not relieve the hardware supplier from providing the proper functions.
- B. All cylinders to be provided by Owner.

2.7 FASTENERS

- A. Manufacture hardware to conform to published templates, generally prepared for machine screw installation.
- B. Furnish screws for installation, with each hardware item. Provide Phillips flat-head screws except as otherwise indicated. Furnish exposed screws to match the hardware finish, or, if exposed in surfaces of other work, to match the finish of such other work as closely as possible, except as otherwise indicated.
- C. Provide concealed fasteners for hardware units which are exposed when the door is closed, except to the extent no standard manufactured units of the type specified are available with concealed fasteners. Do not use thru-bolts unless specifically approved by the Architect.
- D. All hardware shall be installed only with fasteners supplied by manufacturers of specific products.

2.8 PACKING AND MARKING

- A. All hardware shall have the required screws, bolts and fastenings necessary for proper installation and shall be wrapped in the same package as the hardware item for which it is intended and shall match finish of hardware with which to be used.
- B. Each package shall be clearly labeled indicating the portion of the work for which it is intended.

2.9 ENVIROMENTAL CONCERN FOR PACKGING

- A. The hardware shipped to the jobsite is to be packaged in biodegradable packs such as paper or cardboard boxes and wrapping. If non-biodegradable packing such as plastic, plastic bags or large amounts of Styrofoam is utilized, then the Contractor will be responsible for the disposal of the non-biodegradable packing to a licensed or authorized collector for recycling of the non-degradable packing.

2.10 FINISH HARDWARE DESCRIPTION

A. Hardware items shall conform to respective specifications and standards and to requirements specified herein.

B. Materials and Finish Materials and Finishes shall be:

1. Interior Butts: US26D (BHMA 652)
2. Exterior Geared Hinges US28 (BHMA 628)
3. Door Closers: Sprayed to match hardware finish.
4. Exit Devices: US26D (BHMA 626)
5. Kick, Push Plates: US32D (BHMA 630)
6. All other hardware shall be: US26D (BHMA 626), or as scheduled.

C. Hinges

1. Number of hinges per door, two hinges for doors up to and including five feet in height and an additional hinge for each two and one half feet or fraction thereof.
2. Hinges shall be as follows:

Exterior	McKinney Stanley	TA2314 FBB191	4 ½ x 4 ½ NRP 4 ½ x 4 ½ NRP
Interior	McKinney Stanley	TA2714 FBB179	4 ½ x 4 ½ 4 ½ x 4 ½
Elec	McKinney Stanley	TA2714-CC8 CEFBB179	

D. Door Closers:

1. Door closers shall have fully hydraulic, full rack and pinion action. Cylinder body shall be 1-1/2” in diameter, and double heat treated pinion shall be 11/16” in diameter.
2. Hydraulic fluid shall be of a type requiring no seasonal closer adjustment for temperatures ranging from 120 degrees F to -30 degrees F.
3. Spring power shall be continuously adjustable over the full range of closer sizes, and allow for reduced opening force for physically handicapped. Hydraulic regulation shall be by tamper-proof, non-critical valves. Closers shall have separate adjustment for latch speed, general speed, and hydraulic back-check.
4. All closers shall have solid forged steel main arms (and forged forearms for parallel arm closers).
5. Closer arms (and metal covers when specified) shall have a powder coating finish.
6. Provide drop, mounting plates, where required.
7. Do not locate closers on the side of doors facing corridors, passageways or similar type areas. Where it is necessary, due to certain conditions and approval of the Architect, to have closers in corridors, provide such closers with parallel or track type arms.
8. All door closers shall be adjusted by the installer in accordance with the manufacturer’s templates and written instructions. Closers with parallel arms shall have back-check features adjusted prior to installation.

9. Closers shall conform to all applicable code requirements relative to setting closing speeds for closers and maximum pressure for operating interior and exterior doors.
10. Door closers meeting this specification are as follows:

a. LCN

1) Exterior

- a) 4111S-CUSH
- b) 4111S-H-CUSH

2) Interior

- a) 4011
- b) 4111
- c) 4040SE
- d) 4000T
- e) 4310ME-SF
- f) 4040SE-DE

E. Heavy Duty Lever Handle Cylindrical Locks:

1. Locksets for this project shall be heavy duty cylindrical key-in-lever handle type locksets.
2. Locksets shall be 2 ¾" backset with ½" throw latchbolt, with deadlocking latch, and a cylindrical housing of steel with a zinc dichromate finish.
3. Locksets shall be fastened by thru-bolts, thru the 3 ½" diameter inside rose back plate into the threaded studs in the outside rose back plate. Thru-bolts shall be placed in separate bolt holes, thru the door and outside the cylindrical case at 180 deg. from each other.
4. The inside and outside rose scalps shall be 3 ½"diameter wrought brass or bronze. When assembled, all thru-bolts in the face of the door shall be concealed from view. The lever handles shall be solid cast in the same finish as the rose.
5. The ½' throw latchbolt shall be listed and approved for use by Underwriters Laboratories.
6. Strikes shall be curved lip ANSI A115.2 4 7/8" x 1 ¼" wrought brass or bronze.
7. The following locksets shall be considered acceptable for this project:

(no exception)

Sargent 10 Line LL Design

8. Lock functions as indicated in the hardware schedule shall be as follows:

Function	Sargent
A (Storeroom)	04
B (Storeroom)	04
C (Office)	05
D (Passage)	15
E (Vestibule)	16
F (Classroom)	37
G (Spec Classroom)	38
H (Privacy)	65
I (Dummy)	93
J (Electric Lock)	71 RX
K (Key Pad)	KP10G77

F. Push Plates, Door Pulls, Push/Pull Bars:

1. Shall be as manufactured by Rockwood, Burns or Ives.
 - a. Push plates shall be 4" x 16" x .050 thickness unless otherwise listed in hardware sets.
 - 1) Rockwood 70 Series
 - 2) Burns 50 Series
 - 3) Quality 40 Series
 - b. Door pulls shall be 1" x 10"
 - 1) Type A
 - a) Rockwood BF111 (A1 BF157)
 - b) Burns BF26C
 - c) Quality BF163-10"
 - c. Push/pull bars
 - 1) Type A (Wide Stile Doors)
 - a) Rockwood BF11147 x T1006 Mounting
 - b) Burns BF26C x 442 x Sim. Mounting as Above
 - c) Quality BF 482 x Sim. Mounting as Above

G. Kick Plates, Armor Plates, Mop Plates:

1. Kick plates shall be 8 in. high. Armor plates shall be 34 in. high. Mop plates shall be 4 in. high. All plates shall be 2 in. less the width of door. Plates shall be .050 thickness, bevel 4 edges, screws shall be oval head counter-sunk.

H. Stops

1. Shall be furnished at all doors. Wherever and opened door or any item of hardware thereon strikes a wall, at 90 degrees. Provide wall bumpers, unless otherwise indicated in hardware sets.
2. Where wall bumpers cannot be effectively used, a floor stop shall be furnished and installed.
3. Provide roller bumpers for each door where two doors interfere with each other in swinging.

Manufacturer	Wall Bumpers	Floor Stops	Roller Bumpers
Rockwood	409	440, 442	456
Ives	407 ½	436B, 438B	470 Series
Glynn Johnson	WB 50XT	FB13, FB14	RB-3

4. Where overhead stops are listed they shall be the surface mounted type as follows:

Manufacturer	Series
Glynn Johnson	GJ450
Sargent	1540
ABH	4400

PART 3 - EXECUTION

3.1 INSPECTION

- A. It shall be the general contractor's responsibility to inspect all doors openings and doors to determine that each door and door frame has been properly prepared for the required hardware. If errors in dimensions or preparation are encountered, they are to be corrected by the responsible parties prior to the installation of hardware.

3.2 PREPARATION

- A. All doors and frames, requiring field preparation for finish hardware, shall be carefully mortised, drilled for pilot holes, or tapped for machine screws for all items of finish hardware in accordance with the manufacturer's templates and instructions.

3.3 INSTALLATION/ADJUSTMENT/LOCATION

- A. All materials shall be installed in a workmanlike manner following the manufacture's recommended instructions.
- B. Exit Devices shall be carefully installed so as to permit friction free operation of crossbar, touch bar, lever. Latching mechanism shall also operate freely without friction or binding.
- C. Door Closers shall be installed in accordance with the manufacturer's instructions. Each door closer shall be carefully installed, on each door, at the degree of opening indicated on the hardware schedule. Arm position shall be shown on the instruction sheets and required by the finish hardware schedule.
- D. The adjustments for all door closers shall be the installer's responsibility and these adjustments shall be made at the time of installation of the door closer. The closing speed and the latching speed valves, shall be adjusted individually to provide a smooth, continuous closing action without slamming. The delayed action feature or back check valve shall also be adjusted so as to permit the correct delayed action cycle or hydraulic back check valve shall also be adjusted so as the opening cycle. All valves must be properly adjusted at the time of installation. Each door closer has adjustable spring power capable of being adjusted, in the field from size 2 thru 6. It shall be the installers' responsibility to adjust the spring power for each door closer in exact accordance with the spring power adjustment chart illustrated in the door closer installation sheet packed with each door closed.

- E. Installation of all other hardware, including locksets, push-pull latches, overhead holders, door stops, plates and other items, shall be carefully coordinated with the hardware schedule and the manufacturer's instruction sheets.
- F. Locations for finish hardware shall be in accordance with dimensions listed in the pamphlet "Recommended locations for Builders' Hardware" published by the Door and Hardware Institute.

3.4 FIELD QUALITY CONTROL

- A. Upon completion of the installation of the finish hardware, it shall be the responsibility of the finish hardware supplier to visit the project and to examine the hardware for each door on which he has provided hardware and to verify that all hardware is in proper working order. Should he find items of hardware not operating problem he should make a report, in writing, to the general contractor, advising him of the problem and the measures required to correct the problem.

3.5 PROTECTION

- A. All exposed portions of finish hardware shall be carefully protected, by use of cloth, adhesive backed paper or other materials, immediately after installation of the hardware item on the door. The finish shall remain protected until completion of the project. Prior to acceptance of the project by the Architect and owner, the general contractor shall remove the protective material exposing the finish hardware.

3.6 CLEANING

- A. It shall be the responsibility of the general contractor to clean all items of finish hardware and to remove any remaining pieces of protective materials and labels.

3.7 INSTRUCTIONS AND TOOLS

- A. It shall be the responsibility of the finish hardware supplier to provide installation and repair manuals and adjusting tools, wrenches, etc... for the following operating products.
 - 1. Locksets (all types)
 - 2. Exit Devices (all types)
 - 3. Door Closers

3.8 HARDWARE SETS

- A. Each Hardware Set listed below represents the complete hardware requirements for one opening. (Single Door or Pair of Doors). Furnish the quantities required for each set for the work.

HW 1

Doors #01, 02, 03

Each Leaf Shall Have: (4) Hinges, Lockset (Function C), Door Stop

HW 2

Doors #5315

Each Leaf Shall Have: (3) Hinges, Lockset (Function C), Door Stop

HW 3

Doors #07, 08, 11

Each Leaf Shall Have: (4) Hinges, Lockset (Function F), Door Stop

HW 4

Doors #06, 5321

Each Leaf Shall Have: (3) Hinges, Lockset (Function F), Door Stop

HW 5

Doors #10

Each Leaf Shall Have: (4) Hinges, Lockset (Function A), Overhead Stop

END OF SECTION 087100

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Portland, Maine
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087100 - 12

FINISH HARDWARE

SECTION 088000 - GLAZING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes glazing for the following interior products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:
 - 1. Doors.
 - 2. Borrowed lites.

1.2 ACTION SUBMITTALS

- A. Product Data: For each glass product and glazing material indicated.
- B. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

1.3 QUALITY ASSURANCE

- A. Safety Glazing Labeling: Where safety glazing labeling is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.

PART 2 - PRODUCTS

2.1 GLASS PRODUCTS, GENERAL

- A. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass lites in thicknesses as needed to comply with requirements indicated.
- B. Strength: Where float glass is indicated, provide annealed float glass, Kind HS heat-treated float glass, or Kind FT heat-treated float glass. Where heat-strengthened glass is indicated, provide Kind HS heat-treated float glass or Kind FT heat-treated float glass. Where fully tempered glass is indicated, provide Kind FT heat-treated float glass.

2.2 GLASS PRODUCTS

- A. Heat-Treated Float Glass: ASTM C 1048; Type I; Quality-Q3; Class I (clear) unless otherwise indicated; of kind and condition indicated.

2.3 GLAZING GASKETS

- A. Dense Compression Gaskets: Molded or extruded gaskets of profile and hardness required to maintain watertight seal, made from one of the following:
 - 1. Neoprene complying with ASTM C 864.
 - 2. EPDM complying with ASTM C 864.
 - 3. Silicone complying with ASTM C 1115.
 - 4. Thermoplastic polyolefin rubber complying with ASTM C 1115.
- B. Soft Compression Gaskets: Extruded or molded, closed-cell, integral-skinned neoprene, EPDM silicone, or thermoplastic polyolefin rubber gaskets complying with ASTM C 509, Type II, black; of profile and hardness required to maintain watertight seal.
 - 1. Application: Use where soft compression gaskets will be compressed by inserting dense compression gaskets on opposite side of glazing or pressure applied by means of pressure-glazing stops on opposite side of glazing.

2.4 GLAZING SEALANTS

- A. General:
 - 1. Compatibility: Provide glazing sealants that are compatible with one another and with other materials they will contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
 - 2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
- B. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 100/50, Use NT.

2.5 GLAZING TAPES

- A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C 1281 and AAMA 800 for products indicated below:
 - 1. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
- B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:
 - 1. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.
 - 2. AAMA 810.1, Type 2, for glazing application in which tape is used in combination with a full bead of liquid sealant.

2.6 MISCELLANEOUS GLAZING MATERIALS

- A. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
- B. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
- C. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
- D. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).
- E. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.
- F. Perimeter Insulation for Fire-Resistive Glazing: Product that is approved by testing agency that listed and labeled fire-resistant glazing product with which it is used for application and fire-protection rating indicated.

2.7 MONOLITHIC-GLASS TYPES

- A. Glass Type: Fully tempered float glass.
 - 1. Thickness: 6.0 mm.
 - 2. Provide safety glazing labeling.

PART 3 - EXECUTION

3.1 GLAZING, GENERAL

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. Adjust glazing channel dimensions as required by Project conditions during installation to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.
- C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.
- D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.

- E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- G. Provide spacers for glass lites where length plus width is larger than 50 inches.
- H. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

3.2 TAPE GLAZING

- A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.
- B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.
- C. Cover vertical framing joints by applying tapes to heads and sills first and then to jambs. Cover horizontal framing joints by applying tapes to jambs and then to heads and sills.
- D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
- E. Apply heel bead of elastomeric sealant.
- F. Center glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.
- G. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.3 GASKET GLAZING (DRY)

- A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
- B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.
- C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

- D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- E. Install gaskets so they protrude past face of glazing stops.

3.4 SEALANT GLAZING (WET)

- A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.
- B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.
- C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.5 CLEANING AND PROTECTION

- A. Protect glass from contact with contaminating substances resulting from construction operations. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer.
- B. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.

END OF SECTION 088000

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Portland, Maine
Project No.: 11022

SECTION 088113 - DECORATIVE GLASS GLAZING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes the following decorative glass for interior applications:

1. Glass with decorative film overlay.

1.2 PERFORMANCE REQUIREMENTS

- A. General Performance: Installed glazing systems shall withstand normal thermal movement and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; deterioration of glazing materials; or other defects in construction.

1.3 PRECONSTRUCTION TESTING

1.4 ACTION SUBMITTALS

- A. Product Data: For each decorative-glass and glazing product indicated.
- B. Shop Drawings: For decorative glass. Show fabrication and installation details.
- C. Samples: For each exposed product and for each color and texture.
- D. Product Schedule: For decorative glass. Use same designations indicated on Drawings.

1.5 INFORMATIONAL SUBMITTALS

- A. Product certificates.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance data.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under NGA's Certified Glass Installer Program.

- B. Glazing Publications: Comply with published recommendations in GANA's "Glazing Manual" unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.
- C. Safety Glazing: Where safety glazing is indicated, comply with testing requirements in 16 CFR 1201 for Category II materials.

PART 2 - PRODUCTS

2.1 GLASS PRODUCTS, GENERAL

- A. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass lites in thicknesses as needed to comply with requirements indicated.
- B. Strength: Where float glass is indicated, provide annealed float glass, Kind HS heat-treated float glass, or Kind FT heat-treated float glass as needed to comply with requirements indicated. Where heat-strengthened glass is indicated, provide Kind HS heat-treated float glass or Kind FT heat-treated float glass as needed to comply with requirements indicated. Where fully tempered glass is indicated, provide Kind FT heat-treated float glass.

2.2 MONOLITHIC-GLASS PRODUCTS

- A. Heat-Treated Float Glass: ASTM C 1048; Type I; Quality-Q3; Class I (clear) unless otherwise indicated; of kind and condition indicated.

2.3 DECORATIVE GLASS TYPES

- A. Decorative Glass: Glass with decorative film overlay. Use translucent, dimensionally stable, cast PVC film, 2-mil- minimum thickness, with pressure-sensitive, clear adhesive back for adhering to glass and releasable protective backing.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Avery Dennison, Graphics.
 - b. FDC Graphic Films, Inc.
 - c. 3M; Scotchcal.
 - 2. Glass Type: Fully tempered float glass.
 - 3. Glass Thickness: 6.0 mm.
 - 4. Comply with requirements for safety glazing.
 - 5. Patterns: Match Architect's samples.

2.4 GLAZING MATERIALS

- A. Glazing Gaskets, Sealants, Tapes, and Miscellaneous Glazing Materials: As specified in

Division 08 Section "Glazing."

2.5 DECORATIVE-GLASS FABRICATION

- A. Decorative Film Overlay: Apply squarely aligned to glass edges, uniformly smooth, and free from tears, air bubbles, wrinkles, and rough edges, in pattern indicated on Drawings to the back face of clean glass, according to manufacturer's written instructions, including surface preparation and application temperature limitations.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Proceed with installation only after unsatisfactory conditions have been corrected.
- B. Set decorative glass in locations indicated on Drawings. Install glass with hardware and accessories according to hardware manufacturer's written instructions. Attach hardware securely to mounting surfaces.
- C. Decorative Glass: Install glazing as specified in Division 08 Section "Glazing."
- D. Protect decorative glass from damage immediately after installation by attaching crossed streamers to framing and held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels, and clean surfaces.
- E. Protect glass from contact with contaminating substances resulting from construction operations. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer.
- F. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.

END OF SECTION 088113

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Portland, Maine
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SECTION 092216 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Non-load-bearing steel framing systems for interior gypsum board assemblies.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 FRAMING SYSTEMS

- A. Steel Studs and Runners: ASTM C 645. Use either steel studs and runners or dimpled steel studs and runners of equivalent minimum base-metal thickness.

1. Minimum Base-Metal Thickness: 0.018 inch.
2. Depth: As indicated on Drawings.

- B. Slip-Type Head Joints: Where indicated, provide one of the following in thickness not less than indicated for studs and in width to accommodate depth of studs:

1. Single Long-Leg Runner System: ASTM C 645 top runner with 2-inch-deep flanges, installed with studs friction fit into top runner and with continuous bridging located within 12 inches of the top of studs to provide lateral bracing.
2. Double-Runner System: ASTM C 645 top runners, inside runner with 2-inch-deep flanges and fastened to studs, and outer runner sized to friction fit inside runner.
3. Deflection Track: Steel sheet top runner manufactured to prevent cracking of finishes due to deflection of structure above.

- C. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.

1. Minimum Base-Metal Thickness: 0.018 inch.

- D. Cold-Rolled Channel Bridging: Steel, 0.053-inch minimum base-metal thickness, with minimum 1/2-inch-wide flanges.

1. Depth: As indicated on Drawings.

2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches, 0.068-inch-thick, galvanized steel.
- E. Hat-Shaped, Rigid Furring Channels: ASTM C 645.
1. Minimum Base-Metal Thickness: 0.018 inch.
 2. Depth: 7/8 inch.
- F. Resilient Furring Channels: 1/2-inch-deep, steel sheet members designed to reduce sound transmission.
1. Configuration: Asymmetrical or hat shaped.
- G. Cold-Rolled Furring Channels: 0.053-inch uncoated-steel thickness, with minimum 1/2-inch-wide flanges.
1. Depth: 3/4 inch.
 2. Furring Brackets: Adjustable, corrugated-edge type of steel sheet with minimum uncoated-steel thickness of 0.033 inch.
 3. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch-diameter wire, or double strand of 0.048-inch-diameter wire.
- H. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches, wall attachment flange of 7/8 inch, minimum uncoated-metal thickness of 0.018 inch, and depth required to fit insulation thickness indicated.

2.2 AUXILIARY MATERIALS

- A. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Installation Standard: ASTM C 754.
1. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.
- B. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, furnishings, or similar construction.
- C. Install bracing at terminations in assemblies.
- D. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.2 INSTALLING FRAMED ASSEMBLIES

- A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
- B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.
- C. Install studs so flanges within framing system point in same direction.
- D. Install tracks (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts penetrating partitions above ceiling.
 - 1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
 - 2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.
 - a. Install two studs at each jamb unless otherwise indicated.
 - b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch clearance from jamb stud to allow for installation of control joint in finished assembly.
 - c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.
 - 3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
- E. Direct Furring:
 - 1. Screw to wood framing.
 - 2. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.
- F. Z-Furring Members:
 - 1. Erect insulation vertically and hold in place with Z-furring members spaced 24 inches o.c.
 - 2. Except at exterior corners, securely attach narrow flanges of furring members to wall with concrete stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.
 - 3. At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw-attach short flange of furring channel to web of attached channel. At interior corners, space second member no more than 12 inches from corner and cut insulation to fit.

- G. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.

END OF SECTION 092216

SECTION 092900 - GYPSUM BOARD

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior gypsum board.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 INTERIOR GYPSUM BOARD

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. American Gypsum.
2. CertainTeed Corp.
3. Georgia-Pacific Gypsum LLC.
4. National Gypsum Company.
5. USG Corporation.

- B. Gypsum Wallboard: ASTM C 1396/C 1396M.

1. Thickness: 5/8 inch.
2. Long Edges: Tapered and featured (rounded or beveled) for prefilling.

2.2 TRIM ACCESSORIES

- A. Interior Trim: ASTM C 1047.

1. Material: Galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized steel sheet.

2.3 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C 475/C 475M.

- B. Joint Tape:
 - 1. Interior Gypsum Board: Paper.
- C. Joint Compound for Interior Gypsum Board: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.

2.4 AUXILIARY MATERIALS

- A. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.
- B. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.
- C. Sound Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing).

PART 3 - EXECUTION

3.1 APPLYING AND FINISHING PANELS

- A. Comply with ASTM C 840.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- C. Install trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.
- D. Prefill open joints, rounded or beveled edges, and damaged surface areas.
- E. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.
- F. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:
 - 1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
 - 2. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated.
 - a. Primer and its application to surfaces are specified in other Division 09 Sections.
- G. Protect adjacent surfaces from drywall compound and texture finishes and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.

- H. Remove and replace panels that are wet, moisture damaged, and mold damaged.

END OF SECTION 092900

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Portland, Maine
Project No.: 11022

SECTION 095113 - ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes acoustical panels and exposed suspension systems for ceilings.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Coordination Drawings: Drawn to scale and coordinating acoustical panel ceiling installation with hanger attachment to building structure and ceiling mounted items:
- C. Samples: For each exposed finish.
- D. Product test reports.
- E. Research/evaluation reports.
- F. Maintenance data.

1.3 QUALITY ASSURANCE

- A. Acoustical Testing Agency Qualifications: An independent testing laboratory or an NVLAP-accredited laboratory.
- B. Preinstallation Conference: Conduct conference at Project site.

1.4 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Acoustical Ceiling Panels: Full-size panels equal to 2.0 percent of quantity installed.
 - 2. Suspension System Components: Quantity of each exposed component equal to 2.0 percent of quantity installed.

PART 2 - PRODUCTS

2.1 ACOUSTICAL PANEL CEILINGS, GENERAL

- A. Acoustical Panel Standard: Comply with ASTM E 1264.
- B. Metal Suspension System Standard: Comply with ASTM C 635.
- C. Attachment Devices: Size for five times the design load indicated in ASTM C 635, Table 1, "Direct Hung," unless otherwise indicated.
 - 1. Anchors in Concrete: Expansion anchors fabricated from corrosion-resistant materials, with holes or loops for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to five times that imposed by ceiling construction, as determined by testing per ASTM E 488 or ASTM E 1512 as applicable, conducted by a qualified testing and inspecting agency.
 - 2. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hangers of type indicated, and with capability to sustain, without failure, a load equal to 10 times that imposed by ceiling construction, as determined by testing per ASTM E 1190, conducted by a qualified testing and inspecting agency.
- D. Wire Hangers, Braces, and Ties: Zinc-coated carbon-steel wire; ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
 - 1. Size: Select wire diameter so its stress at 3 times hanger design load (ASTM C 635, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 0.106-inch-diameter wire.
- E. Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension system runners.

2.2 ACOUSTICAL PANELS FOR ACOUSTICAL PANEL CEILING

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Armstrong World Industries, Inc.
 - 2. USG Interiors, Inc.
 - 3. Or approved equal.
- B. Type and Size:
 - 1. Armstrong Ultima 1911 Beveled Tegular; 2'-0" x 2'-0" x 3/4".
 - 2. USG Mars ClimaPlus SLT; 2'-0" x 2'-0" x 3/4".
 - 3. Or approved equal.

2.3 METAL SUSPENSION SYSTEM FOR ACOUSTICAL PANEL CEILING

- A. Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet, prepainted, electrolytically zinc coated, or hot-dip galvanized according to ASTM A 653/A 653M, not less than G30 coating designation, with prefinished metal caps on flanges.
 - 1. Structural Classification: Intermediate -duty system.
 - 2. Cap Material: Steel or aluminum cold-rolled sheet.
 - 3. Cap Finish: Painted to match color of acoustical unit.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with ASTM C 636 and seismic design requirements indicated, per manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."
- B. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders.
- C. Suspend ceiling hangers from building's structural members, plumb and free from contact with insulation or other objects within ceiling plenum. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers, use trapezes or equivalent devices. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
 - 1. Do not support ceilings directly from permanent metal forms or floor deck; anchor into concrete slabs.
 - 2. Do not attach hangers to steel deck tabs.
- D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels. Screw attach moldings to substrate at intervals not more than 16 inches o.c. and not more than 3 inches from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet. Miter corners accurately and connect securely.
- E. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- F. Install acoustical panels with undamaged edges and fit accurately into suspension system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.

END OF SECTION 095113

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Portland, Maine
Project No.: 11022

SECTION 096513 - RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Resilient base.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

- B. Samples: For each type of product indicated, in manufacturer's standard-size Samples but not less than 12 inches long, of each resilient product color, texture, and pattern required.

1.3 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.

1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

1.4 PROJECT CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer in spaces to receive resilient products.

- B. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer.

C. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 RESILIENT BASE

A. Resilient Base:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Armstrong World Industries, Inc.
 - b. Johnsonite.
 - c. Roppe Corporation, USA.
- B. Resilient Base Standard: ASTM F 1861.
- 1. Material Requirement: Type TV (vinyl, thermoplastic).
 - 2. Manufacturing Method: Group I (solid, homogeneous).
 - 3. Style: Cove (base with toe).
- C. Minimum Thickness: 0.125 inch.
- D. Height: 4 inches.
- E. Lengths: Coils in manufacturer's standard length.
- F. Outside Corners: Job formed or preformed.
- G. Inside Corners: Job formed or preformed.
- H. Colors and Finish: As selected by Architect from manufacturer's full range.

2.2 INSTALLATION MATERIALS

- A. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.
- B. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.
- C. Do not install resilient products until they are same temperature as the space where they are to be installed.
 - 1. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.
- D. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation.

3.2 RESILIENT BASE INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient base.
- B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
- C. Install resilient base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned.
- D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
- E. Do not stretch resilient base during installation.

3.3 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protection of resilient products.
- B. Cover resilient products until Substantial Completion.

END OF SECTION 096513

Issued for Construction

MMC Library Renovation
Portland, Maine
Project No.: 11022

SECTION 096813 - TILE CARPETING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes modular, fusion-bonded and tufted carpet tile.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show the following:
 - 1. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet tiles.
 - 2. Type of subfloor.
 - 3. Type of installation.
 - 4. Pattern of installation.
 - 5. Pattern type, location, and direction.
 - 6. Pile direction.
- C. Samples: For each exposed product and for each color and texture.

1.4 INFORMATIONAL SUBMITTALS

- A. Product test reports.
- B. Sample warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance data.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who is certified by the International Certified Floorcovering Installers Association at the Commercial II certification level.

- B. Fire-Test-Response Ratings: Where indicated, provide carpet tile identical to those of assemblies tested for fire response according to NFPA 253 by a qualified testing agency.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Comply with CRI 104.

1.8 FIELD CONDITIONS

- A. Comply with CRI 104 for temperature, humidity, and ventilation limitations.

1.9 WARRANTY

- A. Special Warranty for Carpet Tiles: Manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period.
 - 1. Warranty does not include deterioration or failure of carpet tile due to unusual traffic, failure of substrate, vandalism, or abuse.
 - 2. Failures include, but are not limited to, more than 10 percent edge raveling, snags, runs, dimensional stability, excess static discharge, loss of tuft bind strength, loss of face fiber, and delamination.
 - 3. Warranty Period: 10 years from date of Substantial Completion.

1.10 EXTRA MATERIALS

- A. Furnish extra materials described below, before installation begins, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Carpet Tile: Full-size units equal to 5 percent of amount installed for each type indicated, but not less than 10 sq. yd (8.3 sq. m).

PART 2 - PRODUCTS

2.1 CARPET TILE

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. Tandus Flooring, Powerbond. No Substitutions.
- B. Variable Cushion Tufted Textile, VCCT-1.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Tandus Flooring; Powerbond, Consequence.
 - 2. Fiber Type: Dynex nylon.

3. Pile Characteristic: Stratatec™ Patterned Loop.
 4. Gage: 5/64 inch.
 5. Primary Backing: Non woven synthetic fiber.
- C. Carpet Tile Size: As indicated on Drawings.
- D. Performance Characteristics: As follows:
1. Appearance Retention Rating: Heavy traffic, 3.0 minimum according to ASTM D 7330.
 2. Critical Radiant Flux Classification: Not less than 0.45 W/sq. cm.
 3. Dry Breaking Strength: Not less than 100 lbf according to ASTM D 2646.
 4. Tuft Bind: Not less than 3 lbf according to ASTM D 1335.
 5. Delamination: Not less than 3.5 lbf/in. according to ASTM D 3936.
 6. Dimensional Tolerance: Within 1/32 inch of specified size dimensions, as determined by physical measurement.
 7. Dimensional Stability: 0.2 percent or less according to ISO 2551 (Aachen Test).
 8. Resistance to Insects: Comply with AATCC 24.
 9. Colorfastness to Crocking: Not less than 4, wet and dry, according to AATCC 165.
 10. Colorfastness to Light: Not less than 4 after 40 AFU (AATCC fading units) according to AATCC 16, Option E.
 11. Antimicrobial Activity: Not less than 2-mm halo of inhibition for gram-positive bacteria, not less than 1-mm halo of inhibition for gram-negative bacteria, and no fungal growth, according to AATCC 174.
 12. Electrostatic Propensity: Less than 3.5 kV according to AATCC 134.

2.2 INSTALLATION ACCESSORIES

- A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.
- B. Adhesives: Water-resistant, mildew-resistant, nonstaining, pressure-sensitive type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed carpet tile and is recommended by carpet tile manufacturer for releasable installation.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet tile performance. Examine carpet tile for type, color, pattern, and potential defects.
- B. Concrete Subfloors: Verify that concrete slabs comply with ASTM F 710.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

- D. Preparation: Comply with CRI 104, Section 6.2, "Site Conditions; Floor Preparation," and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile installation.
- E. Installation: Comply with CRI 104, Section 14, "Carpet Modules," and with carpet tile manufacturer's written installation instructions.
- F. Installation Method: As recommended in writing by carpet tile manufacturer.
- G. Maintain dye lot integrity. Do not mix dye lots in same area.
- H. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.
- I. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.
- J. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish flooring as marked on subfloor. Use nonpermanent, nonstaining marking device.
- K. Install pattern parallel to walls and borders.
- L. Perform the following operations immediately after installing carpet tile:
 - 1. Remove excess adhesive, seam sealer, and other surface blemishes using cleaner recommended by carpet tile manufacturer.
 - 2. Remove yarns that protrude from carpet tile surface.
 - 3. Vacuum carpet tile using commercial machine with face-beater element.
- M. Protect installed carpet tile to comply with CRI 104, Section 16, "Protecting Indoor Installations."

END OF SECTION 096813

SECTION 096816 - SHEET CARPETING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes sheet carpeting.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show the following:
 - 1. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet.
 - 2. Type of subfloor.
 - 3. Type of installation.
 - 4. Pattern of installation.
 - 5. Pattern type, location, and direction.
 - 6. Pile direction.
- C. Samples: For each exposed product and for each color and texture.

1.4 INFORMATIONAL SUBMITTALS

- A. Product test reports.
- B. Sample warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance data.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who is certified by the International Certified Floorcovering Installers Association at the Commercial II certification level.

- B. Fire-Test-Response Ratings: Where indicated, provide carpet identical to those of assemblies tested for fire response according to NFPA 253 by a qualified testing agency.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Comply with CRI 104.

1.8 FIELD CONDITIONS

- A. Comply with CRI 104 for temperature, humidity, and ventilation limitations.

1.9 WARRANTY

- A. Special Warranty for Carpet: Manufacturer agrees to repair or replace components of carpet installation that fail in materials or workmanship within specified warranty period.
 - 1. Warranty does not include deterioration or failure of carpet due to unusual traffic, failure of substrate, vandalism, or abuse.
 - 2. Failures include, but are not limited to, more than 10 percent edge raveling, snags, runs, dimensional stability, excess static discharge, loss of tuft bind strength, loss of face fiber, and delamination.
 - 3. Warranty Period: 10 years from date of Substantial Completion.

1.10 EXTRA MATERIALS

- A. Furnish extra materials described below, before installation begins, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Carpet: Full-size units equal to 5 percent of amount installed for each type indicated, but not less than 10 sq. yd (8.3 sq. m).

PART 2 - PRODUCTS

2.1 CARPET

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. Tandus Flooring, Powerbond. No Substitutions.
- B. Variable Cushion Tufted Textile, VCCT-1.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Tandus Flooring; Powerbond, Consequence.
 - 2. Fiber Type: Dynex nylon.

3. Pile Characteristic: Stratatec™ Patterned Loop.
4. Gage: 5/64 inch.
5. Primary Backing: Non woven synthetic fiber.

C. Performance Characteristics: As follows:

1. Appearance Retention Rating: Heavy traffic, 3.0 minimum according to ASTM D 7330.
2. Critical Radiant Flux Classification: Not less than 0.45 W/sq. cm.
3. Dry Breaking Strength: Not less than 100 lbf according to ASTM D 2646.
4. Resistance to Insects: Comply with AATCC 24.
5. Colorfastness to Crocking: Not less than 4, wet and dry, according to AATCC 165.
6. Colorfastness to Light: Not less than 4 after 40 AFU (AATCC fading units) according to AATCC 16, Option E.
7. Antimicrobial Activity: Not less than 2-mm halo of inhibition for gram-positive bacteria, not less than 1-mm halo of inhibition for gram-negative bacteria, and no fungal growth, according to AATCC 174.
8. Electrostatic Propensity: Less than 3.5 kV according to AATCC 134.

2.2 INSTALLATION ACCESSORIES

- A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet manufacturer.
- B. Adhesives: Water-resistant, mildew-resistant, nonstaining, pressure-sensitive type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed carpet and is recommended by carpet manufacturer for releasable installation.
- C. Seam Adhesive: Hot-melt adhesive tape or similar product recommended by carpet manufacturer for sealing and taping seams and butting cut edges at backing to form secure seams and to prevent pile loss at seams.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet performance. Examine carpet for type, color, pattern, and potential defects.
- B. Concrete Subfloors: Verify that concrete slabs comply with ASTM F 710.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.
- D. Preparation: Comply with CRI 104, Section 6.2, "Site Conditions; Floor Preparation," and with carpet manufacturer's written installation instructions for preparing substrates indicated to receive carpet installation.

- E. Installation: Comply with CRI 104 and carpet manufacturer's written installation instructions.
- F. Comply with carpet manufacturer's written recommendations and Shop Drawings for seam locations and direction of carpet; maintain uniformity of carpet direction and lay of pile. At doorways, center seams under the door in closed position.
- G. Do not bridge building expansion joints with carpet.
- H. Cut and fit carpet to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet manufacturer.
- I. Extend carpet into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.
- J. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish flooring as marked on subfloor. Use nonpermanent, nonstaining marking device.
- K. Install pattern parallel to walls and borders to comply with CRI 104, Section 15, "Patterned Carpet Installations" and with carpet manufacturer's written recommendations.
- L. Perform the following operations immediately after installing carpet:
 - 1. Remove excess adhesive, seam sealer, and other surface blemishes using cleaner recommended by carpet manufacturer.
 - 2. Remove yarns that protrude from carpet surface.
 - 3. Vacuum carpet using commercial machine with face-beater element.
- M. Protect installed carpet to comply with CRI 104, Section 16, "Protecting Indoor Installations."

END OF SECTION 096816

SECTION 099123 - INTERIOR PAINTING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes surface preparation and the application of paint systems on the following interior substrates:
 - 1. Steel.
 - 2. Wood.
 - 3. Gypsum board.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
- B. Samples: For each type of paint system and in each color and gloss of topcoat.
- C. Product List: For each product indicated. Include printout of current "MPI Approved Products List" for each product category specified in Part 2, with the proposed product highlighted.

1.3 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Paint: 5 percent, but not less than 1 gal. of each material and color applied.

1.4 QUALITY ASSURANCE

- A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Architect will select one surface to represent surfaces and conditions for application of each paint system specified in Part 3.
 - a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft.
 - b. Other Items: Architect will designate items or areas required.

2. Final approval of color selections will be based on mockups.
 - a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 1. Sherwin Williams Company, The.
 2. No substitutions.

2.2 PAINT, GENERAL

- A. MPI Standards: Provide products that comply with MPI standards indicated and that are listed in its "MPI Approved Products List."
- B. Material Compatibility:
 1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.
- C. Colors and Finish: As indicated in Finish Schedule.

2.3 PRIMERS/SEALERS

- A. Primer Sealer, Latex, Interior: MPI #50.
- B. Primer, Latex, for Interior Wood: MPI #39.

2.4 METAL PRIMERS

- A. Primer, Alkyd, Anti-Corrosive, for Metal: MPI #79.

2.5 WATER-BASED PAINTS

- A. Latex, Interior, Flat, (Gloss Level 1): MPI #53.

- B. Latex, Interior, (Gloss Level 2): MPI #44.
- C. Latex, Interior, (Gloss Level 3): MPI #52.
- D. Latex, Interior, (Gloss Level 4): MPI #43.
- E. Latex, Interior, Semi-Gloss, (Gloss Level 5): MPI #54.
- F. Latex, Interior, Gloss, (Gloss Level 6, except minimum gloss of 65 units at 60 degrees): MPI #114.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 - 1. Wood: 15 percent.
 - 2. Gypsum Board: 12 percent.
- C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- D. Proceed with coating application only after unsatisfactory conditions have been corrected.
 - 1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Manual" applicable to substrates indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
 - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
- C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.

3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions and to recommendations in "MPI Manual."
- B. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

3.4 CLEANING AND PROTECTION

- A. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- B. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.5 INTERIOR PAINTING SCHEDULE

- A. Steel Substrates:
 1. Latex over Alkyd Primer System:
 - a. Prime Coat: Primer, alkyd, anti-corrosive, for metal.
 - b. Intermediate Coat: Latex, interior, matching topcoat.
 - c. Topcoat: Latex, interior.
 - d. Color and Finish: As indicated in Finish Schedule.
- B. Wood Substrates: Including wood trim.
 1. Latex System:
 - a. Prime Coat: Primer, latex, for interior wood.
 - b. Intermediate Coat: Latex, interior, matching topcoat.
 - c. Topcoat: Latex, interior.
 - d. Color and Finish: As indicated in Finish Schedule.
- C. Gypsum Board Substrates:
 1. Latex System:
 - a. Prime Coat: Primer sealer, latex, interior.

- b. Intermediate Coat: Latex, interior, matching topcoat.
- c. Topcoat: Latex, interior.
- d. Color and Finish: As indicated in Finish Schedule.

