

PROJECT MANUAL FOR
PATRONS INSURANCE OFFICE
Off Rand Road
Portland, Maine

Construction Documents
14 January 2016

ARCHITECT

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75 York Street
Portland, Me 04101

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By Construction Manager

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SECTION 011000 - SUMMARY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Project information.
 - 2. Work covered by Contract Documents.
 - 3. Access to site.
 - 4. Coordination with occupants.
 - 5. Work restrictions.
 - 6. Specification and drawing conventions.

1.3 PROJECT INFORMATION

- A. Project Identification: Patron's Oxford Offices.
 - 1. Project Location: Portland Technology Park, Rand Road, Portland, Maine.
- B. Architect Identification: The Contract Documents were prepared for Project by Scott Simons Architects, 75 York Street, Portland, ME.
- C. Construction Manager: Zachau Construction, 1185 U.S. Rt. 1, Freeport, ME 04032.
 - 1. Construction Manager for this Project is Project's constructor. The terms "Construction Manager" and "Contractor" are synonymous.

1.4 WORK COVERED BY CONTRACT DOCUMENTS

- A. The Work of Project is defined by the Contract Documents and consists of the following:
 - 1. The Work involves the construction of a new Office Building at location indicated on Drawings. Work includes but is not limited, to demolition, earthwork, site utilities and site improvements, paving, and landscaping. Work also includes concrete foundations and slab-on-grade, wood structure, glue-laminated posts and beams, cross laminated decking, EPDM roof membrane system, sheet metal, wood stud partitions, insulation, gypsum board walls and ceilings, ceramic tile, acoustical ceilings, resilient athletic flooring, carpeting, custom cabinets and fixtures, carpentry, glass storefront system, painting, metal doors, wood doors, metal frames, door hardware, toilet partitions and

accessories, signage, fire alarm systems, security systems, electrical, and heating, ventilating, and air conditioning complete and ready for use.

1.5 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.
- B. General: Contractor shall have limited use of Project site for construction operations as indicated on Drawings by the Contract limits and as indicated by requirements of this Section.
- C. Use of Site: Limit use of Project site to areas within the Contract limits indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.
 - 1. Driveways, Walkways and Entrances: Keep driveways and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or storage of materials.
 - a. Schedule deliveries to minimize use of driveways and entrances by construction operations.
 - b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.

1.6 WORK RESTRICTIONS

- A. Work Restrictions, General: Comply with restrictions on construction operations.
 - 1. Comply with limitations on use of public streets and with other requirements of authorities having jurisdiction.
- B. On-Site Work Hours: Work shall be generally performed during normal business working hours of 7:00 a.m. to 5:00 p.m., Monday through Friday, except otherwise indicated.
 - 1. Weekend Hours: As approved by Architect and Owner.
 - 2. Early Morning Hours: As approved by Architect and Owner.
 - 3. Hours for Utility Shutdowns: As approved by Architect and Owner.
 - 4. Provide 24 hour notice to Architect when performing work other than normal working hours.
- C. Nonsmoking Building: Smoking is not permitted within the building or within 25 feet of entrances, operable windows, or outdoor-air intakes.

1.7 SPECIFICATION AND DRAWING CONVENTIONS

- A. Specification Format: The Specifications are organized into Divisions and Sections using the 33-division format and CSI's "2004 MasterFormat" numbering system.

1. Section Identification: The Specifications use Section numbers and titles to help cross-referencing in the Contract Documents. Sections in the Project Manual are in numeric sequence; however, the sequence is incomplete because all available Section numbers are not used. Consult the table of contents at the beginning of the Project Manual to determine numbers and names of Sections in the Contract Documents.
 2. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.
- B. 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. Specification requirements are to be performed by Contractor unless specifically stated otherwise.
- C. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. One or more of the following are used on Drawings to identify materials and products:
1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
 2. Abbreviations: Materials and products are identified by abbreviations published as part of the U.S. National CAD Standard and scheduled on Drawings.
 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

SECTION 012100 - ALLOWANCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements governing allowances.
 - 1. Certain items are specified in the Contract Documents by allowances. Allowances have been established in lieu of additional requirements and to defer selection of actual materials and equipment to a later date when direction will be provided to Contractor. If necessary, additional requirements will be issued by Change Order.
 - 2. Include the cost of allowances in the contract bid price.
- B. Types of allowances include the following:
 - 1. Unit cost allowances.
- C. Related Sections:
 - 1. Refer to Section 260100 "Basic Electrical Requirement" for allowances to be carried under electrical work.

1.3 SELECTION AND PURCHASE

- A. At the earliest practical date after award of the Contract, advise Architect of the date when final selection and purchase of each product or system described by an allowance must be completed to avoid delaying the Work.
- B. At Architect's request, obtain proposals for each allowance for use in making final selections. Include recommendations that are relevant to performing the Work.
- C. Purchase products and systems selected by Architect from the designated supplier.

1.4 ACTION SUBMITTALS

- A. Submit proposals for purchase of products or systems included in allowances, in the form specified for Change Orders.

1.5 INFORMATIONAL SUBMITTALS

- A. Submit invoices or delivery slips to show actual quantities of materials delivered to the site for use in fulfillment of each allowance.
- B. Submit time sheets and other documentation to show labor time and cost for installation of allowance items that include installation as part of the allowance.
- C. Coordinate and process submittals for allowance items in same manner as for other portions of the Work.

1.6 COORDINATION

- A. Coordinate allowance items with other portions of the Work. Furnish templates as required to coordinate installation.

1.7 ADJUSTMENT OF ALLOWANCES

- A. Allowance Adjustment: To adjust allowance amounts, prepare a Change Order proposal based on the difference between purchase amount and the allowance, multiplied by final measurement of work-in-place where applicable. If applicable, include reasonable allowances for cutting losses, tolerances, mixing wastes, normal product imperfections, and similar margins.
 - 1. Include installation costs in purchase amount only where indicated as part of the allowance.
 - 2. If requested, prepare explanation and documentation to substantiate distribution of overhead costs and other margins claimed.
 - 3. Submit substantiation of a change in scope of work, if any, claimed in Change Orders related to unit-cost allowances.
 - 4. Owner reserves the right to establish the quantity of work-in-place by independent quantity survey, measure, or count.
- B. Submit claims for increased costs because of a change in scope or nature of the allowance described in the Contract Documents, whether for the purchase order amount or Contractor's handling, labor, installation, overhead, and profit.
 - 1. Do not include Contractor's or subcontractor's indirect expense in the Change Order cost amount unless it is clearly shown that the nature or extent of work has changed from what could have been foreseen from information in the Contract Documents.
 - 2. No change to Contractor's indirect expense is permitted for selection of higher- or lower-priced materials or systems of the same scope and nature as originally indicated.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine products covered by an allowance promptly on delivery for damage or defects. Return damaged or defective products to manufacturer for replacement.

3.2 PREPARATION

- A. Coordinate materials and their installation for each allowance with related materials and installations to ensure that each allowance item is completely integrated and interfaced with related work.

3.3 SCHEDULE OF ALLOWANCES

- A. Allowance No. 1: Unit Cost Allowance: Include the sum of \$38 per square yard for carpet tile, including material and labor.

END OF SECTION 012100

SECTION 012300 - ALTERNATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

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

1.3 DEFINITIONS

- A. Alternate: An amount proposed by bidders and stated on the Bid Form for certain work defined in the bidding requirements that may be added to or deducted from the base bid amount if Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.
 - 1. Alternates described in this Section are part of the Work only if enumerated in the Agreement.
 - 2. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate alternate into the Work. No other adjustments are made to the Contract Sum.

1.4 PROCEDURES

- A. Coordination: Revise or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.
 - 1. Include as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not indicated as part of alternate.
- B. Notification: Immediately following award of the Contract, notify each party involved, in writing, of the status of each alternate. Indicate if alternates have been accepted, rejected, or deferred for later consideration. Include a complete description of negotiated revisions to alternates.
- C. Execute accepted alternates under the same conditions as other work of the Contract.
- D. Schedule: A schedule of alternates is included at the end of this Section. Specification Sections referenced in schedule contain requirements for materials necessary to achieve the work described under each alternate.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF ALTERNATES

A. Alternate No. 1: Landscaping Scope of Work.

1. Base Bid: Provide base bid landscaping scope of work as indicated in the Contract Documents.
2. Alternate: Reduce landscaping scope of work as indicated in the Contract Documents.

B. Alternate No. 2: Paint finish for Windows and Metal Siding.

1. Base Bid: Provide 3-Coat Metallic Fluoropolymer finish.
2. Alternate: Provide a Two-Coat Fluoropolymer finish.

C. Alternate No. 3: Photovoltaic System.

1. Base Bid: Do not provide Photovoltaic System.
2. Alternate: Provide Photovoltaic System as indicated in the Contract Documents.

END OF SECTION 012300

SECTION 012500 - SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for substitutions.
- B. Related Requirements:
 - 1. Section 012100 "Allowances" for products selected under an allowance.
 - 2. Section 012300 "Alternates" for products selected under an alternate.
 - 3. Section 016000 "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.

1.3 DEFINITIONS

- A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.
 - 1. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
 - 2. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required in order to meet other Project requirements but may offer advantage to Contractor or Owner.

1.4 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.

1.5 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.
- B. Products with asbestos: Asbestos containing materials are not to be purchased or installed in this project.

1.6 PROCEDURES

- A. Coordination: Revise or adjust affected work as necessary to integrate work of the approved substitutions.

PART 2 - PRODUCTS

2.1 SUBSTITUTIONS

- A. Substitutions: Architect will consider requests for substitution if received within 60 days after commencement of the Work. Requests received after that time may be considered or rejected at discretion of Architect.
 - 1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
 - a. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
 - b. Requested substitution does not require extensive revisions to the Contract Documents.
 - c. Requested substitution is consistent with the Contract Documents and will produce indicated results.
 - d. Substitution request is fully documented and properly submitted.
 - e. Requested substitution will not adversely affect Contractor's construction schedule.
 - f. Requested substitution has received necessary approvals of authorities having jurisdiction.
 - g. Requested substitution is compatible with other portions of the Work.
 - h. Requested substitution has been coordinated with other portions of the Work.
 - i. Requested substitution provides specified warranty.
 - j. 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

SECTION 012600 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

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

1.3 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"

1.4 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. Work Change Proposal Requests issued by Architect are not instructions either to stop work in progress or to execute the proposed change.
 - 2. Within 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 bonds, insurance, taxes, delivery charges, equipment rental, and amounts of trade discounts.
 - c. Include costs of labor and supervision directly attributable to the change.
 - d. Include quotes on supplier's and subcontractor's letterhead for the requested change.
 - e. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.

- B. Contractor-Initiated Proposals: If latent or 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 bonds, insurance, 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 Section 012500 "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.
- C. Proposal Request Form: Use AIA Document G709 for Proposal Requests.

1.5 ADMINISTRATIVE CHANGE ORDERS

- A. Allowance Adjustment: See Section 012100 "Allowances" for administrative procedures for preparation of Change Order Proposal for adjusting the Contract Sum to reflect actual costs of allowances.

1.6 CHANGE ORDER PROCEDURES

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

1.7 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 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements necessary to prepare and process Applications for Payment.
- B. Related Requirements:
 - 1. Section 012100 "Allowances" for procedural requirements governing the handling and processing of allowances.
 - 2. Section 012600 "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.
 - 3. Section 013200 "Construction Progress Documentation" for administrative requirements governing the preparation and submittal of the Contractor's construction schedule.

1.3 DEFINITIONS

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

1.4 SCHEDULE OF VALUES

- A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule.
 - 1. Coordinate 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.

3. Subschedules for Separate Elements of Work: Where the Contractor's construction schedule defines separate elements of the Work, provide subschedules showing values coordinated with each element.
- B. Format and Content: Use 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. Arrange the schedule of values in tabular form with separate columns to indicate the following for each item listed:
 - a. Related Specification Section or Division.
 - b. Description of the Work.
 - c. Name of subcontractor.
 - d. Name of manufacturer or fabricator.
 - e. Name of supplier.
 - f. Change Orders (numbers) that affect value.
 - g. Dollar value of the following, as a percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent.
 - 1) Labor.
 - 2) Materials.
 - 3) Equipment.
 4. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with Project Manual table of contents. Provide multiple line items for principal subcontract amounts in excess of five percent of the 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.
 5. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
 6. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
 - a. Differentiate between items stored on-site and items stored off-site. If required, include evidence of insurance.
 7. 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.

8. 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.
 9. Each item in the schedule of values and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item.
 - a. Temporary facilities and other major cost items that are not direct cost of actual work-in-place may be shown either as separate line items in the schedule of values or distributed as general overhead expense, at Contractor's option.
 10. Schedule Updating: Update and resubmit the schedule of values before the next Applications for Payment when Change Orders or Construction Change Directives result in a change in the Contract Sum.
- C. Draw-Down Schedule: The Contractor shall furnish to the Architect, at the beginning of the project, an expected monthly requisition estimate for the Owner's use in planning funding.

1.5 APPLICATIONS FOR PAYMENT

- A. Each Application for Payment following the initial 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: The date for each progress payment is indicated in the Agreement between Owner and Contractor. The period of construction work covered by each Application for Payment is the period indicated in the Agreement.
1. Submit draft copy of Application for Payment seven days prior to due date for review by Architect.
- C. Application for Payment Forms: Use AIA Document G702 and AIA Document G703 as form for Applications for Payment.
- D. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. 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 for work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at time of Application for Payment.
 3. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.

- E. **Stored Materials:** Include in Application for Payment amounts applied for materials or equipment purchased or fabricated and stored, but not yet installed. Differentiate between items stored on-site and items stored off-site.
1. Provide certificate of insurance, evidence of transfer of title to Owner, and consent of surety to payment, for stored materials.
 2. Provide supporting documentation that verifies amount requested, such as paid invoices. Match amount requested with amounts indicated on documentation; do not include overhead and profit on stored materials.
 3. Provide summary documentation for stored materials indicating the following:
 - a. Value of materials previously stored and remaining stored as of date of previous Applications for Payment.
 - b. Value of previously stored materials put in place after date of previous Application for Payment and on or before date of current Application for Payment.
 - c. Value of materials stored since date of previous Application for Payment and remaining stored as of date of current Application for Payment.
- F. **Transmittal:** Submit three 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 liens from subcontractors, sub-subcontractors, and suppliers for construction period covered by the previous application.
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. The list of subcontractors, principal suppliers and fabricators shall be used to designate which entities involved in the Work must submit waivers. The list shall be approved by the Owner.
 4. Submit final Application for Payment with or preceded by conditional final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.
 5. **Waiver Forms:** Submit executed waivers of lien on forms, acceptable to Owner.
- H. **Record Drawing Updates:** With each Application of Payment, record documents shall be maintained and current for all trades, available for viewing at a central location.
- I. **Initial Application for Payment:** Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
1. List of subcontractors.
 2. Schedule of values.
 3. Contractor's construction schedule (preliminary if not final).

4. Combined Contractor's construction schedule (preliminary if not final) incorporating Work of multiple contracts, with indication of acceptance of schedule by each Contractor.
 5. Products list (preliminary if not final).
 6. Submittal schedule (preliminary if not final).
 7. List of Contractor's staff assignments.
 8. List of Contractor's principal consultants.
 9. Copies of building permits and other required permits.
 10. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
 11. Initial progress report.
 12. Report of preconstruction conference.
 13. Certificates of insurance and insurance policies.
 14. Performance and payment bonds.
- J. Progress Applications for Payment: Administrative actions and submittals that must precede or coincide with submittal of progress Applications for Payment include the following:
1. Contractor's Construction Schedule update.
 2. Submittals for Work being requisitioned for are complete and approved.
 3. Submit list of completed tests, checklists, commissioning, reports, and similar requirements for the work are submitted and in compliance with the Contract Documents.
 4. Minutes of previous month's progress meeting have been distributed.
 5. Record drawings and documents are current.
- K. Application for Payment at Substantial Completion: After Architect issues 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 Certificate(s) of Substantial Completion issued previously for Owner occupancy of designated portions of the Work.
- L. Final Payment Application: After completing Project closeout requirements, 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. Final submittal of record documents and operation, maintenance data and demonstration and training.
 3. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
 4. Updated final statement, accounting for final changes to the Contract Sum.
 5. Waiver Forms: Submit waivers of lien on forms, and executed in a manner, acceptable to the Owner.
 6. Evidence that claims have been settled.
 7. 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.
 8. Final liquidated damages settlement statement, if applicable.

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 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
 - 1. General coordination procedures.
 - 2. Requests for Information (RFIs).
 - 3. Project meetings.
- B. Each contractor shall participate in coordination requirements. Certain areas of responsibility are assigned to a specific contractor.
- C. Related Requirements:
 - 1. Section 013200 "Construction Progress Documentation" for preparing and submitting Contractor's construction schedule.
 - 2. Section 017300 "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
 - 3. Section 017700 "Closeout Procedures" for coordinating closeout of the Contract.

1.3 DEFINITIONS

- A. RFI: Request from Owner, Architect, or Contractor seeking information required by or clarifications of the Contract Documents.

1.4 INFORMATIONAL SUBMITTALS

- A. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:
 - 1. Name, address, and telephone number of entity performing subcontract or supplying products.
 - 2. Number and title of related Specification Section(s) covered by subcontract.
 - 3. Drawing number and detail references, as appropriate, covered by subcontract.

- B. Key Personnel Names: Within 15 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including home, office, and cellular telephone numbers and e-mail addresses. Provide names, addresses, and telephone numbers of individuals assigned as alternates in the absence of individuals assigned to Project.
1. Post copies of list in project meeting room, in temporary field office, and by each temporary telephone. Keep list current at all times.

1.5 GENERAL COORDINATION PROCEDURES

- A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations, included in different Sections that depend on each other for proper installation, connection, and operation.
1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
 2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
 3. Make adequate provisions to accommodate items scheduled for later installation.
 4. Where availability of space is limited, coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair of all components, including mechanical and electrical. Coordinate location of pipes, conduits, ducts and similar items in confined areas to assure proper fit and access. Contractor is responsible for handling interferences created by the work of subcontractors (example, sprinkler pipe interfering with installation of duct work; duct work interfering with installation of light fixtures, overhead construction interfering with installation of finish ceilings at proper height).
 5. Coordinate the work to provide smoke and fire seals for component interfaces and penetrations of smoke walls and fire rated construction.
- B. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.
1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.
- C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities and activities of other contractors to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
1. Preparation of Contractor's construction schedule.
 2. Preparation of the schedule of values.
 3. Installation and removal of temporary facilities and controls.
 4. Delivery and processing of submittals.

5. Progress meetings.
6. Preinstallation conferences.
7. Project closeout activities.
8. Startup and adjustment of systems.

- D. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.
1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. See other Sections for disposition of salvaged materials that are designated as Owner's property.

1.6 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 suggested resolution 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.
 - a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.
- C. RFI Forms: Software-generated form with substantially the same content as indicated above, acceptable to Architect.
1. Attachments shall be electronic files in Adobe Acrobat PDF format.

- 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 Contractor-generated RFIs will be returned without action:
 - a. Requests for approval of submittals.
 - b. Requests for approval of substitutions.
 - c. Requests for approval of Contractor's means and methods.
 - d. Requests for coordination information already indicated in the Contract Documents.
 - e. Requests for adjustments in the Contract Time or the Contract Sum.
 - f. Requests for interpretation of Architect's actions on submittals.
 - g. 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 Section 012600 "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. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly. Software log with not less than the following:
1. Project name.
 2. Name and address of Contractor.
 3. Name and address of Architect.
 4. RFI number including RFIs that were returned without action or withdrawn.
 5. RFI description.
 6. Date the RFI was submitted.
 7. Date Architect's response was received.
- F. 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.
1. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.
 2. Identification of related Field Order, Work Change Directive, and Proposal Request, as appropriate.

1.7 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. Conduct the conference to review responsibilities and personnel assignments.
 2. 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.
 3. 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. Lines of communications.
 - f. Procedures for processing field decisions and Change Orders.
 - g. Procedures for RFIs.
 - h. Procedures for testing and inspecting.
 - i. Procedures for processing Applications for Payment.
 - j. Distribution of the Contract Documents.
 - k. Submittal procedures.
 - 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.
 4. 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 requirements.
 - k. Time schedules.
 - l. Weather limitations.
 - m. Manufacturer's written instructions.
 - 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. Project Closeout Conference: Schedule and conduct a project closeout conference, at a time convenient to Owner and Architect, but no later than 90 days prior to the scheduled date of Substantial Completion.
1. Conduct the conference to review requirements and responsibilities related to Project closeout.
 2. Attendees: Authorized representatives of Owner, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the meeting. Participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.

3. Agenda: Discuss items of significance that could affect or delay Project closeout, including the following:
 - a. Preparation of record documents.
 - b. Procedures required prior to inspection for Substantial Completion and for final inspection for acceptance.
 - c. Submittal of written warranties.
 - d. Requirements for preparing operations and maintenance data.
 - e. Requirements for delivery of material samples, attic stock, and spare parts.
 - f. Requirements for demonstration and training.
 - g. Preparation of Contractor's punch list.
 - h. Procedures for processing Applications for Payment at Substantial Completion and for final payment.
 - i. Submittal procedures.
 - j. Coordination of separate contracts.
 - k. Owner's partial occupancy requirements.
 - l. Installation of Owner's furniture, fixtures, and equipment.
 - m. Responsibility for removing temporary facilities and controls.
 4. Minutes: Entity conducting meeting will record and distribute meeting minutes.
- E. Progress Meetings: Conduct progress meetings at monthly intervals.
1. Coordinate dates of meetings with preparation of payment requests.
 2. 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.
 3. 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. Application for Payment: Contractor shall bring copy of Application for Payment to meeting. Review Application for Payment and required attachments, including record drawing and documents status, waivers of mechanic's liens, list of completed tests, checklists, commissioning, reports, and similar requirements for the work are submitted and in compliance with the Contract Documents.
 - c. 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.
4. 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.
- F. Coordination Meetings: Conduct Project coordination meetings at regular intervals. Project coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and preinstallation conferences.
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 meetings shall be familiar with Project and authorized to conclude matters relating to the Work.
 2. Agenda: Review and correct or approve minutes of the previous coordination meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
 - a. Combined Contractor's Construction Schedule: Review progress since the last coordination meeting. Determine whether each contract is on time, ahead of schedule, or behind schedule, in relation to combined 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.
 - b. Schedule Updating: Revise combined Contractor's construction schedule after each coordination meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with report of each meeting.
 - c. Review present and future needs of each contractor 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) Work hours.
 - 10) Hazards and risks.
 - 11) Progress cleaning.
 - 12) Quality and work standards.
 - 13) Change Orders.
3. Conduct coordination meetings with the mechanical, plumbing, sprinkler and electrical trades. Before the trades start work in an area of the building, make field measurements, review structural clearances and locations of ducts, pipes, conduits, light fixtures, equipment and other items that affect location and proper fit. Prepare coordination sketches to maximize utilization of space for efficient installation of different components. Verify depths and clearances before fabrication of ductwork.
 4. Reporting: Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013100

SECTION 013200 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
 - 1. Startup construction schedule.
 - 2. Contractor's construction schedule.
 - 3. Construction schedule updating reports.
 - 4. Daily construction reports.
 - 5. Material location reports.
 - 6. Site condition reports.
 - 7. Special reports.

1.3 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.
- B. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.
- C. Event: The starting or ending point of an activity.
- D. Float: The measure of leeway in starting and completing an activity.

1.4 INFORMATIONAL SUBMITTALS

- A. Format for Submittals: Submit required submittals in the following format:
 - 1. PDF electronic file.

- B. Startup construction schedule.
- C. Startup Network Diagram: Of size required to display entire network for entire construction period. Show logic ties for activities.
- D. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.
- E. Construction Schedule Updating Reports: Submit with Applications for Payment.
- F. Daily Construction Reports: Submit at weekly intervals.
- G. Material Location Reports: Submit at monthly intervals.
- H. Site Condition Reports: Submit at time of discovery of differing conditions.
- I. Special Reports: Submit at time of unusual event.
- J. Qualification Data: For scheduling consultant.

1.5 QUALITY ASSURANCE

- A. Prescheduling Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination." Review methods and procedures related to the preliminary construction schedule and Contractor's construction schedule, including, but not limited to, the following:
 - 1. Discuss constraints, including work stages area separations and milestones.
 - 2. Review submittal requirements and procedures.
 - 3. Review time required for review of submittals and resubmittals.
 - 4. Review requirements for tests and inspections by independent testing and inspecting agencies.
 - 5. Review time required for Project closeout and Owner startup procedures.
 - 6. Review and finalize list of construction activities to be included in schedule.
 - 7. Review procedures for updating schedule.

1.6 COORDINATION

- A. 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.
 - 3. Allow for time in the construction schedule for materials to dry before they are enclosed to prevent the growth of mold and bacteria

PART 2 - PRODUCTS

2.1 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

- A. Time Frame: Extend schedule from date established for commencement of the Work to date of final 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 main 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 Section 013300 "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's construction schedule with submittal schedule.
 4. Startup and Testing Time: Include no fewer 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 completion of punch list items 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, including, but not limited to, the following:
 - a. Subcontract awards.
 - b. Submittals.
 - c. Purchases.
 - d. Mockups.

- e. Fabrication.
 - f. Sample testing.
 - g. Deliveries.
 - h. Installation.
 - i. Tests and inspections.
 - j. Adjusting.
 - k. Curing.
 - l. Building flush-out.
 - m. Startup and placement into final use and operation.
3. Construction Areas: Identify each major area of construction for each major portion of the Work. Indicate where each construction activity within a major area must be sequenced or integrated with other construction activities to provide for the following:
- a. Structural completion.
 - b. Temporary enclosure and space conditioning.
 - c. Permanent space enclosure.
 - d. Completion of mechanical installation.
 - e. Completion of electrical installation.
 - f. Substantial Completion.
- 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 Requests for Information.
 3. Rejected or unreturned submittals.
 4. Notations on returned submittals.
 5. Pending modifications affecting the Work and Contract Time.

2.2 STARTUP CONSTRUCTION SCHEDULE

- A. Bar-Chart Schedule: Submit startup, horizontal, bar-chart-type construction schedule within seven days of date established for commencement of the Work.
- B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line. Outline significant construction activities for first 60 days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.

2.3 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 commencement of the Work. Base schedule on the startup construction schedule and additional information received since the start of Project.

- 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.

2.4 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 (see special reports).
 - 10. Stoppages, delays, shortages, and losses.
 - 11. Meter readings and similar recordings.
 - 12. Emergency procedures.
 - 13. Orders and requests of authorities having jurisdiction.
 - 14. Change Orders received and implemented.
 - 15. Construction Change Directives received and implemented.
 - 16. Services connected and disconnected.
 - 17. Equipment or system tests and startups.
 - 18. Partial completions and occupancies.
 - 19. Substantial Completions authorized.
- B. Material Location Reports: At monthly intervals, prepare and submit a comprehensive list of materials delivered to and stored at Project site. List shall be cumulative, showing materials previously reported plus items recently delivered. Include with list a statement of progress on and delivery dates for materials or items of equipment fabricated or stored away from Project site. Indicate the following categories for stored materials:
 - 1. Material stored prior to previous report and remaining in storage.
 - 2. Material stored prior to previous report and since removed from storage and installed.
 - 3. Material stored following previous report and remaining in storage.
- C. Site Condition Reports: Immediately on discovery of a difference between site 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.

2.5 SPECIAL REPORTS

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

PART 3 - EXECUTION

3.1 CONTRACTOR'S CONSTRUCTION SCHEDULE

- A. Contractor's Construction Schedule Updating: At monthly intervals, review schedule for 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

SECTION 013300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 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 Requirements:
 - 1. Division 01 Section "Payment Procedures" for submitting Applications for Payment and the schedule of values.
 - 2. Division 01 Section "Construction Progress Documentation" for submitting schedules and reports, including Contractor's construction schedule.
 - 3. Division 01 Section "Operation and Maintenance Data" for submitting operation and maintenance manuals.
 - 4. Division 01 Section "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.

1.3 DEFINITIONS

- A. Action Submittals: Written and graphic information and physical samples that require Architect's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."
- 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. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."
- C. File Transfer Protocol (FTP): Communications protocol that enables transfer of files to and from another computer over a network and that serves as the basis for standard Internet protocols. An FTP site is a portion of a network located outside of network firewalls within which internal and external users are able to access files.
- D. Portable Document Format (PDF): An open standard file format licensed by Adobe Systems used for representing documents in a device-independent and display resolution-independent fixed-layout document format.

1.4 ACTION SUBMITTALS

- A. Submittal Schedule: Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Architect and additional time for handling and reviewing submittals required by those corrections.
1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
 2. Initial Submittal: Within ten (10) days after signing the Contract, submit concurrently with startup construction schedule. Include submittals required during the first 60 days of construction. List those submittals required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.
 3. Final Submittal: Submit concurrently with the first complete submittal of Contractor's construction schedule.
 - a. Submit revised submittal schedule to reflect changes in current status and timing for submittals.
 4. Format: Arrange the following information in a tabular format:
 - a. Scheduled date for first submittal.
 - b. Specification Section number and title.
 - c. Submittal category: Action; informational.
 - d. Name of subcontractor.
 - e. Description of the Work covered.
 - f. Scheduled date for Architect's final release or approval.
 - g. Scheduled date of fabrication.
 - h. Scheduled dates for purchasing.
 - i. Scheduled dates for installation.
 - j. Activity or event number.

1.5 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

- A. Architect's Digital Data Files: Electronic digital data files of the Contract Drawings will be provided by Architect for Contractor's use in preparing submittals, if requested.
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.
 2. Contractors requesting files shall sign the "Electronic Files Request Form and Waiver" and submit agreement included at the end of this section.
- B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
 2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.

3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
 4. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.
 - a. 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.
 4. Sequential Review: Where sequential review of submittals by Architect's consultants, Owner, or other parties is indicated, allow 21 days for initial review of each submittal.
 - a. Mechanical submittals.
 - b. Electrical submittals.
 - c. Data & Communications Systems submittals.
 5. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing.
 6. Submittals with Color Selections: Deliver to Architect a list of submittals required for the exterior color package and a list required for the interior color package. The Architect needs to coordinate the colors of all exterior and interior items and will hold submittals with color selections until all materials in the exterior color package have been received. Allow 2 weeks after the last item has been submitted for return of exterior color selections. The Architect will hold submittals with color selections until all materials in the interior color package have been received. Allow 3 weeks after the last item has been submitted for return of interior color selections. Careful coordination of the Submittal Schedule by the Contractor is required so as not to delay the Work.
- D. Paper Submittals: Place a permanent label or title block on each submittal item for identification.
1. Indicate name of firm or entity that prepared each submittal on label or title block.
 2. Provide a space approximately 6 by 8 inches on label or beside title block to record 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 Contractor.

- e. Name of subcontractor.
 - f. Name of supplier.
 - g. Name of manufacturer.
 - h. 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., ABCD-061000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., ABCD-061000.01.A).
 - i. Number and title of appropriate Specification Section.
 - j. Drawing number and detail references, as appropriate.
 - k. Location(s) where product is to be installed, as appropriate.
 - l. Other necessary identification.
4. 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.
5. Transmittal for Paper Submittals: Assemble each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form. Architect will return without review submittals received from sources other than Contractor.
- a. Transmittal Form for Paper Submittals: Use Contractor's standard transmittal form. Provide locations on form for the following information:
 - 1) Project name.
 - 2) Date.
 - 3) Destination (To:).
 - 4) Source (From:).
 - 5) Name and address of Architect.
 - 6) Name of Construction Manager.
 - 7) Name of firm or entity that prepared submittal.
 - 8) Names of subcontractor, manufacturer, and supplier.
 - 9) Category and type of submittal.
 - 10) Submittal purpose and description.
 - 11) Specification Section number and title.
 - 12) Specification paragraph number or drawing designation and generic name for each of multiple items.
 - 13) Drawing number and detail references, as appropriate.
 - 14) Indication of full or partial submittal.
 - 15) Transmittal number, numbered consecutively.
 - 16) Submittal and transmittal distribution record.
 - 17) Remarks.
 - 18) Signature of transmitter.
- E. Electronic Submittals: Identify and incorporate information in each electronic submittal file as follows:

1. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
 2. Name file with submittal number or other unique identifier, including revision identifier.
 - a. File name shall use project identifier and Specification Section number followed by a decimal point and then a sequential number (e.g., ABCD-061000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., ABCD-061000.01.A).
 3. Provide means for insertion to permanently record Contractor's review and approval markings and action taken by Architect.
 4. Transmittal Form for Electronic Submittals: Use software-generated form from electronic project management software or electronic form acceptable to Owner, containing the following information:
 - a. Project name.
 - b. Date.
 - c. Name and address of Architect.
 - d. Name of Contractor.
 - e. Name of firm or entity that prepared submittal.
 - f. Names of subcontractor, manufacturer, and supplier.
 - g. Category and type of submittal.
 - h. Submittal purpose and description.
 - i. Specification Section number and title.
 - j. Specification paragraph number or drawing designation and generic name for each of multiple items.
 - k. Drawing number and detail references, as appropriate.
 - l. Location(s) where product is to be installed, as appropriate.
 - m. Related physical samples submitted directly.
 - n. Indication of full or partial submittal.
 - o. Transmittal number, numbered consecutively.
 - p. Submittal and transmittal distribution record.
 - q. Other necessary identification.
 - r. Remarks.
- F. Options: Identify options requiring selection by Architect.
- G. Deviations and Additional Information: On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Architect on previous submittals, and deviations from requirements in the Contract Documents, including minor variations and limitations. Include same identification information as related submittal.
- H. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
1. Note date and content of previous submittal.
 2. Note date and content of revision in label or title block and clearly indicate extent of revision.
 3. Resubmit submittals until they are marked with approval notation from Architect's action stamp.

- I. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.
- J. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Architect's action stamp.

PART 2 - PRODUCTS

2.1 SUBMITTAL PROCEDURES

- A. General Submittal Procedure Requirements: Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
 - 1. Submit electronic submittals via email as PDF electronic files.
 - a. Architect will return annotated file. Annotate and retain one copy of file as an electronic Project record document file.
 - 2. Action Submittals: Submit three paper copies of each submittal unless otherwise indicated. Architect will return two copies.
 - 3. Informational Submittals: Submit two paper copies of each submittal unless otherwise indicated. Architect will not return copies.
 - 4. Certificates and Certifications Submittals: Provide a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.
 - a. Provide a digital signature with digital certificate on electronically submitted certificates and certifications where indicated.
 - b. Provide a notarized statement on original paper copy certificates and certifications where indicated.
- B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
 - 1. If information must be specially prepared for submittal because standard 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, or
 - b. Three paper copies of Product Data unless otherwise indicated. Architect will return two copies.
- 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.
- 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. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches, but no larger than 30 by 42 inches.
 - 3. Submit Shop Drawings in the following format:
 - a. PDF electronic file, or
 - b. Three opaque copies of each submittal. Architect will retain two copies; remainder will be returned.
- 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.

- e. Specification paragraph number and generic name of each item.
3. For projects where electronic submittals are required, provide corresponding electronic submittal of Sample transmittal, digital image file illustrating Sample characteristics, and identification information for record.
4. 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.
5. 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 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.
6. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
 - a. Number of Samples: Submit three sets of Samples. Architect will retain two Sample sets; remainder will be returned. Mark up and retain one returned Sample set as a project record sample.
 - 1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
 - 2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.
- E. Contractor's Construction Schedule: Comply with requirements specified in Division 01 Section "Construction Progress Documentation."
- F. Application for Payment and Schedule of Values: Comply with requirements specified in Division 01 Section "Payment Procedures."
- G. Test and Inspection Reports and Schedule of Tests and Inspections Submittals: Comply with requirements specified in Division 01 Section "Quality Requirements."

- H. Closeout Submittals and Maintenance Material Submittals: Comply with requirements specified in Division 01 Section "Closeout Procedures."
- I. Maintenance Data: Comply with requirements specified in Division 01 Section "Operation and Maintenance Data."
- J. 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.
- K. 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 AWS forms. Include names of firms and personnel certified.
- L. 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.
- M. 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.
- N. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
- O. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
- P. 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.
- Q. Product Test Reports: Submit written reports indicating that 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.
- R. 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. Include the following information:
 - 1. Name of evaluation organization.
 - 2. Date of evaluation.
 - 3. Time period when report is in effect.
 - 4. Product and manufacturers' names.
 - 5. Description of product.
 - 6. Test procedures and results.
 - 7. Limitations of use.

- S. 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.
- T. 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.
- U. Field Test Reports: Submit written 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.
- V. 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 or 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.
 - 1. The Contractor shall review submittals for completeness and compliance with the Contract Documents. If submittal contains substitutions, Contractor shall process substitutions in accordance with Section 012500 "Substitution Procedures," and not part

of specified Shop Drawings or Product Data submittals. Contractor is responsible for keeping Subcontractors on time with the submittal schedule. If the Contractor submits submittals that are repeatedly rejected, requiring the Architect to perform multiple reviews of the same submittal because of the failure to properly prepare and complete the submittals.

- a. Owner will compensate Architect for such additional services.
 - b. Owner will deduct the amount of such compensation from the final payment of the Contractor.
- B. Project Closeout and Maintenance Material Submittals: See requirements in Division 01 Section "Closeout Procedures."
- C. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.
1. Stamp or statement shall include the following: "The Contractor represents that he has determined and verified all materials, field measurements, and field construction criteria related thereto or will do so, and that he has checked and coordinated the information contained within such submittals with the requirements of the Work and of the Contract Documents."

3.2 ARCHITECT'S ACTION

- A. Action Submittals: Architect will review each submittal, make marks to indicate corrections or revisions required, and return it. Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate taken, as follows:
1. Reviewed: Final Unrestricted Release. Work may proceed, provided it complies with the Contract Documents.
 2. Furnish as Corrected: Final But Conditional Release. Work may proceed, provided it complies with the notations and corrections on submittals and with Contract Documents. Architect's comments shall be considered a part of the original submittal. Should Contractor disagree with any such comments, so notify the Architect within fourteen (14) days after receipt of such transmittal and before commencing work on the items in question. Failing this, Contractor shall be deemed to have agreed to such comments by the Architect and to have accepted full responsibility for implementing them at no additional cost to the Owner.
 3. Revise and Resubmit: Returned for Resubmittal. Do not proceed with the work at the site or allow submittal at site. Fabrication in shop or factory may proceed on items not affected by the Architect's comments only. Revise submittal in accordance with notations thereon, and resubmit without delay to obtain a different action marking. Revise and Resubmit
 4. Submit Specified Item: Resubmit using a specified item. Where submittal is rejected and returned for resubmittal of a specified product. Consult product section for list of acceptable manufacturers.
 5. Rejected: Where submittal is returned for other reasons, with Architect's explanation included.

- B. 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.
- C. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect.
- D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.
- E. Submittals not required by the Contract Documents may be returned by the Architect without action.

END OF SECTION 01 33 00



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MEMORANDUM

date:
project: Project Name
to: Name
Business Name
Address
Town, State, zipcode
phone: XXX.XXX.XXXX
fax: XXX.XXX.XXXX
subject: Waiver for Electronic Drawing Files

Scott Simons Architects is the architect for the project listed above. We understand that you ("Contractor" or "You"), (company name), wish to receive copies of our drawings and/or specifications in electronic format solely for your use in the construction of the project.

We are willing to disclose to you the (drawing name & number) in electronic format provided that you agree to the following terms and conditions:

1. Architect has prepared and issued printed hard copy drawings and specifications for the project. Solely as an accommodation to the Contractor the Architect will furnish to the Contractor the drawings and/or specifications in electronic format. In the event of a conflict in their content, however, the printed hard copies shall take precedence over the electronic media.
2. The Architect's electronic media are furnished without guarantee of compatibility with the Contractor's software or hardware. The architect has no responsibility for, and makes no representations regarding, the accuracy of the information contained in the electronic files.
3. The Contractor is granted a license to use the drawings and/or specifications in electronic form solely in connection with the construction of the Project.
4. Use of the architect's drawings and/or specifications in the electronic media form by contractor shall be at the Contractor's own risk and shall be without liability to the Architect, the Architect's consultants, and its officers, directors and employees. Architect's sole liability and responsibility will be with respect to the printed hard copies.
5. Because data stored in electronic media form can be altered either intentionally or unintentionally, including without limitation, by translation errors resulting from differences in computer software, hardware and related equipment, disc malfunctions, user error and environmental factors, the Contractor agrees that the Contractor shall indemnify, defend and hold harmless the Architect, the Architect's consultants, and the officers and employees of any of the them from and against any and all claims, liabilities, damages, losses, and costs, including, but not limited to costs of defense, arising for any reason out of changes or modifications to the data in electronic media form in the Contractor's possession or released to others by the Contractor and for any use of the electronic media and printed hard copy drawings and specifications outside the license granted hereunder.
6. The Contractor will pay a fee of \$100 per electronic drawing file (files for release are listed above). Payment will be mailed direct to Scott Simons Architects and shall be received prior to transmittal of the electronic files.

If you agree with the terms and conditions set forth herein please sign, date and return this release form to Scott Simons Architects.

issued

by:

Title:

Scott Simons Architects

Project Manager

accepted

by:

Title:

project:
«Filename»

«ProjectName»

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SECTION 014000 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

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

1.3 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.

1. Laboratory Mockups: Full-size physical assemblies constructed at testing facility to verify performance characteristics.
 2. Integrated Exterior Mockups: Mockups of the exterior envelope erected separately from the building but on Project site, consisting of multiple products, assemblies, and subassemblies.
- D. Preconstruction Testing: Tests and inspections performed specifically for 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, e.g., 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(s).
- 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.

1.4 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.

1.5 ACTION SUBMITTALS

- A. Shop Drawings: For integrated exterior mockups, provide plans, sections, and elevations, indicating materials and size of mockup construction.
 - 1. Indicate manufacturer and model number of individual components.
 - 2. Provide axonometric drawings for conditions difficult to illustrate in two dimensions.

1.6 INFORMATIONAL SUBMITTALS

- A. Contractor's Quality-Control Plan: For quality-assurance and quality-control activities and responsibilities.
- B. Qualification Data: For Contractor's quality-control personnel.
- C. 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.
- D. Schedule of Tests and Inspections: Prepare in tabular form and include the following:
 - 1. Specification Section number and title.
 - 2. Entity responsible for performing tests and inspections.
 - 3. Description of test and inspection.
 - 4. Identification of applicable standards.
 - 5. Identification of test and inspection methods.
 - 6. Number of tests and inspections required.
 - 7. Time schedule or time span for tests and inspections.
 - 8. Requirements for obtaining samples.
 - 9. Unique characteristics of each quality-control service.

1.7 CONTRACTOR'S QUALITY-CONTROL PLAN

- A. Quality-Control Plan, General: Submit quality-control plan within 10 days of Notice of Award or Notice to Proceed, and not less than five days prior to preconstruction conference. Submit in format acceptable to Architect. Identify personnel, procedures, controls, instructions, tests, records, and forms to be used to carry out Contractor's quality-assurance and quality-control responsibilities. Coordinate with Contractor's construction schedule.
- B. Quality-Control Personnel Qualifications: Engage qualified full-time personnel trained and experienced in managing and executing quality-assurance and quality-control procedures similar in nature and extent to those required for Project.
 - 1. Project quality-control manager may also serve as Project superintendent.
- C. Submittal Procedure: Describe procedures for ensuring compliance with requirements through review and management of submittal process. Indicate qualifications of personnel responsible for submittal review.

- D. Testing and Inspection: In quality-control plan, include a comprehensive schedule of Work requiring testing or inspection, including the following:
1. Contractor-performed tests and inspections including subcontractor-performed tests and inspections. Include required tests and inspections and Contractor-elected tests and inspections.
 2. Special inspections required by authorities having jurisdiction and indicated on the "Statement of Special Inspections."
 3. Owner-performed tests and inspections indicated in the Contract Documents.
- E. Continuous Inspection of Workmanship: Describe process for continuous inspection during construction to identify and correct deficiencies in workmanship in addition to testing and inspection specified. Indicate types of corrective actions to be required to bring work into compliance with standards of workmanship established by Contract requirements and approved mockups.
- F. Monitoring and Documentation: Maintain testing and inspection reports including log of approved and rejected results. Include work Architect has indicated as nonconforming or defective. Indicate corrective actions taken to bring nonconforming work into compliance with requirements. Comply with requirements of authorities having jurisdiction.

1.8 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 Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:
1. Name, address, and telephone number of technical representative making report.
 2. Statement on condition of substrates and their acceptability for installation of product.
 3. Statement that products at Project site comply with requirements.

4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
 5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
 6. Statement whether conditions, products, and installation will affect warranty.
 7. Other required items indicated in individual Specification Sections.
- C. **Factory-Authorized Service Representative's Reports:** Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:
1. Name, address, and telephone number of factory-authorized service representative making report.
 2. Statement that equipment complies with requirements.
 3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
 4. Statement whether conditions, products, and installation will affect warranty.
 5. Other required items indicated in individual Specification Sections.
- D. **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.

1.9 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 in material, design, and extent to those indicated for this Project.
- 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 Technical 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. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- J. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:
1. Contractor responsibilities include the following:
 - a. Provide test specimens representative of proposed products and construction.
 - b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
 - c. Provide sizes and configurations of test assemblies, mockups, and laboratory mockups to adequately demonstrate capability of products to comply with performance requirements.
 - d. Build site-assembled test assemblies and mockups using installers who will perform same tasks for Project.
 - e. Build laboratory mockups at testing facility using personnel, products, and methods of construction indicated for the completed Work.
 - f. When testing is complete, remove test specimens, assemblies, and mockups, and laboratory mockups; do not reuse products on Project.
 2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to 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.
- K. 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. Employ supervisory personnel who will oversee mockup construction. Employ workers that will be employed during the construction at Project.
 4. Demonstrate the proposed range of aesthetic effects and workmanship.
 5. 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.
 6. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
 7. Demolish and remove mockups when directed unless otherwise indicated.
- L. Integrated Exterior Mockups: Construct integrated exterior mockup according to approved Shop Drawings. Coordinate installation of exterior envelope materials and products for which mockups are required in individual Specification Sections, along with supporting materials.

1.10 QUALITY CONTROL

- A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.
1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspecting they are engaged to perform.
 2. Payment for these services will be made from testing and inspecting allowances, as authorized by Change Orders.
 3. Costs for retesting and reinspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor.
- 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. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
 2. 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.
 3. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting will be performed.
 4. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.

5. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
 6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
- C. **Manufacturer's Field Services:** Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Section 013300 "Submittal Procedures."
- D. **Manufacturer's Technical Services:** Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.
- E. **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.
- F. **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.
- G. **Associated Services:** Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
1. Access to the Work.
 2. Incidental labor and facilities necessary to facilitate tests and inspections.
 3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
 4. Facilities for storage and field curing of test samples.
 5. Delivery of samples to testing agencies.
 6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
 7. Security and protection for samples and for testing and inspecting equipment at Project site.

- H. 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.
- I. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents as a component of Contractor's quality-control plan. Coordinate and submit concurrently with Contractor's construction schedule. Update as the Work progresses.
 - 1. Distribution: Distribute schedule to Owner, Architect, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

1.11 SPECIAL TESTS AND INSPECTIONS

- A. Special Tests and Inspections: Owner will engage a qualified special inspector to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner, as indicated in Statement of Special Inspections attached to this Section, and as follows:
 - 1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures and reviews the completeness and adequacy of those procedures to perform the Work.
 - 2. Notifying Architect and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
 - 3. Submitting a certified written report of each test, inspection, and similar quality-control service to Architect with copy to Contractor and to authorities having jurisdiction.
 - 4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
 - 5. Interpreting tests and inspections and stating in each report whether tested and inspected work complies with or deviates from the Contract Documents.
 - 6. Retesting and reinspecting corrected work.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

- A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:
 - 1. Date test or inspection was conducted.
 - 2. Description of the Work tested or inspected.
 - 3. Date test or inspection results were transmitted to Architect.
 - 4. Identification of testing agency or special inspector conducting test or inspection.
- B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Architect's reference during normal working hours.

3.2 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. Comply with the Contract Document requirements for cutting and patching in Section 017300 "Execution."
- 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

Project: Patrons Oxford Insurance Office Building
Date Prepared: 1/11/2016

Structural Statement of Special Inspections

Project: *Patrons Oxford Insurance Office Building*

Location: *Portland, ME*

Owner: *Patrons Oxford Insurance Co.*

This *Statement of Special Inspections* encompass the following discipline: **Structural**

This *Statement of Special Inspections* is submitted as a condition for permit issuance in accordance with the Special Inspection and Structural Testing requirements of the Building Code. It includes a schedule of Special Inspection services applicable to this project as well as the name of the Structural Special Inspection Coordinator (SSIC) and the identity of other approved agencies to be retained for conducting these inspections and tests.

The Structural Special Inspection Coordinator shall keep records of all Structural inspections and shall furnish inspection reports to the Building Code Official (BCO) and the Structural Registered Design Professional in Responsible Charge (SRDP). Discovered discrepancies shall be brought to the immediate attention of the Contractor for correction. If such discrepancies are not corrected, the discrepancies shall be brought to the attention of the Building Official and the Structural Registered Design Professional in Responsible Charge. The Special Inspection program does not relieve the Contractor of his or her responsibilities.

Interim reports shall be submitted to the Building Official and the Structural Registered Design Professional in Responsible Charge at an interval determined by the SSIC and the BCO.

A *Final Report of Special Inspections* documenting completion of all required Special Inspections, testing and correction of any discrepancies noted in the inspections shall be submitted to the BCO prior to issuance of a Certificate of Use and Occupancy.

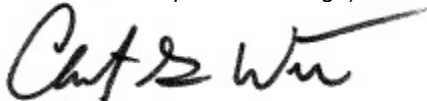
Job site safety and means and methods of construction are solely the responsibility of the Contractor.

Interim Report Frequency: *Upon request of Building Official* _____ or per attached schedule.

Prepared by:

Christopher G. Williams, P.E., S.E.

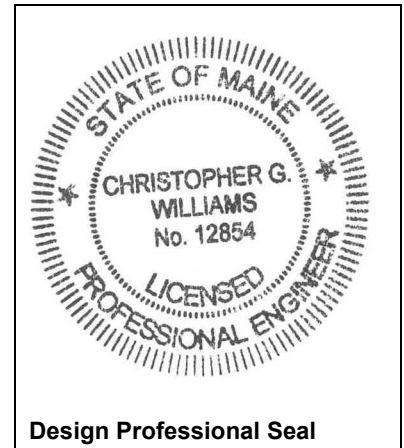
(type or print name of the Structural Registered Design Professional in Responsible Charge)



Signature

1/11/2016

Date



Owner's Authorization:

Building Code Official's Acceptance:

Signature

Date

Signature

Date

Structural Statement of Special Inspections (Continued)

List of Agents

Project: *Patrons Oxford Insurance Office Building*

Location: *Portland, ME*

Owner: *Patrons Oxford Insurance Co.*

This Statement of Special Inspections encompass the following discipline: **Structural**

(Note: Statement of Special Inspections for other disciplines may be included under a separate cover)

This Statement of Special Inspections / Quality Assurance Plan includes the following building systems:

- Soils and Foundations
- Cast-in-Place Concrete
- Precast Concrete System
- Structural Masonry Systems
- Structural Steel
- Wood Construction
- Special Cases

Special Inspection Agencies	Firm	Address, Telephone, e-mail
1. STRUCTURAL Special Inspections Coordinator (SSIC)	<i>Becker Structural Engineers, Inc.</i>	<i>75 York St. Portland, ME 04101 207-879-1838</i>
2. Special Inspector (SI 1)	<i>Becker Structural Engineers, Inc.</i>	<i>75 York St. Portland, ME 04101 207-879-1838</i>
3. Special Inspector (SI 2)	<i>R.W. Gillespie & Associates, Inc.</i>	<i>86 Industrial Park Rd., Ste. 4 Saco, ME 04072 207-286-8008</i>
4. Testing Agency (TA 1)	<i>T.B.D.</i>	<i>T.B.D.</i>
5. Testing Agency (TA 2)		
6. Other (O1)		

Note: The inspectors and testing agencies shall be engaged by the Owner or the Owner's Agent, and not by the Contractor or Subcontractor whose work is to be inspected or tested. Any conflict of interest must be disclosed to the Building Official, prior to commencing work.

Project: Patrons Oxford Insurance Office Building
Date Prepared: 1/11/2016

Structural Statement of Special Inspections (Continued)

Final Report of Special Inspections (SSIC/SI 1)

[To be completed by the Structural Special Inspections Coordinator (SSIC/SI 1). Note that all Agent's Final Reports must be received prior to issuance.]

Project: *Patrons Oxford Insurance Office Building*

Location: *Portland, ME*

Owner: *Patrons Oxford Insurance Co.*

Owner's Address: *P.O. Box 1960
Auburn, ME 04211*

Architect of Record: *Scott Simons* *Scott Simons Architects*
(name) *(firm)*

Structural Registered Design

Professional in Responsible Charge: *Christopher G. Williams, P.E., S.E.* *Becker Structural Engineers, Inc.*
(name) *(firm)*

To the best of my information, knowledge and belief, the Special Inspections required for this project, and itemized in the *Statement of Special Inspections* submitted for permit, have been performed and all discovered discrepancies have been reported and resolved.

Interim reports submitted prior to this final report form a basis for and are to be considered an integral part of this final report.

Respectfully submitted,
Structural Special Inspection Coordinator

Christopher G. Williams, P.E., S.E.

(Type or print name)

Becker Structural Engineers, Inc.

(Firm Name)

Signature

Date

Licensed Professional Seal

Project: Patrons Oxford Insurance Office Building
Date Prepared: 1/11/2016

Structural Statement of Special Inspections (Continued)

Special Inspector's/Agent's Final Report

Project: *Patrons Oxford Insurance Office Building*

Special Inspector or
Agent:

(name)

(firm)

Designation:

SI2

To the best of my information, knowledge and belief, the Special Inspections or testing required for this project, and designated for this Inspector/Agent in the *Statement of Special Inspections* submitted for permit, have been performed and all discovered discrepancies have been reported and resolved.

Interim reports submitted prior to this final report form a basis for and are to be considered an integral part of this final report.

Respectfully submitted,
Special Inspector or Agent:

(Type or print name)

Signature

Date

**Licensed Professional Seal or
Certification Number**

Project: Patrons Oxford Insurance Office Building
Date Prepared: 1/11/2016

Structural Statement of Special Inspections (Continued)

Special Inspector's/Agent's Final Report

Project: *Patrons Oxford Insurance Office Building*

Special Inspector or
Agent:

(name)

(firm)

Designation:

TA1

To the best of my information, knowledge and belief, the Special Inspections or testing required for this project, and designated for this Inspector/Agent in the *Statement of Special Inspections* submitted for permit, have been performed and all discovered discrepancies have been reported and resolved.

Interim reports submitted prior to this final report form a basis for and are to be considered an integral part of this final report.

Respectfully submitted,
Special Inspector or Agent:

(Type or print name)

Signature

Date

SEAL NOT REQUIRED
FOR TESTING AGENCY

***Licensed Professional Seal or
Certification Number***

Structural Schedule of Special Inspections

Qualifications of Inspectors and Testing Technicians

The qualifications of all personnel performing Special Inspection and testing activities are subject to the approval of the Building Official. The credentials of all Inspectors and testing technicians shall be provided to the Special Inspector for their records. *NOTE VERIFICATION THAT QUALIFIED INDIVIDUALS ARE AVAILABLE TO PERFORM STIPULATED TESTING AND/OR INSPECTION SHOULD BE PROVIDED PRIOR TO SUBMITTING STATEMENT. AGENT QUALIFICATIONS IN SCHEDULE ARE SUGGESTIONS ONLY; FINAL QUALIFICATIONS ARE SUBJECT TO THE DISCRETION OF THE REGISTERED DESIGN PROFESSIONAL PREPARING THE SCHEDULE.*

Key for Minimum Qualifications of Inspection Agents:

When the Registered Design Professional in Responsible Charge or Special Inspector of Record deems it appropriate that the individual performing a stipulated test or inspection have a specific certification, license or experience as indicated below, such requirement shall be listed below and shall be clearly identified within the schedule under the Agent Qualification Designation.

PE/SE	Structural Engineer – a licensed SE or PE specializing in the design of building structures
PE/GE	Geotechnical Engineer – a licensed PE specializing in soil mechanics and foundations
EIT	Engineer-In-Training – a graduate engineer who has passed the Fundamentals of Engineering examination

Experienced Testing Technician

ETT	Experienced Testing Technician – An Experienced Testing Technician with a minimum 5 years experience with the stipulated test or inspection
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American Concrete Institute (ACI) Certification

ACI-CFTT	Concrete Field Testing Technician – Grade 1
ACI-CCI	Concrete Construction Inspector
ACI-LTT	Laboratory Testing Technician – Grade 1&2
ACI-STT	Strength Testing Technician

American Welding Society (AWS) Certification

AWS-CWI	Certified Welding Inspector
AWS/AISC-SSI	Certified Structural Steel Inspector

American Society of Non-Destructive Testing (ASNT) Certification

ASNT	Non-Destructive Testing Technician – Level II or III.
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International Code Council (ICC) Certification

ICC-SMSI	Structural Masonry Special Inspector
ICC-SWSI	Structural Steel and Welding Special Inspector
ICC-SFSI	Spray-Applied Fireproofing Special Inspector
ICC-PCSI	Prestressed Concrete Special Inspector
ICC-RCSI	Reinforced Concrete Special Inspector

National Institute for Certification in Engineering Technologies (NICET)

NICET-CT	Concrete Technician – Levels I, II, III & IV
NICET-ST	Soils Technician - Levels I, II, III & IV
NICET-GET	Geotechnical Engineering Technician - Levels I, II, III & IV

Other

Structural Schedule of Special Inspections

SOILS & FOUNDATION CONSTRUCTION

VERIFICATION AND INSPECTION	REQD	EXTENT: CONTINUOUS, PERIODIC, SUBMITTAL, OR NONE	COMMENTS	AGENT	AGENT QUALIFICATION	TASK COMPLETED
	Y/N					
IBC Section 1704.7, 1704.8, 1704.9						
1. Required Verification and Inspection of Soils:						
a. Verify materials below shallow foundations are adequate to achieve the design bearing capacity.	Y	P	IBC 1704.7	SI2	PE/GE, EIT or ETT	
b. Verify excavations are extended to proper depth and have reached proper material.	Y	P	IBC 1704.7	SI2	PE/GE, EIT or ETT	
c. Perform classification and testing of compacted fill and engineered fill materials.	Y	P	IBC 1704.7	TA1	PE/GE, EIT or ETT	
d. Verify use of proper materials, densities and lift thicknesses during placement and compaction of compacted fill and/or engineered fill.	Y	C	IBC 1704.7	TA1	PE/GE, EIT or ETT	
e. Prior to placement of compacted fill, observe subgrade and verify that site has been prepared properly.	Y	P	IBC 1704.7	SI2	PE/GE, EIT or ETT	
2. Required Verification and Inspection of Driven Deep Foundation Elements:						
a. Verify element materials, sizes and lengths comply with the requirements.	N	C	IBC 1704.8	TA1	PE/GE, EIT or ETT	
b. Determine capacities of test elements and conduct additional load tests, as required.	N	C	IBC 1704.8	SI2	PE/GE, EIT or ETT	
c. Observe driving operations and maintain complete and accurate records for each element.	N	C	IBC 1704.8	TA1	PE/GE, EIT or ETT	
d. Verify placement locations and plumbness, confirm type and size of hammer, record number of blows per foot of penetration, determine required penetrations to achieve design capacity, record tip and butt elevations and document any damage to foundation element.	N	C	IBC 1704.8	TA1	PE/GE, EIT or ETT	
3. Required Verification and Inspection of Cast-in-Place Deep Foundation Elements:						
a. Observe drilling operations and maintain complete and accurate records for each element.	N	C	IBC 1704.9	TA1	PE/GE, EIT or ETT	
b. Verify placement locations and plumbness, confirm element diameters, bell diameters (if applicable), lengths, embedment into bedrock (if applicable) and adequate end bearing strata capacity. Record concrete or grout volumes.	N	C	IBC 1704.9	TA1	PE/GE, EIT or ETT	

See Concrete, Masonry, and/or Steel Schedules for additional material inspections for deep foundation elements as applicable.

Structural Schedule of Special Inspections
CONCRETE CONSTRUCTION

VERIFICATION AND INSPECTION	REQD	EXTENT: CONTINUOUS, PERIODIC, SUBMITTAL, OR NONE	COMMENTS	AGENT	AGENT QUALIFICATION	TASK COMPLETED
	Y/N					
IBC Section 1704.4						
1. Inspection of reinforcing steel, including prestressing tendons, and placement	Y	P	ACI 318: 3.5, 7.1-7.7	SII	PE/SE or EIT	
2. Inspection of reinforcing steel welding in accordance with Table 1704.3, Item 5B	N	-	Not applicable. Welding of Reinf Not Allowed	-	-	
3. Inspect bolts to be installed in concrete prior to and during placement of concrete where allowable loads have been increased or where strength design is used.	Y	C	IBC 1911.5	SII	PE/SE or EIT	
4. Inspection of anchors installed in hardened concrete.	Y	P	IBC 1212.1	SII	PE/SE or EIT	
5. Verifying use of required design mix	Y	P	ACI 318: Ch 4, 5.2-5.4	TA1	ACI-CFTT or ACI-STT	
6. At time fresh concrete is sampled to fabricate specimens for strength tests, perform slump and air content tests and determine the temperature of the concrete.	Y	C	ASTM C 172 ASTM C 31 ACI 318: 5.6, 5.8	TA1	ACI-CFTT or ACI-STT	
7. Inspection of concrete and shotcrete placement for proper application techniques	Y	C	ACI 318: 5.9, 5.10	TA1	ACI-CFTT or ACI-STT	
8. Inspection for maintenance of specified curing temperature and techniques	Y	P	ACI 318: 5.11-5.13	SII	PE/SE or EIT	
9. Inspection of Prestressed Concrete						
a. Application of prestressing force.	N	C	ACI 318: 18.20	TA2	PE/SE or EIT	
b. Grouting of bonded prestressing tendons in seismic force resisting system	N	C	ACI 318: 18.18.4	TA1	ACI-CFTT or ACI-STT	
10. Erection of precast concrete members.	N	P	ACI 318: Ch 16	SII	PE/SE or EIT	
11. Verification of in-situ concrete strength, prior to stressing of tendons in post-tensioned concrete and prior to removal of shores and forms from beams and structural slabs.	N	P	ACI 318: 6.2	TA1	ACI-CFTT or ACI-STT	
12. Inspect formwork for shape, location and dimensions of the concrete member being formed.	Y	P	Limitations apply. See below	SII	PE/SE or EIT	

Limitations of item 12: Special inspection includes periodic review of formwork shape, general location, and formwork dimensions that can be readily measured with conventional tape measure. Verification of building layout, building location, foundation extents, column grids, and foundation elevations is excluded.

Structural Schedule of Special Inspections - STEEL CONSTRUCTION

VERIFICATION AND INSPECTION	REQD Y/N	EXTENT: CONTINUOUS, PERIODIC, SUBMITTAL, OR NONE	COMMENTS	AGENT	AGENT QUALIFICATION	TASK COMPLETED
IBC Section 1704.3						
1. Material verification of high-strength bolts, nuts and washers:						
a. Identification markings to conform to ASTM standards specified in the approved construction documents.	Y	P	Applicable ASTM material standards, AISC 360, A3.3	TA1	AWS/AISC-SSI	
b. Manufacturer's certificate of compliance required.	Y	S		SII	PE/SE or EIT	
2. Inspection of high-strength bolting						
a. Snug-tight joints.	Y	P		TA1	AWS/AISC-SSI	
b. Pretensioned and slip-critical joints using turn-of-nut with matchmaking, twist-off bolt or direct tension indicator methods of installation.	Y	P	AISC LRFD Section M2.5	TA1	AWS/AISC-SSI	
c. Pretensioned and slip-critical joints using turn-of-nut without matchmaking or calibrated wrench methods of installation.	Y	C	IBC Sect 1704.3.3	TA1	AWS/AISC-SSI	
3. Material verification of structural steel and cold-formed steel deck:						
a. For structural steel, identification markings to conform to AISC 360.	Y	P	AISC 360, M5.5	SII	PE/SE or EIT	
b. For other steel, identification markings to conform to ASTM standards specified in the approved construction documents.	Y	P	Applicable ASTM material standards	SII	PE/SE or EIT	
c. Manufacturer's certified test reports.	Y	S		SII	PE/SE or EIT	
4. Material verification of weld filler materials:						
a. Identification markings to conform to AWS specification in the approved construction documents.	Y	P	AISC 360, M5.5	TA1	AWS/AISC-SSI	
b. Manufacturer's certificate of compliance required.	Y	S		SII	PE/SE or EIT	
5. Submit current AWS D1.1 welder certificate for all field welders who will be welding on this project.	Y	S	AWS D1.1	SII	PE/SE or EIT	
6. Inspection of welding (IBC 1704.3.1):						
a. Structural steel and cold-formed deck:						
1) Complete and partial joint penetration groove welds.	N	C	AWS D1.1	TA1	AWS-CWI	
2) Multipass fillet welds.	N	C		TA1	AWS-CWI	
3) Single-pass fillet welds > 5/16"	N	C		TA1	AWS-CWI	
4) Plug and slot welds	N	C		TA1	AWS-CWI	
5) Single-pass fillet welds ≤ 5/16"	Y	P		TA1	AWS-CWI	
6) Floor and deck welds.	N	P	AWS D1.3	TA1	AWS-CWI	
b. Reinforcing steel:						
1) Verification of weldability of reinforcing steel other than ASTM A706.	N	-	Not applicable.	-	-	
2) Reinforcing steel-resisting flexural and axial forces in intermediate and special moment frames, and boundary elements of special structural walls of concrete and shear reinforcement.	N	C	AWS D1.4 ACI 318: 3.5.2	TA1	AWS-CWI	
3) Shear reinforcement.	N	C		TA1	AWS-CWI	
4) Other reinforcing steel.	N	P		TA1	AWS-CWI	
7. Inspection of steel frame joint details for compliance (IBC Sect 1704.3.2) with approved construction documents:						
a. Details such as bracing and stiffening.	Y	P	IBC 1704.3.2	SII	PE/SE or EIT	
b. Member locations.	Y	P		SII	PE/SE or EIT	
c. Application of joint details at each connection.	Y	P		SII	PE/SE or EIT	

Structural Schedule of Special Inspection Services
FABRICATION AND IMPLEMENTATION PROCEDURES – STRUCTURAL STEEL

VERIFICATION AND INSPECTION IBC Section 1704.2	REQD	EXTENT:	COMMENTS	AGENT	AGENT QUALIFICATION	TASK COMPLETED
	Y/N	CONTINUOUS, PERIODIC, SUBMITTAL, OR NONE				
1. Fabrications Procedures: Review of fabricator's written procedural and quality control manuals and periodic auditing of fabrication practices by an approved special inspection agency. At the completion of fabrication, the approved fabricator shall submit a certificate of compliance to the building code official stating that the work was performed in accordance with the approved construction documents. -OR- 2. AISC Certification	Y	S	Fabricator shall submit one of the two qualifications	SII	PE/SE or EIT	
3. At completion of fabrication, the approved fabricator shall submit a certificate of compliance to the building code official stating that the work was performed in accordance with the approved construction documents.	Y	S	IBC 1704.2.2	SII	PE/SE or EIT	

Structural Schedule of Special Inspection Services
FABRICATION AND IMPLEMENTATION PROCEDURES – WOOD TRUSSES

VERIFICATION AND INSPECTION IBC Section 1704.2	REQD Y/N	EXTENT: CONTINUOUS, PERIODIC, SUBMITTAL, OR NONE	COMMENTS	AGENT	AGENT QUALIFICATION	TASK COMPLETED
1. Fabrications Procedures: Review of fabricator's written procedural and quality control manuals and periodic auditing of fabrication practices by an approved special inspection agency. At the completion of fabrication, the approved fabricator shall submit a certificate of compliance to the building code official stating that the work was performed in accordance with the approved construction documents. -OR- 2. TPI Inspection Program: Fabricator shall participate in the TPI Quality Assurance Inspection Program, and maintain a copy of the Quality Assurance Procedures Manual, QAP-90. Submit copy of certificate. All trusses shall bear the TPI Registered Mark.	Y	S	Fabricator shall submit one of the two qualifications	SII	PE/SE or EIT	
3. At completion of fabrication, the approved fabricator shall submit a certificate of compliance to the building code official stating that the work was performed in accordance with the approved construction documents	Y	S	IBC 1704.2.2	SII	PE/SE or EIT	

Structural Schedule of Special Inspections
WOOD CONSTRUCTION

VERIFICATION AND INSPECTION IBC Section 1704.6	REQD Y/N	EXTENT: CONTINUOUS, PERIODIC, SUBMITTAL, OR NONE	COMMENTS	AGENT	AGENT QUALIFICATION	TASK COMPLETED
1. Fabrication of high-load diaphragms						
a. Verify wood structural panel sheathing for grade and thickness	Y	P	IBC 1704.6	SII	PE/SE or EIT	
b. Verify the nominal size of framing members at adjoining panel edges	Y	P	IBC 1704.6	SII	PE/SE or EIT	
b. Verify the nail or staple diameter and length	Y	P	IBC 1704.6	SII	PE/SE or EIT	
b. Verify the number of fastener lines	Y	P	IBC 1704.6	SII	PE/SE or EIT	
b. Verify the spacing between fasteners in each line and at edge margins	Y	P	IBC 1704.6	SII	PE/SE or EIT	
2. Load Tests for Joist Hangers: Provide evidence of manufacturer's load test in accordance with ASTM D1761 including the vertical load bearing capacity, torsional moment capacity, and deflection characteristics when there is no calculated procedure recognized by the code.	N	S	IBC 1716 [submit ICBO reports]	SII	PE/SE or EIT	
3. Metal-plate-connected wood trusses spanning 60 feet or greater:						
a. Verify the temporary installation restraint / bracing and the permanent individual truss member restraint / bracing is installed per the approved truss submittal package.	N	P	IBC 1704.6.2.	SII	PE/SE or EIT	

Structural Schedule of Special Inspections
SEISMIC RESISTANCE - STRUCTURAL

VERIFICATION AND INSPECTION	REQD Y/N	EXTENT: CONTINUOUS, PERIODIC, SUBMITTAL, OR NONE	COMMENTS	AGENT	AGENT QUALIFICATION	TASK COMPLETE D
IBC Section 1707						
1. Special inspections for seismic resistance. Special inspection as specified in this section is required for the following:						
a. The seismic-force-resisting systems in structures assigned to Seismic Design Category C, D, E or F	Y	P	IBC 1707.1	SII	PE/SE or EIT	
b. Designated seismic systems in structures assigned to Seismic Design Category D, E, or F.	N	P	IBC 1707.1	SII	PE/SE or EIT	
2. Structural steel: Continuous special inspection for structural welding in accordance with AISC 341.	N	C	IBC 1707.2	TA1	AWS-CWI	
3. Structural wood:						
a. Continuous special inspection during field gluing operations of elements of the seismic-force-resisting system.	N	C	IBC 1707.3	SII	PE/SE or EIT	
b. Periodic special inspections for nailing, bolting, anchoring and other fastening of components within the seismic-force-resisting system (where spacing is 4" o.c., or less) including drag struts, braces and hold-downs	Y	P	IBC 1707.3	SII	PE/SE or EIT	
4. Cold-formed steel framing: Periodic special inspections during welding operations of elements of the seismic-force-resisting system. Periodic special inspections for screw attachment, bolting, anchoring and other fastening of components within the seismic-force-resisting system (where spacing is 4" o.c., or less), including struts, braces, and hold-downs	N	-	CFSF for this project not part of the primary seismic-force resisting system.	-	-	
5. Seismic isolation system. Provide periodic special inspection during the fabrication and installation of isolator units and energy dissipation devices if used as part of the seismic isolation system	N	-	Seismic isolators not used.	-	-	

SEISMIC RESISTANCE CHECK LIST [IBC 1705.3]

Seismic Design Category C

<input checked="" type="checkbox"/> FOR SEISMIC DESIGN CATEGORY C OR HIGHER:
Structural:
<input checked="" type="checkbox"/> The seismic-force-resisting systems <input checked="" type="checkbox"/> Steel Braced Frames and associated connections/anchorage (Not required for SDC C, R=3) <input type="checkbox"/> Steel Moment Frames and associated connections (Not required for SDC C, R=3) <input checked="" type="checkbox"/> Shear walls: <input type="checkbox"/> CMU <input checked="" type="checkbox"/> Wood <input type="checkbox"/> Concrete <input checked="" type="checkbox"/> Diaphragms: <input checked="" type="checkbox"/> Floor <input checked="" type="checkbox"/> Roof <input type="checkbox"/> Other:

WIND RESISTANCE CHECK LIST [IBC 1705.4]

Wind Exposure Category B

REQUIRED	NOT REQUIRED	NOT APPLICABLE	WIND RESISTANCE REQUIREMENTS
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	In wind exposure Category B, where the 3-second-gust basic wind speed is 120 miles per hour (mph) (52.8 m/sec) or greater.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	In wind exposure Categories C and D, where the 3-second-gust basic wind speed is 110 mph (49 m/sec) or greater.

Contractor's Statement of Responsibility

Each contractor responsible for the construction or fabrication of a system or component designated in the Quality Assurance Plan must submit a Statement of Responsibility. The Statement of Responsibility is required for Seismic Design Category C or higher. Make additional copies of this form as required.

Project: Patrons Oxford Insurance Office Building

Contractor's Name:

Address:

License No.:

Description of designated building systems and components included in the Statement of Responsibility:

Contractor's Acknowledgment of Special Requirements

I hereby acknowledge that I have received, read, and understand the Quality Assurance Plan and Special Inspection program.

I hereby acknowledge that control will be exercised to obtain conformance with the construction documents approved by the Building Official.

Signature

Date

Contractor's Provisions for Quality Control

Procedures for exercising control within the contractor's organization, the method and frequency of reporting and the distribution of reports is attached to this Statement.

Identification and qualifications of the person(s) exercising such control and their position(s) in the organization are attached to this Statement.

Fabricator's Certificate of Compliance

Each approved fabricator that is exempt from Special Inspection of shop fabrication and implementation procedures per section 1704.2 of the International Building Code must submit a *Fabricator's Certificate of Compliance* at the completion of fabrication.

Project: Patrons Oxford Insurance Office Building

Fabricator's Name:

Address:

Certification or Approval Agency:

Certification Number:

Date of Last Audit or Approval:

Description of structural members and assemblies that have been fabricated:

I hereby certify that items described above were fabricated in strict accordance with the approved construction documents.

Signature

Date

Title

Attach copies of fabricator's certification or building code evaluation service report and fabricator's quality control manual

Project: Patrons Oxford Insurance Office Building
Date Prepared: 1/11/2016

End of Structural Statement of Special Inspections

October 27, 2015

Ms. Jeanie Bourke
Code Enforcement Officer/Plan Reviewer
Planning & Urban Development Dept.
City of Portland, Maine
389 Congress St., Room 315
Portland, ME 04101

Dear Ms. Bourke,

This letter is in regards to the proposed construction of a new office building for Patrons Oxford Insurance Company located in the Portland Technology Park on Rand Road in Portland, Maine. Our intent is to identify a seismic force resisting system and associated design criteria for the building. The system has been carefully selected based on our research of similar systems in other buildings, our correspondence with experts from professional organizations, and our wide range of experience with seismic design of buildings. However, the proposed system is not currently identified in the adopted building codes, and thus we ask for your approval as the Authority Having Jurisdiction (AHJ) to implement this system into the building's design and construction.

The office building, which is currently in the design phase, consists of a heavy timber beam and column system for support of gravity loads. Lateral loads are intended to be resisted by a combination of plywood-sheathed shearwalls and frames constructed from steel rod cross braces. Our design is based on the International Building Code (IBC), 2009 edition, and the American Society of Civil Engineers Standard 7: Minimum Design Loads for Buildings and other Structures (ASCE-7), 2005 edition.

Mass timber serving as the primary structure for commercial buildings is uncommon where compared to steel and concrete. The building codes do not provide many options for classifying seismic force resisting systems for heavy timber buildings. Table 12.2-1 from the ASCE-7 standard is used to establish seismic design criteria based on the seismic force resisting system that is chosen. Specific to this project, the criteria provided in the table is described below:

- "R" – Response Factor – This factor is used to appropriately reduce the applied seismic forces on a system based on its inherent levels of ductility, toughness and energy dissipation.
- " Ω_0 " – Overstrength Factor – This factor is used to increase the design force on a specific element in a seismic force resisting system in order to eliminate a certain type of failure.

ASCE-7 Table 12.2-1 recognizes plywood-sheathed shearwalls in building frame systems, and thus provides approved criteria for their design. However, the table does not provide criteria for steel braces connected to timber beams and columns, and thus values for "R" and " Ω_0 " cannot be established. Becker Structural Engineers (BSE) has performed research on buildings constructed in U.S. and Canada with similar types of construction to the Patrons Oxford project. BSE also contacted members of the American Wood Council (AWC) in order to consult their expertise in seismic design of heavy timber buildings. Below is a summarized list of our research and findings:

- Critical to the performance of a system resisting seismic loads is its ductility. Ductility is a measure of a system's ability to resist load and undergo deformations after its initial failure

mechanism has been developed. Ductile systems offer increased energy dissipation compared to brittle systems and allow for the engineer to better predict where failure mechanisms will occur. These characteristics are ideal for seismic design of buildings.

- Heavy timber structures are far more prevalent in Canada than the U.S. The Canadian Building Code recognizes the use of timber frames in seismic design and has established criteria for these systems. The Canadian Codes offers values for the resistance factor "R" that range from 2.25 for limited-ductility systems to 3.0 for moderate-ductility systems.
- IBC and ASCE-7 do not provide criteria for timber braced frames. Similar braced frames composed entirely of structural steel and without special seismic detailing (ideal for low and moderate risk seismic designs) provide values for "R" equal to 3.0. Our proposed office building is considered by ASCE-7 to be moderate seismic risk.
- The Simpson Strong-Tie Materials Laboratory at California Polytechnic State University is an example of a timber braced frame building that has been constructed in the U.S. This building, constructed in a high seismic risk area, was designed utilizing a value of R equal to 3.0. The design achieved yielding of the bolted fasteners as the primary failure mode, which is a ductile mechanism consistent with R=3.0 buildings. The ductility was achieved by applying an overstrength factor to the design of the timber brace, eliminating a brittle failure mode in the brace and ensuring a ductile failure mode in the fasteners.
- Steel rod braces connected to timber beams and columns can be designed in a similar fashion. In this configuration, it is ideal to provide the ductile failure mechanism in the steel brace by applying the overstrength factors to the timber elements and their connections. BSE consulted timber engineering experts from AWC, who confirmed that this approach is acceptable and consistent with ductile designs in R=3.0 buildings.

Based on our studies and research, we believe the seismic force resisting system utilizing steel rod braces connected to timber beams and columns is acceptable for use in this project. The lateral system will be designed using a response factor "R" equal to 3.0. Additionally, braced frame connections and all timber elements will be designed using an overstrength factor " Ω_0 " equal to 3.0. This will ensure a ductile mechanism is developed in the steel brace.

As the AHJ for this project, under IBC section 104.11 "Alternate materials, design and methods of construction," you have the authority to approve the implementation of the lateral force resisting system described herein. Should you agree with the information provided in this letter, we would appreciate your signature below, approving the use of the proposed lateral force resisting system for this project. If you have any questions or need further clarification, please do not hesitate to contact us.

Sincerely,

BECKER STRUCTURAL ENGINEERS, Inc.

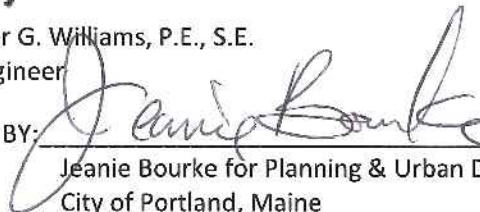


Christopher G. Williams, P.E., S.E.
Project Engineer



Paul B. Becker, P.E.
President

ACCEPTED BY:



Jeanie Bourke for Planning & Urban Development Dept.
City of Portland, Maine

DATE: 10/30/15



SECTION 014200 - REFERENCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 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": Unload, temporarily store, unpack, assemble, erect, place, anchor, apply, work to dimension, finish, cure, protect, clean, and similar operations at Project site.
- 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.
- J. Substantial Completion: The stage in the progress of the Work when the Work or designated portion thereof is sufficiently complete in accordance with the Contract Documents so the Owner can occupy or utilize the Work for its intended use. Minor corrections and repairs that can be performed while the Owner has occupied the building and without undue annoyance to personnel will be acceptable under the definition of Substantial Completion. It shall also include major final cleaning required under the Contract, removal of all surplus equipment and material

not required for completion or remaining work, and the placement of remaining materials and equipment in convenient locations as approved by the Owner.

1.3 INDUSTRY STANDARDS

- A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.
- B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.
- C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.
 - 1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.

1.4 ABBREVIATIONS AND ACRONYMS

- A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities indicated in Gale's "Encyclopedia of Associations: National Organizations of the U.S." or in Columbia Books' "National Trade & Professional Associations of the United States."
- 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. This information is believed to be accurate as of the date of the Contract Documents.
 - 1. DIN - Deutsches Institut fur Normung e.V.; www.din.de.
 - 2. IAPMO - International Association of Plumbing and Mechanical Officials; www.iapmo.org.
 - 3. ICC - International Code Council; www.iccsafe.org.
 - 4. ICC-ES - ICC Evaluation Service, LLC; www.icc-es.org.
- 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. Information is subject to change and is up-to-date as of the date of the Contract Documents.
 - 1. COE - Army Corps of Engineers; www.usace.army.mil.
 - 2. CPSC - Consumer Product Safety Commission; www.cpsc.gov.
 - 3. DOC - Department of Commerce; National Institute of Standards and Technology; www.nist.gov.
 - 4. DOD - Department of Defense; <http://dodssp.daps.dla.mil>.
 - 5. DOE - Department of Energy; www.energy.gov.
 - 6. EPA - Environmental Protection Agency; www.epa.gov.
 - 7. FAA - Federal Aviation Administration; www.faa.gov.

8. FG - Federal Government Publications; www.gpo.gov.
9. GSA - General Services Administration; www.gsa.gov.
10. HUD - Department of Housing and Urban Development; www.hud.gov.
11. LBL - Lawrence Berkeley National Laboratory; Environmental Energy Technologies Division; <http://eetd.lbl.gov>.
12. OSHA - Occupational Safety & Health Administration; www.osha.gov.
13. SD - Department of State; www.state.gov.
14. TRB - Transportation Research Board; National Cooperative Highway Research Program; www.trb.org.
15. USDA - Department of Agriculture; Agriculture Research Service; U.S. Salinity Laboratory; www.ars.usda.gov.
16. USDA - Department of Agriculture; Rural Utilities Service; www.usda.gov.
17. USDJ - Department of Justice; Office of Justice Programs; National Institute of Justice; www.ojp.usdoj.gov.
18. USP - U.S. Pharmacopeia; www.usp.org.
19. USPS - United States Postal Service; www.usps.com.

D. Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the standards and regulations in the following list. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.

1. CFR - Code of Federal Regulations; Available from Government Printing Office; www.gpo.gov/fdsys.
2. DOD - Department of Defense; Military Specifications and Standards; Available from Department of Defense Single Stock Point; <http://dodssp.daps.dla.mil>.
3. DSCC - Defense Supply Center Columbus; (See FS).
4. FED-STD - Federal Standard; (See FS).
5. FS - Federal Specification; Available from Department of Defense Single Stock Point; <http://dodssp.daps.dla.mil>.
 - a. Available from Defense Standardization Program; www.dsp.dla.mil.
 - b. Available from General Services Administration; www.gsa.gov.
 - c. Available from National Institute of Building Sciences/Whole Building Design Guide; www.wbdg.org/ccb.
6. MILSPEC - Military Specification and Standards; (See DOD).
7. USAB - United States Access Board; www.access-board.gov.
8. USATBCB - U.S. Architectural & Transportation Barriers Compliance Board; (See USAB).

E. State 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. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.

1. MDEP - State of Maine Department of Environmental Protection.
2. MDOT - State of Maine Department of Transportation

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 014200

SECTION 014339 - INTEGRATED EXTERIOR MOCKUPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for constructing the Integrated Exterior Mockups.
 - 1. Related Sections that will comprise required components within the Integrated Exterior Mockup include the following:
 - a. Division 03 Section "Cast-In-Place Concrete" for formed concrete wall system.
 - b. Division 06 Section "Rough Carpentry" for wood framing and blocking at windows.
 - c. Division 06 Section "Sheathing" for exterior wall sheathing.
 - d. Division 06 Section "Exterior Finish Carpentry" for exterior wood siding.
 - e. Division 07 Section "Modified Bituminous Sheet Air Barriers" for air barrier systems.
 - f. Division 07 Section "Fiber-Cement Siding" for cement siding systems.
 - g. Division 08 Section "Aluminum-Framed Entrances and Storefronts" for exterior windows.
 - B. Related Sections include the following:
 - 1. Division 01 Section "Quality Requirements" for administrative and procedural requirements for quality assurance and quality control.

1.3 DEFINITIONS

- A. 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.
 - 1. Integrated Exterior Mockups: Mockups of the exterior envelope erected separately from the building but on the project site, consisting of multiple products, assemblies and subassemblies.

- B. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.
 - 1. Using a term such as "carpentry" does not imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as "carpenter." It also does not imply that requirements specified apply exclusively to tradespeople of the corresponding generic name.
- C. Experienced: When used with an entity, "experienced" means having successfully completed a minimum of five previous projects similar in size and scope to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

1.4 QUALITY ASSURANCE

- A. Integrated Exterior Mockups: Before installing portions of the Work requiring mockups, construct integrated exterior mockup as indicated on Drawing attached to this section. Coordinate installation of exterior envelope materials and products for which mockups are required in individual specification sections, along with supporting materials, using materials indicated for the completed Work:
 - 1. Build mockups in location and of size indicated on the drawings.
 - 2. Employ supervisory personnel who will oversee mockup construction. Employ workers that will be employed during the construction at the Project.
 - 3. Demonstrate the proposed range of aesthetic effects and workmanship.
 - 4. Obtain Architect's approval of mockups before starting work, fabrication, or construction.
 - 5. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless such deviations are specifically approved by Architect in writing.
 - 6. Demolish and remove mockups when directed, unless otherwise indicated.

PART 2 - PRODUCTS

- 2.1 Refer to individual specification sections for products and materials required for mockup.

PART 3 - EXECUTION

3.1 MOCKUP REVIEW

- A. Notify Architect seven days in advance of dates and times when mockups will be constructed and ready for review.
 - 1. Notify Architect when backup wall system, air barrier system and window has been installed and ready for review.

- a. Allow seven days for initial review and each re-review of each mockup.
2. Notify Architect when masonry veneer and siding systems has been installed and ready for review.
 - a. Allow seven days for initial review and each re-review of each mockup.

3.2 PROTECTION

- A. Protect mockup assemblies for quality-control service activities.
- B. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.

END OF SECTION 014000

SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.

1.3 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. Sewer Service: Pay sewer-service use charges for sewer usage by all entities for construction operations.
- C. Water Service: Pay water-service use charges for water used by all entities for construction operations.
- D. Electric Power Service: Pay electric-power-service use charges for electricity used by all entities for construction operations.
- E. Heating Fuel: Fuel required for temporary heating will be the responsibility of the Contractor.
- F. Telephone Service: Pay installation, service and use charges for telephone usage, by Contractor, at Project site.
- G. Internet Service: Pay installation, service and use charges for internet usage, by Contractor, at Project site.

1.4 INFORMATIONAL SUBMITTALS

- A. Site Plan: Show temporary facilities, utility hookups, staging areas, and parking areas for construction personnel.
- B. Erosion and Sedimentation Control Plan: Show compliance with requirements of EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent.

- C. Fire-Safety Program: Show compliance with requirements of NFPA 241 and authorities having jurisdiction. Indicate Contractor personnel responsible for management of fire-prevention program.
- D. Moisture-Protection Plan: Describe procedures and controls for protecting materials and construction from water absorption and damage.
 - 1. Describe delivery, handling, and storage provisions for materials subject to water absorption or water damage.
 - 2. Indicate procedures for discarding water-damaged materials, protocols for mitigating water intrusion into completed Work, and replacing water-damaged Work.
 - 3. Indicate sequencing of work that requires water, such as sprayed fire-resistive materials, plastering, and terrazzo grinding, and describe plans for dealing with water from these operations. Show procedures for verifying that wet construction has dried sufficiently to permit installation of finish materials.
- E. Dust- and HVAC-Control Plan: Submit coordination drawing and narrative that indicates the dust- and HVAC-control measures proposed for use, proposed locations, and proposed time frame for their operation. Identify further options if proposed measures are later determined to be inadequate. Include the following:
 - 1. Locations of dust-control partitions at each phase of work.
 - 2. HVAC system isolation schematic drawing.
 - 3. Location of proposed air-filtration system discharge.
 - 4. Waste handling procedures.
 - 5. Other dust-control measures.
- F. Cold-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with cold-weather requirements to protect install concrete and masonry.

1.5 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.

1.6 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.

- B. Frost Protection: Protect footings and slabs from freezing temperatures and prevent frost from occurring beneath footings and slabs. Frozen water found on soil or concrete surface shall be reason for rejection of protection method. Provide corrective measures within 24 hours after notice of condition is given. Evidence of frost at these locations shall be reason for rejection, removal, and replacement at no additional cost to the Owner.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Vinyl Fencing: Standard 3 foot high, orange construction fence with steel posts.
- B. Lumber and Plywood: Comply with requirements in Division 06 Section "Rough Carpentry."
- C. Gypsum Board: Minimum 1/2 inch thick by 48 inches wide by maximum available lengths; regular-type panels with tapered edges. Comply with ASTM C 36/C 36M.
- D. Polyethylene Sheet: Reinforced, fire-resistive sheet, 10-mil minimum thickness, with flame-spread rating of 15 or less per ASTM E 84 and passing NFPA 701 Test Method 2.
- E. Dust-Control Adhesive-Surface Walk-off Mats: Provide mats minimum 36 by 60 inches.
- F. Insulation: Unfaced mineral-fiber blanket, manufactured from glass, slag wool, or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively.

2.2 TEMPORARY FACILITIES

- A. Field Offices, General: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.
- B. Common-Use Field Office: Of sufficient size to accommodate needs of construction personnel office activities and to accommodate Project meetings specified in other Division 01 Sections. Keep office clean and orderly. Furnish and equip offices as follows:
 - 1. Furniture required for Project-site documents including file cabinets, plan tables, plan racks, and bookcases.
 - 2. Conference room of sufficient size to accommodate meetings of 6 individuals. Provide electrical power service and 120-V ac duplex receptacles, with no fewer than one receptacle on each wall. Furnish room with conference table, chairs, and 4-foot- square tack and marker boards.
 - 3. Heating and cooling equipment necessary to maintain a uniform indoor temperature of 68 to 72 deg F.
 - 4. Lighting fixtures capable of maintaining average illumination of 20 fc at desk height.
- C. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.
 - 1. Store combustible materials apart from building.

2.3 EQUIPMENT

- A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.
- B. HVAC Equipment: Provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control. Heaters shall be located outside the building and combustion gases shall be vented outside the building. Maintain observation of units in operation.
 - 1. Use of gasoline-burning space heaters, interior open-flame heaters, or salamander-type heating units is prohibited.
 - 2. Heating Units: Listed and labeled for type of fuel being consumed, by a qualified testing agency acceptable to authorities having jurisdiction, and marked for intended location and application.
- C. Air-Filtration Units: Primary and secondary HEPA-filter-equipped portable units with four-stage filtration. Provide single switch for emergency shutoff. Configure to run continuously.

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.
 - 1. Locate facilities to limit site disturbance as specified in Section 011000 "Summary."
- 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 TEMPORARY UTILITY INSTALLATION

- A. General: Install temporary service or connect to existing service.
 - 1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.
- B. Sewers and Drainage: Provide temporary utilities to remove effluent lawfully.
- C. Water Service: Install water service and distribution piping in sizes and pressures adequate for construction.
- D. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.

- E. Heating: Provide temporary heating required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.
1. Maintain a minimum temperature of 50 deg F in permanently enclosed portions of building for normal construction activities, and 65 deg F for finishing activities and areas where finished Work has been installed.
 - a. Refer to Divisions 02 through 48 for additional temporary heat, ventilation, and humidity requirements for products in those Sections.”
 2. Provide temporary heat to protect all concrete and masonry work during installation as well as other trades needing specific heat requirements to perform and protect their work. See individual specification sections for detailed information.
 3. All concrete slabs on grade, footings and foundations not below the frost line shall be protected from freezing either by heating or protecting with insulation until substantial completion.
- F. Ventilation and Humidity Control: Provide temporary ventilation required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce ambient condition required and minimize energy consumption.
1. Provide dehumidification systems when required to reduce substrate moisture levels to level required to allow installation or application of finishes.
 2. The permanent ventilation system shall be fully operational and run full time for a minimum of 2 weeks before date established for Substantial Completion. Cost of operation shall be included as part of the work.
- G. Electric Power Service: Refer to Division 26 for requirements.
- H. Lighting: Refer to Division 26 for requirements.
- I. Telephone Service: Provide temporary telephone service in common-use facilities for use by all construction personnel.
1. At each telephone, post a list of important telephone numbers.
 - a. Police and fire departments.
 - b. Ambulance service.
 - c. Contractor's home office.
 - d. Contractor's emergency after-hours telephone number.
 - e. Architect's office.
 - f. Engineers' offices.
 - g. Owner's office.
 - h. Principal subcontractors' field and home offices.
 2. Provide an answering service on superintendent's telephone.

- J. Internet Service: Provide high-speed internet service to Construction Manager's field office.

3.3 SUPPORT FACILITIES INSTALLATION

- A. General: Comply with the following:

1. Provide construction for temporary offices, shops, and sheds located within construction area or within 30 feet of building lines that is noncombustible according to ASTM E 136. Comply with NFPA 241.
2. Maintain support facilities until Architect schedules Substantial Completion inspection. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.

- B. Temporary Roads and Parking Areas: Construct and maintain temporary roads and parking areas adequate to support loads and to withstand exposure to traffic during construction period. Locate temporary roads and parking areas within construction limits indicated on Drawings.

1. Provide a reasonably level, graded, well-drained subgrade of satisfactory soil material, compacted to not less than 95 percent of maximum dry density in the top 6 inches.
2. Provide gravel paving course of subbase material not less than 3 inches thick; roller compacted to a level, smooth, dense surface.
3. Provide dust-control treatment that is nonpolluting and nontracking. Reapply treatment as required to minimize dust.

- C. Traffic Controls: Comply with requirements of authorities having jurisdiction.

1. Protect existing site improvements to remain including curbs, pavement, and utilities.
2. Maintain access for fire-fighting equipment and access to fire hydrants.

- D. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.

1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties or endanger permanent Work or temporary facilities.
2. Remove snow and ice as required to minimize accumulations.

- E. Project Identification and Temporary Signs: Prepare Project identification and other signs in sizes indicated. Install signs where indicated to inform public and persons seeking entrance to Project. Do not permit installation of unauthorized signs.

1. Engage an experienced sign painter to apply graphics for Project identification signs. Comply with details indicated. Include name of project, and names of Owner, Architect and Contractor. Comply with details indicated on the sketch attached to the end of this section.
2. Construct signs of exterior-type Grade B-B high-density concrete form overlay plywood in size of 4 by 8 feet and 3/4 inch thickness, unless otherwise indicated. Support on posts or framing of preservative-treated wood or steel.
3. Paint sign panel and applied graphics with exterior-grade alkyd gloss enamel over exterior primer.

4. Temporary Signs: Provide other signs as indicated and as required to inform public and individuals seeking entrance to Project.
 - a. Provide temporary, directional signs for construction personnel and visitors.
5. Maintain and touchup signs so they are legible at all times.
- F. Waste Disposal Facilities: Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."
- G. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.
 1. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.
- H. Temporary Elevator Use: Use of elevators is not permitted.
- I. Temporary Stairs: Until permanent stairs are available, provide temporary stairs where ladders are not adequate.
- J. Temporary Use of Permanent Stairs: Use of new stairs for construction traffic will be permitted, provided stairs are protected and finishes restored to new condition at time of Substantial Completion.

3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.
- B. 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.
 1. Comply with work restrictions specified in Section 011000 "Summary."
- C. Temporary Erosion and Sedimentation Control: Provide measures to prevent soil erosion and discharge of soil-bearing water runoff and airborne dust to undisturbed areas and to adjacent properties and walkways.
 1. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross tree- or plant- protection zones.
 2. Inspect, repair, and maintain erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
 3. Clean, repair, and restore adjoining properties and roads affected by erosion and sedimentation from Project site during the course of Project.
 4. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

- D. Stormwater Control: Comply with requirements of authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.
- E. Tree and Plant Protection: Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from damage from construction operations. Protect tree root systems from damage, flooding, and erosion.
- F. Site Enclosure Fence: Prior to commencing earthwork, furnish and install site enclosure fence in a manner that will prevent people and animals from easily entering site except by entrance gates.
 - 1. Extent of Fence: As required to enclose entire Project site or portion determined sufficient to accommodate construction operations.
- G. Security Enclosure and Lockup: Install temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security. Lock entrances at end of each work day.
- H. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.
- I. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.
 - 1. Where heating or cooling is needed and permanent enclosure is incomplete, insulate temporary enclosures.
- J. 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; manage fire-prevention program.
 - 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 hoses for fire protection of sufficient length to reach construction areas. 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.

3.5 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. Exposed Construction Phase: Before installation of weather barriers, when materials are subject to wetting and exposure and to airborne mold spores, protect as follows:

1. Protect porous materials from water damage.
 2. Protect stored and installed material from flowing or standing water.
 3. Keep porous and organic materials from coming into prolonged contact with concrete.
 4. Remove standing water from decks.
 5. Keep deck openings covered or dammed.
- C. 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. Periodically collect and remove waste containing cellulose or other organic matter.
 4. Discard or replace water-damaged material.
 5. Do not install material that is wet.
 6. Discard, replace, or clean stored or installed material that begins to grow mold.
 7. Perform work in a sequence that allows any wet materials adequate time to dry before enclosing the material in drywall or other interior finishes.
- D. 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. Use permanent HVAC system to control humidity.
 3. Comply with manufacturer's written instructions for temperature, relative humidity, and exposure to water limits.
 - a. Hygroscopic materials that may support mold growth, including wood and gypsum-based products, that become wet during the course of construction and remain wet for 48 hours are considered defective.
 - b. Measure moisture content of materials that have been exposed to moisture during construction operations or after installation. Record readings beginning at time of exposure and continuing daily for 48 hours. Identify materials containing moisture levels higher than allowed. Report findings in writing to Architect.
 - c. Remove materials that cannot be completely restored to their manufactured moisture level within 48 hours.

3.6 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. Remove temporary roads and paved areas not intended for or acceptable for integration into permanent construction. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.
 - 3. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 017700 "Closeout Procedures."

END OF SECTION 015000

SECTION 016000 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

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

1.3 DEFINITIONS

- A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
 - 1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature, that is current as of date of the Contract Documents.
 - 2. New Products: Items that have not previously been incorporated into another project or facility. Products salvaged or recycled from other projects are not considered new products.
- B. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.
- C. Basis-of-Design Product Specification: A specification in which a specific manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of additional manufacturers named in the specification.

1.4 ACTION SUBMITTALS

- A. Basis-of-Design Product Specification Submittal: Comply with requirements in Section 013300 "Submittal Procedures." Show compliance with requirements.

1.5 QUALITY ASSURANCE

- A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.
 - 1. Each contractor is responsible for providing products and construction methods compatible with products and construction methods of other contractors.
 - 2. If a dispute arises between contractors over concurrently selectable but incompatible products, Architect will determine which products shall be used.
- B. Products with asbestos: Asbestos containing materials are not to be purchased or installed in this project.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.
- B. Delivery and Handling:
 - 1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
 - 2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
 - 3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
 - 4. Inspect products on delivery to determine compliance with the Contract Documents and to determine that products are undamaged and properly protected.
- C. Storage:
 - 1. Store products to allow for inspection and measurement of quantity or counting of units.
 - 2. Store materials in a manner that will not endanger Project structure.
 - 3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
 - 4. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
 - 5. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
 - 6. Protect stored products from damage and liquids from freezing.
- D. During the construction process, meet or exceed the following minimum requirements to prevent the growth of mold and bacteria:
 - 1. Keep building materials dry. Wood, porous insulation, paper, fabric, and similar absorptive materials shall be kept dry to prevent the growth of mold and bacteria. Cover

these materials to prevent rain damage, and if resting on the ground, use spacers to allow air to circulate between the ground and the materials.

2. Replace water-damaged materials, or dry within 24 hours, due to the possibility of mold and bacterial growth. Materials that are damp or wet for more than 24 hours shall be discarded if evidence of mold occurs.
3. Immediately remove materials showing signs of mold and mildew, including materials with exposed moisture stains, from the site and properly dispose of them. Replace moldy materials with new, undamaged materials.
4. Require that moisture sensitive materials be delivered dry and protected from the elements.
5. Allow for time in the construction schedule for materials to dry before they are enclosed.

1.7 PRODUCT WARRANTIES

- A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
 1. **Manufacturer's Warranty:** Written warranty furnished by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
 2. **Special Warranty:** Written warranty required by the Contract Documents to provide specific rights for Owner.
- B. **Special Warranties:** Prepare a written document that contains appropriate terms and identification, ready for execution.
 1. **Manufacturer's Standard Form:** Modified to include Project-specific information and properly executed.
 2. **Specified Form:** When specified forms are included with the Specifications, prepare a written document using indicated form properly executed.
 3. See other Sections for specific content requirements and particular requirements for submitting special warranties.
- C. **Submittal Time:** Comply with requirements in Section 017700 "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

- A. **General Product Requirements:** Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.
 1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
 2. **Standard Products:** If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.

3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
4. Where products are accompanied by the term "as selected," Architect will make selection.
5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.
6. Or Equal: Where products are specified by name and accompanied by the term "or equal" or "or approved equal" or "or approved substitute" or approved," comply with provisions in "Product Substitutions" Article to obtain approval for use of an unnamed product.

B. Product Selection Procedures:

1. Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Substitutions for Contractor's convenience will not be considered.
2. Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Substitutions for Contractor's convenience will not be considered.
3. Products:
 - a. Restricted List: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Substitutions for Contractor's convenience will be considered, unless otherwise indicated.
 - b. Nonrestricted List: Where Specifications include a list of names of both available manufacturers and products, provide one of the products listed, or an unnamed product, that complies with requirements. Comply with requirements in Division 01 Section "Substitution Procedures" for consideration of an unnamed product.
4. Manufacturers:
 - a. Restricted List: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Substitutions for Contractor's convenience will be considered, unless otherwise indicated.
 - b. Nonrestricted List: Where Specifications include a list of available manufacturers, provide a product by one of the manufacturers listed, or a product by an unnamed manufacturer, that complies with requirements. Comply with requirements in Division 01 Section "Substitution Procedures" for consideration of an unnamed manufacturer.
5. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in Division 01 Section "Substitution Procedures" for consideration of an unnamed product or manufacturer.

- C. Visual Matching Specification: Where Specifications require "match Architect's sample", provide a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.
 - 1. If no product available within specified category matches and complies with other specified requirements, comply with requirements in Section 012500 "Substitution Procedures" for proposal of product.
- D. Visual Selection Specification: Where Specifications include the phrase "as selected by Architect from manufacturer's full range" or similar phrase, select a product that complies with requirements. Architect will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

PART 3 - EXECUTION (Not Used)

END OF SECTION 016000

SECTION 017300 - EXECUTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes general administrative and procedural requirements governing execution of the Work including, but not limited to, the following:
 - 1. Construction layout.
 - 2. Field engineering and surveying.
 - 3. Installation of the Work.
 - 4. Cutting and patching.
 - 5. Coordination of Owner-installed products.
 - 6. Progress cleaning.
 - 7. Starting and adjusting.
 - 8. Protection of installed construction.

1.3 DEFINITIONS

- A. Cutting: Removal of in-place construction necessary to permit installation or performance of other work.
- B. Patching: Fitting and repair work required to restore construction to original conditions after installation of other work.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For land surveyor.
- B. Certificates: Submit certificate signed by land surveyor certifying that location and elevation of improvements comply with requirements.
- C. Certified Surveys: Submit two copies signed by land surveyor.
- D. Final Property Survey: Submit 3 copies showing the Work performed and record survey data.

1.5 QUALITY ASSURANCE

- A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.
- B. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.
 - 1. Structural Elements: When cutting and patching structural elements, notify Architect of locations and details of cutting and await directions from Architect before proceeding. Shore, brace, and support structural elements during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection
 - 2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety.
 - 3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety.
 - 4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.
- C. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of products and equipment.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Comply with requirements specified in other Sections.
- B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.
 - 1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Architect for the visual and functional performance of in-place materials.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities, mechanical and electrical systems, and other construction affecting the Work.
1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; underground electrical services, and other utilities.
 2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.
- B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
 2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
 3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
- C. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:
1. Description of the Work.
 2. List of detrimental conditions, including substrates.
 3. List of unacceptable installation tolerances.
 4. Recommended corrections.
- D. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Existing Utility Information: Furnish information to Owner that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.
- B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

- C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.
- D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents caused by differing field conditions outside the control of Contractor, submit a request for information to Architect according to requirements in Section 013100 "Project Management and Coordination."

3.3 CONSTRUCTION LAYOUT

- A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Architect promptly.
- B. General: Engage a land surveyor to lay out the Work using accepted surveying practices.
 - 1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
 - 2. Establish limits on use of Project site.
 - 3. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
 - 4. Inform installers of lines and levels to which they must comply.
 - 5. Check the location, level and plumb, of every major element as the Work progresses.
 - 6. Notify Architect when deviations from required lines and levels exceed allowable tolerances.
 - 7. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.
- C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.
- D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.
- E. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect.

3.4 FIELD ENGINEERING

- A. Identification: Owner will identify existing benchmarks, control points, and property corners.
- B. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.

1. Do not change or relocate existing benchmarks or control points without prior written approval of Architect. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Architect before proceeding.
 2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.
- C. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.
1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
 2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
 3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.
- D. Certified Survey: On completion of foundation walls, major site improvements, and other work requiring field-engineering services, prepare a certified survey showing dimensions, locations, angles, and elevations of construction and sitework.
- E. Final Property Survey: Engage a land surveyor to prepare a final property survey showing significant features (real property) for Project. Include on the survey a certification, signed by land surveyor, that principal metes, bounds, lines, and levels of Project are accurately positioned as shown on the survey.
1. Show boundary lines, monuments, streets, site improvements and utilities, existing improvements and significant vegetation, adjoining properties, acreage, grade contours, and the distance and bearing from a site corner to a legal point.
 2. Recording: At Substantial Completion, have the final property survey recorded by or with authorities having jurisdiction as the official "property survey."

3.5 INSTALLATION

- A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
1. Make vertical work plumb and make horizontal work level.
 2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
 3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.

- D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.
- E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on site and placement in permanent locations.
- F. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.
- G. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.
- H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions.
 - 1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
 - 2. Allow for building movement, including thermal expansion and contraction.
 - 3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- I. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.
- J. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

3.6 CUTTING AND PATCHING

- A. Cutting and Patching, General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
 - 1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
- B. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.
- C. Temporary Support: Provide temporary support of work to be cut.
- D. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.

- E. Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching according to requirements in Section 011000 "Summary."
- F. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to minimize interruption to occupied areas.
- G. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
 2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
 3. Concrete: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
 4. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
 5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
 6. Proceed with patching after construction operations requiring cutting are complete.
- H. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other work. Patch with durable seams that are as invisible as practicable. Provide materials and comply with installation requirements specified in other Sections, where applicable.
1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
 2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will minimize evidence of patching and refinishing.
 - a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
 - b. Restore damaged pipe covering to its original condition.
 3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
 - a. Where patching occurs in a painted surface, prepare substrate and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.

4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
 5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.
- I. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.7 PROGRESS CLEANING

- A. General: Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.
1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
 2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F.
 3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
 - a. Use containers intended for holding waste materials of type to be stored.
 4. Coordinate progress cleaning for joint-use areas where Contractor and other contractors are working concurrently.
- B. Site: Maintain Project site free of waste materials and debris.
- C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.
1. Remove liquid spills promptly.
 2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
 - a. Clean interior spaces prior to the start of finish painting, and continue cleaning on an as-needed basis until painting is finished.
 - b. Schedule operations so that dust and other contaminants resulting from cleaning process will not fall on wet or newly coated surfaces.
 3. Remove materials and debris that create tripping hazards.
- D. For general construction, each trade shall pick up the debris and rubbish, generated by that trade, and dispose of in dumpsters furnished by the General Contractor.
- E. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.

- F. Concealed Spaces: Remove dirt, debris and garbage from concealed spaces, including stud cavities before enclosing the space.
- G. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
- H. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Section 017419 "Construction Waste Management and Disposal."
- I. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.
- J. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
- K. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.8 STARTING AND ADJUSTING

- A. Coordinate startup and adjusting of equipment and operating components with requirements in Section 019113 "General Commissioning Requirements."
- B. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
- C. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.
- D. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- E. Manufacturer's Field Service: Comply with qualification requirements in Section 014000 "Quality Requirements."

3.9 PROTECTION OF INSTALLED CONSTRUCTION

- A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.
- B. Comply with manufacturer's written instructions for temperature and relative humidity.
- C. Protect resilient flooring against mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by flooring manufacturer.

1. Cover products installed on floor surfaces with undyed, untreated building paper until inspection for Substantial Completion.
 2. Do not move heavy and sharp objects directly over floor surfaces. Place plywood or hardboard panels over flooring and under objects while they are being moved. Slide or roll objects over panels without moving panels.
- D. Protect roofing materials against cuts, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during the remainder of construction period.
1. Do not move heavy and sharp objects directly over roof surfaces. Place plywood or hardboard panels over roofing and under objects while they are being moved. Slide or roll objects over panels without moving panels.

END OF SECTION 017300

SECTION 017419 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for the following:
 - 1. Recycling nonhazardous construction waste.
 - 2. Disposing of nonhazardous construction waste.

1.3 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. 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.
- C. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.

1.4 PERFORMANCE REQUIREMENTS

- A. General: Salvage/recycle as much percent by weight as possible of total non-hazardous solid waste generated by the Work. Practice efficient waste management in the use of materials in the course of the Work. Use all reasonable means to divert construction and demolition waste from landfills and incinerators. Facilitate recycling and salvage of materials, including the following:
 - 1. Construction Waste:
 - a. Site-clearing waste.
 - b. Masonry and CMU.
 - c. Lumber.
 - d. Wood sheet materials.
 - e. Wood trim.
 - f. Metals.
 - g. Roofing.
 - h. Insulation.

- i. Carpet and pad.
- j. Gypsum board.
- k. Piping.
- l. Electrical conduit.
- m. Packaging: Regardless of salvage/recycle goal indicated above, salvage or recycle 100 percent of the following uncontaminated packaging materials:
 - 1) Paper.
 - 2) Cardboard.
 - 3) Boxes.
 - 4) Plastic sheet and film.
 - 5) Polystyrene packaging.
 - 6) Wood crates.
 - 7) Plastic pails.

1.5 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with hauling and disposal regulations of authorities having jurisdiction.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 RECYCLING CONSTRUCTION WASTE, GENERAL

- A. General: Recycle paper and beverage containers used by on-site workers.
- B. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical.
 - 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.

3.2 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. Site-Clearing Wastes: Chip brush, branches, and trees at landfill facility.

C. 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.

3.3 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

SECTION 017700 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 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.
 - 5. Repair of the Work.

1.3 ACTION SUBMITTALS

- A. Product Data: For cleaning agents.
- B. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.
- C. Certified List of Incomplete Items: Final submittal at Final Completion.

1.4 CLOSEOUT SUBMITTALS

- A. Certificates of Release: From authorities having jurisdiction.
- B. Certificate of Insurance: For continuing coverage.

1.5 MAINTENANCE MATERIAL SUBMITTALS

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

1.6 SUBSTANTIAL COMPLETION PROCEDURES

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

- B. Submittals Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
 2. Submit closeout submittals specified in other Division 01 Sections, including project record documents, operation and maintenance manuals, final completion construction photographic documentation, damage or settlement surveys, property surveys, and similar final record information.
 3. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
 4. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Architect. Label with manufacturer's name and model number where applicable.
 - a. Schedule of Maintenance Material Items: Prepare and submit schedule of maintenance material submittal items, including name and quantity of each item and name and number of related Specification Section. Obtain Architect's signature for receipt of submittals.
 5. Submit test/adjust/balance records.
 6. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
- C. Procedures Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
1. Advise Owner of pending insurance changeover requirements.
 2. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
 3. Complete startup and testing of systems and equipment.
 4. Perform preventive maintenance on equipment used prior to Substantial Completion.
 5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings specified in Section 017900 "Demonstration and Training."
 6. Advise Owner of changeover in heat and other utilities.
 7. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
 8. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
 9. Complete final cleaning requirements, including touchup painting.
 10. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.
- D. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 10 days prior to date the work will be completed and ready for final inspection and tests. 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.

1.7 FINAL COMPLETION PROCEDURES

A. Submittals Prior to Final Completion: Before requesting final inspection for determining final completion, complete the following:

1. Submit a final Application for Payment according to Section 012900 "Payment Procedures."
2. Certified List of Incomplete Items: Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.

B. Inspection: Submit a written request for final inspection to determine acceptance a minimum of 10 days prior to date the work will be completed and ready for final inspection and tests. 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.

1.8 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 list of spaces in sequential order, starting with exterior areas first and proceeding from lowest floor to highest floor.
2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
3. Include the following information at the top of each page:
 - a. Project name.
 - b. Date.
 - c. Name of Architect.
 - d. Name of Contractor.
 - e. Page number.

4. Submit list of incomplete items in the following format:
 - a. PDF electronic file. Architect will return annotated file.

1.9 SUBMITTAL OF PROJECT WARRANTIES

- A. Time of Submittal: 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, or when delay in submittal of warranties might limit Owner's rights under warranty.
 1. Unless indicated otherwise, all warranties shall commence on the date of Substantial Completion.
- B. Partial Occupancy: Submit properly executed warranties within 15 days of completion of designated portions of the Work that are completed and occupied or used by Owner during construction period by separate agreement with Contractor.
- C. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.
 1. Bind warranties and bonds in heavy-duty, three-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper. Submit final warranties as a package for the entire project, assembled and identified as described below.
 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. Warranty Electronic File: 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 bookmarked table of contents at beginning of document.
- D. Provide additional copies of each warranty to include in operation and maintenance manuals.
- E. Warranty Response Time: The Contract shall respond and begin to take necessary action within 7 days of receipt of written notification from the Owner. Response time for life safety items, and for building perimeter security shall be within 24 hours of receipt of written notification from the Owner.

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 designated 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; clean according to manufacturer's recommendations if visible soil or stains remain.
 - j. Resilient flooring shall be scrubbed and cleaned with cleaner recommended by the flooring manufacturer just prior to occupation by Owner. No-wax floors shall be cleaned and buffed in accordance with flooring manufacturer's requirements.
 - k. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Polish mirrors and glass, taking care not to scratch surfaces. Cleaning of windows shall be done just before Owner occupancy.
 - l. Remove labels that are not permanent.
 - m. Wipe surfaces of mechanical and electrical equipment, elevator equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
 - n. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
 - o. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.

- p. Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter on inspection.
 - 1) Clean HVAC system in compliance with NADCA Standard 1992-01. Provide written report on completion of cleaning.
 - q. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency.
 - r. Leave Project clean and ready for occupancy.
- C. Construction Waste Disposal: Comply with waste disposal requirements in Section 017419 "Construction Waste Management and Disposal."

3.2 REPAIR OF THE WORK

- A. Complete repair and restoration operations before requesting inspection for determination of Substantial Completion.
- B. Repair or remove and replace defective construction. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment. Where damaged or worn items cannot be repaired or restored, provide replacements. Remove and replace operating components that cannot be repaired. Restore damaged construction and permanent facilities used during construction to specified condition.
 - 1. Remove and replace chipped, scratched, and broken glass, reflective surfaces, and other damaged transparent materials.
 - 2. Touch up and otherwise repair and restore marred or exposed finishes and surfaces. Replace finishes and surfaces that already show evidence of repair or restoration.
 - a. Do not paint over "UL" and other required labels and identification, including mechanical and electrical nameplates. Remove paint applied to required labels and identification.
 - 3. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.
 - 4. Replace burned-out bulbs, bulbs noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.

END OF SECTION 017700

SECTION 017823 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

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

1.3 DEFINITIONS

- A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.
- B. Subsystem: A portion of a system with characteristics similar to a system.

1.4 CLOSEOUT SUBMITTALS

- A. Manual Content: Operations and maintenance manual content is specified in individual Specification Sections to be reviewed at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.
 - 1. Architect will comment on whether content of operations and maintenance submittals are acceptable.
 - 2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.
- B. Format: Submit operations and maintenance manuals in the following format:
 - 1. PDF electronic file. Assemble each manual into a composite electronically indexed file. Submit on digital media acceptable to 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. One paper copy. Include a complete operation and maintenance directory. Enclose title pages and directories in clear plastic sleeves. Architect will return two copies.
- C. Initial Manual Submittal: Submit draft copy of each manual at least 30 days before commencing demonstration and training. Architect will comment on whether general scope and content of manual are acceptable.
- D. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. Architect will return copy with comments.
 1. Correct or revise 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 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY

- A. Directory: Prepare a single, comprehensive directory of emergency, operation, and maintenance data and materials, listing items and their location to facilitate ready access to desired information. Include a section in the directory for each of the following:
 1. List of documents.
 2. List of systems.
 3. List of equipment.
 4. Subcontractor list.
 5. Warranties
 6. Table of contents.
- B. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.
- C. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.
- D. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.
- E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

2.2 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

- A. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:
1. Title page.
 2. Table of contents.
 3. Manual contents.
- B. Title Page: 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 and primary subcontractors.
 6. Name and contact information for Architect.
 7. Name and contact information for Commissioning Authority.
 8. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
 9. Cross-reference to related systems in other operation and maintenance manuals.
- C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.
- D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
- 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 on 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 on 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 or post-type binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
 - a. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary to provide essential information for proper operation or maintenance of equipment or system.
 - b. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents, and indicate Specification Section number on bottom of spine. 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. Supplementary Text: Prepared on 8-1/2-by-11-inch white bond paper.
 5. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
 - a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts. Maximum size of drawings to be included in the binders shall not exceed 11-by-17-inch.
 - 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.

2.3 EMERGENCY MANUALS

- A. Emergency operations and shutdown information that must be immediately available during emergency situations to protect life and property and to minimize disruptions to building occupants.
- B. Content: Organize manual into a separate section for each of the following:
 1. Type of emergency.
 2. Emergency instructions.
 3. Emergency procedures.
- C. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:
 1. Fire.

2. Flood.
 3. Gas leak.
 4. Water leak.
 5. Power failure.
 6. Water outage.
 7. System, subsystem, or equipment failure.
 8. Chemical release or spill.
- D. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.
- E. Emergency Procedures: Include the following, as applicable:
1. Instructions on stopping.
 2. Shutdown instructions for each type of emergency.
 3. Operating instructions for conditions outside normal operating limits.
 4. Required sequences for electric or electronic systems.
 5. Special operating instructions and procedures.

2.4 OPERATION MANUALS

- A. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:
1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
 2. Performance and design criteria if Contractor has delegated design responsibility.
 3. Operating standards.
 4. Operating procedures.
 5. Operating logs.
 6. Wiring diagrams.
 7. Control diagrams.
 8. Piped system diagrams.
 9. Precautions against improper use.
 10. License requirements including inspection and renewal dates.
- B. Descriptions: Include the following:
1. Product name and model number. Use designations for products indicated on Contract Documents.
 2. Manufacturer's name.
 3. Equipment identification with serial number of each component.
 4. Equipment function.
 5. Operating characteristics.
 6. Limiting conditions.
 7. Performance curves.
 8. Engineering data and tests.
 9. Complete nomenclature and number of replacement parts.

- C. Operating Procedures: Include the following, as applicable:
 - 1. Startup procedures.
 - 2. Equipment or system break-in procedures.
 - 3. Routine and normal operating instructions.
 - 4. Regulation and control procedures.
 - 5. Instructions on stopping.
 - 6. Normal shutdown instructions.
 - 7. Seasonal and weekend operating instructions.
 - 8. Required sequences for electric or electronic systems.
 - 9. Special operating instructions and procedures.
- D. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.
- E. Piped Systems: Diagram piping as installed, and identify color-coding where required for identification.

2.5 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 and drawing or schedule designation or identifier where applicable.
- C. Product Information: Include the following, as applicable:
 - 1. Product name and model number.
 - 2. Manufacturer's name.
 - 3. Color, pattern, and texture.
 - 4. Material and chemical composition.
 - 5. Reordering information for specially manufactured products.
- D. Maintenance Procedures: Include manufacturer's written recommendations and the following:
 - 1. Inspection procedures.
 - 2. Types of cleaning agents to be used and methods of cleaning.
 - 3. List of cleaning agents and methods of cleaning detrimental to product.
 - 4. Schedule for routine cleaning and maintenance.
 - 5. Repair instructions.
- E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.

- F. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
 - 1. Include procedures to follow and required notifications for warranty claims.

2.6 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 and drawing or schedule designation or identifier where applicable.
- 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.
 - 1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
 - 2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.
- F. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.

- G. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.
- H. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
 - 1. Include procedures to follow and required notifications for warranty claims.

PART 3 - EXECUTION

3.1 MANUAL PREPARATION

- A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals.
- B. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.
- C. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.
- D. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.
 - 1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
 - 2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.
- E. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.
 - 1. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.
- F. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.
 - 1. Do not use original project record documents as part of operation and maintenance manuals.

2. Comply with requirements of newly prepared record Drawings in Section 017839 "Project Record Documents."
- G. Comply with Section 017700 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

END OF SECTION 017823

SECTION 017839 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 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.
 - 4. Miscellaneous record submittals.
 - 5. Directories.
- B. Related Requirements:
 - 1. Section 017300 "Execution" for final property survey.
 - 2. Section 017700 "Closeout Procedures" for general closeout procedures.
 - 3. Section 017823 "Operation and Maintenance Data" for operation and maintenance manual requirements.

1.3 CLOSEOUT SUBMITTALS

- A. Submit all project record documents as one submittal package.
- B. Record Drawings: Comply with the following:
 - 1. Number of Copies: Submit one set of marked-up record prints.
- C. Record Specifications: Submit one paper copy of Project's Specifications, including addenda and contract modifications.
- D. Record Product Data: Submit annotated PDF electronic files and directories of each submittal.
 - 1. Where record Product Data are required as part of operation and maintenance manuals, submit duplicate marked-up Product Data as a component of manual.
- E. Miscellaneous Record Submittals: See other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Submit annotated PDF electronic files and directories 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, incorporating new and revised drawings as modifications are issued.
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. Accurately record information in an acceptable drawing technique.
 - c. Record data as soon as possible after obtaining it.
 - d. Record and check the markup before enclosing concealed installations.
 - e. Cross-reference record prints to corresponding archive photographic documentation.
 2. Content: Types of items requiring marking include, but are not limited to, the following:
 - a. Dimensional changes to Drawings.
 - b. Revisions to details shown on Drawings.
 - c. Depths of foundations below first floor.
 - d. Locations and depths of underground utilities.
 - e. Revisions to routing of piping and conduits.
 - f. Revisions to electrical circuitry.
 - g. Actual equipment locations.
 - h. Duct size and routing.
 - i. Locations of concealed internal utilities.
 - j. Changes made by Change Order or Construction Change Directive.
 - k. Changes made following Architect's written orders.
 - l. Details not on the original Contract Drawings.
 - m. Field records for variable and concealed conditions.
 - n. Record information on the Work that is shown only schematically.
 3. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
 4. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
 5. Mark important additional information that was either shown schematically or omitted from original Drawings.
 6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
- B. 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. 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. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
 3. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
 4. For each principal product, indicate whether record Product Data has been submitted in operation and maintenance manuals instead of submitted as record Product Data.
 5. Note related Change Orders, record Product Data, and record Drawings where applicable.
- B. Format: Submit record Specifications as paper copy.

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, record Specifications, and record Drawings where applicable.
- B. Format: Submit record Product Data as annotated PDF electronic file.
 1. Include record Product Data directory organized by Specification Section number and title, electronically linked to each item of record Product Data.

2.4 DIRECTORIES

- A. Directories: Contractor/Subcontractor directory.

1. Submit one hard copy and one copy on electronic media CD-R or USB storage device in PDF format.
- B. Directory: Name, address and telephone number for General Contractor, all major subcontractors, organized by specification section. Provide a separate list in alphabetical order.

2.5 MISCELLANEOUS RECORD SUBMITTALS

- A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.
- B. Format: Submit miscellaneous record submittals as PDF electronic file.
 1. Include miscellaneous record submittals directory organized by Specification Section number and title, electronically linked to each item of miscellaneous record submittals.

PART 3 - EXECUTION

3.1 RECORDING AND MAINTENANCE

- A. Recording: Maintain one copy of each submittal during the construction period for project record document purposes. Post changes and revisions to project record documents as they occur; do not wait until 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

SECTION 017900 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:
 - 1. Demonstration of operation of systems, subsystems, and equipment.
 - 2. Training in operation and maintenance of systems, subsystems, and equipment.
 - 3. Demonstration and training video recordings.

1.3 INFORMATIONAL SUBMITTALS

- A. Instruction Program: Submit outline of instructional program for demonstration and training, including a list of training modules and a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.
 - 1. Indicate proposed training modules using manufacturer-produced demonstration and training video recordings for systems, equipment, and products in lieu of video recording of live instructional module.
- B. Attendance Record: For each training module, submit list of participants and length of instruction time.
- C. Evaluations: For each participant and for each training module, submit results and documentation of performance-based test.

1.4 QUALITY ASSURANCE

- A. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Section 014000 "Quality Requirements," experienced in operation and maintenance procedures and training.
- B. Preinstruction Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination." Review methods and procedures related to demonstration and training including, but not limited to, the following:
 - 1. Inspect and discuss locations and other facilities required for instruction.

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

1.5 COORDINATION

- A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations and to ensure availability of Owner's personnel.
- B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.
- C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data has been reviewed and approved by Architect.

PART 2 - PRODUCTS

2.1 INSTRUCTION PROGRAM

- A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.
 1. Motorized doors, including overhead coiling doors.
 2. Equipment, including food-service equipment.
 3. Fire-protection systems, including fire alarm fire pumps and fire-extinguishing systems.
 4. Intrusion detection systems.
 5. Conveying systems, including elevators.
 6. Heat generation, including boilers pumps and water distribution piping.
 7. Refrigeration systems, including condensers pumps and distribution piping.
 8. HVAC systems, including air-handling equipment air distribution systems and terminal equipment and devices.
 9. HVAC instrumentation and controls.
 10. Electrical service and distribution, including transformers switchboards panelboards uninterruptible power supplies and motor controls.
 11. Lighting equipment and controls.
 12. Communication systems, including intercommunication clocks and programming voice and data and television equipment.
- B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:
 1. Basis of System Design, Operational Requirements, and Criteria: Include the following:

- a. System, subsystem, and equipment descriptions.
 - b. Performance and design criteria if Contractor is delegated design responsibility.
 - c. Operating standards.
 - d. Regulatory requirements.
 - e. Equipment function.
 - f. Operating characteristics.
 - g. Limiting conditions.
 - h. Performance curves.
2. Documentation: Review the following items in detail:
- a. Emergency manuals.
 - b. Operations manuals.
 - c. Maintenance manuals.
 - d. Project record documents.
 - e. Identification systems.
 - f. Warranties and bonds.
 - g. Maintenance service agreements and similar continuing commitments.
3. Emergencies: Include the following, as applicable:
- a. Instructions on meaning of warnings, trouble indications, and error messages.
 - b. Instructions on stopping.
 - c. Shutdown instructions for each type of emergency.
 - d. Operating instructions for conditions outside of normal operating limits.
 - e. Sequences for electric or electronic systems.
 - f. Special operating instructions and procedures.
4. Operations: Include the following, as applicable:
- a. Startup procedures.
 - b. Equipment or system break-in procedures.
 - c. Routine and normal operating instructions.
 - d. Regulation and control procedures.
 - e. Control sequences.
 - f. Safety procedures.
 - g. Instructions on stopping.
 - h. Normal shutdown instructions.
 - i. Operating procedures for emergencies.
 - j. Operating procedures for system, subsystem, or equipment failure.
 - k. Seasonal and weekend operating instructions.
 - l. Required sequences for electric or electronic systems.
 - m. Special operating instructions and procedures.
5. Adjustments: Include the following:
- a. Alignments.
 - b. Checking adjustments.
 - c. Noise and vibration adjustments.
 - d. Economy and efficiency adjustments.

6. Troubleshooting: Include the following:
 - a. Diagnostic instructions.
 - b. Test and inspection procedures.
7. Maintenance: Include the following:
 - a. Inspection procedures.
 - b. Types of cleaning agents to be used and methods of cleaning.
 - c. List of cleaning agents and methods of cleaning detrimental to product.
 - d. Procedures for routine cleaning
 - e. Procedures for preventive maintenance.
 - f. Procedures for routine maintenance.
 - g. Instruction on use of special tools.
8. Repairs: Include the following:
 - a. Diagnosis instructions.
 - b. Repair instructions.
 - c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 - d. Instructions for identifying parts and components.
 - e. Review of spare parts needed for operation and maintenance.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Section 017823 "Operation and Maintenance Data."
- B. Set up instructional equipment at instruction location.

3.2 INSTRUCTION

- A. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
 1. Architect will furnish an instructor to describe basis of system design, operational requirements, criteria, and regulatory requirements.
 2. Owner will furnish an instructor to describe Owner's operational philosophy.
 3. Owner will furnish Contractor with names and positions of participants.
- B. Scheduling: Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.

1. Schedule training with Owner, through Architect, with at least seven days' advance notice.
- C. Training Location and Reference Material: Conduct training on-site in the completed and fully operational facility using the actual equipment in-place. Conduct training using final operation and maintenance data submittals.
- D. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of an oral, a written or a demonstration performance-based test.
- E. Cleanup: Collect used and leftover educational materials and remove from Project site. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

3.3 DEMONSTRATION AND TRAINING SCHEDULE

- A. Demonstration of equipment includes, but is not limited to, the following:
 1. Overhead coiling doors.
- B. Demonstration and training with video recording of equipment includes, but is not limited to, the following:
 1. HVAC equipment and systems.
 2. Electrical equipment and systems.

END OF SECTION 017900

SECTION 023200 - GEOTECHNICAL INVESTIGATIONS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes geotechnical investigations.

1.2 DESCRIPTION

- A. Subsurface explorations have been done at the location of the project and soils reports have been compiled for the purpose of guidance in the design of the project facilities. This work can include open excavation test pits, observation wells and soil borings.
- B. The logs are not intended to indicate subsurface conditions except at the locations of the exploration (at the time explorations were made) and any interpretation the Contractor may make is his responsibility.
- C. The subsurface investigations of the site were made in conjunction with design of the facility to be constructed under this Contract. Portions of this investigation are presented in reports which are a part of the Contract Documents. The reports present the opinion of the Geotechnical Engineer and shall not be interpreted to prescribe or dictate construction procedures or relieve the Contractor in any way of his responsibility for the construction. The explorations are shown on the drawings and the logs are include in Appendix A.
- D. The water levels shown on the log at the exploration locations are based on observations made by the Field personnel at the same time the explorations were made and may or may not represent the groundwater surface in the immediate vicinity of the explorations. They are presented only as an observation of the free-standing water surface in the exploration on the date noted.
- E. The refusal depths shown at the exploration locations indicate only, that in the drill foreman's opinion, sufficient resistance to the advance of the casing, auger, probe rod or sampler was encountered to render further advance impossible or impractical by the procedures and equipment being used. Although refusal may indicate the encountering of the bedrock surface, it may indicate the striking of large cobbles, boulders, very dense or cemented soil, or other buried natural or man- made objects or it may indicate the encountering of a harder zone after penetrating a considerable depth through a weathered or disintegrated zone of the bedrock.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 023200



R.W. Gillespie & Associates, Inc.

Geotechnical Engineering • Environmental Consulting • Materials Testing Services

06 October 2015

Mark Pettingill, CIC, President and CEO
Patrons Oxford Insurance Company
P.O. Box 1960
Auburn, ME 04210-1960

Subject: Geotechnical Engineering Services
Proposed Patrons Oxford Insurance Company Office Building
Portland, Maine
RWG&A Project No. 1518-002

Dear Mr. Pettingill:

R. W. Gillespie & Associates, Inc., (RWG&A) is pleased to provide this geotechnical evaluation in connection with Patrons Oxford Insurance Company's two-story office building to be built on Lot 4 at the west side of the access drive in Portland Technology Park in Portland, Maine. The purpose of this evaluation was to obtain information regarding subsurface conditions and soil properties on which to base geotechnical recommendations for design and construction of building foundations, ground floor slabs, pavement sections, site improvements, and determine seismic site characteristics. The services were performed in general accordance with RWG&A Proposal No. P-9075.GI dated 25 June 2015, and Modification No. 1 to Geotechnical Engineering Services dated 09 September 2015.

The primary geotechnical considerations for design and construction of the building is compressibility of silty clay deposits under additional loads. With appropriate site preparation including use of low density, controlled low strength material to reduce building settlements, the proposed building may be supported on spread and continuous footings with slab-on-grade ground floors. Perimeter foundation drainage is recommended.

Results of our geotechnical evaluations and engineering recommendations are provided in the attached report. RWG&A has enjoyed working with Patrons Oxford Insurance Company, Scott Simons Architects, LLC, and Becker Structural Engineers, Inc. on this project. Please contact us if you have any questions or if we may be of further service.

Sincerely,
R. W. GILLESPIE & ASSOCIATES, INC.

Erik J. Wiberg, P.E.
Chief Geotechnical Engineer

EJW:md
In duplicate



Charles R. Nickerson, P.E.
Principal Reviewer

Copy: Ryan E. Kanteres, AIA, Scott Simons Architects, LLC (via email)
Christopher G. Williams, P.E., S.E., Becker Structural Engineers, Inc. (via email)

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R.W. Gillespie & Associates, Inc.

**Report
of
GEOTECHNICAL ENGINEERING SERVICES
for
PROPOSED PATRONS OXFORD INSURANCE COMPANY OFFICE BUILDING
PORTLAND, MAINE**

**Prepared
for
PATRONS OXFORD INSURANCE COMPANY
AUBURN, MAINE**

**Prepared
by
R. W. GILLESPIE & ASSOCIATES, INC.
SACO, MAINE**



**Erik J. Wiberg
Maine P.E. Serial No. 9178**

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- Appendix B, Exploration Logs
- Appendix C, 2010 Exploration Logs
- Appendix D, Laboratory Test Results
- Appendix E. Report of Crosshole Seismic Testing by Hager-Richter Geoscience, Inc.

R.W. Gillespie & Associates, Inc.

1.0 INTRODUCTION

1.01 Background

Patrons Oxford Insurance Company proposes to construct an office building and associated parking lots and drive way on Lot 4 of the Portland Technology Park in Portland, Maine. The Portland Technology Park is located off of Rand Road near its intersection with the Interstate 95 Exit 47 interchange. The approximate site location is shown on Figure 1, *Locus Map*.

The overall plan dimensions of the proposed office building are about 180 feet by 70 feet with the building's geometry containing several skews. Employee and visitor parking would be provided west of the building with a two-bay handicap parking at the east side (front) of the building. Finished ground floor level will be between elevation 70.0 and 70.25 feet, which ranges from 2 to 3 feet above current ground surface. Proposed site grades in developed areas outside the building range from about elevation 69.9 feet adjacent to the building to 68 feet.

R.W. Gillespie & Associates, Inc.'s (RWG&A's) understanding of the proposed project is based on site visits, communications with Scott Simons Architects, LLC (SSA) and Becker Structural Engineers, Inc., (BSE) and review of the following documents provided to RWG&A:

- Untitled plan showing proposed site layout with requested boring locations dated 23 June 2015 (A- SP01-BORING LOCATIONS 11x17.pdf).
- Letter from BSE to SSA dated 13 July 2015 providing a narrative of structural engineering concepts for the building.
- Plan set prepared by Scott Simons Architects, Inc. titled *Patrons Oxford Offices, Patrons Oxford Insurance, Portland Technology Park, Rand Road, Portland, Maine, 04102*, marked *100% Design Development, date of issued: 09.21.1015*.
- Plan set prepared by Woodard & Curran, Inc. titled *City of Portland Economic Development Office, Portland, Maine & Patrons Oxford Insurance Company, Portland Technology Park Update & LCE 4 Development*, marked *Permitting Plans*, and dated September 2015

1.02 Scope of Services

This geotechnical evaluation was performed to obtain information regarding subsurface soil conditions and properties on which to base recommendations suitable for design of foundations and ground floors, and to determine seismic site characteristics. Services were performed in general accordance with RWG&A Proposal No. P-9075GI dated 25 June 2015. Refer to Appendix A for use and limitations of this report. As performed, RWG&A's scope of services included the following items:

- Reviewed project information and readily available published geologic mapping.
- Prepared a subsurface exploration and sampling program to obtain soil, bedrock, and groundwater information for use in geotechnical evaluations.

- Marked test boring locations in the field and contacted DigSafe and OK-TO-DIG registered utility entities to locate public utilities.
- Arranged to have the soil borings made by a drilling contractor as a subcontractor to RWG&A. Provided technical monitoring of the exploration activities so that depth, location, and sampling methods could be modified in response to subsurface conditions encountered.
- Arranged to have a cross-hole geophysical shear wave velocity test performed to evaluate shear wave velocity in subsurface materials and determine seismic site class in accordance with building code requirements.
- Performed laboratory tests on soil samples recovered from the subsurface explorations to aid in soil description, and for determination of engineering properties needed for foundation design and site development analyses.
- Conducted engineering analyses of the geotechnical aspects of foundation design and slope stability. The engineering analyses included settlement and its control, allowable foundation loads, evaluation of seismic parameters, foundation drainage, and earthwork construction considerations.
- Prepared this report of geotechnical evaluation presenting RWG&A's findings, conclusions, and recommendations.

Elevations used in this report were obtained or interpolated from the above referenced background documents. It is understood the elevations presented on the plan are in units of feet relative to the North American Vertical Datum of 1988 (NAVD88).

2.0 SUBSURFACE EXPLORATION

The subsurface exploration program consisted of twelve test borings, designated B-1 through B-10, and GB-101 and GB-102. Test borings B-1 through B-10 were drilled on 20 and 21 July 2015 by Northern Test Boring, Inc. of Gorham, Maine for soil sampling purposes. Additional test borings GB-101 and GB-102 were drilled on 17 and 18 September 2015 by Great Works Pump & Test Boring, Inc. of Rollinsford, New Hampshire for use in geophysical testing. The approximate locations of the explorations are shown on Figure 2, *Exploration Location Plan*.

Boring locations were measured in the field by tape survey methods using features shown on Google Earth aerial imagery and GPS coordinates of planned boring locations provided by Scott Simons Architects, LLC. Ground surface elevations on the boring logs were interpolated from topographic survey information provided on the background documents. The boring locations and elevations should be considered accurate only to the degree implied by the methods used to determine them. RWG&A marked the as-drilled boring locations with stakes for survey by the project surveyor.

Exploration activities were coordinated and monitored by an RWG&A representative who prepared the exploration logs. The soils were described in general accordance with *ASTM D2488*,

Standard Practice for Description and Identification of Soils (Visual-Manual Procedure). Logs of the explorations are included in Appendix B. Stratification lines shown on the exploration logs represent the estimated boundaries between the different soil types encountered and approximate refusal depths; the soil transitions and refusal depths will be more gradual and vary over short distances. Subsurface information should only be considered representative of subsurface conditions encountered within the vertical reach of the explorations on the date the explorations were made.

In general, borings advanced to depths less than about 27 feet below ground surface were advanced with solid-stem and hollow-stem augers, and deeper borings were advanced using cased hole with rotary wash drilling methods. Split-barrel sampling with standard penetration testing (*ASTM D1586, Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils*) was performed at about 5-foot intervals in Borings B-1 through B-10. Field vane tests (*ASTM D2573, Standard Test Method for Field Vane Shear Test in Cohesive Soil*) and/or thin-walled tube sampling (*ASTM D1587, Standard Practice for Thin-Walled Tube Geotechnical Sampling of Soils*) were performed in medium stiff to soft cohesive soils encountered in borings B-4, B-5, B-8, B-9, and GB-102.

Borings were advanced 12 to 72 feet below local ground surface. Refusal to advancement of a roller cone drill bit was encountered at depths of 56 to 62 feet in borings B-8, B-9, GB-101, and GB-102. Rock drilling was not performed to determine the nature of refusal surfaces except at borings GB-101 and GB-102. Refusal in borings B-8 and B-9 might have occurred on cobbles, boulders, or on bedrock.

Three-inch diameter, solid, Schedule 40 PVC casing set in cement-bentonite grout was installed to a depth of about 72 feet below local ground surface in the completed boreholes for GB-101 and GB-102. The casings were installed to conduct cross-hole geophysical shear wave velocity tests. The cross-hole tests were performed by Hager-Richter Geoscience, Inc., of Salem, New Hampshire, on 24 and 25 September 2015.

2010 Explorations: Maine Test Borings, Inc. conducted three soil borings near the proposed building site in August 2010. The approximate locations are shown on Figure 2 and exploration logs are provided in Appendix C for informational purposes only. RWG&A is unable to ensure the accuracy or completeness of the information provided, either because doing so is impossible, or because of errors or omissions others may have committed when assembling the information. RWG&A does not take accept responsibility for use of, interpretation of, or accuracy of information provided by others.

3.0 LABORATORY TESTING

Laboratory testing was performed to assist in soil description and estimation of engineering properties of encountered soils. The laboratory testing program included 9 moisture content determinations, 2 grain-size analyses, 2 one-dimensional consolidation tests, 2 sets of undrained shear strength using Geonor vane apparatus, and 1 plastic Atterberg limits test. The tests were performed in general accordance with the following methods and procedures:

- ASTM D2216, Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass

- ASTM D422, Standard Test Method for Particle-Size Analyses of Soils
- ASTM D2435, Standard Test Method for One-Dimensional Consolidation Properties of Soils
- ASTM D4318, Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

The laboratory Geonor vane shear tests were performed in accordance with the manufacturer’s recommended procedures. Moisture content test results are presented on the soil boring logs. Results of the other laboratory tests are presented in Appendix D, *Laboratory Test Results*. All tests were conducted at the RWG&A soil and materials testing laboratory in Saco, Maine, which is accredited by the American Association of State Highway and Transportation Officials (AASHTO) for the tests performed.

4.0 SUBSURFACE CONDITIONS

4.01 Subsurface Soils

The subsurface explorations encountered consisted of five primary soil units identified herein as topsoil with organic matter, fill, silty sand, silty clay (glaciomarine), and silty sand with gravel (glacial till). Some of the soil units were locally absent. Logs of the explorations should be referenced for information at specific locations and depths. Subsurface soils and encountered thicknesses are summarized below.

Description	Encountered Thickness (feet)	Generalized Description
Topsoil and Organic Matter	0.25 to 0.6	Occurs as bark mulch fill at boring B-9.
Fill	2.8 to 4	Encountered at borings B-2 and B-9. Sand with silt to silty sand. Boring B-2 drilled within stormwater management basin and B-9 drilled through berm.
Silty Sand	1.4 to 11.2+	Generally very loose to medium dense, moist to wet, fine sand with some silt. Occurs locally with interbedded silty clay to sandy silt layers.
Silty Clay	36 to 42.5*	Silty clay with trace to few sand, moist to wet. Consistency ranged from stiff to very soft in the upper 5 to 10 feet of the deposits, and became very soft to soft with increasing depth.
Silty sand with gravel	10 to 18	Silty fine to coarse sand with gravel, loose to medium dense, wet.
*Where penetrated.		

4.02 Groundwater

Free water was observed at depths ranging from about 4 to 8 feet below ground surface. Water levels observed were influenced by the exploration methods (e.g., slow groundwater response due to low soil permeability) and are not considered representative of stabilized groundwater levels. Groundwater levels at the site will fluctuate due to season, temperature, rainfall, nearby underground utilities, and construction activity in the area; therefore, water levels during and

following construction will vary from those observed in the explorations. Seasonal high groundwater would occur at or near ground surface.

4.03 Bedrock

The drill rigs used roller cone drill bits to drill to refusal surfaces at borings B-8 and B-9, and to drill about 15 feet into refusal surfaces at GB-101 and GB-102; refusal surfaces were interpreted to be on bedrock at GB-101, and GB-102. Refusal to hydraulic pushing of a rod probe occurred at a depth of 51 feet in boring B-4. However, the refusal surfaces at borings B-4, B-8, and B-9 might have been on dense sand or boulder(s), or on bedrock. Maine Geologic Survey mapping indicates bedrock underlying the site is metamorphosed slate and shale.

4.04 Crosshole Seismic Survey

Hager-Richter Geoscience, Inc., (Hager-Richter) performed crosshole seismic testing in a two borehole array comprised of casing installed in completed boreholes GB-101 and GB-102. The purpose of the testing was to evaluate the shear wave velocity of materials in the upper 100 feet and assess Site Class for seismic design in accordance with 2009 International Building Code[®]. The average value of the velocity of shear waves determined for the depth interval of 0 to 100 feet is approximately 800 feet per second, corresponding to Site Class D; see Appendix E for report of Crosshole Seismic Testing.

5.0 ENGINEERING EVALUATIONS

5.01 General

Engineering evaluations for this project are based on the subsurface explorations, laboratory testing data, and preliminary design information available to RWG&A when this report was prepared. This report addresses settlement with finished ground floor level at or below elevation 70.25 feet.

Actual ground surface elevations can vary from elevations developed by aerial and similar approximate topographic mapping methods. Evaluation of settlement for fills and excavations is sensitive to fill thicknesses and/or excavation depths. The engineering evaluations that follow should be reviewed by RWG&A to confirm their continued applicability if existing and proposed site grades, finished floor elevations, structural loads and settlement tolerances, site layout, current or constructed ground surface elevations will vary from those used in RWG&A's evaluations.

5.02 Proposed Construction

The proposed construction consists of a two-story office building with no below-grade spaces except those needed for an elevator pit. Structural framing will be comprised mostly of engineered wood and timber elements. A combination timber and steel framing will be used to resist lateral forces. Becker Structural Engineers, Inc. indicated that column loads would range from 10 to 60 kips with a corresponding average distributed structural load over the building plan area of about 150 pounds per square foot excluding ground floor slabs. Recommended tolerable total and differential settlements provided by the project structural engineer are 1 inch.

Two parking fields are proposed adjacent to the west property boundary between the building and off ramp for Interstate 95 Exit 47. Handicap parking stalls and driveway off of the technology park road are proposed at the east side of the office building.

Existing ground at the site is relatively level with surface elevations ranging from about 67 to 68 feet (NAVD88) within the planned building area and from about 68 to 69 feet (NAVD88) in the planned parking lots. The building site is about 750 feet west of natural slopes that pitch down from about elevation 62 to 30 feet. The upper part of the slopes pitch down at about 2.5 units horizontal to 1 unit vertical. Locally, the slopes may pitch more or less steeper.

5.03 Foundation and Ground Floor Slabs Settlement Evaluations

The silty clay deposits beneath the site will compress under proposed fill weight and building loads. Estimated total post construction settlement for anticipated column loads bearing at 3 to 4 feet below current ground surface, an allowable bearing pressure of 1,500 pounds per square foot, and less than 1 foot in site grade raise as measured from finished floor level to current ground surface elevation would be about 1 inch. For the proposed grade changes of about 3 feet above current ground surface, the total and differential post construction settlement is estimated to be about 2 inches and about 1 to 1.5 inches, respectively, which greater than the tolerable amounts.

Alternatives to reduce post-construction settlements include:

- Use of low density, controlled low strength material (LD-CLSM) as lightweight fill below the building, which would allow the building to be supported on isolated and continuous spread footings,
- Support the building on a mat foundation and use a crawlspace under the ground floor to reduce the weight of fill, and
- Supporting the building and ground floor on slab end-bearing piles.

Reportedly pile foundations and the use of crawl space with mat foundation are uneconomical compared to the use of LD-CLSM fill. RWG&A can further evaluate and provide recommendations for the use of piles and below-grade space with mat foundations, if requested.

LD-CLSM Fill: The purpose of the LD-CLSM fill would be to compensate for additional stresses that would otherwise be placed on compressible soil deposits due to increases in site grade and building loads. Prior experience indicates unit weights of cellular material in the range of about 35 to 40 pounds per cubic foot with 28-day compressive strengths of 80 to 150 pounds per square inch are available from local concrete suppliers.

Based on a proposed finished floor level of 70.25 feet, a 1-foot thick ground floor slab base layer of compacted sand, and the structural load information provided, RWG&A recommends 3 feet of soil below the planned building area be removed and replaced with LD-CLSM, and that LD-CLSM also be used as fill above current ground surface. Estimated total LD-CLSM thickness is about 5 feet. Footings would be located within the LD-CLSM fill. For footings bearing on a minimum three feet of LD-CLSM, estimated total and differential settlements are about 1-inch.

Ground Floor Slab Base Material: Slab-on-grade ground floors are appropriate for the proposed construction. It is understood that a layer of granular material is desirable below the ground floor slab to facilitate installation of subslab utilities. Due to its lower unit weight, which would reduce post-construction settlements compared to structural fill, RWG&A recommends a layer of compacted sand be used as fill between the LD-CLSM and ground floor slab.

5.04 Global Slope Stability

Method of Analysis: Stability analyses were performed based on failure surfaces extend below the building and the slope east of the site. Analyses were performed with the computer software ReSSA® Version 3.0. Rotational arc stability calculations use the Simplified Bishop method of slices. The analyzed profile was taken through the planned building area and slope about 700 feet east of the site. In general, the lowest factors of safety for embankments on natural slopes occur where the total height, measured from the crest of the embankment to the toe of the natural slope, is greatest. The factor of safety is defined as the ratio of the resisting forces to the driving forces causing failure. When the driving and resisting forces are the same, the factor of safety is equal to 1.0, and a landslide is considered imminent. When resisting forces are greater than driving forces, the factor of safety is greater than 1.

Depending upon the type of structure and loading conditions, permanent slopes are generally considered stable if the factor of safety is greater than 1.5 for static conditions and greater than 1.0 for seismic conditions. Depending on structure and loading conditions, current engineering practice considers a factor of safety of 1.3 to be acceptable for temporary conditions such as stockpiles, or if a landslide would result in non-structural property damage only. Based on the sensitive behavior of silty clay deposits at the site, slope stability analyses used drained and undrained shear strength of the cohesive soil deposits.

It should be noted that slope instability might occur even with a calculated factor of safety greater than 1; in general, the likelihood of a landslide occurring becomes lower with increasing factors of safety. Short-term variations in factor of safety may occur due to seasonal variations such as groundwater levels, surface water levels, and soil erosion and deposition. Longer term trends may reflect the influences of weathering, geomorphologic processes, or longer term changes in ground-water conditions. Human activity such as excavating, filling, irrigation, draining, or altering vegetative cover can also influence stability. It is important to note that landslide (and slope instability in general) might not be attributable to a single causal factor.

Shear Strength Parameters: Based on the sensitive behavior of silty clay deposits of the Presumpscot Formation, it is accepted engineering practice to evaluate the stability of natural and man-made slopes using undrained shear strength of cohesive soil deposits. Although the natural slopes have likely been in more-or-less the same configuration for many years, load conditions could develop where undrained shear strengths would control stability (e.g., erosive undercutting in or near drainage channels, and during floods or earthquakes).

Undrained shear strengths were based on shear vane test results from soil borings and *Stress History and Normalized Soil Engineering Parameters* (SHANSEP) relationships for silty clay deposits. Shear strengths were adjusted to account for shear plane orientation of the modeled failure plane (i.e. low angle direct simple shear) relative to vertical oriented shear surfaces in field vane shear strength tests.

Drained analyses were also conducted for failure through the silty clay deposits under static conditions. Drained analyses were not conducted for seismic conditions since undrained shear strengths control under severe dynamic loads. An internal angle of friction angle of 35 degrees was used for silty clay deposits based on values published in *Maine Department of Conservation, Maine Geological Survey Open File No. 90-24, Stability of Natural Slopes in the Presumpscot Formation.*

Assessment of Potential Hazards from Earthquake Motions: Pseudo-static method of slices was used in seismic stability evaluations. Based on currently available subsurface information, thickness, and undrained shear strength of the silty clay deposits, the International Building Code Seismic Site Class is D. Seismic Site Class affects peak ground acceleration used in building design and ground motion evaluations.

Building code ground accelerations are based on 2 percent probability of exceedance in 50 years (return period of 2,500 years). Based on Seismic Site Classes D, an equivalent horizontal destabilizing seismic ground accelerations of 0.08 was used in the model.

Summary of Stability Evaluations: Stability analyses indicates that the factors of safety against a landslide through the building and slope for static and seismic conditions are adequate under existing and proposed conditions. A summary of the results is provided in the table below.

Description	Factor of Safety		
	Static		Seismic
	Undrained	Drained	Site Class D
Calculated Factor of Safety	>3.0	>3.0	1.2
Minimum Acceptable Factor of Safety	≥ 1.5		≥ 1.0

5.05 Pavement Evaluations

Bituminous pavement evaluations for the access drive and heavy-duty areas were based on the following traffic lane information provided by Woodard & Curran, Inc.: 3 single unit (SU30) trucks per day, 1 tractor-trailer truck per week, and 300 passenger automobiles trips per day.

Bituminous concrete pavement section evaluations were based on a 20-year serviceability life for the heavy duty and light duty sections. The terminal serviceability corresponds to 85 percent of drivers/passengers rating the pavement and ride condition as unacceptable. The actual service life will depend on variables such as actual traffic loads, surface water runoff conditions, and maintenance and performance of the asphaltic concrete layer.

Full depth frost protection of pavements would require a total pavement section of about 48 inches which would be cost prohibitive and not consistent with practice in New England. Thinner pavement sections are considered more frost-susceptible than thicker sections built with the same not-frost susceptible materials. It is typical practice in the New England region to provide partial depth frost protection for pavements with the expectation that some frost heaving will occur.

5.06 Construction Considerations

Construction Dewatering: The on-site naturally deposited soils are sensitive to disturbance when wet. To reduce disturbance of exposed subgrade soils, it will be important to divert runoff, provide positive grading to shed seepage and runoff from flat areas, and compact exposed soils to reduce rutting, ponding, and surface water infiltration. Excavations in natural soil deposits below groundwater are expected to be susceptible to sloughing due to groundwater inflow. Excavations extending more than about 1 foot below groundwater will be susceptible to sloughing and instability. RWG&A anticipates that where groundwater is encountered during construction then groundwater control can be accomplished through the use of ditches, sumps, and open pumping techniques.

LD-CLSM is buoyant and will float if exposed to inundation and/or excessive groundwater pore pressures. The Contractor, who is responsible for means and methods of construction, should anticipate the need to provide temporary groundwater water control measures such as a crushed stone drainage layer below the LD-CLSM that outlets to a free draining locations or sumps and pumps.

Use of On-site Soils: The naturally deposited subsurface soils within the anticipated depth of excavation generally consist of sand with silt, silty sand, and silty clay and are considered unsuitable for use as structural fill, or for pavement section base and subbase materials, but might be used as common fill. If the on-site soils are proposed for uses other than common fill in landscaped areas or embankment fill below pavement sections, then the soils should be stockpiled separately and tested to determine if they meet specification requirements for the intended uses.

6.0 GEOTECHNICAL RECOMMENDATIONS

The recommendations presented below are provided for use in design of proposed building foundations, ground floor slabs, and pavement sections. Foundation design and site work construction will be greatly influenced by subsurface conditions at the project site. RWG&A recommends foundation design and construction be in compliance with the requirements of all applicable ordinances, regulations, and rules. When this report was prepared, the applicable building code in Portland, Maine was the Maine Uniform Building and Energy Code which adopts 2009 International Building Code® by reference.

The following is predicated on the following construction sequence:

- Removing unsuitable materials from areas of proposed construction,
- Removing existing soil to a minimum of three feet below current ground surface below the building area, and replacing with LD-CLSM,
- Constructing foundation spread footings to bear on the LD-CLSM surface,
- Placing approximately 2 additional feet of LD-CLSM up to the design subgrade for the ground floor slab base layer,
- Placing and compacting ground floor slab base material and install underslab utilities,

- Constructing the ground floor slab.

6.01 Site Preparation

1. All topsoil, peat, organic material, debris, rubbish, frozen soils, muck, loose, or disturbed soils and other unsuitable materials should be removed from the area of new construction. Topsoil may be stockpiled outside the construction area for reuse in landscaped areas. Unsuitable materials include uncontrolled fills (i.e., fills placed without systematic densification and moisture control to an acceptable percent compaction), asphaltic pavement, and deleterious substances.

Topsoil should be stockpiled outside of the construction area for reuse. Topsoil may be used as fill in landscaped areas but not as common fill below pavements or as fill below proposed building. On-site soils proposed for use in the construction should be stockpiled and tested for compatibility with its intended use.

2. Stripped subgrades beneath planned building and paved area and composed of granular soil should be proof-rolled with a minimum of two passes of a 10-ton roller in each of two perpendicular directions to improve the density of suitable soils. Silty clay to sandy silt subgrades should not be proof-rolled. Rolling of subgrades should be observed for areas of soil rutting or weaving indicative of unsuitable underlying materials. Unsuitable fill and/or soft, loose, and/or disturbed native soil materials should be excavated and replaced with structural fill. If high groundwater is present during subgrade preparation, the vibratory roller should be operated in the “static” mode to avoid liquefying the soil.
3. Site grading should provide positive drainage away from constructed facilities both during and after construction.
4. It should be practicable to accomplish construction dewatering within excavations by open pumping methods. Sand below groundwater might be susceptible to sloughing into excavations. Excavations deeper than 1-foot below groundwater may require the use of side trenches within or adjacent to excavations, or other dewatering methods. Surface runoff and infiltration of groundwater should be controlled so that excavation, filling, and foundation construction can be completed in-the-dry. Dewatering should be continuous until the permanent foundation drainage system is installed, and foundations are built and backfilled. A layer of crushed stone underlain with geotextile might be needed to protect subgrades from disturbance during construction.

6.02 Site Filling

5. Structural fill is recommended for use as fill below ground floor slabs and as backfill within 4 feet of footings and foundation walls only where they are located outside the limits of low-density, LD-CLSM. Structural fill should be a well-graded sand and gravel mixture meeting the following gradation requirements:

Screen or Sieve Size	Percent Passing
6 inches	100
3 inches	70 - 100
No. 4	35-70
No. 40	5-35
No. 200	0-5

(Note: Maximum particle size should be limited to 3 inches within 2 feet of foundation walls, footings, and floor slabs.)

- 6. In open areas, structural fill should be placed in level, uniform lifts not exceeding 9 inches in uncompacted thickness. In confined areas, within 4 feet of foundation walls, and areas where self-propelled compaction equipment should not be used based on vibration considerations, structural fill should be placed in lifts not exceeding 6 inches in uncompacted thickness and be compacted with hand-operated compaction equipment. All fill placed for footing and slab support should be structural fill compacted to at least 95 percent of the maximum dry density as determined by *ASTM Standard D 1557 Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³))*.
- 7. Minimum compaction requirements for granular fill materials are as follows:

Location or Area	Standard Proctor Density ASTM D698	Modified Proctor Density ASTM D1557
Structures and Walkways	95%	92%
Pavements below 18 inches of Subgrade	95%	92%
Trenches	95%	92%
Lawns or Unimproved Areas	92%	90%
Building and Pavement Subgrades (Top 18 inches)	100%	95%

In-place density tests should be performed at the following frequencies to determine whether compaction requirements are met:

Location or Area	Testing Frequency One Test per Lift per
Structures and Walkways	2,000 square feet
Pavements below 18 inches of Subgrade	5,000 square feet
Trenches	150 lineal feet
Lawn or Unimproved Areas	20,000 square feet
Building and Pavement Subgrades (Top 18 inches)	1,000 square feet

- 8. Existing fill and naturally deposited soils below the proposed building should be removed and replaced with LD-CLSM to a depth of 3 feet below pre-development ground surface or elevation 64 feet, whichever is lower. LD-CLSM should be used as fill from current ground surface up to the bottom of the ground floor slab base layer. The LD-CLSM should

be used below exterior slabs sensitive to differential movement between the slab and building. LD-CLSM should extend laterally a minimum of three feet outside the bottom outside edge of perimeter footings. LD-CLSM should only be placed over approved subgrade and should not be placed on frozen ground, snow, or ice.

9. LD-CLSM fill should be Controlled Low-Strength Materials using preformed foam as described in *American Concrete Institutes (ACI's) Report on Controlled Low-Strength Materials, Document 229R-13*. The in-service unit weight should be between 36 and 42 pounds per cubic foot, and minimum recommended compressive strength is 80 pounds per square inch.
10. Maximum recommended lift-thickness for LD-CLSM is 3 feet, unless data substantiating that thicker lifts using material of the same mix design and similar environmental conditions (e.g., air and ground temperature) are technically feasible, is approved by the designer. Additional lifts and concrete should not be placed on top of in-place LD-CLSM until it has a minimum unconfined compressive strength of 20 pounds per square inch.
11. Minimum recommended air and material temperature at the time of placement is 40 degrees. LD-CLSM should be protected from freezing temperatures in accordance with American Concrete Institute's cold-weather concreting procedures, except that LD-CLSM temperature shall be maintained at 50 degrees Fahrenheit or above for a minimum period of 24-hours after placement.
12. Unit weight of LD-CLSM should be determined in the field during placement in general accordance with *ASTM D6023, Standard Test Method for Unit Weight, Yield, Cement Content, and Air Content (Gravimetric) of Controlled Low-Strength Material (CLSM)*. A minimum of one unit weight test should be conducted per 50 cubic yards, or one test per placement per day, whichever is greater.
13. LD-CLSM should be sampled and tested for unconfined compressive strength. Sampling and testing should be conducted in general accordance with *ASTM D4832, Standard Test Method for Preparation and Testing of Controlled Low-Strength Material (CLSM) Test Cylinders*. A minimum of one set of six test cylinders should be made per 50 cubic yards, or one set per placement per day, whichever is greater. Three test cylinders should be tested at 7-days and three test cylinders should be tested at 28-days.
14. LD-CLSM should be protected from freezing temperatures. Rigid insulation should be placed at the top and sides of LD-CLSM exposed to freezing temperatures. Rigid insulation should be extended vertically to an insulated exterior wall to create a continuous layer of insulation and down a minimum of 4 feet below surfaces exposed to freezing temperatures. Rigid insulation should be Type IV extruded polystyrene insulation and a minimum 2 inches thick.