END OF SECTION 099123

Issued for Construction

MMC Library Renovation
Portland, Maine
Project No.: 11022

May 10, 2012

099123 - 6

INTERIOR PAINTING

SECTION 101100 - VISUAL DISPLAY SURFACES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Markerboards.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For visual display surfaces. Include plans, elevations, sections, details, and attachments to other work.

1. Show locations of panel joints.
2. Include sections of typical trim members.

C. Samples: For each exposed product and for each color and texture.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for surface-burning characteristics of fabrics.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For visual display surfaces to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 50 or less.

- B. Preinstallation Conference: Conduct conference at Project site.

1.6 WARRANTY

- A. Special Warranty for Porcelain-Enamel Face Sheets: Manufacturer's standard form in which manufacturer agrees to repair or replace porcelain-enamel face sheets that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Surfaces lose original writing and erasing qualities.
 - b. Surfaces exhibit crazing, cracking, or flaking.
 - 2. Warranty Period: 50 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Porcelain-Enamel Face Sheet: Manufacturer's standard steel sheet with porcelain-enamel coating fused to steel; uncoated thickness indicated.
- B. Hardboard: ANSI A135.4, tempered.
- C. Particleboard: ANSI A208.1, Grade M-1.
- D. Fiberboard: ASTM C 208.

2.2 MARKERBOARD ASSEMBLIES

- A. Porcelain-Enamel Markerboards: Balanced, high-pressure, factory-laminated markerboard assembly of three-ply construction consisting of backing sheet, core material, and 0.021-inch-thick, porcelain-enamel face sheet with gloss finish.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Best-Rite Manufacturing.
 - b. Claridge Products and Equipment, Inc.
 - c. Ghent Manufacturing, Inc.
 - d. Marsh Industries, Inc.; Visual Products Group.
 - e. PolyVision Corporation; a Steelcase company.
 - 2. Manufacturer's Standard Core: Minimum 1/4 inch thick, with manufacturer's standard moisture-barrier backing.

3. Laminating Adhesive: Manufacturer's standard, moisture-resistant thermoplastic type.

2.3 MARKERBOARD ACCESSORIES

- A. Aluminum Frames and Trim: Fabricated from not less than 0.062-inch-thick, extruded aluminum; standard size and shape.
 1. Factory-Applied Trim: Manufacturer's standard.

2.4 FABRICATION

- A. Porcelain-Enamel Visual Display Assemblies: Laminate porcelain-enamel face sheet and backing sheet to core material under heat and pressure with manufacturer's standard flexible, waterproof adhesive.
- B. Visual Display Boards: Factory assemble visual display boards unless otherwise indicated.
 1. Where factory-applied trim is indicated, trim shall be assembled and attached to visual display boards at manufacturer's factory before shipment.
- C. Aluminum Frames and Trim: Fabricate units straight and of single lengths, keeping joints to a minimum. Miter corners to a neat, hairline closure.

2.5 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Prepare surfaces to achieve a smooth, dry, clean surface free of flaking, unsound coatings, cracks, defects, projections, depressions, and substances that will impair bond between visual display surfaces and wall surfaces.
- B. General: Install visual display surfaces in locations and at mounting heights indicated on Drawings. Keep perimeter lines straight, level, and plumb. Provide grounds, clips, backing materials, adhesives, brackets, anchors, trim, and accessories necessary for complete installation.
- C. Visual Display Boards: Attach concealed clips, hangers, and grounds to wall surfaces and to visual display boards with fasteners at not more than 16 inches (400 mm) o.c. Secure both top and bottom of boards to walls.

- D. Clean visual display surfaces according to manufacturer's written instructions. Attach one cleaning label to visual display surface in each room. Cover and protect visual display surfaces.

END OF SECTION 101100

SECTION 104413 - FIRE EXTINGUISHER CABINETS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes fire protection cabinets for fire extinguishers.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For fire protection cabinets. Include plans, elevations, sections, details, and attachments to other work.
- C. Samples: For each exposed product and for each color and texture specified.

1.3 CLOSEOUT SUBMITTALS

- A. Maintenance data.

1.4 QUALITY ASSURANCE

- A. Coordinate size of fire protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.
- B. Coordinate sizes and locations of fire protection cabinets with wall depths.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B.
- B. Clear Float Glass: ASTM C 1036, Type I, Class 1, Quality q3, 6 mm thick.

2.2 FIRE PROTECTION CABINET

- A. Cabinet Type: Suitable for fire extinguisher.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of

the following:

- a. J. L. Industries, Inc., a division of Activar Construction Products Group.
 - b. Larsen's Manufacturing Company.
 - c. Potter Roemer LLC.
 - d. Or approved equal.
- B. Cabinet Material: Steel sheet.
- C. Recessed Cabinet: Cabinet box recessed in walls of sufficient depth to suit style of trim indicated.
1. Exposed Flat Trim: One-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend).
- D. Cabinet Trim Material: Steel sheet.
- E. Door Material: Steel sheet.
- F. Door Style: Center glass panel with frame.
- G. Door Glazing: Clear float glass.
- H. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.
- I. Accessories:
1. Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to fire protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
 2. Door Lock: Cam lock that allows door to be opened during emergency by pulling sharply on door handle.
 3. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as directed by Architect.
 - a. Identify fire extinguisher in fire protection cabinet with the words "FIRE EXTINGUISHER."
 - 1) Location: Applied to cabinet door.
 - 2) Application Process: Decals.
 - 3) Lettering Color: Red.
 - 4) Orientation: Vertical.
- J. Finishes:
1. Manufacturer's standard baked-enamel paint for the following:

- a. Exterior of cabinet door, and trim, except for those surfaces indicated to receive another finish.
 - b. Interior of cabinet and door.
2. Steel: Baked enamel or powder coat.
- a. Color and Gloss: As selected by Architect from manufacturer's full range.

2.3 FABRICATION

- A. Fire Protection Cabinets: Provide manufacturer's standard box (tub), with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated. Miter and weld joints and grind smooth.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Examine walls and partitions for suitable framing depth and blocking where recessed cabinets will be installed and prepare recesses as required by type and size of cabinet and trim style.
- B. Install fire protection cabinets in locations and at mounting heights indicated or, if not indicated, at heights acceptable to authorities having jurisdiction.
- C. Fire Protection Cabinets: Fasten cabinets to structure, square and plumb.
- D. Identification: Apply decals at locations indicated.
- E. Adjust fire protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.
- F. Replace fire protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 104413

Issued for Construction

MMC Library Renovation
Portland, Maine
Project No.: 11022

SECTION 104416 - FIRE EXTINGUISHERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes portable, hand-carried fire extinguishers.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

1.3 INFORMATIONAL SUBMITTALS

- A. Warranty: Sample of special warranty.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

1.5 QUALITY ASSURANCE

- A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."
- B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.
- C. Coordinate type and capacity of fire extinguishers with fire protection cabinets to ensure fit and function.

1.6 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Failure of hydrostatic test according to NFPA 10.
 - b. Faulty operation of valves or release levers.

2. Warranty Period: Six years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

- A. Fire Extinguishers: Type, size, and capacity for each fire protection cabinet indicated.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ansul Incorporated; Tyco International Ltd.
 - b. J. L. Industries, Inc.; a division of Activar Construction Products Group.
 - c. Kidde Residential and Commercial Division; Subsidiary of Kidde plc.
 - d. Larsen's Manufacturing Company.
 - e. Potter Roemer LLC.
 2. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B and bar coding for documenting fire extinguisher location, inspections, maintenance, and recharging.
- B. Multipurpose Dry-Chemical Type: UL-rated 10 lb nominal capacity, with monoammonium phosphate-based dry chemical in manufacturer's standard enameled container.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Examine fire extinguishers for proper charging and tagging.
 1. Remove and replace damaged, defective, or undercharged fire extinguishers.
- B. Install fire extinguishers in locations indicated and in compliance with requirements of authorities having jurisdiction.

END OF SECTION 104416

DIVISION 21 00 00 – FIRE PROTECTION 1

 PART 1 - GENERAL 1

 1.1 GENERAL REQUIREMENTS 1

 1.2 WORK INCLUDED 1

 1.3 RELATED WORK 1

 1.4 INTENT 2

 1.5 INFORMATION 2

 1.6 CODES, PERMITS AND FEES 3

 1.7 COORDINATION 3

 1.8 REQUESTS FOR INTERPRETATION (RFIs) 4

 1.9 GUARANTEE 4

 1.10 WORKMANSHIP, MATERIALS AND DELIVERY 4

 1.11 SHOP DRAWINGS 5

 1.12 RECORD DRAWINGS 5

 1.13 JURISDICTIONAL DISPUTES 5

 1.14 CARTING, HANDLING AND CLEAN-UP 5

 1.15 PROTECTION OF WORK AND PROPERTY 6

 1.16 COORDINATION DRAWINGS 6

 PART 2 - PRODUCTS 6

 2.1 SLEEVES, HANGERS, INSERTS AND EQUIPMENT SUPPORTS 6

 2.2 PIPE, FITTINGS AND FABRICATION 7

 2.3 VALVES 7

 2.4 FIRE DEPARTMENT VALVE (FDV) 8

 2.5 SPRINKLER HEADS 8

 2.6 SPARE HEADS 8

 2.7 FIRE PROTECTION SYSTEM ACCESSORIES 8

 2.8 VALVE TAGS, CHARTS AND PIPE MARKINGS 9

 2.9 SEISMIC RESTRAINTS 9

 PART 3 - EXECUTION 9

 3.1 PIPING INSTALLATION 9

 3.2 FIRE PROTECTION SYSTEM TESTS 10

 3.3 CLEANING AND ADJUSTING 10

 3.4 INSTRUCTIONS 10

DIVISION 21 00 00 – FIRE PROTECTION

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

- A. Consult in detail all other sections relative to the work, including Bidding Requirements, Contract Forms General Conditions, Supplementary Conditions, and Division 1 General Requirements.
- B. Consult all drawings, note Architectural details and all conditions that may affect the work and care for same in executing the work under this Section. Cooperate and coordinate with all trades.

1.2 WORK INCLUDED

- A. The scope of the work under this Section, 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 Fire Protection Work shown on the drawings and as specified herein.
- B. Work Included: The Fire Protection Work will include but not be limited to the following:
 - 1. Complete wet-type standpipe/sprinkler and dry sprinkler systems in the building as indicated. The fire protection work shall extend and connect to the exterior water main as indicated and shall include a fire pump. The entire fire protection system shall be hydraulically designed, furnished and installed by the Fire Protection Subcontractor, based on Ordinary Group 2 hazard criteria.
 - 2. Furnishing and setting of all pipe sleeves.
 - 3. Furnishing only of access panels to General Contractor.
 - 4. Fire and Smoke Stopping. Coordinate materials and methods with Division 7.
 - 5. Provide working drawings showing all sprinklers and piping, with drawings stamped and approved by the Owner's insurer and the local fire department.
 - 6. Conduct a flow test of the existing water main to which the new fire protection service is directly connecting to, in order to obtain current static and residual pressure and flow data for hydraulic calculations.

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 General Contractor and patching shall be performed by the respective trades. Refer to the respective sections.

2. The Fire Protection Subcontractor shall provide all hoisting and rigging for equipment and materials specified herein.
 3. Core drilling, cutting and channeling for Fire Protection systems and equipment for holes five (5) 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. Woodgrounds (Blocking) for fastening air devices and radiation. Refer to Architectural drawings and DIVISION 6 - ROUGH CARPENTRY to determine if these items are provided. Secure to woodgrounds if provided or directly to wall or ceiling surface if not provided. Provide expansion bolts for masonry - concrete - block wall mounting.
 6. Painting of all exposed piping DIVISION 9 - PAINTING
 7. In general, all wiring required for equipment provided by the Fire Protection Contractor and all interlock wiring for this Fire Protection equipment that is not shown or indicated on the Electrical Drawings of DIVISION 26 – ELECTRICAL shall be provided under DIVISION 21 – Fire Protection. Motor Starters, Disconnects and Variable Frequency Drives furnished, installed and wired under DIVISION 26 - ELECTRICAL
 8. Fire and Smoke stopping at penetrations through fire-rated assemblies. Fire-stop materials and methods are specified in Division 7.
- C. Furnish the following materials to be installed under other SECTIONS.
1. Access Doors and Panels to be installed under applicable sections.

1.4 INTENT

- A. It is the intention of the Drawings and this Specification to show and specify a complete fire protection system. Anything that is not shown on the Drawings but is mentioned in the Specifications, or vice-versa or anything not expressly set forth in either, but which is reasonably implied, shall be furnished and performed as though specifically shown and mentioned in both.
- B. Due to the small scale of the Drawings, it is not possible to indicate all offsets, fitting, valves, etc., which may be required to complete the work. The Fire Protection Subcontractor shall study the drawings showing the structural and finished design of the buildings and shall furnish and install all fittings, etc., to fully complete the Fire Protection Work.
- C. Before submitting prices, thoroughly examine all the Contract Documents and the site with special emphasis on all the adjoining work upon which this work depends.
- D. If for any reason the Fire Protection Subcontractor finds that the work cannot be done in any area in accordance with the Plans and Specifications he must immediately notify the Architect in writing of his findings. If for any reason the Fire Protection Subcontractor fails to do this it shall become his responsibility and he shall bear any and all costs for any work involved, at no extra cost to the Owner.

1.5 INFORMATION

- A. The Fire Protection Subcontractor shall obtain detailed information from the manufacturers of apparatus which he is to furnish and/or install as to the proper method of installation and connections. He shall obtain all information from the General Contractor and the other contractors which may be necessary to facilitate his work and the completion of the project.

- B. He shall keep himself fully informed as to the shape, size and position of all openings required for his apparatus and shall give full information to other contractors as required sufficiently in advance of the work so that all openings may be built on schedule. The Fire Protection Subcontractor shall also furnish all sleeves and supports hereinafter specified, shown or implied and shall set same in place.
- C. In the case of failure on the part of the Fire Protection Subcontractor to give proper information as noted above, he will be required to do his own cutting and patching to the satisfaction of the General Contractor and without additional expense to the Owner.

1.6 CODES, PERMITS AND FEES

- A. All fire protection work shall be installed in accordance with the NFPA Code and any regulations of the City of Portland as they apply to the installation. Such laws and ordinances are to be considered a part of this Specification.
- B. The above Fire Protection Ordinances and Building Laws shall be considered as minimum requirements for the fire protection installation. Where specifications call for work to be done in excess of the above requirements, the Specifications shall be followed.
- C. The Fire Protection Subcontractor shall file all required notices and plans and shall secure and pay for all necessary permits for his work.
- D. If any portion of the Fire Protection Plans or Specifications conflict with any rules and regulations with regard to type of materials, equipment, or fixtures to be used, the Fire Protection Subcontractor shall bring it to the Architect's attention. Otherwise, the cost of all work necessary to make the installation comply with the above rules and regulations shall be paid for by the Fire Protection Subcontractor without additional expense to the Owner.

1.7 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. Set all necessary sleeves and inserts before concrete is scheduled to be poured.
- E. Furnish all items to be built-in, in ample time to allow schedules progress of work.
- F. Refer to the Coordination Drawing Section of Specification for Coordination drawing process.
- G. 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.
- H. Verify with the Electrical contractor available electrical characteristics before ordering any equipment.

- I. Verify with the Plumbing contractor available natural gas pressure before ordering any equipment.
- J. Verify 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. Provide fire alarm wiring and control of devices requiring fire alarm control or status indication. Provides fire alarm wiring and control for motors requiring shutdown.
 - 2. Provide power wiring to control transformers and control panels.
- M. Fire Protection contractor provides low voltage control wiring to all Fire Protection requiring control.

1.8 REQUESTS FOR INTERPRETATION (RFIs)

- A. Prepare Requests for Interpretation (RFIs) in accordance to Division 1 and, in addition, adhere to the following:
- B. 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.
- C. If email RFI submissions are allowed by Division 1 then the RFI and Attachment(s) shall be in Adobe Acrobat PDF format.
- D. Submit RFIs in format specified and in addition include:
 - 1. Specification Section number and title and related paragraphs, as appropriate.
 - 2. Drawing number, room name, structural grid coordinates and detail references, as appropriate.
 - 3. Field dimensions and conditions, as appropriate.
 - 4. 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.
 - 5. 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).
 - a. 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.

1.9 GUARANTEE

- A. The Fire Protection Subcontractor shall refer to the applicable requirements of the GENERAL CONDITIONS which shall be strictly enforced.

1.10 WORKMANSHIP, MATERIALS AND DELIVERY

- A. All work of a special nature shall be performed by skilled and qualified workmen who can present credentials showing experience in said trade.
- B. The Fire Protection Subcontractor shall use only new materials free from defects and of good quality. He shall see that all his materials are delivered at the building when required so as to carry on the work in the most effective manner.
- C. Substitute materials will be considered on the basis of quality function and cost to the Owners. In all cases where approved substitute materials are furnished, the Fire Protection Subcontractor shall pay for any additional work or changes required by him or by the other Subcontractors on the job.
- D. The Fire Protection System shall be delivered to the Owner complete and in perfect working order; tested in full accordance with the Plans and Specifications.

1.11 SHOP DRAWINGS

- A. Submit complete Shop Drawings in accordance with the provisions of the GENERAL CONDITIONS.
- B. Shop Drawings shall include information to prove that the requirements of the Specifications and Drawings are complied with and include installation instructions and wiring diagrams. Shop Drawings submittals shall include but not be limited to the following:
Alarm Valve and Accessories.
 - 1. Sprinkler Heads.
 - 2. Pipe and Fittings.
 - 3. Fire Department Valves.
 - 4. Floor Control Assembly.
 - 5. Approved working drawings, stamped by the Owners insurer and the local Fire Department.

1.12 RECORD DRAWINGS

- A. The Fire Protection Subcontractor shall note the requirements of the SPECIAL CONDITIONS, which shall be strictly enforced.

1.13 JURISDICTIONAL DISPUTES

- A. In order to avoid any jurisdictional disputes and work stoppages that could arise during the installation of the work shown on the Drawings or as specified herein, the Fire Protection Subcontractor shall be held responsible to do any sub-letting work that might be required to furnish and install the work shown or specified herein.

1.14 CARTING, HANDLING AND CLEAN-UP

- A. The Fire Protection Subcontractor shall do all carting, handling, hoisting, etc., for his material and equipment at his expense in a safe and satisfactory manner. Any damage resulting there from shall be repaired or paid for by this Subcontractor to the satisfaction of the General Contractor.

- B. Clean-up requirements as specified under the SUPPLEMENTARY CONDITIONS will be strictly enforced.

1.15 PROTECTION OF WORK AND PROPERTY

- A. The Fire Protection Subcontractor shall be responsible for the care and protection of all work included in this Section of the Specification and Drawings until it has been tested and accepted.
- B. After delivery and before, during and after installation, the Fire Protection Subcontractor shall protect all equipment and materials 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.

1.16 COORDINATION DRAWINGS

- A. Prepare Coordination Drawings according to the requirements outlined in Division 1 to a 1/4-inch-equals-1-foot scale or larger. Detail major elements, components, and systems of plumbing equipment and piping in relation to each other and to other systems, installations, and building components. Indicate locations and space requirements for installation, access, and working clearance. Show where sequence and coordination of installations are important to the efficient flow of the Work. Coordinate drawing preparation with effort specified in other Specification Sections. Include the following:
 - 1. Provisions for scheduling, sequencing, moving, and positioning large equipment in the building during construction.
 - 2. Floor plans, elevations, and details, including the following:
 - a. Clearances to meet safety requirements and for servicing and maintaining equipment, including space for equipment disassembly required for periodic maintenance.
 - b. Equipment support details.
 - c. Exterior wall, roof, and foundation penetrations of piping; and their relation to other penetrations and installations.
 - d. Fire-rated interior wall and floor penetrations by fire protection piping.
 - e. Sizes and locations of required concrete pads and bases.
 - 3. Reflected ceiling plans to coordinate and integrate installing air outlets and inlets, light fixtures, alarm and communication systems components, sprinklers, and other ceiling-mounted items.

PART 2 - PRODUCTS

2.1 SLEEVES, HANGERS, INSERTS AND EQUIPMENT SUPPORTS

- A. Pipe sleeves, pipe hangers and equipment supports for all piping shall be furnished and set by the Fire Protection Subcontractor and this Subcontractor shall be responsible for their proper and permanent location.
- B. Sleeves - Cast iron or steel pipe sleeves shall be furnished and set in walls, floor and roof where pipes are to pass through. Sleeves shall be two (2) nominal sizes larger than pipe and shall finish flush with walls.

- C. All pipe openings through floors, exterior building walls; two-hour rated walls or partitions and designated "FIRE RATED PARTITIONS", SHALL BE SEALED. Materials and systems shall be as specified herein.
1. Masonry walls indicated on the General Construction Plans as two-hour rated shall have openings sealed by packing around the pipe with glass fiber rope and sealing each end with 1" fire resistant caulking. Other walls shall be sealed with glass fiber rope only. Seal openings in floors with glass fiber rope and fire resistant caulking as required to make watertight. Sleeves through exterior walls shall be watertight and shall be flexible.
- D. Hangers: All piping shall be rigidly supported from the building structure by means of approved hangers, inserts, and supports. Pipes shall be supported to maintain required grading and pitching of lines to prevent vibration and to secure piping in place and shall be arranged so as to provide for proper expansion and contraction of pipe. All horizontal piping shall be hung with approved adjustable, malleable iron pipe hangers, unless otherwise specified and spaced according to code requirements and manufacturer's recommendations for each type and size of piping.
- E. Hangers for piping of sizes 4 inches and smaller shall be Carpenter Patterson Type No. IA Band, or approved equal, black steel and hanger rods with machine threads; for piping of sizes larger than 4 inches shall be the adjustable clevis hanger type, malleable iron, with extension rod to structure. Hanger rods shall be secured to concrete floor slabs by means of approved type inserts wherever possible.
- F. In addition to normal concrete inserts, beam clamps, etc., the Fire Protection Subcontractor shall furnish and install steel angle hanger supports to meet special conditions where hangers are required under ductwork. PIPING SHALL NOT BE SUPPORTED FROM DUCTWORK OR STRUCTURAL STEEL DECKS.
- G. Vertical risers shall be supported at each floor level with long leg, bolted pipe clamps. In addition each riser shall be supported with a pipe hanger at the top and at offset locations.

2.2 PIPE, FITTINGS AND FABRICATION

- A. Piping Above Ground
1. Material: Fire Protection piping 2" and larger shall be new Berger light wall steel water pipe, ASTM #53, with working pressure of not less than 175 psi. Fittings, couplings and unions, reducers and bushings shall be of a type specifically approved for use in fire protection systems and shall comply with the above mentioned working pressure. Piping 1-1/2" and smaller shall be Schedule 40 black steel with working pressure same as above. Acceptable alternates: Allied, American Steel Pipe. Piping 1-1/2" and smaller shall have threaded joints. Piping 2" and larger shall have roll groove joints with mechanical couplings.
 2. Piping between Siamese connections and related check valves and drain and test piping subject to alternate wetting and drying shall be galvanized steel.
- B. Fabrication: Threaded fittings shall have an approved compound applied to male threads only and jointed watertight. Grooved piping shall be joined with cast iron couplings, with nuts, bolts and rubber gaskets and secured watertight according to manufacturer's recommendations.

2.3 VALVES

- A. Gate valves 2" and smaller shall be all bronze with rising stem and threaded ends, similar to Jenkins 275-U.
- B. Gate valves larger than 2" shall be iron body, bronze mounted, outside screw and yoke type, threaded or flanged end type, similar to Jenkins 824A, 825A.
- C. Where permissible, valves 3" and larger may be butterfly type, iron body, wafer closure with crank handle, indicator and supervisory switch, similar to Grinnell 12427-151.
- D. Check valves 2" and smaller shall be all bronze with threaded ends, swing check type.
- E. Check valves larger than 2" shall be iron body, bronze mounted, swing check type, threaded or flanged end type similar to Jenkins 629.
- F. All valves shall be of the same manufacturer and be UL approved, Milwaukee, Kennedy or Grinnell.

2.4 FIRE DEPARTMENT VALVE (FDV)

- A. Fire Department Valve: shall be similar to Elkhart Model U-25 brass angle valve, 2-1/2" rough brass, with A-327 2-1/2" x 1-1/2" reducer and #310 1-1/2" brass cap and chain. Male threads to meet local Fire Department Standards.

2.5 SPRINKLER HEADS

- A. Sprinkler heads generally shall be of the wet automatic closed type and of temperature rating to satisfy immediate conditions.
 - 1. Heads located in finished ceilings, except where noted otherwise shall be ornamental pendant type, semi-recessed, factory chromium-plated escutcheons. Grinnell or approved equal. All heads installed in 2' x 2' ceiling tiles shall be placed in the center of the tile. Use swing joints if necessary to insure center of tile installation.
 - 2. Heads on exposed piping or in concealed spaces may be upright or pendant type with rough brass finish.
 - 3. Sidewall heads shall be of the extended coverage type, chromium-plated with chromium-plated escutcheons and have U.L. approval for extended coverage. Gem or approved equal.

2.6 SPARE HEADS

- A. Spare heads shall be furnished in a quantity as required by Underwriters or as otherwise directed. Heads shall be packed in a suitable container and shall be representative of, and in proportion to, the number of each type and temperature rating heads installed, in addition, one sprinkler-head shall be provided.

2.7 FIRE PROTECTION SYSTEM ACCESSORIES

- A. The Fire Protection Subcontractor shall furnish and install all accessories necessary to fully complete the fire protection system, as specified or implied, which shall include but not be limited to the following:
 - 1. Sprinkler test connection, similar to Elkhart No. 112. Potter Romer, Seco.

2. Supervisory switches, where indicated on the Drawings, type that attaches directly to O.S.& Y. gate valves or butterfly valves, with retard. Autocall, Potter Romer or equal.
3. Flow switches with retard feature.
4. Inspectors test connection.

2.8 VALVE TAGS, CHARTS AND PIPE MARKINGS

- A. Furnish and install pipe identification markers on all exposed piping installed under this part of the Specification. Piping above removable suspended ceilings shall be considered exposed as well as piping located in mechanical equipment rooms or spaces. Pipe identification markers shall consist of labels or black letters imprinted on color coded background and 1-1/2" color bands. Labels and bands shall indicate the pipe fill and the direction of flow. Pipe identification labels shall be the coiled snap-on type, letters to be 2" high on all pipes 3" diameter and over, letters to be 3/4" high on all pipes under 3" diameter. Pipe identification markers shall be applied to the pipe on 15' centers and at each valve, whichever is closer. Pipe identification shall state "FIRE PROTECTION" in white letters on a Red Background. Pipe identification markers shall be W. H. Brady Co., Seton Co., or Bell Co.
- B. Furnish and install stamped or embossed 1-1/2" diameter brass tags or plastic identification plates for each valve, control entity or piece of equipment. These identification plates shall be permanently attached to their identifying equipment or valves with brass hooks or brass link chain. Each chain valve or plug shall be tagged "DRAIN".
- C. Each brass valve tag shall be lettered for its appropriate service and numbered in consecutive order "FP" for FIRE PROTECTION.
- D. The Fire Protection Subcontractor shall prepare in triplicate a complete listing of each valve, its number and describing its control function. These listings shall be presented to the Architect at the completion of the job.

2.9 SEISMIC RESTRAINTS

- A. Seismic restraints shall be furnished and installed by the Fire Protection Subcontractor in accordance with N.F.P.A. 13 requirements and manufacturers recommendations. This will be strictly enforced.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

- A. All above ground piping shall be installed as closely, as possible to walls, ceilings, beams, columns, etc., consistent with proper space allowance for covering and removal of pipes.
- B. All piping shall be run approximately as indicated on the Drawings and to avoid conflicts, rigidly supported, aligned and/or graded and arranged without sags, pockets or low spots. Low ends of lines shall be fitted with drain leg tees fitted with drain valves.
- C. All piping connections to equipment shall be made with flanges or couplings and shall be suitable for the type of system it serves.

- D. Except where otherwise noted, all piping shall be concealed in walls, ceiling construction, access spaces and chases provided.

3.2 FIRE PROTECTION SYSTEM TESTS

- A. The Fire Protection system shall be tested by the Fire Protection Subcontractor in the presence of the Architect or his representative and the Fire Protection Inspector after completion and before concealing any section from view. Furnish labor, tools and all materials and do all testing as described herein.
- B. The Fire Protection system shall be pressure tested at pressure described herein and in a manner as described herein. Test pressures for each system shall be maintained as long as required by the Architect to determine the tightness of the system and/or as long as required to inspect the joints visually or with painted soap solutions. Wherever testing indicates leaks, the leaks shall be repaired in a manner prescribed by the Engineer and the test shall be reprocessed until the system is proven tight. Test in accordance with NFPA 13 Requirements. Test shall be conducted in the presence of a representative of the local Fire Department.
- C. Furnish and make temporary installation of all pumps, compressors and instruments for the testing. Test pressure shall be held for at least the minimum time periods noted above, or long enough thereafter to prove the system tight that is being tested. Any defects shall be repaired or replaced as directed and the expense shall be paid by the Fire Protection Subcontractor. All soap tested joints shall be washed clean after testing, and all tests water properly drawn off.
- D. Conduct all systems tests and submit reports as required by the local fire department.

3.3 CLEANING AND ADJUSTING

- A. At the completion of the work, all equipment apparatus and exposed trim for same included in this Section shall be cleaned, and where required, polished ready for use.

3.4 INSTRUCTIONS

- A. After completion of assembly and installation of all systems and equipment and piping required under this Section of the Specifications, the Owner's supervisory and operating personnel shall be instructed regarding the operation and maintenance of the systems. The instructions shall be given by the Fire Protection Subcontractor and other qualified personnel who are thoroughly familiar with all systems and shall be furnished for a time period as directed by the Architect.

END OF SECTION 21 00 00

SECTION 23 00 00 – HEATING, VENTILATION AND AIR-CONDITIONING 1

PART 1 - GENERAL 1

1.1 GENERAL REQUIREMENTS 1

1.2 WORK INCLUDED 1

1.3 INTENT 2

1.4 RELATED WORK 2

1.5 STANDARD OF MATERIALS AND WORKMANSHIP 3

1.6 ABBREVIATIONS AND DEFINITIONS 3

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 COORDINATION DRAWINGS 10

1.16 REQUESTS FOR INTERPRETATION (RFIs) 11

1.17 TEMPORARY SERVICES 12

1.18 IDENTIFICATION OF MECHANICAL SERVICES 12

1.19 PROTECTION 13

1.20 COORDINATION 13

1.21 GUARANTEE 14

1.22 CONNECTIONS TO EQUIPMENT 15

1.23 SEISMIC DESIGN 15

1.24 HVAC BASIS OF DESIGN 16

1.25 IAQ PROCEDURES FOR OCCUPIED BUILDINGS UNDER CONSTRUCTION 16

1.26 MANUFACTURERS REPRESENTATIVE 17

1.27 HVAC SYSTEM DEMONSTRATION 17

1.28 ALTERNATES 17

1.29 RELATED DOCUMENTS 18

PART 2 - PRODUCTS 18

2.1 PIPE AND FITTINGS 18

2.2 PIPING SPECIALTIES 19

2.3 VALVES 20

2.4 HANGERS AND SUPPORTS 21

2.5 MECHANICAL IDENTIFICATION 22

2.6 ACCESS DOORS AND FRAMES 24

2.7 PIPING INSULATION 24

2.8 DUCTWORK INSULATION 25

2.9 VIBRATION ISOLATION, SUPPORTS AND SEISMIC RESTRAINT 26

2.10 PIPE EXPANSION FITTINGS AND LOOPS 30

2.11 METERS AND GAUGES 31

2.12 DUCTWORK 32

2.13 DUCTWORK ACCESSORIES 32

2.14 HYDRONIC PIPING SYSTEMS 34

2.15 HYDRONIC SPECIALTIES 34

2.16 STEAM AND CONDENSATE PIPING SYSTEMS 35

2.17 REGISTERS, GRILLES AND DIFFUSERS 35

2.18 VARIABLE VOLUME TERMINAL BOXES 36

2.19 AUTOMATIC TEMPERATURE CONTROLS – FACILITIES MANAGEMENT SYSTEM 37

PART 3 - EXECUTION 56

3.1	PROTECTION	56
3.2	INSTALLATION OF EQUIPMENT-GENERAL	56
3.3	CUTTING, PATCHING AND CORE DRILLING	57
3.4	WIRING	57
3.5	PAINTING	57
3.6	LINTELS	57
3.7	STEEL	58
3.8	INSTALLATION OF METERS AND GAUGES	58
3.9	INSTALLATION OF PIPE AND PIPE FITTINGS	59
3.10	INSTALLATION OF VALVES	60
3.11	INSTALLATION OF PIPING SPECIALTIES.....	61
3.12	INSTALLATION OF HANGERS AND SUPPORTS.....	61
3.13	INSTALLATION OF MECHANICAL IDENTIFICATION.....	62
3.14	INSTALLATION OF PIPE INSULATION	63
3.15	INSTALLATION OF DUCTWORK INSULATION	64
3.16	INSTALLATION OF DUCTWORK.....	66
3.17	INSTALLATION OF DUCTWORK ACCESSORIES.....	67
3.18	INSTALLATION OF HYDRONIC PIPING SYSTEMS	68
3.19	INSTALLATION OF HYDRONIC SPECIALTIES	69
3.20	INSTALLATION OF REGISTERS, GRILLES AND DIFFUSERS.....	69
3.21	INSTALLATION OF VARIABLE AIR VOLUME TERMINAL BOXES	70
3.22	INSTALLATION OF PIPE EXPANSION FITTINGS AND LOOPS	70
3.23	INSTALLATION OF VIBRATION ISOLATION, SUPPORTS AND SEISMIC RESTRAINT ..	71
3.24	TESTING, ADJUSTING AND BALANCING	74
3.25	AIR DUCT AND SYSTEM CLEANING.....	81
3.26	SELECTIVE DEMOLITION	84
3.27	TRIAL USAGE	86
3.28	INSTRUCTIONS TO OWNER.....	86

SECTION 23 00 00 – 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, extend, 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. Provide all labor, equipment, and materials, required to furnish and install all HVAC work, complete as shown on the drawings and specified herein. The following are major items of work included:
 - 1. Selective Demolition
 - 2. Hoisting and rigging for equipment and materials specified herein.
 - 3. Core drilling, cutting and channeling for holes five (5) 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. 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.
 - 6. Premium Time: The project requires work to be completed on premium time (outside normal business hours).
 - 7. Maintain Proper Indoor Air Quality of building during construction.
 - 8. Properly protect all stored and partially installed equipment, piping and ductwork.
 - 9. Submittals and Coordination Drawings.
 - 10. Equipment and Systems:
 - a. Fire and Smoke Stopping. Coordinate materials and methods with Division 7.
 - b. Hot water hydronic piping systems.
 - c. Low Pressure steam and condensate piping systems

- d. Air Terminals
 - e. Supply and return air systems
 - f. Ductwork
 - g. Ductwork insulation
 - h. Piping Insulation
 - i. Mechanical Identification
 - j. Variable Volume Air Control terminal units
 - k. Sound attenuators
 - l. Vibration isolation and Seismic Restraint
 - m. Automatic Temperature Controls and all interlock wiring and monitoring
- 11. Hydronic System cleaning, flushing, chemical treatment and Water Quality report.
 - 12. Testing, Adjusting and Balancing of all air and water systems.
 - 13. System Demonstration/Start-up/Manufacturer Representation.
 - 14. Operations and Maintenance Manuals
 - 15. Record Drawings
 - 16. Test and Clean all ductwork, air moving equipment, and coils.

1.3 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.

1.4 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 General 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 five (5) 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. Fuel, water and electricity for all tests and temporary operation of HVAC equipment. – DIVISION 1 - TEMPORARY FACILITIES AND CONTROLS.
6. Temporary heat. DIVISION 1 - TEMPORARY FACILITIES AND CONTROLS.
7. Openings for Air Devices: In APPLICABLE SECTIONS, in which they occur.
8. Undercut doors and door louvers. DIVISION 8 – OPENINGS.
9. Woodgrounds (Blocking) for fastening air devices and radiation. Refer to Architectural drawings and DIVISION 6 -, ROUGH CARPRENTRY to determine if these items are provided. Secure to woodgrounds if provided or directly to wall or ceiling surface if not provided. Provide expansion bolts for masonry - concrete - block wall mounting.
10. Flashing of ductwork, Equipment Supports and Roof Curbs for HVAC equipment. DIVISION 7 - THERMAL AND MOISTURE PROTECTION.
11. Painting of all exposed ductwork and other mechanical equipment not having enameled surfaces, stainless steel or chromed finishes. DIVISION 9 - PAINTING
12. City water piping and fittings including insulation and backflow prevention on plumbing piping systems connecting to HVAC equipment. DIVISION 22 - PLUMBING.
13. 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.
14. HVAC Motor Starters, Disconnects and Variable Frequency Drives provided under this section shall be installed under DIVISION 26 – ELECTRICAL.
15. Fire and Smoke stopping at penetrations through fire-rated assemblies. Fire-stop materials and methods are specified in DIVISION 7.

C. Furnish the following materials to be installed under other specification sections.

1. Access Doors and Panels to be installed under applicable sections.

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-CONDITONING Article STANDARDS- REFERENCES 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, the following applicable standards (latest editions regardless of years listed below) 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 62.1-2010: Ventilation for Acceptable Indoor Air Quality.

- 2) ASHRAE Standard 111-2008: Practices for Measurement, Testing, Adjusting and balancing of Building Heating, Ventilation, Air-Conditioning, and Refrigeration Systems.
 - 3) ASHRAE Standard 90.1-2010: Energy Standard for Buildings Except Low-Rise Residential Buildings
 - 2. NFPA – National Fire Protection Association
 - a. Special Attention is required for:
 - 1) NFPA 90A: Installation of Air Conditioning and Ventilation Systems.
 - 2) NFPA 90B: Installation of Warm Air Heating and Air-Conditioning Systems
 - 3) NFPA 91: Blower and Exhaust Systems.
 - 4) 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 Air Duct Leakage Test Manual.
 - 4) SMACNA IAQ Guidelines for Occupied Buildings Under Design and Construction
 - 5) SMACNA Duct cleanliness for New Construction Guidelines
 - 6) SMACNA HVAC Systems Testing, Adjusting & Balancing
 - 4. NEC – NATIONAL ELECTRIC CODE
 - 5. OSHA – Occupational Safety & Health Administration
 - 6. UL – Underwriter’s Laboratory
 - 7. EPA – Environmental Protection agency
 - 8. AIA – American Institute of Architects
 - 9. AGA - American Gas Association
 - 10. ANSI – American Nation Standards Institute
 - 11. 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.
 - 12. AWWA – American Water Works Association
 - 13. ARI – American Air Conditioning and Refrigeration Institute
 - 14. IEEE- Institute of Electrical and Electronics Engineers
 - 15. IPCEA – Insulated Power Cable Engineers Association
 - 16. ADA –American Standards Association
 - 17. FM – Factory Mutual Engineering Division
 - 18. CS – Commercial Standard of NBS (US Department of Commerce)
 - 19. NADCA - National Air Duct Cleaners Association – ACR 2006
 - 20. NEMA – National Electrical Manufacturers Association
 - 21. ASTM – American Society of Testing and Materials
 - 22. AMCA – Air Moving and Conditioning Association
 - 23. ADC – American Diffuser Council
 - 24. FGI – Facility Guidelines Institute 2010
- D. CODES and ORDINANCES: Conform with the provisions of the latest editions of the following:
- 1. 2009 International Building Code
 - 2. 2009 International Mechanical Code
 - 3. 2009 International Energy Conservation Code
 - 4. Maine State Building Code
 - 5. City of Portland, ME fire protection codes and/or ordinances
 - 6. The 2011 National Electric Code

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 not 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 reproducible drawings by this Subcontractor and submitted to the Architect, as directed in DIVISION 1, PROJECT CLOSEOUT.

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. Each manual shall contain the following information:
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.

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. 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.
- F. Identification: In addition to the information required by DIVISION 1 - SUBMITTAL PROCEDURES indicate:
- a. Name and address of supplier.
 - b. Name of manufacturer.
 - c. Reference specification section number, article number, article name and page number (e.g. 23 00 00 - 2.10 - VIBRATION ISOLATION AND SIEMIC RESTRAINT – Page 23 00 00 - 14)
 - d. Identify if submittal is a resubmission of previous reviewed equipment.
 - e. Distribution list of all Trade subcontractors and manufacturers who will receive the Engineer's reviewed comments.
- G. Do not manufacture, deliver or install equipment and materials until final review of Submittals has been completed.

- H. 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 air terminal units.
- I. 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 air handlers, roof top units, custom roof curbs, cooling towers, pressure reducing stations, and any equipment that standard manufacturers printed data is not suitable for use.
1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
 - a. Dimensions.
 - b. Equipment Shipping and Operating weights.
 - c. Identification of products.
 - d. Fabrication and installation drawings.
 - e. Roughing-in and setting diagrams.
 - f. Wiring diagrams showing field-installed wiring, including power, signal, and control wiring.
 - g. Design calculations.