6.03 Foundations

15. Foundations should be designed to withstand lateral, uplift, and overturning forces due to wind and earthquake. The in-place soils encountered in the explorations are not considered susceptible to liquefaction. In accordance with the 2009 *International Building Code®* the soil profile at the site is classified as Site Class D.

16. With proper site preparation, the building may be supported on spread footings bearing on LD-CLSM. Footings may be proportioned using an allowable bearing pressure of 3,000 pounds per square foot. The above allowable bearing pressure is based on footings bearing on a minimum of 3 feet of LD-CLSM.

Minimum footing width should be in accordance with concrete design and building code requirements, and not less than 2 feet. For footings having a least lateral dimension less than 3 feet, the above allowable pressure should be taken as 1/3 of the above value times the least dimension in feet. Post-construction total settlements of less than 1-inch are estimated for the above subgrade improvement measures and contact pressure.

17. Excavation of footing and floor slab bearing surfaces in soil or fill should be performed by earthwork equipment fitted with smooth-edged buckets. Any loose, softened, or disturbed material due to construction traffic should be removed prior to placement of concrete.

18. It is recommended that design bottom of footing level for exterior footings bearing on LD-CLSM be 2 feet below lowest adjacent ground surface exposed to freezing temperatures. Interior and exterior footings should bear on LD-CLSM at the same elevation.

19. The integrity of natural soils and structural fill must be maintained during cold weather conditions. Soil subgrades should not be allowed to freeze. Freezing of subgrade soils beneath footings and floor slabs may result in frost heaving and post-construction settlement. The Contractor should make every effort to prevent freezing of subgrade soils. In the event frost penetration occurs, structural fill or naturally deposited soils should be removed and replaced to the depth of the frozen soils. At no time should frozen material be placed as fill.

20. Lateral loads from wind and earthquake may be resisted by friction between the bottom of the footings and LD-CLSM. A friction coefficient of 0.35 at the interfaces is recommended for use in design. A lateral bearing pressure of 150 lbs. per square foot per foot below grade are recommended.

6.04 Ground Floor Slabs

21. Interior ground floor may be slab-on-ground construction and designed based on a subgrade modulus of 150 pounds per cubic inch. The slab should be underlain by a minimum of 12 inches of compacted sand meeting the following gradation.

Sieve Size	Percent Passing
3/8 inch	100
No. 4	95 - 100
No. 8	80 - 100
No. 16	50 - 85
No. 30	25 - 60
No. 50	10 - 30
No. 100	2 - 10

The sand should be placed in compacted to at least 92 percent of the maximum dry density as determined by ASTM D 1557.

22. As a minimum, a vapor retarder should be provided below the floor slab to reduce moisture infiltration. Concrete slab-on-grade floors, regardless of their design or construction, are prone to cracking. The use of control joints is a method to reduce random patterned cracking in slabs on grade. However, even with the control joints, uncontrolled cracking should be expected.

It is anticipated design and construction details of the floor slab, including concrete thickness, reinforcing, bedding, control joint depth and spacing, and the vapor retarder type or waterproofing and thickness, will be provided by the project Structural Engineer and/or Architect with considerations for the moisture sensitivity of floor finishes.

Exterior slabs at entrances and at other locations where ground floor slabs might be exposed to freezing temperatures and where frost heaving and/or settlement would be problematic should be underlain by a minimum of 4 feet of underdrain stone. Underdrain stone should consist of *State of Maine Department of Transportation Standard Specifications, 703.22 Underdrain Backfill Material Type C*. The surrounding area should be pitched to drain away in order to reduce available moisture for ice and frost lens generation. The underdrain stone should be completely wrapped in a filter fabric to prevent the migration of fines from surrounding soils. Drains should be provided to outlet water that collects in the drainage stone.

23. Walkways and exterior slabs at locations where about 1 to 2 inches of settlement and some frost heaving would be tolerable should be underlain by a minimum of 24 inches of crushed stone completely wrapped in a filter fabric or structural fill to provide limited protection against heave. Surrounding grade should slope away from the structure to reduce available moisture for frost lens generation, and the drainage stone should be provided with a drainage pipe to outlet collected water.

6.05 Foundation Drainage

24. Perimeter footing drains should be installed around the building. The drains should be installed outside and adjacent to LD-CLSM and a minimum of 4 feet below surfaces exposed to freezing temperatures. The drains should consist of perforated pipe bedded in 2 cubic feet of underdrain stone per linear foot. The underdrain stone should be completely wrapped in a filter fabric such as Mirafi 160N.
25. Flow from the foundation and underslab drains should be conveyed by gravity to a surface drainage feature or storm drain that will be free flowing at all times and under all conditions. Multiple outlets should be provided so as not to be dependent on a single flow path.

Surface water drainage systems including roof drains should not be connected to the perimeter foundation drains and/or underslab drains unless measures are provided to prevent the rise of water above the lowest underdrain/foundation drain invert level at all times and under all conditions. Surface water drainage features including roof drains, pipes, catch basins, manholes, drip edges, infiltration trenches and basins, should direct

water away from underslab and foundation drainage at all times and locations. Existing and new roof drains should not be connected to the foundation drains.

6.06 Cast-in-Place Concrete Foundation Walls

26. Structural fill should be used as backfill next to retaining walls. Only vibratory plate compactors and/or walk behind rollers should be used to compact backfill within 4 feet of retaining and foundation walls.
27. All fully drained foundation walls with unbalanced earth pressures acting upon them should be designed to withstand an at-rest equivalent fluid unit weight of 65 pounds per square foot ($K_o = 0.5$). Any retaining walls that cannot be allowed to move or are otherwise restrained, such as ones attached to building foundations, should be designed for at-rest conditions as well. Lateral load from vehicle surcharge can be accounted for by applying a uniform vertical pressure equal to 250 pounds per square foot multiplied by the at-rest earth pressure coefficient.
28. The above equivalent fluid unit weights assume provisions are made to prevent the rise of water above the bottom of wall (i.e., footing drains) and that the walls are backfilled with structural fill.
29. It is also recommended that retaining walls be designed with the resultant load within the middle third of the footing and that a maximum contact pressure at the toe of wall be no greater than 1,500 pounds per square foot.

6.07 Pavement Sections

30. It is recommended the pavement section subgrade be compacted by several passes with a smooth drum vibratory roller and a thorough evaluation of the paved area subgrade be undertaken. The evaluation should include proof-rolling with a loaded tandem axle dump truck weighing not less than 25 tons to aid in identifying soft pockets and areas of excess yielding. Wet or saturated subgrades should not be proof-rolled. Soft spots, unsatisfactory soils, areas of excessive pumping, or rutting in excess of 1 inch in depth should be excavated and replaced with suitable compacted fill. If high groundwater is present during subgrade preparation, the vibratory roller should be operated in the “static” mode to avoid liquefying the soil.

Prior to the start of paving and as described above for pavement section subgrade, the surface of the pavement section base course material should be proof-rolled. Areas with any visually discernable pumping and/or rutting should be excavated and replaced with suitable compacted material.

31. The paved parking and drive areas should be constructed with the following pavement sections. Materials and placement methods should meet the requirements of current Maine Department of Transportation Standard Specifications (November 2014 edition).

Component	Thickness in Inches	
	Light Duty	Heavy Duty
Surface Course (Maine DOT Type 12.5 mm)	1-1/2	1-1/2
Binder Course (Maine DOT Type 19 mm)	2	2-1/2
Gravel Base (Maine DOT 703.06 Type A)	3	3
Subbase (Maine DOT 703.06 Type D)	<u>18</u>	<u>21</u>
Totals	<u>25</u>	<u>28</u>

Perimeter pavement underdrains or a free-draining ditch should be provided at the perimeter of paved areas. The invert of the drain or ditch should be a minimum of 1 foot below the pavement section. Underdrains spaced 40-feet on center should be provided below planned paved areas where pavement sections are in cuts.

Light duty pavement sections should be provided where traffic is limited to automobiles only, and heavy-duty pavement sections should be provided where large truck and tractor trailer traffic is anticipated.

- 32. Underdrains should consist of 2 cubic feet of MDOT Underdrain Backfill Material Type C per linear foot, wrapped in a filter fabric, and located a minimum of 1 foot beneath the pavement section. The trench above the geotextile wrapped underdrain stone should be backfilled with MDOT Underdrain Backfill Material Type B. The top of the underdrain trench backfill should be in direct contact with the pavement subbase.
- 33. Each pavement underdrain pipe should be provided with multiple outlet pipes so as not to be reliant upon a single flow path. Drains should be outletted by gravity to surface drainage features or storm drains that will be free flowing under all conditions.
- 34. The pavement sections are designed to support post-construction traffic loads. The sections are not designed to support construction traffic loading. Construction means and methods are the responsibility of the Contractor and the Contractor should anticipate the need to evaluate and employ methods to prevent subgrade softening, rutting, or impairment of overlying fill materials as a result of construction traffic. Measures that should be considered by the Contractor include, but are not limited to, use of lower weight equipment, dispersion of construction traffic, constructing haul roads and construction traffic paths designed to support construction vehicles and equipment, and the use of geotextiles.

6.08 Utilities

- 35. Utilities may be earth-supported but must be designed to accommodate settlements of 2 to 3 inches outside the building limits. Flexible connections are recommended at building envelope penetrations. Bedding placed between the utility and subgrade should meet the utility and manufacturer requirements for the type of conduit or pipe being installed. Filter fabric should be placed beneath and along the sides of crushed stone bedding. Trench

backfill beneath slabs and pavements should be systematically compacted in lifts to reduce post-construction ground surface settlement and cracking of pavements and walkways.

36. It is difficult to properly place and compact trench backfill material where a trench box or excavation shield is used. There is a tendency to remove the trench box after the pipe is installed and then end-dump backfill material with little or no compactive effort applied. The usual result of the above construction practice is post-construction settlement of the ground surface along the trench alignment. This settlement may be tolerable for cross-country alignments; however, under paved areas this usually means having to re-level the surface years after the construction is complete. If this situation is not acceptable, a systematic compaction effort must be applied to the trench backfill below pavements.

6.09 Temporary Excavations

37. Soils at this site, encountered within the anticipated depths of excavations, consist of silty sand, sandy silt, and silty clay. It is anticipated that foundation and utility excavations can be accomplished using sloped, open-cut techniques where these excavations are outside the influence zone of existing foundations or other structural elements. It is also anticipated that dewatering can be accomplished using sumps and open pumping methods.

The Contractor should be aware that slope height, slope inclination, and excavation depths (including utility trench excavations) should in no case exceed those specified in local, state, or federal safety regulations (e.g., OSHA Health and Safety Standards for Excavations, 29 CFR Part 1926, or successor regulations). Such regulations are strictly enforced and, if they are not followed, the Owner, Contractor, and/or earthwork and utility subcontractors could be liable for substantial penalties.

As a safety measure, it is recommended all vehicles and spoil piles be kept a minimum lateral distance from the top of excavations equal to no less than 100 percent of the slope height. Exposed slope faces should be protected against the elements.

6.10 Geotechnical Observation

Geotechnical recommendations provided as the basis for design of this project were developed based on conceptual design information and limited numbers of soil borings and tests. The Owner should be sensitive to the potential need for adjustment during final design and construction. It is recommended that the Owner retain RWG&A to observe geotechnical construction aspects of the project.

As part of the project's construction phase, it is recommended that the Owner retain RWG&A to observe geotechnical construction aspects of the project. If RWG&A is not retained to provide geotechnical observation and associated testing services, RWG&A would not have the opportunity to verify site work is completed in accordance with RWG&A's recommendations. Post-construction performance of the building and site work features would necessarily be based on the interpretations and judgement of others.

Construction services should include observing general compliance with the design concepts, specifications and recommendations, and assisting in development of design changes should

subsurface conditions differ from those anticipated prior to the start of construction. Observation improves the likelihood that the design intent will be carried out during construction. For this project, geotechnical observation and testing of the following aspects is recommended:

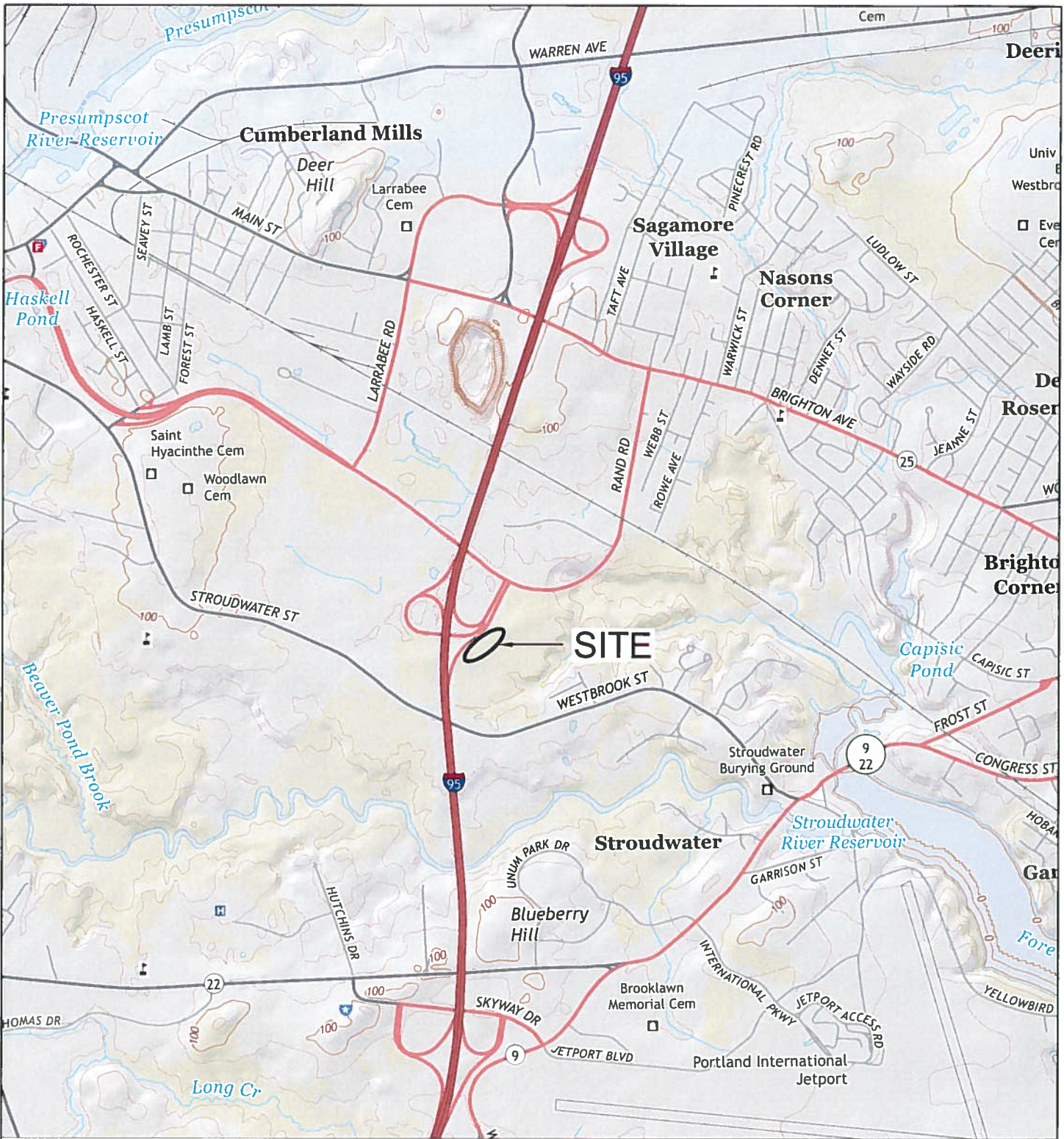
- Review geotechnical aspects of site work submittals,
- Observe site stripping and proof-rolling of subgrade soils,
- Assess suitability of exposed LD-CLSM, spread footing, and slab-on-grade subgrades,
- Field sampling and testing of LD-CLSM,
- Laboratory testing LD-CLSM, and
- Perform laboratory and field testing of structural and other compacted fills. Testing would include grain-size distribution, moisture-density testing, and in-place density testing to determine percent relative compaction and total unit weights.

In addition to geotechnical observation, RWG&A can provide construction inspection and materials testing services. This would include soils, portland cement and asphaltic concrete, masonry, fire proofing, destructive and non-destructive testing, and special inspection services in fulfillment of building code requirements. Soil and materials testing would be performed at the RWG&A's soil testing laboratory in Saco, Maine, which is a full service laboratory accredited by the American Association of State Highway and Transportation Officials (AASHTO) for the testing of soils, steel, concrete, masonry and asphalt.

7.0 CLOSURE

This report has been prepared for specific application to the Patrons Oxford Insurance Company building to be built on Lot 4 of Portland Technology Park in Portland, Maine, and for the exclusive use of Patrons Oxford Insurance Company. This work has been completed in accordance with generally accepted soil and foundation engineering practices. No other warranty, expressed or implied, is made. In the event that any changes are made in the nature, design, or location of proposed buildings, the conclusions and recommendations of this report should be reviewed by RWG&A.

The recommendations presented are based on the results of widely spaced explorations. The nature of variations between explorations may not become evident until construction. If variations are encountered, it will be necessary for RWG&A to re-evaluate the recommendations presented in this report. RWG&A should be retained to review design and specifications to verify that geotechnical evaluations and recommendations provided in this report have been interpreted in the manner they were intended.



0 2000 3000 4000

SCALE, FEET

**FIGURE 1
LOCUS MAP
PROPOSED PATRONS OXFORD INSURANCE
OFFICE BUILDING
PORTLAND, MAINE**

OCTOBER 2015

PROJECT NO. 1518-002

SOURCE:
USGS 7.5-MINUTE TOPOGRAPHIC QUADRANGLE OF
PORTLAND WEST, ME, DATED 2014.

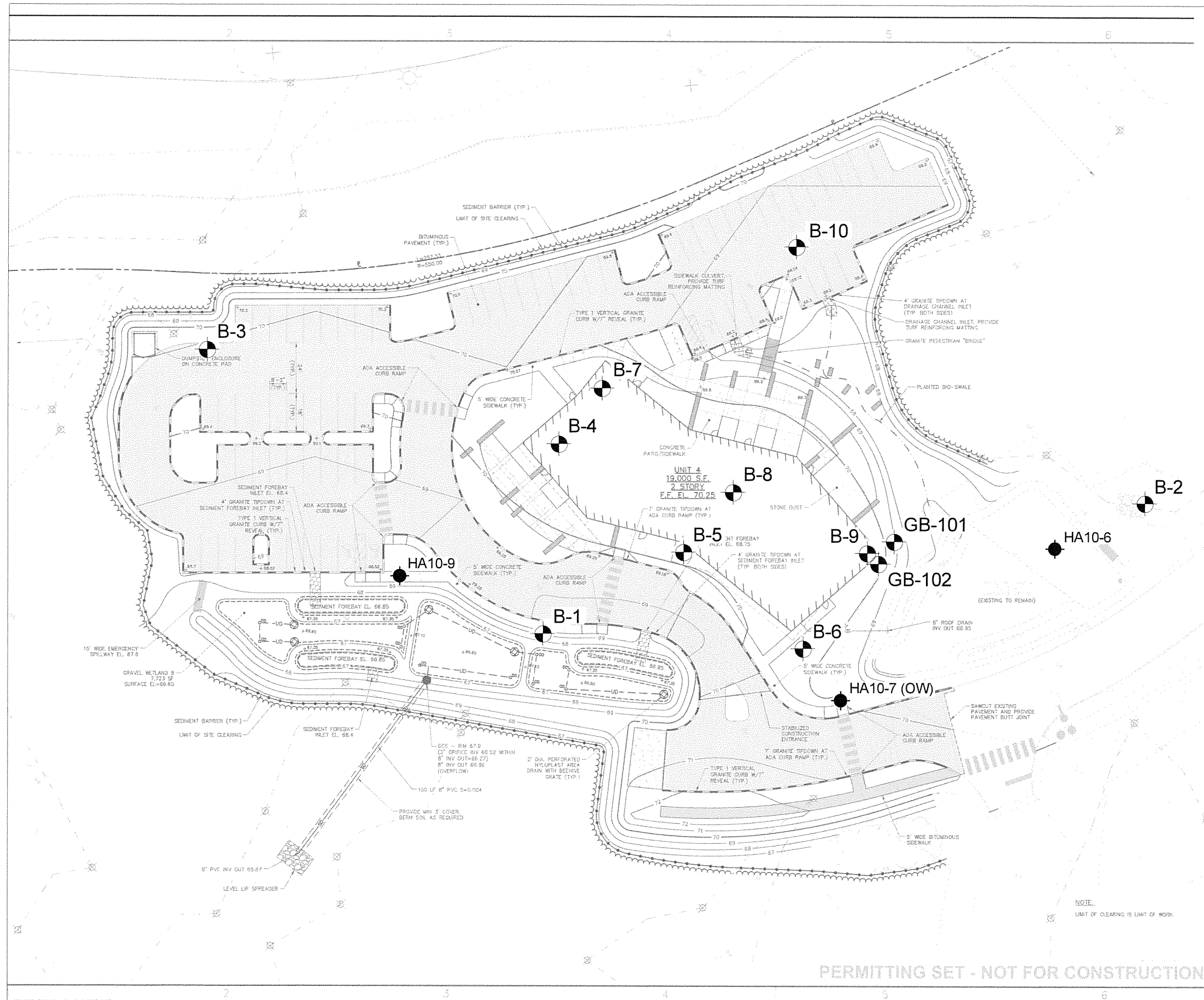


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LEGEND:

-  B-1 APPROXIMATE LOCATION OF SOIL BORING PERFORMED BY RWG&A JULY AND SEPTEMBER 2015.
-  HA10-6 APPROXIMATE LOCATION OF SOIL BORING PERFORMED BY OTHERS AUGUST 2010.

SOURCE:
DRAWING C-03, TITLED "LCE 4 SITE GRADING, DRAINAGE, AND EROSION CONTROL PLAN", BY WOODARD & CURRAN, DATED SEPTEMBER 2015.

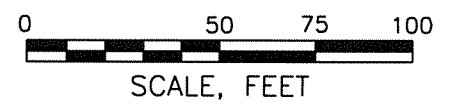
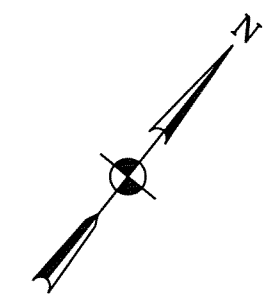


FIGURE 2
EXPLORATION LOCATION PLAN
PROPOSED PATRONS OXFORD INSURANCE
OFFICE BUILDING
PORTLAND, MAINE

OCTOBER 2015 PROJECT NO. 1518-002



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PERMITTING SET - NOT FOR CONSTRUCTION

G:\AutoCAD\1500\1518-002\FIG 2, ELP 1518-002.dwg, 10/16/2015 2:27:33 PM, Xerox WorkCentre 7855 GPD

APPENDIX A
LIMITATIONS

Geotechnical Engineering Services
Proposed Patrons Oxford Insurance Company Office Building
Portland, Maine

LIMITATIONS

This geotechnical evaluation has been limited to consideration of the soil and foundation aspects of the proposed building and site development. The primary purpose of RWG&A's services was to explore subsurface conditions and to provide geotechnical parameters for design and construction. This report identifies construction considerations intended to solely assist engineers that will design the project and monitor its construction, and not to the benefit of others including, but not limited to, the Contractor.

This geotechnical evaluation report might also aid the Contractor responsible for construction, but reliance is not extended to the Contractor for the purposes of bidding and/or building the project. The recommendations and comments provided herein are not intended to be instructions or directives to the project Contractor. The project Contractor must evaluate construction issues encountered in the work on the basis of their experience with similar projects taking into account their own methods and procedures.

This report has not considered the construction from a worker safety perspective. Construction safety is the responsibility of the project Contractor, who is also solely responsible for the means, methods, and sequencing of construction operations. RWG&A is providing this information as a service to Patrons Oxford Insurance Company. Under no circumstances should this information be interpreted to mean that RWG&A and/or Patrons Oxford Insurance Company are assuming responsibility for construction site safety or the Contractor's activities; such responsibility is not being implied and should not be inferred.

RWG&A's scope of services did not include an environmental site assessment relative to oil and hazardous materials or evidence of a potential release or threat of oil or hazardous materials on, below, or around the site. Any statement in this report, or on the exploration logs, regarding odors or unusual or suspicious conditions is for informational purposes only and is not intended to constitute an environmental assessment. RWG&A's scope of services also excluded any service to investigate or detect the presence of mold or other biological contaminants, or any service that was designed or intended to prevent or lower the risk of the occurrence of an infestation of mold or other biological contaminants (MOBC infestation).

APPENDIX B
EXPLORATION LOGS

Geotechnical Engineering Services
Proposed Patrons Oxford Insurance Company Office Building
Portland, Maine

RWG&A, Inc. soil descriptions are based on the following criteria. Descriptive terminology is used to denote the grain size and percentage of each component. The soil descriptions are based on visual-manual classification procedures, Standard Penetration Test results, and the results of laboratory testing on selected soil samples, where available. The Unified Soil Classification Group Symbol will be indicated in capital letters.

COMPONENT DEFINITIONS BY GRADATION SIEVE LIMITS

Materials	Definitions	Fractions	Upper	Lower
Boulders	Material too large to pass through an opening 12 in. square.			
Cobbles	Material passing through a 12 in. opening and retained on the 3 in. sieve.			
Gravel	Material passing the 3 in. sieve and retained on 1/4" (No. 4 sieve).	Coarse Fine	3 in. 3/4 in.	3/4 in. 1/4 in.
Sand	Material passing the No. 4 sieve and retained on the No. 200 sieve.	Coarse Medium Fine	No. 4 (1/4") No. 10 (1/8") No. 40 (1/32")	No. 10 (1/8") No. 40 (1/32") No. 200
Silt	Material passing the No. 200 sieve which is usually non-plastic in character and exhibits little or no strength when air dried.		No. 200	
Clay	Material passing the No. 200 sieve which can also be made to exhibit plasticity within a certain range of moisture contents and which exhibits considerable strength when air dried.		No. 200	

SOIL DESCRIPTION

General

Soils are described as to the Unified Soil Classification Systems Group Symbol, density or consistency, color, grain size distribution and other pertinent properties such as plasticity and dry strength. The RWG&A order of descriptors is as follows:

1. USCS Group Name and Symbol, or Fill
2. Density or Consistency
3. Moisture
4. Grain Size & Constituent percentages
5. Other pertinent descriptors
6. Color

DESCRIPTIVE TERMINOLOGY DENOTING COMPONENT PROPORTIONS

Descriptive Terms	Range of Proportions
Noun (major component)	> 50%
Adjective (secondary component)	20 - 50%
Some (third component)	25 - 45%
Little (second or third component)	15 - 25%
Few (second or third component)	5 - 15%
Trace	0 - 5%
With	Amount of component not determined. Used as a conjunction only. Does not indicate component percentile

OTHER DESCRIPTIVE TERMS

Where appropriate, geological classifications are also used (Glacial Till, etc.)

TYPICAL DESCRIPTIONS

SAND WITH SILT (SP-SM): Medium dense, moist, coarse to medium sand, few silt, brown.

FILL: Loose, dry, fine sand, some gravel and silt, with brick and concrete fragments, dark brown.

SILTY CLAY (CL): Very stiff, moist, silty clay, olive-brown.

DENSITY OR CONSISTENCY OF SOILS

COHESIVE SOILS

Consistency of Cohesive Soils	Standard Penetration Test (Blows Per Foot) (N)	Undrained Shear Strength (TSF)
Very Soft	0 - 2	Below 0.13 (250 psf)
Soft	2 - 4	0.13 to 0.25 (to 500 psf)
Medium	4 - 8	0.25 to 0.5 (to 1,000 psf)
Stiff	8 - 15	0.5 to 1.0 (to 2,000 psf)
Very Stiff	15 - 30	1.0 to 2.0 (to 4,000 psf)
Hard	Over 30	over 2.0 (over 4,000 psf)

Consistency of cohesive soils is based upon field vane shear, torvane, or pocket penetrometer, or laboratory vane shear or Unconsolidated-Undrained Triaxial Compression tests. Consistency of cohesive soils is based upon the Standard Penetration Test when no other data is available.

COHESIONLESS SOILS

Density of Cohesionless Soils	Standard Penetration Test (Blows per Foot) (in)
Very Loose	0 - 4
Loose	4 - 10
Medium Dense	10 - 30
Dense	30 - 50
Very Dense	over 50

PENETRATION RESISTANCE

STANDARD PENETRATION TEST (ASTM D1586) - a 2.0-inch diameter, 1-3/8 inch inside diameter split barrel sample is driven into soil by means of a 140-pound weight falling freely through a vertical distance of 30 inches. The total number of blows required for penetration from 6 to 18 inches is the Standard Penetration Resistance (N).

COBBLES AND BOULDERS

The percentage of cobbles and boulders is estimated visually where possible.

Descriptive Term	Estimated Percentage
Very Few	0 - 10%
Few	10 - 25%
Common	25 - 40%
Numerous	40 - 50%

If the percentage cannot be determined, as in a typical test boring, then use "with" to indicate the presence of cobbles and/or boulders. (i.e., gravelly sand with cobbles and boulders).

FILLS

The following terminology is used to denote size range of man-made materials within fill deposits:

Size Range	Comparative Soil Terms
<No. 200 Sieve	Silt - size
No. 200 to 1/4 in.	Sand - size
1/4 in. to 3 in.	Gravel - size
3 in. to 12 in.	Cobble - size
>12 in.	Boulder - size

SUPPLEMENTAL SOIL DESCRIPTION TERMINOLOGY

Term	Example
Seam	Typically 1/16 to 1/2 inch thick 1/4 inch sand seams
Layer	Greater than 1/2 inch thick 2-inch sand layers
Occasional	One or less per foot of thickness
Frequent	More than one per foot of thickness
Interbedded	Alternating soil layers of different composition
Varved	Alternating thin seams of silt and clay
Mottled	Variations in color



Project Name: Prop. Patrons Oxford Ins. Office Bldg.
 RWG&A Project No. 1518-002
 Location: Portland, Maine
 Client: Patrons Oxford Insurance
 RWG&A Representative: C. Morrell
 Boring Location: See Exploration Location Plan
 Boring Abandonment Method: Backfilled with cuttings
 Observed Water Depth: 7'

Drilling Contractor: Northern Test Boring
 Drill Rig: Diedrich D50
 Driller Rep.: Mike Nadeau
 Date Started: 07/20/2015
 Date Completed: 07/20/2015
 Surface Elevation: 67 (Feet)
 Drilling Method: SSA
 Casing Type: N/A

DEPTH, FT.	SYMBOL SAMPLES	SAMPLE NUMBER	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N BLOWS PER FT.	MOISTURE CONTENT %	LAB TESTS
0		S-1	TOPSOIL AND ORGANIC MATERIAL (3 inches). SILTY SAND (SM); Loose, moist, fine sand, some silt, trace root matter, gray with brown mottling.	20	2 2 4 7	6		
5		S-2		20	2 4 4 5	8		
10		S-3	SILTY CLAY (CL); Very soft, wet, silty clay, gray.	23	WOH/ 24"	WOH		
			Bottom of Exploration at 12'; Not Refusal.					

Notes:



Project Name: Prop. Patrons Oxford Ins. Office Bldg.
 RWG&A Project No. 1518-002
 Location: Portland, Maine
 Client: Patrons Oxford Insurance
 RWG&A Representative: C. Morrell
 Boring Location: See Exploration Location Plan
 Boring Abandonment Method: Backfilled with cuttings
 Observed Water Depth: 4'

Drilling Contractor: Northern Test Boring
 Drill Rig: Diedrich D50
 Driller Rep.: Mike Nadeau
 Date Started: 07/20/2015
 Date Completed: 07/20/2015
 Surface Elevation: 67 (Feet)
 Drilling Method: SSA
 Casing Type: N/A

DEPTH, FT.	SYMBOL SAMPLES	SAMPLE NUMBER	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N BLOWS PER FT.	MOISTURE CONTENT %	LAB TESTS
0		S-1	FILL; Sand with silt, very loose, moist, fine to medium sand, little silt, few gravel from 1.5' - 3', dark brown.	6	1 1 3 3	4		
5		S-2	SILTY SAND WITH CLAY (SM); Loose, wet, fine sand, some silt, little clay from 5' - 5.5', grayish brown.	17	3 2 5 4	7		
10		S-3	SILTY CLAY (CL); Soft, wet, silty clay, gray.	6	2 1 1 1	2		
12			Bottom of Exploration at 12'; Not Refusal.					

Notes:



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Boring Log: B-3

Total Depth (ft): 12

Sheet 1 of 1

Project Name: Prop. Patrons Oxford Ins. Office Bldg.
 RWG&A Project No. 1518-002
 Location: Portland, Maine
 Client: Patrons Oxford Insurance
 RWG&A Representative: C. Morrell
 Boring Location: See Exploration Location Plan
 Boring Abandonment Method: Backfilled with cuttings
 Observed Water Depth: 5'

Drilling Contractor: Northern Test Boring
 Drill Rig: Diedrich D50
 Driller Rep.: Mike Nadeau
 Date Started: 07/20/2015
 Date Completed: 07/20/2015
 Surface Elevation: 69 (Feet)
 Drilling Method: SSA
 Casing Type: N/A

DEPTH, FT.	SYMBOL SAMPLES	SAMPLE NUMBER	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N BLOWS PER FT.	MOISTURE CONTENT %	LAB TESTS
0		S-1	TOPSOIL AND ORGANIC MATERIAL (10 inches). SILTY SAND (SM); Very loose, moist to wet, fine sand, some silt, light brown to grayish brown.	24	1 1 3 5	4		
5		S-2	SANDY SILT (ML); Loose to medium dense, silt with some sand, wet, grayish brown.	22	5 5 6 5	11	24.5	MC GS
10		S-3		23	3 3 3 1	6		
			Bottom of Exploration at 12'; Not Refusal.					

Notes:



Project Name: Prop. Patrons Oxford Ins. Office Bldg.
 RWG&A Project No. 1518-002
 Location: Portland, Maine
 Client: Patrons Oxford Insurance
 RWG&A Representative: C. Morrell
 Boring Location: See Exploration Location Plan
 Boring Abandonment Method: Backfilled with cuttings
 Observed Water Depth: 4'

Drilling Contractor: Northern Test Boring
 Drill Rig: Diedrich D50
 Driller Rep.: Mike Nadeau
 Date Started: 07/21/2015
 Date Completed: 07/21/2015
 Surface Elevation: 67.5 (Feet)
 Drilling Method: Drive and wash
 Casing Type: 4" Steel

DEPTH, FT.	SYMBOL SAMPLES	SAMPLE NUMBER	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N BLOWS PER FT.	MOISTURE CONTENT %	LAB TESTS
0		S-1	TOPSOIL AND ORGANIC MATERIAL (6 inches). SILTY SAND (SM): Very loose to loose, moist to wet, fine sand, some silt, grayish brown.	12	1 1 2 6	3		
5		S-2	Seams of silty clay from 5' - 7'.	20	3 3 5 6	8		
10		FV	SILTY CLAY (CL); Very soft, wet, silty clay, gray. Field Vane: Undrained Shear Strength=530 psf; residual=80 psf.					
15		FV FV	Field Vane: Undrained Shear Strength=490 psf; residual=50 psf. Field Vane: Undrained Shear Strength=410 psf; residual=50 psf.					
20		FV FV	Field Vane: Undrained Shear Strength=330 psf; residual=0 psf. Field Vane: Undrained Shear Strength=340 psf; residual=0 psf.					
25		FV FV	Field Vane: Undrained Shear Strength=380 psf; residual=0 psf. Field Vane: Undrained Shear Strength=410 psf; residual=0 psf. Hydraulic push probe with "a" rod from 26' - 51'.					

Notes: Used 3 5/8x9" Acker field vane. Unable to push vane to 10.8', possible sand seam.



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Boring Log: B-4

Total Depth: 51

Sheet 2 of 2

Project Name: Prop. Patrons Oxford Ins. Office Bldg.
 Location: Portland Maine
 Client: Patrons Oxford Insurance
 Observed Water Depth: 4'

RWG&A Project No. 1518-002
 Surface Elevation: 67.5 (Feet)
 Casing Type: 4" Steel

DEPTH, FT.	SYMBOL SAMPLES	SAMPLE NUMBER	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N BLOWS PER FT.	MOISTURE CONTENT %	LAB TESTS	
30									
35									
40									
45									
50									
51				Bottom of Exploration at 51'; Push probe refusal, probable Glacial Till.					
55									

Notes: Used 3 5/8x9" Acker field vane. Unable to push vane to 10.8', possible sand seam.



Project Name: Prop. Patrons Oxford Ins. Office Bldg.
 RWG&A Project No. 1518-002
 Location: Portland, Maine
 Client: Patrons Oxford Insurance
 RWG&A Representative: C. Morrell
 Boring Location: See Exploration Location Plan
 Boring Abandonment Method: Backfilled with cuttings
 Observed Water Depth: 4'

Drilling Contractor: Northern Test Boring
 Drill Rig: Diedrich D50
 Driller Rep.: Mike Nadeau
 Date Started: 07/21/2015
 Date Completed: 07/21/2015
 Surface Elevation: 67 (Feet)
 Drilling Method: Drive and wash
 Casing Type: 4" Steel

DEPTH, FT.	SYMBOL SAMPLES	SAMPLE NUMBER	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N BLOWS PER FT.	MOISTURE CONTENT %	LAB TESTS
0		S-1	TOPSOIL AND ORGANIC MATERIAL (5 inches). SILTY SAND (SM): Very loose to loose, moist to wet, fine sand, some silt, grayish brown.	14	1 1 2 6	3		
5		S-2	Silty clay layers from 5' - 7'. SILTY CLAY (CL)	22	3 5 4 4	9		
10		FV	Field Vane: Undrained Shear Strength=820 psf; residual=50 psf.					
15		FV FV	Field Vane: Undrained Shear Strength=440 psf; residual=80 psf. Field Vane: Undrained Shear Strength=380 psf; residual=80 psf.					
20		FV FV	Field Vane: Undrained Shear Strength=440 psf; residual=70 psf. Field Vane: Undrained Shear Strength=360 psf; residual=50 psf.					
25		FV FV	Field Vane: Undrained Shear Strength=440 psf; residual=30 psf. Field Vane: Undrained Shear Strength=440 psf; residual=40 psf.					
			Bottom of Exploration at 26.6'; Not Refusal.					

Notes: Used 3 5/8x9" Acker field vane. Unable to push vane to 10.8', possible sand seam.



Project Name: Prop. Patrons Oxford Ins. Office Bldg.
 RWG&A Project No. 1518-002
 Location: Portland, Maine
 Client: Patrons Oxford Insurance
 RWG&A Representative: C. Morrell
 Boring Location: See Exploration Location Plan
 Boring Abandonment Method: Backfilled with cuttings
 Observed Water Depth: 5'

Drilling Contractor: Northern Test Boring
 Drill Rig: Diedrich D50
 Driller Rep.: Mike Nadeau
 Date Started: 07/21/2015
 Date Completed: 07/21/2015
 Surface Elevation: 67 (Feet)
 Drilling Method: 2 1/4 HSA
 Casing Type: NA

DEPTH, FT.	SYMBOL SAMPLES	SAMPLE NUMBER	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N BLOWS PER FT.	MOISTURE CONTENT %	LAB TESTS
0		S-1	TOPSOIL AND ORGANIC MATERIAL (6 inches). SANDY SILT (ML); Loose, moist, silt, some fine sand, grayish brown.	16	1 2 3 6	5		
			SILTY SAND (SM); Loose, moist to wet, fine sand, some silt, grayish brown.					
5		S-2	SANDY SILT (ML); Loose, wet, silt with some sand, grayish brown.	12	4 4 4 4	8	27.6	MC GS
10		S-3	SILTY CLAY (CL); Soft to very soft, wet, silty clay, gray.	14	2 1 1 1	2	36.6	MC
15		S-4		23	WOH/ 24"	WOH	41.8	MC
20		S-5		24	WOH/ 24"	WOH	46.2	MC
25		S-6		2	WOR/ 24"	WOR		
Bottom of Exploration at 27'; Not Refusal.								

Notes:



Project Name: Prop. Patrons Oxford Ins. Office Bldg.
 RWG&A Project No. 1518-002
 Location: Portland, Maine
 Client: Patrons Oxford Insurance
 RWG&A Representative: C. Morrell
 Boring Location: See Exploration Location Plan
 Boring Abandonment Method: Backfilled with cuttings
 Observed Water Depth: 7'

Drilling Contractor: Northern Test Boring
 Drill Rig: Diedrich D50
 Driller Rep.: Mike Nadeau
 Date Started: 07/20/2015
 Date Completed: 07/20/2015
 Surface Elevation: 67.5 (Feet)
 Drilling Method: 2 1/4 HSA
 Casing Type: N/A

DEPTH, FT.	SYMBOL SAMPLES	SAMPLE NUMBER	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N BLOWS PER FT.	MOISTURE CONTENT %	LAB TESTS
0		S-1	TOPSOIL AND ORGANIC MATERIAL (6 inches). SILTY SAND (SM); Loose, moist, fine sand, some silt, grayish brown than orangish brown.	7	1 1 7 6	8		
5		S-2	SILTY CLAY (CL); Stiff to very soft, moist to wet, silty clay, trace fine sand, gray. Pocket Penetrometer: Undrained Shear Strength: Su=2.5 ksf	19	3 5 5 5	10		
10		S-3		4	1 2 1 1	3	30.9	MC
15		S-4		17	1 1 0 1	1		
20		S-5		16	WOH/ 24"	WOH		
25		S-6		19	WOH/ 24"	WOH		
			Bottom of Exploration at 27'; Not Refusal.					

Notes:



Project Name: Prop. Patrons Oxford Ins. Office Bldg.
 RWG&A Project No. 1518-002
 Location: Portland, Maine
 Client: Patrons Oxford Insurance
 RWG&A Representative: C. Morrell
 Boring Location: See Exploration Location Plan
 Boring Abandonment Method: Backfilled with cuttings
 Observed Water Depth: 8'

Drilling Contractor: Northern Test Boring
 Drill Rig: Diedrich D50
 Driller Rep.: Mike Nadeau
 Date Started: 07/21/2015
 Date Completed: 07/21/2015
 Surface Elevation: 67.5 (Feet)
 Drilling Method: Drive and wash
 Casing Type: N/A

DEPTH, FT.	SYMBOL SAMPLES	SAMPLE NUMBER	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N BLOWS PER FT.	MOISTURE CONTENT %	LAB TESTS
0		S-1	<p>TOPSOIL AND ORGANIC MATERIAL (7 inches).</p> <p>SILTY SAND (SM): Loose, moist, fine sand, some silt, dark brown to grayish brown.</p> <p>SILTY CLAY (CL); Stiff to very soft, moist to wet, silty clay, trace fine sand from 2' - 7', grayish brown to gray.</p>	16	1 2 4 5	6		
5		S-2	<p>Pocket Penetrometer: Undrained Shear Strength: Su=3,000 psf.</p>	18	3 3 5 4	8		
10		S-3		24	WOH/ 24"	WOH	46.5	MC
15		U-1					46	MC C LV
20		FV FV	<p>Field Vane: Undrained Shear Strength=550 psf; residual=50 psf.</p> <p>Field Vane: Undrained Shear Strength=490 psf; residual=70 psf.</p>					
25		FV FV	<p>Field Vane: Undrained Shear Strength=600 psf; residual=80 psf.</p> <p>Field Vane: Undrained Shear Strength=600 psf; residual=80 psf.</p>					

Notes: Used 3 5/8x9" Acker field vane. Unable to sample below 40' due to cave-in.



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Boring Log: B-8
 Total Depth: 56
 Sheet 2 of 2

Project Name: Prop. Patrons Oxford Ins. Office Bldg.
 Location: Portland Maine
 Client: Patrons Oxford Insurance
 Observed Water Depth: 8'

RWG&A Project No. 1518-002
 Surface Elevation: 67.5 (Feet)
 Casing Type: N/A

DEPTH, FT.	SYMBOL SAMPLES	SAMPLE NUMBER	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N BLOWS PER FT.	MOISTURE CONTENT %	LAB TESTS
30		U-2					45	MC C LV
35		FV FV	Field Vane: Undrained Shear Strength=570 psf; residual=50 psf. Field Vane: Undrained Shear Strength=600 psf; residual=30 psf.					
40		S-4	SILTY SAND WITH GRAVEL (SM); Loose, wet, fine to coarse sand, some silt, little gravel, gray.	7	4 4 5 4	9		
45								
50								
55			Increased drilling resistance from 55' - 56'. Bottom of Exploration at 56'; Roller cone refusal, possible bedrock or boulder.					

Notes: Used 3 5/8x9" Acker field vane. Unable to sample below 40' due to cave-in.



Project Name: Prop. Patrons Oxford Ins. Office Bldg.
 RWG&A Project No. 1518-002
 Location: Portland, Maine
 Client: Patrons Oxford Insurance
 RWG&A Representative: C. Morrell
 Boring Location: See Exploration Location Plan
 Boring Abandonment Method: Backfilled with cuttings
 Observed Water Depth: 6'

Drilling Contractor: Northern Test Boring
 Drill Rig: Diedrich D50
 Driller Rep.: Mike Nadeau
 Date Started: 07/21/2015
 Date Completed: 07/21/2015
 Surface Elevation: 67 (Feet)
 Drilling Method: Drive and wash
 Casing Type: 4" Steel

DEPTH, FT.	SYMBOL SAMPLES	SAMPLE NUMBER	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N BLOWS PER FT.	MOISTURE CONTENT %	LAB TESTS
0		S-1	FILL; Bark Mulch (3 inches).	14	1	2		
			FILL; Silty sand, very loose, moist, fine sand, some silt, trace medium sand, bluish gray.		1			
					1			
					1			
5		S-2	SILTY SAND (SM); Medium dense, moist to wet, fine sand, some silt, grayish brown.	17	4	10		
					5			
					5			
					3			
10		FV	SILTY CLAY (CL); Medium stiff to soft, wet, silty clay, gray.					
		FV	Field Vane: Undrained Shear Strength=650 psf; residual=80 psf.					
			Field Vane: Undrained Shear Strength=600 psf; residual=80 psf.					
15		FV	Field Vane: Undrained Shear Strength=440 psf; residual=70 psf.					
		FV	Field Vane: Undrained Shear Strength=390 psf; residual=50 psf.					
20		FV	Field Vane: Undrained Shear Strength=410 psf; residual=70 psf.					
		FV	Field Vane: Undrained Shear Strength=400 psf; residual=50 psf.					
25		FV	Field Vane: Undrained Shear Strength=380 psf; residual=0 psf.					
		FV	Field Vane: Undrained Shear Strength=380 psf; residual=0 psf.					
			Began roller cone wash probe.					

Notes: Used 3 5/8x9" Acker field vane.



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Boring Log: B-9
 Total Depth: 62
 Sheet 3 of 3

Project Name: Prop. Patrons Oxford Ins. Office Bldg.
 Location: Portland Maine
 Client: Patrons Oxford Insurance
 Observed Water Depth: 6'

RWG&A Project No. 1518-002
 Surface Elevation: 67 (Feet)
 Casing Type: 4" Steel

DEPTH, FT.	SYMBOL SAMPLES	SAMPLE NUMBER	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N BLOWS PER FT.	MOISTURE CONTENT %	LAB TESTS
60								
			Bottom of Exploration at 62'; Roller cone refusal, possible bedrock or boulder.					
65								
70								
75								
80								
85								

Notes: Used 3 5/8x9" Acker field vane.



Project Name: Prop. Patrons Oxford Ins. Office Bldg.
 RWG&A Project No. 1518-002
 Location: Portland, Maine
 Client: Patrons Oxford Insurance
 RWG&A Representative: C. Morrell
 Boring Location: See Exploration Location Plan
 Boring Abandonment Method: Backfilled with cuttings
 Observed Water Depth: 5'

Drilling Contractor: Northern Test Boring
 Drill Rig: Diedrich D50
 Driller Rep.: Mike Nadeau
 Date Started: 07/20/2015
 Date Completed: 07/20/2015
 Surface Elevation: ()
 Drilling Method: SSA
 Casing Type: 4" Steel

DEPTH, FT.	SYMBOL SAMPLES	SAMPLE NUMBER	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N BLOWS PER FT.	MOISTURE CONTENT %	LAB TESTS
0		S-1	TOPSOIL AND ORGANIC MATERIAL (3 inches). SILTY SAND (SM); Very loose to medium dense, moist to wet, fine sand, some silt, orangish brown to grayish brown.	18	1 2 2 5	4		
5		S-2	SILTY CLAY (CL); Stiff than soft, wet, silty clay, gray.	20	5 6 7 7	13		
10		S-3	SILTY SAND (SM); Very loose, wet, fine sand, some silt, gray. Bottom of Exploration at 12'; Not Refusal.	16	1 1 2 4	3		
15								
20								
25								

Notes:



Project Name: Prop. Patrons Oxford Ins. Office Bldg.
 RWG&A Project No. 1518-002
 Location: Portland, Maine
 Client: Patrons Oxford Insurance
 RWG&A Representative: C. Morrell
 Boring Location: See Exploration Location Plan
 Boring Abandonment Method: Installed Solid Casing
 Observed Water Depth: 7'

Drilling Contractor: Great Works Test Boring
 Drill Rig: CME850
 Driller Rep.: Jeff Lee
 Date Started: 09/17/2015
 Date Completed: 09/17/2015
 Surface Elevation: 67 (Feet)
 Drilling Method: Drive and Wash
 Casing Type: 4" Steel

DEPTH, FT.	SYMBOL SAMPLES	SAMPLE NUMBER	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N BLOWS PER FT.	MOISTURE CONTENT %	LAB TESTS
0			FILL; BARK MULCH (3 inches).					
			FILL, Silty sand, moist, fine sand, some silt, trace medium sand, bluish gray					
			SILTY SAND (SM); Moist to wet, fine sand, some silt, grayish brown.					
5								
10			SILTY CLAY (CL); Silty clay, gray.					
15								
20								
25								

Notes: Installed 3-inch inside diameter, close ended, Schedule 40 PVC casing in completed borehole. Casing was grouted into place using a cement-bentonite mixture. Casing filled with potable water.



Project Name: Prop. Patrons Oxford Ins. Office Bldg.
 Location: Portland Maine
 Client: Patrons Oxford Insurance
 Observed Water Depth: 7'

RWG&A Project No. 1518-002
 Surface Elevation: 67 (Feet)
 Casing Type: 4" Steel

DEPTH, FT.	SYMBOL SAMPLES	SAMPLE NUMBER	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N BLOWS PER FT.	MOISTURE CONTENT %	LAB TESTS
30								
35								
40								
45								
50		S-1	SILTY SAND (SM); Medium dense, wet, fine to medium sand, some silt, few gravel and coarse sand, gray.	11	4 7 4 3	11		
55			Bedrock encountered at 57', roller cone drilled to 72'.					

Notes: Installed 3-inch inside diameter, close ended, Schedule 40 PVC casing in completed borehole. Casing was grouted into place using a cement-bentonite mixture. Casing filled with potable water.



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Boring Log: GB-101

Total Depth: 72

Sheet 3 of 3

Project Name: Prop. Patrons Oxford Ins. Office Bldg.
 Location: Portland Maine
 Client: Patrons Oxford Insurance
 Observed Water Depth: 7'

RWG&A Project No. 1518-002
 Surface Elevation: 67 (Feet)
 Casing Type: 4" Steel

DEPTH, FT.	SYMBOL SAMPLES	SAMPLE NUMBER	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N BLOWS PER FT.	MOISTURE CONTENT %	LAB TESTS
60			Bedrock.					
65								
70								
			Bottom of Exploration at 72'; Terminated boring 15' into rock.					
75								
80								
85								

Notes: Installed 3-inch inside diameter, close ended, Schedule 40 PVC casing in completed borehole. Casing was grouted into place using a cement-bentonite mixture. Casing filled with potable water.



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Boring Log: GB-102

Total Depth (ft): 72

Sheet 1 of 3

Project Name: Prop. Patrons Oxford Ins. Office Bldg.
 RWG&A Project No. 1518-002
 Location: Portland, Maine
 Client: Patrons Oxford Insurance
 RWG&A Representative: C. Morrell
 Boring Location: See Exploration Location Plan
 Boring Abandonment Method: Installed Solid Casing.
 Observed Water Depth: 7'

Drilling Contractor: Great Works Test Boring
 Drill Rig: CME850
 Driller Rep.: Jeff Lee
 Date Started: 09/18/2015
 Date Completed: 09/18/2015
 Surface Elevation: 67 (Feet)
 Drilling Method: Drive and Wash
 Casing Type: 4" Steel

DEPTH, FT.	SYMBOL SAMPLES	SAMPLE NUMBER	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N BLOWS PER FT.	MOISTURE CONTENT %	LAB TESTS
0			TOPSOIL AND ORGANIC MATERIAL (4 inches). SILTY SAND (SM); Moist, fine sand, some silt, grayish brown.					
5								
10			SILTY CLAY (CL); Medium stiff to soft, silty clay, gray.					
15								
20		FV FV	Field Vane: Undrained Shear Strength: Su=480 psf, residual 50 psf. Field Vane: Undrained Shear Strength: Su=490 psf, residual 40 psf.					
25								

Notes: 1. Used 3 5/8"x9" Acker field vane for shear strength testing.
 2. Installed 3-inch inside diameter, close ended, Schedule 40 PVC casing in completed borehole. Casing was grouted into place using a cement-bentonite mixture. Casing filled with potable water.



Project Name: Prop. Patrons Oxford Ins. Office Bldg.
 Location: Portland Maine
 Client: Patrons Oxford Insurance
 Observed Water Depth: 7'

RWG&A Project No. 1518-002
 Surface Elevation: 67 (Feet)
 Casing Type: 4" Steel

DEPTH, FT.	SYMBOL SAMPLES	SAMPLE NUMBER	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N BLOWS PER FT.	MOISTURE CONTENT %	LAB TESTS
30		FV	Field Vane: Undrained Shear Strength: Su=490 psf, residual 50 psf.					
		FV	Field Vane: Undrained Shear Strength: Su=550 psf, residual 40 psf.					
35								
40		FV	Field Vane: Undrained Shear Strength: Su=640 psf, residual 20 psf.					
		FV	Field Vane: Undrained Shear Strength: Su=520 psf, residual 0 psf.					
45			SILTY SAND (SM); Fine to medium sand, some silt, few gravel and coarse sand, gray.					
50								
55								
			Bedrock encountered at 57.5 feet, roller cone drilled to 72'.					

Notes: 1. Used 3 5/8"x9" Acker field vane for shear strength testing.
 2. Installed 3-inch inside diameter, close ended, Schedule 40 PVC casing in completed borehole. Casing was grouted into place using a cement-bentonite mixture. Casing filled with potable water.



R.W. Gillespie & Associates, Inc.
 Geotechnical Engineering • Geohydrology • Materials Testing Services

Boring Log: GB-102

Total Depth: 72

Sheet 3 of 3

Project Name: Prop. Patrons Oxford Ins. Office Bldg.
 Location: Portland Maine
 Client: Patrons Oxford Insurance
 Observed Water Depth: 7'

RWG&A Project No. 1518-002
 Surface Elevation: 67 (Feet)
 Casing Type: 4" Steel

DEPTH, FT.	SYMBOL SAMPLES	SAMPLE NUMBER	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N BLOWS PER FT.	MOISTURE CONTENT %	LAB TESTS
60			Bedrock.					
65								
70								
75			Bottom of Exploration at 72'; Terminated boring 14.5' into rock.					
80								
85								

Notes: 1. Used 3 5/8"x9" Acker field vane for shear strength testing.
 2. Installed 3-inch inside diameter, close ended, Schedule 40 PVC casing in completed borehole. Casing was grouted into place using a cement-bentonite mixture. Casing filled with potable water.

APPENDIX C

2010 EXPLORATION LOGS

Geotechnical Engineering Services
Proposed Patrons Oxford Insurance Company Office Building
Portland, Maine

H&A-TEST BORING-07-1 HA-1107-1R-POR-06-03-08-GLB HA-TB-CORE-WELL-07-1.GDT G:\PROJECTS\34981 - RAND ROAD\000\FIELD EXPLORATIONS\34981-000 HA10-1_HA10-13TB.GPJ 28 Sep 10

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Well Diagram	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel		Sand			Field Test					
								% Coarse	% Fine	% Coarse	% Medium	% Fine	% Fines	Dilatancy	Toughness	Plasticity	Strength	
15	WOR WOR WOM WOM	S6 24	15.0 17.0			CL	Soft to medium stiff, gray, lean CLAY (CL), mps < 1 mm, no odor, wet FV1, 15.4 to 16.0 ft: Raw torque=14/0 ft-lbs, Su=520/0 psf FV2, 16.4 to 17.0 ft: Raw torque=11/1 ft-lbs, Su=410/40 psf						100					
20	WOM WOM WOM WOM	S7 24	20.0 22.0			CL	Soft to medium stiff, gray, lean CLAY (CL) with black streaks, mps < 1 mm, no odor wet -MARINE DEPOSIT-							100				
25	WOR WOR WOR WOR	S8 22	25.0 27.0			CL	Very soft to soft, gray, lean CLAY (CL) with black streaks, mps < 1 mm, no odor, wet FV3, 25.4 to 26.0 ft: Raw torque=3/1 ft-lbs, Su=110/40 psf FV4, 26.4 to 27.0 ft: Raw torque=10/1 ft-lbs, Su=370/40 psf							100				
30	WOR WOR WOR WOR	S9 24	30.0 32.0			CL	Very soft to soft, gray, lean CLAY (CL) with black streaks, mps < 1 mm, no odor, wet -MARINE DEPOSIT-							100				
35	WOR WOR WOR WOR	S10 24	35.0 37.0			CL	Soft to medium stiff, gray, lean CLAY (CL) with black streaks, mps < 1 mm, no odor, wet FV5, 35.4 to 36.0 ft: Raw torque=15/1 ft-lbs, Su=560/40 psf FV6, 36.4 to 37.0 ft: Raw torque=10/1 ft-lbs, Su=370/40 psf							100				

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. HA10-7(OW)

TEST BORING REPORT

Boring No. HA10-9

Project Rand Road Office Park Planned Unit Development, Portland, Maine
 Client Woodard & Curran
 Contractor Maine Test Borings

File No. 34981-000
 Sheet No. 1 of 1
 Start 10 August 2010
 Finish 10 August 2010
 Driller R. Leonard
 H&A Rep. M. Snow

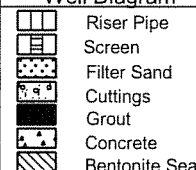
	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	SSA	S	--	Rig Make & Model: Mobile B-53
Inside Diameter (in.)	--	1.375	--	Bit Type: Cutting Head
Hammer Weight (lb)	--	140	-	Drill Mud: None
Hammer Fall (in.)	--	30	-	Casing: SSA to 10.0 ft
				Hoist/Hammer: Winch / Safety Hammer
				PID Make & Model: NA

Elevation 67.0 (approx.)
 Datum NGVD 29

Location
 N 302,638.0
 E 2,909,662.0

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel		Sand			Field Test							
							% Coarse	% Fine	% Coarse	% Medium	% Fine	% Fines	Dilatancy	Toughness	Plasticity	Strength			
0						-FOREST MAT-													
	1	S1	0.0	0.3	OH														
	1	18	2.0		ML	Soft, gray-brown to dark brown, sandy SILT (ML) with roots, mps 0.42 mm, no odor, moist					40	60							
	3			1.0	SM	-TOPSOIL- Very loose, brown-gray, silty SAND (SM) with occasional organics, mps 0.42 mm, no odor, moist					85	15							
	5	S2	2.0																
	6	18	4.0			Similar to above except medium dense													
	7																		
	12			3.4	ML/CL	Stiff, gray-brown, mottled SILT (ML) to lean CLAY (CL), mps 0.42 mm, no odor, moist to wet					5	95							
	4	S3	4.0	4.0	SP-SM	Medium dense, brown-gray, mottled, poorly graded SAND with silt (SP-SM), occasional gray lean clay lenses, mps 0.42 mm, no odor, wet					90	10							
	10	19	6.0			Note: Water encountered at approximately 4.0 ft.													
	9					-MARINE DEPOSIT-													
	4	S4	6.0	6.5	ML/SM	Stiff, brown-gray, sandy SILT (ML) to loose, silty SAND (SM) with occasional gray, mottled, lean clay layers, mps 0.42 mm, no odor, wet					40	60							
	3	21	8.0																
	7																		
	4																		
	1	S5	8.0	8.3	CL	Very soft, gray, lean CLAY (CL), mps <1 mm, no odor, wet							100						
	1	24	10.0			-MARINE DEPOSIT-													
	1																		
	1																		
10				10.0		Bottom of Exploration at 10.0 ft Note: No refusal.													

H&A TEST BORING-07-1 HA-1007-IR-POR-06-03-08.GLB HA-TB-CORE-WELL-07-1.GDT G:\PROJECTS\34981 - RAND ROAD\000\FIELD EXPLORATIONS\34981-000 HA10-1_HA10-13TB.GPJ 28 Sep 10

Water Level Data					Sample ID	Well Diagram	Summary
Date	Time	Elapsed Time (hr.)	Depth (ft) to:		O - Open End Rod T - Thin Wall Tube U - Undisturbed Sample S - Split Spoon Sample		Overburden (ft) 10.0
			Bottom of Casing	Bottom of Hole			Water
							Samples 5S
							Boring No. HA10-9

Field Tests: Dilatancy: R - Rapid S - Slow N - None Plasticity: N - Nonplastic L - Low M - Medium H - High
 Toughness: L - Low M - Medium H - High Dry Strength: N - None L - Low M - Medium H - High V - Very High

*Note: Maximum particle size is determined by direct observation within the limitations of sampler size.

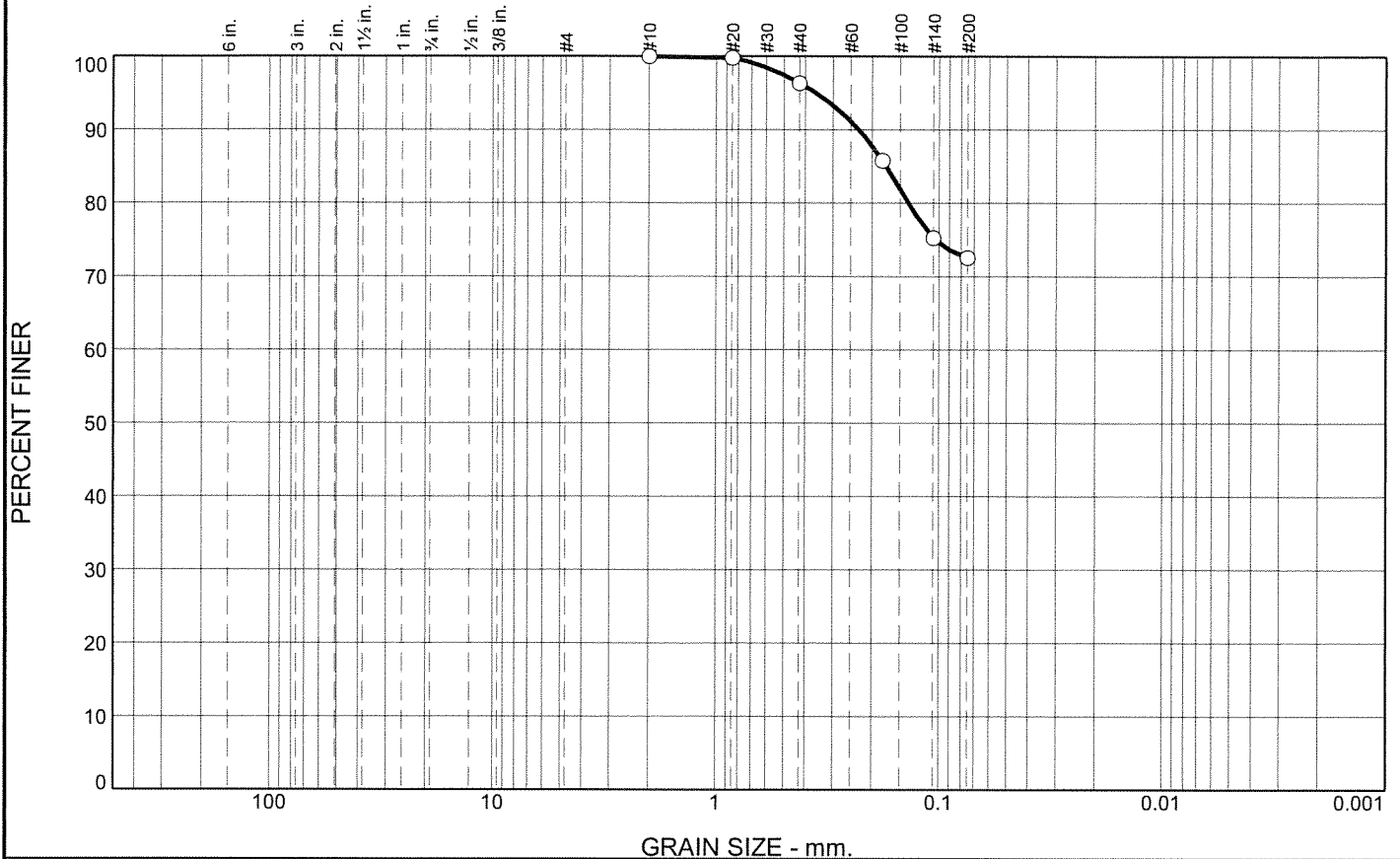
Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

APPENDIX D

LABORATORY TEST RESULTS

Geotechnical Engineering Services
Proposed Patrons Oxford Insurance Company Office Building
Portland, Maine

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	3.6	23.9	72.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#10	100.0		
#20	99.8		
#40	96.4		
#80	85.8		
#140	75.3		
#200	72.5		

Soil Description

silt with sand

Atterberg Limits

PL= LL= PI=

Coefficients

D₈₅= 0.1731 D₆₀= D₅₀=

D₃₀= D₁₅= D₁₀=

C_u= C_c=

Classification

USCS= ML AASHTO= A-4(0)

Remarks

Moisture Content: 24.5%

* (no specification provided)

Sample No.: S-2
Location: Portland, ME

Source of Sample: B-3

Date: 8/24/15
Elev./Depth: 5'-7'

**R.W. Gillespie
& Associates, Inc.
Saco, Maine**

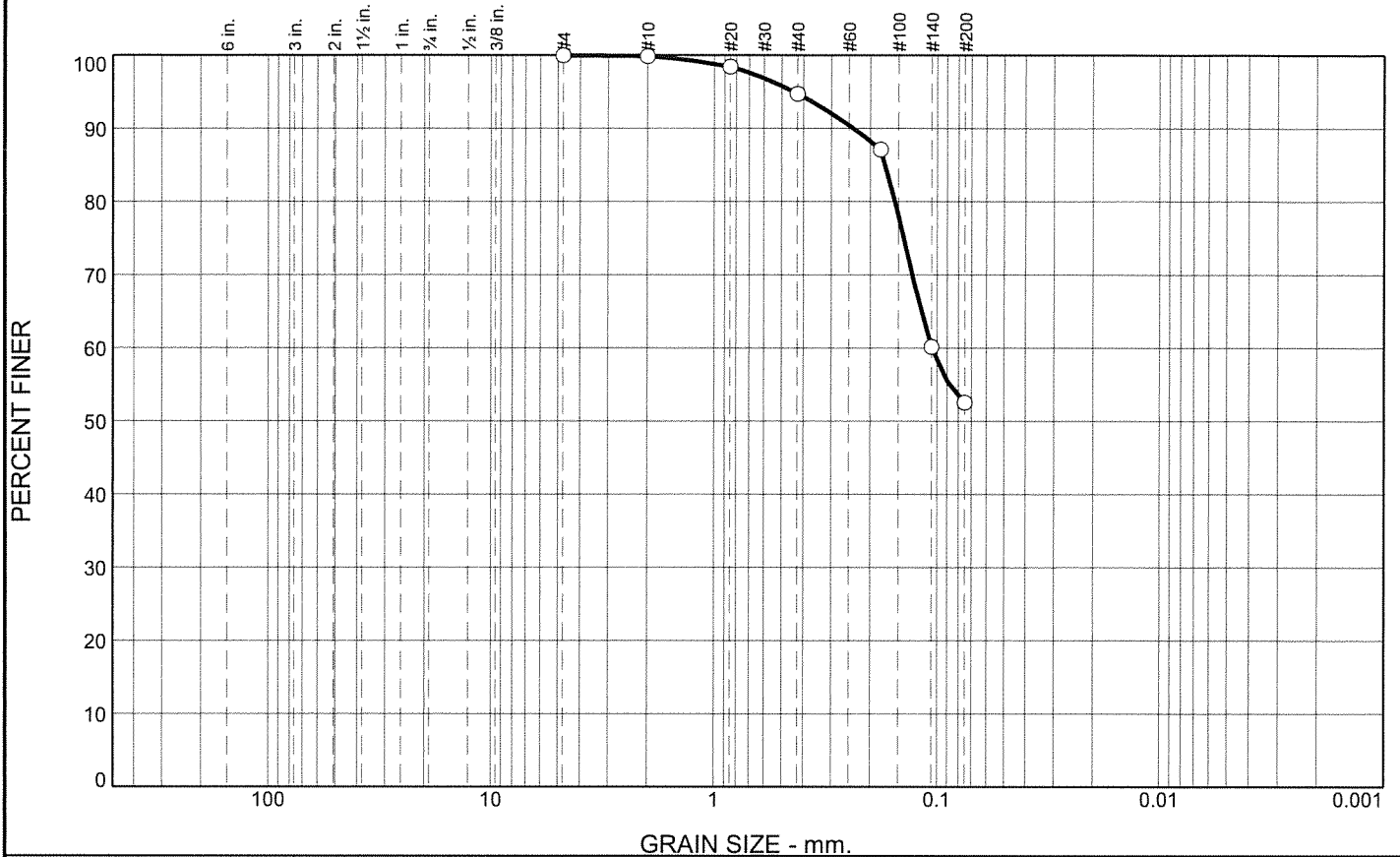
Client: Patrons Oxford Insurance Inc.
Project: Proposed Patrons Oxford Insurance Building

Project No.: 1518-002

Lab No.: 13687a

Tested By: JMB **Checked By:** MTG *MP*

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.1	5.1	42.3	52.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	99.9		
#20	98.4		
#40	94.8		
#80	87.1		
#140	60.2		
#200	52.5		

Soil Description
sandy silt

Atterberg Limits
 PL= LL= PI=

Coefficients
 D₈₅= 0.1714 D₆₀= 0.1056 D₅₀=
 D₃₀= D₁₅= D₁₀=
 C_u= C_c=

Classification
 USCS= ML AASHTO= A-4(0)

Remarks
 Moisture Content: 27.6%

* (no specification provided)

Sample No.: S-2
Location: Portland, ME

Source of Sample: B-6

Date: 8/24/15
Elev./Depth: 5'-7'

**R.W. Gillespie
 & Associates, Inc.
 Saco, Maine**

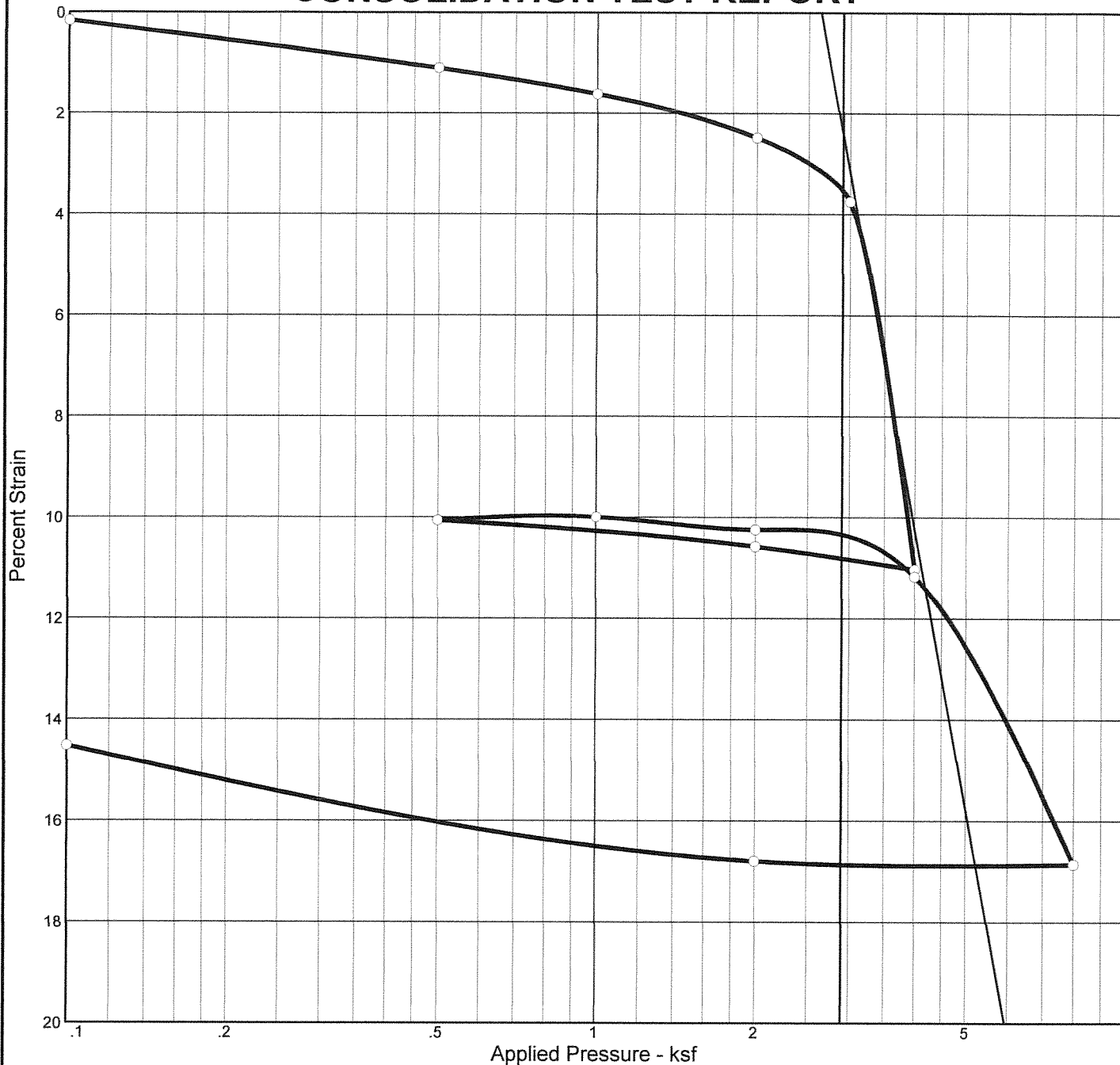
Client: Patrons Oxford Insurance Inc.
Project: Proposed Patrons Oxford Insurance Building

Project No.: 1518-002

Lab No.: 13687b

Tested By: JMB Checked By: MTG *MTG*

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (ksf)	P_c (ksf)	C_c	C_r	Initial Void Ratio
Saturation	Moisture									
96.5 %	46.5 %	73.9			2.76		3.06	1.32	0.03	1.331

MATERIAL DESCRIPTION	USCS	AASHTO
Silty Clay		

Project No. 1518-002 **Client:** Patrons Oxford Insurance Inc.
Project: Proposed Patrons Oxford Insurance Building
Source: B-8 **Sample No.:** U-1 **Elev./Depth:** 15-17'
R.W. Gillespie & Associates, Inc.
Saco, Maine

Remarks:
 Tested By: JMB

Lab No. 13662

Laboratory Vane Shear Test Results

ASTM D4648 Standard Test Method for Laboratory Miniature Vane Shear Test for Saturated Fine-Grained Clayey Soil

Project: Proposed Patrons Oxford Insurance Building Location: Portland, ME
 Client: Patrons Oxford Insurance Date: 7/27/2015
 Project No.: 1518-002 Test Depth: 15 to 17

Boring/Sample No.		B-8, U-1			Lab No.	13662	
Test No.	Test Depth (ft)	Vane Size	Max. Torque (Undisturbed) (kg-cm)	Max. Torque (Remolded) (kg-cm)	Undrained Shear Strength (psf)	Undrained Shear Strength (psf)	Moisture Content
1	15.1	L	34	0	355	0	47%
2	15.35	L	38	0	397	0	46%
3	16.3	L	30	0	313	0	47%
4	16.55	L	32	0	334	0	46%

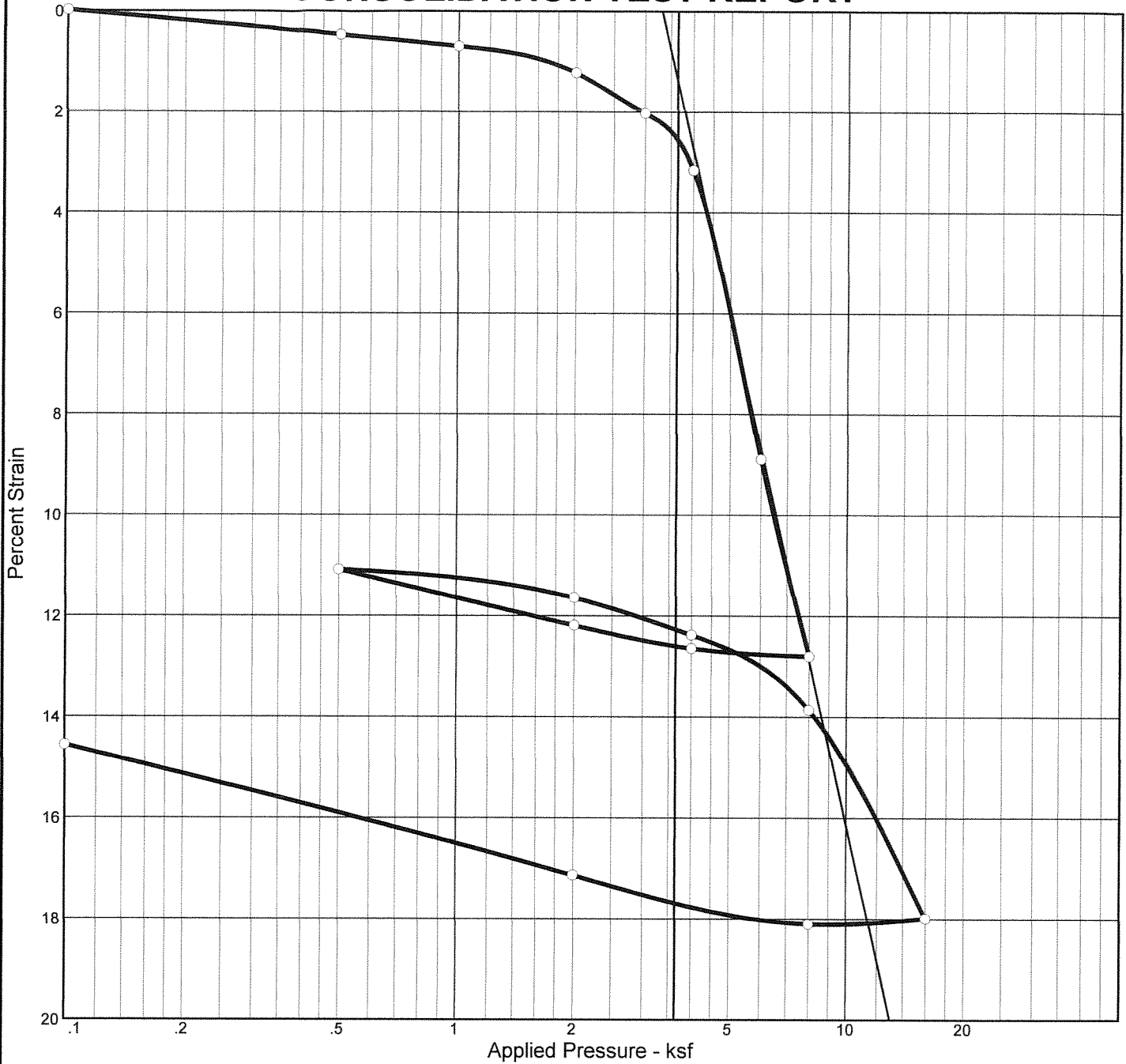
Vane Size	
	(mm)
S	16 x 32
M	20 x 40
L	24.5 x 50.8

Tested By: JMB

Checked By: MTG



CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (ksf)	P _c (ksf)	C _c	C _r	Initial Void Ratio
Saturation	Moisture									
101.1 %	47.3 %	75.2			2.76		4.01	0.77	0.04	1.291

MATERIAL DESCRIPTION								USCS	AASHTO
Silty Clay									

Project No. 1518-002 **Client:** Patrons Oxford Insurance Inc.
Project: Proposed Patrons Oxford Insurance Building
Source: B-8 **Sample No.:** U-2 **Elev./Depth:** 30-32'
R.W. Gillespie & Associates, Inc.
Saco, Maine

Remarks:
 Tested By: JMB

Lab No. 13663

Laboratory Vane Shear Test Results

ASTM D4648 Standard Test Method for Laboratory Miniature Vane Shear Test for Saturated Fine-Grained Clayey Soil

Project: Proposed Patrons Oxford Insurance Building Location: Portland, ME
 Client: Patrons Oxford Insurance Date: 7/27/2015
 Project No.: 1518-002 Test Depth: 30' to 32'

Boring/Sample No.		B-8, U-2			Lab No.		13663	
Test No.	Test Depth (ft)	Vane Size	Max. Torque (Undisturbed) (kg-cm)	Max. Torque (Remolded) (kg-cm)	Undrained Shear Strength (psf)	Undrained Shear Strength (psf)	Moisture Content	
1	30.2	L	48	0	501	0	47%	
2	30.45	L	46	0	480	0	45%	
3	31.2	L	48	0	501	0	44%	
4	31.45	L	32	0	334	0	45%	

Vane Size	
	(mm)
S	16 x 32
M	20 x 40
L	24.5 x 50.8

Tested By: JMB

Checked By: MTG

 R.W. Gillespie & Associates

APPENDIX E

**REPORT OF CROSSHOLE SEISMIC TESTING BY
HAGER-RICHTER GEOSCIENCE, INC.**

Geotechnical Engineering Services
Proposed Patrons Oxford Insurance Company Office Building
Portland, Maine

**CROSSHOLE SEISMIC TESTING
LOT 4 - PORTLAND TECHNOLOGY PARK
PORTLAND, MAINE**

Prepared for:

R.W. Gillespie & Associates, Inc.
86 Industrial Park Road, Suite 4
Saco, Maine 04072

Prepared by:

Hager-Richter Geoscience, Inc.
8 Industrial Way, D10
Salem, New Hampshire 03079

File 15J69
October, 2015

0. EXECUTIVE SUMMARY

Hager-Richter Geoscience, Inc. (Hager-Richter) conducted crosshole seismic testing in one two-borehole array at the Lot 4 site located at the Portland Technology Park in Portland, Maine for R.W. Gillespie & Associates, Inc. (RWG) in September, 2015. The crosshole seismic testing is part of geotechnical investigations for future development. The testing was conducted in accordance with ASTM D4428/D4428 M-07 "Standard Test Methods for Crosshole Seismic Testing."

The objective of the crosshole seismic testing was to determine shear wave velocity (V_s) as a function of depth at the specified location for the determination of seismic site class.

On the basis of the crosshole seismic testing conducted in a two-borehole array at the Lot 4 site located at the Portland Technology Park in Portland, Maine we conclude that the velocity of shear waves, (V_s) varies with depth, Z , as tabulated in Table 1, and as follows:

Z (ft)	V_s (ft/s)	Comments
2.5 - 8.5	$15.362 * Z + 540.32$	N = 3, $r^2 = .99$
8.5 - 57	$8.0266 * Z + 241.03$	N = 16, $r^2 = 0.94$
57- 68.5	5264	N = 6, Std 85 ft/s, 1.6% mean

The average velocity of shear waves for the upper 100 ft, assuming bedrock velocity to 100 ft depth is the same as the model value determined for the interval 57 - 68.4 ft, was determined to be 804 ft/s, and corresponds to Seismic Site Class D based solely on the on average shear wave velocity table in the IBC.

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1. General Site Location
2. Site Plan
3. Geometry of Crosshole Seismic Testing
4. Photograph
5. Distance Between Boreholes
6. Apparent Velocity of Shear Waves
7. Composite Seismograms
8. Model Vs

APPENDICES

- 1 Boring Logs for B-101A and B-101B
- 2 Deviation Data

1. INTRODUCTION

Hager-Richter Geoscience, Inc. (Hager-Richter) conducted crosshole seismic testing in one two-borehole array at the Lot 4 site located at the Portland Technology Park in Portland, Maine for R.W. Gillespie & Associates, Inc. (RWG) of Saco, Maine, in September, 2015. The crosshole seismic testing is part of geotechnical investigations for future development. The project site is located southeast of the Interstate 95 - State Route 25 Interchange on an unnamed access road. The general location of the Site is shown in Figure 1. The testing was conducted in accordance with ASTM D4428/D4428 M-07 "Standard Test Methods for Crosshole Seismic Testing."

The two boreholes were designated by RWG as GB-101 and GB-102, and both were terminated in bedrock at 72 feet below ground surface. Bedrock at this location is mapped as the Vassalboro Formation according to the Bedrock Geologic Map of Maine. The approximate locations of the boreholes are shown in Figure 2. The boring logs are included in Appendix 1, and report the stratigraphy penetrated by the borings from surface downward as follows:

GB-101

2 feet of fill
7 feet of silty sand
38 feet of silty clay
10 feet of silty sand
bedrock of the Vassalboro Fm,
encountered at 57 feet

GB-101

4 inches of soil
8.5 feet of silty sand
36 feet of silty clay
10.5 feet of silty sand
bedrock of the Vassalboro Fm,
encountered at 57.5 feet

The objective of the crosshole seismic testing was to determine the velocity of shear waves as a function of depth and for the determination of seismic site class.

The crosshole seismic testing was conducted on September 24, 2015 by Michael Howley, P.G., and Bryan Carnahan of Hager-Richter. The project was coordinated with Mr. Chris Morrell, of RWG, who was present for the duration of the field work. Field work and subsequent data processing were performed in accordance with ASTM D4428/D4428 M-07 "Standard Test Methods for Crosshole Seismic Testing." The project records will be kept for a minimum of three years.

2. CROSSHOLE SEISMIC TESTING

2.1 General

As noted in the Introduction, the testing was performed in substantial conformance with ASTM D4428/D4428 M-07 "Standard Test Methods for Crosshole Seismic Testing."

2.2 Field Procedures

The two-borehole method was used. The ASTM document specifies the construction details of the boreholes, including a requirement for grouting the casing from bottom to top. The grout provides a path for the elastic signals from the source to the borehole wall in one borehole and from the borehole wall to the geophone in one or more other boreholes. The displacement of each borehole from its location on the surface was measured with a deviation probe, providing the data necessary to calculate the distance between the boreholes.

The geometry of the testing system is shown in Figure 3. The source and geophone are positioned at the same elevation. The source generates a seismic signal that travels as an elastic wave to the geophones, where it is converted to an electric signal, sent to the seismograph via cable, and amplified, filtered, and recorded by the seismograph. Figure 4 is a photograph that shows the physical setup for the testing in the field.

The seismograph is a 24-channel seismograph (Geometrics Geode), coupled to a downhole geophone assembly. The downhole geophone assembly includes a Mark Products triaxial geophone and a mechanical clamping mechanism to secure the assembly to the inside of the casing. The vertical axis of the geophone is oriented vertically (because it is constrained by the borehole), and the horizontal axes are oriented such that one axis is parallel to the direction source-to-receiver and the other axis is perpendicular to that direction. The seismograph records data digitally and the records are available immediately to verify the quality of the data.

The source is a downhole hammer that produces primarily a vertically polarized shear wave but also a compressional wave. The direction of first motion of the shear wave can be reversed, thereby facilitating recognition of the onset of the shear waves at the geophone(s). The number of stacks per shot depth/direction is variable, and the quality of the stacked seismic signal for each shot depth/direction is verified in the field.

The deviation probe is a Mount Sopris downhole tool 2DVA-1000 that was operated with a Mount Sopris MGX-2 portable logger. The downhole tool includes a 3-axis magnetometer and three accelerometers. The manufacturer's stated accuracy is Azimuth $\pm 1^\circ$ and Inclination

±0.3°. Additional specifications and the manual for the deviation probe are available on the website www.mountsopris.com.

2.3 Data Analysis

2.3.1 Velocity. The seismic data are analyzed using the digital data and commercially available software. The arrival times for the shear and compressional waves at each geophone are determined from the digital seismic data. The *apparent*¹ velocities are calculated for each depth from the arrival times and the distances between the boreholes as follows:

$$V_s (S-R) = L (S-R) / \Delta T_s (S-R) \quad \text{Eq 2.3-1}$$

$$V_p (S-R) = L (S-R) / \Delta T_p (S-R) \quad \text{Eq 2.3-2}$$

where:

V is the velocity, with subscripts S and P indicating shear and compressional waves, respectively,

L (S-R) is the distance between borings containing the Source and Receiver;

ΔT (S-R) is the time of transit of elastic energy from the Source to Receiver, averaged for source up and down, and with subscripts as defined for V.

The assumptions inherent in Equations 1 and 2 are that the medium is isotropic and homogeneous within layers, the interface between layers is horizontal, and the displacements are small.

The velocities determined with Equations 1 and 2 are *apparent* velocities. The actual velocities would be determined by correcting for the effects of refraction, if refraction is present, using Snell's Law, which for any two layers is given by

$$\text{SIN } \alpha_1 / \text{SIN } \alpha_2 = V_1 / V_2 \quad \text{Eq 2.3-3}$$

where

α_1 is the angle of incidence,

α_2 is the angle of the refracted wave, and

V_1 and V_2 are the velocities of layers 1 and 2, respectively.

¹Apparent velocity is the distance between the source and the receiver divided by the time required for the seismic signal to travel from the source to the receiver.

2.4 Determination of Average Shear Wave Velocity for Building Code Purposes.

The Building Code uses the average shear wave velocity averaged over the upper 100 ft as one method to determine Seismic Site Class. The average velocity V_{avg} is defined as follows:

$$V_{avg} = \left(\sum_{i=1}^N d_i \right) / \sum_{i=1}^N d_i / V_i \quad \text{Eq. 2.4 -1}$$

where V_{avg} is average shear wave velocity
 d_i is thickness of the i^{th} layer
 V_i is the shear wave velocity of the i^{th} layer
 N is the number of layers

Equation 2.4-1 assumes that the velocity is constant in each layer. Such, however, is not always the case, and a function of the form $Y = a * X + b$ often fits the observed data well. For sections in which the velocity varies as $Y = a * X + b$, the denominator of Eq 2.4-1 can be replaced with the following integral:

$$\int_{Z_1}^{Z_2} dZ / (aZ + b) = [Ln(aZ_2 + b) - Ln(aZ_1 - b)] / a$$

where Z_1 and Z_2 are the depths of top and bottom of the layer in which the velocity varies as $Y = a * X + b$.

The Site Class, based on average shear wave velocity, is defined as follows:

Site Class	Soil Profile Name	Soil Shear Wave Velocity (ft/s)
A	Hard rock	$v_s > 5000$
B	Rock	$2500 < v_s \leq 5000$
C	Very dense soil and soft rock	$1200 < v_s \leq 2500$
D	Stiff soil profile	$600 \leq v_s \leq 1200$
E	Soft soil profile	$v_s < 600$

Although the IBC provides other methods to determine the Site Class, such as standard penetration resistance (blow counts) and soil undrained shear strength, this report uses only the method based on shear wave velocity. Furthermore, there is no consideration of other factors that may affect a site such as liquefaction. The final determination of seismic site class should be made by the project engineer.

2.5 **Limitations of the Method**

Like all geophysical methods, the crosshole seismic method is based on the assumption that the local geology is uncomplicated, and that rock and soil interfaces are planar. For those tests in which the signals are generated in a single boring only, the interfaces are assumed to be horizontal, and this assumption is inherent in correcting for refraction.

Thin units with velocities that are lower than the velocity of adjacent materials may not be detectable with the geometry of a particular installation. (The details important to this limitation are the velocities of adjacent materials, thickness of the units, and the distances as functions of depth between arrays.)

If deviation measurements are not available, then the distance between boreholes is *assumed* to be constant from the surface to the bottom of the boreholes. Although ASTM D4428 does not require deviation measurements to be made for borings with depths less than 50 ft, we have measured departures from vertical of several feet in borings that were only 30 ft deep.

If the casing in each borehole is not grouted in accordance with ASTM D4428, or the grout is not continuous, then the signal may be significantly degraded for at least some depths. The practical result is that the velocity determined under such conditions is less accurate at best, and in some cases may not be determinable. The acoustic noise in the subsurface can be a significant problem, particularly at active construction sites, and may interfere with the signals generated in the crosshole seismic testing. Drilling, pile driving, and the activity of heavy construction equipment have been especially troublesome at some sites.

2.6 **Site Specific**

The borings were reportedly constructed in accordance with the recommendations of ASTM D4428/D4428 M-07 "Standard Test Methods for Crosshole Seismic Testing." A deviation survey was performed by Hager-Richter in the two borings, and the data are given in Appendix 3. The distances between the boreholes for the crosshole testing were determined as a function of depth from the surface, and are reported in Table 1 and shown in Figure 5.

The maximum changes in separation of source and receiver boreholes was 1.4 feet, corresponding to 10.7 % of the distance between the boreholes on the surface (13.08 feet).

Crosshole seismic data were obtained at intervals of 2.5 feet from 2.5 to 67.5 feet depth, with an additional measurement at 68.5 feet depth. No more than 10 stacks of the seismic signals were required to increase the signal-to-noise ratio to an acceptable value.

3. RESULTS AND DISCUSSION

3.1 General

As discussed above, the measured seismic velocities are *apparent* velocities. The distances between borings and the apparent shear wave velocities are reported in Table 1 and are plotted as functions of depth in Figures 5 and 6, respectively.

As noted above, the boreholes were designated by RWG as GB-101 and GB-102, and both were terminated at 72 feet below ground surface. The approximate locations of the boreholes are shown in Figure 2 and Figure 4 is a photograph showing the test setup. The boring logs are included in Appendix 2, and report the stratigraphy penetrated by the borings from surface downward as follows:

<u>GB-101</u>	<u>GB-101</u>
2 feet of fill	4 inches of soil
7 feet of silty sand	8.5 feet of silty sand
38 feet of silty clay	36 feet of silty clay
10 feet of silty sand	10.5 feet of silty sand
bedrock,	bedrock,
encountered at 57 feet	encountered at 57.5 feet

The total depth available for the crosshole seismic testing was 72.0 feet.

3.2 Data Quality

The quality of seismic data is evaluated on the basis of the signal-to-noise (S/N) ratio and the ease with which the onset of the signal can be recognized visually. Only the initial arrival times are used in crosshole seismic testing. The noise for the shear wave (S-wave) includes not only ambient noise but noise due to the P-wave, which always arrives before the S-wave and its wave train continues for a finite time after the arrival of the S-wave. Recognition of the onset of the shear wave is improved significantly by recording and superimposing shear waves that are oppositely polarized.

The quality of seismic data acquired for this project is judged to be good to excellent with the exception of the data for the interval near and in bedrock, 55 - 68.5 ft, where the quality is judged to be poor-fair. The composite plot of the shear wave seismograms is shown in Figure 7. Reversed shear wave arrivals, generated by stacking the downhole source in opposing directions

at each depth, are evident in the seismogram, and are especially well developed in the overburden section between about 25 and 40 feet bgs.

3.3 Refraction Effects

As noted in section 2.3, the velocity obtained by dividing the distance between borings by the time required for the signal to travel between the borings, called *apparent* velocity, may not be the true velocity, especially where the source and receiver are located at a depth near an interface between two materials with different velocities and/or the distance between borings is large. The difference between apparent and true velocity is due to refraction. At some sites, even in the presence of refraction, the direct wave can be recognized and its time used to determine the velocity of the material with the slower velocity.

Examination of the apparent shear wave velocity data in Table 1 shows large velocity changes at the interface between the upper silty sand and silty clay between depths of 7.5 and 12.5 feet and at the interface between the silty sand and bedrock between depths of 50 and 57.5 feet. Based on modeling of the data using the measured velocities above and below the interfaces, we have determined that the apparent velocities at depths 10 feet, 52.5 feet, and 55 feet are due to refractions and are so noted on Table 1.

3.4 Results

As noted above, the distances between borings and the apparent shear wave velocities are reported in Table 1 and are plotted as functions of depth in Figures 5 and 6, respectively.

Our models of the velocities of shear (V_s) waves consist of two simple functions: (1) $Y = C$, where C is a constant determined by averaging, and (2) $Y = A * X + B$, where A and B are constants determined by least squares for individual segments. The model for shear wave velocities is given in Table 2. The shear wave model is shown graphically in Figure 9.

Using the model velocities of shear waves as given in Table 2 – and assuming the bedrock velocity to 100 ft depth is the same as the model value determined for the interval 57 - 68.5 ft – and Eq. 2.4 -1 of Section 2.4, the average velocity of shear waves for the upper 100 ft, V_{s100} , was determined to be 804 ft/s, and corresponds to Seismic Site Class D based solely on the average shear wave velocity table in the IBC.

4. CONCLUSIONS

On the basis of the crosshole seismic testing conducted in a two-borehole array at the Lot 4 site located at the Portland Technology Park in Portland, Maine we conclude that the velocity of shear waves, (V_s) varies with depth, Z , as tabulated in Table 1, and as follows:

Z (ft)	V_s (ft/s)	Comments
2.5 - 8.5	$15.362 * Z + 540.32$	$N = 3, r^2 = .99$
8.5 - 57	$8.0266 * Z + 241.03$	$N = 16, r^2 = 0.94$
57- 68.5	5264	$N = 6, \text{Std } 85 \text{ ft/s, } 1.6\% \text{ mean}$

The average velocity of shear waves for the upper 100 ft, assuming bedrock velocity to 100 ft depth is the same as the model value determined for the interval 57 - 68.4 ft, was determined to be 804 ft/s, and corresponds to Seismic Site Class D based solely on the on average shear wave velocity table in the IBC.

5. LIMITATIONS

This report was prepared for the exclusive use of R.W. Gillespie & Associates, Inc. and its client. Any use by any third party of this Report or any information, documents, records, data, interpretations, advice or opinions given to the Client by Hager-Richter Geoscience, Inc. in the performance of its work shall be at such third party's own risk and without any liability to Hager-Richter Geoscience, Inc.

Hager-Richter Geoscience, Inc. has performed its professional services, obtained its findings, and made its conclusions in accordance with generally accepted and customary principles and practices in the field of geophysics. No other warranty, either expressed or implied, is made. Hager-Richter Geoscience, Inc. is not responsible for the independent conclusions, opinions, or recommendations made by others based on the information, geophysical data, and interpretations presented in this report.

This geophysical testing included a limited set of data obtained at the project Site and was conducted with limited knowledge of the Site and its subsurface conditions. Hager-Richter Geoscience, Inc. does not assume responsibility for the accuracy of information that was provided to us by others about the Site and its subsurface conditions. The findings provided by Hager-Richter Geoscience, Inc. are based solely on the information described in this document. The conclusions drawn from this investigation are considered reliable; however, there may exist localized variations in subsurface conditions that have not been completely defined at this time. It should be noted that our conclusions might be modified if subsurface conditions were better delineated with additional subsurface exploration including, but not limited to, coring and laboratory testing.

TABLE 1
DISTANCE BETWEEN BOREHOLES AND
APPARENT VELOCITIES

Depth (ft)	Source-Receiver Distance (ft)	Shear Wave Travel Time (ms)	Apparent Shear Wave Velocity (ft/s)
2.5	13.08	22.50	581
5	13.10	21.41	612
7.5	13.11	19.93	658
10	13.13	23.52	558*
12.5	13.16	34.99	376
15	13.20	36.44	362
17.5	13.24	37.56	352
20	13.28	35.82	371
22.5	13.32	32.33	412
25	13.37	30.49	438
27.5	13.42	28.56	470
30	13.46	27.36	492
32.5	13.52	26.64	507
35	13.57	25.80	526
37.5	13.62	25.08	543
40	13.67	24.71	553
42.5	13.73	22.32	615
45	13.78	21.77	633
47.5	13.83	21.85	633
50	13.88	23.70	586
52.5	13.94	18.92	737*
55	14.00	10.04	1394*
57.5	14.07	2.68	5258
60	14.14	2.71	5219
62.5	14.22	2.69	5293
65	14.32	2.73	5238
67.5	14.44	2.67	5413
68.5	14.48	2.81	5162

*Apparent velocity due to refraction effects.

**TABLE 2
MODEL VELOCITIES**

Z (ft)	V_s (ft/s)	Comments
2.5 - 8.5	$15.362 * Z + 540.32$	$N = 3, r^2 = .99$
8.5 - 57	$8.0266 * Z + 241.03$	$N = 16, r^2 = 0.94$
57- 68.5	5264	$N = 6, \text{Std } 85 \text{ ft/s}, 1.6\% \text{ mean}$

Abbreviations:

N = Number of data points used
 r^2 = Coefficient of determination
Std = Standard Deviation



APPROXIMATE SCALE (feet)
0 1000 2000



LOCATION

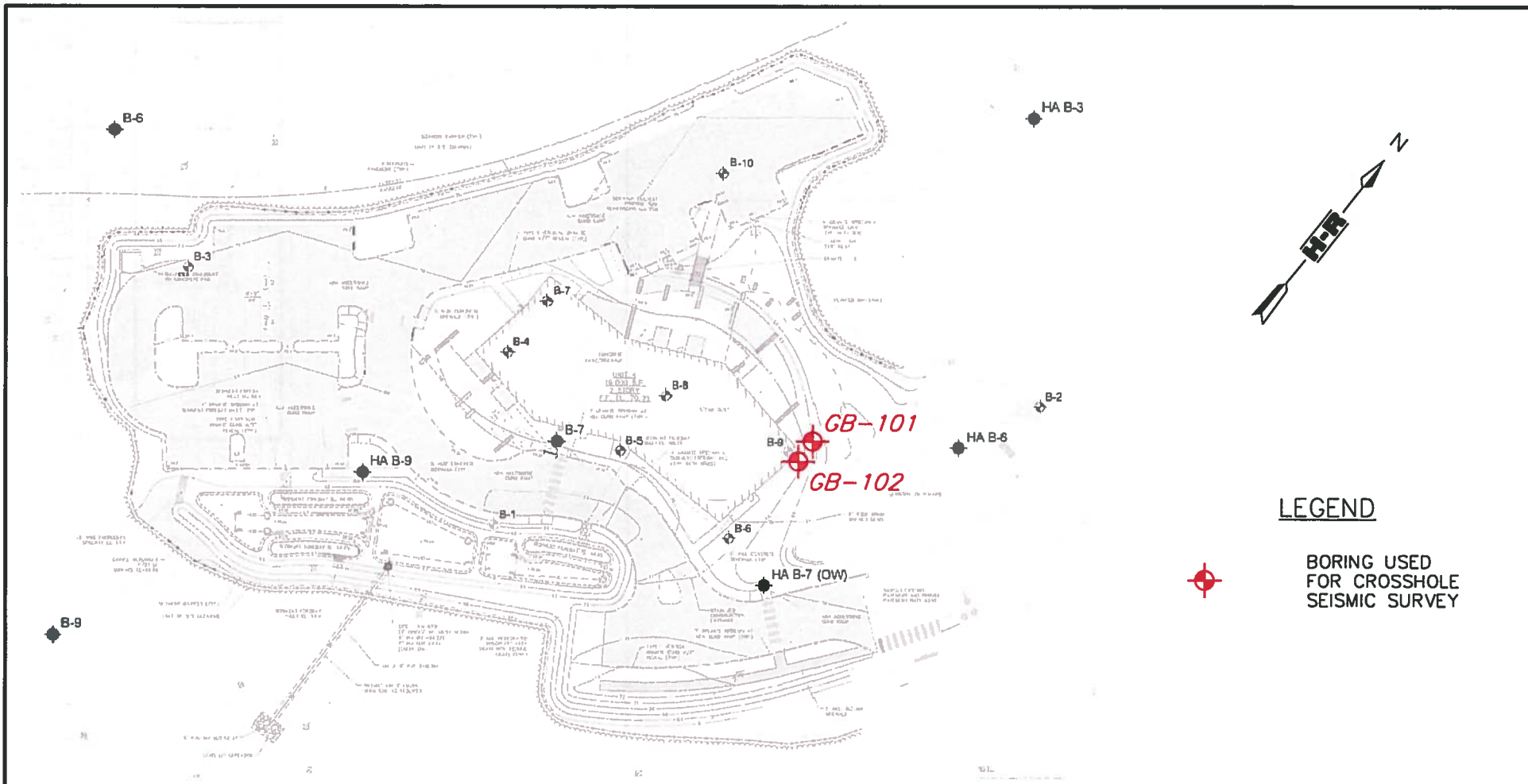
NOTE:

Modified from Google Earth Pro aerial photograph.

Figure 1
General Site Location
Lot 4 – Portland Technology Park
Portland, Maine

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LEGEND

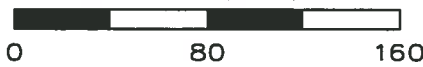


BORING USED FOR CROSSHOLE SEISMIC SURVEY

NOTE:

Modified from site plan provided by R.W. Gillespie & Associates, Inc., identified as FIG 2 ELP 1518-002.pdf.

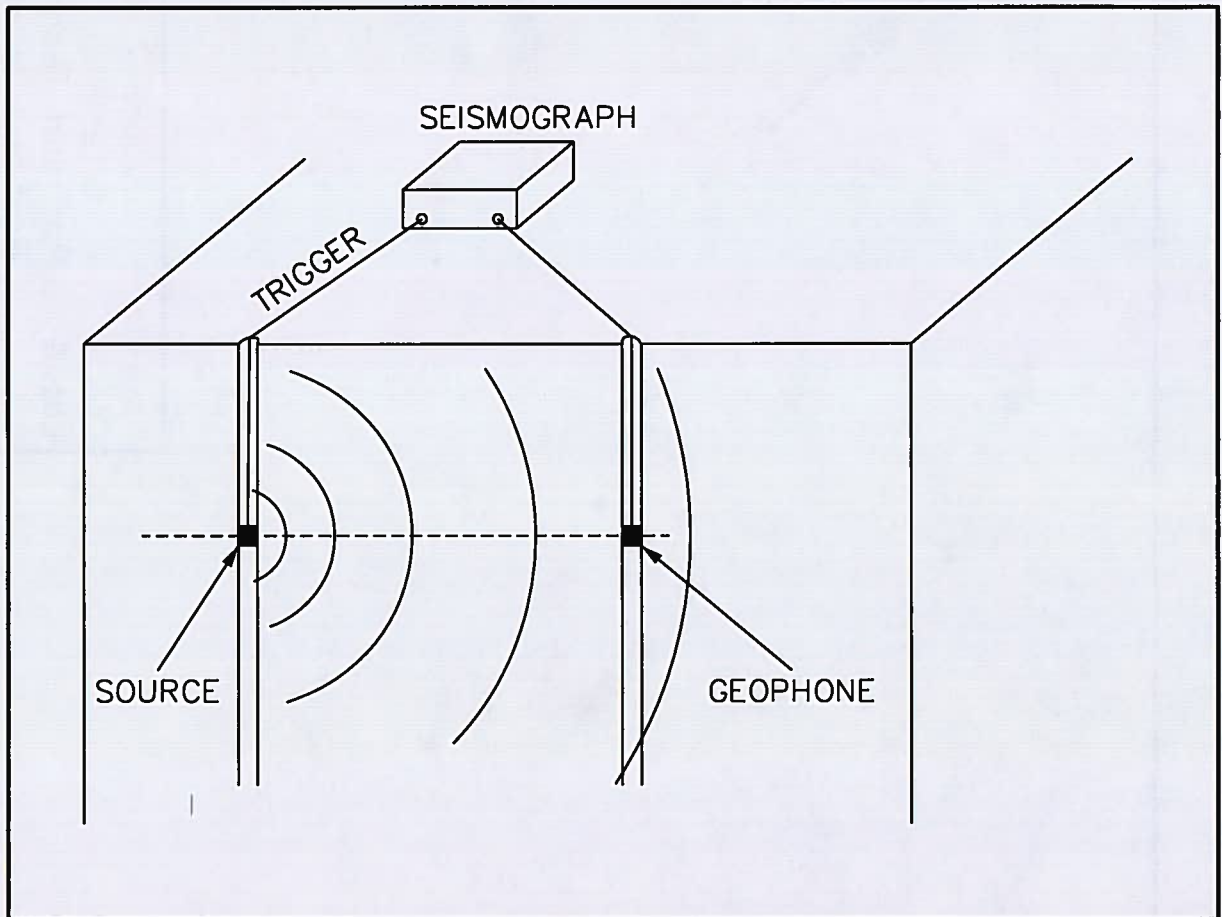
SCALE (feet)



**Figure 2
Site Plan
Lot 4 – Portland Technology Park
Portland, Maine**

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Salem, New Hampshire**



NOT TO SCALE

NOTE:

The source and receiver are placed at the same depths in different borings. A horizontally polarized shear wave is generated by the source, radiates in all directions, travels at the speed determined by the elastic properties and density of the soils, and is detected by the geophone in the receiver boring. When the wave is initiated, a signal is transmitted to the seismograph to start a timing clock, and the wave is recorded as a function of time in the seismograph.

Figure 3
 Survey Geometry
 Lot 4 – Portland Technology Park
 Portland, Maine

File 15J69

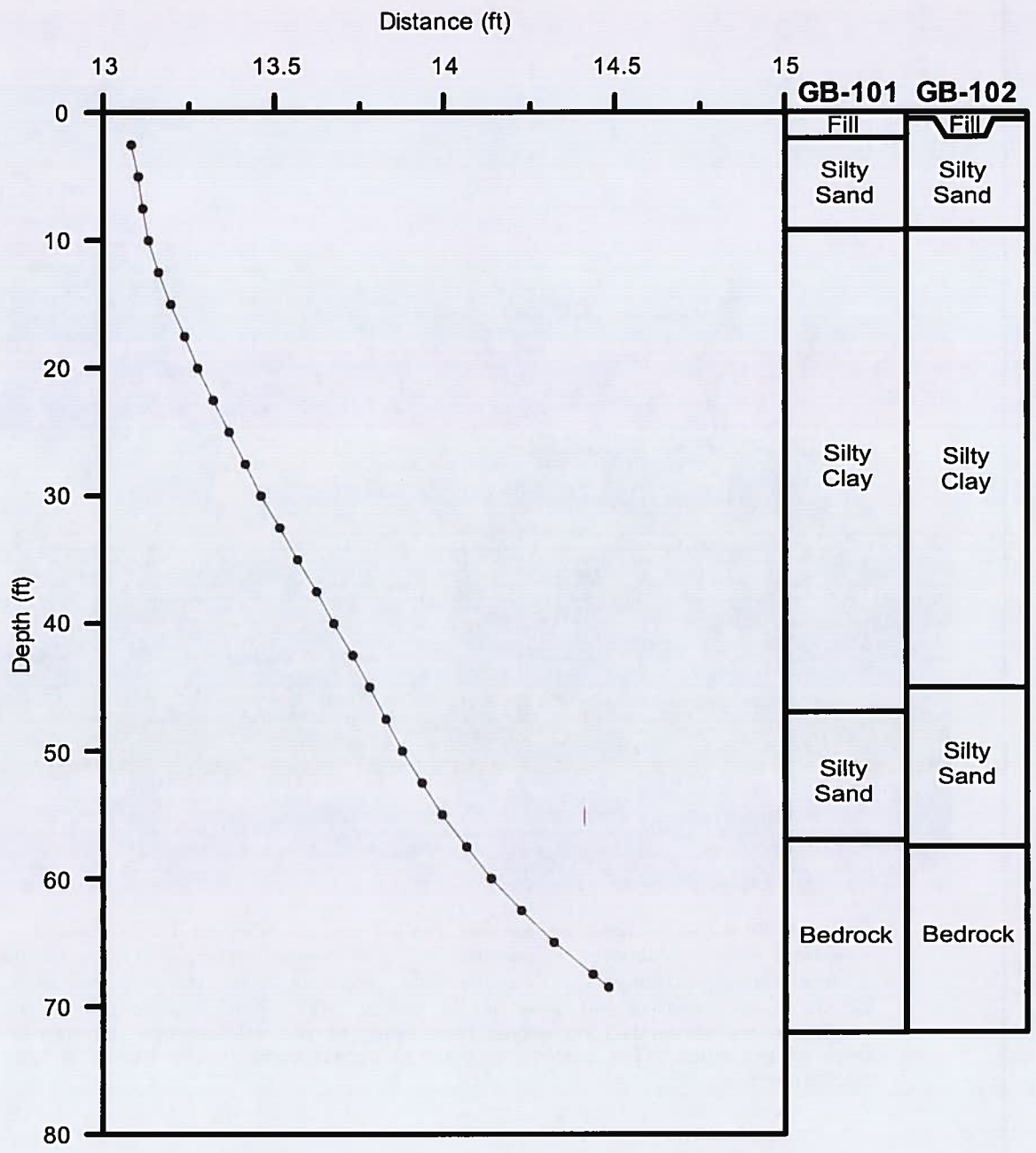
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Photograph showing crosshole seismic testing setup. View to the northeast. The downhole source is located in borehole GB-102 (white casting with blue air hose in foreground, bottom left). The downhole geophone is located in borehole GB-101 (white casting with pink ribbon, center left). Both seismic source and geophone are connected via cables (not seen) to the seismograph, located in the back of the truck. The partially completed access road to the site is in the background.

Figure 4 Site Photo Lot 4 – Portland Technology Park Portland, Maine	
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NOTE:

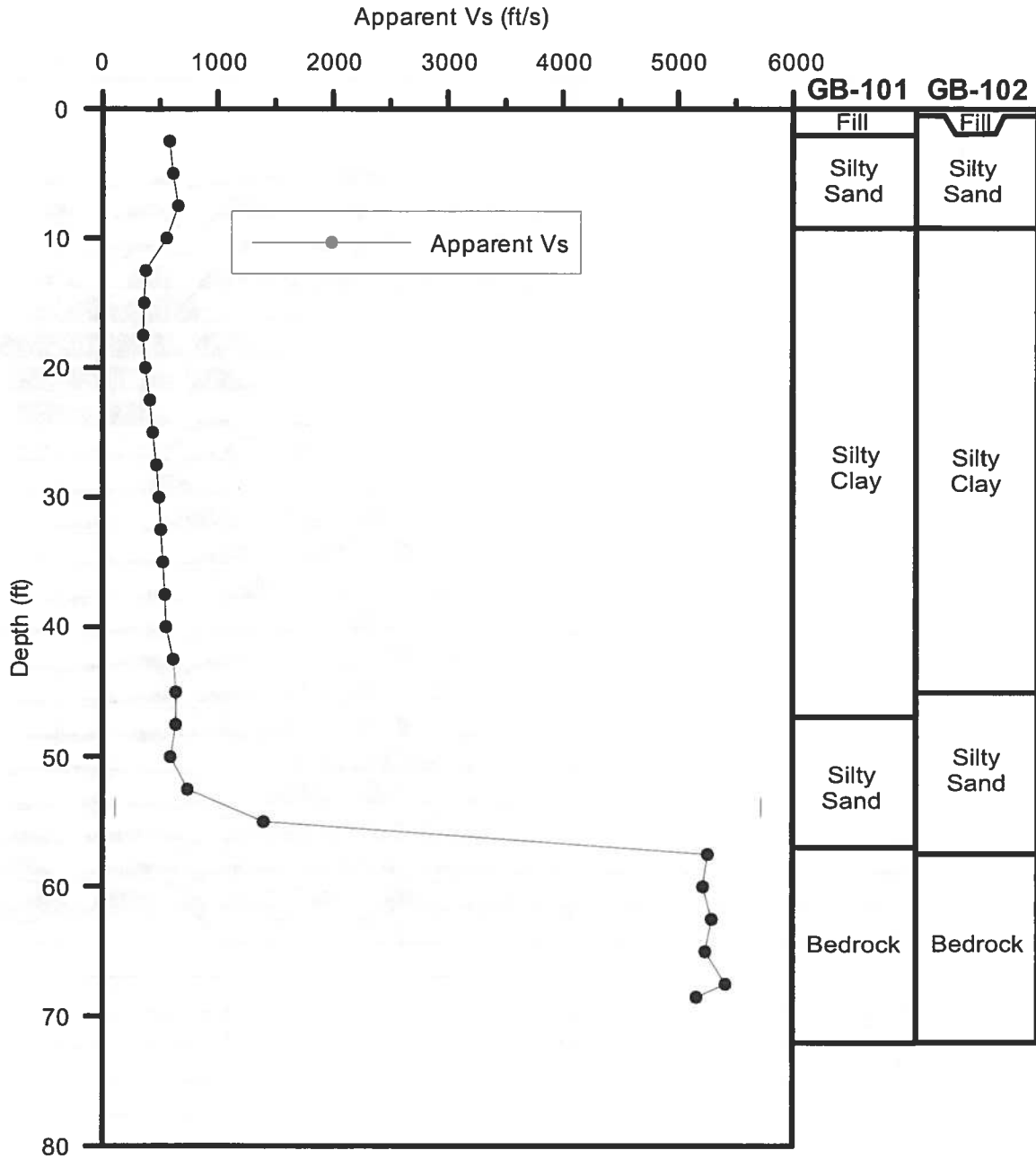
The general geologic log taken from log for boreholes GB-101 & GB-102, provided by R.W. Gillespie & Associates,

Figure 5
Distance Between Boreholes
Lot 4 - Portland Technology Park
Portland, Maine

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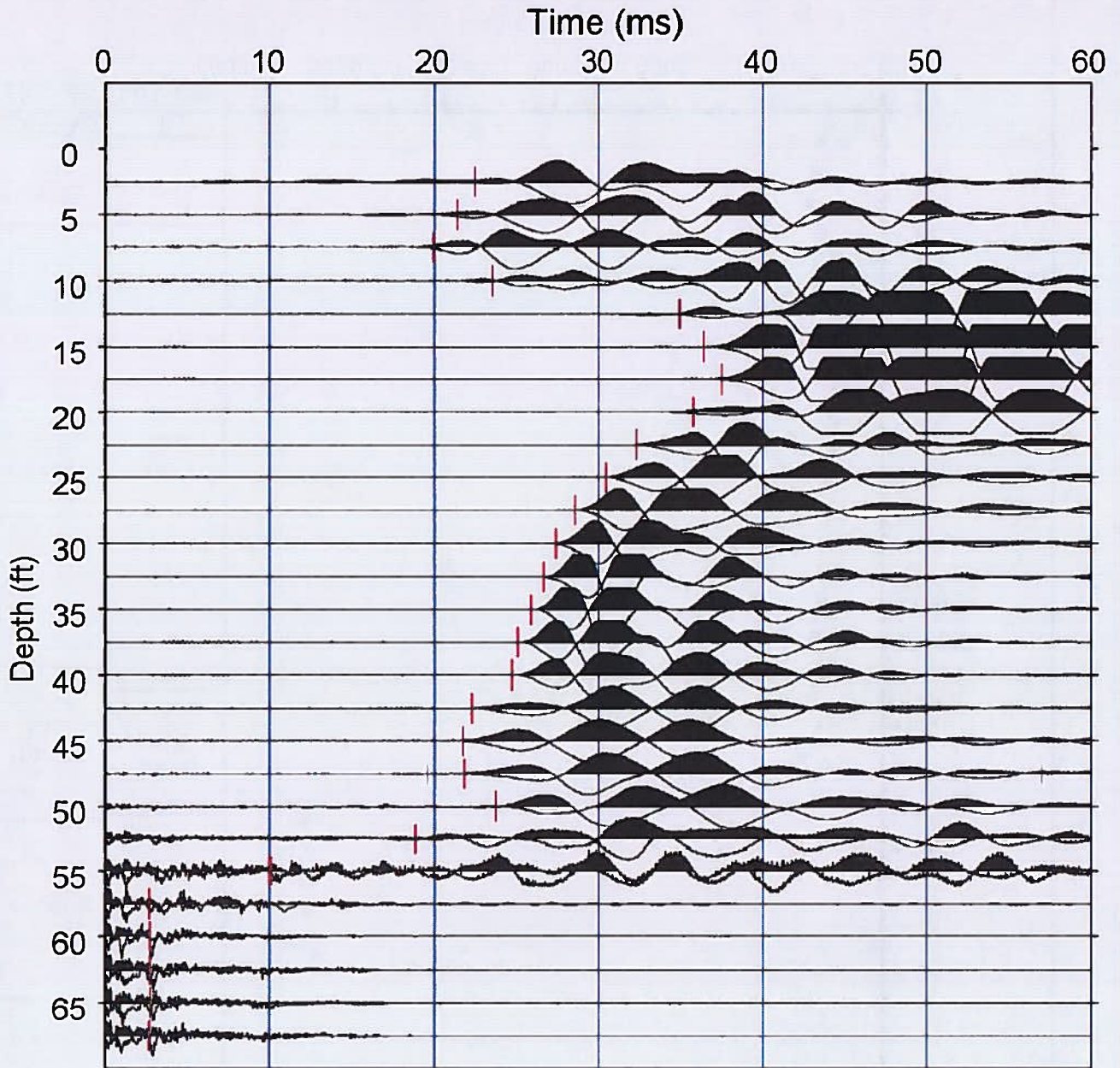


NOTE:

The general geologic log taken from log for boreholes GB-101 & GB-102, provided by R.W. Gillespie & Associates,

Figure 6
Apparent Velocity of Shear Waves
Lot 4 – Portland Technology Park
Portland, Maine

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NOTES:

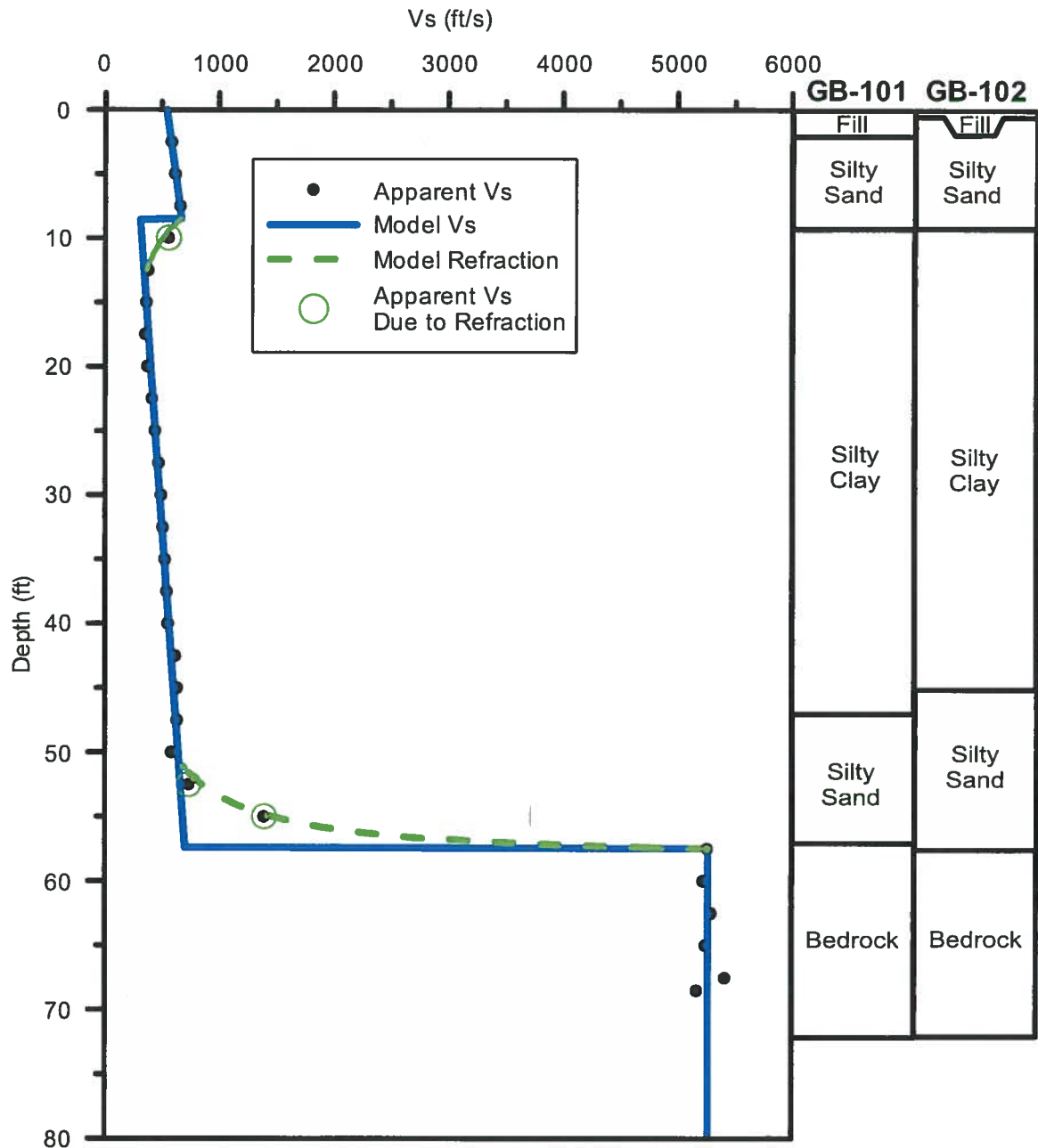
1. Seismic signal generated with a downhole hammer source.
2. Seismic signal detected with a downhole triaxial geophone receiver.
3. Downhole source and receiver positioned at same depth for each seismogram.
4. Superimposed seismograms for each depth represent opposite stacking polarity.
5. Composite seismograms assembled from horizontal component of triaxial geophone.
6. The short red lines mark the initial arrivals of shear waves.

Figure 7
 Composite Seismogram
 Lot 4 – Portland Technology Park
 Portland, Maine

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 Salem, New Hampshire



NOTES:

1. The parameters for the model velocity line are reported in Table 2.
2. Bedrock depth reported in boring logs was used.
3. The general geologic log taken from log for boreholes GB-101 & GB-102, provided by R.W. Gillespie & Associates,

Figure 8
 Model Velocity of Shear Waves
 Lot 4 – Portland Technology Park
 Portland, Maine

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Crosshole Seismic Testing
Lot 4 - Portland Technology Park
Portland, Maine
File 15J69 October, 2015

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APPENDICES

Crosshole Seismic Testing
Lot 4 - Portland Technology Park
Portland, Maine
File 15J69 October, 2015

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APPENDIX 1

BORING LOGS
GB-101 and GB-102



Boring Log: GB-101

Total Depth (ft): 72

Sheet 1 of 3

Project Name: Prop. Patrons Oxford Ins. Office Bldg.
 RWG&A Project No. 1518-002
 Location: Portland, Maine
 Client: Patrons Oxford Insurance
 RWG&A Representative: C. Morrell
 Boring Location: See Exploration Location Plan
 Boring Abandonment Method: Installed Solid Casing
 Observed Water Depth: 7'

Drilling Contractor: Great Works Test Boring
 Drill Rig: CME850
 Driller Rep.: Jeff Lee
 Date Started: 09/17/2015
 Date Completed: 09/17/2015
 Surface Elevation: 67 (Feet)
 Drilling Method: Drive and Wash
 Casing Type: 4" Steel

DEPTH, FT.	SYMBOL SAMPLES	SAMPLE NUMBER	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N BLOWS PER FT.	MOISTURE CONTENT %	LAB TESTS
0			FILL; BARK MULCH (3 inches).					
			FILL, Silty sand, moist, fine sand, some silt, trace medium sand, bluish gray					
			SILTY SAND (SM); Moist to wet, fine sand, some silt, grayish brown.					
5								
10			SILTY CLAY (CL); Silty clay, gray.					
15								
20								
25								

Notes: Installed 3-inch inside diameter, close ended, Schedule 40 PVC casing in completed borehole. Casing was grouted into place using a cement-bentonite mixture. Casing filled with potable water.



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 Geotechnical Engineering • Geohydrology • Materials Testing Services

Boring Log: GB-101

Total Depth: 72

Sheet 2 of 3

Project Name: Prop. Patrons Oxford Ins. Office Bldg.

Location: Portland Maine

Client: Patrons Oxford Insurance

Observed Water Depth: 7'

RWG&A Project No. 1518-002

Surface Elevation: 67 (Feet)

Casing Type: 4" Steel

DEPTH, FT.	SYMBOL	SAMPLE NUMBER	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N BLOWS PER FT.	MOISTURE CONTENT %	LAB TESTS
30								
35								
40								
45								
50		S-1	SILTY SAND (SM); Medium dense, wet, fine to medium sand, some silt, few gravel and coarse sand, gray.	11	4 7 4 3	11		
55			Bedrock encountered at 57', roller cone drilled to 72'.					

Notes: Installed 3-inch inside diameter, close ended, Schedule 40 PVC casing in completed borehole. Casing was grouted into place using a cement-bentonite mixture. Casing filled with potable water.



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Boring Log: GB-101

Total Depth: 72

Sheet 3 of 3

Project Name: Prop. Patrons Oxford Ins. Office Bldg.

Location: Portland Maine

Client: Patrons Oxford Insurance

Observed Water Depth: 7'

RWG&A Project No. 1518-002

Surface Elevation: 67 (Feet)

Casing Type: 4" Steel

DEPTH, FT.	SYMBOL	SAMPLES	SAMPLE NUMBER	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N BLOWS PER FT.	MOISTURE CONTENT %	LAB TESTS
60				Bedrock.					
65									
70				Bottom of Exploration at 72'; Terminated boring 15' into rock.					
75									
80									
85									

Notes: Installed 3-inch inside diameter, close ended, Schedule 40 PVC casing in completed borehole. Casing was grouted into place using a cement-bentonite mixture. Casing filled with potable water.



Project Name: Prop. Patrons Oxford Ins. Office Bldg.
 RWG&A Project No. 1518-002
 Location: Portland, Maine
 Client: Patrons Oxford Insurance
 RWG&A Representative: C. Morrell
 Boring Location: See Exploration Location Plan
 Boring Abandonment Method: Installed Solid Casing.
 Observed Water Depth: 7'

Drilling Contractor: Great Works Test Boring
 Drill Rig: CME850
 Driller Rep.: Jeff Lee
 Date Started: 09/18/2015
 Date Completed: 09/18/2015
 Surface Elevation: 67 (Feet)
 Drilling Method: Drive and Wash
 Casing Type: 4" Steel

DEPTH, FT.	SYMBOL SAMPLES	SAMPLE NUMBER	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N BLOWS PER FT.	MOISTURE CONTENT %	LAB TESTS
0			TOPSOIL AND ORGANIC MATERIAL (4 inches). SILTY SAND (SM); Moist, fine sand, some silt, grayish brown.					
5								
10			SILTY CLAY (CL); Medium stiff to soft, silty clay, gray.					
15								
20		FV	Field Vane: Undrained Shear Strength: Su=480 psf, residual 50 psf.					
		FV	Field Vane: Undrained Shear Strength: Su=490 psf, residual 40 psf.					
25								

Notes: 1. Used 3 5/8"x9" Acker field vane for shear strength testing.
 2. Installed 3-inch inside diameter, close ended, Schedule 40 PVC casing in completed borehole. Casing was grouted into place using a cement-bentonite mixture. Casing filled with potable water.



Project Name: Prop. Patrons Oxford Ins. Office Bldg.
 Location: Portland Maine
 Client: Patrons Oxford Insurance
 Observed Water Depth: 7'

RWG&A Project No. 1518-002
 Surface Elevation: 67 (Feet)
 Casing Type: 4" Steel

DEPTH, FT.	SYMBOL SAMPLES	SAMPLE NUMBER	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N BLOWS PER FT.	MOISTURE CONTENT %	LAB TESTS
30		FV	Field Vane: Undrained Shear Strength: Su=490 psf, residual 50 psf.					
		FV	Field Vane: Undrained Shear Strength: Su=550 psf, residual 40 psf.					
35								
40		FV	Field Vane: Undrained Shear Strength: Su=640 psf, residual 20 psf.					
		FV	Field Vane: Undrained Shear Strength: Su=520 psf, residual 0 psf.					
45			SILTY SAND (SM); Fine to medium sand, some silt, few gravel and coarse sand, gray.					
50								
55								
			Bedrock encountered at 57.5 feet, roller cone drilled to 72'.					

Notes: 1. Used 3 5/8"x9" Acker field vane for shear strength testing.
 2. Installed 3-inch inside diameter, close ended, Schedule 40 PVC casing in completed borehole. Casing was grouted into place using a cement-bentonite mixture. Casing filled with potable water.



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Boring Log: GB-102

Total Depth: 72

Sheet 3 of 3

Project Name: Prop. Patrons Oxford Ins. Office Bldg.

Location: Portland Maine

Client: Patrons Oxford Insurance

Observed Water Depth: 7'

RWG&A Project No. 1518-002

Surface Elevation: 67 (Feet)

Casing Type: 4" Steel

DEPTH, FT.	SYMBOL SAMPLES	SAMPLE NUMBER	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N BLOWS PER FT.	MOISTURE CONTENT %	LAB TESTS
60			Bedrock.					
65								
70								
75								
80								
85								

Bottom of Exploration at 72'; Terminated boring 14.5' into rock.

Notes: 1. Used 3 5/8"x9" Acker field vane for shear strength testing.
 2. Installed 3-inch inside diameter, close ended, Schedule 40 PVC casing in completed borehole. Casing was grouted into place using a cement-bentonite mixture. Casing filled with potable water.

Crosshole Seismic Testing
Lot 4 - Portland Technology Park
Portland, Maine
File 15J69 October, 2015

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APPENDIX 2
DEVIATION DATA

HAGER-RICHTER GEOSCIENCE, INC.

8 Industrial Way - D10
Salem, NH 03079
Phone: 603-893-9944
Fax: 603-893-8313

BOREHOLE DEVIATION LOGS

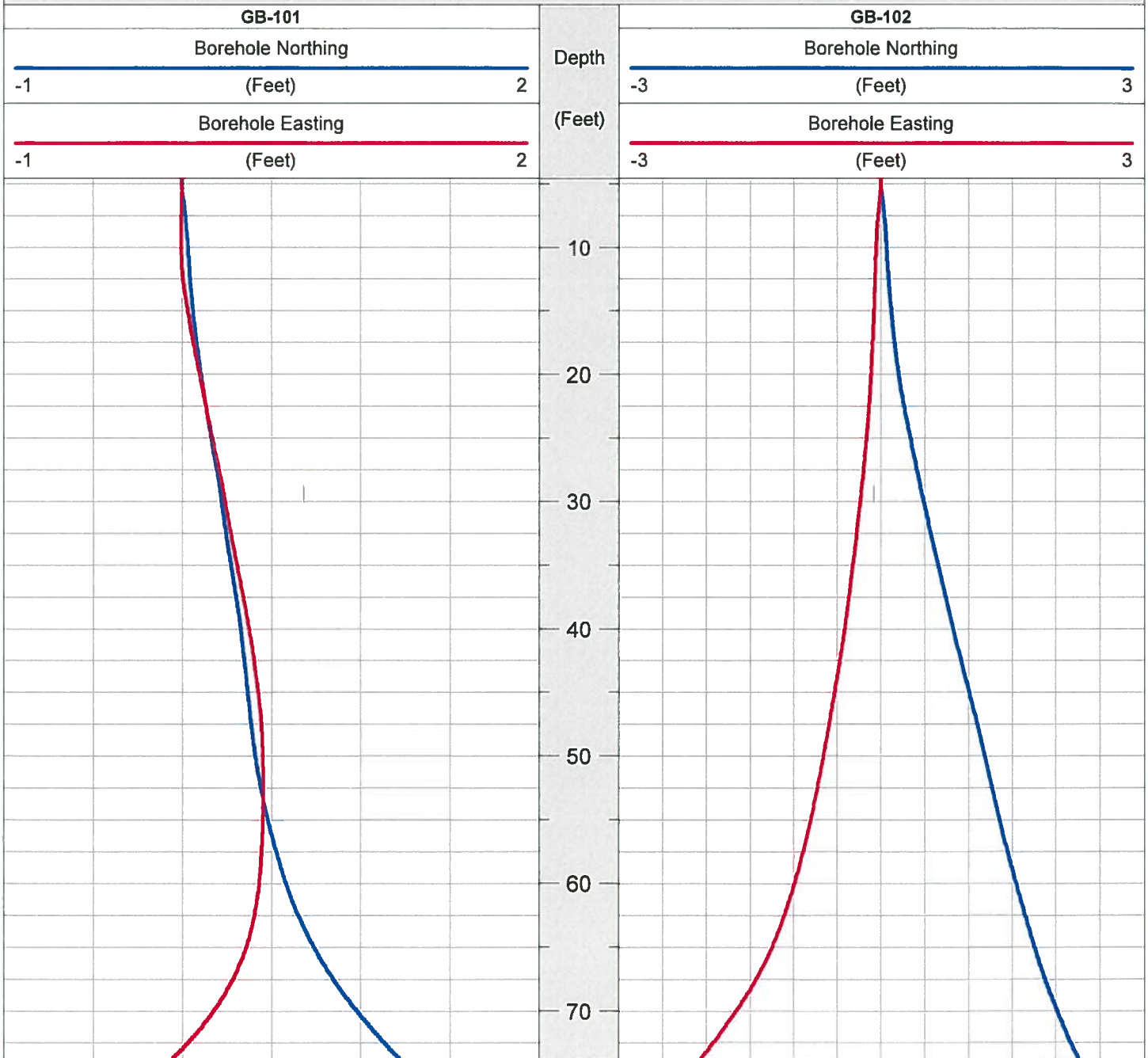
DATE LOGGED:

September 24, 2015

CLIENT: RW Gillespie and Associates, INC
PROJECT: Lot 4 - Portland Technology Park
LOCATION: Portland Technology Park
CITY, STATE: Portland, Maine

H-R FILE: 15J69
LOG DATUM: Ground Surface
ORIENTATION REFERENCE: Magnetic North
LOGGING GEOPHYSICISTS: Michael Howley

Borehole Deviation Logs



**CROSSHOLE SEISMIC TESTING
LOT 4 - PORTLAND TECHNOLOGY PARK
PORTLAND, MAINE**

Prepared for:

R.W. Gillespie & Associates, Inc.
86 Industrial Park Road, Suite 4
Saco, Maine 04072

Prepared by:

Hager-Richter Geoscience, Inc.
8 Industrial Way, D10
Salem, New Hampshire 03079

File 15J69
October, 2015

0. EXECUTIVE SUMMARY

Hager-Richter Geoscience, Inc. (Hager-Richter) conducted crosshole seismic testing in one two-borehole array at the Lot 4 site located at the Portland Technology Park in Portland, Maine for R.W. Gillespie & Associates, Inc. (RWG) in September, 2015. The crosshole seismic testing is part of geotechnical investigations for future development. The testing was conducted in accordance with ASTM D4428/D4428 M-07 "Standard Test Methods for Crosshole Seismic Testing."

The objective of the crosshole seismic testing was to determine shear wave velocity (V_s) as a function of depth at the specified location for the determination of seismic site class.

On the basis of the crosshole seismic testing conducted in a two-borehole array at the Lot 4 site located at the Portland Technology Park in Portland, Maine we conclude that the velocity of shear waves, (V_s) varies with depth, Z , as tabulated in Table 1, and as follows:

Z (ft)	V_s (ft/s)	Comments
2.5 - 8.5	$15.362 * Z + 540.32$	$N = 3, r^2 = .99$
8.5 - 57	$8.0266 * Z + 241.03$	$N = 16, r^2 = 0.94$
57- 68.5	5264	$N = 6, \text{Std } 85 \text{ ft/s}, 1.6\% \text{ mean}$

The average velocity of shear waves for the upper 100 ft, assuming bedrock velocity to 100 ft depth is the same as the model value determined for the interval 57 - 68.4 ft, was determined to be 804 ft/s, and corresponds to Seismic Site Class D based solely on the on average shear wave velocity table in the IBC.

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2.3	Data Analysis	3
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- 1 Boring Logs for B-101A and B-101B
- 2 Deviation Data

1. INTRODUCTION

Hager-Richter Geoscience, Inc. (Hager-Richter) conducted crosshole seismic testing in one two-borehole array at the Lot 4 site located at the Portland Technology Park in Portland, Maine for R.W. Gillespie & Associates, Inc. (RWG) of Saco, Maine, in September, 2015. The crosshole seismic testing is part of geotechnical investigations for future development. The project site is located southeast of the Interstate 95 - State Route 25 Interchange on an unnamed access road. The general location of the Site is shown in Figure 1. The testing was conducted in accordance with ASTM D4428/D4428 M-07 "Standard Test Methods for Crosshole Seismic Testing."

The two boreholes were designated by RWG as GB-101 and GB-102, and both were terminated in bedrock at 72 feet below ground surface. Bedrock at this location is mapped as the Vassalboro Formation according to the Bedrock Geologic Map of Maine. The approximate locations of the boreholes are shown in Figure 2. The boring logs are included in Appendix 1, and report the stratigraphy penetrated by the borings from surface downward as follows:

<u>GB-101</u>	<u>GB-101</u>
2 feet of fill	4 inches of soil
7 feet of silty sand	8.5 feet of silty sand
38 feet of silty clay	36 feet of silty clay
10 feet of silty sand	10.5 feet of silty sand
bedrock of the Vassalboro Fm, encountered at 57 feet	bedrock of the Vassalboro Fm, encountered at 57.5 feet

The objective of the crosshole seismic testing was to determine the velocity of shear waves as a function of depth and for the determination of seismic site class.

The crosshole seismic testing was conducted on September 24, 2015 by Michael Howley, P.G., and Bryan Carnahan of Hager-Richter. The project was coordinated with Mr. Chris Morrell, of RWG, who was present for the duration of the field work. Field work and subsequent data processing were performed in accordance with ASTM D4428/D4428 M-07 "Standard Test Methods for Crosshole Seismic Testing." The project records will be kept for a minimum of three years.

2. CROSSHOLE SEISMIC TESTING

2.1 General

As noted in the Introduction, the testing was performed in substantial conformance with ASTM D4428/D4428 M-07 "Standard Test Methods for Crosshole Seismic Testing."

2.2 Field Procedures

The two-borehole method was used. The ASTM document specifies the construction details of the boreholes, including a requirement for grouting the casing from bottom to top. The grout provides a path for the elastic signals from the source to the borehole wall in one borehole and from the borehole wall to the geophone in one or more other boreholes. The displacement of each borehole from its location on the surface was measured with a deviation probe, providing the data necessary to calculate the distance between the boreholes.

The geometry of the testing system is shown in Figure 3. The source and geophone are positioned at the same elevation. The source generates a seismic signal that travels as an elastic wave to the geophones, where it is converted to an electric signal, sent to the seismograph via cable, and amplified, filtered, and recorded by the seismograph. Figure 4 is a photograph that shows the physical setup for the testing in the field.

The seismograph is a 24-channel seismograph (Geometrics Geode), coupled to a downhole geophone assembly. The downhole geophone assembly includes a Mark Products triaxial geophone and a mechanical clamping mechanism to secure the assembly to the inside of the casing. The vertical axis of the geophone is oriented vertically (because it is constrained by the borehole), and the horizontal axes are oriented such that one axis is parallel to the direction source-to-receiver and the other axis is perpendicular to that direction. The seismograph records data digitally and the records are available immediately to verify the quality of the data.

The source is a downhole hammer that produces primarily a vertically polarized shear wave but also a compressional wave. The direction of first motion of the shear wave can be reversed, thereby facilitating recognition of the onset of the shear waves at the geophone(s). The number of stacks per shot depth/direction is variable, and the quality of the stacked seismic signal for each shot depth/direction is verified in the field.

The deviation probe is a Mount Sopris downhole tool 2DVA-1000 that was operated with a Mount Sopris MGX-2 portable logger. The downhole tool includes a 3-axis magnetometer and three accelerometers. The manufacturer's stated accuracy is Azimuth $\pm 1^\circ$ and Inclination

±0.3°. Additional specifications and the manual for the deviation probe are available on the website www.mountsopris.com.

2.3 Data Analysis

2.3.1 Velocity. The seismic data are analyzed using the digital data and commercially available software. The arrival times for the shear and compressional waves at each geophone are determined from the digital seismic data. The *apparent*¹ velocities are calculated for each depth from the arrival times and the distances between the boreholes as follows:

$$V_s (S-R) = L (S-R) / \Delta T_s (S-R) \qquad \text{Eq 2.3-1}$$

$$V_p (S-R) = L (S-R) / \Delta T_p (S-R) \qquad \text{Eq 2.3-2}$$

where:

V is the velocity, with subscripts S and P indicating shear and compressional waves, respectively,

L (S-R) is the distance between borings containing the Source and Receiver;

ΔT (S-R) is the time of transit of elastic energy from the Source to Receiver, averaged for source up and down, and with subscripts as defined for V.

The assumptions inherent in Equations 1 and 2 are that the medium is isotropic and homogeneous within layers, the interface between layers is horizontal, and the displacements are small.

The velocities determined with Equations 1 and 2 are *apparent* velocities. The actual velocities would be determined by correcting for the effects of refraction, if refraction is present, using Snell's Law, which for any two layers is given by

$$\text{SIN } \alpha_1 / \text{SIN } \alpha_2 = V_1 / V_2 \qquad \text{Eq 2.3-3}$$

where

α_1 is the angle of incidence,

α_2 is the angle of the refracted wave, and

V_1 and V_2 are the velocities of layers 1 and 2, respectively.

¹Apparent velocity is the distance between the source and the receiver divided by the time required for the seismic signal to travel from the source to the receiver.

2.4 Determination of Average Shear Wave Velocity for Building Code Purposes.

The Building Code uses the average shear wave velocity averaged over the upper 100 ft as one method to determine Seismic Site Class. The average velocity V_{avg} is defined as follows:

$$V_{avg} = \left(\sum_{i=1}^N d_i \right) / \sum_{i=1}^N d_i / V_i \quad \text{Eq. 2.4 -1}$$

where V_{avg} is average shear wave velocity
 d_i is thickness of the i^{th} layer
 V_i is the shear wave velocity of the i^{th} layer
 N is the number of layers

Equation 2.4-1 assumes that the velocity is constant in each layer. Such, however, is not always the case, and a function of the form $Y = a * X + b$ often fits the observed data well. For sections in which the velocity varies as $Y = a * X + b$, the denominator of Eq 2.4-1 can be replaced with the following integral:

$$\int_{Z_1}^{Z_2} dZ / (aZ + b) = [Ln(aZ_2 + b) - Ln(aZ_1 - b)] / a$$

where Z_1 and Z_2 are the depths of top and bottom of the layer in which the velocity varies as $Y = a * X + b$.

The Site Class, based on average shear wave velocity, is defined as follows:

Site Class	Soil Profile Name	Soil Shear Wave Velocity (ft/s)
A	Hard rock	$v_s > 5000$
B	Rock	$2500 < v_s \leq 5000$
C	Very dense soil and soft rock	$1200 < v_s \leq 2500$
D	Stiff soil profile	$600 \leq v_s \leq 1200$
E	Soft soil profile	$v_s < 600$

Although the IBC provides other methods to determine the Site Class, such as standard penetration resistance (blow counts) and soil undrained shear strength, this report uses only the method based on shear wave velocity. Furthermore, there is no consideration of other factors that may affect a site such as liquefaction. The final determination of seismic site class should be made by the project engineer.

2.5 **Limitations of the Method**

Like all geophysical methods, the crosshole seismic method is based on the assumption that the local geology is uncomplicated, and that rock and soil interfaces are planar. For those tests in which the signals are generated in a single boring only, the interfaces are assumed to be horizontal, and this assumption is inherent in correcting for refraction.

Thin units with velocities that are lower than the velocity of adjacent materials may not be detectable with the geometry of a particular installation. (The details important to this limitation are the velocities of adjacent materials, thickness of the units, and the distances as functions of depth between arrays.)

If deviation measurements are not available, then the distance between boreholes is *assumed* to be constant from the surface to the bottom of the boreholes. Although ASTM D4428 does not require deviation measurements to be made for borings with depths less than 50 ft, we have measured departures from vertical of several feet in borings that were only 30 ft deep.

If the casing in each borehole is not grouted in accordance with ASTM D4428, or the grout is not continuous, then the signal may be significantly degraded for at least some depths. The practical result is that the velocity determined under such conditions is less accurate at best, and in some cases may not be determinable. The acoustic noise in the subsurface can be a significant problem, particularly at active construction sites, and may interfere with the signals generated in the crosshole seismic testing. Drilling, pile driving, and the activity of heavy construction equipment have been especially troublesome at some sites.

2.6 **Site Specific**

The borings were reportedly constructed in accordance with the recommendations of ASTM D4428/D4428 M-07 "Standard Test Methods for Crosshole Seismic Testing." A deviation survey was performed by Hager-Richter in the two borings, and the data are given in Appendix 3. The distances between the boreholes for the crosshole testing were determined as a function of depth from the surface, and are reported in Table 1 and shown in Figure 5.

The maximum changes in separation of source and receiver boreholes was 1.4 feet, corresponding to 10.7 % of the distance between the boreholes on the surface (13.08 feet).

Crosshole seismic data were obtained at intervals of 2.5 feet from 2.5 to 67.5 feet depth, with an additional measurement at 68.5 feet depth. No more than 10 stacks of the seismic signals were required to increase the signal-to-noise ratio to an acceptable value.

3. RESULTS AND DISCUSSION

3.1 General

As discussed above, the measured seismic velocities are *apparent* velocities. The distances between borings and the apparent shear wave velocities are reported in Table 1 and are plotted as functions of depth in Figures 5 and 6, respectively.

As noted above, the boreholes were designated by RWG as GB-101 and GB-102, and both were terminated at 72 feet below ground surface. The approximate locations of the boreholes are shown in Figure 2 and Figure 4 is a photograph showing the test setup. The boring logs are included in Appendix 2, and report the stratigraphy penetrated by the borings from surface downward as follows:

<u>GB-101</u>	<u>GB-101</u>
2 feet of fill	4 inches of soil
7 feet of silty sand	8.5 feet of silty sand
38 feet of silty clay	36 feet of silty clay
10 feet of silty sand	10.5 feet of silty sand
bedrock,	bedrock,
encountered at 57 feet	encountered at 57.5 feet

The total depth available for the crosshole seismic testing was 72.0 feet.

3.2 Data Quality

The quality of seismic data is evaluated on the basis of the signal-to-noise (S/N) ratio and the ease with which the onset of the signal can be recognized visually. Only the initial arrival times are used in crosshole seismic testing. The noise for the shear wave (S-wave) includes not only ambient noise but noise due to the P-wave, which always arrives before the S-wave and its wave train continues for a finite time after the arrival of the S-wave. Recognition of the onset of the shear wave is improved significantly by recording and superimposing shear waves that are oppositely polarized.

The quality of seismic data acquired for this project is judged to be good to excellent with the exception of the data for the interval near and in bedrock, 55 - 68.5 ft, where the quality is judged to be poor-fair. The composite plot of the shear wave seismograms is shown in Figure 7. Reversed shear wave arrivals, generated by stacking the downhole source in opposing directions

at each depth, are evident in the seismogram, and are especially well developed in the overburden section between about 25 and 40 feet bgs.

3.3 Refraction Effects

As noted in section 2.3, the velocity obtained by dividing the distance between borings by the time required for the signal to travel between the borings, called *apparent* velocity, may not be the true velocity, especially where the source and receiver are located at a depth near an interface between two materials with different velocities and/or the distance between borings is large. The difference between apparent and true velocity is due to refraction. At some sites, even in the presence of refraction, the direct wave can be recognized and its time used to determine the velocity of the material with the slower velocity.

Examination of the apparent shear wave velocity data in Table 1 shows large velocity changes at the interface between the upper silty sand and silty clay between depths of 7.5 and 12.5 feet and at the interface between the silty sand and bedrock between depths of 50 and 57.5 feet. Based on modeling of the data using the measured velocities above and below the interfaces, we have determined that the apparent velocities at depths 10 feet, 52.5 feet, and 55 feet are due to refractions and are so noted on Table 1.

3.4 Results

As noted above, the distances between borings and the apparent shear wave velocities are reported in Table 1 and are plotted as functions of depth in Figures 5 and 6, respectively.

Our models of the velocities of shear (V_s) waves consist of two simple functions: (1) $Y = C$, where C is a constant determined by averaging, and (2) $Y = A * X + B$, where A and B are constants determined by least squares for individual segments. The model for shear wave velocities is given in Table 2. The shear wave model is shown graphically in Figure 9.

Using the model velocities of shear waves as given in Table 2 – and assuming the bedrock velocity to 100 ft depth is the same as the model value determined for the interval 57 - 68.5 ft – and Eq. 2.4 -1 of Section 2.4, the average velocity of shear waves for the upper 100 ft, V_{S100} , was determined to be 804 ft/s, and corresponds to Seismic Site Class D based solely on the average shear wave velocity table in the IBC.

4. CONCLUSIONS

On the basis of the crosshole seismic testing conducted in a two-borehole array at the Lot 4 site located at the Portland Technology Park in Portland, Maine we conclude that the velocity of shear waves, (V_s) varies with depth, Z , as tabulated in Table 1, and as follows:

Z (ft)	V_s (ft/s)	Comments
2.5 - 8.5	$15.362 * Z + 540.32$	$N = 3, r^2 = .99$
8.5 - 57	$8.0266 * Z + 241.03$	$N = 16, r^2 = 0.94$
57- 68.5	5264	$N = 6, \text{Std } 85 \text{ ft/s}, 1.6\% \text{ mean}$

The average velocity of shear waves for the upper 100 ft, assuming bedrock velocity to 100 ft depth is the same as the model value determined for the interval 57 - 68.4 ft, was determined to be 804 ft/s, and corresponds to Seismic Site Class D based solely on the on average shear wave velocity table in the IBC.

5. LIMITATIONS

This report was prepared for the exclusive use of R.W. Gillespie & Associates, Inc. and its client. Any use by any third party of this Report or any information, documents, records, data, interpretations, advice or opinions given to the Client by Hager-Richter Geoscience, Inc. in the performance of its work shall be at such third party's own risk and without any liability to Hager-Richter Geoscience, Inc.

Hager-Richter Geoscience, Inc. has performed its professional services, obtained its findings, and made its conclusions in accordance with generally accepted and customary principles and practices in the field of geophysics. No other warranty, either expressed or implied, is made. Hager-Richter Geoscience, Inc. is not responsible for the independent conclusions, opinions, or recommendations made by others based on the information, geophysical data, and interpretations presented in this report.

This geophysical testing included a limited set of data obtained at the project Site and was conducted with limited knowledge of the Site and its subsurface conditions. Hager-Richter Geoscience, Inc. does not assume responsibility for the accuracy of information that was provided to us by others about the Site and its subsurface conditions. The findings provided by Hager-Richter Geoscience, Inc. are based solely on the information described in this document. The conclusions drawn from this investigation are considered reliable; however, there may exist localized variations in subsurface conditions that have not been completely defined at this time. It should be noted that our conclusions might be modified if subsurface conditions were better delineated with additional subsurface exploration including, but not limited to, coring and laboratory testing.

TABLE 1
DISTANCE BETWEEN BOREHOLES AND
APPARENT VELOCITIES

Depth (ft)	Source-Receiver Distance (ft)	Shear Wave Travel Time (ms)	Apparent Shear Wave Velocity (ft/s)
2.5	13.08	22.50	581
5	13.10	21.41	612
7.5	13.11	19.93	658
10	13.13	23.52	558*
12.5	13.16	34.99	376
15	13.20	36.44	362
17.5	13.24	37.56	352
20	13.28	35.82	371
22.5	13.32	32.33	412
25	13.37	30.49	438
27.5	13.42	28.56	470
30	13.46	27.36	492
32.5	13.52	26.64	507
35	13.57	25.80	526
37.5	13.62	25.08	543
40	13.67	24.71	553
42.5	13.73	22.32	615
45	13.78	21.77	633
47.5	13.83	21.85	633
50	13.88	23.70	586
52.5	13.94	18.92	737*
55	14.00	10.04	1394*
57.5	14.07	2.68	5258
60	14.14	2.71	5219
62.5	14.22	2.69	5293
65	14.32	2.73	5238
67.5	14.44	2.67	5413
68.5	14.48	2.81	5162

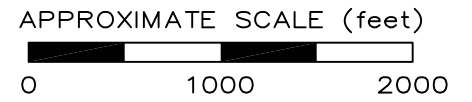
*Apparent velocity due to refraction effects.

**TABLE 2
MODEL VELOCITIES**

Z (ft)	V_s (ft/s)	Comments
2.5 - 8.5	$15.362 * Z + 540.32$	N = 3, $r^2 = .99$
8.5 - 57	$8.0266 * Z + 241.03$	N = 16, $r^2 = 0.94$
57- 68.5	5264	N = 6, Std 85 ft/s, 1.6% mean

Abbreviations:

N = Number of data points used
 r^2 = Coefficient of determination
Std = Standard Deviation

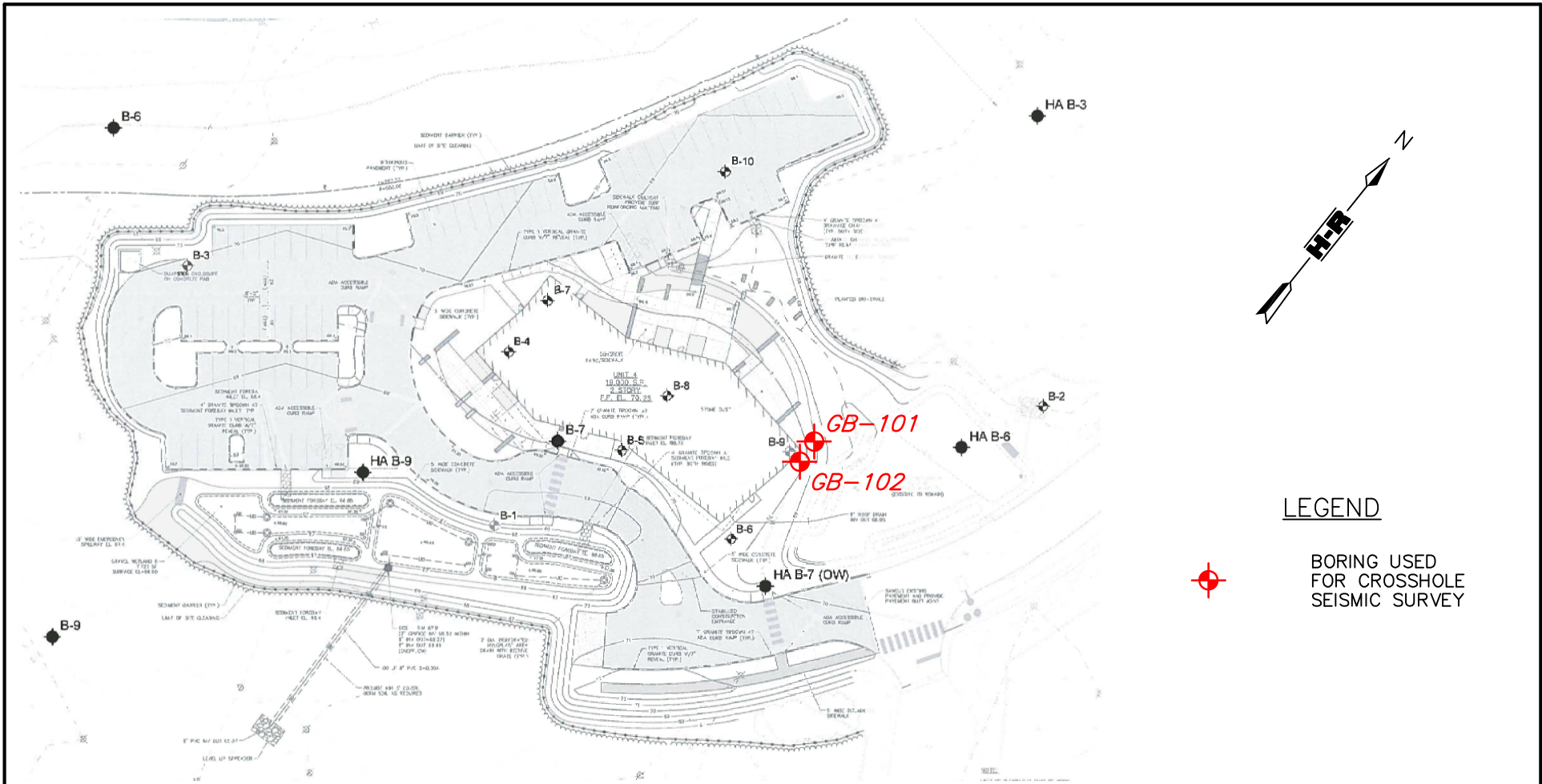


LOCATION

NOTE:

Modified from Google Earth Pro aerial photograph.

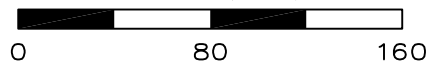
<p>Figure 1 General Site Location Lot 4 – Portland Technology Park Portland, Maine</p>	
File 15J69	October, 2015
<p>HAGER-RICHTER GEOSCIENCE, INC. Salem, New Hampshire</p>	



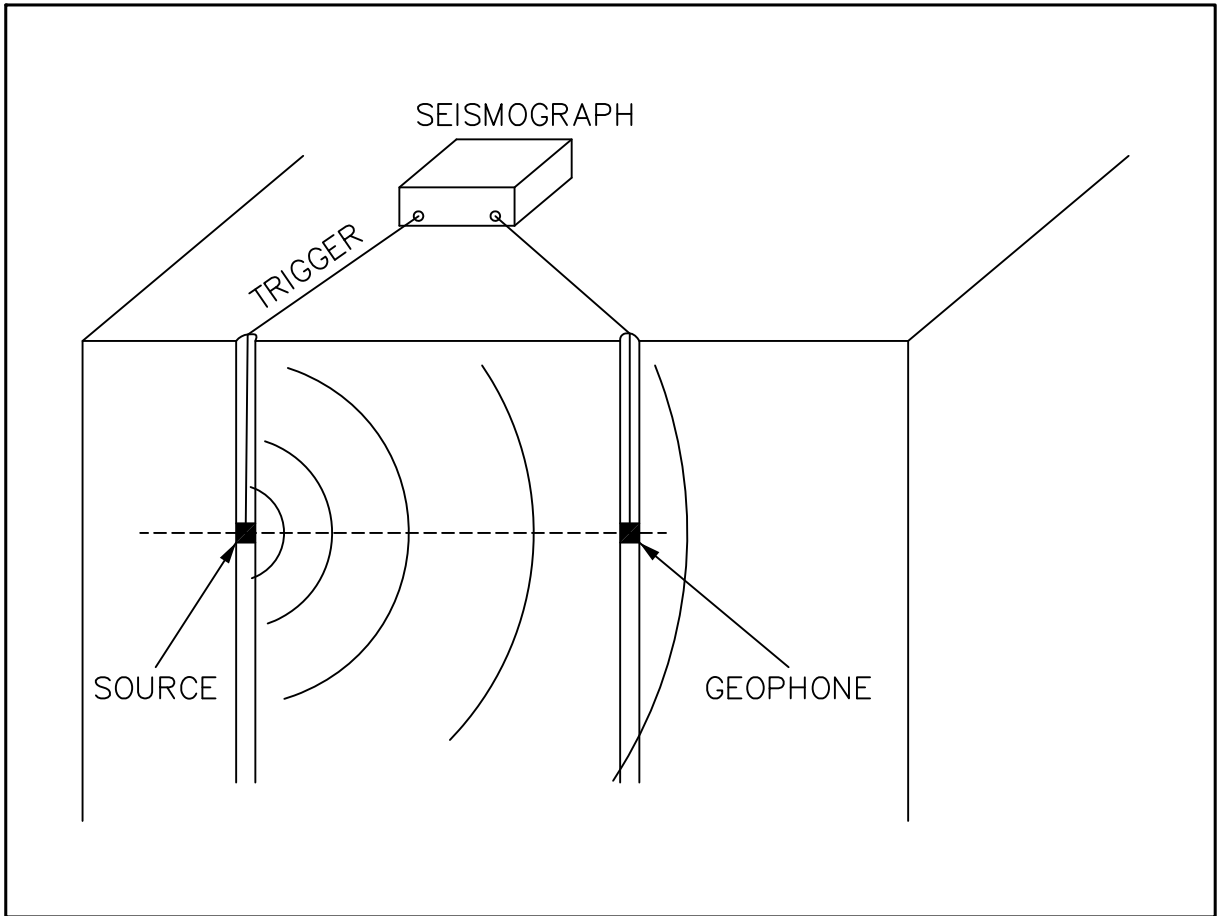
NOTE:

Modified from site plan provided by R.W. Gillespie & Associates, Inc., identified as FIG 2 ELP 1518-002.pdf.

SCALE (feet)



<p>Figure 2 Site Plan Lot 4 – Portland Technology Park Portland, Maine</p>	
File 15J69	October, 2015
<p>HAGER-RICHTER GEOSCIENCE, INC. Salem, New Hampshire</p>	



NOT TO SCALE

NOTE:

The source and receiver are placed at the same depths in different borings. A horizontally polarized shear wave is generated by the source, radiates in all directions, travels at the speed determined by the elastic properties and density of the soils, and is detected by the geophone in the receiver boring. When the wave is initiated, a signal is transmitted to the seismograph to start a timing clock, and the wave is recorded as a function of time in the seismograph.

Figure 3
 Survey Geometry
 Lot 4 – Portland Technology Park
 Portland, Maine

File 15J69

October, 2015

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 Salem, New Hampshire



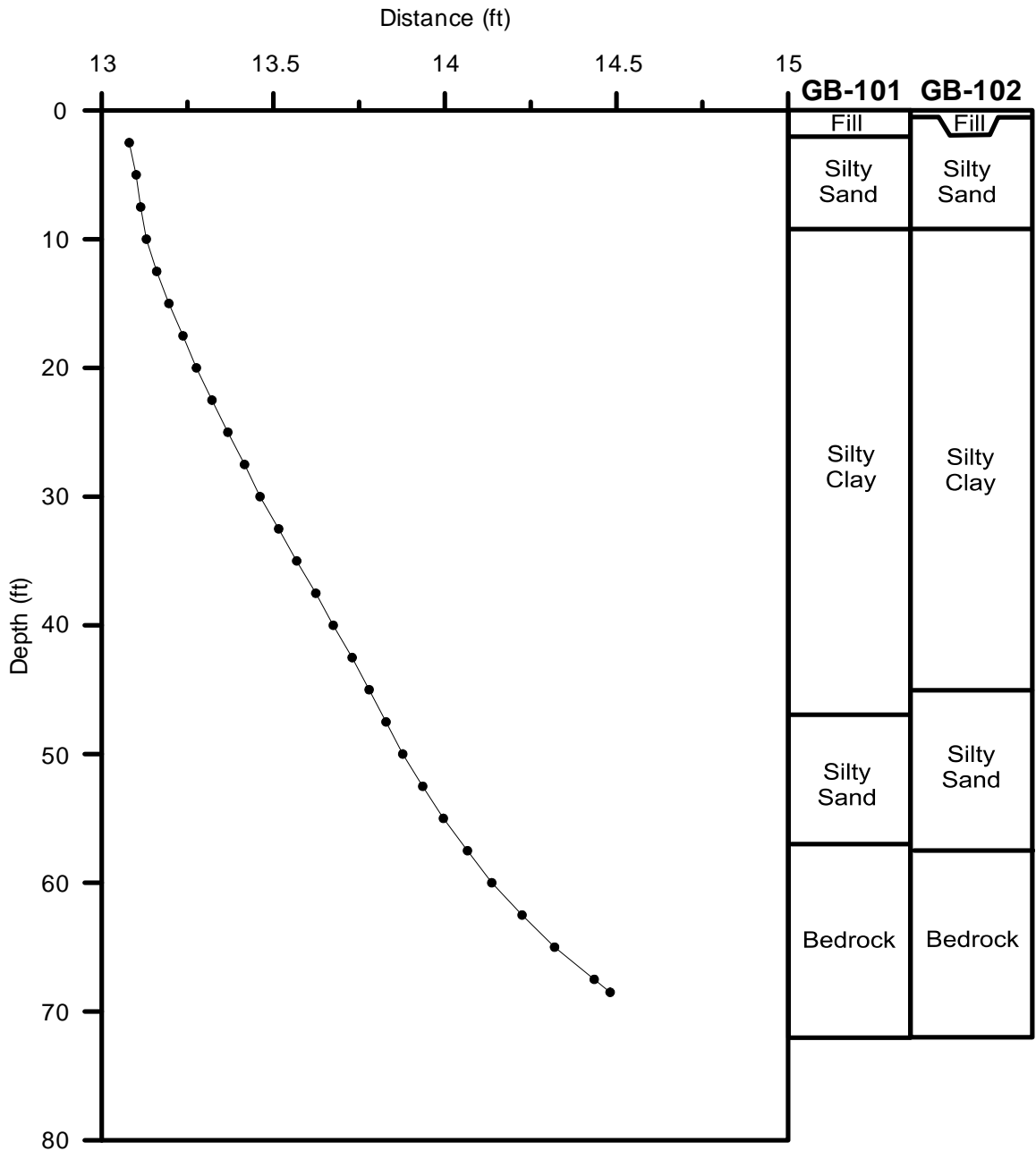
Photograph showing crosshole seismic testing setup. View to the northeast. The downhole source is located in borehole GB-102 (white casting with blue air hose in foreground, bottom left). The downhole geophone is located in borehole GB-101 (white casting with pink ribbon, center left). Both seismic source and geophone are connected via cables (not seen) to the seismograph, located in the back of the truck. The partially completed access road to the site is in the background.

Figure 4
Site Photo
Lot 4 – Portland Technology Park
Portland, Maine

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Salem, New Hampshire



NOTE:

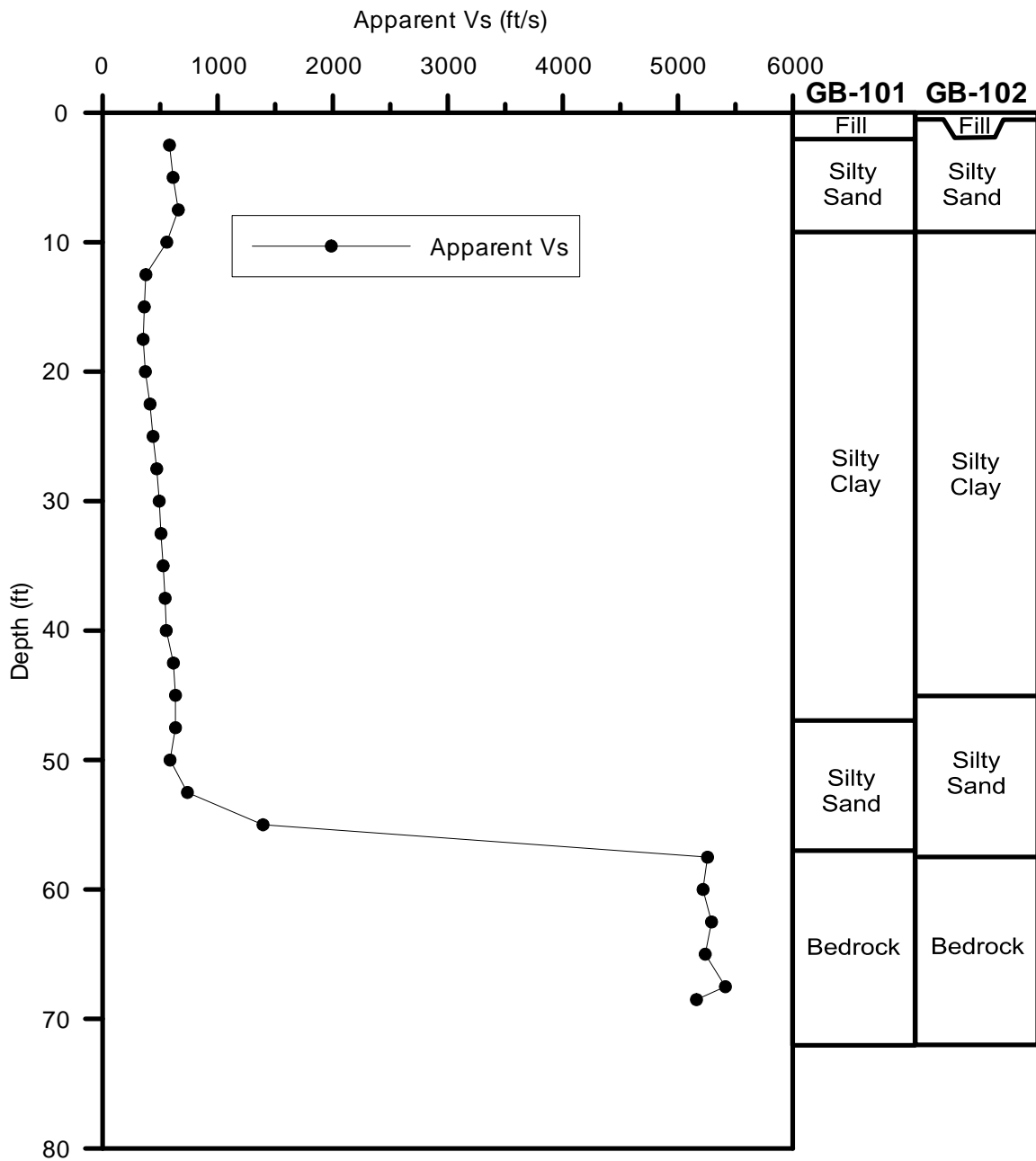
The general geologic log taken from log for boreholes GB-101 & GB-102, provided by R.W. Gillespie & Associates,

Figure 5
Distance Between Boreholes
Lot 4 – Portland Technology Park
Portland, Maine

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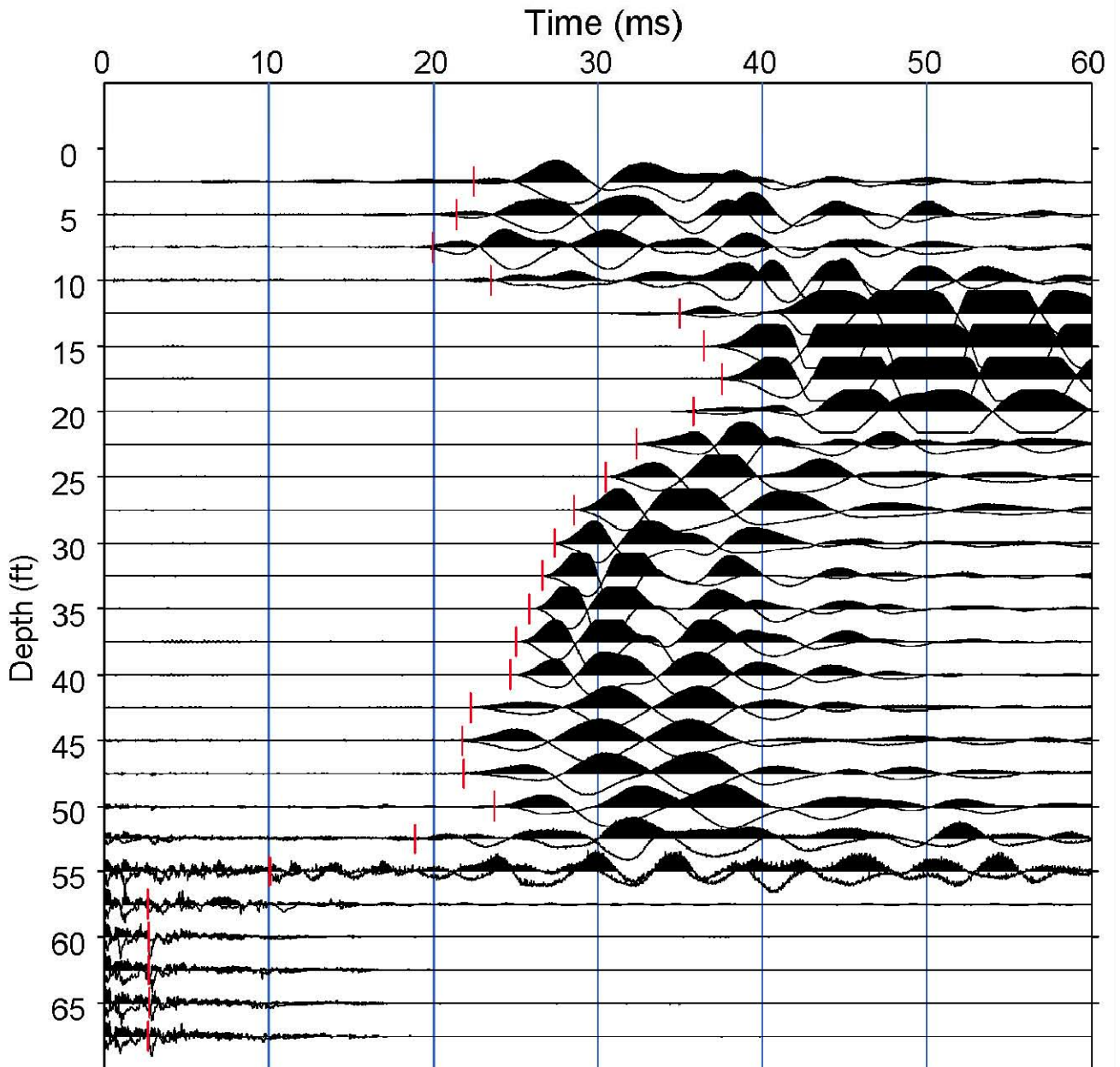


NOTE:

The general geologic log taken from log for boreholes GB-101 & GB-102, provided by R.W. Gillespie & Associates,

Figure 6
 Apparent Velocity of Shear Waves
 Lot 4 – Portland Technology Park
 Portland, Maine

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NOTES:

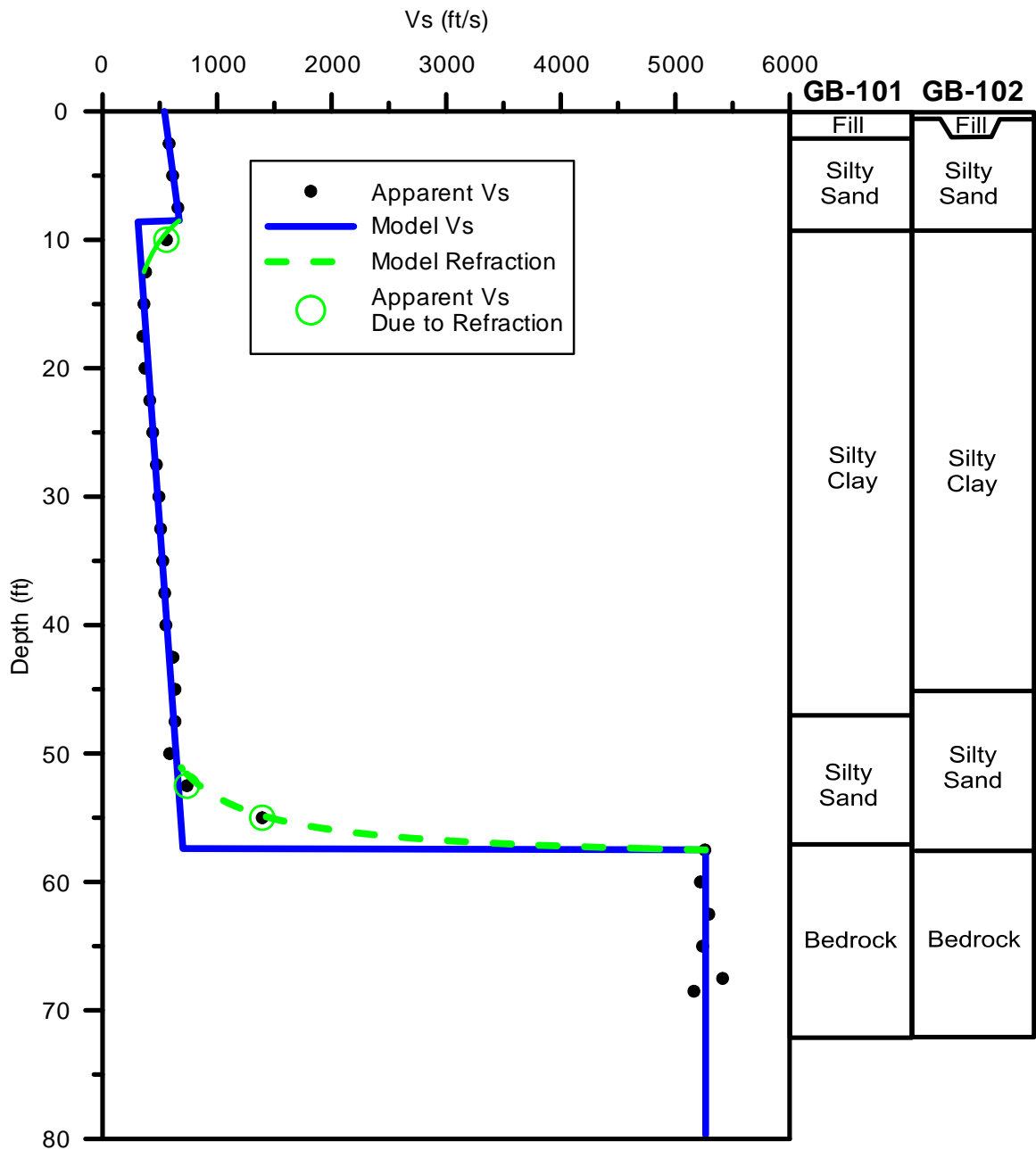
1. Seismic signal generated with a downhole hammer source.
2. Seismic signal detected with a downhole triaxial geophone receiver.
3. Downhole source and receiver positioned at same depth for each seismogram.
4. Superimposed seismograms for each depth represent opposite stacking polarity.
5. Composite seismograms assembled from horizontal component of triaxial geophone.
6. The short red lines mark the initial arrivals of shear waves.

Figure 7
 Composite Seismogram
 Lot 4 – Portland Technology Park
 Portland, Maine

File 15J69

October, 2015

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 Salem, New Hampshire



NOTES:

1. The parameters for the model velocity line are reported in Table 2.
2. Bedrock depth reported in boring logs was used.
3. The general geologic log taken from log for boreholes GB-101 & GB-102, provided by R.W. Gillespie & Associates,

Figure 8
 Model Velocity of Shear Waves
 Lot 4 – Portland Technology Park
 Portland, Maine

File 15J69

October, 2015

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 Salem, New Hampshire

Crosshole Seismic Testing
Lot 4 - Portland Technology Park
Portland, Maine
File 15J69 October, 2015

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APPENDICES

Crosshole Seismic Testing
Lot 4 - Portland Technology Park
Portland, Maine
File 15J69 October, 2015

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APPENDIX 1

BORING LOGS
GB-101 and GB-102



R.W. Gillespie & Associates, Inc.
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Boring Log: GB-101

Total Depth (ft): 72

Sheet 1 of 3

Project Name: Prop. Patrons Oxford Ins. Office Bldg.
 RWG&A Project No. 1518-002
 Location: Portland, Maine
 Client: Patrons Oxford Insurance
 RWG&A Representative: C. Morrell
 Boring Location: See Exploration Location Plan
 Boring Abandonment Method: Installed Solid Casing
 Observed Water Depth: 7'

Drilling Contractor: Great Works Test Boring
 Drill Rig: CME850
 Driller Rep.: Jeff Lee
 Date Started: 09/17/2015
 Date Completed: 09/17/2015
 Surface Elevation: 67 (Feet)
 Drilling Method: Drive and Wash
 Casing Type: 4" Steel

DEPTH, FT.	SYMBOL SAMPLES	SAMPLE NUMBER	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N BLOWS PER FT.	MOISTURE CONTENT %	LAB TESTS
0			FILL; BARK MULCH (3 inches).					
			FILL, Silty sand, moist, fine sand, some silt, trace medium sand, bluish gray.					
			SILTY SAND (SM); Moist to wet, fine sand, some silt, grayish brown.					
5								
10			SILTY CLAY (CL); Silty clay, gray.					
15								
20								
25								

Notes: Installed 3-inch inside diameter, close ended, Schedule 40 PVC casing in completed borehole. Casing was grouted into place using a cement-bentonite mixture. Casing filled with potable water.



Project Name: Prop. Patrons Oxford Ins. Office Bldg.
 Location: Portland Maine
 Client: Patrons Oxford Insurance
 Observed Water Depth: 7'

RWG&A Project No. 1518-002
 Surface Elevation: 67 (Feet)
 Casing Type: 4" Steel

DEPTH, FT.	SYMBOL SAMPLES	SAMPLE NUMBER	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N BLOWS PER FT.	MOISTURE CONTENT %	LAB TESTS
30								
35								
40								
45								
50		S-1	SILTY SAND (SM); Medium dense, wet, fine to medium sand, some silt, few gravel and coarse sand, gray.	11	4 7 4 3	11		
55			Bedrock encountered at 57', roller cone drilled to 72'.					

Notes: Installed 3-inch inside diameter, close ended, Schedule 40 PVC casing in completed borehole. Casing was grouted into place using a cement-bentonite mixture. Casing filled with potable water.



R.W. Gillespie & Associates, Inc.
 Geotechnical Engineering • Geohydrology • Materials Testing Services


Boring Log: GB-101

Total Depth: 72

Sheet 3 of 3

Project Name: Prop. Patrons Oxford Ins. Office Bldg.
 Location: Portland Maine
 Client: Patrons Oxford Insurance
 Observed Water Depth: 7'

RWG&A Project No. 1518-002
 Surface Elevation: 67 (Feet)
 Casing Type: 4" Steel

DEPTH, FT.	SYMBOL SAMPLES	SAMPLE NUMBER	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N BLOWS PER FT.	MOISTURE CONTENT %	LAB TESTS
60			Bedrock.					
65 70 75 80 85			Bottom of Exploration at 72'; Terminated boring 15' into rock.					

Notes: Installed 3-inch inside diameter, close ended, Schedule 40 PVC casing in completed borehole. Casing was grouted into place using a cement-bentonite mixture. Casing filled with potable water.



Project Name: Prop. Patrons Oxford Ins. Office Bldg.
 RWG&A Project No. 1518-002
 Location: Portland, Maine
 Client: Patrons Oxford Insurance
 RWG&A Representative: C. Morrell
 Boring Location: See Exploration Location Plan
 Boring Abandonment Method: Installed Solid Casing.
 Observed Water Depth: 7'

Drilling Contractor: Great Works Test Boring
 Drill Rig: CME850
 Driller Rep.: Jeff Lee
 Date Started: 09/18/2015
 Date Completed: 09/18/2015
 Surface Elevation: 67 (Feet)
 Drilling Method: Drive and Wash
 Casing Type: 4" Steel

DEPTH, FT.	SYMBOL SAMPLES	SAMPLE NUMBER	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N BLOWS PER FT.	MOISTURE CONTENT %	LAB TESTS
0			TOPSOIL AND ORGANIC MATERIAL (4 inches). SILTY SAND (SM); Moist, fine sand, some silt, grayish brown.					
5								
10			SILTY CLAY (CL); Medium stiff to soft, silty clay, gray.					
15								
20		FV	Field Vane: Undrained Shear Strength: Su=480 psf, residual 50 psf.					
20		FV	Field Vane: Undrained Shear Strength: Su=490 psf, residual 40 psf.					
25								

Notes: 1. Used 3 5/8"x9" Acker field vane for shear strength testing.
 2. Installed 3-inch inside diameter, close ended, Schedule 40 PVC casing in completed borehole. Casing was grouted into place using a cement-bentonite mixture. Casing filled with potable water.



Project Name: Prop. Patrons Oxford Ins. Office Bldg.
 Location: Portland Maine
 Client: Patrons Oxford Insurance
 Observed Water Depth: 7'

RWG&A Project No. 1518-002
 Surface Elevation: 67 (Feet)
 Casing Type: 4" Steel

DEPTH, FT.	SYMBOL SAMPLES	SAMPLE NUMBER	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N BLOWS PER FT.	MOISTURE CONTENT %	LAB TESTS
30		FV	Field Vane: Undrained Shear Strength: Su=490 psf, residual 50 psf.					
		FV	Field Vane: Undrained Shear Strength: Su=550 psf, residual 40 psf.					
35								
40		FV	Field Vane: Undrained Shear Strength: Su=640 psf, residual 20 psf.					
		FV	Field Vane: Undrained Shear Strength: Su=520 psf, residual 0 psf.					
45								
50			SILTY SAND (SM); Fine to medium sand, some silt, few gravel and coarse sand, gray.					
55								
			Bedrock encountered at 57.5 feet, roller cone drilled to 72'.					

Notes: 1. Used 3 5/8"x9" Acker field vane for shear strength testing.
 2. Installed 3-inch inside diameter, close ended, Schedule 40 PVC casing in completed borehole. Casing was grouted into place using a cement-bentonite mixture. Casing filled with potable water.



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 Location: Portland Maine
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RWG&A Project No. 1518-002
 Surface Elevation: 67 (Feet)
 Casing Type: 4" Steel

DEPTH, FT.	SYMBOL SAMPLES	SAMPLE NUMBER	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N BLOWS PER FT.	MOISTURE CONTENT %	LAB TESTS
60			Bedrock.					
65								
70								
75			Bottom of Exploration at 72'; Terminated boring 14.5' into rock.					
80								
85								

Notes: 1. Used 3 5/8"x9" Acker field vane for shear strength testing.
 2. Installed 3-inch inside diameter, close ended, Schedule 40 PVC casing in completed borehole. Casing was grouted into place using a cement-bentonite mixture. Casing filled with potable water.

Crosshole Seismic Testing
Lot 4 - Portland Technology Park
Portland, Maine
File 15J69 October, 2015

HAGER-RICHTER
GEOSCIENCE, INC.

APPENDIX 2
DEVIATION DATA

HAGER-RICHTER GEOSCIENCE, INC.

8 Industrial Way - D10
Salem, NH 03079
Phone: 603-893-9944
Fax: 603-893-8313

BOREHOLE DEVIATION LOGS

DATE LOGGED:

September 24, 2015

CLIENT: RW Gillespie and Associates, INC

H-R FILE: 15J69

PROJECT: Lot 4 - Portland Technology Park

LOG DATUM: Ground Surface

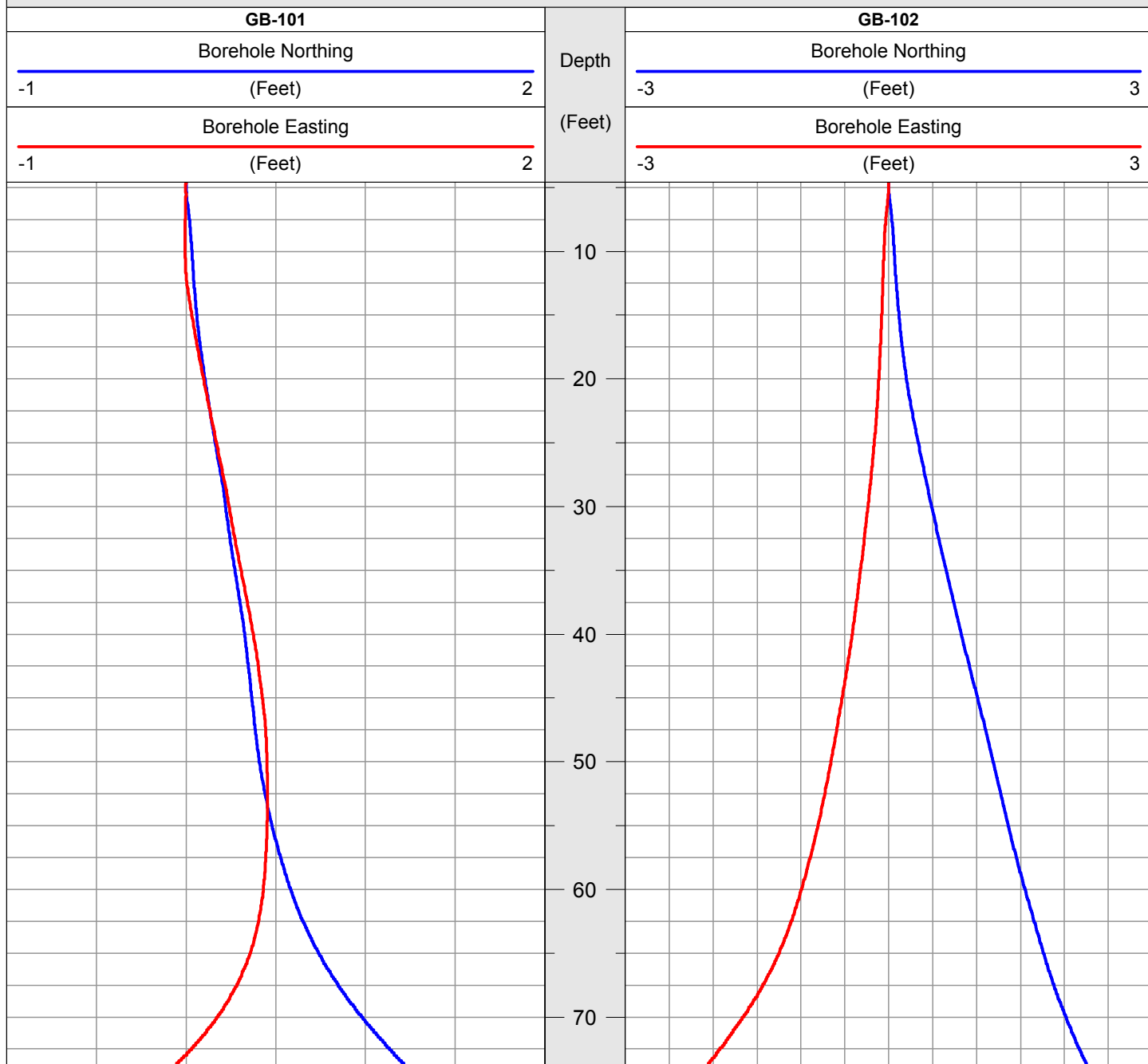
LOCATION: Portland Technology Park

ORIENTATION REFERENCE: Magnetic North

CITY, STATE: Portland, Maine

LOGGING GEOPHYSICISTS: Michael Howley

Borehole Deviation Logs



SECTION 03 30 00 – CAST -IN-PLACE CONCRETE

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. The drawings and general conditions of the contract including General and Supplementary Conditions and other Division 1 Specification sections apply to work of this section.
- B. Examine all other sections of the Specifications for requirements which affect work of this Section whether or not such work is specifically mentioned in this Section.
- C. Coordinate work with that of all trades affecting or affected by work of this Section. Cooperate with such trades to assure the steady progress of all work under the Contract.

1.02 DESCRIPTION OF WORK:

- A. Work included: Provide labor, materials, and equipment necessary to complete the work of this Section and, without limiting the generality thereof, furnish and include the following:
 - 1. The extent of cast-in-place concrete work is shown on drawings and includes (but not by way of limitation) formwork, reinforcing, cast-in-place concrete, accessories, finishing, and casting in of items specified under other Sections of the Specifications or furnished by Owner that are required to be built-in with the concrete.
 - 2. Equipment support pads indicated on mechanical drawings to be installed by the Building Contractor.
 - 3. Cast-in-place retaining walls, exterior slabs on grade and other concrete shown on site drawings.

1.03 RELATED WORK:

- A. Metal Fabrications: Section 05 50 00
 - 1. Expansion Anchors - Section 05 12 00
 - 2. Embedded Items - Section 05 50 00
- B. Anchor Bolts: Section 05 12 00
- C. Joint Sealants: Section 07 90 00

D. Underslab Vapor Retarders/Wall Waterproofing: Division 7

1.04 QUALITY ASSURANCE:

A. Codes and Standards: Comply with provisions of the latest edition of the following except where more stringent requirements are shown or specified:

1. ACI "Manual of Concrete Practice".
2. ACI 117 "Standard Specifications for Tolerances for Concrete Construction and Materials".
3. ACI 211.1 "Standard Practice for Selecting Proportions for Normal, Heavyweight and Mass Concrete."
4. ACI 212.3R "Chemical Admixtures for Concrete."
5. ACI 301 "Specifications for Structural Concrete for Buildings."
6. ACI 302.1R "Guide for Concrete Floor and Slab Construction."
7. ACI 304R "Guide for Measuring, Mixing, Transporting and Placing Concrete."
8. ACI 304.2R "Placing Concrete by Pumping Methods."
9. ACI 306 R "Cold Weather Concreting."
10. ACI 308 "Standard Practice for Curing Concrete."
11. ACI 309R "Guide for Consolidation of Concrete."
12. ACI 315 "ACI Detailing Manual."
13. ACI 318 "Building Code Requirements for Reinforced Concrete."
14. ACI 347R "Guide to Formwork for Concrete."
15. Concrete Reinforcing Steel Institute, "Placing Reinforcing Bars."
16. AISC "Code of Standard Practice for Steel Buildings and Bridges."
17. "Code of Federal Regulations, Part 1926" per the Occupational Safety and Health Administration (OSHA), Department of Labor (Latest Revision).

- B. Materials and installed work may require testing and retesting, as directed by the Architect, at any time during progress of work. Allow free access to material stockpiles and facilities. Tests not specifically indicated to be done at Owner's expense, including retesting of rejected materials and installed work, shall be done at Contractor's expense.

1.05 SUBMITTALS:

- A. Unless otherwise specified, submittals required in this section shall be submitted for review. Submittals shall be prepared and submitted in accordance with Division 1.
- B. General Contractor shall submit a Submittal Schedule to the engineer within 30 days after they have received the Owner's Notice to Proceed.
- C. All submittals shall be reviewed and returned to the Architect within 10 working days.
- D. Incomplete submittals will not be reviewed.
- E. Submittals not reviewed by the General Contractor prior to submission to the Engineer will not be reviewed. Include on the submittal statement or stamp of approval by Contractor, representing that the Contractor has seen and examined the submittal and that all requirements listed in this Section and Division 1 have been complied with.
- F. Engineer will review submittals a maximum of two review cycles as part of their normal services. If submittals are incomplete or otherwise unacceptable and re-submitted, General Contractor shall compensate Engineer for additional review cycles.
- G. Hardcopy Submittals: Submit three prints. Prints will be reviewed by the Engineer, and then the Architect. One marked print will be returned to Contractor for printing and distribution. Multiple copies will not be marked by the Engineer.
- H. Electronic Submittals:
 - 1. Contractor shall include in the submittal schedule an indication of submittals that are intended to be submitted electronically. Upon receipt of the submittal schedule, the Engineer reserves the right to indicate submittals that will not be accepted electronically. Paper copies of such submittals shall be furnished as referenced in this specification.

2. The Engineer reserves the right to require paper copies of submittals that are received electronically. Provide Engineer one (1) paper copies in addition to the electronic submittal. Paper copy will be retained and electronic copy will be returned. Review cycle for such submittals shall not commence until such time that the paper copies are received.
 3. Electronic Submittals shall be submitted in Protected Document Format (PDF) compatible with Bluebeam version 12 or later. Electronic files shall not be broken into smaller individual files. File sizes too large to process email or within a file transfer protocol (FTP) site shall be provided on a CD.
 4. The submission of submittals electronically does not relieve the contractor of their responsibility to review the submittal prior to transmission to the Engineer. Electronic Submittals shall include contractor comments, and a statement and/or stamp of approval by Contractor, representing that the Contractor has seen and examined the submittal and that all requirements listed in this Section and Division 1 have been complied with. Electronic submittals without the Contractor's approval will be rejected and returned.
 5. The Engineer assumes no responsibility for the printed reproduction of submittals reviewed electronically, transmission errors or returned electronic submittals that become corrupted or are otherwise not accessible by the Contractor's or Subcontractor's computer hardware and/or software.
- I. Product Data: Submit producer's or manufacturer's specifications and installation instructions for the following products. Include laboratory test reports and other data to show compliance with specifications (including specified standards).
1. Reinforcement certified mill reports covering chemical and physical properties and yield strength.
 2. Patching products.
 3. Non-shrink grout.
 4. Curing compounds, where applicable.
 5. Admixtures.
 6. Expansion/Adhesive Anchors.

J. Shop Drawings:

1. Shop Drawing Preparation: Electronic files of structural drawings will not be provided to the contractor for preparation of shop drawings. Reproduction of any portion of the Construction Documents for use as Shop drawings is prohibited. Shop drawings created from reproduced Construction Documents will be returned without review. Submit shop drawings for fabrication, bending and placement of concrete reinforcement. Comply with ACI 315, showing bar schedules, stirrup and tie spacing, diagrams of bent bars, and arrangement of concrete reinforcement. Include special reinforcement required at openings through concrete elements. Include supplemental reinforcing and bar supports necessary to support reinforcing steel at proper location within forms or slabs.
 - a. Review of the shop drawings will be made for the size and arrangement of reinforcement. Conformance of the Shop Drawings to the Contract Drawings remains the responsibility of the General Contractor. Engineer's review in no way relieves the General Contractor of this responsibility.
 - b. Shop drawings will not be reviewed as partial submittals. A complete submittal shall be provided all items listed prior. **Incomplete submittals will not be reviewed.**
- K. Mix designs: Submit all laboratory test reports and materials for each mix design listed within. Prepare mixes by the field experience method and/or trial mixtures per the requirements of chapter 5 of ACI 318. Include the calculation of average strength and standard deviation. Proportioning by water cement ratio method will not be permitted.
- L. Samples: Submit samples of materials as specified and as otherwise requested by Architect, including names, sources and descriptions.
- M. Curing Methods: Submit documentation of curing methods to be used for review. Account for anticipated project temperature ranges and conditions in curing methods.
- N. Contraction/Construction Joints: Submit plan indicating proposed location of contraction and construction joints in walls and slabs.
- O. Test Reports: Test reports shall be submitted to the Owner, Architect and Engineer within 48 hour after completion of each test.

PART 2 PRODUCTS

2.01 FORM MATERIALS:

CAST-IN-PLACE CONCRETE

03 30 00 - 5

- A. Forms for Exposed Finish Concrete: Unless otherwise indicated, construct formwork for exposed concrete surfaces with plywood, metal, metal-framed plywood faced or other acceptable panel-type materials, to provide continuous, straight, smooth, exposed surfaces. Furnish in largest practicable sizes to minimize number of joints and to conform to joint system shown on drawings. Provide form material with sufficient thickness to withstand pressure of newly-placed concrete without bow or deflection.
1. Use plywood complying with U.S. Product Standard PS-1 "B-B (Concrete Form) Plywood", Class I, Exterior Grade or better, mill-oiled and edge-sealed, with piece bearing legible inspection trademark.
- B. Forms for Unexposed Finish Concrete: Form concrete surfaces which will be unexposed in finished structure with plywood, lumber, metal or other acceptable material. Provide lumber dressed on at least 2 edges and one side for tight fit.
- C. Form Coatings: Provide commercial formulation form-coating compounds that will not bond with, stain nor adversely affect concrete surfaces, and will not impair subsequent treatments of concrete surfaces.

2.02 REINFORCING MATERIALS:

- A. Reinforcing Bars: ASTM A 615, Grade 60, deformed.
- B. Welded Wire Fabric: ASTM A 185, welded steel wire fabric. Provide welded wire fabric in flat sheets.
- C. Supports for Reinforcement: Provide supports for reinforcement including bolsters, chairs, spacers, and other devices for spacing, supporting and fastening reinforcing bars and welded wire fabric in place. Use plastic, wire bar type supports or concrete block supports complying with CRSI recommendations, unless otherwise specified. Wood, clay brick and other unspecified devices are not acceptable.
1. For slabs-on-grade, use supports with sand plates or horizontal runners where base material will not support chair legs.
 2. For exposed-to-view concrete surfaces, where legs of supports are in contact with forms, provide supports with legs which are plastic protected (CRSI, Class I) or stainless steel protected (CRSI, Class 2).

2.03 CONCRETE MATERIALS:

- A. Single-Source Supplier: Ready-mix concrete shall be from one supplier unless specific written approval is received from the Structural Engineer.

- B. Portland Cement: ASTM C 150, Type I or Type II, unless otherwise approved Use one brand of cement throughout project, unless otherwise acceptable to Architect.
- C. Normal Weight Aggregates: ASTM C 33. Provide from a single source for exposed concrete. Do not use aggregates containing soluble salts or other substances such as iron sulfides, pyrite, marcasite, or ochre which can cause stains on exposed concrete surfaces.
- D. Light Weight Aggregates: ASTM C 330.
- E. Water: Potable.
- F. Air-Entraining Admixture: ASTM C 260.
- G. High-Range Water-Reducing Admixture (Super Plasticizer): ASTM C 494, Type F or Type G containing not more than 1% chloride ions.
- H. Fiber reinforcement shall be Type III Synthetic Virgin Homopolymer Polypropylene Fibers conforming to ASTM C1116. Fiber reinforcing shall be added and distributed prior to incorporation of Super Plasticizer.
- I. Normal range water reducing admixture: ASTM C 494 Type A containing no calcium chloride.
- J. Accelerating Admixture: ASTM C 494, Type C or E.
- K. Blast Furnace Slag: ASTM C989
- L. Fly Ash: ASTM C618, Class C or F
- M. Calcium Chloride is not permitted.

2.04 RELATED MATERIALS:

- A. Underslab Vapor Retarder: Provide vapor retarder over prepared sub base. Refer to architectural drawings, geotechnical report and/or division 7 specifications for additional requirements and vapor retarder location.
- B. Non-Shrink Cement-based Grout: Provide grout consisting of pre-measured, prepackaged materials supplied by the manufacturer requiring only the addition of water. Manufacturer's instructions must be printed on the outside of each bag.
 - 1. Non-shrink: No shrinkage (0.0%) and a maximum 4.0% expansion when tested in accordance with ASTM C-827. No shrinkage (0.0%) and a maximum of 0.3% expansion in the hardened state when tested in accordance with CRD-C-621.

2. Compressive strength: A minimum 28 day compressive strength of 5000 psi when tested in accordance with ASTM C-109.
 3. Setting time: A minimum initial set time of 60 minutes when tested in accordance with ASTM C-191.
 4. Composition: Shall not contain metallic particles or expansive cement.
- C. Absorptive Cover: Burlap cloth made from jute or kenaf, weighing approximately 9 oz. per sq. yd., complying with AASHTO M182, Class 2.
- D. Moisture-Retaining Cover: One of the following, complying with ANSI/ASTM C 171.
1. Waterproof paper.
 2. Polyethylene film.
 3. Polyethylene-coated burlap.
- E. Liquid Membrane-Forming Curing Compound: Liquid type membrane forming curing compound complying with ASTM C 309, Type I, Class A unless other type acceptable to Architect. Curing compound shall not impair bonding of any material, including floor finishes, to be applied directly to the concrete. Demonstrate the non-impairment prior to use.
- F. Preformed Expansion Joint Formers:
1. Bituminous Fiber Type, ASTM D 1751.
 2. Felt Void, Poly-Styrene Cap with removable top as manufactured by SUPERIOR.
- G. Slab Joint Filler: Multi-component polyurethane sealant (self-leveling type).
- H. Waterstops shall be Bentonite/Butyl Rubberbased product. Use in conjunction with manufacturer's approved mastic. Acceptable products include:
1. "Waterstop Rx," by American Colloid Co.
 2. "Adeka Ultra Seal MC-2010," by Asahi Denka Koeyo, Kik MN.

2.05 PROPORTIONING AND DESIGN OF MIXES:

- A. Prepare design mixes for each type and strength of concrete by either laboratory trial batch or field experience methods as specified in ACI 318. Use material, including all admixtures, proposed for use on the project. If trial batch method used, use an independent testing facility acceptable to Architect for preparing and reporting proposed mix designs. The testing facility shall not be the same as used for field quality control testing unless otherwise acceptable to Architect.
- B. Submit written reports to Architect of each proposed mix for each class of concrete. Do not begin concrete production until mixes have been reviewed by Architect.
- C. Proportion design mixes to provide concrete with the following properties:
 1. Footings and foundation walls
 - a. Strength: 3,500 psi at 28 days.
 - b. Aggregate: 3/4"
 - c. W/C Ratio: 0.55 maximum
 - d. Entrained Air: 6% +/- 1.5%
 - e. Slump: 4" maximum
 2. Interior Slabs on grade:
 - a. Strength: 3,000 psi at 28 days
 - b. Aggregate: 3/4" minimum, 1 1/2" maximum.
 - c. W/C Ratio: 0.54 maximum
 - d. Entrapped Air only (no entrainment), 2.5% +/- 1%
 - e. Slump: 4" maximum
 3. Exterior Slabs and all other exposed Site Concrete not specified elsewhere:
 - a. Strength: 5,000 psi at 28 days
 - b. Aggregate: 3/4"
 - c. W/C Ratio: 0.40 maximum
 - d. Entrained Air: 6% +/- 1.5%

- e. Slump: 4" maximum
 - 4. Add air entraining admixture at manufacturers prescribed rate to result in concrete at point of placement having the above noted air contents.
 - 5. Additional slump may be achieved by the addition of a mid-range or high-range water reducing admixture. Maximum slump after the addition of admixture shall be 6 or 8 inches for mid-range or high range water reducing admixtures, respectively.
- D. Adjustment to Concrete Mixes: Mix design adjustments may be requested by Contractor, when characteristics of materials, job conditions, weather, test results, or other circumstances warrant, at no additional cost to Owner and as accepted by Architect. Laboratory test data for revised mix design and strength results must be submitted to and accepted by Structural Engineer before using in work.
- 1. Water may be added at the project only if the maximum specified slump and design mix maximum water/cement ratio is not exceeded.
 - 2. Additional dosages of superplasticizer should be used when delays occur and required slump has not been maintained. A maximum of two additional dosages will be permitted per ACI 212.3R recommendations.

2.06 CONCRETE MIXING:

- A. Job-Site Mixing will not be permitted.
- B. Ready-Mix Concrete: Must comply with the requirements of ASTM C 94, and as herein specified. Provide batch ticket for each batch discharged and used in work, indicating project name, mix type, mix time and quantity.
 - 1. During hot weather, or under conditions contributing to rapid setting of concrete, a shorter mixing time than specified in ASTM C94 may be required by Structural Engineer.
 - 2. When the air temperature is between 85 degrees F. and 90 degrees F., reduce the mixing and delivery time from 1 1/2 hours to 75 minutes, and when the air temperature is above 90 degrees F., reduce the mixing and delivery time to 60 minutes.

PART 3 EXECUTION

3.01 FORMS:

- A. Design, erect, support, brace and maintain formwork to support vertical and lateral loads that might be applied until such loads can be supported by concrete structure. Construct formwork so concrete members and structures are of correct size, shape, alignment, elevation and position.
- B. Design, construct, erect, maintain, and remove forms for cast-in-place concrete work in compliance with ACI 347.
- C. Design formwork to be readily removable without impact, shock or damage to cast-in-place concrete surfaces and adjacent materials.
- D. Construct forms to sizes, shapes, lines and dimensions shown, and to obtain accurate alignment, location, grades, level and plumb work in finished structures. Provide for openings, offsets, keyways, recesses, moldings, rustications, reglets, chamfers, blocking, screeds, bulkheads, anchorages and inserts, and other features required in work. Use selected materials to obtain required finishes. Solidly butt joints and provide backup at joints to prevent leakage of cement paste.
- E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush plates or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces where slope is too steep to place concrete with bottom forms only. Kerf wood inserts for forming keyways, dovetail slots, reglets, recesses, and the like to prevent swelling and for easy removal.
- F. Provide temporary openings where interior area of formwork is inaccessible for clean out, for inspection before concrete placement and for placement of concrete. Securely brace temporary openings and set tightly to forms to prevent loss of concrete mortar. Locate temporary openings on forms at inconspicuous locations.
- G. Chamfer exposed corners and edges as indicated, using wood, metal, PVC or rubber chamfer strips fabricated to produce uniform smooth lines and tight edge joints.
- H. Form Ties: Factory-fabricated, adjustable-length, removable or snap-off metal form ties, designed to prevent form deflection, and to prevent spalling concrete surfaces upon removal.
 - 1. Unless otherwise indicated, provide ties for concrete surfaces to be exposed to view in the final condition so portion remaining within concrete after removal is 1" (minimum) inside concrete.

2. Form ties shall not leave holes larger than 1" diameter in concrete surface. Repair holes left by form ties after removal of formwork.
- I. Provision for Other Trades: Provide openings in concrete formwork to accommodate work of other trades. Determine size and location of openings, recesses, and chases from trades providing such items. Accurately place and securely support items built into forms.
 - J. Cleaning and Tightening: Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt or other debris just before concrete is placed. Retighten forms and bracing after concrete placement as required to eliminate mortar leaks and maintain proper alignment.

3.02 PLACING REINFORCEMENT:

- A. Comply with Concrete Reinforcing Steel Institute's recommended practice for "Placing Reinforcing Bars", for details and methods of reinforcement placement and supports, and as herein specified.
 1. Subgrade tolerance shall conform to a tolerance of $+0/-1 \frac{1}{2}$ ". Base tolerance (fine grading) for slabs shall conform to a tolerance of $+0''/-\frac{3}{4}$ " in. Confirm compliance of above tolerances with surveyed measurements taken at 20 ft. intervals in each direction.
 2. Clean reinforcement of loose rust and mill scale, earth, ice, and other materials which reduce or destroy bond with concrete.
 3. Accurately position, support and secure reinforcement against displacement by formwork, construction, or concrete placement operations. Locate and support reinforcing by metal chairs, runners, bolsters, spacers and hangers, as required.
 4. Place reinforcement to obtain specified coverage for concrete protection within tolerances of ACI-318. Arrange, space and securely tie bars and bar supports to hold reinforcement in position during concrete placement operations. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.
 5. Install welded wire fabric in flat sheets in as long lengths as practicable. Lap adjoining pieces at least one full mesh and lace splices with wire. Offset end laps in adjacent widths to prevent continuous laps in either direction.

3.03 JOINTS:

- A. Construction Joints: Locate and install construction joints, which are not shown on drawings, so as not to impair strength and appearance of the structure, as acceptable to Architect. Submit plan indicating proposed location of construction joints for review prior to beginning work.
1. Provide keyways at least 1-1/2" deep in construction joints in walls, and slabs; bulkheads reviewed by the Engineer, designed for this purpose may be used for slabs.
 2. Roughened surfaces shall be used between walls and footings unless shown otherwise on the drawings. The footing surface shall be roughened to at least an amplitude of 1/4" for the width of the wall before placing the wall concrete.
 3. Place construction joints perpendicular to the main reinforcement. Continue reinforcement across construction joints.
 4. Joints in slabs on grade shall be located and detailed as indicated on the drawings. If saw-cut joints are required, the early-entry dry-cut process shall be used. Refer to ACI 302, section 8.3.12.

3.04 INSTALLATION OF EMBEDDED ITEMS:

- A. General: Set, securely anchor and build into work prior to concrete placement all anchorage devices and all other embedded items, including but not by limitation reinforcement, reinforcing dowels, embedded plates, anchor rods, anchor inserts, sleeves, load transfer plates, diamond dowels and shelf bulk heads required for other work that is attached to, bear upon, or supported by, cast-in-place concrete. Use setting drawings, diagrams, instructions and directions provided by suppliers of items to be attached thereto. Notify other trades to permit installation of their work. Templates to be utilized for setting of anchorage devices shall be constructed in a manner to allow mechanical consolidation of concrete without disturbance. Embedments shall be placed in a timely fashion to permit the inspection of embedments prior to concrete placement. **“Wet Setting” of embedded items into plastic concrete is strictly prohibited.**
- B. Edge Forms and Screed Strips for Slabs: Set edge forms or bulkheads and intermediate screed strips for slabs to obtain required elevations and contours in finished slab surface.
- C. Provide PVC sleeves where pipes and/or conduit pass through exterior concrete or slabs. Sleeves or penetrations shall not be placed through footings, piers, pedestals, drop caps, columns or pilasters unless specifically noted.

- D. Tolerances: Tolerances for Anchor Bolts/Rods, other embedded items and bearing surfaces shall meet the requirement set forth in the latest edition of the American Institute of Steel Construction "Code of Standard Practice for Steel Buildings and Bridges," and ACI 117. The more stringent criteria from these documents shall apply.

3.05 INSTALLATION OF GROUT

- A. Place grout for base plates in accordance with manufacturer's recommendations.
- B. Grout below setting plates as soon as practicable to facilitate erection of steel and prior to removal of temporary bracing and guys. If leveling bolts or shims are used for erection grout shall be installed prior to addition of any column load.
- C. Pack grout solidly between bearing surfaces and bases or plates to ensure that no voids remain. Finish exposed surfaces, protect installed materials and allow to cure. For proprietary grout materials, comply with manufacturer's instructions.

3.06 PREPARATION OF FORM SURFACES:

- A. Coat contact surfaces of forms with a form-coating compound before reinforcement is placed.
- B. Thin form-coating compounds only with thinning agent of type, and in amount, and under conditions of form-coating material manufacturer's directions. Do not allow excess form coating to accumulate in forms or to come into contact with concrete surfaces against which fresh concrete will be placed. Apply in compliance with manufacturer's instructions.

3.07 CONCRETE PLACEMENT:

- A. Preplacement Review: Footing bottoms are subject to review by the Geotechnical Engineer. Reinforcement and all concrete preparation work shall be subject to review by the Structural Engineer. Verify that reinforcing, ducts, anchors, seats, plates and other items cast into concrete are placed and securely held. Notify Engineer and Project Special Inspector 48 hours prior to scheduled placement and obtain approval or waiver of review prior to placement. Be sure that all debris and foreign matter is removed from forms.
- B. Concrete shall be placed in the presence of an approved testing agency.
- C. General: Comply with ACI 304, and as herein specified.

1. Deposit concrete continuously or in layers of such thickness that no concrete will be placed on concrete which has hardened sufficiently to cause the formation of seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as herein specified. Deposit concrete as nearly as practicable to its final location to avoid segregation due to rehandling or flowing.
2. Concrete shall be handled from the mixer to the place of final deposit as rapidly as practicable by methods which will prevent segregation or loss of ingredients and in a manner which will assure that the required quality of the concrete is maintained.
3. Conveying equipment shall be approved and shall be of a size and design such that detectable setting of concrete shall not occur before adjacent concrete is placed. Conveying equipment shall be cleaned at the end of each operation or work day. Conveying equipment and operations shall conform to the following additional requirements:
 - a. Belt conveyors shall be horizontal or at a slope which will not cause excessive segregation or loss of ingredients. Concrete shall be protected against undue drying or rise in temperature. An arrangement shall be used at the discharge end to prevent apparent segregation. Mortar shall not be allowed to adhere to the return length of the belt. Long runs shall be discharged into a hopper or through a baffle.
 - b. Chutes shall be metal or metal-lined and shall have a slope not exceeding 1 vertical to 2 horizontal and not less than 1 vertical to 3 horizontal. Chutes more than 20 feet long, and chutes not meeting the slope requirements may be used provided they discharge into a hopper before distribution.
 - c. Pumping or pneumatic conveying equipment shall be of suitable kind with adequate pumping capacity. Pneumatic placement shall be controlled so that segregation is not apparent in the discharged concrete.
 - d. Concrete shall not be conveyed through pipe made of aluminum alloy. Standby equipment shall be provided on the site.
 - e. Tined rakes are prohibited as a means of conveying fiber reinforced concrete.
4. Do not use reinforcement as bases for runways for concrete conveying equipment or other construction loads.

- D. **Placing Concrete in Forms:** Deposit concrete in forms in horizontal layers not deeper than 18 inches and in a manner to avoid inclined construction joints. Where placement consists of several layers, place each layer while preceding layer is still plastic to avoid cold joints.
1. Consolidate placed concrete by mechanical vibrating equipment. Hand-spading, rodding or tamping as the sole means for the consolidation of concrete will only be permitted with special permission from the Engineer. Use equipment and procedures for consolidation of concrete in accordance with ACI recommended practices.
 2. Use vibrators designed to operate with vibratory equipment submerged in concrete, maintaining a speed of not less than 8000 impulses per minute and of sufficient amplitude to consolidate the concrete effectively. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations not farther than visible effectiveness of machine, generally at points 18 inches maximum apart. Place vibrators to rapidly penetrate placed layer and at least 6 inches into the preceding layer. Do not insert vibrators into lower layers of concrete that have begun to set. At each insertion maintain the duration of vibration for the time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing segregation of mix, generally from 5 to 15 seconds. A spare vibrator shall be kept on the job site during all concrete placing operation.
- E. **Placing Concrete Slabs:** Deposit and consolidate concrete slabs in a continuous operation, within limits of construction joints, until the placing of a panel or section is completed.
1. Consolidate concrete using internal vibrators during placing operations so that concrete is thoroughly worked around reinforcement and other embedded items and into corners.
 2. Bring slab surfaces to correct level with straightedge and strike off. Use bull floats or darbies to smooth surface, free of humps or hollows. Do not disturb slab surfaces prior to beginning finishing operations. Do not sprinkle water on plastic surface.
 3. Maintain reinforcing in proper position during concrete placement operations.
 4. Slab thicknesses indicated on the drawings are minimums. Provide sufficient concrete to account for structure deflection, subgrade fluctuations, and to obtain the specified slab elevation at the flatness and levelness indicated here within.

5. Finish: See “Monolithic Slab Finishes” in this specification for slab finish requirements.
- F. Cold Weather Placing: Protect concrete work from physical damage or reduced strength which could be caused by frost, freezing actions, or low temperatures, in compliance with ACI 306 and as herein specified.
1. When air temperature has fallen to or is expected to fall below 40 degrees F (4 degrees C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 degrees F (10 degrees C), and not more than 80 degrees F (27degrees C) at point of placement.
 2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
 3. Do not use calcium chloride, salt and other materials containing antifreeze agents or chemical accelerators.
 4. All temporary heat, form insulation, insulated blankets, coverings, hay or other equipment and materials necessary to protect the concrete work from physical damage caused by frost , freezing action, or low temperature shall be provided prior to start of placing operations.
 5. When the air temperature has fallen to or is expected to fall below 40 degrees F, provide adequate means to maintain the temperature in the area where concrete is being placed between 50 and 70 degrees F.
- G. Hot Weather Placing: When hot weather conditions exist that would seriously impair quality and strength of concrete, place concrete in compliance with ACI 305 and as herein specified.
1. Cool ingredients before mixing to maintain concrete temperature at time of placement below 90 degrees F. Mixing water may be chilled, or chopped ice may be used to control the concrete temperature provided the water equivalent of the ice is calculated to the total amount of mixing water.
 2. Cover reinforcing steel with water-soaked burlap if it becomes too hot, so that the steel temperature will not exceed the ambient air temperature immediately before embedment in concrete.
 3. Wet forms thoroughly before placing concrete.
 4. Do not use retarding admixtures without the written acceptance by the Architect.

3.08 FINISH OF FORMED SURFACES:

- A. Rough Form Finish: For formed concrete surfaces not exposed-to-view in the finish work or by other construction, unless otherwise indicated. This concrete surface shall have texture imparted by form facing material, with tie holes and defective areas repaired and patched and fins and other projections exceeding 1/4 in. in height rubbed down or chipped off.
- B. Smooth Form Finish: For formed concrete surfaces exposed-to-view, or that are to be covered with a coating material applied directly to concrete, or a covering material applied directly to concrete, such as waterproofing, damp-proofing, painting or other similar system. This as-cast concrete surface shall be obtained with selected form facing material, arranged orderly and symmetrically with a minimum of seams. Repair and patch defective areas with fins or other projections completely removed and smoothed.
- C. Grout Cleaned Finish: Provide grout cleaned finish to scheduled concrete surfaces which have received smooth form finish treatment. Combine one part Portland cement to 1-1/2 parts fine sand by volume and mix with water to consistency of thick paint. Proprietary additives may be used at Contractor's option. Blend standard Portland cement and white Portland cement, amounts determined by trial patches, so that final color of dry grout will closely match adjacent surfaces.
 - 1. Thoroughly wet concrete surfaces and apply grout to coat surfaces and fill small holes. Remove excess grout by scraping and rubbing with clean burlap. Keep damp by fog spray for at least 36 hours after rubbing.
- D. Related Unformed Surfaces: At tops of walls and grade beams, horizontal offset surfaces occurring adjacent to formed surfaces, strike-off, smooth and finish with a texture matching adjacent unformed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

3.09 FLOOR FLATNESS AND LEVELNESS

- A. Floor flatness/levelness tolerances: Tolerances for various floor uses shall conform to the requirements set forth in ACI 117 and ACI 302 for "flat" floor profile.
 - 1. Minimum Test Area Flatness/Levelness: F_F35/F_L25
 - 2. Minimum Local F Number: F_F25/F_L15
- B. Levelness criteria shall be applied to slabs-on-grade only.

- C. Contractor shall measure floor finish within 72 hours after slab finishing and provide corrective measures for finishes not within tolerance. Corrective procedures shall be reviewed by the Architect prior to implementation.

3.10 MONOLITHIC SLAB FINISHES:

- A. Scratch Finish: Apply scratch finish to monolithic slab surfaces that are to receive concrete floor topping or mortar setting beds, and as otherwise indicated.
 - 1. After placing slabs, plane surface to a tolerance not exceeding 1/2 in. in 10 ft. when tested with a 10-ft. straightedge. Slope surfaces uniformly to drains where required. After leveling, roughen surface before final set with stiff brushes, brooms or rakes.
- B. Float Finish: Apply float finish to monolithic slab surfaces to receive trowel finish and other finishes as hereinafter specified, and slab surfaces which are to be covered with membrane or elastic waterproofing, and as otherwise indicated.
- C. Trowel Finish: Apply trowel finish to monolithic slab surfaces indicated, including slab surfaces to be covered with carpet, resilient flooring, paint or other thin-film finish coating system.
- D. Non-Slip Broom Finish: Apply non-slip broom finish to exterior concrete platforms, steps and ramps, and elsewhere as indicated.
- E. Slab finishes for floor coverings not indicated or exposed to view in the final condition shall be coordinated with the Architect prior to slab placement.
- F. Slab Joints: Where indicated, sawn slab contraction joints shall be “soft cut”, immediately after concrete surface is firm enough not to be torn or damaged by the blade.

3.11 CONCRETE CURING AND PROTECTION:

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Protect concrete work from physical damage or reduced strength which could be caused by frost, freezing actions, or low temperatures, in compliance with the requirements of ACI 308 as herein specified.
- B. Curing Methods: Perform curing of concrete by moist curing, by moisture-retaining cover curing, by curing compound, and by combinations thereof, as herein specified unless noted otherwise. Curing shall commence as soon as concrete surfaces are sufficiently hard as to withstand surface damage.
- C. Curing of Slabs-on Grade:

1. Slabs-on-grade shall be cured by wet curing methods unless otherwise noted.
 2. Slabs-on-grade to receive floor coverings with moisture sensitive adhesives shall be cured by means of a moisture retaining covering. Coordinate curing with flooring adhesive manufacturer and flooring installer. Submit curing methods to Architect for review and approval.
- D. Curing Formed Surfaces: Cure formed concrete surfaces, including undersides of beams, supported slabs and other similar surfaces by moist curing with forms in place for full curing period or until forms are removed. If forms are removed, continue curing by methods specified above, as applicable.
- E. Protection From Mechanical Injury: During the curing period and duration of construction, the concrete shall be protected from damaging mechanical disturbances, such as load stresses, heavy shock, and excessive vibration. All finished concrete surfaces shall be protected from damage by construction equipment, materials, or methods, by application of curing procedures, and by rain or running water. Self-supporting structures shall not be loaded in such a way as to overstress the concrete.

3.12 REMOVAL OF FORMS:

- A. Formwork not supporting weight of concrete, such as sides of beams, walls, columns, and similar parts of the work, may be removed after cumulatively curing at not less than 50 degrees F for 24 hours after placing concrete, provided concrete is sufficiently hard to not be damaged by form removal operations, and provided curing and protection operations are maintained.
- B. Formwork supporting weight of concrete, such as joints, slabs and other structural elements, may not be removed in fewer than 14 days or until concrete has attained design minimum compressive strength at 28 days. Determine potential compressive strength of in-place concrete by testing field-cured specimens representative of concrete location or members.
- C. Form facing material may be removed 4 days after placement only if shores and other vertical supports have been arranged to permit removal of form facing material without loosening or disturbing shores and support.

3.13 REUSE OF FORMS:

- A. Clean and repair surfaces of forms to be reused in work. Split, frayed, delaminated or otherwise damaged form facing material will not be acceptable for exposed surfaces. Apply new form coating compound as specified for new formwork.

- B. When forms are extended for successive concrete placement, thoroughly clean surfaces, remove fins and latency, and tighten forms to close joints. Align and secure joint to avoid offsets. Do not use "patched" forms for exposed concrete surfaces, except as acceptable to Architect.

3.14 MISCELLANEOUS CONCRETE ITEMS:

- A. Fill in holes and openings left in concrete structures for passage of work by other trades, unless otherwise shown or directed, after work of other trades is in place. Mix, place, and cure concrete as herein specified, to blend with in-place construction. Provide other miscellaneous concrete filling shown or required to complete work.

3.15 CONCRETE SURFACE REPAIRS:

- A. Patching Defective Areas: Repair and patch defective areas with cement mortar immediately after removal of forms, when acceptable to the Architect.
 - 1. Cut out honeycomb, rock pockets, voids over 1/4 inch in any dimension, and holes left by tie rods and bolts, down to solid concrete but in no case to a depth of less than 1 inch. Make edges of cuts perpendicular to the concrete surface. Thoroughly clean, dampen with water, and brush coat the area to be patched with approved bonding agent. Place patching mortar after bonding compound has dried.
 - 2. For exposed-to-view surfaces, blend white Portland cement and standard Portland cement so that, when dry, patching mortar will match color surrounding. Provide test areas at inconspicuous location to verify mixture and color match before proceeding with patching. Compact mortar in place and strike-off slightly higher than surrounding surface.
- B. Repair of Formed Surfaces: Remove and replace concrete having defective surfaces if defects cannot be repaired to satisfaction of Architect. Surface defects, as such, include color and texture irregularities, form tie holes, cracks, spalls, air bubbles, honeycomb, rock pockets, fins, and other projections on surface and stains and other discolorations that cannot be removed by cleaning.

3.16 QUALITY CONTROL TESTING DURING CONSTRUCTION:

- A. Project Special Inspector shall verify reinforcement, including foundation reinforcement and slab reinforcement (WWF or reinforcing bar). Agent shall verify WWF or reinforcement has been chair/placed with proper clearances.

- B. The Owner shall employ a Testing Laboratory to inspect, sample and test the materials and the production of concrete and to submit test reports. Concrete testing shall be performed by technicians certified by the Maine Concrete Technician Certification Board and/or ACI Concrete Field Testing Technician Grade I.
- C. Concrete shall be sampled and tested for quality control during placement. Quality control testing shall include the following, unless otherwise directed by the Architect.
- D. See Submittals section for report requirements.
- E. Sampling Fresh Concrete: ASTM C 172.
1. Slump: ASTM C143; One test for each set of compressive strength test specimens. Sample shall be taken from middle third of the load per ASTM C172. A slump test must be run prior to the incorporation of the CFP fibers per recommendations of ACI 544. A slump test must be run prior to and following the addition of a water reducer (superplasticizer) per recommendations of ACI 301.
 2. Air Content: ASTM C231 "Pressure method for normal weight concrete." One test for each set of compressive strength specimens measured at point of discharge.
 3. Concrete Temperature: Per ASTM C-1064; One test each time a set of compression test specimens are made.
 4. Compression Test Specimen: ASTM C31; one set of 4 standard cylinders for each compressive strength test, unless otherwise directed. Mold and store cylinders for laboratory cured test specimens except when field-cure test specimens are required.
 - a. An insulated Cure Box for specimen curing shall be supplied by Testing Agency for initial curing as defined in ACI C31.
 - b. Means of heating or cooling the Cure Box shall be provided by the Inspection Agency if required in order to maintain a temperature between 60 and 80 degrees F. Contractor shall provide an electrical source to the Testing Agency when required for temperature control.
 - c. A maximum-minimum thermometer shall be provided in the Cure Box by the Testing Agency to record the temperature range of the Cure Box during specimen curing. The Testing Agency shall record the maximum/minimum temperature of the Cure Box when transferring the specimens to the laboratory.

- d. Test Specimens shall be moist cured.
 - e. Refer to ASTM C31 for additional requirements for Test Specimens.
5. Compressive Strength Tests: ASTM C39; one set for each 50 cu. yds. or fraction thereof, of each concrete class placed in any one day or for each 4,000 sq. ft. of surface area placed; 1 specimen tested at 7 days, 2 specimens tested at 28 days, 1 specimen retained in reserve for later testing if required.
6. Pumped concrete shall be tested at point of discharge per ACI 301.
- F. Additional Tests: The testing service will make additional tests of in-place concrete when test results indicate specified concrete strengths and other characteristics have not been attained in the structure, as directed by the Architect. Testing service may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42, or by other methods, as directed. Contractor shall pay for such tests conducted, and any other additional testing as may be required, when unacceptable concrete is verified.

END OF SECTION

SECTION 033536 - SPECIAL CONCRETE FLOOR FINISHES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section specifies the following:
 - 1. Single application cure-seal-hardener for new concrete floors.
- B. Related Section:
 - 1. Cast-In-Place Concrete: Division 03 Cast-In-Place Concrete sections.

1.2 SUBMITTALS

- A. Product Data: For each type of manufactured material and product indicated.
- B. Certificates: Manufacturer's certification that the installer is acceptable.
- C. Maintenance Data: Maintenance instructions, including precautions for avoiding staining after application.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: Acceptable to the manufacturer.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Delivery: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- B. Storage and Protection: Store materials protected from exposure to harmful environmental conditions and at temperature and humidity conditions recommended by the manufacturer.
- C. Handling: Protect materials from dirt, corrosion, oil, grease and other contaminants.

1.5 PROJECT CONDITIONS

- A. Environmental limitations:
 - 1. Comply with manufacturers written instructions for substrate temperature and moisture content, ambient temperature and humidity, ventilation, and other conditions affecting topping performance.

- B. Close areas to traffic during floor application and after application, for time period recommended in writing by manufacturer.

PART 2 - PRODUCTS

2.1 MATERIAL

- A. Cure-Seal-Hardener: Ashford Formula, a water-based chemically reactive penetrating sealer and hardener that seals by densifying concrete so that water molecules cannot pass through but air and water vapor can, and allows concrete to achieve full compressive strength, minimizing surface crazing and eliminating dusting.
 - 1. Abrasion Resistance to Revolving Disks: At least a 32.5% improvement over untreated samples when tested in accordance with ASTM C779.
 - 2. Surface Adhesion: At least a 22% increase in adhesion for epoxy when tested in accordance with ASTM D3359.
 - 3. Hardening: As follows when tested in accordance with ASTM C39:
 - a. After 7 Days: An increase of at least 40% over untreated samples.
 - b. After 28 Days: An increase of at least 38% over untreated samples.
 - 4. Coefficient of Friction: 0.86 dry, 0.69 wet when tested in accordance with ASTM C1028.
 - 5. Rebound Number: An increase of at least 13.3% over untreated samples when tested in accordance with ASTM C805.
 - 6. Light Exposure Degradation: No evidence of adverse effects on treated samples when tested in accordance with ASTM G23.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrate, with installer present, for conditions affecting performance of finish. Correct conditions detrimental to timely and proper work. Do not proceed until unsatisfactory conditions are corrected.

3.2 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- C. Do not use frozen material. Thaw and agitate prior to use.
- D. If construction equipment must be used for application, diaper all components that might drip oil, hydraulic fluid or other liquids.

3.3 APPLICATION

- A. Compliance: Comply with manufacturer's product data, including product technical bulletins, product catalog installation instructions and product carton instructions for installation.
- B. All work must be performed by an applicator certified by the manufacturer. Certification credentials are required.
- C. New Concrete: Apply cure-seal-hardener to new concrete as soon as the concrete is firm enough to work on after troweling; with colored concrete, wait a minimum of 30 days before application.
 - 1. Spray on at rate of 200 ft²/gal.
 - 2. Keep surface wet with cure-seal-hardener for a minimum soak-in period of 30 minutes without allowing it to dry out or become slippery. In hot weather, slipperiness may appear before the 30 minute time period has elapsed. If that occurs, apply additional cure-seal-hardener as needed to keep the entire surface in a non-slippery state for the first 15 minutes. For the remaining 15 minutes, mist the surface as needed with water to keep the material in a non-slippery state. In hot weather conditions, follow manufacturer's special application procedures.
 - 3. When the treated surface becomes slippery after this period, lightly mist with water until slipperiness disappears.
 - 4. Wait for surface to become slippery again, and then flush entire surface with water to remove all cure-seal-hardener residue.
 - 5. Squeegee surface completely dry, flushing any remaining slippery areas until no residue remains.
 - 6. Wet vacuum or scrubbing machines can be used in accordance with manufacturer's instructions to remove residue.

3.4 PROTECTION:

- A. Protect installed floors for at least 3 months until chemical reaction process is complete.
 - 1. Do not allow traffic on floors for 3 hours after application.
 - 2. Do not allow parking of vehicles on concrete slab.
 - 3. If vehicles must be temporarily parked on slab, place dropcloths under vehicles during entire time parked.
 - 4. Do not allow pipe cutting using pipe cutting machinery on concrete slab.
 - 5. Do not allow temporary placement and storage of steel members on concrete slabs.
 - 6. Clean up spills immediately and spot-treat stains with degreaser or oil emulsifier.
 - 7. Clean floor regularly in accordance with manufacturer's recommendations.

END OF SECTION 033536

SECTION 04 23 00 – REINFORCED UNIT MASONRY

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

- A. Related Documents: The general provisions of the Contract, including General and Supplementary Conditions and General Requirements apply to work specified in this section.
- B. Examine all other sections of the Specifications for requirements which affect work of this Section whether or not such work is specifically mentioned in this Section.
- C. Coordinate work with that of all trades affecting or affected by work of this Section. Cooperate with such trades to assure the steady progress of all work under the Contract.

1.02 DESCRIPTION OF WORK:

- A. Reinforced masonry work includes all labor, materials, and equipment necessary and required for reinforced concrete masonry.
- B. Extent of work to be performed and/or coordinated shown on the drawings and indicated in the specifications including, but not limited to masonry units, reinforcing, accessories, and grout.
- C. Coordinate work with all other trades, including but not limited to concrete reinforcement and structural steel.

1.03 RELATED WORK

- A. Cast-in-Place Concrete: Section 03300
- B. Expansion/Adhesive Anchors: Section 05120
- C. Embedded Items: Section 05500

1.04 QUALITY ASSURANCE:

- A. Codes and Standards: Comply with provisions of the latest edition of the following except where more stringent requirements are shown or specified:
 - 1. ACI 530 “Building Code Requirements for Masonry Structures”.
 - 2. ACI 530.1 “Specification for Masonry Structures”.

3. ACI "Detailing Manual for Reinforced Concrete" (SP-66).
 4. CRSI "Manual of Standard Practice"
 5. CRSI "Placing Reinforcing Bars"
 6. "Code of Federal Regulations, Part 1926" per the Occupational Safety and Health Administration (OSHA), Department of Labor (Latest Revision).
- B. Fire Performance Characteristics: Where indicated, provide materials and construction identical to those of assemblies whose fire resistance has been determined by ASTM E119, by a testing and inspecting organization, by equivalent concrete masonry thickness, or by another means, as acceptable to authorities having jurisdiction.
- C. Materials and installed work may require testing and retesting, as directed by the Architect, at any time during progress of work. Allow free access to material stockpiles and facilities. Tests not specifically indicated to be done at Owner's expense, including retesting of rejected materials and installed work, shall be done at Contractor's expense.

1.05 SUBMITTALS:

- A. Unless otherwise specified, submittals required in this section shall be submitted for review.
- B. General Contractor shall submit a Submittal Schedule to the engineer within 30 days after they have received the Owner's Notice to Proceed.
- C. All submittals shall be reviewed and returned to the Architect within 10 working days.
- D. INCOMPLETE SUBMITTALS WILL NOT BE REVIEWED.
- E. Submittals not reviewed by the General Contractor prior to submission to the Engineer will not be reviewed. Include on the submittal statement or stamp of approval by Contractor, representing that the Contractor has seen and examined the submittal and that all requirements listed in this Section and Section 01000 have been complied with.
- F. Engineer will review submittals a maximum of two review cycles as part of their normal services. If submittals are incomplete or otherwise unacceptable and re-submitted, General Contractor shall compensate Engineer for additional review cycles.
- G. Hardcopy Submittals: Submit three prints. Prints will be reviewed by the Engineer, and then the Architect. One marked print will be returned to Contractor for printing and distribution. Multiple copies will not be marked by the Engineer.

H. Electronic Submittals:

1. Contractor shall include in the submittal schedule an indication of submittals that are intended to be submitted electronically. Upon receipt of the submittal schedule, the Engineer reserves the right to indicate submittals that will not be accepted electronically. Paper copies of such submittals shall be furnished as referenced in this specification.
 2. The Engineer reserves the right to require paper copies of submittals that are received electronically. Provide Engineer one (1) paper copies in addition to the electronic submittal. Paper copy will be retained and electronic copy will be returned. Review cycle for such submittals shall not commence until such time that the paper copies are received.
 3. Electronic Submittals shall be submitted in Protected Document Format (PDF) compatible with Bluebeam version 12 or later. Electronic files shall not be broken into smaller individual files. File sizes too large to process email or within a file transfer protocol (FTP) site shall be provided on a CD.
 4. The submission of submittals electronically does not relieve the contractor of their responsibility to review the submittal prior to transmission to the Engineer. Electronic Submittals shall include contractor comments, and a statement and/or stamp of approval by Contractor, representing that the Contractor has seen and examined the submittal and that all requirements listed in this Section and Division 1 have been complied with. Electronic submittals without the Contractor's approval will be rejected and returned.
 5. The Engineer assumes no responsibility for the printed reproduction of submittals reviewed electronically, transmission errors or returned electronic submittals that become corrupted or are otherwise not accessible by the Contractor's or Subcontractor's computer hardware and/or software.
- I. Product Data: Submit producer's or manufacturer's specifications and installation instructions for the following products. Include laboratory test reports and other data to show compliance with specifications (including specified standards).
1. Reinforcement certified mill reports covering chemical and physical properties and yield strength.
 2. Masonry sizes, shapes, weights, densities, strengths, material composition, admixtures, colors, and manufacturing processes and procedures.
 3. Mortar and/or Grout.

4. Accessories, Ties, and Joint Reinforcement
 5. Admixtures.
 6. Expansion/Adhesive Anchors.
- J. Shop Drawings:
1. Shop Drawing Review: Electronic files of structural drawings will not be provided to the contractor for preparation of shop drawings. Submit shop drawings for fabrication, bending and placement of masonry reinforcement. Comply with ACI 315, showing bar schedules, stirrup and tie spacing, diagrams of bent bars, and arrangement of masonry reinforcement. Include special reinforcement required at openings through masonry. Include supplemental reinforcing and bar supports necessary to support reinforcing steel at proper location within masonry units and bond beams. Coordinate masonry reinforcement with concrete reinforcement.
 2. Review of the shop drawings will be made for the size and arrangement of reinforcement. Conformance of the Shop Drawings to the Contract Drawings remains the responsibility of the General Contractor. Engineer's review in no way relieves the General Contractor of this responsibility. Submit one print and one reproducible. Print will be reviewed and a reproducible will be returned to Contractor for printing and distribution. Multiple copies will not be marked by Engineer.
 3. Shop drawings will not be reviewed as partial submittals. A complete submittal shall be provided all items listed prior. Incomplete submittals will not be reviewed.
 4. Mix designs: Submit all laboratory test reports and materials for each mix design listed within. Prepare mixes by the field experience method and/or trial mixtures per the requirements of chapter 5 of ACI 318. Proportioning by water cement ratio method will not be permitted.
 5. Samples: Submit samples of materials as specified and as otherwise requested by Architect, including names, sources and descriptions.
 6. Contraction/Construction Joints: Submit plan indicating proposed location of contraction and construction joints in masonry walls.

PART 2 - PRODUCTS

2.01 MASONRY MATERIALS

A. Load Bearing Units:

1. Hollow Load Bearing Units: ASTM C-90
 - a. Normal weight units
 - b. Minimum average net area compressive strength = 1,900 psi.
2. Solid Load Bearing Units: ASTM C-145
 - a. Normal weights units
 - b. Minimum average net area compressive strength = 1,900 psi
3. Nominal Dimensions:
 - a. 12" units: 15-5/8"x11-5/8"x7-5/8" actual
 - b. 8" units: 15-5/8x7-5/8"x7-5/8" actual
 - c. 6" units: 15-5/8x5-5/8"x7-5/8" actual
 - d. Provide other nominal sizes as indicated on the Architectural Drawings or in related specifications.
 - e. Construct lintels using reinforced concrete masonry units with grouted joints where shown. Lintels may be prefabricated for incorporation into work.
4. Single Source for Masonry Units: Obtain masonry units of uniform texture and color as specified from single manufacturer.

- B. Fire Rating Requirements: Concrete masonry units shall have a U.L. listed fire rating of as indicated on the Architectural Drawings or in related specifications.

2.02 MORTAR AND GROUT MATERIALS

- A. Portland Cement: ASTM C 150, Type I, except Type III may be used for cold weather construction. Provide natural color unless otherwise indicated.
- B. Ready-Mixed Mortar: Cementitious materials, water, and aggregate complying with requirements specified here within, combined with set-controlling admixtures to produce ready-mixed mortar complying with ASTM C1142.
- C. Aggregate for Mortar: ASTM C144, except for joints less than 1/4" thick, use aggregate graded with 100 percent passing No. 16 Sieve.
- D. Aggregate for Grout: ASTM C 404.
- E. Water: Clean and potable
- F. Additives: None permitted.

2.03 MORTAR AND GROUT MIXES:

- A. General: Do not add admixtures including coloring pigments, air-entraining agents, accelerators, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.
- B. Mortar:
 - 1. Job mixed mortar: Comply with ASTM C270, Proportion Specification for job mixed mortar
 - 2. Ready-mixed mortar: ASTM C 1142
 - 3. Masonry cement shall consist of portland-cement lime; mortar cement is acceptable, masonry cement is not acceptable.
 - 4. Mortar shall be Type S, unless otherwise noted.
 - 5. Mortar compressive stress when tested per ASTM C270 at 28-days shall be a minimum of 1,800 psi.
 - 6. Single Source for Mortar Units: Obtain mortar materials of uniform texture and color as specified from single manufacturer.
- C. Grout:
 - 1. Comply with ASTM C476.

2.03 MASONRY REINFORCEMENT:

- A. General: Comply with this specification for placing reinforcement. Comply with Division 3, Section 03300 for other requirements. Shop fabricate, whenever possible, reinforcing bars shown as bent or hooked.
- B. Deformed Bars: Provide ASTM A615 Grade 60 deformed bars. Except provide ASTM A615 Grade 60s where field bending of reinforcement is required or intended, and ASTM A-706 Grade 60 for all conditions where welding of reinforcement is required.
- C. Smooth Steel Wire: Provide ASTM A675 Grade 80 for all #2 bars of smooth, round stock, where noted on the drawings for use in columns or pilasters as ties.

2.04 MASONRY ACCESSORIES:

- Q. General: Provide accessories and other items as required herein and in related specification sections and as indicated on the drawings. For all types of accessories, hot-dip galvanize after fabrication with 1.5 oz. zinc coating, ASTM A-153, Class B2.
- R. Prefabricated Joint Reinforcing: Provide continuous welded wire units prefabricated in straight lengths of not less than 10', with matching corner and tee units. Fabricate from cold-drawn steel wire complying with ASTM A-82, deformed continuous side rods with 3/16" diameter and plain 9 gage cross-rods, unit width of 1-1/2" less than thickness of wall/partition. Subject to compliance, provide products manufactured by "Dur-O-Wal", "AA Wire Products Company", or approved equal.
 - a. Single Width Walls: Truss type fabricated with single pair 3/16 gauge side rods and 9 gage continuous diagonal cross-rods.
- S. Reinforcing Bar Positioners: Provide reinforcing bar supports/positioners for accurate positioning of horizontal and vertical reinforcement in walls, bond beams, and lintels. Fabricate from cold-drawn plain 9 gage steel wire complying with ASTM A-82. Subject to compliance, provide products manufactured by "Dur-O-Wal", "AA Wire Products Company", or approved equal.
- D. Masonry Anchors and Ties: Provide straps, bars, bolts, rods, dovetail slots, metal fasteners indicated and other required accessory items of type, size, spacing, and at locations as required in related specification sections as identified on the drawings. Where masonry is indicated to be anchored to structural framework with flexible anchors, provide 2-piece anchors which will permit horizontal and vertical movement but will provide lateral restraint out of plane of wall.
- E. Related Masonry Items: Provide joint fillers, insulation, flashings, weepholes, and other items related to masonry work as required in related specification sections and as identified on the drawings.

PART 3 - EXECUTION

3.01 INSTALLATION:

- A. General: Build masonry construction as required in related specification sections and as identified on the drawings. Build masonry construction to full thickness shown, except, single-wythe walls to actual thickness of masonry units, using units of nominal thickness shown or specified.
- B. Do not use frozen materials or materials mixed/coated with ice or frost. Do not build on frozen work. Remove and replace masonry work damaged by frost or freezing. Do not wet concrete masonry units (CMU).
- C. Mortar: Provide full mortar coverage on all horizontal and vertical surfaces including face shells and webs.
- D. Reinforced Concrete Masonry Unit Walls: Lay CMU wall units in running bond with vertical joints in each course centered on units above and below, unless otherwise indicated. Bond and interlock each course at corners and intersections. Use special shaped units where shown, and/or as required for corners, jambs, sash, control joints, lintels, bond beams, and other special conditions.
 - 1. Maintain vertical continuity of core or cell cavities which are to be reinforced and grouted. Keep cavities free of mortar. Solidly bed webs of masonry with mortar where adjacent to cells to be grouted.
 - 2. Use special units or modify standard units, where horizontal reinforcing is shown to provide for continuous placement of reinforcing and grout. Place small mesh expanded metal lath or wire screening in joints under bond beam courses above cells of non-reinforced or non-grouted masonry elements or provide bond beam units with solid bottoms (lintel block units). Provide open end bond beam units where horizontal and vertical reinforcing pass through same units.

3.02 PLACING REINFORCEMENT:

- A. General: Clean reinforcement of loose rust, mill scale, earth, ice, or other materials which will reduce bond to mortar or grout. Do not use reinforcement with kinks or bends not shown on drawings or final shop drawings, or bars with reduced cross-section due to excessive rusting or other causes. Position reinforcement accurately at spacing shown on contract drawings.
- B. Vertical Reinforcing: Support and secure vertical reinforcing against displacement. Vertical reinforcing shall be held in position at the top and bottom and at intervals not exceeding 192

bar diameters nor $10'-0''$ with a minimum clearance of $\frac{1}{4}''$ from the face of the masonry and not less than one bar diameter or $1''$, whichever is greater, between adjacent bars.

1. For columns, piers, and pilasters, provide a clear distance between vertical bars as indicated, but not less than $1-1/2$ times the nominal bar diameter or $1-1/2''$, whichever is greater. Provide lateral ties as indicated in the details.
 2. All dowels shall be grouted even if the dowel is in a cell adjacent to the vertical reinforcing. Unless detailed otherwise on the drawings, dowels shall be the same size, number, and spacing as the vertical reinforcing. Provide lap length of dowels to vertical reinforcing equal to forty-eight (48) times nominal diameter of dowel, unless indicated otherwise on the drawings. Dowels for columns and pilasters shall be installed using steel or wood templates to accurately position dowels as indicated on the drawings.
- C. Horizontal Reinforcing: Support and secure horizontal reinforcing against displacement. Horizontal reinforcing shall be held in position at intervals not exceeding 100 bar diameters with a minimum clearance of $\frac{1}{4}''$ from the face of the masonry and not less than one bar diameter or $1''$, whichever is greater, between adjacent bars. Provide laps or dowels around corners and across intersections as indicated on the drawings.
1. Horizontal reinforcing shall be placed in continuous bond beam or lintel block units and shall be solidly grouted in place. Horizontal reinforcement shall be CONTINUOUS THROUGH CONTROL JOINTS, but shall be DISCONTINUOUS AT EXPANSION JOINTS. Horizontal reinforcement may be placed as masonry work progresses.
- D. Splices: Splice reinforcement where shown or indicated on the drawings. Do not splice at other locations unless acceptable to the Structural Engineer. Minimum lap splice length shall be 48 bar diameters, of the smaller bar diameter, unless indicated otherwise on the drawings. Stagger adjacent splices at least one full lap length so that no more than 25% of the number of bars are spliced at any one location. Where splicing at vertical bars or at dowels, provide full contact, lap ends of bars, and wire tie.
- E. Reinforcing Bar Positioners: Provide where required and at required spacing to support and secure horizontal and vertical reinforcing against displacement and to accurately align and position splices in reinforcement.
- F. Prefabricated Joint Reinforcing: Provide continuous horizontal joint reinforcing as shown/specified. Fully embed longitudinal side rods in mortar for entire length with minimum cover of $5/8''$ on exterior side of walls and $1/2''$ at other locations. Lap reinforcement a minimum of $6''$ at ends of units. Do not bridge control/expansion joints with joint reinforcing. Provide continuity at corners/wall intersections by the use of

prefabricated “L” and “T” sections. Cut/bend units as directed by manufacturer for continuity at returns/offsets/column fireproofing, pipe enclosures, and/or special conditions. Space continuous horizontal reinforcing as follows:

1. For single-wythe walls, space 16” o.c. vertically, unless indicated.

- G. Metal Ties: Where indicate, install in mortar joints as work progresses, with a minimum mortar cover of at least 5/8” on exterior faces and 1/2” on interior faces of masonry work.
- H. Anchors: Install anchors for reinforced masonry elements to supporting structure as indicated on the drawings or required in the specifications.

3.03 FORMWORK AND SHORING:

- A. General: Provide temporary formwork and/or shoring as required for temporary support of reinforced masonry work. Refer to Division 3, Section 03300 for additional requirements.
- B. Removal: Formwork and/or shoring shall not be removed until the reinforced masonry element has cured sufficiently to carry its own weight and any other loads that may be placed on it during construction. It is the contractor’s sole responsibility to determine formwork and shoring requirements and durations. In no case shall formwork or shores be removed before the following periods:

- | | | |
|----|------------------------|---------|
| 1. | Lintels and beams: | 10 days |
| 2. | Masonry soffits: | 7 days |
| 3. | Columns and pilasters: | 7 days |

3.04 GROUTING

- A. General: Grout mix and grout materials shall conform to ASTM C 476. Refer to Division 3, Section 03300, “Cast-In-Place Concrete” for requirements.
1. Use “Fine Grout” for filling spaces less than 2” in either horizontal dimension. Where shown solid, use mortar for cavities less than 3/4” in width or spaces less than 1-1/2” x 2” in horizontal dimensions.
 2. Use “Coarse Grout” for filling cavities 2” or larger in width or cells 2”x3” or larger in horizontal dimensions.

3. Use "Concrete", 3000 psi normal weight, for filling spaces ten (10) inches or larger in both horizontal dimensions.
- B. Preparation: Prior to grouting, inspect and clean grout spaces. Remove dust, dirt, mortar droppings, loose pieces of masonry, and other foreign materials. Clean and position reinforcing. Clean top surface of structural members to ensure bond. After final cleaning and inspection, close and brace clean out holes.
1. Do not grout until entire height of masonry to be grouted has attained sufficient strength to resist forces and pressures of grouting operation. Install shores and braces, if required, before beginning grouting.
- C. Grouting Method: Grouting shall conform to low-lift or high-lift grouting, at Contractor's option, subject to following requirements.
1. Low-Lift Grouting:
 - a. Low-Lift Grouting SHALL NOT exceed a pour of more than five (5) feet in height not the "Maximum Grout Pour Height" identified below.
 - b. Provide minimum clear dimension of two (2) inches and minimum clear area of eight (8) sq. inches in vertical cavities, cells, or cores to be grouted.
 - c. Place vertical reinforcement prior to laying of masonry units. Extend above elevation of maximum pour height as required to allow for splicing. Support and secure reinforcing as masonry is built.
 - d. Lay masonry to maximum pour height. Do not exceed five feet (5 ft.) or if bond beam occurs below five feet (5 ft.) height, stop pour or course below bond beam.
 2. High-Lift Grouting:
 - a. High-Lift Grouting SHALL NOT exceed a pour of one story, but in no case more than twenty-four (24) feet in height nor the "Maximum Grout Pour Height" identified below.
 - b. High-Lift Grouting is NOT PERMITTED unless minimum cavity dimension exceeds three (3) inches and minimum cavity area exceeds ten (10) sq. inches.
 - c. Cleanout holes ARE REQUIRED where high-lift grouting will be employed. Provide cleanouts at the bottom course of masonry at each cell

to be grouted for each pour. For solid grouted masonry space cleanouts at 32 in. o.c.

- d. Cleanout holes shall have minimum width of 3 inches and a minimum height of 6 inches. After cleaning, close cleanouts and brace closures to resist hydrostatic grout pressure.
- e. Prior to grouting, construct masonry elements and place and secure reinforcing to full height of maximum grout pour. Place horizontal bond beam reinforcing as masonry units are laid.
- f. Where lateral tie reinforcing is shown, embed in mortar joints at vertical spacing indicated as units are laid. Where lateral ties wrap vertical reinforcing, embed additional lateral tie reinforcing in mortar joints to resist hydrostatic rupture of masonry face shells. Provide not less than No. 2 bars or 8 gage wire ties spaced at 16 in. o.c. for members with side dimensions of 20 in. or less and at 8 in. o.c. where side dimensions exceed 20 in.

D. Maximum Grout Pour Height: In no case shall total grout pour height exceed the following heights regardless of grouting method used.

Grout Type	Max. Height	Min. Cavity	Min. Cell
Fine	1'-0"	3/4"	1-1/2" x 2"
Fine	5'-0"	2"	2" x 3"
Fine	12'-0"	2-1/2"	2-1/2" x 3"
Fine	24'-0"	3"	3" x 3"
Coarse	1'-0"	2"	2" x 3"
Coarse	5'-0"	2"	2-1/2" x 3"
Coarse	12'-0"	2-1/2"	3" x 3"
Coarse	24'-0"	3"	3" x 4"

Min. Cavity applies to grouting between wythes of cavity walls. Min. Cell applies to grouting of masonry cells where dimension shown equals grout space width minus horizontal reinforcing bar diameter.

E. Grout Placement: Limit grout pours to sections which can be completed in one working day with not more than one (1) hour of interruption of pouring operation. Allow not less than thirty (30) minutes, nor more than one (1) hour between lifts of given pour. Rod or vibrate each lift during pouring operation.

1. Place grout in lifts not to exceed a maximum height of five (5) feet each, regardless of the maximum height of the pour.

2. Place grout in lintels and beams over openings in one continuous pour.
 3. Pour grout using chute or container with spout. Terminate pour 1-1/2" below top course to form key for next pour.
 4. Where bond beams occur, terminate grouting of vertical cells 1-1/2" below bond beam course. After placing horizontal reinforcing and prior to filling vertical cells above bond beam, pour grout into bond beam and strike off flush with top of bond beam course.
- F. Lintels: Install loose lintels of steel and other materials where shown. Provide masonry lintels where shown and wherever openings of more than 1'-0" are shown without structural steel or other supporting lintels. Provide formed-in-place masonry lintels. Provide minimum bearing at each jamb, of 4" at openings less than 4'-0" wide and 8" for wider openings.
- G. Other Items: Provide vertical expansion, control and isolation joints, and provide concealed flashing and weep holes in masonry where shown. Build-in related masonry accessory items as the masonry work progresses. Refer to Section 04200, "Unit Masonry" and related specifications sections and to drawings.
1. Comply with requirements for repair, pointing and cleaning in accordance with Section 04200, "Unit Masonry".
- H. Construction Tolerances: Variations in reinforced masonry work from plumb and level, locations of built-in or embedded items, and other required tolerances shall be as required in related specification sections or as identified on the drawings.
- I. Protection of Work: Do not apply uniform loading for at least 12 hours after building masonry walls or columns. Do not apply concentrated loads for at least 3 days after building masonry walls, lintels, beams, columns, pilasters, and piers.
- J. Responsibility for Errors: Contractor shall bear all costs associated with corrective work resulting from errors or poor workmanship, including costs of architectural and engineering services associated with required correction.
- 3.05 QUALITY CONTROL TESTING DURING CONSTRUCTION:
- A. Testing Agency/Project Special Inspector shall verify reinforcement, including all masonry reinforcement and slab reinforcement (WWF or reinforcing bar). Agent shall verify reinforcement has been chair/placed with proper clearances.
 - B. The Owner shall employ a Testing Laboratory to inspect, sample and test the materials and the production of concrete and to submit test reports. Masonry testing shall be

performed by technicians certified by the Maine Concrete Technician Certification Board and/or ACI concrete field testing technician Grade I.

1. Verify that grouting operations are performed and grout is placed and consolidated in accordance with the specifications.
2. Verify that contractor is using approved admixtures for grout.
3. Sample Fresh Grout: ASTM C-172, except modified for slump to comply with ASTM C-94.
 - a. Slump: ASTM C-143; one (1) test for each grout load at point of discharge; one (1) test for each set of compressive strength test specimens.
 - b. Air Content: ASTM C-173; volumetric method or ASTM C-231 pressure method for normal weight concrete; one (1) for each of compressive strength test specimens.
 - c. Grout Temperature; For each load, at time of arrival, at point of discharge test hourly when air temperature is 40 degree F and above; and each time a set of compression test specimens are made.
 - d. Compression Test Specimens: ASTM C-31; one (1) set of four (4) standard cylinders for each truck or mixer load of grout taken when load is 50% discharged from truck, unless other wise directed. Mold/store cylinders for laboratory cured test specimens except when field-cure test specimens are required.
 - e. Refer to Section 03300, "Cast-In-Place Concrete" for remaining test requirements. Substitute therein the work "grout" for the word "concrete".

END OF SECTION

SECTION 05 12 00 – STRUCTURAL STEEL

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. The drawings and general conditions of the contract including General and Supplementary Conditions and other Division 1 Specification sections apply to work of this section.
- B. Examine all other sections of the Specifications for requirements which affect work of this Section whether or not such work is specifically mentioned in this Section.
- C. Coordinate work with that of all trades affecting or affected by work of this Section. Cooperate with such trades to assure the steady progress of all work under the Contract.

1.02 DESCRIPTION OF WORK:

- A. Extent of structural steel work is shown on drawings, including schedules, notes and details to show size and location of members, typical connections, and type of steel required.
- B. Structural steel is that work defined in AISC “Code of Standard Practice” and as otherwise shown on drawings.

1.03 RELATED WORK

- 1. Section 05 50 00 - Metal Fabrications
- 2. Section 06 18 00 – Glued-Laminated Construction

1.04 QUALITY ASSURANCE:

- A. Codes and Standards: Comply with latest provisions of the following, except as otherwise indicated:
 - 1. AISC “Code of Standard Practice for Steel Buildings and Bridges”, Latest Edition.
 - a. The provisions of Section 10, “Architecturally Exposed Structural Steel”, apply to exposed steel elements for this project. In addition, exposed welds and edges shall be ground to provide smooth surface.

- b. Exclude the word “structural” in reference to the “Design Drawings” in section 3.1 of the Code.
2. AISC “Specification for Structural Steel Buildings”, including “Commentary” and Supplements issued thereto.
 3. AISC “*Specifications for Structural Joints using ASTM A 325 or A 490 Bolts*” approved by the Research Council on Structural Connections of the Engineering Foundation.
 4. AISC 341, “Seismic Provisions for Steel Buildings”.
 5. AWS D1.1 - “Structural Welding Code” - Steel.
 6. AWS D1.3 - “Structural Welding Code” - Sheet Steel.
 7. ASTM A6 “General Requirements for Delivery of Rolled Steel Plates, Shapes, Sheet Piling and Bars for Structural Use.”
 8. “Code of Federal Regulations, Part 1926” per the Occupational Safety and Health Administration (OSHA), Department of Labor (Latest Revision).
- B. Qualifications for Welding Work: Qualify welding processes and welding operators in accordance with AWS D1.1 “Standard Qualification Procedure.”
1. Provide certification that welders to be employed in work have satisfactorily passed AWS D1.1 qualification tests and maintained a current certification. Current certification and/or continuity log shall be submitted and be available in the field.
 2. If re-certification of welders is required, retesting will be the Contractor’s responsibility.
- C. Fabricator Qualifications: Fabricator must be a member of the American Institute of Steel Construction (AISC), be certified for SBD – Conventional Steel Building Structures, STD – Standard for Steel Building Structures. Fabricator shall be certified at time of bidding and for duration of project.

1.05 SUBMITTALS

- A. Unless otherwise specified, submittals required in this section shall be submitted for review. Submittals shall be prepared and submitted in accordance with this section and Division 1.
- B. General Contractor shall submit a Submittal Schedule to the engineer within 30 days after they have received the Owner’s Notice to Proceed.

- C. All submittals shall be reviewed and returned to the Architect within 10 working days.
- D. INCOMPLETE SUBMITTALS WILL NOT BE REVIEWED.
- E. Submittals not reviewed by the General Contractor prior to submission to the Engineer will not be reviewed. Include on the submittal statement or stamp of approval by Contractor, representing that the Contractor has seen and examined the submittal and that all requirements listed in Division 1 have been complied with.
- F. Engineer will review submittals a maximum of two review cycles as part of their normal services. If submittals are incomplete or otherwise unacceptable and re-submitted, General Contractor shall compensate Engineer for additional review cycles.
- G. Hardcopy Submittals: Submit three prints. Prints will be reviewed by the Engineer, and then the Architect. One marked print will be returned to Contractor for printing and distribution. Multiple copies will not be marked by the Engineer.
- H. Electronic Submittals:
 - 1. Contractor shall include in the submittal schedule an indication of submittals that are intended to be submitted electronically. Upon receipt of the submittal schedule, the Engineer reserves the right to indicate submittals that will not be accepted electronically. Paper copies of such submittals shall be furnished as referenced in this specification.
 - 2. The Engineer reserves the right to require paper copies of submittals that are received electronically. Provide Engineer one (1) paper copies in addition to the electronic submittal. Paper copy will be retained and electronic copy will be returned. Review cycle for such submittals shall not commence until such time that the paper copies are received.
 - 3. Electronic Submittals shall be submitted in Protected Document Format (PDF) compatible with Bluebeam version 12 or later. Electronic files shall not be broken into smaller individual files. File sizes too large to process email or within a file transfer protocol (FTP) site shall be provided on a CD.
 - 4. The submission of submittals electronically does not relieve the contractor of their responsibility to review the submittal prior to transmission to the Engineer. Electronic Submittals shall include contractor comments, and a statement and/or stamp of approval by Contractor, representing that the

Contractor has seen and examined the submittal and that all requirements listed in this Section and Division 1 have been complied with. Electronic submittals without the Contractor's approval will be rejected and returned.

5. The Engineer assumes no responsibility for the printed reproduction of submittals reviewed electronically, transmission errors or returned electronic submittals that become corrupted or are otherwise not accessible by the Contractor's or Subcontractor's computer hardware and/or software.
- I. Product Data: Submit producer's or manufacturer's specifications and installation instructions for the following products. Include laboratory test reports and other data to show compliance with specifications (including specified standards).
1. Structural steel certified mill reports for each grade of steel covering chemical and physical properties and yield strengths.
 2. High-strength bolts (each type), including nuts and washers.
 3. Structural steel primer paint (where applicable).
 4. Structural steel top coat paint (where applicable). (Refer to Section 09 90 00.)
 5. AWS D1.1 Welder certifications.
 6. Expansion/Adhesive Anchors (coordinate with section 03 30 00).
- J. Fabricator's Quality Control Procedures: Fabricator shall submit their written procedural and quality control manuals, and evidence of periodic auditing of fabrication practices by an approved inspection Agency.
- K. Fabricator's Certificate of Compliance: At completion of fabrication, fabricator shall submit a certificate of compliance stating that the work was performed in accordance with the construction documents.
- L. Shop Drawings:
1. Shop Drawing Review: Electronic files of structural drawings will not be provided to the contractor for preparation of shop drawings. Reproduction of any portion of the Construction Documents for use as Shop drawings and/or Erection Drawings is prohibited. Shop drawings and/or Erection drawings created from reproduced Construction Documents will be returned without review.

- a. Review of the shop drawings will be made for the size and arrangement of the members and strength of the connections. Conformance of the Shop Drawings to the Contract Drawings remains the responsibility of the General Contractor. Engineer's review in no way relieves the General Contractor of this responsibility.
 - b. Shop drawings will not be reviewed as partial submittals. A complete submittal shall be provided and shall include; erection and piece drawings indicating all members, braced frames, moment frames and connections. Incomplete submittals will not be reviewed.
2. Alternate Connection Design: Connections for all beam, column, braced frame, and moment connections not tabulated in the AISC "Manual of Steel Construction" (ASD or LRFD) have been designed and detailed in the drawings. Alternate connection design shall be allowed only with prior approval of the Structural Engineer. If such approval is granted, all redesigned connections shall be designed by the fabricator's engineer, registered in the State of Maine. Calculations for redesigned connections shall be signed and sealed.
 3. Test Reports: Submit copies of reports of tests conducted on shop and field bolted and welded connections. Include data on type(s) of test conducted and test results.

1.06 DELIVERY, STORAGE AND HANDLING:

- A. Deliver materials to site at such intervals to insure uninterrupted progress of work.
- B. Deliver anchor bolts and anchorage devices, which are to be embedded in cast-in-place, in ample time to not delay work.
- C. Store materials to permit easy access for inspection and identification. Keep steel members off ground, using pallets, platforms, or other supports. Protect steel members and packaged materials from corrosion and deterioration.
- D. Do not store materials on structure in a manner that might cause distortion or damage to members or supporting structures. Steel materials shall be stored in a manner to avoid ponding of precipitation on members. Repair or replace damaged materials or structures as directed.

PART 2 PRODUCTS

2.01 MATERIALS:

- A. Structural Steel Shapes, Plates and Bars (U.N.O): ASTM A 36 minimum, higher strength steel is acceptable.
- B. Structural Steel Hot Rolled Wide Flange Shapes: ASTM A 992 Grade 50 (ASTM A572 Grade 50 with special requirements per AISC Technical Bulletin #3, dated March 1997)
- C. Steel Tube: ASTM A 500, Grade B, $F_y = 46$ ksi.
- D. Steel Pipe: ASTM A 53, Grade B.
- E. Anchor Bolts: ASTM F1554, Grade 36 weldable steel, unless noted otherwise on drawings. Anchor rods that are to be exposed to weather, located in unheated enclosures, or in contact with pressure treated lumber shall be hot dipped galvanized. All anchor bolts shall be headed or double nutted. "J" or "L" type anchor bolts are not permitted. Unless otherwise noted, specified embedment it to top face of head or nut.
- F. Unfinished Threaded Fasteners: ASTM A 307, Grade A, regular low-carbon steel bolts and nuts. Provide hexagonal heads and nuts for all connections.
- G. High-Strength Threaded Fasteners: Heavy hexagon structural bolts, heavy hexagon nuts, and hardened washers, as follows:
 - 1. Quenched and tempered medium-carbon steel bolts, nuts and washers, complying with ASTM A325 or ASTM A490. Refer to drawings for diameter.
 - 2. Direct tension indicator washers or bolts may be used at Contractor's option.
- H. Deformed Bar Anchors, manufactured by Nelson and attached to structural steel. Refer to drawings for diameter and length.
- I. Electrodes for Welding:

1. Minimum 70 ksi electrodes. Filler material shall meet the grouping requirements per AWS D1.1 Table 3.1 for matching strength of connected materials.
 2. All filler metal used welding shall meet the following Charpy V-Notch (CVN) requirements.
 - a. 20 ft-lb at 0 degrees Fahrenheit unless noted otherwise.
 - b. 20 ft-lb at -20 degrees Fahrenheit and 40 ft-lb at 70 degrees Fahrenheit at all complete joint penetration (CJP) groove welds.
- J. Structural Steel Coatings shall be as specified in the Structural Steel Coatings section of this specification, and as specified in Division 9.
- K. Steel Coatings for Exterior Exposed Steel: Except where indicated to be primed and painted, Hot Dipped Galvanized per ASTM A123/A123M (latest edition). Galvanizing shall be applied in a manner to provide Class C faying surfaces for slip critical connections. See Structural Steel Coatings section for additional requirements for galvanizing and painting.
- L. Non Shrink Cement-Based Grout: See Section 03 30 00
- M. Drilled Anchors: Expansion and adhesive by HILTI unless otherwise noted.

2.02 FABRICATION:

- A. Shop Fabrication and Assembly: Fabricate and assemble structural assemblies in shop to greatest extent possible. Fabricate items of structural steel in accordance with AISC Specifications and as indicated on final shop drawings.
1. Properly mark and match-mark materials for field assembly. Fabricate for delivery sequence which will expedite erection and minimize field handling of materials.
 2. Where finishing is required, complete assembly, including welding of units, before start of finishing operations. Provide finish surfaces of members exposed in final structure free of markings, burrs and other defects.
- B. Connections: Weld or bolt shop connections, as indicated.
1. Provide field bolted connections, except where welded connections or other connections are indicated.
 2. Provide high-strength threaded fasteners for principal bolted connections, except where unfinished bolts are indicated.

- C. High-Strength Bolted Connection: Install high-strength threaded fasteners in accordance with AISC “Specification for Structural Joints using ASTM A 325 or A 490 Bolts”. Unless otherwise indicated, all bolted connections are to be tightened to the snug tight condition as defined by AISC.
- D. Welded Construction: Comply with AWS Codes for procedures, appearance and quality of welds, and methods used in correcting welding work.
- E. Holes for Other Work: Provide holes required for securing other work to structural steel framing, and for passage of other work through steel framing members, as shown on final shop drawings.
- F. Cut, drill, or punch holes perpendicular to metal surfaces. Do not flame cut holes or enlarge holes by burning. Drill holes in bearing plates.
- G. Fabricator, Erector and General Contractor shall coordinate safety requirements for the project, in accordance with OSHA Part 1926. Provide all necessary pieces and fabrications as required to safely erect and access the structure for the duration of project construction.
- H. Camber, if any, is indicated on the drawings. Camber indicated is the required camber at time of erection. Contractor shall survey camber prior to placing metal deck.

2.03 STRUCTURAL STEEL COATINGS

- A. Coordinate coating requirements with the Architect, and with Division 9 of the specifications.
- B. To the greatest extent possible, structural steel coatings shall be shop applied.
- C. Coordinate steel markings with coating system to eliminate “bleed through” on steel permanently exposed to view.
- D. Galvanizing, priming and painting for structural steel permanently exposed to view shall meet the requirements of Section 10 of the Code of Standard Practice, “Architecturally Exposed Structural Steel”.
- E. Provide venting/drainage holes in closed tubular members to be hot-dipped galvanized. Holes shall be provided in a location hidden from view in the final condition and in a manner that will not reduce the strength of the member. Hole locations shall be clearly indicated on the Shop Drawings and are subject to review by the Architect.

- F. Follow manufacturer's installation and safety instructions when applying coatings. Adhere to recoat time recommendations set forth by manufacturer.
- G. General: Shop priming of structural steel is not required for heated, interior steel not exposed to view unless noted otherwise.
- H. Steel which is to receive spray-on fireproofing shall not to be primed or painted, unless specified by the Architect.
- I. Unheated structural steel to be enclosed with architectural finishes, including but not by limitation, canopy members and/or roof pop-up members shall be primed with rust inhibitive alkyd primer, Tnemec Series 10 unless noted otherwise. Follow manufacturer's instructions for surface preparation and application. Substitution shall be equal to the above specified products, and shall be submitted for review.
- J. Steel Embedded in Concrete/Below Grade: Steel which is embedded in concrete, below grade/slab level, or as otherwise indicated on the drawings, shall be field painted with cold-applied asphalt emulsion complying with ASTM D 1187. Paint embedded areas only. Do not paint surfaces which are to be welded until welding is complete.
- K. Field Touch-up: Touch-up all paint and galvanizing damage, including but not by limitation, damage caused during shipping, erection, construction damage, and field welded steel. See Division 9 specifications for additional requirements.

PART 3 EXECUTION

3.01 ERECTION:

- A. General: Comply with AISC Specifications for bearing, adequacy of temporary connections, alignment, and removal of paint on surfaces adjacent to field welds.
- B. Erection Procedures: Comply with "Code of Federal Regulations, Part 1926" per the Occupational Safety and Health Administration (OSHA), Department of Labor (Latest Revision).
- C. Surveys: Employ a Registered Land Surveyor to verify elevations of concrete bearing surfaces, and locations of anchor bolts and similar devices, before erection work proceeds, and report discrepancies to Architect and Structural Engineer. Do not proceed with erection until corrections have been made, or until compensating adjustments to structural steel work have been approved by Structural Engineer of Record. Additional surveys required to verify out-of-alignment work and/or corrective work shall be performed at the contractor's expense.

- D. Temporary Shoring and Bracing: This is the sole responsibility of the Contractor. Provide temporary shoring and bracing members with connections of sufficient strength to support imposed loads. Remove temporary members and connections when all permanent members are in place, and all final connections are made, including the floor and roof diaphragms. Provide temporary guy lines to achieve proper alignment of structures as erection proceeds. Comply with OSHA Standard referenced previous. Retain the services of a Specialty Structural Engineer (Not the Engineer of Record) to design specialty shoring and bracing.
- E. Anchor Bolts: Furnish anchor bolts and other connectors required for securing structural steel to foundations and other in-place work.
1. Tighten anchor bolts after supported members have been positioned and plumbed. Do not remove wedges or shims, but if protruding, cut off flush with edge of base or bearing plate prior to packing with grout.
 2. Welding to anchor bolts for corrective measures is strictly prohibited without prior written approval from the Engineer.
- F. Setting Plates and Base Plates:
1. Furnish templates and other devices as necessary for presetting bolts and other anchors to accurate locations. Refer to division 3 of the project Specifications for anchor bolt installation requirements in concrete.
 2. Clean concrete bearing surfaces of bond-reducing materials. Clean bottom surface of setting and bearing plates.
 3. Set loose and attached base plates for structural members on wedges or other adjusting devices.
 4. Pack non-shrink grout solidly between bearing surfaces and bases or plates to ensure that no voids remain. Finish exposed surfaces, protect installed materials, and allow to cure. For proprietary grout materials, comply with manufacturer's instructions.
- G. When installing expansion bolts or adhesive anchors, the contractor shall take measures to avoid drilling or cutting any existing reinforcement or damaging adjacent concrete. Holes shall be blown clean with compressed air and/or cleaned per manufacturer's recommendations prior to the installation of anchors.
- H. Field Assembly:
1. Set structural frames accurately to lines and elevations indicated.

2. Align, adjust, level and plumb members of complete frame in to the tolerances indicated in the AISC Code of Standard Practice and in accordance with OSHA regulations.
 3. Clean bearing surfaces and other surfaces which will be in permanent contact before assembly.
 4. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
 5. Splice members only where indicated and accepted on shop drawings.
 6. Do not enlarge unfair holes in members by burning or by use of drift pins, except in secondary bracing members. Ream holes that must be enlarged to admit bolts.
- I. Tolerances: Erection tolerances shall meet the “Code of Standard Practice” except as noted. Cumulative tolerances of framing elements shall not exceed the available tolerances of façade support systems to ensure and provide a plumb façade face.
- J. Unless specified to be hot-dipped galvanized, all columns, base plates, and brace elements encased in concrete and/or below grade shall be coated with cold-applied asphalt emulsion. Coordinate coating with concrete work.
- K. Erection bolts: Remove erection bolts. On exposed welded construction and at all braced frame members fill holes with plug welds and grind smooth at exposed surface.
- L. Gas Cutting: Do not use gas cutting torches in field for correcting fabrication errors in primary structural framing. Cutting will be permitted only on secondary members which are not under stress, as accepted by the Engineer of Record. Finish gas-cut sections equal to a sheared appearance when permitted.
- M. Coating Damage: Touch up shop applied paint or galvanizing whenever damaged or bare. See “Coatings” sections for additional requirements.
- N. Field Cut Beam Web Penetrations:
1. Field cut beam web penetrations are not permitted without written approval from the Structural Engineer.
 2. Gas cutting torches are not permissible for cutting beam web penetrations without written approval from the Structural Engineer.

3. Beams with field cut beam web penetrations may require reinforcement, subject to the evaluation by the Structural Engineer.
 4. Field cut beam web penetrations may not be permitted in certain locations, subject to the evaluation by the Structural Engineer.
- O. Welders shall have current evidence of passing and maintaining the AWS D1.1 Qualifications test available in the field.
- P. Welding electrodes, welding process, minimum preheat and interpass temperatures shall be in accordance with AISC and AWS specifications. Any structural steel damaged in welding shall be replaced.

3.02 QUALITY CONTROL:

- A. General: Contractor is responsible for maintaining quality control in the field and for providing a structure that is in strict compliance with the Contract Documents.
1. Required inspection and testing services are intended to assist the Contractor in complying with the Contract Documents. These specified services, however, do not relieve the Contractor of his responsibility for compliance, nor are they intended to limit the Contractor's quality control efforts in the field.
- B. Testing: Owner shall engage an Independent Testing Agency to inspect all high-strength bolted and welded connections, to perform tests and prepare reports of their findings. All connections must pass these inspections prior to the installation of subsequent work which they support.
1. Testing agency shall conduct tests and state in each report which specific connections were examined or tested, whether the connections comply with requirements, and specifically state any deviations therefrom.
 2. Contractor shall provide access for testing agency to places where structural steel work is being fabricated, produced or erected so that required inspection and testing can be accomplished. Testing agency may inspect structural steel at plant before shipment. The Engineer, however, reserves the right, at any time before final acceptance, to reject material not complying with specified requirements.
- C. Inspection Requirements (to be performed by the Independent Testing Agency):
1. **Bolted Connections: Inspect all bolted connections in accordance with procedures outlined in the AISC "Specification for Structural Joints using ASTM A325 or A490 Bolts."**

2. Snug Tight Bolted Connections:

- a. The inspector shall monitor the installation of bolts to determine that all plies of connected material have been drawn together and that the selected procedure is used to tighten all bolts.
- b. If the inspector does not monitor the installation of bolts, he shall visually inspect the connection to determine that all plies of connected material have been drawn together and conduct tests on a sampling connection bolts to determine if they have been tightened to the snug tight condition. The test sample shall consist of 10% of the bolts in the connection, but not less than two bolts, selected at random. If more than 10% of the tested bolts fail the initial inspection, the engineer reserves the right to increase the number of bolts tested.

3. Slip Critical Bolted Connections:

- a. The inspector shall monitor the calibration of torquing equipment and the installation of bolts to determine that all plies of connected material have been drawn together and that the selected procedure is used to tighten all bolts.
- b. If the inspector does not monitor the calibration or installation procedures, he shall test all bolts in the affected connection using a manual torque wrench to assure that the required pretension has been reached.

4. Field Welded Connections: inspect and test during fabrication of structural steel assemblies, and during erection of structural steel all welded connections in accordance with procedures outline in AWS D1.1. Record types and location of defects found in work. Record work required and performed to correct deficiencies.

- a. Certify welders and conduct inspections and tests as required. Submit welder certifications to Engineer of Record. Perform visual inspection of all welds. Primary and secondary welds, including fillet welds, full penetration welds, and deck puddle welds, applied in the field and/or shop, shall be visually inspected.
- b. Welds deemed questionable by visual inspection shall receive non-destructive testing. In addition, all partial and full penetration welds, and any other welds indicated on the drawings are to receive non-destructive testing. Non-destructive testing methods include the following:

1. Radiographic Inspection (RT): ASTM E 94 and ASTM E 142; minimum quality level “2-2T”.
 2. Ultrasonic Inspection (UT): ASTM E 164.
 3. Magnetic Particle (MT) inspection procedures may be utilized at the inspectors discretion in addition to RT or UT inspection. MT procedures shall not replace RT or UT procedures without permission from the Structural Engineer.
- c. All welds deemed unacceptable shall be repaired and retested at the Contractor’s expense.
- D. Testing and inspection reports shall be submitted to the Owner, Architect and Engineer within 48 hours of completion of each test or inspection.
- E. Nonconforming Work: Contractor shall be responsible for correcting deficiencies in structural steel work which inspections laboratory test reports have indicated to be not in compliance with requirements. Additional tests and/or surveys shall be performed, at the Contractor’s expense, as may be necessary to show compliance of corrected work. Any costs associated with the Engineer’s review and disposition of faulty works shall be borne by the Contractor.

END OF SECTION

SECTION 055000 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Steel framing and supports for mechanical and electrical equipment.
2. Steel framing and supports for applications where framing and supports are not specified in other Sections.
3. Elevator machine beams, hoist beams,
4. Steel shapes for supporting elevator door sills.
5. Metal ladders.
6. Elevator pit sump covers.
7. Loose bearing and leveling plates for applications where they are not specified in other Sections.
8. Steel flat bar required for wood handrails.

B. Products furnished, but not installed, under this Section include the following:

1. Loose steel lintels.

1.3 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of metal fabrications that are anchored to or that receive other work. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.4 ACTION SUBMITTALS

A. Product Data: For the following:

1. Nonslip aggregates and nonslip-aggregate surface finishes.
2. Prefabricated building columns.
3. Metal nosings and treads.

4. Paint products.
 5. Grout.
- B. Shop Drawings: Show fabrication and installation details. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items. Provide Shop Drawings for the following:
1. Steel framing and supports for mechanical and electrical equipment.
 2. Steel framing and supports for applications where framing and supports are not specified in other Sections.
 3. Elevator machine beams, hoist beams,.
 4. Steel shapes for supporting elevator door sills.
 5. Metal ladders.
 6. Elevator pit sump covers.
 7. Loose bearing and leveling plates for applications where they are not specified in other Sections.
 8. Loose steel lintels.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For professional engineer.
- B. Welding certificates.
- C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

1.6 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.7 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance of Ladders: Provide ladders capable of withstanding the effects of loads and stresses within limits and under conditions specified in ANSI A14.3.
 1. Provide ladders meeting the OSHA requirements of 29CFR 1910.27.

- B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.

- 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 METALS

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.
- B. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- C. Steel Tubing: ASTM A 500/A 500M, cold-formed steel tubing.
- D. Steel Pipe: ASTM A 53/A 53M, Standard Weight (Schedule 40) unless otherwise indicated.

2.3 FASTENERS

- A. General: Unless otherwise indicated, provide Type 304 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.
- B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A; with hex nuts, ASTM A 563; and, where indicated, flat washers.
- C. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, ASTM F 593; with hex nuts, ASTM F 594; and, where indicated, flat washers; Alloy Group 1.
- D. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, ASTM A 563; and, where indicated, flat washers.
 - 1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.
- E. Anchors, General: Anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488/E 488M, conducted by a qualified independent testing agency.
- F. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors.
 - 1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, unless otherwise indicated.
 - 2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 stainless-steel bolts, ASTM F 593, and nuts, ASTM F 594.

2.4 MISCELLANEOUS MATERIALS

- A. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
 - 1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.
- B. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Benjamin Moore & Co.; Epoxy Zinc-Rich Primer CM18/19.
 - b. ICI Devco Coatings; Catha-Coat 313.
 - c. International Coatings Limited; Interzinc 315 Epoxy Zinc-Rich Primer.
 - d. PPG Architectural Finishes, Inc.; Epoxy Zinc Rich Primer 97-670.
 - e. Sherwin-Williams Company (The); Zinc Clad IV, B69A8/B69V8.
 - f. Tnemec Company, Inc.; Tneme-Zinc 90-97.
- C. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish paint systems indicated.
- D. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.
 - 1. Available Products:
 - a. Sealmastic, Type 1; W. R. Meadows
 - b. Hydrocide 600; Sonneborn Building Products.
 - c. Karnak 100 AF; Karnac Chemical Corp.
- F. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.
 - 1. Available Products:
 - a. Five Star Grout by Five Star Products, Inc.
 - b. Masterflow 928 Grout by Master Builders Technologies.
 - c. SonogROUT 10K by Sonneborn.
 - d. 14K Hy Flow by Sonneborn.

2.5 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

- B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- D. Form exposed work with accurate angles and surfaces and straight edges.
- E. Weld corners and seams continuously to comply with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.
- G. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.
- I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.
- J. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches, with a minimum 6-inch embedment and 2-inch hook, not less than 8 inches from ends and corners of units and 24 inches o.c., unless otherwise indicated.

2.6 MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.
- B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.

2.7 METAL LADDERS

- A. General:

1. Comply with ANSI A14.3, except for elevator pit ladders.
2. For elevator pit ladders, comply with ASME A17.1/CSA B44.

B. Fabricate ladders from materials as detailed on the drawings or if not indicated, as follows:

1. Space siderails 18 inches apart unless otherwise indicated.
2. Siderails: Continuous, 1/2-by-2-1/2-inch steel flat bars, with eased edges.
3. Rungs: 3/4-inch- diameter steel bars, spaced 12 inches o.c..
4. Fit rungs in centerline of siderails; plug-weld and grind smooth on outer rail faces.
5. Provide nonslip surfaces on top of each rung, either by coating rung with aluminum-oxide granules set in epoxy-resin adhesive or by using a type of manufactured rung filled with aluminum-oxide grout.
6. Support each ladder at top and bottom and not more than 60 inches o.c. with welded or bolted steel brackets.
7. Prime ladders, including brackets and fasteners, with zinc-rich primer.

C. Aluminum Roof Hatch Ladder:

1. Product: Provide Counterbalanced Lower Sliding Ladder by Jomy or equal.
2. One mobile and one fixed upright.
3. Space siderails 18 inches apart unless otherwise indicated.
4. Siderails: Continuous extruded-aluminum channels or tubes, not less than 2-1/2 inches deep, 3/4 inch wide, and 1/8 inch thick.
5. Rungs: Extruded-aluminum tubes, not less than 3/4 inch deep and not less than 1/8 inch thick, with ribbed tread surfaces.
6. Fit rungs in centerline of siderails; fasten by welding or with stainless-steel fasteners or brackets and aluminum rivets.
7. Support each ladder at top and bottom of fixed length with welded or bolted aluminum brackets.
8. Counter Balance Springs: The ladder is balanced by stainless steel counterbalance springs. It opens and closes with minimal effort. The ladder deploys softly.

2.8 ELEVATOR PIT SUMP COVERS

- A. Fabricate from welded or pressure-locked steel bar grating. Limit openings in gratings to no more than 1/2 inch in least dimension.
- B. Support Frame: Provide 1-1/2 by 1-1/2 by 1/4 inch steel angle around perimeter of sump pit, fastened with 1/4 inch galvanized expansion anchors.
- C. Galvanize steel elevator pit cover, including support frame and fasteners.

2.9 MISCELLANEOUS STEEL TRIM

- A. Unless otherwise indicated, fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.

- B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.
 - 1. Provide with integrally welded steel strap anchors for embedding in concrete or masonry construction.
- C. Prime miscellaneous steel trim with universal primer, unless noted otherwise.

2.10 LOOSE BEARING AND LEVELING PLATES

- A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.
- B. Prime plates with zinc-rich primer.

2.11 FINISHES, GENERAL

- A. Finish metal fabrications after assembly.
- B. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.12 STEEL AND IRON FINISHES

- A. Galvanizing: Provide coating for iron and steel fabrications applied by the hot-dipped process, Duragalv by Duncan Galvanizing. The galvanizing bath shall contain high grade zinc and other earthly materials. Immediately before galvanizing, the steel shall be immersed in a bath of zinc ammonium chloride. The use of the wet kettle process is prohibited. Comply with ASTM A123 for fabricated products and ASTM A 153 for hardware. Provide thickness of galvanizing specified in referenced standards.
 - 1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
- B. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.
 - 1. Shop prime with universal shop primer unless zinc-rich primer is indicated.
- C. Preparation for Shop Priming: Prepare surfaces to comply with requirements indicated below:
 - 1. Exterior Items: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 - 2. Items Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 - 3. Other Items: SSPC-SP 3, "Power Tool Cleaning."
- D. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- C. Field Welding: Comply with the following requirements:
 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 2. Obtain fusion without undercut or overlap.
 3. Remove welding flux immediately.
 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.
- E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

3.2 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.

3.3 INSTALLING BEARING AND LEVELING PLATES

- A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of plates.
- B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if

protruding, cut off flush with edge of bearing plate before packing with nonshrink grout. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.4 ELEVATOR SUMP PIT COVER

- A. Set perimeter support angles 1/4 inch below the edge of the sump pit to allow the sump cover plate to set flush with elevator pit floor.

3.5 ADJUSTING AND CLEANING

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - 1. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780/A 780M.

END OF SECTION 055000

SECTION 055100 - METAL STAIRS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Preassembled steel stairs with concrete-filled treads.
2. Steel tube railings attached to metal stairs.
3. Steel tube handrails attached to walls adjacent to metal stairs.

1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design metal stairs, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Structural Performance of Stairs: Metal stairs shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated.
 1. Uniform Load: 100 lbf/sq. ft..
 2. Concentrated Load: 300 lbf applied on an area of 4 sq. in..
 3. Uniform and concentrated loads need not be assumed to act concurrently.
 4. Stair Framing: Capable of withstanding stresses resulting from railing loads in addition to loads specified above.
 5. Limit deflection of treads, platforms, and framing members to $L/360$ or 1/4 inch, whichever is less.
- C. Structural Performance of Railings: Railings shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated.
 1. Handrails and Top Rails of Guards:
 - a. Uniform load of 50 lbf/ ft. applied in any direction.
 - b. Concentrated load of 200 lbf applied in any direction.
 - c. Uniform and concentrated loads need not be assumed to act concurrently.
 2. Infill of Guards:
 - a. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft..
 - b. Infill load and other loads need not be assumed to act concurrently.

- D. Seismic Performance: Metal stairs shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

- 1. Component Importance Factor is 1.5.

1.4 ACTION SUBMITTALS

- A. Product Data: For metal stairs and the following:

- 1. Paint products.

- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

- C. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified professional engineer.

- B. Welding certificates.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Fabricator of products.

- B. NAAMM Stair Standard: Comply with "Recommended Voluntary Minimum Standards for Fixed Metal Stairs" in NAAMM AMP 510, "Metal Stairs Manual," for class of stair designated, unless more stringent requirements are indicated.

- 1. Preassembled Stairs: Commercial class.

- C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

- D. Regulatory Requirements: Comply with the Americans with Disabilities Act (ADA) and with code provisions as adopted by authorities having jurisdiction.

- 1. Stairs and Handrails: Provide stairs and handrails as required by accessibility regulations and requirements of authorities having jurisdiction. These include, but are not limited to, the following:

- a. Treads and Risers:

- 1) Provide treads with uniform riser heights and tread widths.
 - 2) Provide no less than 11 inch tread width.

- b. Nosings:

- 1) Provide the radius of curvature at the leading edge of the tread of not greater than 1/2 inch.
 - 2) Provide sloped risers or the angle on the underside of the nosing will not be less than 60 degrees from the horizontal.
 - 3) Project nosings not more than 1-1/2 inch.
- c. Size and Spacing of Handrails:
- 1) Handrail Diameter: 1-1/4 to 1-1/2 inches.
 - 2) Space between Wall and Rails: 1-1/2 inches.
 - 3) Either round ends of handrails or return ends of handrails smoothly to floor, wall or post.
 - 4) Handrails shall not rotate within their fittings.
- d. Locations of Handrails:
- 1) Provide handrails at both sides of stairs.
 - 2) Provide continuous inside handrail on switchback or dogleg stairs.
 - 3) Provide continuous handrails on both sides of the stair. When handrails are not continuous, extend handrails at least 12 inches beyond the top riser and at least 12 inches plus the width of one tread beyond the bottom riser. At the top, the extension shall be parallel with the floor or ground surface. At the bottom, continue the handrail to slope for a distance of the width of one tread from the bottom riser; the remainder of the extension shall be horizontal.
 - 4) Mount the top of handrail gripping surface between 34 and 38 inches above stair nosing or ramp surface.
- e. Structural Strength of Handrails: Refer to article in this section "Performance Requirements".
2. Notify Architect of details or specifications not conforming to code.

1.7 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorages for metal stairs. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- C. Coordinate locations of hanger rods and struts with other work so that they will not encroach on required stair width and will be within the fire-resistance-rated stair enclosure.

PART 2 - PRODUCTS

2.1 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For components exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

2.2 FERROUS METALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- B. Steel Tubing: ASTM A 500 (cold formed) or ASTM A 513.
- C. Uncoated, Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, either commercial steel, Type B, or structural steel, Grade 25, unless another grade is required by design loads; exposed.
- D. Uncoated, Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, either commercial steel, Type B, or structural steel, Grade 30, unless another grade is required by design loads.

2.3 FASTENERS

- A. General: Provide zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941, Class Fe/Zn 12 for exterior use, and Class Fe/Zn 5 where built into exterior walls. Select fasteners for type, grade, and class required.
- B. Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A; with hex nuts, ASTM A 563; and, where indicated, flat washers.
- C. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, ASTM A 563; and, where indicated, flat washers.
- D. Machine Screws: ASME B18.6.3.
- E. Lag Screws: ASME B18.2.1.
- F. Plain Washers: Round, ASME B18.22.1.
- G. Lock Washers: Helical, spring type, ASME B18.21.1.
- H. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.
 - 1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, unless otherwise indicated.

2.4 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
- B. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
 - 1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.
- C. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.
- D. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.
 - 1. Available Products:
 - a. Five Star Grout by Five Star Products, Inc.
 - b. Masterflow 928 Grout by Master Builders Technologies.
 - c. SonogROUT 10K by Sonneborn.
 - d. 14K Hy Flow by Sonneborn.
- E. Concrete Materials and Properties: Comply with requirements in Section 033000 "Cast-in-Place Concrete" for normal-weight, air-entrained, ready-mix concrete with a minimum 28-day compressive strength of 3000 psi unless otherwise indicated.
- F. Welded Wire Fabric: ASTM A 185/A 185M, 6 by 6 inches, W1.4 by W1.4, unless otherwise indicated.

2.5 FABRICATION, GENERAL

- A. Provide complete stair assemblies, including metal framing, hangers, struts, railings, clips, brackets, bearing plates, and other components necessary to support and anchor stairs and platforms on supporting structure.
 - 1. Join components by welding unless otherwise indicated.
 - 2. Use connections that maintain structural value of joined pieces.
 - 3. Fabricate treads and platforms of exterior stairs so finished walking surfaces slope to drain.
- B. Preassembled Stairs: Assemble stairs in shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.
- C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

- D. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- E. Form exposed work with accurate angles and surfaces and straight edges.
- F. Weld connections to comply with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. Weld exposed corners and seams continuously unless otherwise indicated.
 - 5. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Type 2 welds: completely sanded joint, some undercutting and pinholes okay.
- G. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts unless otherwise indicated. Locate joints where least conspicuous.
- H. Fabricate joints that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

2.6 STEEL-FRAMED STAIRS

- A. Stair Framing:
 - 1. Fabricate stringers of steel channels.
 - a. Provide closures for exposed ends of channel stringers.
 - 2. Construct platforms of steel channel headers and miscellaneous framing members as indicated.
 - 3. Weld or bolt stringers to headers; weld or bolt framing members to stringers and headers. If using bolts, fabricate and join so bolts are not exposed on finished surfaces.
 - 4. Where stairs are enclosed by gypsum board shaft-wall assemblies, provide hanger rods or struts to support landings from floor construction above or below. Locate hanger rods and struts where they will not encroach on required stair width and will be within the fire-resistance-rated stair enclosure.
- B. Metal-Pan Stairs: Form risers, subtread pans, and subplatforms to configurations shown from steel sheet of thickness needed to comply with performance requirements but not less than 0.067 inch.
 - 1. Steel Sheet: Uncoated cold-rolled steel sheet.
 - 2. Attach risers and subtreads to stringers with brackets made of steel angles or bars. Weld brackets to stringers and attach metal pans to brackets by welding, riveting, or bolting.
 - 3. Shape metal pans to include nosing integral with riser.
 - 4. Provide subplatforms of configuration indicated or, if not indicated, the same as subtreads. Weld subplatforms to platform framing.

- a. Smooth Soffit Construction: Construct subplatforms with flat metal under surfaces to produce smooth soffits.

2.7 STAIR RAILINGS

- A. Steel Tube Railings: Fabricate railings to comply with requirements indicated for design, dimensions, details, finish, and member sizes, including wall thickness of tube, post spacings, and anchorage, but not less than that needed to withstand indicated loads.
 1. Configuration: As indicated on the drawings.
- B. Welded Connections: Fabricate railings with welded connections. Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.
 1. Finish welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Type 2 welds: completely sanded joint, some undercutting and pinholes okay.
- C. Form changes in direction of railings as follows:
 1. As detailed.
- D. Form simple and compound curves by bending members in jigs to produce uniform curvature for each repetitive configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.
- E. Close exposed ends of railing members with prefabricated end fittings.
- F. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 1/4 inch or less.
- G. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, end closures, flanges, miscellaneous fittings, and anchors for interconnecting components and for attaching to other work. Furnish inserts and other anchorage devices for connecting to concrete or masonry work.
 1. Connect posts to stair framing by direct welding unless otherwise indicated.
 2. For nongalvanized railings, provide nongalvanized ferrous-metal fittings, brackets, fasteners, and sleeves, except galvanize anchors embedded in exterior masonry and concrete construction.
- H. Fillers: Provide fillers made from steel plate, or other suitably crush-resistant material, where needed to transfer wall bracket loads through wall finishes to structural supports. Size fillers to suit wall finish thicknesses and to produce adequate bearing area to prevent bracket rotation and overstressing of substrate.

2.8 FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Finish metal stairs after assembly.
- C. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
- D. Apply shop primer to uncoated surfaces of metal stair components, except those with galvanized finishes and those to be embedded in concrete or masonry unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.
 - 1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal stairs to in-place construction. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.
- B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal stairs. Set units accurately in location, alignment, and elevation, measured from established lines and levels and free of rack.
- C. Install metal stairs by welding stair framing to steel structure or to weld plates cast into concrete unless otherwise indicated.
- D. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
- E. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- F. Field Welding: Comply with requirements for welding in "Fabrication, General" Article.
- G. Place and finish concrete fill for treads and platforms to comply with Section 033000 "Cast-in-Place Concrete."

3.2 INSTALLING METAL STAIRS WITH ANCHORED BASEPLATES

- A. Clean concrete and masonry bearing surfaces. Clean bottom surface of baseplates.

- B. Set steel stair baseplates on wedges, shims, or leveling nuts. After stairs have been positioned and aligned, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate.

3.3 INSTALLING RAILINGS

- A. Adjust railing systems before anchoring to ensure matching alignment at abutting joints. Space posts at spacing indicated or, if not indicated, as required by design loads. Plumb posts in each direction. Secure posts and rail ends to building construction as follows:
 - 1. Anchor posts to steel by welding directly to steel supporting members.
- B. Attach handrails to wall with wall brackets. Use type of bracket with predrilled hole for exposed bolt anchorage. Provide bracket with 1-1/2-inch clearance from inside face of handrail and finished wall surface. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads. Secure wall brackets to building construction as follows:
 - 1. For wood stud partitions, use hanger or lag bolts set into studs or wood backing between studs. Coordinate with carpentry work to locate backing members.

3.4 ADJUSTING AND CLEANING

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - 1. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.

END OF SECTION 055100

SECTION 057313 - GLAZED DECORATIVE METAL RAILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Glass-supported railings.

1.3 DEFINITIONS

- A. Railings: Guards, handrails, and similar devices used for protection of occupants at open-sided floor areas and for pedestrian guidance and support, visual separation, or wall protection.

1.4 COORDINATION AND SCHEDULING

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions to ensure that shop primers and topcoats are compatible.
- B. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver items to Project site in time for installation.

1.5 PREINSTALLATION MEETINGS

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

1.6 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Manufacturer's product lines of railings assembled from standard components.
 - 2. Grout, anchoring cement, and paint products.
- B. Shop Drawings: Include plans, elevations, sections, and attachment details.

- C. Samples for Verification: For each type of exposed finish required.
 - 1. Sections of each distinctly different linear railing member, including handrails, top rails, posts, and balusters.
 - 2. Each type of glass required.
 - 3. Fittings and brackets.
 - 4. Assembled Samples of railing systems, made from full-size components, including top rail, post, handrail, and infill. Show method of finishing members at intersections. Samples need not be full height.
- D. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.7 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, according to ASTM E 894 and ASTM E 935.
- B. Preconstruction test reports.
- C. Evaluation Reports: For post-installed anchors, from ICC-ES.

1.8 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with railings by field measurements before fabrication and indicate measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Blum, Julius & Co., Inc.
 - 2. Morse Industries.
 - 3. P & P Artec.
- B. Source Limitations: Obtain each type of railing from single source from single manufacturer.
- C. Product Options: Information on Drawings and in Specifications establishes requirements for system's aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are

indicated by criteria subject to verification by one or more methods, including structural analysis, preconstruction testing, field testing, and in-service performance.

1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.

2.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design railings, including attachment to building construction.
- B. General: In engineering railings to withstand structural loads indicated, determine allowable design working stresses of railing materials based on the following:
 1. Aluminum: The lesser of minimum yield strength divided by 1.65 or minimum ultimate tensile strength divided by 1.95.
 2. Glass: 25 percent of mean modulus of rupture (50 percent probability of breakage), as listed in "Mechanical Properties" in AAMA's Aluminum Curtain Wall Series No. 12, "Structural Properties of Glass."
- C. Structural Performance: Railings, including attachment to building construction, shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
 1. Handrails and Top Rails of Guards:
 - a. Uniform load of 50 lbf/ft. applied in any direction.
 - b. Concentrated load of 200 lbf applied in any direction.
 - c. Uniform and concentrated loads need not be assumed to act concurrently.
 2. Infill of Guards:
 - a. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft..
 - b. Infill load and other loads need not be assumed to act concurrently.
 3. Glass-Supported Railings: Support each section of top rail by a minimum of three glass panels or by other means so top rail will remain in place if any one panel fails.

2.3 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.
- B. Brackets, Flanges, and Anchors: Same metal and finish as supported rails unless otherwise indicated.

2.4 ALUMINUM

- A. Aluminum, General: Provide alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with strength and durability properties for each aluminum form required not less than that of alloy and temper designated below.
- B. Extruded Bars and Shapes: ASTM B 221, Alloy 6063-T5/T52.
- C. Castings: ASTM B 26/B 26M, Alloy A356.0-T6.

2.5 GLASS AND GLAZING MATERIALS

- A. Safety Glazing: Glazing shall comply with 16 CFR 1201, Category II.
- B. Tempered Glass: ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated), Type 1 (transparent flat glass), Quality-Q3. Provide products that have been tested for surface and edge compression according to ASTM C 1048 and for impact strength according to 16 CFR 1201 for Category II materials.
 - 1. Glass Color: Clear.
 - 2. Thickness for Structural Glass Balusters: As required by structural loads, but not less than 12.0 mm.
- C. Safety Glazing Labeling: Permanently mark glass 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.
- D. Glazing Cement and Accessories for Structural Glazing: Glazing cement, setting blocks, shims, and related accessories as recommended or supplied by railing manufacturer for installing structural glazing in metal subrails.
 - 1. Glazing Cement: Nonshrinking organic cement designed for curing by passing an electric current through metal subrail holding glass panel, as standard with manufacturer.
- E. Glazing Gaskets for Glass Infill Panels: Glazing gaskets and related accessories recommended or supplied by railing manufacturer for installing glass infill panels in post-supported railings.

2.6 FASTENERS

- A. Fastener Materials: Unless otherwise indicated, provide the following:
 - 1. Stainless-Steel Components: Type 304 stainless-steel fasteners.
- B. Fasteners for Anchoring to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.

- C. Provide concealed fasteners for interconnecting railing components and for attaching railings to other work unless exposed fasteners are unavoidable.
 - 1. Provide Phillips flat-head machine screws for exposed fasteners unless otherwise indicated.
- D. Post-Installed Anchors: Fastener systems with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC193.
 - 1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, unless otherwise indicated.

2.7 MISCELLANEOUS MATERIALS

- A. Wood Rails: Clear, straight-grained hardwood rails secured to metal bracket.
 - 1. Species: Clear, kiln-dried hard maple.
 - 2. Finish: Transparent polyurethane.
 - 3. Staining: None.
 - 4. Profile: As indicated on the drawings.
- B. Handrail Brackets: SA-01 and SA-02 Wall & Glass Mounted Handrail Bracket by Compearance, clear anodized finish.
- C. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- D. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound.

2.8 FABRICATION

- A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage.
- B. Assemble railings in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.
- C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- D. Form work true to line and level with accurate angles and surfaces.

- E. Fabricate connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate. Locate weep holes in inconspicuous locations.
- F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.
- G. Form changes in direction as follows:
 - 1. As detailed.
- H. Bend members in jigs to produce uniform curvature for each configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.
- I. Close exposed ends of hollow railing members with prefabricated end fittings.
- J. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work where indicated.
 - 1. At brackets and fittings fastened to plaster or gypsum board partitions, provide crush-resistant fillers, or other means to transfer loads through wall finishes to structural supports and to prevent bracket or fitting rotation and crushing of substrate.
- K. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.

2.9 GLAZING PANEL FABRICATION

- A. General: Fabricate to sizes and shapes required; provide for proper edge clearance and bite on glazing panels.
 - 1. Clean-cut or flat-grind edges at butt-glazed sealant joints to produce square edges with slight chamfers at junctions of edges and faces.
 - 2. Grind smooth exposed edges, including those at open joints, to produce square edges with slight chamfers at junctions of edges and faces.
- B. Structural Balusters: Provide tempered glass panels.

2.10 GENERAL FINISH REQUIREMENTS

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipment.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

- C. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.

2.11 ALUMINUM FINISHES

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

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Fit exposed connections together to form tight, hairline joints.
- B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.
 - 1. Do not weld, cut, or abrade surfaces of railing components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
 - 2. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet.
- C. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.
 - 1. Coat concealed surfaces of aluminum that will be in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.
- D. Adjust railings before anchoring to ensure matching alignment at abutting joints.
- E. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.2 STAIR RAILING INSTALLATION

- A. Railings: Secure wood rails with metal brackets. Assemble railings at goosenecks, easements, and splices with rail bolts and glue.

3.3 INSTALLING GLASS PANELS

- A. Glass-Supported Railings: Install assembly to comply with railing manufacturer's written instructions.
 - 1. Attach base channel to building structure, then insert glass into base channel and bond with glazing cement.

- a. Support glass panels in base channel at quarter points with channel-shaped setting blocks that also act as shims to maintain uniform space for glazing cement. Fill remaining space in base channel with glazing cement for uniform support of glass.
2. Adjust spacing of glass panels so gaps between panels are equal before securing in position.
3. Erect glass railings under direct supervision of manufacturer's authorized technical personnel.

3.4 CLEANING

- A. Clean aluminum and stainless steel by washing thoroughly with water and soap, rinsing with clean water, and wiping dry.
- B. Clean and polish glass as recommended in writing by manufacturer. Wash both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion.
- C. Clean wood rails by wiping with a damp cloth and then wiping dry.

3.5 PROTECTION

- A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.
- B. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units.

END OF SECTION 057313

06 10 00 ROUGH CARPENTRY

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. The drawings and general conditions of the contract including General and Supplementary Conditions and other Division 1 Specification sections apply to work of this section.
- B. Examine all other sections of the Specifications for requirements which affect work of this Section whether or not such work is specifically mentioned in this Section.
- C. Coordinate work with that of all trades affecting or affected by work of this Section. Cooperate with such trades to assure the steady progress of all work under the Contract.

1.02 DESCRIPTION OF WORK:

- A. Work Included: Provide labor, materials, and equipment necessary to complete the work of this Section, and without limiting the generality thereof furnish and install the following:
 - 1. Wood framing, including joists, rafters, outriggers, scab-ons, headers, stringers, posts, studs, plates, truss bracing and similar members.
 - 2. Wood grounds, nailers, blocking and sleepers.
 - 3. Wood furring.
 - 4. Floor, roof and wall sheathing.
 - 5. Miscellaneous carpentry as indicated or required and not specified under other Sections of the Specifications.
 - 6. Fasteners and accessories as indicated and required for rough carpentry.
 - 7. Treated wood as specified.
- B. Related Work Specified Elsewhere:
 - 1. Finish carpentry: Section 06 20 00.
 - 2. Prefabricated wood trusses: Section 06 19 00.

3. Wood Roof Decking: Section 06 15 16
4. Glued-Laminated Timber: Section 06 18 00
5. Gypsum wall sheathing: Section 09 25 00.
6. Underlayments: Division 7
7. Furnishing and installing of doors and frames: Division 8.

1.03 QUALITY ASSURANCE:

- A. Codes and Standards: Comply with provisions of the latest edition of the following except where more stringent requirements are shown or specified:
 1. International Building Code, 2009 Edition – International Code Council
 2. ANSI/AF&PA (American Forest & Paper Association) – NDS National Design Specification for Wood Construction – Latest Edition
 3. AHA (American Hardboard Association) A135.4 – Basic Hardboard.
 4. ALSC (American Lumber Standards Committee) – Softwood Lumber Standards.
 5. ANSI A208.1 – Mat-Formed Wood Particleboard.
 6. APA (American Plywood Association).
 7. AWPA (American Wood Preservers Association) C1-All Timber Products – Preservative Treatment by Pressure Process.
 8. AWPA (American Wood Preservers Association) C20-Structural Lumber Fire Retardant Treatment by Pressure Process.
 9. NELMA (New England Lumber Manufacturer’s Association).
 10. NLGA (National Lumber Grades Authority)
 11. NIST (National Institute of Standards and Technology, U. S. Department of Commerce [DOC])
 12. NFPA (National Forest Products Association)

13. NFPA (National Fire Protection Association)
14. SPIB (Southern Pine Inspection Bureau).
15. WCLIB (West Coast Lumber Inspection Bureau).
16. WWPA (Western Wood Products Association).
17. “Code of Federal Regulations, Part 1926” per the Occupational Safety and Health Administration (OSHA), Department of Labor (Latest Revision).

B. Lumber shall be supplied in accordance with the following agencies:

1. Lumber Grading Agency: Certified by NLGA for structural framing.
2. Sheathing Grading Agency: Certified by APA or ICBO approved certification agency. For non-APA rated plywood, provide ICC ES Evaluation report.
3. Grading stamp shall be on lumber and plywood.
4. Submit manufacturer's certificate certifying that products meet or exceed specified requirements.

C. Panelized/Prefabrication plant inspection: Prefabrication plant is subject to plant inspection completed by the Engineer-of-Record or an approved Third Party Inspection Agency. Inspections shall be performed at the Contractor's expense. Plant inspection does not relieve the Contractor of the obligation to perform work in accordance with the Construction Documents or from implementing their own shop and field quality control program.

1.04 SUBMITTALS

- A. Unless otherwise specified, submittals required in this section shall be submitted for review. Submittals shall be prepared and submitted in accordance with Division 1.
- B. General Contractor shall submit a Submittal Schedule to the engineer within 30 days after they have received the Owner's Notice to Proceed.
- C. All submittals shall be reviewed and returned to the Architect within 10 working days.
- D. Incomplete submittals will not be reviewed.

- E. Submittals not reviewed by the General Contractor prior to submission to the Engineer will not be reviewed. Include on the submittal statement or stamp of approval by Contractor, representing that the Contractor has seen and examined the submittal and that all requirements listed in sections Division 1 have been complied with.
- F. Engineer will review submittals a maximum of two review cycles as part of their normal services. If submittals are incomplete or otherwise unacceptable and re-submitted, General Contractor shall compensate Engineer for additional review cycles.
- G. Hardcopy Submittals: Submit three prints. Prints will be reviewed by the Engineer, and then the Architect. One marked print will be returned to Contractor for printing and distribution. Multiple copies will not be marked by the Engineer.
- H. Electronic Submittals:
 - 1. Contractor shall include in the submittal schedule an indication of submittals that are intended to be submitted electronically. Upon receipt of the submittal schedule, the Engineer reserves the right to indicate submittals that will not be accepted electronically. Paper copies of such submittals shall be furnished as referenced in this specification.
 - 2. The Engineer reserves the right to require paper copies of submittals that are received electronically. Provide Engineer one (1) paper copies in addition to the electronic submittal. Paper copy will be retained and electronic copy will be returned. Review cycle for such submittals shall not commence until such time that the paper copies are received.
 - 3. Electronic Submittals shall be submitted in Protected Document Format (PDF) compatible with Adobe Acrobat Professional version 7.0 or later. Electronic files shall not be broken into smaller individual files. File sizes too large to process email or within a file transfer protocol (FTP) site shall be provided on a CD.
 - 4. The submission of submittals electronically does not relieve the contractor of their responsibility to review the submittal prior to transmission to the Engineer. Electronic Submittals shall include contractor comments, and a statement and/or stamp of approval by Contractor, representing that the Contractor has seen and examined the submittal and that all requirements listed in this Section and Division 1 have been complied with. Electronic submittals without the Contractor's approval will be rejected and returned.
 - 5. The Engineer assumes no responsibility for the printed reproduction of submittals

reviewed electronically, transmission errors or returned electronic submittals that become corrupted or are otherwise not accessible by the Contractor's or Subcontractor's computer hardware and/or software.

- I. Panelized Construction Fabrication and Erection Drawings: If the contractor elects to use prefabricated wall, floor and/or roof panels, the panels shall meet or exceed the framing indicated in the construction documents, and applicable code requirements. Review by Engineer is for structural elements only; dimensional review is specifically excluded for this scope. Contractor remains solely responsible for proper fit-up of panels. Shop drawings shall include the following:
 1. Framing layouts for all panel assemblies as required to completely describe panel construction.
 2. Identification of all framing, sheathing and connection components
 3. Sheathing Lap Details
 4. Fastener patterns, spacing, length, diameter and finish for all prefabricated panels including framing and sheathing conditions.
 5. Field fastening and construction details
 6. Alternate framing connections that vary from design documents shall be submitted to the Engineer for approval prior to preparation of the shop drawings. Acceptance of alternate framing connections is subject to Engineer's review based on to project condition. Contractor is responsible to provide as-detailed conditions if alternate connections are not accepted.
- J. Product Data: Submit producer's or manufacturer's specifications and installation instructions for the following products. Include laboratory test reports and other data to show compliance with specifications (including specified standards). Product data shall include ICC/ICBO Evaluation Reports indicating conformance to standards specified here within.
 1. Engineered Wood Products
 2. Pressure Treated Lumber
 3. Sheathing

4. Samples of Exposed to View Wood Members: Submit two samples, 6 inches long, illustrating wood grain, stain, and finish.
5. Hangers, Hardware and Accessories

1.05 DELIVERY, STORAGE, AND PROTECTION

- A. Protect materials from warping or other distortion by stacking to resist movement.
- B. Follow manufacturer's recommendations for storage of Engineered Wood Products and connection hardware.

PART 2 PRODUCTS

2.01 LUMBER MATERIALS

- A. Lumber, General: Factory-mark each piece of lumber with type, grade, mill and grading agency, except omit marking from surfaces to be exposed with transparent finish or without finish.
- B. Nominal sizes are indicated, except as shown by detail dimensions. Provide actual sizes as required by PS 20, for moisture content specified for each use.
 1. Provide dressed lumber, S4S, unless otherwise indicated.
 2. Provide seasoned lumber with 19% maximum moisture content at time of dressing.
- C. For structural framing (4" and wider and from 2" to 4" thick), provide the following grade and species:
 1. Spruce-Pine-Fir (SPF) #1/2 or better, NLGA Graded, unless noted otherwise on Structural Drawings, Minimum Design Stresses:

- a. Fb: 875 psi
- b. Ft: 450 psi
- c. Fv: 135 psi
- d. $F_{c\perp}$: 425 psi
- e. Fc: 1,150 psi
- f. E: 1,400,000 psi

2. Pressure treated lumber: Southern Yellow Pine #2 or better. Minimum Design Stresses:

- a. Fb: 1,300 psi
- b. Ft: 775 psi
- c. Fv: 175 psi
- d. $F_{c\perp}$: 565 psi
- e. Fc: 1,650 psi
- f. E: 1,400,000 psi

3. See structural drawings for grades and bending stress at specific locations.

D. Miscellaneous Lumber: Provide wood for support or attachment of other work including cant strips, bucks, nails, blocking, furring, grounds, stripping and similar members. Provide lumber of sizes indicated, worked into shapes shown, and as follows:

1. Moisture content: 19% maximum for lumber items not specified to receive wood preservative treatment.
2. Grade: Construction Grade light framing size lumber of any species or board size lumber as required. Provide construction grade boards (NELMA, NLGA or WCLB) or No.2 boards (SPIB, NLGA, NELMA, or WWPA).

2.02 SHEATHING LOCATIONS

A. Roof Sheathing: NIST/DOC PS-1 or PS-2 rated, Exposure 1, 5/8 inch thick, 48 x 96 inch sized sheets, square edges, unless noted. Provide H-clips per the manufacturer's

recommendations.

- B. Floor Sheathing: NIST/DOC PS-1 or PS-2 rated, Exposure 1, 48 x 96 inch sized sheets, tongue and groove.
 - 1. 7/8 inch thick at all floors to receive light-weight concrete topping.
 - 2. 3/4 inch thick elsewhere.
- C. Wall Sheathing: NIST/DOC PS-1 or PS-2 rated, Exposure 1, 1/2 inch thick, 48 x 96 inch sized sheets, square edges.
- D. Wall Sheathing at Shear Walls: DOC PS-1 or PS-2 rated, Exposure 1, 1/2 inch thick 48 x 96 inch sheets, square edges, unless noted otherwise.
- E. Thicknesses indicated are nominal.
- F. Sheathing shall be stamped with grading agency stamp
- G. Backing Panels: For mounting electrical or telephone equipment, provide fire-retardant-treated plywood panels where required per Code requirements. Paint as required by electrical code.

2.03 ENGINEERED WOOD PRODUCTS

- A. General: Provide engineered wood products acceptable to authorities having jurisdiction and for which, current model code research or evaluation reports exist that evidence compliance with building code in effect for Project. Provide depths and widths as indicated.
 - 1. Allowable Design Stresses: Provide engineered wood products with allowable design stresses, as published by manufacturer that meet or exceed those indicated. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis, and demonstrated by comprehensive testing performed by a qualified independent testing agency.
 - 2. Source and Species: Unless otherwise indicated, lumber sources in Engineered Wood Products shall be of single source and species.
 - 3. Adhesives shall be exterior type, complying with ASTM D2559.
 - 4. Substitutions: Substitutions of Engineered Wood Products other than those

specified will be permitted only with written certification from the manufacturer that the substituted items “meets or exceeds” all properties of the specified product, including engineering, serviceability, aesthetic and durability characteristics. Substitutions shall not be made without written approval of the Architect and Engineer.