- J. Compliance with specified standards. Be responsible for presenting the processing of submittals to suit manufacturing schedule of equipment and construction schedule of building.
- K. 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.
- L. 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.
- M. Upon receipt of approved Submittals, distribute copies to all trades and manufacturers affected. Submit approved Submittals to authorities having jurisdiction when requested.
- N. Keep one set of reviewed Submittals on the site at all times.
- O. 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.
- P. 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.
- Q. 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.
- R. Drawings not stamped by the General Contractor shall be returned without being examined.

1.15 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 and return ductwork, VAV Boxes, air-handlers, fans, piping lay-outs 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

1.16 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 1/2" 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.

1.17 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.

1.18 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.

1.19 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 cm². 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.

1.20 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. Set all necessary sleeves and inserts before concrete is scheduled to be poured.
- E. Furnish all items to be built-in, in ample time to allow schedules progress of work.
- F. Refer to the Coordination Drawing Section of Specification for Coordination drawing process.
- G. 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.
- H. Verify with the Electrical contractor available electrical characteristics before ordering any equipment.
- I. Verify with the Plumbing contractor available natural gas pressure before ordering any equipment.
- J. Verify Smoke and Smoke/Damper actuator requirements with Fire Alarm and/or electrical contractor before ordering any equipment.
- K. Verify Smoke detector and Fire Alarm interlock requirements before ordering any equipment.
- L. 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.
- M. 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.
- N. HVAC contractor provides low and line voltage control wiring to all equipment requiring control unless specifically called for on the Electrical Drawings or Specifications.
- O. 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.

1.21 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.

1.22 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.

1.23 SEISMIC DESIGN

- A. This project is located within a seismic zone requiring special provisions for the support and restraint of equipment and piping. Seismic-restraint devices shall have horizontal and vertical load testing and analysis performed according to the Office of Statewide Health Planning & Development for the State of California (OSHDP) and shall bear anchorage preapproval "R" number, from OSHDP or another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If pre-approved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer. Testing and calculations must include both shear and tensile loads and 1 test or analysis at 45 degrees to the weakest mode.
- B. Submittals: Submit Shop Drawings and Product Data signed and sealed by a qualified professional engineer. Include the following:
 - 1. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
 - 2. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes, and seismic loads. Include certification that riser system has been examined for excessive stress and that none will exist.
 - 3. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, base weights, equipment static loads, power transmission, component misalignment, and cantilever loads.
 - 4. Seismic-Restraint Details: Detail fabrication and attachment of seismic restraints and snubbers. Show anchorage details and indicate quantity, diameter, and depth of penetration of anchors.
 - 5. Submittals for Interlocking Snubbers: Include load deflection curves up to 1/2-inch deflection in x, y, and z planes.
- 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.

1.24 HVAC BASIS OF DESIGN

- A. For major pieces of HVAC equipment, including but not limited to chillers, boilers, cooling towers, rooftop units, air handlers, Registers Grilles & Diffusers(RGDs), and VAV terminals 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. For roof mounted equipment, the contractor must ensure that his submitted unit either weighs less than the scheduled unit or can be supported by the roof structure.
- C. For all outdoor mounted equipment, which differs from that shown on the schedules, the contractor must ensure that his submitted equipment does not violate any local noise ordinances.
- D. 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.

1.25 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.

1.26 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. 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
 - 2. Submit reports for approval.
 - 3. Include approved reports in close out documents.

1.27 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, chillers and cooling towers, air handlers, boilers, rooftop units, kitchen make up and exhaust systems, fan systems, pumps, terminal units and computer room units. 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.

1.28 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.

1.29 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. PIPE AND TUBE

1. Copper Tube: ASTM B 88, Type L, seamless.

C. FITTINGS

1. Wrought-Steel Butt welding Fittings: ANSI B 16.9; except B 16.28 for short radius elbows and returns; rated to match connected pipe.
2. Wrought Copper Solder Joint Fittings: ANSI B 16.22.

D. UNIONS AND COUPLINGS

1. Pipe Size 2 inch and under: 150 psi malleable iron for threaded ferrous piping; bronze for copper or brass pipe soldered joints.

E. MISCELLANEOUS PIPING MATERIALS/PRODUCTS

1. Welding Materials: Comply with Section II, Part C, ASME Boiler and Pressure Vessel Code for welding materials.
2. Tin-Antimony Solder (95/5): ASTM B 32, Grade 95TA.
3. Silver-Lead Solder: ASTM B 32, Grade 96TS.
4. Brazing Materials: Comply with SFA-5.8, Section II, ASME Boiler and Pressure Vessel Code for brazing filler metal materials.
5. Joint Compound and Tape: Suitable for pipe, system, fluid within system and associated chemical treatment.

F. A. 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 2" 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 PIPING SPECIALTIES

A. PIPE ESCUTCHEONS

1. General: Provide pipe escutcheons as specified herein with inside diameter closely fitting pipe or pipe insulation outside diameter. Select outside diameter of escutcheon to completely cover pipe penetration hole in floors, walls, or ceilings; and pipe sleeve extension, if any. Furnish pipe escutcheons with nickel or chrome finish for occupied areas, prime paint finish for unoccupied areas.
2. Pipe Escutcheons for Moist Areas: For waterproof floors, and areas where water and condensation can be expected to accumulate, provide cast brass or sheet brass escutcheons, solid or split hinged.
3. Pipe Escutcheons for Dry Areas: Provide sheet steel escutcheons, solid or split hinged.

B. DIELECTRIC UNIONS

1. General: Provide standard products for use in service indicated, which effectively isolate ferrous from non-ferrous piping (electrical conductance), prevent galvanic action, and stop corrosion.

C. MECHANICAL SLEEVE SEALS

1. General: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between and sleeve, connected with bolts and pressure plates which cause rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.
2. ACCEPTABLE MANUFACTURERS
 - a. Thunderline Corp.

D. FIRE BARRIER PENETRATION SEALS

1. Provide seals for any opening through fire rated walls, floors, or ceilings used as passage for mechanical components and piping.
2. Cracks, Voids, or Holes UP to 4" Diameter: Use putty or caulking, one piece intumescent elastomer, non-corrosive to metal, compatible with synthetic cable jackets, and capable of expanding 10 times when exposed to flame or heat, UL listed.
3. Openings 4" or Greater: Use sealing system capable of passing 3-hour fire test in accordance with ASTM E-814, consisting of wall wrap or liner, partitions, and end caps capable of expanding when exposed to temperatures of 250 to 350 deg. F., UL listed.
4. ACCEPTABLE MANUFACTURERS
 - a. Electro Products Div./3M.
 - b. Nelson; Unit of General Signal.

E. FABRICATED PIPING SPECIALTIES

1. Pipe Sleeves: Provide pipe sleeves of one of the following:
2. Sheet-Metal: Galvanized sheet steel. Fabricate of following gages: 3" and smaller, 20 gage, 4" to 6", 16 gage, over 6", 14 gauge.
3. Steel-Pipe: Fabricate from schedule 40 galvanized steel pipe; remove burrs.
4. Plastic-Pipe: Fabricate from Schedule 80 PVC plastic pipe; remove burrs.

5. Sleeve Seals: Provide sleeve seals for sleeves located in foundation walls below grade, or in exterior walls.

2.3 VALVES

A. ACCEPTABLE MANUFACTURERS

- a. Jenkins Bros.
- b. Crane Co.
- c. Powell (Wm.) Co.
- d. Conbraco Ind. Inc., (Apollo)
- e. Jamesbury Corp.
- f. Mission Mfg. Co.
- g. Rockwell Mfg. Co.

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. 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.

E. BUTTERFLY VALVES

1. Type BFV1: High performance, Iron lug body, bronze disc, all metal or combination metal and PTFE seal, stainless steel stem, 200 psi WP, -20 to 200 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.

F. CHECK VALVES

1. Type SCV1: Swing check valve, bronze body, regrinding bronze disc, soldered ends, 300 psi, (Jenkins Fig. 4093J).
2. Type SCV2: Swing check valve, bronze body, regrinding bronze disc, screwed ends, Class 300, (Jenkins Fig. 4962J).
3. Type LCV1: Lift check valve, bronze body, bronze disc, spring loaded, screw over cap, screwed ends, Class 150 (Jenkins Fig. 518AJ).
4. Type WCV1: Wafer check valve, iron body, bronze trim, bronze disc, stainless steel spring, (Jenkins Fig. 777).

G. DRAIN VALVES

1. Type DV1: Ball or gate valve with hose end, bronze cap and chain.

H. PLUG VALVES

1. Type PV1: Semi-steel, bolt gland type, (Rockwell Fig. 142 or 143).

I. 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. SWING CHECK VALVES
 - 1) 2" and Less (Soldered Ends); Type SCV1.
 - 2) 2" and Less (Screwed Ends); Type SCV2.
 - c. LIFT CHECK VALVES:
 - 1) 2" and Less; Type LCV1.
 - d. WAFER CHECK VALVES (For Use on Pump Discharge Services):
 - 1) All Sizes; WCV1.
 - e. DRAIN VALVES:
 - 1) Type DV1.
 - f. PLUG VALVES:
 - 1) Type PV1

2.4 HANGERS AND SUPPORTS

A. ACCEPTABLE MANUFACTURERS

- a. Carpenter and Patterson, Inc.
- b. Elcen Metal Products Co.
- c. 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 to 1-1/2 Inch: Adjustable steel band hanger; MSS Type 7.
2. Shields for insulated all insulated hot piping size 3 inch and less: Galvanized steel shield over insulation in 180 deg. segments, minimum 12 inch long at pipe supports.
3. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
4. Vertical Support: Steel riser clamp.

5. Floor Support for Pipe Sizes to 4 Inch: Cast iron adjustable pipe saddle, locknut nipple, floor flange, and concrete pier or steel support.
6. Provide copper plated hangers and supports for copper piping systems.
7. Shields for Vertical Copper Pipe Risers: Sheet lead.

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.

2.5 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. 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. Metal Tags: Brass with stamped letters; tag size minimum 1-1/2 inch diameter with smooth edges.
4. 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. On piping three (3) inches diameter (including insulation) and larger, lettering shall be two (2) inches high capitals. On smaller diameter piping, use 3/4 inch high capital letters.
5. 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.
6. Equipment Nameplates: Metal, with data engraved or stamped, for permanent attachment on equipment.
 - 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: 2-1/2 by 4 inches for control devices, dampers, and valves; 4-1/2 by 6 inches for equipment.

- d. Fasteners: As required to mount on equipment.
 7. Equipment Markers: Engraved, color-coded laminated plastic. Include contact-type, permanent adhesive.
 - a. Terminology: Match schedules as closely as possible.
 - b. Data:
 - 1) Name and plan number.
 - 2) Equipment service.
 - 3) Design capacity.
 - 4) Other design parameters such as pressure drop, entering and leaving conditions, and speed.
 - c. Location: Accessible and visible.
 - d. Size: 2-1/2 by 4 inches for control devices, dampers, and valves; 4-1/2 by 6 inches for equipment.
 8. Equipment Signs: ASTM D 709, Type I, cellulose, paper-base, phenolic-resin-laminate engraving stock; Grade ES-2, black surface, black phenolic core, with white melamine subcore, unless otherwise indicated. Fabricate in sizes required for message. Provide holes for mechanical fastening.
 - a. Data: Instructions for operation of equipment and for safety procedures.
 - b. Engraving: Manufacturer's standard letter style, of sizes and with terms to match equipment identification.
 - c. Thickness: [1/8 inch], unless otherwise indicated.
 - d. Thickness: 1/16 inch for units up to 20 sq. in. or 8 inches in length, and 1/8 inch for larger units.
 - e. Fasteners: Self-tapping, stainless-steel screws or contact-type, permanent adhesive
 9. 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.
 - 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.
 10. 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.
- D. Flow arrows shall be solid black. Arrows shall be six (6) inches long by two (2) inches wide.
- E. Do color coding of pipes with two (2) inch wide bands according to color schedule to be issued by the Owner during the progress of the work.
- F. 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.
- G. Provide typewritten master lists in Operating and Maintenance Instruction Manuals; and shop equipment numbers on Record Prints and sepias.
- H. Identification shall be consistent with Owner's standard methods of identification.
- I. Provide 1-1/2 inch diameter, 1/16 inch thick brass tags with 3/8 inch die stamped black letters. Attach to valves with four (4) inch brass chains. Brass tags may be omitted on small valves which isolate a single piece of equipment such as unit heater, fan coil unit, and section of radiation.

2.6 ACCESS DOORS AND FRAMES

A. ACCEPTABLE MANUFACTURERS

1. Milcor Div.; Inryco Inc.
2. Miami Carey
3. Way Loctor

B. SUBMITTALS

1. Product Data: For each type of access door and frame indicated. Include construction details, fire ratings, materials, individual components and profiles, and finishes.
2. Shop Drawings: Show fabrication and installation details of access doors and frames for each type of substrate. Include plans, elevations, sections, details, and attachments to other work.
3. Access Door and Frame Schedule: Provide complete access door and frame schedule, including types, locations, sizes, latching or locking provisions, and other data pertinent to installation.
4. Coordination Drawings: Refer to "COORDINATION DRAWINGS" this SECTION.

C. GENERAL:

1. Furnish for installation by others access doors for access to all concealed valves or equipment requiring accessibility for maintenance or proper operation, when such elements are located behind building surfaces or enclosures. Access Door Fire rating shall match wall or ceiling assembly fire rating.
2. Instruct appropriate panel installation contractor as to the proper location of all doors. Locate doors so that valve or element served can be easily reached. Size of doors shall be sufficient to serve intended purpose but in no case less than 9 inch by 9 inch. Doors located in corridors, lobbies or other habitable areas shall be reviewed by Architect as to location.
3. Provide prime painted Flush Access Doors and Trimless Frames prime painted with flush screw driver operated cam locks and concealed hinges.
4. Type of panels shall be based on:
 - a. GYPSUM Board Surfaces "Milcor Type K"
 - b. Masonry Construction "Milcor Type M"

2.7 PIPING INSULATION

A. GLASS FIBER

1. Acceptable Manufacturers:
 - a. Knauf.
 - 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.
9. Insulating Cement:
 - a. ASTM C449/C449M.

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 milsthick; 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 as selected by Architect.
 - 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.

2.8 DUCTWORK INSULATION**A. ACCEPTABLE MANUFACTURERS**

1. CertainTeed Corp.
2. Knauf Fiber Glass
3. Owens Corning Fiberglas Corp.

B. GLASS FIBER FLEXIBLE

1. Insulation: ASTM C553; flexible, noncombustible blanket.
 - a. 'K' value: ASTM C518, 0.25 at 75 degrees F.
 - b. Maximum service temperature: 350 degrees F.
 - c. Maximum moisture absorption: 0.50 percent by volume.
2. Vapor Barrier Jacket:
 - a. Kraft paper with glass fiber yarn and bonded to aluminized film.
 - b. Moisture vapor transmission: ASTM E96; 0.02 perm.
 - c. Secure with pressure sensitive tape.
3. Vapor Barrier Tape:
 - a. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure sensitive rubber based adhesive.
4. Tie Wire: Annealed steel, 16 gauge.

C. GLASS FIBER, RIGID

1. Insulation: ASTM C612; rigid, noncombustible blanket.
 - a. 'K' value: ASTM C518, 0.24 at 75 degrees F.
 - b. Maximum service temperature: 350 degrees F.
 - c. Maximum moisture absorption: 0.20 percent by volume.
 - d. Density: 3.0 lb/cu ft.
2. Vapor Barrier Jacket:
 - a. Kraft paper with glass fiber yarn and bonded to aluminized film.
 - b. Moisture vapor transmission: ASTM E96; 0.04 1.3 perm.
 - c. Secure with pressure sensitive tape two coats of vapor barrier mastic and glass tape.
3. Vapor Barrier Tape:
 - a. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure sensitive rubber based adhesive.
4. Indoor Vapor Barrier Finish:
 - a. Cloth: Untreated; 9 oz/sq. yd. weight, glass fabric.
 - b. Vinyl emulsion type acrylic, compatible with insulation, white color.

D. JACKETS

1. PVC Jacket: High-impact, ultraviolet-resistant PVC; 20 mils thick; roll stock ready for shop or field cutting and forming.
 - a. Adhesive: As recommended by insulation material manufacturer.
 - b. PVC jackets are available in several colors. Colored jackets may be used to replace field painting. Ultraviolet rays fade colors. Some colors (black, gray, and white) do not fade as quickly as other colors (red, orange, and green).
 - c. PVC Jacket Color: Off-white.

E. ACCESSORIES

1. Provide staples, bands, wires, tape, anchors, corner angles and similar accessories as recommended by insulation manufacturer for applications indicated.
2. Provide cements, adhesives, coatings, sealers, protective finishes, and similar compounds as recommended by insulation manufacturer for applications indicated.

F. ACCESSORIES

1. Provide staples, bands, wires, tape, anchors, corner angles and similar accessories as recommended by insulation manufacturer for applications indicated.
2. Provide cements, adhesives, coatings, sealers, protective finishes, and similar compounds as recommended by insulation manufacturer for applications indicated.
3. Jacketing Material (Fiberglass & Calcium Silicate): Presized glass cloth jacketing material, not less than 7.8 ounces per square yard.

2.9 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. The work in this section includes the following:
1. Vibration isolation elements for equipment.
 2. Pipe and Duct Supports.
 3. Piping flexible connectors.
 4. Seismic restraints for isolated equipment.
 5. Seismic restraints for non-isolated equipment.
 6. Certification of seismic restraint designs and installation supervision.
 7. Structural design of all vibration isolation, supports and seismic restraints.
- D. SUBMITTALS
1. Product Data sheets on
 - a. For each specific vibration isolators and restraints to be utilized detailing compliance with the specification. Reference "TYPE" as per "PRODUCTS" section of this specification.
 - b. An itemized list of all isolated and non-isolated equipment including detailed schedules showing isolator, support and seismic restraints proposed for each piece of equipment, referencing material and calculation drawing numbers.
 2. Shop Drawings
 - a. Show base construction for equipment; include dimensions, structural member sizes and support point locations.
 - b. When walls and slabs are used as support and/or seismic restraint locations, details of acceptable methods for ducts and pipe must be included.
 - c. Indicate isolation devices selected with complete dimensional and deflection data before condition is accepted for installation.
 - d. Provide specific details of isolators, supports and seismic restraints and anchors; include number, size and locations for each piece of equipment.
 - e. Coordinated or contract drawings shall be marked-up with the specific locations and types of isolators, supports and restraints shown for all pipe and duct. Rod bracing requirements and assigned load at each location shall be clearly delineated. Any and all tributary loads shall be considered for proper sizing.
 - f. For ceiling suspended equipment design restraints for a minimum installation angle of 30° from vertical. Indicate maximum installation angle allowed for restraint system as well as braced and unbraced rod lengths at each allowable installation condition.
 - g. Calculate thrust for fan heads, axial and centrifugal fans to determine whether thrust restraints are required. (See EQUIPMENT INSTALLATION)
 3. Structural Certification and Analysis
 - a. Seismic restraint calculations must be provided for all connections of equipment to the structure. All performance of products (such as; strut, cable, anchors, clips, etc.) associated with restraints must be supported with manufacturer's data sheets or certified calculations.
 - b. Isolator calculations must be provided for all connections of equipment to the structure. All performance of products associated with isolators must be supported with manufacturer's data sheets or certified structural calculations.

- c. Support calculations must be provided for all connections of equipment to the structure. All performance of products associated with supports must be supported with manufacturer's data sheets or certified structural calculations.
 - d. For roof mounted equipment both the seismic acceleration, wind loads (30 psf), and snow loads shall be calculated, the highest load shall be utilized for the design of the isolator, support and/or restraints.
 - e. Certifications of calculations to document isolators, supports and seismic restraint designs must be stamped by a professional engineer registered in the State where the project is located.
 - 1) Analysis must indicate calculated dead loads, derived loads and materials utilized for connections to equipment and structure. Analysis must detail anchoring methods, bolt diameter, embedment and weld length.
4. An in force, Errors and Omissions insurance certificate must accompany submittals. Manufacturer's product liability insurance certificates are not acceptable.

E. MANUFACTURER'S RESPONSIBILITY

1. Manufacturer of isolators, supports and vibration and seismic control equipment shall have the following responsibilities:
 - a. Determine vibration isolation, support and seismic restraint sizes and locations.
 - b. Provide equipment vibration isolation, support and seismic restraints as specified.
 - c. Guarantee specified isolation system deflections.
 - d. Provide installation instructions, drawings and field supervision to insure proper installation and performance of systems.

F. RELATED WORK

1. 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.
2. 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.

G. SEISMIC RESTRAINTS AND VIBRATION ISOLATION TYPES

1. General
 - a. All isolation and seismic restraint devices shall be capable of accepting, without failure, the "G" forces as determined by the seismic certification and calculations as described in the "SUBMITTAL DATA REQUIREMENTS" section of these specifications.
 - b. Corrosion protection for outdoor applications shall be as follows:
 - 1) Springs shall be cadmium plated, zinc electroplated or powder coated.
 - 2) Hardware shall be cadmium or zinc plated.
 - 3) All other metal parts shall be hot spray or hot dipped galvanized or zinc electroplated.
 - c. All seismic restraint devices
 - 1) Shall maintain the equipment in a captive position and not short circuit isolation device during normal operating conditions.
 - 2) Shall have provisions for bolting and/or welding to the structure.
 - d. Welding of springs to isolator housing, base plates, etc. is strictly prohibited.
2. Seismic Restraint Types
 - a. TYPE III: Restraints for suspended systems.

- 1) Vibration isolated systems shall be braced with multiple 7 x 19 galvanized steel cables with approved attachment devices (such as thimbles and wire rope clips) to equipment and structure.
 - 2) Non-isolated systems shall be braced with structural steel strut or cable with approved attachment devices to equipment and structure.
 - 3) Steel angles (by contractor) shall be provided to prevent rod bending of hung equipment where indicated by the Seismic Restraint Supplier's submittals. Steel angles shall be attached to the rods with a minimum of three clamps model "SRC" at each restraint location. Welding of support rods to angles is not acceptable.
3. Vibration Isolator Types
- a. TYPE C: Spring Hanger Isolator
 - 1) a. Spring element (same as TYPE A) within a steel box with an Elastomer bushing to insulate lower support rod from the hanger box.
 - 2) b. Steel hanger box shall be capable of 30-degree misalignment between the rod attachment to structure and the connection to the supported equipment. Hanger boxes shall withstand three times the rated load without failure.
 - 3) Model "SH" as manufactured by NAI.
 - b. TYPE E: Elastomer Hanger Isolator
 - 1) Molded neoprene element with a bushing to insulate lower support rod from the hanger box.
 - 2) Steel hanger box shall withstand three times the rated load without failure.
 - 3) Model "NH" as manufactured by NAI.
 - c. TYPE F: Combination Spring/Elastomer Hanger Isolator
 - 1) Spring and neoprene elements in a steel hanger box with the features as described for TYPE C and E isolators.
 - 2) Model "SNH" as manufactured by NAI.
 - d. TYPE I: Thrust Restraints
 - 1) A spring element same as TYPE A shall be combined with steel angles, backup plates, threaded rod, washers and nuts to produce a pair of devices capable of limiting thrust movement of air moving equipment to 1/4".
 - 2) Restraints shall be easily converted in the field from a compression type to tension type.
 - 3) Unit shall be factory precompressed.
 - 4) Model "TR" as manufactured by NAI.
 - e. TYPE J: Telescoping Riser Guide
 - 1) Telescoping arrangement of two sizes of steel tubing separated by a minimum 1/2" thickness of TYPE H pad.
 - 2) Model "TRG" as manufactured by NAI.
 - f. TYPE K: Resilient Pipe Anchors and Guides
 - 1) All directional acoustical pipe anchor, consisting of a telescopic arrangement of two sizes of steel tubing separated by a minimum 1/2" thickness of TYPE H pad.
 - 2) Vertical restraint shall be provided by a similar material arranged to prevent vertical travel in either direction.
 - 3) Allowable loads on neoprene pad shall not exceed 500 PSI and the design shall be balanced for equal resistance in any direction.
 - 4) Model "RAG" as manufactured by NAI.

H. 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-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".

2.10 PIPE EXPANSION FITTINGS AND LOOPS

A. 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.

B. SUBMITTALS

1. Product Data: For each type of pipe expansion joint and alignment guide indicated.
2. 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) 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.

C. 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.

D. EXPANSION JOINTS

1. Acceptable Manufacturers:
 - a. Metraflex, Inc.
 - b. Adscop
 - c. Flexonics
2. Basis of Design: Metraflex, Inc. model HP.
3. 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.

E. PIPE ALIGNMENT GUIDES

- 1. Two piece welded steel with enamel paint, bolted, with spider to fit standard pipe, frame with four mounting holes, clearance for minimum 1 inch thick insulation, minimum 3 inch travel.

F. SWIVEL JOINTS

- 1. Double ball bearing race, field lubricated, with rubber (Buna-N) O-ring seals.

G. MATERIALS FOR ANCHORS

- 1. Steel Shapes and Plates: ASTM A 36/A 36M.
- 2. Bolts and Nuts: ASME B18.10 or ASTM A 183, steel, hex head.
- 3. Washers: ASTM F 844, steel, plain, flat washers.
- 4. Mechanical Fasteners: Insert-wedge-type stud with expansion plug anchor for use in hardened portland cement concrete, and tension and shear capacities appropriate for application.
 - a. Stainless-steel studs are available.
 - b. Stud: Threaded, zinc-coated carbon steel.
 - c. Expansion Plug: Zinc-coated steel.
 - d. Washer and Nut: Zinc-coated steel.
- 5. Chemical Fasteners: Insert-type-stud bonding system anchor for use with hardened portland cement concrete, and tension and shear capacities appropriate for application.
 - a. Bonding Material: ASTM C 881, Type IV, Grade 3, 2-component epoxy resin suitable for surface temperature of hardened concrete where fastener is to be installed.
 - b. Stainless-steel studs are available.
 - c. Stud: ASTM A 307, zinc-coated carbon steel with continuous thread on stud, unless otherwise indicated.
 - d. Washer and Nut: Zinc-coated steel.
- 6. Concrete: Portland cement mix, 3000 psi minimum. Refer to DIVISION 3 - "Cast-in-Place Concrete" for formwork, reinforcement, and concrete.
- 7. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink, nonmetallic grout; suitable for interior and exterior applications.
 - a. Properties: Nonstaining, noncorrosive, and nongaseous.
 - b. Design Mix: 5000-psi, 28-day compressive strength.

2.11 METERS AND GAUGES

A. 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.

2.12 DUCTWORK

A. SUBMITTALS

- 1. Ductwork construction standards.
- 2. Refer to "COORDINATION DRAWINGS" this SECTION.

B. PRESSURE CLASSIFICATION

<u>CLASS</u>	<u>S.P. ("WG)</u>	<u>TYPE</u>	<u>SEAL CLASS</u>	<u>MAX. VEL.(FPM)</u>
6	4 to 6	POS	A	2500 UP
3	2 to 3	POS/NEG	B	2500 DN
2	up to 2	POS/NEG	C	1500 DN

C. MATERIALS

- 1. STEEL DUCTS: ASTM A525 galvanized steel sheet, lock forming quality, having zinc coating of 1.25 oz per sq ft for each side in conformance with ASTM A90.
- 2. INSULATED FLEXIBLE SUPPLY DUCT:
 - a. Interlocking spiral of galvanized steel, stainless steel or aluminum as applicable to installation rated to 2 WG inch positive and 1.5 inch WG negative for class 2 ducts and 15 inch WG positive or negative for Class 3,4,6 and 10 ducts.
 - b. Wrap flexible duct with flexible glass fiber insulation, enclosed by seamless aluminum pigmented plastic vapor barrier jacket; maximum 0.23 K value at 75 Deg. F.
- 3. DUCT SEALANT: Non-hardening, non-migrating mastic or liquid elastic sealant as compounded and recommended by duct manufacturer specifically for sealing joints in ductwork.
- 4. DUCTWORK SUPPORT MATERIALS: Hot dipped galvanized steel fasteners, anchors, rods, straps, trim and angle support for ductwork.
 - a. For exposed stainless steel ductwork, provide matching stainless steel support materials.
 - b. For aluminum ductwork, provide matching aluminum support materials.

D. Class 2 DUCTWORK

- 1. Fabricate in accordance with SMACNA Duct Construction Standards. Provide duct gages, reinforcing, and sealing for applicable operating pressures.
- 2. Construct T's, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline. Where rectangular elbows are used, provide turning vanes. Where acoustical lining is indicated, provide turning vanes of perforated metal with glass fiber insulation.
- 3. Increase duct sizes gradually, not exceeding 15 deg. divergences wherever possible. Divergence upstream of equipment shall not exceed 30 deg.; convergence downstream shall not exceed 45 deg.
- 4. Connect fabric flexible duct to metal duct with 22 gauge draw bands.

E. Class 3 and 6 DUCTWORK

- 1. Fabricate in accordance with SMACNA Duct Construction Standards. Provide duct gages, reinforcing, and sealing for applicable operating pressures.
- 2. Construct T's, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline. Where rectangular elbows are used, provide turning vanes. Where acoustical lining is indicated, provide turning vanes of perforated metal with glass fiber insulation.
- 3. Transform duct sizes gradually, not exceeding 15 degrees divergence and 30 degrees convergence. Connect double wall insulated flexible duct to metal duct with adhesives plus sheetmetal screws.

2.13 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. 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. Fabricate single blade dampers for duct sizes to 12" x 30".
4. Fabricate opposed blade dampers with maximum blade sizes 12" x 72". Assemble center and edge crimped blades in prime coated or galvanized frame with suitable hardware.
5. Except in round ductwork 12 inches and smaller, provide end bearings. On multiple blade dampers, provide oil-impregnated nylon or sintered bronze bearings.
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.

C. TURNING VANES

1. Fabricated Type: Construct in accordance with SMACNA Duct Construction Standards.
2. Manufactured Type: 1-1/2" wide curved blades set at 3/4" O.C., supported with bars perpendicular to blades set at 2" O.C.
3. Acoustical Type: Airfoil shaped aluminum extrusions with perforated faces and fiberglass fill.
4. Provide stainless turning vanes and accessories in all stainless ductwork.

D. FIRE DAMPERS

1. Fabricate in accordance with NFPA 90A and UL 555; provide UL label for 1-1/2 hour rating unless architectural plans call for 3 hour or greater rating.
2. Curtain type fire dampers; galvanized steel with interlocking blades; stainless steel closure spring and latches for horizontal installations. Blades out of air stream for all duct pressure classes.
3. Fusible links, UL 33, shall separate at 165 deg. F.
4. Curtain Type Dynamic Fire Dampers shall have UL 555 differential pressure rating for 4 in. W.G. and minimum UL 555 velocity rating of 2000 fpm.
5. Multi-blade Type Dynamic fire dampers shall have UL 555 differential pressure rating for 6 in. W.G. and minimum UL 555 velocity rating of 3000 fpm.
6. Provide means to determine damper position from visual inspection of exterior of duct.
7. Provide 30" sleeve with access door for fusible link access.
8. Provide stainless dampers and accessories in all stainless ductwork.

E. FLEXIBLE DUCT CONNECTORS

1. Fabricate in accordance with SMACNA Duct Construction Standards.
2. UL listed fire retardant neoprene coated woven glass fiber fabric to NFPA 90A, minimum density 20 oz per sq yd, approximately 6 inches wide, crimped into metal edging strip.
3. Leaded vinyl sheet, minimum 0.55 inch thick, 0.87 lbs per sq ft, 10 dB attenuation in 10 to 10,000 Hz range.

F. DUCT ACCESS DOORS

1. Fabricate in accordance with SMACNA Duct Construction Standards.
2. Provide flush frames for un-insulated ductwork, extended frames for insulated ductwork.
3. Provide one side hinged, other side with one latch type handle for doors 12" high and smaller, 2 handle type latches for larger doors.

4. Provide stainless access doors and accessories in all stainless ductwork

2.14 HYDRONIC PIPING SYSTEMS

A. ASME COMPLIANCE:

1. Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation.

B. PIPE AND FITTINGS

1. Pipe Size 2" and Smaller: Black steel pipe; Schedule 40; Class 125 cast iron fittings; threaded joints.
2. Pipe Size 3" and Smaller: Copper tube, Type L, hard drawn temper; wrought copper fittings; tin-antimony solder (95/5) joints.
3. Pipe Run Within Concrete Construction: Copper tube; Type K, soft annealed temper; no joints or fittings allowed; sleeve tube with continuous length of 3/8" minimum thickness of rubber pipe insulation.

C. VALVES: Unless otherwise indicated provide valves as listed in the "VALVES" and "HYDRONIC SPECIALTIES" paragraphs of this specification.

2.15 HYDRONIC SPECIALTIES

A. SUBMITTALS

1. Product Data Sheets: For each type of Hydronic Specialty indicated.
2. Shop Drawings: Show all Hydronic Specialties on Coordination drawings. Refer to "COORDINATION DRAWINGS" this SECTION.

B. ASME COMPLIANCE:

1. Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation. Safety valves and pressure vessels shall bear appropriate ASME label.

C. COMBINATION BALANCING AND SHUT-OFF VALVES – 1" AND UNDER

1. Valves shall be of bronze body/brass ball construction with glass and carbon filled TFE seat rings.
2. Valves are to have differential pressure read-out ports across valve seat area. Read-out ports to be fitted with internal EPT inserts and check valves.
3. Valve bodies to have 1/4" NPT tapped drain/purge port.
4. Valves to have memory stop feature to allow valve to be closed for service and then reopened to set point without disturbing balance position. All valves to have calibrated nameplates to assure specific valve settings.
5. Valves shall be designed for positive shut off.
6. Valves to be provided with preformed insulation to permit access for balance and read-out.
7. Provide extended stems for all valves in insulated piping systems. Stems shall extend to length necessary for full handle exposure outside of insulation system.
8. Valves to be Bell & Gossett Circuit Setter Plus or equivalent by Taco.

D. BALANCE COCKS

1. Threaded or Soldered Ends (as required) 2" and Smaller: Class 125, bronze body, bronze plug; screwdriver operated, straight or angle pattern.
2. ACCEPTABLE MANUFACTURERS
 - a. American Air Filter Co.

- b. B&G ITT; Fluid Handling Div.
- c. Spirax Sarco Co.
- d. Taco, Inc.

E. AIR VENTS

- 1. Manual: Screwdriver or thumbscrew operated 1/8 inch NPS connection.
- 2. Automatic: Float principle; stainless steel float and mechanism; cast iron body; 125 psi; 2 inch NPS inlet and outlet connections.
- 3. ACCEPTABLE MANUFACTURERS
 - a. Armstrong Machine Works.
 - b. B&G ITT; Fluid Handling Div.
 - c. Spirax Sarco Co.

2.16 STEAM AND CONDENSATE PIPING SYSTEMS

A. DEFINITIONS

- 1. LOW PRESSURE: 0 to 15 psig.

B. LP STEAM PIPE AND FITTINGS

- 1. Size 2" and Less: SCH. 40 black steel pipe; 125 psi cast iron threaded fittings.

C. LP CONDENSATE PIPE AND FITTINGS

- 1. Size 2" and Less: SCH. 80 black steel pipe; 125 psi cast iron threaded fittings.

D. VALVES

- 1. Unless otherwise indicated provide valves as listed in the "VALVES" paragraph of these specifications.

2.17 REGISTERS, GRILLES AND DIFFUSERS

A. ACCEPTABLE MANUFACTURERS

- 1. Krueger Mfg. Co.
- 2. Titus Products Div.; Philips Industries, Inc.
- 3. Price

B. SUBMITTALS

- 1. Product Data: For each product indicated, include the following:
 - a. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
 - b. Diffuser, Register, and Grille Schedule: Indicate Drawing designation, room location, quantity, model number, size, and accessories furnished.
- 2. Shop Drawings: Show all register, grilles and diffusers on Coordination drawings. Refer to "COORDINATION DRAWINGS" this SECTION.

C. GENERAL

- 1. Provide manufacturers standard air outlets and inlets of type, size, materials, and with accessories and options indicated.

D. FINISH

- 1. Finish of all registers, grilles and diffusers shall be standard color selected by Architect. Provide color samples to Architect for his approval during the submittal process.

- E. SQUARE PANEL RECTANGULAR CEILING DIFFUSERS
 - 1. Type: Square, adjustable pattern, one piece face panel diffuser to discharge air as shown on drawings.
 - 2. Frame: Coordinate with architectural ceiling type and Reflected ceiling plan.
 - 3. Fabrication: Steel or Aluminum with finish to be coordinated with the Architect.

- F. CEILING EXHAUST AND RETURN REGISTERS/GRILLES
 - 1. Type: Streamlined blades, 3/4 inch maximum spacing, with blades set at 45 degrees, vertical or horizontal face as indicated on schedules.
 - 2. Frame: Coordinate with architectural ceiling type and Reflected Ceiling Plan.
 - 3. Fabrication: Steel with 20 gage minimum frames and 22 gage minimum blades, steel and aluminum with 20 gage minimum frame, or aluminum extrusions, with factory finish to be coordinated with the Architect.
 - 4. Damper: Integral, gang-operated, opposed blade type with removable key operator, operable from face.

2.18 VARIABLE VOLUME TERMINAL BOXES

- A. ACCEPTABLE MANUFACTURERS
 - 1. Titus Products Div.; Philips Industries, Inc.
 - 2. Metalaire
 - 3. Price

- B. SUBMITTALS
 - 1. For each product indicated, include the following:
 - a. Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
 - b. Detail equipment assemblies and indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection.
 - c. Include a schedule showing unique model designation, room location, model number, size, and accessories furnished.
 - d. Wiring Diagrams: Power, signal, and control wiring.
 - 2. Coordination Drawings: Show all VAV terminals on Coordination drawings. Clearly indicate access and service area requirements. Refer to "COORDINATION DRAWINGS" this SECTION.

- C. GENERAL
 - 1. Provide where shown on drawings variable volume terminal boxes with hot water reheat coils and pressure independent volume controllers.

- D. Terminals shall be certified under the latest edition of ARI Standard 880. Leakage shall be a maximum of 2 percent of design at 3 inches inlet static pressure.

- E. The terminal casing shall be minimum 22 gauge galvanized steel. Units shall include sound attenuator section. Units designed for hospital application shall have liner system to ensure that no insulation or sound attenuator materials come in contact with the air stream.

- F. The terminal box shall incorporate multi point center-averaging velocity sensors. The sensor must provide control signal accuracy of +/- 5% at any inlet condition.

- G. The terminal box with Hot water coils shall be provided with factor gasketed access door with cam lock for inspection of heating coil.

- H. Provide with factory mounted control power disconnect.

2.19 AUTOMATIC TEMPERATURE CONTROLS – FACILITIES MANAGEMENT SYSTEM

A. ACCEPTABLE MANUFACTURERS

- a. Johnson Controls
- b. Honeywell
- c. Siemens

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. Provide new or updated graphics and User Interface software as necessary to control the new components from the existing User Interface.
- 3. 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 Honeywell.
- 2. The FMS shall be a complete 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 or Netscape.
- 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.
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.
4. 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.
5. 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.
6. 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. Schematics, sequences and flow diagrams.
 - d. 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.]
 - e. Samples of Graphic Display screen types and associated menu penetrations to show hierarchy and functional interrelationships.
 - f. Detailed Bill of Material list for each Node, identifying quantity, part number, description, and optional features.
 - g. 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.
 - h. 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.
 - i. Room Schedule including a separate line for each VAV box and terminal unit indicating minimum/maximum cfm, pickup gain, box area, and bias setting.
 - j. Details of all FMS interfaces and connections to the work of other trades.
 - k. Product data sheets for all products including software.
 - l. 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.
 - 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 recalibrations required as a result of Warranty service.