- B. Laminated-Veneer Lumber (LVL): Lumber manufactured by laminating wood veneers in a continuous press using an exterior-type adhesive complying with ASTM D 2559 to produce members with grain of veneers parallel to their lengths and complying with the following requirements:

Boise Cascade	$F_b = 3080 \text{ psi}, E = 2.0 \times 10^6$
I-Level:	$F_b = 2600 \text{ psi}, E = 1.9 \times 10^6$

- C. Parallel-Strand Lumber (PSL): Lumber manufactured by laying up wood strands using an exterior-type adhesive complying with ASTM D 2559, and cured under pressure to produce members with grain of strands parallel to their lengths and complying with the following requirements:

I-Level:	$F_{c } = 2,900 \text{ psi}, F_b = 2900 \text{ psi}, E = 2.0 \times 10^6$
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- D. Laminated Strand Lumber (LSL): Lumber manufactured by laying up wood strands using an exterior-type adhesive complying with ASTM D 2559, and cured under pressure to produce members with laminations of strands parallel to their lengths and complying with the following requirements:

I-Level:	$F_b = 1,700 \text{ psi}, E = 1.3 \times 10^6$ (depths to 8 5/8")
	$F_b = 1,700 \text{ psi}, E = 1.7 \times 10^6$ (depth 9 1/4" and up)

2.04 ACCESSORIES

- A. Fasteners, Anchors, Connectors and Hardware:

1. Fasteners (for wood framing): Nail fasteners shall meet requirements of ASTM F1667. Unless noted otherwise, nails referenced on drawings are to be Common Nails with dimensions as follows:

- a. 8d: 2 1/2" long by 0.131" diameter shank with 0.281" diameter head
 - b. 10d: 3" long by 0.148" diameter shank with 0.312" diameter head
 - c. 12d: 3 1/4" long by 0.148" diameter shank with 0.312" diameter head
 - d. 16d: 3 1/2" long by 0.162" diameter shank with 0.344" diameter head
2. Anchor Bolts: ASTM A307 headed and SSTB Anchor Bolts by Simpson StrongTie, unless noted otherwise. "J" or "L" type anchor bolts shall not be substituted.
 3. Screw fasteners (where indicated on drawings or required to install connection hardware):
 - a. SD & SDS Screws by Simpson Strong Tie
 - b. RSS Screws by GRK Fasteners, (800) 263-0463
 - c. Timberlok Screws by Fasten Master.
 - d. Wood Screws: ANSI/ASME Standard B18.6.1
 4. Lag Screws: ANSI/ASME Standard B18.2.1. Provide lead hole per NDS Chapter 11.
 5. Through Bolts: ANSI/ASME Standard B18.2.1:
 - a. Holes for through bolts shall be a minimum of 1/32nd and a maximum of 1/16th larger than bolt diameter.
 - b. A standard cut washer shall be provided between the wood and bolt head, and wood and nut, unless noted otherwise.
- B. Structural Framing Connectors, Hardware or Joist Hangers: As indicated on the drawings or sized to suit framing conditions, manufactured by Simpson or approved alternate.
1. Unless noted, fill all nail holes to achieve manufacturer's maximum reaction rating.
 2. Use nail diameter and length as specified by connector manufacturer. Substitutions of pneumatic nails or "joist hanger" (non standard length) nails shall not be made without written authorization of the Engineer.
- C. Construction Adhesive: APA AFG-01, approved for use with type of construction panel

indicated by both adhesive and panel manufacturer.

D. ALL ANCHORS, CONNECTORS AND FASTENERS IN CONTACT WITH PRESSURE TREATED LUMBER, AND/OR AT EXTERIOR EXPOSURE SHALL HAVE COATINGS AS FOLLOWS, UNLESS NOTED OTHERWISE:

1. Anchor Bolts/Bolts/Lag Bolts: Hot Dipped Galvanized, ASTM A123
2. Connection Hardware, unless otherwise noted: Simpson Strongtie Z-Max (G185 per ASTM A653) or Hot Dipped Galvanized (HDG, ASTM A123). Use hot dipped galvanized fasteners, ASTM A153 with these hangers.
3. Nails and Fasteners, unless otherwise noted: Hot Dipped Galvanized, ASTM A153. Use type 304 or 316 stainless steel fasteners with stainless hardware
4. Proprietary coatings used in conjunction with pressure treated fastener coatings will be permitted with written permission from the Architect and Engineer.

2.05 FACTORY WOOD TREATMENT

A. PRESSURE TREATED LUMBER (P. T.)

1. Wood Preservative (Pressure Treatment): AWPA Treatment, ACQ-C (amine formulated), ACQ-D or CA-B, ammonia free.
2. The use of ACZA and CCA treated lumber is strictly prohibited.
3. Retention:
 - a. Above Ground Use: ACQ: 0.25 pcf, CA-B: 0.10 pcf
 - b. Ground Contact Use: ACQ: 0.40 pcf, CA-B: 0.21 pcf.
4. See Section the "Fasteners, Anchors, Connectors and Hardware" portion of this specification for fastener, anchor and hardware requirements for use with pressure treated lumber.
5. Pressure treated lumber shall not contain ammonia unless authorized by the Architect and Engineer. Ammonia content shall be verified with the Pressure Treatment manufacturer.

PART 3 EXECUTION

3.01 PREFABRICATED CONSTRUCTION REQUIREMENTS (PANELIZED CONSTRUCTION, CONSTRUCTED OFF-SITE)

- A. Prefabrication shall not commence until shop drawings have been approved by the Engineer and Architect.
- B. Panels shall meet or exceed the framing designed in the construction documents, and applicable code requirements.
- C. Framing shall not be drilled, notched or cut for any reason without prior written approval from the Structural Engineer (ie. passage of wiring, piping).
- D. Quality Assurance Requirements:
 - 1. Panelized/Prefabrication plant inspection: Prefabrication plant is subject to plant inspection completed by the Engineer-of-Record or an approved Third Party Inspection Agency prior to shipment to the jobsite. Inspections shall be performed at the Contractor's expense. Plant inspection does not relieve the Contractor of the obligation to perform work in accordance with the Construction Documents or from implementing their own shop and field quality control program.
 - 2. Panel sheathing shall not be covered with air barrier (Tyvar, Tyvek, Construction Paper, etc) prior to shipment and until visual inspection by Engineer is complete.
 - 3. Wall panels shall be constructed utilizing results of an as-built foundation survey to ensure that wall panels fit up correctly on foundation. Employ a Registered Land Surveyor to determine elevations and locations of concrete bearing surfaces, and locations of anchor bolts and similar devices, before erection work proceeds, and report discrepancies to Architect and Structural Engineer. Do not proceed with erection until corrections have been made, or until compensating adjustments to prefabricated wood construction have been approved by Structural Engineer of Record. Additional surveys required to verify out-of-alignment work and/or corrective work shall be performed at the contractor's expense.
 - 4. Fasteners into sheathing and framing shall not be overdriven. Head of fastener shall be flush with surface of member being fastened. Maximum indentation tolerance from flush shall be 1/16 inch.

E. Wall Framing Requirements:

1. At bearing walls, coordinate wall stud locations to line up directly below floor framing.
2. Wall studs shall line up vertically between floors.
3. Wall panels shall be constructed to provide full bearing of panel bottom plate to supporting structure.
4. Construct wall panels to allow for field placement of top-most top plate to ensure overlapping of all joints

F. Sheathing Requirements:

1. All horizontal joints in plywood sheathing shall be blocked with full-depth blocking.
2. Attach adjacent panels together by overlapping sheathing a minimum of 1 ½" and fastening with approved fasteners specified.

3.02 FRAMING

- A. Set members level and plumb, in correct position.
- B. Unless noted otherwise, wall top plates shall be doubled. Install top plates with overlapping corners and at intersections with adjoining partitions. End joints in double top plates shall be offset at least 48 inches.
- C. Make provisions for erection loads, and for sufficient temporary bracing to maintain structure safe, plumb, and in true alignment until completion of erection and installation of permanent bracing.
- D. Place horizontal members, crown side up.
- E. Construct load bearing framing members full length without splices.
- F. Double members at openings over 24 inches wide and as indicated. Space short studs over and under opening to stud spacing.
- G. Double joists under partitions that run parallel to joist framing.

- H. Posts and columns shall be blocked at floor and/or roof levels with framing matching or exceeding post dimensions down to supporting foundation.
- I. Place sill gasket directly on cementitious foundation. Puncture gasket clean and fit tight to protruding foundation anchor bolts.
- J. Coordinate installation of wood decking, joist members, rafter members and/or prefabricated wood trusses.
- K. Curb roof openings except where prefabricated curbs are provided. Form corners by alternating lapping side members.
- L. Coordinate curb installation with installation of decking and support of deck openings, and roofing vapor retardant.
- M. Rough Carpentry Fastening Schedule: Unless otherwise indicated on the drawings, provide minimum nailing and fastening per IBC Table 2304.9.1.

3.03 SHEATHING

- A. Secure roof sheathing with longer edge perpendicular to framing members and with ends staggered and sheet ends over bearing provide gap between panels as recommended by manufacturer. Utilize H-clips at panel edges per manufacturer's recommendations or as indicated. Provide blocking where indicated on the Drawings.
- B. Secure floor sheathing with longer edge perpendicular to framing members and with ends staggered and sheet ends over bearing. Secure tongue in groove per manufacturers instructions. Glue and nail/screw as indicated. Provide blocking where indicated on the Drawings. Floor sheathing shall be laid out in a manner to prevent squeaks.
- C. Secure wall sheathing with long dimension perpendicular to wall studs, with ends over firm bearing and staggered.
- D. Install telephone and electrical panel backboards with plywood sheathing material where required. Size as indicated, 6 inch larger than panel space required or per local Code requirements.

3.04 TOLERANCES

- A. Framing Members: 1/4 inch from true position, maximum.

- B. Fasteners Driving Tolerance: Unless noted otherwise, fastener heads shall be driven flush with attached framing member or sheathing. Maximum indentation tolerance from flush shall be 1/16 inch.

END OF SECTION

SECTION 061053 - MISCELLANEOUS ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Composite nail base insulated wall sheathing.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

1.3 DELIVERY, STORAGE, AND HANDLING

- A. Stack lumber flat with spacers beneath and between each bundle to provide air circulation. Protect lumber from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 COMPOSITE NAIL BASE INSULATED WALL SHEATHING

- A. Board Insulation Bonded to Plywood: Hunter Panels Xci Ply are a high thermal resistive rigid insulation panel composed of a closed cell polyisocyanurate foam core bonded on one side to a premium performance coated glass facer on one side and fire treated plywood on the other..

1. Manufacturer: Hunter Panels; Xci Ply.
2. Type: ASTM C 1289, Type V: Grade 2 (20 psi).
3. Fire Retardant Treated Plywood Thickness: 5/8 inch.
4. Panel Size: 4 feet by 8 feet.
5. Thickness / R Value: based on ASTM C 518 at 75 degrees F (23.9 degrees C)
 - a. 3.1 inches / R Value 15.9 with 5/8 inch plywood facing

2.2 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
- B. Nails, Brads, and Staples: ASTM F 1667.

- C. Screws for Fastening Composite Nail Base Insulated Wall Sheathing: Steel drill screws, in type and length recommended by sheathing manufacturer for thickness of sheathing to be attached, with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B 117. Provide washers or plates if recommended by sheathing manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Set carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit carpentry accurately to other construction. Locate furring, nailers, blocking and similar supports to comply with requirements for attaching other construction.
 - 1. Composite Insulating Wall Sheathing: Attach sheathing panels securely to substrate with manufacturer-approved fasteners in compliance with the following:
 - a. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code.

END OF SECTION 061053

SECTION 061516 - WOOD ROOF DECKING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes glue-laminated wood roof decking
- B. Related Requirements:
 - 1. Section 061000 "Rough Carpentry" for dimension lumber items associated with wood roof decking.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. For glued-laminated wood roof decking, include installation instructions and data on lumber, adhesives, and fabrication.
- B. Samples: 24 inches long, showing the range of variation to be expected in appearance of wood roof decking.

1.3 INFORMATIONAL SUBMITTALS

- A. Research/Evaluation Reports: For glued-laminated wood roof decking indicated to be of diaphragm design and construction, from ICC-ES.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Schedule delivery of wood roof decking to avoid extended on-site storage and to avoid delaying the Work.
- B. Store materials under cover and protected from weather and contact with damp or wet surfaces. Provide for air circulation within and around stacks and under temporary coverings. Stack wood roof decking with surfaces that are to be exposed in the final Work protected from exposure to sunlight.

PART 2 - PRODUCTS

2.1 WOOD ROOF DECKING, GENERAL

- A. General: Comply with DOC PS 20 and with applicable grading rules of inspection agencies certified by ALSC's Board of Review.

2.2 GLUED-LAMINATED WOOD ROOF DECKING

- A. Roof Decking Species: Southern yellow pine.
- B. Roof Decking Nominal Size: 4 by 6.
- C. Roof Decking Configuration: For glued-laminated wood roof decking indicated to be of diaphragm design and construction, provide tongue-and-groove configuration that complies with research/evaluation report.
- D. Face Grade: Decorative: #2 & Better; Sound knots and natural characteristics are allowed, including chipped edge knots, short end splits, seasoning checks, and some pin holes. Face knot holes, stains, end slits, skips, roller splits, and planer burns are not allowed.
- E. Moisture Content: Provide wood roof decking with 15 percent maximum moisture content at time of dressing.
- F. Face Surface: Smooth.
- G. Edge Pattern: Vee grooved.
- H. Laminating Adhesive: Wet-use type complying with ASTM D 2559.

2.3 ACCESSORY MATERIALS

- A. Fasteners for Solid-Sawn Roof Decking: Provide fastener size and type complying with AITC 112 for thickness of deck used.
- B. Fasteners for Glued-Laminated Roof Decking: Provide fastener size and type complying with requirements in "Installation" Article for installing laminated roof decking.
 - 1. Refer to structural drawings for additional fastener requirements.
- C. Nails: Common; complying with ASTM F 1667, Type I, Style 10.
- D. Spikes: Round; complying with ASTM F 1667, Type III, Style 3.
- E. Fastener Material: Hot-dip galvanized steel.
- F. Bolts for Anchoring Roof Decking to Walls: Carbon steel; complying with ASTM A 307 with ASTM A 563 hex nuts and, where indicated, flat washers, all hot-dip zinc coated.
- G. Installation Adhesive: For glued-laminated wood roof decking indicated to be of diaphragm design and construction, provide adhesive that complies with research/evaluation report.
- H. Sealants: Latex, complying with applicable requirements in Section 079200 "Joint Sealants" and recommended by sealant manufacturer and manufacturer of substrates for intended application.
- I. Penetrating Sealer: Clear sanding sealer complying with Section 099300 "Staining and Transparent Finishing" and compatible with topcoats specified for use over it.

2.4 FABRICATION

- A. Shop Fabrication: Where preservative-treated roof decking is indicated, complete cutting, trimming, surfacing, and sanding before treating.
- B. Predrill roof decking for lateral spiking to adjacent units to comply with AITC 112.
- C. Seal Coat: After fabricating and surfacing roof decking, apply a saturation coat of penetrating sealer in fabrication shop.
- D. Apply indicated finish materials to comply with Section 099300 "Staining and Transparent Finishing" in fabrication shop.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine walls and support framing in areas to receive wood roof decking for compliance with installation tolerances and other conditions affecting performance of wood roof decking.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install laminated wood roof decking to comply with manufacturer's written instructions.
 - 1. Locate end joints for controlled random lay-up.
 - 2. Nail each course of glued-laminated wood roof decking at each support with one nail slant nailed above the tongue and one nail straight nailed through the face.
 - 3. Large diameter nails (20d and larger) may be required for 4-by-6 and 4-by-8 roof decking. Comply with manufacturer's requirements for installation. If required, predrill roof decking to prevent splitting.
 - 4. Glue adjoining roof decking courses together by applying a 3/8-inch bead of adhesive to the top of tongues, according to research/evaluation report.
- B. Anchor wood roof decking, where supported on walls and beams, with fasteners as indicated on the structural drawings.
- C. Apply joint sealant to seal roof decking at exterior walls at the following locations:
 - 1. Between roof decking and supports located at exterior walls.
 - 2. Between roof decking and exterior walls that butt against underside of roof decking.
 - 3. Between tongues and grooves of roof decking over exterior walls and supports at exterior walls.

3.3 ADJUSTING

- A. Repair damaged surfaces and finishes after completing erection. Replace damaged roof decking if repairs are not approved by Architect.

3.4 PROTECTION

- A. Provide water-resistive barrier over roof decking as the Work progresses to protect roof decking until roofing is applied.

END OF SECTION 061516

SECTION 061800 - GLUED-LAMINATED CONSTRUCTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes framing using structural glued-laminated timber.
- B. Related Requirements:
 - 1. Section 061000 "Rough Carpentry" for dimension lumber items associated with structural glued-laminated timber.
 - 2. Section 061516 "Wood Roof Decking" for glued-laminated wood roof decking.

1.3 DEFINITIONS

- A. Structural Glued-Laminated (Glulam) Timber: An engineered, stress-rated timber product assembled from selected and prepared wood laminations bonded together with adhesives and with the grain of the laminations approximately parallel longitudinally.

1.4 SUBMITTALS

- A. Unless otherwise specified, submittals required in this section shall be submitted for review. Submittals shall be prepared and submitted in accordance with Division 1.
- B. General Contractor shall submit a Submittal Schedule to the engineer within 30 days after they have received the Owner's Notice to Proceed.
- C. All submittals shall be reviewed and returned to the Architect within 10 working days.
- D. Incomplete submittals will not be reviewed.
- E. Submittals not reviewed by the General Contractor prior to submission to the Engineer will not be reviewed. Include on the submittal statement or stamp of approval by Contractor, representing that the Contractor has seen and examined the submittal and that all requirements listed in sections Division 1 have been complied with.
- F. Engineer will review submittals a maximum of two review cycles as part of their normal services. If submittals are incomplete or otherwise unacceptable and re-submitted, General Contractor shall compensate Engineer for additional review cycles.
- G. Hardcopy Submittals: Submit three prints. Prints will be reviewed by the Engineer, and then the Architect. One marked print will be returned to Contractor for printing and distribution. Multiple copies will not be marked by the Engineer.

- H. Electronic Submittals:
1. Contractor shall include in the submittal schedule an indication of submittals that are intended to be submitted electronically. Upon receipt of the submittal schedule, the Engineer reserves the right to indicate submittals that will not be accepted electronically. Paper copies of such submittals shall be furnished as referenced in this specification.
 2. The Engineer reserves the right to require paper copies of submittals that are received electronically. Provide Engineer one (1) paper copies in addition to the electronic submittal. Paper copy will be retained and electronic copy will be returned. Review cycle for such submittals shall not commence until such time that the paper copies are received.
 3. Electronic Submittals shall be submitted in Protected Document Format (PDF) compatible with Adobe Acrobat Professional version 7.0 or later. Electronic files shall not be broken into smaller individual files. File sizes too large to process email or within a file transfer protocol (FTP) site shall be provided on a CD.
 4. The submission of submittals electronically does not relieve the contractor of their responsibility to review the submittal prior to transmission to the Engineer. Electronic Submittals shall include contractor comments, and a statement and/or stamp of approval by Contractor, representing that the Contractor has seen and examined the submittal and that all requirements listed in this Section and Division 1 have been complied with. Electronic submittals without the Contractor's approval will be rejected and returned.
 5. The Engineer assumes no responsibility for the printed reproduction of submittals reviewed electronically, transmission errors or returned electronic submittals that become corrupted or are otherwise not accessible by the Contractor's or Subcontractor's computer hardware and/or software.
- I. Product Data: For each type of product.
1. Include data on lumber, adhesives, fabrication, and protection.
 2. For connectors. Include installation instructions.
- J. Shop Drawings:
1. Show layout of structural glued-laminated timber system and full dimensions of each member.
 2. Indicate species and laminating combination.
 3. Include large-scale (1"-1ft min) details of all connections.
- K. Samples: Full width and depth, 24 inches long, showing the range of variation to be expected in appearance of structural glued-laminated timber.
1. Apply specified factory finish to three sides of half length of each Sample.
- L. Certificates of Conformance: Issued by a qualified testing and inspecting agency indicating that structural glued-laminated timber complies with requirements in AITC A190.1.
- M. Research/Evaluation Reports: For structural glued-laminated timber and timber connectors, from ICC-ES.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: An AITC- or APA-EWS-licensed firm certified for chain of custody by an FSC-accredited certification body.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. General: Comply with provisions in AITC 111.
- B. Individually wrap members using plastic-coated paper covering with water-resistant seams.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Unadilla Laminated Products

2.2 STRUCTURAL GLUED-LAMINATED TIMBER

- A. General: Provide structural glued-laminated timber that complies with AITC A190.1 and AITC 117 or research/evaluation reports acceptable to authorities having jurisdiction.
 - 1. Factory mark each piece of structural glued-laminated timber with AITC Quality Mark or APA-EWS trademark. Place mark on surfaces that are not exposed in the completed Work.
 - 2. Provide structural glued-laminated timber made from single species.
 - 3. Provide structural glued-laminated timber made from solid lumber laminations; do not use laminated veneer lumber.
 - 4. Provide structural glued-laminated timber made with wet-use adhesive complying with AITC A190.1.
 - 5. Adhesive shall not contain urea-formaldehyde resins.
 - 6. Adhesives shall comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Department of Health Services') "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- B. Species and Grades for Beams and Purlins:
 - 1. Species and Beam Stress Classification: Southern-Pine, 24F-V3, 1800 ksi or better U.N.O.
 - 2. Lay-up: Unbalanced, except provide balanced layup at all cantilevered beams and beams continuous over supports.

- C. Species and Grades for Columns:
 - 1. Species and Combination Symbol: Southern-Pine, 48 SOG 1/10 or better U.N.O.
- D. Appearance Grade: Architectural, complying with AITC 110.
 - 1. For Architectural appearance grades, fill voids as required by AITC 110. Use clear wood inserts, of matching grain and color, for filling voids and knot holes more than 1/4 inch wide.

2.3 TIMBER CONNECTORS

- A. Fabricate beam seats from steel with minimum 1/4" bearing plates and side plates, as shown on the drawings. .
- B. Provide bolts, 3/4" unless otherwise indicated, complying with ASTM A 307, Grade A; nuts complying with ASTM A 563; and, where indicated, flat washers.
- C. Materials: Unless otherwise indicated, fabricate from the following materials:
 - 1. Structural-steel shapes, plates, and flat bars complying with ASTM A 36/A 36M.
- D. Finish steel assemblies and fasteners with rust-inhibitive primer, 2-mil dry film thickness.
- E. Refer to Division 9 for paint requirements

2.4 MISCELLANEOUS MATERIALS

- A. End Sealer: Manufacturer's standard, transparent, colorless wood sealer that is effective in retarding the transmission of moisture at cross-grain cuts and is compatible with indicated finish.
- B. Penetrating Sealer: Manufacturer's standard, transparent, penetrating wood sealer that is compatible with indicated finish.

2.5 FABRICATION

- A. Shop fabricate connections to greatest extent possible, including cutting to length and drilling bolt holes.
 - 1. Dress exposed surfaces as needed to remove planing and surfacing marks.
- B. Fabricate members to radius indicated on drawings
- C. Camber: Fabricate horizontal and inclined members of less than 1:1 slope with either circular or parabolic camber equal to 1/500 of span.
- D. End-Cut Sealing: Immediately after end cutting each member to final length, apply a saturation coat of end sealer to ends and other cross-cut surfaces, keeping surfaces flood coated for not less than 10 minutes.

- E. Seal Coat: After fabricating, sanding, and end-coat sealing, apply a heavy saturation coat of penetrating sealer on surfaces of each unit.

2.6 FACTORY FINISHING

- A. Wiped Stain Finish: Manufacturer's standard, dry-appearance, penetrating acrylic stain and sealer; oven dried and resistant to mildew and fungus.
 - 1. Color: As selected by Architect from manufacturer's full range
- B. Clear Finish: Manufacturer's standard, two-coat, clear varnish finish; resistant to mildew and fungus.
- C. Finishing materials shall comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Department of Health Services') "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates in areas to receive structural glued-laminated timber, with Installer present, for compliance with requirements, installation tolerances, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Erect structural glued-laminated timber true and plumb and with uniform, close-fitting joints. Provide temporary bracing to maintain lines and levels until permanent supporting members are in place.
 - 1. Handle and temporarily support glued-laminated timber to prevent surface damage, compression, and other effects that might interfere with indicated finish.
- B. Cutting: Avoid extra cutting after fabrication. Where field fitting is unavoidable, comply with requirements for shop fabrication.
- C. Fit structural glued-laminated timber by cutting and restoring exposed surfaces to match specified surfacing and finishing.
 - 1. Predrill for fasteners using timber connectors as templates.
 - 2. Finish exposed surfaces to remove planing or surfacing marks and to provide a finish equivalent to that produced by machine sanding with No.120 grit sandpaper.
 - 3. Coat cross cuts with end sealer.
- D. Install timber connectors as indicated.

1. Unless otherwise indicated, install bolts with same orientation within each connection and in similar connections.
2. Install bolts with orientation as indicated or, if not indicated, as directed by Architect.
3. Temporary Shoring and Bracing:
 - a. This is the sole responsibility of the Contractor. Provide temporary shoring and bracing members with connections of sufficient strength to support imposed loads. Remove temporary members and connections when all permanent members are in place, and all final connections are made, including the floor and roof diaphragms. Provide temporary guy lines to achieve proper alignment of structures as erection proceeds. Comply with OSHA Standard referenced previous. Retain the services of a Specialty Structural Engineer (Not the Engineer of Record) to design specialty shoring and bracing.

3.3 ADJUSTING

- A. Repair damaged surfaces and finishes after completing erection. Replace damaged structural glued-laminated timber if repairs are not approved by Architect.

3.4 PROTECTION

- A. Do not remove wrappings on individually wrapped members until they no longer serve a useful purpose, including protection from weather, sunlight, soiling, and damage from work of other trades.
 1. Coordinate wrapping removal with finishing work. Retain wrapping where it can serve as a painting shield.
 2. Slit underside of wrapping to prevent accumulation of moisture inside the wrapping.

END OF SECTION

SECTION 06 19 00 – METAL PLATE CONNECTED PRE-FABRICATED WOOD TRUSSES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. The drawings and general conditions of the contract including General and Supplementary Conditions and other Division 1 Specification sections apply to work of this section.
- B. Examine all other sections of the Specifications for requirements which affect work of this Section whether or not such work is specifically mentioned in this Section.
- C. Coordinate work with that of all trades affecting or affected by work of this Section. Cooperate with such trades to assure the steady progress of all work under the Contract.

1.02 DESCRIPTION OF WORK:

- A. Definition: Prefabricated wood trusses include planar structural units consisting of metal plate connected members which are fabricated from dimension lumber and which have been cut and assembled prior to delivery to the job site. Work to include anchorage, blocking, curbing, miscellaneous framing and bracing.
- B. Types of fabricated wood trusses are indicated on the drawings.

1.03 RELATED WORK SPECIFIED ELSEWHERE:

- A. Section 06 10 00 - Rough Carpentry
- B. Section 06 18 00 – Glued-Laminated Timber

1.04 QUALITY ASSURANCE:

- A. TPI Standards: Comply with applicable requirements and recommendations of the following Truss Plate Institute (TPI) publications, Latest Edition:
 - 1. ANSI/TPI 1 “National Design Standard for Construction. Metal Plate Connected Wood Truss.”
 - 2. ANSI/AF&PA (American Forest & Paper Association) – NDS National Design Specification for Wood Construction – Latest Edition
 - 3. “Commentary and Appendices to ANSI/TPI 1 for Bracing Wood Trusses.”

4. "Building Component Safety Information, BCSI 1"
 5. DSB-89 "Recommended Design Specification for Temporary Bracing of Metal Plate Connected Wood Trusses."
 6. "Quality Assurance Procedures Manual for In-Plant Inspections, QAP-90."
 7. "Quality Control Manual."
 8. "Code of Federal Regulations, Part 1926" per the Occupational Safety and Health Administration (OSHA), Department of Labor (Latest Revision).
- B. Wood Structural Design Standard: Comply with applicable requirements of "National Design Specification for Wood Construction", published by American Forest and Paper Association.
- C. Lumber Standard: Comply with PS 20 and with applicable rules of the respective grading inspecting agencies for species and grade of lumber indicated.
- D. Connector Plate Manufacturer's Qualifications: Provide truss connector plates manufactured by a firm which is a member of TPI and which complies with TPI quality control procedures for manufacture of connector plates published in TPI "Quality Control Manual."
- E. Fabricator's Qualifications:
1. Provide trusses by a firm which has a record of successfully fabricating trusses similar to type and length indicated.
 2. TPI Inspection Program: Fabricator shall participate in the TPI Quality Assurance Inspection Program, and maintain a copy of the Quality Assurance Procedures Manual, QAP-90. All trusses fabricated for this project shall bear the TPI Registered Mark to indicate compliance with this program.
- F. Uniformity of Manufacturer for Connector Plates: Provide metal connector plates from a single manufacturer.

1.05 SUBMITTALS:

- A. Unless otherwise specified, submittals required in this section shall be submitted for review. Submittals shall be prepared and submitted in accordance with Division 1.

- B. General Contractor shall submit a Submittal Schedule to the engineer within 30 days after they have received the Owner's Notice to Proceed.
- C. All submittals shall be reviewed and returned to the Architect within 10 working days.
- D. Incomplete submittals will not be reviewed.
- E. Submittals not review by the General Contractor prior to submission the Engineer will not be reviewed. Include on the submittal a statement or stamp of approval by the Contractor, representing that the Contractor has seen and examined the submittal and that all requirements listed in sections Division 1 have been complied with.
- F. Engineer will review submittals a maximum of two review cycles as part of their normal services. If submittals are incomplete or otherwise unacceptable and re-submitted, General Contractor shall compensate Engineer for additional review cycles.
- G. **Truss design calculations without the appropriate signature and seal indicated below will be rejected and returned without review.**
- H. Hardcopy Submittals: Submit three prints. Prints will be reviewed by the Engineer, and then the Architect. One marked print will be returned to Contractor for printing and distribution. Multiple copies will not be marked by the Engineer.
- I. Electronic Submittals:
 - 1. Contractor shall include in the submittal schedule an indication of submittals that are intended to be submitted electronically. Upon receipt of the submittal schedule, the Engineer reserves the right to indicate submittals that will not be accepted electronically. Paper copies of such submittals shall be furnished as referenced in this specification.
 - 2. The Engineer reserves the right to require paper copies of submittals that are received electronically. Provide Engineer one (1) paper copies in addition to the electronic submittal. Paper copy will be retained and electronic copy will be returned. Review cycle for such submittals shall not commence until such time that the paper copies are received.
 - 3. Electronic Submittals shall be submitted in Protected Document Format (PDF) compatible with Adobe Acrobat Professional version 7.0 or later. Electronic files shall not be broken into smaller individual files. File sizes too large to process email or within a file transfer protocol (FTP) site shall be provided on a CD.

4. The submission of submittals electronically does not relieve the contractor of their responsibility to review the submittal prior to transmission to the Engineer. Electronic Submittals shall include contractor comments, and a statement and/or stamp of approval by Contractor, representing that the Contractor has seen and examined the submittal and that all requirements listed in this Section and Division 1 have been complied with. Electronic submittals without the Contractor's approval will be rejected and returned.
 5. The Engineer assumes no responsibility for the printed reproduction of submittals reviewed electronically, transmission errors or returned electronic submittals that become corrupted or are otherwise not accessible by the Contractor's or Subcontractor's computer hardware and/or software.
- J. Product Data: Submit fabricator's technical data covering lumber, metal plates, hardware, fabrication process, treatment (if any), handling and erection.
1. Submit certificate, signed by an officer of fabricating firm, indicating that trusses to be supplied for project comply with indicated requirements.
 2. Submit evidence of participation in the TPI Inspection program.
- K. Shop Drawings: Submit shop drawings, showing species, sizes and stress grade of lumber to be used; pitch, span, camber, configuration and spacing for each type of truss required; type size, material, finish, design value and location of metal connector plates; and bearing and anchorage details.
1. Electronic files of structural drawings **will not** be provided to the contractor for preparation of shop drawings. Reproduction of any portion of the Construction Documents for use as Shop drawings and/or Erection Drawings is prohibited. Shop drawings and/or Erection drawings created from reproduced Construction Documents will be returned without review.
 2. **Conformance of the Shop Drawings to the Contract Drawings remains the responsibility of the General Contractor. Engineer's review in no way relieves the General Contractor of this responsibility. Submit three prints. Prints will be reviewed by the Engineer, and then the Architect. One marked print will be returned to Contractor for printing and distribution. Multiple copies will not be marked by the Engineer.**
 3. Truss Placement Plan: Provide drawings indicating truss layout.

- a. Include all trusses and components, including girder trusses, piggyback trusses, and hangers.
 - b. Provided dimensions for layout, including bearing locations & widths, and truss spacing
4. Design: Design shall be in accordance with the applicable provisions of the latest edition of the American Forest & Paper Association's (AF&PA's) National Design Specification for Wood Construction, ANSI/TPI 1, and all applicable legal requirements. Submit the following information in the calculation submittal for each truss or truss component. Calculations are to be prepared under the direct supervision of a Professional Engineer Registered in the State of Maine. Calculations shall be signed and sealed by a Professional Engineer Registered in the State of Maine. Truss designer is responsible for the design of the entire truss assembly, including permanent lateral bracing. Lateral loads shall be resolved into the building lateral load resisting system.
- a. Loading: Include all loadings applied to the truss, including uniform, concentrated loads and locations. Include effects of mechanical equipment, drifted and unbalanced snow. Indicate distribution of loads to top and bottom chords. The calculations shall clearly show these loads and their application to the trusses.
 - b. Wind & Seismic Loading Criteria: Include all appropriate information wind & seismic loading criteria. Including design code, wind speed and exposure. Design code and wind speed shall be as indicated in the drawings.
 1. Provide uplift calculations and truss uplift reactions as appropriate.
 - c. Load Combinations: The calculations shall list all load combinations including all factors that apply.
 - d. Adjustments to lumber and metal connector plate design values for conditions of use. Adjustment of value for duration of load or conditions of use shall be in accordance with AF&PA's National Design Specification for Wood Construction.
 - e. Truss-to-Truss Connections: Provide hanger designs where applicable. Provide design of connectors in multi-ply trusses. Provide connection design for piggyback trusses.
 - f. Stress and Deflection calculations: Provide member stresses and joint displacement for each load and load combination, and displacement to span

ratio. Indicate camber independently from displacement calculations. Provide bearing stresses at supports.

- g. Deflection Limits: Design trusses to limit deflection under design live or snow loads to L/240 for roof trusses, L/480 for floor trusses.
- h. Long-term deflections (creep): Design of second floor trusses supporting gypcrete floor shall consider the effects of creep for sustained load conditions. The trusses shall be designed to meet ANSI-TPI National Design Standard requirements for creep in metal plate wood trusses.**
- i. Reaction: Provide minimum and maximum reactions, including uplift as applicable. Indicate the load combination that produces these reactions.
- j. Girder truss bearing stress limitation: Bearing stress values at girder trusses shall be no greater than the values indicated below. Truss manufacturer shall provide additional truss plies, truss bearing enhancement devices or additional material as necessary to meet this requirement.

Girder trusses bearing stress maximum limit, unless noted
otherwise: 425 psi

- k. Net Section at Hanger Connections: Design shall account for the net section loss to truss members from hung mechanical, electrical, plumbing and fire protection systems. General contractor shall coordinate hanger systems with the truss designer. Hanger systems are not designed by the Engineer of Record. See the "Execution" portion of this specification for additional requirements.
5. Field built trusses: To the greatest extent possible, trusses are to be prefabricated. Truss field fabrication is subject to the approval of the Structural Engineer. Additional design, quality assurance and quality control procedures may be necessary based on the requirements of the Structural Engineer.
 6. Truss Assembly Drawings: Provide drawings depicting how each truss is to be constructed. Provide all geometry, including length, height, joint locations, slope, camber, overhangs, metal plate connectors, and lumber grades
 7. Permanent Member Bracing: The truss manufacturer shall specify all permanent bracing required for lateral support of tension and compression members, both webs and chords. Gable end wall bracing shall also be specified. Permanent bracing loads

shall be resolved to the building lateral load resisting system. Provide strong back locations for parallel chord floor trusses.

8. With all copies of drawing submittal provide “BCSI 1 (latest edition) Guide to Good practice for Handling, Installing & Bracing of Metal Plate Wood Trusses”, Jointly produced by the Wood Truss Council of America and the Truss Plate Institute.

1.06 DELIVERY, STORAGE, HANDLING:

- A. Handle and store trusses with care, and in accordance with manufacturer's instructions and TPI recommendations to avoid damage from bending, overturning or other cause for which truss is not designed to resist or endure.
- B. Time delivery and erection of trusses to avoid extended on-site storage and to avoid delaying work of other trades whose work must follow erection of trusses.
- C. A copy of the BCSI (latest edition) Summary Sheet, “Guide for Handling, Installing and Bracing of Metal Plate Connected Wood Trusses” shall be provided to the installer at delivery.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS:

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering metal connector plates which may be incorporated in the work include, but are not limited to, the following:

Gang Nail Systems, Inc.
Hydro-Air Engineering, Inc.
Inter-Lock Steel Co., Inc.
Link-Wood Construction Systems
Robbins Manufacturing Co.
Tee-Lok Corp.
Truss Connectors of America
Truswall Systems Corp.

2.02 MATERIALS:

- A. Lumber:

1. Factory mark each plate of lumber with type, grade, mill and grading agency.
 2. Provide actual sizes as required by PS 20 for dressed limber, S4S, unless otherwise indicated. Minimum member sizes (nominal) are as follows:
 - a. Chord members: 2x6 U.N.O.
 - b. Chord members, parallel chord trusses: 4x2 ("flat" orientation)
 - c. Web members: 2x4
 3. Provide seasoned lumber with a maximum moisture content of 19% at time of dressing, and the moisture content of lumber shall be no less than 7% at time of manufacturing.
 4. Lumber Species: Eastern Woods (Spruce) graded by NLGA, NELMA or NHPMA. Southern Pine graded by SPIB. Douglass Fir Larch graded by NLGA.
 5. Lumber Grade:
 - a. Chord Members: MSR 1650f-1.5E lumber for all chords.
 - b. Web Members: No. 2 or better visually graded lumber for all webs. MSR lumber is acceptable in lieu of visually graded lumber for web members.
 6. Stress Rating: Provide lumber which has been either graded or tested and certified, at indicated moisture content, to have the following minimum values:
 - a. MSR: $F_b = 1650$ psi, $F_t = 1020$ psi, $F_c = 1700$ psi, $E = 1,500,000$ psi
 - b. No.2: $F_b = 875$ psi, $F_t = 450$ psi, $F_c = 1150$ psi, $E = 1,400,000$ psi
 7. Pressure treated lumber shall not be used.
- B. Metal Connector Plates, Fasteners and Anchorages:
1. Connector Plate Material: Metal complying with following requirements, unless otherwise indicated: Not less than 0.036" thick, coated thickness, and shall meet or exceed ASTM A653/ASTMA653M grade 33. Working stresses in steel are to be applied to effectiveness ratios for plates as determined by test and in accordance with ANSI/TPI 1.

- a. Galvanized Sheet Steel: ASTM A924/924M, Coating G60.
- b. Electrolytic Zinc Coated Steel Sheet: ASTM A 591, Coating Class C, with minimum structural quality equivalent to ASTM A 446, Grade A.
- C. Hangers and Uplift Anchors: Hangers are to be designed and supplied as part of the truss package, and shall be manufactured by Simpson StrongTie. Preliminary uplift anchors are indicated on the Contract Documents. Final uplift connector type and/or quantity will be selected based on truss reactions. G.C. coordinate with engineer's marks on approved truss shop drawings.

2.03 FABRICATION:

- A. Trusses shall be fabricated to meet the quality requirements of ANSI/TPI 1.
- B. Cut truss members to accurate lengths, angles and sizes to produce close fitting joints with wood-to-wood bearing in assembled units.
- C. Fabricate metal connector plates to size, configuration, thickness and anchorage details required for types of joint designs indicated.
- D. Assemble truss members in design configuration indicated using jigs or other means to ensure uniformity and accuracy of assembly with close fitting joints. Position members to produce design camber indicated.
- E. Connect truss members by means of metal connector plates accurately located and securely fastened to wood members by means indicated or approved.
- F. Permanent web member bracing locations shall be marked on the truss members by means of a paint mark or tag of contrasting color. Tags shall not be removed without the permission of the Architect and Engineer.
- G. All trusses shall bear the TPI Registered Mark, The TPI Quality Stamp, indicating current participation with the in-plant inspection program per the standards established in QAP-90.

PART 3 EXECUTION

3.01 GENERAL:

Erect and brace trusses to comply with recommendations of manufacturer and the Truss Plate Institute. Erection shall comply with current Occupational Safety & Health Administration (OSHA) requirements.

- A. Inspect trusses for damage prior to erection. Apparent damage to trusses, if any, shall be reported to Truss Manufacturer prior to erection.
- B. Truss Submittals and any supplementary information provided by the Truss Manufacturer shall be provided by the Contractor to the individual or organization responsible for the installation of the Trusses.
- C. Erect trusses with plane of truss webs vertical (plumb) and parallel to each other, located accurately at design spacing indicated. Where applicable, insure bearing wall studs and trusses are aligned. The maximum out-of-true plumb tolerance shall be the depth of the truss in inches divided by 100. The maximum bow tolerance from true straight shall be the length of the truss in inches divided by 400, at any point considering multiple curvature when applicable.
- D. Hoist units in place by means of lifting equipment suited to sizes and types of trusses required, applied at designated lift points as recommended by fabricator, exercising care not to damage truss members or joints by out-of-plane bending or other causes.
- E. Provide temporary bracing as required to maintain trusses plumb, parallel and in location indicated. Temporary bracing during construction is the responsibility of the contractor and the installer, as part of the contractor's "Means and Methods". TEMPORARY BRACING MUST BE PROVIDED IN THREE DIFFERENT PLANES OF THE TRUSS. BRACING SHALL BE INSTALLED ALONG THE BOTTOM CHORD, ALONG THE TOP CHORD AND WITHIN THE WEB MEMBERS. CONTRACTOR SHALL FOLLOW THE RECOMMENDATIONS OF SUMMARY SHEETS BCSI-B1/B2 FOR HANDLING, INSTALLING AND BRACING METAL CONNECTED WOOD TRUSSES. TEMPORARY BRACING SHALL BE LEFT IN PLACE AND BECOME PART OF THE PERMANENT BRACING FOR THE BUILDING. MAXIMUM BRACE SPACINGS INDICATED IN THIS DOCUMENT SHALL NOT BE EXCEEDED.
- F. Modifications required to the temporary bracing to comply with permanent bracing requirements, if any, shall be noted on the Structural Contract Documents. Install necessary supplemental permanent bracing and related components to enable trusses to maintain design spacing, withstand live and dead loads including lateral loads, and to comply with other indicated requirements.
- G. Anchor trusses securely at all bearing points to comply with methods and details indicated.

- H. Do not cut, notch, bore, drill or remove truss members.
- I. Hanging Loads: Hangers for mechanical, electrical, plumbing and fire protection systems, including but not by limitation, piping, conduit, ducting and mechanical equipment, shall be made to top of the bottom chord of the truss. Connections that require fasteners to penetrate the chord longitudinally shall not be utilized. Hanger loads shall be placed at truss panel points where required by the truss design.
- J. Metal plates shall not be removed and/or be replaced. Plates that are not fully pressed into the wood shall not be repaired without the direction of the Truss Manufacturer. The Architect and Truss Manufacturer shall be notified of deficient metal plate installation. Repairs shall be submitted to the Architect for review prior to implementation.

END OF SECTION

SECTION 062013 - EXTERIOR FINISH CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Exterior standing and running trim.
2. Lumber siding.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials, dimensions, profiles, textures, and colors and include construction and application details.
 1. Include data for wood-preservative treatment from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained. Include chemical-treatment manufacturer's written instructions for finishing treated material.
 2. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced before shipment to Project site to levels specified.
 3. Include copies of warranties from chemical-treatment manufacturers for each type of treatment.
- B. Samples for Verification:
 1. For each species and cut of lumber and panel products, with 1/2 of exposed surface finished; 50 sq. in. for lumber and 8 by 10 inches for panels.

1.4 INFORMATIONAL SUBMITTALS

- A. Compliance Certificates:
 1. For lumber that is not marked with grade stamp.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant-treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Stack lumber, plywood, and other panels flat with spacers between each bundle to provide air circulation. Protect materials from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

1.7 FIELD CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecast weather conditions permit work to be performed and at least one coat of specified finish can be applied without exposure to rain, snow, or dampness.
 - 1. For exterior ornamental wood columns, comply with manufacturer's written instructions and warranty requirements.
- B. Do not install finish carpentry materials that are wet, moisture damaged, or mold damaged.
 - 1. Indications that materials are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that materials are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Lumber: DOC PS 20 and the following grading rules:
 - 1. NeLMA: Northeastern Lumber Manufacturers' Association, "Standard Grading Rules for Northeastern Lumber."
 - 2. NLGA: National Lumber Grades Authority, "Standard Grading Rules for Canadian Lumber."
 - 3. RIS: Redwood Inspection Service, "Standard Specifications for Grades of California Redwood Lumber."
 - 4. SPIB: The Southern Pine Inspection Bureau, "Standard Grading Rules for Southern Pine Lumber."
 - 5. WCLIB: West Coast Lumber Inspection Bureau, Standard No. 17, "Grading Rules for West Coast Lumber."
 - 6. WWPA: Western Wood Products Association, "Western Lumber Grading Rules."

- B. Factory mark each piece of lumber with grade stamp of inspection agency indicating grade, species, moisture content at time of surfacing, and mill.
 - 1. For exposed lumber, mark grade stamp on end or back of each piece, or omit grade stamp and provide certificates of grade compliance issued by inspection agency.
- C. Softwood Plywood: DOC PS 1.
- D. Hardboard: ANSI A135.4.

2.2 STANDING AND RUNNING TRIM

- A. Lumber Trim: EcoDeck Thermally Modified Premium Wood.
- B. 1-1/4" thick standard decking in widths of 5, 6-3/4 and 8-1/2 inches.

2.3 LUMBER SIDING

- A. Board siding system consisting of EcoDeck Thermally Modified Premium Wood and vented rain screen support system.
- B. 1-1/4" thick standard decking in widths of 5, 6-3/4 and 8-1/2 inches.
- C. Rainscreen Clip by Wood Haven, Inc. mounted to furring strips.

2.4 MISCELLANEOUS MATERIALS

- A. Fasteners for Exterior Finish Carpentry: Provide nails or screws, in sufficient length to penetrate not less than 1-1/2 inches into wood substrate.
 - 1. For face-fastening siding, provide stainless steel ringed-shank siding nails.
- B. Wood Glue: Waterproof resorcinol glue recommended by manufacturer for exterior carpentry use.
- C. Horizontal Joint Flashing for Panel Siding: Preformed, stainless-steel, Z-shaped flashing.

2.5 FABRICATION

- A. Ease edges of lumber less than 1 inch in nominal thickness to 1/16-inch radius and edges of lumber 1 inch or more in nominal thickness to 1/8-inch radius.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine finish carpentry materials before installation. Reject materials that are wet, moisture damaged, and mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean substrates of projections and substances detrimental to application.
- B. Prime lumber and moldings to be painted, including both faces and edges, unless factory primed. Cut to required lengths and prime ends. Comply with requirements in Section 099113 "Exterior Painting."

3.3 INSTALLATION, GENERAL

- A. Do not use materials that are unsound, warped, improperly treated or finished, inadequately seasoned, or too small to fabricate with proper jointing arrangements.
 - 1. Do not use manufactured units with defective surfaces, sizes, or patterns.
- B. Install exterior finish carpentry level, plumb, true, and aligned with adjacent materials. Use concealed shims where necessary for alignment.
 - 1. Scribe and cut exterior finish carpentry to fit adjoining work. Refinish and seal cuts as recommended by manufacturer.
 - 2. Install to tolerance of 1/8 inch in 96 inches for level and plumb. Install adjoining exterior finish carpentry with 1/32-inch maximum offset for flush installation and 1/16-inch maximum offset for reveal installation.
 - 3. Coordinate exterior finish carpentry with materials and systems in or adjacent to it. Provide cutouts for mechanical and electrical items that penetrate exterior finish carpentry.

3.4 STANDING AND RUNNING TRIM INSTALLATION

- A. Install flat-grain lumber with bark side exposed to weather.
- B. Install trim with minimum number of joints practical, using full-length pieces from maximum lengths of lumber available. Do not use pieces less than 24 inches long except where necessary.
 - 1. Use scarf joints for end-to-end joints.
 - 2. Stagger end joints in adjacent and related members.

- C. Fit exterior joints to exclude water. Cope at returns and miter at corners to produce tight-fitting joints with full-surface contact throughout length of joint. Plane backs of casings to provide uniform thickness across joints, where necessary for alignment.
- D. Where face fastening is unavoidable, countersink fasteners, fill surface flush, and sand unless otherwise indicated.

3.5 LUMBER SIDING

- A. Install with Rainscreen Clip in accordance with manufacturer's instructions.

3.6 ADJUSTING

- A. Replace exterior finish carpentry that is damaged or does not comply with requirements. Exterior finish carpentry may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing. Adjust joinery for uniform appearance.

3.7 CLEANING

- A. Clean exterior finish carpentry on exposed and semiexposed surfaces. Touch up factory-applied finishes to restore damaged or soiled areas.

3.8 PROTECTION

- A. Protect installed products from damage from weather and other causes during construction.
- B. Remove and replace finish carpentry materials that are wet, moisture damaged, and mold damaged.
 - 1. Indications that materials are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that materials are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 062013

SECTION 062023 - INTERIOR FINISH CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Interior standing and running trim.
 - 2. Shelving and clothes rods.
 - 3. Wood ceilings.
 - 4. T&G finish wall.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials, dimensions, profiles, textures, and colors and include construction and application details.
- B. Samples for Verification:
 - 1. For each species and cut of lumber and panel products with non-factory-applied finish, with 1/2 of exposed surface finished, 50 sq. in. for lumber and 8 by 10 inches for panels.
 - 2. For each finish system and color of lumber and panel products with factory-applied finish, 50 sq. in. for lumber and 8 by 10 inches for panels.

1.4 INFORMATIONAL SUBMITTALS

- A. Evaluation Reports: For fire-retardant-treated wood, from ICC-ES.
- B. Sample Warranty: For manufacturer's warranty.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Stack lumber, plywood, and other panels flat with spacers between each bundle to provide air circulation. Protect materials from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.
- B. Deliver interior finish carpentry materials only when environmental conditions meet requirements specified for installation areas. If interior finish carpentry materials must be stored

in other than installation areas, store only where environmental conditions meet requirements specified for installation areas.

1.6 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install interior finish carpentry materials until building is enclosed and weatherproof, wet work in space is completed and nominally dry, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.
- B. Do not install finish carpentry materials that are wet, moisture damaged, or mold damaged.
 - 1. Indications that materials are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that materials are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Lumber: DOC PS 20 and the following grading rules:
 - 1. NeLMA: Northeastern Lumber Manufacturers' Association, "Standard Grading Rules for Northeastern Lumber."
 - 2. NHLA: National Hardwood Lumber Association, "Rules for the Measurement and Inspection of Hardwood & Cypress."
 - 3. NLGA: National Lumber Grades Authority, "Standard Grading Rules for Canadian Lumber."
 - 4. SPIB: The Southern Pine Inspection Bureau, "Standard Grading Rules for Southern Pine Lumber."
 - 5. WCLIB: West Coast Lumber Inspection Bureau, Standard No. 17, "Grading Rules for West Coast Lumber."
 - 6. WWPA: Western Wood Products Association, "Western Lumber Grading Rules."
- B. Factory mark each piece of lumber with grade stamp of inspection agency indicating grade, species, moisture content at time of surfacing, and mill.
 - 1. For exposed lumber, mark grade stamp on end or back of each piece, or omit grade stamp and provide certificates of grade compliance issued by inspection agency.
- C. Softwood Plywood: DOC PS 1.
- D. Particleboard: ANSI A208.1, Grade M-2 or Grade M-2-Exterior Glue, where indicated.
- E. Melamine-Faced Particleboard: Particleboard complying with ANSI A208.1, Grade M-2, finished on both faces with thermally fused, melamine-impregnated decorative paper and

complying with requirements of NEMA LD3, Grade VGL, for test methods 3.3, 3.4, 3.6, 3.8, and 3.10.

1. Color: As selected by Architect from manufacturer's full range.

2.2 INTERIOR TRIM

A. Hardwood Lumber Trim for Transparent Finish (Stain or Clear Finish):

1. Species and Grade: White maple; Clear; NHLA.
2. Finger Jointing: Not allowed.
3. Gluing for Width: Use for lumber trim wider than 6 inches.
4. Face Surface: Surfaced (smooth).
5. Matching: Selected for compatible grain and color.

B. Lumber Trim for Opaque Finish (Painted Finish):

1. Species and Grade: Poplar; B finish; NHLA.
2. Finger Jointing: Allowed.
3. Face Surface: Surfaced (smooth).

2.3 OPEN WALL SHELVING

A. Thermoset Decorative Overlay (melamine) shelves with 3 mm PVC edging, 3/4 inch thick unless noted otherwise.

B. Wall Brackets: Knappe & Vogt No. 182, twin slotted standards with No. 82 heavy-duty U-Brackets. Color as selected by Architect.

2.4 SHELVING AND CLOTHES RODS

A. Closet Shelving: Made from the following material, 3/4 inch thick.

1. Melamine-faced particleboard with applied-PVC front edge.

B. Shelf Cleats: 3/4-by-3-1/2-inch boards, eastern white pine as specified above for shelving.

C. Shelf Brackets with Rod Support: BHMA A156.16, B04051; prime-painted formed steel.

D. Clothes Rods: 1-5/16-inch-diameter, chrome-plated-steel tubes.

E. Rod Flanges: Clear, kiln-dried, white maple turnings.

2.5 WOOD CEILINGS

A. Ship-lapped Southern yellow pine to match structural wood decking as close as possible.

2.6 T&G FINISH WALL

- A. Ship-lapped Southern yellow pine to match structural wood decking as close as possible.

2.7 MISCELLANEOUS MATERIALS

- A. Fasteners for Interior Finish Carpentry: Nails, screws, and other anchoring devices of type, size, material, and finish required for application indicated to provide secure attachment, concealed where possible.
- B. Multipurpose Construction Adhesive: Formulation complying with ASTM D 3498 that is recommended for indicated use by adhesive manufacturer.

2.8 FABRICATION

- A. Ease edges of lumber less than 1 inch in nominal thickness to 1/16-inch radius and edges of lumber 1 inch or more in nominal thickness to 1/8-inch radius.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine finish carpentry materials before installation. Reject materials that are wet, moisture damaged, and mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean substrates of projections and substances detrimental to application.
- B. Before installing interior finish carpentry, condition materials to average prevailing humidity in installation areas for a minimum of 24 hours.

3.3 INSTALLATION, GENERAL

- A. Do not use materials that are unsound, warped, improperly treated or finished, inadequately seasoned, too small to fabricate with proper jointing arrangements, or with defective surfaces, sizes, or patterns.
- B. Install interior finish carpentry level, plumb, true, and aligned with adjacent materials. Use concealed shims where necessary for alignment.

1. Scribe and cut interior finish carpentry to fit adjoining work. Refinish and seal cuts as recommended by manufacturer.
2. Where face fastening is unavoidable, countersink fasteners, fill surface flush, and sand unless otherwise indicated.
3. Install to tolerance of 1/8 inch in 96 inches for level and plumb. Install adjoining interior finish carpentry with 1/32-inch maximum offset for flush installation and 1/16-inch maximum offset for reveal installation.
4. Coordinate interior finish carpentry with materials and systems in or adjacent to it. Provide cutouts for mechanical and electrical items that penetrate interior finish carpentry.

3.4 STANDING AND RUNNING TRIM INSTALLATION

- A. Install with minimum number of joints practical, using full-length pieces from maximum lengths of lumber available. Do not use pieces less than 24 inches long, except where necessary. Stagger joints in adjacent and related standing and running trim. Miter at returns, miter at outside corners, and cope at inside corners to produce tight-fitting joints with full-surface contact throughout length of joint. Use scarf joints for end-to-end joints. Plane backs of casings to provide uniform thickness across joints where necessary for alignment.
 1. Match color and grain pattern of trim for transparent finish (stain or clear finish) across joints.
 2. Install trim after gypsum-board joint finishing operations are completed.
 3. Install without splitting; drill pilot holes before fastening where necessary to prevent splitting. Fasten to prevent movement or warping. Countersink fastener heads on exposed carpentry work and fill holes.

3.5 OPEN WALL SHELVING INSTALLATION

- A. Install standards for adjustable shelf brackets according to manufacturer's written instructions, spaced not more than 36 inches o.c. and within 6 inches of end of shelves. Fasten to framing members, blocking, or metal backing, or use toggle bolts or hollow wall anchors.
- B. 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.
 1. Fasten shelves to cleats with finish nails or trim screws, set flush.
 2. Fasten shelves to brackets to comply with bracket manufacturer's written instructions.

3.6 SHELVING AND CLOTHES ROD INSTALLATION

- A. Cut shelf cleats at ends of shelves about 1/2 inch less than width of shelves and sand exposed ends smooth.
- B. 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. Use 2 fasteners at each framing member.

1. Apply a bead of multipurpose construction adhesive to back of shelf cleats before installing. Remove adhesive that is squeezed out after fastening shelf cleats in place.
- C. Install shelf brackets according to manufacturer's written instructions, spaced not more than 32 inches o.c. Fasten to framing members, blocking, or metal backing, or use toggle bolts or hollow wall anchors.
- D. Install rod flanges for rods as indicated. Fasten to shelf cleats, framing members, blocking, or metal backing, or use toggle bolts or hollow wall anchors. Install rods in rod flanges.

3.7 ADJUSTING

- A. Replace interior finish carpentry that is damaged or does not comply with requirements. Interior finish carpentry may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing. Adjust joinery for uniform appearance.

3.8 CLEANING

- A. Clean interior finish carpentry on exposed and semiexposed surfaces. Restore damaged or soiled areas and touch up factory-applied finishes, if any.

3.9 PROTECTION

- A. Protect installed products from damage from weather and other causes during construction.
- B. Remove and replace finish carpentry materials that are wet, moisture damaged, and mold damaged.
 1. Indications that materials are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 2. Indications that materials are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 062023

SECTION 064023 - INTERIOR ARCHITECTURAL WOODWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Wood cabinets.
 - 2. Plastic-laminate cabinets.
 - 3. Plastic-laminate countertops.
 - 4. Solid-surfacing-material countertops.
 - 5. Wood bench.
 - 6. Cubbies.
 - 7. Reception desk.
 - 8. CPU storage rack.
 - 9. Wood wall panels.
 - 10. Wood display wall.
 - 11. Custom sliding wood doors.
 - 12. Shop finishing of interior woodwork.

1.3 DEFINITIONS

- A. Interior architectural woodwork includes wood furring, blocking, shims, and hanging strips for installing woodwork items unless concealed within other construction before woodwork installation.

1.4 ACTION SUBMITTALS

- A. Product Data: For panel products high-pressure decorative laminate adhesive for bonding plastic laminate solid-surfacing material 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.
 - 1. Show details full size.
 - 2. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.

3. Show locations and sizes of cutouts and holes for plumbing fixtures and other items installed in architectural woodwork.
4. Show veneer leaves with dimensions, grain direction, exposed face, and identification numbers indicating the flitch and sequence within the flitch for each leaf.

C. Samples for Initial Selection:

1. Shop-applied transparent finishes.
2. Plastic laminates.
3. PVC edge material.
4. Thermoset decorative panels.
5. Solid-surfacing materials.

D. Samples for Verification:

1. Lumber with or for transparent finish, not less than 50 sq. in. or 5 inches wide by 24 inches long, for each species and cut, finished on 1 side and 1 edge.
2. Veneer-faced panel products with or for transparent finish, 8 by 10 inches, for each species and cut. Include at least one face-veneer seam and finish as specified.
3. Plastic laminates, 8 by 10 inches, for each type, color, pattern, and surface finish.
4. Thermoset decorative-panels, 8 by 10 inches, for each type, color, pattern, and surface finish.
5. Solid-surfacing materials, 6 inches square.
6. Exposed cabinet hardware and accessories, one unit for each type and finish.

1.5 QUALITY ASSURANCE

- A. Quality Standard: Unless otherwise indicated, comply with AWI's "Architectural Woodwork Quality Standards" for grades of interior architectural woodwork indicated for construction, finishes, installation, and other requirements.
1. The Contract Documents contain selections chosen from options in the quality standard and additional requirements beyond those of the quality standard. Comply with such selections and requirements in addition to the quality standard.
- B. Fire-Test-Response Characteristics: Where fire-retardant materials or products are indicated, provide materials and products with specified fire-test-response characteristics as determined by testing identical products per test method indicated by UL, ITS, or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify with appropriate markings of applicable testing and inspecting agency in the form of separable paper label or, where required by authorities having jurisdiction, imprint on surfaces of materials that will be concealed from view after installation.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver woodwork until painting and similar operations that could damage woodwork have been completed in installation areas. If woodwork must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Project Conditions" Article.

1.7 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.
- B. Field Measurements: Where woodwork is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
 - 1. Locate concealed framing, blocking, and reinforcements that support woodwork by field measurements before being enclosed, and indicate measurements on Shop Drawings.
 - 2. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating woodwork without field measurements. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.8 COORDINATION

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that interior architectural woodwork can be supported and installed as indicated.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Provide materials that comply with requirements of AWI's quality standard for each type of woodwork and quality grade specified, unless otherwise indicated.
- B. Wood Species and Cut for Transparent Finish: White maple, plain sawn or sliced.
- C. Wood Products: Comply with the following:
 - 1. Particleboard: ANSI A208.1, Grade M-2.
 - 2. Hardwood Plywood and Face Veneers: HPVA HP-1, Grade A veneers.
 - a. Veneer Core Construction, All Locations Except as Noted: Veneer core plywood, no voids.
 - 1) 3/4-Inch Thickness: 7 plies.
 - 2) 1/2-Inch Thickness: 5 plies.
- D. Thermoset Decorative Panels: Particleboard or medium-density fiberboard finished with thermally fused, melamine-impregnated decorative paper complying with LMA SAT-1.

1. Colors: Provide full color options available from Panolam or Panval not just standard white, putty, almond, and grey.
- E. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or, if not indicated, as required by woodwork quality standard.
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering high-pressure decorative laminates that may be incorporated into the Work include, but are not limited to, the following:
 - a. Formica Corporation.
 - b. Lamin-Art, Inc.
 - c. Nevamar Company, LLC; Decorative Products Div.
 - d. Panolam Industries International Incorporated. (Pionite)
 - e. Westinghouse Electric Corp.; Specialty Products Div.
 - f. Wilsonart International; Div. of Premark International, Inc.
- F. Solid-Surfacing Material: Homogeneous solid sheets of filled plastic resin complying with ISSFA-2.
1. 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:
 - a. Avonite, Inc.
 - b. E. I. du Pont de Nemours and Company.
 - c. Formica Corporation.
 - d. Nevamar Company, LLC; Decorative Products Div.
 - e. Swan Corporation (The).
 - f. Wilsonart International; Div. of Premark International, Inc.
 2. Type: Standard type, unless Special Purpose type is indicated.
 3. Colors and Patterns: As selected by Architect from manufacturer's full range.

2.2 CABINET HARDWARE AND ACCESSORIES

- A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets, except for items specified in Division 08 Section "Door Hardware (Scheduled by Describing Products)."
- B. Frameless Concealed Hinges (European Type): BHMA A156.9, B01602, 100 degrees of opening, self-closing.
1. Available Products:
 - a. Blum: BH75T1550.
 - b. Grass: GHA3703M.
 - c. MEPLA: CS04 (MH146304550015).
- C. Pulls: Drawer Pull by Brunner Enterprises, Inc.; anodized aluminum finish.

- D. Adjustable Shelf Standards and Supports:
1. Available Products: Knap & Vogt Mfg. Co.: No. 82 heavy-duty brackets, No. 182 Standards, color as selected by the Architect.
- E. Shelf Rests: BHMA A156.9, B04013; plastic, two-pin type with shelf hold-down clip.
1. Plastic double pin shelf clip: Provide 1/4 inch diameter hole, clear or white color as selected by the Architect.
 - a. Available Products:
 - 1) Hardware Concepts, Inc.: Series 5033.
 - 2) AllenField: No. 55 Double Pin.
- F. Drawer Slides: BHMA A156.9, B05091; Heavy Duty (Grade 1HD-100 and Grade 1HD-200): Side mounted; full-extension type; zinc-plated steel ball-bearing slides.
1. Available Products:
 - a. Grass 6610.
 - b. Mepla-Alfit: AL 5300.
 - c. KV 8417.
 - d. Blum 430E Series.
- G. Counter Support Brackets: Provide one of the following
1. Heavy gage aluminum angle, MIG welded corners, 5/16 inch holes for mounting, and primed finish for field painting. Provide Rakks Counter Support, Model No. EH-1818, by Ragine Corporation (800-826-6006) or approved substitution.
- H. ADA Counter Support Brackets: Provide the following:
1. Heavy gage aluminum angle, MIG welded corners, 5/16 inch holes for mounting, and primed finish for field painting. Provide Rakks EHV Vanity Bracket, 18 by 21-1/2 inch, by Ragine Corporation (800-826-6006) or approved substitution.
- I. Drawer and Door Locks: Provide Locks by Olympus Lock, Inc.; 100 DR door lock and 200 DW drawer lock. No substitutions.
1. Provide 6 master keys with all locks keyed alike.
 2. Provide on all drawers and doors.
 3. Provide epoxy adhesive to retain lock attachments in place.
- J. Grommets for Cable Passage through Countertops: 3-inch OD, black, molded-plastic grommets and matching plastic caps with slot for wire passage.
1. Product: Provide No. 35-3" by Outwater Plastics, Woodridge, NJ, (800) 631-8375.

- K. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.
 - 1. Satin Chromium Plated: BHMA 626 for brass or bronze base; BHMA 652 for steel base.
 - 2. Satin Stainless Steel: BHMA 630.
- L. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.

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. Rough Carriages for Stairs: No. 2 grade and the following species, kiln dried to 15 percent maximum moisture content:
 - 1. Spruce-pine-fir (south).
- C. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls and elsewhere as required for corrosion resistance. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.
- D. Adhesives, General: Do not use adhesives that contain urea formaldehyde.
- E. VOC Limits for Installation Adhesives and Glues: Use installation adhesives that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
 - 1. Wood Glues: 30 g/L.
 - 2. Contact Adhesive: 250 g/L.
- F. Adhesive for Bonding Plastic Laminate: Contact cement.
 - 1. Adhesive for Bonding Edges: Hot-melt adhesive or adhesive specified above for faces.

2.4 FABRICATION, GENERAL

- A. Interior Woodwork Grade: Unless otherwise indicated, provide Custom-grade interior woodwork complying with referenced quality standard.
- B. Wood Moisture Content: Comply with requirements of referenced quality standard for wood moisture content in relation to ambient relative humidity during fabrication and in installation areas.
- C. Fabricate woodwork to dimensions, profiles, and details indicated. Ease edges to radius indicated for the following:

1. Corners of Cabinets and Edges of Solid-Wood (Lumber) Members 3/4 Inch Thick or Less: 1/16 inch.
 2. Edges of Rails and Similar Members More Than 3/4 Inch Thick: 1/8 inch.
 3. Corners of Cabinets and Edges of Solid-Wood (Lumber) Members and Rails: 1/16 inch.
- D. Complete fabrication, including assembly, finishing, and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
1. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements indicated on Shop Drawings before disassembling for shipment.
- E. Shop-cut openings to maximum extent possible to receive hardware, appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.
1. Seal edges of openings in countertops with a coat of varnish.

2.5 WOOD CABINETS FOR TRANSPARENT FINISH (Kitchen Area)

- A. Grade: Premium.
- B. AWI Type of Cabinet Construction: Flush overlay without face frame.
- C. Wood Species and Cut for Exposed Surfaces: White maple, plain sawn or sliced.
1. Grain Direction: Vertically for drawer fronts, doors, and fixed panels.
 2. Matching of Veneer Leaves: Book match.
 3. Vertical Matching of Veneer Leaves: End match.
 4. Veneer Matching within Panel Face: Running match.
- D. Component Materials:
1. Body Members: Ends, bottom, divisions, rails and tops: 3/4 inch thick veneer covered, particleboard or medium density fiberboard (MDF) panels, all exposed and semi-exposed sides. Provide Type B or C flush joint for underside of wall cabinets as required by AWI 400-G-7.
 2. Shelves: Minimum 3/4 inch thick veneer covered panels. Provide material and thickness required to meet AWI 400-G-8.
 3. Backs: 1/4 inch thick panels.
 4. Drawer sides, backs: 1/2" panels or solid lumber.
 5. Drawer Bottoms: 1/4" panels.
 6. Drawer Fronts: 3/4" panels.
 7. Cabinet Doors: 3/4" panels.
 8. Edging: 3 mm wood.

9. Base Toe Kick: Plywood.

2.6 PLASTIC-LAMINATE CABINETS (All Areas except Kitchen)

- A. Grade: Custom, unless noted otherwise.
- B. AWI Type of Cabinet Construction: Flush overlay without face frame.
- C. Component Materials:
 1. Body members - ends, bottom, divisions, rails and tops: .028" exterior laminate over 3/4 inch thick particleboard, interior Thermoset Decorative Overlay (melamine) with 3 mm PVC edging, all exposed and semi-exposed sides. Provide Type B or C flush joint for underside of wall cabinets as required by AWI 400-G-7.
 2. Shelves: Minimum 3/4 inch thick particleboard, Thermoset Decorative Overlay (melamine) each side with 3 mm PVC edging. Provide material and thickness required to meet AWI 400-G-8.
 3. Backs: 1/4 inch thick particleboard, Thermoset Decorative Overlay (melamine) each side.
 4. Drawer sides, backs and subfronts: 1/2" hardwood plywood or solid lumber.
 5. Drawer Bottoms: 1/4" hardwood plywood.
 6. Drawer Fronts: .028" exterior laminate over 3/4 inch thick particleboard, interior Thermoset Decorative Overlay (melamine) with 3 mm PVC edging.
 7. Cabinet Doors: .028" exterior laminate over 3/4 inch thick particleboard, interior Thermoset Decorative Overlay (melamine) with 3 mm PVC edging.
 8. Edging: Band all exposed edges with 3 mm PVC.
 9. Base Toe Kick: Hardwood plywood.
- D. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
 1. As selected by Architect from laminate manufacturer's full range in the following categories:
 - a. Solid colors, matte finish.
 - b. Patterns, matte finish.

2.7 PLASTIC-LAMINATE COUNTERTOPS

- A. Grade: Premium.
- B. High-Pressure Decorative Laminate Grade: HGS.
- C. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
 1. As selected by Architect from manufacturer's full range in the following categories:
 - a. Solid colors, matte finish.

b. Patterns, matte finish.

- D. Grain Direction: Parallel to cabinet fronts.
- E. Edge Treatment: As indicated.
- F. Core Material: Particleboard.
- G. Core Material at Sinks: Exterior-grade plywood.
- H. Backer Sheet: Provide plastic-laminate backer sheet, Grade BKL, on underside of countertop substrate.

2.8 SOLID-SURFACING-MATERIAL COUNTERTOPS

- A. Grade: Premium.
- B. Solid-Surfacing-Material Thickness: 1/2 inch.
- C. Colors, Patterns, and Finishes: Provide materials and products that result in colors of solid-surfacing material complying with the following requirements:
 - 1. As selected by Architect from manufacturer's full range.
- D. Fabricate tops in one piece, unless otherwise indicated. Comply with solid-surfacing-material manufacturer's written recommendations for adhesives, sealers, fabrication, and finishing.
 - 1. Fabricate tops with shop-applied edges of materials and configuration indicated.
 - 2. Fabricate tops with shop-applied backsplashes.
- E. Install integral sink bowls in countertops in shop.
- F. Drill holes in countertops for plumbing fittings and soap dispensers in shop.

2.9 WOOD WALL/CEILING PANELING

- A. Wood Species and Cut: White maple, plain sliced.
 - 1. Lumber Trim and Edges: At fabricator's option, trim and edges indicated as solid wood (except moldings) may be either lumber or veneered construction compatible with grain and color of veneered panels.
- B. Matching of Adjacent Veneer Leaves: Book match.
- C. Veneer Matching within Panel Face: Running match.
- D. Panel-Matching Method: No matching between panels is required. Select and arrange panels for similarity of grain pattern and color between adjacent panels.

2.10 WOOD DISPLAY WALL

- A. Ship-lapped Southern yellow pine to match structural wood decking as close as possible.

2.11 CUSTOM SLIDING WOOD DOOR

- A. Two sliding wood doors shall be fabricated from 1/4 inch thick birch plywood faces with solid birch interior framework to form a hollow core door. Approximate door size is 6'-7" wide by 8'-0" high.
- B. Hardware: Sliding door hardware shall consist of the following components from Johnson Hardware's Series 1562 by-pass pocket door kits:
 - 1. Track: #100 track sections as required for pocket door configuration.
 - 2. Hangers: #1125 wheel hangers, three hangers per door leaf.
 - 3. Door Guides: One #2083 finished floor guide and one #2032 side mount door guide.
 - 4. Pulls: As selected by the Architect.
- C. Door Finish: Natural clear finish.

2.12 SHOP FINISHING

- A. Grade: Provide finishes of same grades as items to be finished.
- B. General: Finish architectural woodwork at fabrication shop as specified in this Section. Defer only final touchup, cleaning, and polishing until after installation.
- C. Preparation for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing architectural woodwork, as applicable to each unit of work.
 - 1. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of woodwork. Apply two coats to back of paneling and to end-grain surfaces. Concealed surfaces of plastic-laminate-clad woodwork do not require backpriming when surfaced with plastic laminate, backing paper, or thermoset decorative panels.
- D. Transparent Finish:
 - 1. Grade: Custom.
 - 2. AWI Finish System TR-5: Catalyzed vinyl.
 - 3. Staining: None required.
 - 4. Open Finish for Open-Grain Woods: Do not apply filler to open-grain woods.
 - 5. Sheen: Satin, 30-50 gloss units.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Before installation, condition woodwork to average prevailing humidity conditions in installation areas.
- B. Before installing architectural woodwork, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming.

3.2 INSTALLATION

- A. Grade: Install woodwork to comply with requirements for the same grade specified in Part 2 for fabrication of type of woodwork involved.
- B. Assemble woodwork and complete fabrication at Project site to comply with requirements for fabrication in Part 2, to extent that it was not completed in the shop.
- C. Install woodwork level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb (including tops) to a tolerance of 1/8 inch in 96 inches.
- 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 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. Complete installation of hardware and accessory items as indicated.
 - 1. Install cabinets with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
 - 2. Maintain veneer sequence matching of cabinets with transparent finish.
 - 3. 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.
 - 1. Align adjacent solid-surfacing-material countertops and form seams to comply with manufacturer's written recommendations using adhesive in color to match countertop. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
 - 2. Install countertops with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
 - 3. Secure backsplashes to walls with adhesive.

4. Calk space between backsplash and wall with sealant specified in Division 07 Section "Joint Sealants."
- H. Paneling: Anchor paneling to supporting substrate with finish nails. Fill with colored putty to match wood finish.
 1. Install flush paneling with no more than 1/16 inch in 96-inch vertical cup or bow and 1/8 inch in 96-inch horizontal variation from a true plane.
- I. Touch up finishing work specified in this Section after installation of woodwork. Fill nail holes with matching filler where exposed.

3.3 ADJUSTING AND CLEANING

- A. Repair damaged and defective woodwork, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.
- B. Clean, lubricate, and adjust hardware.
- C. Clean woodwork on exposed and semiexposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

END OF SECTION 064023

SECTION 072100 - THERMAL INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Extruded polystyrene foam-plastic board.
 - 2. Glass-fiber blanket.
 - 3. Spray-applied cellulosic insulation.
 - 4. Sprayed Foam insulation.

1.3 ACTION SUBMITTALS

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

1.4 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each product, for tests performed by a qualified testing agency.
- B. Evaluation Reports: For foam-plastic insulation, from ICC-ES.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.
- B. Protect foam-plastic board insulation as follows:
 - 1. Do not expose to sunlight except to necessary extent for period of installation and concealment.
 - 2. Protect against ignition at all times. Do not deliver foam-plastic board materials to Project site until just before installation time.
 - 3. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.

PART 2 - PRODUCTS

2.1 EXTRUDED POLYSTYRENE FOAM-PLASTIC BOARD

- A. Extruded polystyrene boards in this article are also called "XPS boards." Roman numeral designators in ASTM C 578 are assigned in a fixed random sequence, and their numeric order does not reflect increasing strength or other characteristics.
- B. Extruded Polystyrene Board, Type IV: ASTM C 578, Type IV, 25-psi minimum compressive strength; unfaced; maximum flame-spread and smoke-developed indexes of 25 and 450, respectively, per ASTM E 84.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Dow Chemical Company (The); Styrofoam Square Edge Insulation.
 - b. Owens Corning; Foamular® 250.
 - c. Pactiv Corporation; GreenGuard Type IV 25 PSI Insulation Board.
 - 2. R-Value: 5.0 per inch.
 - 3. Application: Foundation and below slab insulation, and where indicated for exterior wall assemblies.

2.2 GLASS-FIBER BLANKET

- A. Glass-Fiber Blanket, Unfaced: ASTM C 665, Type I; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CertainTeed Corporation.
 - b. Guardian Building Products, Inc.
 - c. Johns Manville; a Berkshire Hathaway company.
 - d. Knauf Insulation.
 - e. Owens Corning.
 - 2. R-Value: 3.0 to 3.2 per inch, depending on thickness.
 - 3. Application: Where indicated on the drawings.

2.3 SPRAY-APPLIED CELLULOSIC INSULATION

- A. Pneumatically Blown, Dense-Packed & Netted Cellulosic Insulation: ASTM C 1149, Type II, chemically treated for flame-resistance, processing, and handling characteristics, sprayed-in-place to a minimum density of 3.5 to 4.0 lbs per cubic foot..

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Central Fiber LLC.
 - b. GreenFiber.
 - c. Hamilton Manufacturing Inc.
 - d. International Cellulose Corp.
 - e. National Fiber.
2. R-Value: Minimum of 3.7 per inch.
3. Applications:
 - a. Exterior wall insulation.
 - b. Roof framed cavities.

2.4 SPRAYED FOAM INSULATION

- A. Sprayed Polyurethane Foam Sealant for Perimeter of Doors and Windows (Type 1): 1- or 2-component, foamed-in-place, polyurethane foam sealant, 1.5 to 2.0 lb/cu. ft. density; flame spread index of 25 or less according to ASTM E 162; with primer and noncorrosive substrate cleaner recommended by foam sealant manufacturer.
 1. Products:
 - a. Great Stuff Window & Door by Dow
 - b. Froth-Pak by Insta-Foam Products, Inc.
 - c. Zerodraft Insulating Air Sealant by Zerodraft.
- B. Closed-Cell Spray Polyurethane Foam (Type 2): ASTM C 1029, Type II, minimum density of 1.5 lb/cu. ft..
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Corbond® Performance Insulation System.
 - b. Henry Permax 1.8 Closed Cell Foam Insulation.
 - c. Styrofoam™ SPF Insulation.
 2. Flame/Smoke Properties: 25/450 in accordance with ASTM E84.
 3. R-Value, Aged: 6.2 per inch.
 4. Application: Where indicated on the drawings.

2.5 PROTECTIVE COATINGS

- A. Flame-Resistive Coating for Foamed-in-Place Insulation: Provide one of the following products approved by the Maine State Fire Marshall:
 1. Cafco: TB-415.
 2. Cafco: TB-15.

3. Flame Seal TB.
4. International Fireproof Technology, Inc.: DC315.
5. TPR2: Fireshell F10E.
6. TPR2: Fireshell F1E.

2.6 ACCESSORIES

- A. Adhesive for Bonding Insulation: Product compatible with insulation and air and water barrier materials, and with demonstrated capability to bond insulation securely to substrates without damaging insulation and substrates.
- B. Insulation Webbing: Webbing used with cellulose insulation as a backer to hold spray.
 1. Product: InsulWeb™ by J&R Products, Inc..
- C. Z-Shaped Furring: With non-slotted web, typical profile thickness of .090 inch, wall attachment flange of >1.375 inch and depth required to fit insulation thickness indicated.
 1. Product: EcoStud Z Furring by Superior Polymer Products.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean substrates of substances that are harmful to insulation, including removing projections capable of puncturing insulation or vapor retarders, or that interfere with insulation attachment.

3.2 INSTALLATION, GENERAL

- A. Comply with insulation manufacturer's written instructions applicable to products and applications.
- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.
- C. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- D. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness or to achieve R-value.

3.3 INSTALLATION OF SLAB INSULATION

- A. On horizontal surfaces, loosely lay insulation units according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.

3.4 INSTALLATION OF FOUNDATION WALL INSULATION

- A. On vertical foundation surfaces, set insulation units using manufacturer's recommended adhesive according to manufacturer's written instructions.
 - 1. If not otherwise indicated, extend insulation a minimum of 48 inches below exterior grade line.
- B. Butt panels together for tight fit.

3.5 INSTALLATION OF INSULATION IN FRAMED CONSTRUCTION

- A. Blanket Insulation: Install in cavities formed by framing members according to the following requirements:
 - 1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
 - 2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
 - 3. Maintain 3-inch clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
- B. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces around doors and windows where required to prevent gaps in insulation using the following materials:
 - 1. Spray Polyurethane Insulation Type 1: Apply according to manufacturer's written instructions.
- C. Spray-Applied Cellulosic Insulation: Apply spray-applied insulation according to manufacturer's written instructions. Do not apply insulation until installation of pipes, ducts, conduits, wiring, and electrical outlets in walls is completed and windows, electrical boxes, and other items not indicated to receive insulation are masked. After insulation is applied, make flush with face of studs by using method recommended by insulation manufacturer.
- D. Sprayed Foam Insulation Type 2: Comply with insulation manufacturer's written instructions applicable to products and applications. Spray insulation to envelop entire area to be insulated and fill voids. Apply in multiple passes to not exceed maximum thicknesses recommended by manufacturer. Do not spray into rising foam. Install into cavities formed by framing members to achieve thickness indicated on Drawings.
 - 1. At Locations Exposed To View: Apply Flame-Resistive Coating in accordance with manufacturer's recommendations.

3.6 PROTECTION

- A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse

and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION 072100

SECTION 072616 - BELOW-GRADE VAPOR RETARDERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Vapor retarders under slabs-on-grade.

1.3 DEFINITIONS

- A. Vapor Retarder: Material with a water vapor transmission rating of not over 0.04g per square foot per hour.
- B. Vapor Barrier: Material with a water vapor transmission rating of not over 0.015g per square foot per hour.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Verification: 12 inch square units for each type of vapor retarder, vapor barrier, or air barrier indicated.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect materials from physical damage and from deterioration by moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

1.6 PROJECT CONDITIONS

- A. Separate and recycle waste materials.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers and Products: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following products listed in Part 2 of this Section.

2.2 VAPOR RETARDERS FOR UNDER SLABS

- A. Vapor Retarder with extremely low permeance for critically sensitive, low permeance floor coverings such as rubber, vinyl, urethane, epoxy and methyl methacrylate, as well as linoleum and wood, having the following qualities:
1. Minimum Permeance: ASTM E-96, not greater than 0.01 perms.
 2. Tensile Strength: ASTM E154 or D638, Class A – over 45 lbf/in.
 3. Puncture Resistance: ASTM E-154, Class B – over 1700 grams.
 4. Water Vapor Barrier: ASTM E-1745, meets or exceeds Class B.
 5. Thickness of Barrier (Plastic) ACI 302.1R-96, not less than 15 mils.
- B. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
1. Stego Wrap, 15 mil thick vapor retarder by Stego Industries LLC, (877) 464-7834.
 2. Griffolyn® 15 by Reef Industries.
 3. Sealtight Perminator 15 mil Underslab Vapor-Mat by W.R. Meadows, Inc.
 4. Viper VaporCheck 16 by Insulation Solutions, Inc.
- C. Vapor-Retarder Tape (for slabs): Stego Warp red polyethylene tape or tape as recommended by the manufacturer.
- D. Double-Stick Edge Tape: Preformed 1-1/2" wide two-sided adhesive. Available products include "Fab Tape" by Reef Industries.
- E. Expansion Joint Filler: Installer may elect to use Deck-O-Foam Expansion Joint Filler by WR Meadows or equal. Foam expansion joint filler with pre-scored removable strip for installation of joint sealant.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for Sections in which substrates and related work are specified and other conditions affecting performance.

- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean substrates of substances harmful to vapor retarders, including removing projections capable of puncturing vapor retarders, or of interfering with attachment.
- B. Do not install carpet over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet manufacturer.

3.3 INSTALLATION, GENERAL

- A. Comply with manufacturer's written instructions applicable to products and application indicated.
- B. Extend retarders in thickness indicated to envelop entire area to be covered. Cut and fit tightly around obstructions. Remove projections that interfere with placement.

3.4 INSTALLATION OF UNDER-SLAB VAPOR RETARDERS

- A. Moisture vapor retarder system shall be installed at all interior floor slabs and as otherwise indicated in the drawings in strict accordance with the manufacturer's printed instructions and as follows:
 1. Snap chalk line along inside perimeter of foundation walls at top of slab elevation.
 2. Without wetting, clean a 3" wide band on the surface of the concrete below the chalk line at approximately mid-slab height. Remove dirt, residual form release, or other bond inhibiting surface contaminants. Grind smooth any surface projections within the band.
 3. While removing the contact paper on the backside, firmly press 2" wide double-stick edge tape onto wall, parallel to the chalk line on the cleaned band at mid-slab elevation.
 4. Remove contact paper on the face side.
 5. Apply a 12" wide strip of vapor retarder covering only the bottom 1" of contact surface on the edge tape. Cut, fit, and seal corner details with vapor retarder seaming tape.
 6. Align top edge of Deck-O-Foam expansion joint material to chalk line, and press material onto remaining 1" of exposed perimeter strip adhesive.
 7. Roll out vapor retarder material, overlapping edge rolls and all seams by 3". Tape all seams with vapor retarder seaming tape.
 8. All tears, punctures, etc. to be repaired and taped as required to maintain the watertight integrity of the vapor retarder system.

3.5 PROTECTION

- A. Protect installed vapor retarders from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where vapor retarders are subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION 072616

SECTION 072713 - MODIFIED BITUMINOUS SHEET AIR BARRIERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes self-adhering, vapor-retarding, modified bituminous sheet air barriers.

1.3 DEFINITIONS

- A. Air-Barrier Material: A primary element that provides a continuous barrier to the movement of air.
- B. Air-Barrier Accessory: A transitional component of the air barrier that provides continuity.
- C. Air-Barrier Assembly: The collection of air-barrier materials and accessory materials applied to an opaque wall, including joints and junctions to abutting construction, to control air movement through the wall.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review air-barrier requirements and installation, special details, mockups, air-leakage and bond testing, air-barrier protection, and work scheduling that covers air barriers.
 - 2. Review approved shop drawings and product submittals.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include manufacturer's written instructions for evaluating, preparing, and treating substrate; technical data; and tested physical and performance properties of products.
- B. Shop Drawings: For air-barrier assemblies.
 - 1. Show locations and extent of air barrier. Include details for substrate joints and cracks, counterflashing strips, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.
 - 2. Include details of interfaces with other materials that form part of air barrier.

1.6 INFORMATIONAL SUBMITTALS

- A. Product Certificates: From air-barrier manufacturer, certifying compatibility of air barriers and accessory materials with Project materials that connect to or that come in contact with air barrier.
- B. Product Test Reports: For each air-barrier assembly, for tests performed by a qualified testing agency.
- C. Warranty: Provide sample warrantee for Installer and Manufacturer.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer and has a successful track record of installing the specified product for a minimum of 5 years.
- B. Mockups: Build mockups to set quality standards for materials and execution.
 - 1. Build integrated mockups of exterior wall assembly as shown on Drawings, incorporating backup wall construction, external cladding, window, storefront, door frame and sill, insulation, ties and other penetrations, and flashing to demonstrate surface preparation, crack and joint treatment, application of air barriers, and sealing of gaps, terminations, and penetrations of air-barrier assembly.
 - a. Coordinate construction of mockups to permit inspection by Owner's testing agency of air barrier before external insulation and cladding are installed.
 - b. Include junction with roofing membrane and foundation wall intersection.
 - c. If Architect determines mockups do not comply with requirements, reconstruct mockups and apply air barrier until mockups are approved.
 - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Remove and replace liquid materials that cannot be applied within their stated shelf life.
- B. Protect stored materials from direct sunlight.

1.9 FIELD CONDITIONS

- A. Environmental Limitations: Apply air barrier within the range of ambient and substrate temperatures recommended by air-barrier manufacturer.

1. Protect substrates from environmental conditions that affect air-barrier performance.
2. Do not apply air barrier to a damp or wet substrate or during snow, rain, fog, or mist.

1.10 WARRANTY

- A. Material Warranty: Manufacturer agrees to repair or replace components of air barrier system that fail in materials or workmanship within specified warranty period.
 1. Warranty Period: 5 years from date of Substantial Completion.
- B. Special Project Warranty: Submit air barrier Installer's warranty, signed by Installer, covering Work of this Section, including all components of air barrier system for the following warranty period:
 1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Source Limitations: Obtain primary air-barrier materials and air-barrier accessories from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. General: Air barrier shall be capable of performing as a continuous vapor-retarding air barrier and as a liquid-water drainage plane flashed to discharge to the exterior incidental condensation or water penetration. Air-barrier assemblies shall be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, penetrations, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.
- B. Air-Barrier Assembly Air Leakage: Maximum 0.04 cfm/sq. ft. of surface area at 1.57 lbf/sq. ft., when tested according to ASTM E 283, ASTM E 783 or ASTM E 2357.

2.3 SELF-ADHERING SHEET AIR BARRIER

- A. Modified Bituminous Sheet: 40-mil-thick, self-adhering sheet consisting of 36 mils of rubberized asphalt laminated to a 4-mil-thick, cross-laminated polyethylene film with release liner on adhesive side.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Carlisle Coatings & Waterproofing Inc.; CCW-705.
 - b. Grace Construction Products; W.R. Grace & Co. -- Conn.; Perm-A-Barrier Wall Membrane..

- c. Henry Company; Blueskin SA.
 - d. Tremco Incorporated; ExoAir 110/110LT.
2. Physical and Performance Properties:
- a. Air Permeance: Maximum 0.004 cfm/sq. ft. of surface area at 1.57-lbf/sq. ft. pressure difference; ASTM E 2178.
 - b. Tensile Strength: Minimum 250 psi; ASTM D 412, Die C.
 - c. Ultimate Elongation: Minimum 200 percent; ASTM D 412, Die C.
 - d. Puncture Resistance: Minimum 40 lbf; ASTM E 154.
 - e. Water Absorption: Maximum 0.15 percent weight gain after 48-hour immersion at 70 deg F; ASTM D 570.
 - f. Vapor Permeance: Maximum 0.05 perm; ASTM E 96/E 96M, Water Method.

2.4 ACCESSORY MATERIALS

- A. General: Accessory materials recommended by air-barrier manufacturer to produce a complete air-barrier assembly and compatible with primary air-barrier membrane.
- B. Primer: Liquid primer recommended for substrate by air-barrier material manufacturer.
- C. Termination Sealant: Dow Corning, Dow 758 Sealant, or manufacturer's approved silicone sealant for adhering to polyethylene facer.
- D. Liquid Membrane: Air barrier manufacturer's two component liquid membrane.
- E. Substrate-Patching Membrane: Manufacturer's standard trowel-grade substrate filler.
- F. Adhesive and Tape: Air-barrier manufacturer's standard adhesive and pressure-sensitive adhesive tape.
- G. Sprayed Foam Sealant: Refer to Division 07 Section "Thermal Insulation" for spray foam insulation applied at doors and windows.
- H. Membrane Strip Flashing: Vapor retarding, 40 mils thick, smooth surfaced, self-adhering; consisting of 36 mils of rubberized asphalt laminated to a 4-mil- thick polyethylene film with release liner backing.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
 - 1. Verify that substrates are sound and free of oil, grease, dirt, excess mortar, or other contaminants.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SURFACE PREPARATION

- A. Clean, prepare, and treat substrate according to manufacturer's written instructions. Provide clean, dust-free, and dry substrate for air-barrier application.
- B. Mask off adjoining surfaces not covered by air barrier to prevent spillage and overspray affecting other construction.
- C. Prepare, fill, prime, and treat joints and cracks in substrates. Remove dust and dirt from joints and cracks according to ASTM D 4258.
 - 1. Install modified bituminous strips and center over treated construction and contraction joints and cracks exceeding a width of 1/16 inch.
- D. At changes in substrate plane, apply liquid membrane fillets at sharp corners and edges to form a smooth transition from one plane to another.
- E. Cover gaps in substrate plane greater than 1/2 inch and form a smooth transition from one substrate plane to another with stainless-steel sheet mechanically fastened to structural framing to provide continuous support for air barrier.

3.3 INSTALLATION

- A. General: Install modified bituminous sheets and accessory materials according to air-barrier manufacturer's written instructions and according to recommendations in ASTM D 6135.
 - 1. When ambient and substrate temperatures range between 25 and 40 deg F, install self-adhering, modified bituminous air-barrier sheet produced for low-temperature application. Do not install low-temperature sheet if ambient or substrate temperature is higher than 60 deg F.
- B. Corners: Prepare, prime, and treat inside and outside corners according to ASTM D 6135.
 - 1. Install membrane strip flashing centered over vertical inside corners. Install 3/4-inch fillets of termination sealant on horizontal inside corners.
- C. Prepare, treat, and seal vertical and horizontal surfaces at terminations and penetrations with termination sealant and according to ASTM D 6135.
- D. Apply primer to substrates at required rate and allow it to dry. Limit priming to areas that will be covered by air-barrier sheet on same day. Reprime areas exposed for more than 24 hours.
 - 1. Prime glass-fiber-surfaced gypsum sheathing with number of prime coats needed to achieve required bond, with adequate drying time between coats.
- E. Apply and firmly adhere modified bituminous sheets horizontally over area to receive air barrier. Accurately align sheets and maintain uniform 2-1/2-inch-minimum lap widths and end laps. Overlap and seal seams, and stagger end laps to ensure airtight installation.

1. Apply sheets in a shingled manner to shed water without interception by any exposed sheet edges.
 2. Roll sheets firmly to enhance adhesion to substrate.
- F. Apply continuous modified bituminous sheets over membrane strip flashing bridging substrate cracks, construction, and contraction joints.
- G. Seal top of through-wall flashings to air-barrier sheet with an additional 6-inch-wide, membrane strip flashing.
- H. Seal exposed edges of sheet at seams, cuts, penetrations, and terminations not concealed by metal counterflashings or ending in reglets with sealant.
- I. Install air-barrier sheet and accessory materials to form a seal with adjacent construction and to maintain a continuous air barrier.
1. Coordinate air-barrier installation with installation of roofing membrane and base flashing to ensure continuity of air barrier with roofing membrane.
 2. Install membrane strip flashing on roofing membrane or base flashing so that a minimum of 3 inches of coverage is achieved over each substrate.
- J. Connect and seal exterior wall air-barrier membrane continuously to roofing-membrane air barrier, concrete below-grade structures, floor-to-floor construction, exterior glazing and window systems, glazed curtain-wall systems, storefront systems, exterior louvers, exterior door framing, and other construction used in exterior wall openings, using accessory materials.
- K. Wall Openings: Prime concealed, perimeter frame surfaces of windows, curtain walls, storefronts, and doors. Apply membrane strip flashing so that a minimum of 3 inches of coverage is achieved over each substrate. Maintain 3 inches of full contact over firm bearing to perimeter frames with not less than 1 inch of full contact.
1. Membrane Strip Flashing: Roll firmly to enhance adhesion.
- L. Fill gaps in perimeter frame surfaces of windows, curtain walls, storefronts, doors, and miscellaneous penetrations of air-barrier membrane with foam sealant.
- M. At end of each working day, seal top edge of air-barrier material to substrate with termination sealant.
- N. Apply joint sealants forming part of air-barrier assembly within manufacturer's recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.
- O. Repair punctures, voids, and deficient lapped seams in air barrier. Slit and flatten fishmouths and blisters. Patch with air-barrier sheet extending 6 inches beyond repaired areas in all directions.
- P. Do not cover air barrier until it has been tested and inspected by Owner's testing agency.
- Q. Correct deficiencies in or remove air barrier that does not comply with requirements; repair substrates and reapply air-barrier components.

3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform inspections.
- B. Inspections: Air-barrier materials, accessories, and installation are subject to inspection for compliance with requirements. Inspections may include the following:
 - 1. Continuity of air-barrier system has been achieved throughout the building envelope with no gaps or holes.
 - 2. Continuous structural support of air-barrier system has been provided.
 - 3. Site conditions for application temperature and dryness of substrates have been maintained.
 - 4. Maximum exposure time of materials to UV deterioration has not been exceeded.
 - 5. Surfaces have been primed.
 - 6. Laps in sheet materials have complied with the minimum requirements and have been shingled in the correct direction (or mastic applied on exposed edges), with no fishmouths.
 - 7. Termination mastic has been applied on cut edges.
 - 8. Air barrier has been firmly adhered to substrate.
 - 9. Compatible materials have been used.
 - 10. Transitions at changes in direction and structural support at gaps have been provided.
 - 11. Connections between assemblies (membrane and sealants) have complied with requirements for cleanliness, surface preparation and priming, structural support, integrity, and continuity of seal.
 - 12. All penetrations have been sealed.
- C. Air barriers will be considered defective if they do not pass tests and inspections.
 - 1. Apply additional air-barrier material, according to manufacturer's written instructions, where inspection results indicate insufficient thickness.
 - 2. Remove and replace deficient air-barrier components for retesting as specified above.
- D. Repair damage to air barriers caused by testing; follow manufacturer's written instructions.

3.5 CLEANING AND PROTECTION

- A. Protect air-barrier system from damage during application and remainder of construction period, according to manufacturer's written instructions.
 - 1. Protect air barrier from exposure to UV light and harmful weather exposure as required by manufacturer. If exposed to these conditions for more than 120 days, remove and replace air barrier or install additional, full-thickness, air-barrier application after repairing and preparing the overexposed membrane according to air-barrier manufacturer's written instructions.
 - 2. Protect air barrier from contact with incompatible materials and sealants not approved by air-barrier manufacturer.

- B. Clean spills, stains, and soiling from construction that would be exposed in the completed Work, using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 072713

SECTION 074646 - FIBER-CEMENT SIDING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Fiber-cement siding.

1.2 COORDINATION

- A. Coordinate siding installation with flashings and other adjoining construction to ensure proper sequencing.

1.3 PREINSTALLATION MEETINGS

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

1.4 ACTION SUBMITTALS

- A. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation methods.
- B. Shop Drawings: Provide detailed drawings of non-standard applications of fiber cement materials which are outside the scope of the standard details and specifications provided by the manufacturer.
- C. Attachment System Engineered Drawings:
 - 1. Provide engineered design for attachment and back-up framing to support exterior cladding.
 - 2. Provide static calculations verifying sizing of members, attachment devices and fasteners to support the exterior cladding with a safety factor required by Authority Having Jurisdiction (AHJ).
 - 3. Include designed fastener spacing as recommended by Trufast Engineering Evaluation Reports.
 - 4. Provide installation drawings and details.
- D. Samples for Initial Selection: For fiber-cement siding including related accessories.
- E. Samples for Verification:

1. 6-inch square sample of siding.
2. 12-inch long-by-actual-width sample of cladding attachment system.

1.5 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of fiber-cement siding.
- B. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for fiber-cement siding.
- C. Research/Evaluation Reports: For each type of fiber-cement siding required, from ICC-ES.
- D. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of product, including related accessories, to include in maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Minimum of 2 years of experience with installation of similar products
- B. Mockups: Build exterior integrated mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and to set quality standards for fabrication and installation.
 1. Build mockup of typical wall area as shown on Drawings.
 2. Build mockups for fiber-cement siding and venting system including accessories.
 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store packaged materials in original containers with labels intact until time of use.
- B. Store materials on elevated platforms, under cover, and in a dry location.

1.9 WARRANTY

- A. Warranty: Manufacturer warrants that its products are manufactured in accordance with its applicable material specifications and are free from defects in materials and workmanship.

1. Only products that are installed and used in accordance with applicable manufacturer's instructions and specifications are warranted.
2. The warranty is applicable only to claims made in writing and received by the manufacturer within thirty days after the defect was discovered and within ten years after the date of the shipment of the product by the manufacturer.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain products, including related accessories, from single source from single manufacturer.

2.2 FIBER-CEMENT SIDING

- A. General: ASTM C 1186, Type A, Grade II, fiber-cement board, noncombustible when tested according to ASTM E 136; with a flame-spread index of 25 or less when tested according to ASTM E 84.
 1. Basis of Design: AFC Cladding Fiber Cement Panels by American Fiber Cement Corp.; 6901 S. Pierce St. Suite 260, Littleton, CO 80128. ASD. Toll Free Tel: (800) 688-8677 ext. 102. Tel: (303) 978-1199. Fax: (303) 978-0308. Email: danglada@afcladding.com. Web: <http://www.americanfibercement.com>.
- B. Through Color High Density Fiber Cement Panels: Cebonit by AFC Corp..
 1. Application: Exterior.
 2. Thickness: 5/16 inch.
 3. Finish: Through-colored, muted, matte finish with a unique weather-proof treatment which makes it resistant to staining and surface dirt.
 4. Color: As selected by the Architect.

2.3 ACCESSORIES

- A. Aluminum Joint Closures and Decorative Corner Profiles: Manufacturer's standard products as detailed. Maximum thickness of finishing profile to be 0.8 mm or 21 gauge.

2.4 ATTACHMENT AND FIXING

- A. Attachment system for ventilated rain screen construction of exterior cladding panels.
 1. Fixing Accessories:
 - a. Steel screws: Trufast SIP TP or LD fasteners with Tru-Kote protective coating, or approved substitute.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of fiber-cement siding and related accessories.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Detailing Requirements:

- 1. Air space at top and bottom of building or wall termination shall be 3/4 inch to facilitate airflow from behind the panels. Do not block vertical airflow at windows, doors, eaves, or at the base of the building. Airflow shall be continuous from bottom to top so there is air movement behind each panel. Air flow behind the cement fiber panels is critical to the performance of the rain screen constructions.
- 2. Fasteners in profile shall accommodate thermal expansion/contraction of metal and not interfere with panel application.
- 3. Install panels from top of building to bottom.
- 4. For straight walls, start panel installation in center and work outward.
- 5. For walls with inside corners, start installation at corner and work across wall.
- 6. Pattern: Semi pattern with horizontal panels. Panel size as indicated.

3.3 INSTALLATION

- A. General: Comply with manufacturer's written installation instructions applicable to products and applications indicated unless more stringent requirements apply.
 - 1. Do not install damaged components.
 - 2. Attachment System: Comply with manufacturer's engineered design for cladding support framing.
 - 3. Comply with manufacturer's recommendations for fastener spacing.

3.4 ADJUSTING AND CLEANING

- A. Remove damaged, improperly installed, or otherwise defective materials and replace with new materials complying with specified requirements.
- B. Clean finished surfaces according to manufacturer's written instructions and maintain in a clean condition during construction.

END OF SECTION 074646

SECTION 075323 - ETHYLENE-PROPYLENE-DIENE-MONOMER (EPDM) ROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Adhered ethylene-propylene-diene-monomer (EPDM) roofing system.
 - 2. Roof insulation.
 - 3. Walkway pads.
- B. Products installed, but not furnished, under this Section include the following:
 - 1. Roof drains furnished under Division 22 Section "Plumbing Specialties".

1.3 DEFINITIONS

- A. Roofing Terminology: Definitions in ASTM D 1079 and glossary of NRCA's "The NRCA Roofing and Waterproofing Manual" apply to work of this Section.

1.4 PREINSTALLATION MEETINGS

- A. Preliminary Roofing Conference: Before starting roof deck construction, conduct conference at Project site.
 - 1. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck Installer, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
 - 2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
 - 3. Review and finalize construction schedule, and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - 4. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.
 - 5. Review structural loading limitations of roof deck during and after roofing.
 - 6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that affects roofing system.
 - 7. Review governing regulations and requirements for insurance and certificates if applicable.

8. Review temporary protection requirements for roofing system during and after installation.
9. Review roof observation and repair procedures after roofing installation.

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

1. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck Installer, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
3. Review and finalize construction schedule, and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
4. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.
5. Review structural loading limitations of roof deck during and after roofing.
6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that affects roofing system.
7. Review governing regulations and requirements for insurance and certificates if applicable.
8. Review temporary protection requirements for roofing system during and after installation.
9. Review roof observation and repair procedures after roofing installation.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For roofing system. Include plans, elevations, sections, details, and attachments to other work, including:

1. Base flashings and membrane terminations.
2. Tapered insulation, including slopes.
3. Roof plan showing orientation of steel roof deck and orientation of roofing and fastening spacings and patterns for mechanically fastened roofing.
4. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.

C. Samples for Verification: For the following products:

1. Sheet roofing, of color required.
2. Roof paver in each color and texture required.
3. Walkway pads or rolls, of color required.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and manufacturer.

B. Manufacturer's installation rating of the roofing contractor.

- C. Manufacturer Certificates: Signed by roofing manufacturer certifying that roofing system complies with requirements specified in "Performance Requirements" Article.
 - 1. Submit evidence of complying with performance requirements.
- D. Product Test Reports: For components of roofing system, tests performed by manufacturer and witnessed by a qualified testing agency.
- E. Research/Evaluation Reports: For components of roofing system, from ICC-ES.
- F. Inspection Report: Copy of roofing system manufacturer's inspection report of completed roofing installation.
- G. Sample Warranties: For manufacturer's special warranties.

1.7 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For roofing system to include in maintenance manuals.

1.8 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer that is UL listed for roofing system identical to that used for this Project.
- B. Installer Qualifications: Engage an experienced installer to perform work of this Section who has specialized in installing roofing similar to that required for this Project and who is approved, authorized, or licensed by the roofing system manufacturer to install manufacturer's product. Contractor shall have installed a minimum of 500,000 square feet and have a manufacturer's installation rating of 9.0 or better.
 - 1. Work associated with single-ply membrane roofing, including (but not limited to) insulation, flashing, and membrane sheet joint sealers, shall be performed by Installer of this Work.
- C. Upon completion of the installation, an inspection shall be made by the system manufacturer to ascertain that the roofing system has been installed according to the applicable manufacturer's specifications and details. No "early bird" warranty will be accepted. The results of the warranty inspection shall be submitted in writing to Owner for their review and records.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing and mixing with other components.
- B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.

1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.
- C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.
- D. Handle and store roofing materials, and place equipment in a manner to avoid permanent deflection of deck.

1.10 FIELD CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

1.11 WARRANTY

- A. A manufacturer's sole source 20-year written Total Roofing System Warranty shall be provided with a peak gust wind speed limitation of 70 mph (measured 30 feet above the ground). Warranty shall cover both labor and materials with no dollar limitation and shall state that the Total roofing System will remain in a watertight condition. The contractor shall provide as part of the shop drawing submittal process, certification indicating that the manufacturer has reviewed and has agreed to such wind coverage indicated.
 1. Total Roofing System is defined as the following materials and provided by the roof system manufacturer: membrane, flashings, counterflashings, adhesives, sealants, insulation, cover boards, fasteners, fastener plates, fastener bars, metal work.
 2. The warranty shall be for twenty (20) years starting after final acceptance of the total roofing system by the roof system manufacturer. Defective materials or installation shall be removed, properly disposed of, and replaced at the manufacturer's expense.
 3. The warranty shall provide that if within the warranty period the roofing system becomes non-watertight or if the elastomeric sheet splits, tears, or separates at the seams because of defective materials and/or materials and cost thereof shall be the responsibility of the manufacturer. Should the manufacturer or his approve applicator fail to perform repairs within 72 hours of notification, the warranty will not be voided because of work being performed by others to repair the roofing regardless of the manufacturer's warranty to the contrary.
 4. The total Roofing System shall be applied by a roofing Contractor approved by the system manufacturer. After inspection and acceptance of the installed roof system, the warranty will be issued.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. General Performance: Installed roofing and base flashings shall withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Roofing and base flashings shall remain watertight.
 - 1. Accelerated Weathering: Roofing system shall withstand 2000 hours of exposure when tested according to ASTM G 152, ASTM G 154, or ASTM G 155.
 - 2. Impact Resistance: Roofing system shall resist impact damage when tested according to ASTM D 3746 or ASTM D 4272.
- B. Material Compatibility: Roofing materials shall be compatible with one another and adjacent materials under conditions of service and application required, as demonstrated by roofing manufacturer based on testing and field experience.
- C. Roofing System Design: Provide membrane roofing system that is identical to systems that have been successfully tested by a qualified testing and inspecting agency to resist wind speed of 70 mph (measured 30 feet above the ground).
- D. Exterior Fire-Test Exposure: ASTM E 108 or UL 790, Class A; for application and roof slopes indicated; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

2.2 EPDM ROOFING

- A. EPDM: ASTM D 4637, Type I, nonreinforced, uniform, flexible EPDM sheet.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Carlisle SynTec Incorporated.
 - b. Firestone Building Products.
 - c. Johns Manville.
 - d. Versico Incorporated.
 - 2. Thickness: 60 mils, nominal.
 - 3. Exposed Face Color: Black.

2.3 AUXILIARY ROOFING MATERIALS

- A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with roofing.

1. Adhesives and sealants that are not on the exterior side of weather barrier shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
 - a. Plastic Foam Adhesives: 50 g/L.
 - b. Gypsum Board and Panel Adhesives: 50 g/L.
 - c. Multipurpose Construction Adhesives: 70 g/L.
 - d. Fiberglass Adhesives: 80 g/L.
 - e. Contact Adhesive: 80 g/L.
 - f. Other Adhesives: 250 g/L.
 - g. Single-Ply Roof Membrane Sealants: 250 g/L.
 - h. Nonmembrane Roof Sealants: 300 g/L.
 - i. Sealant Primers for Nonporous Substrates: 250 g/L.
 - j. Sealant Primers for Porous Substrates: 775 g/L.
 - B. Sheet Flashing: 60-mil-thick EPDM, partially cured or cured, according to application.
 - C. Protection Sheet: Epichlorohydrin or neoprene nonreinforced flexible sheet, 55- to 60-mil-thick, recommended by EPDM manufacturer for resistance to hydrocarbons, non-aromatic solvents, grease, and oil.
 - D. Bonding Adhesive: Manufacturer's standard, State of Maine VOC Compliant.
 - E. Seaming Material: Manufacturer's standard, synthetic-rubber polymer primer and 6-inch-wide minimum, butyl splice tape with release film.
 - F. Lap Sealant: Manufacturer's standard, single-component sealant, colored to match membrane roofing.
 - G. Water Cutoff Mastic: Manufacturer's standard butyl mastic sealant.
 - H. Metal Termination Bars: Manufacturer's standard, predrilled stainless-steel or aluminum bars, approximately 1 by 1/8 inch thick; with anchors.
 - I. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Global 4470, designed for fastening membrane to substrate, and acceptable to roofing system manufacturer.
 - J. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, molded pipe boot flashings, preformed inside and outside corner sheet flashings, reinforced EPDM securement strips, T-joint covers, in-seam sealants, termination reglets, cover strips, and other accessories.
- 2.4 SUBSTRATE BOARDS
- A. Substrate Board: ASTM C 1396/C 1396M, Type X gypsum board, 5/8 inch thick.
 - B. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Global 4470, designed for fastening substrate panel to roof deck.

2.5 ROOF INSULATION

- A. General: Preformed roof insulation boards manufactured or approved by EPDM roofing manufacturer, selected from manufacturer's standard sizes suitable for application, of thicknesses indicated.
- B. Polyisocyanurate Board Insulation: ASTM C 1289, Type II, Class 1, Grade 2, felt or glass-fiber mat facer on both major surfaces.
 - 1. Thickness: Two layers of 3 inch thick insulation, providing a total in place thickness of 6 inches, unless indicated otherwise.
- C. Tapered Insulation: Provide factory-tapered insulation boards fabricated to slope of 1/4 inch per 12 inches unless otherwise indicated.
- D. Provide preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated.

2.6 INSULATION ACCESSORIES

- A. General: Roof insulation accessories recommended by insulation manufacturer for intended use and compatibility with roofing.
- B. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Global 4470, designed for fastening roof insulation and cover boards to substrate, and acceptable to roofing system manufacturer.
- C. Cover Board: 1/2 inch thick, high-density polyiso insulation panel designed for use as cover board.
 - 1. Compressive Strength: 100 psi.
 - 2. R-Value: 2.5.
 - 3. Density: 4 lbs/pcf.

2.7 WALKWAYS

- A. Flexible Walkways: Factory-formed, nonporous, heavy-duty, solid-rubber, slip-resisting, surface-textured walkway pads or rolls, approximately 3/16 inch thick and acceptable to roofing system manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work:

1. Verify that roof openings and penetrations are in place, curbs are set and braced, and roof-drain bodies are securely clamped in place.
2. Verify that wood blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.
3. Verify that surface plane flatness and fastening of steel roof deck complies with requirements in Section 053100 "Steel Decking."

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing installation according to roofing system manufacturer's written instructions. Remove sharp projections.
- B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.

3.3 ROOFING INSTALLATION, GENERAL

- A. Install roofing system according to roofing system manufacturer's written instructions.
- B. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at the end of the workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.

3.4 SUBSTRATE BOARD INSTALLATION

- A. Install substrate board with long joints in continuous straight lines, perpendicular to roof slopes with end joints staggered between rows. Tightly butt substrate boards together.
 1. Fasten substrate board to top flanges of steel deck to resist uplift pressure at corners, perimeter, and field of roof according to roofing system manufacturers' written instructions.

3.5 INSULATION INSTALLATION

- A. Coordinate installing roofing system components so insulation is not exposed to precipitation or left exposed at the end of the workday.
- B. Comply with roofing system and insulation manufacturer's written instructions for installing roof insulation.
- C. Install tapered insulation under area of roofing to conform to slopes indicated.
- D. Install insulation under area of roofing to achieve required thickness. Where overall insulation thickness is 2.7 inches or greater, install two or more layers with joints of each succeeding layer staggered from joints of previous layer a minimum of 6 inches in each direction.

1. Where installing composite and noncomposite insulation in two or more layers, install noncomposite board insulation for bottom layer and intermediate layers, if applicable, and install composite board insulation for top layer.
- E. Trim surface of insulation where necessary at roof drains so completed surface is flush and does not restrict flow of water.
- F. Install insulation with long joints of insulation in a continuous straight line with end joints staggered between rows, abutting edges and ends between boards. Fill gaps exceeding 1/4 inch with insulation.
 1. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.
- G. Loosely Laid Insulation: Loosely lay insulation units over substrate.
- H. Install cover boards over insulation with long joints in continuous straight lines with end joints staggered between rows. Offset joints of insulation below a minimum of 6 inches in each direction. Loosely butt cover boards together and fasten to roof deck.
 1. Fasten cover boards according to requirements of manufacturer for specified warranty and performance.

3.6 ADHERED MEMBRANE ROOFING INSTALLATION

- A. Adhere roofing over area to receive roofing according to membrane roofing system manufacturer's written instructions. Unroll membrane roofing and allow to relax before installing.
- B. Start installation of roofing in presence of roofing system manufacturer's technical personnel.
- C. Accurately align roofing, and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.
- D. Bonding Adhesive: Apply to substrate and underside of roofing at rate required by manufacturer, and allow to partially dry before installing roofing. Do not apply to splice area of roofing.
- E. In addition to adhering, mechanically fasten roofing securely at terminations, penetrations, and perimeters.
- F. Apply roofing with side laps shingled with slope of roof deck where possible.
- G. Tape Seam Installation: Clean and prime both faces of splice areas, apply splice tape, and firmly roll side and end laps of overlapping roofing according to manufacturer's written instructions to ensure a watertight seam installation. Apply lap sealant and seal exposed edges of roofing terminations.
- H. Repair tears, voids, and lapped seams in roofing that do not comply with requirements.

- I. Spread sealant or mastic bed over deck-drain flange at roof drains, and securely seal membrane roofing in place with clamping ring.

3.7 BASE FLASHING INSTALLATION

- A. Install sheet flashings and preformed flashing accessories, and adhere to substrates according to roofing system manufacturer's written instructions.
- B. Apply bonding adhesive to substrate and underside of sheet flashing at required rate, and allow to partially dry. Do not apply to seam area of flashing.
- C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.
- D. Clean splice areas, apply splicing cement, and firmly roll side and end laps of overlapping sheets to ensure a watertight seam installation. Apply lap sealant and seal exposed edges of sheet flashing terminations.
- E. Terminate and seal top of sheet flashings.

3.8 WALKWAY INSTALLATION

- A. Flexible Walkways: Install walkway products in locations indicated. Adhere walkway products to substrate with compatible adhesive according to roofing system manufacturer's written instructions.
- B. Roof-Paver Walkways: Install walkway roof pavers according to manufacturer's written instructions in locations indicated, to form walkways. Leave 3 inches of space between adjacent roof pavers.

3.9 ROOF DRAIN INSTALLATION

- A. Install roof drain and accessories in strict accordance with manufacturer's written instructions, providing a permanent weather tight installation.
 1. Inspect and determine substrate to be in satisfactory condition, with deck fully anchored and aligned at proper location and elevation. All surfaces shall be smooth, dry, clean, free of sharp edges, and other irregularities.
 2. Attach deck flange securely to substrate.
 3. Assemble and flash gravel stop flange into roof system per roof system and roof drain manufacturer requirements.
 4. Securely attach strainer basket.

3.10 FIELD QUALITY CONTROL

- A. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion.

1. Notify Architect or Owner 48 hours in advance of the date and time of inspection.
- B. Repair or remove and replace components of roofing system where inspections indicate that they do not comply with specified requirements.
- C. Additional testing and inspecting, at Contractor's expense, will be performed to determine if replaced or additional work complies with specified requirements.

3.11 PROTECTING AND CLEANING

- A. Protect membrane roofing system from damage and wear during remainder of construction period. When remaining construction does not affect or endanger roofing, inspect roofing for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.
- B. Correct deficiencies in or remove membrane roofing system that does not comply with requirements, repair substrates, and repair or reinstall membrane roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.
- C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 075323

SECTION 076200 - SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Manufactured reglets with counterflashing.
 - 2. Formed roof-drainage sheet metal fabrications.
 - 3. Formed low-slope roof sheet metal fabrications.
 - 4. Formed wall sheet metal fabrications.
 - 5. Formed flat seam metal wall panels.

1.3 COORDINATION

- A. Coordinate sheet metal flashing and trim layout and seams with sizes and locations of penetrations to be flashed, and joints and seams in adjacent materials.
- B. Coordinate sheet metal flashing and trim installation with adjoining roofing and wall materials, joints, and seams to provide leakproof, secure, and noncorrosive installation.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review construction schedule. Verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - 2. Review special roof details, roof drainage, roof-penetration flashing, equipment curbs, and condition of other construction that affect sheet metal flashing and trim.
 - 3. Review requirements for insurance and certificates if applicable.
 - 4. Review sheet metal flashing observation and repair procedures after flashing installation.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each manufactured product and accessory.

- B. Shop Drawings: For sheet metal flashing and trim.
 - 1. Include plans, elevations, sections, and attachment details.
 - 2. Detail fabrication and installation layouts, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled work.
 - 3. Include identification of material, thickness, weight, and finish for each item and location in Project.
 - 4. Include details for forming, including profiles, shapes, seams, and dimensions.
 - 5. Include details for joining, supporting, and securing, including layout and spacing of fasteners, cleats, clips, and other attachments. Include pattern of seams.
 - 6. Include details of termination points and assemblies.
 - 7. Include details of expansion joints and expansion-joint covers, including showing direction of expansion and contraction from fixed points.
 - 8. Include details of roof-penetration flashing.
 - 9. Include details of edge conditions, including eaves, ridges, valleys, rakes, crickets, and counterflashings as applicable.
 - 10. Include details of special conditions.
 - 11. Include details of connections to adjoining work.
 - 12. Detail formed flashing and trim at scale of not less than 1-1/2 inches per 12 inches.
- C. Samples for Initial Selection: For each type of sheet metal and accessory indicated with factory-applied finishes.
- D. Samples for Verification: For each type of exposed finish.
 - 1. Sheet Metal Flashing: 12 inches long by actual width of unit, including finished seam and in required profile. Include fasteners, cleats, clips, closures, and other attachments.
 - 2. Trim, Metal Closures, Expansion Joints, Joint Intersections, and Miscellaneous Fabrications: 12 inches long and in required profile. Include fasteners and other exposed accessories.
 - 3. Unit-Type Accessories and Miscellaneous Materials: Full-size Sample.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For sheet metal flashing and trim, and its accessories, to include in maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Fabricator Qualifications: Employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage. Store sheet metal flashing and trim materials away from uncured concrete and masonry.

- B. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to extent necessary for period of sheet metal flashing and trim installation.

1.9 WARRANTY

- A. Special Warranty on Finishes: Manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 - 2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. General: Sheet metal flashing and trim assemblies shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.
- B. Sheet Metal Standard for Flashing and Trim: Comply with SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.
- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 SHEET METALS

- A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.
- B. Aluminum Sheet: ASTM B 209, alloy as standard with manufacturer for finish required, with temper as required to suit forming operations and performance required; with smooth, flat surface.
 - 1. Exposed Coil-Coated Finish:

- a. Base Bid: Metallic Fluoropolymer; AAMA 621. Three-coat fluoropolymer finish with suspended metallic flakes containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - 1) Color and Gloss: Allow for color selection in the Metallic range to match aluminum storefront and curtain wall system.
 - b. Alternate: Two-Coat Fluoropolymer; AAMA 2605. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - 1) Color and Gloss: Allow for color selection in the color to match aluminum storefront and curtain wall system.
2. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with minimum total dry film thickness of 0.5 mil.

2.3 UNDERLAYMENT MATERIALS

- A. Self-Adhering, High-Temperature Sheet: Minimum 30 mils thick, consisting of a slip-resistant polyethylene- or polypropylene-film top surface laminated to a layer of butyl- or SBS-modified asphalt adhesive, with release-paper backing; specifically designed to withstand high metal temperatures beneath metal roofing. Provide primer according to written recommendations of underlayment manufacturer.
 1. Thermal Stability: ASTM D 1970; stable after testing at 240 deg F or higher.
 2. Low-Temperature Flexibility: ASTM D 1970; passes after testing at minus 20 deg F or lower.

2.4 MISCELLANEOUS MATERIALS

- A. General: Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and as recommended by manufacturer of primary sheet metal unless otherwise indicated.
- B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal.
 1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
 - a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating. Provide metal-backed EPDM or PVC sealing washers under heads of exposed fasteners bearing on weather side of metal.

- b. Blind Fasteners: High-strength aluminum or stainless-steel rivets suitable for metal being fastened.
 - c. Spikes and Ferrules: Same material as gutter; with spike with ferrule matching internal gutter width.
2. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.
 3. Fasteners for Stainless-Steel Sheet: Series 300 stainless steel.
- C. Sealant Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.
- D. Elastomeric Sealant: ASTM C 920, elastomeric silicone polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.
- E. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.
- F. Bituminous Coating: Cold-applied asphalt emulsion according to ASTM D 1187.
- G. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required for application.

2.5 MANUFACTURED SHEET METAL FLASHING AND TRIM

- A. Reglets: Units of type, material, and profile required, formed to provide secure interlocking of separate reglet and counterflashing pieces, and compatible with flashing indicated with factory-mitered and -welded corners and junctions and with interlocking counterflashing on exterior face, of same metal as reglet.
1. Basis-of-Design Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Fry Reglet Corporation; Fry Reglet STX Stucco Reglet with SpringLok Counterflashing.
 2. Material: Stainless steel, 0.020 inch thick.
 3. Accessories:
 - a. Counterflashing Wind-Restraint Clips: Provide clips to be installed before counterflashing to prevent wind uplift of counterflashing's lower edge.
 4. Finish: Mill.

2.6 FABRICATION, GENERAL

- A. General: Custom fabricate sheet metal flashing and trim to comply with details shown and recommendations in cited sheet metal standard that apply to design, dimensions, geometry,

metal thickness, and other characteristics of item required. Fabricate sheet metal flashing and trim in shop to greatest extent possible.

1. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
 2. Obtain field measurements for accurate fit before shop fabrication.
 3. Form sheet metal flashing and trim to fit substrates without excessive oil canning, buckling, and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.
 4. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.
- B. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of 1/4 inch in 20 feet on slope and location lines indicated on Drawings and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.
- C. Expansion Provisions: Form metal for thermal expansion of exposed flashing and trim.
1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with butyl sealant concealed within joints.
 2. Use lapped expansion joints only where indicated on Drawings.
- D. Sealant Joints: Where movable, nonexpansion-type joints are required, form metal to provide for proper installation of elastomeric sealant according to cited sheet metal standard.
- E. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.
- F. Seams: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use.
- G. Do not use graphite pencils to mark metal surfaces.

2.7 ROOF-DRAINAGE SHEET METAL FABRICATIONS

- A. Parapet Scuppers: Fabricate scuppers to dimensions required, with closure flange trim to exterior, 4-inch-wide wall flanges to interior, and base extending 4 inches beyond cant or tapered strip into field of roof. Fabricate from the following materials:
- a. Aluminum: 0.032 inch thick.

2.8 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

- A. Roof Edge Flashing (Metal Flashing, Metal Ridge Cap): Fabricate in minimum 96-inch long, but not exceeding 12-foot long sections. Furnish with 6-inch wide, joint cover plates. Shop fabricate interior and exterior corners.
1. Joint Style: Butted with expansion space and 6-inch wide, concealed backup plate.

2. Fabricate with scuppers spaced 10 feet apart, to dimensions required with 4-inch wide flanges and base extending 4 inches beyond cant or tapered strip into field of roof. Fasten gravel guard angles to base of scupper.
3. Fabricate from the Following Materials:

- a. Aluminum: 0.050 inch thick.

- B. Metal Parapet Flashing: Fabricate in minimum 96-inch-long, but not exceeding 12-foot-long, sections. Fabricate joint plates of same thickness as copings. Furnish with continuous cleats to support edge of external and interior legs. Miter corners, fasten and seal watertight. Shop fabricate interior and exterior corners.

1. Coping Profile: Fig 3-4A according to SMACNA's "Architectural Sheet Metal Manual."
2. Joint Style: Butted with expansion space and 6-inch-wide, concealed backup plate.
3. Fabricate from the Following Materials:

- a. Aluminum: 0.050 inch thick.

2.9 WALL SHEET METAL FABRICATIONS

- A. Flat Seam Metal Wall Panels: Custom fabricate sheet metal wall panels to comply with details shown and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions (panel width and seam height), geometry, metal thickness, and other characteristics of installation. Fabricate sheet metal roofing and accessories in shop to greatest extent possible.

1. Flat-Seam Wall Panels: Form flat-seam panels from metal sheets 20 by 28 inches with 1/2-inch notched and folded edges.
2. Fabricate from 0.032 inch thick aluminum.

- B. Wall and Sill Flashing: Fabricate continuous flashings in minimum 96-inch-long, but not exceeding 12-foot-long, sections, under siding systems. Fabricate from the following materials:

1. Aluminum: 0.032 inch thick.

- C. Opening Flashings in Frame Construction: Fabricate head, sill, jamb, and similar flashings to extend 4 inches beyond wall openings. Form head and sill flashing with 2-inch-high, end dams. Fabricate from the following materials:

1. Aluminum: 0.032 inch thick.

- D. Aluminum Storefront Window Sills: Fabricate sill flashings to extend width of wall openings. Fabricate from the following materials:

1. Aluminum: 0.050 inch thick.

- E. Aluminum Flat Stock at Foundations: Fabricate flat stock as detailed.

1. Joint Style: Butted with expansion space and 6-inch wide, concealed backup plate.
2. Fabricate from the following materials:

- a. Aluminum: 0.250 inch thick.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, substrate, and other conditions affecting performance of the Work.
 1. Verify compliance with requirements for installation tolerances of substrates.
 2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
 3. Verify that air- or water-resistant barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 UNDERLAYMENT INSTALLATION

- A. Self-Adhering Sheet Underlayment: Install self-adhering sheet underlayment, wrinkle free. Prime substrate if recommended by underlayment manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation; use primer for installing underlayment at low temperatures. Apply in shingle fashion to shed water, with end laps of not less than 6 inches staggered 24 inches between courses. Overlap side edges not less than 3-1/2 inches. Roll laps and edges with roller. Cover underlayment within 14 days.

3.3 INSTALLATION, GENERAL

- A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
 1. Install sheet metal flashing and trim true to line, levels, and slopes. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.
 2. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
 3. Space cleats not more than 12 inches apart. Attach each cleat with at least two fasteners. Bend tabs over fasteners.
 4. Install exposed sheet metal flashing and trim with limited oil canning, and free of buckling and tool marks.
 5. Torch cutting of sheet metal flashing and trim is not permitted.
 6. Do not use graphite pencils to mark metal surfaces.

- B. Metal Protection: Where dissimilar metals contact each other, or where metal contacts pressure-treated wood or other corrosive substrates, protect against galvanic action or corrosion by painting contact surfaces with bituminous coating or by other permanent separation as recommended by sheet metal manufacturer or cited sheet metal standard.
 - 1. Underlayment: Where installing sheet metal flashing and trim directly on cementitious or wood substrates, install underlayment and cover with slip sheet.
- C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at maximum of 10 feet with no joints within 24 inches of corner or intersection.
 - 1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with sealant concealed within joints.
 - 2. Use lapped expansion joints only where indicated on Drawings.
- D. Fasteners: Use fastener sizes that penetrate wood blocking or sheathing not less than 1-1/4 inches for nails and not less than 3/4 inch for wood screws.
- E. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.
- F. Seal joints as required for watertight construction.
 - 1. Use sealant-filled joints unless otherwise indicated. Embed hooked flanges of joint members not less than 1 inch into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is between 40 and 70 deg F, set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealant-type joints at temperatures below 40 deg F.
 - 2. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."

3.4 ROOF-DRAINAGE SYSTEM INSTALLATION

- A. General: Install sheet metal roof-drainage items to produce complete roof-drainage system according to cited sheet metal standard unless otherwise indicated. Coordinate installation of roof perimeter flashing with installation of roof-drainage system.
- B. Parapet Scuppers: Continuously support scupper, set to correct elevation, and seal flanges to interior wall face, over cants or tapered edge strips, and under roofing membrane.
 - 1. Anchor scupper closure trim flange to exterior wall and seal with elastomeric sealant to scupper.

3.5 ROOF FLASHING INSTALLATION

- A. General: Install sheet metal flashing and trim to comply with performance requirements and cited sheet metal standard. Provide concealed fasteners where possible, and set units true to line, levels, and slopes. Install work with laps, joints, and seams that are permanently watertight and weather resistant.
- B. Roof Edge Flashing: Anchor to resist uplift and outward forces according to recommendations in cited sheet metal standard unless otherwise indicated. Interlock bottom edge of roof edge flashing with continuous cleat anchored to substrate at staggered 3-inch centers.
- C. Copings: Anchor to resist uplift and outward forces according to recommendations in cited sheet metal standard unless otherwise indicated.
 - 1. Interlock exterior and interior bottom edge of coping with continuous cleat anchored to substrate at 16-inch centers.

3.6 WALL FLASHING INSTALLATION

- A. General: Install sheet metal wall flashing to intercept and exclude penetrating moisture according to cited sheet metal standard unless otherwise indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.
- B. Flat-Seam Metal Wall Panels: Attach flat-seam metal panels to substrate with cleats, starting at one side and working across to other side. After panels are in place, mallet seams tight.
 - 1. Attach wall panels with cleats spaced not more than 24 inches (600 mm) o.c. Lock and mallet seams tight to base flashing.
 - 2. Attach edge flashing to wall with continuous cleat fastened to roof substrate at 12-inch o.c. spacing. Lock panels to edge flashing and mallet seams tight.
- C. Wall and Sill Flashing at Siding Systems: Conform to detail to drain moisture out of rain-screen cladding systems.
- D. Opening Flashings in Frame Construction: Install continuous head, sill, jamb, and similar flashings to extend 4 inches beyond wall openings and behind cladding systems.
- E. Reglets: Install reglets in accordance with manufacturer's written instructions. Install at transition from membrane roofing to bottom of wood or metal siding systems.

3.7 ERECTION TOLERANCES

- A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of 1/4 inch in 20 feet on slope and location lines indicated on Drawings and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.
- B. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerances specified in MCA's "Guide Specification for Residential Metal Roofing."

3.8 CLEANING AND PROTECTION

- A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
- B. Clean and neutralize flux materials. Clean off excess solder.
- C. Clean off excess sealants.
- D. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of sheet metal flashing and trim installation, remove unused materials and clean finished surfaces as recommended by sheet metal flashing and trim manufacturer. Maintain sheet metal flashing and trim in clean condition during construction.
- E. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 076200

SECTION 077200 - ROOF ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Roof hatches.

1.3 COORDINATION

- A. Coordinate layout and installation of roof accessories with roofing membrane and base flashing and interfacing and adjoining construction to provide a leakproof, weathertight, secure, and noncorrosive installation.
- B. Coordinate dimensions with rough-in information or Shop Drawings of equipment to be supported.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of roof accessory.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: For roof accessories.
 - 1. Include plans, elevations, keyed details, and attachments to other work. Indicate dimensions, loadings, and special conditions. Distinguish between plant- and field-assembled work.
- C. Samples: For each exposed product and for each color and texture specified, prepared on Samples of size to adequately show color.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Roof plans, drawn to scale, and coordinating penetrations and roof-mounted items. Show the following:

1. Size and location of roof accessories specified in this Section.
2. Method of attaching roof accessories to roof or building structure.
3. Other roof-mounted items including mechanical and electrical equipment, ductwork, piping, and conduit.
4. Required clearances.

B. Sample Warranties: For manufacturer's special warranties.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For roof accessories to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General Performance: Roof accessories shall withstand exposure to weather and resist thermally induced movement without failure, rattling, leaking, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.

2.2 ROOF HATCH

A. Roof Hatches: Metal roof-hatch units with lids and insulated curbs, welded or mechanically fastened and sealed corner joints, continuous lid-to-curb counterflashing and weathertight perimeter gasketing, straight sides, and integrally formed deck-mounting flange at perimeter bottom.

1. Available Manufacturers and Products:

- a. Bilco: Model "S".
- b. Dur-Red Products: Model LH.
- c. Milcor: Model M1
- d. O'Keefe's Inc.: Model RH

B. Type and Size: Single-leaf lid, 30 by 36 inches.

C. Loads: Minimum 40-lbf/sq. ft. external live load and 20-lbf/sq. ft. internal uplift load.

D. Hatch Material: Aluminum-zinc alloy-coated steel sheet.

1. Thickness: Manufacturer's standard thickness for hatch size indicated.
2. Finish: Factory prime coating.

E. Construction:

1. Insulation: Cellulosic-fiber board, glass-fiber board or polyisocyanurate board.
2. Nailer: Factory-installed wood nailer continuous around hatch perimeter.

3. Hatch Lid: Opaque, insulated, and double walled, with manufacturer's standard metal liner of same material and finish as outer metal lid.
 4. Curb Liner: Manufacturer's standard, of same material and finish as metal curb.
 5. On ribbed or fluted metal roofs, form flange at perimeter bottom to conform to roof profile.
 6. Fabricate curbs to minimum height of 12 inches above roofing surface unless otherwise indicated.
 7. Sloping Roofs: Where slope or roof deck exceeds 1:48, fabricate curb with perimeter curb height that is constant. Equip hatch with water diverter or cricket on side that obstructs water flow.
- F. Hardware: Spring operators, hold-open arm, galvanized-steel spring latch with turn handles, galvanized-steel butt- or pintle-type hinge system, and padlock hasps inside and outside.
1. Provide two-point latch on lids larger than 84 inches.
 2. Provide remote-control operation.
- G. Safety Railing System: Roof-hatch manufacturer's standard system including rails, clamps, fasteners, safety barrier at railing opening, and accessories required for a complete installation; attached to roof hatch and complying with 29 CFR 1910.23 requirements and OSHA Standards Nos. 1910.23 and 1926.500 – 1926.503.
1. Height: 42 inches above finished roof deck.
 2. Posts and Rails: Galvanized-steel pipe, 1-1/4 inches in diameter or galvanized-steel tube, 1-5/8 inches in diameter.
 3. Flat Bar: Galvanized steel, 2 inches high by 3/8 inch thick.
 4. Maximum Opening Size: System constructed to prevent passage of a sphere 21 inches in diameter.
 5. Self-Latching Gate: Fabricated of same materials and rail spacing as safety railing system. Provide manufacturer's standard hinges and self-latching mechanism.
 6. Post and Rail Tops and Ends: Weather resistant, closed or plugged with prefabricated end fittings.
 7. Provide weep holes or another means to drain entrapped water in hollow sections of handrail and railing members.
 8. Fabricate joints exposed to weather to be watertight.
 9. Fasteners: Manufacturer's standard, finished to match railing system.
 10. Finish: Manufacturer's standard.
 - a. Color: As selected by Architect from manufacturer's full range.
- H. Ladder-Assist Post: Roof-hatch manufacturer's standard device for attachment to roof-access ladder.
1. Operation: Post locks in place on full extension; release mechanism returns post to closed position.
 2. Height: 42 inches above finished roof deck.
 3. Material: Steel tube.
 4. Post: 1-5/8-inch- diameter pipe.
 5. Finish: Manufacturer's standard baked enamel or powder coat.
 - a. Color: As selected by Architect from manufacturer's full range.

2.3 METAL MATERIALS

- A. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A 792/A 792M, AZ50 coated.
 - 1. Factory Prime Coating: Where field painting is indicated, apply pretreatment and white or light-colored, factory-applied, baked-on epoxy primer coat, with a minimum dry film thickness of 0.2 mil.
 - 2. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester-backer finish consisting of prime coat and wash coat, with a minimum total dry film thickness of 0.5 mil.
- B. Aluminum Extrusions and Tubes: ASTM B 221, manufacturer's standard alloy and temper for type of use, finished to match assembly where used; otherwise mill finished.
- C. Steel Shapes: ASTM A 36/A 36M, hot-dip galvanized according to ASTM A 123/A 123M unless otherwise indicated.
- D. Steel Tube: ASTM A 500/A 500M, round tube.
- E. Galvanized-Steel Tube: ASTM A 500/A 500M, round tube, hot-dip galvanized according to ASTM A 123/A 123M.
- F. Steel Pipe: ASTM A 53/A 53M, galvanized.

2.4 MISCELLANEOUS MATERIALS

- A. General: Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items required by manufacturer for a complete installation.
- B. Cellulosic-Fiber Board Insulation: ASTM C 208, Type II, Grade 1, thickness as indicated.
- C. Glass-Fiber Board Insulation: ASTM C 726, nominal density of 3 lb/cu. ft., thermal resistivity of 4.3 deg F x h x sq. ft./Btu x in. at 75 deg F, thickness as indicated.
- D. Polyisocyanurate Board Insulation: ASTM C 1289, thickness and thermal resistivity as indicated.
- E. Gaskets: Manufacturer's standard tubular or fingered design of neoprene, EPDM, PVC, or silicone or a flat design of foam rubber, sponge neoprene, or cork.

2.5 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. 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.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of the Work.
- B. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
- C. Verify dimensions of roof openings for roof accessories.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install roof accessories according to manufacturer's written instructions.
 - 1. Install roof accessories level; plumb; true to line and elevation; and without warping, jogs in alignment, buckling, or tool marks.
 - 2. Anchor roof accessories securely in place so they are capable of resisting indicated loads.
 - 3. Use fasteners, separators, sealants, and other miscellaneous items as required to complete installation of roof accessories and fit them to substrates.
 - 4. Install roof accessories to resist exposure to weather without failing, rattling, leaking, or loosening of fasteners and seals.
- B. Roof Curb Installation: Install each roof curb so top surface is level.
- C. Roof-Hatch Installation:
 - 1. Verify that roof hatch operates properly. Clean, lubricate, and adjust operating mechanism and hardware.
 - 2. Attach safety railing system to roof-hatch curb.
 - 3. Attach ladder-assist post according to manufacturer's written instructions.

3.3 REPAIR AND CLEANING

- A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing according to ASTM A 780/A 780M.
- B. Clean exposed surfaces according to manufacturer's written instructions.
- C. Clean off excess sealants.
- D. Replace roof accessories that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION 077200

SECTION 078413 - PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

- 1. Penetrations in fire-resistance-rated walls.
- 2. Penetrations in smoke barriers.

B. Related Requirements:

- 1. Section 078443 "Joint Firestopping" for joints in or between fire-resistance-rated construction, at exterior curtain-wall/floor intersections, and in smoke barriers.

1.3 PREINSTALLATION MEETINGS

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

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product proposed. Include product characteristics, typical uses, performance and limitation criteria, test data, and installation instructions.
- B. Shop Drawings: For each through-penetration firestop system, show each kind of construction condition penetrated, relationships to adjoining construction, and kind of penetrating item. Include firestop design designation of testing and inspecting agency acceptable to authorities having jurisdiction that evidences compliance with requirements for each condition required.
- C. Product Schedule: For each penetration firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing and inspecting agency.
 - 1. Engineering Judgments: Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping system, submit illustration, with modifications marked, approved by penetration firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly. Obtain approval of authorities having jurisdiction prior to submittal.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer. Provide a list of at least 3 completed projects and name and contact information for installer.
- B. Product Test Reports: For each penetration firestopping system, for tests performed by a qualified testing agency.

1.6 CLOSEOUT SUBMITTALS

- A. Installer Certificates: From Installer indicating that penetration firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: A person experienced in installing through-penetration firestop systems similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful performance. Qualifications include having the necessary experience, staff, and training to install manufacturer's products per specified requirements. Manufacturer's willingness to sell its through-penetration firestop system products to Contractor or to Installer engaged by Contractor does not in itself confer qualification on buyer.
- B. Preinstallation Conference: Conduct conference at Project site.
- C. Special Inspections: Allow for 1 of each type of firestopping system to be removed and inspected for conformance with approved submittals. All firestopping shall be inspected prior to the installation of ceilings.
- D. Above Ceiling review: Prior to the installation of ceilings, a review of construction completion shall be conducted for firestopping and other items that will not be visible when the ceilings have been installed.

1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install penetration firestopping system when ambient or substrate temperatures are outside limits permitted by penetration firestopping system manufacturers or when substrates are wet because of rain, frost, condensation, or other causes.
- B. Install and cure penetration firestopping materials per manufacturer's written instructions using natural means of ventilations or, where this is inadequate, forced-air circulation.

1.9 COORDINATION

- A. Coordinate construction of openings and penetrating items to ensure that penetration firestopping systems can be installed according to specified firestopping system design.

- B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetration firestopping systems.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics:

1. Perform penetration firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
2. Test per testing standards referenced in "Penetration Firestopping Systems" Article. Provide rated systems complying with the following requirements:
 - a. Penetration firestopping systems shall bear classification marking of a qualified testing agency.
 - 1) UL in its "Fire Resistance Directory."
 - 2) Intertek Group in its "Directory of Listed Building Products."
 - 3) FM Global in its "Building Materials Approval Guide."

2.2 PENETRATION FIRESTOPPING SYSTEMS

- A. Penetration Firestopping Systems: Systems that resist spread of fire, 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.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. 3M Fire Protection Products.
 - b. A/D Fire Protection Systems Inc.
 - c. Hilti, Inc.
 - d. RectorSeal.
 - e. Specified Technologies, Inc.
 - f. Tremco, Inc.
- B. Penetrations in Fire-Resistance-Rated Walls: Penetration firestopping systems with 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. Penetrations in Smoke Barriers: Penetration firestopping systems with ratings determined per UL 1479, based on testing at a positive pressure differential of 0.30-inch wg.

1. L-Rating: Not exceeding 5.0 cfm/sq. ft. of penetration opening at and no more than 50-cfm cumulative total for any 100 sq. ft. at both ambient and elevated temperatures.
- D. Exposed Penetration Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, per ASTM E 84.
1. For fire-resistive joint systems exposed to view in public spaces upon completion of Work, provide products that are paintable.
 - a. Mechanical, electrical and elevator machine rooms are not considered public spaces.
- E. 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 system manufacturer and approved by qualified testing and inspecting agency for conditions indicated.
1. Permanent forming/damming/backing materials.
 2. Substrate primers.
 3. Collars.
 4. Steel sleeves.

2.3 FILL MATERIALS

- A. Cast-in-Place Firestop Devices: Factory-assembled devices for use in cast-in-place concrete floors and consisting of an outer sleeve lined with an intumescent strip, a flange attached to one end of the sleeve for fastening to concrete formwork, and a neoprene gasket.
- B. Latex Sealants: Single-component latex formulations that do not re-emulsify after cure during exposure to moisture.
- C. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.
- D. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced intumescent elastomeric sheet bonded to galvanized-steel sheet.
- E. Intumescent Putties: Nonhardening, water-resistant, intumescent putties containing no solvents or inorganic fibers.
- F. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.
- G. Mortars: Prepackaged dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.
- H. Pillows/Bags: Reusable heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents, and fire-retardant

additives. Where exposed, cover openings with steel-reinforcing wire mesh to protect pillows/bags from being easily removed.

- I. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.
- J. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants.

2.4 MIXING

- A. Penetration Firestopping Materials: For those products requiring mixing before application, comply with penetration firestopping system manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- 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. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning: Before installing penetration firestopping systems, clean out openings immediately to comply with manufacturer's written instructions and with the following requirements:
 - 1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of penetration firestopping materials.
 - 2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with penetration firestopping materials. Remove loose particles remaining from cleaning operation.
 - 3. Remove laitance and form-release agents from concrete.
- B. Prime substrates where recommended in writing by manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

3.3 INSTALLATION

- A. General: Install penetration firestopping systems to comply with manufacturer's written installation instructions and published drawings for products and applications.

- B. 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.
 - 1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not forming permanent components of firestopping.
- C. Install fill materials by proven techniques to produce the following results:
 - 1. Fill voids and cavities formed by openings, forming materials, accessories and penetrating items to achieve required fire-resistance ratings.
 - 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.

3.4 IDENTIFICATION

- A. Wall Identification: Permanently label walls containing penetration firestopping systems with the words "FIRE AND/OR SMOKE BARRIER - PROTECT ALL OPENINGS," using lettering not less than 3 inches high and with minimum 0.375-inch strokes.
 - 1. Locate in accessible concealed floor, floor-ceiling, or attic space at 15 feet from end of wall and at intervals not exceeding 30 feet.
 - 2. Do not install identification on exposed finished wall locations.
- B. Penetration Identification: Identify each penetration firestopping system with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of penetration firestopping system edge so labels are visible to anyone seeking to remove penetrating items or firestopping systems. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:
 - 1. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
 - 2. Contractor's name, address, and phone number.
 - 3. Designation of applicable testing and inspecting agency.
 - 4. Date of installation.
 - 5. Manufacturer's name.
 - 6. Installer's name.

3.5 FIELD QUALITY CONTROL

- A. Owner will engage a qualified testing agency to perform tests and inspections according to ASTM E 2174.

- B. Where deficiencies are found or penetration firestopping system is damaged or removed because of testing, repair or replace penetration firestopping system to comply with requirements.
- C. Proceed with enclosing penetration firestopping systems with other construction only after inspection reports are issued and installations comply with requirements.
- D. Reinstall firestopping materials that have been removed for inspection.

3.6 CLEANING AND PROTECTION

- A. Clean off excess fill materials adjacent to openings as the Work progresses by methods and with cleaning materials that are approved in writing by penetration firestopping system manufacturers and that do not damage materials in which openings occur.
- B. Provide final protection and maintain conditions during and after installation that ensure that penetration firestopping systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, immediately cut out and remove damaged or deteriorated penetration firestopping material and install new materials to produce systems complying with specified requirements.

END OF SECTION 078413

SECTION 078443 - JOINT FIRESTOPPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Joints in or between fire-resistance-rated constructions.
 - 2. Joints in smoke barriers.

- B. Related Requirements:

- 1. Section 078413 "Penetration Firestopping" for penetrations in fire-resistance-rated walls, horizontal assemblies, and smoke barriers and for wall identification.

1.3 PREINSTALLATION MEETINGS

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

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product proposed for use. List product characteristics, typical uses, performance and limitation criteria, test data, and installation instructions.
- B. Shop Drawings: For each fire-resistive joint system, show each kind of construction condition in which joints are installed; also show relationships to adjoining construction. Include fire-resistive joint system design designation of testing and inspecting agency acceptable to authorities having jurisdiction that demonstrates compliance with requirements for each condition indicated.
- C. Product Schedule: For each joint firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing agency.
 - 1. Engineering Judgments: Where Project conditions require modification to a qualified testing agency's illustration for a particular joint firestopping system condition, submit illustration, with modifications marked, approved by joint firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Test Reports: For each joint firestopping system, for tests performed by a qualified testing agency.

1.6 CLOSEOUT SUBMITTALS

- A. Installer Certificates: From Installer indicating that joint firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: A firm experienced in installing fire-resistive joint systems similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful performance. Qualifications include having the necessary experience, staff, and training to install manufacturer's products per specified requirements. Manufacturer's willingness to sell its fire-resistive joint system products to Contractor or to Installer engaged by Contractor does not in itself confer qualification on buyer.
- B. Preinstallation Conference: Conduct conference at Project site.
- C. Special Inspections: Allow for 1 of each type of joint firestopping system to be removed and inspected for conformance with approved submittals.
- D. Above Ceiling review: Prior to the installation of ceilings, a review of construction completion shall be conducted for joint firestopping and other items that will not be visible when the ceilings have been installed.

1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install joint firestopping systems when ambient or substrate temperatures are outside limits permitted by joint firestopping system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.
- B. Install and cure joint firestopping systems per manufacturer's written instructions using natural means of ventilation or, where this is inadequate, forced-air circulation.

1.9 COORDINATION

- A. Coordinate construction of joints to ensure that joint firestopping systems can be installed according to specified firestopping system design.
- B. Coordinate sizing of joints to accommodate joint firestopping systems.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics:

1. Perform joint firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
2. Test per testing standards referenced in "Joint Firestopping Systems" Article. Provide rated systems complying with the following requirements:
 - a. Joint firestopping systems shall bear classification marking of a qualified testing agency.
 - 1) UL in its "Fire Resistance Directory."
 - 2) Intertek Group in its "Directory of Listed Building Products."

2.2 JOINT FIRESTOPPING SYSTEMS

- A. Joint Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of assemblies in or between which joint firestopping systems are installed. Joint firestopping 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: Provide joint firestopping systems with ratings determined per ASTM E 1966 or UL 2079.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. 3M Fire Protection Products.
 - b. A/D Fire Protection Systems Inc.
 - c. W.R. Grace & Co., Construction Products Division.
 - d. Hilti, Inc.
 - e. Nelson Firestop; a brand of Emerson Industrial Automation.
 - f. RectorSeal.
 - g. Specified Technologies, Inc.
 - h. Tremco, Inc.
 - i. United States Gypsum Company.
 2. Fire-Resistance Rating: Equal to or exceeding the fire-resistance rating of the wall, floor, or roof in or between which it is installed.
- C. Joints in Smoke Barriers: Provide fire-resistive joint systems with ratings determined per UL 2079 based on testing at a positive pressure differential of 0.30-inch wg.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. 3M Fire Protection Products.
 - b. A/D Fire Protection Systems Inc.
 - c. W.R. Grace & Co., Construction Products Division.
 - d. Hilti, Inc.
 - e. Nelson Firestop; a brand of Emerson Industrial Automation.
 - f. RectorSeal.
 - g. Specified Technologies, Inc.
 - h. Tremco, Inc.
 - i. United States Gypsum Company.
2. L-Rating: Not exceeding 5.0 cfm/ft. of joint at both ambient and elevated temperatures. Provide systems with L-rating where walls and partitions also are smoke barriers. Where a fire-resistive joint system is not available with the ability to resist smoke, provide smoke sealant material to one side of wall to stop the passage of smoke.
- D. Exposed Joint Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.
1. For fire-resistive joint systems exposed to view in public spaces upon completion of Work, provide products that are paintable.
 - a. Mechanical, electrical and elevator machine rooms are not considered public spaces.
- E. Accessories: Provide components of fire-resistive joint systems, including primers and forming materials, that are needed to install elastomeric fill materials and to maintain ratings required. Use only components specified by joint firestopping system manufacturer and approved by the qualified testing agency for conditions indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- 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. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning: Before installing fire-resistive joint systems, clean joints immediately to comply with fire-resistive joint system manufacturer's written instructions and the following requirements:
 1. Remove from surfaces of joint substrates foreign materials that could interfere with adhesion of elastomeric fill materials or compromise fire-resistive rating.

2. Clean joint substrates to produce clean, sound surfaces capable of developing optimum bond with elastomeric fill materials. Remove loose particles remaining from cleaning operation.
 3. Remove laitance and form-release agents from concrete.
- B. Prime substrates where recommended in writing by joint firestopping system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

3.3 INSTALLATION

- A. General: Install fire-resistive joint systems to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.
- B. Install forming materials and other accessories of types required to support elastomeric 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 elastomeric 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.
- C. Install elastomeric fill materials for fire-resistive joint systems by proven techniques to produce the following results:
1. Elastomeric fill voids and cavities formed by joints and forming materials as required to achieve fire-resistance ratings indicated.
 2. Apply elastomeric fill materials so they contact and adhere to substrates formed by joints.
 3. For elastomeric fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 FIELD QUALITY CONTROL

- A. Inspecting Agency: Owner will engage a qualified testing agency to perform tests and inspections according to ASTM E 2393.
- B. Before installation of ceilings, walls, and adjacent construction that would conceal fire-resistive joint systems, inspect joints to verify complete installation of fire-resistive joint systems materials.
- C. Where deficiencies are found or joint firestopping systems are damaged or removed due to testing, repair or replace joint firestopping systems so they comply with requirements.
- D. Proceed with enclosing joint firestopping systems with other construction only after inspection reports are issued and installations comply with requirements.
- E. Reinstall firestopping materials that have been removed for inspection.

3.5 CLEANING AND PROTECTION

- A. Clean off excess elastomeric fill materials adjacent to joints as the Work progresses by methods and with cleaning materials that are approved in writing by joint firestopping system manufacturers and that do not damage materials in which joints occur.
- B. Provide final protection and maintain conditions during and after installation that ensure joint firestopping systems are without damage or deterioration at time of Substantial Completion. If damage or deterioration occurs despite such protection, cut out and remove damaged or deteriorated fire-resistive joint systems immediately and install new materials to produce fire-resistive joint systems complying with specified requirements.

END OF SECTION 078443

SECTION 079200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

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

1.3 ACTION SUBMITTALS

- A. Product Data: For each joint-sealant product.
- B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.
- C. Samples for Verification: For each kind and color of joint sealant required, provide Samples with joint sealants in 1/2-inch-wide joints formed between two 6-inch-long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.
- D. 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. Qualification Data: For qualified testing agency.
- B. Product Test Reports: For each kind of joint sealant, for tests performed by manufacturer and witnessed by a qualified testing agency or a qualified testing agency.
- C. Sample Warranties: For special warranties.

1.5 QUALITY ASSURANCE

- A. **Installer Qualifications:** An experienced installer who has specialized in installing joint sealants similar in material, design, and extent to those indicated for this Project and whose work has resulted in joint-sealant installations with a record of successful in-service performance.
- B. **Product Testing:** Test joint sealants using a qualified testing agency.
 - 1. **Testing Agency Qualifications:** Qualified according to ASTM C 1021 to conduct the testing indicated.

1.6 FIELD CONDITIONS

- A. Do not proceed with installation of joint sealants under the following conditions:
 - 1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F.
 - 2. When joint substrates are wet.
 - 3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
 - 4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.7 WARRANTY

- A. **Special Installer's Warranty:** 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.

PART 2 - PRODUCTS

2.1 JOINT SEALANTS, GENERAL

- A. **Compatibility:** Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.
- B. **Colors of Exposed Joint Sealants:** As selected by Architect from manufacturer's full range.

2.2 SILICONE JOINT SEALANTS

- A. **Sealant Type 1:** Single-component, nonsag, plus 100 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 100/50, Use NT.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Dow Corning Corporation; 790; 756 SMS for cold applications.
 - b. GE Advanced Materials - Silicones; SilPruf LM SCS2700.
 - c. Pecora Corporation; 890.
 - d. Sika Corporation, Construction Products Division; SikaSil-C990.
 - e. Tremco Incorporated; Spectrem 1.
- B. Sealant Type 2: Not Used.
- C. Sealant Type 3: Single-component, nonsag, plus 100 percent and minus 50 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 100/50, Uses T and NT.
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Pecora Corporation; 301 NS (VOC 50).
 - b. Tremco Incorporated; Spectrem 800 (VOC 1).
- D. Sealant Type 4: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, acid-curing silicone joint sealant: ASTM C 920, Type S, Grade NS, Class 25, Use NT.
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Dow Corning Corporation; 786(VOC 33) (Food)
 - b. GE Advanced Materials - Silicones; Sanitary SCS1700.
 - c. Tremco Incorporated; Tremsil 200 Sanitary (VOC 1).
- E. Sealant Type 4A: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, acid-curing silicone joint sealant: ASTM C 920, Type S, Grade NS, Class 25, Use NT.
 1. Provide elastomeric sealant NSF certified for end-use application indicated. Provide sealant that, when cured and washed, meets requirements of Food and Drug Administration's 21 CFR, Section 177.2600 for use in areas that come in contact with food.
 2. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Dow Corning Corporation; 786(VOC 33).
 - b. Kason; 3700 Series Rubbaseal Silicone Sealant.
 - c. C. R. Larence Co.; CRL 33S Silicone (VOC 39).

2.3 LATEX JOINT SEALANTS

- A. Sealant Type 5: Acrylic Latex: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. BASF Building Systems; Sonolac (VOC 41).
 - b. Bostik, Inc.; Chem-Calk 600.
 - c. Pecora Corporation; AC-20 (VOC 31).
 - d. Sherwin-Williams 950A
 - e. Tremco Incorporated; Tremflex 834.

2.4 JOINT-SEALANT BACKING

- A. Sealant Backing Material, General: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin), and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
- C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

2.5 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, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
 - 1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
 - 2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air.
 - 3. Remove laitance and form-release agents from concrete.
 - 4. 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. Nonporous joint substrates include the following:
 - a. Metal.
 - b. Glass.
 - c. Porcelain enamel.
 - d. Glazed surfaces of ceramic tile.
- 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.

3.3 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

- B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. 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.
- D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- E. 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.
- F. 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.
 - a. Use masking tape to protect surfaces adjacent to recessed tooled joints.

3.4 CLEANING

- A. 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.

3.5 PROTECTION

- A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out, remove, and repair damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

3.6 JOINT-SEALANT SCHEDULE

- A. Exterior Control, Expansion, and Soft Joints Between Metal Cladding System Flashing and Metal Door Frames, and Storefronts.
 - 1. Silicone Joint Sealant: Sealant Type 1.
 - 2. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- B. Under Exterior Door Thresholds.
 - 1. Silicone Joint Sealant: Sealant Type 1.
 - 2. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- C. Exterior Joints for Which No Other Sealant Type is Indicated.
 - 1. Silicone Joint Sealant: Sealant Type 1.
 - 2. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- D. Interior Isolation and Contraction Joints in Cast-In-Place Concrete Slabs.
 - 1. Silicone Joint Sealant: Sealant Type 3.
 - 2. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- E. Concealed Interior Perimeter Joints of Exterior Openings.
 - 1. Silicone Joint Sealant: Sealant Type 1.
 - 2. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- F. Exposed Interior Perimeter Joints of Exterior Openings.
 - 1. Latex Joint Sealant: Sealant Type 5.
 - 2. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- G. Perimeter Joints Between Interior Wall Surfaces and Frames of Interior Doors Windows and Elevator Entrances.
 - 1. Latex Joint Sealant: Sealant Type 5.
 - 2. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- H. Joints between Plumbing Fixtures and Walls and Floors and Between Countertops and Walls.
 - 1. Silicone Joint Sealant: Sealant Type 4.
 - 2. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- I. Interior Joints in Food Service Areas.
 - 1. Silicone Joint Sealant: Sealant Type 4A.
 - 2. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- J. Interior Joints for Which No Other Sealant is Indicated.
 - 1. Latex Joint Sealant: Sealant Type 5.

2. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

END OF SECTION 079200

SECTION 081113 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes hollow-metal work.
- B. Related Work includes cladding exterior hollow metal door with Petrarch Panel.

1.3 DEFINITIONS

- A. Minimum Thickness: Minimum thickness of base metal without coatings according to NAAMM-HMMA 803 or SDI A250.8.

1.4 COORDINATION

- A. Coordinate anchorage installation for hollow-metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

1.5 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Inspect and discuss condition of substrate and other preparatory work performed by other trades.
 - 2. Review tie-in to air barrier system.

1.6 ACTION SUBMITTALS

- A. General: Submittals for Sections 081113, 081416 and 087100 shall be made concurrently.
- B. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, core descriptions, fire-resistance ratings, and finishes.
- C. Shop Drawings: Include the following:

1. Elevations of each door type.
 2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.
 3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
 4. Locations of reinforcement and preparations for hardware.
 5. Details of each different wall opening condition.
 6. Details of anchorages, joints, field splices, and connections.
 7. Details of accessories.
 8. Details of moldings, removable stops, and glazing.
 9. Details of conduit and preparations for power, signal, and control systems.
- D. Schedule: Provide a schedule of hollow-metal work prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final Door Hardware Schedule.

1.7 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each type of hollow-metal door and frame assembly, for tests performed by a qualified testing agency.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver hollow-metal work palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.
1. Provide additional protection to prevent damage to factory-finished units.
- B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
- C. Store hollow-metal work vertically under cover at Project site with head up. Place on minimum 4-inch-high wood blocking. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Standard Steel Doors and Frames:
 - a. Ceco Door Products; an Assa Abloy Group company.
 - b. Curries Company.
 - c. J/R Metal Frames Manufacturing, Inc.
 - d. Steelcraft; a division of Ingersoll-Rand.

- B. Source Limitations: Obtain hollow-metal work from single source from single manufacturer.

2.2 REGULATORY REQUIREMENTS

- A. Fire-Rated Assemblies: Complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.
 - 1. Smoke- and Draft-Control Assemblies: Provide an assembly with gaskets listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing according to UL 1784 and installed in compliance with NFPA 105.
- B. Fire-Rated, Borrowed-Lite Assemblies: Complying with NFPA 80 and listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction for fire-protection ratings indicated, based on testing according to NFPA 257 or UL 9.