H. COMMISSIONING

1. Fully commission all aspects of the Facility Management System work.
2. 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.
3. The Engineer will use the check sheet as the basis for acceptance testing with the ATC Contractor.
4. 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.
 - 5. 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.
 - 6. Promptly rectify all listed deficiencies and submit to the Engineer that this has been done.
- I. Distributed Web-Based User Interface, or User Interface
 - 1. All features and functions defined in this Automatic Temperature Controls specification section as accessible via a user interface shall be available to a user on any facility computer connected directly to the network, or any computer connected to the internet via a wide area or virtual private network (WAN/VPN) to the automation network, and shall be conformed to the following specifications.
 - a. The software shall run on the Microsoft Internet Explorer (6.0 or higher) browser and support the following functions:
 - 1) Configuration
 - 2) Commissioning
 - 3) Data Trending and Archiving
 - 4) Monitoring
 - 5) Alerting/Alarming
 - 6) Commanding
 - 7) System Diagnostics
 - b. The user interface will function on standard owner computers with the following minimum hardware characteristics:
 - 1) 512 MB RAM
 - 2) 2.0 GHz Clock Speed Pentium 4 Microprocessor
 - 3) 100.0 GB Hard Drive.
 - 4) 1 Keyboard with 83 keys (minimum).
 - 5) SVGA 1024x768 resolution display with 64K colors and 16 bit color depth
 - 6) Mouse or other pointing device
 - c. Access to the distributed web based user interface environment shall be by multiple users simultaneously via multiple user-name sign-ins, with associated passwords, and assigned security levels.
- J. OPERATOR STATION
 - 1. Work Station:
 - a. Configuration: Microsoft Office compatible, utilizing the latest standard Intel Duo-Core based microcomputer system.
 - b. Minimum memory: 8 GB RAM.
 - c. Memory clock speed: Min 2.5 GHz.
 - d. Cache memory: 256 kbyte.
 - e. Display: 20 inch LCD color monitor.
 - f. Keyboard: Low profile, detachable, having Qwerty layout plus a 10 key numeric keypad, dedicated function keys.
 - g. Hard disk drive: 720 GB.
 - h. Mouse: Software supported mouse with support software including self building menus and displays of system operations and functions.
 - i. Printer: Support color printer.

- j. Operating System: Windows XP or Windows 7
- 2. Printer:
 - a. 600 DPI, 6 PPM color Laser Printer.
- 3. Portable Operators Terminal:
 - a. Provide one portable operators terminal with keypad and carrying case. Terminal shall be able to plug in to any DDC panel to monitor and/or change all setpoints. Keyboard entry commands shall be in English with full written instructions made available as to how to use terminal.
- 4. System Support: Minimum ten (10) work stations connected to multi-user, multi-tasking environment with concurrent capability to:
 - a. Access DDC network.
 - b. Access or control same control unit.
 - c. Access or modify same control unit data base.
 - d. Archive data, alarms, and network actions to hard disk regardless of what application programs are being currently executed.
 - e. Develop and edit data base.
 - f. Implement and tune DDC control.
 - g. Develop graphics.
 - h. Control facility.
- 5. Uninterruptible power supply:
 - a. Sized for 50% spare capacity. The UPS shall be complete with batteries, external bypass and line conditioning.

K. 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. Each Control unit shall be equipped with the necessary un-interruptible power 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.
- L. LOCAL AREA NETWORKS (LAN)
- 1. Provide communication between control units over local area network (LAN).
 - 2. LAN Capacity: Not less than 60 stations or nodes.
 - 3. Break in Communication Path: Alarm and automatically initiate LAN reconfiguration.
 - 4. LAN Data Speed: Minimum 10 Mbs.
 - 5. Communication Techniques: Allow interface into network by multiple operation stations and by auto-answer/auto-dial modems. Support communication over telephone lines utilizing modems.
 - 6. Transmission Median: Fiber optic or single pair of solid 24 gauge twisted, shielded copper cable.
 - 7. Network Support: Time for global point to be received by any station, shall be less than 3 seconds. Provide automatic reconfiguration if any station is added or lost. If

transmission cable is cut, reconfigure two sections with no disruption to system's operation, without operator intervention.

M. OPERATING SYSTEM SOFTWARE

1. Input/Output Capability From User Interface:
 - a. Request display of current values or status in tabular or graphic format.
 - b. Command selected equipment to specified state.
 - c. Initiate logs and reports.
 - d. Change analog limits.
 - e. Add, delete, or change points within each control unit or application routine.
 - f. Change point input/output descriptors, status, alarm descriptors, and engineering unit descriptors.
 - g. Add new control units to system.
 - h. Modify and set up maintenance scheduling parameters.
 - i. Develop, modify, delete or display full range of color graphic displays.
 - j. Automatically archive select data even when running third party software.
 - k. Provide capability to sort and extract data from archived files and to generate custom reports.
 - l. Support two printer operations.
 - 1) Alarm printer: Print alarms, operator acknowledgements, action messages, system alarms, operator sign-on and sign-off.
 - 2) Data printer: Print reports, page prints, and data base prints.
 - m. Select daily, weekly or monthly as scheduled frequency to synchronize time and date in digital control units. Accommodate daylight savings time adjustments.
 - n. Print selected control unit data base.
2. Operator System Access: Via software password with minimum 30 access levels at work station and minimum 3 access levels at each control unit.
3. Data Base Creation and Support: Changes shall utilize standard procedures. Control unit shall automatically check work station data base files upon connection and verify data base match. Minimum capability shall include:
 - a. Add and delete points.
 - b. Modify any point parameter.
 - c. Change, add, or delete English language descriptors.
 - d. Add, modify, or delete alarm limits.
 - e. Add, modify, or delete points in start/stop programs, trend logs, etc.
 - f. Create custom relationship between points.
 - g. Create or modify DDC loops and parameters.
 - h. Create or modify override parameters.
 - i. Add, modify, and delete any applications program.
 - j. Add, delete, develop, or modify dynamic color graphic displays.
4. Dynamic Color Graphic Displays:
 - a. Utilizes custom symbols or system supported library of symbols.
 - b. Sixteen 256 colors.
 - c. Sixty (60) outputs of real time, live dynamic data per graphic.
 - d. Dynamic graphic data.
 - e. 1,000 separate graphic pages.
 - f. Modify graphic screen refresh rate between 1 and 60 seconds.
5. User Interface:
 - a. Accept data from LAN as needed without scanning entire network for updated point data.
 - b. Interrogate LAN for updated point data when requested.
 - c. Allow operator command of devices.
 - d. Allow operator to place specific control units in or out of service.
 - e. Allow parameter editing of control units.

- f. Store duplicate data base for every control unit and allow down loading while system is on line.
 - g. Control or modify specific programs.
 - h. Develop, store and modify dynamic color graphics.
 - i. Provide data archiving of assigned points and support overlay graphing of this data utilizing up to four (4) variables.
6. Alarm Processing:
- a. Off normal condition: Cause alarm and appropriate message, including time, system, point descriptor, and alarm condition. Select alarm state/value and which alarms shall cause automatic dial-out.
 - b. Critical alarm or change-of-state: Display message, stored on disk for review and sort, or print.
 - c. Print on line changeable message, up to 60 characters in length, for each alarm point specified.
 - d. Display alarm reports on video. Display multiple alarms in order of occurrence.
 - e. Define time delay for equipment start-up or shutdown.
 - f. Allow unique routing of specific alarms.
 - g. Operator specifies if alarm requires acknowledgement.
 - h. Continue to indicate unacknowledged alarms after return to normal.
 - i. Alarm notification:
 - 1) Automatic print.
 - 2) Display indicating alarm condition.
 - 3) Selectable audible alarm indication.
7. Event Processing: Automatically initiate commands, user defined messages, take specific control actions or change control strategy and application programs resulting from event condition. Event condition may be value crossing operator defined limit, change-of-state, specified state, or alarm occurrence or return to normal.
8. Automatic Restart: Automatically restart field equipment on restoration of power. Provide time delay between individual equipment restart and time of day start/stop.
9. Messages:
- a. Automatically display or print user-defined message subsequent to occurrence of selected events.
 - b. Compose, change, or delete any message.
 - c. Display or log any message at any time.
 - d. Assign any message to any event.
10. Reports:
- a. Manually requested with time and date.
 - b. Long term data archiving to hard disk.
 - c. Automatic directives to download to transportable media such as floppy diskettes for storage.
 - d. Data selection methods to include data base search and manipulation.
 - e. Data extraction with mathematical manipulation.
 - f. Data reports shall allow development of XY curve plotting, tabular reports (both statistical and summary), and multi-point timed based plots with not less than four (4) variables displayed.
 - g. Generating reports either normally at operator direction, or automatically under work station direction.
 - h. Reports may either manually displayed or printed, or may be printed automatically on daily, weekly, monthly, yearly or scheduled basis.
 - i. Include capability for statistical data manipulation and extraction.
 - j. Provide capability to generate four types of reports: Statistical detail reports, summary reports, trend graphic plots, x-y graphic plots.
11. Parameter Save/Restore: Store most current operating system, parameter changes, and modifications on disk or diskette.
12. Data Collection:

- a. Automatically collect and store in disk files.
 - b. Daily electrical energy consumption, peak demand, and time of peak demand for up to electrical meters over 2 year period.
 - c. Daily consumption for up to 30 meters over a 2 year period.
 - d. Daily billable electrical energy consumption and time for up to 1024 zones over a 10 year period.
 - e. Provide archiving of stored data for use with system supplied custom reports.
13. Graphic Display: Support graphic development on work station with software features:
- a. Page linking.
 - b. Generate, store, and retrieve library symbols.
 - c. Single or double height characters.
 - d. Sixty (60) dynamic points of data per graphic page.
 - e. Pixel level resolution.
 - f. Animated graphics for discrete points.
 - g. Analog bar graphs.
 - h. Display real time value of each input or output line diagram fashion.
14. Dynamic Color Graphics
- a. Provide dynamic 256 color graphics for the following systems:
 - 1) Boiler Plant including pumps.
 - 2) Chiller plant including pumps and cooling tower
 - 3) Each air handling unit.
 - 4) Floor plans including each terminal box on each floor.
 - b. User Interface shall update in real time and shall include every point which is monitored or controlled. Ie a cooling tower graphic shall include entering and leaving condenser water temperature, fan(s) status, fan(s) speed and bypass valve position (if a bypass valve is used).
 - c. All access to graphics shall be via mouse input - no keyboard input shall be required. Each point shall be a maximum of three mouse clicks away ie choose desired floor plan, click on volume box on floor plan, click on point on volume box to be accessed.
 - d. Schematics included with the construction documents shall be used as a basis for producing the graphics. Points which are in alarm shall be clearly indicated on each graphic.
 - e. Graphics of variable volume boxes shall be included on each floor plan and shall reference the variable volume box number on the contract documents HVAC schedule. Graphics shall list for each box the rooms or areas served by the box.
15. Maintenance Management:
- a. Run time monitoring, per point.
 - b. Maintenance scheduling targets with automatic annunciation, scheduling and shutdown.
 - c. Equipment safety targets.
 - d. Display of maintenance material and estimated labor.
 - e. Target point reset, per point.
16. Advisories:
- a. Summary which contains status of points in locked out condition.
 - b. Continuous operational or not operational report of interrogation of system hardware and programmable control units for failure.
 - c. Report of power failure detection, time and date.
 - d. Report of communication failure with User Interface, field interface unit, point, programmable control unit.

N. LOAD CONTROL PROGRAMS

1. General: Support inch-pounds and S.I. metric units of measurement.
2. Demand Limiting:

- a. Monitor total power consumption per power meter and shed associated loads automatically to reduce power consumption to an operator set maximum demand level.
 - b. Input: Pulse count from incoming power meter connected to pulse accumulator in control unit.
 - c. Forecast demand (kW): Predicted by sliding window method.
 - d. Automatically shed loads throughout the demand interval selecting loads with independently adjustable on and off time of between one and 255 minutes.
 - e. Demand Target: Minimum of 3 per demand meter; change targets based upon (1) time, (2) status of pre-selected points, or (3) temperature.
 - f. Load: Assign load shed priority, minimum "ON" time and maximum "OFF" time.
 - g. Limits: Include control band (upper and lower limits).
 - h. Output advisory if loads are not available to satisfy required shed amount, advise shed requirements [and requiring operator acknowledgement].
3. Automatic Time Scheduling:
- a. Self-contained programs for automatic start/stop/scheduling of building loads.
 - b. Support up to seven (7) normal day schedules, seven (7) "special day" schedules and two (2) temporary day schedules.
 - c. Special days schedule shall support up to 30 unique date/duration combinations.
 - d. Any number of loads assigned to any time program; each load can have individual time program.
 - e. Each load assigned at least 16 control actions per day with 1 minute resolution.
 - f. Time schedule operations may be:
 - 1) Start.
 - 2) Optimized Start.
 - 3) Stop.
 - 4) Optimized Stop.
 - 5) Cycle.
 - 6) Optimized Cycle.
 - g. Minimum of 30 holiday periods up to 100 days in length may be specified for the year.
 - h. Create temporary schedules.
 - i. Broadcast temporary "special day" date and duration.
4. Start/Stop Time Optimization:
- a. Perform optimized start/stop as function of outside conditions, inside conditions, or both.
 - b. Adaptive and self-tuning, adjusting to changing conditions unattended.
 - c. For each point under control, establish and modify:
 - 1) Occupancy period.
 - 2) Desired temperature at beginning of occupancy period.
 - 3) Desired temperature at end of occupancy period.
5. Night Setback/Setup Program: Reduce heating space temperature setpoint or raise cooling space temperature setpoint during unoccupied hours; in conjunction with scheduled start/stop and optimum start/stop programs.
6. Calculated Points: Define calculations and totalization computed from monitored points (analog/digital points), constants, or other calculated points.
- a. Employ arithmetic, algebraic, Boolean, and special function operations.
 - b. Treat calculated values like any other analog value, use for any function that a "hard wired point" might be used.
7. Event Initiated Programming: Event may be initiated by any data point, causing series of controls in a sequence.
- a. Define time interval between each control action between 0 to 3600 seconds.
 - b. Output may be analog value.
 - c. Provide for "skip" logic.

- d. Verify completion of one action before proceeding to next. If not verified, program shall be able to skip to next action.
- 8. Direct Digital Control: Each control unit shall provide Direct Digital Control software so that the operator may customize control strategies and sequences of operation by defining the appropriate control loop algorithms and choosing the optimum loop parameters.
 - a. Control loops: Defined using "modules" that are analogous to standard control devices.
 - b. Output: Paired or individual digital outputs for pulse-width modulation, and analog outputs, as required.
 - c. Firmware:
 - 1) PID with analog or pulse-width modulation output.
 - 2) Floating control with pulse-width modulated outputs.
 - 3) Two-position control.
 - 4) Primary and secondary reset schedule selector.
 - 5) Hi/Lo signal selector.
 - 6) Single pole double throw relay.
 - 7) Single pole double throw time delay relay with delay before break, delay before make and interval time capabilities.
 - d. Direct Digital Control loops: Downloaded upon creation or on operator request. On sensor failure, program shall execute user defined failsafe output.
 - e. Display: Value or state of each of the lines which interconnect DDC modules.
- 9. Fine Tuning Direct Digital Control PID or floating loops:
 - a. Display information:
 - 1) Control loop being tuned
 - 2) Input (process) variable
 - 3) Output (control) variable
 - 4) Setpoint of loop
 - 5) Proportional band
 - 6) Integral (reset) Interval
 - 7) Derivative (rate) Interval
 - b. Display format: Graphic, with automatic scaling; with input and output variable superimposed on graph of "time" vs "variable".
- 10. Trend logging:
 - a. Each control unit will store samples of control unit's data points.
 - b. Minimum of 7 days historical data shall be stored.
 - c. Update file continuously at discretely assignable intervals.
 - d. Automatically initiate upload request and then store data on hard disk.
 - e. Time synchronize sampling at operator specified times and intervals with sample resolution of one minute.
 - f. Co-ordinate sampling with on/off state of specified point.
 - g. Display trend samples on work station in graphic format. Automatically scale trend graph with minimum 60 samples of data in plot of time vs data.
 - h. Provide trending operations during the commissioning process as needed to trouble shoot system dis-functions.

O. 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.

P. TERMINAL BOX UNIT CONTROLLERS

1. The controls contractor shall furnish the terminal control unit controller, damper motor, and flow transducer for installation on each terminal unit by the terminal unit manufacturer under DIVISION 23. These devices shall be delivered to the terminal unit manufacturer's factory in sufficient time for the terminal unit manufacturer to meet their schedule obligations. The cost of factory mounting, wiring, enclosure to meet local code and any factory testing and programming of the terminal control unit shall be included by the terminal box manufacturer.
2. The control contractor shall be responsible for installation of space sensors and communications transmission bus.

3. The terminal box manufacturer shall provide a flow cross or two (2) pipe sensor suitable for interfacing with a Microbridge flow transducer.
4. The sheetmetal contractor shall provide a minimum of three (3) duct diameters of straight duct upstream from the terminal box inlet.
5. The sheetmetal contractor shall insure all terminal box controllers are located a minimum of three (3) feet from all obstructions (walls, pipes, etc.) so as to remain accessible.
6. The sheetmetal contractor shall provide for dry storage of terminal units and mounted terminal box controllers upon receipt at jobsite.
7. The air flow balancing contractor shall check all terminal units and make any changes in the air flow parameters to ensure that the terminal box controls perform in accordance with the approved specifications and schedules.
8. Terminal Equipment Control Units (TEC's) shall be provided for direct digital control of terminal vav boxes as specified. Units shall be UL Listed (UL916 PAZX, 864 UDTZ) and CSA approved.
9. The VAV box controllers shall be powered from a 24 VAC source and shall function normally under an operating range of 18 to 28 VAC (-25% to +17%), allowing for power source fluctuations and voltage drops. The BMCS contractor shall provide a dedicated power source and separate isolation transformer for each controller unable to function normally under the specified operating range. The controllers shall also function normally under ambient conditions of 32-122 Deg.F. and 10% to 95%RH (non-condensing). Provide each controller with a suitable cover or enclosure to protect the intelligence board assembly.
10. The controller shall include a differential pressure transducer that shall connect to the terminal unit manufacturer's standard averaging air velocity sensor to measure the average differential pressure in the duct. The controller shall convert this value to actual air flow. Single point air velocity sensing is not acceptable. The differential pressure transducer shall have a measurement range of 0 to 4000 f.p.m. and measurement accuracy of +/- 5% at 400 to 4000 fpm , insuring primary air flow conditions shall be controlled and maintained to within +/- 32 FPM of setpoint at the specified parameters. The BMCS contractor shall provide the velocity sensor if required to meet the specified functionality.
11. Each controller shall include provisions for manual and automatic calibration of the differential pressure transducer in order to maintain stable control and insuring against drift over time. Calibration shall be accomplished by stroking the terminal unit damper actuator to a 0% position so that a 0 cfm air volume reading is sensed. The controller shall automatically accomplish this whenever the system mode switches from occupied to unoccupied or vice versa. Manual calibration may be accomplished by either commanding the actuator to 0% via the portable terminal or by depressing the room sensor override switch. Calibration of the transducer at the controller location shall not be necessary.
12. The VAV box controller shall interface to a matching room temperature sensor as previously specified. The controller shall function to maintain space temperature to within +/- 1.5 Deg. of setpoint at the room sensor location.
13. A damper actuator shall mount on the damper shaft and shall provide complete modulating control of the damper.
 - a. The actuator motor shall de-energize when the damper has reached the operator or system determined position.
 - b. Damper actuator position status shall be monitored from the central or remote User Interface and shall be displayed in percent open notation. Systems which provide only end switch feedback are not acceptable.
 - c. The actuator shall be a removable and separate device from the Terminal Equipment Control Unit. If integral to the Terminal Equipment Control Unit, the actuator shall be removable for servicing without removing the Terminal Equipment Control Unit.

14. The valve actuators shall mount on the valve body and provide complete modulating control of the valve.
 - a. The valve actuator motor shall be of the non-stall type and shall de-energize when the valve has reached either the operator or system determined position.
 - b. Valve position status shall be monitored from the User Interface and shall be displayed in percent open notation. Systems which provide only end switch feedback are not acceptable.
 - c. Changes made during setup or normal operation to the Terminal Equipment Control Unit by a portable operator's terminal or User Interface shall not be affected by loss of communication on the LAN communication bus.
 - d. It shall not be necessary to disconnect the communications bus for communication between the Portable Operator's Terminal and the Terminal Equipment Control Unit.
 - e. Each controller performing space heating control shall incorporate an algorithm allowing for modulation of a hot water reheat valve as required to satisfy space heating requirements. Each controller shall also incorporate an algorithm that allows for resetting of the associated air handling unit discharge temperature if required to satisfy space cooling requirements. This algorithm shall function to signal the respective Network controller to perform the required discharge temperature reset in order to maintain space temperature cooling setpoint.

Q. SENSORS

1. Electronic Sensors: Vibration and corrosion resistant; for wall, immersion, or duct mounting as required.
2. Thermistor temperature sensors as follows:
 - a. Accuracy: Plus or minus 0.36 deg F at calibration point.
 - b. Wire: Twisted, shielded-pair cable.
 - c. Insertion Elements in Ducts and equipment: Single point, 18 inches long; use where not affected by temperature stratification or where ducts are smaller than 9 sq. ft..
 - d. Averaging Elements in Ducts and equipment: 72 inches long, flexible use where prone to temperature stratification or where ducts are larger than 9 sq. ft.; length as required.
 - e. Insertion Elements for Liquids: Brass socket with minimum insertion length of 2-1/2 inches.
3. Static-Pressure Transmitter: Nondirectional sensor with suitable range for expected input, and temperature compensated.
 - a. Accuracy: 2 percent of full scale with repeatability of 0.5 percent.
 - b. Output: 4 to 20 mA.
 - c. Building Static-Pressure Range: 0 to 0.25 inch wg
 - d. Duct Static-Pressure Range: 0 to 5 inches wg.
4. Pressure Transmitters: Direct acting for gas, liquid, or steam service; range suitable for system; proportional output 4 to 20 mA.
5. Equipment operation sensors as follows:
 - a. Status Inputs for Fans: Differential-pressure switch with adjustable range of 0 to 5 inches wg.
 - b. Status Inputs for Pumps: Differential-pressure switch piped across pump with adjustable pressure-differential range of 8 to 60 psig
 - c. Status Inputs for Electric Motors: Current-sensing relay with current transformers, adjustable and set to 175 percent of rated motor current.
6. Electronic Valve/Damper Position Indication: Visual scale indicating percent of travel and 2- to 10-V dc, feedback signal.
7. Water-Flow Switches: Pressure-flow switches of bellows-actuated mercury or snap-acting type, with appropriate scale range and differential adjustment, with stainless-steel or bronze paddle.

R. AIRFLOW/TEMPERATURE MEASUREMENT DEVICES

1. Manufacturer
 - a. The model numbers and components below are based on the IAQ Gold Series system by Ebtron Inc. This specification is meant to establish a standard of quality only and is not meant to limit competitive bidding by other manufacturers. Requirements below for data logging may be performed at DDC panel if desired.
2. Provide airflow/temperature measurement devices where indicated on the plans and/or specifications. Fan inlet measurement devices shall not be substituted for duct or plenum measurement devices indicated on the plans.
3. Each measurement device shall consist of one or more sensor probe assemblies and a single microprocessor-based transmitter. Each sensor probe assembly will contain one or more independently wired sensor housings. Multiple sensor housings shall be equally weighted and averaged by the transmitter prior to output. Pitot tubes and arrays are not acceptable. Vortex shedding flow meters are not acceptable.
4. All Sensor Probe Assemblies
 - a. Each sensor housing shall be manufactured of a U.L. listed engineered thermoplastic.
 - b. Each sensor housing shall utilize two hermetically sealed, bead-in-glass thermistor probes to determine airflow rate and ambient temperature. Devices that use "chip" type thermistors are unacceptable. Devices that do not have 2 thermistors in each sensor housing are not acceptable.
 - c. Each sensor housing shall be calibrated at a minimum of 16 airflow rates and have an accuracy of +/-2% of reading over the entire operating airflow range. Each sensor assembly shall be calibrated to standards that are traceable to the National Institute of Standards and Technology (NIST).
 - 1) Devices whose accuracy is the combined accuracy of the transmitter and sensor probes must demonstrate that the total accuracy meets the performance requirements of this specification throughout the measurement range.
 - d. The operating temperature range for the sensor probe assembly shall be -20° F to 160° F. The operating humidity range for the sensor probe assembly shall be 0-99% RH (non-condensing).
 - e. Each temperature sensor shall be calibrated at a minimum of 3 temperatures and have an accuracy of +/-0.15° F over the entire operating temperature range. Each temperature sensor shall be calibrated to standards that are traceable to the National Institute of Standards and Technology (NIST).
 - f. Each sensor probe assembly shall have an integral, U.L. listed, plenum rated cable and terminal plug for connection to a remotely mounted transmitter. All terminal plug interconnecting pins shall be gold plated.
 - g. Each sensor assembly shall not require matching to the transmitter in the field.
 - h. A single manufacturer shall provide both the airflow/temperature measuring probe(s) and transmitter at a given measurement location.
5. Duct and Plenum Sensor Probe Assemblies
 - a. Sensor housings shall be mounted in an extruded, gold anodized, 6063 aluminum tube probe assembly.
 - b. The number of sensor housings provided for each location shall be determined by the manufacturer based on the requirements of the application.
 - c. Probe assembly mounting brackets shall be constructed of 304 stainless steel. Probe assemblies shall be mounted using one of the following options:
 - 1) Insertion mounted through the side or top of the duct
 - 2) Internally mounted inside the duct or plenum
 - 3) Standoff mounted inside the plenum
 - d. The operating airflow range shall be 0 to 5,000 FPM unless otherwise indicated on the plans.
6. Transmitters

- a. The transmitter shall have an LCD display capable of displaying airflow and temperature. Airflow shall be field configurable to be displayed as a velocity or a volumetric rate.
 - b. The transmitter shall be capable of displaying the individual airflow and temperature readings of each sensor on the LCD display.
 - 1) The transmitter shall operate on 24 VAC. The transmitter shall not require an isolated power source.
 - c. The operating temperature range for the transmitter shall be -20° F to 120° F. The transmitter shall be protected from weather and water.
 - d. The transmitter shall be capable of communicating with the host controls using one of the following interface options:
 - 1) Linear analog output signal: Field selectable, fuse protected and isolated, 0-10VDC and 4-20mA (4-wire)
 - 2) RS-485: Field selectable BACnet-MS/TP, ModBus-RTU and Johnson Controls N2 Bus
 - 3) 10 Base-T Ethernet: Field selectable BACnet Ethernet, BACnet-IP, ModBus-TCP and TCP/IP
 - 4) LonWorks Free Topology
7. The measuring device shall be UL listed as an entire assembly.
 8. The manufacturer's authorized representative shall review and approve placement and operating airflow rates for each measurement location indicated on the plans and/or called for in specifications. A written report shall be submitted to the consulting mechanical engineer if any measurement locations do not meet the manufacturer's placement requirements.

S. AUTOMATIC CONTROL VALVES:

1. All automatic control valves shall be fully proportioning with modulating plug or V-port inner guides, unless otherwise specified. 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.

T. DAMPERS:

1. All dampers shall be provided by automatic temperature controls contractor except those in air handling units; these dampers shall be provided by air handler supplier.
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. All damper bearings are to be made of nylon. Bushings that turn in the bearings are to be oil-impregnated sintered metal.
- d. 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.

U. 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.

V. DDC COMPONENT INSTALLATION

1. EXAMINATION
 - a. Verify that conditioned power supply is available to the control units and to the User Interfaces within the owner facility. Verify that field end devices, and wiring is installed prior to installation proceeding.

2. INSTALLATION

- a. Install control units and other hardware in position on permanent walls where not subject to excessive vibration.
- b. Install software in control units and in operator work station. Implement all features of programs to specified requirements and appropriate to sequence of operation.
- c. Provide with 120v AC, 15 amp dedicated emergency power circuit to each programmable control unit.
- d. All electric wiring and wiring connections, either line voltage or low voltage, required for the installation of the temperature control system, as herein specified, shall be provided by the temperature control contractor unless specifically shown on the electrical drawings or called for in the electrical specifications. The wiring installation shall be in accordance with National and Local Codes and with the Electrical portion of these specifications. All wiring shall be run concealed wherever possible. Exposed wiring shall be run in raceways. Raceways shall be Wiremold 200 series with all elbows, raceways, covers, mounting stops, box extensions and wiring for a complete and neat installation.
- e. All wiring shall comply with the requirements of the DIVISION 26 – ELECTRICAL.

3. MANUFACTURER'S FIELD SERVICES

- a. Start and commission systems. Allow sufficient time for start-up and commissioning prior to placing control systems in permanent operation.
- b. Provide service engineer to instruct Owner's representative in operation of systems plant and equipment period as specified in INSTRUCTIONS TO OWNER paragraph of these specifications.
- c. Provide basic operator training for persons on data display, alarm and status descriptors, requesting data, execution of commands and request of logs. Include dedicated instructor time as specified in INSTRUCTIONS TO OWNER paragraph of these specifications. Provide training on site.

W. SEQUENCE OF OPERATION**1. GENERAL**

- a. All setpoints and time delays mentioned in the following sequences shall be adjustable by the operator without any hardware or software revisions.
- b. All sequences of operations shall be performed by direct digital control (DDC) panels. Software in the DDC panels shall determine occupied and unoccupied mode of operation. Names for all points and variables shall be coordinated with owner and/or Engineer.
- c. Fail-safe positions are position that devices will go to when de-energized: no = normally open, nc = normally closed. All heating coils (pre-heat, heating and reheat) shall have two way control valve arrangement with the normally open position (stay open on power failure) to the coil.
- d. Whenever a piece of HVAC equipment is off per the control system or main power is disconnected, the control devices for the unit shall go to their fail-safe position.
- e. Supply and return smoke isolation dampers (nc) for air handling shall close whenever associated unit is off. Provide end switches to verify position of dampers before unit starts.
- f. Whenever a piece of HVAC equipment is off per the control system or main power is disconnected, the control devices for the unit shall go to their fail-safe position.
- g. Dampers shall be provided by automatic temperature controls contractor including those for air handling units.

2. FIRE ALARM INTERLOCKS**3. VAV AIR TERMINAL UNIT SEQUENCES:**

- a. Room sensor modulates VAV damper between maximum and minimum position to maintain setpoint. When damper modulates to minimum position and room temperature continues to drop, room sensor modulates the heating water control

valve and discharge air temperature to maintain room setpoint, until discharge temperature reaches maximum allowable setpoint of 105dg F (adjustable). If the space temperature continues to fall below the setpoint, then supply damper and control valve shall modulate open together up to the heating cfm while maintaining the discharge air setpoint of 105 dg F to maintain space temperature. Room sensor reports temperature.

- b. Operator Workstation: Display the following data:
 - 1) Room/area served.
 - 2) Room occupied/unoccupied.
 - 3) Room temperature.
 - 4) Room temperature set point, occupied.
 - 5) Room temperature set point, unoccupied.
 - 6) VAV terminal air-damper position as percent open.
 - 7) VAV terminal Reheat Control-valve position as percent open.
- c. Safeties/Alarms
 - 1) The control system shall initiate an alarm, describing the alarm if any of the following conditions are met (all setpoints and time periods below shall be adjustable by user from the FMSs central console). Whenever a unit is shut down because of one of the safeties, the control system shall retain in memory the reading and setpoint of each device to help the operator in isolating the reason for the problem. All control system sensors shall have a high and low software alarm limit to indicate temperature problems or a faulty sensor.
 - a) Any space temperature is more than ten degrees from setpoint as sensed by the terminal boxes DDC box controller for five minutes.

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.

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. Clean and steel brush surfaces of welds. Then prime coat all steel supports and brackets.
- C. On uninsulated piping, steel brush and prime coat welds.
- D. Touch-up or repaint all surfaces damaged during shipment or installation and prepare surface for finish painting.
- E. Paint with flat black, all surfaces visible behind air diffusers and grilles, including surfaces behind grilles provided by others to which sheetmetal connects.
- F. Prime coat material and finish painting shall conform to the PAINTING paragraph of the architectural specifications.

3.6 LINTELS

- A. Lintels required for duct openings and other mechanical components shall be furnished under the MISCELLANEOUS METAL portion of the architectural specifications, and shall be installed under the MASONRY portion of the architectural portion of these specifications.
- B. This contractor shall coordinate with the general contractor and the structural engineer to ensure that openings are formed in accordance with requirements of the architectural portions of this specification listed above before proceeding with installation of mechanical work over lintels.

3.7 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.

3.8 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. Test Plug Location:
 - a. Control valves 3/4 inch & larger - inlets and outlets.
 - b. Reheat coils - inlets and outlets.
2. Dial Thermometer Location:
 - a. Each supply air zone.
 - b. Each return air zone.

3.9 INSTALLATION OF 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. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and 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 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. **SOLDERED JOINTS:** Solder copper tube and fitting joints where indicated, in accordance with recognized industry practice. Cut tube ends squarely, ream to full diameter, and clean outside of tube ends and inside of fittings. Apply solder flux to joint areas of both tubes and fittings. Insert tube full depth into fitting, and solder in manner which will draw solder full depth and circumference of joint. Wipe excess solder from joint before it hardens.

- C. **WELDED JOINTS:** Weld joints in accordance with recognized industry standards as follows:
1. Weld only when ambient temperature is above 0 deg. F.

2. Bevel pipe ends at a 37.5 deg. angle where possible, smooth rough cuts, and clean to remove slag, metal particles and dirt.
3. Use pipe clamps or tack weld joints with 1" long welds; 4 welds for pipe sizes to 10", 8 welds for pipe sizes 12" to 20".
4. Build up welds with stringer bead pass, followed by hot pass, followed by cover or filler pass. Eliminate valleys at center and edges of each weld. Weld by procedure which will ensure elimination of unsound or unfused metal, cracks, oxidation, blow-holes and nonmetallic inclusions.
5. Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

D. 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.

E. PIPING TESTS

1. Test pressure piping in accordance with ASME B 31.
2. 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.
3. Required test period is 2 hours.
4. Test each piping system at 150% of operating pressure indicated, but not less than 25 psi test pressure.
5. 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.
6. 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.
7. Drain test water from systems after testing and repair work has been completed.

3.10 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.

3.11 INSTALLATION OF PIPING SPECIALTIES

- A. PIPE ESCUTCHEONS: Install on each pipe penetration through floors, walls partitions and ceilings where penetration is exposed to view.
- 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.
- 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.

3.12 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.
- B. PIPE HANGERS AND SUPPORTS
 - 1. Support horizontal piping as follows:

- | | | | | |
|--|----|----------------|--------------|----------|
| | a. | PIPE SIZE | MAX. SPACING | ROD DIA. |
| | b. | 1/2" to 1-1/4" | 6'-6" | 3/8" |
| | c. | 1-1/2 to 2" | 10'-0" | 3/8" |
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.

3.13 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.

C. APPLICATION

1. EQUIPMENT NAMEPLATES: Install and permanently fasten equipment nameplates on each major item of mechanical equipment that does not have nameplate or has nameplate that is damaged or located where not easily visible. Locate nameplates where accessible and visible. Include nameplates for the following general categories of equipment:
 - a. Primary balancing dampers.
 - b. Control components
2. EQUIPMENT MARKERS: Install equipment markers with permanent adhesive on or near each major item of mechanical equipment. Data required for markers may be included on signs, and markers may be omitted if both are indicated.
 - a. Letter Size: Minimum 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 - b. Distinguish among multiple units, indicate operational requirements, indicate safety and emergency precautions, warn of hazards and improper operations, and identify units.
 - c. Include markers for the following general categories of equipment:
 - 1) Meters, gages, thermometers, and similar units.
3. EQUIPMENT SIGNS: Install equipment signs with screws or permanent adhesive on or near each major item of mechanical equipment. Locate signs where accessible and visible.
 - a. Identify mechanical equipment with equipment markers in the following color codes:
 - b. Green: For cooling equipment and components.
 - c. Yellow: For heating equipment and components.
 - d. Green and Yellow: For combination cooling and heating equipment and components.
 - e. Brown: For energy-reclamation equipment and components.
 - f. Letter Size: Minimum 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger

- lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- g. Distinguish among multiple units, indicate operational requirements, indicate safety and emergency precautions, warn of hazards and improper operations, and identify units.
 - h. Include signs for the following general categories of equipment:
 - 1) Primary balancing dampers.
 - 2) Control Components
- 4. **WARNING-TAG INSTALLATION:** Print required message on, and attach warning tags to, equipment and other items where required.
 - 5. **ACCESS PANELS:** Identify all access doors and panels.
 - 6. **VALVES:** Identify valves, except valves within heating or cooling terminals, with metal tags.
 - 7. **VALVE CHART AND SCHEDULE:** Provide valve chart and schedule in aluminum frame with clear plastic shield. Install at location as directed.
 - 8. **CONCEALED EQUIPMENT LOCATION INDICATORS:** Provide markings for all concealed equipment and systems requiring routine maintenance to indicate location of access. Equipment to be indicated includes but is not limited to terminal boxes, terminal equipment, reheat coils, filters, control dampers, etc. Coordinate marking system methods and products with Owner and Architect.
- D. Locate Piping identification and flow arrows as follows:
- 1. Identify piping, concealed or exposed, 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.
 - 2. On vertical pipes approximately seven feet above floor.
 - 3. Behind each access door and panel.
 - 4. At each change of direction of piping.
 - 5. On each piping branch close to point of connection to main piping.
 - 6. At valves.
 - 7. At no greater than intervals of 50 feet on straight runs of piping, and on both sides of walls.
- E. Locate Ductwork identification and flow arrows as follows:
- 1. 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.
 - 2. On vertical ductwork approximately seven feet above floor.
 - 3. Behind each access door and panel.
 - 4. At each change of direction of ductwork.
 - 5. On each ductwork branch close to point of connection to main ductwork.
 - 6. At no greater than intervals of 25 feet on straight runs of ductwork, and on both sides of walls.
- F. Do color coding of pipes with two (2) inch wide bands according to color schedule to be issued by the Owner during the progress of the work.
- G. Install valve tags at each valve. Attach to valves with four (4) inch brass chains.

3.14 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 re-attachable.
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. INSULATION OMITTED: Omit insulation on condensate piping between steam trap and union; and on unions, flanges, strainers flexible connections, and expansion joints.

B. PIPE INSULATION APPLICATION

1. Insulate the following piping systems with the type and thickness of insulation indicated as follows:
 - 1) F.G.=FIBERGLASS

PIPING SYSTEM	INSUL TYPE	RUNOUT TO 1.5"	1"	1.25"	1.5"
			AND LESS	TO 1.5"	TO 4"
HOT WATER SUP/RET	F.G	1.5	1.5	1.5	2.0
LP STEAM	F.G.	1.5	1.5	1.5	3.0
STEAM CONDENSATE	F.G.	1.5	1.5	1.5	3.0

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.

3.15 INSTALLATION OF DUCTWORK INSULATION

A. GENERAL

1. Install materials after ductwork has been tested and approved.
2. Install materials in accordance with manufacturer's instructions.
3. Cut insulation according to manufacturer's written instructions to prevent compressing insulation to less than 75 percent of its nominal thickness.
4. Clean and dry ductwork prior to insulating. Butt insulation joints firmly together to ensure complete and tight fit over surfaces to be covered.
5. Keep insulation materials dry during application and finishing.
6. Apply insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by the insulation material manufacturer.
7. Apply insulation with the least number of joints practical.

8. Apply insulation over fittings and specialties, with continuous thermal and vapor-retarder integrity.
9. 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.
10. Maintain integrity of vapor barrier and protect it to prevent puncture and other damage.
11. Interior Wall and Partition Penetrations: Extend ductwork insulation without interruption through walls, floors and similar ductwork penetrations, except fire-rated walls and partitions.
12. Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire/smoke damper sleeves for fire-rated wall and partition penetrations. For insulation indicated to have vapor retarders, taper termination and seal insulation ends with vapor-retarder mastic.
13. Refer to DIVISION 7 Section "Through-Penetration Firestop Systems." for firestopping materials and requirements for penetrations through fire and smoke barriers.
14. Floor Penetrations: Terminate insulation at underside of floor assembly and at floor support at top of floor. For insulation indicated to have vapor retarders, taper termination and seal insulation ends with vapor-retarder mastic.
15. Roof Penetrations: Apply insulation for interior applications to a point even with top of roof flashing.
 - a. Seal penetrations with vapor-retarder mastic.
 - b. Apply insulation for exterior applications tightly joined to interior insulation ends.
 - c. Seal insulation to roof flashing with vapor-retarder mastic.
16. Provide rigid removable insulated panels for duct access doors. Panel insulation value and materials shall match insulation requirements of duct system.

B. INSTALLATION

1. FLEXIBLE FIBERGLASS: Seal jacket joints with vapor barrier tape to match jacket. Staple seams 6" O.C. with outward cinching staples, then seal with pressure sensitive tape matching jacket. Install without sag on underside of ductwork. Use adhesive or mechanical fasteners where necessary to prevent sagging. Seal vapor barrier penetrations by mechanical fasteners with vapor barrier tape. Stop and point insulation around access doors and damper operators to allow operation without disturbing wrapping.
2. RIGID FIBERGLASS: Secure insulation to ductwork using mechanical fasteners with pin spacing no greater than 12 inch on center. Seal vapor barrier penetrations by mechanical fasteners with vapor barrier tape. Tape joints and edges with 3 inch pressure sensitive vapor barrier tape to match jacket. Stop and point insulation around access doors and damper operators to allow operation without disturbing wrapping. Duct Liner Not acceptable on Healthcare Projects. Duct Liner is not F&T standard delete unless specifically used on the project.

C. APPLICATION

1. Exposed Indoor Ducts
 - a. Insulate all exposed return and supply air ducts within finished spaces with 1.5 inch thick Rigid Fiberglass ductwork insulation or other such thickness that the installed R value accounting for compression is minimum R5. Cover with PVC jacket for field painting.
2. Concealed Indoor Ducts
 - a. Insulate all concealed return and supply air ducts with 1.5 inch thick Flexible Fiberglass ductwork insulation or other such thickness that the installed R value accounting for compression is minimum R5.
3. Concealed Indoor Ducts for Healthcare Buildings
 - a. Insulate all concealed return and supply air ducts with 2 inch thick Flexible Fiberglass ductwork insulation that has a minimum R value accounting for compression of R8

For use in buildings with low supply and return temperatures.

4. Ducts Located in Unconditioned Attics or Crawlspace
 - a. Insulate all concealed return and supply air ducts with 1.5 inch thick Rigid Fiberglass ductwork insulation or other such thickness that the installed R value accounting for compression is minimum R5.

3.16 INSTALLATION OF DUCTWORK

A. GENERAL

1. Align ductwork accurately at connections, within 1/8 inch misalignment tolerance and internal surfaces smooth.
2. Support ducts rigidly with suitable ties, braces, hangers and anchors of type which will hold ducts true to shape and to prevent buckling.
3. Limit clearance to 2 inch where furring is shown for enclosure or concealment of ducts, but allow for insulation thickness, if any.
4. Locate insulated ductwork for 1 inch clearance outside of insulation.
5. Coordinate layout with suspended ceiling and lighting layouts and similar finish work.
6. Non-Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls and are exposed to view, conceal spaces between construction openings and ducts or duct insulation with sheet metal flanges of same metal thickness as ducts. Overlap openings on 4 sides by at least 1-1/2 inches.
7. Fire-Rated Partition Penetrations: Where ducts pass through walls, partitions, ceilings and floors, install appropriately rated fire dampers, sleeves, and fire-stopping materials.
8. Smoke Barrier Penetrations: Where ducts pass through walls, partitions, ceilings and floors, install appropriately rated smoke dampers, sleeves, and fire-stopping materials.
9. Maintain indicated fire/smoke rating of walls, partitions, ceilings, and floors at duct penetrations. Seal with fire-stop materials.
10. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.
11. Coordinate duct installation with installation of accessories, dampers, coils frames, equipment, controls and other associated work of the ductwork system.
12. Install in the ductwork system control dampers furnished by the Automatic Temperature Control Contractor, assemble such multiple section dampers and provide required blank off plates where dampers are smaller than the duct.
13. Provide openings in ductwork where required to accommodate thermometers, sensors, and controllers. Provide pilot tube openings where required for testing of systems.
14. Set plenum doors 6 to 12 inches above floor. Arrange door swing so that fan static pressure holds door in closed position.
15. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork.
16. Where allowed, install flexible supply ductwork so that full cross sectional area is maintained, take care not to crush collapse or crimp duct.
17. Flexible ductwork not allowed on return air systems.

B. CLASS 2 DUCTWORK

1. Assemble and install to achieve maximum leakage rate of 5 percent.
2. Seal ductwork, after installation, to seal class recommended, and method prescribed in SMACNA "Duct Standards".
3. Support ductwork in manner complying with SMACNA "Duct Standards", hanger and support section.
4. Connect register, grilles and diffusers or troffers (where connection is concealed) to ducts with 5 foot maximum length of flexible or insulated flexible duct as required by the application. Hold in place with strap or clamp. Connect to air terminal with 22 gauge draw bands.

C. CLASS 3, AND 6 DUCTWORK

1. Assemble and install to achieve maximum leakage rate of 1 percent.
2. Seal ductwork, after installation, to seal class recommended, and method prescribed in SMACNA "Duct Standards".
3. Support ductwork in manner complying with SMACNA "Duct Standards", hanger and support section.
4. Connect Variable Air Volume Terminal inlets with 2 foot maximum length of double wall flexible insulated duct if required by the application. Hold in place with strap or clamp. Attach to duct and variable air volume air terminal inlet with 22 gauge metal draw band and sheet metal screws.
5. Provide duct leak testing.

D. LEAK TESTING

1. Perform tests and inspections.
2. Leakage Tests:
3. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual."
4. Test all Class 3, 4, 6 and 10 supply, return, and exhaust systems.
5. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
6. Test for leaks before insulation application.
7. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test entire system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure. Give seven days' advance notice for testing.

E. CLEANING

1. Clean ductwork internally, unit by unit as it is installed, of dust and debris. Clean external surfaces of foreign substances.
2. Duct System Cleanliness Tests:
 - a. Visually inspect duct system to ensure that no visible contaminants are present.
 - b. Test sections of metal duct system, chosen randomly by Owner/Engineer, for cleanliness according to "Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."
 - 1) Acceptable Cleanliness Level: Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.
3. Duct system will be considered defective if it does not pass tests and inspections. Clean entire system
4. Prepare test and inspection reports.

F. DUCTWORK APPLICATION SCHEDULE

	<u>System</u>	<u>Class</u>	<u>Material</u>
1.	Supply from fan to VAV terminal	6	Steel
2.	Supply from VAV terminal/Duct Coil to Diffusers	2	Steel
3.	Return & Relief – VAV systems	3	Steel

3.17 INSTALLATION OF DUCTWORK ACCESSORIES

- A. Install accessories in accordance with manufacturer's instructions and as indicated.
- B. Fire Dampers
 1. Install fire dampers, smoke dampers and combination fire/smoke dampers with required perimeter mounting angles, sleeves, and breakaway duct connections. Install dampers in

- accordance with manufacturer's UL Installation Instructions, labeling, and NFPA 90A at locations indicated on the drawings. Any damper installation that is not in accordance with the manufacturer's UL Installation Instructions must be approved prior to installation.
2. Dampers must be accessible to allow inspection, adjustment, and replacement of components. Provide duct access doors in ductwork or plenums required to provide this access. Provide access doors required in walls, ceilings, or other general building construction.
 3. Install dampers square and free from racking. Do not compress or stretch the damper frame into the duct or opening. Handle dampers using the frame or sleeve. Do not lift or move dampers using blades, actuator or jackshaft.
- C. Provide flexible connections immediately adjacent to equipment in ducts associated with fans and motorized equipment. Cover connections to medium and high pressure fans with leaded vinyl sheet, held in place with metal straps.
- D. Provide duct access doors for inspection and cleaning before and after filters, fans, automatic dampers, fire and or smoke dampers and elsewhere as indicated. Provide minimum 8 x 8 inch size for hand access, 18 x 18 inch size for shoulder access, and as indicated.

3.18 INSTALLATION OF HYDRONIC PIPING SYSTEMS

- A. GENERAL: Unless otherwise indicated install hydronic piping as follows:
1. Install eccentric reducers where pipe is reduced in size in direction of flow, with tops of both pipes and reducer flush.
 2. Install piping at a uniform grade of 0.2 percent upward in direction of flow.
 3. 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.
 4. Install drains, consisting of a tee fitting, NPS 3/4 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.
 5. Reduce pipe sizes using eccentric reducer fitting installed with level side up.
 6. 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.
 7. Install manual air vents at the system high points to allow bleeding off air.
- B. VALVES: Unless otherwise indicated install valves as listed below and elsewhere as indicated.
1. Isolation: ball and butterfly valves.
 2. Throttling: ball and butterfly valves
 3. Combination balancing and shut-off: Refer to "HYDRONIC SPECIALTIES" elsewhere in these specifications.
 4. Provide isolation valves at each hydronic terminal, coil and equipment and elsewhere as indicated.
 5. Provide combination balancing and shut-off valves at each hydronic terminal, coil and equipment and elsewhere as indicated.
 6. Provide balance cock at the by-pass port of each 3-way control.
 7. 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.
- C. EQUIPMENT CONNECTIONS:

1. 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.
2. Size for supply and return piping connections shall be same as for equipment connections.
3. Install control valves in accessible locations close to connected equipment.
4. 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.
5. Install ports for pressure and temperature gages at terminal, coil and equipment inlet and outlet connections.

3.19 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. Provide valved drain and hose connection on strainer blow down connection.
- E. 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.
- F. Pipe relief valve outlet to nearest floor drain.
- G. Where one line vents several relief valves, make cross sectional area equal to sum of individual vent areas.

3.20 INSTALLATION OF REGISTERS, GRILLES AND DIFFUSERS

- A. Install diffusers, registers, and grilles level and plumb.
- B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated on architectural ceiling grids, as much as practicable. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
- C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.
- D. Adjusting: After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

- E. Install safety chains on all diffusers, registers, and grilles install more than 15' above the floor. Refer to VIBRATION ISOLATION AND SEISMIC RESTRAINT paragraph of these specifications for additional requirements.

3.21 INSTALLATION OF VARIABLE AIR VOLUME TERMINAL BOXES

- A. Install in accordance with manufacturer's instructions.
- B. Provide ceiling access doors or locate units above easily removable ceiling components.
- C. Support units individually from structure. Do not support from adjacent ductwork.
- D. Connect to ductwork.
- E. Install heating coils.

3.22 INSTALLATION OF PIPE EXPANSION FITTINGS AND LOOPS

- A. Install in accordance with manufacturer's instructions.
- B. Construct spool pieces to exact size of flexible connection for future insertion.
- C. Install flexible pipe connectors on pipes connected to equipment supported by vibration isolation. Provide line size flexible connectors.
- D. Install flexible connectors at right angles to displacement. Install one end immediately adjacent to isolated equipment and anchor other end. Install in horizontal plane unless indicated otherwise.
- E. Rigidly anchor pipe to building structure where necessary. Provide pipe guides so movement is directed along axis of pipe only. Erect piping such that strain and weight is not on cast connections or apparatus.
- F. Provide support and equipment required to control expansion and contraction of piping. Provide loops, pipe offsets, and swing joints, or expansion joints where required or indicated.
- G. Provide expansion loops as indicated on drawings.

H. EXPANSION-JOINT INSTALLATION

- 1. Install manufactured, nonmetallic expansion joints according to FSA's "Technical Handbook: Non-Metallic Expansion Joints and Flexible Pipe Connectors."
- 2. Install expansion joints of sizes matching size of piping in which they are installed.
- 3. Install alignment guides to allow expansion and to avoid end-loading and torsional stress.

I. PIPE BEND AND LOOP INSTALLATION

- 1. Install pipe bends and loops cold-sprung in tension or compression as required to partly absorb tension or compression produced during anticipated change in temperature.
- 2. Attach pipe bends and loops to anchors.
 - a. Steel Anchors: Attach by welding. Comply with ASME B31.9 and ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 - b. Concrete Anchors: Attach by fasteners. Follow fastener manufacturer's written instructions.

J. SWING CONNECTIONS

1. Connect risers and branch connections to mains with at least five pipe fittings, including tee in main.
2. Connect risers and branch connections to terminal units with at least four pipe fittings, including tee in riser.
3. Connect mains and branch connections to terminal units with at least four pipe fittings, including tee in main.

K. ALIGNMENT-GUIDE INSTALLATION

1. Install guides on piping adjoining pipe expansion joints and bends and loops.
2. Coordinate below with structural Sections and Drawings if welding is included in structural work.
3. Attach guides to pipe and secure to building structure.

L. ANCHOR INSTALLATION

1. Install anchors at locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.
2. Fabricate and install steel anchors by welding steel shapes, plates, and bars to piping and to structure. Comply with ASME B31.9 and AWS D1.1.
3. Construct concrete anchors of poured-in-place concrete of dimensions indicated and include embedded fasteners.
4. Install pipe anchors according to expansion-joint manufacturer's written instructions if expansion joints or compensators are indicated.
5. Use grout to form flat bearing surfaces for expansion fittings, guides, and anchors installed on or in concrete.

3.23 INSTALLATION OF VIBRATION ISOLATION, SUPPORTS AND 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.

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) 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.
- 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. Vertical riser supports for water & steam pipe 4" diameter and larger shall be isolated from the structure using TYPE K guides and anchors.
- e. Install TYPE FC-2 flexible connectors at all connections of pipe to externally isolated equipment.

D. SEISMIC RESTRAINTS

1. Installation

- a. All floor mounted equipment whether isolated or not shall be snubbed, anchored, bolted or welded to the structure. Calculations that determine that isolated equipment movement may be less than the operating clearance of snubbers (restraints) do not preclude the need for snubbers. All equipment must be positively attached to the structure.
- b. All suspended equipment including, but not limited to; air handling units, pumps, fans, tanks, stacks, VAV boxes, unit heaters, fan powered boxes, cabinet unit heaters, etc. shall be two or four point independently braced with TYPE III restraints. Install cable braces taught for non-isolated equipment and slack with 1/2" cable deflection for isolated equipment. VAV Boxes (without fans) attached directly to ductwork on the main supply side shall be considered as ductwork for seismic design purposes. Rod bracing shall be installed as per approved submittals and shop drawings. Equipment rigidly connected to ductwork weighing less than 75 lbs. is excluded.
- c. All horizontally suspended pipe and duct shall use RESTRAINT TYPE III. Spacing of seismic bracing shall be as per TABLE B at the end of this section.
- d. For all trapeze-supported piping, the individual pipes must be attached to the trapeze support at the designated restraint locations.
- e. For overhead supported equipment, over stress of the building structure must not occur. Bracing may occur from:
 - 1) Flanges of structural beams.
 - 2) Upper truss chords in bar joists.
 - 3) Cast in place inserts or drilled and shielded inserts in concrete structures.
- f. Pipe Risers
 - 1) Where pipe pass through cored holes, holes must be packed with resilient material or fire stop as specified in other sections of this specification and/or state and local codes. No additional horizontal seismic bracing is required at these locations.
 - 2) Non-isolated, constant temperature pipe risers through cored holes require a riser clamp at each floor level on top of the slab attached in a seismically approved manner for vertical restraint.
 - 3) Non-isolated, constant temperature pipe risers in pipe shafts require structural steel attached in a seismically approved manner at each floor level and a riser clamp at each floor level on top of, and fastened to the

- structural steel. The riser clamp and structural steel must be capable of withstanding all thermal, static and seismic loads.
- 4) Isolated and/or variable temperature risers through cored holes require Type K riser resilient Guides and Anchors installed to meet both thermal expansion and seismic acceleration criteria.
 - 5) Isolated and/or variable temperature risers in pipe shafts require Type K resilient riser guides and anchors installed on structural steel to meet both thermal expansion and seismic acceleration criteria. Each floor level must have a riser clamp that does not interfere with the thermal expansion/contraction of the pipe.
- g. Diffusers shall be attached to lay-in ceilings with earthquake clips or other approved means of positive attachment to the T- bar ceiling structure.
 - h. All non-isolated floor or wall mounted equipment and tanks shall use RESTRAINT TYPE III.
 - i. Where base anchoring of equipment is insufficient to resist seismic forces, restraint TYPE III shall be located above the unit's center of gravity to suitably resist "G" forces specified.
 - 1) Vertically mounted tanks and up-blast tubular centrifugal fans, tanks or similar equipment may require this additional restraint.
 - j. A rigid piping or duct system shall not be braced to dissimilar parts of a building or two dissimilar building systems that may respond in a different mode during an earthquake. Examples: Wall and roof; solid concrete wall and a metal deck with lightweight concrete fill, pipes & duct that cross a building expansion joint.
2. Exclusions from seismic requirements on non life safety equipment:
 - a. Curb mounted mushroom, exhaust and vent fans with curb area less than nine square feet are excluded unless specifically detailed in the schedules or drawings.
 - b. Duct exemptions
 - 1) Rectangular, Square and Oval ducts less than six square feet in cross sectional area.
 - 2) Round duct less than 33 inches in diameter.
 - 3) Individual ducts suspended by hangers positively attached to the structure that are less than 12 inches in length as measured to top of the duct to the point of attachment to the structure. Hangers must be attached within 2 inches of the top of the duct with a minimum of two #10 sheet metal screws. If any hanger in the run exceeds the 12" limit, seismic bracing is required for the run.
 - c. Piping exemptions
 - 1) All piping less than 2-1/2" diameter except in mechanical rooms where piping less than 1-1/4" is exempted.
 - 2) All clevis or single level trapeze supported piping suspended by hangers with positive attachment to the structure that are less than 12 inches in length as measured from the top of the pipe to the point of attachment to the structure. If any hanger in the run exceeds the 12" limit, seismic bracing is required for the run.
 3. Exclusions from seismic requirements on life safety equipment.
 - a. Duct exemptions
 - 1) Smoke evacuation duct or fresh air make-up air that has a cross sectional area less than 3 square feet.

E. 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)		--	--	--

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

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.

3.24 TESTING, ADJUSTING AND BALANCING

A. ACCEPTABLE BALANCERS

- 1. Testing, Adjusting and balancing for projects within a 75 mile radius of Boston shall be performed by one of the following firms:
 - a. E.L. Barrett

- b. Leonhardt
 - c. Thomas Young
 - d. J.F. Coffey Associates, Inc.
2. Outside a 75 mile radius of Boston, provide the services of an independent AABC or NEBB certified air balancing contractor. Submit contractor qualifications for approval prior to commencement of testing, adjusting, and balancing.
- B. 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.
 - o. Service and balance valves are open.
- C. Submit field reports. Report defects and deficiencies noted during performance of services which prevent system balance.
- D. Beginning of work means acceptance of existing conditions.
- E. PREPARATION
1. Coordinate 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.
- F. 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.

G. 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.
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.

H. RENOVATION PRE-CONSTRUCTION TESTING

1. Measure and prepare a balancing report prior to demolition and/or new construction.
2. 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. Test all associated heating and cooling generation and transfer equipment serving the renovated spaces.
3. Testing technician shall record the physical condition of all equipment being tested. Note condition, maintenance or repairs required.
4. Prior to commencing testing coordinate with owner to ensure the all equipment is operational and spaces are accessible.
5. Submit pre-construction testing report for review and approval prior to commencement of demolition.
6. Record sound and vibration within spaces being renovated.
7. Measure and record all main supply, return and exhaust air ducts at limit of demolition.

I. PHASED CONSTRUCTION

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.

J. AIR SYSTEM PROCEDURE

1. Balance systems in accordance with latest edition of the SMACNA HVAC Systems Testing, Adjusting & Balancing.
2. Adjust air handling and distribution systems to provide required or design supply, return, and exhaust air quantities [at site altitude].
3. Make air quantity measurements in ducts by Pivot tube traverse of entire cross sectional area of duct.
4. Measure air quantities at registers, grilles and diffusers.
5. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.
6. Use volume control devices to regulate air quantities only to the extent that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct internal devices such as dampers and splitters. Use of diffuser and register dampers shall be for small adjustment only and dampers shall not be closed more than 15%.
7. Vary total system air quantities by adjustment of fan speeds. Provide drive changes required. Vary branch air quantities by damper regulation.

8. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.
9. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan. Make allowances for 50 percent loading of filters.
10. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.
11. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.
12. Where modulating dampers are provided, take measurements and balance at extreme conditions. Balance variable volume systems at maximum air flow rate, full cooling, and at minimum air flow rate, full heating.
13. Variable Volume Systems.
 - a. Compensate for Diversity: When the total airflow of all terminal units is more than the indicated airflow of the fan, place a selected number of terminal units at a minimum set-point airflow with the remainder at maximum-airflow condition until the total airflow of the terminal units equals the indicated airflow of the fan. Select the reduced-airflow terminal units so they are distributed evenly among the branch ducts
 - b. Work with ATC contractor to determine optimal duct static pressure sensor setpoint: Demand-based Static pressure reset:
 - 1) Static Pressure shall be determined within the range of 0.5" to MaxP by a continuously polling direct-acting control loop whose control point is the damper position of the most open VAV damper and whose setpoint is 90% open.
 - 2) MaxP shall be determined by the air balancing contractor in conjunction with the control contractor as required to provide design airflow in all boxes downstream of the duct static pressure sensor.
14. Building Pressurization: Work with ATC contractor to determine optimal differential pressure CFM to maintain building pressure at +0.010" across entire operating range. Test at full economizer, minimum air flow, all VAV boxes commanded to minimum, and all VAV boxes commanded to full cooling.
15. Space Pressurization: Spaces with Room Differential Control: Work with ATC contractor to determine optimal differential pressure CFM to maintain 0.010" (negative or positive as required) between pressure controlled space and reference space. Test at full economizer, minimum air flow, all VAV boxes commanded to minimum, and all VAV boxes commanded to full cooling.

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. Air Terminal Units
 - b. Registers, Grilles and Diffusers
 - c. Duct Mains
 - d. Building Pressure
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. Reading rooms

M. REPORT FORMS: Provide sound level, water, air, and vibration - testing, balancing and adjustment. Submit reports in the following format:

1. Title Page:
 - a. Name of Testing, Adjusting, and Balancing Agency
 - b. Address of Testing, Adjusting, and Balancing Agency
 - c. Telephone number of Testing, Adjusting, and Balancing Agency
 - d. Project name
 - e. Project location
 - f. Project Architect
 - g. Project Engineer
 - h. Project Contractor
 - i. Project altitude
 - j. Report date
2. Summary Comments:
 - a. Design versus final performance
 - b. Notable characteristics of system
 - c. Description of systems operation sequence
 - d. Summary of outdoor and exhaust flows to indicate amount of building pressurization
 - e. Nomenclature used throughout report
 - f. Test conditions
3. Instrument List:
 - a. Instrument
 - b. Manufacturer
 - c. Model number
 - d. Serial number
 - e. Range
 - f. Calibration date
4. Electric Motors:
 - a. Manufacturer
 - b. Model/Frame
 - c. HP/BHP
 - d. Phase, voltage, amperage; nameplate, actual, no load
 - e. RPM
 - f. Service factor
 - g. Starter size, rating, heater elements
 - h. Sheave Make/Size/Bore
5. V-Belt Drive:
 - a. Identification/location

- b. Required driven RPM
 - c. Driven sheave, diameter and RPM
 - d. Belt, size and quantity
 - e. Motor sheave diameter and RPM
 - f. Center to center distance, maximum, minimum, and actual
6. Pump Data:
- a. Identification/number
 - b. Manufacturer
 - c. Size/model
 - d. Impeller
 - e. Service
 - f. Design flow rate, pressure drop, BHP
 - g. Actual flow rate, pressure drop, BHP
 - h. Discharge pressure
 - i. Suction pressure
 - j. Total operating head pressure
 - k. Shut off, discharge and suction pressures
 - l. Shut off, total head pressure
7. Heating Coil Data:
- a. Identification/number
 - b. Location
 - c. Service
 - d. Manufacturer
 - e. Air flow, design and actual
 - f. Water flow, design and actual
 - g. Water pressure drop, design and actual
 - h. Entering water temperature, design and actual
 - i. Leaving water temperature, design and actual
 - j. Entering air temperature, design and actual
 - k. Leaving air temperature, design and actual
 - l. Air pressure drop, design and actual
8. Air Moving Equipment
- a. Location
 - b. Manufacturer
 - c. Model number
 - d. Serial number
 - e. Arrangement/Class/Discharge
 - f. Air flow, specified and actual
 - g. Return air flow, specified and actual
 - h. Outside air flow, specified and actual
 - i. Total static pressure (total external), specified and actual
 - j. Inlet pressure
 - k. Discharge pressure
 - l. Duct static pressure setpoint: Max, Minimum and Optimized.
 - m. Sheave Make/Size/Bore
 - n. Number of Belts/Make/Size
 - o. Fan RPM
9. Return Air/Outside Air Data:
- a. Identification/location
 - b. Design air flow
 - c. Actual air flow
 - d. Design return air flow
 - e. Actual return air flow
 - f. Design outside air flow
 - g. Actual outside air flow

- h. Return air temperature
- i. Outside air temperature
- j. Required mixed air temperature
- k. Actual mixed air temperature
- l. Design outside/return air ratio
- m. Actual outside/return air ratio
- 10. Duct Traverse:
 - a. System zone/branch
 - b. Duct size
 - c. Area
 - d. Design velocity
 - e. Design air flow
 - f. Test velocity
 - g. Test air flow
 - h. Duct static pressure
 - i. Air temperature
 - j. Air correction factor
- 11. Duct Leak Test:
 - a. Description of ductwork under test
 - b. Duct design operating pressure
 - c. Duct design test static pressure
 - d. Duct capacity, air flow
 - e. Maximum allowable leakage duct capacity times leak factor
 - f. Test apparatus
 - g. Blower
 - h. Orifice, tube size
 - i. Orifice size
 - j. Calibrated
 - k. Test static pressure
 - l. Test orifice differential pressure
 - m. Leakage
- 12. Air Monitoring Station Data:
 - a. Identification/location
 - b. System
 - c. Size
 - d. Area
 - e. Design velocity
 - f. Design air flow
 - g. Test velocity
 - h. Test air flow
- 13. Flow Measuring Station:
 - a. Identification/number
 - b. Location
 - c. Size
 - d. Manufacturer
 - e. Model number
 - f. Serial number
 - g. Design Flow rate
 - h. Design pressure drop
 - i. Actual/final pressure drop
 - j. Actual/final flow rate
 - k. Station calibrated setting
- 14. Terminal Unit Data:
 - a. Manufacturer
 - b. Type, constant, variable, single, dual duct

- c. Identification/number
- d. Location
- e. Model number
- f. Size
- g. Minimum static pressure
- h. Minimum design air flow
- i. Maximum design air flow
- j. Maximum actual air flow
- k. Inlet static pressure
- 15. Air Distribution Test Sheet:
 - a. Air terminal number
 - b. Room number/location
 - c. Terminal type
 - d. Terminal size
 - e. Area factor
 - f. Design velocity
 - g. Design air flow
 - h. Test (final) velocity
 - i. Test (final) air flow
 - j. Percent of design air flow
- 16. Space Pressurization Report:
 - a. Pressurized (positive or negative) room number/location
 - b. Referenced room/location(s)
 - c. Pressure relationship
 - d. Measured pressure differential
- 17. Sound Level Report:
 - a. Location
 - b. Octave bands - equipment off
 - c. Octave bands - equipment on
- 18. Vibration Test:
 - a. Location of points:
 - b. Fan bearing, drive end
 - c. Fan bearing, opposite end
 - d. Motor bearing, center (if applicable)
 - e. Motor bearing, drive end
 - f. Motor bearing, opposite end
 - g. Casing (bottom or top)
 - h. Casing (side)
 - i. Duct after flexible connection (discharge)
 - j. Duct after flexible connection (suction)
 - k. Horizontal, velocity and displacement
 - l. Vertical, velocity and displacement
 - m. Axial, velocity and displacement
 - n. Normally acceptable readings, velocity and acceleration
 - o. Unusual conditions at time of test
 - p. Vibration source (if non-complying)

3.25 AIR DUCT AND SYSTEM CLEANING

- A. Owner Testing:
 - 1. Owner will obtain testing of duct cleanliness at their discretion if in the opinion of the owner, engineer or commissioning agent the installed systems have not been properly protected as required by these specifications.

2. If owner obtained tests show that air duct and system cleanliness fail to meet the industry standards then the contractor will be required to obtain the services of an independent cleaning contractor to clean and verify systems per the procedures specified herein.
- B. Engage a certified Air system cleaning specialist (ASCS) to clean the following systems:
1. Duct mains, branches, elbows, turning vanes, plenums, VAV boxes and sound attenuators.
 2. Air outlets and inlets (registers, grilles, and diffusers).
 3. Supply, return, and exhaust fans including fan housings, plenums (except ceiling return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
 4. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
 5. Coils and related components.
 6. Return-air ducts, dampers, actuators, and turning vanes except in ceiling return plenums.
 7. Supply-air ducts, dampers, actuators, and turning vanes.
 8. Dedicated exhaust and ventilation components and makeup air systems.
- C. ASCS Qualifications: A certified member of National Air Duct Cleaners Association (NADCA).
1. Certification: Employ an ASCS certified by NADCA on a full-time basis
 2. Supervisor Qualifications: Certified as an ASCS by NADCA
- D. Experience: Submit records of experience in the field of HVAC systems cleaning.
- E. Examination:
1. Examine systems to determine appropriate methods, tools, and equipment required for performance of work.
 2. Prepare written report listing conditions detrimental to performance of work.
 3. Proceed with work only after unsatisfactory conditions have been corrected.
- F. SUBMITTALS
1. Ductwork cleaning procedures.
 2. Refer to "COORDINATION DRAWINGS" this SECTION. Show location of required access doors for proper system cleaning.
 3. Refer to "RECORD DRAWINGS" this SECTION. Show location of access doors installed during cleaning process.
- G. Perform cleaning and testing prior to Testing, Adjusting and Balancing. Upon completion of air duct and system cleaning and prior to Testing, Adjusting and Balancing replace all Air filters.
- H. Use duct-mounted access doors, as required, for physical and mechanical entry and for inspection.
1. Install additional duct-mounting access doors to comply with duct cleaning standards.
 2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection. Replace damaged and deteriorated flexible ducts.
 3. Disconnect and reconnect flexible connectors as needed for cleaning and inspection. Replace damaged and deteriorated flexible connectors
 4. Reseal rigid-fiberglass-duct systems according to NAIMA recommended practices.
 5. Replace damaged fusible links on fire and smoke dampers. Replacement fusible links shall be same rating as those being replaced.
 6. Remove and reinstall ceiling components to gain access for duct cleaning. Clean ceiling components after they have been removed and replaced.

- I. Mark position of dampers and air-directional mechanical devices before cleaning, and restore to their marked position on completion.
- J. Particulate Collection and Odor Control:
 - 1. Where venting vacuuming system inside building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron size (or greater) particles.
 - 2. When venting vacuuming system outside building, use filtration to contain debris removed from the HVAC system and locate exhaust down wind and away from air intakes and other points of entry into building.
- K. Clean the following metal-duct system components by removing visible surface contaminants and deposits:
 - 1. Air outlets and inlets (registers, grilles, and diffusers).
 - 2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
 - 3. Air-handling-unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
 - 4. Coils and related components.
 - 5. Return-air ducts, dampers, and actuators, except in ceiling plenums and mechanical room.
 - 6. Supply-air ducts, dampers, actuators, and turning vanes.
 - 7. Dedicated exhaust and ventilation components.
- L. Mechanical Cleaning Methodology:
 - 1. Clean metal-duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
 - 2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of ducts so areas being cleaned are under negative pressure.
 - 3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts or duct liner.
 - 4. Clean fibrous-glass duct liner with HEPA vacuuming equipment, and do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
 - 5. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
 - 6. Provide operative drainage system for washdown procedures.
 - 7. Biocidal Agents and Coatings: Apply biocidal agents if fungus is present; use according to manufacturer's written instructions after removal of surface deposits and debris.
- M. Cleanliness Verification:
 - 1. Verify cleanliness after mechanical cleaning and before application of treatment, including biocidal agents and protective coatings.
 - 2. Visually inspect metal-duct systems for contaminants.
 - 3. Where contaminants are discovered, reclean and reinspect duct systems.
- N. Duct Access
 - 1. Install duct-mounting access doors where access doors do not currently exist to allow for the cleaning of ducts, accessories, and terminal units as follows:
 - a. Refer to ACCESS DOORS AND FRAMES this section.
 - b. On both sides of duct coils.
 - c. Downstream from volume dampers, turning vanes, and equipment.

- d. Adjacent to fire or smoke dampers; reset or install new fusible links.
- e. Before and after each change in direction, at maximum 50-footspacing.
- f. On sides of ducts where adequate clearance is available.

O. Connections

1. Reconnect ducts to fans and air-handling units with existing flexible connectors after cleaning ducts and flexible connectors. Replace existing damaged and deteriorated flexible connectors.
2. For fans developing static pressures of 5-inch wgand higher, cover replacement flexible connectors with loaded vinyl sheet held in place with metal straps.
3. Reconnect terminal units to supply ducts with existing flexible ducts or replace damaged and deteriorated existing flexible ducts with maximum 12-inchlengths of new flexible duct.
4. Reconnect diffusers or light troffer boots to low-pressure ducts with existing flexible ducts or replace damaged and deteriorated existing flexible ducts with maximum 60-inch lengths of flexible duct clamped or strapped in place.
5. Reconnect existing and new flexible ducts to metal ducts with adhesive plus sheetmetal screws.

P. Testing/Reporting

1. NADCA ACR 2006 Vacuum Test Method: Sections of metal-duct system, chosen randomly by Owner, Architect, or Engineer shall be tested for cleanliness according to NADCA vacuum test gravimetric analysis. Test a minimum of 1 location for each 1000 square foot of project area.
 - a. 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 cm².
 - b. If analysis determines that levels of debris are equal to or lower than suitable levels, system shall have passed cleanliness verification.
 - c. If analysis determines that levels of debris exceed suitable levels, system cleanliness verification will have failed and metal-duct system shall be re-cleaned and re-verified.
2. Verification of Coil Cleaning: Cleaning shall restore coil pressure drop to within 10 percent of pressure drop measured when coil was first installed. If original pressure drop is not known, coil will be considered clean only if it is free of foreign matter and chemical residue, based on thorough visual inspection.
3. Report results of tests in writing.

3.26 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.
- 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. 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.
- I. 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.
- J. 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.

K. 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.

L. 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.

3.27 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.

3.28 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

SECTION 26 00 00 – ELECTRICAL 1

PART 1 - GENERAL 1

1.1 GENERAL REQUIREMENTS 1

1.2 WORK INCLUDED 1

1.3 INTENT 2

1.4 RELATED WORK 3

1.5 STANDARD OF MATERIALS AND WORKMANSHIP 4

1.6 ABBREVIATIONS AND DEFINITIONS 4

1.7 EXAMINATION 5

1.8 CODES, STANDARDS, AND REGULATIONS 5

1.9 DRAWINGS 6

1.10 FABRICATION OF MATERIALS 7

1.11 PERMITTING CHARGES 7

1.12 SUBMITTALS 8

1.13 EQUIPMENT COORDINATION DRAWINGS 9

1.14 REQUESTS FOR INTERPRETATION (RFIs) 10

1.15 RECORD DOCUMENTS 10

1.16 OPERATION AND MAINTENANCE DATA 11

1.17 ELECTRICAL BASIS OF DESIGN 12

1.18 CONNECTIONS TO EQUIPMENT 12

1.19 COORDINATION 12

1.20 TEMPORARY SERVICES 13

1.21 IDENTIFICATION OF ELECTRICAL SYSTEMS 14

1.22 PROTECTION 14

1.23 SEISMIC DESIGN 14

1.24 GUARANTEE 15

1.25 DEMOLITION 15

PART 2 - PRODUCTS 16

2.1 SUPPORTING DEVICES 16

2.2 CONDUCTORS AND CABLES 17

2.3 RACEWAYS AND BOXES 17

2.4 WIRING DEVICES 20

2.5 ELECTRICAL IDENTIFICATION 22

2.6 GROUNDING 24

2.7 PANELBOARDS (AND MODIFICATIONS) 24

2.8 INTERIOR LIGHTING 26

2.9 RACEWAY SUPPORT SYSTEM 29

2.10 FIRE ALARM SYSTEMS 29

2.11 SEISMIC RESTRAINTS AND VIBRATION ISOLATION TYPES 31

2.12 TOUCHUP PAINT 33

PART 3 - INSTALLATION 33

3.1 EXAMINATION 33

3.2 PREPARATION 34

3.3 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK 34

3.4 CLEANING AND REPAIR OF EXISTING EQUIPMENT 35

3.5 CUTTING AND PATCHING 35

3.6 ROUGH-IN 35

3.7 ELECTRICAL INSTALLATIONS 35

3.8 ELECTRICAL SUPPORTING METHODS 36

3.9 INSTALLATION OF ELECTRICAL SUPPORTING DEVICES 36

3.10 INSTALLATION OF CONDUCTORS AND CABLES 37

3.11	INSTALLATION OF ELECTRICAL WIRING DEVICES	39
3.12	INSTALLATION OF RACEWAYS AND BOXES	41
3.13	INSTALLATION OF ELECTRICAL IDENTIFICATION	44
3.14	INSTALLATION OF GROUNDING SYSTEMS.....	47
3.15	INSTALLATION OF PANELBOARDS	49
3.16	INSTALLATION OF INTERIOR LIGHTING	50
3.17	INSTALLATION OF RACEWAY SUPPORT SYSTEMS	52
3.18	INSTALLATION OF FIRE ALARM SYSTEMS	53
3.19	INSTALLATION OF VIBRATION ISOLATION AND SIESMIC RESTRAINT.....	55
3.20	TOUCHUP PAINTING	57

SECTION 26 00 00 – ELECTRICAL

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, so as to provide coordination with all trades for items such as - clearance for equipment maintenance & operation, proper voltages, correct receptacle types, etc.
- 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 Electrical 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. Examine all Drawings and other Sections of Specifications for requirements that affect work of this Section.
- B. Perform work and provide materials and equipment as shown on the Drawings and as specified herein. Work shall include, but not be limited to, all labor, materials, tools, equipment, insurance, transportation, temporary protection, supervision, and incidental items required for a complete installation. Drawings and specifications form complimentary requirements; provide work specified and not shown on drawings and work shown on drawings and not specified as though explicitly shown on both. Completely coordinate work of this Section with work of other Sections and Trades to provide a complete and functional installation.
- C. Provide all labor, equipment, material, implements and materials required to furnish and install all Electrical work, complete as shown on the drawings and noted herein. The following are major items of WORK INCLUDED:
 - 1. Hoisting and rigging for equipment and materials specified herein.
 - 2. Core drilling, cutting and channeling for holes five (5) inches and less in diameter.
 - 3. Furnish and maintain in safe and adequate condition, all staging and scaffolding that is required for work of this section.
 - 4. Premium Time: The project requires work to be completed on premium time (outside normal business hours).

5. Maintain temporary electrical system throughout building during construction.
6. Modification/Work-in existing unit substations.
7. Distribution panels.
8. Panelboards.
9. Disconnect switches (not supplied with equipment).
10. Circuit breakers (not supplied with equipment).
11. Fuses.
12. Motor controllers (not supplied with equipment).
13. Grounding.
14. Raceways and boxes.
15. Raceway support system.
16. Conductors and cables.
17. Wiring devices, including but not limited to, receptacles, switches, occupancy sensors, time switches, etc.
18. Lighting control system.
19. Emergency lighting bypass relay.
20. Interior lighting.
21. Electrical Supporting devices.
22. Pull boxes.
23. Junction boxes.
24. Electrical identification, including but not limited to, nameplates, device markings, cable and conduit identification, etc.
25. Seismic restraints.
26. Fire and Smoke Stopping. Coordinate materials and methods with DIVISION 7.
27. Electrical identification, including but not limited to, nameplates, device markings, cable and conduit identification, etc.
28. Modifications to existing fire alarm system.
29. Modifications to existing audio/visual nurse call system.
30. Submittals.
31. Short Circuit and Coordination Study.
32. Coordination Drawings.
33. Record Documents.
34. Electrical acceptance tests.
35. Operation and Maintenance (O&M) Manuals.
36. System startup, demonstration and training.

1.3 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 Electrical 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 Electrical Contractor shall provide fully qualified personnel to fulfill this requirement. The Electrical Contractor shall be responsible for prompt replacement of defective materials, equipment and parts of equipment and related damages.

1.4 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.
- B. The following related items are included under Sections listed below:
1. Except as specified herein, cutting shall be the responsibility of the General Contractor and patching shall be performed by the respective trades. Refer to the respective Sections.
 2. The Electrical Contractor shall provide all hoisting and rigging for equipment and materials specified herein.
 3. The Electrical Contractor shall provide all core-drilling, cutting and channeling for electrical equipment requiring holes five (5) inches and less in diameter.
 4. The Electrical Contractor shall furnish and maintain in safe and adequate condition, all staging and scaffolding that is required for work of this Section.
 5. Temporary light and power for use during construction and testing. DIVISION 1 – CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS.
 6. Painting of all exposed electrical equipment not having enameled surfaces, stainless steel or chromed finishes. DIVISION 9 - PAINTING
 7. In general, all wiring required for equipment provided by the HVAC Contractor that requires Automatic Controls and all interlock wiring 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.
 8. The Electrical Contractor shall provide all fire stopping related to Division 16 work in accordance with DIVISION 7 – FIRE-STOPPING.
 9. The Electrical Contractor shall seal all penetrations through non-rated walls, ceilings, floors, etc related to DIVISION 26 work in accordance with DIVISION 7 – JOINT SEALERS.
 10. The Electrical Contractor shall provide all electrical power, fire alarm and line-voltage control wiring connections to power operated doors, hardware, emergency call buttons, etc. in accordance with and in coordination with DIVISION 8 – DOORS AND WINDOWS with particular attention to DIVISION 8 – FINISH HARDWARE and DIVISION 28 – INTRUSION DETECTION SYSTEM.
 11. The Electrical Contractor shall provide all electrical power, fire alarm and line-voltage control wiring connections to display boards, illuminated signage, etc. in accordance with and in coordination with DIVISION 10 – SPECIALTIES. Furnish the following materials to be installed under other SECTIONS.
 12. The Electrical Contractor shall provide all electrical power, fire alarm and line-voltage control wiring connections to power operated projection screens, medical equipment, laboratory equipment, hardware, etc. in accordance with and in coordination with DIVISION 11 – EQUIPMENT.
 13. Electrical Subcontractor shall provide power and raceway support for all intrusion detection system equipment, refer to DIVISION 28 - INTRUSION DETECTION SYSTEM.
 14. The Electrical Contractor shall provide a plan indicating the location and size of each access panel to the General Contractor for review and coordination. Access panels required for electrical system shall be furnished and installed by the electrical contractor in accordance with DIVISION 8 – ACCESS DOORS AND FRAMES.
 15. The Electrical Contractor shall review in detail DIVISION 1 – ALTERNATES and include alternate pricing in the bid as required by BIDDING REQUIREMENTS, CONTRACTING REQUIREMENTS, and applicable parts of DIVISION 1 – GENERAL REQUIREMENTS. Any exclusions shall be clearly outlined in the bid otherwise all related work and costs shall be included.
 16. Fire and Smoke stopping at penetrations through fire-rated assemblies. Fire-stop materials and methods are specified in DIVISION 7.