2.3 INTERIOR DOORS AND FRAMES

- A. Construct interior doors and frames to comply with the standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- B. Heavy-Duty Doors and Frames: SDI A250.8, Level 2.
 - 1. Physical Performance: Level B according to SDI A250.4.
 - 2. Doors:
 - a. Type: As indicated in the Door and Frame Schedule.
 - b. Thickness: 1-3/4 inches.
 - c. Face: Uncoated, cold-rolled steel sheet, minimum thickness of 0.042 inch.
 - d. Edge Construction: Model 2, Seamless.
 - e. Core: Kraft-paper honeycomb.
 - 3. Frames:
 - a. Materials: Uncoated steel sheet, minimum thickness of 0.053 inch.
 - b. Construction: Knocked down.
 - 4. Exposed Finish: Prime.

2.4 EXTERIOR HOLLOW-METAL DOORS AND FRAMES

- A. Construct exterior doors and frames to comply with the standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- B. Heavy-Duty Doors and Frames: SDI A250.8, Level 2.

1. Physical Performance: Level B according to SDI A250.4.
2. Doors:
 - a. Type: As indicated in the Door and Frame Schedule.
 - b. Thickness: 1-3/4 inches
 - c. Face: Metallic-coated steel sheet, minimum thickness of 0.042 inch, with minimum A60 coating.
 - d. Edge Construction: Model 2, Seamless.
 - e. Core: Manufacturer's polyurethane core.
 - 1) Thermal-Rated Doors: Provide doors fabricated with thermal-resistance value (R-value) of not less than 10 when tested according to ASTM C 1363.
3. Frames:
 - a. Materials: Metallic-coated steel sheet, minimum thickness of 0.053 inch, with minimum A40 coating.
 - b. Construction: Face welded.
4. Exposed Finish: Prime.

2.5 BORROWED LITES

- A. Hollow-metal frames of uncoated steel sheet, minimum thickness of 0.053 inch.
- B. Construction: Face welded.

2.6 FRAME ANCHORS

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

2.7 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- B. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- C. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum A60 metallic coating.

1. Wipe Coat Galvanneal materials will not be considered acceptable.
- D. Frame Anchors: ASTM A 879/A 879M, Commercial Steel (CS), 04Z coating designation; mill phosphatized.
 1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.
- E. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.
- F. 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 hollow-metal frames of type indicated.
- G. Mineral-Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.
- H. Glazing: Comply with requirements in Section 088000 "Glazing."
- I. Bituminous Coating: Cold-applied asphalt mastic, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.8 FABRICATION

- A. Fabricate hollow-metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for metal thickness. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.
- B. Hollow-Metal Doors:
 1. Fire Door Cores: As required to provide fire-protection ratings indicated.
 2. Vertical Edges for Single-Acting Doors: Bevel edges 1/8 inch in 2 inches.
 3. Top Edge Closures: Close top edges of doors with inverted closures, except provide flush closures at exterior doors of same material as face sheets.
 4. Bottom Edge Closures: Close bottom edges of doors where required for attachment of weather stripping with end closures or channels of same material as face sheets.
 5. Exterior Doors: Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.
 6. Full hinge cut-outs for non-handed doors will not be acceptable.
- C. Hollow-Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.

1. Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.
 2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
 3. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.
 4. Floor Anchors: Weld anchors to bottoms of jambs with at least four spot welds per anchor; however, for slip-on drywall frames, provide anchor clips or countersunk holes at bottoms of jambs.
 5. 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) Three anchors per jamb up to 60 inches high.
 - 2) Four anchors per jamb from 60 to 90 inches high.
 - 3) Five anchors per jamb from 90 to 96 inches high.
 - 4) Five anchors per jamb plus one additional anchor per jamb for each 24 inches or fraction thereof above 96 inches high.
 6. Head Anchors: Two anchors per head for frames more than 42 inches wide and mounted in metal-stud partitions.
 7. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.
 - a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
 - b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.
- D. Fabricate concealed stiffeners and edge channels from either cold- or hot-rolled steel sheet.
- E. Hardware Preparation: Factory prepare hollow-metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, the Door Hardware Schedule, and templates.
1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
 2. Comply with applicable requirements in SDI A250.6 and BHMA A156.115 for preparation of hollow-metal work for hardware.
- F. Stops and Moldings: Provide stops and moldings around glazed lites and louvers where indicated. Form corners of stops and moldings with butted hairline joints.
1. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of hollow-metal work.
 2. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
 3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.
 4. Provide loose stops and moldings on inside of hollow-metal work.

5. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.

2.9 ACCESSORIES

- A. Mullions and Transom Bars: Join to adjacent members by welding or rigid mechanical anchors.
- B. Grout Guards: Formed from same material as frames, not less than 0.016 inch thick.

2.10 STEEL FINISHES

- A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.
 1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.
- B. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.3 INSTALLATION

- A. General: Install hollow-metal work plumb, rigid, properly aligned, and securely fastened in place. Comply with Drawings and manufacturer's written instructions.

- B. Hollow-Metal Frames: Install hollow-metal frames for doors, transoms, sidelites, borrowed lites, and other openings, of size and profile indicated. Comply with SDI A250.11 or NAAMM-HMMA 840 as required by standards specified.
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. At fire-rated openings, install frames according to NFPA 80.
 - b. 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.
 - c. Install frames with removable stops located on secure side of opening.
 - d. Install door silencers in frames before grouting.
 - e. Remove temporary braces necessary for installation only after frames have been properly set and secured.
 - f. Check plumb, square, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
 - g. Field apply bituminous coating to backs of frames that will be filled with grout containing antifreezing agents.
 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 power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
 3. Wood-Stud Partitions: Solidly pack mineral-fiber insulation inside frames.
 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.
- C. Hollow-Metal Doors: Fit hollow-metal doors accurately in frames, within clearances specified below. Shim as necessary.
1. Non-Fire-Rated Steel Doors:
 - a. Between Door and Frame Jambs and Head: 1/8 inch plus or minus 1/32 inch.
 - b. Between Edges of Pairs of Doors: 1/8 inch to 1/4 inch plus or minus 1/32 inch.
 - c. At Bottom of Door: 3/4 inch plus or minus 1/32 inch.
 - d. Between Door Face and Stop: 1/16 inch to 1/8 inch plus or minus 1/32 inch.
 2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
 3. Smoke-Control Doors: Install doors and gaskets according to NFPA 105.

- D. Glazing: Comply with installation requirements in Section 088000 "Glazing" and with hollow-metal manufacturer's written instructions.
 - 1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches o.c. and not more than 2 inches o.c. from each corner.

3.4 ADJUSTING AND CLEANING

- A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow-metal work that is warped, bowed, or otherwise unacceptable.
- B. Remove grout and other bonding material from hollow-metal work immediately after installation.
- C. 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.
- D. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

END OF SECTION 081113

SECTION 081416 - FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 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.
4. Factory glazing of wood doors.

B. Related Requirements:

1. Section 088000 "Glazing" for glass view panels in flush wood doors.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of door. Include details of core and edge construction and trim for openings. 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; and the following:

1. Dimensions and locations of blocking.
2. Dimensions and locations of mortises and holes for hardware.
3. Dimensions and locations of cutouts.
4. Undercuts.
5. Fire-protection ratings for fire-rated doors.

C. Samples for Verification:

1. Factory finishes applied to actual door face materials, approximately 8 by 10 inches, for each material and finish.

1.4 INFORMATIONAL SUBMITTALS

- A. Sample Warranty: For special warranty.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Comply with requirements of referenced standard and manufacturer's written instructions.
- B. Package doors individually in plastic bags or cardboard cartons.
- C. Mark each door on bottom rail with opening number used on Shop Drawings.

1.6 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install doors until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during remainder of construction period.

1.7 WARRANTY

- A. A. Special Warranty: Manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Warping (bow, cup, or twist) more than 1/4 inch in a 42-by-84-inch section.
 - b. Telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch span.
 - 2. Warranty shall also include installation and finishing that may be required due to repair or replacement of defective doors.
 - 3. Warranty Period for Solid-Core Interior Doors: Life of installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Flush Wood Doors:
 - a. Algoma Hardwoods Inc.
 - b. Eggers Industries.
 - c. Graham Wood Doors; an Assa Abloy Group company.
 - d. Marshfield Door Systems, Inc..
 - e. VT Industries Inc.
- B. Source Limitations: Obtain flush wood doors from single manufacturer.

2.2 FLUSH WOOD DOORS, GENERAL

- A. Quality Standard: In addition to requirements specified, comply with WDMA I.S.1-A, "Architectural Wood Flush Doors."
 - 1. Contract Documents contain selections chosen from options in quality standard and additional requirements beyond those of quality standard. Comply with those selections and requirements in addition to quality standard.
- B. WDMA I.S.1-A Performance Grade: Extra Heavy Duty.
- C. Fire-Rated Wood Doors: Doors complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.
 - 1. Include all requirements as part of the door construction per Category "A" guidelines."
 - 2. Cores: Provide core specified or mineral core as needed to provide fire-protection rating indicated.
 - 3. Edge Construction: Provide edge construction with intumescent seals concealed by outer stile. Comply with specified requirements for exposed edges.
 - 4. Pairs: Provide fire-retardant stiles that are listed and labeled for applications indicated without formed-steel edges and astragals. Provide stiles with concealed intumescent seals. Comply with specified requirements for exposed edges.
- D. Smoke- and Draft-Control Door Assemblies: Listed and labeled for smoke and draft control, based on testing according to UL 1784.
- E. Particleboard-Core Doors:
 - 1. Particleboard: ANSI A208.1, Grade LD-2.
 - 2. Blocking: Provide wood blocking in particleboard-core doors as needed to eliminate through-bolting hardware.
- F. Structural-Composite-Lumber-Core Doors:
 - 1. Structural Composite Lumber: WDMA I.S.10.
 - a. Screw Withdrawal, Face: 700 lbf.
 - b. Screw Withdrawal, Edge: 400 lbf.
 - 2. Provide doors with structural-composite-lumber cores instead of particleboard cores for the following doors:
 - a. Doors indicated to receive exit devices.
 - b. Doors where oversized glass lites exceed more than 40 percent of the door surface area.
 - c. Doors where louvers exceed more than 40 percent of the door surface area.
- G. Mineral-Core Doors:

1. Core: Noncombustible mineral product complying with requirements of referenced quality standard and testing and inspecting agency for fire-protection rating indicated.
2. Blocking: Provide composite blocking with improved screw-holding capability approved for use in doors of fire-protection ratings indicated as needed to eliminate through-bolting hardware.
3. Edge Construction: At hinge stiles, provide laminated-edge construction with improved screw-holding capability and split resistance. Comply with specified requirements for exposed edges.
 - a. Screw-Holding Capability: 550 lbf per WDMA T.M.-10.

2.3 VENEER-FACED DOORS FOR TRANSPARENT FINISH

A. Interior Solid-Core Doors:

1. Grade: Premium, with Grade A faces.
2. Species: Select white birch.
3. Cut: Plain sliced (flat sliced).
4. Match between Veneer Leaves: Book match.
5. Assembly of Veneer Leaves on Door Faces: Center-balance match.
6. Exposed Vertical Edges: Same species as faces - edge Type A.
7. Core: Particleboard except where structural composite lumber is required.
8. Construction: Five plies. Stiles and rails are bonded to core, then entire unit is abrasive planed before veneering.

2.4 DOORS FOR OPAQUE FINISH

A. Interior Solid-Core Doors:

1. Grade: Premium.
2. Faces: MDO.
 - a. Apply MDO to standard-thickness, closed-grain, hardwood face veneers or directly to high-density hardboard crossbands.
 - b. Hardboard Faces: ANSI A135.4, Class 1 (tempered) or Class 2 (standard).
 - c. MDF Faces: ANSI A208.2, Grade 150 or Grade 160.
3. Exposed Vertical Edges: Any closed-grain hardwood.
4. Core: Particleboard except where structural composite lumber is required.
5. Construction: Five plies. Stiles and rails are bonded to core, then entire unit is abrasive planed before veneering.

2.5 LIGHT FRAMES

A. Wood Beads for Light Openings in Wood Doors: Provide manufacturer's standard wood beads unless otherwise indicated.

1. Wood Species: Same species as door faces.

2. Profile: Flush rectangular beads.
 3. At wood-core doors with 20-minute fire-protection ratings, provide wood beads and metal glazing clips approved for such use.
- B. Metal Frames for Light Openings in Fire-Rated Doors: Manufacturer's standard frame formed of 0.048-inch thick, cold-rolled steel sheet; factory primed for paint finish; and approved for use in doors of fire-protection rating indicated.

2.6 FABRICATION

- A. Factory fit doors to suit frame-opening sizes indicated. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.
1. Comply with NFPA 80 requirements for fire-rated doors.
- B. Factory machine doors for hardware that is not surface applied. Locate hardware to comply with DHI-WDHS-3. Comply with final hardware schedules, door frame Shop Drawings, BHMA-156.115-W, and hardware templates.
1. Coordinate with hardware mortises in metal frames to verify dimensions and alignment before factory machining.
 2. Metal Astragals: Factory machine astragals and formed-steel edges for hardware for pairs of fire-rated doors.
- C. Openings: Factory cut and trim openings through doors.
1. Light Openings: Trim openings with moldings of material and profile indicated. Attach wood rectangular glazing beads flush with door face. Apply shims and sealant as required to set glazing.
 2. Glazing: Factory install glazing in doors indicated to be factory finished. Comply with applicable requirements in Section 088000 "Glazing."

2.7 FACTORY FINISHING

- A. General: Comply with referenced quality standard for factory finishing. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.
1. Finish faces, all four edges, edges of cutouts, and mortises. Stains and fillers may be omitted on bottom edges, edges of cutouts, and mortises.
- B. Factory finish doors.
- C. Transparent Finish:
1. Grade: Premium.
 2. Finish: WDMA TR-4 conversion varnish or WDMA TR-6 catalyzed polyurethane.
 3. Staining: None required.
 4. Effect: Open-grain finish.

5. Sheen: Satin.

D. Opaque Finish: Field finished. Refer to Section 099123 "Interior Painting."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine doors and installed door frames, with Installer present, before hanging doors.
 - 1. Verify that installed frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
 - 2. Reject doors with defects.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Hardware: For installation, see Section 087100 "Door Hardware."
- B. Installation Instructions: Install doors to comply with manufacturer's written instructions and referenced quality standard, and as indicated.
 - 1. Install fire-rated doors according to NFPA 80.
 - 2. Install smoke- and draft-control doors according to NFPA 105.
- 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.

3.3 ADJUSTING

- A. Operation: Rehang or replace doors that do not swing or operate freely.
- B. Finished Doors: Replace doors that are damaged or that do not comply with requirements. Doors may be repaired or refinished if Work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION 081416

SECTION 083213 – INTERIOR ALUMINUM DOORS, DOOR FRAMES AND GLAZING FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes the following for interior use:

1. Pre-finished aluminum door frames.
2. Pre-finished aluminum window frames.
3. Pre-finished aluminum framing systems.
4. Pre-finished aluminum and glass doors.

1.2 ACTION SUBMITTALS

A. Product data: Manufacturer's fabrication and installation instructions.

1. Include information on factory finish, glazing gaskets, accessories and other required components.

B. Shop drawings: Submit schedule indicating opening numbers, frame types, dimensions, swings and hardware requirements.

C. Include elevations and details indicating frame types, profiles, conditions at openings, methods and locations of anchoring, glazing requirements, hardware locations and reinforcements for hardware.

D. Samples: Submit the following:

1. Full range of manufacturer's standard finishes for the Architect's selection.
2. Where normal color variations are expected, include additional samples to show range of such variation.

E. Instructions: Provide copies of manufacturer's data for fabrication and installation of aluminum door frames.

1.3 QUALITY ASSURANCE

A. Single Source Responsibility: Provide aluminum frames, aluminum and glass doors and accessories produced by a single manufacturer for each type of product indicated.

B. Manufacturer's qualifications: Company specializing in the manufacturing of door frame systems with a minimum of 10 years of documented experience on a comparable sized project.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Deliver frames and doors cartoned to provide protection during transit and storage at project site.
- B. Inspect frames and doors upon delivery for damage.
 - 1. Repair minor damage to pre-finished products by means as recommended by the manufacturer.
 - 2. Replace frames that cannot be satisfactorily repaired.
- C. Store frames at the project site under cover and as near as possible to the final installation location. Do not use covering material that will cause discoloration of aluminum finish.

1.5 ENVIRONMENTAL REQUIREMENTS

- A. Do not begin installation of the frames or doors until the area of work has been completely enclosed and the interior is protected from the elements.
- B. Maintain temperature and humidity in areas of installation within reasonable limits, as close as possible to final occupancy. If necessary, provide temperature control and ventilation to maintain required environmental conditions.

1.6 WARRANTY

- A. Warrant against defects in manufacturing of materials for a period of 2 years from date of substantial completion.
- B. Warrant framing finish against defects, including cracking, flaking, blistering, peeling and excessive fading, chalking and non-uniformity in color for a period of 5 years.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide indicated products by the following:
 - 1. Wilson Partitions, 60 Bonner St., Stamford, CT. 203-316-8033.
- B. Products:
 - 1. Interior Aluminum-Framed Storefronts: Series 375.
 - 2. Swinging Doors: NS212 Series Narrow Stile Door.
 - 3. Sliding Doors: Arcadia ULT5820 Series.

2.2 INTERIOR ALUMINUM STOREFRONTS

A. Materials:

1. Aluminum: Controlled alloy billets meeting requirements of ASTM B221, 6063 T5 alloy, to assure compliance with tight dimensional tolerances and maintain color uniformity.

B. Extruded Aluminum Frames:

1. Snap-On Trim Profile: Provide frames with the following characteristics:
 - a. Rectilinear design.
 - b. Trim: 1-1/2 inch.
 - c. Accepts 1/4 inch glass.

2.3 SWINGING DOORS

- ### A. Design Requirements: Arcadia NS212 Series Narrow Stile Entrance is a single source package of door, doorframe and hardware that is engineered for moderate traffic.

- ### B. Major portions of the door stiles a nominal .125 inches and glass stops .050 inches thick.

1. Vertical Stiles: 2 inches.
2. Top Rail: 2-1/16 inches.
3. Bottom Rail: 10/12 inches.
4. Glazing Stops: Square snap-in type for 1/4 inch glass infill.

C. Materials:

1. Door Members: Extruded 6063-T6 aluminum alloy (ASTM B221-Alloy G.S. 10a T6).
2. Screws, fastening devices, and internal components: Aluminum, stainless steel, or zinc plated steel in accordance with ASTM A-164. Shall be aluminum or steel, providing the steel is properly isolated from aluminum.
3. Glazing Gasket (compression-type design).

- ### D. Hardware: Hardware furnished and installed by the door manufacturer, and include the following standard hardware as selected:

1. Hinging: (butt)
2. Latches/Strike: (Adams Rite hardware)

2.4 SLIDING DOORS

- ### A. Component parts and accessories shall be of aluminum alloy, stainless steel or non-metallic materials which will neither deteriorate nor promote corrosion.

- ### B. Sill shall have a full-length nylon track cap.

- ### C. Panel members shall have a minimum of 5/8 inch glass penetration into the aluminum.

- D. Operable panel shall be equipped with two adjustable steel tandem ball bearing rollers (all stainless steel tandem rollers and housings optional).
- E. Locking device Adams-Rite maximum security lock MS+1850 with stainless steel hook bolt standard.
- F. Operating panels shall have an extruded 3/4 inch diameter – 8 inch O.C. aluminum wire pull handle set in either clear or black architect finish – other colors available.
- G. Operating panels shall contain a bottom rail vinyl sweep.
- H. Horizontal members shall have two contact points incorporating silicone treated woven pile with mylar center fins. All vertical members shall have four contact points of silicone treated woven pile with mylar center fins. All shall be held in integral extruded slots and secured to prevent movement or loss while operating sash.
- I. Fixed and/or sliding panels shall be constructed to allow for either factory or field glazing. Panel glazing shall be accomplished using a “marine” style reusable, wraparound black flexible PVC or EPDM material per commercial standard CS23060 without the need for separate glazing beads or putty style bedding compounds. The glazing channel shall be provided with the unit for 1/4 inch single glazing.
- J. All assembly and installation screws shall be 18-8 or 410 stainless steel.

2.5 GLAZING

- A. Glazing: Comply with Section 088000 "Glazing."
- B. Glazing Gaskets: Manufacturer's standard sealed-corner pressure-glazing system of black, resilient elastomeric glazing gaskets, setting blocks, and shims or spacers.

2.6 FABRICATION

- A. Storefronts:
 - 1. Pre-machine jambs and prepare for hardware, with concealed reinforcement plates, drilled and tapped as required, and fastened within the frame.
 - 2. Provide corner reinforcements and alignment clips for precise butt or mitered connections.
 - 3. Fabricate all components to allow secure installation without exposed fasteners.
 - 4. Manufacturer shall pre-cut and ship all frame materials knock-down.
- B. Doors:
 - 1. Stiles and rails shall be tubular sections accurately joined, flush and hairline at corners with heavy concealed reinforcement brackets secured with machine bolts, with optional MIG weld. Exposed screws not permitted.
 - 2. Each door leaf equipped with an adjusting mechanism, located in the top rail near the lock stile.

3. Prepare internal reinforcement for door hardware.
4. Custom hardware templates and physical hardware must be submitted prior to any fabrication.

2.7 ALUMINUM FINISHES

- A. Factory finish extruded frame components so that any part exposed to view upon completion of installation will be uniform in finish and color.
- B. Clear Anodic Coating (AC-2): Comply with AAMA 611.
 1. Commercial, AAM12C22A21 anodized coating, less than .04 mil minimum thick.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine project conditions and verify that the work of this section may properly commence. Do not proceed with the installation until unsatisfactory conditions have been corrected.
- B. Verify that the wall thickness does not exceed manufacturer's recommended tolerances of specified frame throat size.

3.2 INSTALLATION

- A. Comply with door and door frame manufacturer's printed installation instructions and approved shop drawings. Strictly adhere to maintaining specified wall thickness to insure dimension does not exceed frame throat size specified. Installation not to be attempted in areas where the wall thickness exceeds the tolerance of the specified throat size.
- B. Install frames plumb and square, securely anchored to substrates with fasteners recommended by frame manufacturer.
 1. Use concealed installation clips to assure that splices and connections are tightly butted and properly aligned.
 2. Secure clips to main structural extrusion components and not to snap-in or trim members.
 3. Do not use screws or other fasteners that will be exposed to view when installation is complete.
- C. Install doors in accordance with approved shop drawings and manufacturers installation instructions

3.3 ADJUSTING AND CLEANING

- A. Clean exposed frames promptly after installation, using cleaning methods recommended by frame manufacturer.

- B. Touch up marred areas so that touch-up is not visible from a distance of 4 feet. Remove and replace frames that cannot be satisfactorily adjusted.

3.4 PROTECTION

- A. Provide protection required to assure that frames will be without damage or deterioration upon substantial completion of the project.

3.5 DOOR HARDWARE SCHEDULE

- A. The hardware sets listed below indicate the items of hardware required for each opening. It is the bidder's responsibility to accurately furnish the proper quantities, items, sizes, weights and functions as required by the plans and specifications. If an opening has, through error, been omitted from the following hardware sets, it shall be the bidder's responsibility to supply hardware of equivalent quality and quantity, as that which is specified for a comparable opening.

SWINGING ALUMINUM DOOR

HW10

Doors 109B, 111, 201, 202, 206, 207, 208, 210, 221, 222, 226, 227

Hinges

Lockset

Cylinder by others

Door stop by others

SLIDING ALUMINUM DOOR

HW12

Doors 102, 106, 209, 211, 212A, 212B, 213A, 213B, 215, 216, 217, 218, 219

Sliding door hardware

Sliding door lock

Cylinder by others

END OF SECTION 083213

SECTION 083323 - OVERHEAD COILING DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Fire-rated service doors.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type and size of overhead coiling door and accessory.
 - 1. Include construction details, material descriptions, dimensions of individual components, profiles for slats, and finishes.
 - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished accessories.
 - 3. Include description of automatic closing device and testing and resetting instructions.
- B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data.
 - 1. Include plans, elevations, sections, and mounting details.
 - 2. Include details of equipment assemblies, and indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection.
 - 3. Include points of attachment and their corresponding static and dynamic loads imposed on structure.
 - 4. For exterior components, include details of provisions for assembly expansion and contraction and for excluding and draining moisture to the exterior.
 - 5. Show locations of controls, locking devices, detectors or replaceable fusible links, and other accessories.
 - 6. Include diagrams for power, signal, and control wiring.
- C. Samples for Verification: For each type of exposed finish on the following components, in manufacturer's standard sizes:
 - 1. Curtain slats.
 - 2. Include similar Samples of accessories involving color selection.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For overhead coiling doors to include in maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer for both installation and maintenance of units required for this Project.
- B. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at as close to neutral pressure as possible according to NFPA 252 or UL 10B.
 - 1. Smoke Control: Provide doors that are listed and labeled with the letter "S" on the fire-rating label by a qualified testing agency for smoke- and draft-control based on testing according to UL 1784; with maximum air-leakage rate of 3.0 cfm/sq. ft. of door opening at 0.10-inch wg for both ambient and elevated temperature tests.

PART 2 - PRODUCTS

2.1 MANUFACTURERS, GENERAL

- A. Source Limitations: Obtain overhead coiling doors from single source from single manufacturer.
 - 1. Obtain operators and controls from overhead coiling door manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Overhead coiling doors shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - 1. Component Importance Factor: 1.0.

2.3 FIRE-RATED DOOR ASSEMBLY

- A. Fire-Rated Service Door: Overhead fire-rated coiling door formed with curtain of interlocking metal slats.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Series 630 by Overhead Door Corporation or comparable product by one of the following:

- a. Cookson Company.
 - b. Cornell Iron Works, Inc.
 - c. Mahon Door Corporation.
 - d. McKeon Rolling Steel Door Company, Inc.
 - e. Raynor.
 - f. Wayne-Dalton Corp.
- B. Operation Cycles: Door components and operators capable of operating for not less than 20,000. One operation cycle is complete when a door is opened from the closed position to the fully open position and returned to the closed position.
- C. Fire Rating: 1 hour and with smoke control.
- D. Door Curtain Material: Galvanized steel.
- E. Door Curtain Slats: Flat profile slats of 2-5/8-inch center-to-center height.
- F. Curtain Jamb Guides: Galvanized steel with exposed finish matching curtain slats.
- G. Hood: Match curtain material and finish.
1. Shape: Round or square.
 2. Mounting: Between jambs.
- H. Locking Devices: Equip door with slide bolt for padlock.
- I. Electric Door Operator:
1. Usage Classification: Light duty, up to 10 cycles per hour.
 2. Operator Location: Front of hood.
 3. Safety: Listed according to UL 325 by a qualified testing agency for commercial or industrial use.
 4. Motor Exposure: Interior.
 5. Provide hood to enclose any exposed motor components.
 6. Emergency Manual Operation: Crank type.
 7. Obstruction Detection Device: Automatic photoelectric sensor.
 8. Control Station: Interior mounted.
 9. Other Equipment: Audible and visual signals.
- J. Curtain Accessories: Equip door with smoke seals and automatic closing device,.
- K. Door Finish:
1. Baked-Enamel or Powder-Coated Finish: Color as selected by Architect from manufacturer's full range.
 2. Interior Curtain-Slat Facing: Match finish of exterior curtain-slat face.

2.4 MATERIALS, GENERAL

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.5 DOOR CURTAIN MATERIALS AND CONSTRUCTION

- A. Door Curtains: Fabricate overhead coiling-door curtain of interlocking metal slats, designed to withstand wind loading indicated, in a continuous length for width of door without splices. Unless otherwise indicated, provide slats of thickness and mechanical properties recommended by door manufacturer for performance, size, and type of door indicated, and as follows:
 - 1. Steel Door Curtain Slats: Zinc-coated (galvanized), cold-rolled structural steel sheet; complying with ASTM A 653/A 653M, with G90 zinc coating; nominal sheet thickness (coated) of 0.028 inch; and as required.
- B. Curtain Jamb Guides: Manufacturer's standard angles or channels and angles of same material and finish as curtain slats unless otherwise indicated, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Slot bolt holes for guide adjustment. Provide removable stops on guides to prevent overtravel of curtain.

2.6 HOODS

- A. General: Form sheet metal hood to entirely enclose coiled curtain and operating mechanism at opening head. Contour to fit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Form closed ends for surface-mounted hoods and fascia for any portion of between-jamb mounting that projects beyond wall face. Equip hood with intermediate support brackets as required to prevent sagging.
 - 1. Galvanized Steel: Nominal 0.028-inch-thick, hot-dip galvanized steel sheet with G90 zinc coating, complying with ASTM A 653/A 653M.
 - 2. Include automatic drop baffle on fire-rated doors to guard against passage of smoke or flame.

2.7 LOCKING DEVICES

- A. Safety Interlock Switch: Equip power-operated doors with safety interlock switch to disengage power supply when door is locked.

2.8 CURTAIN ACCESSORIES

- A. Smoke Seals: Equip each fire-rated door with replaceable smoke-seal perimeter gaskets or brushes for smoke and draft control as required for door listing and labeling by a qualified testing agency.
- B. Astragal for Interior Doors: Equip each door bottom bar with a replaceable, adjustable, continuous, compressible gasket of flexible vinyl, rubber, or neoprene as a cushion bumper.

- C. Automatic-Closing Device for Fire-Rated Doors: Equip each fire-rated door with an automatic-closing device or holder-release mechanism and governor unit complying with NFPA 80 and an easily tested and reset release mechanism. Release mechanism for motor-operated doors shall allow testing without mechanical release of the door. Automatic-closing device shall be designed for activation by the following:
 - 1. Building fire-detection, smoke-detection, and -alarm systems.

2.9 COUNTERBALANCING MECHANISM

- A. General: Counterbalance doors by means of manufacturer's standard mechanism with an adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to top of curtain with barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.
- B. Counterbalance Barrel: Fabricate spring barrel of manufacturer's standard hot-formed, structural-quality, seamless or welded carbon-steel pipe, of sufficient diameter and wall thickness to support rolled-up curtain without distortion of slats and to limit barrel deflection to not more than 0.03 in./ft. of span under full load.
- C. Counterbalance Spring: One or more oil-tempered, heat-treated steel helical torsion springs. Size springs to counterbalance weight of curtain, with uniform adjustment accessible from outside barrel. Secure ends of springs to barrel and shaft with cast-steel barrel plugs.
 - 1. Fire-Rated Doors: Equip with auxiliary counterbalance spring and prevent tension release from main counterbalance spring when automatic closing device operates.
- D. Torsion Rod for Counterbalance Shaft: Fabricate of manufacturer's standard cold-rolled steel, sized to hold fixed spring ends and carry torsional load.
- E. Brackets: Manufacturer's standard mounting brackets of either cast iron or cold-rolled steel plate.

2.10 ELECTRIC DOOR OPERATORS

- A. General: Electric door operator assembly of size and capacity recommended and provided by door manufacturer for door and operation-cycles requirement specified, with electric motor and factory-prewired motor controls, starter, gear-reduction unit, solenoid-operated brake, clutch, control stations, control devices, integral gearing for locking door, and accessories required for proper operation.
 - 1. Comply with NFPA 70.
 - 2. Control equipment complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6, with NFPA 70 Class 2 control circuit, maximum 24-V ac or dc.
- B. Usage Classification: Electric operator and components capable of operating for not less than number of cycles per hour indicated for each door.
- C. Door Operator Location: Operator location indicated for each door.

1. Front-of-Hood Mounted: Operator is mounted to the right or left door head plate with the operator on coil side of the door-hood assembly and connected to the door drive shaft with drive chain and sprockets. Front clearance is required for this type of mounting.
- D. Motors: Reversible-type motor with controller (disconnect switch) for motor exposure indicated.
1. Electrical Characteristics:
 - a. Phase: Single phase.
 - b. Volts: 115 V.
 - c. Hertz: 60.
 2. Motor Size: Minimum size as indicated. If not indicated, large enough to start, accelerate, and operate door in either direction from any position, at a speed not less than 8 in./sec. and not more than 12 in./sec., without exceeding nameplate ratings or service factor.
 3. Operating Controls, Controllers, Disconnect Switches, Wiring Devices, and Wiring: Manufacturer's standard unless otherwise indicated.
 4. Coordinate wiring requirements and electrical characteristics of motors and other electrical devices with building electrical system and each location where installed.
- E. Limit Switches: Equip each motorized door with adjustable switches interlocked with motor controls and set to automatically stop door at fully opened and fully closed positions.
- F. Obstruction Detection Devices: External entrapment protection consisting of indicated automatic safety sensor capable of protecting full width of door opening. For fire-rated doors, activation delays closing.
1. Photoelectric Sensor: Manufacturer's standard system designed to detect an obstruction in door opening without contact between door and obstruction.
- G. Control Station: Three-button control station in fixed location with momentary-contact push-button controls labeled "Open" and "Stop" and sustained- or constant-pressure push-button control labeled "Close."
1. Interior-Mounted Units: Full-guarded, surface-mounted, heavy-duty type, with general-purpose NEMA ICS 6, Type 1 enclosure.
- H. Emergency Manual Operation: Equip each electrically powered door with capability for emergency manual operation. Design manual mechanism so required force for door operation does not exceed 25 lbf.
- I. Emergency Operation Disconnect Device: Equip operator with hand-operated disconnect mechanism for automatically engaging manual operator and releasing brake for emergency manual operation while disconnecting motor without affecting timing of limit switch. Mount mechanism so it is accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.
- J. Motor Removal: Design operator so motor may be removed without disturbing limit-switch adjustment and without affecting emergency manual operation.

- K. Audible and Visual Signals: Audible alarm and visual indicator lights in compliance with regulatory requirements for accessibility.

2.11 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM/NOMMA's "Metal Finishes Manual for Architectural and Metal Products (AMP 500-06)" for recommendations for applying and designating finishes.
- B. 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.

2.12 STEEL AND GALVANIZED-STEEL FINISHES

- A. Baked-Enamel or Powder-Coat Finish: Manufacturer's standard baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry film thickness.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates areas and conditions, with Installer present, for compliance with requirements for substrate construction and other conditions affecting performance of the Work.
- B. Examine locations of electrical connections.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install overhead coiling doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.
- B. Install overhead coiling doors, hoods, controls, and operators at the mounting locations indicated for each door.
- C. Accessibility: Install overhead coiling doors, switches, and controls along accessible routes in compliance with regulatory requirements for accessibility.
- D. Fire-Rated Doors: Install according to NFPA 80.
- E. Smoke-Control Doors: Install according to NFPA 80 and NFPA 105.

3.3 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
 - 1. Perform installation and startup checks according to manufacturer's written instructions.
 - 2. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.
 - 3. Test door closing when activated by detector or alarm-connected fire-release system. Reset door-closing mechanism after successful test.

3.4 ADJUSTING

- A. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion.
 - 1. Adjust exterior doors and components to be weather-resistant.
- B. Lubricate bearings and sliding parts as recommended by manufacturer.
- C. Adjust seals to provide tight fit around entire perimeter.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain overhead coiling doors.

END OF SECTION 083323

SECTION 084113 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Exterior and interior storefront framing.
 - 2. Storefront framing for punched openings.
 - 3. Exterior and interior manual-swing entrance doors and door-frame units.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Inspect and discuss condition of substrate and other preparatory work performed by other trades.
 - 2. Review structural loading limitations.
 - 3. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - 4. Review tie-in to air barrier system.
 - 5. Review use of Rivnuts for hardware.
 - 6. Review sill flashing details and components.
 - 7. Review coordination with electrical or additional hardware provided by others.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: For aluminum-framed entrances and storefronts. Include plans, elevations, sections, full-size details, and attachments to other work.
 - 1. Include details of provisions for assembly expansion and contraction and for draining moisture occurring within the assembly to the exterior.
 - 2. Include full-size isometric details of each vertical-to-horizontal intersection of aluminum-framed entrances and storefronts, showing the following:

- a. Joinery, including concealed welds.
 - b. Anchorage.
 - c. Expansion provisions.
 - d. Glazing.
 - e. Flashing and drainage.
3. Show connection to and continuity with adjacent thermal, weather, air, and vapor barriers.
- C. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.
- D. Fabrication Sample: Of each vertical-to-horizontal intersection of assemblies, made from 12-inch lengths of full-size components and showing details of the following:
1. Joinery, including concealed welds.
 2. Anchorage.
 3. Expansion provisions.
 4. Glazing.
 5. Flashing and drainage.
- E. Entrance Door Hardware Schedule: Prepared by or under supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams. Coordinate final entrance door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of entrance door hardware.
- F. Delegated-Design Submittal: For aluminum-framed entrances and storefronts indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

- A. Energy Performance Certificates: For aluminum-framed entrances and storefronts, accessories, and components, from manufacturer.
1. Basis for Certification: NFRC-certified energy performance values for each aluminum-framed entrance and storefront.
- B. Product Test Reports: For aluminum-framed entrances and storefronts, for tests performed by manufacturer and witnessed by a qualified testing agency or a qualified testing agency.
- C. Quality-Control Program: Developed specifically for Project, including fabrication and installation, according to recommendations in ASTM C 1401. Include periodic quality-control reports.
- D. Sample Warranties: For special warranties.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For aluminum-framed entrances and storefronts to include in maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
- B. Testing Agency Qualifications: Qualified according to ASTM E 699 for testing indicated and accredited by IAS or ILAC Mutual Recognition Arrangement as complying with ISO/IEC 17025.
- C. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.
 - 1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.

1.8 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of aluminum-framed entrances and storefronts that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including, but not limited to, excessive deflection.
 - b. Noise or vibration created by wind and thermal and structural movements.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - d. Water penetration through fixed glazing and framing areas.
 - e. Failure of operating components.
 - 2. Warranty Period: Two years from date of Substantial Completion.
- B. Special Finish Warranty: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design aluminum-framed entrances and storefronts.
- B. General Performance: Comply with performance requirements specified, as determined by testing of aluminum-framed entrances and storefronts representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.
 1. Aluminum-framed entrances and storefronts shall withstand movements of supporting structure including, but not limited to, story drift, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
 2. Failure also includes the following:
 - a. Thermal stresses transferring to building structure.
 - b. Glass breakage.
 - c. Noise or vibration created by wind and thermal and structural movements.
 - d. Loosening or weakening of fasteners, attachments, and other components.
 - e. Failure of operating units.
- C. Structural Loads:
 1. Wind Loads: As indicated on Drawings.
- D. Deflection of Framing Members: At design wind pressure, as follows:
 1. Deflection Normal to Wall Plane: Limited to 1/175 of clear span for spans up to 13 feet 6 inches and to 1/240 of clear span plus 1/4 inch for spans greater than 13 feet 6 inches or an amount that restricts edge deflection of individual glazing lites to 3/4 inch, whichever is less.
 2. Deflection Parallel to Glazing Plane: Limited to amount not exceeding that which reduces glazing bite to less than 75 percent of design dimension and that which reduces edge clearance between framing members and glazing or other fixed components to less than 1/8 inch.
 - a. Operable Units: Provide a minimum 1/16-inch clearance between framing members and operable units.
 3. Cantilever Deflection: Where framing members overhang an anchor point, as follows:
 - a. Perpendicular to Plane of Wall: No greater than 1/240 of clear span plus 1/4 inch for spans greater than 11 feet 8-1/4 inches or 1/175 times span, for spans less than 11 feet 8-1/4 inches.

- E. Structural: Test according to ASTM E 330 as follows:
1. When tested at positive and negative wind-load design pressures, assemblies do not evidence deflection exceeding specified limits.
 2. When tested at 150 percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not evidence material failures, structural distress, or permanent deformation of main framing members exceeding 0.2 percent of span.
 3. Test Durations: As required by design wind velocity, but not less than 10 seconds.
- F. Air Infiltration: Test according to ASTM E 283 for infiltration as follows:
1. Fixed Framing and Glass Area:
 - a. Maximum air leakage of 0.06 cfm/sq. ft. at a static-air-pressure differential of 6.24 lbf/sq. ft..
 2. Entrance Doors:
 - a. Pair of Doors: Maximum air leakage of 1.0 cfm/sq. ft. at a static-air-pressure differential of 1.57 lbf/sq. ft..
 - b. Single Doors: Maximum air leakage of 0.5 cfm/sq. ft. at a static-air-pressure differential of 1.57 lbf/sq. ft..
- G. Water Penetration under Static Pressure: Test according to ASTM E 331 as follows:
1. No evidence of water penetration through fixed glazing and framing areas when tested according to a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft..
- H. Water Penetration under Dynamic Pressure: Test according to AAMA 501.1 as follows:
1. No evidence of water penetration through fixed glazing and framing areas when tested at dynamic pressure equal to 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft..
 2. Maximum Water Leakage: No uncontrolled water penetrating assemblies or water appearing on assemblies' normally exposed interior surfaces from sources other than condensation. Water leakage does not include water controlled by flashing and gutters, or water that is drained to exterior.
- I. Seismic Performance: Aluminum-framed entrances and storefronts shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
- J. Energy Performance: Certify and label energy performance according to NFRC as follows:
1. Thermal Transmittance (U-factor): Fixed glazing and framing areas shall have U-factor of not more than 0.45 Btu/sq. ft. x h x deg F as determined according to NFRC 100.
 2. Solar Heat Gain Coefficient: Fixed glazing and framing areas shall have a solar heat gain coefficient of no greater than 0.40 as determined according to NFRC 200.
 3. Condensation Resistance: Fixed glazing and framing areas shall have an NFRC-certified condensation resistance rating of no less than 45 as determined according to NFRC 500.

- K. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes:

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 MANUFACTURERS

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

1. EFCO Corporation.
2. Kawneer North America; an Alcoa company.
3. Tubelite.
4. Oldcastle Building Envelope Company.

- B. Products:

1. Exterior Aluminum-Framed Storefronts:
 - a. EFCO: System 403.
 - b. Kawneer: Trifab VG 451 T.
 - c. Tubelite: 14000 Series.
 - d. Oldcastle: 3000 Thermal MultiPlane.
2. Interior Aluminum-Framed Storefronts:
 - a. EFCO: System 402.
 - b. Kawneer: Trifab VG 450.
 - c. Tubelite: 4500 Series.
 - d. Oldcastle: 3000 non-thermal MultiPlane.
3. Exterior Aluminum Windows:
 - a. EFCO: System 403.
 - b. Kawneer: Trifab VG 451 T
 - c. Tubelite: 14000 series.
 - d. Oldcastle: 3000 Thermal MultiPlane
4. Doors and Entrances:
 - a. EFCO: Series D200.
 - b. Kawneer: 190 Entrance
 - c. Tubelite: Narrow Stile Entrance.
 - d. Oldcastle: Series 212

2.3 FRAMING

- A. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.

1. Construction:
 - a. Exterior: Thermally broken
 - b. Interior: Nonthermal.
 2. Glazing System: Retained mechanically with gaskets on four sides.
 3. Glazing Plane: Front.
 4. Finish: High-performance organic finish.
 5. Fabrication Method: Field-fabricated stick system.
 6. Exterior Jambs and Head Framing: Provide manufacturer's standard extruded aluminum continuous thermal flat filler for use at jambs and head framing. This extrusion provides the necessary profile for sealing with the building air barrier system. Channel type jamb components will not be acceptable.
- B. Backer Plates: Manufacturer's standard, continuous backer plates for framing members, if not integral, where framing abuts adjacent construction.
- C. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.
- D. Subsills for Exterior Storefronts: Manufacturer's standard thermally broken extruded aluminum sill flashing, color to match framing.
- E. Materials:
1. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
 - a. Sheet and Plate: ASTM B 209.
 - b. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221.
 - c. Extruded Structural Pipe and Tubes: ASTM B 429/B 429M.
 - d. Structural Profiles: ASTM B 308/B 308M.
 2. Steel Reinforcement: Manufacturer's standard zinc-rich, corrosion-resistant primer complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM, and prepare surfaces according to applicable SSPC standard.
 - a. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
 - b. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.
 - c. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011M.

2.4 ENTRANCE DOOR SYSTEMS

- A. Entrance Doors: Manufacturer's standard glazed entrance doors for manual-swing operation.
1. Door Construction: 1-3/4-inch overall thickness, with minimum 0.125-inch- thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods.

2. Door Design: Narrow stile; 2-1/8-inch nominal width.
3. Glazing Stops and Gaskets: Square, snap-on, extruded-aluminum stops and preformed gaskets.
 - a. Provide nonremovable glazing stops on outside of door.

2.5 ENTRANCE DOOR HARDWARE

- A. Entrance Door Hardware: Hardware not specified in this Section is specified in Section 087100 "Door Hardware."
- B. General: Provide entrance door hardware for each entrance door to comply with requirements in this Section.
 1. Opening-Force Requirements:
 - a. Egress Doors: Not more than 15 lbf to release the latch and not more than 30 lbf to set the door in motion and not more than 15 lbf to open the door to its minimum required width.
 - b. Accessible Interior Doors: Not more than 5 lbf to fully open door.
- C. Designations: Requirements for design, grade, function, finish, size, and other distinctive qualities of each type of entrance door hardware are indicated in "Entrance Door Hardware Sets" Article. Products are identified by using entrance door hardware designations as follows:
 1. Named Manufacturers' Products: Manufacturer and product designation are listed for each door hardware type required for the purpose of establishing minimum requirements. Manufacturers' names are abbreviated in "Entrance Door Hardware Sets" Article.
 2. References to BHMA Standards: Provide products complying with these standards and requirements for description, quality, and function.
- D. Weather Stripping: Manufacturer's standard replaceable components.
 1. Compression Type: Made of ASTM D 2000, molded neoprene, or ASTM D 2287, molded PVC.
- E. Thresholds: BHMA A156.21, raised thresholds beveled with a slope of not more than 1:2, with maximum height of 1/2 inch.

2.6 GLAZING

- A. Glazing: Comply with Section 088000 "Glazing."
- B. Glazing Gaskets: Manufacturer's standard sealed-corner pressure-glazing system of black, resilient elastomeric glazing gaskets, setting blocks, and shims or spacers.
- C. Glazing Sealants: As recommended by manufacturer.

- D. Weatherseal Sealants: ASTM C 920 for Type S; Grade NS; Class 25; Uses NT, G, A, and O; chemically curing silicone formulation that is compatible with structural sealant and other system components with which it comes in contact; recommended by structural-sealant, weatherseal-sealant, and structural-sealant-glazed storefront manufacturers for this use.
1. Color: Match structural sealant.

2.7 ACCESSORIES

- A. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.
1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
 2. Reinforce members as required to receive fastener threads.
 3. Use exposed fasteners with countersunk Phillips screw heads, finished to match framing system, fabricated from 300 series stainless steel.
- B. Anchors: Three-way adjustable anchors with minimum adjustment of 1 inch that accommodate fabrication and installation tolerances in material and finish compatible with adjoining materials and recommended by manufacturer.
1. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A 123/A 123M or ASTM A 153/A 153M requirements.
- C. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.
- D. Bituminous Paint: Cold-applied asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos, formulated for 30-mil thickness per coat.

2.8 FABRICATION

- A. Form or extrude aluminum shapes before finishing.
- B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
- C. Fabricate components that, when assembled, have the following characteristics:
1. Profiles that are sharp, straight, and free of defects or deformations.
 2. Accurately fitted joints with ends coped or mitered.
 3. Physical and thermal isolation of glazing from framing members.
 4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
 5. Provisions for field replacement of glazing from exterior.
 6. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.

- D. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.
- E. Storefront Framing: Fabricate framing in profiles indicated for flush glazing (without projecting stops). Provide subframes and reinforcing of types indicated or, if not indicated, as required for a complete system. Factory assemble components to greatest extent possible. Disassemble components only as necessary for shipment and installation.
- F. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.
 - 1. At exterior doors, provide compression weather stripping at fixed stops.
 - 2. At interior doors, provide silencers at stops to prevent metal-to-metal contact. Install three silencers on strike jamb of single-door frames and two silencers on head of frames for pairs of doors.
- G. Entrance Doors: Reinforce doors as required for installing entrance door hardware.
 - 1. At pairs of exterior doors, provide sliding-type weather stripping retained in adjustable strip and mortised into door edge.
 - 2. At exterior doors, provide weather sweeps applied to door bottoms.
- H. Entrance Door Hardware Installation: Factory install entrance door hardware to the greatest extent possible. Cut, drill, and tap for factory-installed entrance door hardware before applying finishes.
- I. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.9 ALUMINUM FINISHES

- A. Base Bid Exterior Finish: High-Performance Organic Finish; Three-coat fluoropolymer finish with suspended metallic flakes complying with AAMA 2605 and containing not less than 70 percent FEVE resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - 1. Color and Gloss: Allow for color selection in the Metallic range to match metal siding.
- B. Alternate Exterior Finish: Two-Coat Fluoropolymer; AAMA 2605. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - 1. Color and Gloss: Allow for color selection in the color to match metal siding.
- C. Clear Anodic Finish for Interior Storefronts and Entrances: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.

2.10 SOURCE QUALITY CONTROL

- A. Structural Sealant: Perform quality-control procedures complying with ASTM C 1401 recommendations including, but not limited to, assembly material qualification procedures, sealant testing, and assembly fabrication reviews and checks.

2.11 HARDWARE FINISHES

- A. Standard: BHMA A156.18, as indicated in door hardware sets.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Provide the following finishes:
 - 1. Weatherstripping Aluminum
 - 2. Threshold Aluminum

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare surfaces that are in contact with structural sealant according to sealant manufacturer's written instructions to ensure compatibility and adhesion. Preparation includes, but is not limited to, cleaning and priming surfaces.

3.3 INSTALLATION

- A. General:
 - 1. Comply with manufacturer's written instructions.
 - 2. Do not install damaged components.
 - 3. Fit joints to produce hairline joints free of burrs and distortion.
 - 4. Rigidly secure nonmovement joints.
 - 5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
 - 6. Seal perimeter and other joints watertight unless otherwise indicated.
- B. Metal Protection:

1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with materials recommended by manufacturer for this purpose or by installing nonconductive spacers.
 2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.
- C. Set continuous sill members and flashing in full sealant bed as specified in Section 079200 "Joint Sealants" to produce weathertight installation.
- D. Install components plumb and true in alignment with established lines and grades.
- E. Install operable units level and plumb, securely anchored, and without distortion. Adjust weather-stripping contact and hardware movement to produce proper operation.
- F. Install glazing as specified in Section 088000 "Glazing."
- G. Install weatherseal sealant according to Section 079200 "Joint Sealants" and according to sealant manufacturer's written instructions to produce weatherproof joints. Install joint filler behind sealant as recommended by sealant manufacturer.
- H. Entrance Doors: Install doors to produce smooth operation and tight fit at contact points.
1. Exterior Doors: Install to produce weathertight enclosure and tight fit at weather stripping.
 2. Field-Installed Entrance Door Hardware: Install surface-mounted entrance door hardware according to entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.

3.4 ERECTION TOLERANCES

- A. Erection Tolerances: Install aluminum-framed entrances and storefronts to comply with the following maximum tolerances:
1. Plumb: 1/8 inch in 10 feet; 1/4 inch in 40 feet.
 2. Level: 1/8 inch in 20 feet; 1/4 inch in 40 feet.
 3. Alignment:
 - a. Where surfaces abut in line or are separated by reveal or protruding element up to 1/2 inch wide, limit offset from true alignment to 1/16 inch.
 - b. Where surfaces are separated by reveal or protruding element from 1/2 to 1 inch wide, limit offset from true alignment to 1/8 inch.
 - c. Where surfaces are separated by reveal or protruding element of 1 inch wide or more, limit offset from true alignment to 1/4 inch.
 4. Location: Limit variation from plane to 1/8 inch in 12 feet; 1/2 inch over total length.

END OF SECTION 084113

SECTION 084413 - GLAZED ALUMINUM CURTAIN WALLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes glazed aluminum curtain walls.
- B. Related Requirements:
 - 1. Section 084113 "Aluminum-Framed Entrances and Storefronts" for entry doors.

1.3 PREINSTALLATION MEETINGS

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

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: For glazed aluminum curtain walls. Include plans, elevations, sections, full-size details, and attachments to other work.
 - 1. Include details of provisions for assembly expansion and contraction and for draining moisture occurring within the assembly to the exterior.
 - 2. Include full-size isometric details of each vertical-to-horizontal intersection of glazed aluminum curtain walls, showing the following:
 - a. Joinery, including concealed welds.
 - b. Anchorage.
 - c. Expansion provisions.
 - d. Glazing.
 - e. Flashing and drainage.
 - 3. Show connection to and continuity with adjacent thermal, weather, air, and vapor barriers.

- C. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.
- D. Delegated-Design Submittal: For glazed aluminum curtain walls indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Energy Performance Certificates: For glazed aluminum curtain walls, accessories, and components from manufacturer.
 - 1. Basis for Certification: NFRC-certified energy performance values for each glazed aluminum curtain wall.
- C. Product Test Reports: For glazed aluminum curtain walls, for tests performed by manufacturer and witnessed by a qualified testing agency or performed by a qualified testing agency.
- D. Quality-Control Program (for structural glazing only): Developed specifically for Project, including fabrication and installation, according to recommendations in ASTM C 1401. Include periodic quality-control reports.
- E. Source quality-control reports.
- F. Sample Warranties: For special warranties.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For glazed aluminum curtain walls to include in maintenance manuals.
- B. Maintenance Data for Structural Sealant: For structural-sealant-glazed curtain walls to include in maintenance manuals. Include ASTM C 1401 recommendations for post-installation-phase quality-control program.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
- B. Testing Agency Qualifications: Qualified according to ASTM E 699 for testing indicated.
- C. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.

1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.
- D. Structural-Sealant Glazing: Comply with ASTM C 1401 for design and installation of curtain wall assemblies.

1.8 MOCKUPS

- A. Mockups: Build exterior integrated mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
1. Build mockup of typical wall area as shown on Drawings.
 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 WARRANTY

- A. Special Assembly Warranty: Manufacturer agrees to repair or replace components of glazed aluminum curtain wall that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
1. Failures include, but are not limited to, the following:
 - a. Structural failures including, but not limited to, excessive deflection.
 - b. Noise or vibration created by wind and thermal and structural movements.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - d. Water penetration through fixed glazing and framing areas.
 - e. Failure of operating components.
 2. Warranty Period: Two years from date of Substantial Completion.
- B. Special Finish Warranty: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of factory-applied finishes within specified warranty period.
1. Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 2. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design glazed aluminum curtain walls.
- B. General Performance: Comply with performance requirements specified, as determined by testing of glazed aluminum curtain walls representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.
1. Glazed aluminum curtain walls shall withstand movements of supporting structure including, but not limited to, story drift, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
 2. Failure also includes the following:
 - a. Thermal stresses transferring to building structure.
 - b. Glass breakage.
 - c. Noise or vibration created by wind and thermal and structural movements.
 - d. Loosening or weakening of fasteners, attachments, and other components.
 - e. Failure of operating units.
- C. Structural Loads:
1. Wind and Seismic Loads: As indicated on Structural Drawings.
- D. Deflection of Framing Members: At design wind pressure, as follows:
1. Deflection Normal to Wall Plane: Limited to 1/175 of clear span for spans up to 13 feet 6 inches and to 1/240 of clear span plus 1/4 inch for spans greater than 13 feet 6 inches or an amount that restricts edge deflection of individual glazing lites to 3/4 inch, whichever is less.
 2. Deflection Parallel to Glazing Plane: Limited to amount not exceeding that which reduces glazing bite to less than 75 percent of design dimension and that which reduces edge clearance between framing members and glazing or other fixed components to less than 1/8 inch.
- E. Structural: Test according to ASTM E 330 as follows:
1. When tested at positive and negative wind-load design pressures, assemblies do not evidence deflection exceeding specified limits.
 2. When tested at 150 percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not evidence material failures, structural distress, or permanent deformation of main framing members exceeding 0.2 percent of span.
 3. Test Durations: As required by design wind velocity, but not less than 10 seconds.
- F. Air Infiltration: Test according to ASTM E 283 for infiltration as follows:
1. Fixed Framing and Glass Area:

- a. Maximum air leakage of 0.06 cfm/sq. ft. at a static-air-pressure differential of 6.24 lbf/sq. ft..
- G. Water Penetration under Static Pressure: Test according to ASTM E 331 as follows:
1. No evidence of water penetration through fixed glazing and framing areas when tested according to a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 15 lbf/sq. ft..
- H. Water Penetration under Dynamic Pressure: Test according to AAMA 501.1 as follows:
1. No evidence of water penetration through fixed glazing and framing areas when tested at dynamic pressure equal to 20 percent of positive wind-load design pressure, but not less than 15 lbf/sq. ft..
 2. Maximum Water Leakage: No uncontrolled water penetrating assemblies or water appearing on assemblies' normally exposed interior surfaces from sources other than condensation. Water leakage does not include water controlled by flashing and gutters, or water that is drained to exterior.
- I. Seismic Performance: Glazed aluminum curtain walls shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
1. Seismic Drift Causing Glass Fallout: Complying with criteria for passing based on building occupancy type when tested according to AAMA 501.6 at design displacement and 1.5 times the design displacement.
- J. Energy Performance: Certify and label energy performance according to NFRC as follows:
1. Thermal Transmittance (U-factor): Fixed glazing and framing areas shall have U-factor of not more than 0.69 Btu/sq. ft. x h x deg F as determined according to NFRC 100.
 2. Solar Heat Gain Coefficient: Fixed glazing and framing areas shall have a solar heat gain coefficient of no greater than 0.45 as determined according to NFRC 200.
 3. Condensation Resistance: Fixed glazing and framing areas shall have an NFRC-certified condensation resistance rating of no less than 55 as determined according to NFRC 500.
- K. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes:
1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.
 2. Thermal Cycling: No buckling; stress on glass; sealant failure; excess stress on framing, anchors, and fasteners; or reduction of performance when tested according to AAMA 501.5.
 - a. High Exterior Ambient-Air Temperature: That which produces an exterior metal-surface temperature of 180 deg F.
 - b. Low Exterior Ambient-Air Temperature: 0 deg F.
- L. Structural-Sealant Joints:
1. Designed to carry gravity loads of glazing.
 2. Designed to produce tensile or shear stress of less than 20 psi.

- M. Structural Sealant: Capable of withstanding tensile and shear stresses imposed by structural-sealant-glazed curtain walls without failing adhesively or cohesively. When tested for preconstruction adhesion and compatibility, cohesive failure of sealant shall occur before adhesive failure.
1. Adhesive failure occurs when sealant pulls away from substrate cleanly, leaving no sealant material behind.
 2. Cohesive failure occurs when sealant breaks or tears within itself but does not separate from each substrate because sealant-to-substrate bond strength exceeds sealant's internal strength.

2.2 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide Kawneer 1620 SSG Wall System or comparable product by one of the following:
1. EFCO Corporation.
 2. United States Aluminum.
 3. Vistawall Architectural Products; The Vistawall Group; a Bluescope Steel company.

2.3 FRAMING

- A. Framing Members: Manufacturer's 2 by 6-inch, extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.
1. Construction: Thermally broken.
 2. Glazing System: Retained mechanically with gaskets on four sides and retained mechanically with gaskets on two sides and structural sealant on two sides.
 3. Glazing Plane: Front.
 4. Finish: High-performance organic finish.
 5. Fabrication Method: Either factory- or field-fabricated system.
- B. Pressure Caps: Manufacturer's standard aluminum components that mechanically retain glazing.
1. Include snap-on aluminum trim that conceals fasteners.
- C. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.
- D. Materials:
1. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
 - a. Sheet and Plate: ASTM B 209.
 - b. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221.

- c. Extruded Structural Pipe and Tubes: ASTM B 429/B 429M.
 - d. Structural Profiles: ASTM B 308/B 308M.
2. Steel Reinforcement: Manufacturer's standard zinc-rich, corrosion-resistant primer complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM, and prepare surfaces according to applicable SSPC standard.
- a. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
 - b. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.
 - c. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011M.

2.4 ENTRANCES

- A. Entrances: Comply with Section 084113 "Aluminum-Framed Entrances and Storefronts."

2.5 GLAZING

- A. Glazing: Comply with Section 088000 "Glazing."
- B. Glazing Gaskets: Comply with Section 088000 "Glazing."
- C. Glazing Sealants: Comply with Section 088000 "Glazing."
- D. Structural Glazing Sealants: ASTM C 1184, chemically curing silicone formulation that is compatible with system components with which it comes in contact, specifically formulated and tested for use as structural sealant and approved by structural-sealant manufacturer for use in curtain-wall assembly indicated.
 1. Color: As selected by Architect from manufacturer's full range of colors.
- E. Weatherseal Sealants: ASTM C 920 for Type S; Grade NS; Class 25; Uses NT, G, A, and O; chemically curing silicone formulation that is compatible with structural sealant and other system components with which it comes in contact; recommended by structural-sealant, weatherseal-sealant, and structural-sealant-glazed curtain-wall manufacturers for this use.
 1. Color: Match structural sealant.

2.6 ACCESSORIES

- A. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.
 1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
 2. Reinforce members as required to receive fastener threads.
 3. Use exposed fasteners with countersunk Phillips screw heads, finished to match framing system, fabricated from 300 series stainless steel.

- B. Anchors: Three-way adjustable anchors with minimum adjustment of 1 inch that accommodate fabrication and installation tolerances in material and finish compatible with adjoining materials and recommended by manufacturer.
 - 1. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A 123/A 123M or ASTM A 153/A 153M requirements.
- C. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.
- D. Framed Corners: Provide angled corner extrusions as indicated on the drawings.
- E. Bituminous Paint: Cold-applied asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos, formulated for 30-mil thickness per coat.

2.7 FABRICATION

- A. Form or extrude aluminum shapes before finishing.
- B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
- C. Fabricate components that, when assembled, have the following characteristics:
 - 1. Profiles that are sharp, straight, and free of defects or deformations.
 - 2. Accurately fitted joints with ends coped or mitered.
 - 3. Physical and thermal isolation of glazing from framing members.
 - 4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
 - 5. Provisions for field replacement of glazing from exterior.
 - 6. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
- D. Fabricate components to resist water penetration as follows:
 - 1. Internal guttering system or other means to drain water passing joints, condensation occurring within framing members, and moisture migrating within glazed aluminum curtain wall to exterior.
 - 2. Pressure-equalized system or double barrier design with primary air and vapor barrier at interior side of glazed aluminum curtain wall and secondary seal weeped and vented to exterior.
- E. Curtain-Wall Framing: Factory assemble frame units according to Shop Drawings to greatest extent possible. Rigidly secure nonmovement joints. Seal joints watertight, unless otherwise indicated. Assemble components to drain water passing joints, condensation occurring in glazing channels, condensation occurring within framing members, and moisture migrating within the system to the exterior.

- F. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.8 ALUMINUM FINISHES

- A. Base Bid: High-Performance Organic Finish; Three-coat fluoropolymer finish with suspended metallic flakes complying with AAMA 2605 and containing not less than 70 percent FEVE resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - 1. Color and Gloss: Allow for color selection in the Metallic range to match metal siding.
- B. Alternate: Two-Coat Fluoropolymer; AAMA 2605. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - 1. Color and Gloss: Allow for color selection in the color to match metal siding.

2.9 SOURCE QUALITY CONTROL

- A. Structural Sealant: Perform quality-control procedures complying with ASTM C 1401 recommendations including, but not limited to, assembly material qualification procedures, sealant testing, and assembly fabrication reviews and checks.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare surfaces that will contact structural sealant according to sealant manufacturer's written instructions to ensure compatibility and adhesion. Preparation includes, but is not limited to, cleaning and priming surfaces.

3.3 INSTALLATION

- A. General:
 - 1. Comply with manufacturer's written instructions.
 - 2. Do not install damaged components.
 - 3. Fit joints to produce hairline joints free of burrs and distortion.

4. Rigidly secure nonmovement joints.
5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
6. Where welding is required, weld components in concealed locations to minimize distortion or discoloration of finish. Protect glazing surfaces from welding.
7. Seal joints watertight unless otherwise indicated.

B. Metal Protection:

1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with primer, applying sealant or tape, or installing nonconductive spacers as recommended by manufacturer for this purpose.
2. Where aluminum is in contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

C. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within glazed aluminum curtain wall to exterior.

D. Install components plumb and true in alignment with established lines and grades.

E. Install operable units level and plumb, securely anchored, and without distortion. Adjust weather-stripping contact and hardware movement to produce proper operation.

F. Install glazing as specified in Section 088000 "Glazing."

1. Prepare surfaces that will contact structural sealant according to sealant manufacturer's written instructions to ensure compatibility and adhesion. Preparation includes, but is not limited to, cleaning and priming surfaces.

G. Install weatherseal sealant according to Section 079200 "Joint Sealants" and according to sealant manufacturer's written instructions to produce weatherproof joints. Install joint filler behind sealant as recommended by sealant manufacturer.

3.4 ERECTION TOLERANCES

A. Erection Tolerances: Install glazed aluminum curtain walls to comply with the following maximum tolerances:

1. Plumb: 1/8 inch in 10 feet; 1/4 inch in 40 feet.
2. Level: 1/8 inch in 20 feet; 1/4 inch in 40 feet.
3. Alignment:
 - a. Where surfaces abut in line or are separated by reveal or protruding element up to 1/2 inch wide, limit offset from true alignment to 1/16 inch.
 - b. Where surfaces are separated by reveal or protruding element from 1/2 to 1 inch wide, limit offset from true alignment to 1/8 inch.
 - c. Where surfaces are separated by reveal or protruding element of 1 inch wide or more, limit offset from true alignment to 1/4 inch.
4. Location: Limit variation from plane to 1/8 inch in 12 feet; 1/2 inch over total length.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Structural-Sealant Adhesion: Test structural sealant according to recommendations in ASTM C 1401, Destructive Test Method A, "Hand Pull Tab (Destructive)," Appendix X2.
 - 1. Test a minimum of two areas on each building facade.
 - 2. Repair installation areas damaged by testing.
- C. Glazed aluminum curtain walls will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

END OF SECTION 084413

SECTION 087100 - DOOR HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes:

- 1. Mechanical door hardware for the following:
 - a. Swinging doors.
- 2. Furnish cylinders for door hardware specified in Section 083213 "Aluminum Doors, Door Frames and Glazing Frames."
- 3. Electrified door hardware.

- B. Related Sections:

- 1. Section 081113 "Hollow Metal Doors and Frames" for door silencers provided as part of hollow-metal frames.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction and installation details, material descriptions, dimensions of individual components and profiles, and finishes.

- B. Shop Drawings: Details of electrified door hardware, indicating the following:

- 1. Wiring Diagrams: For power, signal, and control wiring and including the following:
 - a. Details of interface of electrified door hardware and building safety and security systems.
 - b. Schematic diagram of systems that interface with electrified door hardware.
 - c. Point-to-point wiring.
 - d. Risers.
 - e. Elevations doors controlled by electrified door hardware.
- 2. Operation Narrative: Describe the operation of doors controlled by electrified door hardware.

- C. Samples for Initial Selection: For plastic protective trim units in each finish, color, and texture required for each type of trim unit indicated.

- D. Samples for Verification: For exposed door hardware of each type required, in each finish specified, prepared on Samples of size indicated below. Tag Samples with full description for coordination with the door hardware schedule. Submit Samples before, or concurrent with, submission of door hardware schedule.
1. Sample Size: Full-size units or minimum 2-by-4-inch Samples for sheet and 4-inch long Samples for other products.
 - a. Full-size Samples will be returned to Contractor. Units that are acceptable and remain undamaged through submittal, review, and field comparison process may, after final check of operation, be incorporated into the Work, within limitations of keying requirements.
- E. Other Action Submittals:
1. Door Hardware Schedule: Prepared by or under the supervision of Installer, detailing fabrication and assembly of door hardware, as well as installation procedures and diagrams. Coordinate final door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
 - a. Submittal Sequence: Submit door hardware schedule concurrent with submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate the fabrication of other work that is critical in Project construction schedule.
 - b. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule." Double space entries, and number and date each page.
 - c. Format: Use same scheduling sequence and format and use same door numbers as in the Contract Documents.
 - d. Content: Include the following information:
 - 1) Identification number, location, hand, fire rating, size, and material of each door and frame.
 - 2) Locations of each door hardware set, cross-referenced to Drawings on floor plans and to door and frame schedule.
 - 3) Complete designations, including name and manufacturer, type, style, function, size, quantity, function, and finish of each door hardware product.
 - 4) Description of electrified door hardware sequences of operation and interfaces with other building control systems.
 - 5) Fastenings and other pertinent information.
 - 6) Explanation of abbreviations, symbols, and codes contained in schedule.
 - 7) Mounting locations for door hardware.
 - 8) List of related door devices specified in other Sections for each door and frame.
 2. Keying Schedule: Prepared by or under the supervision of Installer, detailing Owner's final keying instructions for locks. Include schematic keying diagram and index each key set to unique door designations that are coordinated with the Contract Documents.

1.4 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For electrified door hardware, from the manufacturer.
 - 1. Certify that door hardware approved for use on types and sizes of labeled fire-rated doors complies with listed fire-rated door assemblies.
- B. Product Test Reports: For compliance with accessibility requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for door hardware on doors located in accessible routes.
- C. Warranty: Special warranty specified in this Section.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of door hardware to include in maintenance manuals. Include final hardware and keying schedule.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has completed door hardware similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- B. Architectural Hardware Consultant Qualifications: A person who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project and who is currently certified by DHI as follows:
 - 1. For door hardware, an Architectural Hardware Consultant (AHC) who is also an Electrified Hardware Consultant (EHC) or Architectural Openings Consultant (AOC).
- C. Source Limitations: Obtain each type of door hardware from a single manufacturer.
- D. Fire-Rated Door Assemblies: Where fire-rated door assemblies are indicated, provide door hardware rated for use in assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C, unless otherwise indicated.
- E. Smoke- and Draft-Control Door Assemblies: Where smoke- and draft-control door assemblies are required, provide door hardware that meet requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105.
 - 1. Air Leakage Rate: Maximum air leakage of 0.3 cfm/sq. ft. at the tested pressure differential of 0.3-inch wg of water.
- F. Electrified Door Hardware: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.

- G. Means of Egress Doors: Latches do not require more than 15 lbf to release the latch. Locks do not require use of a key, tool, or special knowledge for operation.
- H. Accessibility Requirements: Comply with applicable provisions in the DOJ's 2010 ADA Standards for Accessible Design for door hardware on doors in an accessible route.
1. Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf.
 2. Comply with the following maximum opening-force requirements:
 - a. Interior, Non-Fire-Rated Hinged Doors: 5 lbf applied perpendicular to door.
 - b. Fire Doors: Minimum opening force allowable by authorities having jurisdiction.
 3. Bevel raised thresholds with a slope of not more than 1:2. Provide thresholds not more than 1/2 inch high.
 4. Closers: Adjust door and gate closer sweep periods so that, from an open position of 90 degrees, the time required to move the door to a position of 12 degrees from the latch is 5 seconds minimum.
 5. Spring Hinges: Adjust door and gate spring hinges so that, from an open position of 70 degrees, the time required to move the door to the closed position is 1.5 seconds minimum.
- I. Keying Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination." In addition to Owner Contractor, and Architect, conference participants shall also include Installer's Architectural Hardware Consultant. Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including, but not limited to, the following:
1. Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.
 2. Preliminary key system schematic diagram.
 3. Requirements for key control system.
 4. Requirements for access control.
- J. Preinstallation Conference: Conduct conference at Project site.
1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 2. Inspect and discuss preparatory work performed by other trades.
 3. Inspect and discuss electrical roughing-in for electrified door hardware.
 4. Review sequence of operation for each type of electrified door hardware.
 5. Review required testing, inspecting, and certifying procedures.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Inventory door hardware on receipt and provide secure lock-up for door hardware delivered to Project site.

- B. Tag each item or package separately with identification coordinated with the final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package.
- C. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.

1.8 COORDINATION

- A. Coordinate layout and installation of floor-recessed door hardware with floor construction. Cast anchoring inserts into concrete.
- B. Installation Templates: Distribute for doors, frames, and other work specified to be factory prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.
- C. Security: Coordinate installation of door hardware, keying, and access control with Owner's security consultant.
- D. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.

1.9 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including excessive deflection, cracking, or breakage.
 - b. Faulty operation of doors and door hardware.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.
 - 2. Warranty Period: Three years from date of Substantial Completion, unless otherwise indicated.
 - a. Exit Devices: Two years from date of Substantial Completion.
 - b. Manual Closers: 10 years from date of Substantial Completion.

1.10 MAINTENANCE SERVICE

- A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.
- B. Maintenance Service: Beginning at Substantial Completion, provide six months' full maintenance by skilled employees of door hardware Installer. Include quarterly preventive

maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper door and door hardware operation. Provide parts and supplies that are the same as those used in the manufacture and installation of original products.

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

- A. General: Provide door hardware for each door to comply with requirements in this Section and door hardware sets indicated in Part 3 "Door Hardware Sets" Article.
 - 1. Door Hardware Sets: Provide quantity, item, size, finish or color indicated, and named manufacturers' products.
 - 2. Sequence of Operation: Provide electrified door hardware function, sequence of operation, and interface with other building control systems indicated.
- B. Designations: Requirements for design, grade, function, finish, size, and other distinctive qualities of each type of door hardware are indicated in Part 3 "Door Hardware Schedule" Article. Products are identified by using door hardware designations, as follows:
 - 1. Named Manufacturers' Products: Manufacturer and product designation are listed for each door hardware type required for the purpose of establishing minimum requirements. Manufacturers' names are abbreviated in Part 3 "Door Hardware Schedule" Article.
 - 2. References to BHMA Designations: Provide products complying with these designations and requirements for description, quality, and function.

2.2 HINGES, GENERAL

- A. Quantity: Provide the following, unless otherwise indicated:
 - 1. Two Hinges: For doors with heights up to 60 inches.
 - 2. Three Hinges: For doors with heights 61 to 90 inches.
 - 3. Four Hinges: For doors with heights 91 to 120 inches.
 - 4. For doors with heights more than 120 inches, provide 4 hinges, plus 1 hinge for every 30 inches of door height greater than 120 inches.
- B. Template Requirements: Except for hinges and pivots to be installed entirely (both leaves) into wood doors and frames, provide only template-produced units.
- C. Hinge Weight: Unless otherwise indicated, provide the following:
 - 1. Entrance Doors: Heavy-weight hinges.
 - 2. Doors with Closers: Antifriction-bearing hinges.
 - 3. Interior Doors: Antifriction-bearing hinges.
- D. Hinge Base Metal: Unless otherwise indicated, provide the following:
 - 1. Exterior Hinges: Stainless steel, with stainless-steel pin.

- 2. Interior Hinges: Steel, with steel pin.
 - 3. Hinges for Fire-Rated Assemblies: Steel, with steel pin.
- E. Hinge Options: Where indicated in door hardware sets or on Drawings:
- 1. Nonremovable Pins: Provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for outswinging exterior doors and outswinging corridor doors with locks.
 - 2. Corners: Square.
- F. Fasteners: Comply with the following:
- 1. Machine Screws: For metal doors and frames. Install into drilled and tapped holes.
 - 2. Wood Screws: For wood doors and frames.
 - 3. Threaded-to-the-Head Wood Screws: For fire-rated wood doors.
 - 4. Screws: Phillips flat-head; machine screws (drilled and tapped holes) for metal doors and wood screws for wood doors and frames. Finish screw heads to match surface of hinges.

2.3 HINGES

- A. Butts and Hinges: BHMA A156.1.
- B. Template Hinge Dimensions: BHMA A156.7.
- C. Available Manufacturers:
 - 1. Hager Companies (HAG).
 - 2. McKinney Products Company; an ASSA ABLOY Group company (MCK).
 - 3. Stanley Commercial Hardware; Div. of The Stanley Works (STH).
- D. The following is a guide for hinge size and type required for this project.

	Manufacturer	Interior:	Exterior
1-3/4" Doors up to 3'-0" wide	Stanley	FBB179-4 1/2"	FBB191-4 1/2"
	Hager	BB1279-4 1/2"	BB1191-4 1/2"
	McKinney	TA-TB2714-4 1/2"	TA-TB2314-4 1/2"
1-3/4" Doors over 3'-0" wide	Stanley	FBB168-4 1/2"	FBB199-4 1/2"
	Hager	BB1168-4 1/2"	BB1199-4 1/2"
	McKinney	T4A-T4B3786-4 1/2"	T4A-T4B3386-4 1/2"

2.4 SPRING HINGES

- A. Self-Closing Hinges: BHMA A156.17.
- B. Spring Hinges: Provide Hager 1250 full mortised, spring hinge or approved substitute.

2.5 CONTINUOUS HINGES

- A. Continuous-Geared Hinges: Minimum 0.120-inch- thick, hinge leaves with minimum overall width of 4 inches; fabricated to full height of door and frame. Provide concealed, self-lubricating thrust bearings, 2.56 inches on center. Finish components after milling and drilling are complete. Fabricate hinges to template screw locations.
 - 1. Basis-of-Design Product: 780-111 HD by Roton or a comparable product of one of the following:
 - a. McKinney Products Company; an ASSA ABLOY Group company; MCK-14 HD.
 - b. Select Products Limited; SL-14 HD.

2.6 MECHANICAL LOCKS AND LATCHES, GENERAL

- A. Lock Throw: Comply with testing requirements for length of bolts required for labeled fire doors, and as follows:
 - 1. Bored Locks: Minimum 1/2-inch latchbolt throw.
- B. Lock Backset: 2-3/4 inches, unless otherwise indicated.
- C. Lock Trim:
 - 1. Levers: Cast.
 - 2. Escutcheons (Roses): Forged.
 - 3. Dummy Trim: Match lever lock trim and escutcheons.
 - 4. Operating Device: Lever with escutcheons (roses).
- D. Strikes: Provide manufacturer's standard strike for each lock bolt or latchbolt complying with requirements indicated for applicable lock or latch and with strike box and curved lip extended to protect frame; finished to match lock or latch.
 - 1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
 - 2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
 - 3. Aluminum-Frame Strike Box: Manufacturer's special strike box fabricated for aluminum framing.
 - 4. Rabbet Front and Strike: Provide on locksets for rabbeted meeting stiles.

2.7 BORED LOCKS AND LATCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Mechanical Locks and Latches:
 - a. Best Lock Corporation (BLC).
 - b. Corbin Russwin Architectural Hardware; Div. of Yale Security Inc. (CR).

- c. Sargent Manufacturing Company; an Assa Abloy Group company (SGT).
- d. Schlage Lock Company; an Ingersoll-Rand Company (SCH).

B. Bored Locks: BHMA Grade 1; Series 4000.

1. Provide one of the following manufacturers and designs:

- a. Best: 9K Series
- b. Corbin Russwin: CL3300 Series.
- c. Sargent: 10 Line
- d. Schlage: ND Series

C. Auxiliary Locks: BHMA Grade 1.

D. Lock Trim: Comply with the following:

1. Lockset Designs: Provide the lockset design designated below or, if sets are provided by another manufacturer, provide designs that match those designated:

- a. Best: 15 C
- b. Corbin Russwin: NZD
- c. Sargent: LL
- d. Schlage: Rhodes

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

FUNCTION	SARGENT	SCHLAGE	CORBIN/RUSWIN	BEST
(1) (utility)	04	80	57	D
(2) (office)	05	53	51	AB
(3) (passage)	15	10	10	N
(4) (classroom)	37	70	55	R
(5) (entrance)	16	60	72	C
(6) (privacy)	65	40	20	L

2.8 ELECTRIC STRIKES

A. Electric Strikes: BHMA A156.31; Grade 1; with faceplate to suit lock and frame.

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

- a. Adams Rite Manufacturing Co; an ASSA ABLOY Group company.
- b. DynaLock Corp.
- c. HES, Inc.; an ASSA ABLOY Group company.
- d. Locknetics; an Ingersoll-Rand Company (LSE).
- e. Precision Hardware, Inc. (PH).

2.9 EXIT DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Sargent Manufacturing Company; an Assa Abloy Group company (SGT).
 - 2. Von Duprin; an Ingersoll-Rand Company (VD).
- B. Products: All exit devices for this project shall be one of the following:
 - 1. The 80 and 90 Series exit device by Sargent & Co.
 - 2. 98 and 55 Series by Von Duprin Division
- C. Exit Devices: BHMA A156.3, Grade 1.
- D. Accessibility Requirements: Where handles, pulls, latches, locks, and other operating devices are indicated to comply with accessibility requirements, comply with the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)."
 - 1. Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf.
- E. Exit Devices for Means of Egress Doors: Comply with NFPA 101. Exit devices shall not require more than 15 lbf to release the latch. Locks shall not require use of a key, tool, or special knowledge for operation.
- F. Panic Exit Devices: Listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for panic protection, based on testing according to UL 305.
- G. Fire Exit Devices: Devices complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire and panic protection, based on testing according to UL 305 and NFPA 252.
- H. Outside Trim: Pull with cylinder; material and finish to match locksets, unless otherwise indicated.
- I. Through Bolts: For exit devices and trim on metal doors.
- J. Top and Bottom Strikes: Where vertical rod exit devices are indicated for interior doors, provide standard surface-mounted top strike and flush or recessed bottom strike.
- K. The following functions shall be required where specified:

FUNCTION	VON DUPRIN	SARGENT
A	CD55NL-OP	16-9404
B	CD98EO	16-8810
C	98L	8813ET
D	98L-BE	8815ET
E	98EO-F	12-8810

F	98L-F	12-8813ET
G	98L-F-BE	12-8815ET
H	CD9827EO	16-8710
I	9827L	8713ET
J	9827L-BE	8715ET
K	CD9827EO x LBR	16-PP/PR8710
L	9827L x LBR	PP/PR8713ET
M	9827L-BE x LBR	PP/PR8715ET
N	9827EO-F	12-8710
O	9827L-F	12-8713ET
P	9827L-F-BE	12-8715ET
Q	9827EO-F x LBR	12-PP/PR8710
R	9827L-F x LBR	12-PP/PR8713ET
S	9827-L-F-BE x LBR	12-PP/PR8715ET
T	EL9827-TL	56-8710-306
U	EL98NL-OP	56-8804
V	9827T1	8710-306

2.10 LOCK CYLINDERS

- A. Lock Cylinders: Tumbler type, constructed from brass or bronze, stainless steel, or nickel silver.
 - 1. Manufacturer: Same manufacturer as for locking devices.
- B. Standard Lock Cylinders: BHMA A156.5; Grade 1; permanent cores that are interchangeable; face finished to match lockset.
- C. Construction Master Keys: Provide cylinders with feature that permits voiding of construction keys without cylinder removal. Provide 10 construction master keys.

2.11 KEYING

- A. Keying System: Factory registered, complying with guidelines in BHMA A156.28, Appendix A. Incorporate decisions made in keying conference.
 - 1. Master Key System: Change keys and a master key operate cylinders.
 - 2. Keyed Alike: Key all cylinders to same change key.
- B. Keys: Nickel silver.
 - 1. Stamping: Permanently inscribe each key with a visual key control number and include the following notation:
 - a. Notation: Information to be furnished by Owner.
 - 2. Quantity: In addition to one extra key blank for each lock, provide the following:
 - a. Cylinder Change Keys: Three.
 - b. Master Keys: Five.

2.12 KEY CONTROL SYSTEM

- A. Key Control Cabinet: BHMA A156.5; metal cabinet with baked-enamel finish; containing key-holding hooks, labels, 2 sets of key tags with self-locking key holders, key-gathering envelopes, and temporary and permanent markers; with key capacity of 150 percent of the number of locks.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Key Boxes and Cabinets.
 - b. GE Security, Inc.
 - c. TelKee; Oasis International.
 2. Wall-Mounted Cabinet: Cabinet with hinged-panel door equipped with key-holding panels and pin-tumbler cylinder door lock.
- B. Cross-Index System: Single-index system for recording key information. Include three receipt forms for each key-holding hook. Set up by key control manufacturer.

2.13 OPERATING TRIM

- A. Operating Trim: BHMA A156.6; stainless steel, unless otherwise indicated.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Burns Manufacturing Incorporated.
 - b. Don-Jo Mfg., Inc.
 - c. Hager Companies.
 - d. IVES Hardware; an Ingersoll-Rand Company (IVS).
 - e. Rockwood Manufacturing Company; an ASSA ABLOY Group company.
 - f. Trimco.
 - B. Door Pulls, 1 inch diameter.
 1. Size: ADA compliant, unless indicated otherwise, provide 10 inches center to center, with 3 1/2 inch projection and 2 1/2 inch clearance.
 2. Available Products:
 - a. Hager Companies, H4J.
 - b. IVES Hardware; an Ingersoll-Rand Company; 8103EZ.

- C. Push Bars, 1 inch diameter.

2.14 ACCESSORIES FOR PAIRS OF DOORS

- A. Coordinators: BHMA A156.3; consisting of active-leaf, hold-open lever and inactive-leaf release trigger; fabricated from steel with nylon-coated strike plates; with built-in, adjustable safety release; and with internal override.

2.15 SURFACE CLOSERS

- A. Surface Closers: BHMA A156.4; rack-and-pinion hydraulic type with adjustable sweep and latch speeds controlled by key-operated valves and forged-steel main arm. Comply with manufacturer's written recommendations for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory-sized closers, adjustable to meet field conditions and requirements for opening force.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Surface-Mounted Closers:
 - a. LCN Closers; an Ingersoll-Rand Company (LCN).
 - b. SARGENT Manufacturing Company; an ASSA ABLOY Group company.
- C. Accessibility Requirements: Where handles, pulls, latches, locks, and other operating devices are indicated to comply with accessibility requirements, comply with the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)."
 - 1. Comply with the following maximum opening-force requirements:
 - a. Interior, Non-Fire-Rated Hinged Doors: 5 lbf applied perpendicular to door.
 - b. Fire Doors: Minimum opening force allowable by authorities having jurisdiction.
- D. Door Closers for Means of Egress Doors: Comply with NFPA 101. Door closers shall not require more than 30 lbf to set door in motion and not more than 15 lbf to open door to minimum required width.
- E. Size of Units: Unless otherwise indicated, comply with manufacturer's written recommendations for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory-sized closers, adjustable to meet field conditions and requirements for opening force.
 - 1. LCN:
 - a. Exterior: 4040 Series
 - b. Interior: 4040 Series
 - 2. Sargent:
 - a. Exterior: 281
 - b. Interior: 281

2.16 AUTOMATIC DOOR OPERATORS

- A. Exterior Doors: Provide Horton Model 4100 LE Access Operator. No substitutions.
- B. Interior Doors: Provide Horton Model 7100 Access Operator. No substitutions.

- C. Provide actuating push plates, inside and outside.
 - 1. Pushbutton: 1" diameter round, red pushbutton switch. Face plates shall be engraved with the international symbol for accessibility and "Press To Open". Jamb mounted.
- D. Combination Motion/Presence Sensors: Where indicated, provide self-contained units; consisting of both motion and presence sensors in a single metal or plastic housing; adjustable to provide detection field sizes and functions required by BHMA A156.10.
 - 1. Motion Sensor: K-band-frequency, microwave-scanner units; with relay hold time of not less than 2 to 10 seconds.
 - a. Provide capability for switching between bidirectional and unidirectional detection.
- E. Coordinate requirements with electrical contractor.

2.17 MECHANICAL STOPS AND HOLDERS

- A. Stops and Bumpers: BHMA A156.16, Grade 1.
 - 1. Provide wall stops for doors unless floor or other type stops are scheduled or indicated. Do not mount floor stops where they will impede traffic. Where floor or wall stops are not appropriate, provide overhead holders.
 - 2. Provide matching finishes for hardware units at each door or opening, to the greatest extent possible, and except as otherwise indicated. Reduce differences in color and textures as much as commercially possible where the base metal or metal forming process is different for individual units of hardware exposed at the same door or opening. In general, match items to the manufacturer's standard finish for the latch and lock set (or push-pull units if no latch-lock sets) for color and texture.
- B. Wall Stops: Wall type bumpers with concealed type flange shall be used where ever possible.
 - 1. Available Products:
 - a. Ives - 407 1/2
 - b. Door Controls - 3211T
 - c. Rockwood - 409
- C. Floor Stops: Where wall type bumpers cannot be used, provide dome type, floor mounted stops of the proper height as follows:
 - 1. Available Products:
 - a. Ives - 436, 438
 - b. Door Controls - 3310X, 3320X
 - c. Rockwood - 440, 442

- D. Exterior doors striking masonry and doors specified to have door stops and holders, shall have cast bronze wall or floor type door stops with hook or staple type holders to selectively hold doors in open position. The following will be acceptable:
 - 1. Available Products:
 - a. Ives - 445, 446
 - b. Door Controls - 3237X, 3347X
 - c. Rockwood - 473, 477
- E. Silencers for Wood Door Frames: BHMA A156.16, Grade 1; neoprene or rubber, minimum 5/8 by 3/4 inch; fabricated for drilled-in application to frame.
- F. Silencers for Metal Door Frames: BHMA A156.16, Grade 1; neoprene or rubber, minimum diameter 1/2 inch; fabricated for drilled-in application to frame.

2.18 DOOR GASKETING

- A. Door Gasketing: BHMA A156.22; air leakage not to exceed 0.50 cfm per foot of crack length for gasketing other than for smoke control, as tested according to ASTM E 283; with resilient or flexible seal strips that are easily replaceable and readily available from stocks maintained by manufacturer.
- B. Weatherstripping:
 - 1. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame. Basis-of-Design Product, No. A626A by National Guard Products or approved substitute.
 - 2. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed. Basis-of-Design Product, No. 600A by National Guard Products or approved substitute.
 - 3. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed. Basis-of-Design Product, No. 95WH by National Guard Products or approved substitute.
- C. Smoke-Labeled Gasketing: Assemblies complying with NFPA 105 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for smoke-control ratings indicated, based on testing according to UL 1784.
 - 1. Provide smoke-labeled gasketing on fire-rated doors and on smoke-labeled doors. Basis-of-Design Product, No. 5050 by National Guard Products or approved substitute.
- D. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.

2.19 THRESHOLDS

- A. Thresholds: BHMA A156.21; fabricated to full width of opening indicated.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. National Guard Products, Inc.
 - b. Pemko Manufacturing Co.
 - c. Reese Enterprises, Inc.
 - d. Zero International, Inc.
- B. Basis-of-Design Product: Provide No. 896 with door bottom sweep No. 95WH by National Guard Products or approved substitute.

2.20 METAL PROTECTIVE TRIM UNITS

- A. Metal Protective Trim Units: BHMA A156.6; fabricated from 0.050-inch-thick stainless steel; with manufacturer's standard machine or self-tapping screw fasteners.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Burns Manufacturing Incorporated.
 - b. Don-Jo Mfg., Inc.
 - c. Hager Companies (HAG).
 - d. IVES Hardware; an Ingersoll-Rand Company (IVS).
 - e. Rockwood Manufacturing Company; an ASSA ABLOY Group company.
 - B. Size: 1-1/2 inches less than door width on push side and 1/2 inch less than door width on pull side, by height specified in door hardware sets.
 - C. Fasteners: Manufacturer's standard machine or self-tapping screws.
 - D. Fabricate protection plates as follows:
 1. Push Plates: 16" high by 8" wide.
 2. Kick Plates: 10" high by 1-1/2" less than door width for single doors and 1" less than door width for pairs of doors. Kick plates shall be applied to push side of all doors where noted.

2.21 FABRICATION

- A. Manufacturer's Nameplate: Do not provide products that have manufacturer's name or trade name displayed in a visible location except in conjunction with required fire-rated labels and as otherwise approved by Architect.
1. Manufacturer's identification is permitted on rim of lock cylinders only.
- B. Base Metals: Produce door hardware units of base metal indicated, fabricated by forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness. Furnish metals of a quality equal to or greater than that of specified door hardware units and BHMA A156.18.
- C. Fasteners: Provide door hardware manufactured to comply with published templates prepared for machine, wood, and sheet metal screws. Provide screws that comply with commercially

recognized industry standards for application intended, except aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished heads to match surface of door hardware, unless otherwise indicated.

1. Concealed Fasteners: For door hardware units that are exposed when door is closed, except for units already specified with concealed fasteners. Do not use through bolts for installation where bolt head or nut on opposite face is exposed unless it is the only means of securely attaching the door hardware. Where through bolts are used on hollow door and frame construction, provide sleeves for each through bolt.
2. Fire-Rated Applications:
 - a. Wood or Machine Screws: For the following:
 - 1) Hinges mortised to doors or frames; use threaded-to-the-head wood screws for wood doors and frames.
 - 2) Strike plates to frames.
 - 3) Closers to doors and frames.
 - b. Steel Through Bolts: For the following unless door blocking is provided:
 - 1) Surface hinges to doors.
 - 2) Closers to doors and frames.
 - 3) Surface-mounted exit devices.
3. Spacers or Sex Bolts: For through bolting of hollow-metal doors.
4. Fasteners for Wood Doors: Comply with requirements in DHI WDHS.2, "Recommended Fasteners for Wood Doors."
5. Gasketing Fasteners: Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.

2.22 FINISHES

- A. Provide finishes complying with BHMA A156.18 as indicated in door hardware schedule.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- D. Provide the following finishes:

1. Butts and Hinges:	26D
2. Continuous Gear Hinges	28
3. Locks & Lock Trim:	26D
4. Exit Devices:	32D
5. Door Controls - Closers:	Sprayed Alum. Finish

6.	Door Stops	26D/32D
7.	Weatherstripping	Aluminum
8.	Threshold	Aluminum
9.	Kickplates	32D
10.	Pulls	32D

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance.
- B. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Steel Doors and Frames: For surface applied door hardware, drill and tap doors and frames according to ANSI/SDI A250.6.
- B. Wood Doors: Comply with DHI WDHS.5 "Recommended Hardware Reinforcement Locations for Mineral Core Wood Flush Doors."

3.3 INSTALLATION

- A. Mounting Heights: Mount door hardware units at heights indicated on Drawings or to comply with the following unless otherwise indicated or required to comply with governing regulations.
 - 1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
 - 2. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."
- B. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing. Do not install surface-mounted items until finishes have been completed on substrates involved.
 - 1. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
 - 2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.

- C. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than the number recommended by manufacturer for application indicated or one hinge for every 30 inches of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.
- D. Lock Cylinders: Install construction cores to secure building and areas during construction period.
 - 1. Replace construction cores with permanent cores as indicated in keying schedule.
- E. Key Control System: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.
- F. Boxed Power Supplies: Locate power supplies as indicated or, if not indicated, above accessible ceilings. Verify location with Architect.
 - 1. Configuration: Provide least number of power supplies required to adequately serve doors with electrified door hardware.
- G. Thresholds: Set thresholds for exterior doors and other doors indicated in full bed of sealant complying with requirements specified in Section 079200 "Joint Sealants."
- H. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they will impede traffic.
- I. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.
- J. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.
- K. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.

3.4 ADJUSTING

- A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.
 - 1. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.
- B. Occupancy Adjustment: Approximately three months after date of Substantial Completion, Installer's Architectural Hardware Consultant shall examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors, door hardware, and electrified door hardware.

3.5 CLEANING AND PROTECTION

- A. Clean adjacent surfaces soiled by door hardware installation.

- B. Clean operating items as necessary to restore proper function and finish.
- C. Provide final protection and maintain conditions that ensure that door hardware is without damage or deterioration at time of Substantial Completion.

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain door hardware and door hardware finishes. Refer to Section 017900 "Demonstration and Training."

3.7 DOOR HARDWARE SCHEDULE

- A. The hardware sets listed below indicate the items of hardware required for each opening. It is the bidder's responsibility to accurately furnish the proper quantities, items, sizes, weights and functions as required by the plans and specifications. If an opening has, through error, been omitted from the following hardware sets, it shall be the bidder's responsibility to supply hardware of equivalent quality and quantity, as that which is specified for a comparable opening.

SINGLE ALUMINUM ENTRANCE DOOR

HW1

Doors 108A, 109A

Exit Device (function A) (outside pull)

Pull

Closer with drop plate

Floor Stop

Balance of hardware by aluminum door supplier.

SINGLE ALUMINUM ENTRANCE DOOR w/ CARD ACCESS

HW2

Doors 101A, 101B, 105, 110A, 116

Exit Device (function A) (outside pull)

Electric strike

Power supply box

Auto door operator (drs 101A, 101B)

Pull

Closer with drop plate

Floor Stop

Balance of hardware by aluminum door supplier.

Description of Operation: Door to be unlocked with use of proximity card reader by others. Doors will open with activation of auto door operators.

ALUMINUM VESTIBULE DOORS

HW3

Doors 110B

Push/Pulls
Closer with drop plate
Floor Stop

Balance of hardware by aluminum door supplier.

SINGLE OUTSIDE DOOR

HW4

Doors 02A, 03A

Continuous gear hinge
Exit Device (function B)
Closer
Weatherstripping
Door Bottom Sweep
Kickplate
Threshold

JANITOR, ELECTRICAL, MECHANICAL, EMR

HW5

Doors 123, 124, 127, 128, 129, 220

Hinges
Closer
Lockset (utility function 1)
Kick plate
Wall stop
Smoke gasketing

PRIVATE TOILET - NON-RATED

HW6

Doors 114A, 119, 120, 121, 122, 205, 225

Hinges
Lockset (privacy function 6)

Closer
Wall Stop
Silencers

TOILET VESTIBULE (no locks)

HW7

Doors 112, 113, 203, 223

Hinges
Push Plate
Pull
Closer
Kick Plate
Wall Stop
Silencers

TOILET STALL DOORS

HW8

Doors 112A, 112B, 113A, 203A, 203B, 223A, 223B

1-Hinge
1-Spring hinge
Lockset (privacy function 6)
Wall Stop
Silencers

SINGLE FIRE RATED CORRIDOR OR ASSEMBLY EXIT

HW9

Doors 02B, 03B

Hinges
Closer
Exit Device (function F)
Kickplate
Wall Stop
Smoke gasketing

OFFICE OR STORAGE (no smoke seals)

HW10

Doors 107, 114B, 115, 118

Hinges

Lockset (classroom function 4)
Door Stop
Silencers

OFFICE OR STORAGE w/ CARD ACCESS

HW11

Doors 117A

Hinges
Lockset (classroom function 4)
Electric strike
Power supply box
Door Stop
Silencers

OFFICE OR STORAGE (rated)

HW12

Doors 117B

Hinges
Closer
Lockset (classroom function 4)
Door Stop
Smoke gasketing

SWINGING ALUMINUM DOORS

HW13

Doors 102, 109B, 201, 202, 206, 207, 221, 222, 226, 227

Cylinders
Closer for door 111
Door stops

SWINGING ALUMINUM DOORS w/ CARD ACCESS

HW14

Doors 111, 208, 210

Cylinders

Closer with drop plate
Electric strike
Power supply box
Door stops

END OF SECTION 087100

SECTION 088000 - GLAZING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes:
 - 1. Glass for doors, interior borrowed lites and storefront framing.
 - 2. Glazing sealants and accessories.

1.3 DEFINITIONS

- A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.
- B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C 1036.
- C. IBC: International Building Code.
- D. Interspace: Space between lites of an insulating-glass unit.

1.4 COORDINATION

- A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Glass Samples: For each type of the following products; 12 inches square.
 - 1. Insulating glass.
- C. Glazing Accessory Samples: For colored spacers, in 12-inch lengths.
- D. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

- E. Delegated-Design Submittal: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.6 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For glass.
- B. Product Test Reports: For insulating glass, for tests performed by a qualified testing agency.
- C. Sample Warranties: For special warranties.

1.7 QUALITY ASSURANCE

- A. Manufacturer Qualifications for Insulating-Glass Units with Sputter-Coated, Low-E Coatings: A qualified insulating-glass manufacturer who is approved and certified by coated-glass manufacturer.
- B. Glass Testing Agency Qualifications: A qualified independent testing agency accredited according to the NFRC CAP 1 Certification Agency Program.
- C. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Protect glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.
- B. Comply with insulating-glass manufacturer's written instructions for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

1.9 FIELD CONDITIONS

- A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.
 - 1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or are below 40 deg F.

1.10 WARRANTY

- A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or

to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.

1. Warranty Period: 10 years from date of Substantial Completion.
- B. Manufacturer's Special Warranty for Laminated Glass: Manufacturer agrees to replace laminated-glass units that deteriorate within specified warranty period. Deterioration of laminated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.
1. Warranty Period: Five years from date of Substantial Completion.
- C. Manufacturer's Special Warranty for Insulating Glass: Manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.
1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.
- B. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design glazing.
- C. Structural Performance: Glazing shall withstand the following design loads within limits and under conditions indicated determined according to the IBC and ASTM E 1300.
1. Design Wind Pressures: As indicated on Drawings.
 2. Design Wind Pressures: Determine design wind pressures applicable to Project according to ASCE/SEI 7, based on heights above grade indicated on Drawings.
 - a. Wind Design Data: As indicated on Structural Drawings.
 - b. Basic Wind Speed: 100 mph.
 - c. Importance Factor: 1.0.
 - d. Exposure Category: B.

3. Maximum Lateral Deflection: For glass supported on all four edges, limit center-of-glass deflection at design wind pressure to not more than 1/50 times the short-side length or 1 inch, whichever is less.
 4. Differential Shading: Design glass to resist thermal stresses induced by differential shading within individual glass lites.
- D. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.
- E. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:
1. For monolithic-glass lites, properties are based on units with lites 6 mm thick.
 2. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.
 3. U-Factors: Center-of-glazing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed as Btu/sq. ft. x h x deg F.
 4. Solar Heat-Gain Coefficient and Visible Transmittance: Center-of-glazing values, according to NFRC 200 and based on LBL's WINDOW 5.2 computer program.
 5. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

2.2 GLASS PRODUCTS, GENERAL

- A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.
1. GANA Publications: "Glazing Manual."
 2. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."
- B. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction or manufacturer. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
- C. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IgCC.
- D. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass that complies with performance requirements and is not less than the thickness indicated.
1. Minimum Glass Thickness for Exterior Lites: 6 mm.
 2. Thickness of Tinted Glass: Provide same thickness for each tint color indicated throughout Project.
- E. Strength: Where annealed float glass is indicated, provide annealed float glass, heat-strengthened float glass, or fully tempered float glass. Where heat-strengthened float glass is

indicated, provide heat-strengthened float glass or fully tempered float glass. Where fully tempered float glass is indicated, provide fully tempered float glass.

2.3 GLASS PRODUCTS

- A. Clear Annealed Float Glass: ASTM C 1036, Type I, Class 1 (clear), Quality-Q3.
- B. Fully Tempered Float Glass: ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.
 - 1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.
- C. Heat-Strengthened Float Glass: ASTM C 1048, Kind HS (heat strengthened), Type I, Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.
 - 1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.

2.4 LAMINATED GLASS

- A. Laminated Glass: ASTM C 1172. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.
 - 1. Construction: Laminate glass with polyvinyl butyral interlayer to comply with interlayer manufacturer's written instructions.
 - 2. Interlayer Thickness: Provide thickness not less than that indicated and as needed to comply with requirements.
 - 3. Interlayer Color: Medium frost pattern, unless otherwise indicated.

2.5 INSULATING GLASS

- A. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E 2190.
 - 1. Sealing System: Dual seal, with silicone primary seal and butyl secondary seal.
 - 2. Spacer: Aluminum with mill or clear anodic finish.
 - 3. Desiccant: Molecular sieve or silica gel, or a blend of both.

2.6 FIRE-PROTECTION-RATED GLAZING

- A. Fire-Protection-Rated Glazing, General: Listed and labeled by a testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 252 for door assemblies and NFPA 257 for window assemblies.

- B. Laminated Ceramic Glazing (Type 1): Laminated glass made from 2 plies of clear, ceramic flat glass; 5/16-inch total nominal thickness; complying with testing requirements in 16 CFR 1201 for Category II materials.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Nippon Electric Glass Co., Ltd. (distributed by Technical Glass Products); FireLite Plus.
 - b. Schott North America, Inc.; Laminated Pyran Platinum L.
 - c. Vetrotech Saint-Gobain; SGG Keralite FR-L.
- C. Laminated Glass with Intumescent Interlayers (Type 2): Laminated glass made from multiple plies of uncoated, clear float glass; with intumescent interlayers; complying with testing requirements in 16 CFR 1201 for Category II materials.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. InterEdge, Inc., a subsidiary of AFG Industries, Inc.; Pyrobel.
 - b. Pilkington Group Limited (distributed by Technical Glass Products); PyroStop.
 - c. Vetrotech Saint-Gobain; SGG Contraflam N2.

2.7 GLAZING SEALANTS

- A. General:
1. Compatibility: Compatible with one another and with other materials they 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.
 3. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range.
- B. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 100/50, Use NT.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Dow Corning Corporation; 790.
 - b. GE Advanced Materials - Silicones; SilPruf LM SCS2700.
 - c. May National Associates, Inc.; Bondaflex Sil 290.
 - d. Pecora Corporation; 890.
 - e. Sika Corporation, Construction Products Division; SikaSil-C990.
 - f. Tremco Incorporated; Spectrem 1.
- C. Glazing Sealants for Fire-Rated Glazing Products: Products that are approved by testing agencies that listed and labeled fire-resistant glazing products with which they are used for applications and fire-protection ratings indicated.

2.8 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 804.3 tape, where indicated.
 - 2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
 - 3. AAMA 807.3 tape, for glazing applications in which tape is not 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 applications in which tape is used in combination with a full bead of liquid sealant.

2.9 MISCELLANEOUS GLAZING MATERIALS

- A. General: Provide products of material, size, and shape complying with referenced glazing standard, with requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.
- B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
- C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
- D. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
- E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).
- F. 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.
- G. 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.

2.10 FABRICATION OF GLAZING UNITS

- A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.
 - 1. Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.
 - a. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.
- B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites to produce square edges with slight chamfers at junctions of edges and faces.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:
 - 1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
 - 2. Presence and functioning of weep systems.
 - 3. Minimum required face and edge clearances.
 - 4. Effective sealing between joints of glass-framing members.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.
- B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that leave visible marks in the completed Work.

3.3 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. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass includes glass with edge

damage or other imperfections that, when installed, could weaken glass, impair performance, or impair appearance.

- C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
- D. 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.
- E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- F. Provide spacers for glass lites where length plus width is larger than 50 inches.
 - 1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
 - 2. Provide 1/8-inch minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.
- G. 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.
- H. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.
- I. Set glass lites with proper orientation so that coatings face exterior or interior as specified.
- J. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.
- K. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

3.4 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, then to jambs. Cover horizontal framing joints by applying tapes to jambs, 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. Do not remove release paper from tape until right before each glazing unit is installed.
- F. Apply heel bead of elastomeric sealant.
- G. 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.
- H. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.5 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.

3.6 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.

3.7 STRUCTURAL SILICONE JOINTS

- A. Inspect insulating units, verifying proper placement and support of setting blocks. Clean edge of insulating unit to assure full adhesion of sealant.
- B. Verify silicone has been checked for compatibility with the seals of insulating glass units and glazing channel substrates and gaskets.
- C. Stabilize glass, fully retained to prevent movement during curing of the joint sealant.
- D. Install backer rod to permit proper depth of joint sealant.
- E. Schedule sealant operations during periods of minimal wind to prevent pick up of airborne dust. Gun silicone into joint under pressure without displacing backer rod, fully wetting surfaces for full adhesion, providing weather tight seal. Gun or tool silicone, providing smooth uniform joint without excess material on glass. Remove smears from glass, using methods that do not damage glass or sealant.

3.8 CLEANING AND PROTECTION

- A. Immediately after installation remove nonpermanent labels and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains.
 - 1. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer. Remove and replace glass that cannot be cleaned without damage to coatings.
- C. Remove and replace glass that is damaged during construction period.
- D. Wash glass on both exposed surfaces not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

3.9 MONOLITHIC GLASS SCHEDULE

- A. Tempered Glass: Clear fully tempered float glass.
 - 1. Minimum Thickness: 6 mm.
 - 2. Safety glazing required.
 - 3. Application: All interior glass, unless noted otherwise.

3.10 LAMINATED GLASS SCHEDULE

- A. Laminated Glass (Frosted Glass): Clear laminated glass with two plies of annealed float glass.

1. Minimum Thickness of Each Glass Ply: 3 mm.
2. Interlayer Thickness: 0.030 inch.
3. Interlayer Pattern: Medium frost.
4. Safety glazing required.

3.11 INSULATING GLASS SCHEDULE

A. Insulating Glass: Clear insulating glass.

1. Overall Unit Thickness: 5/8 inch.
2. Thickness of Each Glass Lite: 6.0 mm.
3. Outdoor Lite: Float glass.
4. Interspace Content: Air.
5. Indoor Lite: Float glass.
6. Provide tempered glass and safety glazing labeling where required by code.
7. Application: Exterior hollow metal doors and frames.

B. Low E Insulated Glass: Low-e-coated, clear insulating glass.

1. Basis-of-Design Product: Solarban 60.
2. Overall Unit Thickness: 1 inch.
3. Thickness of Each Glass Lite: 6.0 mm.
4. Outdoor Lite: Tempered glass.
5. Interspace Content: Air.
6. Indoor Lite: Tempered glass.
7. Winter Nighttime U-Factor: 0.29 maximum.
8. Solar Heat Gain Coefficient: 0.39 minimum.
9. Visible Light Transmission: 70%.
10. Provide tempered glass and safety glazing labeling where required by code.
11. Application: Exterior aluminum storefronts and entrances.

3.12 FIRE-PROTECTION-RATED GLAZING TYPES

A. Fire Rated Glass, Type 1: 45-minute fire-rated glazing; laminated ceramic glazing.

1. Provide safety glazing labeling.

B. Fire Rated Glass, Type 2: 60-minute and 90-minute fire-rated glazing; laminated glass with intumescent interlayers.

1. Provide safety glazing labeling.

END OF SECTION 088000

SECTION 092116 - GYPSUM BOARD SHAFT WALL ASSEMBLIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Gypsum board shaft wall assemblies.

1.3 ACTION SUBMITTALS

- A. Product Data: For each component of gypsum board shaft wall assembly.

1.4 INFORMATIONAL SUBMITTALS

- A. Evaluation Reports: For shaft wall assemblies and firestop tracks, from ICC-ES.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

1.6 FIELD CONDITIONS

- A. Environmental Limitations: Comply with ASTM C 840 requirements or with gypsum board manufacturer's written recommendations, whichever are more stringent.
- B. Do not install interior products until installation areas are enclosed and conditioned.
- C. Do not install panels that are wet, moisture damaged, or mold damaged.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, and irregular shape.
 - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or blotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.
- B. STC-Rated Assemblies: Provide materials and construction identical to those of assemblies tested according to ASTM E 90 and classified according to ASTM E 413 by a testing and inspecting agency.

2.2 GYPSUM BOARD SHAFT WALL ASSEMBLIES

- A. Fire-Resistance Rating: As indicated.
- B. STC Rating: As indicated.
- C. Studs: Manufacturer's standard profile for repetitive members, corner and end members, and fire-resistance-rated assembly indicated.
 - 1. Depth: As indicated.
 - 2. Minimum Base-Metal Thickness: 0.033 inch.
- D. Runner Tracks: Manufacturer's standard J-profile track with manufacturer's standard long-leg length, but at least 2 inches long and matching studs in depth.
 - 1. Minimum Base-Metal Thickness: Matching steel studs.
- E. Firestop Tracks: Provide firestop track at head of shaft wall on each floor level.
- F. Elevator Hoistway Entrances: Manufacturer's standard J-profile jamb strut with long-leg length of 3 inches, matching studs in depth, and not less than 0.033 inch thick.
- G. Room-Side Finish: As indicated.
- H. Shaft-Side Finish: As indicated.
- I. Insulation: Sound attenuation blankets.

2.3 PANEL PRODUCTS

- A. Panel Size: Provide in maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.
- B. Gypsum Shaftliner Board, Type X: ASTM C 1396/C 1396M; manufacturer's proprietary fire-resistive liner panels with paper faces.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CertainTeed Corporation.
 - b. Georgia-Pacific Building Products.
 - c. National Gypsum Company.
 - d. Temple-Inland Building Products by Georgia-Pacific.
 - e. United States Gypsum Company.
2. Thickness: 1 inch.
3. Long Edges: Double bevel.

C. Gypsum Board: As specified in Section 092900 "Gypsum Board."

2.4 NON-LOAD-BEARING STEEL FRAMING

- A. Steel Framing Members: Comply with ASTM C 645 requirements for metal unless otherwise indicated.
 1. Protective Coating: ASTM A 653/A 653M, G40, hot-dip galvanized unless otherwise indicated.
- B. Firestop Tracks: Top runner manufactured to allow partition heads to expand and contract with movement of the structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Fire Trak Corp.
 - b. Metal-Lite.
 - c. Steel Network, Inc. (The).

2.5 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with manufacturer's written recommendations.
- B. Trim Accessories: Cornerbead, edge trim, and control joints of material and shapes as specified in Section 092900 "Gypsum Board" that comply with gypsum board shaft wall assembly manufacturer's written recommendations for application indicated.
- C. Steel Drill Screws: ASTM C 1002 unless otherwise indicated.
- D. Track Fasteners: Power-driven fasteners of size and material required to withstand loading conditions imposed on shaft wall assemblies without exceeding allowable design stress of track, fasteners, or structural substrates in which anchors are embedded.

1. Expansion Anchors: Fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 5 times design load, as determined by testing according to ASTM E 488 conducted by a qualified testing agency.
 2. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 10 times design load, as determined by testing according to ASTM E 1190 conducted by a qualified testing agency.
- E. Sound Attenuation Blankets: As specified in Section 092900 "Gypsum Board."
- F. Acoustical Sealant: As specified in Section 092900 "Gypsum Board."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates to which gypsum board shaft wall assemblies attach or abut, with Installer present, including hollow-metal frames, elevator hoistway door frames, cast-in anchors, and structural framing. Examine for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, or mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Sprayed Fire-Resistive Materials: Coordinate with gypsum board shaft wall assemblies so both elements of Work remain complete and undamaged. Patch or replace sprayed fire-resistive materials removed or damaged during installation of shaft wall assemblies to comply with requirements specified in Section 078100 "Applied Fireproofing."
- B. After sprayed fire-resistive materials are applied, remove only to extent necessary for installation of gypsum board shaft wall assemblies and without reducing the fire-resistive material thickness below that which is required to obtain fire-resistance rating indicated. Protect remaining fire-resistive materials from damage.

3.3 INSTALLATION

- A. General: Install gypsum board shaft wall assemblies to comply with requirements of fire-resistance-rated assemblies indicated, manufacturer's written installation instructions, and ASTM C 754 other than stud-spacing requirements.
- B. Do not bridge building expansion joints with shaft wall assemblies; frame both sides of expansion joints with furring and other support.

- C. Install supplementary framing in gypsum board shaft wall assemblies around openings and as required for blocking, bracing, and support of gravity and pullout loads of fixtures, equipment, services, heavy trim, furnishings, wall-mounted door stops, and similar items that cannot be supported directly by shaft wall assembly framing.
 - 1. Elevator Hoistway: At elevator hoistway-entrance door frames, provide jamb struts on each side of door frame.
- D. Penetrations: At penetrations in shaft wall, maintain fire-resistance rating of shaft wall assembly by installing supplementary steel framing around perimeter of penetration and fire protection behind boxes containing wiring devices, elevator call buttons, elevator floor indicators, and similar items.
- E. Isolate perimeter of gypsum panels from building structure to prevent cracking of panels, while maintaining continuity of fire-rated construction.
- F. Firestop Tracks: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.
- G. Sound-Rated Shaft Wall Assemblies: Seal gypsum board shaft walls with acoustical sealant at perimeter of each assembly where it abuts other work and at joints and penetrations within each assembly.
- H. Cant Panels: At projections into shaft exceeding 4 inches, install 1/2- or 5/8-inch-thick gypsum board cants covering tops of projections.
 - 1. Slope cant panels at least 75 degrees from horizontal. Set base edge of panels in adhesive and secure top edges to shaft walls at 24 inches o.c. with screws fastened to shaft wall framing.
 - 2. Where steel framing is required to support gypsum board cants, install framing at 24 inches o.c. and extend studs from the projection to shaft wall framing.
- I. 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.

3.4 PROTECTION

- A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- B. Remove and replace panels that are wet, moisture damaged, or mold damaged.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, and irregular shape.
 - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 092116.23

SECTION 092900 - GYPSUM BOARD

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Interior gypsum board.
 - 2. Tile backing panels.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Drawings: Submit drawings indicating locations of control joints.
- C. Samples for Verification: For the following products:
 - 1. Trim Accessories: Full-size Sample in 12-inch-long length for each trim accessory indicated.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

1.5 FIELD CONDITIONS

- A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written instructions, whichever are more stringent.
- B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.
- C. Do not install panels that are wet, moisture damaged, and mold damaged.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.

2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

2.2 GYPSUM BOARD, GENERAL

- A. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.3 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. Lafarge North America Inc.
 5. National Gypsum Company.
 6. PABCO Gypsum.
 7. Temple-Inland.
 8. USG Corporation.
- B. Gypsum Board, Type X: ASTM C 1396/C 1396M.
 1. Thickness: 5/8 inch.
 2. Long Edges: Tapered.

2.4 SPECIALTY GYPSUM BOARD

- A. Glass-Mat Interior Gypsum Board: ASTM C 1658/C 1658M. With fiberglass mat laminated to both sides. Specifically designed for interior use.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Georgia-Pacific Building Products; DensArmor Plus Fireguard.
 - b. National Gypsum Company; Gold Bond® Brand eXP Fire-Shield Interior Extreme Gypsum Panel.
2. Core: 5/8 inch, Type X.
 3. Long Edges: Tapered.
 4. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.
- B. Acoustically Enhanced Gypsum Board: ASTM C 1396/C 1396M. Multilayer products constructed of two layers of gypsum boards sandwiching a viscoelastic sound-absorbing polymer core.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. National Gypsum Company; Sound Break.
 - b. Quiet Solution, Quiet Rock EZ Snap.
 2. Core: 5/8 inch, Type X.
 3. Long Edges: Tapered.

2.5 TILE BACKING PANELS

- A. Glass-Mat, Water-Resistant Backing Board: ASTM C 1178/C 1178M, with manufacturer's standard edges.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CertainTeed Corporation: Diamondback® GlasRoc Tile Backer.
 - b. Georgia-Pacific Building Products; DensShield Tile Backer.
 - c. National Gypsum Company.
 2. Core: 5/8 inch, Type X.
 3. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

2.6 TRIM ACCESSORIES

- A. Interior Trim: ASTM C 1047.
1. Material:
 - a. Galvanized or aluminum-coated steel sheet or rolled zinc.
 - b. Trim-Tex, Super Seal Tear Away™ L Bead where abutting exterior metal doors and windows.
 2. Shapes:
 - a. Cornerbead.

- b. Bullnose bead.
 - c. LC-Bead: J-shaped; exposed long flange receives joint compound.
 - d. Expansion (control) joint.
- B. Partition Closure: Adjustable partition closure, spring loaded, extruded aluminum channels with filler strips. Provide Mullion Mate I (2" to 4-1/2") or Mullion Mate II (4-1/2" to 6-1/2") by Gordon, Inc.

2.7 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C 475/C 475M.
- B. Joint Tape:
- 1. Interior Gypsum Board: Paper.
 - 2. Tile Backing Panels: As recommended by panel manufacturer.
- 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.
- 1. Prefilling: At open joints and damaged surface areas, use setting-type taping compound.
 - 2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping or drying-type, all-purpose compound.
 - a. Use setting-type taping with mold-resistant gypsum wallboard.
 - b. Use setting-type compound for installing paper-faced metal trim accessories.
 - 3. Fill Coat: For second coat, use setting-type, sandable topping or drying-type, all-purpose compound.
 - 4. Finish Coat: For third coat, use drying-type, all-purpose compound.
 - 5. Skim Coat: Not required.
- D. Joint Compound for Tile Backing Panels:
- 1. Glass-Mat, Water-Resistant Backing Panel: As recommended by backing panel manufacturer.

2.8 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.
- B. Steel Drill Screws: ASTM C 1002 unless otherwise indicated.
- 1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch thick.

- C. Sound-Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
 - 1. Fire-Resistance-Rated Assemblies: Available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Roxul Inc.; Roxul AFB.
 - b. USG Corporation; ThermaFiber SAFB.
 - 2. Insulation Support Anchors: Continuous, galvanized metal support strip, 0.032 inch (20 gage) thickness by 1 inch wide, with approximately 2 1/2 inch long pre-punched arrow shaped tabs at 8 inches on center.
 - a. Product: Insul-Hold; Insul-Hold Co., Inc., a division of J/R Metal Frames Manufacturing, Inc.
- D. Acoustical 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, provide products by one of the following:
 - a. Pecora Corporation; AC-20 FTR or AIS-919.
 - b. USG Corporation; SHEETROCK Acoustical Sealant.
- E. Thermal Insulation: As specified in Section 072100 "Thermal Insulation."
- F. Fire-Resistive Joint Systems: As specified in Division 07 Section "Fire-Resistive Joint Systems."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and substrates including welded hollow-metal frames and support framing, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLYING AND FINISHING PANELS, GENERAL

- A. Comply with ASTM C 840.

- B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
- C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.
- D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
- E. Form control and expansion joints with space between edges of adjoining gypsum panels.
- F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
 - 1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. in area.
 - 2. Fit gypsum panels around ducts, pipes, and conduits.
 - 3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch-wide joints to install sealant.
- G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments. Provide 1/4- to 1/2-inch-wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- H. Wood Framing: Install gypsum panels over wood framing, with floating internal corner construction. Do not attach gypsum panels across the flat grain of wide-dimension lumber, including floor joists and headers. Float gypsum panels over these members or provide control joints to counteract wood shrinkage.
- I. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written instructions for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.
- J. Fire-Resistance-Rated Gypsum Board Assemblies: Provide fire-resistive joint system at the top of fire-resistance-rated gypsum board assemblies. Provide firestop system around any structural penetration of wall assembly.
- K. Smoke-Rated Gypsum Board Assemblies: Provide a tight, taped joint at the top of smoke-rated assemblies and around any penetrations to assemblies at both side of the assembly. The use of acoustical sealant will be acceptable to fill gaps up to 3/8 inch wide.
- L. Install sound attenuation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.

3.3 APPLYING INTERIOR GYPSUM BOARD

- A. Install interior gypsum board in the following locations:
1. Type X: Vertical and horizontal surfaces unless otherwise indicated.
 2. Mold-Resistant Type: As indicated on Drawings.
 3. Acoustically Enhanced Type: As indicated on Drawings.
- B. Single-Layer Application:
1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing unless otherwise indicated.
 2. On partitions/walls, apply gypsum panels vertically (parallel to metal framing) and horizontally (perpendicular to wood framing) unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
 - a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
 - b. At stairwells and other high walls, install panels horizontally unless otherwise indicated or required by fire-resistance-rated assembly.
 3. Fastening Methods: Apply gypsum panels to supports with steel drill screws.
- C. Multilayer Application:
1. On ceilings, apply gypsum board indicated for base layers before applying face layers on walls/partitions; apply face layers in same sequence. Apply base layers at right angles to framing members and offset face-layer joints one framing member, 16 inches minimum, from parallel base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly.
 2. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
 3. Fastening Methods: Fasten base layers and face layers separately to supports with screws.

3.4 APPLYING EXTERIOR GYPSUM PANELS FOR CEILINGS AND SOFFITS

- A. Apply panels perpendicular to supports, with end joints staggered and located over supports.
1. Install with 1/4-inch open space where panels abut other construction or structural penetrations.
 2. Fasten with corrosion-resistant screws.

3.5 APPLYING TILE BACKING PANELS

- A. Glass-Mat, Water-Resistant Backing Panels: Comply with manufacturer's written installation instructions and install at locations indicated to receive tile. Install with 1/4-inch gap where panels abut other construction or penetrations.
- B. Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.

3.6 INSTALLING TRIM ACCESSORIES

- A. General: For 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.
- B. Control Joints: Install control joints at locations indicated on approved Shop Drawings according to ASTM C 840 and in specific locations approved by Architect for visual effect.
- C. Interior Trim: Install in the following locations:
 - 1. Cornerbead: Use at outside corners unless otherwise indicated.
 - 2. Bullnose Bead: Use where indicated.
 - 3. LC-Bead: Use at exposed panel edges.

3.7 FINISHING GYPSUM BOARD

- A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
- B. Prefill open joints and damaged surface areas.
- C. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.
- D. Gypsum Board Finish Levels: Finish interior panels to levels indicated below and according to ASTM C 840:
 - 1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
 - 2. Level 2: Panels that are substrate for tile.
 - 3. Level 3: Where indicated on Drawings.
 - 4. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated.
 - 5. Level 5: Not required.
- E. Glass-Mat Faced Panels: Finish according to manufacturer's written instructions.

3.8 FIELD QUALITY CONTROL

- A. Above-Ceiling Observation: Before Contractor installs gypsum board ceilings, conduct an above-ceiling observation and report deficiencies in the Work observed. Do not proceed with installation of gypsum board to ceiling support framing until deficiencies have been corrected.
1. Complete the following in areas to receive gypsum board ceilings:
 - a. Installation, insulation, and leak and pressure testing of water piping systems.
 - b. Installation of air-duct systems.
 - c. Installation of air devices.
 - d. Installation of mechanical system control-air tubing.
 - e. Installation of ceiling support framing.
 - f. Installation of Penetration Firestopping and Fire-Resistive Joint Systems.

3.9 PROTECTION

- A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.
- B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- C. Remove and replace panels that are wet, moisture damaged, and mold damaged.
1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 092900

SECTION 093013 - CERAMIC TILING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Ceramic mosaic tile.
 - 2. Porcelain tile.
 - 3. Glazed wall tile.
 - 4. Stone thresholds.
 - 5. Tile backing panels.
 - 6. Waterproof and crack isolation membrane.
 - 7. Metal edge strips.

1.3 DEFINITIONS

- A. General: Definitions in the ANSI A108 series of tile installation standards and in ANSI A137.1 apply to Work of this Section unless otherwise specified.
- B. ANSI A108 Series: ANSI A108.01, ANSI A108.02, ANSI A108.1A, ANSI A108.1B, ANSI A108.1C, ANSI A108.4, ANSI A108.5, ANSI A108.6, ANSI A108.8, ANSI A108.9, ANSI A108.10, ANSI A108.11, ANSI A108.12, ANSI A108.13, ANSI A108.14, ANSI A108.15, ANSI A108.16, and ANSI A108.17, which are contained in its "Specifications for Installation of Ceramic Tile."
- C. Module Size: Actual tile size plus joint width indicated.
- D. Face Size: Actual tile size, excluding spacer lugs.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review requirements in ANSI A108.01 for substrates and for preparation by other trades.

1.5 ACTION SUBMITTALS

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

- B. Shop Drawings: Show widths, details, and locations of expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces.
- C. Samples for Initial Selection: For tile, grout, and accessories involving color selection.
- D. Samples for Verification:
 - 1. Full-size units of each type and composition of tile and for each color and finish required.
 - 2. Full-size units of each type of trim and accessory for each color and finish required.
 - 3. Stone thresholds in 6-inch lengths.
 - 4. Metal edge strips in 6-inch lengths.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Master Grade Certificates: For each shipment, type, and composition of tile, signed by tile manufacturer and Installer.
- C. Product Certificates: For each type of product.
- D. Product Test Reports: For tile-setting and -grouting products.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirements in ANSI A137.1 for labeling tile packages.
- B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.
- C. Store aggregates where grading and other required characteristics can be maintained and contamination can be avoided.
- D. Store liquid materials in unopened containers and protected from freezing.

1.8 FIELD CONDITIONS

- A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations for Tile: Obtain tile of each type and color or finish from single source or producer.

1. Obtain tile of each type and color or finish from same production run and of consistent quality in appearance and physical properties for each contiguous area.

2.2 PRODUCTS, GENERAL

- A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.
 1. Provide tile complying with Standard grade requirements unless otherwise indicated.
- B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCNA installation methods specified in tile installation schedules, and other requirements specified.
- C. Factory Blending: For tile exhibiting color variations within ranges, blend tile in factory and package so tile units taken from one package show same range in colors as those taken from other packages and match approved Samples.

2.3 TILE PRODUCTS

- A. Porcelain Floor Tile: Unglazed porcelain tile.
 1. Manufacturer: Subject to compliance with requirements, provide product by the following:
 - a. Daltile; Division of Dal-Tile International Inc.; Color Body Porcelain
 2. Composition: Porcelain.
 3. Face Size: 12 by 24 inches.
 4. Thickness: Manufacturer's standard.
 5. Face: Plain with square or cushion edges.
 6. Tile Color and Pattern: As selected by Architect from manufacturer's full range.
 7. Grout Color: As selected by Architect from manufacturer's full range.
- B. Porcelain Stair Treads: Unglazed porcelain tile.
 1. Manufacturer: Subject to compliance with requirements, provide product by the following:
 - a. Atlas Concorde - Trust Scalino.
 2. Composition: Porcelain.
 3. Face Size: 13 by 24 inches.
 4. Face: Natural slip resistant.
 5. Tile Color: Titanium.
 6. Grout Color: As selected by Architect from manufacturer's full range.
- C. Glazed Wall Tile: Provide flat tile complying with the following requirements:

1. Module Size: 3 by 6 inches and 9 by 12 inches.
2. Thickness: 5/16 inch.
3. Face: Plain with cushion edges.
4. Tile Type/Products: Available products include the following:
 - a. American Olean: Profiles.
5. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile. Provide shapes as follows, selected from manufacturer's standard shapes:
 - a. Base for Thin-Set Mortar Installations: Straight, module size 6 by 6 inches.
 - b. Wainscot Cap for Thin-Set Mortar Installations: Surface bullnose, module size 8 by 2 inches.

2.4 THRESHOLDS

- A. General: Fabricate to sizes and profiles indicated or required to provide transition between adjacent floor finishes.
 1. Bevel edges at 1:2 slope, with lower edge of bevel aligned with or up to 1/16 inch above adjacent floor surface. Finish bevel to match top surface of threshold. Limit height of threshold to 1/2 inch or less above adjacent floor surface.
- B. Marble Thresholds: ASTM C 503/C 503M, with a minimum abrasion resistance of [10] [12] according to ASTM C 1353 or ASTM C 241/C 241M and with honed finish.
 1. Description: Uniform, fine- to medium-grained white stone with gray veining.

2.5 WATERPROOF AND CRACK ISOLATION MEMBRANE

- A. General: Manufacturer's standard product, selected from the following that complies with ANSI A118.10 and ANSI A118.12, and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.
- B. Fabric-Reinforced, Fluid-Applied Membrane: System consisting of liquid-latex rubber or elastomeric polymer and continuous fabric reinforcement.
 1. Products: Subject to compliance with requirements, provide the following:
 - a. Laticrete International, Inc.; Laticrete 9235 Waterproof Membrane. (2.39 g/L)
 - b. MAPEI Corporation; Mapelastic AquaDefense. (0 g/L)

2.6 UNCOUPLING MEMBRANE

- A. Corrugated Polyethylene: Corrugated polyethylene with dovetail-shaped corrugations and with anchoring webbing on the underside; 1/8-inch nominal thickness with a grid structure of 1/2-inch by 1/2-inch square cavities.

1. Products: Subject to compliance with requirements, provide the following:
 - a. Schluter Systems L.P.; DITRA.

2.7 SETTING MATERIALS

A. Portland Cement Mortar (Thickset) Installation Materials: ANSI A108.02.

1. Cleavage Membrane: Asphalt felt, ASTM D 226/D 226M, Type I (No. 15); or polyethylene sheeting, ASTM D 4397, 4.0 mils thick.
2. Latex Additive: Manufacturer's standard water emulsion, serving as replacement for part or all of gaging water, of type specifically recommended by latex-additive manufacturer for use with field-mixed portland cement and aggregate mortar bed.

B. Latex-Portland Cement Mortar (Thinset): ANSI A118.4.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Bonsal American, an Oldcastle company.
 - b. Bostik, Inc.
 - c. C-Cure.
 - d. Custom Building Products.
 - e. Laticrete International, Inc.
 - f. MAPEI Corporation.
2. Provide prepackaged, dry-mortar mix containing dry, redispersible, vinyl acetate or acrylic additive to which only water must be added at Project site.
3. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to the other requirements in ANSI A118.4.

2.8 GROUT MATERIALS

A. High-Performance Tile Grout (Polymer-Modified): ANSI A118.7.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Bonsal American, an Oldcastle company.
 - b. Bostik, Inc.
 - c. C-Cure.
 - d. Custom Building Products.
 - e. Laticrete International, Inc.
 - f. MAPEI Corporation.
2. Polymer Type: Ethylene vinyl acetate or acrylic additive, in dry, redispersible form, prepackaged with other dry ingredients.

2.9 MISCELLANEOUS MATERIALS

- A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.
- B. Metal Edge Strips: Angle or L-shaped, height to match tile and setting-bed thickness, metallic or combination of metal and PVC or neoprene base, designed specifically for flooring applications; satin anodized aluminum exposed-edge material.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Schluter Systems L.P.
 - 1) Rondec edge trim. Provide at all exterior corners and wainscot top edge conditions.
 - 2) Schiene transition trim. Provide at all floor tile transitions to other materials (equal thickness; carpet, rubber flooring.
 - 3) Reno-TK transition trim. Provide at floor tile transitions from porcelain tile to carpet.

2.10 ELASTOMERIC SEALANTS

- A. General: Provide manufacturer's standard sanded acrylic caulking containing a mildew-cide or antimicrobial protection.
- B. Colors: Provide colors of exposed sealants to match colors of grout in tile adjoining sealed joints unless otherwise indicated.
- C. Products: Available products include the following:
 - 1. Keracaulk™ S by Mapei
 - 2. CeramaSeal by Bostik Findley

2.11 MIXING MORTARS AND GROUT

- A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.
- B. Add materials, water, and additives in accurate proportions.
- C. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
 - 1. Verify that substrates for setting tile are firm; dry; clean; free of coatings that are incompatible with tile-setting materials, including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.
 - 2. Verify that concrete substrates for tile floors installed with thinset mortar comply with surface finish requirements in ANSI A108.01 for installations indicated.
 - a. Verify that surfaces that received a steel trowel finish have been mechanically scarified.
 - b. Verify that protrusions, bumps, and ridges have been removed by sanding or grinding.
 - 3. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed.
 - 4. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Architect.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Fill cracks, holes, and depressions in concrete substrates for tile floors installed with thinset mortar with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.
- B. Where indicated, prepare substrates to receive waterproofing by applying a reinforced mortar bed that complies with ANSI A108.1A and is sloped 1/4 inch per foot toward drains.
- C. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

3.3 CERAMIC TILE INSTALLATION

- A. Comply with TCNA's "Handbook for Ceramic, Glass, and Stone Tile Installation" for TCNA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 series "Specifications for Installation of Ceramic Tile" that are referenced in TCNA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.

1. For the following installations, follow procedures in the ANSI A108 series of tile installation standards for providing 95 percent mortar coverage:
 - a. Tile floors in wet areas.
 - b. Tile floors consisting of tiles 8 by 8 inches or larger.
- B. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.
- C. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.
- D. Provide manufacturer's standard trim shapes where necessary to eliminate exposed tile edges.
- E. Where accent tile differs in thickness from field tile, vary setting-bed thickness so that tiles are flush.
- F. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.
 1. For tile mounted in sheets, make joints between tile sheets same width as joints within tile sheets so joints between sheets are not apparent in finished work.
 2. Where adjoining tiles on floor, base, walls, or trim are specified or indicated to be same size, align joints.
 3. Where tiles are specified or indicated to be whole integer multiples of adjoining tiles on floor, base, walls, or trim, align joints unless otherwise indicated.
- G. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:
 1. Ceramic Mosaic Tile: 1/16 inch.
 2. Glazed Wall Tile: 1/16 inch.
 3. Porcelain Tile: 1/4 inch.
- H. Lay out tile wainscots to dimensions indicated or to next full tile beyond dimensions indicated.
- I. Expansion Joints: Provide expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated. Form joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.
 1. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them.
- J. Stone Thresholds: Install stone thresholds in same type of setting bed as adjacent floor unless otherwise indicated.

1. At locations where mortar bed (thickset) would otherwise be exposed above adjacent floor finishes, set thresholds in latex-portland cement mortar (thinset).

- K. Metal Edge Strips: Install where exposed edge of tile flooring meets carpet, wood, or other flooring that finishes flush with top of tile.

3.4 TILE BACKING PANEL INSTALLATION

- A. Install panels and treat joints according to ANSI A108.11 and manufacturer's written instructions for type of application indicated. Use latex-portland cement mortar for bonding material unless otherwise directed in manufacturer's written instructions.

3.5 WATERPROOFING/CRACK ISOLATION MEMBRANE INSTALLATION

- A. Install waterproofing to comply with manufacturer's written instructions to produce membrane of uniform thickness and bonded securely to substrate.
- B. Do not install tile or setting materials over waterproofing until waterproofing/crack isolation membrane has cured.

- C. Locations:

1. Second floor Toilet Rooms receiving tile flooring. Turn membrane up 2 inches minimum at perimeter walls to keep water from traveling under partitions.

3.6 ADJUSTING AND CLEANING

- A. Remove and replace tile that is damaged or that does not match adjoining tile. Provide new matching units, installed as specified and in a manner to eliminate evidence of replacement.
- B. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.
1. Remove grout residue from tile as soon as possible.
 2. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions but no sooner than 10 days after installation. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.

3.7 PROTECTION

- A. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear. If recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors.

- B. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.
- C. Before final inspection, remove protective coverings and rinse neutral protective cleaner from tile surfaces.

3.8 INTERIOR CERAMIC TILE INSTALLATION SCHEDULE

- A. Interior Floor Installations, Concrete Subfloor:
 - 1. Tile Installation F111; cement mortar bed (thickset) with cleavage membrane.
 - a. Ceramic Tile Type: Porcelain floor tile.
 - b. Bond Coat for Cured-Bed Method: Latex- portland cement mortar.
 - c. Grout: Polymer-modified unsanded grout.
 - 2. Tile Installation F125: Thin-set mortar on partial crack isolation membrane; TCA F125.
 - a. Tile Type: Ceramic floor tile.
 - b. Thin-Set Mortar: Latex portland cement mortar.
 - c. Grout: Polymer-modified unsanded grout.
 - 3. Tile Installation F125A (Ditra): Thin-set mortar on uncoupling membrane; TCA F125A.
 - a. Tile Type: Porcelain floor tile.
 - b. Thin-Set Mortar: Dry-set portland cement mortar.
 - c. Grout: Polymer-modified sanded grout.
- B. Interior Wall Installations, Wood or Metal Studs or Furring:
 - 1. Ceramic Tile Installation: TCNA W245 or TCNA W248; thinset mortar on glass-mat, water-resistant gypsum backer board.
 - a. Ceramic Tile Type: Ceramic wall tile.
 - b. Thinset Mortar: Latex- portland cement mortar.
 - c. Grout: Polymer-modified unsanded grout.

END OF SECTION 093013

SECTION 095113 - ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes acoustical panels and exposed suspension systems for ceilings.
- B. Products furnished, but not installed under this Section, include anchors, clips, and other ceiling attachment devices to be cast in concrete.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of size indicated below.
 - 1. Acoustical Panel: Set of 6-inch-square Samples of each type, color, pattern, and texture.
 - 2. Exposed Suspension-System Members, Moldings, and Trim: Set of 6-inch-long Samples of each type, finish, and color.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.
- B. Product Test Reports: For each acoustical panel ceiling, for tests performed by manufacturer and witnessed by a qualified testing agency or a qualified testing agency.
- C. Evaluation Reports: For each acoustical panel ceiling suspension system and anchor and fastener type, from ICC-ES.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For finishes to include in maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials 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 percent of quantity installed.
 - 2. Suspension-System Components: Quantity of each exposed component equal to 2 percent of quantity installed.
 - 3. Hold-Down Clips: Equal to 2 percent of quantity installed.

1.7 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to NVLAP for testing indicated.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver acoustical panels, suspension-system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.
- B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.
- C. Handle acoustical panels carefully to avoid chipping edges or damaging units in any way.

1.9 FIELD CONDITIONS

- A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Acoustical ceiling shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
- B. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: Comply with ASTM E 1264 for Class A materials.
 - 2. Smoke-Developed Index: 50 or less.

- C. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

2.2 ACOUSTICAL PANELS, GENERAL

- A. Source Limitations:
 - 1. Acoustical Ceiling Panel: Obtain each type from single source from single manufacturer.
 - 2. Suspension System: Obtain each type from single source from single manufacturer.
- B. Source Limitations: Obtain each type of acoustical ceiling panel and supporting suspension system from single source from single manufacturer.
- C. Glass-Fiber-Based Panels: Made with binder containing no urea formaldehyde.
- D. Acoustical Panel Standard: Provide manufacturer's standard panels of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectances unless otherwise indicated.
 - 1. Mounting Method for Measuring NRC: Type E-400; plenum mounting in which face of test specimen is 15-3/4 inches away from test surface according to ASTM E 795.
- E. Acoustical Panel Colors and Patterns: Match appearance characteristics indicated for each product type.
 - 1. Where appearance characteristics of acoustical panels are indicated by referencing pattern designations in ASTM E 1264 and not manufacturers' proprietary product designations, provide products selected by Architect from each manufacturer's full range that comply with requirements indicated for type, pattern, color, light reflectance, acoustical performance, edge detail, and size.

2.3 ACOUSTICAL PANELS FOR ACOUSTICAL PANEL CEILING (APC-1)

- A. Products: Subject to compliance with requirements, provide one of the following:
 - 1. Armstrong World Industries, Inc.; Ultima Shiplap, No. 1989.
- B. Classification: Provide panels complying with ASTM E 1264 for type, form, and pattern as follows:
 - 1. Type and Form: Type IV, mineral base with membrane-faced overlay; Form 2, water felted; with vinyl overlay on face.
 - 2. Pattern: E (lightly textured).
- C. Color: White.
- D. LR: Not less than 0.90.

- E. NRC: Not less than 0.75.
- F. CAC: 35.
- G. Edge/Joint Detail: Shiplap with beveled edge.
- H. Thickness: 3/4 inch.
- I. Modular Size: 24 by 48 inches.
- J. Antimicrobial Treatment: Broad spectrum fungicide and bactericide based.

2.4 METAL SUSPENSION SYSTEMS, GENERAL

- A. Metal Suspension-System Standard: Provide manufacturer's standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C 635/C 635M.
 - 1. High-Humidity Finish: Comply with ASTM C 635/C 635M requirements for "Coating Classification for Severe Environment Performance" where high-humidity finishes are indicated.
- B. Attachment Devices: Size for five times the design load indicated in ASTM C 635/C 635M, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.
- C. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:
 - 1. Zinc-Coated, Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
 - 2. Size: Select wire diameter so its stress at three times hanger design load (ASTM C 635/C 635M, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 0.106-inch- diameter wire.
- D. Hanger Rods and Flat Hangers: Mild steel, zinc coated or protected with rust-inhibitive paint.
- E. Angle Hangers: Angles with legs not less than 7/8 inch wide; formed with 0.04-inch-thick, galvanized-steel sheet complying with ASTM A 653/A 653M, G90 coating designation; with bolted connections and 5/16-inch-diameter bolts.
- F. Seismic Stabilizer Bars: Manufacturer's standard perimeter stabilizers designed to accommodate seismic forces.
- G. Seismic Struts: Manufacturer's standard compression struts designed to accommodate seismic forces.
- H. Seismic Clips: Manufacturer's standard seismic clips designed and spaced to secure acoustical panels in place.
- I. Hold-Down Clips: Where indicated, provide manufacturer's standard hold-down clips spaced 24 inches o.c. on all cross tees.

1. Available Products: UHDC by Armstrong or L15 by USG.

2.5 METAL SUSPENSION SYSTEM

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Armstrong World Industries, Inc.; Prelude 15/16" Exposed Tee System (7300 Series).
 2. CertainTeed Corporation; S11 System.
 3. Chicago Metallic Corporation; 1200 System.
 4. United States Gypsum Company; DX 24 System.
- B. Wide-Face, Capped, 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 15/16-inch- wide metal caps on flanges.
 1. Structural Classification: Intermediate-duty system.
 2. End Condition of Cross Runners: Override (stepped) or butt-edge type, as standard with manufacturer.
 3. Face Design: Flat, flush.
 4. Cap Material: Steel cold-rolled sheet.
 5. Cap Finish: Painted white.

2.6 FIRE-RATED METAL SUSPENSION SYSTEM

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Armstrong: Prelude® XL® Fire Guard™ 15/16" Exposed Tee System.
- B. Narrow-Face, Capped, 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 15/16-inch- wide metal caps on flanges.
 1. Structural Classification: Intermediate-duty system.
 2. End Condition of Cross Runners: Override (stepped) or butt-edge type, as standard with manufacturer.
 3. Face Design: Flat, flush.
 4. Cap Material: Steel cold-rolled sheet.
 5. Cap Finish: Painted white.

2.7 METAL EDGE MOLDINGS AND TRIM

- A. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that comply with

seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension-system runners.

1. Provide manufacturer's standard edge moldings that fit acoustical panel edge details and suspension systems indicated and that match width and configuration of exposed runners unless otherwise indicated.
 2. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.
- B. Perimeter Trim Channel (Select Locations): Provide Trim Channel: (6") wide face with 3/4" horizontal legs, straight or curved sections with special bosses formed for attachment to the tee-bar connection clip or hanging clip; commercial quality, extruded aluminum, factory-finished in factory-applied baked polyester paint to match grid color.
1. Splice Plate: Galvanized steel finish; formed to fit into special bosses and locked in place with factory-installed screws.
 2. Tee-Bar Connection Clip: Commercial quality aluminum finish to match trim channel formed to fit into special bosses and locked in place by factory-installed screws and attached to suspension system members.
 3. Hanging Clip: Commercial quality aluminum finish to match trim channel formed to lock into special bosses and attach to suspension system members.
 4. Available Products: Products include, but are not limited to Axiom Classic Trim by Armstrong or Compasso by USG.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.
- B. Examine acoustical panels before installation. Reject acoustical panels that are wet, moisture damaged, or mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. 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, and comply with layout shown on reflected ceiling plans.

3.3 INSTALLATION

- A. General: Install acoustical panel ceilings to comply with ASTM C 636/C 636M and seismic design requirements indicated, according to manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."
1. Fire-Rated Assembly: Install fire-rated ceiling systems according to tested fire-rated design.
- B. Suspend ceiling hangers from building's structural members and as follows:
1. Hangers shall be single lengths of wire without splices; coordinate lengths in deep ceiling cavities.
 2. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
 3. Splay hangers only where required and, if permitted with fire-resistance-rated ceilings, to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 4. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension-system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
 5. Secure wire hangers to ceiling-suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
 6. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both the structure to which hangers are attached and the type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
 7. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
 8. 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.
 9. Do not attach hangers to steel deck tabs.
 10. Do not attach hangers to steel roof deck. Attach hangers to structural members.
 11. Space hangers not more than 48 inches o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 8 inches from ends of each member.
 12. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.
- C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.

- D. Suspension system shall be reinforced to support diffusers, light fixtures and any additional members. Install hanger wires to grid at each corner of light fixtures. Coordinate location with electrical and other trades.
1. Each individual fixture and attachment with combined weight of 56 pounds or less shall have two 12-gage wire hangers attached at diagonal corners of the fixture. These wires shall be slack. Fixtures and attachments with a combined weight of greater than 56 pounds shall be independently supported from the structure at all four corners.
- E. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.
1. 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.
 2. Do not use exposed fasteners, including pop rivets, on moldings and trim.
- F. Install suspension-system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- G. 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.
1. Arrange directionally patterned acoustical panels as follows:
 - a. As indicated on reflected ceiling plans.
 - b. Install panels with pattern running in one direction parallel to long axis of space.
 2. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension-system runners and moldings.
 3. For reveal-edged panels on suspension-system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.
 4. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.
 5. Install hold-down clips in areas within 10 feet of exterior doors or vestibule doors; space as recommended by panel manufacturer's written instructions, unless otherwise indicated or required.

3.4 FIELD QUALITY CONTROL

- A. Above-Ceiling Observation: Before Contractor installs acoustical panel ceilings, conduct an above-ceiling observation and report deficiencies in the Work observed. Do not proceed with installation of acoustical panels until deficiencies have been corrected.
1. Complete the following in areas to receive gypsum board ceilings:
 - a. Installation of 80 percent of lighting fixtures, powered for operation.
 - b. Installation, insulation, and leak and pressure testing of water piping systems.

- c. Installation of air-duct systems.
- d. Installation of air devices.
- e. Installation of mechanical system control-air tubing.
- f. Installation of Penetration Firestopping and Fire-Resistive Joint Systems.

3.5 CLEANING

- A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension-system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 095113

SECTION 096513 - RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Resilient base.
 - 2. Resilient stair accessories.
 - 3. Resilient molding accessories.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each exposed product and for each color and texture specified, not less than 12 inches long.
- C. Samples for Initial Selection: For each type of product indicated.
- D. Samples for Verification: For each type of product indicated and for each color, texture, and pattern required in manufacturer's standard-size Samples, but not less than 12 inches long.
- E. Product Schedule: For resilient base and accessory products. Use same designations indicated on Drawings.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Furnish not less than 10 linear feet for every 500 linear feet or fraction thereof, of each type, color, pattern, and size of resilient product installed.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F.

1.6 FIELD CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive resilient products during the following time periods:
 - 1. 48 hours before installation.
 - 2. During installation.
 - 3. 48 hours after installation.
- B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.
- C. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 THERMOSET-RUBBER BASE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Burke Mercer Flooring Products, Division of Burke Industries Inc.
 - 2. Flexco.
 - 3. Roppe Corporation, USA.
- B. Product Standard: ASTM F 1861, Type TS (rubber, vulcanized thermoset), Group I (solid, homogeneous).
 - 1. Style and Location:
 - a. Style B, Cove.
- C. Thickness: 0.125 inch.
- D. Height: 4 inches.
- E. Lengths: Coils in manufacturer's standard length.
- F. Outside Corners: Preformed.
- G. Inside Corners: Job formed or preformed.
- H. Colors: As selected by Architect from full range of industry colors.

2.2 RESILIENT STAIR ACCESSORIES

- A. Resilient Stair Treads:

1. Manufacturers: Subject to compliance with requirements, provide product by the following:
 - a. Johnsonite: VIHTR
- B. Resilient Stair Treads Standard: ASTM F 2169.
 1. Material Requirement: Type TS (rubber, vulcanized thermoset).
 2. Surface Design:
 - a. Class 2, Pattern: Hammered design.
 3. Manufacturing Method: Group 1, tread with embedded abrasive strips and Group 2, tread with contrasting color for the visually impaired.
- C. Nosing Style: Square, adjustable to cover angles between 60 and 90 degrees.
- D. Nosing Height: 1-1/2 inches.
- E. Thickness: 1/4 inch and tapered to back edge.
- F. Size: Lengths and depths to fit each stair tread in one piece or, for treads exceeding maximum lengths manufactured, in equal-length units.
- G. Rubber Risers: Smooth, flat, risers, 1/8 inch thick integral with tread unit.
- H. Risers: Smooth, flat, coved-toe, 7 inches high by length matching treads integral with tread unit; produced by same manufacturer as treads and recommended by manufacturer for installation with treads.
- I. Riser and Tread Fillers: Provide Johnsonite Subfloor Leveling System components to fill the riser space below the existing nosing to comply with details. Also use Subfloor Leveling System to level the top tread to surrounding floor surface.
- J. Colors and Patterns: As selected by Architect from full range of industry colors.

2.3 VINYL MOLDING ACCESSORY

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Armstrong World Industries, Inc.
 2. Burke Mercer Flooring Products, Division of Burke Industries Inc.
 3. Flexco.
 4. Johnsonite; A Tarkett Company.
 5. Musson Rubber Company.
 6. Roppe Corporation, USA.
- B. Profile and Dimensions:

1. Transition Strip between VCT and Carpet/Ceramic Tile: CE-XX-A by Johnsonite or approved substitute.
2. Transition Strip between VCT and Carpet: CE-XX-A by Johnsonite or approved substitute.
3. Transition Strip between Sheet Flooring and VCT: CD-XX-C by Johnsonite or approved substitute.
4. Reducer Strip between Concrete and VCT: RRS-XX-C by Johnsonite or approved substitute.
5. Reducer Strip between Concrete and Carpet: EG-XX-L by Johnsonite or approved substitute.

C. Colors and Patterns: As selected by Architect from full range of industry colors.

2.4 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by resilient-product manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by resilient-product manufacturer for resilient products and substrate conditions indicated.
- C. Stair-Tread Nose Filler: Two-part epoxy compound recommended by resilient stair-tread manufacturer to fill nosing substrates that do not conform to tread contours.
 1. Use adhesives that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
 - a. Rubber Floor Adhesives: 60 g/L.
- D. Epoxy Adhesives: Two-part epoxy compound recommended by resilient tread manufacturer to adhere rubber treads and risers to substrates.
 1. Use adhesives that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
 - a. Rubber Floor Adhesives: 60 g/L.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
 1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.

- B. Proceed with installation only after unsatisfactory conditions have been corrected.
 - 1. Installation of resilient products indicates acceptance of surfaces and conditions.

3.2 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; remove bumps and ridges to produce a uniform and smooth substrate.
- C. Do not install resilient products until they are the same temperature as the space where they are to be installed.
 - 1. At least 48 hours in advance of installation, move resilient products and installation materials into spaces where they will be installed.
- D. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient products.

3.3 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 practical 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.
- F. Preformed Corners: Install preformed corners before installing straight pieces.
- G. Job-Formed Corners:
 - 1. Inside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches in length.
 - a. Miter or cope corners to minimize open joints.

3.4 RESILIENT ACCESSORY INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient accessories.

B. Resilient Stair Accessories:

1. Use stair-tread-nose filler to fill nosing substrates that do not conform to tread contours.
2. Tightly adhere to substrates throughout length of each piece.
3. For treads installed as separate, equal-length units, install to produce a flush joint between units.

C. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of floor covering that would otherwise be exposed.

3.5 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protecting resilient products.

B. Perform the following operations immediately after completing resilient-product installation:

1. Remove adhesive and other blemishes from exposed surfaces.
2. Sweep and vacuum horizontal surfaces thoroughly.
3. Damp-mop horizontal surfaces to remove marks and soil.

C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

D. Cover resilient products subject to wear and foot traffic until Substantial Completion.

END OF SECTION 096513

SECTION 096519 - RESILIENT TILE FLOORING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Vinyl composition floor tile.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples for Initial Selection: For each type of floor tile indicated.
- C. Samples for Verification: Full-size units of each color and pattern of floor tile required.
- D. Product Schedule: For floor tile. Use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of floor tile to include in maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Floor Tile: Furnish one box for every 50 boxes or fraction thereof, of each type, color, and pattern of floor tile installed.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store floor tile and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F. Store floor tiles on flat surfaces.

1.8 FIELD CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive floor tile during the following time periods:
 - 1. 48 hours before installation.
 - 2. During installation.
 - 3. 48 hours after installation.
- B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.
- C. Close spaces to traffic during floor tile installation.
- D. Close spaces to traffic for 48 hours after floor tile installation.
- E. Install floor tile after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: For resilient tile flooring, 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.

2.2 VINYL COMPOSITION FLOOR TILE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Armstrong World Industries, Inc.; Imperial Texture Standard Excelon.
 - 2. Mannington Mills, Inc.; Essentials.
 - 3. Tarkett, Inc.; Expressions.
- B. Tile Standard: ASTM F 1066, Class 2, through-pattern tile.
- C. Wearing Surface: Smooth.
- D. Thickness: 0.125 inch.

- E. Size: 12 by 12 inches.
- F. Colors and Patterns: As selected by Architect from full range of industry colors.

2.3 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by floor tile manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by floor tile and adhesive manufacturers to suit floor tile and substrate conditions indicated.
- C. Floor Polish: Provide protective, liquid floor-polish products recommended by floor tile manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
 - 1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of floor tile.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SUBSTRATE TESTING

- A. General: Conduct testing using an independent agency with a minimum of five years' experience in moisture emission testing or as pre-approved by the manufacturer of the flooring material.
- B. Moisture Emission Testing: Conduct moisture emission testing of concrete slabs-on-grade and elevated slabs to receive floor coverings or coatings by the calcium chloride test method. Perform tests in accordance with ASTM F-1869.
 - 1. Conduct a minimum of three tests for the first 1,000 sq. ft. and one additional test for each additional 1,000 sq. ft.
 - 2. Ambient test environment shall conform to ASTM-1869 and be reflective of the building's normal operational environment.
 - 3. Conduct tests on bare concrete, free of surface contaminants, adhesives, curing compounds or sealers.

4. Locate test locations a minimum of five feet from exterior walls or interior walls that penetrate the floor. Do not conduct tests over random cracks or within five feet of control or construction joints.
 5. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
- C. Internal Relative Humidity Testing: Conduct internal relative humidity testing of concrete slabs-on-grade and elevated slabs to receive floor coverings or coatings in accordance with ASTM F-2170.
1. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.
- D. Surface Alkalinity Testing: Conduct alkalinity testing of the concrete surface at all moisture emission test locations in accordance with ASTM F710 5.3.1.
- E. Submit all test results to the Architect, flooring installer and manufacturer of the flooring materials before installation of the flooring materials.

3.3 PREPARATION

- A. Prepare substrates according to floor tile manufacturer's written instructions to ensure adhesion of resilient products.
- B. Concrete Substrates: Prepare according to ASTM F 710.
1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
 2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by floor tile manufacturer. Do not use solvents.
- C. Access Flooring Panels: Remove protective film of oil or other coating using method recommended by access flooring manufacturer.
- D. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- E. Do not install floor tiles until they are the same temperature as the space where they are to be installed.
1. At least 48 hours in advance of installation, move resilient floor tile and installation materials into spaces where they will be installed.
- F. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient floor tile.

3.4 FLOOR TILE INSTALLATION

- A. Comply with manufacturer's written instructions for installing floor tile.

- B. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.
 - 1. Lay tiles square with room axis in pattern indicated.
- C. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.
 - 1. Lay tiles with grain direction alternating in adjacent tiles (basket-weave pattern) in pattern of colors and sizes indicated.
- D. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.
- E. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.
- F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent marking device.
- G. Install floor tiles on covers for telephone and electrical ducts, building expansion-joint covers, and similar items in finished floor areas. Maintain overall continuity of color and pattern between pieces of tile installed on covers and adjoining tiles. Tightly adhere tile edges to substrates that abut covers and to cover perimeters.
- H. Adhere floor tiles to flooring substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

3.5 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protecting floor tile.
- B. Perform the following operations immediately after completing floor tile installation:
 - 1. Remove adhesive and other blemishes from exposed surfaces.
 - 2. Sweep and vacuum surfaces thoroughly.
 - 3. Damp-mop surfaces to remove marks and soil.
- C. Protect floor tile from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- D. Floor Polish: Remove soil, adhesive, and blemishes from floor tile surfaces before applying liquid floor polish.
 - 1. Apply two coats of sealer and two finish coats.

E. Cover floor tile until Substantial Completion.

END OF SECTION 096519

SECTION 096566 - RESILIENT ATHLETIC FLOORING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Resilient Athletic Flooring.

1.2 SUBMITTALS

- A. Product Data: Submit manufacturer's technical data, application instructions and general recommendations.
- B. Shop Drawing: Provide drawing indicating floor termination details and game line layout.
- C. Samples for Selection: Submit two samples, 8 x 4 inch (200 x 100 mm) in size illustrating color and texture for each floor material for each color specified.
- D. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.
- E. Manufacturer's maintenance instructions.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer approved Installer, who has technical qualifications, currently certified in writing, and facilities to install specified systems.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Store products in dry spaces protected from the weather, with ambient temperatures maintained between 55 and 80 deg F.
- B. Store rolls upright.

1.5 PROJECT CONDITIONS

- A. Concrete and Concrete Finishing
1. Concrete tolerance 1/8" in radius of 10'
 2. Surface must be steel troweled smooth
 3. Concrete shall be 2,500 – 3,000 psi compressive strength after 28 days.

4. Concrete shall be free of washed river gravel, pea gravel, flint, hardener additives, or curing compounds.
 5. No lightweight concrete.
- B. Do not install floor system until concrete has been cured 60 days.
- C. Permanent heat, light and ventilation shall be installed and operating during and after installation. Maintaining a temperature range of 55 to 80 degrees Fahrenheit and a relative humidity range of 35 to 50%.
- D. After floors are finished, area is to be kept locked by General Contractor to allow curing time for the finish. If after required curing time the General Contractor requires use of the area, General Contractor shall protect the floor by covering with non-fibred kraft paper or red rosin paper with taped joints, until acceptance by Owner of complete gymnasium floor.

1.6 WARRANTY

- A. Guarantee shall not cover damage caused in whole or in part by casualty, ordinary wear and tear, abuse, use for which the materials are not designed, faulty construction of the building, settlement of the building walls, failure of the other contractors to adhere to specifications, separation of the concrete slab and excessive dryness or excessive moisture from humidity, spillage, migration through the slab or wall, or any other source.
- B. The manufacturer hereby warrants the floor systems material to be free from manufacturing defects for a period of five (5) years. This warranty is in lieu of all other warranties, expressed or implied, including but not limited to any warranty of merchantability or fitness for a particular purpose, and of any other obligations on the part of the manufacturer. In the event of breach of any warranty, the liability of the manufacturer shall be limited to repairing or replacing the DD Lino Floor systems. Material and system components supplied by the manufacturer and proven to be defective in manufacture, and shall not include any other damages, either direct or consequential.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Manufacturer: Provide one of the following:
1. Mats, Inc.: DD Linopol.
 2. Eco Surfaces; ECOfit.

2.2 DD Linopol MATERIALS

- A. Composition of Finish Flooring: 4 mm thick linoleum with a jute backing.
1. Width: 6'-7".
 2. Length: 88'-6" to 95'.

- B. Vapor Barrier: 6 mil polyethylene
- C. Elastic Underlayment: 6 mm, PUR bound polyester foam granules.

2.3 ECOfit MATERIALS

- A. Composition of Finish Flooring: 3.2mm surface layer is fusion-bonded to a recycled rubber backing.
 - 1. Width: 4 foot.
 - 2. Overall Thickness: 6 mm.

2.4 ACCESSORIES

- A. Subfloor Filler: White premix latex; type recommended by flooring material manufacturer.
- B. Adhesives: Provide adhesive per manufacturer recommendations.
- C. Base: Refer to Division 09 Section "Resilient Base and Accessories for wall base used with floor materials.
- D. Transitions: Refer to Division 09 Section "Resilient Base and Accessories for transitions to adjacent floor materials.