- C. Furnish the following materials to be installed under other SECTIONS.
 - 1. The Electrical Contractor shall furnish and wire duct smoke detectors installed under DIVISION 23 - HEATING VENTILATION AND AIR-CONDITIONING.
- D. Wire the following materials furnished and installed under other SECTIONS.
 - 1. Sprinkler flow, tamper, pressure and alarm switches furnished and installed under DIVISION 21 - FIRE PROTECTION.
 - 2. Heating, ventilating and air-conditioning equipment furnished and installed under DIVISION 23 – HEATING VENTILATION AND AIR-CONDITIONING.

1.5 STANDARD OF MATERIALS AND WORKMANSHIP

- A. Conditions of the Contract and DIVISION 1, General Requirements, shall be made part of this Section:
 - 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 ducts and conduit parallel with or perpendicular to building planes.
 - 5. Conceal conduit and cables in finished areas. Install work so as to require a minimum amount of furring.
 - 6. Equipment, materials and work shall comply with the requirements of generally recognized agencies, including, but not limited to, agencies listed under DIVISION 26 Article CODES, STANDARDS AND REGULATIONS 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. "EC" as mentioned herein means specifically "Electrical Contractor" when used in conjunction with contractor, equipment, work or articles within this specification.
- B. "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.
- C. A.T.C. as mentioned herein means specifically Automatic Temperature Control as it refers to the manufacturer or description of work and equipment
- D. "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.
- E. The term "Applicable Section Contractor" or "A.S.C." shall be understood to refer to a contractor or contractors other than the E or any Electrical Subcontractor.
- F. "Shown on drawings" as used in the specifications shall mean "noted", "indicated", "scheduled", "detailed", or any other diagrammatic or written reference made on the drawings.

- G. "Provide" as used in the specifications and on the drawings shall mean "furnish" and "install", "connect", "apply", "erect", "construct", or similar terms, unless otherwise indicated.
- H. "Material" as used in the specifications shall mean any "product", "equipment", "device", "assembly", or "item" required under the Contract, as indicated by trade or brand name, manufacturer's name, standard specification reference or other description.
- I. "Approved" or "Approval" shall mean the written approval of the Architect.
- J. "Contract Documents" shall mean the entire set of Drawings and Specifications as listed in the Table of Contents of the General Conditions including all bound and unbound material and all items officially issued to date such as addenda, bulletins, job modifications, sketches, etc.
- K. "Specification" shall mean all information contained in the bound or unbound volume, including all "Contract Documents" defined therein, except for the drawings.
- L. "Accessible" shall indicate ease of access with or without the use of ladders and without requiring extensive removal of other equipment, such as ductwork, piping, etc. to gain access. "Accessible Ceiling" indicates acoustic tile type hung ceilings. Concealed spline or sheetrock ceilings with access panels shall not be considered accessible ceilings.
- M. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, hung ceilings, embedded in construction or in crawl spaces.
- N. "Exposed" shall mean not installed underground or "Concealed" as defined above.
- O. "Electrical Subcontractor" shall refer to the Subcontractor responsible for furnishing and installation of all work indicated on the Electrical Drawings and in the Electrical Specifications.
- P. "Owner" shall refer to the Owner or his designated representative.

1.7 EXAMINATION

- A. Examine the Specifications and Drawings, including the Specifications and Drawings of other DIVISIONS before bid.
- B. Before submitting bid, visit and examine the site where work is to be carried out and become familiar with all features and characteristics that affect the work of this SECTION.
- 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 that existed up to the time of bid.

1.8 CODES, STANDARDS, AND REGULATIONS

- A. Electrical work shall comply with the latest editions of the following codes, including State amendments, which have been accepted by local authorities:
 - 1. IBC – International Building Code
 - 2. Maine State Building Code
 - 3. 2009 International Energy Conservation Code

4. Maine State Energy Code
5. City of Portland, ME fire protection codes and/or ordinances
6. NFPA 13 – Sprinkler Systems
7. NFPA 70 - National Electrical Code with State Amendments
8. NFPA 72 - National Fire Alarm Code with State Amendments
9. NFPA 101 - Life Safety Code
10. ANSI C2 - National Electrical Safety Code
11. NFPA 99 - Health Care Facilities
12. NFPA 110 – Emergency and Standby Power Systems

B. Electrical work shall comply with the current standards of the following organizations:

1. ADA - Americans with Disabilities Act
2. IEEE - Institute of Electrical and Electronics Engineers
3. IES - Illuminating Engineering Society
4. EIA/TIA - Electronic Industries Association/Telecommunications Industry Association
 - a. EIA/TIA-568 Commercial Building Wiring Standard.
 - b. EIA/TIA-569 Commercial Building Standard for Telecommunication Pathways and Spaces.
5. OSHA - Occupational Safety and Health Act
6. FM - Factory Mutual Association
7. UL - Underwriters' Laboratories
8. ANSI - American National Standards Institute
9. NEMA - National Electric Manufacturers Association
10. ASTM - American Society for Testing and Materials
11. Owner's Insurance Underwriter
12. U.S. Department of Health and Human Services - Guidelines for Construction and Equipment of Hospital and Medical Facilities
13. NECA 1-2006 – Standard practices for Good Workmanship in Electrical Contracting.
14. NETA 2007 Acceptance Testing Specifications, InterNational Electrical Testing Association.

C. When requirements listed in this Section conflict with each other, with the contract documents or with the requirements of applicable Codes, Standards or Regulations, the most stringent requirements shall apply.

D. In addition to complying with the specified requirements, comply with pertinent regulations of governmental agencies and Authorities Having Jurisdiction (AHJ) including local and state building, plumbing, mechanical, electrical, fire, and health department codes and standards.

1.9 DRAWINGS

A. The Drawings are schematic in nature and are intended to show approximate locations of apparatus, luminaires, devices conduit run, etc. 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 code required clearances, space and provision for servicing of equipment, removal and reinstallation.
- F. Provide all ceiling mounted components, including light luminaires, smoke detectors, remote test/reset stations, occupancy sensors, access doors, panels, etc., in strict accordance with reflected ceiling plans.

1.10 FABRICATION OF MATERIALS

- A. Before prefabricating equipment for installation, make certain that such items can be installed as shown on the 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 equipment 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 not 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 PERMITTING 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 assist the owner in applications for and to the local utility company energy rebate programs, including pricing information. The application and pricing information shall be submitted prior to the luminaire, lamp and ballast shop drawing submittal.

1.12 SUBMITTALS

- A. Refer to DIVISION 1 - Submittals and specifications for shop drawing requirements. Without limiting the generality thereof, the Electrical Subcontractor shall also submit the additional information noted herein.
- B. General: Follow the procedures specified in DIVISION 1. Unless otherwise noted in DIVISION 1 the required shop drawing submittals shall be reviewed and returned for two full or partial submissions as part of the base Engineering scope of services. All additional submittal reviews shall be billed to the general contractor at \$750.00 per submittal.
- C. Substitutions: The DIVISION 26 contractor shall submit on the system, components, materials, manufacture, etc. utilized by the Engineer as the "Basis of Design." The contractor shall be allowed to utilize one of the listed manufacturers for items that are not listed with a "Basis of Design." When a substitution is allowed by the Architect and/or Engineer it shall be the full responsibility of the DIVISION 26 contractor to coordinate all differences with field conditions, owner, owners representatives, commissioning agent, other trades, etc. Any costs and schedule delays due to changes, modifications, redesigns, removal and replacement created by the contractors substitution or failure to coordinate substitution shall be the responsibility of the contractor.
- D. Present, not later than three (3) weeks after award of the Contract, a list of Shop Drawings shall 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.
- E. Do not manufacture, deliver or install equipment and materials until final review of Shop Drawings has been completed.
- F. Prior to submission of Shop Drawings, the Electrical 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 Shop Drawings. The Electrical 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 by the Architect. Review of the Shop Drawings shall not relieve the Electrical Subcontractor from the responsibility for departures from the Contract Documents. Errors in shop drawings shall be the sole responsibility of the Electrical Subcontractor whether the drawings are reviewed or not.
- G. Shop drawings shall be submitted in groups by systems. For example, all luminaires, lamps, ballasts and accessories shall be submitted simultaneously in one package.
- H. Submit for review, two transparency and (2) blue- or black-line reproductions of each Shop Drawing larger than 8 ½" x 11". Submit seven (7) copies of smaller certified Shop Drawings of all equipment, materials, equipment wiring, diagrams, motors, starters, controls and schedules. Ensure that shop drawings have adequate clear space for all stamps. When requested, resubmit drawings promptly.
- I. Submit certified Shop Drawings and distribute prints to all trades and manufacturers affected.
- J. Be responsible for presenting the processing of shop drawings to suit manufacturing schedule of equipment and construction schedule of building.

- K. 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.
- L. Each Shop Drawing shall indicate clearly the correct name and address of the project, the intended use and location of the equipment, and the specified designated number.
- M. Upon receipt of approved Shop Drawings, distribute prints to all trades and manufacturers affected.
- N. Keep one set of reviewed Shop Drawings on the site at all times.
- O. Bind one set of the corrected "Reviewed" Shop Drawings in each Operation and Maintenance Instructions Manual. Refer to DIVISION 1 - SUBMITTALS, DIVISION 1 - PROJECT CLOSEOUT.
- P. Provide information to other Contractors as required of concrete equipment bases and for any other work to be performed by other trades.
- Q. The Electrical 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.

1.13 EQUIPMENT COORDINATION DRAWINGS

- A. Prepare Coordination Drawings according to the requirements outlined in DIVISION 1. Before work progresses, in addition to the shop drawings listed herein, Coordination Drawings shall be prepared by the HVAC and Sheetmetal Subcontractors, at a suitable scale not less than 3/8 inch equals one foot, showing structure, sheetmetal layout and other information as needed for coordination. (Where the HVAC and Sheetmetal Contractors are not part of the scope or do not create the Coordination Drawings, the Electrical Subcontractor shall create the Coordination Drawings as required to include all pertinent information.) The Electrical Subcontractor shall add major electrical equipment, components, and feeders to these Coordination Drawings indicating locations and space requirements for installation, access, and working clearance. The Electrical Subcontractor shall show where sequence and coordination of installations are important to the efficient flow of the Work. Coordinate drawing preparation with effort specified in other Specification Sections. Include the following electrical information on the Coordination Drawings:
 - 1. Provisions for scheduling, sequencing, moving, and positioning large equipment in the building during construction.
 - 2. Floor plans, elevations, and details, including the following:
 - a. Clearances to meet safety requirements and for servicing and maintaining equipment, including space for equipment disassembly required for periodic maintenance.
 - b. Electric Coordination drawings shall include, as a minimum, all light luminaires, all switchboards, panelboards, transformers, motor control centers, feeder junction and pull boxes, feeder conduits sized 1 ¼" and greater, busways, MI cable, cable trays, all floor standing equipment, all fire alarm panels and terminal cabinets, generators, transfer switches, UPS', and control panels.
 - c. Electrical Room Layouts indicating all equipment and Code required clearances.
 - d. Equipment support details.
 - e. Exterior wall, roof, and foundation penetrations of cable and raceway; and their relation to other penetrations and installations.

- f. Fire-rated interior wall and floor penetrations by electrical installations.
- g. Sizes and locations of required concrete pads and bases.
3. Reflected ceiling plans to coordinate and integrate installing air supply diffusers and returns, light luminaires, alarm and communication systems components, sprinklers, and other ceiling-mounted items.
4. All costs associated with all aspects of the Coordination Drawings, regardless of how many times they are required to be redrawn and how long it is required to produce a complete coordinated set of drawings, shall be borne by the Electrical Subcontractor.

1.14 REQUESTS FOR INTERPRETATION (RFIs)

- A. Prepare Requests for Interpretation (RFIs) in accordance to Division 1 and, in addition, adhere to the following:
- B. 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.
- C. If email RFI submissions are allowed by DIVISION 1 then the RFI and Attachment(s) shall be in Adobe Acrobat PDF format.
- D. Submit RFIs in format specified and in addition include:
 1. Specification Section number and title and related paragraphs, as appropriate.
 2. Drawing number, room name, structural grid coordinates and detail references, as appropriate.
 3. Field dimensions and conditions, as appropriate.
 4. 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.
 5. 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).
 - a. 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.

1.15 RECORD DOCUMENTS

- A. Prepare record documents in accordance with the requirements in DIVISION 1. In addition to the requirements specified in DIVISION 1, indicate installed conditions for:
 1. Major raceway systems, size and location, for both exterior and interior; locations of control devices; distribution and branch electrical circuitry; and fuse and circuit breaker size and arrangements.
 2. Equipment locations (exposed and concealed), dimensioned from prominent building lines.
 3. Approved substitutions, Contract Modifications, and actual equipment and materials installed.
- B. Engage the services of a Land Surveyor or Professional Engineer registered in the state in which the project is located as specified in DIVISION 1 to record the locations and invert elevations of underground installations.

1.16 OPERATION AND MAINTENANCE DATA

- A. Prepare maintenance manuals in accordance with DIVISION 1 Section "PROJECT CLOSEOUT." In addition to the requirements specified in DIVISION 1, include the following information for equipment items:
1. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.
 2. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions.
 3. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
 4. Servicing instructions and lubrication charts and schedules.
- B. The minimum information that shall be furnished in the maintenance manual shall include the following:
1. Individual characteristics for trouble shooting sequences for each item of each:
 - a. Panelboards.
 - b. Dry-type transformers.
 - c. Motor controllers (not supplied with equipment).
 2. Catalog cut sheets for every item for which a shop drawing is required.
 3. Schedule of loads served from each:
 - a. Panelboards.
 - b. Dry-type transformers.
 - c. Motor controllers (not supplied with equipment).
 4. On-hand spare parts list and complete parts list for each:
 - a. Panelboards.
 - b. Dry-type transformers.
 - c. Disconnect switches and circuit breakers(not supplied with equipment).
 - d. Motor controllers (not supplied with equipment).
 - e. Fire alarm system.
 5. Tap setting schedule for each:
 - a. Dry-type transformers.
 6. Overload element schedule for each motor starter.
 7. Bolt tightening torques and inspection intervals on each:
 - a. Bolted bus connection.
 - b. Cable connection.
 - c. Miscellaneous bolted electrical connections.
 8. Manufacturers' recommended cleaning intervals and special procedures for each:
 - a. Cooling fins.
 - b. Dry-type transformer coil assembly.
 - c. Electrical equipment interior.
 - d. Electrical equipment ventilation opening.
 - e. Luminaire lenses and reflectors.
 9. Main and arcing contact adjustment and replacement for each:
 - a. Circuit breaker.
 - b. Motor starter.
 10. Calibration and exercise procedures and intervals for each:
 - a. Molded case breaker.
 11. "As designed" and "as left" adjustable circuit breaker settings.
 12. Testing interval and target values for ground fault protection circuit relays.
 13. Testing and trouble shooting procedures unique to special systems.
 14. Approved special construction details that differ from the details shown on Drawings.

1.17 ELECTRICAL BASIS OF DESIGN

- A. For major pieces of electrical equipment, including but not limited to medium-voltage switchgear, medium-voltage transformers, secondary unit substations, switchgear, switchboards, transfer switches, generators, fire alarm, etc., the engineer's basis of design is the unit shown on the plans, listed in the schedules and outlined in the specification. 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 to or better than the scheduled unit and IF he ensures that the unit fits within the allotted electrical space.
- B. For equipment supported by the buildings structure or an architectural element the contractor must ensure that the submitted unit either weighs less than the scheduled unit or can be supported by the roof structure.
- C. For all outdoor mounted equipment, which differs from that shown on the schedules, the contractor must ensure that his submitted equipment does not violate any local ordinances.
- D. 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.

1.18 CONNECTIONS TO EQUIPMENT

- A. The Electrical Contractor shall provide all electrical and control 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.

1.19 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.
- D. Set all necessary sleeves and inserts before concrete is scheduled to be poured.
- E. Furnish all items to be built-in, in ample time to allow scheduled progress of work.
- F. Refer to the Coordination Drawing Section of the Specification for Coordination drawing process.
- G. Coordinate electrical power, control and interlock wiring requirements with the HVAC, Plumbing and Fire Protection Contractors two (2) weeks after receipt of signed contract to allow proper coordination between trades.

- H. Verify with the electrical characteristics of mechanical equipment with the DIVISION 23 contractors before ordering any equipment and/or installation of any electrical equipment.
 - I. Verify the electrical characteristics of the elevator with the elevator contractor and general contractor to ensure complete coordination of power, control, fire alarm, signal and interlock wiring required by the contractor of this section. Examples are transfer switch interlock wiring, fire alarm interface with recall system, elevator hoist-way motorized damper fire alarm and power interface, disconnect location, elevator machine room receptacle location, sump pump, etc..
 - J. Verify with the electrical characteristics of appliances and laundry equipment with the general contractor before ordering any equipment and/or installation of any electrical equipment.
 - K. Verify smoke and damper actuator requirements with the general contractor and DIVISION 23 contractors before ordering any equipment and/or installation of any electrical equipment.
 - L. Coordinate Duct Smoke detector sampling tube lengths and requirements with HVAC contractor.
 - M. Coordinate sprinkler flow switch and tamper switch locations and requirements with fire protection contractor.
 - N. Verify duct smoke detector and fire alarm interface requirements with HVAC contractor.
 - O. Wire all motor starters, control devices, relays, pilot lights, accessories, contactors, wiring diagrams, and the like required for proper operation, connection and control of motorized equipment, provided by the HVAC. Plumbing and Fire Protection Contractor as specified and/or shown on the drawings.
 - P. Electrical Contractor shall be responsible for the following:
 - 1. Mount and connect motor 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.
 - Q. HVAC contractor provides low and line voltage control wiring to all equipment requiring control unless specifically called for on the Electrical drawings or specifications.
 - R. General contractor shall provide all roof openings. Roof openings shall be the minimum size required for conduit penetrations.
- 1.20 TEMPORARY SERVICES
- A. Temporary Fire Alarm System: Electrical Contractor shall be responsible to provide temporary fire alarm service and system as outlined in specification DIVISION 1 - TEMPORARY FACILITIES AND CONTROLS. The Electrical Contractor shall be responsible for all negotiations and coordination with the Dartmouth Hitchcock Medical Center and the LEBANON Fire Department. The temporary fire alarm service shall be disconnected and reconnected during the hours of construction, in full coordination with the LEBANON Fire Department and General Contractor, to avoid false alarms from construction debris, dust, etc. The temporary fire alarm system shall include heat detectors, cabling, pull stations and horn/strobe units.

- B. Permanent electrical service and systems shall not be used as a temporary, except with written permission of the Architect, Owner and Engineer.

1.21 IDENTIFICATION OF ELECTRICAL SYSTEMS

- A. After finish painting is complete, identify all electrical system. 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. Labeling of new systems added to existing systems shall be consistent with the existing numbering system and terminology. Do not use numbers that have already been used.
- C. Labeling on all exposed conduit shall be on top of the conduit out of line of sight.
- D. Submit sample labels for review.
- E. Provide typewritten master lists in Operating and Maintenance Instruction Manuals; and shop equipment numbers on Record Prints and sepias.
- F. Identification shall be consistent with Owner's standard methods of identification.

1.22 PROTECTION

- A. Protect all electrical equipment, system and work from damage. Keep all equipment dry and clean at all times.
- B. Cover openings in equipment, and conduits, 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, conduit and temporary services installed within Section 16000 from weather damage.

1.23 SEISMIC DESIGN

- A. This project is located within a seismic zone requiring special provisions for the support and restraint of equipment and piping. Seismic-restraint devices shall have horizontal and vertical load testing and analysis performed according to the Office of Statewide Health Planning & Development for the State of California (OSHPD) and shall bear anchorage pre-approval "R" number, from OSHPD or another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If pre-approved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer. Testing and calculations must include both shear and tensile loads and 1 test or analysis at 45 degrees to the weakest mode.
- B. Shop Drawings: Signed and sealed by a qualified professional engineer. Include the following:

1. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
 2. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes, and seismic loads. Include certification that riser system has been examined for excessive stress and that none will exist.
 3. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, base weights, equipment static loads, power transmission, component misalignment, and cantilever loads.
 4. Seismic-Restraint Details: Detail fabrication and attachment of seismic restraints and snubbers. Show anchorage details and indicate quantity, diameter, and depth of penetration of anchors.
 5. Submittals for Interlocking Snubbers: Include load deflection curves up to 1/2-inch deflection in x, y, and z planes.
- 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.

1.24 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 Electrical contractor 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.

1.25 DEMOLITION

- A. The following systems shall be included for demolition as part of this project:
 1. Dry-type transformers.
 2. Panelboards.
 3. Disconnect switches and circuit breakers.
 4. Fuses.
 5. Motor controllers.
 6. Grounding.
 7. Raceways and boxes.
 8. Raceway support system.
 9. Conductors and cables.

10. Control / signal conductors.
 11. Wiring devices, including but not limited to, receptacles, switches, occupancy sensors, time switches, etc.
 12. Lighting control system.
 13. Interior lighting.
 14. Electrical Supporting devices.
 15. Pull boxes.
 16. Junction boxes.
 17. Electrical identification, including but not limited to, nameplates, device markings, cable and conduit identification, etc.
 18. Seismic restraints.
 19. Fire-stopping.
 20. Electrical identification, including but not limited to, nameplates, device markings, cable and conduit identification, etc.
 21. Fire alarm system.
 22. Master clock system.
- B. The Electrical Contractor shall work with the demolition contractor to de-energize, cut and make safe all electrical systems to be completely demolished. The scope of work shall include coordination with existing electrical, fire alarm, public address, master clock and bell systems to insure any and all systems passing through are temporarily rerouted, reconnected and in working order for continuous operation. The Electrical Contractor shall also be responsible to coordinate the disconnection of any system connecting to a utility company service or municipal system prior to building demolition.
- C. The Electrical Contractor shall de-energize and make safe all electrical systems required to be demolished. Electrical equipment scheduled to be maintained or relocated shall be removed, stored, cleaned, and repaired prior to re-installation – this is the responsibility of the Electrical Contractor.
- D. The Electrical Contractor shall be responsible to understand the wiring and continuity of all systems and system wiring prior to demolition or removal. System wiring providing service to areas outside the area of construction shall maintained in such a manner that will not impact the full operation of the facility.
- E. The Electrical Contractor shall coordinate with DIVISION 1 – GENERAL REQUIREMENTS, DIVISION 1 – Demolition.

PART 2 - PRODUCTS

2.1 SUPPORTING DEVICES

- A. Channel and angle support systems, hangers, anchors, sleeves, brackets, fabricated items, and fasteners are designed to provide secure support from the building structure for electrical components.
1. Material: Steel, except as otherwise indicated, protected from corrosion with zinc coating or with treatment of equivalent corrosion resistance using approved alternative finish or inherent material characteristics.
 2. Metal Items for Use in Damp Locations: Hot-dip galvanized steel, except as otherwise indicated.

- B. Steel channel supports have 9/16-inch (14-mm) diameter holes at a maximum of 8 inches (203 mm) o.c., in at least 1 surface.
 - 1. Fittings and accessories mate and match with channels and are from the same manufacturer.
- C. Raceway and Cable Supports: Manufactured clevis hangers, riser clamps, straps, threaded C-clamps with retainers, ceiling trapeze hangers, wall brackets, and spring steel clamps or "click"-type hangers.

2.2 CONDUCTORS AND CABLES

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Wires and Cables:
 - a. American Insulated Wire Corp
 - b. BICC Brand-Rex Company.
 - c. Carol Cable Co., Inc.
 - d. Senator Wire & Cable Company.
 - e. Southwire Company.
 - 2. Connectors for Wires and Cables:
 - a. General Signal; O-Z/Gedney Unit.
 - b. Monogram Co.; AFC.
 - c. Square D Co.; Anderson.
 - d. 3M Company; Electrical Products Division.
- B. Building Wires and Cables
 - 1. UL-listed building wires and cables with conductor material, insulation type, cable construction, and rating as specified in Part 3 "INSTALLATION OF CONDUCTORS AND CABLES", "Wire and Insulation Applications" paragraph.
 - 2. Rubber Insulation Material: Comply with NEMA WC 3.
 - 3. Thermoplastic Insulation Material: Comply with NEMA WC 5.
 - 4. Cross-Linked Polyethylene Insulation Material: Comply with NEMA WC 7.
 - 5. Ethylene Propylene Rubber Insulation Material: Comply with NEMA WC 8.
 - 6. Conductor Material: Copper.
 - 7. Stranding: All conductors shall be stranded.
- C. Connectors and Splices
 - 1. UL-listed, factory-fabricated wiring connectors of size, ampacity rating, material, type, and class for application and service indicated. Comply with Project's installation requirements and as specified in Part 3 "INSTALLATION OF CONDUCTORS AND CABLES", "Wire and Insulation Applications" paragraph.

2.3 RACEWAYS AND BOXES

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Metal Conduit and Tubing:
 - a. Alflex Corp.
 - b. Anamet, Inc.; Anaconda Metal Hose.
 - c. Anixter Brothers, Inc.
 - d. Carol Cable Co., Inc.
 - e. Cole-Flex Corp.

- f. Electri-Flex Co.
 - g. Flexcon, Inc.; Coleman Cable Systems, Inc.
 - h. Grinnell Co.; Allied Tube and Conduit Div.
 - i. Monogram Co.; AFC.
 - j. Spiraduct, Inc.
 - k. Triangle PWC, Inc.
 - l. Wheatland Tube Co.
2. Nonmetallic Conduit and Tubing:
- a. Anamet, Inc.; Anaconda Metal Hose.
 - b. Arnco Corp.
 - c. Breeze-Illinois, Inc.
 - d. Cantex Industries; Harsco Corp.
 - e. Certainteed Corp.; Pipe & Plastics Group.
 - f. Cole-Flex Corp.
 - g. Condux International; Electrical Products.
 - h. Electri-Flex Co.
 - i. George-Ingraham Corp.
 - j. Hubbell, Inc.; Raco, Inc.
 - k. Lamson & Sessions; Carlon Electrical Products.
 - l. R&G Sloan Manufacturing Co., Inc.
 - m. Spiraduct, Inc.
 - n. Thomas & Betts Corp.
3. Conduit Bodies and Fittings:
- a. American Electric; Construction Materials Group.
 - b. Crouse-Hinds; Div. of Cooper Industries.
 - c. Emerson Electric Co.; Appleton Electric Co.
 - d. Hubbell, Inc.; Killark Electric Manufacturing Co.
 - e. Lamson & Sessions; Carlon Electrical Products.
 - f. O-Z/Gedney; Unit of General Signal.
 - g. Scott Fetzer Co.; Adalet-PLM.
 - h. Spring City Electrical Manufacturing Co.
4. Metal Wireways:
- a. Hoffman Engineering Co.
 - b. Keystone/Rees, Inc.
 - c. Square D Co.
5. Nonmetallic Wireways:
- a. Hoffman Engineering Co.
 - b. Lamson & Sessions; Carlon Electrical Products.
6. Surface Metal Raceways:
- a. Airey-Thompson Co., Inc.; A-T Power Systems.
 - b. American Electric; Construction Materials Group.
 - c. Butler Manufacturing Co.; Walker Division.
 - d. Square D Co.
 - e. Wiremold Co. (The); Electrical Sales Division.
7. Surface Nonmetallic Raceways:
- a. Anixter Brothers, Inc.
 - b. Butler Manufacturing Co.; Walker Division.
 - c. Hubbell, Inc.; Wiring Device Division.
 - d. JBC Enterprises, Inc.; Enduro Fiberglass Systems.
 - e. Lamson & Sessions; Carlon Electrical Products.
 - f. Panduit Corp.
 - g. Thermotools Co.
 - h. United Telecom; Premier Telecom Products, Inc.
 - i. Wiremold Co. (The); Electrical Sales Division.
8. Boxes, Enclosures, and Cabinets:

- a. American Electric; FL Industries.
 - b. Butler Manufacturing Co.; Walker Division.
 - c. Crouse-Hinds; Div. of Cooper Industries.
 - d. Electric Panelboard Co., Inc.
 - e. Erickson Electrical Equipment Co.
 - f. Hoffman Engineering Co.; Federal-Hoffman, Inc.
 - g. Hubbell Inc.; Killark Electric Manufacturing Co.
 - h. Hubbell Inc.; Raco, Inc.
 - i. Lamson & Sessions; Carlon Electrical Products.
 - j. O-Z/Gedney; Unit of General Signal.
 - k. Parker Electrical Manufacturing Co.
 - l. Robroy Industries, Inc.; Electrical Division.
 - m. Scott Fetzer Co.; Adalet-PLM.
 - n. Spring City Electrical Manufacturing Co.
 - o. Thomas & Betts Corp.
 - p. Woodhead Industries, Inc.; Daniel Woodhead Co.
- B. Metal Conduit And Tubing
1. Rigid Steel Conduit: ANSI C80.1.
 2. Rigid Aluminum Conduit: ANSI C80.5.
 3. IMC: ANSI C80.6.
 4. Plastic-Coated Steel Conduit and Fittings: NEMA RN 1.
 5. Plastic-Coated IMC and Fittings: NEMA RN 1.
 6. EMT and Fittings ANSI C80.3.
 - a. Fittings: Set-screw type.
 7. FMC: Aluminum.
 8. FMC: Zinc-coated steel.
 9. LFMC: Flexible steel conduit with PVC jacket. UL listed.
 10. Fittings: NEMA FB 1; compatible with conduit/tubing materials.
- C. Nonmetallic Conduit And Tubing
1. ENT: NEMA TC 13.
 2. RNC: NEMA TC 2, Schedule 40 or 80 PVC.
 3. ENT and RNC Fittings: NEMA TC 3; match to conduit or conduit/tubing type and material.
 4. LFNC: UL 1660.
- D. Metal Wireways
1. Material: Sheet metal sized and shaped as indicated.
 2. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
 3. Select features, unless otherwise indicated, as required to complete wiring system and to comply with NFPA 70.
 4. Wireway Covers: Screw-cover type.
 5. Finish: Manufacturer's standard enamel finish.
- E. Nonmetallic Wireways
1. Description: Fiberglass polyester, extruded and fabricated to size and shape indicated, with no holes or knockouts. Cover is gasketed with oil-resistant gasket material and fastened with captivated screws treated for corrosion resistance. Connections are flanged, with stainless-steel screws and oil-resistant gaskets.
 2. Description: PVC plastic, extruded and fabricated to size and shape indicated, with snap-on cover and mechanically coupled connections using plastic fasteners.

3. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
4. Select features, unless otherwise indicated, as required to complete wiring system and to comply with NFPA 70.

F. Surface Raceways

1. Surface Metal Raceways: Galvanized steel with snap-on covers. Finish with manufacturer's standard prime coating.
2. Surface Nonmetallic Raceways: 2-piece construction, manufactured of rigid PVC compound with matte texture and manufacturer's standard color.
3. Types, sizes, and channels as indicated and required for each application, with fittings that match and mate with raceways.

G. Outlet And Device Boxes

1. Sheet Metal Boxes: NEMA OS 1.
2. Cast-Metal Boxes: NEMA FB 1, Type FD, cast box with gasketed cover.
3. Nonmetallic Boxes: NEMA OS 2.

H. Pull and Junction Boxes

1. Small Sheet Metal Boxes: NEMA OS 1.
2. Cast-Metal Boxes: NEMA FB 1, cast aluminum with gasketed cover.

I. Enclosures And Cabinets

1. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous hinge cover and flush latch.
 - a. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
 - b. Nonmetallic Enclosures: Plastic, finished inside with radio-frequency-resistant paint.
2. Cabinets: NEMA 250, Type 1, galvanized steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel. Hinged door in front cover with flush latch and concealed hinge. Key latch to match panelboards. Include metal barriers to separate wiring of different systems and voltage, and include accessory feet where required for freestanding equipment.

2.4 WIRING DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Wiring Devices:
 - a. Hubbell Inc.
 - b. Leviton
 - c. Pass & Seymour
2. Multi-Outlet Assemblies:
 - a. Wiremold Co.

B. Wiring Devices

1. Comply with NEMA Standard WD 1, "General Purpose Wiring Devices."
2. Enclosures: NEMA 1 equivalent, except as otherwise indicated.
3. Color: As determined by Architect, except as otherwise indicated or required by Code. Unless specific direction by the Architect is given, facility standard shall be ivory.
4. Receptacles connected to emergency power: Red devices with red plate.

5. Receptacles, Straight-Blade, Hospital Grade: Listed and labeled for compliance with Hospital Grade of UL Standard 498, "Electrical Attachment Plug and Receptacle," and Federal Specification W-C-598. Hubbell #HBL8300 grade level.
6. Receptacles, Straight-Blade, Special Features: Comply with the basic requirements specified above for straight-blade receptacles of the class and type indicated, and with the following additional requirements:
 - a. Ground-Fault Circuit Interrupter (GFCI) Receptacles:
 - 1) UL Standard 943, "Ground Fault Circuit Interrupters," feed-through type, with integral NEMA 5-20R duplex receptacle arranged to protect connected downstream receptacles on the same circuit. Design units for installation in a 2-3/4-inch (70-mm) deep outlet box without an adapter.
 - 2) Self-testing with internal diagnostics.
 - 3) Red and green LED's on face. Steady green indicates power on condition. Steady red indicates presence of ground fault condition, flashing red indicates loss of capability to protect against ground fault.
 - 4) "Hubbell #GFR8300H__ST"
 - b. Weather resistant (WR) Receptacles: "Hubbell #HBL8300SGxxx", "Pass & Seymour #WR63Hxxx" or "Leviton #WR8300xxx"
 - c. Tamper Resistant Receptacles: "Hubbell #GFR8300SGxxx", "Pass & Seymour #TR63Hxxx" or "Leviton #TR8300xxx"
 - d. Isolated Ground Receptacles: Equipment grounding contacts are connected only to the green grounding screw terminal of the device and have inherent electrical isolation from the mounting strap.
 - 1) Devices: Listed and labeled as isolated ground receptacles.
 - 2) Isolation Method: Integral to the receptacle construction and not dependent on removable parts.
 - e. Transient-Voltage Surge-Suppressor (TVSS) Receptacles: Duplex type, NEMA 5-20R configuration, with integral transient-voltage surge protection in a minimum of 3 modes: line-to-ground, line-to-neutral, and neutral-to-ground; listed as complying with UL Standard 1449 "Transient Voltage Surge Suppressors."
 - 1) Surge Protection Components: Multiple metal-oxide varistors, rated for 500 V transient suppression voltage nominal clamp level and minimum single transient pulse energy dissipation of 140 J, line-to-neutral, and 70 J, line-to-ground and neutral-to-ground.
 - 2) Active Protection Indication: A light visible in the face of the device indicates the state of the device as "active" or "no longer active."
 - 3) Identification: Distinctive marking on face of device denotes transient-voltage surge-suppressor type unit.
7. Pendant Cord/Connector Devices: Matching, locking type, plug and plug receptacle body connector, NEMA L5-20P and L5-20R, heavy-duty grade.
 - a. Bodies: Nylon with screw-open cable-gripping jaws and provision for attaching external cable grip.
 - b. External Cable Grip: Woven wire mesh type made of high-strength galvanized-steel wire strand and matched to cable diameter and with attachment provision designed for the corresponding connector.
8. Cord and Plug Sets: Match voltage and current ratings and number of conductors to requirements of the equipment being connected.
 - a. Cord: Rubber-insulated, stranded copper conductors, with type SOW-A jacket. Grounding conductor has green insulation. Ampacity is equipment rating plus 30 percent minimum.
 - b. Plug: Male configuration with nylon body and integral cable-clamping jaws. Match to cord and to receptacle type intended for connection.
9. Snap Switches: Quiet-type a.c. switches, NRTL listed and labeled as complying with UL Standard 20 "General Use Snap Switches," and with Federal Specification W-S-896.

- 10. Combination Switch and Receptacle: Both devices in a single gang unit with plaster ears and removable tab connector that permits separate or common feed connection.
 - a. Switch: 20 ampere, 120-277 V a.c.
 - b. Receptacle: NEMA configuration 5-15R.
- 11. Dimmer Switches: Modular full-wave solid-state units with integral, quiet on-off switches, and audible and electromagnetic noise filters.
 - a. Wattage rating exceeds connected load by 30 percent minimum, except as otherwise indicated.
 - b. Control: Continuously adjustable slide, toggle or rotary knob. Single-pole or 3-way switch to suit connections.
 - c. LED Fixture Dimmers: Modular dimmer switches compatible with the driver type supplying the fixture.
 - d. Incandescent Lamp Dimmers: Modular dimmer switches for incandescent luminaires; switch poles and wattage as otherwise indicated, 120 V, 60 Hz with continuously adjustable rotary knob, toggle, or slide, single-pole with soft tap or other quiet switch. Equip with electromagnetic filter to eliminate noise, RF and TV interference, and 5-inch (127-mm) wire connecting leads.
 - e. Fluorescent Lamp Dimmers: Modular dimmer switches compatible with dimmer ballasts. Trim potentiometer adjusts low-end dimming. Dimmer-ballast combination is capable of consistent dimming to a maximum of 10 percent of full brightness.
- 12. Wall Plates: Single and combination types that mate and match with corresponding wiring devices. Features include the following:
 - a. Color: Plates for normal power devices shall be ivory. Plates for emergency power devices shall be red. Matching wiring device except as otherwise indicated.
 - b. Plate-Securing Screws: Metal with heads colored to match plate finish.
 - c. Material for Finished Spaces: High Impact Nylon, except as otherwise indicated.

C. Multi-Outlet Assemblies

- 1. Comply with Standard UL 5, "Surface Metal Raceways and Fittings."
- 2. Components of Assemblies: Products of a single manufacturer designed to be used together to provide a complete matching assembly of raceways and receptacles.
- 3. Raceway Material: Metal, with manufacturer's standard corrosion-resistant finish.
- 4. Raceway Material: Nonmetallic.
- 5. Devices shall comply with section wiring device requirements in these specifications.
- 6. Wire: No. 12 AWG.

2.5 ELECTRICAL IDENTIFICATION

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:

- 1. Brady USA, Inc.; Industrial Products Div.
- 2. Ideal Industries, Inc.
- 3. Brother
- 4. Seton Name Plate Co.

B. Raceway and Cable Labels

- 1. Manufacturer's Standard Products: Where more than one type is listed for a specified application, selection is Installer's option, but provide single type for each application category. Use colors prescribed by ANSI A13.1, NFPA 70, and these Specifications.
- 2. Conform to ANSI A13.1, Table 3, for minimum size of letters for legend and minimum length of color field for each raceway or cable size.
 - a. Color: Black legend on orange field.