2.5 COLORS

- A. Color as selected by Architect from manufacturer's full line of color options including wood grain options.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions where installation of products will occur, with Installer present, for compliance with manufacturer's requirements. Verify that substrates and conditions are satisfactory for resilient product installation and comply with requirements specified.
- B. Concrete Subfloors: Verify that concrete slabs cured a minimum 60 days and the following:
 - 1. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by flooring manufacturer.
 - 2. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits.
- C. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Remove grease, oil, and other penetrating contaminants. Repair damaged and deteriorated concrete to acceptable condition. Leave surface free of dust, dirt, laitance, and efflorescence.
- B. Moving cracks and joints shall be thoroughly routed and vacuumed clean, then filled with approved material.
- C. Vacuum clean substrate.

3.3 INSTALLATION

- A. Follow all manufacturer's installation instructions.
- B. Install elastic mat over entire floor and glue to substrate as recommended by manufacturer. Roll and hammer edges as recommended.
- C. Lay out sheets of Linoleum by roll number.
- D. Glue linoleum flooring to elastic mat.
- E. Underscribe and cut edge and ends of rolls.
- F. Roll floor with roller.
- G. Heat weld seams, and trim.

3.4 CLEANING AND PROTECTING

- A. Protect flooring against mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by flooring manufacturer.
- B. Clean floor surfaces not more than 4 days before dates scheduled for inspections intended to establish date of Substantial Completion in each area of Project. Clean products according to manufacturer's written recommendations.

END OF SECTION 096566

SECTION 096723 - RESINOUS FLOORING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes resinous flooring systems with epoxy resin body coat(s).
 - 1. Resinous flooring system as shown on the drawings and in schedules.

1.3 SYSTEM DESCRIPTION

- A. The work shall consist of preparation of the substrate, the furnishing and application of an epoxy based multi roller applied flooring system with flintshot or Q-Rok quartz aggregate and urethane topcoat. The system shall have the color and texture as specified by the Owner with a nominal thickness of 1/8 inch. It shall be applied to the prepared area as defined in the plans strictly in accordance with the Manufacturer's recommendations.
- B. Cove base to be applied per manufacturers standard details unless otherwise noted.

1.4 SUBMITTALS

- A. Product Data: Latest edition of Manufacturer's literature including performance data and installation procedures.
- B. Samples: A 3 x 3 inch square sample of the proposed system. Color, texture, and thickness shall be representative of overall appearance of finished system subject to normal tolerances.
- C. MSDS Sheets: Submit MSDS sheets for all resinous flooring components to the Plant Safety Representative for approval before delivering products to the site.

1.5 QUALITY ASSURANCE

- A. The Manufacturer shall have a minimum of 10 years experience in the production, sales, and technical support of epoxy and urethane industrial flooring and related materials.
- B. The Applicator shall have experience in installation of the flooring system as confirmed by the manufacturer in all phases of surface preparation and application of the product specified.

- C. A pre-installation conference shall be held between Applicator, General Contractor and the Owner to review and clarification of this specification, application procedure, quality control, inspection and acceptance criteria and production schedule.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Packing and Shipping:

- 1. Deliver all components of the system to the site in the Manufacturer's packaging, clearly identified with the product type and batch number.

B. Storage and Protection:

- 1. The Applicator shall be provided with a storage area for all components. The area shall be between 60 F and 90 F, dry, out of direct sunlight and in accordance with the Manufacturer's recommendations and relevant health and safety regulations.
- 2. Copies of Material Safety Data Sheets (MSDS) for all components shall be kept on site for review by the Engineer or other personnel.

C. Waste Disposal:

- 1. The Applicator shall be provided with adequate disposal facilities for non-hazardous waste generated during installation of the system.

1.7 PROJECT CONDITIONS

A. Site Requirements:

- 1. Application may proceed while air, material and substrate temperatures are between 60 F and 90 F providing the substrate temperature is above the dew point. Outside of this range, the Manufacturer shall be consulted.
- 2. The relative humidity in the specific location of the application shall be less than 85 % and the surface temperature shall be at least 5 F above the dew point.
- 3. The Applicator shall ensure that adequate ventilation is available for the work area.
- 4. The Applicator shall be supplied with adequate lighting equal to the final lighting level during the preparation and installation of the system.

B. Conditions of new concrete to be coated with epoxy material.

- 1. Concrete shall be moisture cured for a minimum of 7 days and have fully cured a minimum of twenty eight days in accordance with ACI-308 prior to the application of the coating system pending moisture tests.
- 2. Concrete shall have a flat rubbed finish, float or light steel trowel finish (a hard steel trowel finish is neither necessary or desirable).
- 3. Sealers and curing agents should not to be used.
- 4. Concrete surfaces on grade shall have been constructed with a vapor barrier to protect against the effects of vapor transmission and possible delamination of the system.

C. Safety Requirements:

1. All open flames and spark-producing equipment shall be removed from the work area prior to commencement of application.
2. "No Smoking" signs shall be posted at the entrances to the work area.
3. The Owner shall be responsible for the removal of foodstuffs from the work area.
4. Non-related personnel in the work area shall be kept to a minimum.

1.8 WARRANTY

- A. Dur-A-Flex, Inc. warrants that material shipped to buyers at the time of shipment substantially free from material defects and will perform substantially to Dur-A-Flex, Inc. published literature if used in accordance with the latest prescribed procedures and prior to the expiration date.
- B. Dur-A-Flex, Inc. liability with respect to this warranty is strictly limited to the value of the material purchase.

PART 2 - PRODUCTS

2.1 RESINOUS FLOORING

- A. Dur-A-Flex, Inc, Shop Floor, Epoxy-Based seamless flooring system.
 1. System Materials:
 - a. Primer: Dur-A-Flex, Inc, Dur-A-Glaze #4 WB resin and hardener.
 - b. Broadcast and Grout Coat: Dur-A-Flex, Inc, Shop Floor resin and hardener.
 - c. The aggregate shall be Dur-A-Flex, Inc. Flintshot or Q-Rok quartz aggregate.
 - d. Topcoat: Dur-A-Flex, Inc. Armor Top resin, hardener and grit.
 2. Patch Materials:
 - a. Shallow Fill and Patching: Use Dur-A-Flex, Inc. Dur-A-Glaze Rapid Patch.
 - b. Deep Fill and Sloping Material (over ¼ inch): Use Dur-A-Flex, Inc. Dur-A-Crete.

2.2 PRODUCT REQUIREMENTS

- A. Primer: Dur-A-Glaze #4 WB.
 1. Percent Solids: 56 %
 2. VOC: 2 g/L
 3. Bond Strength to Concrete ASTM D 4541: 550 psi, substrates fails
 4. Hardness, ASTM D 3363: 3H
 5. Elongation, ASTM D 2370: 9 %
 6. Flexibility (1/4: Cylindrical mandrel), ASTM D 1737 Pass
 7. Impact Resistance, MIL D-2794: >160
 8. Abrasion Resistance ASTM D 4060,
CS 17 wheel, 1,000 g Load 30 mg loss

B. Broadcast and Grout Coat: Dur-A-Glaze Shop Floor.

1.	VOC:	7.9 g/L
2.	Compressive Strength, ASTM D 695:	17,500 psi
3.	Tensile Strength, ASTM D 638:	4,000 psi
4.	Flexural Strength, ASTM D 790:	6,250 psi
5.	Flexural Modulus of Elasticity, ASTM D 790:	6.2 x 10 ⁵
6.	Abrasion Resistance, ASTM D 4060 C-10 Wheel, 1,000 gm load, 1,000 cycles:	24 mg loss
7.	Flame Spread/NFPA-101, ASTM E 84:	Class A
8.	Flammability, ASTM D 635:	Self Extinguishing
9.	Indentation, MIL D-3134:	0.025 Max
10.	Impact Resistance MIL D-3134:	Pass
11.	Water Absorption. MIL D-24613:	0.04%

C. Topcoat: Armor Top.

1.	Percent Solids:	95 %
2.	VOC:	0 g/L
3.	Tensile Strength, ASTM D 2370:	7,000 psi
4.	Adhesion, ASTM 4541:	Substrate Failure
5.	Hardness, ASTM D 3363:	4H
6.	60° Gloss ASTM D 523:	70
7.	Abrasion Resistance, ASTM D4060	Gloss Satin
	CS 17 wheel (1,000 g load) 1,000 cycles	4 8 mg loss with grit
		10 12 mg loss without grit
8.	Pot Life, 70 F, 50% RH:	2 Hours
9.	Full Chemical Resistance:	7 days

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas and conditions, with Applicator present, for compliance with requirements for maximum moisture content, installation tolerances and other conditions affecting flooring performance.

1. Verify that substrates and conditions are satisfactory for flooring installation and comply with requirements specified.

3.2 PREPARATION

A. General:

1. New and existing concrete surfaces shall be free of oil, grease, curing compounds, loose particles, moss, algae growth, laitance, friable matter, dirt, and bituminous products.
2. Moisture Testing: Perform tests recommended by manufacturer and as follows:

- a. Perform relative humidity test using in situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75% relative humidity level measurement.
 - b. If the relative humidity exceeds 75% then Dur-A-Flex, Inc Dur-A-Glaze MVP Primer moisture mitigation system must be installed prior to resinous flooring installation. Slab-on grade substrates without a vapor barrier may also require the moisture mitigation system.
3. There shall be no visible moisture present on the surface at the time of application of the system. Compressed oil-free air and/or a light passing of a propane torch may be used to dry the substrate.
 4. Mechanical surface preparation:
 - a. Shot blast all surfaces to receive flooring system with a mobile steel shot, dust recycling machine (Blastrac or equal). All surface and embedded accumulations of paint, toppings hardened concrete layers, laitance, power trowel finishes and other similar surface characteristics shall be completely removed leaving a bare concrete surface having a minimum profile of CSP 4-5 as described by the International Concrete Repair Institute.
 - b. Floor areas inaccessible to the mobile blast machines shall be mechanically abraded to the same degree of cleanliness, soundness and profile using diamond grinders, needle guns, bush hammers, or other suitable equipment.
 - c. Where the perimeter of the substrate to be coated is not adjacent to a wall or curb, a minimum 1/4 inch key cut shall be made to properly seat the system, providing a smooth transition between areas. The detail cut shall also apply to drain perimeters and expansion joint edges.
 - d. Cracks and joints (non-moving) greater than 1/8 inch wide are to be chiseled or chipped-out and repaired per manufacturer's recommendations.
 5. At spalled or worn areas, mechanically remove loose or delaminated concrete to a sound concrete and patch per manufacturer's recommendations.

3.3 APPLICATION

A. General:

1. The system shall be applied in seven distinct steps as listed below:
 - a. Substrate preparation.
 - b. Priming.
 - c. First broadcast coat application with first aggregate broadcast.
 - d. Second broadcast coat with second aggregate broadcast.
 - e. Topcoat application, urethane.
2. Immediately prior to the application of any component of the system, the surface shall be dry and any remaining dust or loose particles shall be removed using a vacuum or clean, dry, oil-free compressed air.
3. The handling, mixing and addition of components shall be performed in a safe manner to achieve the desired results in accordance with the Manufacturer's recommendations.

4. The system shall follow the contour of the substrate unless pitching or other leveling work has been specified by the Architect.
5. A neat finish with well-defined boundaries and straight edges shall be provided by the Applicator.

B. Primer:

1. The primer shall consist of a liquid resin and hardener that is mixed at the ratio of 1 parts resin to 4 part hardener per the manufacturer's instructions.
2. The primer shall be applied by flat squeegee and back rolled at the rate of 200-250 sf/gal to yield a dry film thickness of 4 mils.

C. Broadcast Coat:

1. The broadcast coat shall be applied as a double broadcast system as specified by the Architect.
2. The broadcast coat shall be comprised of two components, a resin, and hardener as supplied by the Manufacturer and mixed in the ratio of 2 parts resin to 1 part hardener.
3. The resin shall be added to the hardener and thoroughly mixed by suitably approved mechanical means.
4. The broadcast coat shall be applied over horizontal surfaces using "v" notched squeegee and back rolled at the rate of 90-100 sf/gal.
5. Quartz aggregate shall be broadcast to excess into the wet material at the rate of 0.5 lbs/sf.
6. Allow material to fully cure. Vacuum, sweep and/or blow to remove all loose aggregate.
7. Apply a second coat of resin with a coverage rate of 90-100 sf/gal and broadcast aggregate to excess at the rate of 0.5 lbs/sf.
8. Allow material to fully cure. Vacuum, sweep and/or blow to remove all loose aggregate.

D. Grout Coat:

1. The grout coat shall be comprised of liquid components, combined at a ratio of 2 parts resin to 1 part hardener by volume and shall be thoroughly blended by mechanical means such as a high speed paddle mixer.
2. The grout coat shall be squeegee applied with a coverage rate of 90 sf/gal (flintshot) or 50 sf/gal (Q-Rok).
3. The grout coat will be back rolled and cross rolled to provide a uniform texture and finish.

E. Topcoat (Urethane):

1. The topcoat of Armor Top shall be roller applied at the rate of 500 sf/gal to yield a dry film thickness of 3 mils.
2. The topcoat shall be comprised of a liquid resin, hardener and grit that is mixed per the manufacturer's instructions.
3. The finished floor will have a nominal thickness of 1/8 inch.

3.4 CLEANING AND PROTECTING

- A. Cure flooring material in compliance with manufacturer's directions, taking care to prevent their contamination during stages of application and prior to completion of the curing process.
- B. Remove masking. Perform detail cleaning at floor termination, to leave cleanable surface for subsequent work of other sections.

END OF SECTION 096723

SECTION 096813 - TILE CARPETING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes modular carpet tile.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include manufacturer's written data on physical characteristics, durability, and fade resistance.
 - 2. Include manufacturer's written installation recommendations for each type of substrate.
- B. Samples for Initial Selection: For each type of carpet tile.
 - 1. Include Samples of exposed edge, transition, and other accessory stripping involving color or finish selection.
- C. Samples for Verification: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.
 - 1. Carpet Tile: Full-size Sample.
 - 2. Exposed Edge, Transition, and Other Accessory Stripping: 12-inch-long Samples.
- D. Product Schedule: For carpet tile. Use same designations indicated on Drawings.
- E. Sustainable Product Certification: Provide ANSI/NSF 140 certification for carpet products.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Test Reports: For carpet tile, for tests performed by a qualified testing agency.
- C. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For carpet tiles to include in maintenance manuals. Include the following:
 - 1. Methods for maintaining carpet tile, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
 - 2. Precautions for cleaning materials and methods that could be detrimental to carpet tile.

1.6 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. Carpet Tile: Full-size units equal to 5 percent of amount installed for each type indicated, but not less than 10 sq. yd..

1.7 QUALITY ASSURANCE

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

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Comply with CRI's "CRI Carpet Installation Standard."

1.9 FIELD CONDITIONS

- A. Comply with CRI's "CRI Carpet Installation Standard" for temperature, humidity, and ventilation limitations.
- B. Environmental Limitations: Do not deliver or install carpet tiles until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at levels planned for building occupants during the remainder of the construction period.
- C. Do not install carpet tiles over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet tile manufacturer.
- D. Where demountable partitions or other items are indicated for installation on top of carpet tiles, install carpet tiles before installing these items.

1.10 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, the following:
 - a. More than 10 percent edge raveling, snags, and runs.
 - b. Dimensional instability.
 - c. Excess static discharge.
 - d. Loss of tuft-bind strength.
 - e. Loss of face fiber.
 - f. Delamination.
3. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CARPET TILE

- A. Manufacturer: To be determined. Refer to Section 012100 "Allowances" for carpet tile allowance.

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 comply with flammability requirements for installed carpet tile, and are recommended by carpet tile manufacturer for releasable installation.
- C. Edge/Transition Strips: Refer to Section 096513 "Resilient Base and Accessories."

PART 3 - EXECUTION

3.1 EXAMINATION

- 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.
- B. Examine carpet tile for type, color, pattern, and potential defects.
- C. Concrete Slabs: Verify that finishes comply with requirements specified in Section 033000 "Cast-in-Place Concrete" and that surfaces are free of cracks, ridges, depressions, scale, and foreign deposits.

1. Moisture Testing: Perform tests so that each test area does not exceed 200 sq. ft., and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
 - a. Anhydrous Calcium Chloride Test: ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
 - b. Relative Humidity Test: Using in situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.
 - c. Perform additional moisture tests recommended in writing by adhesive and carpet tile manufacturers. Proceed with installation only after substrates pass testing.

D. Wood Subfloors: Verify the following:

1. Underlayment over subfloor complies with requirements specified in Section 061600 "Sheathing."
2. Underlayment surface is free of irregularities and substances that may interfere with adhesive bond or show through surface.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. General: Comply with CRI's "Carpet Installation Standards" and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile.
- B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch wide or wider, and protrusions more than 1/32 inch unless more stringent requirements are required by manufacturer's written instructions.
- C. Concrete Substrates: Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by adhesive and carpet tile manufacturers.
- D. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

3.3 INSTALLATION

- A. General: Comply with CRI's "CRI Carpet Installation Standard," Section 18, "Modular Carpet" and with carpet tile manufacturer's written installation instructions.
- B. Installation Method: As recommended in writing by carpet tile manufacturer.
- C. Maintain dye-lot integrity. Do not mix dye lots in same area.
- D. Maintain pile-direction patterns recommended in writing by carpet tile manufacturer.

- E. 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.
- F. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.
- G. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on carpet tile as marked on subfloor. Use nonpermanent, nonstaining marking device.
- H. Install pattern parallel to walls and borders.

3.4 CLEANING AND PROTECTION

- A. Perform the following operations immediately after installing carpet tile:
 - 1. Remove excess adhesive 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.
- B. Protect installed carpet tile to comply with CRI's "Carpet Installation Standard," Section 20, "Protecting Indoor Installations."
- C. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

END OF SECTION 096813

SECTION 099113 - EXTERIOR PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes surface preparation and the application of paint systems on the following exterior substrates:
 - 1. Steel and iron.
 - 2. Galvanized metal.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
 - 1. Indicate VOC content.
- B. Samples for Initial Selection: For each type of topcoat product.
- C. Samples for Verification: For each type of paint system and each color and gloss of topcoat.
 - 1. Submit Samples on rigid backing, 8 inches square.
 - 2. Apply coats on Samples in steps to show each coat required for system.
 - 3. Label each coat of each Sample.
 - 4. Label each Sample for location and application area.
- D. Product List: Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules. Include color designations.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Coating Maintenance Manual: Upon conclusion of the project, the Contractor or paint manufacturer/supplier shall furnish a coating maintenance manual, such as Sherwin-Williams "Custodian Project Color and Product Information" report or equal. Manual shall include an Area Summary with finish schedule, Area Detail designating where each product/color/finish was used, product data pages, Material Safety Data Sheets, care and cleaning instructions, touch-up procedures, and color samples of each color and finish used.

1.5 QUALITY ASSURANCE

- A. Applicator Qualifications: Engage an experienced Applicator who has completed painting system applications similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance.
- B. Source Limitations: Obtain block fillers, primers and undercoat materials for each coating system from the same manufacturer as the finish coats.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.
 - 1. Maintain containers in clean condition, free of foreign materials and residue.
 - 2. Remove rags and waste from storage areas daily.

1.7 FIELD CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.
- B. Do not apply paints in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Benjamin Moore & Co.
 - 2. California Paints.
 - 3. PPG Architectural Finishes, Inc. (Pittsburgh Paints, Glidden Professional, Flood Stains)
 - 4. Sherwin-Williams Company (The).
- B. Products: Subject to compliance with requirements, provide one of the products listed in the Exterior Painting Schedule for the paint category indicated.

2.2 PAINT, GENERAL

- A. Material Compatibility:
 - 1. Materials for use within each paint system shall be 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, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.

B. Colors: As selected by Architect from manufacturer's full range.

1. Allow for up to 5 different color selections.

2.3 METAL PRIMERS

A. Ferrous-Metal Primer: Factory-formulated rust-inhibitive metal primer for exterior application.

1. Benjamin Moore; Moore's IMC Acrylic Metal Primer No. M04.
2. California; Rust Stop DTM 100% Acrylic Latex Metal Primer.
3. Devco Coatings; 4020-1000 Devflex 4020PF DTM Primer & Flat Finish. (91 g/L)
4. Pittsburgh Paints; 90-712 Pitt-Tech One Pack Interior/Exterior Primer Finish DTM Industrial Enamel. (123 g/L)
5. Sherwin-Williams; IMC DTM Acrylic Primer/Finish, B66W1. (150 g/L)

B. Galvanized Metal Primer: Factory-formulated galvanized metal primer for exterior application.

1. Benjamin Moore; Moore's IMC Acrylic Metal Primer No. M04.
2. Devco Coatings; 4020-1000 Devflex 4020PF DTM Primer & Flat Finish. (91 g/L)
3. Pittsburgh Paints; 90-709 Pitt-Tech One Pack Interior/Exterior Primer/Finish DTM Industrial Enamel. (123 g/L)
4. Sherwin-Williams; IMC DTM Acrylic Primer/Finish, B66W1. (150 g/L)

2.4 EXTERIOR LATEX PAINTS

A. Exterior Semi-Gloss Acrylic Enamel: Factory-formulated semi-gloss acrylic enamel for exterior application.

1. Benjamin Moore; DTM Acrylic Semi-Gloss Enamel M29: Applied at a dry film thickness of not less than 2.0 mils.
2. California Paints; Rust Stop DTM 100% Acrylic Semi-Gloss, 10XX.
3. Devco Coatings; 4216-XXXX, High Performance Waterborne Acrylic Semi-Gloss Enamel.
4. Pittsburgh Paints; 6-900XI Speedhide Exterior Semi-Gloss Latex: Applied at a dry film thickness of not less than 1.5 mils.
5. Sherwin-Williams; IMC DTM Acrylic Coating Semi-Gloss (Waterborne) B66W200 Series. (250 g/L)

2.5 EXTERIOR HIGH PERFORMANCE PAINTS

A. Exterior Ferrous Metal: (Surface Preparation: SSPC-SP6)

1. Coat 1: Tnemec Series 90-97 Tnemec-Zinc (shop applied) at 3.0 mils DFT
2. Coat 2: Tnemec Series 27 Typoxy (shop applied) at 3.0 mils DFT
3. Coat 3: Tnemec Series 1075 Endura-Shield II at 3.0 mils DFT

4. Coat 4: Tnemec Series 1071/1072 Flouronar or Tnemec Series 1078 Flouronar Metallic at 2.5 mils DFT

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. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.
- C. 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 Architectural Painting Specification Manual" applicable to substrates and paint systems 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.
- 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.
- D. Steel Substrates: Remove rust, loose mill scale, and shop primer if any. Clean using methods recommended in writing by paint manufacturer.
- E. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.
- F. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints. Uniformly abrade galvanized surfaces with a palm sander and 60 grit aluminum oxide so surface is free of oil and surface contaminants.

3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual."
 - 1. Use applicators and techniques suited for paint and substrate indicated.
 - 2. Paint surfaces behind movable items same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed items with prime coat only.
 - 3. Paint both sides and edges of exterior doors and entire exposed surface of exterior door frames.
 - 4. Paint entire exposed surface of window frames and sashes.
 - 5. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
 - 6. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.
- B. Tinting: Tint primer of colors such as reds, yellows, and oranges with a gray basecoat system designed to help provide color coverage.
- C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance. Give special attention to ensure edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces. When using colors such as red, yellow or orange, an extra coat of finish may be necessary. Notify Architect when additional coats do not fix the problem.
- D. 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.
- E. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:
 - 1. Paint the following work where exposed to view:
 - a. Equipment, including panelboards and switch gear.
 - b. Uninsulated metal piping.
 - c. Uninsulated plastic piping.
 - d. Pipe hangers and supports.
 - e. Metal conduit.
 - f. Plastic conduit.
 - g. Tanks that do not have factory-applied final finishes.

3.4 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

- C. 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.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.5 EXTERIOR PAINTING SCHEDULE

A. Steel and Iron Substrates:

- 1. Acrylic Enamel Coating System:
 - a. Prime Coat: Primer, rust inhibitive, water based. Apply over shop primer.
 - b. Intermediate Coat: Acrylic enamel, matching topcoat.
 - c. Topcoat: Acrylic enamel, semi-gloss (MPI Gloss Level 5).
- 2. High Performance Paint System: Apply to exposed steel columns by the Entry.

B. Galvanized-Metal Substrates:

- 1. Acrylic Enamel Coating System:
 - a. Prime Coat: Primer, rust inhibitive, water based. Apply over shop primer.
 - b. Intermediate Coat: Acrylic enamel, matching topcoat.
 - c. Topcoat: Acrylic enamel, semi-gloss (MPI Gloss Level 5).

END OF SECTION 099113

SECTION 099123 - INTERIOR PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes surface preparation and the application of paint systems on the following interior substrates:
 - 1. Steel and iron.
 - 2. Galvanized metal.
 - 3. Gypsum board.
 - 4. Plastic.
 - 5. Cotton or canvas insulation covering.
 - 6. ASJ insulation covering.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
 - 1. Indicate VOC content.
- B. Samples for Initial Selection: For each type of topcoat product.
- C. Samples for Verification: For each type of paint system and in each color and gloss of topcoat.
 - 1. Submit Samples on rigid backing, 8 inches square.
 - 2. Apply coats on Samples in steps to show each coat required for system.
 - 3. Label each coat of each Sample.
 - 4. Label each Sample for location and application area.
- D. Product List: Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules. Include color designations.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Coating Maintenance Manual: Upon conclusion of the project, the Contractor or paint manufacturer/supplier shall furnish a coating maintenance manual, such as Sherwin-Williams "Custodian Project Color and Product Information" report or equal. Manual shall include an Area Summary with finish schedule, Area Detail designating where each product/color/finish

was used, product data pages, Material Safety Data Sheets, care and cleaning instructions, touch-up procedures, and color samples of each color and finish used.

1.5 QUALITY ASSURANCE

- A. Applicator Qualifications: Engage an experienced Applicator who has completed painting system applications similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance.
- B. Source Limitations: Obtain block fillers, primers and undercoat materials for each coating system from the same manufacturer as the finish coats.
- C. 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.
 - 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.
 - 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.
 - 1. Maintain containers in clean condition, free of foreign materials and residue.
 - 2. Remove rags and waste from storage areas daily.

1.7 FIELD CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.
- B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Benjamin Moore & Co.
 2. California Paints.
 3. PPG Architectural Finishes, Inc. (Pittsburgh Paints, Glidden Professional, Flood Stains)
 4. Sherwin-Williams Company (The).
- B. Products: Subject to compliance with requirements, provide one of the products listed in the Interior Painting Schedule for the paint category indicated.

2.2 PAINT, GENERAL

- A. Material Compatibility:
1. Materials for use within each paint system shall be 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, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.
- B. Colors: As selected by Architect from manufacturer's full range.
1. Allow for up to 10 different color selections.

2.3 PRIMERS/SEALERS

- A. Low-VOC Latex Primer/Sealer:
1. Cal: Envirotech Zero VOC Interior Latex Primer/Sealer, 64600.
 2. Moore: Pristine Eco Spec Interior Latex Primer Sealer, No. 231
 3. Glidden Professional: 9116-1200 LifeMaster No VOC Interior Primer. (0 g/L)
 4. PPG: Pure Performance Interior Latex Primer, 9-900 Series. (0 g/L)
 5. SW: ProMar 200 Zero VOC Interior Latex Primer B28W02600 Series. (0 g/L)]
- B. High-Build Primer/Sealer:
1. Cal: Hide-A-Spray, 91-20. (VOC 76 g/L)
 2. Glidden Professional: 1040-1200, High Build Surfacer Interior Primer Sealer. (100g/L)
 3. PPG: 6-1 Speedhide Interior MaxBuild High Build Surfacer. (<50 g/L)
 4. SW: PrepRite High Build Interior Latex Primer/Surfacer B28W601 (VOC 74 g/L).
 5. Moore: Super Spec Satin-Fil 172 (VOC 31g/L)

2.4 METAL PRIMERS

A. Rust-Inhibitive Primer (Water Based):

1. Cal: Rust Stop DTM 100% Acrylic Semi-Gloss, 10XX.
2. Devoe Coatings: 4020-1000 Devflex 4020PF DTM Primer & Flat Finish. (91 g/L)
3. Moore: IMC Acrylic Metal Primer M04. (51 g/L)
4. Pittsburgh Paints; 90-712 Pitt-Tech One Pack Interior/Exterior Primer Finish DTM Industrial Enamel. (123 g/L)
5. S-W: IMC Pro-Cryl Universal Primer, B66-310 Series. (100 g/L)

2.5 WOOD PRIMERS

A. Latex-Based Wood Primer:

1. Cal: ASAP "30" 50300.
2. Glidden Professional: 3210-1200 Gripper Interior/Exterior Primer Sealer. (100 g/L)
3. Moore: Super Spec Latex Enamel Undercoater & Primer Sealer #253.
4. PPG: Seal Grip Interior Primer/Finish, 17-951. (45 g/L)
5. S-W: PrepRite Classic Latex Primer B28W101 Series.

B. Wood-Knot Sealer: Sealer recommended in writing by topcoat manufacturer for use in paint systems indicated.

2.6 LATEX PAINTS

A. Low-VOC Latex (Flat):

1. California Paints: Envirotech Zero VOC 100% Acrylic Flat, 633XX.
2. Glidden Professional: 1209-XXXXN Ultra-hide No VOC Interior Flat Paint (0 g/L)
3. Moore: Eco Spec Interior Latex Flat, No. 219.
4. PPG: 6-4110XI Series, Speedhide zero Interior Zero VOC Interior Flat Latex. (0 g/L)
5. SW: ProMar 200 Zero VOC Interior Latex Flat B30-2600 Series. (0 g/L)]

B. Low-VOC Latex (Low Luster):

1. California Paints: Envirotech Zero VOC 100% Acrylic Eggshell, 631XX.
2. Glidden Professional: 1411-XXXX Ultra-hide No VOC Interior Eggshell Paint (0 g/L)
3. Moore: Pristine Eco Spec Interior Latex Eggshell, No. 223
4. PPG: 6-4310XI Series, Speedhide zero Interior Zero VOC Latex Eggshell Interior. (0 g/L)
5. SW: ProMar 200 Zero VOC Interior Latex Eg-Shell B20-2600 Series. (0 g/L)]

C. Low-VOC Latex (Semi-gloss):

1. California Paints: Envirotech Zero VOC 100% Acrylic Semi-Gloss, 663XX.
2. Glidden Professional: 1415-XXXXN Ultra-hide No VOC Interior Semi-Gloss Paint (0 g/L)

3. Moore: Pristine Acrylic Semi-Gloss, No. 214
4. PPG: 6-4510XI Series, Speedhide zero Interior Zero VOC Latex Semi-Gloss. (0 g/L)
5. SW: ProMar 200 Zero VOC Interior Latex Semi-Gloss B31-2600 Series. (0 g/L)]

2.7 HIGH PERFORMANCE EPOXY PAINTS

A. Waterborne Epoxy Finish:

1. Moore: Moorcraft Super Spec Acrylic Epoxy Coating No. 256.
2. PPG: 98-1 Aquapon WB Water Base Epoxy (250 g/L)
3. S-W: IMC Water Based Catalyzed Epoxy Gloss, B70 Series. (200 g/L)

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. Masonry (Clay and CMUs): 12 percent.
 3. Gypsum Board: 12 percent.
- C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.
- D. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.
- E. 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 Architectural Painting Specification Manual" applicable to substrates and paint systems 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.
- D. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceeds that permitted in manufacturer's written instructions.
- E. Steel Substrates: Remove rust, loose mill scale, and shop primer, if any. Clean using methods recommended in writing by paint manufacturer.
- F. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.
- G. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints. Uniformly abrade galvanized surfaces with a palm sander and 60 grit aluminum oxide so surface is free of oil and surface contaminants.
- H. Wood Substrates:
 - 1. Scrape and clean knots, and apply coat of knot sealer before applying primer.
 - 2. Sand surfaces that will be exposed to view, and dust off.
 - 3. Prime edges, ends, faces, undersides, and backsides of wood.
 - 4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.
- I. Cotton or Canvas Insulation Covering Substrates: Remove dust, dirt, and other foreign material that might impair bond of paints to substrates.

3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions and to recommendations in "MPI Manual."
 - 1. Use applicators and techniques suited for paint and substrate indicated.
 - 2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
 - 3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
 - 4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
 - 5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.

- B. Tinting: Tint primer of colors such as reds, yellows, and oranges with a gray basecoat system designed to help provide color coverage.
 - 1. Do not tint prime or base coat for multi-colored finishes.
- C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance. Give special attention to ensure edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces. When using colors such as red, yellow or orange, an extra coat of finish may be necessary. Notify Architect when additional coats do not fix the problem.
- D. 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.
- E. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:
 - 1. Paint the following work where exposed in equipment rooms: Not applicable.
 - 2. Paint the following work where exposed in occupied spaces:
 - a. Equipment, including panelboards.
 - b. Uninsulated metal piping.
 - c. Uninsulated plastic piping.
 - d. Pipe hangers and supports.
 - e. Metal conduit.
 - f. Plastic conduit.
 - g. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
 - h. Other items as directed by Architect.
 - 3. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.

3.4 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. 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.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.5 INTERIOR PAINTING SCHEDULE

- A. CMU Substrates:
 - 1. High-Performance Epoxy System:
 - a. Block Filler: Block filler, latex, interior/exterior.
 - b. Intermediate Coat: High performance epoxy, matching topcoat.
 - c. Topcoat: Latex, interior, high performance epoxy, semi-gloss (MPI Gloss Level 5).
- B. Steel Substrates: interior hollow metal doors and frames, borrow lites, wood door metal window frames, exposed piping.
 - 1. Low-Odor/VOC Latex System:
 - a. Prime Coat: Primer, rust inhibitive, water based.
 - b. Intermediate Coat: Latex, interior, low odor/VOC, matching topcoat.
 - c. Topcoat: Latex, interior, low odor/VOC, semi-gloss (MPI Gloss Level 5).
- C. Galvanized-Metal Substrates: Exterior hollow metal doors and frames.
 - 1. Low-Odor/VOC Latex System:
 - a. Prime Coat: Primer, rust inhibitive, water based.
 - b. Intermediate Coat: Latex, interior, low odor/VOC, matching topcoat.
 - c. Topcoat: Latex, interior, low odor/VOC, semi-gloss (MPI Gloss Level 5).
- D. Plastic Substrates: Exposed plastic piping.
 - 1. Low-Odor/VOC Latex System:
 - a. Prime Coat: Primer, latex, for interior wood.
 - b. Intermediate Coat: Latex, interior, low odor/VOC, matching topcoat.
 - c. Topcoat: Latex, interior, low odor/VOC, flat (MPI Gloss Level 1).
- E. Gypsum Board Substrates:
 - 1. Low-Odor/VOC Latex System:
 - a. Prime Coat: Primer sealer, interior, low odor/VOC.
 - b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
 - c. Topcoat: Latex, interior, institutional low odor/VOC, flat (MPI Gloss Level 1) for ceilings.
 - d. Topcoat: Latex, interior, institutional low odor/VOC eggshell (MPI Gloss Level 3) for walls.
- F. Fiberglass-Faced Gypsum Board Substrates:
 - 1. Low-Odor/VOC Latex System:
 - a. Prime Coat: High-Build Primer/Sealer.

- a. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
 - b. Topcoat: Latex, interior, institutional low odor/VOC eggshell (MPI Gloss Level 3).
- G. Cotton or Canvas and ASJ Insulation-Covering Substrates: Including pipe and duct coverings.
- 1. Low-Odor/VOC Latex System:
 - a. Prime Coat: Primer sealer, interior, low odor/VOC.
 - b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
 - c. Topcoat: Latex, interior, institutional low odor/VOC, flat (MPI Gloss Level 1).

END OF SECTION 099123

SECTION 099300 - STAINING AND TRANSPARENT FINISHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes surface preparation and application of wood stains and transparent finishes on the following substrates:
 - 1. Exterior Substrates:
 - a. Exposed glued-laminated beams and columns.
 - b. Exposed cross-laminate members.
 - c. Dressed lumber (finish carpentry or wood siding).
 - 2. Interior Substrates:
 - a. Exposed glued-laminated beams and columns.
 - b. Exposed cross-laminate members.
 - c. Dressed lumber (finish carpentry or woodwork).

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
 - 1. Include printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.
 - 2. Indicate VOC content.
- B. Samples for Initial Selection: For each type of product.
- C. Samples for Verification: For each type of finish system and in each color and gloss of finish required.
 - 1. Submit Samples on representative samples of actual wood substrates, 8 inches square or 8 inches long.
 - 2. Apply coats on Samples in steps to show each coat required for system.
 - 3. Label each coat of each Sample.
 - 4. Label each Sample for location and application area.

- D. Product List: Cross-reference to finish system and locations of application areas. Use same designations indicated on Drawings and in schedules. Include color designations.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Coating Maintenance Manual: Upon conclusion of the project, the Contractor or paint manufacturer/supplier shall furnish a coating maintenance manual, such as Sherwin-Williams "Custodian Project Color and Product Information" report or equal. Manual shall include an Area Summary with finish schedule, Area Detail designating where each product/color/finish was used, product data pages, Material Safety Data Sheets, care and cleaning instructions, touch-up procedures, and color samples of each color and finish used.

1.5 QUALITY ASSURANCE

- A. Applicator Qualifications: Engage an experienced Applicator who has completed painting system applications similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance.
- B. Source Limitations: Obtain sealer materials for each coating system from the same manufacturer as the finish coats.
- C. Mockups: Apply mockups of each finish system indicated and each color selected to verify preliminary selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
 - 1. Architect will select one surface to represent surfaces and conditions for application of each type of finish system and substrate.
 - 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 stain color selections will be based on mockups.
 - a. If preliminary stain color selections are not approved, apply additional mockups of additional stain colors selected by Architect at no added cost to Owner.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.
 - 1. Maintain containers in clean condition, free of foreign materials and residue.
 - 2. Remove rags and waste from storage areas daily.

1.7 FIELD CONDITIONS

- A. Apply finishes only when temperature of surfaces to be finished and ambient air temperatures are between 50 and 95 deg F.

- B. Do not apply finishes when relative humidity exceeds 85 percent, at temperatures less than 5 deg F above the dew point, or to damp or wet surfaces.
- C. Do not apply exterior finishes in snow, rain, fog, or mist.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Benjamin Moore & Co.
 - 2. California Paints.
 - 3. PPG Architectural Finishes, Inc. (Pittsburgh Paints, Glidden Professional, Flood Stains, Sikkens)
 - 4. Samuel Cabot Incorporated.
 - 5. Sherwin-Williams Company (The)
- B. Products: Subject to compliance with requirements, provide one of the products listed in wood finish systems schedules for the product category indicated.

2.2 MATERIALS, GENERAL

- A. Material Compatibility:
 - 1. Materials for use within each paint system shall be 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, products shall be recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

2.3 VARNISHES

- A. Alkyd-Based Varnish:
 - 1. Sikkens: Cetol 1.

2.4 POLYURETHANE VARNISHES

- A. Waterborne Clear Acrylic (Satin):
 - 1. Ben Moore: Lenmar Aqua Plastic Waterborne Clear Satin, 1WB-1427.
 - 2. PPG: Olympic 42786 Interior Acrylic Polyurethane Satin Clear Finish.
 - 3. S-W: Minwax Polycrylic.

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 Exterior Wood Substrates: 15 percent, when measured with an electronic moisture meter.
- C. Maximum Moisture Content of Interior Wood Substrates: 10 percent, when measured with an electronic moisture meter.
- D. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- E. Proceed with finish application only after unsatisfactory conditions have been corrected.
 - 1. Beginning finish application constitutes Contractor's acceptance of substrates and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and finishing.
 - 1. After completing finishing operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
- C. Clean and prepare surfaces to be finished according to manufacturer's written instructions for each substrate condition and as specified.
 - 1. Remove dust, dirt, oil, and grease by washing with a detergent solution; rinse thoroughly with clean water and allow to dry. Remove grade stamps and pencil marks by sanding lightly. Remove loose wood fibers by brushing.
 - 2. Remove mildew by scrubbing with a commercial wash formulated for mildew removal and as recommended by stain manufacturer.
- D. Exterior Wood Substrates:
 - 1. Scrape and clean knots, and apply coat of knot sealer before applying primer.
 - 2. Prime edges, ends, faces, undersides, and backsides of wood.
 - a. For solid hide stained wood, stain edges and ends after priming.

- b. For varnish-coated stained wood, stain edges and ends and prime with varnish. Prime undersides and backsides with varnish.
 3. Countersink steel nails, if used, and fill with putty or plastic wood filler tinted to final color. Sand smooth when dried.
- E. Interior Wood Substrates:
 1. Scrape and clean knots, and apply coat of knot sealer before applying primer.
 2. Apply wood filler paste to open-grain woods, as defined in "MPI Architectural Painting Specification Manual," to produce smooth, glasslike finish.
 3. Sand surfaces exposed to view and dust off.
 4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dry.

3.3 APPLICATION

- A. Apply finishes according to manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual."
 1. Use applicators and techniques suited for finish and substrate indicated.
 2. Finish surfaces behind movable equipment and furniture same as similar exposed surfaces.
 3. Do not apply finishes over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
- B. Apply finishes to produce surface films without cloudiness, holidays, lap marks, brush marks, runs, ropiness, or other surface imperfections.

3.4 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing finish application, clean spattered surfaces. Remove spattered materials by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from finish application. Correct damage by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced finished wood surfaces.

3.5 EXTERIOR WOOD-FINISH-SYSTEM SCHEDULE

- A. Exposed Glue-Laminated Beam and Column Substrates:

1. Varnish System:
 - a. Two Finish Coats: Alkyd-based varnish.
 - B. Exposed Cross-Laminated Lumber Substrates:
 1. Varnish System:
 - a. Two Finish Coats: Alkyd-based varnish.
 - C. Wood Substrates: Wood trim and siding.
 1. Varnish System:
 - a. Two Finish Coats: Alkyd-based varnish.
- 3.6 INTERIOR WOOD -FINISH-SYSTEM SCHEDULE
- A. Wood Substrates: Glued-laminated construction.
 1. Polyurethane Varnish System:
 - a. Prime Coat: Polyurethane varnish matching topcoat.
 - b. Intermediate Coat: Polyurethane varnish matching topcoat.
 - a. Topcoat: Varnish, interior, polyurethane, oil modified, satin (MPI Gloss Level 4).
 - B. Wood Substrates: Wood structural deck and wood ceilings and walls.
 1. Polyurethane Varnish System:
 - a. Prime Coat: Polyurethane varnish matching topcoat.
 - b. Intermediate Coat: Polyurethane varnish matching topcoat.
 - c. Topcoat: Varnish, interior, polyurethane, oil modified, satin (MPI Gloss Level 4).
 - C. Wood Substrates: Wood trim.
 1. Polyurethane Varnish System:
 - a. Prime Coat: Polyurethane varnish matching topcoat.
 - b. Intermediate Coat: Polyurethane varnish matching topcoat.
 - c. Topcoat: Varnish, interior, polyurethane, oil modified, satin (MPI Gloss Level 4).

END OF SECTION 099300

SECTION 101400 - SIGNS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following types of signs:
 - 1. Panel signs.

1.3 DEFINITIONS

- A. ADA-ABA Accessibility Guidelines: U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines."

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of sign specified, including details of construction relative to materials, dimensions of individual components, profiles, and finishes.
- B. Shop Drawings: Show fabrication and erection of signs. Include plans, elevations, and large-scale sections of typical members and other components.
 - 1. Provide message list for each sign required, including large-scale details of wording and lettering layout.
 - 2. For signs supported by or anchored to permanent construction, provide setting drawings, templates, and directions for installation of anchor bolts and other anchors to be installed as a unit of Work in other Sections.
- C. Samples for Selection: Manufacturer's color charts consisting of actual units or sections of units showing the full range of colors available.

1.5 INFORMATION SUBMITTALS

- A. Warranty: Special warranty specified in this Section.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For signs to include in maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Sign Fabricator Qualifications: Firm experienced in producing signs similar to those indicated for this Project, with a record of successful in-service performance, and sufficient production capacity to produce sign units required without causing delay in the Work.
- B. Single-Source Responsibility: For each separate sign type required, obtain signs from one source of a single manufacturer.
- C. Regulatory Requirements: Comply with the Americans with Disabilities Act (ADA) and with code provisions as adopted by authorities having jurisdiction.
- D. Design Concept: The Drawings indicate sizes, profiles, and dimensional requirements of signs and are based on the specific types and models indicated. Sign units by other manufacturers may be considered provided deviations in dimensions and profiles do not change the design concept as judged by the Architect. The burden of proof of equality is on the proposer.

1.8 PROJECT CONDITIONS

- A. Field Measurements: Take field measurements prior to preparation of shop drawings and fabrication to ensure proper fitting. Show recorded measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delay.

1.9 COORDINATION

- A. Coordinate placement of anchorage devices with templates for installing signs.

1.10 WARRANTY

- A. Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Deterioration of polymer finishes beyond normal weathering.
 - b. Deterioration of embedded graphic image colors and sign lamination.
 - 2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Acrylic Sheet: ASTM D 4802, Category A-1 (cell-cast sheet), Type UVA (UV absorbing).

2.2 PANEL SIGNS

- 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. Mohawk Sign Systems.
 - 2. Welch Architectural Signage.
- B. Substrate: Fabricate signs from 1/8 inch thick matte clear acrylic with edges mechanically and smoothly finished to eliminate cut marks. Background color to be subsurface.
 - 1. Background Color: As selected by the Architect from manufacturer's standard colors.
 - 2. Edge Condition: Straight.
 - 3. Corner Condition: Rounded to 3/8 inch radius.
 - 4. Size: 6 by 6 inch, unless noted otherwise.
- C. Copy: Complying with ADA Accessibility Guidelines.
- D. Letterform: Route copy into face of substrate 1/32 inch deep. Chemically weld (inlay) computer precision cut tactile copy into routed letter openings so that tactile copy is embedded in substrate and remains at least 1/32" above surface of substrate.
 - 1. Height: 5/8 inch minimum letter height.
- E. Braille: Use engrave process for all Braille areas. Engrave Braille dots into surface of clear material.
- F. Symbols of Accessibility:
 - 1. Accessible elements: Provide international symbol of accessibility.
 - a. Provide male and female symbols as required for toilets.
 - 2. Elevators: Provide symbol containing person on stairs with flame.
- G. Provide characters complying with ADA Accessibility Guidelines and ICC/ANSI A117.1. Text shall be accompanied by Grade 2 braille.

2.3 ACRYLIC SHEET FINISHES

- A. Colored Coatings for Acrylic Sheet: For copy and background colors, provide colored coatings, including inks, dyes, and paints, that are recommended by acrylic manufacturers for optimum adherence to acrylic surface and that are UV and water resistant for five years for application intended.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.
- B. Verify that items are sized and located to accommodate signs.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Locate sign units and accessories where indicated, using mounting methods of the type described and in compliance with the manufacturer's instructions.
 - 1. Install signs level, plumb, and at the height indicated, with sign surfaces free from distortion or other defects in appearance.
 - 2. Interior Wall Signs: Install signs on walls adjacent to latch side of door where applicable. Where not indicated or possible, such as double doors, install signs on nearest adjacent walls. Locate to allow approach within 3 inches of sign without encountering protruding objects or standing within swing of door.
- B. Wall-Mounted Signs: Comply with sign manufacturer's written instructions except where more stringent requirements apply.
 - 1. Two-Face Tape: Mount signs to smooth, nonporous surfaces. Do not use this method for vinyl-covered or rough surfaces.
 - 2. Signs Mounted on Glass: Provide matching opaque plate on opposite side of glass to conceal mounting materials.

3.3 CLEANING AND PROTECTION

- A. After installation, clean soiled sign surfaces according to the manufacturer's instructions. Protect units from damage until acceptance by the Owner.

3.4 PANEL SIGN SCHEDULE

A. Types:	Sizes:	Quantity:
Men's Restrooms	Provide 8" x 6"	one for each room
Women's Restrooms	Provide 8" x 6"	one for each room
Stairs	Provide 6" x 6"	one for each door to stair
Landings	Provide 18" x 18" (per Life Safety Code)	one for each landing
Exit	Provide 6" x 6"	one for each exit

Elevator Provide 8" x 6" one between each elevator
(In case of Fire Use Stairs) at each floor

- B. Rooms with more than one entrance door shall have a sign at each door.
- C. Final room names and numbers will be verified during the submittal.
- D. Allow for 20 informational signs, 6 by 6 inch, with minimum of 15 characters each and room number.

END OF SECTION 101400

SECTION 102800 - TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Public-use washroom accessories.
 - 2. Public-use shower room accessories.
 - 3. Warm-air dryers.
 - 4. Custodial accessories.

1.3 COORDINATION

- A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.
- B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
 - 2. Include anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
 - 3. Include electrical characteristics.
- B. Samples: Full size, for each exposed product and for each finish specified.
 - 1. Approved full-size Samples will be returned and may be used in the Work.
- C. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.
 - 1. Identify locations using room designations indicated.
 - 2. Identify accessories using designations indicated.

1.5 INFORMATIONAL SUBMITTALS

- A. Sample Warranty: For manufacturer's special warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For accessories to include in maintenance manuals.

1.7 WARRANTY

- A. Manufacturer's Special Warranty for Mirrors: Manufacturer agrees to repair or replace mirrors that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, visible silver spoilage defects.
 - 2. Warranty Period: 15 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 PUBLIC-USE WASHROOM ACCESSORIES

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated in this section or substitute product by one of the following:
 - 1. A & J Washroom Accessories, Inc.
 - 2. American Specialties, Inc.
 - 3. Bradley Corporation.
 - 4. GAMCO Specialty Accessories; a division of Bobrick Washroom Equipment, Inc.
- B. Toilet Tissue (Roll) Dispenser:
 - 1. Basis-of-Design Product: Bobrick No. B-2888.
 - 2. Description: Roll-in-reserve dispenser with hinged front secured with tumbler lockset.
 - 3. Mounting: Surface mounted.
 - 4. Operation: Noncontrol delivery with standard spindle.
 - 5. Capacity: Designed for 4-1/2- or 5-inch- diameter tissue rolls.
 - 6. Material and Finish: Stainless steel, No. 4 finish (satin).
- C. Combination Towel Dispenser/Waste Receptacle: Where this designation is indicated, provide stainless-steel combination unit complying with the following:
 - 1. Products: Available products include the following:

- a. Similar to No. B-3944 by Bobrick.
 2. Recessed Type with Projecting Receptacle: Designed for nominal 4-inch wall depth with continuous, seamless wall flange; towel dispenser in unit's upper compartment designed to dispense minimum of 600 C-fold or 800 multifold paper towels; waste receptacle in unit's lower portion secured by tumbler lockset and with minimum 12-gal. capacity, reusable, vinyl liner; and upper compartment double-panel door with continuous hinge and tumbler lockset.
- D. Automatic-Soap Dispenser:
1. Basis-of-Design Product: Bobrick No. B-2013.
 2. Description: Designed for dispensing soap in foam form.
 3. Mounting: Vertically oriented, surface mounted.
 4. Capacity: 27 oz.
 5. Materials: Valve shall be sensor-activated and not require contact with the dispenser to function; and stainless-steel cover with unbreakable window-type refill indicator.
 6. Lockset: Tumbler type.
 7. Refill Indicator: Window type.
- E. Grab Bar:
1. Basis-of-Design Product: Bobrick No. B-5806 Series.
 2. Mounting: Flanges with concealed fasteners.
 3. Material: Stainless steel, 0.05 inch thick.
 - a. Finish: Smooth, No. 4 finish (satin) on ends and slip-resistant texture in grip area.
 4. Outside Diameter: 1-1/4 inches.
 5. Configuration and Length: As indicated on Drawings.
- F. Sanitary-Napkin Disposal Unit:
1. Basis-of-Design Product: Bobrick No. B-254.
 2. Mounting: Surface mounted.
 3. Door or Cover: Self-closing, disposal-opening cover.
 4. Receptacle: Removable.
 5. Material and Finish: Stainless steel, No. 4 finish (satin).
- G. Mirror Unit:
1. Basis-of-Design Product: Bobrick No. B-165.
 2. Frame: Stainless-steel channel.
 - a. Corners: Welded and ground smooth.
 3. Hangers: Produce rigid, tamper- and theft-resistant installation, using method indicated below.
 - a. One-piece, galvanized-steel, wall-hanger device with spring-action locking mechanism to hold mirror unit in position with no exposed screws or bolts.

- b. Wall bracket of galvanized steel, equipped with concealed locking devices requiring a special tool to remove.
4. Sizes: As indicated on the drawings.

2.3 PUBLIC-USE SHOWER ROOM ACCESSORIES

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated in this section or substitute product by one of the following:

1. A & J Washroom Accessories, Inc.
2. American Specialties, Inc.
3. Bradley Corporation.
4. GAMCO Specialty Accessories; a division of Bobrick Washroom Equipment, Inc.

- B. Shower Curtain Rod:

1. Basis-of-Design Product: Bobrick No. B-6047.
2. Description: 1-1/4-inch OD; fabricated from nominal 0.05-inch- thick stainless steel.
3. Mounting Flanges: Stainless-steel flanges designed for exposed fasteners.
4. Finish: No. 4 (satin).

- C. Shower Curtain:

1. Basis-of-Design Product: Bobrick No. 204-2.
2. Size: Minimum 6 inches wider than opening by 72 inches high.
3. Material: Vinyl, minimum 0.006 inch thick, opaque, matte.
4. Color: White.
5. Grommets: Corrosion resistant at minimum 6 inches o.c. through top hem.
6. Shower Curtain Hooks: Chrome-plated or stainless-steel, spring wire curtain hooks with snap fasteners, sized to accommodate specified curtain rod. Provide one hook per curtain grommet.

- D. Robe Hook:

1. Basis-of-Design Product: Bobrick B-7671.
2. Description: Single-prong unit.
3. Material and Finish: Stainless steel, No. 4 finish (satin).

- E. Towel Pin:

1. Basis-of-Design Product: Bobrick B-7677.
2. Description: Projecting minimum of 4-3/8 inches from wall surface.
3. Material and Finish: Stainless steel, No. 4 finish (satin).

2.4 CUSTODIAL ACCESSORIES

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated in this section or substitute product by one of the following:

1. A & J Washroom Accessories, Inc.
2. American Specialties, Inc.
3. Bradley Corporation.
4. GAMCO Specialty Accessories; a division of Bobrick Washroom Equipment, Inc.

B. Mop and Broom Holder:

1. Basis-of-Design Product: Bobrick No. B-223 x 36.
2. Description: 0.0375-inch thick, stainless-steel hat channel with four spring-loaded, rubber, cam-type, mop/broom holders.
3. Length: 36 inches.
4. Mop/Broom Holders: Four, spring-loaded, rubber hat, cam type.
5. Material and Finish: Stainless steel, No. 4 finish (satin).

2.5 WARM-AIR DRYERS

A. Warm-Air Dryer:

1. Basis-of-Design Product: Dyson Airblade V.
2. Mounting: Surface mounted.
3. Operation: Electronic-sensor activated with HEPA filtration.
4. Cover Material and Finish: Aluminum die-cast casing.
5. Electrical Requirements: 115 V, 12 A, 1400 W.

2.6 MATERIALS

- A. Stainless Steel: ASTM A 666, Type 304, 0.031-inch minimum nominal thickness unless otherwise indicated.
- B. Steel Sheet: ASTM A 1008/A 1008M, Designation CS (cold rolled, commercial steel), 0.036-inch minimum nominal thickness.
- C. Galvanized-Steel Sheet: ASTM A 653/A 653M, with G60 hot-dip zinc coating.
- D. Galvanized-Steel Mounting Devices: ASTM A 153/A 153M, hot-dip galvanized after fabrication.
- E. Fasteners: Screws, bolts, and other devices of same material as accessory unit and tamper-and-theft resistant where exposed, and of galvanized steel where concealed.
- F. Chrome Plating: ASTM B 456, Service Condition Number SC 2 (moderate service).
- G. Mirrors: ASTM C 1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.

2.7 FABRICATION

- A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.
- B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.
- B. Grab Bars: Install to withstand a downward load of at least 250 lbf, when tested according to ASTM F 446.

3.2 ADJUSTING AND CLEANING

- A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.
- B. Remove temporary labels and protective coatings.
- C. Clean and polish exposed surfaces according to manufacturer's written instructions.

END OF SECTION 102800

SECTION 104413 - FIRE PROTECTION CABINETS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Fire-protection cabinets for the following:
 - a. Portable fire extinguishers.
- B. Related Requirements:
 - 1. Section 104416 "Fire Extinguishers."

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Show door hardware, cabinet type, trim style, and panel style. Include roughing-in dimensions and details showing recessed-, semirecessed-, or surface-mounting method and relationships of box and trim to surrounding construction.
- B. Shop Drawings: For fire-protection cabinets. Include plans, elevations, sections, details, and attachments to other work.
- C. Samples for Verification: For each type of exposed finish required, prepared on Samples 6 by 6 inches square.
- D. Product Schedule: For fire-protection cabinets. Indicate whether recessed, semirecessed, or surface mounted. Coordinate final fire-protection cabinet schedule with fire-extinguisher schedule to ensure proper fit and function. Use same designations indicated on Drawings.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For fire-protection cabinets to include in maintenance manuals.

1.5 COORDINATION

- 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 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Fire-Protection Cabinets: Listed and labeled to comply with requirements in ASTM E 814 for fire-resistance rating of walls where they are installed.

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. JL Industries, Inc.; a division of the Activar Construction Products Group.
 - b. Larsens Manufacturing Company.
 - c. Potter Roemer LLC.
 - 2. Available Products: Subject to compliance with requirements, provide one of the following.
 - a. J.L. Industries: Cosmopolitan Series 8137F17.
 - b. Larsen's: Architectural Series SS 2409-6R.
 - c. Potter-Roemer: Alta Series 7062-A-4.
- B. Cabinet Construction: Nonrated.
 - 1. Fire-Rated Cabinets: Construct fire-rated cabinets with double walls fabricated from 0.043-inch-thick cold-rolled steel sheet lined with minimum 5/8-inch-thick fire-barrier material. Provide factory-drilled mounting holes.
- C. Cabinet Material: Cold-rolled steel sheet.
 - 1. Shelf: Same metal and finish as cabinet.
- D. Semirecessed Cabinet: One-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend).
 - 1. Rolled-Edge Trim: 2-1/2-inch backbend depth.
- E. Cabinet Trim Material: Stainless-steel sheet.
- F. Door Material: Stainless-steel sheet.
- G. Door Style: Fully glazed panel with frame.
- H. Door Glazing: Tempered float glass (clear).

- I. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.
 - 1. Provide projecting door pull and friction latch.
 - 2. Provide continuous hinge, of same material and finish as trim, permitting door to open 180 degrees.
- J. Materials:
 - 1. Cold-Rolled Steel: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B.
 - a. Finish: Baked enamel or powder coat.
 - b. Color: White.
 - 2. Stainless Steel: ASTM A 666, Type 304.
 - a. Finish: No. 4 directional satin finish.
 - 3. Tempered Float Glass: ASTM C 1048, Kind FT, Condition A, Type I, Quality q3, 3 mm thick, Class 1 (clear).

2.3 IDENTIFICATION

- A. Identification: Projecting sign with lettering complying with authorities having jurisdiction for letter style, size, spacing, and location.
 - 1. Available Products:
 - a. PTD-182 by Larsen.
 - b. PTD109 by J.L. Industries.
 - 2. Location: Applied to wall above extinguisher.
 - 3. Application Process: Pressure-sensitive tape or screw fasteners.
 - 4. Lettering Color: White on red background with graphic of fire extinguisher and arrow pointing down.

2.4 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.
 - 1. Weld joints and grind smooth.
 - 2. Provide factory-drilled mounting holes.
 - 3. Prepare doors and frames to receive locks.
 - 4. Install door locks at factory.
- B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles.

1. Fabricate door frames with tubular stiles and rails and hollow-metal design, minimum 1/2 inch thick.
 2. Fabricate door frames of one-piece construction with edges flanged.
 3. Miter and weld perimeter door frames.
- C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

2.5 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's AMP 500, "Metal Finishes Manual for Architectural and Metal Products," for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces of fire-protection cabinets from damage by applying a strippable, temporary protective covering before shipping.
- C. Finish fire-protection cabinets after assembly.
- D. 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.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine walls and partitions for suitable framing depth and blocking where recessed or semirecessed cabinets will be installed.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare recesses for recessed or semirecessed fire-protection cabinets as required by type and size of cabinet and trim style.

3.3 INSTALLATION

- A. General: Install fire-protection cabinets in locations and at mounting heights indicated or, if not indicated, at heights indicated below:
 1. Fire-Protection Cabinets: 54 inches above finished floor to top of cabinet.
- B. Fire-Protection Cabinets: Fasten cabinets to structure, square and plumb.
 1. Unless otherwise indicated, provide recessed fire-protection cabinets. If wall thickness is inadequate for recessed cabinets, provide semirecessed fire-protection cabinets.

2. Provide inside latch and lock for break-glass panels.
 3. Fasten mounting brackets to inside surface of fire-protection cabinets, square and plumb.
- C. Identification: Install identification above fire extinguisher cabinet.

3.4 ADJUSTING AND CLEANING

- A. Remove temporary protective coverings and strippable films, if any, as fire-protection cabinets are installed unless otherwise indicated in manufacturer's written installation instructions.
- B. Adjust fire-protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.
- C. On completion of fire-protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.
- D. Touch up marred finishes, or replace fire-protection cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by fire-protection cabinet and mounting bracket manufacturers.
- E. 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

SECTION 104416 - FIRE EXTINGUISHERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes portable, hand-carried fire extinguishers and mounting brackets for fire extinguishers.
- B. Related Requirements:
 - 1. Section 104413 "Fire Protection Cabinets."

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include rating and classification, material descriptions, dimensions of individual components and profiles, and finishes for fire extinguisher and mounting brackets.
- B. Product Schedule: For fire extinguishers. Coordinate final fire-extinguisher schedule with fire-protection cabinet schedule to ensure proper fit and function. Use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

- A. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fire extinguishers to include in maintenance manuals.

1.6 COORDINATION

- A. Coordinate type and capacity of fire extinguishers with fire-protection cabinets to ensure fit and function.

1.7 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 PERFORMANCE REQUIREMENTS

- 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.
 - 1. Provide fire extinguishers approved, listed, and labeled by FM Global.

2.2 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

- A. Fire Extinguishers: Type, size, and capacity for each fire-protection cabinet and mounting bracket indicated.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Amerex Corporation.
 - b. Ansul Incorporated; Tyco International.
 - c. Badger Fire Protection.
 - d. Buckeye Fire Equipment Company.
 - e. JL Industries, Inc.; a division of the Activar Construction Products Group.
 - f. Kidde Residential and Commercial Division.
 - g. Larsens Manufacturing Company.
 - h. Potter Roemer LLC.
 - 2. Valves: Manufacturer's standard.
 - 3. Handles and Levers: Manufacturer's standard.
 - 4. 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 in Steel Container: UL-rated 4-A:60-B:C, 10-lb (4.5-kg) nominal capacity, with monoammonium phosphate-based dry chemical in enameled-steel container.

2.3 MOUNTING BRACKETS

- A. Mounting Brackets: Manufacturer's standard steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or black baked-enamel finish.

2.4 IDENTIFICATION

- A. Identification: Projecting sign with lettering complying with authorities having jurisdiction for letter style, size, spacing, and location.
 - 1. Available Products:
 - a. PTD-182 by Larsen.
 - b. PTD109 by J.L. Industries.
 - 2. Location: Applied to wall above extinguisher.
 - 3. Application Process: Pressure-sensitive tape or screw fasteners.
 - 4. Lettering Color: White on red background with graphic of fire extinguisher and arrow pointing down.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine fire extinguishers for proper charging and tagging.
 - 1. Remove and replace damaged, defective, or undercharged fire extinguishers.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install fire extinguishers and mounting brackets in locations indicated and in compliance with requirements of authorities having jurisdiction.
 - 1. Mounting Brackets: 54 inches above finished floor to top of fire extinguisher.
- B. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.
- C. Install a fire extinguisher in each fire extinguisher cabinet.

- D. Identification: Install identification above each wall-mounted fire extinguisher.

END OF SECTION 104416

SECTION 108000 - OTHER SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Recirculating range hood with fire suppression.

1.2 SUBMITTALS

- A. Product Data: Include construction details, material descriptions and thicknesses, dimensions, profiles, fastening and mounting methods, specified options, and finishes for each type of accessory specified.

PART 2 - PRODUCTS

2.1 RECIRCULATING RANGE HOOD WITH FIRE SUPPRESSION

- A. Hood shall be D1000-F Series by DENLAR Fire Protection.
- B. Unit shall be wall mounted so that the bottom of the mounting bracket sits 24" to 30" above the cooktop.
- C. Unit shall be of stainless steel construction (#18 & #20 GA, polished 304) w/ no sharp edges and brushed finish.
- D. Unit shall have fire suppression system factory installed.
- E. Activation of the mechanical fire suppression system shall be by 212 degree fusible link.
- F. Wet chemical extinguishing agent: Low PH Amerex 660 (pressurized potassium citrate / potassium acetate mix).
- G. Unit shall have centrifugal fan with air delivery of 380 to 610 cfm, fan speed controller will be infinitely variable.
- H. Unit shall be ETL listed, tested to UL300A standards, fan motor shall be permanently lubricated and meet UL507.
- I. Unit shall include a fuel shut-off device for gas & electric appliances, activated at suppression system discharge.
- J. Unit shall also automatically disconnect range element once a certain pre-set temperature is reached.

- K. Unit shall have multiple alarm contacts pre-installed (local, remote & trouble alarms) and an audible buzzer.
- L. Lighting shall be by 60w shatter-proof bulb.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.

3.2 ADJUSTING AND CLEANING

- A. Adjust specialties for unencumbered, smooth operation and verify that mechanisms function properly. Replace damaged or defective items.

3.3 CLEANING

- A. Clean surfaces prior to inspection. Replace damaged or defective items.

END OF SECTION 108000

SECTION 113100 - RESIDENTIAL APPLIANCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Cooking appliances.
 - 2. Refrigeration appliances.
 - 3. Cleaning appliances.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, dimensions, furnished accessories, and finishes for each appliance.
- B. Product Schedule: For appliances. Use same designations indicated on Drawings.
- C. Product Certificates: For each type of appliance, from manufacturer.
- D. Operation and Maintenance Data: For each residential appliance to include in operation and maintenance manuals.
- E. Warranties: Sample of special warranties.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers trained and approved by manufacturer for installation and maintenance of units required for this Project.
- B. Regulatory Requirements: Comply with the following:
 - 1. NFPA: Provide electrical appliances listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Accessibility: Where residential appliances are indicated to comply with accessibility requirements, comply with the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines.

1.5 WARRANTY

- A. Special Warranties: Manufacturer's standard form in which manufacturer agrees to repair or replace residential appliances or components that fail in materials or workmanship within specified warranty period.
1. Warranty Period: One year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 WALL OVENS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product from manufacturer indicated:
1. KitchenAid; a division of Whirlpool Corporation.
- B. Electric Wall Oven: One-oven unit.
1. Basis-of-Design Product: KOCE507ESS.
 2. Mounting: Built-in wall.
 3. Dimensions:
 - a. Width: 27 inches.
 - b. Depth: 26.88 inches.
 - c. Height: 42.5 inches.
 4. Capacity: 4.3 cu. ft. lower oven and 1.4 cu. ft. upper oven.
 5. Operation: Microwave, baking and convection, and self-cleaning.
 6. Broiler: Located in top of oven.
 7. Oven Doors: Counterbalanced, removable, with observation window and full-width handle.
 8. Electric Power Rating:
 - a. Ovens: Manufacturer's standard.
 - b. Broiler: Manufacturer's standard.
 9. Electric Power Supply: 240 V, 60 Hz, 1 phase, 30 A.
 10. Controls: Digital panel controls and timer display.
 11. Material: Stainless steel.

2.2 MICROWAVE OVENS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product from manufacturer indicated:
1. KitchenAid; a division of Whirlpool Corporation.
- B. Microwave Oven: Provide two.

1. Basis-of-Design Product: To be determined.
2. Material: Stainless steel.

2.3 REFRIGERATOR/FREEZERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product from manufacturer indicated:
1. KitchenAid; a division of Whirlpool Corporation.
- B. Refrigerator/Freezer Type 1: Two-door refrigerator/freezer with freezer on top and complying with AHAM HRF-1.
1. Basis-of-Design Product: To be determined.
 2. Type: Freestanding.
 3. Dimensions:
 - a. Width: 48 inches.
 - b. Depth: 24 inches.
 - c. Height: 73 inches.
 4. Appliance Color/Finish: Stainless steel.
- C. Refrigerator Type 2: One-door refrigerator with no freezer complying with AHAM HRF-1.
1. Basis-of-Design Product: To be determined.
 2. Type: Freestanding.
 3. Dimensions:
 - a. Width: 24 inches.
 - b. Depth: 24 inches.
 - c. Height: 73 inches.
 4. Appliance Color/Finish: Stainless steel.

2.4 UNDERCOUNTER REFRIGERATOR/FREEZERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product from manufacturer indicated:
1. KitchenAid; a division of Whirlpool Corporation.
- B. Refrigerator/Freezer: One-door refrigerator with inside freezer compartment and complying with AHAM HRF-1.
1. Basis-of-Design Product: To be determined.
 2. Type: Undercounter.
 3. Dimensions:
 - a. Width: 36 inches.

- b. Depth: 24 inches.
 - c. Height: 34-1/2 inches.
4. Appliance Color/Finish: Stainless steel.

2.5 DISHWASHERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product from manufacturer indicated:
- 1. KitchenAid; a division of Whirlpool Corporation.
- B. Dishwasher: Complying with AHAM DW-1 and ASSE 1006. Provide two.
- 1. Basis-of-Design Product: To be determined.
 - 2. Type: Built-in undercounter.
 - 3. Dimensions:
 - a. Width: 24 inches.
 - b. Depth: 25-3/4 inches.
 - c. Height: 34-1/2 inches.
 - 4. Tub and Door Liner: Stainless steel with sealed detergent and automatic rinsing-aid dispensers.
 - 5. Appliance Color/Finish: Stainless steel.

2.6 GENERAL FINISH REQUIREMENTS

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. 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.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances, power connections, and other conditions affecting installation and performance of residential appliances.
- B. Examine roughing-in for piping systems to verify actual locations of piping connections before appliance installation.
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. General: Comply with manufacturer's written instructions.
- B. Freestanding Equipment: Place units in final locations after finishes have been completed in each area. Verify that clearances are adequate to properly operate equipment.
- C. Range Anti-Tip Device: Install at each range according to manufacturer's written instructions.
- D. Utilities: See Divisions 22 and 26 for plumbing and electrical requirements.

3.3 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Tests and Inspections:
 - 1. Perform visual, mechanical, and electrical inspection and testing for each appliance according to manufacturers' written recommendations. Certify compliance with each manufacturer's appliance-performance parameters.
 - 2. Leak Test: After installation, test for leaks. Repair leaks and retest until no leaks exist.
 - 3. Operational Test: After installation, start units to confirm proper operation.
 - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and components.
- C. An appliance will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

3.4 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain residential appliances.

END OF SECTION 113100

SECTION 122413 - ROLLER SHADES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes:
 - 1. Manually operated light-filtering roller shades.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include styles, material descriptions, construction details, dimensions of individual components and profiles, features, finishes, and operating instructions.
- B. Shop Drawings: Show location and extent of roller shades. Include elevations, sections, details, and dimensions not shown in Product Data. Show installation details, mountings, attachments to other work, operational clearances, and relationship to adjoining work.
- C. Samples for Initial Selection: For each colored component of each type of roller shade indicated.
 - 1. Include similar Samples of accessories involving color selection.
- D. Samples for Verification: Not less than 3 inches square, with specified treatments applied. Mark face of material.
- E. Window Treatment Schedule: For roller shades. List the room numbers indicated on Drawings.

1.3 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For roller shades to include in maintenance manuals. Include the following:
 - 1. Methods for maintaining roller shades and finishes.
 - 2. Precautions about cleaning materials and methods that could be detrimental to fabrics, finishes, and performance.
 - 3. Operating hardware.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has completed installation of roller shades similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- B. Source Limitations: Obtain roller shades through one source from a single manufacturer.

- C. Fire-Test-Response Characteristics: Provide roller shade band materials with the fire-test-response characteristics indicated, as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:

- 1. Flame-Resistance Ratings: Passes NFPA 701.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver shades in factory packages, marked with manufacturer and product name, fire-test-response characteristics, and location of installation using same room designations indicated on Drawings and in a window treatment schedule.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install roller shades until construction and wet and dirty finish work in spaces, including painting, is complete and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- B. Field Measurements: Where roller shades are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Allow clearances for operable glazed units' operation hardware throughout the entire operating range. Notify Architect of discrepancies. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.7 WARRANTY

- A. Roller Shade Hardware and Chain: Manufacturer's standard non-depreciating twenty-five year limited warranty.
- B. Shade Cloth: Standard non-depreciating 10-year limited warranty.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide MechoShade by MechoShade Systems, Inc. or an approved substitute.

2.2 ROLLER SHADE TYPES

- A. Roller Shade Schedule:
 - 1. Shade Type 1: Manual operating, chain drive, light-filtering roller shades in all exterior windows of rooms and spaces shown on the Drawings and schedules.

2.3 ROLLER SHADES

- A. Light-Filtering Shade Cloth: EcoVeil group, 1550 Series, fabricated from TPO for both core yarn and jacket, single thickness, non-raveling 0.030 inch (0.762 mm) thick fabric.
 - 1. Fabric Width: As required for windows.
 - 2. Weave: 3 percent open 2 x 2 basket weave.
 - 3. Colors: As selected by Architect from manufacturer's full range
 - 4. Bottom Hem: Straight.
- B. Rollers: Electrogalvanized or epoxy primed steel or extruded-aluminum tube of diameter and wall thickness required to support and fit internal components of operating system and the weight and width of shade band material without sagging; designed to be easily removable from support brackets; with manufacturer's standard method for attaching shade material. Provide capacity for one roller shade band per roller, unless otherwise indicated on Drawings.
- C. Direction of Roll: Regular, from back of roller.
- D. Mounting Brackets: Galvanized or zinc-plated steel.
- E. Fascia: L-shaped, formed-steel sheet or extruded aluminum; long edges returned or rolled; continuous panel concealing front and bottom of shade roller, brackets, and operating hardware and operators; length as indicated on Drawings; removable design for access.
- F. Top/Back Cover: L shaped; material and finish to match fascia; combining with fascia and end caps to form a six-sided headbox enclosure sized to fit shade roller and operating hardware inside.
- G. Manual Shade Operation: Provide with continuous loop bead chain, clutch, and cord tensioner and bracket.
 - 1. Position of Clutch Operator: Right side of roller, as determined by hand of user facing shade from inside, unless otherwise indicated on Drawings.
 - 2. Clutch: Capacity to lift size and weight of shade; sized to fit roller or provide adaptor.
 - 3. Bead Chain: Nickel-plated metal.
 - 4. Operating Function: Stop and hold shade at any position in ascending or descending travel.
- H. Mounting: Wall type mounting on gypsum sidewalls permitting easy removal and replacement without damaging roller shade or adjacent surfaces and finishes.

2.4 FABRICATION

- A. Product Description: Roller shade consisting of a roller, a means of supporting the roller, a flexible sheet or band of material carried by the roller, a means of attaching the material to the roller, a bottom bar, and an operating mechanism that lifts and lowers the shade.
- B. Concealed Components: Non-corrodible or corrosion-resistant-coated materials.
 - 1. Lifting Mechanism: With permanently lubricated moving parts.

- C. Unit Sizes: Obtain units fabricated in sizes to fill window and other openings as follows, measured at 74 deg F:
 - 1. Shade Units Installed between (Inside) Jamb: Edge of shade not more than 1/4 inch from face of jamb. Length equal to head to sill dimension of opening in which each shade is installed.
- D. Installation Fasteners: Not fewer than two fasteners per bracket, fabricated from metal non-corrosive to shade hardware and adjoining construction; type designed for securing to supporting substrate; and supporting shades and accessories under conditions of normal use.
- E. Color-Coated Finish: For metal components exposed to view, apply manufacturer's standard baked finish complying with manufacturer's written instructions for surface preparation including pretreatment, application, baking, and minimum dry film thickness.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, operational clearances, and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 ROLLER SHADE INSTALLATION

- A. Install roller shades level, plumb, square, and true according to manufacturer's written instructions, and located so shade band is not closer than 2 inches to interior face of glass. Allow clearances for window operation hardware.

3.3 ADJUSTING

- A. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

3.4 CLEANING AND PROTECTION

- A. Clean roller shade surfaces after installation, according to manufacturer's written instructions.
- B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer that ensure that roller shades are without damage or deterioration at time of Substantial Completion.
- C. Replace damaged roller shades that cannot be repaired, in a manner approved by Architect, before time of Substantial Completion.

3.5 SCHEDULE

- A. Provide Shade Type 1 (light-filtering shades) in all perimeter windows, unless noted otherwise.

END OF SECTION 122123

SECTION 124813 - ENTRANCE FLOOR MATS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Carpet-type mats.

1.3 SUBMITTALS

- A. Product Data: Include manufacturer's specifications and installation instructions, construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of floor mat.
- B. Samples for Selection: For each type of floor mat and frame indicated.
- C. Maintenance Data: For cleaning and maintaining floor mats to include in maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain floor mats and frames through one source from a single manufacturer.
- B. Accessibility Requirements: In addition to requirements of authorities having jurisdiction, provide installed floor mats that comply with Section 4.5 in the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- 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. Carpet-Type Mats:

- a. Mats Incorporated.

2.2 FLOOR MATS

- A. General: Provide colors, patterns, and profiles of materials, including metals and metal finishes indicated or specified. If not indicated, provide colors, patterns, and profiles selected by Architect from manufacturer's standards.
- B. Carpet-Type Mats: Polypropylene carpet tile bonded to 1/8- to 1/4-inch- thick, flexible vinyl backing to form mats 3/8 or 7/16 inch thick with nonraveling edges.
 1. Available Products: Products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Calypso Tile by Mats, Inc.

2.3 FABRICATION

- A. General: Where possible, verify sizes by field measurement before shop fabrication.
- B. Floor Mats: Shop fabricate units to greatest extent possible in sizes as indicated. If not otherwise indicated, provide single unit for each mat installation; do not exceed manufacturer's recommended maximum sizes for units that are removed for maintenance and cleaning. Where joints in mats are necessary, space symmetrically and away from normal traffic lanes. Miter corner joints in framing elements with hairline joints or provide prefabricated corner units without joints.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install surface-type units to comply with manufacturer's written instructions at locations indicated; coordinate with entrance locations and traffic patterns.

3.2 PROTECTION

- A. Defer installation of floor mats until Project is near Substantial Completion.

END OF SECTION 124813

SECTION 124816 - FOOT GRILLES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes recessed foot grilles and frames.

1.2 SUBMITTALS

- A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of foot grille and frame.
- B. Shop Drawings: Show fabrication, assembly, joint locations, installation details, layout, plans, elevations, full-scale sections, details of patterns or designs, anchors, and accessories for foot grilles and frames.
- C. Samples for Selection: For each product requiring finish and color selections.
- D. Maintenance Data: For cleaning and maintaining foot grilles. Include in maintenance manuals.

1.3 QUALITY ASSURANCE

- A. Accessibility Requirements: In addition to requirements of authorities having jurisdiction, provide installed foot grilles that comply with Section 4.5 in the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)."

1.4 PROJECT CONDITIONS

- A. Field Measurements: Verify blocked-out openings in floors by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
 - 1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish opening dimensions and proceed with fabricating foot grilles and frames without field measurements. Coordinate floor construction to ensure that actual opening dimensions correspond to established dimensions.

1.5 COORDINATION

- A. Coordinate size and location of oversized recesses in concrete work to receive foot grilles and frames. Defer frame installations until building enclosure is completed and related interior finish work is in progress. Concrete, reinforcement, and formwork requirements are specified in Division 3 Section "Cast-in-Place Concrete."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers and Products: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Mats, Inc.: Design Track.

2.2 MATERIALS

- A. Extruded Aluminum: ASTM B 221 (ASTM B 221M), alloy 6061-T6 or alloy 6063-T5, T6, or T52 as standard with manufacturer. Coat surface of frame in contact with cementitious materials with manufacturer's standard protective coating.

2.3 FRAMES

- A. Provide manufacturer's standard frames of size and style for grille type, for permanent recessed installation in subfloor, complete with installation anchorages and accessories. Unless otherwise indicated, fabricate frame of same material and finish as grilles.

2.4 FOOT GRILLES

- A. General: Provide manufacturer's standard foot grille assemblies consisting of treads of type and profile indicated, joined together by cross members or interlocked, and with support legs (if any) and other components needed to produce a complete installation.
- B. Aluminum Foot Grilles: Provide manufacturer's standard foot grilles with extruded members, top-surfaced tread rails, and as follows:
1. Tread Rails: Extruded-aluminum tread rails with extruded-aluminum frame.
 2. Tread Rail Spacing: 1-1/2 inches o.c. with 1/8- to 3/16-inch wide openings between treads.
 3. Aluminum Finish: Mill.
 4. Top Surface: Plain aluminum, cross cut rectangular pattern.

2.5 SUPPORT SYSTEM

- A. Level Bed Applications: Provide manufacturer's standard vinyl cushion support system.

2.6 FABRICATION

- A. Shop fabricate foot grilles to greatest extent possible in sizes as indicated. If not otherwise indicated, provide each grille as a single unit; do not exceed manufacturer's recommended

maximum sizes for units that are removed for maintenance and cleaning. Where joints in grilles are necessary, space symmetrically and away from normal traffic lanes.

- B. Fabricate frame members in single lengths or, where frame dimensions exceed maximum available lengths, provide minimum number of pieces possible, with hairline joints equally spaced and pieces spliced together by straight connecting pins.

2.7 ALUMINUM FINISHES

- A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- B. Mill Finish: AA-M10 (Mechanical Finish: as fabricated; no other applied finish unless buffing is required to remove scratches, welding, or grinding produced in fabrication process).

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install recessed foot grilles and frames to comply with manufacturer's written instructions at locations indicated and with top of foot grilles and frames in relationship to one another and to adjoining finished flooring as recommended by manufacturer. Set foot grille tops at height for most effective cleaning action. Coordinate top of foot grille surfaces with doors that swing across grilles to provide clearance under door.

3.2 PROTECTION

- A. After completing frame installations, provide temporary filler of plywood or fiberboard in foot grille recesses and cover frames with plywood protective flooring. Maintain protection until construction traffic has ended and Project is near Substantial Completion.

END OF SECTION 124816

SECTION 142400 - HYDRAULIC ELEVATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes hydraulic passenger elevators.
- B. Related Sections include the following:
 - 1. Division 03 Section "Cast-in-Place Concrete" for setting sleeves, inserts, and anchoring devices in concrete.
 - 2. Division 04 Section "Unit Masonry" for setting sleeves, inserts, and anchoring devices in masonry and for grouting elevator entrance frames installed in masonry walls.
 - 3. Division 05 Section "Metal Fabrications" for the following:
 - a. Attachment plates and angle brackets for supporting guide-rail brackets.
 - b. Hoist beams.
 - c. Structural-steel shapes for subsills.
 - d. Pit ladders.
 - 4. Division 26 Section "Electrical" for telephone service for elevators.
 - 5. Division 26 Section "Electrical" for smoke detectors in elevator lobbies to initiate emergency recall operation and heat detectors in shafts and machine rooms to disconnect power from elevator equipment before sprinkler activation and for connection to elevator controllers.
 - 6. Division 27 Sections for telephone service to elevators.
 - 7. Division 28 Sections for smoke detectors in elevator lobbies to initiate emergency recall operation and heat detectors in shafts and machine rooms to disconnect power from elevator equipment before sprinkler activation and for connection to elevator controllers.

1.3 DEFINITIONS

- A. Definitions in ASME A17.1 apply to work of this Section.
- B. Defective Elevator Work: Operation or control system failure, including excessive malfunctions; performances below specified ratings; excessive wear; unusual deterioration or aging of materials or finishes; unsafe conditions; need for excessive maintenance; abnormal noise or vibration; and similar unusual, unexpected, and unsatisfactory conditions.

1.4 SUBMITTALS

- A. Product Data: Include capacities, sizes, performances, operations, safety features, finishes, and similar information. Include product data for the following:
 - 1. Car enclosures and hoistway entrances.
 - 2. Operation, control, and signal systems.
- B. Shop Drawings: Show plans, elevations, sections, and large-scale details indicating service at each landing, pit equipment layout, coordination with building structure, relationships with other construction, and locations of equipment and signals. Include large-scale layout of car control station. Indicate variations from specified requirements, maximum dynamic and static loads imposed on building structure at points of support, and maximum and average power demands.
- C. Samples for Selection: For exposed finishes of cars, hoistway doors and frames, and signal equipment; 3-inch- square Samples of sheet materials; and 4-inch lengths of running trim members.
- D. Manufacturer Certificates: Signed by elevator manufacturer certifying that hoistway, pit, and machine room layout and dimensions, as shown on Drawings, and electrical service, as shown and specified, are adequate for elevator system being provided.
- E. Operation and Maintenance Data: For elevators to include in emergency, operation, and maintenance manuals.
 - 1. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include diagnostic and repair information available to manufacturer's and Installer's maintenance personnel.
- F. Inspection and Acceptance Certificates and Operating Permits: As required by authorities having jurisdiction for normal, unrestricted elevator use.
- G. Warranty: Special warranty specified in this Section.
- H. Continuing Maintenance Proposal: Service agreement specified in this Section.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Elevator manufacturer or manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
- B. Regulatory Requirements: Design elevator system to meet the seismic risk zone as determined by the authority having jurisdiction, including building official and elevator inspector.
- C. Accessibility Requirements: Comply with Section 4.10 in the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)."

- D. Fire-Rated Hoistway Entrance Assemblies: Door and frame assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing at as close to neutral pressure as possible according to NFPA 252.
- E. The elevator installation shall be a design that can be maintainable by any licensed elevator maintenance company employing journeymen mechanics, without the need to purchase or lease additional diagnostic devices, special tools, or instructions from the original equipment manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle materials, components and equipment in manufacturer's protective packaging.
- B. Store materials, components, and equipment off of ground, under cover, and in a dry location. Handle according to manufacturer's written recommendations to prevent damage, deterioration, or soiling.

1.7 COORDINATION

- A. Coordinate installation of sleeves, block outs, and items that are embedded in concrete or masonry for elevator equipment. Furnish templates and installation instructions and deliver to Project site in time for installation.
- B. Coordinate sequence of elevator installation with other work to avoid delaying the Work.
- C. Coordinate locations and dimensions of other work relating to hydraulic elevators including pit ladders, sumps, and floor drains in pits; entrance subsills; and electrical service, electrical outlets, lights, and switches in pits and machine rooms.
- D. Coordinate size of elevator pit with manufacturer selected. Provide any necessary revisions to pit or shaft size at no additional cost to the Owner.

1.8 WARRANTY

- A. Special Manufacturer's Warranty: Manufacturer's standard form in which manufacturer agrees to repair, restore, or replace defective elevator work within specified warranty period.
 - 1. Warranty Period: One year from date of Substantial Completion.

1.9 MAINTENANCE SERVICE

- A. Initial Maintenance Service: Beginning at Substantial Completion, provide one year's full maintenance service by skilled employees of elevator Installer. Include monthly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper elevator operation at rated speed and capacity. Provide parts and supplies same as those used in the manufacture and installation of original equipment.

1. Perform maintenance, including emergency callback service, during normal working hours.
 2. Include 24-hour-per-day, 7-day-per-week emergency callback service.
 - a. Response Time: Two hours or less.
- B. Continuing Maintenance Proposal: Provide a continuing maintenance proposal from Installer to Owner, in the form of a standard one-year maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- 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. Otis Elevator Co.; HydroFit Hydraulic Elevator.

2.2 SYSTEM DESCRIPTION

- A. Equipment Description: Holeless Hydraulic elevator with Machine-Room Less application.
- B. Equipment Control: Elevonic® Control System.
- C. Quantity of Elevators: 1 unit.
- D. Elevator Stop Designations: 1 and 2.
- E. Stops: 2.
- F. Openings: In line openings.
- G. Travel: As indicated on the drawings.
- H. Rated Capacity: 2500 lb.
- I. Rated Speed: 100 fpm.
- J. Platform Size: 6'-6 3/4" W x 4'-11 1/8" D
- K. Clear Inside Dimensions: 6'-5 9/16" W x 4'-3 9/16" D
- L. Cab Height: 7'-9".
- M. Clear Cab Height: 7'-9" with 5/16" floor recess and 4 LED ceiling
- N. Entrance Type and Width: Two Speed Doors at 48"

- O. Entrance Height: 7' 0".
- P. Main Power Supply: 480 Volts, 3-Phase, 60Hz + or - 5% of normal, three-Phase, with a separate equipment grounding conductor.
- Q. Car Lighting Power Supply: 120 Volts, Single-phase, 15 Amp, 60 Hz.
- R. Machine and Controller Location: No machine-room required, tank and controller in hoistway pit.
- S. Signal Fixtures: Manufacturer's standard with stainless steel metal button targets (exc. CA).
- T. Controller Location: Inside hoistway, accessible by a door in a side hoistway wall on the 1st or 2nd landing.
- U. Stopping Accuracy: $\pm 1/4"$ (6.4 mm) under any loading condition or direction of travel.
- V. Operation: Simplex Collective Operation: Using a microprocessor-based controller, operation shall be automatic by means of the car and hall buttons. If all calls in the system have been answered, the car shall park at the last landing served.
- W. Operating Features – Standard
 - 1. Full Collective Operation.
 - 2. Fan and Light Protection.
 - 3. Firefighters' Service Phase I and Phase II.
 - 4. Top of Car Inspection.
- X. Door Control Features:
 - 1. Door control to open doors automatically when car arrives at a landing in response to a normal hall or car call.
 - 2. Elevator doors shall be provided with a reopening device that will stop and reopen the car door(s) and hoistway door(s) automatically should the door(s) become obstructed by an object or person.
 - 3. Door protection shall consist of a two dimensional, multi-beam array projecting across the car door opening.
 - 4. Door nudging operation to occur if doors are prevented from closing for an adjustable period of time.
- Y. Provide equipment according to seismic zone: 2.

2.3 DESIGN AND SPECIFICATIONS

- A. Provide machine-roomless holeless hydraulic elevators from Otis Elevator Company. The control system and car design based on materials and systems manufactured by Otis Elevator Company. Specifically, the system shall consist of the following components:

1. The entire hydraulic system and the controller shall be located inside the hoistway. No extra machine room or control closet space is required.
2. Sleep mode operation for LED ceiling lights and car fan.
3. LED lighting standard in ceiling lights and elevator fixtures.
4. Sleep mode operation for LED ceiling lights and car fan.

B. Approved Installer: Otis Elevator

2.4 EQUIPMENT: MACHINE COMPONENTS

- A. The hydraulic system shall be of compact design suitable for operation under the required pressure. The power component shall be mounted in the hydraulic-fluid storage tank. The control valve shall control flow for up and down directions hydraulically and shall include an integral check valve. A control section including control solenoids shall direct the main valve and control: up and down starting, acceleration, transition from full speed to leveling speed, up and down stops, pressure relief and manual lowering. All of these functions shall be fully adjustable for maximum smoothness and to meet contract conditions. System to be provided with a low-pressure switch and a shut-off valve. The entire hydraulic system with hydraulic-fluid storage tank, power component and valves shall be located in the hoistway pit and be easily accessible for maintenance through an access door in the hoistway wall.
- B. A microprocessor-based controller shall be provided, including necessary starting switches together with all relays, switches, solid-state components and hardware required for operation, including door operation, as described herein. A three (3) phase overload device shall be provided to protect the motor against overloading. The controller shall be located together with the hydraulic system in the hoistway pit and be easily accessible for maintenance through the same access door that is also used for the hydraulic system.
- C. A manual lowering feature shall permit lowering the elevator at slow speed in the event of power failure or for adjusting purposes.
- D. Pressure Switch

2.5 EQUIPMENT HOISTWAY COMPONENTS

- A. Plunger(s) and Cylinder(s): Each cylinder shall be constructed of steel pipe of sufficient thickness and suitable for the operating pressure. The top of each cylinder shall be equipped with a cylinder head with a drip ring to collect any oil seepage as well as an internal guide ring and self-adjusting packing. Each plunger shall be constructed of selected steel tubing or pipe of proper diameter machined true and smooth with a fine polished finish. Each plunger shall be provided with a stop ring electrically welded to it to prevent the plunger from leaving the cylinder. Each plunger and cylinder shall be installed plumb and shall operate freely with minimum friction.
- B. Car Guide Rails: Tee-section steel rails with brackets and fasteners.
- C. Polyurethane type buffers shall be used.

- D. Wiring: Wiring for hoistway electrical devices included in scope of the elevator system, hall panels, pit emergency stop switch, and the traveling cable for the elevator car.
- E. Hoistway Entrances:
 - 1. Frames: Entrance frames shall be of bolted construction for complete one-piece unit assembly. All frames shall be securely fastened to fixing angles mounted in the hoistway and shall be of UL fire rated steel.
 - 2. Sills shall be extruded aluminum.
 - 3. Doors: Entrance doors shall be of metal construction with vertical channel reinforcements.
 - 4. Fire Rating: Entrance and doors shall be UL fire rated for 1-1/2 hour.
 - 5. Entrance Finish: Satin stainless steel.
 - 6. Entrance marking plates: Entrance jambs shall be marked with 4" x 4" (102 mm x 102 mm) plates having raised floor markings with Braille located adjacent to the floor marking. Marking plates shall be provided on both sides of the entrance.
 - 7. Sight Guards: sight guards will be furnished with all doors painted to match with painted doors, painted black for stainless steel and gold satin doors.
- F. Fascia: Galvanized sheet steel shall be provided at the front of the hoistway.

2.6 EQUIPMENT: CAR COMPONENTS

- A. Cab: Steel Shell Cab with laminated vertical removable panels
- B. Paints and laminate to be selected from manufacturer's catalog of choices.
- C. Brushed Stainless Steel finished base plate located at top and bottom
- D. Car Front Finish: Satin Stainless Steel.
- E. Car Door Finish: Satin Stainless Steel.
- F. Ceiling Type: Flat steel ceiling Brushed Steel Finish (BSF) with 4 LED lights.
- G. Emergency Car Lighting: An emergency power unit employing a 6-volt sealed rechargeable battery and totally static circuits shall be provided to illuminate the elevator car in the event of building power failure.
- H. Fan: A one-speed 120 VAC fan will be mounted to the structural ceiling to facilitate in-car air circulation, meeting A17.1 code requirements. The fan shall be rubber mounted to prevent the transmission of structural vibration and will include a baffle to diffuse audible noise. A switch shall be provided in the car-operating panel to control the fan.
- I. Handrail: Handrails shall be provided on the side walls and rear walls of the car enclosure. Handrails shall be 3/8" x 2" (9.5 mm x 51 mm) flat tubular handrail with a Brushed Steel Finish.
- J. Threshold: Extruded Aluminum **or** Bronze Finish **or** Nickel-Silver Finish.

- K. Emergency Exit Contact: An electrical contact shall be provided on the car-top exit.
- L. Guides: Car roller type guides at the top and the bottom.
- M. Platform: Car platform shall be constructed of metal.
- N. Certificate frame: Provide a Certificate frame with a satin stainless steel finish.
- O. The LED ceiling lights and the fan should automatically shut off when the system is not in use and be powered back up after a passenger calls the elevator and pushes a hall button.

2.7 EQUIPMENT: SIGNAL DEVICES AND FIXTURES

- A. Car Operating Panel: A car operating panel shall be provided which contains all push buttons, key switches, and message indicators for elevator operation. The car operating panel shall have a satin stainless steel finish.
- B. A car operating panel shall be furnished. It shall contain a bank of round stainless steel, mechanical LED illuminated buttons. Flush mounted to the panel and marked to correspond to the landings served. All buttons to have raised numerals and Braille markings with:
 - 1. Flat Flush Mounted satin stainless steel button with blue or white LED illuminating halo or gold satin button with white LED illuminating halo.
- C. The car operating panel shall be equipped with the following features:
 - 1. Raised markings and Braille to the left hand side of each push-button.
 - 2. Car Position Indicator at the top of and integral to the car operating panel.
 - 3. Door open and door close buttons.
 - 4. Inspection key-switch.
 - 5. Elevator Data Plate marked with elevator capacity and car number.
 - 6. Help Button: The help button shall initiate two-way communication between the car and a location inside the building, switching over to another location if the call is unanswered, where personnel are available who can take the appropriate action. Visual indicators are provided for call initiation and call acknowledgement.
 - 7. Landing Passing Signal: A chime bell shall sound in the car to signal that the car is either stopping at or passing a floor served by the elevator.
 - 8. In car stop switch (toggle or key unless local code prohibits use)
 - 9. Firefighter's hat.
 - 10. Firefighter's Phase II Key-switch.
 - 11. Call Cancel Button.
- D. Car Position Indicator: A digital, LED car position indicator shall be integral to the car operating panel.
- E. Hall Fixtures: Hall fixtures shall be provided with necessary push buttons and key switches for elevator operation.

- F. Integral Hall fixtures shall feature round stainless steel, mechanical buttons marked to correspond to the landings. Hall fixtures to be located in the entrance frame face or the wall. Buttons shall be in vertically mounted fixture. Fixture shall be satin stainless steel finish.
- G. Button Options:
 - 1. Flat Flush Mounted satin stainless steel button with blue or white LED illuminating halo or gold satin button with white LED illuminating halo.
- H. Car Lantern and Chime: A directional lantern visible from the corridor shall be provided in the car entrance. When the car stops and the doors are opening, the lantern shall indicate the direction in which the car is to travel and a chime will sound.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine elevator areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance. Verify critical dimensions and examine supporting structure and other conditions under which elevator work is to be installed.
 - 1. For the record, prepare a written report, endorsed by Installer, listing dimensional discrepancies and conditions detrimental to performance or indicating that dimensions and conditions were found to be satisfactory.
 - 2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Sound Isolation: Mount rotating and vibrating equipment on vibration-isolating mounts designed to effectively prevent transmission of vibrations to structure and thereby eliminate sources of structure-borne noise from elevator system.
- B. Install piping above the floor, where possible. Where not possible, install underground piping in Schedule 40 PVC pipe casing assembled with solvent-cemented fittings.
- C. Install piping above the floor, where possible. Where not possible, cover underground piping with permanent protective wrapping before backfilling.
- D. Lubricate operating parts of systems as recommended by manufacturers.
- E. Alignment: Coordinate installation of hoistway entrances with installation of elevator guide rails for accurate alignment of entrances with car. Where possible, delay installation of sills and frames until car is operable in shaft. Reduce clearances to minimum, safe, workable dimension at each landing.
- F. Leveling Tolerance: 1/4 inch, up or down, regardless of load and direction of travel.
- G. Set sills flush with finished floor surface at landing. Fill space under sill solidly with nonshrink, nonmetallic grout.

- H. Locate hall signal equipment for elevators as follows, unless otherwise indicated:
1. For groups of elevators, locate hall push-button stations between two elevators at center of group or at location most convenient for approaching passengers.
 2. Place hall lanterns either above or beside each hoistway entrance.
 3. Mount hall lanterns at a minimum of 72 inches above finished floor.

3.3 FIELD QUALITY CONTROL

- A. Acceptance Testing: On completion of elevator installation and before permitting use (either temporary or permanent) of elevators, perform acceptance tests as required and recommended by ASME A17.1 and by governing regulations and agencies.
- B. Advise Owner, Architect, and authorities having jurisdiction in advance of dates and times tests are to be performed on elevators.

3.4 PROTECTION

- A. Temporary Use: Temporary use is not allowed.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to operate, adjust, and maintain elevator. Refer to Division 01 Section "Demonstration and Training."
- B. Check operation of elevator with Owner's personnel present and before date of Substantial Completion. Determine that operation systems and devices are functioning properly.
- C. Check operation of elevator with Owner's personnel present not more than one month before end of warranty period. Determine that operation systems and devices are functioning properly.

END OF SECTION 142400

SECTION 211000 - FIRE-SUPPRESSION SPRINKLER SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. The fire protection system shall be an automatic sprinkler system arranged to properly protect the building and shall meet NFPA 13 and Maine State Fire Marshall requirements. The ceiling space is congested, the sprinkler piping layout will need to be carefully coordinated.
- B. This Section includes fire-suppression sprinklers, piping, and equipment.
- C. The Sprinkler Contractor shall place the sprinkler system in service and hand over the sprinkler system to the General Contractor for care and maintenance.
- D. Performance and Design Criteria: Provide products and systems complying with specific performance and design criteria indicated.

1.3 SYSTEM PERFORMANCE REQUIREMENTS

- A. Design sprinklers and obtain approval from authorities having jurisdiction. The design of the automatic sprinkler system shall be complete with all necessary accessories for proper operation.
- B. The system shall be hydraulically calculated in accordance with all provisions of the Contract Documents and any authority having jurisdiction.
- C. The contract documents do not include a fire pump. Provide over-sized piping as required to meet required system hydraulics. Contractor shall review the civil plans, the existing site and existing fire flow data. If the contractor or authority with jurisdiction determines that a fire pump is required: Provide in accordance with NFPA 20, "Stationary Pumps for Fire Protection," for fire pumps, drivers, controllers, accessories, and their installation.
- D. Design sprinkler piping according to the following and obtain approval from authorities having jurisdiction:
 - 1. Include a 5 percent margin of safety for available water flow and pressure.
 - 2. Include losses through water-service piping, valves, and backflow preventers.
- E. Sprinkler Occupancy Hazard Classifications:
 - 1. Light Hazard:

- a. Office and Public Areas
- 2. Ordinary Hazard, Group 1:
 - a. General Storage Areas
 - b. Mechanical Equipment Rooms
 - c. Building Service Areas.
 - d. Electrical Equipment Rooms
- F. Minimum Density for Automatic-Sprinkler Piping Design shall be in accordance with NFPA 13. Maximum Protection Area per Sprinkler shall be in accordance with NFPA 13.
- G. Provide deluge coverage on glass as indicated on Sheet A101.

1.4 GENERAL REQUIREMENTS

- A. Components and Installation: Capable of producing piping systems with 175-psig minimum working-pressure rating, unless otherwise indicated.
- B. Protect all systems from freezing.
- C. Bundled/Grouped wired in concealed spaces: Non-combustible spaces having 15 or more non-plenum-rated wires grouped together shall be fully sprinklered.
- D. Seismic Performance: If required by the authority with jurisdiction, fire-suppression piping shall be capable of withstanding the effects of earthquake motions determined according to NFPA 13.
- E. Elevators: Provide sprinkler protection in accordance with authority with jurisdiction requirements.
- F. Coordinate fire department connection type and location with local fire department.
- G. The sprinkler contract starts inside the sprinkler valve room with a connection to the water entry. Coordinate with the site contractor.
- H. Contractor shall obtain and pay for required permits.

1.5 SUBMITTALS

- A. Shop Drawings: Submit working plans, prepared according to NFPA 13, and hydraulic calculations with cross reference to applicable drawings, water supply data, and equipment schedule with ratings for the system to the Owner's Representative, Insurance Underwriter, and other authorities having jurisdiction.
- B. Product Data: Catalog sheets, specifications, and installation instructions. Indicate UL or FM approval for each product. Include the following additional information:
 - 1. Pipe and fitting materials and methods of joining for sprinkler piping.
 - 2. Pipe hangers and supports.

3. Piping seismic restraints.
 4. Valves, including specialty valves, accessories, and devices.
 5. Alarm devices. Include electrical data.
 6. Electrical Devices: Complete description of intended use, wiring diagrams, data plate information and, in the case of switching devices, whether normally on or normally off. Include motor test data.
 7. Mechanical Devices: Complete description of intended use, including normal operating capacities and working pressures.
 8. Enclosures: Dimensions, materials, gages of metals; type of door hinges and locks, and methods of securing the enclosure members to the building construction.
 9. Hose Threads: Verify that hose threads on fire department connections match threads on equipment used by the local or servicing fire department.
- C. Design Data: The portions of the sprinkler system not sized on the Contract Drawings shall be sized in accordance with NFPA requirements for Hydraulically Designed Systems. Submit drawings and hydraulic calculations for approval.
- D. Delegated-Design Submittal: In addition to Shop Drawings, Product Data, and other required submittals, submit three copies of a statement, signed and sealed by the responsible sprinkler system design professional. Indicate that products and systems comply with performance and design criteria in the Contract Documents.
1. Certification: Submit Contractor's NICET certification and number or PE license number.
- E. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping" and "Contractor's Material and Test Certificate for Underground Piping."
- F. Maintenance Data: For each type of sprinkler specialty to include in maintenance manuals specified in Division 1.

1.6 QUALITY ASSURANCE

A. Sprinkler Contractor

1. Installer Qualifications: An experienced installer who has designed and installed fire-suppression piping similar to that indicated for this Project and obtained design approval and inspection approval from authorities having jurisdiction.
2. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified sprinkler designer. Base calculations on results of fire hydrant flow test. Sprinkler designer shall be legally qualified and licensed 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 fire-suppression piping that are similar to those indicated for this Project in material, design, and extent.
3. Contractor shall be a licensed fire sprinkler contractor.

B. Manufacturer Qualifications:

1. Firms whose equipment, specialties, and accessories are listed by product name and manufacturer in UL's "Fire Protection Equipment Directory" and FM's "Fire Protection Approval Guide" and that comply with other requirements indicated.

2. Sprinkler Components: Listing/approval stamp, label, or other marking by a testing agency acceptable to authorities having jurisdiction.
3. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.
4. Factory Mutual Engineering Corporation (FM) Approval Guide

C. NFPA Requirements:

1. NFPA#1 Fire Prevention Code.
2. NFPA #13 "Standard for the Installation of Sprinkler Systems"
3. If a fire pump is required: Comply with NFPA 20, "Stationary Pumps for Fire Protection," for fire pumps, drivers, controllers, accessories, and their installation.
4. NFPA #24 Standard for the Installation of Private Fire Service Mains and Their Appurtenances
5. NFPA 291: Recommend Practice for Flow Testing and Marking of Hydrants

1.7 COORDINATION

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for fire-suppression installations.
- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- C. Coordinate requirements for access panels and doors for fire-suppression items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

1.8 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. Sprinkler Cabinets: Finished, wall-mounting steel cabinet and hinged cover, with space for a minimum of six spare sprinklers plus sprinkler wrench. Include the number of sprinklers required by NFPA 13 and wrench for sprinklers. Include separate cabinet with sprinklers and wrench for each type of sprinkler on Project.

PART 2 - PRODUCTS

2.1 PIPING

- A. Pipe and fittings shall conform to the requirements of NFPA 13. Pipe shall be listed by UL and be FM approved, and installed per its listing and approval.

- 2.2 Sprinkler piping shall be black steel schedule 40, 2 inch and smaller, and thinwall 2 ½ inch and larger. C factor 120.

- A. System piping shall be substantially supported to the building structure. The installation of hangers and supports shall adhere to the requirements set forth in N.F.P.A. 13. Materials used in the installation or construction of hangers and supports shall be listed and approved for such application.

2.3 JOINING MATERIALS

- A. Furnish in accordance with NFPA 13.
- B. Transition Couplings: AWWA C219, sleeve type, or other manufactured fitting the same size as, with pressure rating at least equal to, and with ends compatible with piping to be joined.

2.4 SPRINKLERS

- A. Fire sprinklers shall be of one manufacturer throughout the building. No mixing of sprinkler brands shall be permitted. Sprinklers shall be of all brass frame construction with a quick response frangible bulb type fusible element.
- B. Automatic Sprinklers: With UL listed heat-responsive elements.
- C. Sprinkler Types and Categories: Nominal 1/2-inch orifice for "Ordinary" temperature classification rating, unless otherwise indicated or required by application.
- D. Provide quick response sprinklers.
- E. Sprinkler Escutcheons: Materials, types, and finishes of sprinklers. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.
- F. Sprinkler Guards: Wire-cage type, including fastening device for attaching to sprinkler.

2.5 SPRINKLER SPECIALTY FITTINGS

- A. Sprinkler specialty fittings shall be UL listed or FMG approved, with 175-psig minimum working-pressure rating, and made of materials compatible with piping.
- B. Sprinkler Drain and Alarm Test Fittings: Cast- or ductile-iron body; with threaded or locking-lug inlet and outlet, test valve, and orifice and sight glass.
- C. Sprinkler Branch-Line Test Fittings: Brass body with threaded inlet, capped drain outlet, and threaded outlet for sprinkler.
- D. Sprinkler Inspector's Test Fitting: Cast- or ductile-iron housing with threaded inlet and drain outlet and sight glass.
- E. Drop-Nipple Fittings: UL 1474, adjustable with threaded inlet and outlet, and seals.
- F. Dry-Pipe-System Fittings: UL listed for dry-pipe service.

2.6 VALVES

- A. Valves shall be UL listed and FMG approved
- B. System Control Valve: The wet system control valve shall be a listed indicating type valve. Control valve shall be UL Listed and Factory Mutual Approved for fire protection installations. System control valve shall be rated for normal system pressure but in no case less than 175 PSI.

2.7 WATERFLOW ALARMS

- A. Flow of water equal to or greater than that from a single automatic sprinkler (smallest orifice in system) shall result in an audible alarm on the premises within 5 minutes after such flow begins and until such flow stops.
- B. The alarm apparatus shall consist of a listed alarm check valve or other listed waterflow-indicating device with the necessary attachments to give an alarm.
- C. The apparatus for a dry pipe system shall consist of alarm attachments to the dry pipe valve.

2.8 FIRE DEPARTMENT CONNECTION

- A. A system fire department connection shall be provided on the system riser in accordance with NFPA 13. Fire department connection shall be UL Listed and Factory Mutual Approved for fire protection use.
- B. Fire department connection shall be recessed type, flush mounted in the outside wall. Cast brass body, clapper inlets, brass plate, adapters and plugs with chain.
- C. Include inlets with threads according to NFPA 1963 and local fire department requirements.
- D. Provide escutcheon plate and labeling per NFPA 13.

2.9 BACKFLOW PREVENTION

- A. Provide in accordance with manufacturers recommendations.
- B. Provide in accordance with NFPA 13. Provide a permanent means of testing the backflow preventer in accordance with NFPA 13 requirements.
- C. Backflow preventer types; provide as required by Portland Water District.
 - 1. Double check: Watts Series 709DCDA or 774DCDA detector check fire service applications; or approved equal.
 - 2. RPZ: Watts Series 909RPDA or 994RPDA, detector check fire service applications; or approved equal. Provide proper drainage.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Refer to Division 31 for excavating, trenching, and backfilling.

3.2 SERVICE-ENTRANCE PIPING

- A. Connect fire-suppression piping to water-service piping of size and in location indicated for service entrance to building. Refer to Division 31 for exterior piping.
- B. Install shutoff valve, pressure gage, drain, and other NFPA-required accessories at connection to water-service piping.
- C. Provide backflow prevention as required by the local water district.

3.3 PREPARATION

- A. The nature of the work requires coordination with other trades. Shop fabrication shall be done at the Contractor's risk. Relocation of piping and components to avoid obstructions may be necessary. Relocation, if required, shall be done at the Contractor's expense. The installation shall be performed in a workmanlike manner as determined by the Owner's Representative and in accordance with the Contract Documents, manufacturer's printed installation instructions, and submitted and Owner's Representative reviewed drawings.

3.4 SPRINKLER APPLICATIONS

- A. General: Use sprinklers according to the following applications:
 - 1. Rooms/spaces without Ceilings: Upright sprinklers.
 - 2. All occupied rooms with Finished Ceilings: Recessed Pendent.
 - 3. Provide sprinkler guards for heads in mechanical and storage spaces, less than 8 ft. above finished floor subject to mechanical damage.
 - 4. Low ceilings (under 8 feet): Concealed
 - 5. Attics: attic sprinklers.
 - 6. Wall Mounting: Sidewall sprinklers.
 - 7. Spaces Subject to Freezing: Upright; pendent, dry-type; and sidewall, dry-type sprinklers.
- B. Finishes
 - a. Unfinished spaces not exposed to view: rough bronze.
 - b. Recessed Sprinklers: White
 - c. Provide escutcheons with matching color for finished spaces.

3.5 SYSTEM INSTALLATIONS

- A. Earthquake Protection: Install piping according to NFPA 13 to protect from earthquake damage.

- B. Water supply control valves shall be electrically supervised and mechanically locked for proper position. Water flow and supervisory circuits shall be in accordance with the requirements of electrical specifications. Electric connections to sprinkler system shall be by Division 26. Furnish wiring diagrams for all equipment.
- C. Fire Department Connection: A system fire department connection shall be provided on the system riser in accordance with N.F.P.A. 13. Fire department connection shall be installed in an area accessible for the first response unit. Coordinate with local fire department.
- D. A sprinkler head wrench of each style and model installed shall be provided to the owner at the completion of the project. A representative sampling of each sprinkler head style and model shall be provided to the owner and housed in a sprinkler head cabinet at or near the sprinkler riser. The number of sprinkler heads provided to the owner shall be in accordance with NFPA 13.
- E. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, sized and located according to NFPA 13

3.6 SPRINKLER INSTALLATION

- A. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing. Use dry-type sprinklers per NFPA 13.
- B. Install sprinkler piping with drains for complete system drainage.
- C. Hangers and Supports: Comply with NFPA 13 for hanger materials.

3.7 LABELING AND IDENTIFICATION

- A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.

3.8 FIELD QUALITY CONTROL

- A. Flush, test, and inspect sprinkler piping according to NFPA 13, "System Acceptance" Chapter.
- B. Verify that specialty valves, trim, fittings, controls, and accessories are installed and operate correctly.
- C. Verify that specified tests of piping are complete.
- D. Verify that damaged sprinklers and sprinklers with paint or coating not specified are replaced with new, correct type.
- E. Verify that sprinklers are correct types, have correct finishes and temperature ratings, and have guards as required for each application.
- F. Verify that potable-water supplies have correct types of backflow preventers.

- G. Verify that fire department connections have same type compatible with local fire department equipment.
- H. Replace piping system components that do not pass test procedures and retest to demonstrate compliance. Repeat procedure until satisfactory results are obtained.
- I. Fill wet-pipe sprinkler piping with water.
- J. Energize circuits to electrical equipment and devices.
- K. Coordinate with fire alarm tests. Operate as required.

3.9 CLEANING

- A. Clean dirt and debris from sprinklers.
- B. Remove and replace sprinklers having paint other than factory finish.

3.10 PROTECTION

- A. Protect sprinklers from damage until Substantial Completion.

END OF SECTION 210000

SECTION 220500 – COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Refer to Section 230500, common work results for plumbing are included in this section.

END OF SECTION 220500

SECTION 220519 – THERMOMETERS AND PRESSURE GAUGES FOR PLUMBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Refer to Section 230519 for thermometer and pressure gauges for plumbing.

END OF SECTION 220519

SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Refer to Section 230529 for hangers and supports for plumbing piping and equipment.

END OF SECTION 220529

SECTION 220548 - SEISMIC CONTROLS FOR PLUMBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Refer to Section 230548 for seismic controls for plumbing.

END OF SECTION 220548

SECTION 220553 – IDENTIFICATION FOR PLUMBING PIPING & EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Refer to Section 230553 for identification for plumbing piping and equipment.

END OF SECTION 220553

SECTION 220700 - PLUMBING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Refer to Section 230700 for plumbing insulation.

END OF SECTION 220700

SECTION 221116 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 22 Section "Common Work Results for Plumbing"
 - 2. Division 22 Section "Hangers and Supports"
 - 3. Division 22 Section "Plumbing Specialties" for water distribution piping specialties.

1.2 SUMMARY

- A. This Section includes domestic water piping from locations indicated to fixtures and equipment inside the building.
- B. Drawings show the general layout of piping and accessories but do not show all required fittings and offsets that may be necessary to connect piping to equipment and to coordinate with other trades. Fabricate piping based on field measurements. Provide all necessary fittings and offsets.
- C. General layout shown, provide piping to fixtures as required by the Maine Plumbing Code. A licensed master plumber shall perform or supervise the work and provide layouts, piping, and fittings as required by code.

1.3 SUBMITTALS

- A. Product Data: For the following products:
 - 1. Specialty valves.
 - 2. Transition fittings.
 - 3. Dielectric fittings.
 - 4. Flexible connectors.
 - 5. Escutcheons.
 - 6. Sleeves and sleeve seals.
 - 7. Water penetration systems.

- B. Field quality-control reports.

1.4 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

- B. Comply with the UPC 2009 edition, subject to the exclusions and amendments set forth by the Maine Plumbers Examining Board.
- C. Comply with local building and plumbing codes.
- D. Qualify brazing processes for copper and copper alloy pipe and tube according to ANSI/AWS C3.4.
- E. Comply with NSF 61, "Drinking Water System Components-Health Effects; Sections 1 through 9," for potable domestic water piping and components.
- F. Water line components shall be lead-free.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.
- B. Transition Couplings for Aboveground Pressure Piping: Coupling or other manufactured fitting the same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.
- C. Transition Couplings for Underground Pressure Piping: AWWA C219, metal, sleeve-type coupling or other manufactured fitting the same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.

2.2 DUCTILE-IRON PIPING

- A. From inside face of exterior wall to a distance of approximately 5 feet outside of building (coordinate with Division 2). Provide flanged and anchored connection to interior piping. Materials shall be approved by the local water utility.
- B. Ductile iron pipe shall meet requirements of AWWA Standard C-151 (latest revision) and be cement lined and seal coated to meet AWWA Standard C-104 (latest revision). Joints shall meet requirements of AWWA C-111 (latest revision). Interior seal coated, bituminous paint oil cut, emulsion not acceptable, thickness minimum of 2 mils dry film thickness. Exterior bituminous coated with minimum of 2 mils dry film thickness. Class 52 wall thickness, 4-inch diameter through 12-inch diameter inclusive. Mechanical joint pipe to be furnished with gland, gaskets and Cor-Ten bolts and nuts.
- C. Ductile Iron Fittings Including Bends, Reducers, Off-Sets, Tees And Sleeves: Material shall be ASTM A536 latest, grade 70-50-05, in accordance with AWWA C153 (latest revision). Fittings shall be cement lined AWWA C104 (latest revision) or fusion bonded epoxy coated with a 5 mil nominal thickness per AWWA C550 and C116. Interior seal coated AWWA C104 with minimum of 4 mils dry film thickness. Exterior bituminous coated, 4 mils minimum dry film thickness or fusion bonded epoxy coated with a 5 mil nominal thickness per AWWA C550 and

C116. Mechanical joint with accessories furnished: D.I. glands, gaskets, Cor-Ten T-bolts and nuts. Pressure Rating: Class 350 pressure rating in accordance with AWWA C153.

2.3 COPPER TUBING

- A. Soft Copper Tube: ASTM B 88, Types K and L, water tube, annealed temper.
1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
 2. Bronze Flanges: ASME B16.24, Class 150, with solder-joint end. Furnish Class 300 flanges if required to match piping.
 3. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces and solder-joint or threaded ends.
- B. Hard Copper Tube: ASTM B 88, Types L and M, water tube, drawn temper.
1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
 2. Bronze Flanges: ASME B16.24, Class 150, with solder-joint end. Furnish Class 300 flanges if required to match piping.
 3. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces and solder-joint or threaded ends.
 4. Copper, Grooved-End Fittings: ASTM B 75 copper tube or ASTM B 584 bronze castings.
 5. Copper-Tubing, Keyed Couplings: Copper-tube dimensions and design similar to AWWA C606. Include ferrous housing sections, gasket suitable for hot water, and bolts and nuts.
- C. Mechanically formed copper or steel tee connections are not acceptable.

2.4 AQUATHERM PIPING

- A. Pipe shall be Aquatherm Greenpipe, or Greenpipe Faser, available from Aquatherm, Inc. Domestic hot water shall contain a fiber layer (faser) to restrict thermal expansion. As proof of Aquatherm's demanding quality standards, all properly installed Aquatherm pipe systems carry a 10-year warranty for property damage liability coverage of up to \$15 million per damage event. This warranty covers the pipes, the fittings, and any incidental damage caused by material failure. The policy also provides an additional \$15 million for personal injury.
- B. Pipe shall be manufactured from a PP-R resin meeting the short-term properties and long-term strength requirements of ASTM F 2389. The pipe shall contain no rework or recycled materials except that generated in the manufacturer's own plant from resin of the same specification from the same raw material. All pipe shall be made in a three layer extrusion process. Domestic hot water shall contain a fiber layer (faser) to restrict thermal expansion. All pipe shall comply with the rated pressure requirements of ASTM F 2389. All pipe shall be certified by NSF International as complying with NSF 14, NSF 61, and ASTM F 2389 or CSA B137.11.
- C. Fittings shall be manufactured from a PP-R resin meeting the short-term properties and long-term strength requirements of ASTM F 2389. The fittings shall contain no rework or recycled

materials except that generated in the manufacturer's own plant from resin of the same specification from the same raw material. All fittings shall be certified by NSF International as complying with NSF 14, NSF 61, and ASTM F 2389 or CSA B137.11.

- D. Where indicated on the drawings that a Plenum-rated Piping System is needed, then the pipe shall be pre-insulated or field insulated, and when tested with standard un-insulated fittings per CAN/ULC-S102.2-03 or ASTM E84, the system consisting of wrapped or coated pipe and bare fittings shall have a Flame Spread Classification of less than 25 and Smoke Development rating of less than 50.
- E. Where indicated on the drawings that the pipe will be exposed to direct UV light for more than 30 days, it shall be provided with a Factory applied, UV-resistant coating or alternative UV protection.
- F. If heat tracing is specified for the piping, it should be installed on the pipe interior or exterior, and it must be suitable for use with plastic piping and self-regulating to ensure the surface temperature of the pipe and fittings will not exceed 70°C (158°F).
- G. Where up to 1 inch of standard insulation is indicated in Section 220700, a factory installed, thermal (radiant, conductive, and convective) and vapor barrier insulation shall be provided. Where more than 1 inch of standard insulation is indicated in Section 220700, additional overlap of factory installed, thermal (radiant, conductive, and convective) and vapor barrier insulation shall be provided to ensure equivalent thermal resistance. The thick wall, self-insulating fittings do not require an additional vapor barrier for the piping system to meet this performance level. The thermal barrier is UV resistant, CFC-free, non-porous, non-fibrous, and resist mold growth. The pipe with the integral thermal barrier with standard unprotected fittings shall meet the ASTM E84 and the CAN/ULC S102.2 requirements for a Flame Spread Rating of 25 and Smoke Development rating of 50.
- H. Manufacturer shall warrant pipe and fittings for 10 years to be free of defects in materials or workmanship. Warranty shall cover labor and material costs of repairing and/or replacing defective materials and repairing any incidental damage caused by failure of the piping system do to defects in materials or workmanship.

2.5 PEX DOMESTIC WATER PIPING

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following. PEX-a manufacturer system warranty shall cover tubing for a duration of 30 years from the date of installation.
 - 1. Uponor Wirsbo hePEX (Basis of Design)
 - 2. Rehau
 - 3. Mr. PEX
- B. Code approved:
 - 1. International Code Conference (ICC) – International Plumbing Code (IPC)
 - 2. Uniform Plumbing Code (UPC)
 - 3. Comply with ANSI/NSF Standard 14.
 - 4. Comply with ANSI/NSF Standard 61

5. Certification of flame spread/smoke development rating of 25/50 in accordance with ASTM E84 provided the installation meets one of the following requirements.
 - a. Tubing spacing is a minimum of 18 inches apart for the following sizes: 3/8" through 3/4".
 - b. Tubing is wrapped with 1/2" fiberglass insulation with a flame spread of not more than 20 and a smoke-developed rating of not more than 30 and a nominal density of 4.0 to 4.5 pcf. Tubing can run with three tubes separated by zero inches and then 18 inches between the next group of three tubes for the following sizes: 3/8" through 2".

C. Tubing

1. Material: Crosslinked polyethylene (PEX) manufactured by PEX-a or Engel method
2. Type: Wirsbo AQUAPEX
3. Material Standard: Manufactured in accordance with ASTM F876 and ASTM F877 and tested for compliance by an independent third party agency
4. Standard grade hydrostatic design and pressure ratings from PPI
5. Fire-rated assembly listings in accordance with ANSI/UL 263
 - a. UL Design No. L557 — 1-hour wood frame floor/ceiling assemblies
 - b. UL Design No. K913 — 2-hour concrete floor/ceiling assemblies
 - c. UL Design No. U372 — 1-hour wood stud/gypsum wallboard wall assemblies
 - d. UL Design No. V444 — 1-hour steel stud/gypsum wallboard wall assemblies
6. Minimum Bend Radius (cold bending): No less than six times the outside diameter. Use a bend support as supplied by the PEX tubing manufacturer for tubing with a bend radius less than stated.
7. Nominal Inside Diameter: Provide tubing with nominal inside diameter, in accordance with ASTM F876 as indicated.

D. Fittings

1. Material: Fitting assembly is manufactured from material listed in paragraph 5.1 of ASTM F1960.
2. Material Standard: Comply with ASTM F1960.
3. Type: PEX-a cold expansion fitting. Assembly consists of the appropriate ProPEX insert with a corresponding ProPEX Ring.

E. Manifolds

1. Material
 - a. Type L copper body with UNS 3600 series brass ProPEX outlet connections
 - b. Engineered Plastic (EP) body with ProPEX outlet connections
2. Manifold Type
 - a. Uponor ProPEX 1" Copper Manifold
 - b. Uponor engineered plastic (EP) Manifold

3. All manifolds manufactured with the appropriate-sized ProPEX fittings on the manifold supply inlets.

F. Accessories

1. Angle stops and straight stops that are compatible with PEX tubing are supplied by the PEX tubing manufacturer.
2. Bend supports designed for maintaining tight radius bends are supplied by the PEX tubing manufacturer.
3. ProPEX expander tool to install the ASTM F1960 compatible fittings are supplied by the PEX tubing manufacturer.
4. The tubing manufacturer provides clips and/or PEX rails for supporting tubing runs.
5. All horizontal tubing hangers and riser clamps are epoxy-coated material.

2.6 VALVES

A. Ball Valves

1. The valve body and adapter shall be constructed using Lead Free brass. Lead Free ball valves shall comply with state codes and standards, where applicable, requiring reduced lead content.
2. ½" to 2" ball valves: 2-piece full port Lead Free brass ball valves: The valve must have a blowout proof pressure retaining 316 stainless steel stem, 316 stainless steel ball, virgin PTFE seats, seals, stem packing seal and thrust washer. Valve must have adjustable packing. Valves with O-ring stem seal only are not acceptable. Pressure rating no less than 600psi WOG non-shock, 150psi WSP. Valve shall be manufactured to the MSS-SP-110 standard and shall be a Watts Series LFB6080 (threaded) or LFB6081 (solder).
3. Valve sizes 2-1/2" to 4" threaded, shall be rated to 400psi WOG non-shock and 125psi WSP. Valve sizes 2-1/2" to 3" solder shall be rated to 400psi WOG non-shock and 125psi WSP. Valve shall be a Watts Series LFFBV-3C (threaded) or LFFBVS-3C (solder).
4. Aquatherm Greenpipe: Valves shall be manufactured in accordance with the manufacturer's specifications and shall comply with the performance requirements of ASTM F 2389 or CSA B137.11. The valves shall contain no rework or recycled thermoplastic materials except that generated in the manufacturer's own plant from resin of the same specification from the same raw material.
5. Comply with MSS SP-110.

B. Swing check valves:

1. Construct pressure containing parts of Valves as follows: Bronze Valves: 125 or 150 psi: ANSI/ASTM B 62; Iron Body Valves: ANSI/ASTM A-126, Grade B.
2. Check valves shall be lead free.
3. Comply with the following standards for design, workmanship, material and testing: Bronze Valves: MSS SP – 80; Cast Iron Valves: MSS SP – 71
4. Construct valves of pressure casting free of any impregnating materials. Construct disc and hanger as one piece. Support hanger pins by removable side plug.
5. Threaded Ends 2" and Smaller: Class 125, bronze body, screwed cap, Teflon disc.
6. Soldered Ends 2" and Smaller: Class 125, bronze body, screwed cap, Teflon disc.

7. Flanged Ends 2-1/2" and Larger: Class 125, iron body, bronze mounted, horizontal swing, cast-iron disc.
- C. Refer to Division 22 Section "Plumbing Specialties" for balancing and drain valves.

PART 3 - EXECUTION

3.1 EXCAVATION

- A. Refer to Division 31 for excavating, trenching, and backfilling.

3.2 PIPING APPLICATIONS

- A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below, unless otherwise indicated.
- B. Flanges may be used on aboveground piping, unless otherwise indicated. Piping 5" and larger: Grooved joints may be used on aboveground grooved-end piping.
- C. Mechanically formed tee-branch outlets and brazed joints shall not be used.
- D. Underground Domestic Water Service Piping: Use any of the following piping materials for each size range:
1. NPS 2 and Smaller: PE pipe; insert fittings for PE pipe; and banded or crimp-ring joints.
 2. NPS 2-1/2 and larger: ductile-iron pipe; mechanical- or push-on-joint, ductile-iron fittings; and restrained, gasketed joints.
- E. Aboveground Domestic Water or Non-Potable Water Piping: Use the following piping materials for each size range:
1. NPS 2 and Smaller: Type L copper, PEX, or Aquatherm.
 2. NPS 2.5 to 3: Type L copper, or Aquatherm.
- F. Underground piping to island kitchen – PEX. No joints permitted underground.

3.3 VALVE APPLICATIONS

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
1. Shutoff Duty: ball valves.
 2. Drain Duty: Hose-end drain valves.

3.4 VALVE INSTALLATION

- A. Install sectional valve close to water main on each branch and riser serving plumbing fixtures or equipment.
- B. Install shutoff valve on each water supply to equipment and on each water supply to plumbing fixtures without supply stops.
- C. Install hose end drain valves for equipment, at base of each water riser, at low points in horizontal piping, and where required to drain water piping.

3.5 PIPING INSTALLATION

- A. Refer to Division 22 Section "Common Work Results for Plumbing" for basic piping installation.
- B. Extend domestic water service piping to exterior water distribution piping in sizes and locations indicated.
- C. Install underground ductile-iron piping according to AWWA C600 and NFPA 24.
- D. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve, inside building at each domestic water service.
- E. Provide dielectric fittings as specified in Section 230500.
- F. Install water-pressure regulators downstream from shutoff valves. Refer to Division 22 Section "Plumbing Specialties" for water-pressure regulators. Set outlet pressure at 80 psig maximum.
- G. Install aboveground domestic water piping level and plumb.
- H. Provide firestopping as per Section 230500 "Common Work Results for HVAC".
- I. Fill water piping. Check components to determine that they are not air bound and that piping is full of water.
- J. Perform the following steps before operation:
 - 1. Close drain valves, hydrants, and hose bibbs.
 - 2. Open shutoff valves to fully open position.
 - 3. Open throttling valves to proper setting.
 - 4. Remove plugs used during testing of piping and plugs used for temporary sealing of piping during installation.
 - 5. Remove and clean strainer screens. Close drain valves and replace drain plugs.
- K. Check plumbing equipment and verify proper settings, adjustments, and operation. Do not operate water heaters before filling with water.
- L. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.6 JOINT CONSTRUCTION

- A. Refer to Division 22 Section “Common Work Results for Plumbing” for basic piping joint construction.
- B. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.
- C. Fusion Welded Aquatherm Joints:
 - 1. Install fittings and joints using socket-fusion, electrofusion, or butt-fusion as applicable for the fitting type. All fusion-well joints shall be made in accordance with the pipe and fitting manufacturer’s specifications and product standards.
 - 2. Fusion-weld tooling, welding machines, and electrofusion devices shall be as specified by the pipe and fittings manufacturer.
 - 3. Prior to joining, the pipe and fittings shall be prepared in accordance with F 2389 and the manufacturer’s specifications.
 - 4. Joint preparation, setting and alignment, fusion process, cooling times and working pressure shall be in accordance with the pipe and fitting manufacturer’s specifications.

3.7 PEX PIPING INSTALLATION

- A. Install PEX tubing in accordance with the tubing manufacturer's recommendations and as indicated in the installation handbook.
- B. Do not install PEX tubing within 6 inches of gas appliance vents or within 12 inches of any recessed light fixtures.
- C. Do not solder within 18 inches of PEX tubing in the same waterline. Make sweat connections prior to making PEX connections.
- D. Do not expose PEX tubing to direct sunlight for more than 30 days.
- E. Ensure no glues, solvents, sealants or chemicals come in contact with the tubing without prior permission from the tubing manufacturer.
- F. Use grommets or sleeves at the penetration for PEX tubing passing through metal studs.
- G. Protect PEX tubing with sleeves where abrasion may occur.
- H. Use strike protectors where PEX tubing penetrates a stud or joist and has the potential for being struck with a screw or nail.
- I. Use tubing manufacturer-supplied bend supports where bends are less than six times the outside tubing diameter.
- J. PEX-a Piping Hanger Spacing: Install hangers for PEX-a piping with the following maximum spacing:
 - 1. 1 inch and below: Maximum span, 32 inches.
 - 2. 1¼ inch and above: Maximum span, 48 inches.

3. PEX-a Piping Hanger Spacing with PEX-a Support Channel: Install hangers for PEX-a piping with horizontal support channel in accordance with local jurisdiction and manufacturer's recommendations, with the following maximum spacing: Maximum span, 8 feet.
- K. Pipe Joint Construction: PEX-a Connections: Install per manufacturer's recommendations. Use manufacturer-recommended cold-expansion tool for F1960 connections.
- L. Pressurize PEX tubing with air in accordance with applicable codes or in the absence of applicable codes to a pressure of 25 psi above normal working pressure of the system.
- M. Comply with safety precautions when pressure testing, including use of compressed air, where applicable. Do not use water to pressurize the system if ambient air temperature has the possibility of dropping below 32°F.

3.8 HANGER AND SUPPORT INSTALLATION

- A. Hanger, support, and anchor devices are specified in Division 22 Section "Hangers and Supports."

3.9 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment and machines to allow service and maintenance.
- C. Connect domestic water piping to exterior water service piping. Use transition fitting to join dissimilar piping materials.
- D. Connect water piping in sizes indicated, but not smaller than sizes of unit connections.
- E. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

3.10 FIELD QUALITY CONTROL

- A. Follow local code requirements.
- B. Inspect domestic water piping as follows:
 1. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
 2. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
 - a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.

END OF SECTION 221116

SECTION 221119 - PLUMBING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 22 Section "Common Work Results for Plumbing"

1.2 SUMMARY

- A. This Section includes plumbing specialties.

1.3 PERFORMANCE REQUIREMENTS

- A. Provide components and installation capable of producing piping systems with following minimum working-pressure ratings, unless otherwise indicated:
 - 1. Domestic Water Piping: 125 psig.
 - 2. Sanitary Waste and Vent Piping: 10-foot head of water.
 - 3. Storm Drainage Piping: 10-foot head of water.

1.4 ACTION SUBMITTALS

- A. Product Data: Include rated capacities and shipping, installed, and operating weights. Indicate materials, finishes, dimensions, required clearances, and methods of assembly of components; and piping and wiring connections.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data
- B. Field test reports.

1.6 QUALITY ASSURANCE

- A. Plumbing specialties shall bear label, stamp, or other markings of specified testing agency.

- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with local building and plumbing codes.
- D. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for piping materials and installation.
- E. Water line components shall be lead-free.
- F. NSF Compliance: Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic domestic water piping components. Include marking "NSF-PW" on plastic potable-water piping and "NSF-DWV" on plastic drain, waste, and vent piping. Comply with NSF 61, "Drinking Water System Components--Health Effects, Sections 1 through 9," for potable domestic water plumbing specialties.

PART 2 - PRODUCTS

2.1 ACCESS PANELS

- A. Provide access panels to concealed valves, cleanouts, and components that require service access. All components shall have proper access in accordance with manufactures' recommendations. Refer to Section 220500.

2.2 BACKFLOW PREVENTERS

- A. Manufacturers:
 - 1. Ames Co., Inc.
 - 2. Cla-Val Co.
 - 3. Apollo
 - 4. CMB Industries, Inc.; Febco Backflow Preventers.
 - 5. Conbraco Industries, Inc.
 - 6. Watts Industries, Inc.; Water Products Div.
 - 7. Zurn Industries, Inc.; Wilkins Div.
- B. General: ASSE standard, backflow preventers.
 - 1. NPS 2 and Smaller: Bronze body with threaded ends.
 - 2. NPS 2-1/2 and Larger: Bronze, cast-iron, steel, or stainless-steel body with flanged ends.
 - 3. Interior Components: Corrosion-resistant materials. AWWA C550 or FDA-approved
 - 4. Exterior Finish: manufacturer's standard.
 - 5. Strainer: On inlet, lead-free.
 - 6. Lead free.
 - 7. Backflow preventers for hot water over 110F shall be a listed type for that application.
- C. Atmospheric-Type Vacuum Breakers: ASSE 1001, with floating disc and atmospheric vent.

- D. Hose-Connection Vacuum Breakers: Watts Series 8FR; ASSE 1011, nickel plated, with non-removable and manual drain features, and ASME B1.20.7, garden-hose threads on outlet. Units attached to rough-bronze-finish hose connections may be rough bronze.
- E. Double-Check Backflow Prevention Assemblies:
1. Watts Series LF007 (2-1/2" and smaller)
 2. Watts Series LF709 (3" and larger)
 3. ASSE 1015, suitable for continuous pressure application. Include shutoff valves on inlet and outlet, and strainer on inlet; test cocks; and two positive-seating check valves. Pressure Loss: 5 psig maximum, through middle 1/3 of flow range.
 4. Lead-free
- F. Reduced-Pressure-Principle Backflow Preventers: ASSE 1013, suitable for continuous pressure application. Include ball or gate valves on inlet and outlet, and strainer on inlet; test cocks; and pressure-differential relief valve with ASME A112.1.2 air-gap fitting located between two positive-seating check valves. Pressure Loss: 12 psig maximum, through middle 1/3 of flow range.
1. Provide lead-free construction.
 2. Provide air gap fitting.
 3. Provide lead-free bronze strainer/
 4. Watts Series LF909 or LF994

2.3 UTILITY WATER METERS

- A. Service Water Meter: provide meter in accordance with the Portland Water District specifications.
1. Jessica Hanscom, Asset Management Technician; Portland Water District; Phone: 207-774-5961 ext. 3033; E-mail: jhanscom@pwd.org; URL (Home page): <http://www.pwd.org>

2.4 WATER PRESSURE REGULATORS

- A. Manufacturers:
1. Zurn Industries, Inc.; Wilkins Div.
 2. Cashco, Inc.
 3. Cla-Val Co.
 4. Conbraco Industries, Inc.
 5. FLOMATIC Corp.
 6. Honeywell Braukmann.
 7. IMI Cash Valve.
 8. Watts Industries, Inc.; Water Products Div.
- B. The water pressure reducing valve shall be Lead Free, certified to NSF/ANSI 372 and ASSE Listed 1003, with an integral strainer, direct acting integral by-pass and balance piston actuator. The main body shall be low lead cast bronze (ASTM B 584) alloy. The bell shall be composite

plastic. The cartridge shall be NSF Listed acetal and incorporate an integral seat. The seat disc elastomer shall be NSF Listed EPDM. The assembly shall be accessible for maintenance without removing the device from the line. The water pressure reducing valve shall be a Zurn Wilkins Model NR3XL or equal.

2.5 BALANCING VALVES

A. DHW Recirculation Balancing Valves

1. Furnish and install as indicated on the plans, Circuit Solver in the domestic hot water piping. Circuit Solver shall be self-contained and fully automatic without additional piping or control mechanisms. Valve shall be Circuit Solver as manufactured by ThermOmegaTech or equivalent.
2. Circuit Solver shall regulate the flow of recirculated domestic hot water based on water temperature entering Circuit Solver regardless of system operating pressure.
3. When fully closed valve shall bypass a minimum flow to maintain dynamic control of the recirculating loop and provide a means for system sanitizing.
4. Valve shall be factory adjustable from 105°F to 140°F as required by project conditions. Valve shall modulate between open and closed position within a 10°F range.
5. Valve body and all internal components shall be constructed of stainless steel with major components constructed of type 303 stainless steel.
6. Valve shall be rated to 200 PSIG maximum working pressure. Valve s shall be rated to 300°F maximum working temperature.
7. Valve s shall be standard tapered female pipe thread, NPT.
8. Circuit Solver shall be ANSI/AWWA C800 compliant. Circuit Solvers shall be NSF-61 certified with zero lead content for use in all domestic water systems.
9. Thermal actuator shall be spring operated and self-cleaning, delivering closing thrust sufficient to keep orifice opening free of scale deposits. Thermal actuator shall be rated for a minimum of 200,000 cycles.

2.6 THERMOSTATIC WATER MIXING VALVE PACKAGE

A. Manufacturers:

- a. Armstrong International, Inc.
- b. Lawler Manufacturing Company, Inc.
- c. Leonard Valve Company.
- d. Powers; a division of Watts Water Technologies, Inc.
- e. Symmons Industries, Inc.

B. **TMV-1** Basis of Design: Leonard LF Thermostatic Mixing Valve TM-26-LF.

1. Thermostatic water mixing valve, solid bimetal thermostat directly linked to valve porting to control the intake of hot and cold water and compensate for supply temperature or pressure fluctuations. The TMV shall be highly responsive and cannot be damaged by extremes in temperature. 1/2" Sweat inlets and outlet, 0.5 GPM minimum flow capacity.
2. Integral combination checkstops, Internal parts of lead free bronze, lead free brass, and stainless steel, Integral wall support, Color-coded dial, HOT-COLD with directional

indicators, Maximum operating pressure 125 PSI, Adjustable high temperature limit stop set for 120° F, Locking temperature adjustment knob.

3. This product shall be certified to meet Low Lead requirements of wetted surface area containing less than 0.25% lead by weight

2.7 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers:

1. Pressure Rating: 125 psig minimum unless otherwise indicated.
2. Lead free.
3. Body: Bronze for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved, epoxy coated and for NPS 2-1/2 and larger.
4. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
5. Screen: Stainless steel with round perforations unless otherwise indicated.
6. Perforation Size: Strainers NPS 2 and Smaller: 0.020 inch; Strainers NPS 2-1/2 to NPS 4: 0.045 inch.
7. Drain: Pipe plug for 2" and smaller; factory-installed, hose-end drain valve for 2-1/2" and larger.

2.8 HYDRANTS AND HOSE BIBBS

A. Manufacturers:

1. Josam Co.
2. Murdock, Inc.
3. Simmons Manufacturing Co.
4. Smith, Jay R. Mfg. Co.
5. Tyler Pipe; Wade Div.
6. Watts Industries, Inc.; Drainage Products Div.
7. Woodford Manufacturing Co.
8. Zurn
9. MAPA Products

B. General: ASME A112.21.3M, key-operation hydrant with pressure rating of 125 psig.

1. Inlet: NPS 3/4 or NPS 1 threaded or solder joint.
2. Outlet: ASME B1.20.7, garden-hose threads.
3. Operating Keys: One with each key-operation hydrant.

C. Non-freeze Concealed-Outlet Wall Hydrants: Zurn Z1322-EZ encased Ecolotrol anti-siphon; ASSE 1019, 3/4" pipe connection; automatic draining with flush-mounting box with cover, integral non-removable hose-connection backflow preventer, casing and operating rod to match wall thickness, concealed outlet, and wall clamp. Provide nickel bronze box and hinged cover with operating key lock and "WATER" cast on cover.

2.9 WATER HAMMER ARRESTORS

- A. Lead-free 0.25% maximum weighted average lead content requirement, consist of a copper body with a low lead brass hexagonal male pipe threaded inlet, an acetal, polycarbonate or low lead brass piston with Buna Nitrile or EPDM o-rings and lead free solder; ASSE® Listed 1010, ANSI A112.26.1. The device shall be pre-charged and sealed at the factory. The Water Hammer Arrester shall be a WILKINS Model 1250XL.

1. Water Hammer/Shock arrestor sizes per PDI Standards and as follows:

- a. SA-A 1-11 FU
- b. SA-B 12-32 FU
- c. SA-C 33-60 FU
- d. SA-D 61-113
- e. SA-E 114-154 FU

2.10 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

- A. Open Drains:

- 1. Description: Shop or field fabricate from ASTM A 74, Service class, hub-and-spigot, cast-iron, soil-pipe fittings. Include P-trap, hub-and-spigot riser section; and where required, increaser fitting joined with ASTM C 564, rubber gaskets.
- 2. Size: Same as connected waste piping with increaser fitting of size indicated.

- B. Floor-Drain, Trap-Seal Primer Fittings:

- 1. Description: Cast iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
- 2. Size: Same as floor drain outlet with NPS 1/2 side inlet.

2.11 AIR-GAP FITTINGS

- A. Dishwasher: ASSE 1021, fitting suitable for use with domestic dishwashers and for deck mounting; with plastic body, chrome-plated brass cover; and capacity of at least 5 gpm; and inlet pressure of at least 5 psig at temperature of at least 140°F. Provide ports for garbage disposal or dishwasher hoses as required; Airgap International, Inc. or approved equal.
- B. Small AC condensate drain into sink trap: Airgap International, Inc. Drain Boa; Inlet port directly accepts 3/8" poly tubing. Dual plumbing code listed sink tailpiece fitting. Listed by NSF® and UPC®.
- C. Fixed Air-Gap Fittings: Zurn Z1024/Z1025 or Precision Plumbing Products ; manufactured cast-iron or bronze drainage fitting with semi-open top with threads or device to secure drainage inlet piping in top and bottom spigot or threaded outlet larger than top inlet. Include design complying with ASME A112.1.2 that will provide fixed air gap between installed inlet and outlet piping.

2.12 DRAIN VALVES

- A. Ball-Valve-Type, Hose-End Drain Valves:
1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
 2. Pressure Rating: 400-psig minimum CWP.
 3. Size: NPS 3/4.
 4. Body: Copper alloy.
 5. Ball: Chrome-plated brass.
 6. Seats and Seals: Replaceable.
 7. Handle: Vinyl-covered steel.
 8. Inlet: Threaded or solder joint.
 9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

2.13 CLEANOUTS

- A. Manufacturers
1. Zurn
 2. Smith, Jay R. Mfg. Co.
 3. Josam Co.
 4. Tyler Pipe, Wade Div.
 5. Watts Industries, Inc., Drainage Products Div.
 6. Mifab
- B. Cleanouts shall be easily accessible and shall be gastight and watertight. Provide a minimum clearance of 24 inches for the rodding. Size of cleanout shall be same as pipe size through 4". Pipes 4" and larger shall have 4" cleanouts.
- C. Floor Cleanouts: Mifab C1000 Series floor cleanout with heavy-duty nickel-bronze or stainless steel adjustable top.
1. Compliance: ANSI/ASME A112.36.2M.
 2. Load Rating: Up to 7,499 pounds.
 3. Body: A1, 8-inch diameter body. Lacquered, ASTM A 48, Class 25 cast iron body with anchor flange. O-ring secondary gasket seal. 4-inch; 4"NPS machined integral body threads.
 4. Combined Access Cover and Plug Top Assembly: Heavy-duty, round, 5-inch diameter; square, 5-inch by 5-inch (for tile insertion), adjustable, Type 304 stainless steel top assembly with No. 4 satin finish. Neoprene primary gasket seal. Vandal-resistant stainless steel screws.
 5. When a waterproof membrane is used in the floor system, provide clamping collars on the cleanouts.
 6. In carpeted areas, provide carpet cleanout markers.
- D. Cleanouts shall consist of "Y" fittings and (1/8 inch) bends with brass or bronze screw plugs.
- E. Provide cleanouts at or near the base of the vertical stacks with the cleanout plug located approximately 24 inches above the floor. If there are no fixtures installed on the lowest floor, the cleanout shall be installed at the base of the stack Cleanout shall consist of sanitary tees. . Extend the cleanouts to the wall access cover; Mifab 1400 Series.

- F. In horizontal runs above grade, cleanouts shall consist of cast brass tapered screw plug in fitting or caulked/no hub cast iron ferrule. Plain end (no-hub) piping in interstitial space or above ceiling may use plain end (no-hub) blind plug and clamp.

2.14 FLOOR DRAINS

A. Manufacturers

1. Zurn Industries, Inc
2. Jay R. Smith Mfg. Co.
3. Tyler Pipe, Wade Div.
4. Watts Industries, Inc
5. Mifab

- B. Floor drains shall comply with ASME A112.21.1M.

- C. Provide outlet type as required by piping system used.

- D. Provide ½” trap primer connection as indicated on plans.

- E. Heavy Duty **FD-1**: mechanical rooms; ZURN Z525-P 9" diameter top drain, Dura-Coated cast iron body with 3” bottom outlet, seepage pan and adjustable extension frame with medium-duty cast iron deep slotted grate.

- F. Light Duty **FD-2**: bathroom and finished areas; ZURN ZN415BZ-P, Dura-Coated cast iron body with 2” bottom outlet, combination invertible membrane clamp and adjustable collar with seepage slots, and “TYPE BZ” polished nickel bronze light-duty leveling strainer.

2.15 TRAP SEAL PRIMER VALVES

1. Manufacturers:

- a. Precision Plumbing Products, Inc.
- b. Josam Co.
- c. Watts.
- d. Zurn
- e. Mifab
- f. Sioux Chief

- B. Trap primer make up lines must have a continuous slope to the floor drain.

C. Electronic Trap Primer – **TP-1**

1. Precision Plumbing Products Model MP-500
2. Operation: A preset timer energizes a normally closed electronic solenoid valve. Potable water flows across the air gap and is distributed via trap primer feed lines. The timer then de-energizes the solenoid allowing it to close until the next operational cycle.
3. Cabinet: Surface-mounted steel box; NEMA Type 1, UL 50, 12” x 12” x 4” - 16 gauge steel w/screw on cover ANSI 61 gray polyester powder paint.

4. Electric Controls: Pre-set timer opens once for 6 seconds every 24hours. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application. 120/1/60, 0.23 Amps. Circuit Breaker, Test Switch, Timer, Solenoid Valve UL Listed. Electrical assembly listed per UL # 73.
5. Air gap fitting
6. Solenoid valve with integral strainer screen
7. Piping: ASTM B 88, Type L copper water tubing. 95-5 lead-free. Containing lead not in the excess of 0.2%; Inlet: ½” NPT male; Outlet: ½” NPT female.
8. Provide a distribution unit for multiple outlet installations.
9. Standard: ASSE 1044.

D. Water Saver Trap Primer – **TP-2**:

1. Precision Plumbing Products 1 1/2” Tail Piece floor drain trap priming assembly; provided with a braided 1/2” stainless steel flexible priming make up water line with 5/8” compression fitting, and chrome plated escutcheons for both the wall tube and make up water line.
2. Minimum discharge rate at 0.5 gpm is 2.5 oz.
3. Standard: ASSE 1044.

E. Automatic Trap Seal Primer – **TP-3**:

1. MIFAB’s M-500 Series of pressure activated trap seal primers (MR-500, M1-500 and M2500) can be connected to any cold water line, and will be automatically activated when a valve or faucet, that is on the line, is opened.
2. A pressure drop of three (3) PSI shall activate the trap seal primer.
3. Trap seal primers can be disassembled in the field. Their unique design permits filter replacement without affecting the performance of the primer. The “O” ring seals are tested for reliability at a temperature range of -40 degrees to 450 degrees F.
4. The trap seal primer shall not require adjustment.
5. Standard: ASSE 1018.

2.16 ROOF DRAINS

A. Roof Drains: Comply with ASME A112.21.2M.

B. Manufacturers

1. MIFAB
2. Josam Co.
3. Froet Industries
4. Smith, Jay R. Mfg. Co.
5. Tyler Pipe, Wade Div.
6. Watts
7. Zurn

C. **RD-1** Basis of Design: Mifab R1200-EU large sump roof drain Coordinate Drain Type with roofer:

1. Large Sump Roof Drain for 1-3/4 inches to 7 inches insulation. Compliance: ANSI/ASME A112.21.2M. Body: A2 deep sump body. Lacquered, ASTM-A 48, Class 25 cast iron body with anchor flange. Dome Strainer: Self-locking poly dome strainer. Free area of 136 square inches. Membrane Clamp Ring: 2-5/16-inch wide, ASTM A 48, Class 25 cast iron, waterproofing membrane clamp ring with integral gravel stop. Extension Flange: Adjustable, ASTM A 48, Class 25 cast iron, extension deck flange and under deck clamp.
2. Large Sump Roof Drain with Adjustable Ballast Guard for I.R.M.A. Roofs: MIFAB R1200-HC-M lacquered cast iron deep sump roof drain with anchor flange, adjustable extension with auxiliary drainage slots, secondary clamp, large cast iron waterproofing membrane clamp ring with integral gravel stop and metal dome strainer with a free area of 136 sq. inches.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.
- B. Install backflow preventers in each water supply to hydronic systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.
 1. Locate backflow preventers in same room as connected equipment or system.
 2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe to floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are not acceptable for this application.
 3. Do not install bypass piping around backflow preventers.
 4. Access shall be provided for testing, maintenance and repair. Locate backflow preventer between 2 feet and 5 feet above floor.
 5. Test of Backflow Prevention Assemblies: Backflow prevention assembly shall be tested using gauges specifically designed for the testing of backflow prevention assemblies. Gauges shall be tested annually for accuracy in accordance with the University of Southern California's Foundation of Cross Connection Control and Hydraulic Research or the American Water Works Association Manual of Cross Connection (Manual M-14). Report form for each assembly shall include, as a minimum, the following:
 - a. Data on Device Data on Testing Firm
 - b. Type of Assembly Name
 - c. Manufacturer Address
 - d. Model Number Certified Tester
 - e. Serial Number Certified Tester No.
 - f. Size Date of Test
 - g. Location
 - h. Test Pressure Readings Serial Number and Test Data of Gauges
 - i. If the unit fails to meet specified requirements, the unit shall be repaired and retested.

- C. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.
- D. Install pressure regulators with inlet and outlet shutoff valves and balance valve bypass. Install pressure gages on inlet and outlet.
- E. Install strainers on supply side of each control valve, pressure regulator, and solenoid valve.
- F. Trap primers:
 - 1. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.
 - a. Exception: Fitting may be omitted if trap has trap-seal primer connection.
 - b. Size: Same as floor drain inlet.
 - 2. Install trap seal primers in accordance with manufacturer's instructions.
 - 3. Cycle trap seal primers a minimum of 6 times to ensure optimum performance.
 - 4. Ensure flux and other debris is removed.
 - 5. Use only Teflon tape around threads. Do not use pipe dope or paste.
 - 6. Do not solder fittings directly onto inlet or outlet of primer.
 - 7. Do not install trap seal primers closer than 40 feet apart when using same potable water supply line.
 - 8. Mount trap seal primers in a vertical position 1 foot above finished floor for every 20 feet of floor drain trap make-up water line.
 - 9. Install union connection above trap seal primers.
 - 10. Install line shut-off valve upstream of trap seal primers to shut off water supply when performing maintenance on trap seal primers.
 - 11. Avoid direct installation to prevent foreign material from entering directly into trap seal primers.
- G. Install expansion joints on vertical risers, stacks, and conductors if indicated.
- H. Cleanouts:
 - 1. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated: Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated. Locate at each change in direction of piping greater than 45 degrees. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping. Locate at base of each vertical soil and waste stack.
 - 2. Install cleanout deck plates with top flush with finished floor, for floor cleanouts for piping below floors.
 - 3. Install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall, for cleanouts located in concealed piping.
 - 4. Install flashing flange and clamping device with each stack and cleanout passing through floors with waterproof membrane.
- I. Install floor drains in accordance with manufacturer's instructions at locations indicated on the drawings.

1. Protect installed floor drains from damage during construction.
 2. Install floor drains at low points of surface areas to be drained.
 3. Install floor drains plumb, level, and to correct elevation.
 4. Ensure top of floor drains are flush with top of finished floor.
 5. Install floor drains using manufacturer's supplied hardware.
 6. Coordinate depressed/pitched slab with concrete contractor.
 7. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
 8. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.
- J. Roof Drains:
1. Coordination:
 - a. Roof drains installed and flashed by roofing contractor.
 - b. Roof drains furnished, insulated, and connected to piping by Division 22.
 2. Examine areas to receive roof drains. Notify Architect of conditions that would adversely affect installation or subsequent use. Do not proceed with installation until unsatisfactory conditions are corrected.
 3. Install roof drains in accordance with manufacturer's instructions at locations indicated on the drawings.
 4. Install roof drains plumb, level, and to correct elevation.
 5. Install roof drains using manufacturer's supplied hardware.
 6. Protect installed roof drains from damage during construction.
- K. Fasten wall-hanging plumbing specialties securely to supports attached to building substrate if supports are specified and to building wall construction if no support is indicated.
- L. Fasten recessed-type plumbing specialties to reinforcement built into walls.
- M. Install wood-blocking reinforcement for wall mounting and recessed-type plumbing specialties.
- N. Install individual shutoff valve in each water supply to plumbing specialties. Install shutoff valves in accessible locations.
- O. Install air vents at piping high points. Include ball valve in inlet.
- P. Install traps on plumbing specialty drain outlets.
- Q. Water hammer arrestors shall be installed at flush valve water closets, as shown on the plans and as recommended by Plumbing & Drainage Institute Standard PDI-WH-201. Locate units at the end of branch lines, between the last two fixtures served. Size units based on fixture unit total of branch. All branch pipes serving flush valve water closets shall have water hammer arrestors.
- R. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

S. Circuit Solver DHW Recirculation Balancing Valves:

1. Provide Circuit Solver in each domestic hot water return piping branch beyond last hot water device in that branch.
2. Provide suitable line size isolation valves, unions, and strainer.
3. Provide suitable access panel as required in non-accessible ceilings and walls.

3.2 ROUGHING-IN FOR UTILITY WATER METERS

- A. Pay all required fees.
- B. Install water meters, piping, and specialties according to AWWA M6 and utility's requirements.

3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.
- C. Connect plumbing specialties to piping specified in other Division 22 Sections.
- D. Connect plumbing specialties and devices that require power according to Electrical Specification Sections.

3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled trap seal primer systems and their installation, including piping and electrical connections. Report results in writing. Representative shall train Owner's maintenance personnel to adjust, operate, and maintain.
 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Remove malfunctioning units, replace with new units, and retest.
 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.5 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 221119

SECTION 221316 – PLUMBING SANITARY AND STORM PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 22 Section "Common Work Results for Plumbing"
 - 2. Division 22 Section "Plumbing Specialties" for soil, waste, and vent piping systems specialties.

1.2 SUMMARY

- A. This Section includes soil and waste, sanitary drainage and vent piping.
- B. This Section includes storm-drainage piping.
- C. Drawings show the general layout of piping and accessories but do not show all required fittings and offsets that may be necessary to connect piping to equipment and to coordinate with other trades. Fabricate piping based on field measurements. Provide all necessary fittings and offsets.
- D. General layout shown, provide piping to fixtures as required by the Maine Plumbing Code. A licensed master plumber shall perform or supervise the work and provide layouts, piping, and fittings as required by code.

1.3 PERFORMANCE REQUIREMENTS

- A. Comply with the utility requirements for the connection of to the municipal utility services. Obtain and pay for all necessary permits from the applicable municipal department. Obtain authority to connect to their existing mains.
- B. Provide components and installation capable of producing piping systems with working-pressure ratings per local plumbing code.

1.4 SUBMITTALS

- A. Product Data: For pipe, tube, fittings, and couplings.
- B. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

1.5 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with the UPC 2009 edition, subject to the exclusions and amendments set forth by the Maine Plumbers Examining Board.
- C. Comply with local building and plumbing codes.
- D. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-DWV" for plastic drain, waste, and vent piping; "NSF-drain" for plastic drain piping; "NSF-tubular" for plastic continuous waste piping; and "NSF-sewer" for plastic sewer piping.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

2.2 CAST-IRON SOIL PIPING

- A. Hubless
 - 1. Hubless Cast Iron pipe and fittings shall be manufactured from gray cast iron and shall conform to ASTM A-888 and CISPI Standard 301. All pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute.
 - 2. Hubless couplings shall conform to CISPI Standard 310 for standard couplings or ASTM C-1540 for heavy duty couplings where indicated. Gaskets shall conform to ASTM C-564. All pipe and fittings to be produced by a single manufacturer and are to be installed in accordance with manufacturer's recommendations and local code requirements. Couplings shall be installed in accordance with the manufacturer's band tightening sequence and torque. Tighten bands with a properly calibrated torque limiting device.
- B. Hub and Spigot Cast Iron Soil Pipe and Fittings:
 - 1. Hub and Spigot Cast Iron pipe and fittings shall be manufactured from gray cast iron and shall conform to ASTM A-74. All pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute. Pipe and fittings to be Service (SV) Extra Heavy (XH)
 - 2. Joints can be made using a compression gasket manufactured from a neoprene elastomer meeting the requirements of ASTM C-564 or lead and oakum. All pipe and fittings to be produced by a single manufacturer and are to be installed in accordance with manufacturer's recommendations and local code requirements. The system shall be hydrostatically tested after installation to 10 ft. of head (4.3 psi maximum).

2.3 PVC DRAINAGE PIPING

- A. Pipe and fittings shall be manufactured from PVC compound with a cell class of 12454 per ASTM D-1784 and conform with National Sanitation Foundation (NSF) standard 14. Pipe shall be iron pipe size (IPS) conforming to ASTM D-1785 and ASTM D-2665. Fittings shall conform to ASTM D-2665.
- B. All pipe and fittings to be produced by a single manufacturer and to be installed in accordance with manufacturer's recommendations and local code requirements. Solvent cements shall conform to ASTM D-2564, primer shall conform to ASTM F-656. The system to be manufactured by Charlotte Pipe and Foundry Co. or approved equal; and shall be intended for non-pressure drainage applications where the temperature will not exceed 140°F.

PART 3 - EXECUTION

3.1 EXCAVATION

- A. Comply with requirements for excavating, trenching, and backfilling specified in Division 31.

3.2 PIPING APPLICATIONS

- A. Transition and special fittings with pressure ratings at least equal to piping pressure ratings may be used in applications below, unless otherwise indicated.
- B. Flanges may be used on aboveground pressure piping, unless otherwise indicated.
- C. Soil, Waste, and Vent Piping: Use any of the following piping materials for each size range: PVC or Cast iron
- D. Elevator sump pump discharge piping: Type L sweated copper.
- E. Storm Drain Piping: PVC or Cast iron

3.3 PIPING INSTALLATION

- A. Refer to Division 22 Section "Common Work Results for Plumbing" for basic piping installation.
- B. Provide firestopping as per Section 230500 "Common Work Results for HVAC".
- C. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
- D. Install PVC soil and waste drainage and vent piping according to ASTM D 2665.
- E. Install underground PVC soil and waste drainage piping according to ASTM D 2321.

- F. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if 2 fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
- G. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.
- H. Install drainage and vent piping at the minimum slopes as required by the local plumbing code.
- I. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- J. Install cleanouts at grade and extend to where building drains connect to site piping. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.
- K. Install wall penetration system at each service pipe penetration through foundation wall. Make installation watertight. Refer to Division 22 Section "Common Work Results for Plumbing" for wall penetration systems.

3.4 JOINT CONSTRUCTION

- A. Refer to Division 22 Section "Common Work Results for Plumbing" for basic piping joint construction.
- B. Cast-Iron, Soil-Piping Joints: Make joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings." Gasketed Joints: Make with rubber gasket matching class of pipe and fittings. Hubless Joints: Make with rubber gasket and sleeve or clamp.

3.5 VALVE INSTALLATION

- A. Shutoff Valves: Install full-port ball valve on each pump discharge.
- B. Check Valves: Install swing check valve, downstream from shutoff valve, on each pump discharge.

3.6 HANGER AND SUPPORT INSTALLATION

- A. Hanger, support, and anchor devices are specified in Division 22 Section "Hangers and Supports."

3.7 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect interior drainage piping to exterior drainage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect drainage and vent piping to fixtures and equipment as shown on the plans.
- D. Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.

3.8 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
 - 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 - 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Test piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
 - 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
 - 2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 - 3. Roughing-in Plumbing Test Procedure: Test piping on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
 - 4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg. Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
 - 5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
- C. Test force-main piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Leave uncovered and unconcealed new, altered, extended, or replaced force-main piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 2. Cap and subject piping to static-water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
 3. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
- D. Re-inspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for re-inspection.
- E. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

3.9 CLEANING

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.

END OF SECTION 221316

SECTION 221429 – ELEVATOR SUMP PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Related Sections include the following: Division 22 Section "Common Work Results for Plumbing"

1.2 SUMMARY

- A. This Section includes sump pumps for elevator sump pits.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Wiring Diagrams: For power, signal, and control wiring.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For pumps and controls, to include in operation and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Product Options: Drawings indicate size, profiles, connections, and dimensional requirements of pumps and are based on specific manufacturer types and models indicated. Other manufacturers' pumps with equal performance characteristics may be considered.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Retain shipping flange protective covers and protective coatings during storage.
- B. Protect bearings and couplings against damage.

- C. Comply with pump manufacturer's rigging instructions for handling.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Liberty Pumps.
 - 2. Weil Pump Co.
 - 3. Little Giant Pump Co.
 - 4. Weil Pump Co.
 - 5. Zoeller Pump Co. (Basis of Design)
 - 6. Myers
 - 7. Stancor

2.2 ELEVATOR SUMP PUMP

- A. The Oil Smart control system shall be designed and approved for the safe operation of pumping, alarming and monitoring of elevator sump pits. The Oil Smart shall activate a pump to remove water from elevator pits in accordance with ASME A17.1.
- B. Components required for the repair of the pump shall be shipped within a period of 24 hours.
- C. The castings shall be constructed of Class 25 cast iron. The motor housing shall be oil filled to dissipate heat. Air filled motors shall not be considered equal since they do not properly dissipate heat from the motor. All mating parts shall be machined and sealed with a Buna-N O-ring. All fasteners exposed to the liquid shall be stainless steel. The motor shall be protected on the top side with sealed cord entry plate with molded pins to conduct electricity eliminating the ability of water to enter internally through the cord. The motor shall be protected on the lower side with a unitized ceramic/carbon seal with stainless steel housings and spring or engineered double lip seal with stainless steel springs. The pump shall be furnished with stainless steel handle. The exterior of the casting shall be protected with powder coat paint. The pump shall have cast iron support legs, enabling it to be a free standing unit.
- D. The submersible pump shall be supplied with a 25 feet of multiconductor power cord. It shall be cord type YELLOW UL 16-3 SJE00W 300V 105°C, capable of continued exposure to the pumped liquid. The power cord shall be sized for the rated full load amps of the pump in accordance with the National Electric Code. The power cable shall not enter the motor housing directly but will conduct electricity to the motor by means of a water tight compression fitting cord plate assembly, with molded pins to conduct electricity. This will eliminate the ability of water to enter internally through the cord, by means of a damaged or wicking cord.
- E. Single phase motors shall be oil filled, permanent split capacitor, Class B insulated NEMA B design, rated for continuous duty. At maximum load the winding temperature shall not exceed 130 degrees C un submerged. Since air filled motors are not capable of dissipating heat they shall not be considered equal. The pump motor shall have an integral thermal overload switch in

the windings for protecting the motor. The capacitor circuit shall be mounted internally in the pump.

- F. An upper sleeve and lower ball bearing shall be required. The lower ball bearing shall be a single ball / race type bearing. Both bearings shall be permanently lubricated by the oil, which fills the motor housing. The motor shaft shall be made of 300 or 400 series stainless steel.
- G. The pump shall have a unitized carbon / ceramic seal with stainless steel housings and spring, or engineered double lip seal with stainless steel springs. The motor plate / housing interface shall be sealed with a Buna-N O-ring. The impeller shall be vortex style made of an engineered polymer, with pump out vanes on the back shroud to keep debris away from the seal area. It shall be threaded to the motor shaft.
- H. The pump shall have a ground continuity check and the motor chamber shall be Hi-potted to test for electrical integrity, moisture content and insulation defects. The motor and volute housing shall be pressurized, and an air leak decay test is performed to ensure integrity of the motor housing. The pump shall be run, voltage current monitored, and the tester checks for noise or other malfunction.
- I. Controls:
 - 1. The Oil Smart shall stop the pump before oil or other harmful substances enter our water supply. Indicator lights will illuminate on the control panel for the following: power, pump running, high water, and high oil. The panel has a set of auxiliary contacts that activate on power loss or high Oil/Water conditions. These contacts can be connected to the Oil Smart remote panel which contains audio/visual alarming along with auxiliary contacts for connection to Building Automation System.
 - 2. The control unit has three probes and a float ball switch. The pump will activate when the middle probe contacts water, and will remain on until the first, longest probe no longer is in contact with water. A high water alarm is activated when third or shortest probe contacts water. The system will ignore a small film of oil, however larger volumes of oil will be detected when the alarm probe does not detect water and the float ball activates. The system will continue to operate, removing water not oil from the vault even when oil has been detected.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in of plumbing piping systems to verify actual locations of piping connections before pump installation.

3.2 CONCRETE

- A. Install concrete bases of dimensions indicated for sump pumps. Refer to Division 22 Section "Common Work Results for Plumbing."

- B. Concrete for pits and sumps is specified in Division 3. Coordinate pit size with Division 3. The minimum sump size shall be 20" x 20" x 30" deep.

3.3 INSTALLATION

- A. Install pumps according to manufacturer's written instructions.
- B. Install pumps and arrange to provide access for maintenance, including removal of motors, impellers, couplings, and accessories.
- C. Support piping so weight of piping is not supported by pumps.
- D. Coordinate location of GFI 3-prong grounded electrical receptacles, extension cords are not permitted.
- E. Pit must be cleaned of debris after installation.

3.4 CONNECTIONS

- A. Install swing check valve on each pump discharge.
- B. Install electrical connections for power, controls, and devices. Connect pump, level switch, and alarm panel to GFCI outlets.

3.5 STARTUP SERVICE

- A. Perform startup service.
- B. Complete installation and startup checks according to manufacturer's written instructions.

3.6 ADJUSTING

- A. Adjust pumps to function smoothly, and lubricate as recommended by manufacturer.
- B. Adjust control set points.

3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain controls and pumps.

END OF SECTION 221429

SECTION 223300 - ELECTRIC WATER HEATERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the electric water heaters and accessories.

1.3 SUBMITTALS

- A. Product Data: For each type and size of water heater indicated. Include rated capacities, operating characteristics, furnished specialties, and accessories.
- B. Operation and Maintenance Data: For electric water heaters to include in emergency, operation, and maintenance manuals.
- C. Warranty: Special warranty specified in this Section.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain same type of electric water heaters through one source from a single manufacturer.
- B. Product Options: Drawings indicate size, profiles, and dimensional requirements of electric water heaters and are based on the specific system indicated
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2007.
- E. ASME Compliance: Where indicated, fabricate and label commercial water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
- F. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9," for all components that will be in contact with potable water.
- G. Hydrostatically test water heater storage tanks before shipment to minimum of one and one-half times pressure rating.

1.5 COORDINATION

- A. Coordinate size and location of concrete bases. Refer to Division 22 Section "Common Work Results for Plumbing".

1.6 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of electric water heaters that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including storage tank and supports.
 - b. Faulty operation of controls.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal use.
 - 2. Warranty Periods: From date of Substantial Completion:
 - a. Electric Water Heaters:
 - 1) Storage Tank: Five years.
 - 2) Controls and Other Components: Two years.

PART 2 - PRODUCTS

2.1 COMMERCIAL ELECTRIC WATER HEATERS

- A. Manufacturers:
 - 1. Bradford White Corporation.
 - 2. Lochinvar Corporation.
 - 3. Rheem
 - 4. Ruud
 - 5. Smith, A. O. Water Products Company.
 - 6. State Industries, Inc.
- B. The heater shall be constructed in accordance with ASME Code, shall bear appropriate symbol and be listed with the National Board as required. Heater shall be listed with Underwriters' Laboratories and approved to The National Sanitation Foundation Standard No. 5.
- C. All internal surfaces of the tank shall be glass-lined with an alkaline borosilicate composition that has been fused-to-steel by firing at a temperature of 1600°F.
- D. Tank shall be cathodically protected with powered anodes.
- E. The entire vessel is to be enclosed in a round steel enclosure with baked enamel finish.

- F. Water heater shall have an electronic control with large LCD displaying current water heater status; provide real time element status and sensing, low water cutoff and economy mode operation. Shall have 120 volt control circuit transformer, transformer fusing, magnetic contactors, element fusing per N.E.C., and commercial grade incoloy sheathed flange or gold mounted elements with prewired terminal leads.
- G. Temperature controls include limiting switch which will require resetting manually in the event the temperature reaches 190°F.
- H. Foam insulation shall meet the thermal efficiency and/or standby loss requirements of the U. S. Department of Energy and current edition of ASHRAE/IESNA 90.1.
- I. Heater shall include a CSA Certified and ASME Rated T&P relief valve and drain valve.
- J. Water heater should incorporate the iCOMM™ system for remote monitoring, leak detection and fault alert.
- K. Compression Tanks: Steel pressure-rated tank constructed with welded joints and factory-installed butyl-rubber diaphragm. Include air pre-charge to minimum system-operating pressure at tank.
 - 1. Manufacturers:
 - a. AMTROL Inc.
 - b. Armstrong Pumps, Inc.
 - c. Taco, Inc.
 - d. Wessels Co.
 - 2. Construction:
 - a. Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1, pipe thread.
 - b. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
 - c. Air-Charging Valve: Factory installed.
 - 3. Capacity and Characteristics: As shown on the plans.

PART 3 - EXECUTION

3.1 WATER HEATER INSTALLATION

- A. Install water heaters level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.
- B. Water heaters shall be supported and restrained by the specified supports.

- C. Extend water-heater relief-valve outlet, with drain piping same as domestic water piping in continuous downward pitch, and discharge by positive air gap to mop basin.
- D. Install water-heater drain piping as indirect waste to spill by positive air gap into mop basin or floor drain.
- E. Install hose-end drain valves at low points in water piping for water heaters that do not have tank drains. Refer to Division 22 Section "Plumbing Specialties" for hose-end drain valves.
- F. Install plumbing specialties as shown on the plans and in accordance with manufactures' recommendations.
- G. Fill water heaters with water.
- H. Charge compression tanks with air.

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to water heaters to allow service and maintenance. Arrange piping for easy removal of water heaters.
- C. Ground equipment according to electrical specifications.
- D. Connect wiring according to electrical specifications.

3.3 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.
- B. Perform the following field tests and inspections and prepare test reports:
 - 1. Leak Test: After installation, test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Operational Test: After electrical circuitry has been energized, confirm proper operation.
 - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Remove and replace water heaters that do not pass tests and inspections and retest as specified above.

END OF SECTION 223300

SECTION 224000 - PLUMBING FIXTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 22 Section "Common Work Results for Plumbing"
 - 2. Section 221116 - Domestic Water Piping: Material and installation of piping systems, valves, and piping specialties.
 - 3. Division 22 Section "Plumbing Specialties" for backflow preventers and specialty fixtures not in this Section.

1.2 SUMMARY

- A. Plumbing Fixtures

1.3 SUBMITTALS

- A. Product Data: Include selected fixture and trim, fittings, accessories, appliances, appurtenances, equipment, and supports and indicate materials and finishes, dimensions, construction details, and flow-control rates for each type of fixture indicated.
- B. Maintenance Data: For plumbing fixtures to include in maintenance manuals specified in Division 1.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain plumbing fixtures, faucets, and other components of each category through one source from a single manufacturer. Exception: If fixtures, faucets, or other components are not available from a single manufacturer, obtain similar products from other manufacturers specified for that category.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with the UPC 2009 edition, subject to the exclusions and amendments set forth by the Maine Plumbers Examining Board.
- D. Comply with local building and plumbing codes.

- E. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; about plumbing fixtures for people with disabilities.
- F. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.
- G. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.
- H. Water line components shall be lead-free.

1.5 COORDINATION

- A. Coordinate roughing-in and final plumbing fixture locations, and verify that fixtures can be installed to comply with original design and referenced standards.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Common Plumbing Fixture Requirements
 - 1. Fixtures shall be water conservation type in accordance with local, state, and federal requirements.
 - 2. Vitreous china, nonabsorbent, hard-burned, and vitrified throughout the body shall be provided. Porcelain enameled ware shall have specially selected, acid-resisting enamel coating evenly applied on surfaces. No fixture will be accepted that shows cracks, crazes, blisters, thin spots, or other flaws.
 - 3. Fixture color shall be white except as specified herein.
 - 4. Provide combinations of fixtures and trim, faucets, fittings, and other components that are compatible.
 - 5. Fixtures shall be equipped with appurtenances such as traps, faucets, stop valves, and drain fittings.
 - 6. Each fixture and piece of equipment requiring connections to the drainage system, except grease interceptors, shall be equipped with a trap.
 - 7. Brass expansion or toggle bolts capped with acorn nuts shall be provided for supports, and polished chromium-plated pipe, valves, and fittings shall be provided where exposed to view.
 - 8. Fixtures with the supply discharge below the rim shall be equipped with backflow preventers.
 - 9. Fixture supports for off-the-floor fixtures shall be of the chair-carrier type. The carrier shall provide the necessary means of mounting the fixture, with a foot or feet to anchor the assembly to the floor slab. Adjustability shall be provided to locate the fixture at the desired height and in proper relation to the wall. Support plates, in lieu of chair carrier,

shall be fastened to the wall structure only where it is not possible to anchor a floor-mounted chair carrier to the floor slab.

10. Provide access panels to concealed valves and components. All components shall have proper access in accordance with manufactures' recommendations. Refer to Section 220500.
11. Mounting heights: Refer to Architectural Plans.

2.2 FLUSH VALVE WATER CLOSETS

A. Manufacturers

1. TOTO
2. American Standard, Inc.
3. Kohler Co.
4. Sloan
5. Zurn

B. **P-1** Basis of Design: TOTO CT708E(G) wall mounted high efficiency, white (cotton) vitreous china siphon jet water closet with elongated bowl.

1. 1.28 gpf wall mount outlet bowl
2. Fixture shall qualify according to ASME test procedures as a high-efficiency water closet
3. Elongated front bowl with ceramic glaze
4. SC534 open front seat
5. Top Spud
6. Siphon jet
7. 1-1/2" spud for flushometer valve
8. 2 Bolt Caps
9. Flush valve: TET1LN32#CP Eco Power electronic flushometer valve with manual override button and 24 hour flush for trap seal protection.

C. **P-1A**: Same as P-1, ADA accessible.

1. See architectural sections for mounting height.

D. **P-1B** Basis of Design: TOTO CT708E(G) wall mounted high efficiency, white vitreous china siphon jet water closet with elongated bowl.

1. 1.28 gpf wall mount back outlet bowl
2. Fixture shall qualify according to ASME test procedures as a high-efficiency water closet
3. SC534 open front seat
4. Top Spud
5. See architectural sections for mounting heights.
6. Siphon Jet
7. 1-1/2" spud for flushometer valve
8. 2 Bolt Caps
9. Floor Flange, (same material as the connecting pipe drain), with all brass bolts and with rubber gasket.

10. Flush valve: TMT1LN32#CP Eco Power electronic flushometer valve with manual override button and 24 hour flush for trap seal protection.

2.3 URINALS MANUAL FLUSH

A. Manufacturers

1. TOTO
2. Sloan
3. American Standard, Inc.
4. Kohler Co.
5. Zurn

B. **P-2** Basis of Design: TOTO UT105U(G) wall mounted high efficiency, white (cotton) vitreous china and concealed trapway.

1. 0.128 gpf wall mount back outlet
2. Washout flushing
3. 1-1/2" top spud for flushometer valve
4. Low profile dome strainer
5. Concealed integral trap
6. ADA accessible, front rim mounted 17" above finished floor.
7. Flush valve: TEU1U12#CP Eco Power electronic flushometer valve with manual override button and 24 hour flush for trap seal protection.

2.4 LAVATORIES

A. Lavatory Manufacturers:

1. Duravit
2. American Standard
3. Kohler
4. Toto

B. **P-3** Basis of Design: Duravit 041955 white washbasin with overflow, with tap platform and ceramic shroud. Refer to installation requirements for locations of waste and supply piping and mixing valve to fit within shroud.

1. Dimensions: 21 5/8" x 17 1/2"
2. Vitreous china
3. Single hole punch.
4. TLT10 mixing valve.
5. Faucet: TOTO TEL121CP, self-generating hydropowered eco power system with micro sensor positioned underneath the spout and consistent water distribution. 1.0 GPM laminar flow.
6. P-trap: Heavy cast brass 1 1/4 x 1 1/2 adjustable trap with cleanout plug and 12 inch center to end. Furnished with slip nuts, 17 gauge seamless tubular brass wall bend, and steel shallow flange.

7. Supply line: supplied by fixture manufacturer, or by McGuire or Brasscraft. Shall be lead-free, loose key standard stop lavatory supply kit, two polished chrome, solid brass angle stops with round wheel handles, two 12" flexible chrome-plated lavatory risers complete with two forged brass with set screw flanges; connections: 1/2" sweat x 3/8" OD.

2.5 STAINLESS STEEL SINKS

A. Sink Manufacturers:

1. Kraus
2. Elkay Manufacturing Co.
3. Just Manufacturing Co.
4. Kindred
5. Advance Tabco

B. Faucet Manufacturers

1. Chicago
2. Zurn
3. Kohler
4. American Standard

C. **P-4** Basis of Design: Kraus, under mount, stainless steel, two compartment sink. Commercial grade satin finish, 16 gauge, type 304 stainless steel with sound proofing and extra deep bowls.

1. Overall Size: 33" x 20 3/4" x 10" deep, basin split 60/40.
2. Faucet: Moen Align single handle high arc pulldown kitchen faucet, model 7565 series, 1.5 GPM, duralast cartridge, ADA compliant.
3. Supplies: with stops.
4. Drain Piping: offset grid drain with 2"chrome-plated cast-brass trap, 0.045-inch- thick tubular brass waste to wall, and wall escutcheons.

D. **P-9** Basis of Design: Kraus, under mount, stainless steel, single compartment sink. Commercial grade satin finish, 16 gauge, type 304 stainless steel with sound proofing and extra deep bowls.

1. Overall Size: 15" x 12 3/4" x 7" deep.
2. Faucet: Moen Align single handle high arc pulldown kitchen faucet, model 7565 series, 1.5 GPM, duralast cartridge, ADA compliant.
3. Supplies: with stops.
4. Drain Piping: offset grid drain with 2"chrome-plated cast-brass trap, 0.045-inch- thick tubular brass waste to wall, and wall escutcheons.

2.6 SHOWERS

A. Manufacturers:

1. Aquarius
 2. Aquabath
 3. Aquatic
 4. Kohler
- B. Transfer Shower **P-5A** Basis of Design: Aquarius G 3682 BF 0.5, ADA compliant, gelcoat fiberglass transfer shower stall with grab bars and foldable seat.
1. Material: reinforced fiberglass
 2. Finish: sanitary grade polyester gelcoat
 3. Color: White.
 4. Drain Location: Center.
 5. Soap tray: molded
 6. ADA Seat: 32"x21" HDPE fold-up. Provide loose for future use, not factory installed. Provide blocking in shower stall, both sides, for future for seat installation support.
 7. Top: Open.
 8. Threshold: ½"
 9. ADA Grab bars: smooth radius SS; 33.5"x18"x1.5" and 24"x1.5"
 10. One 1" diameter stainless steel shower rod with receiver cups
 11. Drain: Grid, NPS 2.
 12. Provide with the following options:
 - a. White Shower curtain
 - b. Collapsible rubber dam
 13. Shower valve: Symmons Model Origins 9603-PLR-1.5-CHKS hand shower system.
 - a. Pressure-balancing mixing valve with adjustable stop screw to limit handle turn.
 - b. ADA compliant.
 - c. Wall/hand shower with 60" flexible metal hose, in-line vacuum breaker, wall connection and flange. 36" slide bar for hand shower mounting.
 - d. Provide modifications:
 - 1) -1.5 flow restrictor
 - 2) -CHKS integral check stops
- C. Roll-In Shower **P-5** Basis of Design: Aquarius G 6233 BF 0.75, ADA Compliant, gelcoat fiberglass Roll-In shower stall with grab bars and foldable seat.
1. Material: reinforced fiberglass
 2. Finish: sanitary grade polyester gelcoat
 3. Color: White.
 4. Drain Location: Center.
 5. Soap tray: molded
 6. Top: Open.
 7. Threshold: ¾"
 8. One 1" diameter stainless steel shower rod with receiver cups
 9. Drain: Grid, NPS 2.
 10. Provide with the following options:

- a. White Shower curtain
 - b. Collapsible rubber dam
11. Shower valve: Symmons Model Origins 9603-PLR-1.5-CHKS hand shower system.
- a. Pressure-balancing mixing valve with adjustable stop screw to limit handle turn.
 - b. ADA compliant.
 - c. Wall/hand shower with 60" flexible metal hose, in-line vacuum breaker, wall connection and flange. 36" slide bar for hand shower mounting.
 - d. Provide modifications:
 - 1) -1.5 flow restrictor
 - 2) -CHKS integral check stops

2.7 MOP SERVICE BASIN

A. Manufacturers:

1. Zurn
2. Fiat
3. Mustee

B. **P-6** Basis of Design: Fiat MSB24x24, molded stone floor mounted mop sink, stainless steel drain body, combination dome strainer and lint basket.

1. Dimensions: 24:x24:x10" deep
2. Provide with the following options:
 - a. Stainless Steel Wall Guard: Provide 20 gage type 304 stainless steel bumpers used to protect walls adjacent to mop basin. Two panels shall be supplied for corner installation
 - b. Mop holder
 - c. Hose and hose bracket
3. Faucet: Chicago Faucets No. 897=CP, wall mounted 8" adjustable hot and cold water sink faucet, chrome plated solid brass construction. Vacuum breaker spout with 3/4" male hose thread and pail hook. 2 3/8" metal lever handles with eight point tapered broach and secured blue and red buttons. Quarter-turn re-buildable compression cartridge, opens and closes 90°, closes with water pressure, features square tapered stem.
4. Install check valves at HW and CW connections.

2.8 ELECTRIC WATER COOLERS

A. Manufacturers

1. Elkay Manufacturing Co.
2. Haws Corporation.
3. Oasis Corporation.

4. Sunroc Corp.
 - B. **P-7** Basis of Design: Elkay Model EDFP217FC, Two-level wall mounted drinking fountain constructed of #18 gauge, type 304, stainless steel polished to a lustrous satin finish. Contoured basin minimizes splashing and has exclusive FlexiGuard® safety bubbler to prevent accidental mouth injuries. Keyed in location to prevent rotation. Easy to operate, fully functional push-buttons are vandal-resistant. Vandal-resistant bottom cover plates included. Flow regulator provides constant stream from 20 to 105 psi water pressure.
 1. Provide LK1110 glass filler, mounted on drinking fountain deck and MPW200 In wall carrier mounting plate.
 - C. **P-8** Basis of Design: Elkay Model EMASM Surface Mount bottle filling station designed for installations without the need for electricity. Bottle filler shall provide 1.0 GPM flow rate with laminar flow to minimize splashing. Shall include integrated silver ion antimicrobial protection in key areas. Unit shall meet ADA guidelines. Unit shall be a Lead-free design which is certified to NSF/ANSI 61 and 372 and meets Federal and State low-lead requirements.
 1. Stainless steel bottle filler wrapper with ABS plastic alcove.
 2. Includes robust hanging bracket for surface mount.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for water soil and for waste piping systems and supports to verify actual locations and sizes of piping connections and that locations and types of supports match those indicated, before plumbing fixture installation. Use manufacturer's roughing-in data if roughing-in data are not indicated.
- B. Examine walls, floors, and cabinets for suitable conditions where fixtures are to be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FIXTURE INSTALLATION - GENERAL

- A. Assemble and support fixtures, trim, fittings, and other components according to manufacturers' written instructions.
- B. Install fixtures level and plumb according to manufacturers' written instructions and roughing-in drawings.
- C. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.
- D. Install traps on fixture outlets as required.

- E. Install escutcheons at piping wall ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings. Refer to Division 22 Section "Common Work Results for Plumbing" for escutcheons.
- F. Set shower receptors and mop service basins in leveling bed of cement grout. Refer to Division 22 Section "Common Work Results for Plumbing" for grout.
- G. Seal joints between fixtures and walls, floors, and counters using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color.

3.3 WATER CLOSETS AND URINALS

- A. Install flushometer valves for accessible water closets and urinals with handle mounted on wide side of compartment. Install other actuators in locations that are easy for people with disabilities to reach.

3.4 SINKS AND LAVATORIES

- A. Install faucet-spout fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.

3.5 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Use chrome-plated brass or copper tube, fittings, and valves in locations exposed to view. Plain copper tube, fittings, and valves may be used in concealed locations.
- C. Supply and Waste Connections to Plumbing Fixtures: Connect fixtures with water supplies, stops, risers, traps, and waste piping. Use size fittings required to match fixtures. Connect to plumbing piping.
- D. Provide plumbing hookups to Fixtures and Equipment Specified in Section 113100 "Residential Appliances". Connect fixtures and equipment with water supplies Use size fittings required to match fixtures and equipment. Connect to plumbing piping.
- E. Residential Dishwasher: When the sink is equipped with a garbage disposal unit, the dishwasher waster shall be connected to the inlet side of the disposal after passing through the required air gap fitting. When the sink is not equipped with a garbage disposal unit, the dishwasher waste shall be connected to the continuous waste of the sink using a wye-branch fitting, after passing through the required air gap fitting. The wye branch fitting may be installed in any vertical section of the continuous waste on the inlet side of the trap. The wye branch fitting shall not be installed in a horizontal run.

3.6 FIELD QUALITY CONTROL

- A. Verify that installed fixtures are categories and types specified for locations where installed.
- B. Check that fixtures are complete with trim, faucets, fittings, and other specified components.
- C. Inspect installed fixtures for damage. Replace damaged fixtures and components.
- D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.
- E. Water-Cooler Testing: After electrical circuitry has been energized, test for compliance with requirements. Test and adjust controls and safeties. Repair or replace malfunctioning units. Retest as specified above after repairs or replacements are made.
- F. Install fresh batteries in sensor-operated mechanisms.

3.7 ADJUSTING

- A. Operate and adjust fixtures. Replace damaged and malfunctioning fixtures.
- B. Adjust water pressure to produce proper flow and stream.
- C. Adjust tempering devices to a maximum outlet temperature of 110 degrees F.
- D. Replace washers and seals of leaking and dripping faucets and stops.
- E. Water coolers: Adjust fixture flow regulators for proper flow and stream height. Adjust water-cooler temperature settings.

3.8 CLEANING

- A. After completing fixture installation, inspect unit. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.
- B. Clean fixtures and other fittings with manufacturers' recommended cleaning methods and materials. Remove faucet spouts and strainers, remove sediment and debris, and reinstall strainers and spouts. Remove sediment and debris from drains.
- C. Clean fixtures, on completion of installation, according to manufacturer's written instructions.

3.9 PROTECTION

- A. Provide protective covering for installed fixtures and fittings.
- B. Do not allow use of fixtures for temporary facilities unless allowed in Division 1.

END OF SECTION 224000

SECTION 230500 – COMMON WORK RESULTS FOR MECHANICAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. This section applies to Division 21, 22, & 23 sections.

1.2 GENERAL

- A. This Section includes mechanical items common to all of this division specification sections.
- B. Provide services, skilled and common labor, and all apparatus and materials required for the complete installation as shown and within the intent of the contract documents, field conditions, and code requirements.
- C. The intention of these Contract Documents is to call for finished work, fully tested and ready for operation. Any components or labor not mentioned in the Contract Documents but required for functioning systems shall be provided. Should there appear to be any discrepancies or questions of intent, the Contractor shall refer the matter to the Architect/Engineer for decision before start of any related work.
- D. The drawings show the general arrangement of systems and equipment but do not show all required fittings and offsets that may be necessary to connect pipes and ductwork to equipment, and to coordinate with other trades. Provide all necessary fittings, offsets and runs based on field measurements and at no additional cost. Coordinate with other trades for space available and relative location of equipment and accessories. Pipe and duct location on the drawings shall be altered by contractor where necessary to avoid interferences and clearance difficulties.
- E. This contractor will be responsible to carry out the commissioning requirements specified. Refer to Division 1 for additional requirements.

1.3 EFFICIENCY MAINE

- A. This project intends to pursue Efficient Maine prescriptive and/or custom incentives. The contractor shall participate in the activities associated with Efficiency Maine incentive approval process including but not limited to; preparation and submission of required incentive applications and the tracking and submission of measure specific invoices to Efficiency Maine within 60 days of the completion of the work.
- B. The contractor shall also:
 - 1. Become familiar with the Efficiency Maine Business Program including available incentives and the application and review process.

2. Review plans and specifications for compliance with Efficiency Maine standards for applicable systems and technologies.
 3. Review plans and specifications for any and all incentive opportunities.
- C. The project schedule shall reflect and accommodate the time required to achieve application pre-approval from Efficiency Maine (EM). No equipment shall be purchased until pre-approval is received from EM.
- D. All invoices shall be forwarded to EM within 60 days of the completion of work. This deliverable shall be shown on the project schedule as a milestone date and coordinated with all contractors to assure compliance with this requirement.
- E. Efficiency Maine is available to assist in the application process and can be reached at 866-376-2463. Contractor must contact EM prior to submittals to review the project equipment and scope.
- F. As a minimum, obtain rebates for the following:
1. Multi Split Heat Pumps

EFFICIENCY MAINE BUSINESS PROGRAM
Prescriptive Ductless Mini-Split Heat Pumps
effRT Data Collection & Information Form
For Lost Opportunity/New Construction/Replace on Burnout



ZONE DUCTLESS MINI-SPLIT HEAT PUMP INCENTIVE CALCULATION WORKSHEET

TABLE 1: AIR SOURCE SYSTEMS ONLY		
Zones	Minimum HSPF	Maximum Incentive (\$/System)
1	12.0	\$500
2	10.0	\$750
3	10.0	\$1,000
4 or more	10.0	\$1,250

1.4 DEFINITIONS

- A. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.
- B. "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.
- C. "Provide": Furnish and install, complete and ready for the intended use.
- D. "Shall": The word shall is used to indicate mandatory requirements strictly to be followed in order to conform to the standard and procedures and from which no deviation is permitted.

- E. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and attics.
- F. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- G. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- H. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.
- I. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- J. Terminal: A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.

1.5 SUBMITTALS

- A. Provide in accordance with Division 1 of the specifications.

1.6 SUBSTITUTIONS

- A. Provide in accordance with Division 1 of the specifications.

1.7 QUALITY ASSURANCE

- A. All work, materials, and equipment shall comply with the rules and regulations of all codes and ordinances of the local, state, and federal authorities. Such codes, when more restrictive, shall take precedence over these plans and specifications.
- B. Multiple Units: When two or more units of materials or equipment of the same type or class are required, these units shall be products of one manufacturer.
- C. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- D. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications." Comply with provisions in ASME B31 Series, "Code for Pressure Piping." Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- E. Electrical Characteristics for Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical

services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

- F. The Contractor shall hold a license to perform the work as issued by the local jurisdiction.
- G. Plumbing work shall be performed by, or under, the direct supervision of a licensed master plumber.
- H. Electrical work shall be performed by, or under, the direct supervision of a licensed electrician.
- I. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, product selected shall be compatible with products previously selected, even if previously selected products were also options.
 - 1. Each contractor is responsible for providing products and construction methods compatible with products and construction methods of other contractors.
 - 2. If a dispute arises between contractors over concurrently selectable but incompatible products, Engineer will determine which products shall be used.

1.8 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Provide in accordance with Division 1 - Product Requirements.
- B. Piping:
 - 1. Pipe and tube required by the applicable standard to be cleaned and capped shall be delivered to the job site with factory-applied end-caps. Maintain end-caps through shipping, storage, and handling to prevent pipe-end damage and prevent entrance of dirt, debris, and moisture.
 - 2. Protect stored pipe and tube from moisture and dirt. Elevate above grade. When stored inside, do not exceed the structural capacity of the floor.
 - 3. Protect fittings, flanges, and piping specialties from moisture and dirt.
 - 4. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.9 COORDINATION

- A. Coordinate use of project space and sequence of installation of mechanical and electrical work, which is indicated diagrammatically on drawings. Follow routings shown for pipes, ducts, and conduits as closely as practicable, with due allowance for available physical space; make runs parallel with lines of building. Utilize space efficiently to maximize accessibility for other installations, for maintenance, and for repairs.
- B. Coordinate use of project space and sequence of installation of work.
- C. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for installations. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

- D. Access panels shall be provided for concealed valves and controls, or any item requiring inspection or maintenance. Access panels shall be of sufficient size and located so that the concealed items may be serviced, maintained, or replaced.
- E. Coordinate with Division 9 requirements for access panels and doors for items requiring access that are concealed behind finished surfaces.

PART 2 - PRODUCT

2.1 PRODUCT CRITERIA

- A. Standard Products: Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products for at least 3 years. See other specification sections for any exceptions.
- B. Equipment Service: Products shall be supported by a service organization that maintains a complete inventory of repair parts and is located reasonably close to the site.
- C. Multiple Units: When two or more units of materials or equipment of the same type or class are required, these units shall be products of one manufacturer.
- D. Assembled Units: Manufacturers of equipment assemblies, which use components made by others, assume complete responsibility for the final assembled product.
- E. Nameplates: Nameplate bearing manufacturer's name or identifiable trademark shall be securely affixed in a conspicuous place on equipment, or name or trademark cast integrally with equipment, stamped or otherwise permanently marked on each item of equipment.
- F. Asbestos products or equipment or materials containing asbestos shall not be used.

2.2 PIPE JOINING MATERIALS

- A. Refer to individual Division 22 and 23 piping Sections for pipe, tube, and fitting materials and joining methods. Refer to individual piping Sections for special joining materials not listed below.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.
- C. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- D. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.
- E. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

- F. Solvent Cements for Joining Plastic Piping: CPVC Piping: ASTM F 493. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

2.3 TRANSITION FITTINGS

- A. AWWA Transition Couplings: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined. Underground Piping NPS 1-1/2 and Smaller: Manufactured fitting or coupling. Underground Piping NPS 2 and Larger: AWWA C219, metal sleeve-type coupling. Aboveground Pressure Piping: Pipe fitting.
- B. Plastic-to-Metal Transition Fittings: one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
- C. Flexible Transition Couplings for Underground Non-pressure Drainage Piping: ASTM C 1173 with elastomeric sleeve; ends same size as piping to be joined, and corrosion-resistant metal band on each end.

2.4 DIELECTRIC FITTINGS

- A. Provide where copper tubing and ferrous metal pipe are joined.
- B. Fittings shall match piping specifications. Threaded dielectric union, ANSI B16.39. Watts Series LF3000 (lead free) or approved equal. Flange union with dielectric gasket and bolt sleeves, ANSI B16.42. Dielectric flange fittings: Watts Series LF3100.

2.5 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve; Thunderline Link-Seal, or approved equal.
 - 1. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - 2. Pressure Plates: Glass-reinforced nylon.
 - 3. Connecting Bolts and Nuts: Stainless steel, of length required to secure pressure plates to sealing elements.

2.6 ESCUTCHEONS

- A. Escutcheons shall be manufactured from nonferrous metals and shall be chrome-plated. Metals and finish shall conform to ASME A112.19.2. Escutcheons shall be one-piece type where mounted on chrome-plated pipe or tubing, and one-piece of split-pattern type elsewhere. ID shall closely fit around pipe, tube, and insulation of insulated piping and an OD that completely cover the opening.
- B. All escutcheons shall have setscrews for maintaining a fixed position against a surface.

2.7 ROOFING

- A. Coordinate roofing with Division 7.

2.8 MOTORS

A. Motor Characteristics

1. Motors 1/2 HP and Larger: Three phase.
2. Motors smaller than 1/2 HP: Single phase.
3. Frequency Rating: 60 Hz.
4. Voltage Rating: NEMA standard voltage selected to operate on nominal circuit voltage to which motor is connected.
5. Service Factor: 1.15 for open drip proof motors; 1.0 for totally enclosed motors.
6. Duty: Continuous duty at ambient temperature of 105 deg F and at altitude of 3300 feet above sea level.
7. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.
8. Enclosure: as specified.

B. Polyphase Motors

1. Description: NEMA MG 1, Design B, medium induction motor.
2. Efficiency: Premium efficiency ratings shall meet or exceed the NEMA Premium qualifying efficiencies. Efficiencies shall be eligible for utility rebates. For example, 1800-RPM ODP minimum required efficiency for a 7.5 HP motor is 91.0%
3. Stator: Copper windings, unless otherwise indicated. Multispeed motors shall have separate winding for each speed.
4. Rotor: Squirrel cage, unless otherwise indicated.
5. Bearings: Double-shielded, pre-lubricated ball bearings suitable for radial and thrust loading.
6. Temperature Rise: Match insulation rating, unless otherwise indicated.
7. Insulation: Class F, unless otherwise indicated.
8. Motors Used with Reduced-Inrush Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.

C. Single-Phase Motors

1. Type: One of the following, to suit starting torque and requirements of specific motor application: Permanent-split capacitor, Split-phase start, capacitor run, Capacitor start, capacitor run.
2. Shaded-Pole Motors: For motors 1/20 hp and smaller only.
3. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.
4. Bearings: Ball type for belt-connected motors and other motors with high radial forces on motor shaft; sealed, pre-lubricated-sleeve type for other single-phase motors.

- D. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
1. Provide AEGIS® Shaft Grounding Ring (SGR) on either DE or NDE of motor to divert current away from the bearings and protect bearings in attached equipment.
 2. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
 3. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
 4. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
 5. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

2.9 VIBRATION ISOLATION

- A. All equipment shall be isolated to prevent vibration transmission to the building structure.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS

- A. Install piping, ductwork, and equipment to allow maximum possible headroom unless specific mounting heights are indicated. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- B. Install equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- C. Coordinate location of piping, sleeves, inserts, hangers, ductwork and equipment. Locate piping, sleeves, inserts, hangers, ductwork and equipment clear of windows, doors, openings, light outlets, and other services and utilities. Follow manufacturer's published recommendations for installation methods not otherwise specified.
- D. Any structural member weakened or impaired by cutting, notching, or otherwise shall be reinforced, repaired, or replaced so as to be left in safe structural condition in accordance with the local building code requirements.
- E. Install piping and ductwork in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- F. 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.
- G. Install systems above accessible ceilings to allow sufficient space for ceiling panel removal.

- H. Install piping to permit valve servicing.
- I. Install equipment and other components to allow right of way for piping installed at required slope.
- J. Install free of sags and bends.
- K. Provide unions or flanges at connections to equipment.
- L. Install fittings for changes in direction and branch connections.
- M. Make allowances for application of insulation.
- N. Select system components with pressure rating equal to or greater than system operating pressure.
- O. Verify final equipment locations for roughing-in.
- P. Protection and Cleaning: Equipment and materials shall be carefully handled, properly stored, and adequately protected to prevent damage before and during installation, in accordance with the manufacturer's recommendations. Damaged or defective items shall be replaced. Protect all finished parts of equipment. Close duct and pipe openings with caps or plugs during installation. Tightly cover and protect fixtures and equipment against dirt, water, chemical, or mechanical injury. At completion of all work thoroughly clean fixtures, exposed materials and equipment.

3.2 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and the relevant specification section specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel or groove plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8. Only brazing alloys having a liquid temperature above 1000°F shall be used.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows: Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

- G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- H. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
 - 2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
 - 3. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
 - 4. PVC Non-pressure Piping: Join according to ASTM D 2855.
- I. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.
- J. Plastic Non-pressure Piping Gasketed Joints: Join according to ASTM D 3212.

3.3 PIPE PENETRATIONS

- A. Provide sealants for all pipe penetrations. All pipe penetrations shall be sealed.
- B. Refer to Section 230700 "Mechanical Insulation".
- C. Sleeve Clearance: Sleeve through floors, walls, partitions, and beam flanges shall be one inch greater in diameter than external diameter of pipe. Sleeve for pipe with insulation shall be large enough to accommodate the full insulation thickness.
- D. Provide sleeves for pipes passing through concrete and masonry construction. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint. Cut sleeves to length for mounting flush with both surfaces. Provide sleeves in new walls and slabs as new walls and slabs are constructed. Provide steel pipe sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Piping through concrete or masonry shall not be subject to any load from the building construction.
 - 1. Sleeves are not required in drywall construction.
 - 2. Sleeves are not required for core-drilled holes.
- E. Exterior- Pipe Penetrations:
 - 1. Install sleeve-seal systems in sleeves at service piping entries into building.
 - 2. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.
- F. Escutcheons: Provide for penetrations in finished spaces where pipes are exposed.

- G. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Division 7.
- H. Plastic and copper piping penetrating framing members, and within one-inch of the framing, shall be protected with 10-gauge steel nailing plates. The steel plate shall extend along the framing member a minimum of 1.5" beyond the OD of the pipe or tubing.

3.4 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated: Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment. Install flanges in piping NPS 2-1/2 and larger, adjacent to flanged or grooved-ended valves and at final connection to each piece of equipment. Provide dielectric fittings at connection between copper and ferrous metal.
- B. Swing Connections for Expansion: Connect risers and branch connections to mains with at least five pipe fittings, including tee in main. Connect mains and branch connections to terminal units with at least four pipe fittings, including tee in main.

3.5 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor materials and equipment.
- B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.
- C. Attach to substrates as required to support applied loads.

3.6 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Provide in accordance with Division 5.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor materials and equipment. Field Welding: Comply with AWS D1.1.

3.7 FIRESTOPPING

- A. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire stop materials. Refer to Division 7 for materials. Seal all penetrations through fire- or smoke-rated wall, partition, ceiling, or roof assemblies with firestopping system. Refer to Architectural plans for location of rated assemblies.

3.8 PAINTING

- A. Painting of plumbing and mechanical systems, equipment, and components is specified in Division 9.
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.9 CONCRETE HOUSEKEEPING PADS

- A. Concrete pads shall be provided by Division 22 & 23. Provide in accordance with Division 3.
- B. Coordinate size, thickness, doweling, and reinforcing of concrete equipment housekeeping pads and piers with equipment manufacturer to ensure adequate space, embedment and prevent edge breakout failures.
- C. Construct concrete bases not less than 4 inches larger in both directions than supported unit.
- D. Housekeeping Pads must be adequately reinforced and adequately sized for proper installation of equipment anchors.
- E. Provide 4" high (+/-) housekeeping pads for the following:
 - 1. DHW Heater
 - 2. As noted on plans
 - 3. As recommended by Equipment manufacturer.

3.10 ROOFING

- A. Refer to Division 7.
- B. Coordinate installation of roof curbs, equipment supports, and roof penetrations.

3.11 PROJECT CLOSEOUT

- A. Provide Demonstration and Training in accordance Division 1.
- B. Provide Project Record Documents in accordance with Division 1.
- C. Follow Closeout procedures as per Division 1.
- D. Provide Operation and Maintenance information in accordance with Division 1.

END OF SECTION 230500

SECTION 230519 – THERMOMETERS AND PRESSURE GAUGES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 23 Section “Common Work Results for Mechanical”
 - 2. Mechanical equipment Sections that specify meters and gauges as part of factory-fabricated equipment.

1.2 SUMMARY

- A. This Section includes thermometers and pressure gauges.

1.3 ACTION SUBMITTALS

- A. Product Data: Include scale range, ratings, and calibrated performance curves for each gauge, fitting, specialty, and accessory specified.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For meters and gages to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Ashcroft
 - 2. Weksler
 - 3. Ernst Gauge Co.
 - 4. Terice: H. O. Terice Co.
 - 5. Weiss Instruments, Inc.

2.2 THERMOMETERS

- A. Liquid-In-Glass Industrial Thermometers: shall be a blue reading (Fill Type Spirit: Blue colored, organic) liquid-in-glass adjustable angle type, 9" scale, cast aluminum case with cured polyester powder coating, clear acrylic window and brass separable thermowell. Thermometers will be Terrice BX9 Series or approved equal.
- B. Scale Range: Temperature ranges for services listed are as follows: The proper range will be selected so that the operating temperature of the material being measured will fall approximately in the middle of the scale.
1. Domestic Hot Water: 30 to 180 deg F, with 2-degree scale divisions.
 2. Domestic Cold Water: 0 to 100°F, with 1°F scale divisions.
- C. Thermowells: Provide fitting with protective socket for installation in threaded pipe fitting to hold fixed thermometer stem.
1. Material: Brass, for use in copper piping.
 2. Material: Stainless steel, for use in steel piping.
 3. Where insulation thickness exceeds 2", a longer stem thermometer will be used with an extension neck brass separable thermowell. The extension neck will be at least 2" long.
 4. Thermometers for measuring fluid temperatures will have stems with insertion lengths of roughly half of the pipe diameter; minimum insertion length will be 2".
 5. Cap: Threaded, with chain permanently fastened to socket. Heat-Transfer Fluid: Mixture of graphite and glycerin.

2.3 PRESSURE GAUGES

- A. Pressure gauges shall be 3½" dial size with a flangeless cast aluminum case, stainless steel friction ring and glass window. Movement will be brass with a bronze bourdon tube and brass socket. Dial face will be white with black figures; pointer will be friction adjustable type. Accuracy shall be ±1% of scale range, ASME B40.1 Grade 1A. Pressure gauges will be Terrice No. 600CB approved equal.
1. Connector: Brass, NPT 1/4.
 2. Units of Measure: PSI
 3. Provide silicone-damped movement.
 4. Range: The proper range shall be selected so that the average operating pressure falls approximately in the middle of the scale selected.
 5. Install pressure-gauge needle valve and snubber (Tericce No. 872 pressure snubbers) in piping to pressure gauges; ASME B40.5, NPS 1/4 brass bushing with corrosion-resistant porous-metal disc of material suitable for system fluid and working pressure.
 6. Needle Valves: Terrice 735 Series; NPS 1/4 brass or 316 stainless steel needle type.
- B. Scale Range: Pressure ranges for services listed are as follows: The proper range will be selected so that the operating pressure of the material being measured will fall approximately in the middle of the scale.
1. Domestic Hot Water: 0 to 100 psi
 2. Domestic Cold Water: 0 to 100 psi.

PART 3 - EXECUTION

3.1 GAUGE INSTALLATION, GENERAL

- A. Install according to manufacturer's written instructions for applications where used.

3.2 THERMOMETER INSTALLATION

- A. Install thermometers and adjust vertical and tilted positions.
- B. Install thermowells with extension on insulated piping.
- C. Install separable sockets in vertical position in piping tees.

3.3 PRESSURE-GAUGE INSTALLATION

- A. Install pressure gauges in piping tees with pressure-gauge valve located on pipe at most readable position.
- B. Install valve and snubber in piping for each pressure gage for fluids.

3.4 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 and 23 Sections. Drawings indicate general arrangement of piping and specialties. Install adjacent to machines and equipment to allow service and maintenance. Connect per manufacturers recommendations.

3.5 ADJUSTING AND CLEANING

- A. Calibrate according to manufacturer's written instructions, after installation.
- B. Adjust faces to proper angle for best visibility.
- C. Clean windows and clean factory-finished surfaces. Replace cracked and broken windows, and repair scratched and marred surfaces with manufacturer's touchup paint.

END OF SECTION 230519

SECTION 220529 - HANGERS AND SUPPORTS FOR PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 23 Section "Common Work Results for Mechanical"
 - 2. Division 23 Section "Mechanical Insulation"

1.2 SUMMARY

- A. This Section includes hangers and supports for piping and equipment.

1.3 ACTION SUBMITTALS

- A. Submit product data on all hanger and support devices, including shields and attachment methods. Product data to include, but not limited to materials, finishes, approvals, load ratings, and dimensional information.
- B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following; include Product Data for components:
 - 1. Trapeze pipe hangers.
 - 2. Metal framing systems.
 - 3. Pipe stands.
 - 4. Equipment supports.
- C. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - 1. Detail fabrication and assembly of trapeze hangers.
 - 2. Design Calculations: Calculate requirements for designing trapeze hangers.
 - 3. Welded steel support designs
 - 4. Structural Performance: Hangers and supports for HVAC piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.4 QUALITY ASSURANCE

- A. Provide in accordance with MSS SP69 - Manufacturers Standardization Society: Pipe Hangers and Supports- Selection and Application
- B. Steel pipe hangers and supports shall have the manufacturer's name, part number, and applicable size stamped in the part itself for identification.
- C. Pipe Hangers, Supports, and Components: The materials of all pipe hanging and supporting elements shall be in accordance with MSS SP-58.
- D. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Pipe Hangers and Supports:
 - a. B-Line Systems, Inc.
 - b. Carpenter & Patterson, Inc.
 - c. Grinnell Corp.
 - d. Hubbard Enterprises/Holdrite®
 - e. National Pipe Hanger Corp.
 - f. Piping Technology & Products, Inc.
 - g. Unistrut
 - h. Anvil International, Inc.
 - i. Empire

2.2 PIPE HANGERS AND SUPPORTS

- A. Hangers:
 - 1. Uninsulated pipes 2 inch and smaller:
 - a. Adjustable steel swivel ring (band type) hanger, B-Line B3170.
 - b. Adjustable steel swivel J-hanger, B-Line B3690.
 - c. Malleable iron ring hanger, B-Line B3198R or hinged ring hanger, B3198H.
 - d. Malleable iron split-ring hanger with eye socket, B-Line B3173 with B3222.
 - e. Adjustable steel clevis hanger, B-Line B3104 or B3100.
 - 2. Uninsulated pipes 2-1/2 inch and larger:
 - a. Adjustable steel clevis hanger, B-Line B3100.

- b. Pipe roll with sockets, B-Line B3114.
 - c. Adjustable steel yoke pipe roll, B-Line B3110.
 3. Insulated pipe- Hot or steam piping:
 - a. 2 inch and smaller pipes: use adjustable steel clevis with galvanized sheet metal shield. B-Line B3100 with B3151 series.
 - b. 2-1/2 inch and larger pipes: Adjustable steel yoke pipe roll with pipe covering protection saddle. B-Line B3110 with B3160-B3165 series. Pipe roll with sockets with pipe covering protection saddle, B-Line B3114 with B3160-B3165 series.
 4. Insulated pipe- Cold or chilled water piping:
 - a. 5 inch and smaller pipes: use adjustable steel clevis with galvanized sheet metal shield. B-Line B3100 with B3151 series.
 - b. 6 inch and larger pipes: Pipe roll with sockets with pipe covering protection saddle, B-Line B3114 with B3160-B3165 series. Adjustable steel yoke pipe roll with pipe covering protection saddle. B-Line B3110 with B3160-B3165 series.
- B. Pipe Clamps: When flexibility in the hanger assembly is required due to horizontal movement, use pipe clamps with weldless eye nuts, B-Line B3140 or B3142 with B3200. For insulated lines use double bolted pipe clamps, B-Line B3144 or B3146 with B3200.
- C. Multiple or Trapeze Hanger
 1. Trapeze hangers shall be constructed from 12 gauge roll formed ASTM A1011 SS Grade 33 structural steel channel, 1-5/8 inch by 1-5/8 inch minimum, B-Line B22 strut or stronger as required.
 2. Mount pipes to trapeze with 2 piece pipe straps sized for outside diameter of pipe, B-Line B2000 Series.
 3. For pipes subjected to axial movement:
 - a. Strut mounted roller support, B-Line B3126. Use pipe protection shield or saddles on insulated lines.
 - b. Strut mounted pipe guide, B-Line B2417.
- D. Wall Supports
 1. Pipes 4 inch and smaller:
 - a. Carbon steel hook, B-Line B3191.
 - b. Carbon steel J-hanger, B-Line B3690.
 2. Pipes larger than 4 inch:
 - a. Welded strut bracket and pipe straps, B-Line B3064 and B2000 series.
 - b. Welded steel brackets, B-Line B3066 or B3067, with roller chair or adjustable steel yoke pipe roll. B-Line B3120 or B3110. Use pipe protection shield or saddles on insulated lines.
- E. Floor Supports

1. Hot piping under 6 inch and all cold piping: Carbon steel adjustable pipe saddle and nipple attached to steel base stand sized for pipe elevation. B-Line B3093 and B3088T or B3090 and B3088. Pipe saddle shall be screwed or welded to appropriate base stand.
- F. Vertical Supports: Steel riser clamp sized to fit outside diameter of pipe, B-Line B3373.
- G. Copper Tubing Supports
1. Hangers shall be sized to fit copper tubing outside diameters.
 - a. Adjustable steel swivel ring (band type) hanger, B-Line B3170CT.
 - b. Malleable iron ring hanger, B-Line B3198RCT or hinged ring hanger B3198HCT.
 - c. Malleable iron split-ring hanger with eye socket, B-Line B3173CT with B3222.
 - d. Adjustable steel clevis hanger, B-Line B3104CT.
 2. For supporting copper tube to strut use epoxy painted pipe straps sized for copper tubing, B-Line B2000 series, or plastic inserted vibration isolation clamps, B-Line BVT series.
- H. Plastic Pipe Supports: V-Bottom clevis hanger with galvanized 18-gauge continuous support channel, B-Line B3106 and B3106V, to form a continuous support system for plastic pipe or flexible tubing.
- I. Supplementary Structural Supports: Design and fabricate supports using structural quality steel bolted framing materials as manufactured by Cooper B-Line. Channels shall be roll formed, 12 gauge ASTM A1011 SS Grade 33 steel, 1-5/8 inch by 1-5/8 inch or greater as required by loading conditions. Submit designs for pipe tunnels, pipe galleries, etc., to engineer for approval. Use clamps and fittings designed for use with the strut system.

2.3 UPPER ATTACHMENTS

A. Beam Clamps

1. Beam clamps shall be used where piping is to be suspended from building steel. Clamp type shall be selected on the basis of load to be supported, and load configuration.
2. C-Clamps shall have locknuts and cup point set screws, B-Line B351L, or B3036L. Top flange c-clamps shall be used when attaching a hanger rod to the top flange of structural shapes, B-Line B3034 or B3033. Refer to manufacturer's recommendation for setscrew torque. Retaining straps shall be used to maintain the clamps position on the beam where required.
3. Center loaded beam clamps shall be used where specified. Steel clamps shall be B-Line B3050, or B3055. Malleable iron or forged steel beam clamps with cross bolt shall be B-Line B3054 or B3291-B3297 Series as required to fit beams.

B. Concrete Inserts

1. Cast in place spot concrete inserts shall be used where applicable; either steel or malleable iron body, B-Line B2500 or B3014. Spot inserts shall allow for lateral adjustment and have means for attachment to forms. Select inserts to suit threaded hanger rod sizes, B-Line N2500 or B3014N series.

2. Continuous concrete inserts shall be used where applicable. Channels shall be 12 gauge, ASTM A1011 SS Grade 33 structural quality carbon steel, complete with styrofoam inserts and end caps with nail holes for attachment to forms. The continuous concrete insert shall have a load rating of 2,000 lbs/ft. in concrete, B-Line B22I, 32I, or 52I. Select channel nuts suitable for strut and rod sizes.

2.4 VIBRATION ISOLATION AND SUPPORTS

- A. For air conditioning and other vibrating system applications, use a clamp that has a vibration dampening insert and a nylon inserted locknut. For copper and steel tubing use B-Line BVT series Vibraclamps, for pipe sizes use BVP series.
- B. For larger tubing or piping subjected to vibration, use neoprene or spring hangers as required.
- C. For base mounted equipment use vibration pads, molded neoprene mounts, or spring mounts as required.
- D. Vibration isolation products as manufactured by B-Line, Vibratrol systems.

2.5 ACCESSORIES

- A. Hanger Rods shall be threaded both ends, or continuous threaded rods of circular cross section. Use adjusting locknuts at upper attachments and hangers. No wire, chain, or perforated straps are allowed.
- B. Shields shall be 180 degree galvanized sheet metal, 12 inch minimum length, 18 gauge minimum thickness, designed to match outside diameter of the insulated pipe, B-Line B3151.
- C. Pipe protection saddles shall be formed from carbon steel, 1/8 inch minimum thickness, sized for insulation thickness. Saddles for pipe sizes greater than 12 inch shall have a center support rib.

2.6 FINISHES

- A. Indoor Finishes
 1. Hangers and clamps for support of bare copper piping shall be coated with copper colored epoxy paint, B-Line Dura-Copper®. Additional PVC coating of the epoxy painted hanger shall be used where necessary.
 2. Hangers for other than bare copper pipe shall be zinc plated in accordance with ASTM B633 OR shall have an electro-deposited green epoxy finish, B-Line Dura-Green®.
 3. Strut channels shall be pre-galvanized in accordance with ASTM A653 SS Grade 33 G90 OR have an electro-deposited green epoxy finish, B-Line Dura-Green®.
- B. Outdoor Finishes: Hangers and strut located outdoors shall be hot dip galvanized after fabrication in accordance with ASTM A123. All hanger hardware shall be hot dip galvanized or stainless steel. Zinc plated hardware is not acceptable for outdoor or corrosive use.

2.7 METAL FRAMING SYSTEMS (“UNISTRUT”)

A. MFMA Manufacturer Metal Framing Systems:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cooper B-Line, Inc.
 - b. Flex-Strut Inc.
 - c. Thomas & Betts Corporation.
 - d. Unistrut Corporation; Tyco International, Ltd.
2. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes.
3. Standard: MFMA-4.
4. Channels: Continuous slotted steel channel with in-turned lips.
5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
7. Coating: Unistrut Perma-green or similar.

2.8 PIPE STANDS

- A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.
- B. Compact Pipe Stand: One-piece plastic unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.
- C. Low-Type, Single-Pipe Stand: One-piece plastic or stainless-steel base unit with plastic roller, for roof installation without membrane penetration.
- D. High-Type, Single-Pipe Stand:
 1. Description: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
 2. Base: Plastic.
 3. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.
 4. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.
- E. High-Type, Multiple-Pipe Stand:
 1. Description: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
 2. Bases: One or more; plastic.
 3. Vertical Members: Two or more protective-coated-steel channels.
 4. Horizontal Member: Protective-coated-steel channel.
 5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.

- F. Curb-Mounted-Type Pipe Stands: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Provide hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
- C. Metal Framing System Installation: Provide per manufactures recommendations and calculations.
- D. Thermal-Hanger Shield Installation: Provide in pipe hanger or shield for insulated piping.
- E. Fastener System Installation:
 - 1. Provide powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Provide fasteners according to powder-actuated tool manufacturer's operating manual.
 - 2. Provide mechanical-expansion anchors in concrete after concrete is placed and completely cured. Provide fasteners according to manufacturer's written instructions.
- F. Pipe Stand Installation:
 - 1. Provide per manufactures recommendations and calculations.
 - 2. Pipe Stand Types except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
 - 3. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb.
- G. Provide hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- H. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

- I. Provide hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- J. Provide lateral bracing with pipe hangers and supports to prevent swaying.
- K. Provide building attachments within concrete slabs or attach to structural steel. Provide additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Provide concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- L. Load Distribution: Provide hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- M. Pipe Slopes: Provide hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by plumbing code and ASME B31.9 for building services piping.
- N. Insulated Piping:
 - 1. Attach clamps and spacers to piping.
 - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
 - 2. Thermal-Hanger Shields: Provide with insulation same thickness as piping insulation.

3.2 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make bearing surface smooth.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 2. Obtain fusion without undercut or overlap.
 3. Remove welding flux immediately.
 4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.4 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.5 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.6 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
- D. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- E. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.
- F. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

3.7 HANGER SPACING

- A. Support piping and tubing not listed below according to MSS SP-69 and manufacturer's written instructions.
- B. Provide hangers for drawn-temper copper piping with the following maximum horizontal spacing and minimum rod sizes:
 - 1. NPS ½ and ¾: Maximum span, 5 feet; minimum rod size, 3/8 inch.
 - 2. NPS 1: Maximum span, 6 feet; minimum rod size, 3/8 inch.
 - 3. NPS 1-¼: Maximum span, 7 feet; minimum rod size, 3/8 inch.
 - 4. NPS 1-½ to 2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
 - 5. NPS 2-½: Maximum span, 9 feet; minimum rod size, 1/2 inch.
 - 6. NPS 3: Maximum span, 10 feet; minimum rod size, 1/2 inch.
 - 7. Maximum vertical steel and copper pipe attachment spacing: 10 feet.
- C. Piping Hangers for Plastic Piping:
 - 1. Space hangers according to pipe manufacturer's written instructions for service conditions. Avoid point loading. Space and install hangers with the fewest practical rigid anchor points.
 - 2. In systems where large fluctuations in temperature occur, allowances must be made for expansion and contraction of the piping system. Since changes in direction in the system are usually sufficient to allow for expansion and contraction, hangers must be placed so as not to restrict this movement.
 - 3. Hangers shall not compress, distort, cut or abrade the piping. All piping shall be supported at intervals sufficiently close to maintain correct pipe alignment and to prevent sagging or grade reversal. Pipe should also be supported at all branch ends and at all changes of direction.
 - 4. Provide hangers for piping with the following maximum horizontal spacing and minimum rod diameters (pipe temperature 100°F or lower).
 - a. NPS 1 and smaller: 4 feet with 3/8-inch rod.
 - b. NPS 1-¼ and 1-½ and NPS 2: 5 feet with 3/8-inch rod.
 - c. NPS 3: 6 feet with 1/2-inch rod.
 - d. NPS 4: 6.5 feet with 5/8-inch rod.
 - 5. Provide supports for vertical piping every 10 feet.
- D. Support vertical piping independently of connected horizontal piping. Support vertical pipes at base and at every floor. Wherever possible, locate riser clamps directly below pipe couplings or shear lugs.
- E. Place a hanger within 12 inches of each horizontal elbow.

END OF SECTION 230529

SECTION 230553 – IDENTIFICATION FOR MECHANICAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Division 23 Section "Common Work Results for Mechanical"

1.2 SUMMARY

- A. This Section includes the following mechanical identification materials and their installation.

1.3 SUBMITTALS

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

1.4 QUALITY ASSURANCE

- A. ASME Compliance: 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.

1.5 COORDINATION

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with location of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT IDENTIFICATION DEVICES

- A. Equipment Markers: Engraved, color-coded laminated plastic; attach with screws or contact-type, permanent adhesive. Size: 2-1/2" x 1" or as applicable.
 - 1. Terminology: Match schedules as closely as possible.

2. Data: Name and plan number, equipment service, design capacity, and other design parameters such as pressure drop, entering and leaving conditions, and speed.
- B. Equipment located above the ceiling that requires servicing shall be labeled on the ceiling using a labeling machine.

2.2 PIPING IDENTIFICATION DEVICES

- A. Manufactured Pipe Markers, General: Seton, Brady, or approved equal; preprinted, color-coded, with lettering indicating service, and showing direction of flow.
1. Colors: Comply with ASME A13.1, unless otherwise indicated.
 2. Lettering: Use piping system terms indicated and abbreviate only as necessary for each application length. Size of letters and length of color field per ASME A13.1.
 3. Pipes with OD, Including Insulation; Full-band snap-around pipe markers extending 360 degrees around pipe at each location.
 4. Arrows: Integral with piping system service lettering to accommodate both directions; or as separate unit on each pipe marker to indicate direction of flow.
 5. Minimum length of color field and size of letters shall be in accordance with Uniform Plumbing Code requirements.
- B. Types:
1. Self-adhesive type: Seton Opti-Code.
 2. Snap-around type: Seton Setmark.
 3. Wrap-around type: Seton Ultra-mark; PVF over-laminated polyester construction seals in and protects graphics; suitable for outdoor or harsh environments.

PART 3 - EXECUTION

3.1 APPLICATIONS, GENERAL

- A. Products specified are for applications referenced in other Division 22 or 23 Sections. If more than single-type material, device, or label is specified for listed applications, selection is Installer's option.

3.2 EQUIPMENT IDENTIFICATION

- A. 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.
1. 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.

2. Data: Distinguish among multiple units, indicate operational requirements, indicate safety and emergency precautions, warn of hazards and improper operations, and identify units.
 3. Locate markers where accessible and visible. Include markers for the following general categories of equipment:
 - a. All scheduled equipment.
 - b. Space GAS monitor/transmitter device
- B. Equipment located above the ceiling that requires servicing shall be labeled on the ceiling using a labeling machine.
1. Ceilings 10 feet and lower: Letters shall be ¼" high, black.
 2. Ceilings higher than 10 feet: Letters shall be 3/8" high, black.
 3. Label all equipment above ceiling that requires servicing or access.
 4. Locate labels on the ceiling grid, adjacent to the ceiling tile that provides the best access to the valve or item that requires servicing.

3.3 PIPING IDENTIFICATION

- A. Piping Identification Types:
1. Piping or Insulation 5-7/8 inch OD or smaller: Snap-around marker or self-adhesive marker.
 2. Piping or Insulation 6 inch OD and Larger: Strap-around with nylon ties or self-adhesive marker.
 3. Provide wrap-around pipe markers for outdoor pipes. Install wrap-around pipe markers completely around pipe.
- B. Install manufactured pipe markers indicating service on each piping system.
1. Install pipe markers to manufacturer's instructions.
 2. Identify piping, concealed or exposed. Include service and flow direction.
 3. Install in clear view and align with axis of piping.
 4. Locate identification at maximum 20 feet centers on straight runs including risers and drops, adjacent to each valve and tee, at each side of penetration of structure or enclosure, and at each obstruction.
 5. At access doors, manholes, and similar access points that permit view of concealed piping.
 6. At least one per room.
- C. Unions covered by insulation: Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.

3.4 ADJUSTING

- A. Relocate mechanical identification materials and devices that have become visually blocked by other work.

3.5 CLEANING

- A. Clean faces of mechanical identification devices.

END OF SECTION 230553

SECTION 230593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes Testing, Adjusting, & Balancing

1.3 ACTION SUBMITTALS

- A. Use standard forms from AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems." NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems." SMACNA's TABB "HVAC Systems - Testing, Adjusting, and Balancing." TAB firm's forms approved by Architect. TABB "Contractors Certification Manual."

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: Within 30 days of Contractor's Notice to Proceed, submit documentation that the TAB specialist and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.
- B. Contract Documents Examination Report: Within 60 days of Contractor's Notice to Proceed, submit the Contract Documents review report as specified in Part 3.
- C. Instrument calibration reports, to include the following:
 - 1. Instrument type and make.
 - 2. Serial number.
 - 3. Application.
 - 4. Dates of use.
 - 5. Dates of calibration.

1.5 QUALITY ASSURANCE

- A. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."
- B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."

- C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.7.2.3 - "System Balancing."

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems designs that may preclude proper TAB of systems and equipment.
- B. Examine installed systems for balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are applicable for intended purpose and are accessible.
- C. Examine the approved submittals for HVAC systems and equipment.
- D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems output, and statements of philosophies and assumptions about HVAC system and equipment controls.
- E. Examine air plenums used for supply, return, or relief air to verify that they are properly separated from adjacent areas. Verify that penetrations in plenum walls are sealed and fire-stopped if required.
- F. Examine equipment performance data including fan and pump curves.
 - 1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
 - 2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.
- G. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.
- H. Examine test reports specified in individual system and equipment Sections.
- I. Examine HVAC equipment and verify that bearings are greased, belts are aligned and tight, filters are clean, and equipment with functioning controls is ready for operation.
- J. Examine terminal units and verify that they are accessible and their controls are connected and functioning.

- K. Examine strainers. Verify that startup screens have been replaced by permanent screens with indicated perforations.
- L. Examine operating safety interlocks and controls on HVAC equipment.
- M. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

- A. Prepare a TAB plan that includes the following:
 - 1. Equipment and systems to be tested.
 - 2. Strategies and step-by-step procedures for balancing the systems.
 - 3. Instrumentation to be used.
 - 4. Sample forms with specific identification for all equipment.
- B. Perform system-readiness checks of HVAC systems and equipment to verify system readiness for TAB work. Include, at a minimum, the following:
 - 1. Airside:
 - a. Verify that leakage and pressure tests on air distribution systems have been satisfactorily completed.
 - b. Duct systems are complete with terminals installed.
 - c. Volume and fire dampers are open and functional.
 - d. Clean filters are installed.
 - e. Fans are operating, free of vibration, and rotating in correct direction.
 - f. Variable-frequency controllers' startup is complete and safeties are verified.
 - g. Automatic temperature-control systems are operational.
 - h. Ceilings are installed.
 - i. Windows and doors are installed.
 - j. Suitable access to balancing devices and equipment is provided.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Total System Balance", ASHRAE 111 or SMACNA's "HVAC Systems - Testing, Adjusting, and Balancing" and in this Section.
- B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.
 - 1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
 - 2. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to the mechanical insulation specification.

- C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.
- D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Cross-check the summation of required outlet volumes with required fan volumes.
- B. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.
- C. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.
- D. Check for airflow blockages.
- E. Check condensate drains for proper connections and functioning.
- F. Check for proper sealing of air-handling-unit components.
- G. Verify that air duct system is sealed as specified in the ductwork specification.

3.5 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

- A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
 - 1. Measure total airflow.
 - a. Where duct conditions allow, measure airflow by Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses to obtain total airflow.
 - b. Where duct conditions are not suitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
 - c. If a reliable Pitot-tube traverse or coil traverse is not possible, measure airflow at terminals and calculate the total airflow.
 - 2. Measure fan static pressures as follows:
 - a. Measure static pressure directly at the fan outlet or through the flexible connection.
 - b. Measure static pressure directly at the fan inlet or through the flexible connection.
 - c. Measure static pressure across each component that makes up the air-handling system.
 - d. Report artificial loading of filters at the time static pressures are measured.
 - 3. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.

4. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload occurs.
- B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows.
1. Measure airflow of submain and branch ducts.
 2. Adjust submain and branch duct volume dampers for specified airflow.
 3. Re-measure each submain and branch duct after all have been adjusted.
- C. Adjust air inlets and outlets for each space to indicated airflows.
1. Set airflow patterns of adjustable outlets for proper distribution without drafts.
 2. Measure inlets and outlets airflow.
 3. Adjust each inlet and outlet for specified airflow.
 4. Re-measure each inlet and outlet after they have been adjusted.
- D. Verify final system conditions.
1. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to design if necessary.
 2. Re-measure and confirm that total airflow is within design.
 3. Re-measure all final fan operating data, rpms, volts, amps, and static profile.
 4. Mark all final settings.
 5. Measure and record all operating data.
 6. Record final fan-performance data.

3.6 PROCEDURES FOR MOTORS

- A. Motors 1/2 HP and Larger: Test at final balanced conditions and record the following data:
1. Manufacturer's name, model number, and serial number.
 2. Motor horsepower rating.
 3. Motor rpm.
 4. Phase and hertz.
 5. Nameplate and measured voltage, each phase.
 6. Nameplate and measured amperage, each phase.
 7. Starter size and thermal-protection-element rating.
 8. Service factor and frame size.
- B. Motors Driven by Variable-Frequency Controllers: Test manual bypass of controller to prove proper operation.

3.7 PROCEDURES FOR HEAT-TRANSFER COILS

- A. Measure, adjust, and record the following data for each electric heating coil:
1. Nameplate data.

2. Airflow.
3. Entering- and leaving-air temperature at full load.
4. Voltage and amperage input of each phase at full load.
5. Calculated kilowatt at full load.
6. Fuse or circuit-breaker rating for overload protection.

3.8 PROCEDURES FOR DOMESTIC HOT WATER RECIRCULATION SYSTEMS

- A. Prepare test reports with pertinent design data and number in sequence starting at pump to end of system.
- B. Balancing shall include the following minimum data:
 1. Pump flow
 2. Balancing valve flows: proportionally balance flow to each recirculation loop.
- C. Pumps:
 1. Adjust balancing valves at pumps to obtain design water flow. Record pressure rise across pumps and GPM flow from pump curve. Permanently mark the balanced position for each valve. (Note: If discharge valves on the pumps are used for balancing, record the head being restricted by the valves).
 2. Do not deadhead the pumps. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded. Running amps and brake horsepower of pump motor under full flow and no flow conditions.
 3. Calculate impeller size by plotting the shutoff head on pump curves and include the following pump test report data:
 4. Unit Data:
 - a. Unit identification.
 - b. Location.
 - c. Service.
 - d. Make and size.
 - e. Model and serial numbers.
 - f. Water flow rate in gpm.
 - g. Water pressure differential in feet of head or psig.
 - h. Pump rpm.
 - i. Impeller diameter in inches.
 - j. Seal type.
 - k. Motor Data: as specified herein before.
 5. Test Data (Indicated and Actual Values):
 - a. Static head in feet of head or psig.
 - b. Pump shutoff pressure in feet of head or psig.
 - c. Actual impeller size in inches.
 - d. Full-open flow rate in gpm.
 - e. Full-open pressure in feet of head or psig.
 - f. Final discharge pressure in feet of head or psig.
 - g. Final suction pressure in feet of head or psig.

- h. Final total pressure in feet of head or psig.
- i. Final water flow rate in gpm.
- j. Voltage at each connection.

3.9 TOLERANCES

- A. Set HVAC system's airflow rates and water flow rates within the following tolerances:
 1. Fans: Plus or minus 10 percent.
 2. Air Outlets and Inlets: Plus or minus 10 percent.

3.10 FINAL REPORT

- A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
 1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
 2. Include a list of instruments used for procedures, along with proof of calibration.
 3. Certify validity and accuracy of field data.
- B. Final Report Contents: In addition to certified field-report data, include the following:
 1. Fan curves.
 2. Manufacturers' test data.
 3. Field test reports prepared by system and equipment installers.
 4. Other information relative to equipment performance; do not include Shop Drawings and Product Data.
- C. General Report Data: In addition to form titles and entries, include the following data:
 1. Title page.
 2. Name and address of the TAB specialist.
 3. Project name.
 4. Project location.
 5. Architect's name and address.
 6. Engineer's name and address.
 7. Contractor's name and address.
 8. Report date.
 9. Signature of TAB supervisor who certifies the report.
 10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
 11. Summary of contents including the following:
 - a. Indicated versus final performance.
 - b. Notable characteristics of systems.
 - c. Description of system operation sequence if it varies from the Contract Documents.

12. Nomenclature sheets for each item of equipment.
 13. Data for terminal units, including manufacturer's name, type, size, and fittings.
 14. Notes to explain why certain final data in the body of reports vary from indicated values.
 15. Test conditions for fans and pump performance forms including the following:
 - a. Settings for outdoor-, return-, and exhaust-air dampers.
 - b. Conditions of filters.
 - c. Cooling coil, wet- and dry-bulb conditions.
 - d. Face and bypass damper settings at coils.
 - e. Fan drive settings including settings and percentage of maximum pitch diameter.
 - f. Settings for supply-air, static-pressure controller.
 - g. Other system operating conditions that affect performance.
- D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:
1. Quantities of outdoor, supply, return, and exhaust airflows.
 2. Water and steam flow rates.
 3. Duct, outlet, and inlet sizes.
 4. Pipe and valve sizes and locations.
 5. Terminal units.
 6. Balancing stations.
 7. Position of balancing devices.
- E. Ducted Heat Pump Test Reports: include the following:
1. Unit Data:
 - a. Unit identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and unit size.
 - e. Manufacturer's serial number.
 - f. Discharge arrangement.
 - g. Number, type, and size of filters.
 2. Test Data (Indicated and Actual Values):
 - a. Total airflow rate in cfm.
 - b. Total system static pressure in inches wg.
 - c. Fan rpm.
 - d. Discharge static pressure in inches wg.
 - e. Filter static-pressure differential in inches wg.
 - f. Coil static-pressure differential in inches wg.
 - g. Outdoor airflow in cfm.
 - h. Return airflow in cfm.
- F. Electric-Coil Test Reports: include the following:
1. Unit Data:

- a. System identification.
 - b. Location.
 - c. Coil identification.
 - d. Capacity in Btu/h.
 - e. Number of stages.
 - f. Connected volts, phase, and hertz.
 - g. Rated amperage.
 - h. Airflow rate in cfm.
 - i. Face area in sq. ft.
 - j. Minimum face velocity in fpm.
2. Test Data (Indicated and Actual Values):
 - a. Heat output in Btu/h.
 - b. Airflow rate in cfm.
 - c. Air velocity in fpm.
 - d. Entering-air temperature in deg F.
 - e. Leaving-air temperature in deg F.
 - f. Voltage at each connection.
 - g. Amperage for each phase.
- G. Air-to-Air Energy-Recovery Unit Reports
1. Unit Data:
 - a. Unit identification.
 - b. Location.
 - c. Service.
 - d. Make and type.
 - e. Model and serial numbers.
 2. Motor Data: as specified herein before.
 3. Test Data (Indicated and Actual Values):
 - a. Total exhaust airflow rate in cfm.
 - b. Purge exhaust airflow rate in cfm.
 - c. Outside airflow rate in cfm.
 - d. Total exhaust fan static pressure in inches wg.
 - e. Total outside-air fan static pressure in inches wg.
 - f. Pressure drop on each side of recovery wheel in inches wg.
 - g. Exhaust air temperature entering in deg F.
 - h. Exhaust air temperature leaving in deg F.
 - i. Outside-air temperature entering in deg F.
 - j. Outside-air temperature leaving in deg F.
- H. Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:
1. Report Data:
 - a. System and air-handling-unit number.

- b. Location and zone.
- c. Traverse air temperature in deg F.
- d. Duct static pressure in inches wg.
- e. Duct size in inches.
- f. Duct area in sq. ft.
- g. Indicated airflow rate in cfm.
- h. Indicated velocity in fpm.
- i. Actual airflow rate in cfm.
- j. Actual average velocity in fpm.

3.11 VERIFICATION OF TAB REPORT

- A. Owner or Commissioning authority will randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.
- B. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
- C. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.
- D. If TAB work fails, proceed as follows:
 - 1. TAB specialists shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.
 - 2. If the second final inspection also fails, Owner may contract the services of another TAB specialist to complete TAB work according to the Contract Documents and deduct the cost of the services from the original TAB specialist's final payment.
- E. Prepare test and inspection reports.

END OF SECTION 230593

SECTION – 230700 - MECHANICAL INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 7 for firestopping materials and requirements for penetrations through fire and smoke barriers.
 - 2. Division 23 Section "Common Work Results for Mechanical"
 - 3. Division 23 Section "Hangers and Supports for Piping and Equipment" for pipe insulation shields and protection saddles.
 - 4. Division 23 Section "Metal Ducts" for duct liner.

1.2 SUMMARY

- A. This Section includes insulation; insulating cements; field-applied jackets; accessories and attachments; and sealing compounds.

1.3 ACTION SUBMITTALS

- A. Product Data: Identify thermal conductivity, Greenguard Certification, thickness, and jackets (both factory and field applied, if any), for each type of product indicated.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the U.S. Department of Labor, Bureau of Apprenticeship and Training.
- B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
- C. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Ship insulation materials in containers marked by manufacturer with appropriate ASTM specification designation, type and grade, and maximum use temperature.
- B. All of the insulation materials and accessories covered by this specification shall be delivered to the job site and stored in a safe, dry place with appropriate labels and/or other product identification.
- C. Store tapes, adhesives, mastics, cements, and insulation materials in ambient conditions in accordance with the recommendations of the manufacturer.
- D. Follow manufacturer's recommended handling practices.
- E. The contractor shall use whatever means are necessary to protect the insulation materials and accessories before, during, and after installation. No insulation material shall be installed that has become damaged in any way. The contractor shall also use all means necessary to protect work and materials installed by other trades.
- F. Fiber Glass and Mold: Contractor shall take precaution to protect insulation. Any fiber glass insulation that becomes wet or torn should be replaced at no additional cost. Air handling insulation used in the air stream must be discarded if exposed to water.

1.6 COORDINATION

- A. Coordinate size and location of supports, hangers, and insulation shields. Coordinate clearance requirements with other trades for insulation application.
- B. Schedule insulation application after testing systems. Insulation application may begin on segments of systems that have satisfactory test results.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Certainteed
 - 2. Knauf
 - 3. Owens-Corning
 - 4. John Mansville
 - 5. Armstrong
 - 6. Aeroflex USA
 - 7. Nomaco K-Flex

2.2 PIPING INSULATION MATERIALS

A. General

1. Supply fiber glass products that have achieved GREENGUARD Children & Schools Certification.
2. Surface Burning Characteristics: Insulation and related materials shall have surface burning characteristics determined by test performed on identical products per ASTM E 84 mounted and installed as per ASTM E 2231. All testing shall be performed by a testing and inspecting agency acceptable to authorities having jurisdiction. Insulation, jacket materials, adhesives, mastics, tapes and cement material containers shall be labeled with appropriate markings of applicable testing and inspecting agency. Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
3. Supply fiber glass products that are manufactured using a certified 25 % minimum recycled content.

B. Provide thermal hanger shields as specified in Section 230529.

C. Glass Fiber:

1. Knauf 1000°F Pipe Insulation with ECOSE Technology meeting ASTM C547 Type IV Grade A, ASTM C585, and ASTM C795; rigid, molded, noncombustible per ASTM E136; k value: ASTM C335, 0.23 at 75°F mean temperature. Maximum Service Temperature: 1000°F, or Johns Manville's Micro-Lok[®] HP meeting ASTM C547, Type I, maximum service temperature of 850°F meeting the other requirements. Vapor Retarder Jacket: ASJ/SSL conforming to ASTM C1136 Type I, secured with self-sealing longitudinal laps and butt strips.
2. PVC Fitting Covers: The Proto Fitting Cover System or Johns Manville Zeston[®] polyvinyl chloride (PVC) parts shall consist of one piece and two piece pre-molded high impact UV-resistant PVC fitting covers with fiberglass inserts and accessories, which include elbows, tee/valves, end caps, mechanical line couplings, and specialty fittings. Fittings shall be made of Zeston[®] or LoSMOKE[®] grade PVC, 25/50 rated per ASTM E-84. Thermal Value of fiberglass insert: K value of 0.26 at 75°F; resistance to fungi and bacteria. (ASTM G 21, ASTM G 22): does not promote growth of fungi or bacteria.

D. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.

1. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
3. Materials shall have a maximum thermal conductivity of 0.27 Btu-in/h-ft²- °F at a 75°F mean temperature when tested in accordance with ASTM C 177 or ASTM C 518, latest revisions.
4. Materials shall have a maximum water vapor transmission of 0.08 perm-inches when tested in accordance with ASTM E 96, Procedure-A, latest revision.
5. Materials shall have a flame spread index of less than 25 and a smoke developed index of less than 50 when tested in accordance with ASTM E 84, latest revision.
6. Provide Armaflex WB finish for outdoor exposed piping.

2.3 DUCTWORK INSULATION MATERIALS

- A. Flexible Fiber Glass Blanket: Johns Manville's Microlite® XG Duct Wrap or Knauf Friendly Feel® Duct Wrap with ECOSE Technology meeting ASTM C553 Types I, II and III, and ASTM C1290; GREENGUARD certified; flexible, limited combustible; k value: ASTM C177, 0.29 at 75°F mean temperature. Maximum Service Temperature: faced: 250°F; unfaced: 350°F. Vapor Retarder Jacket: FSK conforming to ASTM C1136 Type II. Installation: Maximum allowable compression is 25%. Securement: Secured in place using outward cinching staples in combination with appropriate pressure-sensitive aluminum foil or PSK tape, or in combination with glass fabric and vapor retarder mastic. Density: concealed areas: Minimum 0.75 PCF; exposed areas: Minimum 1.0 PCF.

2.4 ACCESSORY MATERIALS

- A. Accessory materials installed as part of insulation work under his section shall include (but not be limited to):
 - 1. Closure Materials - Butt strips, bands, wires, staples, mastics, adhesives; pressure-sensitive tapes.
 - 2. Adhesive: As recommended by insulation material manufacturer. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated
 - 3. Support Materials - Hanger straps, hanger rods, saddles, support rings
- B. All accessory materials shall be installed in accordance with manufacturer's instructions.
- C. Mastics: Materials recommended by insulation material manufacturer that are compatible with insulation materials, jackets, and substrates.

PART 3 - EXECUTION

3.1 EXAMINATION & PREPARATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application. Verify that systems to be insulated have been tested and are free of defects. Verify that surfaces to be insulated are clean and dry.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. Before starting work under this section, carefully inspect the site and installed work of other trades and verify that such work is complete to the point where installation of materials and accessories under this section can begin.
- D. Ensure that all pipe and fitting surfaces over which insulation is to be installed are clean and dry. Ensure that insulation is clean, dry, and in good mechanical condition with all factory-applied vapor or weather barriers intact and undamaged. Wet, dirty, or damaged insulation

shall not be acceptable for installation. Ensure that pressure testing of piping and fittings has been completed prior to installing insulation.

3.2 GENERAL APPLICATION REQUIREMENTS

- A. Provide insulation materials, accessories, and finishes according to the manufacturer's written instructions; with smooth, straight, and even surfaces; free of voids throughout, including the length of ducts and fittings, valves, and specialties.
- B. Provide insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each system as specified in insulation system schedules.
- C. Provide accessories compatible with insulation materials and suitable for the service. Provide accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Provide insulation with longitudinal seams at top and bottom of horizontal pipe runs and equipment.
- E. Provide multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Seal joints and seams with vapor-retarder mastic on insulation indicated to receive a vapor retarder.
- H. Keep insulation materials dry during application and finishing.
- I. Provide insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by the insulation material manufacturer.
- J. Provide insulation over fittings, valves, and specialties, with continuous thermal and least number of joints practical.
- K. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and specialties around anchor attachments.
 - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
- L. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- M. Provide insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
 2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c. For below ambient services, apply vapor-barrier mastic over staples.
 4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.
- N. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- O. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- P. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

3.3 PIPE AND DUCTWORK PENETRATIONS

- A. Insulation Installation at Roof or Aboveground Exterior Wall Penetrations: Install insulation continuously through roof penetrations.
1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation above roof/wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside roof/wall flashing at least 2 inches below top of roof flashing.
 4. Seal jacket to roof/wall flashing with flashing sealant.
- B. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- C. Insulation Installation at Fire-Rated Penetrations:
1. Fire Dampers: Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.
 2. Pipe or duct penetrations (no fire damper): Install insulation continuously through penetrations of fire-rated walls and partitions. Comply with requirements in Division 7 for firestopping and fire-resistive joint sealers.

3.4 INSTALLATION OF PIPING INSULATION

- A. Metal shields shall be installed between hangers or supports and the piping insulation. Provide in accordance with Section 230529.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
 - 1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
 - 2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
 - 3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
 - 4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
 - 5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
 - 6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
 - 7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
 - 8. For services not specified to receive a field-applied jacket except for flexible elastomeric, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
- C. Insulate instrument connections for specialties (examples: thermometers, sensors, etc.) on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. Install removable insulation covers at fittings and equipment that require servicing and locations with service requirements.
- E. Glass Fiber Piping Insulation

1. Locate seams in the least visible location.
2. Insulation installed on piping operating below ambient temperatures must have a continuous vapor retarder. All joints, seams and fittings must be sealed. On systems operating above ambient, the butt joints should not be sealed.

F. Flexible Elastomeric Insulation

1. Seal longitudinal seams and end joints with manufacturers recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
2. Insulation Installation on Pipe Flanges: Install pipe insulation to outer diameter of pipe flange. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation. Secure insulation to flanges and seal seams with manufacturers recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
3. Insulation Installation on Pipe Fittings and Elbows: Install mitered sections of pipe insulation. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
4. Insulation Installation on Valves and Pipe Specialties: Install preformed valve covers manufactured of same material as pipe insulation when available. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation. Install insulation to flanges as specified for flange insulation application. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
5. After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating. Prior to applying the finish, the insulation shall be wiped clean with denatured alcohol. The finish shall not be tinted. To insure good adhesion, the temperature should be above 50 °F during application and drying. Outdoor exposed piping shall have the seams located on the lower half of the pipe.
6. Outdoor exposed piping shall be painted with two coats of Armaflex WB Finish. Prior to applying the Finish, the insulation shall be wiped clean with denatured alcohol. The Finish shall not be tinted. Outdoor exposed piping shall have the seams located on the lower half of the pipe.

3.5 INSTALLATION OF DUCTWORK INSULATION

A. Flexible Fiberglass Blanket Insulation Installation:

1. Secure with adhesive and insulation pins.
2. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
3. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
4. Firmly butt all joints.
5. Where vapor retarder performance is required, all penetrations and damage to the facing shall be repaired using pressure-sensitive tape matching the facing, or mastic prior to

system startup. Pressure-sensitive tapes shall be a minimum 3 inches wide and shall be applied with moving pressure using a squeegee or other appropriate sealing tool. Closure shall have a 25/50 Flame Spread/Smoke Developed Rating per UL 723. The longitudinal seam of the vapor retarder must be overlapped a minimum of 2 inches.

6. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
 - a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
 - b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
 - c. Insulation shall be additionally secured to the bottom of rectangular ductwork over 24 inches wide using mechanical fasteners on 18-inch centers. Care should be exercised to avoid over-compression of the insulation during installation.
 - d. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - e. Do not over-compress insulation during installation. Install Duct Wrap using manufacturer's stretch-out tables to obtain specified R-value using a maximum compression of 25%.
 - f. Impale insulation over pins and attach speed washers.
 - g. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
 7. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.
 8. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
 9. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.
- B. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
1. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
 2. Install vapor stops for ductwork and plenums operating below 50°F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.

- C. Fire-rated insulation system installation: Where fire-rated insulation system is indicated, secure system to ducts and duct hangers and supports to maintain a continuous fire rating. Insulate duct access panels and doors to achieve same fire rating as duct.

3.6 FINISHES

- A. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

3.7 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections: Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation.
- C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.8 PIPING INSULATION APPLICATION SCHEDULE

- A. Application schedules identify piping system and indicate pipe size ranges and material, thickness, and jacket requirements. For piping systems not indicated, insulate to with a similar thickness and type as those specified.
- B. All cold surfaces that may "sweat" must be insulated. Vapor barrier must be maintained, insulation shall be applied with a continuous, unbroken moisture and vapor seal. All hangers, supports, anchors, or other projections that are secured to cold surfaces shall be insulated and vapor sealed to prevent condensation.
- C. For above-ambient services, do not install insulation to the following: testing agency labels and stamps, nameplates, and cleanouts.
- D. Insulation thicknesses and installations shall meet or exceed the requirements of ASHRAE Standard 90.1-2010, IECC 2012, or thicknesses indicated, whichever is of superior insulating performance. If piping type is omitted from list below, provide insulation per ASHRAE or IECC or as per similar duty.
- E. Domestic hot water: 1/2" thickness, runouts and non-recirculated portions, except as noted below.
- F. Domestic hot water: 1-1/4" and less: Glass Fiber, 1" thickness; 1-1/2" and larger: Glass Fiber, 1.5" thickness.
 - 1. Recirculating piping including the supply and return.
 - 2. The first 8 feet for a non-recirculating storage system.

3. The inlet pipe between the storage tank and a heat trap in a non-recirculating storage system.
- G. Domestic cold water: Glass Fiber, ½” thickness.
- H. Horizontal Rainwater conductors: Glass Fiber, 1” thickness. Provide for all horizontal piping and any vertical piping within 10 feet of the roof drain.
- I. Roof Drain Bodies: Flexible Elastomeric, ½” thickness. Alternatively, roof drain bowls may be insulated with 2” of closed-cell spray-foam provided by Division 7. Coordinate with Division 7.
- J. AC pan drain or other cold drain piping; (35° to 60°F): Flexible Elastomeric, ½” thickness.
- K. Ductless split: ½” Armaflex for liquid and gas piping. Coordinate with Section 238310, insulated line kits to be furnished.

3.9 DUCT SYSTEM APPLICATIONS

- A. Insulation materials and thicknesses are specified in schedules at the end of this Section. For duct systems not indicated, insulate to with a similar thickness and type as those specified.
- B. Insulation thicknesses and installations shall meet or exceed the requirements of ASHRAE Standard 90.1-2007, or thicknesses indicated, whichever is of superior insulating performance.
- C. Items Not Insulated: Unless otherwise indicated, do not apply insulation to the following systems, materials, and equipment:
 1. Metal ducts with duct liner.
 2. Factory-insulated flexible ducts.
 3. Factory-insulated plenums, casings, and access doors.
 4. Flexible connectors.

3.10 DUCT AND PLENUM APPLICATION SCHEDULE

- A. Heat Pump Supply Ducts: Flexible Fiber Glass Blanket:
 1. Concealed or Unconditioned Space: R-6, 1.5” thickness.
 2. Return Air Plenums: None
 3. Exposed to Conditioned Space: None
- B. ERU Exhaust Ducts: Flexible Fiber Glass Blanket: R-6, 1.5” thickness- within 10 feet of ERU.
- C. Return ducts within conditioned space: None required.
- D. Outside air intake and exhaust ducts and plenums from outside wall to ERU’s: Flexible Fiber Glass Blanket; R-8, 2” thickness.

END OF SECTION 230700

SECTION 233113 - DUCTWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 8 for Access Doors
 - 2. Division 23 Section "Common Work Results for Mechanical"
 - 3. Division 23 Section "Mechanical Insulation"
 - 4. Division 23 Section "Diffusers, Registers, and Grilles."
 - 5. Division 23 Control Section
 - 6. Division 23 Section "Testing, Adjusting, and Balancing".

1.2 SUMMARY

- A. This Section includes metal ducts and accessories for heating, ventilating, and air-conditioning systems.

1.3 SYSTEM DESCRIPTION

- A. Drawings show the general layout of ductwork and accessories but do not show all required fittings and offsets that may be necessary to connect ducts to equipment, diffusers, grilles, etc., and to coordinate with other trades. Fabricate ductwork based on field measurements. Provide all necessary fittings and offsets. Coordinate with other trades for space available and relative location of HVAC equipment and accessories on ceiling grid. Duct sizes on the drawings are inside dimensions, which maybe altered by Contractor to other dimensions with the same air handling characteristics where necessary to avoid interferences and clearance difficulties.
- B. The contractor must comply with the enclosed specification in its entirety. If on inspections, the engineer finds changes have been made without prior written approval, the contractor will make the applicable changes to comply with this specification, at the contractor's expense.
- C. At the discretion of the engineer, sheet metal gauges, and reinforcing may be randomly checked to verify all duct construction is in compliance.

1.4 PERFORMANCE REQUIREMENTS

- A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.

- B. Structural Performance: Duct hangers and supports and seismic restraints shall withstand the effects of gravity and seismic loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible", ASCE/SEI 7, and SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems."
- C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of the following products:
 - 1. Liners and adhesives.
 - 2. Sealants and gaskets.
- B. Shop Drawings:
 - 1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
 - 2. Factory- and shop-fabricated ducts and fittings.
 - 3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
 - 4. Dimensions of main duct runs from building grid lines.
 - 5. Fittings.
 - 6. Reinforcement and spacing.
 - 7. Seam and joint construction.
 - 8. Penetrations through fire-rated and other partitions.
 - 9. Equipment installation based on equipment being used on Project.
 - 10. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
 - 11. Hangers and supports, including methods for duct and building attachment, seismic restraints, and vibration isolation.
- C. Delegated-Design Submittal:
 - 1. Sheet metal thicknesses.
 - 2. Joint and seam construction and sealing.
 - 3. Reinforcement details and spacing.
 - 4. Materials, fabrication, assembly, and spacing of hangers and supports.
- D. Ductwork Specialties Product Data; provide for the following:
 - 1. Sealant
 - 2. Duct-mounted access doors and panels.
 - 3. Flexible ducts.
 - 4. Manual-volume dampers: Damper manufacturer's printed application and performance data including pressure, velocity and temperature limitations shall be submitted for approval.
 - 5. Fire dampers: Provide complete submittal information (including installation instructions) and the manufacturer's certification of compliance with these specifications for approval prior to bidding. Contractor shall include damper manufacturer's

Installation Instructions as part of the submittal. These instructions shall describe the applicable requirements for damper sleeve thickness, retaining angles, and methods of attachment, duct-to-sleeve connections, preparation of wall or floor openings, and all other requirements to provide an installation equivalent to that tested by the damper manufacturer during the UL Standard 555 qualification procedures. Contractor shall detail any proposed installations that deviate from these manufacturer's instructions and explain the needed deviations.

6. Louvers: Include printed catalog pages showing specified models with appropriate AMCA Certified Ratings Seals. For units with factory-applied color finishes, provide color chart. Provide product test reports: Based on evaluation of comprehensive tests performed by a qualified testing agency or by manufacturer and witnessed by a qualified testing agency, for each type of louver.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

1.7 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."
- C. National Fire Protection Association (NFPA): 90A: Standard for the Installation of Air Conditioning and Ventilating Systems
- D. Sheet Metal and Air Conditioning Contractors National Association (SMACNA): 3rd Edition: 2005 HVAC Duct Construction Standards, Metal and Flexible; 1st Edition: 1985 HVAC Air Duct Leakage Test Manual

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver sealant and fire stopping materials to site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration period for use, pot life, curing time, and mixing instructions for multi-component materials.
- B. Deliver, store and handle materials according to manufacturer's written recommendations.
- C. All ductwork, equipment, and fittings delivered and stored on the job site must be capped to prevent the entry of moisture, construction dust or other debris.

PART 2 - PRODUCTS

2.1 SHEET METAL MATERIALS

- A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
 - 1. Galvanized Coating Designation: G60 or G90 as indicated.
 - 2. Finishes for Surfaces Exposed to View: Mill phosphatized.
- C. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- D. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.2 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- D. Cross Breaking or Cross Beading: Cross break or cross bead duct sides 19 inches and larger and 0.0359 inch thick or less, with more than 10 sq. ft. of un-braced panel area, unless ducts are lined. All large ducts must be braced as required to prevent drumming.
- E. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Fig. 2-3 Rectangular Elbows: Type RE2 square throat with vanes, Type RE1 radius (1.5W minimum), or Type RE5 dual radius. Square throat is not allowed.
2. Vane support in elbows: Fig 2-4. Turning vanes shall be Harper double wall turning vanes fabricated from the same material as the duct. Mounting rails shall have friction insert tabs that align the vanes automatically. Tab spacing shall be as specified in Figure 2-3 of the 1995 SMACNA Manual, "HVAC Duct Construction Standards, Metal & Flexible" Second Edition standard. Rail systems with non-standard tab spacing shall not be accepted. Due to tensile loading, vanes shall be capable of supporting 250 pounds when secured according to the manufacturer's instructions.
3. Fig. 2-5 Rectangular Divided Flow Branches: Type 1, Type 2, Type 4A, or 4B.
4. Fig. 2-6 Branch Connections: 45-degree entry, 45-degree lead-in, bell-mouth or spin-in (single diffuser supply only).
5. Fig. 2-7 Offsets and Transitions. Use gradual offsets as shown, 90-degree offsets shall be avoided.
6. Fig 2-9 Duct Coils: heating coils with transitions and access door.

2.3 ROUND DUCT FABRICATION

- A. Fabricate supply ducts of galvanized steel according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" latest edition.
- B. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 1. Concealed Round Ducts: Shall be longitudinal Grooved Seam Flat lock (RL-5 seam) at 2-inch wg construction.
 2. Snap lock seams shall not be used for this project.
- C. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.4 HANGERS AND SUPPORTS

- A. Hanger Rods: Cadmium-plated steel rods and nuts.
- B. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."
- C. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
- D. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

- E. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

2.5 SEALANT MATERIALS

- A. Joint Sealant/Mastic: Shall be flexible, water-based, adhesive sealant designed for use in all pressure duct systems. After curing, it shall be resistant to ultraviolet light and shall prevent the entry of water, air and moisture into the duct system. Sealer shall be UL 723 and UL 181 listed and meet NFPA 90A requirements.
 - 1. Maximum 5 flame spread and 0 smoke-developed (ASTM E-84 Tunnel Test).
 - 2. Generally provide liquid sealant for low clearance slip joints and heavy, permanently elastic, mastic type where clearances are larger.
 - 3. Resistance to mold, mildew and water: Excellent
 - 4. Color: Gray
 - 5. Duct sealant/mastic shall meet requirement for "LEED IEQ Credit 4.1: Low Emitting Materials: Adhesive and Sealant". ITW TACC Miracle Kingco water-based sealants, or approved equal.
- B. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

2.6 FITTINGS

- A. Tees, Laterals, and Conical Tees: Use 45 degree; fabricate to comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," with metal thicknesses specified for longitudinal seam straight duct.
- B. Diverging-Flow Fittings: Fabricate with a reduced entrance to branch taps with no excess material projecting from body onto branch tap entrance.
- C. Elbows: Diameters 3 through 8 inches shall be two-section die stamped; all others shall be gored construction, maximum 18 degree angle, with all seams continuously welded or standing seam. Coat galvanized areas of fittings damaged by welding with corrosion resistant aluminum paint or galvanized repair compound.

2.7 LOUVERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Ruskin Company
 - 2. American Warming and Ventilating, Inc.
 - 3. Arrow United Industries.
 - 4. Cesco Products.
 - 5. Construction Specialties, Inc.
 - 6. Greenheck.

- B. Louvers shall be AMCA Licensed. Louvers shall comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" for fabrication, construction details, and installation procedures.
- C. Fabrication: Design: Stationary drainable louver type with drain gutters in each blade and head with downspouts in jambs and mullions with all welded construction. Hidden vertical supports to allow continuous line appearance up to 120 inches. Steeply angled integral sill. Frame Depth: 4 inches; Wall Thickness: 0.081 inch nominal. Material: Extruded aluminum, Alloy 6063-T6. Blades: Style: Drainable. 45 degrees at 4 inches nominal. Wall Thickness: 0.081 inch nominal. Material: Extruded aluminum, Alloy 6063-T6. Recycled Content: 18% post-consumer. 55% pre-consumer, post-industrial, total 73% by weight.
- D. Performance Data: Based on testing 48 inch x 48 inch size unit in accordance with AMCA 500.
 - 1. Free Area: 52 percent, nominal.
 - 2. Free Area Size: 8.34 square feet.
 - 3. Maximum Recommended Air Flow through Free Area: 1075 feet per minute.
 - 4. Air Flow: 8966 cubic feet per minute.
 - 5. Maximum Pressure Drop (Intake): 0.225 inches w.g.
 - 6. Water Penetration: Maximum of 0.01 ounces per square foot of free area at an air flow of 1075 feet per minute free area velocity when tested for 15 minutes.
 - 7. Design Wind load: Per Code.
 - 8. Louvers shall be factory engineered to withstand the specified seismic loads. Minimum design loads shall be calculated to comply with ASCE – 7, or local requirements of Authority Having Jurisdiction (AHJ).
- E. Bird Screen: aluminum, 5/8" mesh, removable frame, re-wireable.
- F. Premium Kynar Paint Finish: Before paint application, louvers shall be thoroughly cleaned and pretreated. Cleaning includes complete submersion in alkali cleaner, detergent deoxidization, amorphous chrome phosphate conversion ® ® coating and acidulated final rinse. Kynar 500 or Hylar 5000 finish shall be applied to provide 1.2 mils factory applied, baked-on film build in accordance with AAMA 2605-98* "Voluntary Specification Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Architectural Extrusions and Panels". Color shall be as selected by Architect.
- G. Accessories: Insulated Blank-Off Panels as scheduled: 0.040 aluminum sheet, 2 inches thick, aluminum skin insulated core, factory installed with removable fasteners and neoprene gaskets.

2.8 MANUAL-VOLUME DAMPERS

- A. Manual balancing dampers meeting the following specifications shall be furnished and installed on all branch ducts and where shown on plans. Testing and ratings to be in accordance with AMCA Standard 500-D.
- B. Single-Blade Rectangular Dampers shall consist of: an 18 ga. galvanized steel frame with 3-1/2 in. depth; blades fabricated from 20 ga. galvanized steel; integral 1/2 in. dia axles. Damper suitable for pressures to 1.0 in. wg, velocities to 2000 fpm and temperatures to 180°F. Basis of design is Greenheck model MBD-10.

- C. Multi-Blade Rectangular Dampers shall consist of: a 16 ga. galvanized steel hat channel frame with 5 in. depth; triple V type blades fabricated from 16 ga. galvanized steel; ½ in. dia. plated steel axles; external (out of the airstream) blade-to-blade linkage. Damper suitable for pressures to 4.0 in. w.g. (996 Pa), velocities to 2000 fpm and temperatures to 180°F. Basis of design is Greenheck model MBD15.
- D. Round dampers shall consist of: a 20 ga. galvanized steel frame with 6 in. depth; blades fabricated from 20 ga. galvanized steel; 3/8 in. square plated steel axles turning in acetal bearings. Damper suitable for pressures to 1.0 in. wg, velocities to 2000 fpm and temperatures to 180°F. Basis of design is Greenheck model MBDR50.

2.9 REMOTE DAMPER OPERATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Pottorff
 - 2. Ventfabrics, Inc.
 - 3. Young Regulator Company.
- B. Ratings: Temperature Rating: -25°F to 180°F; Air Flow Rating: 1,500 fpm; Differential Pressure Rating: 1 in. wg.
- C. Construction:
 - 1. Basis of Design: Pottorff Model RCS-10 (rectangular); RCS-10R (round)
 - 2. Frame: 6" x minimum 22 gauge, roll formed galvanized steel with reinforcing beads at each end.
 - 3. Blade: Round, minimum 22 gauge, galvanized steel with center formed V for added rigidity. Flat blades are not acceptable.
 - 4. Axles: Minimum 3/8" square plated steel, mechanically attached to blade. Bearings: Molded synthetic, sleeve-type turning in tight sealing hole in frame.
 - 5. Mounting: Vertical and/or Horizontal
 - 6. Actuator: Remote cable controlled quadrant shall be factory installed to the damper, attached to a minimum 36 inch long flexible cable controlled, and controlled by a 3/16 inch Allen hex-head drive with 15/16 inch round white finishing plug (suitable for painting) and integral side-mounting flange. The entire assembly shall be factory assembled and tested prior to shipment, field assembled systems are not acceptable.
 - 7. Finish: Mill galvanized.

2.10 FIRE DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Air Balance Inc.
 - 2. Cesco Products
 - 3. Greenheck Fan Corporation.
 - 4. METALAIRE, Inc.

5. Nailor Industries Inc.
 6. Prefco
 7. Ruskin Company.
- B. Type: Static; rated and labeled according to UL 555S by an NRTL.
- C. Fire Rating: 1-1/2 hours.
- D. Frame: Curtain type with blades outside airstream except when located behind grille where blades may be inside airstream; fabricated with roll-formed, 0.034-inch- thick galvanized steel; with mitered and interlocking corners.
- E. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.
1. Minimum Thickness: 0.052 or 0.138 inch thick, as indicated, and of length to suit application.
 2. Exception: Omit sleeve where damper-frame width permits direct attachment of perimeter mounting angles on each side of wall or floor; thickness of damper frame must comply with sleeve requirements.
- F. Mounting Orientation: Vertical or horizontal as indicated.
- G. Blades: Roll-formed, interlocking, 0.034-inch- thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch- thick, galvanized-steel blade connectors.
- H. Horizontal Dampers: Include blade lock and stainless-steel closure spring.
- I. Heat-Responsive Device: Replaceable, 165°F rated, fusible links.
- J. Provide the grille option for curtain style fire dampers provides mounting flanges on the sleeve to ease installation of grilles in the field (Grilles specified in Section 233713). The flanges shall be made out of 20 gauge galvanized steel (3/4 inch x 2 in. long) with .149 in. diameter hole for fastening of grille. The flanges are concealed when the grille is installed.

2.11 DUCT-MOUNTED ACCESS DOORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Ductmate Industries, Inc.
 2. Greenheck Fan Corporation.
 3. McGill Air Flow LLC.
 4. Nailor Industries Inc.
 5. Cesco
 6. Buckley
- B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-10, "Duct Access Doors and Panels," and 2-11, "Access Panels - Round Duct."

1. Door: Double wall, rated for up to 4.5" static pressure. Door panel filled with 1" fiberglass insulation; ¾ lb. density. Hinges and Latches: 1-by-1-inch continuous piano hinge and cam latches. Fabricate doors airtight and suitable for duct pressure class.
2. Frame: Galvanized sheet steel, with bend-over tabs.
3. Provide 1/8" thick neoprene gaskets.
4. Locks: Access doors less than 16 Inches Square: Two cam locks. Doors over 16" shall have four locks.

2.12 FLEXIBLE CONNECTORS

- A. Provide for all air moving equipment. General: Flame-retarded or noncombustible fabrics, coatings, and adhesives complying with UL 181, Class 0 or 1. Factory fabricated with a strip of fabric 3-1/2 inches wide attached to two strips of 2-3/4-inch- wide, 0.028-inch- thick, galvanized, sheet steel or 0.032-inch aluminum sheets. Select metal compatible with connected ducts. Duro-Dyne, Hardcast, or approved equal.
- B. Indoor Flexible Connector Fabric: Glass fabric double coated with polychloroprene or neoprene. Minimum Weight: 26 oz. /sq. yd. Tensile Strength: 480 lbf/inch in the warp, and 360 lbf/inch in the filling.

2.13 FLEXIBLE DUCTS

- A. General: Comply with UL 181, Class 0 or 1. Flame Spread: Less than 25; Smoke Developed: Less than 50.
- B. All products shall be certified by Greenguard Environmental Institute; independent testing of products for emissions of respirable particles and Volatile Organic Compounds (VOC's), including formaldehyde and other specific product-related pollutants. Greenguard provides independent, third-party certification of IAQ performance. Certification is based upon criteria used by EPA, OSHA and WHO.
- C. Rated Positive Pressure: 10" w.g. per UL-181. Maximum negative pressure: ¾".
- D. Flexible Ducts, Insulated: Factory-fabricated, insulated, round duct, with an outer jacket enclosing glass-fiber insulation around a continuous inner liner.
 1. R6 insulation, Basis of Design: Atco #86
 2. Reinforcement: Steel-wire helix encapsulated in inner liner.
 3. Jacket (inner and outer): Polyethylene film.
- E. Flexible Duct Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action, in sizes 3 to 18 inches to suit duct size.
- F. Hangers shall be band type, 1" wide minimum.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION, GENERAL

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.
- B. Install ducts and accessories according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- C. Construct and install each duct system for the specific duct pressure classification indicated.
- D. Properly seam, brace, stiffen, support and render ducts mechanically airtight. Adjust ducts to suit job conditions. Dimensions may be changed as approved, if cross sectional area is maintained.
- E. Install ducts in lengths not less than 12 feet, unless interrupted by fittings. Install ducts with fewest possible joints.
- F. Install fabricated fittings for changes in directions, changes in size and shape, and connections.
- G. Install couplings tight to duct wall surface with a minimum of projections into duct.
- H. Install ductwork to allow maximum headroom. Install ducts, unless otherwise indicated, vertically and horizontally, parallel and perpendicular to building lines; avoid diagonal runs. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- I. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
- J. Conceal ducts from view in finished spaces. Do not encase horizontal runs in solid partitions, unless specifically indicated.
- K. Coordinate layout with suspended ceiling, lighting layouts, and similar finished work.
- L. Electrical Equipment Spaces: Route ductwork to avoid passing through transformer vaults and electrical equipment spaces and enclosures.
- M. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.

3.2 MATERIALS

- A. Hangers, accessories, and dampers shall be same material as parent duct.

- B. Refer to Specification Section 230700 for sheet metal covering of rigid insulation for protection from maintenance personnel crossing insulated ductwork in mechanical spaces.
- C. All ducts shall be G60 galvanized steel.

3.3 DUCT CLASSIFICATIONS AND SEALING

- A. Static-Pressure Classifications: Unless otherwise indicated, construct ducts to the following:
 - 1. Supply Ducts: 2 in. w.g.
 - 2. Return Ducts: 2-inch wg, negative pressure.
 - 3. Exhaust Ducts: 2-inch wg, negative pressure.
- B. Seam And Joint Sealing
 - 1. General: Seal duct seams and joints according to the duct pressure class indicated and as described in SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."
 - 2. Seal to SMACNA Class A; all joints, longitudinal and transverse seams, and connections in ductwork shall be securely fastened and sealed with welds, gaskets, or duct sealant. Exceptions:
 - a. Continuously welded and locking-type longitudinal joints and seams on ducts operating at less than 2 in. wg pressure classification.
 - b. Exposed exhaust or return ducts operating at less than 2 in. wg pressure classification.
 - c. Exposed supply ducts in the space that the duct serves.
 - 3. Seal externally insulated ducts before insulation installation.

3.4 DUCT PENETRATIONS

- A. Fire or Smoke Rated Penetrations not requiring a fire and/or smoke damper: Where ducts pass through walls, floors, or partitions that are required to have a fire resistance rating and fire dampers are not required, the opening in the construction around the duct shall be as follows:
 - 1. Not exceeding a 1" average clearance on all sides.
 - 2. Filled solid with firestopping material as specified in Section 230500.
- B. Fire-Rated Penetrations – Fire Damper: Provide fire damper as specified under Duct Accessories paragraph.
- C. Non-Fire-Rated Exposed Penetrations: Where ducts pass through interior partitions and exterior walls, and are exposed to view, conceal space between construction opening and duct or duct insulation with sheet metal flanges of same metal thickness as duct. Overlap opening on four sides by at least 1-1/2 inches.
- D. Non-Fire-Rated Concealed Penetrations: Provide insulation infill and acoustical sealant around gaps. Tightly seal to prevent sound transmission. Neatly finish.

- E. Roof penetrations by ducts shall use counter-flashed curbs.
- F. Flexible air ducts or connectors shall not pass through any wall, floor, or ceiling.

3.5 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."
- B. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.
- C. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.
- D. Install upper attachments to structures. Select and size upper attachments with pull-out, tension,

3.6 FLEXIBLE DUCT

- A. Provide in accordance with manufacturer's and Air Diffusion Council recommendations.
- B. Flexible ducts shall be supported at manufacturer's recommended intervals, but at no greater distance than 5 feet. Maximum permissible sag is 1/2" per foot of spacing between supports.
- C. Install duct fully extended; do not install in the compressed state or use excess lengths.
- D. Avoid bending ducts across sharp corners or incidental contact with metal fixtures, pipes, conduits, or hot equipment. Radius at centerline shall not be less than one duct diameter.
- E. Hanger or saddle material in contact with the duct shall be at least 1-1/2" wide.
- F. Provide at least 2 duct diameters of straight duct at the entrance to register, grilles, and diffusers.

3.7 DUCT ACCESSORIES INSTALLATION

- A. Install duct accessories according to applicable details shown in SMACNA's "HVAC Duct Construction Standards--Metal and Flexible".
- B. Provide duct transitions, offsets and connections to dampers, coils, and other equipment in accordance with SMACNA Standards
- C. Each register, grille, or diffuser shall have a means of air flow adjustment. Provide volume damper in branch duct if not furnished with the RGD.
- D. Adjust operable devices for proper action.

- E. Install duct access panels for access components that require servicing.
1. Install duct access panels to allow access to interior of ducts for cleaning, inspecting, adjusting, and maintaining per equipment manufacturers' requirements.
 2. Install access panels on side of duct where adequate clearance is available.
 3. Locate panel upstream and/or downstream as recommended by manufacturer.
 4. Locations:
 - a. On both sides of duct coils.
 - b. At outdoor-air intake and exhaust plenums.
 - c. Adjacent to and close enough to fire dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
 - d. Control devices requiring inspection.
 - e. Elsewhere as indicated or required by duct accessory manufacturer
 5. Inspect locations of access doors and verify that purpose of access door can be performed.
- F. Control Damper Installation
1. Damper submittals shall be coordinated for type, quantity, and size to ensure compatibility with sheet metal design.
 2. Duct openings shall be free of any obstruction or irregularities that might interfere with blade or linkage rotation or actuator mounting. Duct openings shall measure $\frac{1}{4}$ in. larger than damper dimensions and shall be square, straight, and level.
 3. Individual damper sections, as well as entire multiple section assemblies, must be completely square and free from racking, twisting, or bending. Measure diagonally from upper corners to opposite lower corners of each damper section. Both dimensions must be within $\frac{1}{8}$ in. of each other.
 4. Follow the manufacturer's instructions for field installation of control dampers. Unless specifically designed for vertical blade application, dampers must be mounted with blade axis horizontal.
 5. Damper blades, axles, and linkage must operate without binding. Before system operation, cycle damper after installation to ensure proper operation. On multiple section assemblies, all sections must open and close simultaneously.
 6. Provide a visible and accessible indication of damper position on the drive shaft end.
 7. Support ductwork in area of damper when required to prevent sagging due to damper weight.
 8. After installation of low-leakage dampers with seals, caulk between frame and duct opening to prevent leakage around perimeter of damper.
- G. Fire Damper Installation
1. Examine areas to receive dampers. Notify the Engineer of conditions that would adversely affect installation or subsequent utilization of dampers. Do not proceed with installation until unsatisfactory conditions are corrected
 2. 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.

3. Dampers must be accessible to allow inspection, adjustment, and replacement of components. The sheet metal contractor shall furnish any access doors in ductwork or plenums required to provide this access. The general contractor shall furnish any access doors required in walls, ceilings, or other general building construction.
4. Install dampers square and free from racking.
5. The installing contractor shall provide and install bracing for multiple section assemblies to support assembly weight and to hold against system pressure.
6. Do not compress or stretch the damper frame into the duct or opening.
7. Attach multiple damper section assemblies together in accordance with manufacturer's instructions. Install support mullions as reinforcement between assemblies as required.
8. Handle dampers using the frame or sleeve. Do not lift or move dampers using blades, actuator or jackshaft.
9. Tests and Inspections: Operate dampers to verify full range of movement and verify that proper heat-response device is installed.

3.8 LOUVER INSTALLATION

- A. Louvers to be furnished by Division 23; mounted and installed by the contractor responsible for the outside wall construction. Ductwork shall be connected to the louvers by Division 23.
- B. Verify louver openings by field measurements before fabrication and indicate measurements on Shop Drawings. For new construction, or where field measurements cannot be made without delaying the Work, establish opening dimensions and proceed with fabricating louvers without field measurements. Coordinate construction to ensure that actual opening dimensions correspond to established dimensions. Coordinate setting drawings, diagrams, templates, instructions, and directions for installation of anchorages that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to Project site.
- C. Installation
 1. Locate and place louvers and vents level, plumb, and at indicated alignment with adjacent work.
 2. Pitch horizontal ducts and plenums connected to louvers downward toward louvers not less than 1 inch in 10 feet. Connect to louver to allow drainage to exterior. Seal duct water-tight.
 3. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weather tight connection.
 4. Form closely fitted joints with exposed connections accurately located and secured.
 5. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.
 6. Repair finishes damaged by cutting, welding, soldering, and grinding. Restore finishes so no evidence remains of corrective work. Return items that cannot be refinished in the field to the factory, make required alterations, and refinish entire unit or provide new units.
 7. Install concealed gaskets, flashings, joint fillers, and insulation as louver installation progresses, where weather tight louver joints are required.

- D. Clean exposed surfaces of louvers and vents that are not protected by temporary covering, to remove fingerprints and soil during construction period. Do not let soil accumulate until final cleaning. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Thoroughly rinse surfaces and dry.
- E. Restore louvers and vents damaged during installation and construction so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by Architect, remove damaged units and replace with new units.

3.9 FIELD QUALITY CONTROL

- A. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."
- B. HVAC systems shall not be operated during construction.
- C. Upon completion of installation duct systems and before HVAC system start-up, visually inspect the ductwork proper installation
- D. Cover supply openings with filter media prior to system start-up to catch any loose material that may remain inside the ductwork. Turn the HVAC system on and allow it to run until steady state operation is reached. Remove the temporary filter media from supply openings and, along with it, any loose material blown downstream and caught by the filter media.
- E. All ductwork shall be provided with temporary enclosures to keep the HVAC system free of dust and construction debris. The HVAC system includes any interior surface of the facility's air distribution system for conditioned spaces and/or occupied zones. This includes the entire duct from the points where the air enters the system to the points where the air is discharged from the system.
- F. Check all filters in accordance with their manufacturer's instructions. Use specified grade of filters at all times that system is operating.

END OF SECTION 233113

SECTION 233713 - DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 23 Section "Common Work Results for HVAC"
 - 2. Division 23 Section "Ductwork"
 - 3. Division 23 Section "Testing, Adjusting, and Balancing" for balancing diffusers, registers, and grilles.

1.2 SUMMARY

- A. This Section includes ceiling- and wall-mounted diffusers, registers, and grilles.

1.3 DEFINITIONS

- A. Diffuser: Circular, square, or rectangular air distribution outlet, generally located in the ceiling and comprised of deflecting members discharging supply air in various directions and planes and arranged to promote mixing of primary air with secondary room air.
- B. Grille: A louvered or perforated covering for an opening in an air passage, which can be located in a sidewall, ceiling, or floor.
- C. Register: A combination grille and damper.

1.4 SUBMITTALS

- A. Each manufacturer shall check noise level ratings for registers and diffusers to insure that the sizes selected will not produce noise to exceed 30 db, "A" scale, measured at occupant level; notify Owner's representative of problems prior to shop drawing submittal.
- B. Pressure drop, airflow and noise criteria selection is based on design equipment. Manufacturers not submitting design makes must provide written certification in front of submittal that equipment submitted has been checked against and performs equal to the design make.
- C. Product Data: For each model indicated, include the following:
 - 1. Data Sheet: For each type of air outlet and inlet, and accessory furnished; indicate construction, finish, and mounting details.

2. Performance Data: Include throw and drop, static-pressure drop, and noise ratings for each type of air outlet and inlet.
 3. Schedule of diffusers, registers, and grilles indicating drawing designation, room location, quantity, model number, size, and accessories furnished.
 4. Assembly Drawing: For each type of air outlet and inlet; indicate materials and methods of assembly of components.
- D. Coordinate locations with reflected ceiling plans and wall elevations as applicable.
- E. Coordinate mounting frame with associated mounting surface.

1.5 QUALITY ASSURANCE

- A. Product Options: Drawings and schedules indicate specific requirements of diffusers, registers, and grilles and are based on the specific requirements of the systems indicated. Other manufacturers' products with equal performance characteristics may be considered. Refer to Division 1 Section "Substitutions."
- B. NFPA Compliance: Install diffusers, registers, and grilles according to NFPA 90A, "Standard for the Installation of Air-Conditioning and Ventilating Systems."
- C. Sound pressure levels shall be determined by using AHRI Standard 885-2008 "Procedure for Estimating Occupied Space Sound Levels in the Application of Air Terminals and Outlets".

PART 2 - PRODUCTS

2.1 GENERAL

- A. Diffusers, registers, and grilles are scheduled on Drawings.
- B. Mounting type shall match the mounting surface. Coordinate with mounting conditions.
- C. Material shall match the specified ductwork. Coordinate with Section 233113 "Ductwork".
- D. Testing: Test performance according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."
- E. Grilles shall be finished in White Powder Coat, unless noted otherwise.
- F. Manufacturers
1. Price
 2. Titus
 3. Metal-Aire
 4. Anemostat
 5. Nailor

2.2 RETURN OR EXHAUST

A. Return/Exhaust Grille, 45-degree deflection

1. Material: steel (Price 530 Series) or aluminum (Price 630 Series)
2. Provide damper as scheduled.
3. Grilles of the sizes indicated on the plans. Grilles shall be 45 degree deflection fixed louver type with blades spaced 3/4" on center. The blades shall run parallel to the long dimension of the grille.

B. Slot Return

1. Furnish and install Price model SDR return outlet of the sizes, configurations and mounting types indicated on the plans and outlet schedule.
2. Return units shall match in appearance the model SDS linear supply diffusers.
3. The SDR border shall be heavy extruded aluminum construction with extruded aluminum spacers and mitered end flanges, open ends, flush end caps or angle end caps.
4. Provide with insulated plenums. Plenums shall be constructed of zinc coated steel and have 1/4" internal insulation. Plenum assemblies shall be of a side inlet configuration.

2.3 SUPPLY

A. Double-deflection Supply Register

1. Material: steel (Price 520D Series) or aluminum (Price 620D Series)
2. Grilles of the sizes indicated on the plans.
3. Registers shall be double deflection type with two sets of fully adjustable deflection blades spaced 3/4" on center. The front set of blades shall run parallel to the short dimension of the register.
4. The integral volume control damper shall be of the opposed blade type. Material shall match the register material. The damper shall be operable from the register face.

B. Square ceiling diffusers, Adjustable pattern

1. Material: steel (Price Model SCDA) or aluminum (Price Model ASCDA)
2. Diffusers shall consist of a precision formed back cone of one piece seamless construction which incorporates a round inlet collar of sufficient length for connecting rigid or flexible duct.
3. The diffuser shall integrate with all duct sizes shown on the plans without affecting the face size and appearance of the unit. An inner cone assembly shall consist of 3 cones (or optional 4 cones) which drop below the ceiling plane to assure optimal VAV air diffusion performance.
4. The inner cone assembly shall be completely removable from the diffuser face to allow full access to any dampers or other ductwork components located near the diffuser neck.
5. Non-protrusive airflow directional tabs shall be provided on the back of the inner cones which may be positioned for either horizontal or vertical discharge.

C. Linear Slot Ceiling Diffusers

1. Material: steel (Price Model SDS)

2. Diffusers shall have discharge slots (quantity and widths as scheduled) with extruded aluminum aerodynamically curved "ice-tong" shaped pattern controllers for 180 degree air pattern control and airflow dampering if required.
3. The diffuser border shall be heavy extruded aluminum construction with extruded aluminum spacers and (mitered end flanges, open ends, flush end caps or angle end caps).
4. Diffuser shall be provided with insulated plenums. Plenums shall be constructed of zinc coated steel and have 1/4" internal insulation. Plenum assembly shall have sloped shoulders for enhanced spread characteristics. Plenum assemblies shall be of a side inlet configuration.

2.4 FLOOR GRILLES

A. Heavy Duty Linear Bar Grilles

1. Furnish and install Price model LBPH supply/return grilles. Grilles shall have fixed 15-degree blades, spaced 1/4 inch on center.
2. The outlet core shall have extruded aluminum receiving bar.
3. Blades shall run parallel to the long dimension of the grille.
4. The grille border shall be heavy duty extruded aluminum construction with precise factory mitered corners and reinforcing support bars for extra support for the core receiving bar. Price heavy duty flanged "border 1000".
5. Provide Price "Type A" countersunk screw-hole fasteners.
6. The blade spacers shall not exceed 6 inch on center for floor applications. The support bars shall not exceed 10 inch on center.
7. The core shall be held into the border with removable core clips allowing the removal of the core without special tools.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install diffusers, registers, and grilles level and plumb, according to manufacturer's written instructions, Coordination Drawings, original design, and referenced standards.
- B. 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, as much as practicable. For units installed in lay-in ceiling panels, locate units in the center of the 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 connection to ducts.

3.3 ADJUSTING

- A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.
- B. Adjustable outlet diffuser: adjust pattern for draft-free air distribution.

3.4 CLEANING

- A. After installation of diffusers, registers, and grilles, inspect exposed finish. Clean exposed surfaces to remove burrs, dirt, and smudges. Replace diffusers, registers, and grilles that have damaged finishes.

END OF SECTION 233713

SECTION 237200 - AIR-TO-AIR ENERGY RECOVERY EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Packaged Energy Recovery Units – Fixed Plate Enthalpic

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, furnished specialties, and accessories.
- B. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
- C. Wiring Diagrams: For power, signal, and control wiring.
- D. Operation and Maintenance Data: For air-to-air energy recovery equipment to include in maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. ARI Compliance: Capacity ratings for air-to-air energy recovery equipment shall comply with ARI 1060, "Rating Air-to-Air Energy Recovery Equipment."
- C. ASHRAE Compliance:
 - 1. Applicable requirements in ASHRAE 62.1-2004, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
 - 2. Capacity ratings for air-to-air energy recovery equipment shall comply with ASHRAE 84, "Method of Testing Air-to-Air Heat Exchangers."
- D. UL Compliance: UL 1812.

1.5 COORDINATION

- A. Coordinate layout and installation of air-to-air energy recovery equipment and suspension system with other construction that penetrates ceilings or is supported by them.

PART 2 - PRODUCTS

2.1 PACKAGED ENERGY RECOVERY UNITS – FIXED PLATE ENTHALPIC

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Mitsubishi Electric Sales Canada Inc.
 2. RenewAire LLC.
- B. Quality Assurance
1. The energy recovery cores used in these products shall be third party Certified by AHRI under its Standard 1060 for Energy Recovery Ventilators. AHRI published certifications shall confirm manufacture's published performance for airflow, static pressure, temperature and total effectiveness, purge air (OACF) and exhaust air leakage (EATR). Products that are not currently AHRI Certified will not be accepted.
 2. Manufacturer shall be able to provide evidence of independent testing of the core by Underwriters Laboratory (UL), verifying a maximum flame spread index (FSI) of 25 and a maximum smoke developed index (SDI) of 50 thereby meeting NFPA 90A and NFPA 90B requirements for materials in a compartment handling air intended for circulation through a duct system. The method of test shall be UL Standard 723.
 3. Unit shall be listed under UL 1812 Standard for Ducted Air to Air Heat Exchangers. Some exceptions to UL Listing may apply. Units intended for "Outdoor Use" shall be listed using the specific UL requirements for rain penetration, corrosion protection and seal durability and shall be so labeled.
 4. The ERV core shall be warranted to be free of manufacturing defects and to retain its functional characteristics, under circumstances of normal use, for a period of ten years from the date of purchase. The balance-of-unit shall be warranted to be free of manufacturing defects and to retain its functional characteristics, under circumstances of normal use, for a period of two years from the date of purchase.
- C. Performance
1. Energy Transfer: The ERV shall be capable of transferring both sensible and latent energy between airstreams. Latent energy transfer shall be accomplished by direct water vapor transfer from one air stream to the other, without exposing transfer media in succeeding cycles directly to the exhaust air and then to the fresh air.
 2. Passive Frost Control: The ERV core shall perform without condensing or frosting under normal operating conditions (defined as outside temperatures above -10°F and inside relative humidity below 40%). Occasional more extreme conditions shall not affect the usual function, performance or durability of the core. No condensate drains will be allowed.

3. Continuous Ventilation: Unit shall have the capacity to operate continuously without the need for bypass, recirculation, pre-heaters, or defrost cycles under normal operating conditions.
4. Positive Airstream Separation: Water vapor transfer shall be through molecular transport by hygroscopic resin and shall not be accomplished by “porous plate” mechanisms. Exhaust and fresh airstreams shall travel at all times in separate passages, and airstreams shall not mix.
5. Laminar Flow: Airflow through the ERV core shall be laminar over the products entire operating airflow range, avoiding deposition of particulates on the interior of the energy exchange plate material.

D. Construction

1. The energy recovery component shall be of fixed-plate cross-flow construction, with no moving parts.
2. No condensate drain pans or drains shall be allowed and unit shall be capable of operating in both winter and summer conditions without generating condensate.
3. The unit case shall be constructed of G90 galvanized, 20-gauge steel, with lapped corners and zinc plated screw fasteners. The unit roof shall be one piece or have watertight standing seam joints and shall overlap wall panels and doors in order to positively shed water.
4. Access doors shall provide easy access to blowers, ERV cores, and filters. Doors shall have an airtight compression seal using closed cell foam gaskets rated for outdoor exposure. Pressure taps, with captive plugs, shall be provided allowing cross-core pressure measurement allowing for accurate airflow measurement.
5. Case walls and doors shall be insulated with 1 inch, 4 pound density, foil/scrim faced, high-density fiberglass board insulation, providing a cleanable surface and eliminating the possibility of exposing the fresh air to glass fibers, and with minimum R-value of 4.3 (hr·ft²·°F/BTU).
6. The ERV cores shall be protected by a MERV-8 rated, 2” nominal, pleated, disposable filter in both airstreams.
7. Unit shall have single-point power connection and a single-point 24 VAC contactor control connection
8. Blower motors shall be ECM.
9. The unit electrical box shall include a factory installed, non-fused disconnect switch and a 24 VAC, Class II transformer/relay package.
10. The ERV shall be provided “inverter-ready” allowing for applications of inverters supplied and installed by others

E. Options

1. Provide unit and duct connection orientation per project schedule.
2. Provide factory installed disconnect switches.
3. Provide ECM controlled motors allowing for to preset speeds or variable speed operation with a 0-10 volt DC control signal.
4. Provide factory installed isolation dampers for both air streams. The insulated dampers shall be of a low leakage design and shall not restrict the airstream, reducing airflow, in any way. The dampers shall be opened with a motor actuator powered by the standard unit transformer package and have a spring return for low off-position power consumption.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine casing insulation materials and filter media before air-to-air energy recovery equipment installation. Reject insulation materials and filter media that are wet, moisture damaged, or mold damaged.
- C. Examine roughing-in for electrical services to verify actual locations of connections before installation.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.
- E. Locate and orient unit to provide the shortest and most straight duct connections. Provide service clearances as indicated on the plans. Locate units distant from sound critical occupancies.

3.2 INSTALLATION

- A. Install units with clearances for service and maintenance.
- B. Screw or bolt mounting straps or brackets directly to the sheet metal case as necessary. Remove the access doors before installing screws — make sure the fasteners don't damage internal parts. Do not screw into the access doors.
- C. Provide rubber or spring type isolators appropriately sized for corner weights of the specific unit.
- D. Provide flexible duct connections at unit duct flanges.
- E. Install new filters at completion of equipment installation and before testing, adjusting, and balancing.
- F. Sound Control: To control sound associated with the two blower outlets:
 - 1. Provide straight, gradual transition ductwork for a minimum of 2-1/2 duct diameters downstream from the blower outlet.
 - 2. Provide continuous acoustic insulation treatment of the duct until after the first elbow or tee.

3.3 CONNECTIONS

- A. Comply with requirements for piping specified in Division 23 Section "Hydronic Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Comply with requirements for ductwork specified in Division 23 Section "Ductwork."

- C. Install piping adjacent to machine to allow service and maintenance.

3.4 FIELD QUALITY CONTROL

- A. Test and Balancing: Test and Balancing may not begin until 100% of the installation is complete and fully functional.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- C. Tests and Inspections:
 - 1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - 3. Set field-adjustable switches and circuit-breaker trip ranges as indicated.
- D. Air-to-air energy recovery equipment will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain air-to-air energy recovery units.

END OF SECTION 237200

SECTION 238130 – MULTI-SPLIT SYSTEMS AND CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Section 230500 “Common Work Results for HVAC”

1.2 SUMMARY

- A. This Section includes:
 - 1. Multi split heat pump systems
 - 2. Automatic Temperature Controls
 - 3. Obtain Efficiency Maine Rebates, as per Section 230500.

1.3 SUBMITTALS

- A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.
- B. Operation and Maintenance Data
- C. Schematic drawings for each controlled HVAC system indicating the following:
 - 1. I/O points labeled with point names shown. Indicate instrument range, normal operating set points, and alarm set points. Indicate fail position of each damper and valve, if included in Project.
 - 2. I/O listed in table format showing point name, type of device, manufacturer, model number, and cross-reference to product data sheet number.
 - 3. A graphic showing location of control I/O in proper relationship to HVAC system.
 - 4. Wiring diagram with each I/O point having a unique identification and indicating labels for all wiring terminals.
 - 5. Unique identification of each I/O that shall be consistently used between different drawings showing same point.
 - 6. Elementary wiring diagrams of controls for HVAC equipment motor circuits including interlocks, switches, relays and interface to DDC controllers.
 - 7. Narrative sequence of operation.
- D. Control riser diagram indicating the following:
 - 1. Each device connected to network with unique identification for each.
 - 2. Interconnection of each different network in DDC system.

3. For each network, indicate communication protocol, speed and physical means of interconnecting network devices, such as copper cable type, or fiber-optic cable type. Indicate raceway type and size for each.

E. Warranty: Special warranty specified in this Section.

1.4 QUALITY ASSURANCE

- A. Product Options: Drawings indicate size, profiles, and dimensional requirements of split-system units and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."
- B. All electrical work shall comply with the N.E.C. and local electrical codes.
- C. Energy-Efficiency Ratio: Equal to or greater than prescribed by ASHRAE 90.1, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings."
- D. Coefficient of Performance: Equal to or greater than prescribed by ASHRAE 90.1, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings."
- E. A dry air holding charge shall be provided in the indoor section.
- F. The outdoor unit shall be pre-charged with R-410a refrigerant for 70 feet of refrigerant tubing.

1.5 COORDINATION

- A. Coordinate size and location of concrete bases for units. Cast anchor-bolt inserts into bases. Refer to Section 230500.
- B. Where the mechanical work will be installed in close proximity to, or will interfere with, work of other trades, the contractor shall assist in working out space conditions to make a satisfactory adjustment. If the contractor installs his/her work before coordinating with other trades, so as to cause any interference with work of other trades, the contractor shall make the necessary changes in his/her work to correct the condition.
- C. Coordinate details of telephone line, internet service provider, and associated requirements.
- D. Coordinate and schedule work with all other work in the same area, or with work that is dependent upon other work, to facilitate mutual progress.
- E. Coordinate location of thermostats and other exposed control sensors with plans and room details before installation.
- F. Coordination with controls specified in other sections or divisions. Other sections and/or divisions of this specification include controls and control devices that are to be part of or interfaced to the controls system specified in this section. These controls shall be integrated into the system and coordinated by the contractor.

1.6 WARRANTY

- A. The units shall have a manufacturer's parts and defects warranty for a period five (5) years from date of installation. The compressor shall have an extended warranty of seven (7) years from date of installation. If, during this period, any part should fail to function properly due to defects in workmanship or material, it shall be replaced or repaired at the discretion of the manufacturer. This warranty will not include labor.
- B. Provide remote service diagnostic monitoring from the nearest service location. At the request of the owner, a service diagnostic call will be made to troubleshoot and resolve (if possible) any reported system complaints. The owner will provide a dedicated telephone line for connection to the system.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Mitsubishi
 - 2. Samsung
 - 3. Fujitsu
 - 4. Trane
 - 5. Daikin

2.2 OUTDOOR UNITS

- A. The Mitsubishi MXZ HyperHeat outdoor units shall be specifically designed to work with the manufacturer's family of indoor units. The outdoor unit shall be completely factory assembled, piped and wired. Each unit shall be run tested at the factory prior to shipment.
- B. Systems shall provide 100% heating capacity at 5°F, and heating performance down to -13°F.
- C. Unit Cabinet:
 - 1. The casing shall be fabricated of galvanized steel, bonderized, finished with an electrostatically applied, thermally fused acrylic or polyester powder coating for corrosion protection. Assembly hardware shall be cadmium plated for weather resistance.
 - 2. Cabinet color shall be Munsell 3Y 7.8/1.1.
 - 3. Two (2) mild steel mounting feet, traverse mounted across the cabinet base pan, welded mount, providing four (4) slotted mounting holes shall be furnished. Assembly shall withstand lateral wind gust up to 155 MPH to meet applicable weather codes.
- D. Fan:
 - 1. The unit shall be furnished with a direct drive, high performance propeller type fan.
 - 2. The condenser fan motor shall be a variable speed, direct current (DC) motor and shall have permanently lubricated bearings.

3. Fan speed shall be switch automatically according to the number of operating indoor units and the compressor operating frequency.
4. The fan motor shall be mounted with vibration isolation for quiet operation.
5. The fan shall be provided with a raised guard to prevent contact with moving parts.
6. The outdoor unit shall have horizontal discharge airflow.
7. Outdoor unit sound level shall not exceed 55 dB (A).

E. Coil:

1. The outdoor unit coil shall be of nonferrous construction with lanced or corrugated plate fins on copper tubing.
2. The coil shall be protected with an integral guard.
3. Refrigerant flow from the outdoor unit to the indoor units shall be independently controlled by means of individual electronic linear expansion valves for each indoor unit.
4. Outdoor unit shall be pre-charged with sufficient R-410a refrigerant for up to one hundred and thirty-one (131) feet of refrigerant piping.
5. All refrigerant lines between outdoor and indoor units shall be of annealed, refrigeration grade copper tubing, ARC Type, meeting ASTM B280 requirements, individually insulated in twin-tube, flexible, closed-cell, CFC-free (ozone depletion potential of zero), elastomeric material for the insulation of refrigerant pipes and tubes with thermal conductivity equal to or better than 0.27 BTU-inch/hour per Sq Ft / °F, a water vapor transmission equal to or better than 0.08 Perm-inch and superior fire ratings such that insulation will not contribute significantly to fire and up to 1" thick insulation shall have a Flame-Spread Index of less than 25 and a Smoke-development Index of less than 50 as tested by ASTM E 84 and CAN / ULC S-102.
6. All refrigerant connections between outdoor and indoor units shall be flare type.

F. Compressor:

1. The compressor shall be a high performance, hermetic, inverter driven, variable speed, dual rotary type.
2. The compressor motor shall be direct current (DC) type equipped with a factory supplied and installed inverter drive package.
3. The outdoor unit shall be equipped with a suction side refrigerant accumulator.
4. The compressor will be equipped with an internal thermal overload.
5. The compressor shall be mounted to avoid the transmission of vibration.

G. Branch Boxes:

1. The outdoor unit shall have a 3/8" liquid line connection and a 5/8" gas line connection. Pipe lines running from the outdoor unit shall connect to a 3-port, a 5-port branch box, or a combination of both.
2. The outdoor unit must be connected to at least one branch box. It can also be connected to two 3-port branch boxes, to one 3-port and one 5-port branch box, or to two 5-port branch boxes (At least two ports have to be left unused in this case).
3. The branch boxes shall be installed indoors in an area with a temperature between 67°F and 95°F and a relative humidity of 80% or lower.

H. Piping Requirements: The outdoor unit must have the ability to operate within the following refrigerant piping and height limitations without the need for line size changes, traps or additional oil.

I. Electrical:

1. The unit electrical power shall be 208/230 volts, 1-phase, 60 hertz.
2. The unit shall be capable of satisfactory operation within voltage limits of 187 volts to 253 volts.
3. The outdoor unit shall be controlled by the microprocessors located in the indoor unit and in the outdoor unit communicating system status, operation, and instructions digitally over A-Control – a system directing that the indoor unit be powered directly from the outdoor unit using a 3-wire, 14 gauge AWG connection plus ground.
4. The outdoor unit shall be equipped with Pulse Amplitude Modulation (PAM) compressor inverter drive control for maximum efficiency with minimum power consumption.

2.3 INDOOR UNITS

A. The indoor unit shall be fully factory assembled, wired and run tested prior to shipment. Contained within the indoor unit shall be all factory wiring, piping, control circuit board, fan, and fan motor. The unit shall have a self-diagnostic function, 3-minute restart time delay mechanism, an auto restart function, an emergency / test operation. Indoor unit shall be charged with dry air before shipment from factory.

B. The indoor units shall be capable of working with single-zone or multi-zone outdoor units.

C. Unit Cabinet:

1. The casing shall have a white finish– Munsell 1.0Y 9.2/0.2.
2. Multi directional drain and refrigerant piping, offering three (3) direction pipe alignment for all refrigerant piping and two (2) direction pipe alignment for condensate draining shall be standard.
3. Wall Mounted Units: There shall be a separate back plate that secures the indoor unit firmly to the wall. The installation-plate shall be securely attached to the wall using appropriate anchor method. Installing contractor shall determine the best method and be responsible for proper mounting of the installation plate to the wall.
4. Ceiling Recessed Units: Provide a four-way cassette style indoor unit that recesses into the ceiling with a ceiling grille. The indoor unit shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, electronic modulating linear expansion device, control circuit board and fan motor. The unit shall have a self-diagnostic function, 3-minute time delay mechanism, an auto restart function, an emergency operation function and a test run switch. Indoor unit and refrigerant pipes shall be charged with dehydrated air before shipment from the factory. The cabinet shall be a compact 22-7/16” wide x 22-7/16” deep so it will fit within a standard 24” square suspended ceiling grid. The cabinet panel shall have provisions for a field installed filtered outside air intake. Four-way grille shall be fixed to bottom of cabinet allowing two, three or four-way blow. The unit shall include a condensate lift mechanism that will be able to raise drain water 19” inches above the condensate pan.
5. Horizontal Ducted: The cabinet shall be low profile, ceiling-concealed ducted not to exceed 7-7/8” in depth and equipped with four corner mounting brackets. The unit shall include a condensate lift mechanism that will be able to raise drain water 21” inches above the condensate pan.

D. Fan - Wall Mounted:

1. The indoor unit fan shall be an assembly with a line-flow fan direct driven by a single motor.
2. The fan shall be statically and dynamically balanced and run on a motor with permanently lubricated bearing.
3. A manual adjustable guide vane shall be provided with the ability to change the airflow from side to side (left to right).
4. An integral, motorized, multi-position, horizontal air sweep flow louver shall provide for uniform air distribution, up and down. Five (5) positions plus Auto and Swing shall be provided, controlled from the remote controller.
5. The indoor fan shall operate at one of five (5) speeds: Super High, High, Medium, Low, and Quiet plus Auto Fan Mode for models up to 18,000 BTU/h, and four (4) speeds: Powerful, High, Medium and Low plus Auto Fan Mode for the 24,000 BTU/h model. All speeds shall be selected from the remote controller.

E. Fan – Ceiling Recessed Units:

1. The indoor fan shall be an assembly with a turbo fan direct driven by a single motor.
2. The indoor fan shall be statically and dynamically balanced to run on a motor with permanently lubricated bearings.
3. The indoor fan shall consist of three (3) speeds, Low, Mid, and High.
4. The indoor unit shall have an adjustable air outlet system offering 4-way airflow, 3-way airflow, or 2-way airflow.
5. The auto air swing vanes shall be capable of automatically swinging up and down for uniform air distribution.

F. Fan – Horizontal Ducted Units

1. The indoor unit fan shall be an assembly with Sirocco blowers.
2. The indoor fan shall be statically and dynamically balanced to run on a motor with permanently lubricated bearings.
3. The indoor fan shall consist of three (3) speeds, High, Mid, and Low.
4. The indoor unit shall have a ducted air outlet system and ducted return air system.
5. Provide a return air inlet box with MERV8 filters. Cabinet constructed of non-insulated 20 gauge G-60 galvanized steel; knurled thumb screws on access door allow easy filter replacement. UL 723 foam gasket provides air-tight connection to indoor unit and access. Return connection in rear shall be easily field converted to bottom

G. Coil:

1. The indoor unit coil shall be of nonferrous construction with smooth plate fins on copper tubing.
2. The refrigerant tubing shall have inner grooves for high efficiency heat exchange.
3. All tube joints shall be brazed with PhosCopper or silver alloy.
4. The coils shall be pressure tested at the factory.
5. A sloped, corrosion resistant condensate pan with drain shall be provided under the coil.
6. Provide the optional drain pan level switch (DPLS1), designed to connect to the control board, shall be provided, and installed on the condensate pan to prevent condensate from overflowing.

H. Electrical:

1. The indoor unit electrical power shall be 208 / 230 volts, 1-phase, 60 hertz.
2. The system shall be equipped with A-Control – a system allowing each indoor unit to be powered and controlled directly from the outdoor unit using a 14 gauge (AWG) 3-wire connection plus ground providing both primary power and integrated, bi-directional, digital control signal without additional connections.
3. The indoor units shall not have any supplemental or “back-up” electrical heating elements.

2.4 LINE SETS

- A. PDM Preinsulated Pipes; “Gelcopper”, Mitsubishi Diamondback Linesets; or approved equal.
- B. Polyethylene closed cell foam: assures thermal insulation from surroundings.
 1. ASTM C 1427-07 compliant
 2. Type I (tubular)
 3. Grade I (insulation material for use on typical commercial system non-crosslinked).
 4. Low-density polyethylene foam: closed cells foam, CFC and HCFC gas free
 5. Water vapor permeability: ASTM E96-00 compliant
 6. Working temperature: ASTM C 1427-07 compliant
 7. Wall thickness: 1/2" and 3/4"
 8. Surface burning characteristics: UL 94, top rated – UL 723,
 9. ASTM E84 (25/50) compliant, flame and Spread Index less than 25 and Smoke Development Index less than 50 as tested according to UL 723.
 10. R-Value: between 6.0 and 3.0 (depending on pipe diameter)
- C. Copper
 1. Pipes: Manufactured according to ASTM B280
 2. Copper: No. C122200 DHP (phosphorous deoxidized, high residual phosphorous), 99.90%.
 3. R410a approved.
- D. Outer Jacket: Additional white polyethylene jacket cover protects foam insulation from tearing during installation process. Marking: insulation incrementally marked by every foot to ensure accurate initial unit charge. UV resistant. Paintable: The insulation can be painted to match the surroundings.

2.5 AUTOMATIC TEMPERATURE CONTROLS

- A. Provide all labor, materials, equipment, and service necessary for a complete and operating building automation system. The system shall be furnished by the multi-split manufacturer, basis of design: Mitsubishi.
- B. Provide labor, materials, special tools, equipment, enclosures, power supplies, software, software licenses, project-specific software configurations and database entries, interfaces, wiring, installation, labeling, engineering, calibration, documentation, submittals, testing, verification, training services, permits and licenses, transportation, shipping, handling, administration, supervision, management, insurance, warranty, specified services and items required by the

Contract that are required for the functional turn-key operation of the complete and fully functional Controls Systems. Documents are diagrammatic only. Equipment and labor not specifically referred to herein or on the plans, which are required to meet the functional intent, shall be provided without additional cost to the Owner.

- C. Provide all components in accordance with the manufacturer's recommendations. Perform the installation under the supervision of competent technicians regularly employed in the installation of DDC systems.
- D. Provide equipment, piping, and wiring/raceway parallel to building lines (i.e., horizontal, vertical, and parallel to walls) wherever possible.
- E. Provide sufficient slack and flexible connections to allow for vibration of piping and equipment.
- F. All equipment, installation, and wiring shall comply with acceptable industry specifications and standards for performance, reliability, and compatibility and be executed in strict adherence to local codes and standard practices. Contractor shall continually monitor the field installation for code compliance and quality of workmanship. Contractor shall have work inspected by local and/or state authorities having jurisdiction over the work.
- G. Temperature Sensors: Provide temperature sensors in locations that are accessible and provide a good representation of sensed media. Installations in dead spaces are not acceptable. Calibrate sensors according to manufacturer's instructions. Do not use sensors designed for one application in a different application.
- H. Room Temperature Sensors: Verify location of thermostats and other exposed control sensors with plans and room details before installation. Mount the sensors on interior walls to sense the average room temperature at the locations indicated. Avoid locations near heat sources such as copy machines or locations by supply air outlet drafts. Mount the center of the sensor 48 inches above the floor to meet ADA requirements.
- I. Mitsubishi EB-50GU-A Centralized Controller
 - 1. Manages up to 50 Indoor Units individually, in a group or in a collective batch operation
 - 2. All EB-50GU Centralized Controllers shall be equipped with one RJ-45 Ethernet port to support interconnection with a network PC via a closed/direct Local Area Network (LAN).The EB-50GU Centralized Controller shall be capable of performing initial settings via a PC using the EB-50GU Centralized Controller's initial setting browser.
 - 3. Standard software functions shall be available so that the building manager can securely log into each EB-50GU via the PC's web browser to support operation monitoring, scheduling, error email, interlocking and online maintenance diagnostics. Standard software functions shall not expire.
 - 4. Provide the PAC-SC51KUA Power Supply.
 - 5. Supports dual set point functionality (connected model dependent)
 - 6. Displays:
 - a. CITY MULTI® compressor speed and hi/low pressure
 - b. Advanced HVAC Controller (DC-A2IO) input/output status
 - c. Indoor unit free contact input/output status
 - d. Space Temperature and Humidity
 - e. Error code

- f. Unoccupied setback up temperature range
7. Functions
- a. Hold function (temporarily disables schedules)
 - b. Initial setting
 - c. Operation data back-up
8. Permits or prohibits remote controller functions:
- a. On/Off
 - b. Change Operation Mode
 - c. Change Set point Temperature
 - d. Filter Status
 - e. Change Fan Speed
 - f. Change Air Direction
9. External input/output signals can be used for batch operations such as Start/Stop and Emergency Stop (Requires PAC-YG10HA)
10. Temperature set point range limits can be set for local remote controllers
11. User defined indoor unit functions:
- a. On/Off
 - b. Monitoring and Operation
 - c. Operation mode:
 - 1) Auto (Dual or Single set point)
 - 2) Cool
 - 3) Heat
 - 4) Fan
 - 5) Drying
 - 6) Setback
 - d. Temperature Setting
 - e. Fan Speed
 - f. Airflow Direction
12. Monitoring and Control:
- a. Indoor units
 - b. DIDO controllers
 - c. Interlock setting enables integration of general equipment inputs/outputs and indoor units
13. Scheduling
- a. Daily
 - b. Annually
 - c. Five pattern weekly seasonal schedule
14. Twenty four scheduled events per day, indoor unit model dependent:

- a. ON/OFF
- b. Mode
- c. Temperature Setting
- d. Vane Direction
- e. Fan
- f. Speed
- g. Operation Prohibits

15. Trend data:

- a. Fan operation time
- b. Thermo-on time
- c. Set temperature
- d. Room temperature

J. Digital Input Digital Output (DIDO) Board

1. The DIDO board shall be capable of providing On/Off control for non-Mitsubishi Electric equipment via the Centralized Controller's licensed web browser functions and the TG-2000 software.
2. Each DIDO board shall have two digital inputs and two digital outputs. Each digital output shall be capable of supporting an independent schedule via the Centralized Controller's web browser functions and the TG-2000 software.
3. Status indication of the On/Off state of the non-Mitsubishi Electric equipment shall be either via the On/Off status of the digital output or by receipt of a digital input to the DIDO board.
4. The DIDO board shall be capable of receiving a digital input for interlock settings with the indoor units or digital outputs on the DIDO board. Based on the digital input status the DIDO board shall be capable of setting the following parameter on the indoor unit On/Off, Mode, and Set Temperature to predefined settings. The DIDO board shall also be capable of interlocking the On/Off state of a digital output on the DIDO board based on an onboard channel digital input status or a free contact input status from system indoor units.

K. Advanced HVAC Controller

1. Mitsubishi DC-A2IO, provide quantity as needed.
2. Hardware:
 - a. Digital or Analog Inputs (Sensor data collected in real-time)
 - b. 6 Digital Outputs
 - c. 2 Analog Outputs (provide AL2-2DA)
3. Provide Interlocking of indoor units with third party equipment:
 - a. Heaters
 - b. ERU's

L. Thermostats: Mitsubishi MHK1 remote controller kit.

1. Backlit, easy-to-read display

2. User functions allow user to set:
 - a. On/Off
 - b. Operation modes cool, heat, drying, fan
 - c. Set temperature (separate dual set points for heat and cool)
 - d. Fan speed setting
 - e. Airflow direction
3. Day/Time display with a 12-hour clock
4. Filter sign display
5. Optimal start
6. Adjustable auto deadband
7. Space temperature offset adjustment
8. Hold function
9. Temporary schedule override
10. Reset to factory default
11. Auto lock display
12. Timer Operation:
 - a. Daily Timer: On/Off times can be set up to 4 times per day in 15-minute increments.
 - b. Weekly Timer: On/Off times can be set up to 4 times per day of the week in 15-minute increments. Choice of 5-2 and 5-1-1 weekly schedules for heat, cool, auto (separate for each mode)
 - c. Auto-off Timer: Turns indoor unit Off at scheduled time up to 24 hours in advance
13. Room Temperature: Displays room temperature sensed either at the indoor unit or at the remote controller (default)
14. Set temperature range limits (dependent on the system connected):
 - a. Cooling from 50° to 99°F
 - b. Heating from 40° to 90°F
 - c. Auto from 50° to 90°F with dual temperature setting
15. Diagnostics: Displays and records error codes
16. No addressing required
17. Wiring: Connects using five-conductor cable from MIFH1 Wireless Receiver (cable included) to indoor unit; wireless RF from the MIFH1 Wireless Receiver to the MRCH1 Remote Controller
18. Uses two “AA” alkaline batteries (provide)
19. MIFH1 WIRELESS RECEIVER: Mounts next to or near indoor units to allow MRCH1 Remote Controller operation.
20. MRC1 CABLE: Connects MIFH1 Wireless Receiver to five- pin CN105 on indoor unit control board; Length: 6-1/2'.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Provide units level and plumb.
- B. Roof support framework will be provided to support the bottom of the condensing units 30” minimum above the roof. Anchor units to supports with removable, cadmium-plated fasteners. Coordinate dimensions of this framework.
- C. Provide evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.
- D. Provide and connect pre-charged refrigerant tubing to component's quick-connect fittings. Provide tubing to allow access to unit.
- E. Provide raceways, boxes, and cabinets according to Division 26.
- F. Provide building wire and cable according to Division 26.
- G. Provide signal and communication cable according to Division 26.

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Provide piping adjacent to unit to allow service and maintenance.
- C. Coordinate locations of indoor units with structure, ceiling grid, and other trades – must maintain heat pump manufacturer’s recommended service clearances.
- D. Electrical Connections: Comply with requirements in Electrical Specification Sections for power wiring, switches, and motor controls.
- E. Provide insulated refrigerant piping per heat pump manufacturer’s recommendations. Provide and connect pre-charged refrigerant tubing to component's quick-connect fittings. Provide tubing to allow access to unit. Test and inspect refrigerant piping according to ASME B31.5, Chapter VI.
- F. Route indoor unit condensate drains to sink traps, floor drains, plumbing code compliant, or other locations as indicated.

3.3 SPLIT SYSTEM FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections. Report results in writing.
- B. Perform the following field tests and inspections and prepare test reports:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Remove and replace malfunctioning units and retest as specified above.
- D. Engage a factory-authorized service representative to perform startup service. Complete installation and startup checks according to manufacturer's written instructions.
- E. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain units.
- F. Refer to Division 1 for further requirements.

3.4 CONTROL SYSTEM FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections. Report results in writing.
1. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove and replace malfunctioning units and retest.
 2. Perform initial settings that need to be made on the web browser.
 3. Test and adjust controls and safeties.
 4. Test calibration of controllers by disconnecting input sensors and stimulating operation with compatible signal generator.
 5. Test each point through its full operating range to verify that safety and operating control set points are as required.
 6. Test each control loop to verify stable mode of operation and compliance with sequence of operation. Adjust PID actions.
 7. Test each system for compliance with sequence of operation.
 8. Test software and hardware interlocks.
- B. Check DDC system as follows:
1. Verify that DDC controller power supply is from emergency power supply, if applicable.
 2. Verify that wires at control panels are tagged with their service designation and approved tagging system.
 3. Verify that spare I/O capacity has been provided.
 4. Verify that DDC controllers are protected from power supply surges.
- C. Replace damaged or malfunctioning controls and equipment and repeat testing procedures.
- D. Calibrating and Adjusting:
1. Calibrate instruments.
 2. Make three-point calibration test for both linearity and accuracy for each analog instrument.

3. Calibrate equipment and procedures using manufacturer's written recommendations and instruction manuals. Use test equipment with accuracy at least double that of instrument being calibrated.
 4. Stroke and adjust dampers, following the manufacturer's recommended procedure, so that valve or damper is 100 percent open and closed.
 5. Provide diagnostic and test instruments for calibration and adjustment of system.
- E. Adjust initial temperature set points.
- F. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to three visits to Project during other than normal occupancy hours for this purpose.
- G. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain the system.
- H. Provide a qualified instructor (or instructors) with five years minimum field experience with the installation and programming of similar systems. Orient training to the specific systems installed. Coordinate training times with the Owner. Training shall take place at the job site.
- I. This training shall last 8 hours. Upon completion of the Training, each trainee should fully understand the project's DDC system operation.

3.5 CONTROL SEQUENCES OF OPERATIONS

- A. Ductless Split: Provide temperature controls including occupied and unoccupied setpoints, per the owner defined occupancy schedule. Program and set up the heat pumps and the Mitsubishi central controller.
1. ON/OFF operations.
 2. Temperature settings
 3. Temperature range limit settings.
 4. Operation mode switching
 5. Night setback
 6. Fan Speed
 7. Hold – scheduled operations disabled
 8. Schedule – weekly, annual, today
- B. Energy Recovery Units. Program and set up via the Mitsubishi central controller.
1. The ERU units shall be turned ON and OFF based on a schedule configured by the building operator.
 2. The controls shall modulate the ERU fan speed to provide optimal indoor air quality.
- C. Duct Coils – 238216: Stand-alone electric duct heaters shall operate only during winter conditions. The intent is to temper the ERU airflow to maintain 65°F minimum duct temperature.
- D. Electric Heaters – 238239.19 – Local electric heater shall have standalone wall thermostats.