- b. Legend: Indicates voltage and service (ie, normal, critical, life safety, equipment branch).
 3. Adhesive Labels: Preprinted, flexible, self-adhesive vinyl. Legend is overlaminated with a clear, weather- and chemical-resistant coating.
 4. Pretensioned, Wraparound Plastic Sleeves: Flexible, preprinted, color-coded, acrylic bands sized to suit the diameter of the line it identifies and arranged to stay in place by pretensioned gripping action when placed in position.
 5. Colored Adhesive Tape: Self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide (0.08 mm thick by 25 to 51 mm wide).
 6. Underground Line Warning Tape: Permanent, bright-colored, continuous-printed, vinyl tape with the following features:
 - a. Size: Not less than 6 inches wide by 4 mils thick (152 mm wide by 0.102 mm thick).
 - b. Compounded for permanent direct-burial service.
 - c. Embedded continuous metallic strip or core.
 - d. Printed Legend: Indicates type of underground line.
 7. Tape Markers: Vinyl or vinyl-cloth, self-adhesive, wraparound type with preprinted numbers and letters.
 8. Aluminum, Wraparound Marker Bands: Bands cut from 0.014-inch- (0.4-mm-) thick aluminum sheet, with stamped or embossed legend, and fitted with slots or ears for permanently securing around wire or cable jacket or around groups of conductors.
 9. Plasticized Card-Stock Tags: Vinyl cloth with preprinted and field-printed legends. Orange background, except as otherwise indicated, with eyelet for fastener.
 10. Aluminum-Faced Card-Stock Tags: Weather-resistant, 18-point minimum card stock faced on both sides with embossable aluminum sheet, 0.002 inch (0.05 mm) thick, laminated with moisture-resistant acrylic adhesive, and punched for the fastener. Preprinted legends suit each application.
 11. Brass or Aluminum Tags: Metal tags with stamped legend, punched for fastener. Dimensions: 2 by 2 inches (51 by 51 mm) by 0.05 inch (1.3 mm).
- C. Engraved Nameplates And Signs
 1. Manufacturer's Standard Products: Where more than one type is listed for a specified application, selection is Installer's option, but provide single type for each application category. Use colors prescribed by ANSI A13.1, NFPA 70, and these Specifications.
 2. Engraving stock, melamine plastic laminate, 1/16-inch (1.6-mm) minimum thick for signs up to 20 sq. in. (129 sq. cm), 1/8 inch (3.2 mm) thick for larger sizes.
 - a. Engraved Legend: Black letters on white face.
 - b. Punched for mechanical fasteners.
 3. Baked-Enamel Signs for Interior Use: Preprinted aluminum signs, punched for fasteners, with colors, legend, and size as indicated or as otherwise required for the application. 1/4-inch (6.4-mm) grommets in corners for mounting.
 4. Exterior, Metal-Backed, Butyrate Signs: Weather-resistant, nonfading, preprinted, cellulose acetate butyrate signs with 0.0396-inch (1-mm), galvanized steel backing, with colors, legend, and size appropriate to the application. 1/4-inch (6.4-mm) grommets in corners for mounting.
 5. Fasteners for Plastic-Laminated and Metal Signs: Self-tapping stainless-steel screws or No. 10/32 stainless-steel machine screws with nuts and flat and lock washers.
- D. Miscellaneous Identification Products
 1. Cable Ties: Fungus-inert, self-extinguishing, 1-piece, self-locking, Type 6/6 nylon cable ties with the following features:
 - a. Minimum Width: 3/16 inch (5 mm).
 - b. Tensile Strength: 50 lb (22.3 kg) minimum.
 - c. Temperature Range: Minus 40 to 185 deg F (Minus 4 to 85 deg C).
 - d. Color: As indicated where used for color coding.

2. Paint: Alkyd-urethane enamel over primer as recommended by enamel manufacturer.

2.6 GROUNDING

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 1. Chance: A. B. Chance Co.
 2. Erico Inc.; Electrical Products Group.
 3. ILSCO.
- B. Grounding and Bonding Products
 1. Governing Requirements: Where types, sizes, ratings, and quantities indicated are in excess of National Electrical Code (NEC) requirements, the more stringent requirements and the greater size, rating, and quantity indications govern.
- C. Wire and Cable Grounding Conductors
 1. Comply with DIVISION 26 Section "Wires and Cables." Conform to NEC Table 8, except as otherwise indicated, for conductor properties, including stranding.
 - a. Material: Copper Only.
 2. Equipment Grounding Conductors: Insulated with green color insulation.
 3. Grounding-Electrode Conductors: Stranded cable.
 4. Bare Copper Conductors: Conform to the following:
 - a. Solid Conductors: ASTM B 3.
 - b. Assembly of Stranded Conductors: ASTM B 8.
 - c. Tinned Conductors: ASTM B 33.
 5. Miscellaneous Conductors
 - a. Grounding Bus: Bare, annealed-copper bars of rectangular cross section.
 - b. Braided Bonding Jumpers: Copper tape, braided No. 30 AWG bare copper wire, terminated with copper ferrules.
 - c. Bonding Straps: Soft copper, 0.05 inch (1 mm) thick and 2 inches (50 mm) wide, except as indicated.
 6. Connector Products
 - a. Pressure Connectors: High-conductivity-plated units.
 - b. Bolted Clamps: Heavy-duty type.

2.7 PANELBOARDS (AND MODIFICATIONS)

- A. General: The scope of this project requires new circuit breakers in existing panelboards. All new equipment shall conform to these specifications.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Cutler-Hammer/Eaton Corp.
- C. Panelboard Fabrication
 1. Enclosures: Flush- or surface-mounted cabinets as indicated. NEMA PB 1, Type 1, unless otherwise indicated to meet environmental conditions at installed location.
 - a. Outdoor Locations: NEMA 250, Type 3R.
 - b. Kitchen Areas: NEMA 250, Type 4X, stainless steel.
 - c. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
 - d. Hazardous Areas Indicated on Drawings: NEMA 250, Type 7C.

1. Front: Entire front trim hinged to box with piano hinge and standard door within hinged trim cover. Front for surface-mounted panelboards shall be same dimensions as box. Front trim shall be Eaton "DD" style – front piano-hinged to box. Fronts for flush panelboards shall overlap box, unless otherwise indicated.
 2. Directory Frame: Metal, mounted inside each panelboard door.
 3. Bus: Hard drawn copper of 98 percent conductivity.
 4. Main and Neutral Lugs: Compression type.
 5. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment ground conductors. Bonded to box.
 6. Service Equipment Approval: Listed for use as service equipment for panelboards with main service disconnect.
 7. Future Devices: Equip with mounting brackets, bus connections, and necessary appurtenances, for the overcurrent protective device ampere ratings indicated for future installation of devices.
 8. Special Features: Include the following features for panelboards as indicated:
 - a. Isolated Equipment Ground Bus: Adequate for branch-circuit equipment ground conductors; insulated from box.
 - b. Split Bus: Vertical bus of indicated panelboards divided into 2 vertical sections with connections as indicated.
 - c. Skirt for Surface-Mounted Panelboards: Same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and floor.
 9. Extra Gutter Space: Dimensions and arrangement as indicated.
 - a. Gutter Barrier: Arranged to isolate section of gutter as indicated.
 - b. Column-Type Panelboard Configuration: Narrow cabinet extended as wireway to overhead junction box equipped with ground and neutral terminal buses.
 - c. Subfeed: Overcurrent protective device or lug provision as indicated.
 10. Feed-through Lugs: Sized to accommodate feeders indicated.
- D. Lighting and Appliance Branch-Circuit Panelboards
1. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.
 2. Doors: In panelboard front, with concealed hinges. Secure with flush catch and tumbler lock, all keyed alike.
 3. Populate panelboards with circuit breakers as defined on the drawings. Balance of space in all panelboards shall be filled with 1P20A spares. Spaces in panelboards not acceptable.
 4. Provide trim as described above.
 5. Provide locks for circuit breakers serving exit sign circuits, fire alarm system and emergency call and nurse call systems.
- E. Distribution Panelboards
1. Doors: In panelboard front, except omit in fusible-switch panelboard, unless otherwise indicated. Secure door with vault-type latch with tumbler lock, all keyed alike.
 2. Branch-Circuit Breakers: Where overcurrent protective devices are indicated to be circuit breakers, use bolt-on circuit breakers, except circuit breakers 225-A frame size and greater may be plug-in type where individual positive-locking device requires mechanical release for removal.
- F. Overcurrent Protective Devices
1. Molded-Case Circuit Breaker: NEMA AB 1, handle lockable.
 - a. Characteristics: Frame size, trip rating, number of poles, and auxiliary devices as indicated and interrupting capacity rating to meet available fault current.
 - b. Application Listing: Appropriate for application, including Type SWD for switching fluorescent lighting loads and Type HACR for motors and for heating, air-conditioning, and refrigerating equipment.

- c. Circuit Breakers, 200 A and Larger: Trip units interchangeable within frame size.
 - d. Circuit Breakers, 400 A and Larger: Field-adjustable short-time and continuous current settings.
 - e. Current-Limiting Trips: Where indicated, let-through ratings less than NEMA FU 1, Class RK-5.
 - f. Current Limiters: Where indicated, integral fuse listed for circuit breaker.
 - g. Lugs: Mechanical lugs and power-distribution connectors for number, size, and material of conductors indicated.
 - h. Shunt Trip: Where indicated.
 - i. Undervoltage Trip: Where indicated.
 - j. Ground fault circuit interrupter: Where indicated.
 - k. Final circuit breaker AIC shall be based on coordination study, specification Part 1.
2. Fusible Switch: NEMA KS 1, Type HD, clips to accommodate specified fuses, handle lockable.
- G. Accessory Components And Features
1. Accessory Set: Include tools and miscellaneous items as required for overcurrent protective device test, inspection, maintenance, and operation.
 2. Portable Test Set: Arranged to permit testing of functions of solid-state trip devices without removal from panelboard.
 3. Fungus Proofing: Permanent fungicidal treatment for panelboard interior, including overcurrent protective devices and other components.

2.8 INTERIOR LIGHTING

- A. Products: Subject to compliance with requirements, provide one of the products specified in the Luminaire Schedule on the Drawings.
- B. Luminaires and Luminaire Components, General
1. Metal Parts: Free from burrs, sharp corners, and edges.
 2. Sheet Metal Components: Steel, except as indicated. Form and support to prevent warping and sagging.
 3. Doors, Frames, and Other Internal Access: Smooth operating, free from light leakage under operating conditions, and arranged to permit relamping without use of tools. Arrange doors, frames, lenses, diffusers, and other pieces to prevent accidental falling during relamping and when secured in operating position.
 4. Reflecting Surfaces: Minimum reflectance as follows, except as otherwise indicated:
 - a. White Surfaces: 85 percent.
 - b. Specular Surfaces: 83 percent.
 - c. Diffusing Specular Surfaces: 75 percent.
 - d. Laminated Silver Metallized Film: 90 percent.
 5. Lenses, Diffusers, Covers, and Globes: 100 percent virgin acrylic plastic or water white, annealed crystal glass, except as otherwise indicated.
 - a. Plastic: High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
 - b. Lens Thickness: 0.125 inch (3 mm) minimum; except where greater thickness is indicated.
 6. Luminaire Support Components:
 - a. Single-Stem Hangers: 1/2-inch (12-mm) steel tubing with swivel ball fitting and ceiling canopy. Finish same as luminaire.
 - b. Twin-Stem Hangers: Two, 1/2-inch (12-mm) steel tubes with single canopy arranged to mount a single luminaire. Finish same as luminaire.
 - c. Rod Hangers: 3/16-inch- (5-mm-) minimum diameter, cadmium-plated, threaded steel rod.

- d. Hook Hanger: Integrated assembly matched to luminaire and line voltage and equipped with threaded attachment, cord, and locking-type plug.
- 7. Fluorescent Luminaires: Conform to UL 1570.
- 8. Fluorescent Ballasts: Electronic integrated circuit, solid-state, full-light-output, energy-efficient type compatible with lamps and lamp combinations to which connected.
 - a. Certification by Electrical Testing Laboratory (ETL).
 - b. Labeling by Certified Ballast Manufacturers Association (CBM).
 - c. Type: Class P, high power factor, except as otherwise indicated.
 - d. Integral lamp end-of-life protection.
 - e. Sound Rating: "A" rating, except as otherwise indicated.
 - f. Voltage: Match connected circuits.
 - g. Lamp Flicker: Less than 5 percent.
 - h. Minimum Power Factor: 90 percent.
 - i. Total Harmonic Distortion (THD) of Ballast Current: Less than 10 percent.
 - j. Conform to FCC Regulations Part 15, Subpart J for electromagnetic interference.
 - k. Conform to IEEE C62.41, Category A, for resistance to voltage surges for normal and common modes.
 - l. Multilamp Ballasts: Use 2, 3, or 4 lamp ballasts for multilamp luminaires where possible.
 - m. Luminaires in multiple light level and multiple switching applications: provide additional ballasts as required in order to accommodate light level and multiple switching requirements as detailed on the plans. Utilize "master-satellite" pairs with factory modular wiring or tandem-wire luminaires to minimize ballast count.
 - n. Lamp-ballast connection method does not reduce normal rated life of lamps.
 - o. Low-Temperature Fluorescent Ballasts: Comply with above requirements, except ballast may be Class P electromagnetic type. Starting temperature is minus 20 deg C or colder.
 - p. Dimming Ballasts: Electronic type providing smooth dimming over a minimum range from 100 to 5 percent light output. Listed for use with specific fluorescent dimming system provided. Dimming systems are specified in DIVISION 26 Section "Lighting Control Equipment." Fluorescent wall dimmers are specified in DIVISION 26 Section "Wiring Devices."
 - q. Ballast disconnect: Provide UL listed disconnecting means between ballast and line per NEC 410.136.
- 9. Electromagnetic Interference (EMI) Filters: Integral to luminaire assembly. Provide one filter for each ballast. Suppress EMI as required by MIL-STD-461.
- 10. Incandescent Luminaires: Conform to UL 1571.
- 11. Track-Lighting Systems: Conform to UL 1574. Provide components, including track, fittings, and luminaires, from same manufacturer and as recommended by manufacturer for intended use.
- 12. Exit Signs: Conform to UL 924 and the following:
 - a. Sign Colors: Conform to local code.
 - b. Minimum Height of Letters: Conform to local code.
 - c. Arrows: Include as indicated.
 - d. Lamps for AC Operation: Light-emitting diodes (LED), 70,000 hours minimum rated life.
- 13. Self-Powered Exit Signs (Battery Type): Integral automatic high/low trickle charger in a self-contained power pack.
 - a. Battery: Sealed, maintenance-free, nickel-cadmium type with special warranty.
- 14. Emergency Lighting Units: Conform to UL 924. Provide self-contained units with the following features:
 - a. Battery: Sealed, maintenance-free, lead-acid type with minimum 10-year nominal life and special warranty.
 - b. Charger: Minimum 2-rate, fully automatic, solid-state type, with sealed transfer relay.

- c. Operation: Relay automatically turns lamp on when supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. Relay disconnects lamps and battery and automatically recharges and floats on trickle charger when normal voltage is restored.
 - d. Wire Guard: Where indicated, provide heavy-chrome-plated wire guard arranged to protect lamp heads or luminaires.
 - e. Time-Delay Relay: Provide time-delay relay in emergency lighting unit control circuit arranged to hold unit ON for fixed interval after restoration of power after an outage. Provide adequate time delay to permit HID lamps to restrike and develop adequate output.
15. Emergency Fluorescent Power Supply Unit: Conform to UL 924.
- a. Internal Type: Self-contained, modular, battery-inverter unit factory mounted within luminaire body.
 - 1) Test Switch and LED Indicator Light: Visible and accessible without opening luminaire or entering ceiling space.
 - 2) Battery: Sealed, maintenance-free, nickel-cadmium type with minimum 10-year nominal life.
 - 3) Charger: Fully automatic, solid-state, constant-current type.
 - 4) Operation: Relay automatically turns lamp on when supply circuit voltage drops to 80 percent of nominal voltage or below. Relay disconnects lamp and battery and automatically recharges when normal voltage is restored.
 - 5) Provide constant-on conductor to each unit in addition to switch leg, per manufacturer's wiring diagram.
 - b. External Type: Self-contained, modular, battery-inverter unit.
 - 1) Test Switch and LED Indicator Light: Visible and accessible without entering ceiling space.
 - 2) Battery: Sealed, maintenance-free, nickel-cadmium type with minimum 10-year nominal life.
 - 3) Charger: Fully automatic, solid-state, constant-current type.
 - 4) Operation: Relay automatically turns lamp on when supply circuit voltage drops to 80 percent of nominal voltage or below. Battery automatically recharges when normal voltage is restored.

C. Lamps

- 1. Comply with ANSI C78 series that is applicable to each type of lamp.
- 2. Fluorescent Color Temperature and Minimum Color-Rendering Index (CRI):
 - a. Linear fluorescent: 3500 K and 85 CRI, except as otherwise indicated.
 - b. Compact fluorescent: 3500 K and 82 CRI, except as otherwise indicated
- 3. Compact fluorescent lamps: Integral lamp end-of-life protection.
- 4. Non-compact Fluorescent Lamp Life: Rated average is 20,000 hours at 3 hours per start when used on rapid start circuits.
- 5. Metal Halide Color Temperature and Minimum Color-Rendering Index (CRI): 3600 K and 70 CRI, except as otherwise indicated.
- 6. Lamps to be used on dimming circuits shall be "seasoned" a minimum of 100 hours at full output prior to installation on dimming ballast.

D. Finishes

- 1. Manufacturer's standard, except as otherwise indicated, applied over corrosion-resistant treatment or primer, free of streaks, runs, holidays, stains, blisters, and similar defects.

2.9 RACEWAY SUPPORT SYSTEM

- A. General: Raceway support system shall include, but not be limited to, raceways for telephone, data, security, CCTV, wireless paging, nurse call systems, and other medical systems.
 - 1. All telecommunications pathway components shall be installed as per ANSI/TIA/EIA-568-B.1 and 569-A.
 - 2. Raceway support system shall include cable tray, refer to appropriate section within this specification.
- B. Outlet Boxes
 - 1. Flush wall mounted 4-11/16 inches square pressed galvanized steel. Box eliminators are prohibited.
 - 2. Center vertical barrier for combination receptacle/device.
- C. Plaster Cover
 - 1. Single gang for single device.
 - 2. Two gang for combination receptacle/device.
- D. Cover Plates
 - 1. Same material, finish, and color as for wiring devices.
 - 2. 2"x4" mud-ring.
- E. Raceways
 - 1. All raceways shall be EMT.
 - 2. Per appropriate section with insulated throat bushings on all conduit runs and rubber grommeted holes between boxes or box sections.
- F. Telephone Backboards
 - 1. 3/4 inch plywood of size shown on Drawings.
- G. Cabinets
 - 1. Same as for panelboard enclosures.
 - 2. 3/4 inch plywood shall cover interior back of the enclosure.
- H. Telephone Room Entrances and Through-Wall Pathways
 - 1. STI ESPATH Series 44 EZD44 fire-rated max pathway.
 - 2. EZP544W: max 5 gang wall plate brackets.
 - 3. EZDP144FK EZPATH Max Fire rated floor kit.

2.10 FIRE ALARM SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. New devices shall be Simplex to match existing facility standard.
- B. Functional Description of System
 - 1. Maintain the system functions and operating features of the existing system. Provide new programming as required to accommodate the modifications to the system.
- C. Addressable Devices
 - 1. Alarm-Initiating Devices: Classified as addressable devices according to NFPA 72.
 - a. Communication Transmitter and Receiver: Integral to device. Provides each device with a unique identification and capability for status reporting to the FACP.

- b. External Addressable Interface Unit: May be used where specified devices are not manufactured and labeled with integral multiplex transmitter and receiver. Arrange to monitor status of each device individually.

D. Manual Pull Stations

- 1. Description: Double-action type, fabricated of metal or plastic, and finished in red with molded, raised-letter operating instructions of contrasting color.
 - a. Break-Glass Feature: Stations requiring the breaking of a glass panel are unacceptable. Stations requiring the breaking of a concealed glass rod are acceptable.
 - b. Station Reset: Key or wrench operated, double pole, double throw, switch rated for the voltage and current at which it operates. Stations have screw terminals for connections.

E. Smoke Detectors

- 1. General: Comply with UL 268. Include the following features:
 - a. Factory Nameplate: Serial number and type identification.
 - b. Operating Voltage: 24-V dc, nominal.
 - c. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
 - d. Plug-in Arrangement: Detector and associated encapsulated electronic components are mounted in a module that connects to a fixed base with a twist-locking plug connection. The plug connection requires no springs for secure mounting and contact maintenance. Terminals in the fixed base accept building wiring.
 - e. Integral Visual Indicating Light: Connect to indicate detector has operated.
 - f. Remote Controllability: Individually monitor detectors at the FACP for calibration, sensitivity, and alarm condition, and individually adjust for sensitivity from the FACP.
- 2. Photoelectric Smoke Detectors: Include the following features:
 - a. Detector Sensitivity: Between 2.5- and 3.5-percent-per-foot (0.008- and 0.011-percent-per-mm) smoke obscuration when tested according to UL 268.
 - b. Sensor: An infrared detector light source with matching silicon-cell receiver.
- 3. Duct Smoke Detector: Ionization type.
 - a. Sampling Tube: Design and dimensions as recommended by the manufacturer for the specific duct size and installation conditions where applied.
 - b. Relay Fan Shutdown: Rated to interrupt fan motor-control circuit.

F. Alarm-Indicating Devices

- 1. General: Equip alarm-indicating devices for mounting as indicated. Provide terminal blocks for system connections.
- 2. Visual Alarm Devices: Xenon strobe lights with clear or nominal white polycarbonate lens. Mount lenses on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch (25-mm) high letters on the lens.
 - a. Devices have a minimum light output of 115 candela.
 - b. Devices have a minimum light output as indicated on the Drawings.
 - c. Strobe Leads: Factory connected to screw terminals.
 - d. Combination devices consist of factory-combined, audible and visual alarm units in a single mounting assembly.
- 3. Remote Alarm Indicator: LED type, mounted flush in a single gang wall plate.
 - a. Connected to indicate the alarm operation of a single detector or other device.
 - b. Legend: "Alarm."
- 4. Voice/Tone Speakers: Comply with UL 1480.
 - a. Matching Transformers: Tap range matched to the acoustical environment of the speaker location.

- b. High-Range Speaker Units: Rated 2 to 15 W.
- c. Low-Range Speaker Units: Rated 1 to 2 W.
- d. Speaker Mounting: Flush, semirecessed, surface, or surface-mounted bidirectional as indicated.

G. Remote Device Location-Indicating Lights and Identification Plates

- 1. Description: An LED-indicating light in the vicinity of each sprinkler water-flow switch and valve tamper switch denotes the associated device is in an abnormal or trouble mode. Lamp is flush mounted in a single gang wall plate. A red, laminated, phenolic-resin identification plate at the indicating light identifies, in engraved white letters, the room where the valve is located or the protected spaces downstream from the water-flow switch.

H. Emergency Power Supply

- 1. General: Components include valve-regulated, recombinant lead acid battery, charger, and an automatic transfer switch. Battery nominal life expectancy is 10 years, minimum.
- 2. General: Components include nickel-cadmium-type battery, charger, and an automatic transfer switch. Battery nominal life expectancy is 20 years, minimum.
- 3. Battery capacity is adequate to operate the complete alarm system in normal or supervisory (nonalarm) mode for a period of 24 hours. At the end of this period, the battery has sufficient capacity to operate the system, including alarm-indicating devices in either alarm or supervisory mode, for a period of 15 minutes.
 - a. Magnetic door holders are not served by emergency power. Magnetic door holders are released when normal power fails.
- 4. Battery Charger: Solid-state, fully automatic, variable-charging-rate type. Provide capacity for 150 percent of the connected system load while maintaining the batteries at full charge. In the event batteries are fully discharged, the charger recharges them completely within 4 hours. Charger output is supervised as part of system power supply supervision.
- 5. Integral Automatic Transfer Switch: Transfers the load to the battery without loss of signals or status indications when normal power fails.

I. Wire

- 1. Wire: Solid-copper conductors with 600-V rated, 75 deg C, color-coded insulation.
 - a. Low-Voltage Circuits: No. 16 AWG, minimum.
 - b. Line-Voltage Circuits: No. 12 AWG, minimum.

2.11 SEISMIC RESTRAINTS AND VIBRATION ISOLATION TYPES

- 1. General
 - a. All isolation and seismic restraint devices shall be capable of accepting, without failure, the "G" forces as determined by the seismic certification and calculations as described in the "SUBMITTAL DATA REQUIREMENTS" section of these specifications.
 - b. Corrosion protection for outdoor applications shall be as follows:
 - 1) Springs shall be cadmium plated, zinc electroplated or powder coated.
 - 2) Hardware shall be cadmium or zinc plated.
 - 3) All other metal parts shall be hot spray or hot dipped galvanized or zinc electroplated.
 - c. All seismic restraint devices
 - 1) Shall maintain the equipment in a captive position and not short circuit isolation device during normal operating conditions.
 - 2) Shall have provisions for bolting and/or welding to the structure.
 - d. Welding of springs to isolator housing, base plates, etc. is strictly prohibited.
- 2. Seismic Restraint Types

- a. TYPE I: Same as Type B isolator.
 - b. TYPE II: Where required, each corner or side of equipment base shall incorporate a seismic restraint snubber having an all directional resilient neoprene pad limit stops. Restraints shall be fabricated of plate, structural members or square metal tubing. Model "SS" as manufactured by NAI.
 - c. TYPE III: Restraints for suspended systems.
 - 1) Vibration isolated systems shall be braced with multiple 7 x 19 galvanized steel cables with approved attachment devices (such as thimbles and wire rope clips) to equipment and structure.
 - 2) Non-isolated systems shall be braced with structural steel strut or cable with approved attachment devices to equipment and structure.
 - 3) Steel angles (by contractor) shall be provided to prevent rod bending of hung equipment where indicated by the Seismic Restraint Supplier's submittals. Steel angles shall be attached to the rods with a minimum of three clamps model "SRC" at each restraint location. Welding of support rods to angles is not acceptable.
 - d. TYPE IV: Double deflection neoprene.
 - 1) Mountings shall be fabricated to resist the wind or seismic forces. Model "RNM" as manufactured by NAI.
 - e. TYPE V: Rigid attachment to structure utilizing wedge type expansion anchors for bolting and steel plates, either cast-in or anchored with wedge type expansion bolts, for welding. Powder shots are not acceptable. Concrete anchor bolt spacing shall be in accordance with anchor manufacturer's published standards.
3. Vibration Isolator Types
- a. TYPE A: Spring Isolator - Free Standing
 - 1) Spring shall have a minimum outer diameter to overall height ratio of 0.8: 1 at rated deflection.
 - 2) Reserve deflection (from published load ratings to solid height) of 50% of the rated deflection.
 - 3) Minimum 1/4" thick neoprene acoustical base pad or cup on underside, unless designated otherwise.
 - 4) Model "SM" as manufactured by NAI.
 - b. TYPE B: Spring Isolator - Restrained
 - 1) Shall be the same as TYPE A with the following additional features.
 - a) Integral restraining bolts with elastomeric cushions preventing metal-to-metal contact.
 - b) Internal spring adjusting nut or bolt.
 - c) Built-in all-directional limit stops with minimum 1/8" clearance under normal operation.
 - d) Model "RSM" as manufactured by NAI.
 - c. TYPE C: Spring Hanger Isolator
 - 1) a. Spring element (same as TYPE A) within a steel box with an Elastomer bushing to insulate lower support rod from the hanger box.
 - 2) b. Steel hanger box shall be capable of 30-degree misalignment between the rod attachment to structure and the connection to the supported equipment. Hanger boxes shall withstand three times the rated load without failure.
 - 3) Model "SH" as manufactured by NAI.
 - d. TYPE D: Double deflection neoprene
 - 1) Mountings shall be fabricated to resist the wind or seismic forces.
 - 2) Model "RNM" as manufactured by NAI.
 - e. TYPE E: Elastomer Hanger Isolator
 - 1) Molded neoprene element with a bushing to insulate lower support rod from the hanger box.
 - 2) Steel hanger box shall withstand three times the rated load without failure.

- 3) Model "NH" as manufactured by NAI.
- f. TYPE F: Combination Spring/Elastomer Hanger Isolator
 - 1) Spring and neoprene elements in a steel hanger box with the features as described for TYPE C and E isolators.
 - 2) Model "SNH" as manufactured by NAI.
- g. TYPE M: Flashable restrained isolator
 - 1) Shall have all features of TYPE B isolator.
 - 2) Shall have galvanized steel spring pocket covers for adjustment and/or removal and replacement of springs.
 - 3) The combination floating top rail and top flashing shall be fabricated of two formed and nested layers of 12 ga. galvanized steel.
 - 4) Isolator shall be flashed directly into the waterproofing membrane.
 - 5) To be complete with wood nailers, plywood sides, counter flashing and resilient weather seal.
 - 6) Model "FRSM" as manufactured by NAI.
- h. TYPE P: Elastomer Isolator
 - 1) Double deflection neoprene compression mountings.
 - 2) Non-skid top and bottom surfaces.
 - 3) Threaded bolting sleeves shall be embedded in the isolator.
 - 4) Drilled tie-down bolt holes shall be provided in the base plate.
 - 5) Model "FMD" by NAI.

B. EQUIPMENT BASES, CURBS & SUPPORTS

- 1. GENERAL
 - a. All non galvanized materials shall be prime paint finished.
- 2. BASE TYPES
 - a. TYPE B-1: Structural Steel Base
 - 1) Welded steel stand with 1-1/2" +/- adjustable legs.
 - 2) Provide pre-drilled holes for unit attachment to the stand.
 - 3) Model "CRS" as manufactured by NAI.

2.12 TOUCHUP PAINT

- A. For Equipment: Provided by equipment manufacturer and selected to match equipment finish.
- B. For Nonequipment Surfaces: Matching type and color of undamaged, existing adjacent finish.

PART 3 - INSTALLATION

3.1 EXAMINATION

- A. Verify that field measurements and circulating arrangements are as shown on Drawings.
- B. Verify that abandoned wiring and equipment serve only abandoned facilities.
- C. Demolition Drawings are based on casual field observation and existing record documents. Contractor shall report discrepancies to Owner and Architect/Engineer before disturbing existing installation.
- D. The start of demolition is verification that the contractor accepts and thoroughly understands existing conditions.

3.2 PREPARATION

- A. Disconnect electrical systems in walls, floors, and ceilings scheduled for removal.
- B. Provide temporary wiring and connections to maintain existing systems in service during construction. When work must be performed on energized equipment, feeders or branch circuits, use personnel experienced in such operations.
- C. Existing Fire Alarm System: Maintain existing system in service until new system is accepted. Disable system only to make switchovers and connections. Notify Owner, Architect/Engineer, and local fire service at least 24 hours before partially or completely disabling system. Minimize outage duration. Make temporary connections to maintain service in areas adjacent to work area.
- D. Existing Systems: Maintain existing systems in service until new system is complete and ready for service and new system is accepted. Disable systems only to make switchovers and connections. Obtain permission from Owner/Architect/Engineer at least 24 hours before partially or completely disabling system. Minimize outage duration. Make temporary connections to maintain service in areas adjacent to work area.

3.3 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

- A. Demolish and extend existing electrical work under provisions of DIVISION 1, DIVISION 2, and this Section. Install relocated materials and equipment under the provisions of DIVISION 1.
- B. Accessible Work Indicated to Be Demolished: Remove exposed electrical installation in its entirety.
- C. Abandoned Work: Cut and remove buried raceway 2 inches (50 mm) below the surface of adjacent construction. Remove existing wiring in its entirety. Cap and patch surface to match existing finish.
- D. Removal: Contractor (DIVISION 26) shall be responsible to disconnect, make safe and lower to the ground all electrical systems, equipment, materials and components indicated for removal or demolition. Electrical conduit and conductors, feeders and branch circuits for all electrical systems indicated on the drawings and in the specifications shall be removed in their entirety unless otherwise indicated. The demolished material shall be collected and removed from the project site by the Demolition or General Contractor.
- E. Temporary Disconnection: Remove, store, clean, reinstall, reconnect, and make operational components indicated for relocation or labeled existing to be maintained.
- F. Remove, relocate, and extend existing installations to accommodate the construction process, phasing and the temporary partitions utilized to segregate the construction areas from occupied areas.
- G. Where electrical work to remain is damaged or disturbed in the course of the Work, remove damaged portions and install new products of equal capacity, quality, and functionality.
- H. Repair adjacent construction and finishes damaged during demolition and extension work.
- I. Maintain access to existing electrical installations which remain active. Modify installation or provide access panel as appropriate.

- J. Extend existing installations using materials and methods compatible with existing electrical installations or as specified.

3.4 CLEANING AND REPAIR OF EXISTING EQUIPMENT

- A. Clean and repair existing materials and equipment indicated as, existing to be maintained or existing to be relocated.
- B. Panelboards: Clean exposed surfaces and check tightness of electrical connections. Replace damaged circuit breakers and provide filler plates for vacant positions. Provide typed circuit directory showing revised circuiting arrangement.
- C. Luminaires: Remove existing luminaires for cleaning. Use mild detergent to clean all exterior and interior surfaces; rinse with clean water and wipe dry. Replace lamps, ballasts, and broken electrical components. Install luminaires in new location as indicated on the drawings.

3.5 CUTTING AND PATCHING

- A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces necessary for electrical installations. Perform cutting by skilled mechanics of the trades involved.
- B. Repair disturbed surfaces to match adjacent undisturbed surfaces.

3.6 ROUGH-IN

- A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.
- B. Refer to equipment specifications, drawings, elevations and shop drawings in Divisions 2 through 28 to verify rough-in requirements.

3.7 ELECTRICAL INSTALLATIONS

- A. General: Sequence, coordinate, and integrate the various elements of electrical systems, materials, and equipment. Comply with the following requirements:
 1. Verify all dimensions by field measurements.
 2. Arrange for chases, slots, and openings in other building components during progress of construction, to allow for electrical installations.
 3. Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components, as they are constructed.
 4. Sequence, coordinate, and integrate installations of electrical materials and equipment for efficient flow of the Work. Give particular attention to large equipment requiring positioning prior to closing in the building.
 5. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible.
 6. Coordinate connection of electrical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.

7. Install systems, materials, and equipment to conform with approved submittal data, including coordination drawings, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the Work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, refer conflict to the Architect.
8. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished spaces.
9. Install electrical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations.
10. Install access panel or doors where units are concealed behind finished surfaces. Access panels and doors are specified in DIVISION 8.
11. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.

3.8 ELECTRICAL SUPPORTING METHODS

- A. Damp Locations and Outdoors: Hot-dip galvanized materials or nonmetallic, U-channel system components.
- B. Dry Locations: Steel materials.
- C. Support Clamps for PVC Raceways: Click-type clamp system.
- D. Conform to manufacturer's recommendations for selecting supports.
- E. Strength of Supports: Adequate to carry all present and future loads, times a safety factor of at least 4; 200-lb- (90-kg-) minimum design load.

3.9 INSTALLATION OF ELECTRICAL SUPPORTING DEVICES

- A. Install devices to securely and permanently fasten and support electrical components.
- B. Raceway Supports: Comply with NFPA 70 and the following requirements:
 1. Conform to manufacturer's recommendations for selecting and installing supports.
 2. Install individual and multiple raceway hangers and riser clamps to support raceways. Provide U bolts, clamps, attachments, and other hardware necessary for hanger assembly and for securing hanger rods and conduits.
 3. Support parallel runs of horizontal raceways together on trapeze- or bracket-type hangers.
 4. Spare Capacity: Size supports for multiple conduits so capacity can be increased by a 25 percent minimum in the future.
 5. Support individual horizontal raceways with separate, malleable iron pipe hangers or clamps.
 6. Hanger Rods: 1/4-inch (6-mm) diameter or larger threaded steel, except as otherwise indicated.
 7. Spring Steel Fasteners: Specifically designed for supporting single conduits or tubing. May be used in lieu of malleable iron hangers for 1-1/2-inch (38-mm) and smaller raceways serving lighting and receptacle branch circuits above suspended ceilings and for fastening raceways to channel and slotted angle supports.

8. In vertical runs, arrange support so the load produced by the weight of the raceway and the enclosed conductors is carried entirely by the conduit supports, with no weight load on raceway terminals.
- C. Vertical Conductor Supports: Install simultaneously with conductors.
- D. In open overhead spaces, cast boxes threaded to raceways need not be separately supported, except where used for luminaire support; support sheet-metal boxes directly from the building structure or by bar hangers. Where bar hangers are used, attach the bar to raceways on opposite sides of the box and support the raceway with an approved fastener not more than 24 inches (610 mm) from the box.
- E. Fastening: Unless otherwise indicated, securely fasten electrical items and their supporting hardware to the building structure. Perform fastening according to the following:
 1. Fasten by means of machine screws, welded threaded studs, or spring-tension clamps on steel.
 2. Select fasteners so the load applied to any fastener does not exceed 25 percent of the proof-test load.

3.10 INSTALLATION OF CONDUCTORS AND CABLES

- A. Examination
 1. Examine raceways and building finishes to receive wires and cables for compliance with requirements for installation tolerances and other conditions affecting performance of wires and cables. Do not proceed with installation until unsatisfactory conditions have been corrected.
- B. Wire and Insulation Applications
 1. Branch Circuits:
 - a. General: Type THHN/THWN, copper conductor, in raceway.
 2. Branch Circuits:
 - a. General: Type THHN/THWN, copper conductor, in raceway.
 - b. Optional:
 - 1) Hospital Grade Armored Cable may be used only for lighting and convenience outlet wiring and only for those branches, applications, and areas which are not identified herein as exceptions. The exception branches and areas where AC cable is not acceptable are as follows:
 - a) Emergency branch circuits.
 - b) Life safety branch circuits.
 - c) Critical branch circuits
 - d) Emergency equipment branch circuits.
 - e) Exposed locations.
 - f) Mechanical, electrical, and boiler rooms.
 - g) Exterior and Sitework.
 - h) Wet and damp locations.
 - 2) If AC cable is utilized, branch circuit wiring for receptacles and lighting in areas with accessible suspended ceilings shall be installed in electric metallic tubing from panelboards to a junction box within the room served, above the suspended ceiling. Vertical AC cable shall be run for the junction box to the devices within the room. Horizontal cabling within the walls shall not be permitted. Where structural conditions and code rules permit and only when approved by the authority having jurisdiction, hospital grade No. 12 gauge armor-clad (AC) cable with a No. 12 insulated green ground wire

and with an internal bond wire may be used for all wiring within each room beyond the junction box mounted above the suspended ceiling. If AC cable is used, T&B insulated Tite-Bite connectors or equal shall be used, and wiring shall be installed in a neat and workmanlike manner.

- 3) AC cable shall be secured at intervals not exceeding 4-1/2 feet and within 12 inches of every outlet box or fitting. At all terminations, a fitting shall be provided to protect the conductors from abrasion. Approved insulating bushings shall be provided between the conductors and the armor. The connector or clamp by which the cable is fastened to boxes or cabinets shall be metal, of double lock-nut construction, UL approved for use with AC cable, and of such design that the insulating bushing will be visible for inspection. Internal box cable clamps are not acceptable.
3. Fire Alarm Circuits: Type THHN/THWN, in raceway.
4. Class 1 Control Circuits: Type THHN/THWN, in raceway.
5. Class 2 Control Circuits: Type THHN/THWN, in raceway.

C. Installation

1. Install wires and cables as indicated, according to manufacturer's written instructions and NECA's "Standard of Installation."
2. Remove existing wires from raceway before pulling in new wires and cables.
3. Pull Conductors: Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
4. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
5. Install exposed cables, parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
6. Support cables according to DIVISION 26 Sections.
7. Seal around cables penetrating fire-rated elements according to DIVISION 7 Section "Firestopping."
8. Identify wires and cables according to DIVISION 26 Section "Electrical Identification."

D. Connections

1. Conductor Splices: Keep to minimum.
2. Install splices and tapes that possess equivalent or better mechanical strength and insulation ratings than conductors being spliced.
3. Use splice and tap connectors compatible with conductor material.
4. Use oxide inhibitor in each splice and tap connector for aluminum conductors.
5. Wiring at Outlets: Install conductor at each outlet, with at least 12 inches (300 mm) of slack.
6. Connect outlets and components to wiring and to ground as indicated and instructed by manufacturer.
7. 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. Equipment Connections

1. Follow homerun circuit numbers on Drawings in connecting circuits to panelboards. If field observation shows that the indicated circuit numbers are not connected to the corresponding panel overcurrent device, make all corrections necessary. Each branch circuit homerun containing two or more circuits with a common neutral shall be connected to the circuit breaker or switch in a three- or four-wire branch circuit panelboard so that no two of the circuits will be fed from the same phase.

2. Provide all wiring to and between motors, starters, line voltage (120-600 volt) control devices, disconnect switches, and other related electrical equipment, except where such items are factory wired.
3. Terminate power wiring for elevator systems at the respective controller, and be in compliance with the manufacturer's approved shop drawings.
4. Provide power and wiring connections to the control devices for electrically operated overhead doors, door operators, and control devices which will be provided under other DIVISIONS.

F. Maximum Branch Circuit Lengths

1. The following indicates maximum installed length a circuit can have and still maintain an adequate voltage level at the last point of use. If the circuit length exceeds the length listed, use the next largest wire size. Multiple circuit runs in the same raceway shall have all conductors sized the same based on worst case circuit lengths.
2. The following table is based on copper conductors, 85% pf, and steel conduit.

CIRCUIT FEET (LENGTH – < 2% VOLTAGE DROP)						
WIRE SIZE (AMPS)	1-PHASE (1P CIRCUIT BREAKER)		1-PHASE (2P CIRCUIT BREAKER)		3-PHASE (3P CIRCUIT BREAKER)	
	120V	277V	208V	480V	208V	480V
#12 (20ACB-16A)	75' (2.0%)	175' (2.0%)	125' (1.9%)	300' (2.0%)	75' (1.9%)	175' (2.0%)
#10 (30ACB-24A)	75' (1.8%)	200' (2.0%)	150' (2.0%)	325' (1.9%)	85' (2.0%)	175' (1.8%)
#6 (50ACB-40A)			200' (1.88%)	450' (1.83%)	125' (2.0%)	275' (1.94%)
#6 (60ACB-48A)			175' (1.97%)	400' (1.96%)	100' (1.95%)	225' (1.9%)

G. Field Quality Control

1. Testing: On installation of wires and cables and before electrical circuitry has been energized, demonstrate product capability and compliance with requirements.
2. Procedures: Perform each visual and mechanical inspection and electrical test stated in NETA ATS, Section 7.3.1. Certify compliance with test parameters.
3. Correct malfunctioning conductors and cables at Project site, where possible, and retest to demonstrate compliance; otherwise, remove and replace with new units and retest.

3.11 INSTALLATION OF ELECTRICAL WIRING DEVICES

- A. Comply with NECA 1-2006, including the mounting heights listed in that standard, unless otherwise noted.
- B. Device Types:
 1. Hospital grade devices shall be provided as required.
 2. Tamper resistant devices shall be provided in all common areas and pediatric patient care areas.
 3. GFCI devices shall be provided for all devices within 6' of the rim of sinks.
- C. Coordination with Other Trades:

1. Take steps to insure that devices and their boxes are protected. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of the boxes.
2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
4. Install wiring devices after all wall preparation, including painting, is complete.

D. Conductors:

1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
4. Existing Conductors:
 - a. Cut back and pigtail, or replace all damaged conductors.
 - b. Straighten conductors that remain and remove corrosion and foreign matter.
 - c. Pigtailling existing conductors is permitted provided the outlet box is large enough.

E. Device Installation:

1. Replace all devices that have been in temporary use during construction or that show signs that they were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches (152 mm) in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by the manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.

F. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles **up**, and on horizontally mounted receptacles to the **right**.
2. Install hospital-grade receptacles in patient-care areas with the ground pin or neutral blade at the top.

- G. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

- H. Dimmers:
 - 1. Install dimmers within terms of their listing.
 - 2. Verify that dimmers used for fan speed control are listed for that application.
 - 3. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device listing conditions in the written instructions.

- I. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

- J. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

- K. Identification
 - 1. Comply with Division 26 Section "Identification for Electrical Systems."

 - 2. Receptacles: Identify panelboard and circuit number from which served. Use hot, stamped or engraved machine printing with **[black]** **[white]** **[red]**-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

- L. Field Quality Control
 - 1. Perform tests and inspections and prepare test reports.
 - a. In healthcare facilities, prepare reports that comply with recommendations in NFPA 99.
 - b. Test Instruments: Use instruments that comply with UL 1436.
 - c. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated LED indicators of measurement.
 - 2. Tests for Convenience Receptacles:
 - a. Line Voltage: Acceptable range is 105 to 132 V.
 - b. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is not acceptable.
 - c. Ground Impedance: Values of up to 2 ohms are acceptable.
 - d. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
 - e. Using the test plug, verify that the device and its outlet box are securely mounted.
 - f. The tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.
 - 3. Test straight blade hospital-grade convenience outlets for the retention force of the grounding blade according to NFPA 99. Retention force shall be not less than 4 oz. (115 g).

3.12 INSTALLATION OF RACEWAYS AND BOXES

- A. Examine surfaces to receive raceways, boxes, enclosures, and cabinets for compliance with installation tolerances and other conditions affecting performance of raceway installation. Do not proceed with installation until unsatisfactory conditions have been corrected.

- B. Wiring Methods
 - 1. Outdoors: Use the following wiring methods:
 - a. Exposed: RMC or IMC.
 - b. Concealed: RMC or IMC.

- c. Underground, Single Run: RNC.
 - d. Underground, Grouped: RNC.
 - e. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
 - f. Boxes and Enclosures: NEMA 250, Type 3R or Type 4.
2. Indoors: Use the following wiring methods:
- a. Exposed: EMT.
 - b. Concealed: EMT.
 - c. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC; except in wet or damp locations, use LFMC.
 - d. Damp or Wet Locations: RMC.
 - e. Boxes and Enclosures: NEMA 250, Type 1, except as follows:
 - 1) Damp or Wet Locations: NEMA 250, Type 4, stainless steel.
 - 2) Damp or Wet Locations: NEMA 250, Type 4, nonmetallic.

C. Installation

1. Install raceways, boxes, enclosures, and cabinets as indicated, according to manufacturer's written instructions.
2. Minimum Raceway Size: 3/4-inch trade size (DN21).
3. Conceal conduit and EMT, unless otherwise indicated, within finished walls and ceilings.
4. Keep raceways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
5. Install raceways level and square and at proper elevations. Provide adequate headroom.
6. Complete raceway installation before starting conductor installation.
7. Support raceways as specified in DIVISION 26.
8. Use temporary closures to prevent foreign matter from entering raceways.
9. Protect stub-ups from damage where conduits rise through floor slabs. Arrange so curved portion of bends is not visible above the finished slab.
10. Make bends and offsets so ID is not reduced. Keep legs of bends in the same plane and straight legs of offsets parallel, unless otherwise indicated.
11. Use raceway fittings compatible with raceways and suitable for use and location. For intermediate steel conduit, use threaded rigid steel conduit fittings, unless otherwise indicated.
12. Run concealed raceways, with a minimum of bends, in the shortest practical distance considering the type of building construction and obstructions, unless otherwise indicated.
13. Raceways Embedded in Slabs (Not Permitted Without Explicit, Written Directive From Owner, Architect Or Engineer): Install in middle third of slab thickness where practical, and leave at least 1-inch (25-mm) concrete cover.
 - a. Secure raceways to reinforcing rods to prevent sagging or shifting during concrete placement.
 - b. Space raceways laterally to prevent voids in concrete.
 - c. Run conduit larger than 1-inch trade size (DN27) parallel to or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.
 - d. Transition from nonmetallic tubing to Schedule 80 nonmetallic conduit, rigid steel conduit, or IMC before rising above floor.
14. Install exposed raceways parallel to or at right angles to nearby surfaces or structural members, and follow the surface contours as much as practical.
 - a. Run parallel or banked raceways together, on common supports where practical.
 - b. Make bends in parallel or banked runs from same centerline to make bends parallel. Use factory elbows only where elbows can be installed parallel; otherwise, provide field bends for parallel raceways.
15. Join raceways with fittings designed and approved for the purpose and make joints tight.

- a. Make raceway terminations tight. Use bonding bushings or wedges at connections subject to vibration. Use bonding jumpers where joints cannot be made tight.
- b. Use insulating bushings to protect conductors.
16. Tighten set screws of threadless fittings with suitable tools.
17. Terminations: Where raceways are terminated with locknuts and bushings, align raceways to enter squarely and install locknuts with dished part against the box. Where terminations are not secure with 1 locknut, use 2 locknuts: 1 inside and 1 outside the box.
18. Where raceways are terminated with threaded hubs, screw raceways or fittings tightly into the hub so the end bears against the wire protection shoulder. Where chase nipples are used, align raceways so the coupling is square to the box and tighten the chase nipple so no threads are exposed.
19. Install pull wires in empty raceways. Use No. 14 AWG zinc-coated steel or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of the pull wire.
20. Telephone and Signal System Raceways, 2-Inch Trade Size (DN53) and Smaller: In addition to the above requirements, install raceways in maximum lengths of 150 feet (45 m) and with a maximum of two 90-degree bends or equivalent. Separate lengths with pull or junction boxes where necessary to comply with these requirements.
21. Install raceway sealing fittings according to manufacturer's written instructions. Locate fittings at suitable, approved, and accessible locations and fill them with UL-listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:
 - a. Where conduits pass from warm to cold locations, such as the boundaries of refrigerated spaces.
 - b. Where otherwise required by NFPA 70.
22. Stub-up Connections (Not Permitted Without Explicit, Written Directive From Owner, Architect Or Engineer): Extend conduits through concrete floor for connection to freestanding equipment. Install with an adjustable top or coupling threaded inside for plugs set flush with the finished floor. Extend conductors to equipment with rigid steel conduit; FMC may be used 6 inches (150 mm) above the floor. Install screwdriver-operated, threaded flush plugs flush with floor for future equipment connections.
23. Flexible Connections: Use maximum of 6 feet (1830 mm) of FMC for recessed and semirecessed luminaires; for equipment subject to vibration, noise transmission, or movement; and for all motors. Use LFMC in wet or damp locations. Install separate ground conductor across flexible connections.
24. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in a nonmetallic sleeve.
25. Do not install aluminum conduits embedded in or in contact with concrete.
26. PVC Externally Coated, Rigid Steel Conduits: Use only fittings approved for use with that material. Patch all nicks and scrapes in PVC coating after installing conduits.
27. Surface Raceways: Install a separate, green, ground conductor in raceways from junction box supplying the raceways to receptacle or luminaire ground terminals.
 - a. Select each surface raceway outlet box, to which a luminaire is attached, of sufficient diameter to provide a seat for the luminaire canopy.
 - b. Where a surface raceway is used to supply a fluorescent luminaire having central-stem suspension with a backplate and a canopy (with or without extension ring), no separate outlet box is required.
 - c. Provide surface metal raceway outlet box, and the backplate and canopy, at the feed-in location of each fluorescent luminaire having end-stem suspension.
 - d. Where a surface metal raceway extension is made from an existing outlet box on which a luminaire is installed, no additional surface-mounted outlet box is required. Provide a backplate slightly smaller than the luminaire canopy.

28. Set floor boxes level and adjust to finished floor surface.
29. Install hinged-cover enclosures and cabinets plumb. Support at each corner.
30. Raceways for medical equipment vendor cabling shall be coordinated with the medical equipment vendor for exact length, routing and configuration.

D. Protection

1. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure coatings, finishes, and cabinets are without damage or deterioration at the time of Substantial Completion.
 - a. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
 - b. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

E. Cleaning

1. On completion of installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finish, including chips, scratches, and abrasions.

3.13 INSTALLATION OF ELECTRICAL IDENTIFICATION

A. Install identification devices according to manufacturer's written instructions.

B. Install labels where indicated and at locations for best convenience of viewing without interference with operation and maintenance of equipment.

C. Lettering, Colors, and Graphics: Coordinate names, abbreviations, colors, and other designations used for electrical identification with corresponding designations used in the Contract Documents or required by codes and standards. Use consistent designations throughout the Project.

D. Sequence of Work: Where identification is to be applied to surfaces that require finish, install identification after completion of finish work.

E. Self-Adhesive Identification Products: Clean surfaces of dust, loose material, and oily films before applying.

F. Install painted identification as follows:

1. Clean surfaces of dust, loose material, and oily films before painting.
2. Prime Surfaces: For galvanized metal, use single-component, acrylic vehicle coating formulated for galvanized surfaces. For concrete masonry units, use heavy-duty, acrylic-resin block filler. For concrete surfaces, use clear, alkali-resistant, alkyd binder-type sealer.
3. Apply one intermediate and one finish coat of silicone alkyd enamel.
4. Apply primer and finish materials according to manufacturer's instructions.

G. Identify Raceways and Exposed Cables of Certain Systems with Color Banding: Band exposed and accessible raceways of the systems listed below for identification.

1. Bands: Pretensioned, snap-around, colored plastic sleeves; colored adhesive tape; or a combination of both. Make each color band 2 inches (51 mm) wide, completely encircling conduit, and place adjacent bands of 2-color markings in contact, side by side.
2. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot (15-m) maximum intervals in straight runs, and at 25 feet (7.6 m) in congested areas.

- 3. Colors: To match facility standards or as follows:
 - a. Fire-Alarm System: Red.
 - b. Fire-Suppression Supervisory and Control System: Red and yellow.
 - c. Combined Fire-Alarm and Security System: Red and blue.
 - d. Security System: Blue and yellow.
 - e. Mechanical and Electrical Supervisory System: Green and blue.
 - f. Telecommunications System: Green and yellow.

- H. Install Caution Signs for Enclosures Over 600 V: Use pressure-sensitive, self-adhesive label indicating system voltage in black, preprinted on orange field. Install on exterior of door or cover.

- I. Install Circuit Identification Labels on Boxes: Label externally as follows:
 - 1. Exposed Boxes: Pressure-sensitive, self-adhesive plastic label on cover.
 - 2. Concealed Boxes: Plasticized card-stock tags.
 - 3. Labeling Legend: Permanent, waterproof listing of panel and circuit number or equivalent.

- J. Color-Code Conductors: Secondary service, feeder, and branch circuit conductors throughout the secondary electrical system.
 - 1. Color code as follows:

208/120 volt	PHASE	480/277 volt
Black	A	Brown
Red	B	Orange
Blue	C	Yellow
White	Neutral	Gray
* or white with colored (other than green) tracer.		

- 2. Factory-apply color the entire length of the conductors, except the following field-applied, color-coding methods may be used in lieu of factory-coded wire for sizes larger than No. 10 AWG.
 - a. Colored, pressure-sensitive plastic tape in half-lapped turns for a distance of 6 inches (150 mm) from terminal points and in boxes where splices or taps are made. Apply the last 2 turns of tape with no tension to prevent possible unwinding. Use 1-inch- (25-mm-) wide tape in colors as specified. Adjust tape bands to avoid obscuring cable identification markings.
 - b. Colored cable ties applied in groups of 3 ties of specified color to each wire at each terminal or splice point starting 3 inches (76 mm) from the terminal and spaced 3 inches (76 mm) apart. Apply with a special tool or pliers, tighten to a snug fit, and cut off excess length.

- K. Device Coverplate Identification: Engrave with 1/8 inch high black capital letters designating as follows:
 - 1. All receptacle coverplates, both normal and emergency, shall be engraved with the following branch circuit source information:
 - a. Panelboard number.
 - b. Circuit number.
 - c. Example: "RLNIA - 5"
 - 2. Emergency NEMA 5-15R and 5-20R receptacle coverplates shall be engraved with the following branch circuit source information:

- a. "EMERGENCY".
 - b. Panelboard number.
 - c. Circuit number.
 - d. Example: "EMERGENCY"
 - e. "RLNIA - 5"
3. Other than NEMA 5-15R and 5-20R receptacle coverplates shall be engraved with the following:
 - a. Voltage
 - b. Number of phases.
 - c. Current rating.
 - d. Example: "208/3P/50A"
 4. Single outlet type NEMA 5-20R bed receptacle, tied to bedside headwall bedstop relay, shall be engraved "BED".
 5. Dialysis GFCI receptacle shall be engraved "DIALYSIS ONLY".
 6. Receptacles protected upstream on associated branch circuit by a ground fault circuit interrupter device shall be engraved "GFCI PROTECTED".
 7. Special systems/communication systems devices shall be engraved designating device (ie. FIREPHONE, DATA, EKG, TEL, TV, etc.)
- L. Power Circuit Identification: Use metal tags or aluminum wraparound marker bands for cables, feeders, and power circuits in vaults, pull boxes, junction boxes, manholes, and switchboard rooms.
1. Legend: 1/4-inch- (6.4-mm-) steel letter and number stamping or embossing with legend corresponding to indicated circuit designations.
 2. Fasten tags with nylon cable ties; fasten bands using integral ears.
- M. Apply identification to conductors as follows:
1. Conductors to Be Extended in the Future: Indicate source and circuit numbers.
 2. Multiple Power or Lighting Circuits in the Same Enclosure: Identify each conductor with source, voltage, circuit number, and phase. Use color coding for voltage and phase indication of secondary circuit.
 3. Multiple Control and Communications Circuits in the Same Enclosure: Identify each conductor by its system and circuit designation. Use a consistent system of tags, color coding, or cable marking tape.
- N. Apply warning, caution, and instruction signs and stencils as follows:
1. Install warning, caution, and instruction signs where indicated or required to ensure safe operation and maintenance of electrical systems and of items to which they connect. Install engraved, plastic-laminated instruction signs with approved legend where instructions or explanations are needed for system or equipment operation. Install butyrate signs with metal backing for outdoor items.
 2. Emergency-Operating Signs: Install engraved laminate signs with white legend on red background with minimum 3/8-inch- (9-mm-) high lettering for emergency instructions on power transfer, load shedding, and other emergency operations.
- O. Install identification as follows:
1. Apply equipment identification labels of engraved plastic laminate on each major unit of equipment, including central or master unit of each system. This includes communication, signal, and alarm systems, unless units are specified with their own self-explanatory identification. Except as otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high lettering on 1-1/2-inch- (38-mm-) high label; where 2 lines of text are required, use lettering 2 inches (51 mm) high. Use black lettering on white field. Apply labels for each unit of the following categories of equipment.
 - a. Panelboards, electrical cabinets, and enclosures.
 - b. Access doors and panels for concealed electrical items.

- c. Motor starters.
- d. Push-button stations.
- e. Transformers.
- 2. Apply designation labels of engraved plastic laminate for disconnect switches, breakers, push buttons, pilot lights, motor control centers, and similar items for power distribution and control components above, except panelboards and alarm/signal components where labeling is specified elsewhere.
 - a. Each panel and/or piece of equipment shall have an engraved nameplate for each section. Engraved nameplate shall include panel designation, voltage, phase, ampere rating of upstream feeder breaker or main circuit breaker, and designation of upstream panel or other device similar to:

PANEL L42
100 AMPERE, 480/277 VOLT, 3 PHASE, 4 WIRE
FED FROM PANEL D42

- b. Where panel is fed directly from an upstream transformer, nameplate shall be similar to:

PANEL D22
800 AMPERE, 208/120 VOLT, 3 PHASE, 4 WIRE,
FED FROM PANEL D42 VIA 225 kVA TRANSFORMER

- 3. Panelboards shall be provided with typewritten directories with plastic protector indicating circuit numbers, equipment served and room number of the area served. All room numbers used for directory cards shall be the room numbers assigned by the Owner and not necessarily room numbers indicated on the drawings. Coordinate all room numbers with Architect prior to final printing of directory cards. Directory cards shall be edited and maintained during the course of construction to keep an accurate, up to date record of each feeder or branch circuit.

3.14 INSTALLATION OF GROUNDING SYSTEMS

- A. General: Ground electrical systems and equipment according to NEC requirements, except where Drawings or Specifications exceed NEC requirements.
- B. Electrical Room Grounding Bus: Space 1 inch (25 mm) from wall and support from wall 6 inches (150 mm) above finished floor, except as otherwise indicated.
- C. Grounding Conductors: Route along the shortest and straightest paths possible, except as otherwise indicated. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- D. Bond interior metal piping systems and metal air ducts to equipment grounding conductors of associated pumps, fans, blowers, electric heaters, and air cleaners. Use braided-type bonding straps.
- E. Application
 - 1. Equipment Grounding Conductors: Comply with NEC Article 250 for types, sizes, and quantities of equipment grounding conductors, except where specific types, larger sizes, or more conductors than required by NEC are indicated.
 - a. Install equipment grounding conductor with circuit conductors for the items below in addition to those required by Code:

- 1) Feeders and branch circuits.
 - 2) Lighting circuits.
 - 3) Receptacle circuits.
 - 4) Single-phase motor or appliance branch circuits.
 - 5) Three-phase motor or appliance branch circuits.
 - 6) Flexible raceway runs.
 - 7) Armored and metal-clad cable runs.
- b. Busway Supply Circuits: Install separate equipment grounding conductor from the grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding-bar terminal on busway.
 - c. Nonmetallic Raceways: Install an equipment grounding conductor in nonmetallic raceways unless they are designated for telephone or data cables.
 - d. Air-Duct Equipment Circuits: Install an equipment grounding conductor to duct-mounted electrical devices operating at 120 V and above, including air cleaners and heaters. Bond conductor to each unit and to air duct.
2. Signal and Communication Systems: For telephone, alarm, voice and data, and other communication systems, provide a No. 4 AWG minimum insulated grounding conductor in raceway from grounding-electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.
 - a. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-2-by-12-inch (6-by-50-by-300-mm) grounding bus.
 - b. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.
 3. Separately Derived Systems: Where NEC requires grounding, ground according to NEC Paragraph 250-26.

F. Connections

1. General: Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.
 - a. Use electroplated or hot-tin-coated materials to assure high conductivity and to make contact points closer in order of galvanic series.
 - b. Make connections with clean, bare metal at points of contact.
 - c. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
 - d. Make aluminum-to-galvanized steel connections with tin-plated copper jumpers and mechanical clamps.
 - e. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.
2. Equipment Grounding-Wire Terminations: For No. 8 AWG and larger, use pressure-type grounding lugs. No. 10 AWG and smaller grounding conductors may be terminated with winged pressure-type connectors.
3. Noncontact Metal Raceway Terminations: Where metallic raceways terminate at metal housings without mechanical and electrical connection to housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to grounding bus or terminal in housing. Bond electrically noncontinuous conduits at both entrances and exits with grounding bushings and bare grounding conductors, except as otherwise indicated.
4. Tighten screws and bolts for grounding and bonding connectors and terminals according to manufacturer's published torque-tightening values. Where these requirements are not available, use those specified in UL 486A and UL 486B.
5. Compression-Type Connections: Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Use tools and dies recommended by manufacturer of connectors. Provide embossing die code or other standard method to

make a visible indication that a connector has been adequately compressed on grounding conductor.

6. Moisture Protection: Where insulated grounding conductors are connected to grounding rods or grounding buses, insulate entire area of connection and seal against moisture penetration of insulation and cable.

3.15 INSTALLATION OF PANELBOARDS

- A. Install panelboards and accessory items according to NEMA PB 1.1.
- B. Mounting Heights: Top of trim 74 inches (1880 mm) above finished floor, unless otherwise indicated.
- C. Mounting: Plumb and rigid without distortion of box. Mount flush panelboards uniformly flush with wall finish.
- D. Circuit Directory: Type directory to indicate installed circuit loads after balancing panelboard loads. Obtain approval before installing.
 1. Circuit Numbering: Number each pole permanently using the convention of odd numbers on the left, even numbers on the right. Utilize manufacturer's self-adhering number stickers or if not available provide self-adhering number stickers from Brady, Panduit, Ideal or equal. Hand-written numbering is not acceptable.
- E. Install filler plates in unused spaces.
- F. Provision for Future Circuits at Flush Panelboards: Stub four 1-inch (27-RMC) empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch (27-RMC) empty conduits into raised floor space or below slab not on grade.
- G. Wiring in Panelboard Gutters: Arrange conductors into groups, and bundle and wrap with wire ties after completing load balancing.
- H. Identification
 1. Identify field-installed wiring and components and provide warning signs as specified in DIVISION 26 Section "Electrical Identification."
 2. Panelboard Nameplates: Label each panelboard with engraved laminated-plastic or metal nameplates mounted with corrosion-resistant screws.
- I. Grounding
 1. Make equipment grounding connections for panelboards as indicated.
 2. Provide ground continuity to main electrical ground bus as indicated.
- J. Connections
 1. Tighten electrical connectors and terminals, including grounding connections, according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- K. Field Quality Control
 1. Prepare for acceptance tests as follows:
 - a. Make insulation-resistance tests of each panelboard bus, component, and connecting supply, feeder, and control circuits.
 - b. Make continuity tests of each circuit.

2. Testing: After installing panelboards and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.
 - a. Procedures: Perform each visual and mechanical inspection and electrical test stated in NETA ATS, Section 7.5 for switches and Section 7.6 for molded-case circuit breakers. Certify compliance with test parameters.
 - b. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, remove and replace with new units, and retest.
3. Balancing Loads: After Substantial Completion, but not more than 2 months after Final Acceptance, conduct load-balancing measurements and make circuit changes as follows:
 - a. Perform measurements during period of normal working load as advised by Owner.
 - b. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility. Make special arrangements with Owner to avoid disrupting critical 24-hour services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
 - c. Recheck loads after circuit changes during normal load period. Record all load readings before and after changes and submit test records.
 - d. Tolerance: Difference exceeding 20 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as required to meet this minimum requirement.
4. Infrared Scanning: After Substantial Completion, but not more than 2 months after Final Acceptance, perform an infrared scan of each panelboard. Remove fronts to make joints and connections accessible to a portable scanner.
 - a. Follow-up Infrared Scanning: Perform an additional follow-up infrared scanning of each panelboard 11 months after date of Substantial Completion.
 - b. Instrument: Use an approved infrared scanning device designed to measure temperature or detect significant deviations from normal values. Provide calibration record for device used.
 - c. Record of Infrared Scanning: Prepare a certified report identifying panelboards checked and describing results of scanning. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

L. Adjusting

1. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

M. Cleaning

1. On completion of installation, inspect interior and exterior of panelboards. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish.

3.16 INSTALLATION OF INTERIOR LIGHTING

- A. Set units plumb, square, and level with ceiling and walls, and secure according to manufacturer's written instructions and approved Shop Drawings. Support luminaires according to requirements of DIVISION 26.
- B. Support for Recessed and Semirecessed Grid-Type Fluorescent Luminaires: Units may not be supported from suspended ceiling support system. Install support system rods or wires at a minimum of 4 rods or wires for each luminaire, located not more than 6 inches (150 mm) from luminaire corners.
 1. Install support clips for recessed luminaires, securely fastened to ceiling grid members, at or near each luminaire corner.

2. Luminaires Smaller than Ceiling Grid: Install a minimum of 4 rods or wires for each luminaire and locate at corner of ceiling grid where luminaire is located. Do not support luminaires by ceiling acoustical panels.
 3. Luminaires of Sizes Less than Ceiling Grid: Center in acoustical panel. Support luminaires independently with at least two 3/4-inch (20-mm) metal channels spanning and secured to ceiling tees.
- C. Support for Suspended Luminaires: Brace pendants and rods over 48 inches (1200 mm) long to limit swinging. Support stem-mounted, single-unit, suspended fluorescent luminaires with twin-stem hangers. For continuous rows, use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of chassis, including one at each end.
- D. Air-Handling Luminaires: Install with dampers closed.
- E. Lamping: Where specific lamp designations are not indicated, lamp units according to manufacturer's instructions.
- F. Emergency Fluorescent Power Supply Unit:
1. Each unit shall have a constant-hot connection in addition to any switch legs. This unswitched conductor shall be connected to the same branch circuit as the luminaires.
- G. Connections
1. Ground lighting units. Tighten electrical connectors and terminals, including grounding connections, according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- H. Field Quality Control
1. Inspect each installed luminaire for damage. Replace damaged luminaires and components.
 2. Give advance notice of dates and times for field tests.
 3. Provide instruments to make and record test results.
 4. Tests: Verify normal operation of each luminaire after luminaires have been installed and circuits have been energized with normal power source. Interrupt electrical energy to demonstrate proper operation of emergency lighting installation. Include the following information in tests of emergency lighting equipment:
 - a. Duration of supply.
 - b. Low battery voltage shutdown.
 - c. Normal transfer to battery source and retransfer to normal.
 - d. Low supply voltage transfer.
 5. Replace or repair malfunctioning luminaires and components, then retest. Repeat procedure until all units operate properly.
 6. Report results of tests.
 7. Replace luminaires that show evidence of corrosion during Project warranty period.
- I. Adjusting and Cleaning
1. Clean luminaires after installation. Use methods and materials recommended by manufacturer.
 2. Adjust aimable luminaires to provide required light intensities.

3.17 INSTALLATION OF RACEWAY SUPPORT SYSTEMS

- A. Furnish and install the trunk riser raceways, outlet box, and outlet box raceways as shown on Drawings and specified.
- B. Stub trunk riser and homerun outlet box raceways to load cable tray system, or to nearest accessible CORRIDOR ceiling.
- C. Raceways and conduits
 1. Minimum outlet box conduit size shall be 1".
 2. No section of conduit shall contain more than two 90 degree bends between pull points. If this requirement cannot be met, an appropriately sized pull box shall be provided after the 2nd 90 degree bend (reference Section 4.4.2.3.1 of the TIA/EIA-569 standard).
 3. Provide the shortest and most direct conduit and raceway routing path for each drop to the cable tray. Coordinate routing of raceways for each drop to ensure that the maximum length does not exceed 295' (length is measured from patch panel to outlet).
 4. Install bell-cap type bushing at termination point adjacent to cable tray.
 5. Install pullstrings in all raceways.
 6. All Telecommunications pathways shall be bonded as per ANSI/TIA/EIA-607(A) Standards, and in conjunction with NEC requirements. Refer to grounding section of these specifications for additional information and requirements.
 7. All sleeves and conduits shall have grounding bushings.
 8. All grounding conductors shall be insulated, no bare copper cables shall be permitted.
 9. All grounding conductors shall have dedicated pathways through walls, ceiling, etc. and shall not be permitted to share the same penetration pathway with communication cabling.
- D. Access panels shall be installed for raceways in hard ceilings, with a maximum distance between panels of 10'-0".
- E. Device heights shall be as indicated on Architectural drawings. Standard device heights above finished floor shall be as follows;
 1. Outlet device: 18"
 2. Wall phone: 54"
 3. Wireless outlet: 7'-0"
- F. Install telephone raceways to within six inches of telephone backboards.
- G. Paint telephone backboards with two coats of gray, fire resistant enamel paint on all sides. Provide 1/2" spacers between wall and backboards. Install 120 volt receptacle on the lower left corner of backboard.
- H. Furnish and install 200 pound test, braided nylon pull-cords in all empty conduits.
- I. Mark each conduit end for identification and destination of raceway.
- J. Provide system (identifying nameplate centered on main trunk riser boxes and cabinets (ie. TEL, DATA, CCTV, etc.).
- K. Coordination
 1. Comply with all requirements of the Owner's representative for all raceways, boxes, cover plates, etc., and their specific installation considerations.
 2. Consult with Owner's representative prior to installation to determine special device plate and raceway requirements for the following communication/special systems:

- a. Broadcast Television
- b. Building Automation
- c. Central Dictating
- d. Closed Circuit Television
- e. Data Processing
- f. Internal Telephone
- g. Local Area Network
- h. Personnel Register/Silent Page
- i. Physiological Monitoring
- j. Public Telephone
- k. Radio Transmission
- l. Security

3.18 INSTALLATION OF FIRE ALARM SYSTEMS

- A. Manual Pull Stations: Mount semiflush in recessed back boxes with operating handles 48 inches (1220 mm) above the finished floor or lower as indicated.
- B. Water-Flow Detectors and Valve Supervisory Switches: Connect for each sprinkler valve station required to be supervised.
- C. Smoke Detectors: Install ceiling-mounted detectors not less than 4 inches (100 mm) from a side wall to the near edge. Install detectors located on the wall at least 4 inches (100 mm), but not more than 12 inches (300 mm), below the ceiling. For exposed solid-joist construction, mount detectors on the bottom of the joists. On smooth ceilings, install detectors not over 30 feet (9 m) apart in any direction. Install detectors no closer than 60 inches (1520 mm) from air registers.
- D. Audible Alarm-Indicating Devices: Install not less than 90 inches (2280 mm) above the finished floor nor less than 6 inches (150 mm) below the ceiling. Install bells and horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille or as indicated. Combine audible and visual alarms at the same location into a single unit.
- E. Visual Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and not more than 80 inches (2030 mm) above the finished floor and at least 6 inches (150 mm) below the ceiling.
- F. Device Location-Indicating Lights: Locate in public space near the device they monitor.
- G. Install system according to NFPA standards referenced in Parts 1 and 2 of this Section.
- H. Fire Alarm Power Supply Disconnect: Paint red and label "FIRE ALARM." Provide with lockable handle or cover.
- I. Wiring Installation
 - 1. Wiring Method: Install wiring in metal raceway according to DIVISION 26 Section "Raceways, Boxes, and Cabinets." Conceal raceway except in unfinished spaces and as indicated.
 - 2. Wiring within Enclosures: Install conductors parallel with or at right angles to the sides and back of the enclosure. Bundle, lace, and train the conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with the fire alarm system to terminal blocks. Mark each terminal

according to the system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.

3. Cable Taps: Use numbered terminal strips in junction, pull or outlet boxes, cabinets, or equipment enclosures where circuit connections are made.
4. Color Coding: Color-code fire alarm conductors differently from the normal building power wiring. Use one color code for alarm circuit wiring and a different color code for supervisory circuits. Color-code audible alarm-indicating circuits differently from alarm-initiating circuits. Use different colors for visual alarm-indicating devices. Paint fire alarm system junction boxes and covers red.
5. Risers: Install at least 2 vertical cable risers to serve the fire alarm system. Separate risers in close proximity to each other with a minimum one-hour-rated wall, so the loss of one riser does not prevent the receipt or transmission of signal from other floors or zones.

J. Identification

1. Identify system components, wiring, cabling, and terminals according to DIVISION 26 Section "Electrical Identification."

K. Grounding

1. Ground cable shields and equipment according to system manufacturer's instructions to eliminate shock hazard and to minimize, to the greatest extent possible, ground loops, common mode returns, noise pickup, cross talk, and other impairments.
2. Signal Ground Terminal: Locate at main equipment rack or cabinet. Isolate from power system and equipment grounding.
3. Install grounding electrodes of type, size, location, and quantity as indicated. Comply with installation requirements of DIVISION 26 Section "Grounding."
4. Ground equipment and conductor and cable shields. For audio circuits, minimize, to the greatest extent possible, ground loops, common mode returns, noise pickup, cross talk, and other impairments. Provide 5-ohm ground at main equipment location. Measure, record, and report ground resistance.

L. Field Quality Control

1. Manufacturer's Field Service: Provide services of a factory-authorized service representative to supervise the field assembly and connection of components and the pretesting, testing, and adjustment of the system.
2. Pretesting: After installation, align, adjust, and balance the system and perform complete pretesting. Determine, through pretesting, the conformance of the system to the requirements of the Drawings and Specifications. Correct deficiencies observed in pretesting. Replace malfunctioning or damaged items with new ones and retest until satisfactory performance and conditions are achieved. Prepare forms for systematic recording of acceptance test results.
3. Report of Pretesting: After pretesting is complete, provide a letter certifying the installation is complete and fully operable, including the names and titles of the witnesses to the preliminary tests.
4. Final Test Notice: Provide a 10-day minimum notice in writing when the system is ready for final acceptance testing.
5. Minimum System Tests: Test the system according to the procedures outlined in NFPA 72. Minimum required tests are as follows:
 - a. Verify the absence of unwanted voltages between circuit conductors and ground.
 - b. Test all conductors for short circuits using an insulation-testing device.
 - c. With each circuit pair, short circuit at the far end of the circuit and measure the circuit resistance with an ohmmeter. Record the circuit resistance of each circuit on the record drawings.
 - d. Verify that the control unit is in the normal condition as detailed in the manufacturer's operation and maintenance manual.

- e. Test initiating and indicating circuits for proper signal transmission under open circuit conditions. One connection each should be opened at not less than 10 percent of the initiating and indicating devices. Observe proper signal transmission according to class of wiring used.
 - f. Test each initiating and indicating device for alarm operation and proper response at the control unit. Test smoke detectors with actual products of combustion.
 - g. Test the system for all specified functions according to the approved operation and maintenance manual. Systematically initiate specified functional performance items at each station, including making all possible alarm and monitoring initiations and using all communications options. For each item, observe related performance at all devices required to be affected by the item under all system sequences. Observe indicating lights, displays, signal tones, and annunciator indications. Observe all voice audio for routing, clarity, quality, freedom from noise and distortion, and proper volume level.
 - h. Test Both Primary and Secondary Power: Verify by test that the secondary power system is capable of operating the system for the period and in the manner specified.
6. Retesting: Correct deficiencies indicated by tests and completely retest work affected by such deficiencies. Verify by the system test that the total system meets the Specifications and complies with applicable standards.
 7. Report of Tests and Inspections: Provide a written record of inspections, tests, and detailed test results in the form of a test log. Submit log upon the satisfactory completion of tests.
 8. Tag all equipment, stations, and other components at which tests have been satisfactorily completed.

M. Cleaning And Adjusting

1. Cleaning: Remove paint splatters and other spots, dirt, and debris. Touch up scratches and marred finish to match original finish. Clean unit internally using methods and materials recommended by manufacturer.

N. Demonstration

1. Startup Services: Engage a factory-authorized service representative to provide startup service and to demonstrate and train Owner's maintenance personnel as specified below.
 - a. Train Owner's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing, adjusting, and preventive maintenance. Provide a minimum of 8 hours' training.
 - b. Training Aid: Use approved operation and maintenance manual material as an instructional aid. Refer to DIVISION 1 Section "Contract Closeout." Provide copies of this material for use in the instruction in both hard copy and DVD format.
 - c. Schedule training with Owner with at least 7 days' advance notice.

O. On-Site Assistance

1. Occupancy Adjustments: When requested within one year of date of Substantial Completion, provide on-site assistance in adjusting sound levels, controls, and sensitivities to suit actual occupied conditions. Provide up to 3 requested adjustment visits to the site for this purpose.

3.19 INSTALLATION OF VIBRATION ISOLATION AND SEISMIC RESTRAINT

A. General

1. Isolation 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. Seismic Restraints

1. Installation

- a. All floor mounted equipment whether isolated or not shall be snubbed, anchored, bolted or welded to the structure. Calculations that determine that isolated equipment movement may be less than the operating clearance of snubbers (restraints) do not preclude the need for snubbers. All equipment must be positively attached to the structure.
 - b. All suspended equipment including, but not limited to transformers, etc. shall be two or four point independently braced with TYPE III restraints. Install cable braces taut for non-isolated equipment and slack with ½" cable deflection for isolated equipment. Rod bracing shall be installed as per approved submittals and shop drawings. Equipment connected to ductwork weighing less than 75 lbs. is excluded.
 - c. All horizontally suspended cable trays, bus duct and conduit shall use RESTRAINT TYPE III. Spacing of seismic bracing shall be as per TABLE B at the end of this section.
 - d. For all trapeze-supported conduit, the individual conduits must be transversely and vertically attached to the trapeze support at the designated restraint locations.
 - e. For overhead supported equipment, over stress of the building structure must not occur. Bracing may occur from:
 - 1) Flanges of structural beams.
 - 2) Upper truss chords in bar joists.
 - 3) Cast in place inserts or drilled and shielded inserts in concrete structures.
 - f. Conduit Risers
 - 1) Where conduits pass through cored holes, holes must be packed with resilient material or fire stop as specified in other sections of this specification and/or state and local codes. No additional horizontal seismic bracing is required at these locations.
 - g. Luminaires such as panel light shall be attached to lay-in ceilings with earthquake clips or other approved means of positive attachment to the T- bar ceiling structure.
 - h. A rigid conduit, cable tray or bus duct system shall not be braced to dissimilar parts of a building or two dissimilar building systems that may respond in a different mode during an earthquake. Examples: Wall and roof; solid concrete wall and a metal deck with lightweight concrete fill, conduit that crosses a building expansion joint.
2. Exclusions from seismic requirements on non life safety equipment:
 - a. All conduit less than 2-1/2" diameter.
 - b. All clevis or single level trapeze supported conduit, cable tray or bus duct suspended by hangers with positive attachment to the structure that are less than 12 inches in length as measured from the top of the conduit, cable tray or bus duct to the point of attachment to the structure. If any hanger in the run exceeds the 12" limit, seismic bracing is required for the run.
 3. Exclusions from seismic requirements on life safety equipment.
 - a. None

C. 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 REQUIREMENTS FOR ELECTRICAL EQUIPMENT			EQUIPMENT INSTALLATION ATTACHMENT POINT						
			ON GRADE			ABOVE GRADE			
EQUIPMENT	SIZE	MOUNTING	ISOL	DEFL	BASE	ISOL	DEFL	BASE	
GENERAL PURPOSE TRANSFORMERS – DRY TYPE	ALL	FLOOR	D	0.30	- -	D	0.30	- -	
		CEILING	E	0.30	- -				E
GENERATORS	ALL	FLOOR	B	0.75	- -	B	1.50	- -	
UPS	Over 15 Kva	FLOOR	D	0.30	B-1	B	0.75	B-1	

TABLE B SEISMIC BRACING TABLE		
EQUIPMENT	ON CENTER SPACING	
	TRANSVERSE	LONGITUDINAL
CONDUIT	40 Feet	80 Feet
BUS DUCT	30 Feet	60 Feet
CABLE TRAY	40 Feet	80 Feet

NOTE WELL

(1) Projects that contain large concentrations of conduit 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.

3.20 TOUCHUP PAINTING

- A. Thoroughly clean damaged areas and provide primer, intermediate, and finish coats to suit the degree of damage at each location.
- B. Follow paint manufacturer's written instructions for surface preparation and for timing and application of successive coats.

END OF SECTION 26 00 00