END OF SECTION 238130

SECTION 238216 - COILS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes electric resistance air coils.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each air coil.
 - 2. Include rated capacities, operating characteristics, and pressure drops for each air coil.
 - 3. Include diagrams for power, signal, and control wiring.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For air coils to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 COILS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. Greenheck
 - 2. Brasch Manufacturing Co., Inc.
 - 3. Chromalox.
 - 4. Dunham-Bush, Inc.
 - 5. INDEECO.
 - 6. Trane.
- B. Approvals - Heaters shall meet the requirements of the National Electrical Code and shall be listed by Underwriters Laboratories for zero spacing between the duct and combustible surfaces and for use with heat pumps and air conditioning equipment.

- C. Heating elements shall be open coil, 80% nickel, 20% chromium, Grade-A resistance wire. Coils shall be machine crimped into stainless steel terminals extending at least 1" into the airstream and all terminal hardware shall be stainless steel. Coils shall be supported by ceramic bushings staked into supporting brackets.
- D. Heater frames and terminal boxes shall be corrosion resistant steel. Unless otherwise indicated, the terminal box shall be NEMA 1 construction and shall be provided with a hinged, latching cover and multiple concentric knockouts for field wiring.
- E. All heaters shall be furnished with a disc type, automatic reset thermal cutout for primary over temperature protection. All heaters shall also be furnished with disc type, load-carrying manual reset thermal cutouts, factory wired in series with heater stages for secondary protection. Heat limiters or other fusible over temperature devices are not acceptable.
- F. Heaters shall be rated for the voltage, phase and number of heating stages indicated in the schedule. All three-phase heaters shall have equal, balanced, three-phase stages. All internal wiring shall be stranded copper with 105°C insulation and shall be terminated in crimped connectors or box lugs.
- G. Terminal blocks shall be provided for all field wiring and shall be sized for installation of 75°C copper wire rated in accordance with NEC requirements.
- H. Heaters shall be furnished either with the Control Option specified in the schedule and described below or with the specific components listed in the schedule.
- I. Controls:
 - 1. Automatic limit switch for primary over temperature protection
 - 2. Manual reset limit switch for secondary over temperature protection
 - 3. Solid state relays are used to provide continuous modulation.
 - 4. Safety magnetic contactors controlled by the automatic reset cutout, for each heater circuit.
 - 5. Fuses to protect each circuit in any heater drawing more than 48 amps.
 - 6. A transformer, with any overcurrent protection required by UL or the NEC, to supply the internal control circuit of 24 volts for SCR control. Wiring to remotely mounted thermostats can be Class II since thermostat circuits are low voltage limited power circuits.
 - 7. A built-in, snap-acting disconnect switch with door interlock to protect service personnel.
 - 8. Power terminal board
 - 9. Control terminal board
- J. Electronic Thermostats:
 - 1. Duct-mounted thermostat shall be microcomputer-based, PI Control
 - 2. Controls heater to maintain adjustable discharge temperature.
 - 3. Range: 50° to 90°F – set at 65°F.
 - 4. Type: Proportional 0-10 VDC
 - 5. For use with SCR controller

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine ducts to receive air coils for compliance with requirements for installation tolerances and other conditions affecting coil performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install coils level and plumb.
- B. Install coils in metal ducts and casings constructed according to SMACNA's "HVAC Duct Construction Standards, Metal and Flexible."
- C. Clean coils using materials and methods recommended in writing by manufacturers, and clean inside of casings and enclosures to remove dust and debris.

3.3 CONNECTIONS

- A. Ground equipment according to Division 26.
- B. Connect wiring according to Division 26.

3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Operational Test: After electrical circuitry has been energized, operate electric coils to confirm proper unit operation.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Prepare test and inspection reports.

END OF SECTION 238216

SECTION 238216.14 - COILS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes electric resistance air coils.
- B. Related Requirements:
 - 1. Section 238216.11 "Hydronic Air Coils."
 - 2. Section 238216.12 "Steam Air Coils."
 - 3. Section 238216.13 "Refrigerant Air Coils."

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each air coil.
 - 2. Include rated capacities, operating characteristics, and pressure drops for each air coil.
- B. Shop Drawings: Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which coil location and ceiling-mounted access panels are shown and coordinated with each other.
- B. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For air coils to include in operation and maintenance manuals.

1.6 FIELD CONDITIONS

- A. Altitude above Mean Sea Level: <Insert feet (m)>.

PART 2 - PRODUCTS

2.1 DESCRIPTION

- A. ASHRAE Compliance: Comply with applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

2.2 COILS

- A. Manufacturers: Subject to compliance with requirements, **[provide products by the following] [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:**
- B. Basis-of-Design Product: Subject to compliance with requirements, provide **[product indicated on Drawings]** <Insert manufacturer's name; product name or designation> or comparable product by one of the following:
1. Brasch Manufacturing Co., Inc.
 2. Chromalox.
 3. Dunham-Bush, Inc.
 4. INDEECO.
 5. Trane.
 6. **<Insert manufacturer's name>.**
- C. Testing Agency Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Coil Assembly: Comply with UL 1995.
- E. Heating Elements: Coiled resistance wire of 80 percent nickel and 20 percent chromium; surrounded by compacted magnesium-oxide powder in tubular-steel sheath; with spiral-wound, copper-plated, steel fins continuously brazed to sheath.
- F. Heating Elements: Open-coil resistance wire of 80 percent nickel and 20 percent chromium, supported and insulated by floating ceramic bushings recessed into casing openings, and fastened to supporting brackets.
- G. High-Temperature Coil Protection: Disk-type, automatically reset, thermal-cutout, safety device; serviceable through terminal box without removing heater from duct or casing.
1. Secondary Protection: Load-carrying, manually reset or manually replaceable, thermal cutouts; factory wired in series with each heater stage.
- H. Frames: Galvanized-steel channel frame, minimum **[0.052 inch (1.3 mm)] [0.064 inch (1.6 mm)] [0.079 inch (2.0 mm)]** thick for **[slip-in] [flanged]** mounting.
- I. Control Panel: **[Unit] [Remote]** mounted with disconnecting means and overcurrent protection. Include the following controls:

1. Magnetic contactor.
 2. Mercury contactor.
 3. Toggle switches; one per step.
 4. Step controller.
 5. Time-delay relay.
 6. Pilot lights; one per step.
 7. Airflow proving switch.
- J. See Section 230900 "Instrumentation and Control for HVAC" for thermostat.
- K. Thermostats: Wall-mounted thermostats, with temperature range from 50 to 90 deg F (10 to 32 deg C), and 2.5 deg F (1.4 deg C) throttling range.
- L. Capacities and Characteristics:
1. Coil Face Dimensions:
 - a. Length: <Insert inches (mm)>.
 - b. Height: <Insert inches (mm)>.
 2. Mounting: [Slip in] [Flanged].
 3. Air Side:
 - a. Flow Rate: <Insert cfm (L/s)>.
 - b. Face Velocity: <Insert fpm (m/s)>.
 - c. Static Pressure Drop: <Insert inches wg (Pa)>.
 - d. Total Capacity: <Insert Btu/h (kW)>.
 - e. Entering Temperature: <Insert deg F (deg C)>.
 - f. Leaving Temperature: <Insert deg F (deg C)>.
 4. Electrical Characteristics:
 - a. Capacity: <Insert kilowatts>.
 - b. Number of Steps: <Insert number>.
 - c. Volts: <Insert value>.
 - d. Phase: <Insert value>.
 - e. Hertz: <Insert value>.
 - f. Full-Load Amperes: <Insert value>.
 - g. Minimum Circuit Ampacity: <Insert value>.
 - h. Maximum Overcurrent Protection: <Insert amperage>.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine ducts, plenums, and casings to receive air coils for compliance with requirements for installation tolerances and other conditions affecting coil performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install coils level and plumb.
- B. Install coils in metal ducts and casings constructed according to SMACNA's "HVAC Duct Construction Standards, Metal and Flexible."
- C. Clean coils using materials and methods recommended in writing by manufacturers, and clean inside of casings and enclosures to remove dust and debris.

3.3 CONNECTIONS

- A. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- B. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections[**with the assistance of a factory-authorized service representative**]:
 - 1. Operational Test: After electrical circuitry has been energized, operate electric coils to confirm proper unit operation.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Prepare test and inspection reports.

END OF SECTION 238216.14

SECTION 238239.19 - WALL AND CEILING UNIT HEATERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes wall and ceiling heaters with propeller fans and electric-resistance heating coils.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include rated capacities, operating characteristics, furnished specialties, and accessories.
 - 2. Include plans, elevations, sections, and details.
 - 3. Wiring Diagrams: Power, signal, and control wiring.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For wall and ceiling unit heaters to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. Indeeco.
 - 2. Berko
 - 3. Chromalox, Inc.
 - 4. Markel
 - 5. Qmark
 - 6. Trane Inc.

2.2 WALL – CEILING HEATERS

- A. The specified heating equipment shall include an electric, fan-forced air ceiling/wall heater suitable for space heating. Basis of Design: Indeeco CCI Series.
- B. The ceiling heater shall be designed for ceiling/wall recess or surface mounting.
- C. Depth of wall opening for wall units: 4-5/16”.
- D. Provide surface mounting box option for surface mounted units.
- E. Provide T-bar adapter for T-bar ceiling mounted units, 23.75” x 23.75”.
- F. Comply with UL 2021 and NFPA 70.
- G. Cabinet
 - 1. Heater Housing shall be constructed from heavy 18gauge steel.
 - 2. Grille shall have a white or almond epoxy/powder paint finish. Grille openings shall be less than 0.25” to discourage tampering with the elements (pencil-proof).
- H. Coil: Heater Element shall be of finned tubular type.
- I. Fan and motor
 - 1. Motor shall be thermally protected and have permanently lubricated ball bearings.
 - 2. Fan shall operate at 160 CFM minimum.
 - 3. Fan Over-ride shall purge heater of residual heat to prevent an over heat condition.
 - 4. Thermal Cutout shall be of the bi-metal type and built into the system.
- J. Controls
 - 1. Controls: Adjustable built-in thermostat.
 - 2. Electrical Connection: Provide a factory disconnect switch.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive wall and ceiling unit heaters for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for electrical connections to verify actual locations before unit-heater installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install wall and ceiling unit heaters to comply with NFPA 90A.
- B. Install wall and ceiling unit heaters level and plumb.
- C. Install wall-mounted thermostats and switch controls in electrical outlet boxes at heights to match lighting controls. Verify location of thermostats and other exposed control sensors with Drawings and room details before installation.
- D. Ground equipment according to Division 26.
- E. Connect wiring according to Division 26.

END OF SECTION 238239.19

SECTION 260100 - BASIC ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. General requirements applicable to all Division 26 sections.
 - 2. Allowances for Utility Construction Charges

1.3 TEMPORARY POWER AND LIGHTING

- A. Provide a separately metered temporary electrical service for the construction area.
- B. Power Distribution: Provide weatherproof, grounded circuits with ground-fault interruption features, with proper power characteristics and either permanently wired or plug-in connections as appropriate for intended use. Provide overload-protected disconnect switch for each circuit at distribution panel. Space 4-gang convenience outlets (20 amp circuit) so that every portion of work can be reached with 100' extension cord.
- C. Temporary Lighting: Provide lighting of intensity and quality sufficient for proper and safe performance of the work and for access thereto and security thereof, minimum average illumination level in every room shall be 20 footcandles.

1.4 ALLOWANCES FOR UTILITY CONSTRUCTION CHARGES

- A. Provide a \$25,000 allowance as specified in Division 01 for electric utility company utility construction charges associated with the electric service.
- B. Provide a \$10,000 allowance as specified in Division 01 for communications utility company utility construction charges associated with the project.

1.5 GENERAL REQUIREMENTS APPLICABLE TO ALL DIVISION 26 SECTIONS

- A. Regulatory Requirements:
 - 1. Conform to the requirements of all laws and regulations applicable to the work.
 - 2. Conform to the requirements of Federal State and Municipal Building Codes.
 - 3. Cooperate with all authorities having jurisdiction.

4. Compliance with laws and regulations governing the work on this project does not relieve the Contractor from compliance with more restrictive requirements contained in these specifications.
5. If the Contract Documents are found to be at variance with any law or regulation, the Contractor shall notify the Architect/Engineer promptly in writing. The Contractor shall assume full responsibility for any work contrary to law or regulation, and shall bear all costs for the corrections thereof.
6. Minimum Requirements: The more stringent of the 2014 National Electrical Code (NEC) or the edition enforced by the local Authority Having Jurisdiction, Underwriters Laboratories, Inc. (UL), the National Fire Codes, and National Fire Protection Association (NFPA) are a minimum requirement for work under this section. Design drawings and other specification sections shall govern in those instances where requirements are greater than those required by code.

B. REFERENCES

1. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
 - a. National Fire Protection Association (NFPA).
 - b. National Electrical Code (NEC)
 - c. National Electrical Safety Code (NESC)
 - d. Underwriters Laboratories, Inc. (UL)
 - e. American National Standards Institute (ANSI)
 - f. Certified Ballast Manufacturers Association (CBM)
 - g. National Electrical Manufacturers Association (NEMA)
 - h. International Municipal Signal Association (IMSA)
 - i. Institute of Electrical and Electronic Engineers (IEEE)
 - j. American Society for Testing Materials Specifications (ASTM)
 - k. National Bureau of Standards Handbook (NBS)
 - l. Occupational Safety and Health Administration (OSHA)
 - m. Americans with Disabilities Act (ADA)
 - n. Insulated Power Cable Engineers Association Specifications (IPCEA)

C. Permits, Fees, and Inspections:

1. Secure and pay for all permits, fees, licenses, inspections, etc., required for the work under Division 26.
2. Schedule and pay for all legally required inspections and cooperate with inspecting officers.
3. Provide Certificates of Inspection and Approval from all regulatory authorities having jurisdiction over the work in Division 26.

D. The Contractor shall study all drawings and specifications and acquaint itself with the existing conditions and the requirements of the plans and specifications. No claim will be recognized for extra compensation due to the failure of the Contractor to familiarize itself with the conditions and extent of the proposed work.

E. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.

- F. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.

1.6 EFFICIENCY MAINE

- A. This project intends to pursue Efficient Maine (EM) prescriptive and/or custom incentives. The contractor shall participate in the activities associated with Efficiency Maine incentive approval process including but not limited to; preparation and submission of required incentive application(s) and the tracking and submission of measure specific invoices to Efficiency Maine within 60 days of the completion of the work.
- B. The contractor shall also:
 - 1. Become familiar with the Efficiency Maine Business Program including available incentives and the application and review process.
 - 2. Review plans and specifications for any and all incentive opportunities, prescriptive and custom.
- C. The project schedule shall reflect and accommodate the time required to achieve application preapproval from EM. No equipment shall be purchased until preapproval is received from EM.
- D. All invoices shall be forwarded to EM within 60 days of the completion of work. This deliverable shall be shown on the project schedule as a milestone date and coordinated with all contractors to assure compliance with this requirement.
- E. Efficiency Maine is available to assist in the application process and can be reached at 866-376-2463

1.7 COORDINATION

- A. Provide coordination drawings in accordance with Division 01.
- B. Coordinate the work of Division 26 with other Divisions, the Owner, and utility companies.
- C. Coordinate arrangement, mounting, and support of electrical equipment:
 - 1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
 - 2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
 - 3. To allow right of way for piping and conduit installed at required slope.
 - 4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.
- D. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

- E. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 08.
- F. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07.

PART 2 - PRODUCTS – Not Used

PART 3 - EXECUTION – Not Used

END OF SECTION 260100

SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Building wires and cables rated 600 V and less.
 - 2. Connectors, splices, and terminations rated 600 V and less.
- B. Related Sections include the following:
 - 1. Division 26 Section "Conductors and Cables for Electronic Safety and Security" for cabling used for electronic safety and security systems.
 - 2. Division 27 for cabling used for voice and data circuits.

1.3 DEFINITIONS

- A. EPDM: Ethylene-propylene-diene terpolymer rubber.
- B. NBR: Acrylonitrile-butadiene rubber.

1.4 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the International Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Alcan Products Corporation; Alcan Cable Division.
 2. American Insulated Wire Corp.; a Leviton Company.
 3. General Cable Corporation.
 4. Senator Wire & Cable Company.
 5. Southwire Company.
- B. Aluminum and Copper Conductors: Comply with NEMA WC 70.
- C. Conductor Insulation: Comply with NEMA WC 70
- D. Multiconductor Cable: Comply with NEMA WC 70 for metal-clad cable, Type MC
- E. Power-limited cable: Type CMP for plenum applications, type CMR for non-plenum applications.

2.2 CONNECTORS AND SPLICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. AFC Cable Systems, Inc.
 2. Hubbell Power Systems, Inc.
 3. O-Z/Gedney; EGS Electrical Group LLC.
 4. 3M; Electrical Products Division.
 5. Tyco Electronics Corp.
- B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Copper for feeders smaller than No. 4 AWG; copper or aluminum for feeders No. 4 AWG and larger. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
1. Use copper for all sizes where required by manufacturer's instructions for equipment supplied by feeders.

- B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Exposed Feeders: Type THHN-THWN, single conductors in raceway
- B. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type THHN-THWN, single conductors in raceway
- C. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway
- D. Exposed Branch Circuits: Type THHN-THWN, single conductors in raceway
- E. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN, single conductors in raceway or metal-clad cable, Type MC
- F. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway
- G. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.
- H. Class 1 Control Circuits: Type THHN-THWN, in raceway. Type MC cable shall be permitted where concealed in building finishes.
- I. Class 2 Control Circuits: Type THHN-THWN, in raceway

3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.
- B. 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.
- C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- E. Support cables according to Division 26 Section "Hangers and Supports for Electrical Systems."
- F. Identify and color-code conductors and cables according to Division 26 Section "Identification for Electrical Systems."

3.4 CONNECTIONS

- A. 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.
- B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
 - 1. Use oxide inhibitor in each splice and tap conductor for aluminum conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least **12 inches** of slack.

3.5 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Division 26 Section "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.6 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Division 07 Section "Penetration Firestopping."

3.7 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
- B. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
- C. Test Reports: Prepare a written report to record the following:
 - 1. Test procedures used.
 - 2. Test results that comply with requirements.
 - 3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.
- D. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION 260519

SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes grounding and bonding systems and equipment, plus the following special applications:
 - 1. Foundation steel electrodes.

1.3 ACTION SUBMITTALS

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

1.4 INFORMATIONAL SUBMITTALS

- A. As-Built Data: Plans showing dimensioned as-built locations of grounding features specified in "Field Quality Control" Article, including the following:
 - 1. Test wells.
 - 2. Ground rods.
 - 3. Grounding arrangements and connections for separately derived systems.
- B. Qualification Data: For testing agency and testing agency's field supervisor.
- C. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Certified by NETA.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. 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:

1. [Burndy; Part of Hubbell Electrical Systems.](#)
2. [ERICO International Corporation.](#)
3. [ILSCO.](#)
4. [O-Z/Gedney; a brand of Emerson Industrial Automation.](#)
5. [Thomas & Betts Corporation; A Member of the ABB Group.](#)

2.2 SYSTEM DESCRIPTION

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with UL 467 for grounding and bonding materials and equipment.

2.3 CONDUCTORS

- A. Insulated Conductors: Copper or tinned-copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:
 1. Solid Conductors: ASTM B 3.
 2. Stranded Conductors: ASTM B 8.
 3. Tinned Conductors: ASTM B 33.
 4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, **1/4 inch (6 mm)** in diameter.
 5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
 6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; **1-5/8 inches (41 mm)** wide and **1/16 inch (1.6 mm)** thick.
 7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; **1-5/8 inches (41 mm)** wide and **1/16 inch (1.6 mm)** thick.
- C. Grounding Bus: Predrilled rectangular bars of annealed copper, **1/4 by 4 inches (6.3 by 100 mm)** in cross section, not less than 12 inches long, with **9/32-inch (7.14-mm)** holes spaced **1-1/8 inches (28 mm)** apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V and shall be Lexan or PVC, impulse tested at 5000 V.

2.4 CONNECTORS

- A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.
- B. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.
- C. Bus-Bar Connectors: Compression type, copper or copper alloy, with two wire terminals.

- D. Beam Clamps: Mechanical type, terminal, ground wire access from four directions, with dual, tin-plated or silicon bronze bolts.
- E. Cable-to-Cable Connectors: Compression type, copper or copper alloy.
- F. Cable Tray Ground Clamp: Mechanical type, zinc-plated malleable iron.
- G. Conduit Hubs: Mechanical type, terminal with threaded hub.
- H. Ground Rod Clamps: Mechanical type, copper or copper alloy, terminal with hex head bolt.
- I. Lay-in Lug Connector: Mechanical type, copper rated for direct burial terminal with set screw.
- J. Service Post Connectors: Mechanical type, bronze alloy terminal, in short- and long-stud lengths, capable of single and double conductor connections.
- K. Straps: Solid copper, cast-bronze clamp. Rated for 600 A.
- L. U-Bolt Clamps: Mechanical type, copper or copper alloy, terminal listed for direct burial.
- M. Water Pipe Clamps:
 - 1. Mechanical type, two pieces with zinc-plated bolts.
 - a. Material: Tin-plated aluminum.
 - b. Listed for direct burial.
 - 2. U-bolt type with malleable-iron clamp and copper ground connector.

2.5 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel; **3/4 inch by 10 feet (19 mm by 3 m)**.

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Conductors: Install solid or stranded conductor for No. 10 AWG and smaller, and stranded conductors for No. 8 AWG and larger unless otherwise indicated.
- B. Underground Grounding Conductors: Install barecopper conductor, No. 2/0 AWG minimum.
 - 1. Bury at least **24 inches (600 mm)** below grade.
- C. Grounding Bus: Install in electrical equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
 - 1. Install bus horizontally, on insulated spacers **2 inches (50 mm)** minimum from wall, **6 inches (150 mm)** above finished floor unless otherwise indicated.

D. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
3. Connections to Ground Rods at Test Wells: Bolted connectors.
4. Connections to Structural Steel: Welded connectors.

3.2 GROUNDING AT THE SERVICE

- A. Equipment grounding conductors and grounding electrode conductors shall be connected to the ground bus. Install a main bonding jumper between the neutral and ground buses.

3.3 GROUNDING SEPARATELY DERIVED SYSTEMS

- A. Transformers: Comply with NEC 250.

3.4 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

- A. Comply with utility company grounding requirements.
- B. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches (100 mm) will extend above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches (50 mm) above to 6 inches (150 mm) below concrete. Seal floor opening with waterproof, nonshrink grout.
- C. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, stranded, hard-drawn copper bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields according to written instructions by manufacturer of splicing and termination kits.

3.5 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.
- B. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.

- C. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.
- D. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate insulated equipment grounding conductor. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.
- E. Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

3.6 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Ground Rods: Drive rods until tops are **2 inches (50 mm)** below finished floor or final grade unless otherwise indicated.
 - 1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
 - 2. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.
- C. Test Wells: Ground rod driven through drilled hole in bottom of handhole. Handholes are specified in Section 260543 "Underground Ducts and Raceways for Electrical Systems," and shall be at least **12 inches (300 mm)** deep, with cover.
 - 1. Install at least one test well for each service unless otherwise indicated. Install at the ground rod electrically closest to service entrance. Set top of test well flush with finished grade or floor.
- D. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.
 - 1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
 - 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
 - 3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.
- E. Grounding and Bonding for Piping:

1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
 2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
 3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.
- F. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install bonding jumper to bond across flexible duct connections to achieve continuity.
- G. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than **60 feet (18 m)** apart.
- H. Concrete-Encased Grounding Electrode (Ufer Ground): Provide using one of the following methods:
1. Fabricate according to NFPA 70; use a minimum of **20 feet (6 m)** of bare copper conductor not smaller than No. 4 AWG.
 - a. If concrete foundation is less than **20 feet (6 m)** long, coil excess conductor within base of foundation.
 - b. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building's grounding grid or to grounding electrode external to concrete.
 2. Concrete-Encased Grounding Electrode (Ufer Ground): Fabricate according to NFPA 70; using electrically conductive coated steel reinforcing bars or rods, at least **20 feet (6.0 m)** long. If reinforcing is in multiple pieces, connect together by the usual steel tie wires or exothermic welding to create the required length.

3.7 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Tests and Inspections:
1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
 2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
 3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, at ground test wells. Make tests at ground rods before any conductors are connected.

- a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
 - b. Perform tests by fall-of-potential method according to IEEE 81.
4. Prepare dimensioned Drawings locating each test well, ground rod and ground-rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.
- C. Grounding system will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.
- E. Report measured ground resistances that exceed the following values:
1. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 10 ohms.
 2. Power and Lighting Equipment or System with Capacity of 500 to 1000 kVA: 5 ohms.
- F. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION 260526

SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Hangers and supports for electrical equipment and systems.
 - 2. Construction requirements for concrete bases.
- B. Related Sections include the following:
 - 1. Division 26 Section "Vibration And Seismic Controls For Electrical Systems" for products and installation requirements necessary for compliance with seismic criteria.

1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. IMC: Intermediate metal conduit.
- C. RMC: Rigid metal conduit.

1.4 PERFORMANCE REQUIREMENTS

- A. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.
- B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- C. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of 5 times the applied force.

1.5 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

- B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
 - 1. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
 - 2. Fittings and Accessories: Products of channel and angle manufacturer and designed for use with those items.
 - 3. Fitting and Accessory Materials: Same as channels and angles
 - 4. Rated Strength: Selected to suit applicable load criteria.
- B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.
- C. Conduit and Cable Support Devices: steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.
- E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
 - 1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
 - 2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc coated steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
 - 3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
 - 4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
 - 5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
 - 6. Toggle Bolts: All-steel springhead type.
 - 7. Hanger Rods: Threaded steel.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.
- B. Materials: Comply with requirements in Division 05 Section "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.
- B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be **1/4 inch (6 mm)** in diameter.
- C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
 - 1. Secure raceways and cables to these supports with two-bolt conduit clamps.

3.2 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.
- B. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus **200 lb (90 kg)**.
- C. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
 - 1. To Wood: Fasten with lag screws or through bolts.
 - 2. To New Concrete: Bolt to concrete inserts.
 - 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
 - 4. To Existing Concrete: Expansion anchor fasteners.
 - 5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete **4 inches (100 mm)** thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than **4 inches (100 mm)** thick.

6. To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts.
 7. To Light Steel: Sheet metal screws.
 8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that meet seismic-restraint strength and anchorage requirements.
- D. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Comply with installation requirements in Division 05 Section "Metal Fabrications" for site-fabricated metal supports.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- C. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 PAINTING

- A. Touchup: Comply with requirements in Division 09 painting Sections for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 260529

SECTION 260533 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Metal conduits, tubing, and fittings.
 - 2. Metal wireways and auxiliary gutters.
 - 3. Surface raceways.
 - 4. Cable trays.
 - 5. Boxes, enclosures, and cabinets.

1.3 DEFINITIONS

- A. ARC: Aluminum rigid conduit.
- B. GRC: Galvanized rigid steel conduit.
- C. IMC: Intermediate metal conduit.

1.4 ACTION SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

1.5 INFORMATIONAL SUBMITTALS

- A. Source quality-control reports.

PART 2 - PRODUCTS

2.1 METAL CONDUITS, TUBING, AND FITTINGS

- A. **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:

1. [AFC Cable Systems, Inc.](#)
 2. [Allied Tube & Conduit; a Tyco International Ltd. Co.](#)
 3. [Anamet Electrical, Inc.](#)
 4. [Electri-Flex Company.](#)
 5. [O-Z/Gedney; a brand of EGS Electrical Group.](#)
 6. [Southwire Company.](#)
 7. [Thomas & Betts Corporation.](#)
 8. [Wheatland Tube Company; a division of John Maneely Company.](#)
- B. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. GRC: Comply with ANSI C80.1 and UL 6.
- D. ARC: Comply with ANSI C80.5 and UL 6A.
- E. IMC: Comply with ANSI C80.6 and UL 1242.
- F. EMT: Comply with ANSI C80.3 and UL 797.
- G. FMC: Comply with UL 1; zinc-coated steel or aluminum.
- H. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.
- I. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.
1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886 and NFPA 70.
 2. Fittings for EMT:
 - a. Material: Steel.
 - b. Type: Setscrew or compression.
 3. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.

2.2 METAL WIREWAYS AND AUXILIARY GUTTERS

- A. [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:
1. [Cooper B-Line, Inc.](#)
 2. [Hoffman; a Pentair company.](#)
 3. [Square D; a brand of Schneider Electric.](#)
- B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1 unless otherwise indicated, and sized according to NFPA 70.

- C. Fittings and Accessories: Include covers, 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.
- D. Wireway Covers: Screw-cover type unless otherwise indicated.
- E. Finish: Manufacturer's standard enamel finish.

2.3 SURFACE METAL RACEWAYS

- A. Listing and Labeling: Surface raceways shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Surface Metal Raceways: Galvanized steel with snap-on covers complying with UL 5. Manufacturer's standard enamel finish in color selected by Architect.
 - 1. Basis of design is Wiremold 4000 series.

2.4 CABLE TRAYS

- A. General Requirements for Cable Trays
 - 1. Cable Trays and Accessories: Identified as defined in NFPA 70 and marked for intended location, application, and grounding.
 - a. Source Limitations: Obtain cable trays and components from single manufacturer.
 - 2. Structural Performance: See individual cable tray types for specific values for the following parameters:
 - a. Uniform Load Distribution: Capable of supporting a uniformly distributed load on the indicated support span when supported as a simple span and tested according to NEMA VE 1.
 - b. Concentrated Load: A load applied at midpoint of span and centerline of tray.
 - 1) Load and Safety Factors: Applicable to both side rails and rung capacities.

2.5 WIRE-BASKET CABLE TRAYS

- A. 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:
 - 1. Cooper B-Line, Inc.
 - 2. Allied Tube & Conduit; a Tyco International Ltd. Co.
 - 3. Mono-Systems, Inc.
 - 4. MP Husky.

B. Description:

1. Configuration: Wires are formed into a standard **2-by-4-inch (50-by-100-mm)** wire mesh pattern with intersecting wires welded together. Mesh sections must have at least one bottom longitudinal wire along entire length of section.
2. Materials: High-strength-steel longitudinal wires with no bends.
3. Safety Provisions: Wire ends along wire-basket sides (flanges) rounded during manufacturing to maintain integrity of cables and installer safety.
4. Sizes:
 - a. Straight sections shall be furnished in standard **118-inch (3000-mm)** lengths.
 - b. Wire-Basket Depth: **2-inch (50-mm)** usable loading depth by **12 inches (300 mm)** wide.
5. Connector Assemblies: Bolt welded to plate shaped to fit around adjoining tray wires and mating plate. Mechanically joins adjacent tray wires to splice sections together or to create horizontal fittings.
6. Connector Assembly Capacity: Splices located within support span shall not diminish rated loading capacity of cable tray.
7. Hardware and Fasteners: Steel, zinc plated according to ASTM B 633.

2.6 BOXES, ENCLOSURES, AND CABINETS

- A. **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:
 1. [O-Z/Gedney; a brand of EGS Electrical Group.](#)
 2. [RACO; a Hubbell Company.](#)
 3. [Thomas & Betts Corporation.](#)
 4. [Wiremold / Legrand.](#)
- B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.
- C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
- D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, aluminum, Type FD, with gasketed cover.
- E. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing **50 lb (23 kg)**. Outlet boxes designed for attachment of luminaires weighing more than **50 lb (23 kg)** shall be listed and marked for the maximum allowable weight.
- F. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- G. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum with gasketed cover.
- H. Box extensions used to accommodate new building finishes shall be of same material as recessed box.

- I. Device Box Dimensions: 4 inches square by 2-1/8 inches deep (100 mm square by 60 mm deep).
- J. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 with continuous-hinge cover with flush latch unless otherwise indicated.
 - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
 - 2. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.
- K. Cabinets:
 - 1. NEMA 250, Type 1 unless otherwise noted galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
 - 2. Hinged door in front cover with flush latch and concealed hinge.
 - 3. Key latch to match panelboards.
 - 4. Metal barriers to separate wiring of different systems and voltage.
 - 5. Accessory feet where required for freestanding equipment.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

- A. Indoors: Apply raceway products as specified below unless otherwise indicated:
 - 1. Exposed, Not Subject to Physical Damage: EMT.
 - 2. Exposed and Subject to Severe Physical Damage: GRC or IMC. Raceway locations include the following:
 - a. Loading dock.
 - b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
 - 3. Concealed in Ceilings and Interior Walls and Partitions: EMT.
 - 4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
 - 5. Damp or Wet Locations: GRC or IMC.
 - 6. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel in institutional and commercial kitchens and damp or wet locations.
- B. Minimum Raceway Size: [1/2-inch (16-mm)] [3/4-inch (21-mm)] trade size.
- C. Raceway Fittings: Compatible with raceways and suitable for use and location.
 - 1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
 - 2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.

3. EMT: Use setscrew or compression, steel fittings. Comply with NEMA FB 2.10.
4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

D. Install surface raceways only where indicated on Drawings.

3.2 INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.
- B. 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.
- C. Complete raceway installation before starting conductor installation.
- D. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.
- E. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- F. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within **12 inches (300 mm)** of changes in direction.
- G. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- H. Support conduit within **12 inches (300 mm)** of enclosures to which attached.
- I. Stub-ups to Above Recessed Ceilings:
 1. Use EMT, IMC, or RMC for raceways.
 2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
- J. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- K. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to **1-1/4-inch (35mm)** trade size and insulated throat metal bushings on **1-1/2-inch (41-mm)** trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.
- L. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.

- M. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.
- N. Cut conduit perpendicular to the length. For conduits **2-inch (53-mm)** trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.
- O. Install pull wires in empty raceways. Use polypropylene 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 pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.
- P. Surface Raceways:
1. Install surface raceway with a minimum **2-inch (50-mm)** radius control at bend points.
 2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding **48 inches (1200 mm)** and with no less than two supports per straight raceway section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.
- Q. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with 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 according to NFPA 70.
- R. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:
1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 2. Where an underground service raceway enters a building or structure.
 3. Where otherwise required by NFPA 70.
- S. Comply with manufacturer's written instructions for solvent welding RNC and fittings.
- T. Expansion-Joint Fittings:
1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed **30 deg F (17 deg C)** and that has straight-run length that exceeds **25 feet (7.6 m)**. Install in each run of aboveground RMC and EMT conduit that is located where environmental temperature change may exceed **100 deg F (55 deg C)** and that has straight-run length that exceeds **100 feet (30 m)**.
 2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
 - a. Outdoor Locations Not Exposed to Direct Sunlight: **125 deg F (70 deg C)** temperature change.
 - b. Outdoor Locations Exposed to Direct Sunlight: **155 deg F (86 deg C)** temperature change.
 - c. Indoor Spaces Connected with Outdoors without Physical Separation: **125 deg F (70 deg C)** temperature change.

3. Install fitting(s) that provide expansion and contraction for at least **0.00041 inch per foot of length of straight run per deg F** (**0.06 mm per meter of length of straight run per deg C**) of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least **0.000078 inch per foot of length of straight run per deg F** (**0.0115 mm per meter of length of straight run per deg C**) of temperature change for metal conduits.
 4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
 5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.
- U. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of **72 inches (1830 mm)** of flexible conduit for recessed and semirecessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
1. Use LFMC in damp or wet locations.

V. CABLE TRAY INSTALLATION

1. Install cable trays according to NEMA VE 2.
2. Install cable trays as a complete system, including fasteners, hold-down clips, support systems, barrier strips, adjustable horizontal and vertical splice plates, elbows, reducers, tees, crosses, cable dropouts, adapters, covers, and bonding.
3. Install cable trays so that the tray is accessible for cable installation and all splices are accessible for inspection and adjustment.
4. Remove burrs and sharp edges from cable trays.
5. Fasten cable tray supports to building structure and install seismic restraints.
6. Design fasteners and supports to carry cable tray, the cables, and a concentrated load of **200 lb (90 kg)**. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems." Comply with seismic-restraint details according to Section 260548 "Vibration and Seismic Controls for Electrical Systems."
7. Place supports so that spans do not exceed maximum spans on schedules and provide clearances shown on Drawings. Install intermediate supports when cable weight exceeds the load-carrying capacity of the tray rungs.
8. Construct supports from channel members, threaded rods, and other appurtenances furnished by cable tray manufacturer. Arrange supports in trapeze or wall-bracket form as required by application.
9. Support bus assembly to prevent twisting from eccentric loading.
10. Locate and install supports according to NEMA VE 2. Do not install more than one cable tray splice between supports.
11. Support wire-basket cable trays with trapeze hangers.
12. Support trapeze hangers for wire-basket trays with **3/8-inch- (10-mm-)** diameter rods.
13. Install expansion connectors where cable trays cross building expansion joints and in cable tray runs that exceed dimensions recommended in NEMA VE 2. Space connectors and set gaps according to applicable standard.
14. Make changes in direction and elevation using manufacturer's recommended fittings.
15. Make cable tray connections using manufacturer's recommended fittings.
16. Seal penetrations through fire and smoke barriers. Comply with requirements in Division 07
17. Install cable trays with enough workspace to permit access for installing cables.

W. CABLE TRAY GROUNDING

1. Ground cable trays according to NFPA 70 unless additional grounding is specified. Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."
2. Cable trays with communications cable shall be bonded together with splice plates listed for grounding purposes or with listed bonding jumpers.
3. When using epoxy- or powder-coat painted cable trays as a grounding conductor, completely remove coating at all splice contact points or ground connector attachment. After completing splice-to-grounding bolt attachment, repair the coated surfaces with coating materials recommended by cable tray manufacturer.

X. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.

Y. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.

Z. Locate boxes so that cover or plate will not span different building finishes.

AA. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.

BB. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

3.3 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.4 FIRESTOPPING

A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Division 07.

3.5 PROTECTION

A. Protect coatings, finishes, and cabinets from damage and deterioration.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.

END OF SECTION 260533

SECTION 260544 - SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Sleeves for raceway and cable penetration of non-fire-rated construction walls and floors.
2. Sleeve-seal systems.
3. Sleeve-seal fittings.
4. Grout.
5. Silicone sealants.

B. Related Requirements:

1. Division 07 for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

1.3 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.1 SLEEVES

A. Wall Sleeves:

1. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, plain ends.
2. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

- B. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies: Galvanized-steel sheet; 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.

C. Sleeves for Rectangular Openings:

1. Material: Galvanized sheet steel.
2. Minimum Metal Thickness:
 - a. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and with no side larger than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
 - b. For sleeve cross-section rectangle perimeter 50 inches (1270 mm) or more and one or more sides larger than 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

2.2 SLEEVE-SEAL SYSTEMS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.

1. Subject to compliance with requirements, provide a product by one of the following or approved equal:
 - a. Advance Products & Systems, Inc.
 - b. CALPICO, Inc.
 - c. Metraflex Company (The).
 - d. Pipeline Seal and Insulator, Inc.
 - e. Proco Products, Inc.
2. Sealing Elements: EPDM rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
3. Pressure Plates: Carbon steel
4. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating of length required to secure pressure plates to sealing elements.

2.3 SLEEVE-SEAL FITTINGS

A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit shall have plastic or rubber waterstop collar with center opening to match piping OD.

2.4 GROUT

- A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.
- B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- C. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

- D. Packaging: Premixed and factory packaged.

2.5 SILICONE SEALANTS

- A. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.
 - 1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.
 - 2. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- B. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

- A. Comply with NECA 1.
- B. Comply with NEMA VE 2 for cable tray and cable penetrations.
- C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:
 - 1. Interior Penetrations of Non-Fire-Rated Walls and Floors:
 - a. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants."
 - b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.
 - 2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
 - 3. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and raceway or cable unless sleeve seal is to be installed or unless seismic criteria require different clearance.
 - 4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
 - 5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level. Install sleeves during erection of floors.
- D. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:

1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
 2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.
- E. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- F. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.
- B. Install type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.3 SLEEVE-SEAL-FITTING INSTALLATION

- A. Install sleeve-seal fittings in new walls and slabs as they are constructed.
- B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.
- C. Secure nailing flanges to concrete forms.
- D. Using grout, seal the space around outside of sleeve-seal fittings.

END OF SECTION 260544

SECTION 260548 - VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:

1. Isolation pads.
2. Spring isolators.
3. Restrained spring isolators.
4. Channel support systems.
5. Restraint cables.
6. Hanger rod stiffeners.
7. Anchorage bushings and washers.

- B. Related Sections include the following:

1. Section 260529 "Hangers and Supports for Electrical Systems" for commonly used electrical supports and installation requirements.

1.3 DEFINITIONS

- A. The IBC: International Building Code.
- B. ICC-ES: ICC-Evaluation Service.

1.4 PERFORMANCE REQUIREMENTS

- A. NOTE: This information is copied from Structural Drawing S000 dated 03/14/2014.

- B. Building Code

1. Maine Uniform Building And Energy Code
2. International Building Code, 2009 Edition
3. International Existing Building Code, 2009 Edition
4. ASCE 7-05 Minimum Design Loads For Buildings And Other Structures

- C. Wind-Restraint Loading (outdoor equipment):

1. Basic Wind Speed: 100 Mph

2. Wind Load Importance Factor (I_w): 1.15
3. Wind Exposure: B
4. Internal Pressure Coefficient: +/-0.18

D. Design Seismic Loading:

1. Equivalent Lateral Force Procedure
2. Seismic Use Group III
3. Seismic Importance Factor (I_e): 1.25
4. Mapped Spectral Response Accelerations:
 - a. S_s : 0.346
 - b. S_1 : 0.079
5. Seismic Site Class: C
6. Spectral Response Coefficients:
 - a. S_{ds} : 0.277
 - b. S_{d1} : 0.090
7. Seismic Design Category: B
8. Importance Factor (I_p): A factor assigned to each structure according to its occupancy category as prescribed in Section 11.5.1 of ASCE/SEI 7-05. The following components are $I_p = 1.5$:
 - a. Fire alarm system
 - b. Generator and emergency power distribution system.

1.5 ACTION SUBMITTALS

A. Product Data: For the following:

1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.
 - a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an agency acceptable to authorities having jurisdiction.
 - b. Annotate to indicate application of each product submitted and compliance with requirements.
3. Restrained-Isolation Devices: Include ratings for horizontal, vertical, and combined loads.

B. Delegated-Design Submittal: For vibration isolation and seismic-restraint details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, seismic forces required to select vibration isolators and seismic restraints.
 - a. Coordinate design calculations with wind-load calculations required for equipment mounted outdoors. Comply with requirements in other electrical Sections for equipment mounted outdoors.
2. Indicate materials and dimensions and identify hardware, including attachment and anchorage devices.
3. Field-fabricated supports.
4. Seismic-Restraint Details:
 - a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
 - b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
 - c. Preapproval and Evaluation Documentation: By an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

1.6 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Show coordination of seismic bracing for electrical components with other systems and equipment in the vicinity, including other supports and seismic restraints.
- B. Qualification Data: For professional engineer.
- C. Welding certificates.
- D. Field quality-control test reports.

1.7 QUALITY ASSURANCE

- A. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.
- B. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- C. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproval by ICC-ES, or preapproval by 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 preapproved 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.

- D. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATORS

- 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. [Ace Mountings Co., Inc.](#)
 2. [Amber/Booth Company, Inc.](#)
 3. [California Dynamics Corporation.](#)
 4. [Isolation Technology, Inc.](#)
 5. [Kinetics Noise Control.](#)
 6. [Mason Industries.](#)
 7. [Vibration Eliminator Co., Inc.](#)
 8. [Vibration Isolation.](#)
 9. [Vibration Mountings & Controls, Inc.](#)
- B. Pads: Arrange in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment.
1. Resilient Material: Oil- and water-resistant neoprene, rubber, or hermetically sealed compressed fiberglass.
- C. Spring Isolators: Freestanding, laterally stable, open-spring isolators.
1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 5. Baseplates: Factory drilled for bolting to structure and bonded to **1/4-inch- (6-mm-)** thick, rubber isolator pad attached to baseplate underside. Baseplates shall limit floor load to **500 psig (3447 kPa)**.
 6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.
- D. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic or limit-stop restraint.
1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to weight being removed; factory-drilled baseplate bonded to **1/4-inch- (6-mm-)** thick, neoprene or rubber isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.
 2. Restraint: Seismic or limit-stop as required for equipment and authorities having jurisdiction.

3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.2 SEISMIC-RESTRAINT DEVICES

- 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. [Amber/Booth Company, Inc.](#)
 2. [California Dynamics Corporation.](#)
 3. [Cooper B-Line, Inc.; a division of Cooper Industries.](#)
 4. [Hilti Inc.](#)
 5. [Loos & Co.; Seismic Earthquake Division.](#)
 6. [Mason Industries.](#)
 7. [TOLCO Incorporated; a brand of NIBCO INC.](#)
 8. [Unistrut; Tyco International, Ltd.](#)
- B. General Requirements for Restraint Components: Rated strengths, features, and application requirements shall be as defined in reports by an agency acceptable to authorities having jurisdiction.
1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.
- C. Channel Support System: MFMA-3, shop- or field-fabricated support assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; and rated in tension, compression, and torsion forces.
- D. Restraint Cables: ASTM A 603 galvanized-steel cables with end connections made of steel assemblies with thimbles, brackets, swivels, and bolts designed for restraining cable service; and with a minimum of two clamping bolts for cable engagement.
- E. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections or Reinforcing steel angle clamped to hanger rod. Do not weld stiffeners to rods.
- F. Bushings for Floor-Mounted Equipment Anchor: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchors and studs.
- G. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices.
- H. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

- I. Mechanical Anchor: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchors with strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter.
- J. Adhesive Anchor: Drilled-in and capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

2.3 FACTORY FINISHES

- A. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.
 - 1. Powder coating on springs and housings.
 - 2. All hardware shall be galvanized. Hot-dip galvanize metal components for exterior use.
 - 3. Baked enamel or powder coat for metal components on isolators for interior use.
 - 4. Color-code or otherwise mark vibration isolation and seismic-control devices to indicate capacity range.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

- A. Multiple Raceways or Cables: Secure raceways and cables to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.
- B. Strength of Support and Seismic-Restraint Assemblies: Sselect sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.3 SEISMIC-RESTRAINT DEVICE INSTALLATION

A. Equipment and Hanger Restraints:

1. Install restrained isolators on electrical equipment where specified in other Division 26 sections.
2. Install resilient, bolt-isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds **0.125 inch (3.2 mm)**.
3. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.

B. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

C. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

D. Drilled-in Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
5. Set anchors to manufacturer's recommended torque, using a torque wrench.
6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

- #### A. Install flexible connections in runs of raceways, cables, wireways, cable trays, and busways where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where they terminate with connection to equipment that is anchored to a different structural element from the one supporting them as they approach equipment.

3.5 FIELD QUALITY CONTROL

- A. Perform tests and inspections.

- B. Tests and Inspections:
 - 1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
 - 2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
 - 3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
 - 4. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
 - 5. Test to 90 percent of rated proof load of device.
 - 6. Measure isolator restraint clearance.
 - 7. Measure isolator deflection.
 - 8. Verify snubber minimum clearances.
 - 9. If a device fails test, modify all installations of same type and retest until satisfactory results are achieved.

- C. Remove and replace malfunctioning units and retest as specified above.

- D. Prepare test and inspection reports.

3.6 ADJUSTING

- A. Adjust isolators after isolated equipment is at operating weight.

- B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

- C. Adjust active height of spring isolators.

- D. Adjust restraints to permit free movement of equipment within normal mode of operation.

END OF SECTION 260548

SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Identification for conductors.
 - 2. Warning labels and signs.
 - 3. Instruction signs.
 - 4. Equipment identification labels.
 - 5. Miscellaneous identification products.

1.3 SUBMITTALS

- A. Product Data: For each electrical identification product indicated.

1.4 QUALITY ASSURANCE

- A. Comply with ANSI A13.1 and IEEE C2.
- B. Comply with NFPA 70.
- C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.
- D. Comply with ANSI Z535.4 for safety signs and labels.
- E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

1.5 COORDINATION

- A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual; and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.
- B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

- C. Coordinate installation of identifying devices with location of access panels and doors.
- D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 CONDUCTOR IDENTIFICATION MATERIALS

- A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than **3 mils (0.08 mm)** thick by **1 to 2 inches (25 to 50 mm)** wide.
- B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

2.2 WARNING LABELS AND SIGNS

- A. Comply with NFPA 70 and 29 CFR 1910.145.
- B. Self-Adhesive Warning Labels: Factory-printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.

2.3 INSTRUCTION SIGNS

- A. Engraved, laminated acrylic or melamine plastic, minimum **1/16 inch (1.6 mm)** thick for signs up to **20 sq. inches (129 sq. cm)** and **1/8 inch (3.2 mm)** thick for larger sizes.
 - 1. Engraved legend with black letters on white face.
 - 2. Punched or drilled for mechanical fasteners.
 - 3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.4 EQUIPMENT IDENTIFICATION LABELS

- A. Adhesive Film Label: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be **3/8 inch (10 mm)**.
- B. Stenciled Legend for outdoor installations: In nonfading, waterproof, black ink or paint. Minimum letter height shall be 1 inch (25 mm).

2.5 CABLE TIES

- A. General-Purpose Cable Ties: Fungus inert, self extinguishing, one piece, self locking, Type 6/6 nylon.

1. Minimum Width: **3/16 inch (5 mm)**.
2. Tensile Strength at **73 deg F (23 deg C)**, According to ASTM D 638: **12,000 psi (82.7 MPa)**.
3. Temperature Range: **Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C)**.
4. Color: Black except where used for color-coding.

B. Plenum-Rated Cable Ties: Self extinguishing, UV stabilized, one piece, self locking.

1. Minimum Width: **3/16 inch (5 mm)**.
2. Tensile Strength at **73 deg F (23 deg C)**, According to ASTM D 638: **7000 psi (48.2 MPa)**.
3. UL 94 Flame Rating: 94V-0.
4. Temperature Range: **Minus 50 to plus 284 deg F (Minus 46 to plus 140 deg C)**.
5. Color: Black.

2.6 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Paint: Comply with requirements in Division 09 painting Sections for paint materials and application requirements. Select paint system applicable for surface material and location (exterior or interior).
- B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Verify identity of each item before installing identification products.
- B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
- C. Apply identification devices to surfaces that require finish after completing finish work.
- D. System Identification Color-Coding Bands for Raceways and Cables: Each color-coding band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. 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-foot (7.6-m)** maximum intervals in congested areas.
- E. Aluminum Wraparound Marker Labels and Metal Tags: Secure tight to surface of conductor or cable at a location with high visibility and accessibility.
- F. Cable Ties: For attaching tags. Use general-purpose type, except as listed below:
1. Outdoors: UV-stabilized nylon.
 2. In Spaces Handling Environmental Air: Plenum rated.

- G. Painted Identification: Comply with requirements in Division 09 painting Sections for surface preparation and paint application.

3.2 IDENTIFICATION SCHEDULE

- A. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.
 - 1. Color-Coding for Phasem Identification, 600 V or Less: Use colors listed below for ungrounded conductors.
 - a. Color shall be factory applied.
 - b. Colors for 208/120-V Circuits:
 - 1) Phase A: Black.
 - 2) Phase B: Red.
 - 3) Phase C: Blue.
- B. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive warning labels
 - 1. Comply with 29 CFR 1910.145.
 - 2. Identify system voltage with black letters on an orange background.
 - 3. Apply to exterior of door, cover, or other access.
 - 4. For equipment with multiple power or control sources, apply to door or cover of equipment including, but not limited to, the following:
 - a. Power transfer switches.
 - b. Controls with external control power connections.
 - 5. Equipment to Be Labeled:
 - 6. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be engraved melamine label
 - a. Enclosures and electrical cabinets.
 - b. Access doors and panels for concealed electrical items.
 - c. Emergency system boxes and enclosures.
 - d. Enclosed switches and enclosed circuit breakers.
 - e. Enclosed controllers.
 - f. Variable-speed controllers.
 - g. Push-button stations.
 - h. Power transfer equipment.
 - i. Contactors, Remote-controlled switches, dimmer modules, and control devices.

END OF SECTION 260553

SECTION 260923 - LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Standalone daylight-harvesting switching controls.
 - 2. Indoor occupancy sensors.

- B. Related Requirements:

- 1. Section 262726 "Wiring Devices" for wall-box dimmers, wall-switch occupancy sensors, and manual light switches.

1.3 ACTION SUBMITTALS

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

- B. Shop Drawings: Show installation details for occupancy and light-level sensors.

- 1. Interconnection diagrams showing field-installed wiring.
 - 2. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For each type of lighting control device to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 DAYLIGHT-HARVESTING DIMMING CONTROLS

- A. **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:
1. [Hubbell Building Automation, Inc.](#) – Basis of Design
 2. [Cooper Industries, Inc.](#)
 3. [Leviton Manufacturing Co., Inc.](#)
 4. [Lithonia Lighting; Acuity Brands Lighting, Inc.](#)
- B. System Description: Sensing daylight levels, the system adjusts the indoor electrical lighting levels. As daylight increases, the lights are dimmed.
1. Lighting control set point is based on two lighting conditions:
 - a. When no daylight is present (target level).
 - b. When significant daylight is present.
- C. Ceiling-Mounted Dimming Controls: Solid-state, light-level sensor unit, with separate controller unit, to detect changes in lighting levels that are perceived by the eye.
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 2. Sensor Output: 0- to 10-V dc to operate electronic dimming drivers. Sensor is powered by controller unit.
 3. Power Pack: Sensor has 24-V dc, Class 2 power source, as defined by NFPA 70.

2.2 INDOOR OCCUPANCY SENSORS

- A. **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:
1. [Hubbell Building Automation, Inc.](#) – Basis of Design
 2. [Cooper Industries, Inc.](#)
 3. [Leviton Manufacturing Co., Inc.](#)
 4. [Lithonia Lighting; Acuity Brands Lighting, Inc.](#)
 5. [Philips Lighting Controls.](#)
 6. [Sensor Switch, Inc.](#)
- B. General Requirements for Sensors: Wall- or ceiling-mounted, solid-state indoor occupancy sensors with a separate power pack.
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 2. Operation: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn them off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.

3. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor is powered from the power pack.
 4. Power Pack: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc, 150-mA, Class 2 power source, as defined by NFPA 70.
 5. Mounting:
 - a. Sensor: Suitable for mounting in any position on a standard outlet box.
 - b. Relay: Externally mounted through a 1/2-inch (13-mm) knockout in a standard electrical enclosure.
 - c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
 6. Indicator: Digital display, to show when motion is detected during testing and normal operation of sensor.
 7. Bypass Switch: Override the "on" function in case of sensor failure.
 8. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc (21.5 to 2152 lux); turn lights off when selected lighting level is present.
- C. Dual-Technology Type: Ceiling mounted; detect occupants in coverage area using PIR and ultrasonic detection methods. The particular technology or combination of technologies that control on-off functions is selectable in the field by operating controls on unit.
1. Sensitivity Adjustment: Separate for each sensing technology.
 2. Detector Sensitivity: Detect occurrences of 6-inch- (150-mm-) minimum movement of any portion of a human body that presents a target of not less than 36 sq. in. (232 sq. cm), and detect a person of average size and weight moving not less than 12 inches (305 mm) in either a horizontal or a vertical manner at an approximate speed of 12 inches/s (305 mm/s).
 3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. (93 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.

2.3 CONDUCTORS AND CABLES

- A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 18 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- C. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 14 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 SENSOR INSTALLATION

- A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression systems, and partition assemblies.
- B. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

3.2 WIRING INSTALLATION

- A. Wiring Method: Comply with Section 260519 "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size is **1/2 inch (13 mm)**.
- B. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.
- C. Size conductors according to lighting control device manufacturer's written instructions unless otherwise indicated.
- D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.3 IDENTIFICATION

- A. Identify components and power and control wiring according to Section 260553 "Identification for Electrical Systems."
 - 1. Identify controlled circuits in lighting contactors.
 - 2. Identify circuits and luminaires controlled by photoelectric and occupancy sensors at daylight harvesting controller.

3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: For daylight harvesting controls, Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- B. Perform the following tests and inspections.
 - 1. Operational Test: After installing switches and sensors, and after electrical circuitry has been energized, start units to confirm proper unit operation.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Lighting control devices will be considered defective if they do not pass tests and inspections.

- D. Prepare test and inspection reports.

3.5 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting sensors to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.
 - 1. For occupancy and motion sensors, verify operation at outer limits of detector range. Set time delay to suit Owner's operations.
 - 2. For daylighting controls, adjust set points and deadband controls to suit Owner's operations.

3.6 DEMONSTRATION

- A. Coordinate demonstration of products specified in this Section with demonstration requirements for low-voltage, programmable lighting control systems specified in Section 260943.13 "Addressable-Fixture Lighting Controls" and Section 260943.23 "Relay-Based Lighting Controls."
- B. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices.

END OF SECTION 260923

SECTION 260943 - NETWORK LIGHTING CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes manually operated lighting controls with relays, time clock, photocell control, external source relays and control module.
- B. Related Sections:
 - 1. Section 260923 "Lighting Control Devices" for photoelectric sensors, occupancy sensors, and multipole contactors.

1.3 MANDATORY PROGRAMMING MEETING

- 1.4 Lighting control system programming shall be mapped out at a meeting between the owner, engineer, and contractor. This meeting shall be scheduled by the Contractor and shall be completed before product is ordered. Action Submittals for this section shall not be returned to the Contractor before this meeting is completed.

1.5 DEFINITIONS

- A. BACnet: A networking communication protocol that complies with ASHRAE 135.
- B. BAS: Building automation system.
- C. LonWorks: A control network technology platform for designing and implementing interoperable control devices and networks.
- D. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling and power-limited circuits.
- E. Monitoring: Acquisition, processing, communication, and display of equipment status data, metered electrical parameter values, power quality evaluation data, event and alarm signals, tabulated reports, and event logs.
- F. PC: Personal computer; sometimes plural as "PCs."

- G. Power Line Carrier: Use of radio-frequency energy to transmit information over transmission lines whose primary purpose is the transmission of power.
- H. RS-485: A serial network protocol, similar to RS-232, complying with TIA-485-A.
- I. UTP: Unshielded twisted pair.

1.6 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for control modules, power distribution components, manual switches and plates, and conductors and cables.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 2. Outline Drawings: Indicate dimensions, weights, arrangement of components, and clearance and access requirements.
 - 3. Block Diagram: Show interconnections between components specified in this Section and devices furnished with power distribution system components. Indicate data communication paths and identify networks, data buses, data gateways, concentrators, and other devices to be used. Describe characteristics of network and other data communication lines.
 - 4. Wiring Diagrams: For power, signal, and control wiring. Coordinate nomenclature and presentation with a block diagram.

1.7 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Submit evidence that lighting controls are compatible with connected monitoring and control devices and systems specified in other Sections.
 - 1. Show interconnecting signal and control wiring and interfacing devices that prove compatibility of inputs and outputs.
 - 2. For networked controls, list network protocols and provide statements from manufacturers that input and output devices meet interoperability requirements of the network protocol.
- B. Field quality-control reports.
- C. Software licenses and upgrades required by and installed for operation and programming of digital and analog devices.
- D. Warranty: Sample of special warranty.

1.8 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For lighting controls to include in emergency, operation, and maintenance manuals.
- B. Software and Firmware Operational Documentation:
 - 1. Software operating and upgrade manuals.
 - 2. Program Software Backup: On a magnetic media or compact disc, complete with data files.
 - 3. Device address list.
 - 4. Printout of software application and graphic screens.

1.9 QUALITY ASSURANCE

- A. Source Limitations: Obtain lighting control module and power distribution components through one source from a single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with 47 CFR, Subparts A and B, for Class A digital devices.
- D. Comply with NFPA 70.

1.10 COORDINATION

- A. Coordinate lighting control components to form an integrated interconnection of compatible components.
 - 1. Match components and interconnections for optimum performance of lighting control functions.
- B. Coordinate lighting control components specified in this Section with components specified in Section 262416 "Panelboards."

1.11 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of lighting controls that fail in materials or workmanship or from transient voltage surges within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Failure of software input/output to execute switching or dimming commands.
 - b. Failure of modular relays to operate under manual or software commands.
 - c. Damage of electronic components due to transient voltage surges.
 - 2. Warranty Period: Two years from date of Substantial Completion.

3. Extended Warranty Period Failure Due to Transient Voltage Surges: five years.
4. Extended Warranty Period for Electrically Held Relays: 10 years from date of Substantial Completion.

1.12 SOFTWARE SERVICE AGREEMENT

- A. Technical Support: Beginning with Substantial Completion, provide software support for two years.
- B. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system. Upgrade shall include new or revised licenses for use of the software.
 1. Provide 30 days' notice to Owner to allow scheduling and access to system and to allow Owner to upgrade computer equipment if necessary.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. **Basis-of-Design Product:** Subject to compliance with requirements, provide Hubbell LX series or comparable product by one of the following:
 1. Acuity Brands Lighting, Inc.; Lithonia Lighting brand.
 2. Cooper Controls
 3. Leviton Mfg. Company Inc.
 4. Lighting Control & Design, Inc.
 5. Lightolier Controls; a division of Genlyte Group, LLC.
 6. Lutron Electronics Co., Inc.
 7. Wattstopper, project-specific custom solution.

2.2 SYSTEM REQUIREMENTS

- A. Expandability: System shall be capable of increasing the number of control functions in the future by 25 percent of current capacity; to include equipment ratings, housing capacities, spare relays, terminals, number of conductors in control cables, and control software.
- B. Performance Requirements: Manual switches, an internal timing and control unit, and external sensors or other control signal sources send a signal to a PC-based network-system control module that processes the signal according to its programming and routes an open or close command to one or more relays in the power-supply circuits, or routes variable commands to one or more dimmers, for groups of lighting fixtures or other loads.

2.3 CONTROL MODULE

- A. Control Module Description: Comply with UL 508 (CAN/CSA C22.2, No. 14); microprocessor-based, networked, control unit; mounted in preassembled, modular relay panel. Low-voltage-controlled, latching-type, single-pole lighting circuit relays shall be prime output circuit devices. Where indicated, a limited number of digital or analog, low-voltage control-circuit outputs shall be supported by control unit and circuit boards associated with relays. Control units shall be capable of receiving inputs from sensors and other sources. Line-voltage components and wiring shall be separated from low-voltage components and wiring by barriers. Control module shall be locally programmable.

2.4 POWER DISTRIBUTION COMPONENTS

- A. Modular Relay Panel: Comply with UL 508, UL 916, and UL 924; factory assembled with modular single-pole relays, power supplies, and accessory components required for specified performance.
1. Cabinet: Steel with hinged, locking door.
 - a. Barriers separate low-voltage and line-voltage components.
 - b. Directory: Mounted on back of door. Identifies each relay as to load groups controlled and each programmed pilot device if any.
 - c. Control Power Supply: Transformer and full-wave rectifier with filtered dc output.
 2. Single-Pole Relays: Mechanically held unless otherwise indicated; split-coil, momentary-pulsed type.
 - a. Low-Voltage Leads: Plug connector to the connector strip in cabinet and pilot light power where indicated.
 - b. Rated Capacity (Mounted in Relay Panel): 20 A, 125-V ac for tungsten filaments; 20 A, 277-V ac for ballasts.
 - c. Endurance: 50,000 cycles at rated capacity.
 - d. Mounting: Provision for easy removal and installation in relay cabinet.
- B. Line-Voltage Surge Suppression: Factory installed as an integral part of 120- and 277-V ac, solid-state control panels or field-mounting surge suppressors that comply with Section 264313 "Transient-Voltage Suppression for Low-Voltage Electrical Power Circuits" for Category A locations.

2.5 MANUAL ANALOG SWITCHES AND PLATES

- A. Push-Button or key-operated type switches as indicated on the drawings: Modular, momentary-contact, low-voltage type.
1. Match color specified in Section 262726 "Wiring Devices."
 2. Integral green LED pilot light to indicate when circuit is on.
 3. Where key operated switches are indicated, the Owner shall have the option of choosing, at the mandatory programming meeting, push-button switches that are programmed to be inoperative during school hours.

- B. Manual, Maintained Contact, Full- or Low-Voltage Switch: Comply with Section 262726 "Wiring Devices."
- C. Wall Plates: Single and multigang plates as specified in Section 262726 "Wiring Devices."
- D. Legend: Engraved or permanently silk-screened on wall plate where indicated. Use designations indicated on Drawings.

2.6 FIELD-MOUNTED DIGITAL CONTROLS AND PLATES

- A. Connection Type: RS-485 protocol, category 5e UTP cable, using RJ45 connectors. Power shall be from the control unit.
- B. Pushbutton Switches: Modular, solid-state, programmable, digital, momentary contact, designed to connect to a microprocessor based control unit as a manual control source.
 - 1. Mounting: Standard single-gang recessed switchbox, using device plates specified in Section 262726 "Wiring Devices."
 - 2. Multi-Gang Mounting: One to six pushbuttons per gang.

2.7 CONDUCTORS AND CABLES

- A. Power Wiring to Supply Side of Class 2 Power Source: Not smaller than No. 12 AWG, complying with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- B. Classes 2 and 3 Control Cables: Stranded copper, complying with UL 83, multiconductor cable with copper conductors not smaller than No. 18 AWG, complying with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- C. Class 1 Control Cables: Stranded copper, complying with UL 83, multiconductor cable with copper conductors not smaller than No. 14 AWG, complying with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- D. Structured Network Digital and Multiplexed Signal Cables: UTP cable with copper conductors, complying with TIA/EIA-568-B.2, Category 5e for horizontal copper cable and with Section 267400 "Telecommunications."
- E. RS-485 Cables:
 - 1. Standard Cable: NFPA 70, Type CMR.
 - a. Paired, 2 pairs, twisted, No. 22 AWG, stranded (7x30) tinned copper conductors.
 - b. PVC insulation.
 - c. Unshielded.
 - d. PVC jacket.
 - e. Flame Resistance: Comply with UL 1581.

PART 3 - EXECUTION

3.1 WIRING INSTALLATION

- A. Comply with NECA 1.
- B. Wiring Method: Install wiring in raceways except where installed in accessible ceilings. Minimum conduit size shall be **1/2 inch (13 mm)**.
 - 1. For power wiring comply with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
 - 2. For digital data transmission and low-voltage (operating at less than 50 V) remote control and signaling cables, comply with Section 260523 "Control-Voltage Electrical Power Cables."
- C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points. Separate power-limited and non-power-limited conductors according to conductor manufacturer's written instructions.
- D. Install field-mounting transient voltage suppressors for lighting control devices in Category A locations that do not have integral line-voltage surge protection.
- E. Size conductors according to lighting control device manufacturer's written instructions unless otherwise indicated.
- F. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in terminal cabinets, equipment enclosures, and in junction, pull, and outlet boxes.
- G. Identify components and power and control wiring according to Section 260553 "Identification for Electrical Systems."

3.2 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Tests and Inspections:
 - 1. Test for circuit continuity.
 - 2. Verify that the control module features are operational.
 - 3. Check operation of local override controls.
 - 4. Test system diagnostics by simulating improper operation of several components selected by Architect.
- C. Lighting controls will be considered defective if they do not pass tests and inspections.

- D. Prepare test and inspection reports.

3.3 SOFTWARE INSTALLATION

- A. Install and program software with initial settings of adjustable values. Make backup copies of software and user-supplied values. Provide current licenses for software.

3.4 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain lighting controls and software training for PC-based control systems. See Division 01 for further information.

END OF SECTION 260943

SECTION 262416 - PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Lighting and appliance branch-circuit panelboards.

1.3 DEFINITIONS

- A. SVR: Suppressed voltage rating.
- B. TVSS: Transient voltage surge suppressor.

1.4 SUBMITTALS

- A. Product Data: For each type of panelboard, switching and overcurrent protective device, transient voltage suppression device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each panelboard and related equipment.
 - 1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
 - 2. Detail enclosure types and details for types other than NEMA 250, Type 1.
 - 3. Detail bus configuration, current, and voltage ratings.
 - 4. Short-circuit current rating of panelboards and overcurrent protective devices.
 - 5. Include evidence of NRTL listing for series rating of installed devices.
 - 6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 - 7. Include wiring diagrams for power, signal, and control wiring.
 - 8. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graph paper; include selectable ranges for each type of overcurrent protective device.
- C. Field Quality-Control Reports:
 - 1. Test procedures used.

2. Test results that comply with requirements.
 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
- D. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.
- E. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
 2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Member company of NETA or an NRTL.
1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.
- B. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.
- C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- E. Comply with NEMA PB 1.
- F. Comply with NFPA 70.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.
- B. Handle and prepare panelboards for installation according to NEMA PB 1.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations:

1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - a. Ambient Temperature: Not exceeding 23 deg F (minus 5 deg C) to plus 104 deg F (plus 40 deg C).
 - b. Altitude: Not exceeding 6600 feet (2000 m).

B. Service Conditions: NEMA PB 1, usual service conditions, as follows:

1. Ambient temperatures within limits specified.
2. Altitude not exceeding 6600 feet (2000 m).

1.8 COORDINATION

- A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

1.9 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.
1. Warranty Period: Five years from date of Substantial Completion.

1.10 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Keys: Two spares for each type of panelboard cabinet lock.
 2. Circuit Breakers: As scheduled
 3. Fuses for Fused Switches: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
 4. Fuses for Fused Power-Circuit Devices: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

- A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
- B. Enclosures: Flush- and surface-mounted cabinets as scheduled.
 - 1. Rated for environmental conditions at installed location.
 - a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
 - b. Outdoor Locations: NEMA 250, Type 3R.
 - c. Wash-Down Areas: NEMA 250, Type 4X, stainless steel.
 - 2. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
 - 3. Finishes:
 - a. Panels and Trim: Steel and galvanized steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
 - b. Back Boxes: Galvanized steel or same finish as panels and trim.
 - 4. Directory Card: Inside panelboard door, mounted in transparent card holder.
- C. Incoming Mains Location: Top or bottom to match incoming feeder..
- D. Phase, Neutral, and Ground Buses:
 - 1. Material: Tin-plated aluminum.
 - 2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
 - 3. Extra-Capacity Neutral Bus: Neutral bus rated 200 percent of phase bus and UL listed as suitable for nonlinear loads.
- E. Conductor Connectors: Suitable for use with conductor material and sizes.
 - 1. Material: Tin-plated aluminum.
 - 2. Main and Neutral Lugs: Mechanical type.
 - 3. Ground Lugs and Bus-Configured Terminators: Mechanical type.
 - 4. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
 - 5. Subfeed (Double) Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
 - 6. Gutter-Tap Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
 - 7. Extra-Capacity Neutral Lugs: Rated 200 percent of phase lugs mounted on extra-capacity neutral bus.

- F. Service Equipment Label: NRTL labeled for use as service equipment for panelboards or load centers with one or more main service disconnecting and overcurrent protective devices.
- G. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
- H. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals.

2.2 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. 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:
 - 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - 3. Siemens Energy & Automation, Inc.
 - 4. Square D; a brand of Schneider Electric.
- B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- C. Mains: as indicated on schedules. Provide sub feed lugs where indicated.
- D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.
- E. Contactors in Main Bus: NEMA ICS 2, Class A, electrically held, general-purpose controller, with same short-circuit interrupting rating as panelboard.
 - 1. Internal Control-Power Source: Control-power transformer, with fused primary and secondary terminals, connected to main bus ahead of contactor connection.
- F. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.
- G. Column-Type Panelboards: Narrow gutter extension, with cover, to overhead junction box equipped with ground and neutral terminal buses.

2.3 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. 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:
 - 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - 3. Siemens Energy & Automation, Inc.
 - 4. Square D; a brand of Schneider Electric.
- B. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
3. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings:
 - a. Instantaneous trip.
 - b. Long- and short-time pickup levels.
 - c. Long- and short-time time adjustments.
 - d. Ground-fault pickup level, time delay, and I^2t response.
4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
5. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
6. Arc-Fault Circuit Interrupter (AFCI) Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.
7. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:
 - a. Standard frame sizes, trip ratings, and number of poles.
 - b. Lugs: Compression style, suitable for number, size, trip ratings, and conductor materials.
 - c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
 - d. Shunt Trip: trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.
 - e. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
 - f. Auxiliary Contacts: One SPDT switch with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts and "b" contacts operate in reverse of circuit-breaker contacts.
 - g. Alarm Switch: Single-pole, normally open contact that actuates only when circuit breaker trips.
 - h. Multipole units enclosed in a single housing or factory assembled to operate as a single unit.
 - i. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in on position.
 - j. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.

2.4 PANELBOARD SUPPRESSORS – provide integral mounted for panel MDP

- A. 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:
 1. Current Technology; a subsidiary of Danahar Corporation.
 2. Eaton Electrical Inc.; Cutler-Hammer Business Unit.

3. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 4. Liebert Corporation.
 5. Siemens Energy & Automation, Inc.
 6. Square D; a brand of Schneider Electric.
- B. Surge Protection Device: IEEE C62.41-compliant, integrally mounted, solid-state, parallel-connected, non-modular type, with sine-wave tracking suppression and filtering modules, UL 1449, second edition, short-circuit current rating matching or exceeding the panelboard short-circuit rating, and with the following features and accessories:
1. Accessories:
 - a. LED indicator lights for power and protection status.
 - b. Audible alarm, with silencing switch, to indicate when protection has failed.
 - c. One set of dry contacts rated at 5 A and 250-V ac, for remote monitoring of protection status.

2.5 ACCESSORY COMPONENTS AND FEATURES

- A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Receive, inspect, handle, and store panelboards according to NECA 407.
- B. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.
- C. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with mounting and anchoring requirements specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
- B. Mount top of trim 90 inches (2286 mm) above finished floor unless otherwise indicated.
- C. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- D. Install overcurrent protective devices and controllers not already factory installed.

1. Set field-adjustable, circuit-breaker trip ranges.
- E. Install filler plates in unused spaces.
- F. Stub four 1-inch (27-GRC) empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch (27-GRC) empty conduits into raised floor space or below slab not on grade.
- G. Arrange conductors in gutters into groups and bundle and wrap with wire ties.
- H. Comply with NECA 1.

3.3 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Division 26 Section "Identification for Electrical Systems."
- B. Create a directory to indicate installed circuit loads; incorporate Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.
- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
- D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Tests and Inspections:
 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- C. Panelboards will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

- A. Adjust moving parts and operable component to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges.

END OF SECTION 264216

SECTION 262713 - ELECTRICITY METERING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes equipment for electricity metering by utility company.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For electricity-metering equipment.
 - 1. Dimensioned plans and sections or elevation layouts.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.5 PROJECT CONDITIONS

- A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:
 - 1. Notify Owner no fewer than five days in advance of proposed interruption of electrical service.
 - 2. Do not proceed with interruption of electrical service without Owner's written permission.

1.6 COORDINATION

- A. Electrical Service Connections: Coordinate with utility companies and components they furnish as follows:
 - 1. Comply with requirements of utilities providing electrical power services.

2. Coordinate installation and connection of utilities and services, including provision for electricity-metering components.

PART 2 - PRODUCTS

2.1 EQUIPMENT FOR ELECTRICITY METERING BY UTILITY COMPANY

- A. Meters will be furnished by utility company.
- B. Meter Sockets: Comply with requirements of electrical-power utility company.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with equipment installation requirements in NECA 1.

3.2 IDENTIFICATION

- A. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
 1. Equipment Identification Labels: Adhesive film labels with clear protective overlay.

END OF SECTION 262713

SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Receptacles, receptacles with integral GFCI, and associated device plates.
 - 2. Twist-locking receptacles.
 - 3. Snap switches and wall-box dimmers.
 - 4. Cord and plug sets.

1.3 DEFINITIONS

- A. GFCI: Ground-fault circuit interrupter.
- B. Pigtail: Short lead used to connect a device to a branch-circuit conductor.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: List of legends and description of materials.
- C. Samples: One for each type of device and wall plate specified, in each color specified.
- D. Field quality-control test reports.
- E. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing label warnings and instruction manuals that include labeling conditions.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of wiring device and associated wall plate through one source from a single manufacturer. Insofar as they are available, obtain all wiring devices and associated wall plates from a single manufacturer and one source.

- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NFPA 70.

1.6 COORDINATION

- A. Receptacles for Owner-Furnished Equipment: Match plug configurations.
 - 1. Cord and Plug Sets: Match equipment requirements.

1.7 EXTRA MATERIALS

- A. Furnish extra materials described in subparagraphs below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

PART 2 - PRODUCTS

2.1 STRAIGHT BLADE RECEPTACLES

- A. Convenience Duplex Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.

2.2 GFCI RECEPTACLES

- A. General Description: Straight blade, non-feed-through type. Comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 943, Class A, and include indicator light that is lighted when device is tripped.
- B. Duplex GFCI Convenience Duplex Receptacles, 125 V, 20 A:

2.3 TWIST-LOCKING RECEPTACLES

- A. Single Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration L5-20R, and UL 498. Provide other configurations where indicated on plans.

2.4 CORD AND PLUG SETS

- A. Description: Match voltage and current ratings and number of conductors to requirements of equipment being connected.
 - 1. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and equipment-rating ampacity plus a minimum of 30 percent.

2. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.
- 2.5 SNAP SWITCHES must match the push button switches provided with the daylight harvesting controls and with the wall mounted occupancy switches.
- A. Comply with NEMA WD 1 and UL 20
 - B. Switches, 120/277 V, 20 A – single or two pole, three way or 4 way as indicated on plans.
 - C. Pilot Light Switches, 20 A:
 1. Description: Single pole, with neon-lighted handle, illuminated when switch is "ON."
- 2.6 WALL PLATES
- A. Single and combination types to match corresponding wiring devices.
 1. Plate-Securing Screws: Metal with head color to match plate finish.
 2. Material for Finished and unfinished Spaces: Brushed stainless steel.
 3. Material for Damp Locations: Thermoplastic with spring-loaded lift cover, and listed and labeled for use in "wet locations."
 - B. Wet-Location, Weatherproof : NEMA 250, complying with type 3R enclosure
- 2.7 FINISHES
- A. Color: Wiring device catalog numbers in Section Text do not designate device color.
 1. Wiring Devices : White, unless otherwise indicated or required by NFPA 70 or device listing.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.
- B. 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.

C. 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.

D. 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.

E. 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.

F. 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.

G. 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.

- H. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

3.2 IDENTIFICATION

- A. Comply with Division 26 Section "Identification for Electrical Systems."
 - 1. Receptacles: Identify panelboard and circuit number from which served. Provide machine-printed adhesive labels on wall plates.

3.3 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
 - 1. Test Instruments: Use instruments that comply with UL 1436.
 - 2. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated LED indicators of measurement.
- B. Tests for Convenience Receptacles:
 - 1. Line Voltage: Acceptable range is 105 to 132 V.
 - 2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is not acceptable.
 - 3. Ground Impedance: Values of up to 2 ohms are acceptable.
 - 4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
 - 5. Using the test plug, verify that the device and its outlet box are securely mounted.
 - 6. 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.

END OF SECTION 262726

SECTION 262813 - FUSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 QUALITY ASSURANCE

- A. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with NEMA FU 1 for cartridge fuses.
- D. Comply with NFPA 70.
- E. Comply with UL 248-11 for plug fuses.

1.3 PROJECT CONDITIONS

- A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F (5 deg C) or more than 100 deg F (38 deg C), apply manufacturer's ambient temperature adjustment factors to fuse ratings.

1.4 COORDINATION

- A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

1.5 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than 2 of each size and type.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provided products by one of the following or approved equal:
1. Cooper Bussmann, Inc.
 2. Edison Fuse, Inc.
 3. Ferraz Shawmut, Inc.
 4. Littelfuse, Inc.

2.2 CARTRIDGE FUSES

- A. Characteristics: NEMA FU 1, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.

2.3 PLUG FUSES

- A. Characteristics: UL 248-11, nonrenewable plug fuses; 125-V ac.

2.4 PLUG-FUSE ADAPTERS

- A. Characteristics: Adapters for using Type S, rejection-base plug fuses in Edison-base fuseholders or sockets; ampere ratings matching fuse ratings; irremovable once installed.

2.5 SPARE-FUSE CABINET

- A. Characteristics: Wall-mounted steel unit with full-length, recessed piano-hinged door and key-coded cam lock and pull.
1. Size: Adequate for storage of spare fuses specified with 15 percent spare capacity minimum.
 2. Finish: Gray, baked enamel.
 3. Identification: "SPARE FUSES" in 1-1/2-inch- (38-mm-) high letters on exterior of door.
 4. Fuse Pullers: For each size of fuse, where applicable and available, from fuse manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.

- B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.
- C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.
- D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FUSE APPLICATIONS

- A. Cartridge Fuses:
 - 1. Service Entrance and Feeders: Class L, fast acting
 - 2. Motor Branch Circuits and other branch circuits: Class RK1, time delay.
 - 3. Control Circuits: Class CC, fast acting.
- B. Plug Fuses:
 - 1. Motor Branch Circuits and other branch circuits: Edison-base type, dual-element time delay.

3.3 INSTALLATION

- A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.
- B. Install plug-fuse adapters in Edison-base fuseholders and sockets. Ensure that adapters are irremovable once installed.
- C. Install spare-fuse cabinet(s).

3.4 IDENTIFICATION

- A. Install labels complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems" and indicating fuse replacement information on inside door of each fused switch and adjacent to each fuse block, socket, and holder.

END OF SECTION 262813

SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Fusible switches.
2. Nonfusible switches.
3. Molded-case switches.
4. Enclosures.

1.3 DEFINITIONS

- A. NC: Normally closed.
- B. NO: Normally open.
- C. SPDT: Single pole, double throw.

1.4 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Enclosed switches and circuit breakers shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.5 SUBMITTALS

- A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
 1. Enclosure types and details for types other than NEMA 250, Type 1.
 2. Current and voltage ratings.
 3. Short-circuit current ratings (interrupting and withstand, as appropriate).
 4. Include evidence of NRTL listing for series rating of installed devices.

5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
- B. Shop Drawings: For enclosed switches and circuit breakers. Include plans, elevations, sections, details, and attachments to other work.
 1. Wiring Diagrams: For power, signal, and control wiring.
- C. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
 1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Member company of NETA or an NRTL.
 1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.
- B. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single source from single manufacturer.
- C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- E. Comply with NFPA 70.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 1. Ambient Temperature: Not less than minus 22 deg F (minus 30 deg C) and not exceeding 104 deg F (40 deg C).
 2. Altitude: Not exceeding 6600 feet (2010 m).

1.8 COORDINATION

- A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

1.9 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than 3 of each size and type.
 2. Fuse Pullers: two for each size and type.

PART 2 - PRODUCTS

2.1 FUSIBLE SWITCHES

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product by one of the following or approved equal:
1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 3. Siemens Energy & Automation, Inc.
 4. Square D; a brand of Schneider Electric.
- B. Type HD, Heavy Duty, Single Throw, 240-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- C. Accessories:
1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
 2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
 3. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
 4. Auxiliary Contact Kit: One NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.
 5. Lugs: Mechanical type, suitable for number, size, and conductor material.

2.2 NONFUSIBLE SWITCHES

- A. Type HD, Heavy Duty, Single Throw, 240 V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- B. Accessories:
1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.

2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Auxiliary Contact Kit: One NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.
4. Lugs: Mechanical type, suitable for number, size, and conductor material.

2.3 ENCLOSURES

- A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.
 1. Indoor, Dry and Clean Locations: NEMA 250, Type 1
 2. Outdoor Locations: NEMA 250, Type 3R
 3. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4X
 4. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.
- B. Comply with mounting and anchoring requirements specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
- C. Install fuses in fusible devices.
- D. Comply with NECA 1.

3.3 IDENTIFICATION

- A. Comply with requirements in Division 26 Section "Identification for Electrical Systems."
 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
 2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Acceptance Testing Preparation:
 - 1. Test insulation resistance for each enclosed switch and circuit breaker, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
 - 3. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports, including a certified report that identifies enclosed switches and circuit breakers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

END OF SECTION 262816

SECTION 262913 - ENCLOSED CONTROLLERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes the following enclosed controllers rated 600 V and less:
 - 1. Full-voltage manual.
 - 2. Full-voltage magnetic.

1.3 DEFINITIONS

- A. CPT: Control power transformer.
- B. MCCB: Molded-case circuit breaker.
- C. MCP: Motor circuit protector.
- D. N.C.: Normally closed.
- E. N.O.: Normally open.
- F. OCPD: Overcurrent protective device.
- G. SCR: Silicon-controlled rectifier.

1.4 SUBMITTALS

- A. Product Data: For each type of enclosed controller. Include manufacturer's technical data on features, performance, electrical characteristics, ratings, and enclosure types and finishes.
- B. Shop Drawings: For each enclosed controller. Include dimensioned plans, elevations, sections, details, and required clearances and service spaces around controller enclosures.
 - 1. Show tabulations of the following:
 - a. Each installed unit's type and details.
 - b. Factory-installed devices.
 - c. Nameplate legends.
 - d. Short-circuit current rating of integrated unit.

2. Wiring Diagrams: For power, signal, and control wiring.
- C. Field quality-control reports.
- D. Operation and Maintenance Data: For enclosed controllers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
1. Routine maintenance requirements for enclosed controllers and installed components.
 2. Manufacturer's written instructions for setting field-adjustable overload relays.
 3. Manufacturer's written instructions for testing, adjusting, and reprogramming reduced-voltage solid-state controllers.
- E. Load-Current and Overload-Relay Heater List: Compile after motors have been installed, and arrange to demonstrate that selection of heaters suits actual motor nameplate full-load currents.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
1. Ambient Temperature: Not less than minus 22 deg F (minus 30 deg C) and not exceeding 104 deg F (40 deg C).
 2. Altitude: Not exceeding 6600 feet (2010 m).

1.7 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Fuses for Fused Switches and Control Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than 2 of each size and type.
 2. Indicating Lights: two of each type and color installed.
 3. Auxiliary Contacts: Furnish one spare(s) for each size and type of magnetic controller installed.
 4. Power Contacts: Furnish three spares for each size and type of magnetic contactor installed.

PART 2 - PRODUCTS

2.1 FULL-VOLTAGE CONTROLLERS

- A. General Requirements for Full-Voltage Controllers: Comply with NEMA ICS 2, general purpose, Class A.
- B. Motor-Starting Switches: "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off or on.
 - 1. Surface mounting.
 - 2. Red pilot light.
- C. Fractional Horsepower Manual Controllers: "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off, on, or tripped.
 - 1. Overload Relays: Inverse-time-current characteristics; NEMA ICS 2, Class 10 tripping characteristics; heaters matched to nameplate full-load current of actual protected motor; external reset push button bimetallic type.
 - 2. Surface mounting.
 - 3. Red pilot light.
- D. Magnetic Controllers: Full voltage, across the line, electrically held.
 - 1. Contactor Coils: Pressure-encapsulated type with coil transient suppressors.
 - a. Operating Voltage: Depending on contactor NEMA size and line-voltage rating, manufacturer's standard matching control power or line voltage.
 - 2. Power Contacts: Totally enclosed, double-break, silver-cadmium oxide; assembled to allow inspection and replacement without disturbing line or load wiring.
 - 3. Control Circuits: 24 V ac; obtained from integral CPT, with primary and secondary fuses, with CPT of sufficient capacity to operate integral devices and remotely located pilot, indicating, and control devices.
 - a. CPT Spare Capacity: 50 VA.
 - 4. Melting Alloy Overload Relays:
 - a. Inverse-time-current characteristic.
 - b. Class 10 tripping characteristic.
 - c. Heaters in each phase matched to nameplate full-load current of actual protected motor and with appropriate adjustment for duty cycle.
 - d. Ambient compensated.
 - e. Automatic resetting.
 - 5. Solid-State Overload Relay:
 - a. Switch or dial selectable for motor running overload protection.
 - b. Sensors in each phase.

- c. Class 10 tripping characteristic selected to protect motor against voltage and current unbalance and single phasing.
 - 6. N.C or N.O., isolated overload alarm contact.
 - 7. External overload reset push button.
- E. Combination Magnetic Controller: Factory-assembled combination of magnetic controller, OCPD, and disconnecting means.
 - 1. Fusible Disconnecting Means:
 - a. NEMA KS 1, heavy-duty, horsepower-rated, fusible switch with clips or bolt pads to accommodate Class J fuses.
 - b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
 - c. Auxiliary Contacts: N.O./N.C., arranged to activate before switch blades open.
 - 2. Nonfusible Disconnecting Means:
 - a. NEMA KS 1, heavy-duty, horsepower-rated, nonfusible switch.
 - b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
 - c. Auxiliary Contacts: N.O./N.C., arranged to activate before switch blades open.

2.2 ENCLOSURES

- A. Enclosed Controllers: NEMA ICS 6, to comply with environmental conditions at installed location.
 - 1. Dry and Clean Indoor Locations: Type 1.
 - 2. Outdoor Locations: Type 3R.
 - 3. Other Wet or Damp Indoor Locations: Type 4X.

2.3 ACCESSORIES

- A. General Requirements for Control Circuit and Pilot Devices: NEMA ICS 5; factory installed in controller enclosure cover unless otherwise indicated.
 - 1. Push Buttons, Pilot Lights, and Selector Switches: Heavy-duty, oiltight type.
 - a. Push Buttons: Covered types; maintained as indicated.
 - b. Pilot Lights: LED types; colors as indicated.
 - c. Selector Switches: Rotary type.
- B. N.C./ N.O. auxiliary contact(s).
- C. Control Relays: Auxiliary and adjustable time-delay relays.

- D. Phase-Failure, Phase-Reversal, and Undervoltage and Overvoltage Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connections. Provide adjustable undervoltage, overvoltage, and time-delay settings.
- E. Cover gaskets for Type 1 enclosures.
- F. Terminals for connecting power factor correction capacitors to the line side of overload relays.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and surfaces to receive enclosed controllers, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
- B. Examine enclosed controllers before installation. Reject enclosed controllers that are wet, moisture damaged, or mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Wall-Mounted Controllers: Install enclosed controllers on walls with tops at uniform height unless otherwise indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For controllers not at walls, provide freestanding racks complying with Division 26 Section "Hangers and Supports for Electrical Systems."
- B. Seismic Bracing: Comply with requirements specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
- C. Install fuses in each fusible-switch enclosed controller.
- D. Comply with NECA 1.

3.3 IDENTIFICATION

- A. Identify enclosed controllers, components, and control wiring. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
 - 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
 - 2. Label each enclosure with engraved nameplate.

3.4 CONTROL WIRING INSTALLATION

- A. Install wiring between enclosed controllers and remote devices. Comply with requirements in Division 26 Section "Control-Voltage Electrical Power Cables."

- B. Bundle, train, and support wiring in enclosures.
- C. Connect selector switches and other automatic-control selection devices where applicable.

3.5 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 - 1. Inspect controllers, wiring, components, connections, and equipment installation.
 - 2. Test insulation resistance for each enclosed-controller element, component, connecting motor supply, feeder, and control circuits.
 - 3. Test continuity of each circuit.
 - 4. Verify that voltages at controller locations are within plus or minus 10 percent of motor nameplate rated voltages.
 - 5. Test each motor for proper phase rotation.
 - 6. Perform each electrical test and visual and mechanical inspection stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 7. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- B. Enclosed controllers will be considered defective if they do not pass tests and inspections.

3.6 ADJUSTING

- A. Set field-adjustable switches, auxiliary relays, time-delay relays, timers, and overload-relay pickup and trip ranges.
- B. Adjust overload-relay heaters or settings if power factor correction capacitors are connected to the load side of the overload relays.
- C. Adjust the trip settings of MCPs and thermal-magnetic circuit breakers with adjustable instantaneous trip elements. Initially adjust to six times the motor nameplate full-load ampere ratings and attempt to start motors several times, allowing for motor cooldown between starts. If tripping occurs on motor inrush, adjust settings in increments until motors start without tripping. Do not exceed eight times the motor full-load amperes (or 11 times for NEMA Premium Efficient motors if required). Where these maximum settings do not allow starting of a motor.

3.7 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain enclosed controllers.

END OF SECTION 262913

SECTION 263213 - ENGINE GENERATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes packaged engine-generator sets for emergency power supply with the following features:
 - 1. Diesel engine.
 - 2. Unit-mounted cooling system.
 - 3. Unit-mounted control and monitoring.
 - 4. Performance requirements for sensitive loads.
 - 5. Outdoor enclosure.
- B. Related Sections include the following:
 - 1. Section 263600 "Transfer Switches" for transfer switches including sensors and relays to initiate automatic-starting and -stopping signals for engine-generator sets.

1.3 DEFINITIONS

- A. Operational Bandwidth: The total variation from the lowest to highest value of a parameter over the range of conditions indicated, expressed as a percentage of the nominal value of the parameter.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of packaged engine generator indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. In addition, include the following:
 - 1. Thermal damage curve for generator.
 - 2. Time-current characteristic curves for generator protective device.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 1. Dimensioned outline plan and elevation drawings of engine-generator set and other components specified.

2. Design Calculations: Signed and sealed by a qualified professional engineer. Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
3. Vibration Isolation Base Details: Signed and sealed by a qualified professional engineer. Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include base weights.
4. Wiring Diagrams: Power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

- A. Manufacturer Seismic Qualification Certification: Submit certification that engine-generator set, batteries, battery racks, accessories, and components will withstand seismic forces defined in Section 260548 "Vibration and Seismic Controls for Electrical Systems." Include the following:
 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- B. Qualification Data: For installer and manufacturer.
- C. Source quality-control test reports.
 1. Certified summary of prototype-unit test report.
 2. Certified Test Reports: For components and accessories that are equivalent, but not identical, to those tested on prototype unit.
 3. Certified Summary of Performance Tests: Certify compliance with specified requirement to meet performance criteria for sensitive loads.
 4. Report of factory test on units to be shipped for this Project, showing evidence of compliance with specified requirements.
 5. Report of sound generation.
 6. Report of exhaust emissions showing compliance with applicable regulations.
 7. Certified Torsional Vibration Compatibility: Comply with NFPA 110.
- D. Field quality-control test reports.
- E. Warranty: Special warranty specified in this Section.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For packaged engine generators to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
1. List of tools and replacement items recommended to be stored at Project for ready access. Include part and drawing numbers, current unit prices, and source of supply.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- 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. Fuses: One for every 10 of each type and rating, but no fewer than one of each.
 2. Filters: One set each of lubricating oil, fuel, and combustion-air filters.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
1. Maintenance Proximity: Not more than four hours' normal travel time from Installer's place of business to Project site.
 2. Engineering Responsibility: Preparation of data for vibration isolators and seismic restraints of engine skid mounts, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.
- B. Manufacturer Qualifications: A qualified manufacturer. Maintain, within **100 miles** of Project site, a service center capable of providing training, parts, and emergency maintenance repairs.
- C. Source Limitations: Obtain packaged generator sets and auxiliary components through one source from a single manufacturer.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- E. Comply with ASME B15.1.
- F. Comply with NFPA 37.
- G. Comply with NFPA 70.
- H. Comply with NFPA 110 requirements for Level 1 emergency power supply system.
- I. Comply with UL 2200.
- J. Engine Exhaust Emissions: Comply with applicable state and local government requirements.

- K. Noise Emission: Comply with 72 dB(A) @ 23' under full load for maximum noise level due to sound emitted by generator set including engine, engine exhaust, engine cooling-air intake and discharge, and other components of installation.

1.9 PROJECT CONDITIONS

- A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:
 - 1. Notify Owner no fewer than five days in advance of proposed interruption of electrical service.
 - 2. Do not proceed with interruption of electrical service without Owner's written permission.

- B. Environmental Conditions: Engine-generator system shall withstand the following environmental conditions without mechanical or electrical damage or degradation of performance capability:
 - 1. Ambient Temperature: Minus 15 to plus 40 deg C.
 - 2. Relative Humidity: 0 to 95 percent.
 - 3. Altitude: Sea level to 1000 feet (300 m).

1.10 COORDINATION

- A. Coordinate size and location of concrete bases for package engine generators. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

- B. Selective Coordination: Emergency system overcurrent protective devices shall provide selective coordination as required by code between the emergency source and downstream devices. Coordinate overcurrent protective devices specified in this section with those specified in other division 26 sections to achieve selective coordination.

1.11 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of packaged engine generators and associated auxiliary components that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Five years from date of Substantial Completion.

1.12 MAINTENANCE SERVICE

- A. Initial Maintenance Service: Beginning at Substantial Completion, provide 12 months' full maintenance by skilled employees of manufacturer's designated service organization. Include

quarterly exercising to check for proper starting, load transfer, and running under load. Include routine preventive maintenance as recommended by manufacturer and adjusting as required for proper operation. Provide parts and supplies same as those used in the manufacture and installation of original equipment.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide equipment and services as manufactured by Onan/Cummins Power Generation; Industrial Business Group or a comparable product by one of the following:

1. Kohler Co.; Generator Division.
2. Caterpillar, Inc.

2.2 ENGINE-GENERATOR SET

- A. Factory-assembled and -tested, engine-generator set.
- B. Mounting Frame: Maintain alignment of mounted components without depending on concrete foundation; and have lifting attachments.
1. Rigging Diagram: Inscribed on metal plate permanently attached to mounting frame to indicate location and lifting capacity of each lifting attachment and generator-set center of gravity.
- C. Capacities and Characteristics:
1. Power Output Ratings: 175 kW, 218.75 kVA.
 2. Output Connections: 208/120 volts, three-phase, four wire.
 3. Nameplates: For each major system component to identify manufacturer's name and address, and model and serial number of component.
- D. Generator-Set Performance:
1. Steady-State Voltage Operational Bandwidth: 3 percent of rated output voltage from no load to full load.
 2. Transient Voltage Performance: Not more than 20 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within three seconds.
 3. Steady-State Frequency Operational Bandwidth: 0.5 percent of rated frequency from no load to full load.
 4. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.

5. Transient Frequency Performance: Less than 5 percent variation for 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within five seconds.
6. Output Waveform: At no load, harmonic content measured line to line or line to neutral shall not exceed 5 percent total and 3 percent for single harmonics. Telephone influence factor, determined according to NEMA MG 1, shall not exceed 50 percent.
7. Sustained Short-Circuit Current: For a 3-phase, bolted short circuit at system output terminals, system shall supply a minimum of 300 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to generator system components.
8. Start Time: Comply with NFPA 110, Type 10, system requirements.

E. Generator-Set Performance for Sensitive Loads:

1. Oversizing generator compared with the rated power output of the engine is permissible to meet specified performance.
 - a. Nameplate Data for Oversized Generator: Show ratings required by the Contract Documents rather than ratings that would normally be applied to generator size installed.
2. Steady-State Voltage Operational Bandwidth: 1 percent of rated output voltage from no load to full load.
3. Transient Voltage Performance: Not more than 10 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within 0.5 second.
4. Steady-State Frequency Operational Bandwidth: Plus or minus 0.25 percent of rated frequency from no load to full load.
5. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.
6. Transient Frequency Performance: Less than 2-Hz variation for 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within three seconds.
7. Output Waveform: At no load, harmonic content measured line to neutral shall not exceed 2 percent total with no slot ripple. Telephone influence factor, determined according to NEMA MG 1, shall not exceed 50 percent.
8. Sustained Short-Circuit Current: For a 3-phase, bolted short circuit at system output terminals, system shall supply a minimum of 300 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to winding insulation or other generator system components.
9. Excitation System: Performance shall be unaffected by voltage distortion caused by nonlinear load.
 - a. Provide permanent magnet excitation for power source to voltage regulator.
10. Start Time: Comply with NFPA 110, Type 10, system requirements.

2.3 ENGINE

- A. Fuel: Fuel oil, Grade DF-2
 - 1. Ultra Low Sulphur content as required by the State of Maine
- B. Rated Engine Speed: 1800 rpm.
- C. Maximum Piston Speed for Four-Cycle Engines: 2250 fpm (11.4 m/s).
- D. Lubrication System: The following items are mounted on engine or skid:
 - 1. Filter and Strainer: Rated to remove 90 percent of particles 5 micrometers and smaller while passing full flow.
 - 2. Thermostatic Control Valve: Control flow in system to maintain optimum oil temperature. Unit shall be capable of full flow and is designed to be fail-safe.
 - 3. Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassembly and without use of pumps, siphons, special tools, or appliances.
- E. Engine Fuel System:
 - 1. Main Fuel Pump: Mounted on engine. Pump ensures adequate primary fuel flow under starting and load conditions.
 - 2. Relief-Bypass Valve: Automatically regulates pressure in fuel line and returns excess fuel to source.
- F. Coolant Jacket Heater: Electric-immersion type, factory installed in coolant jacket system. Comply with NFPA 110 requirements for Level 1 equipment for heater capacity.
- G. Governor Adjustable isochronous, with speed sensing.
- H. Cooling System: Closed loop, liquid cooled, with radiator factory mounted on engine-generator-set mounting frame and integral engine-driven coolant pump.
 - 1. Coolant: Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacturer.
 - 2. Size of Radiator: Adequate to contain expansion of total system coolant from cold start to 110 percent load condition.
 - 3. Expansion Tank: Constructed of welded steel plate and rated to withstand maximum closed-loop coolant system pressure for engine used. Equip with gage glass and petcock.
 - 4. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.
 - 5. Coolant Hose: Flexible assembly with inside surface of nonporous rubber and outer covering of aging-, ultraviolet-, and abrasion-resistant fabric.
 - a. Rating: 50-psig (345-kPa) maximum working pressure with coolant at 180 deg F (82 deg C), and noncollapsible under vacuum.
 - b. End Fittings: Flanges or steel pipe nipples with clamps to suit piping and equipment connections.

- I. Muffler/Silencer: Critical type, sized as recommended by engine manufacturer and selected with exhaust piping system to not exceed engine manufacturer's engine backpressure requirements.
1. Minimum sound attenuation of 25 dB at 500 Hz.
 2. Sound level measured at a distance of 10 feet (3 m) from exhaust discharge after installation is complete shall be 85 dBA or less.
- J. Air-Intake Filter: Heavy-duty, engine-mounted air cleaner with replaceable dry-filter element and "blocked filter" indicator.
- K. Starting System: 24-V electric, with negative ground.
1. Components: Sized so they will not be damaged during a full engine-cranking cycle with ambient temperature at maximum specified in Part 1 "Project Conditions" Article.
 2. Cranking Motor: Heavy-duty unit that automatically engages and releases from engine flywheel without binding.
 3. Cranking Cycle: As required by NFPA 110 for system level specified
 4. Battery: Adequate capacity within ambient temperature range specified in Part 1 "Project Conditions" Article to provide specified cranking cycle at least three times without recharging.
 5. Battery Cable: Size as recommended by engine manufacturer for cable length indicated. Include required interconnecting conductors and connection accessories.
 6. Battery Rack: Factory fabricated of metal with acid-resistant finish. Thermostatically controlled heater shall be arranged to maintain battery above 10 deg C regardless of external ambient temperature within range specified in Part 1 "Project Conditions" Article. Include accessories required to support and fasten batteries in place.
 7. Battery-Charging Alternator: Factory mounted on engine with solid-state voltage regulation and 35-A minimum continuous rating.
 8. Battery Charger: Current-limiting, automatic-equalizing and float-charging type. Unit shall comply with UL 1236 and include the following features:
 - a. Operation: Equalizing-charging rate of 10 A shall be initiated automatically after battery has lost charge until an adjustable equalizing voltage is achieved at battery terminals. Unit shall then be automatically switched to a lower float-charging mode and shall continue to operate in that mode until battery is discharged again.
 - b. Automatic Temperature Compensation: Adjust float and equalize voltages for variations in ambient temperature from minus 40 deg C to plus 60 deg C to prevent overcharging at high temperatures and undercharging at low temperatures.
 - c. Automatic Voltage Regulation: Maintain constant output voltage regardless of input voltage variations up to plus or minus 10 percent.
 - d. Ammeter and Voltmeter: Flush mounted in door. Meters shall indicate charging rates.
 - e. Safety Functions: Sense abnormally low battery voltage and close contacts providing low battery voltage indication on control and monitoring panel. Sense high battery voltage and loss of ac input or dc output of battery charger. Either condition shall close contacts that provide a battery-charger malfunction indication at system control and monitoring panel.
 - f. Enclosure and Mounting: NEMA 250, Type 1, wall-mounted cabinet.

2.4 FUEL OIL STORAGE

- A. Comply with NFPA 30.
- B. Base-Mounted Fuel Oil Tank: Factory installed and piped, complying with UL 142 fuel oil tank. Features include the following:
 - 1. Tank level indicator.
 - 2. Capacity: Greater of 300 gallons or Fuel for twenty four (24) hours' continuous operation at 100 percent rated power output.
 - 3. Vandal-resistant fill cap, or within lockable generator enclosure.
 - 4. Containment Provisions: Comply with requirements of authorities having jurisdiction.

2.5 CONTROL AND MONITORING

- A. Automatic Starting System Sequence of Operation: When mode-selector switch on the control and monitoring panel is in the automatic position, remote-control contacts in one or more separate automatic transfer switches initiate starting and stopping of generator set. When mode-selector switch is switched to the on position, generator set starts. The off position of same switch initiates generator-set shutdown. When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms. Operation of a remote emergency-stop switch also shuts down generator set.
- B. Manual Starting System Sequence of Operation: Switching on-off switch on the generator control panel to the on position starts generator set. The off position of same switch initiates generator-set shutdown. When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms. Operation of a remote emergency-stop switch also shuts down generator set.
- C. Configuration: Operating and safety indications, protective devices, basic system controls, and engine gages shall be grouped in a common control and monitoring panel mounted on the generator set. Mounting method shall isolate the control panel from generator-set vibration.
- D. Indicating and Protective Devices and Controls: As required by NFPA 110 for Level 1 system, and the following:
 - 1. AC voltmeter.
 - 2. AC ammeter.
 - 3. AC frequency meter.
 - 4. DC voltmeter (alternator battery charging).
 - 5. Engine-coolant temperature gage.
 - 6. Engine lubricating-oil pressure gage.
 - 7. Running-time meter.
 - 8. Ammeter-voltmeter, phase-selector switch(es).
 - 9. Generator-voltage adjusting rheostat.
 - 10. Fuel tank derangement alarm.
 - 11. Fuel tank high-level shutdown of fuel supply alarm.
 - 12. Generator overload.
- E. Indicating and Protective Devices and Controls:

1. AC voltmeter.
 2. AC ammeter.
 3. AC frequency meter.
 4. AC Wattmeter
 5. AC Power Factor meter
 6. DC voltmeter (alternator battery charging).
 7. Engine-coolant temperature gage.
 8. Engine lubricating-oil pressure gage.
 9. Running-time meter.
 10. Ammeter-voltmeter, phase-selector switch(es).
 11. Generator-voltage adjusting rheostat.
 12. Start-stop switch.
 13. Overspeed shutdown device.
 14. Coolant high-temperature shutdown device.
 15. Coolant low-level shutdown device.
 16. Oil low-pressure shutdown device.
 17. Fuel tank derangement alarm.
- F. Supporting Items: Include sensors, transducers, terminals, relays, and other devices and include wiring required to support specified items. Locate sensors and other supporting items on engine or generator, unless otherwise indicated.
- G. Connection to Data Link: A separate terminal block, factory wired to Form C dry contacts, for each alarm and status indication is reserved for connections for data-link transmission of indications to remote data terminals. Data system connections to terminals are covered in Section 260913 "Electrical Power Monitoring and Control."
- H. Remote Alarm Annunciator: Comply with NFPA 99. An LED labeled with proper alarm conditions shall identify each alarm event and a common audible signal shall sound for each alarm condition. Silencing switch in face of panel shall silence signal without altering visual indication. Connect so that after an alarm is silenced, clearing of initiating condition will reactivate alarm until silencing switch is reset. Cabinet and faceplate are surface- or flush-mounting type to suit mounting conditions indicated.
- I. Remote Emergency-Stop Switch: Surface; wall mounted, unless otherwise indicated; and labeled. Push button shall be protected from accidental operation.
- 2.6 GENERATOR OVERCURRENT AND FAULT PROTECTION
- A. Generator Circuit Breaker: Molded-case, electronic-trip type; 100 percent rated; complying with UL 489.
1. Tripping Characteristics: Adjustable long-time and short-time delay and instantaneous.
 2. Trip Settings: Selected to coordinate with generator thermal damage curve.
 3. Shunt Trip: Connected to trip breaker when generator set is shut down by other protective devices.
 4. Mounting: Adjacent to or integrated with control and monitoring panel.
- B. Ground-Fault Indication: Comply with NFPA 70, "Emergency System" signals for ground-fault. Integrate ground-fault alarm indication with other generator-set alarm indications.

2.7 GENERATOR, EXCITER, AND VOLTAGE REGULATOR

- A. Comply with NEMA MG 1.
- B. Drive: Generator shaft shall be directly connected to engine shaft. Exciter shall be rotated integrally with generator rotor.
- C. Electrical Insulation: Class H or Class F.
- D. Stator-Winding Leads: Brought out to terminal box to permit future reconnection for other voltages if required.
- E. Construction shall prevent mechanical, electrical, and thermal damage due to vibration, overspeed up to 125 percent of rating, and heat during operation at 110 percent of rated capacity.
- F. Enclosure: Dripproof.
- G. Instrument Transformers: Mounted within generator enclosure.
- H. Voltage Regulator: Solid-state type, separate from exciter, providing performance as specified.
 - 1. Adjusting rheostat on control and monitoring panel shall provide plus or minus 5 percent adjustment of output-voltage operating band.
- I. Strip Heater: Thermostatically controlled unit arranged to maintain stator windings above dew point.
- J. Windings: Two-thirds pitch stator winding and fully linked amortisseur winding.
- K. Subtransient Reactance: 12percent, maximum.

2.8 OUTDOOR GENERATOR-SET ENCLOSURE

- A. Description: Vandal-resistant, weatherproof steel housing, wind resistant up to 100 mph (160 km/h). Multiple panels shall be lockable and provide adequate access to components requiring maintenance. Panels shall be removable by one person without tools. Instruments and control shall be mounted within enclosure.
- B. The complete diesel engine generator set, including generator control panel, engine starting batteries and fuel oil tank, shall be enclosed in a factory assembled, sound attenuated enclosure mounted on the fuel tank base.
 - 1. A weather resistant, sound attenuated enclosure of steel with electrostatically applied powder coated baked polyester paint. The enclosure shall have a resulting sound level of 71.0 dB(A) @ 23 ft with the genset running under full load. It shall consist of a roof, side walls, and end walls. Fasteners shall be either zinc plated or stainless steel.
 - 2. Enclosure Sound Attenuation: Acoustical foam shall be provided between all supports and inside doors and sound baffles on air intake and air discharge.

- C. Interior Lights with Switch: Factory-wired, vaporproof-type fixtures within housing; arranged to illuminate controls and accessible interior. Arrange for external electrical connection.
 - 1. DC lighting system for operation when remote source and generator are both unavailable.
- D. Convenience Outlet: Factory wired, GFCI. Arrange for external electrical connection.

2.9 VIBRATION ISOLATION DEVICES

- A. Elastomeric Isolator Pads: Oil- and water-resistant elastomer or natural rubber, arranged in single or multiple layers, molded with a nonslip pattern and galvanized-steel baseplates of sufficient stiffness for uniform loading over pad area, and factory cut to sizes that match requirements of supported equipment.

2.10 FINISHES

- A. Indoor and Outdoor Enclosures and Components: Manufacturer's standard finish over corrosion-resistant pretreatment and compatible primer.

2.11 SOURCE QUALITY CONTROL

- A. Prototype Testing: Factory test engine-generator set using same engine model, constructed of identical or equivalent components and equipped with identical or equivalent accessories.
 - 1. Tests: Comply with NFPA 110, Level 1 Energy Converters and with IEEE 115.
- B. Project-Specific Equipment Tests: Before shipment, factory test engine-generator set and other system components and accessories manufactured specifically for this Project. Perform tests at rated load and power factor. Include the following tests:
 - 1. Test components and accessories furnished with installed unit that are not identical to those on tested prototype to demonstrate compatibility and reliability.
 - 2. Full load run.
 - 3. Maximum power.
 - 4. Voltage regulation.
 - 5. Transient and steady-state governing.
 - 6. Single-step load pickup.
 - 7. Safety shutdown.
 - 8. Provide 14 days' advance notice of tests and opportunity for observation of tests by Owner's representative.
 - 9. Report factory test results within 10 days of completion of test.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas, equipment bases, and conditions, with Installer present, for compliance with requirements for installation and other conditions affecting packaged engine-generator performance.
- B. Examine roughing-in of piping systems and electrical connections. Verify actual locations of connections before packaged engine-generator installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with packaged engine-generator manufacturers' written installation and alignment instructions and with NFPA 110.
- B. Install packaged engine generator to provide access, without removing connections or accessories, for periodic maintenance.
- C. Install packaged engine generator on concrete base. Secure sets to anchor bolts installed in concrete bases. Concrete base construction is specified in Section 260529, "Hangers and Supports for Electrical Systems."
- D. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not specified to be factory mounted.

3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping and specialties.
- B. Connect fuel, cooling-system, and exhaust-system piping adjacent to packaged engine generator to allow service and maintenance.
- C. Connect engine exhaust pipe to engine with flexible connector.
- D. Connect fuel piping to engines with a gate valve and union and flexible connector.
 - 1. Diesel storage tanks, tank accessories, piping, valves, and specialties for fuel systems are specified in Section 231113 "Facility Fuel-Oil Piping."
- E. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- F. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.4 IDENTIFICATION

- A. Identify system components according to Section 230553 "Identification for HVAC Piping and Equipment" and Section 260553 "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.

- B. Tests and Inspections:
 - 1. Perform tests recommended by manufacturer and each electrical test and visual and mechanical inspection for "AC Generators and for Emergency Systems" specified in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 2. NFPA 110 Acceptance Tests: Perform tests required by NFPA 110 that are additional to those specified here including, but not limited to, single-step full-load pickup test.
 - 3. The manufacturer's local dealer shall provide a temporary resistive 1.0 PF load bank and temporary cable to test the generator set at 100% nameplate rating. All fuel for testing is to be supplied by the contractor.
 - 4. Battery Tests: Equalize charging of battery cells according to manufacturer's written instructions. Record individual cell voltages.
 - a. Measure charging voltage and voltages between available battery terminals for full-charging and float-charging conditions. Check electrolyte level and specific gravity under both conditions.
 - b. Test for contact integrity of all connectors. Perform an integrity load test and a capacity load test for the battery.
 - c. Verify acceptance of charge for each element of the battery after discharge.
 - d. Verify that measurements are within manufacturer's specifications.
 - 5. Battery-Charger Tests: Verify specified rates of charge for both equalizing and float-charging conditions.
 - 6. System Integrity Tests: Methodically verify proper installation, connection, and integrity of each element of engine-generator system before and during system operation. Check for air, exhaust, and fluid leaks.
 - 7. Exhaust Emissions Test: Comply with applicable government test criteria.
 - 8. Voltage and Frequency Transient Stability Tests: Use recording oscilloscope to measure voltage and frequency transients for 50 and 100 percent step-load increases and decreases, and verify that performance is as specified.

- C. Coordinate tests with tests for transfer switches and run them concurrently.

- D. Test instruments shall have been calibrated within the last 12 months, traceable to standards of NIST, and adequate for making positive observation of test results. Make calibration records available for examination on request.

- E. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
- F. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
- G. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- H. Remove and replace malfunctioning units and retest as specified above.
- I. Retest: Correct deficiencies identified by tests and observations and retest until specified requirements are met.
- J. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation resistances, time delays, and other values and observations. Attach a label or tag to each tested component indicating satisfactory completion of tests.
- K. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each power wiring termination and each bus connection. Remove all access panels so terminations and connections are accessible to portable scanner.
 - 1. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 - 2. Record of Infrared Scanning: Prepare a certified report that identifies terminations and connections checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain packaged engine generators. Refer to Division 01.

END OF SECTION 263213

SECTION 263353 - STATIC UNINTERRUPTIBLE POWER SUPPLY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

- 1. Three-phase, on-line, double-conversion, static-type, UPS units with the following features:
 - a. Surge suppression.
 - b. Input harmonics reduction.
 - c. Rectifier-charger.
 - d. Inverter.
 - e. Static bypass transfer switch.
 - f. Battery and battery disconnect device.
 - g. External maintenance bypass/isolation panel.
 - h. Remote UPS monitoring provisions.
 - i. Battery monitoring.
 - j. Remote monitoring.

1.3 DEFINITIONS

- A. EMI: Electromagnetic interference.
- B. LCD: Liquid-crystal display.
- C. LED: Light-emitting diode.
- D. PC: Personal computer.
- E. THD: Total harmonic distortion.
- F. UPS: Uninterruptible power supply.

1.4 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: UPS shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include data on features, components, ratings, and performance.
- B. Shop Drawings: For UPS. Include plans, elevations, sections, details, and attachments to other work.
 1. Detail equipment assemblies and indicate dimensions, weights, components, and location and identification of each field connection. Show access, workspace, and clearance requirements; details of control panels; and battery arrangement.
 2. Wiring Diagrams: For power, signal, and control wiring.

1.6 INFORMATIONAL SUBMITTALS

- A. Seismic Qualification Certificates: For UPS equipment, from manufacturer.
 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- B. Manufacturer Certificates: For each product, from manufacturer.
- C. Factory Test Reports: Comply with specified requirements.
- D. Field quality-control reports.
- E. Performance Test Reports: Indicate test results compared with specified performance requirements, and provide justification and resolution of differences if values do not agree.
- F. Warranties: Sample of special warranties.

1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For UPS units to include in emergency, operation, and maintenance manuals.

1.8 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses: One for every 10 of each type and rating, but no fewer than one of each.
2. Cabinet Ventilation Filters: One complete set(s).

1.9 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. UL Compliance: Listed and labeled under UL 1778 by an NRTL.

1.10 WARRANTY

- A. Special Battery Warranties: Specified form in which manufacturer and Installer agree to repair or replace UPS system storage batteries that fail in materials or workmanship within specified warranty period.
 1. Warranted Cycle Life for Premium Valve-Regulated, Lead-calcium Batteries: Equal to or greater than that represented in manufacturer's published table, including figures corresponding to the following, based on annual average battery temperature of 77 deg F (25 deg C):

Discharge Rate	Discharge Duration	Discharge End Voltage	Cycle Life
8 hours	8 hours	1.67	40 cycles
30 minutes	30 minutes	1.67	125 cycles
15 minutes	1.5 minutes	1.67	750 cycles

- B. Special UPS Warranties: Specified form in which manufacturer and Installer agree to repair or replace components that fail in materials or workmanship within special warranty period.
 1. Special Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 OPERATIONAL REQUIREMENTS

- A. Automatic operation includes the following:
 1. Normal Conditions: Load is supplied with power flowing from the normal power input terminals, through the rectifier-charger and inverter, with the battery connected in parallel with the rectifier-charger output.
 2. Abnormal Supply Conditions: If normal supply deviates from specified and adjustable voltage, voltage waveform, or frequency limits, the battery supplies energy to maintain constant, regulated inverter power output to the load without switching or disturbance.
 3. If normal power fails, energy supplied by the battery through the inverter continues supply-regulated power to the load without switching or disturbance.

4. When power is restored at the normal supply terminals of the system, controls automatically synchronize the inverter with the external source before transferring the load. The rectifier-charger then supplies power to the load through the inverter and simultaneously recharges the battery.
 5. If the battery becomes discharged and normal supply is available, the rectifier-charger charges the battery. On reaching full charge, the rectifier-charger automatically shifts to float-charge mode.
 6. If any element of the UPS system fails and power is available at the normal supply terminals of the system, the static bypass transfer switch switches the load to the normal ac supply circuit without disturbance or interruption.
 7. If a fault occurs in the system supplied by the UPS, and current flows in excess of the overload rating of the UPS system, the static bypass transfer switch operates to bypass the fault current to the normal ac supply circuit for fault clearing.
 8. When the fault has cleared, the static bypass transfer switch returns the load to the UPS system.
 9. If the battery is disconnected, the UPS continues to supply power to the load with no degradation of its regulation of voltage and frequency of the output bus.
- B. Manual operation includes the following:
1. Turning the inverter off causes the static bypass transfer switch to transfer the load directly to the normal ac supply circuit without disturbance or interruption.
 2. Turning the inverter on causes the static bypass transfer switch to transfer the load to the inverter.
- C. Maintenance Bypass/Isolation Panel Operation: Switch is interlocked so it cannot be operated unless the static bypass transfer switch is in the bypass mode. Device provides manual selection among the three conditions in subparagraphs below without interrupting supply to the load during switching:
1. Full Isolation: Load is supplied, bypassing the UPS. Normal UPS ac input circuit, static bypass transfer switch, and UPS load terminals are completely disconnected from external circuits.
 2. Maintenance Bypass: Load is supplied, bypassing the UPS. UPS ac supply terminals are energized to permit operational checking, but system load terminals are isolated from the load.
 3. Normal: Normal UPS ac supply terminals are energized and the load is supplied through either the static bypass transfer switch and the UPS rectifier-charger and inverter, or the battery and the inverter.
- D. Environmental Conditions: The UPS shall be capable of operating continuously in the following environmental conditions without mechanical or electrical damage or degradation of operating capability, except battery performance.
1. Ambient Temperature for Electronic Components: 32 to 104 deg F (0 to 40 deg C).
 2. Ambient Temperature for Battery: 77 +/-9°F (25 +/-5°C).
 3. Relative Humidity: 0 to 95 percent, noncondensing.
 4. Altitude: Sea level to 4000 feet (1220 m).

2.2 PERFORMANCE REQUIREMENTS

- A. The UPS shall perform as specified in this article while supplying rated full-load current, composed of any combination of linear and nonlinear load, up to 100 percent nonlinear load with a load crest factor of 3.0, under the following conditions or combinations of the following conditions:
1. Inverter is switched to battery source.
 2. Steady-state ac input voltage deviates up to plus or minus 10 percent from nominal voltage.
 3. Steady-state input frequency deviates up to plus or minus 5 percent from nominal frequency.
 4. THD of input voltage is 15 percent or more with a minimum crest factor of 3.0, and the largest single harmonic component is a minimum of 5 percent of the fundamental value.
 5. Load is 30 percent unbalanced continuously.
- B. Minimum Duration of Supply: If battery is sole energy source supplying rated full UPS load current at 80 percent power factor, duration of supply is 18 minutes.
- C. Input Voltage Tolerance: System steady-state and transient output performance remains within specified tolerances when steady-state ac input voltage varies plus 10, minus 20 percent from nominal voltage.
- D. Overall UPS Efficiency: Equal to or greater than 86 percent at 100 percent load, 85 percent at 75 percent load, and 84 percent at 50 percent load.
- E. Maximum Acoustical Noise: 60 dB, "A" weighting, emanating from any UPS component under any condition of normal operation, measured 4 feet from nearest surface of component enclosure.
- F. Maximum Energizing Inrush Current: Eight times the full-load current.
- G. Maximum AC Output-Voltage Regulation for Loads up to 50 Percent Unbalanced: Plus or minus 2 percent over the full range of battery voltage.
- H. Output Frequency: 60 Hz, plus or minus 0.5 percent over the full range of input voltage, load, and battery voltage.
- I. Limitation of harmonic distortion of input current to the UPS shall be as follows:
1. Description: Either a tuned harmonic filter or an arrangement of rectifier-charger circuits shall limit THD to 10 percent, maximum, at rated full UPS load current, for power sources with X/R ratio between 2 and 30.
- J. Maximum Harmonic Content of Output-Voltage Waveform: 5 percent rms total and 3 percent rms for any single harmonic, for 100 percent rated nonlinear load current with a load crest factor of 3.0.
- K. Minimum Overload Capacity of UPS at Rated Voltage: 125 percent of rated full load for 10 minutes, and 150 percent for 30 seconds in all operating modes.

- L. Maximum Output-Voltage Transient Excursions from Rated Value: For the following instantaneous load changes, stated as percentages of rated full UPS load, voltage shall remain within stated percentages of rated value and recover to, and remain within, plus or minus 2 percent of that value within 100 ms:
 - 1. 50 Percent: Plus or minus 5 percent.
 - 2. 100 Percent: Plus or minus 5 percent.
 - 3. Loss of AC Input Power: Plus or minus 1 percent.
 - 4. Restoration of AC Input Power: Plus or minus 1 percent.
- M. Input Power Factor: A minimum of 0.85 lagging when supply voltage and current are at nominal rated values and the UPS is supplying rated full-load current.
- N. EMI Emissions: Comply with FCC Rules and Regulations and with 47 CFR 15 for Class A equipment.

2.3 UPS SYSTEMS

- A. 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:
 - 1. [Eaton Corporation](#).
 - 2. [Liebert Corporation](#).
 - 3. [MGE UPS SYSTEMS](#).
 - 4. [Mitsubishi Electric Automation, Inc.](#)
 - 5. [Toshiba Corporation](#); Industrial Systems.
- B. Electronic Equipment: Solid-state devices using hermetically sealed, semiconductor elements. Devices include rectifier-charger, inverter, static bypass transfer switch, and system controls.
- C. Rated load: 7.5 kVA.
- D. Enclosures: Comply with NEMA 250, Type 1, unless otherwise indicated.
- E. Control Assemblies: Mount on modular plug-ins, readily accessible for maintenance.
- F. Surge Suppression: Protect internal UPS components from surges that enter at each ac power input connection including main disconnect switch, static bypass transfer switch, and maintenance bypass/isolation panel. Protect rectifier-charger, inverter, controls, and output components.
 - 1. Use factory-installed surge suppressors tested according to IEEE C62.41.1 and IEEE C62.41.2, Category B.
 - 2. Additional Surge Protection: Protect internal UPS components from low-frequency, high-energy voltage surges described in IEEE C62.41.1 and IEEE C62.41.2. Design the circuits connecting with external power sources and select circuit elements, conductors, conventional surge suppressors, and rectifier components and controls so input assemblies will have adequate mechanical strength and thermal and current-carrying capacity to withstand stresses imposed by 40-Hz, 180 percent voltage surges described in IEEE C62.41.1 and IEEE C62.41.2.

- G. Seismic-Restraint Design: UPS assemblies, subassemblies, and components (and fastenings and supports, mounting, and anchorage devices for them) shall be designed and fabricated to withstand static and seismic forces.
- H. UPS Cabinet Ventilation: Redundant fans or blowers draw in ambient air near the bottom of cabinet and discharge it near the top rear.
- I. Output Circuit Neutral Bus, Conductor, and Terminal Ampacity: Rated phase current times a multiple of 1.73, minimum.

2.4 RECTIFIER-CHARGER

- A. Capacity: Adequate to supply the inverter during rated full output load conditions and simultaneously recharge the battery from fully discharged condition to 95 percent of full charge within 10 times the rated discharge time for duration of supply under battery power at full load.
- B. Output Ripple: Limited by output filtration to less than 0.5 percent of rated current, peak to peak.
- C. Control Circuits: Immune to frequency variations within rated frequency ranges of normal and emergency power sources.
 - 1. Response Time: Field adjustable for maximum compatibility with local generator-set power source.
- D. Battery Float-Charging Conditions: Comply with battery manufacturer's written instructions for battery terminal voltage and charging current required for maximum battery life.

2.5 INVERTER

- A. Description: Pulse-width modulated, with sinusoidal output. Include a bypass phase synchronization window adjustment to optimize compatibility with local engine-generator-set power source.

2.6 STATIC BYPASS TRANSFER SWITCH

- A. Description: Solid-state switching device providing uninterrupted transfer. A contactor or electrically operated circuit breaker automatically provides electrical isolation for the switch.
- B. Switch Rating: Continuous duty at the rated full UPS load current, minimum.

2.7 BATTERY

- A. Description: Valve-regulated, premium, heavy-duty, recombinant, lead-calcium units; factory assembled in an isolated compartment or in a separate matching cabinet, complete with battery disconnect switch.
 - 1. Arrange for drawout removal of battery assembly from cabinet for testing and inspecting.

- B. 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:
1. [C&D Technologies, Inc.](#)
 2. [Eaton Corporation.](#)
 3. [EnerSys.](#)
 4. [Panasonic Corporation of North America](#); Panasonic Industrial Company.
- C. Seismic-Restraint Design: Battery racks, cabinets, assemblies, subassemblies, and components (and fastenings and supports, mounting, and anchorage devices for them) shall be designed and fabricated to withstand static and seismic forces.

2.8 CONTROLS AND INDICATIONS

- A. Description: Group displays, indications, and basic system controls on a common control panel on front of UPS enclosure.
- B. Minimum displays, indicating devices, and controls include those in lists below. Provide sensors, transducers, terminals, relays, and wiring required to support listed items. Alarms include audible signals and visual displays.
- C. Indications: Plain-language messages on a digital LCD or LED.
1. Quantitative indications shall include the following:
 - a. Input voltage, each phase, line to line.
 - b. Input current, each phase, line to line.
 - c. Bypass input voltage, each phase, line to line.
 - d. Bypass input frequency.
 - e. System output voltage, each phase, line to line.
 - f. System output current, each phase.
 - g. System output frequency.
 - h. DC bus voltage.
 - i. Battery current and direction (charge/discharge).
 - j. Elapsed time discharging battery.
 2. Basic status condition indications shall include the following:
 - a. Normal operation.
 - b. Load-on bypass.
 - c. Load-on battery.
 - d. Inverter off.
 - e. Alarm condition.
 3. Alarm indications shall include the following:
 - a. Bypass ac input overvoltage or undervoltage.
 - b. Bypass ac input overfrequency or underfrequency.
 - c. Bypass ac input and inverter out of synchronization.
 - d. Bypass ac input wrong-phase rotation.

- e. Bypass ac input single-phase condition.
 - f. Bypass ac input filter fuse blown.
 - g. Internal frequency standard in use.
 - h. Battery system alarm.
 - i. Control power failure.
 - j. Fan failure.
 - k. UPS overload.
 - l. Battery-charging control faulty.
 - m. Input overvoltage or undervoltage.
 - n. Input circuit breaker tripped.
 - o. Input wrong-phase rotation.
 - p. Input single-phase condition.
 - q. Approaching end of battery operation.
 - r. Battery undervoltage shutdown.
 - s. Maximum battery voltage.
 - t. Inverter fuse blown.
 - u. Inverter overtemperature.
 - v. Static bypass transfer switch overtemperature.
 - w. Inverter power supply fault.
 - x. Inverter transistors out of saturation.
 - y. Identification of faulty inverter section/leg.
 - z. Inverter output overvoltage or undervoltage.
 - aa. UPS overload shutdown.
 - bb. Inverter current sensor fault.
 - cc. Inverter output contactor open.
 - dd. Inverter current limit.
4. Controls shall include the following:
- a. Inverter on-off.
 - b. UPS start.
 - c. Battery test.
 - d. Alarm silence/reset.
 - e. Output-voltage adjustment.
- D. Dry-form "C" contacts shall be available for remote indication of the following conditions:
- 1. UPS on battery.
 - 2. UPS on-line.
 - 3. UPS load-on bypass.
 - 4. UPS in alarm condition.
 - 5. UPS off (maintenance bypass closed).
- E. Emergency Power Off Switch: Capable of local operation and operation by means of activation by external dry contacts.

2.9 MAINTENANCE BYPASS/ISOLATION PANEL

- A. Description: Manually operated arrangement of switching devices with mechanically actuated contact mechanism arranged to route the flow of power to the load around the rectifier-charger, inverter, and static bypass transfer switch.
 - 1. Switches shall be electrically and mechanically interlocked to prevent interrupting power to the load when switching to bypass mode.
 - 2. Switches shall electrically isolate other UPS components to permit safe servicing.
- B. Comply with NEMA PB 2 and UL 891.
- C. Switch Rating: Continuous duty at rated full UPS load current.
- D. Mounting Provisions: Separate wall-mounted unit.
- E. Key interlock requires unlocking maintenance bypass/isolation panel before switching from normal position with key that is released only when the UPS is bypassed by the static bypass transfer switch. Lock is designed specifically for mechanical and electrical component interlocking.

2.10 MONITORING BY REMOTE COMPUTER

- A. Description: Communication module in unit control panel provides capability for remote monitoring of status, parameters, and alarms specified in "Controls and Indications" Article. The remote computer and the connecting signal wiring are not included in this Section. Include the following features:
 - 1. Connectors and network interface units or modems for data transmission via RS-232 link.
 - 2. Software designed for control and monitoring of UPS functions and to provide on-screen explanations, interpretations, diagnosis, action guidance, and instructions for use of monitoring indications and development of meaningful reports. Permit storage and analysis of power-line transient records

2.11 BASIC BATTERY MONITORING

- A. 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:
 - 1. [Albercorp.](#)
 - 2. [BTECH, Inc.](#)
 - 3. [Eaton Corporation.](#)
- B. Battery Ground-Fault Detector: Initiates alarm when resistance to ground of positive or negative bus of battery is less than 5000 ohms.
- C. Battery compartment smoke/high-temperature detector initiates an alarm when smoke or a temperature greater than 75 deg C occurs within the compartment.

- D. Annunciation of Alarms: At UPS control panel and remote computer.

2.12 BATTERY-CYCLE WARRANTY MONITORING

- A. Description: Electronic device, acceptable to battery manufacturer as a basis for warranty action, for monitoring of charge-discharge cycle history of batteries covered by cycle-life warranties.
- B. Performance: Automatically measures and records each discharge event, classifies it according to duration category, and totals discharges according to warranty criteria, displaying remaining warranted battery life on front panel display.
- C. Additional monitoring functions and features shall include the following:
 - 1. Measuring and Recording: Total voltage at battery terminals; initiates alarm for excursions outside the proper float-voltage level.
 - 2. Keypad on Device Front Panel: Provides access to monitored data using front panel display.
 - 3. Alarm Contacts: Arranged to initiate local and remote alarm for battery discharge events or abnormal battery voltage.
 - 4. Memory: Stores recorded data in nonvolatile electronic memory.
 - 5. RS-232 Port: Permits downloading of data to a portable PC.
 - 6. Modem: Makes measurements and recorded data accessible to a remote PC via telephone line. Computer is not specified in this Section.

2.13 SOURCE QUALITY CONTROL

- A. Factory test complete UPS system before shipment. Include the following:
 - 1. Test and demonstration of all functions, controls, indicators, sensors, and protective devices.
 - 2. Full-load test.
 - 3. Transient-load response test.
 - 4. Overload test.
 - 5. Power failure test.
- B. Observation of Test: Give 14 days' advance notice of tests and provide opportunity for Owner's representative to observe tests at Owner's choice.
- C. Report test results. Include the following data:
 - 1. Description of input source and output loads used. Describe actions required to simulate source load variation and various operating conditions and malfunctions.
 - 2. List of indications, parameter values, and system responses considered satisfactory for each test action. Include tabulation of actual observations during test.
 - 3. List of instruments and equipment used in factory tests.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for conditions affecting performance of the UPS.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Equipment Mounting: Install UPS on concrete base. Comply with requirements for concrete base specified in Division 03.
 - 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.
 - 2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 - 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 4. Install anchor bolts to elevations required for proper attachment to supported equipment.
- B. Maintain minimum clearances and workspace at equipment according to manufacturer's written instructions and NFPA 70.
- C. Connections: Interconnect system components. Make connections to supply and load circuits according to manufacturer's wiring diagrams unless otherwise indicated.

3.3 GROUNDING

- A. Separately Derived Systems: Comply with NFPA 70 requirements for connecting to grounding electrodes and for bonding to metallic piping near isolation transformer.

3.4 IDENTIFICATION

- A. Identify components and wiring according to Section 260553 "Identification for Electrical Systems."
 - 1. Identify each battery cell individually.

3.5 BATTERY EQUALIZATION

- A. Equalize charging of battery cells according to manufacturer's written instructions. Record individual-cell voltages.

3.6 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Tests and Inspections:
1. Comply with manufacturer's written instructions.
 2. Inspect interiors of enclosures, including the following:
 - a. Integrity of mechanical and electrical connections.
 - b. Component type and labeling verification.
 - c. Ratings of installed components.
 3. Inspect batteries and chargers according to requirements in NETA Acceptance Testing Specifications.
 4. Test manual and automatic operational features and system protective and alarm functions.
 5. Test communication of status and alarms to remote monitoring equipment.
 6. Load the system using a variable-load bank to simulate kilovolt amperes, kilowatts, and power factor of loads for unit's rating. Use instruments calibrated within the previous six months according to NIST standards.
 - a. Simulate malfunctions to verify protective device operation.
 - b. Test duration of supply on emergency, low-battery voltage shutdown, and transfers and restoration due to normal source failure.
 - c. Test harmonic content of input and output current less than 25, 50, and 100 percent of rated loads.
 - d. Test output voltage under specified transient-load conditions.
 - e. Test efficiency at 50, 75, and 100 percent of rated loads.
 - f. Test remote status and alarm panel functions.
 - g. Test battery-monitoring system functions.
- C. Seismic-restraint tests and inspections shall include the following:
1. Inspect type, size, quantity, arrangement, and proper installation of mounting or anchorage devices.
 2. Test mounting and anchorage devices according to requirements in Section 260548.16 "Seismic Controls for Electrical Systems."
- D. The UPS system will be considered defective if it does not pass tests and inspections.
- E. Record of Tests and Inspections: Maintain and submit documentation of tests and inspections, including references to manufacturers' written instructions and other test and inspection criteria. Include results of tests, inspections, and retests.
- F. Prepare test and inspection reports.

3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain the UPS.

END OF SECTION 263353

SECTION 263600 - TRANSFER SWITCHES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes transfer switches rated 600 V and less, including the following:
 - 1. Automatic transfer switches.
- B. Related Requirements:
 - 1. Division 21 for automatic transfer switches for fire pumps.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, weights, operating characteristics, furnished specialties, and accessories.
- B. Shop Drawings: Dimensioned plans, elevations, sections, and details showing minimum clearances, conductor entry provisions, gutter space, installed features and devices, and material lists for each switch specified.
 - 1. Single-Line Diagram: Show connections between transfer switch, bypass/isolation switch, power sources, and load; and show interlocking provisions for each combined transfer switch and bypass/isolation switch.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For manufacturer.
- B. Manufacturer Seismic Qualification Certification: Submit certification that transfer switches accessories, and components will withstand seismic forces defined in Section 260548 "Vibration and Seismic Controls for Electrical Systems." Include the following:
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01, include the following:
1. Features and operating sequences, both automatic and manual.
 2. List of all factory settings of relays; provide relay-setting and calibration instructions, including software, where applicable.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Maintain a service center capable of providing training, parts, and emergency maintenance repairs within a response period of less than eight hours from time of notification.
- B. Source Limitations: Obtain automatic transfer switches through one source from a single manufacturer.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Comply with NEMA ICS 1.
- E. Comply with NFPA 70.
- F. Comply with NFPA 99.
- G. Comply with NFPA 110.
- H. Comply with UL 1008 unless requirements of these Specifications are stricter.

1.7 FIELD CONDITIONS

- A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service:
1. Notify Owner no fewer than five days in advance of proposed interruption of electrical service.
 2. Do not proceed with interruption of electrical service without Owner's written permission.

1.8 COORDINATION

- A. For floor mounted equipment, coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Section 033000 "Cast-in-Place Concrete."

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

- A. Contactor Transfer Switches:
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide products manufactured by Emerson; ASCO Power Technologies, LP or comparable product by one of the following:
 - a. Kohler Power Systems; Generator Division.
 - b. Onan/Cummins Power Generation; Industrial Business Group.
 - c. Russelectric, Inc.

2.2 GENERAL TRANSFER-SWITCH PRODUCT REQUIREMENTS

- A. Indicated Current Ratings: Apply as defined in UL 1008 for continuous loading and total system transfer, including tungsten filament lamp loads not exceeding 30 percent of switch ampere rating, unless otherwise indicated.
- B. Tested Fault-Current Closing and Withstand Ratings: Adequate for duty imposed by protective devices at installation locations in Project under the fault conditions indicated, based on testing according to UL 1008.
 - 1. Where transfer switch includes internal fault-current protection, rating of switch and trip unit combination shall exceed indicated fault-current value at installation location.
- C. Suitable for use as service equipment, with manual disconnecting means and overcurrent protective device.
- D. Solid-State Controls: Repetitive accuracy of all settings shall be plus or minus 2 percent or better over an operating temperature range of minus 20 to plus 70 deg C.
- E. Resistance to Damage by Voltage Transients: Components shall meet or exceed voltage-surge withstand capability requirements when tested according to IEEE C62.41. Components shall meet or exceed voltage-impulse withstand test of NEMA ICS 1.
- F. Electrical Operation: Accomplish by a nonfused, momentarily energized solenoid or electric-motor-operated mechanism, mechanically and electrically interlocked in both directions.
- G. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.

1. Limitation: Switches using molded-case switches or circuit breakers or insulated-case circuit-breaker components are not acceptable.
 2. Switch Action: Double throw; mechanically held in both directions.
 3. Contacts: Silver composition or silver alloy for load-current switching. Conventional automatic transfer-switch units, rated 225 A and higher, shall have separate arcing contacts.
- H. Neutral Terminal: Solid and fully rated, unless otherwise indicated.
- I. Factory Wiring: Train and bundle factory wiring and label, consistent with Shop Drawings, either by color-code or by numbered or lettered wire and cable tape markers at terminations. Color-coding and wire and cable tape markers are specified in Section 260553 "Identification for Electrical Systems."
1. Designated Terminals: Pressure type, suitable for types and sizes of field wiring indicated.
 2. Power-Terminal Arrangement and Field-Wiring Space: Suitable for top, side, or bottom entrance of feeder conductors as indicated.
 3. Control Wiring: Equipped with lugs suitable for connection to terminal strips.
- J. Enclosures: Comply with NEMA ICS 6 and UL 508. Indoor enclosures shall be NEMA 250, Type 1 unless otherwise indicated. Outdoor enclosures shall be NEMA 250, Type 3R with strip heater.

2.3 AUTOMATIC TRANSFER SWITCHES

- A. Comply with Level 1 equipment according to NFPA 110.
- B. Switching Arrangement: Double-throw type, incapable of pauses or intermediate position stops during normal functioning, unless otherwise indicated.
- C. Manual Switch Operation: Unloaded. Control circuit automatically disconnects from electrical operator during manual operation.
- D. Signal-Before-Transfer Contacts: A set of normally open/normally closed dry contacts operates in advance of retransfer to normal source. Interval is adjustable from 1 to 30 seconds.
- E. In-Phase Monitor: Factory-wired, internal relay controls transfer so it occurs only when the two sources are synchronized in phase. Relay compares phase relationship and frequency difference between normal and emergency sources and initiates transfer when both sources are within 15 electrical degrees, and only if transfer can be completed within 60 electrical degrees. Transfer is initiated only if both sources are within 2 Hz of nominal frequency and 70 percent or more of nominal voltage.
- F. Motor Disconnect and Timing Relay: Controls designate starters so they disconnect motors before transfer and reconnect them selectively at an adjustable time interval after transfer. Control connection to motor starters is through wiring external to automatic transfer switch. Time delay for reconnecting individual motor loads is adjustable between 1 and 60 seconds, and settings are as indicated. Relay contacts handling motor-control circuit inrush and seal currents are rated for actual currents to be encountered.

G. Automatic Transfer-Switch Features:

1. Undervoltage Sensing for Each Phase of Normal Source: Sense low phase-to-ground voltage on each phase. Pickup voltage shall be adjustable from 85 to 100 percent of nominal, and dropout voltage is adjustable from 75 to 98 percent of pickup value. Factory set for pickup at 90 percent and dropout at 85 percent.
2. Adjustable Time Delay: For override of normal-source voltage sensing to delay transfer and engine start signals. Adjustable from zero to six seconds, and factory set for one second.
3. Voltage/Frequency Lockout Relay: Prevent premature transfer to generator. Pickup voltage shall be adjustable from 85 to 100 percent of nominal. Factory set for pickup at 90 percent. Pickup frequency shall be adjustable from 90 to 100 percent of nominal. Factory set for pickup at 95 percent.
4. Time Delay for Retransfer to Normal Source: Adjustable from 0 to 30 minutes, and factory set for 10 minutes to automatically defeat delay on loss of voltage or sustained undervoltage of emergency source, provided normal supply has been restored.
5. Test Switch: Simulate normal-source failure.
6. Switch-Position Pilot Lights: Indicate source to which load is connected.
7. Source-Available Indicating Lights: Supervise sources via transfer-switch normal- and emergency-source sensing circuits.
 - a. Normal Power Supervision: Green light with nameplate engraved "Normal Source Available."
 - b. Emergency Power Supervision: Red light with nameplate engraved "Emergency Source Available."
8. Unassigned Auxiliary Contacts: Two normally open, single-pole, double-throw contacts for each switch position, rated 10 A at 240-V ac.
9. Transfer Override Switch: Overrides automatic retransfer control so automatic transfer switch will remain connected to emergency power source regardless of condition of normal source. Pilot light indicates override status.
10. Engine Starting Contacts: One isolated and normally closed, and one isolated and normally open; rated 10 A at 32-V dc minimum.
11. Engine Shutdown Contacts: Time delay adjustable from zero to five minutes, and factory set for five minutes. Contacts shall initiate shutdown at remote engine-generator controls after retransfer of load to normal source.
12. Engine-Generator Exerciser: Solid-state, programmable-time switch starts engine generator and transfers load to it from normal source for a preset time, then retransfers and shuts down engine after a preset cool-down period. Initiates exercise cycle at preset intervals adjustable from 7 to 30 days. Running periods are adjustable from 10 to 30 minutes. Factory settings are for 7-day exercise cycle, 20-minute running period, and 5-minute cool-down period. Exerciser features include the following:
 - a. Exerciser Transfer Selector Switch: Permits selection of exercise with and without load transfer.
 - b. Push-button programming control with digital display of settings.
 - c. Integral battery operation of time switch when normal control power is not available.

2.4 SOURCE QUALITY CONTROL

- A. Factory test and inspect components, assembled switches, and associated equipment. Ensure proper operation. Check transfer time and voltage, frequency, and time-delay settings for compliance with specified requirements. Perform dielectric strength test complying with NEMA ICS 1.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Design each fastener and support to carry load indicated by seismic requirements and according to seismic-restraint details. See Section 260548 "Vibration and Seismic Controls for Electrical Systems."
- B. Floor-Mounting Switch: Anchor to floor by bolting.
 - 1. Concrete Bases: 4 inches (100 mm) high, reinforced, with chamfered edges. Extend base no more than 4 inches (100 mm) in all directions beyond the maximum dimensions of switch, unless otherwise indicated or unless required for seismic support. Construct concrete bases according to Section 260529 "Hangers and Supports for Electrical Systems."
- C. Identify components according to Section 260553 "Identification for Electrical Systems."
- D. Set field-adjustable intervals and delays, relays, and engine exerciser clock.

3.2 CONNECTIONS

- A. Wiring to Remote Components: Match type and number of cables and conductors to control and communication requirements of transfer switches as recommended by manufacturer. Increase raceway sizes at no additional cost to Owner if necessary to accommodate required wiring.
- B. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- C. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
 - 1. After installing equipment and after electrical circuitry has been energized, test for compliance with requirements.

2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 3. Measure insulation resistance phase-to-phase and phase-to-ground with insulation-resistance tester. Include external annunciation and control circuits. Use test voltages and procedure recommended by manufacturer. Comply with manufacturer's specified minimum resistance.
 - a. Check for electrical continuity of circuits and for short circuits.
 - b. Inspect for physical damage, proper installation and connection, and integrity of barriers, covers, and safety features.
 - c. Verify that manual transfer warnings are properly placed.
 - d. Perform manual transfer operation.
 4. After energizing circuits, demonstrate interlocking sequence and operational function for each switch at least three times.
 - a. Simulate power failures of normal source to automatic transfer switches and of emergency source with normal source available.
 - b. Simulate loss of phase-to-ground voltage for each phase of normal source.
 - c. Verify time-delay settings.
 - d. Verify pickup and dropout voltages by data readout or inspection of control settings.
 - e. Perform contact-resistance test across main contacts and correct values exceeding 500 microhms and values for 1 pole deviating by more than 50 percent from other poles.
 - f. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown.
 5. Ground-Fault Tests: Coordinate with testing of ground-fault protective devices for power delivery from both sources.
 - a. Verify grounding connections and locations and ratings of sensors.
- B. Coordinate tests with tests of generator and run them concurrently.
- C. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation and contact resistances and time delays. Attach a label or tag to each tested component indicating satisfactory completion of tests.
- D. Remove and replace malfunctioning units and retest as specified above.
- E. Prepare test and inspection reports.
- F. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switch. Remove all access panels so joints and connections are accessible to portable scanner.
1. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

2. Record of Infrared Scanning: Prepare a certified report that identifies switches checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.4 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain transfer switches and related equipment as specified below. Refer to Section 017900 "Demonstration and Training."
- B. Coordinate this training with that for generator equipment.

END OF SECTION 263600

SECTION 265119 - LED INTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

- 1. Interior solid-state luminaires that use LED technology.
- 2. Lighting fixture supports.

B. Related Requirements:

- 1. Section 260923"Lighting Control Devices" for automatic control of lighting, including photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.

1.3 DEFINITIONS

- A. CCT: Correlated color temperature.
- B. CRI: Color Rendering Index.
- C. Fixture: See "Luminaire."
- D. IP: International Protection or Ingress Protection Rating.
- E. LED: Light-emitting diode.
- F. Lumen: Measured output of lamp and luminaire, or both.
- G. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

- 1. Arrange in order of luminaire designation.
- 2. Include data on features, accessories, and finishes.
- 3. Include physical description and dimensions of luminaires.
- 4. Include life, output (lumens, CCT, and CRI), and energy efficiency data.
- 5.

6. Photometric data and adjustment factors based on laboratory tests IES LM-79 and IES LM-80.
 - a. Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.
- B. Samples for Verification: As requested by Architect.
 1. Include Samples of luminaires and accessories to verify finish selection.
- C. Product Schedule: For luminaires and lamps. Use same designations indicated on Drawings.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For luminaires and lighting systems to include in operation and maintenance manuals.
 1. Provide a list of all lamp module types used on Project; use ANSI and manufacturers' codes.

1.6 QUALITY ASSURANCE

- A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturer's laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.
- B. Provide luminaires from a single manufacturer for each luminaire type.
- C. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

PART 2 - PRODUCTS

2.1 LUMINAIRE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. NRTL Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by an NRTL.
- C. Recessed Fixtures: Comply with NEMA LE 4.

- D. CRI of minimum 70. CCT as scheduled on the drawings.
- E. Rated lamp life of 50,000 hours.
- F. Lamps dimmable from 100 percent to 0 percent of maximum light output where dimming control is indicated on the drawings.
- G. Internal driver or remote driver as applicable for each scheduled luminaire.
- H. Nominal Operating Voltage: As scheduled on the drawings. .
 - 1. Lens Thickness: At least 0.125 inch (3.175 mm) minimum unless otherwise indicated.

2.2 MATERIALS

- A. Metal Parts:
 - 1. Free of burrs and sharp corners and edges.
 - 2. Sheet metal components shall be steel unless otherwise indicated.
 - 3. Form and support to prevent warping and sagging.
- B. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.
- C. Diffusers and Globes:
 - 1. Acrylic Diffusers: One hundred percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
 - 2. Glass: Annealed crystal glass unless otherwise indicated.
 - 3. Lens Thickness: At least 0.125 inch (3.175 mm) minimum unless otherwise indicated.
- D. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Locate labels where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
 - 1. Label shall include the following lamp characteristics:
 - a. "USE ONLY" and include specific lamp type.
 - b. Lamp diameter, shape, size, wattage, and coating.
 - c. CCT and CRI for all luminaires.

2.3 METAL FINISHES

- A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

2.4 LUMINAIRE FIXTURE SUPPORT COMPONENTS

- A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.
- B. Stem Hangers: **1/2-inch (13-mm)** steel tubing with swivel ball fittings and ceiling canopy. Finish shall match luminaire.
- C. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, **12 gage (2.68 mm)** minimum.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before fixture installation. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 TEMPORARY LIGHTING

- A. If approved by the Architect, use selected permanent luminaires for temporary lighting. When construction is sufficiently complete, clean luminaires used for temporary lighting and install new lamps.

3.3 INSTALLATION

- A. Comply with NECA 1.
- B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.
- C. Install lamps in each luminaire.
- D. Supports:
 - 1. Sized and rated for luminaire weight.
 - 2. Able to maintain luminaire position after cleaning and relamping.
 - 3. Provide support for luminaire without causing deflection of ceiling or wall.
 - 4. Luminaire mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and vertical force of 400 percent of luminaire weight.

- E. Ceiling-Grid-Mounted Luminaire Supports: Use grid as a support element.
1. Install ceiling support system rods or wires, independent of the ceiling suspension devices, for each luminaire. Locate not more than **6 inches (150 mm)** from luminaire corners.
 2. Support Clips: Fasten to luminaires and to ceiling grid members at or near each luminaire corner with clips that are UL listed for the application.
 3. Luminaires of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support luminaires independently with at least two metal channels spanning and secured to ceiling tees.
 4. Install at least one independent support rod or wire from structure to a tab on luminaire. Wire or rod shall have breaking strength of the luminaire weight at a safety factor of 3.
- F. Flush-Mounted Luminaire Support:
1. Secured to outlet box.
 2. Attached to ceiling structural members at four points equally spaced around circumference of luminaire.
 3. Trim ring flush with finished surface.
- G. Wall-Mounted Luminaire Support:
1. Attached to structural members in walls
 2. Attached to a minimum 20 gauge backing plate attached to wall structural members
 3. Attached using through bolts and backing plates on either side of wall.
 4. Do not attach luminaires directly to gypsum board.
- H. Suspended Luminaire Support:
1. Pendants and Rods: Where longer than **48 inches (1200 mm)**, brace to limit swinging.
 2. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.
 3. Continuous Rows of Luminaires: Use tubing or cord for wiring at one point and wire support for suspension for each unit length of luminaire chassis, including one at each end.
 4. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.
- I. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.

3.4 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
 - 2. Test for Emergency Lighting: Interrupt normal power supply to demonstrate proper operation. Verify transfer from normal power to emergency power and retransfer to normal.
- B. Luminaire will be considered defective if it does not pass operation tests and inspections.

3.6 STARTUP SERVICE

- A. Comply with requirements for startup specified in Section 260943 "Network Lighting Controls."

END OF SECTION 265119

SECTION 265219 - EMERGENCY AND EXIT LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Exit signs.
 - 2. Emergency lighting units.
 - 3. Luminaire supports.

1.3 DEFINITIONS

- A. CCT: Correlated color temperature.
- B. CRI: Color Rendering Index.
- C. Fixture: See "Luminaire" Paragraph.
- D. Lumen: Measured output of lamp and luminaire, or both.
- E. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of emergency lighting unit, exit sign, and emergency lighting support.
 - 1. Include data on features, accessories, and finishes.
 - 2. Include physical description of the unit and dimensions.
 - 3. Battery and charger for light units.
 - 4. Include life, output of luminaire (lumens, CCT, and CRI), and energy-efficiency data.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For luminaires and lighting systems to include in emergency, operation, and maintenance manuals.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR EMERGENCY LIGHTING

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. NRTL Compliance: Fabricate and label emergency lighting units, exit signs, and batteries to comply with UL 924.
- C. Comply with NFPA 70 and NFPA 101.
- D. Comply with NEMA LE 4 for recessed luminaires.
- E. Internal Type Emergency Power Unit: Self-contained, modular, battery-inverter unit, factory mounted within luminaire body and compatible with ballast.
 - 1. Emergency Connection: Operate LED light engine continuously at an output of 1100 lumens each upon loss of normal power. Connect unswitched circuit to battery-inverter unit and switched circuit to luminaire ballast.
 - 2. Operation: Relay automatically turns lamp on when power-supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
 - 3. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - a. Ambient Temperature: Less than 0 deg F (minus 18 deg C) or exceeding 104 deg F (40 deg C), with an average value exceeding 95 deg F (35 deg C) over a 24-hour period.
 - b. Ambient Storage Temperature: Not less than minus 4 deg F (minus 20 deg C) and not exceeding 140 deg F (60 deg C).
 - c. Humidity: More than 95 percent (condensing).
 - d. Altitude: Exceeding 3300 feet (1000 m).
 - 4. Nightlight Connection: Operate lamp continuously at 40 percent of rated light output.
 - 5. Test Push-Button and Indicator Light: Visible and accessible without opening luminaire or entering ceiling space.
 - a. Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
 - b. Indicator Light: LED indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.

6. Battery: Sealed, maintenance-free, nickel-cadmium type.
 7. Charger: Fully automatic, solid-state, constant-current type with sealed power transfer relay.
 8. Remote Test: Switch in handheld remote device aimed in direction of tested unit initiates coded infrared signal. Signal reception by factory-installed infrared receiver in tested unit triggers simulation of loss of its normal power supply, providing visual confirmation of either proper or failed emergency response.
 9. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.
- F. External Type: Self-contained, modular, battery-inverter unit, suitable for powering one or more lamps, remote mounted from luminaire.
1. Emergency Connection: Operate LED light engine continuously. Connect unswitched circuit to battery-inverter unit and switched circuit to luminaire.
 2. Operation: Relay automatically turns lamp on when power-supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
 3. Nightlight Connection: Operate lamp in a remote luminaire continuously.
 4. Battery: Sealed, maintenance-free, nickel-cadmium type.
 5. Charger: Fully automatic, solid-state, constant-current type.
 6. Housing: NEMA 250, Type 1 enclosure listed for installation inside, on top of, or remote from luminaire. Remote assembly shall be located no less than half the distance recommended by the emergency power unit manufacturer, whichever is less.
 7. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
 8. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
 9. Remote Test: Switch in handheld remote device aimed in direction of tested unit initiates coded infrared signal. Signal reception by factory-installed infrared receiver in tested unit triggers simulation of loss of its normal power supply, providing visual confirmation of either proper or failed emergency response.
 10. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.

2.2 EXIT SIGNS

- A. General Requirements for Exit Signs: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.
- B. Internally Lighted Signs:
1. Operating at nominal voltage of 120 V ac.
 2. Lamps for AC Operation: LEDs; 50,000 hours minimum rated lamp life.
 3. Self-Powered Exit Signs (Battery Type): Internal emergency power unit.

2.3 MATERIALS

A. Metal Parts:

1. Free of burrs and sharp corners and edges.
2. Sheet metal components shall be steel unless otherwise indicated.
3. Form and support to prevent warping and sagging.

B. Doors, Frames, and Other Internal Access:

1. Smooth operating, free of light leakage under operating conditions.
2. Designed to permit relamping without use of tools.
3. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

2.4 METAL FINISHES

- A. 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.

2.5 LUMINAIRE SUPPORT COMPONENTS

- A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.
- B. Support Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, 12 gage (2.68 mm).

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for conditions affecting performance of luminaires.
- B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before luminaire installation.
- C. Examine walls, floors, roofs, and ceilings for suitable conditions where emergency lighting luminaires will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with NECA 1.

- B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.
- C. Install lamps in each luminaire.
- D. Supports:
 - 1. Sized and rated for luminaire and emergency power unit weight.
 - 2. Able to maintain luminaire position when testing emergency power unit.
 - 3. Provide support for luminaire and emergency power unit without causing deflection of ceiling or wall.
 - 4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire and emergency power unit weight and vertical force of 400 percent of luminaire weight.
- E. Wall-Mounted Luminaire Support:
 - 1. Attached to structural members in walls.
 - 2. Do not attach luminaires directly to gypsum board.
- F. Suspended Luminaire Support:
 - 1. Pendants and Rods: Where longer than 48 inches (1200 mm), brace to limit swinging.
 - 2. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.
 - 3. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.
- G. Ceiling Grid Mounted Luminaires:
 - 1. Secure to any required outlet box.
 - 2. Secure emergency power unit using approved fasteners in a minimum of four locations, spaced near corners of emergency power unit.
 - 3. Use approved devices and support components to connect luminaire to ceiling grid and building structure in a minimum of four locations, spaced near corners of luminaire.

3.3 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.
- B. Luminaire will be considered defective if it does not pass operation tests and inspections.

3.5 STARTUP SERVICE

A. Perform startup service:

1. Charge emergency power units and batteries minimum of one hour and depress switch to conduct short-duration test.
2. Charge emergency power units and batteries minimum of 24 hours and conduct one-hour discharge test.

END OF SECTION 265219

SECTION 280513 - CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. RS-232 cabling.
 - 2. RS-485 cabling.
 - 3. Fire alarm wire and cable.
 - 4. Identification products.

1.3 DEFINITIONS

- A. BICSI: Building Industry Consulting Service International.
- B. EMI: Electromagnetic interference.
- C. IDC: Insulation displacement connector.
- D. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control and signaling power-limited circuits.
- E. Open Cabling: Passing telecommunications cabling through open space (e.g., between the studs of a wall cavity).
- F. RCDD: Registered Communications Distribution Designer.

1.4 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Pathways shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Qualification Data: For qualified layout technician, installation supervisor, and field inspector.
- C. Seismic Qualification Certificates: For pathways, accessories, and components, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- D. Field quality-control reports.
- E. Operation and Maintenance Data: For wire and cable to include in operation and maintenance manuals. In addition to items specified in Division 01, include the following:
 - 1. Allowable pulling tension of cable.
 - 2. Cable connectors and terminations recommended by the manufacturer.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An NRTL.
 - 1. Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.
- B. 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.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.7 PROJECT CONDITIONS

- A. Do not install conductors and cables that are wet, moisture damaged, or mold damaged.
 - 1. Indications that wire and cables are wet or moisture damaged include, but are not limited to, discoloration and sagging of factory packing materials.
- B. Environmental Limitations: Do not deliver or install UTP, optical fiber, and coaxial cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC

system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

PART 2 - PRODUCTS

2.1 PATHWAYS

- A. Conduit and Boxes: Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems."
- B. Outlet boxes shall be no smaller than 2 inches (50 mm) wide, 3 inches (75 mm) high, and 2-1/2 inches (64 mm) deep.

2.2 RS-232 CABLE

- A. Standard Cable: NFPA 70, Type CMR.
 - 1. Paired, 2 pairs, No. 22 AWG, stranded (7x30) tinned copper conductors.
 - 2. Polypropylene insulation.
 - 3. Individual aluminum foil-polyester tape shielded pairs with 100 percent shield coverage.
 - 4. PVC jacket.
 - 5. Pairs are cabled on common axis with No. 24 AWG, stranded (7x32) tinned copper drain wire.
 - 6. Flame Resistance: Comply with UL 1581.
- B. Plenum-Rated Cable: NFPA 70, Type CMP.
 - 1. Paired, 2 pairs, No. 22 AWG, stranded (7x30) tinned copper conductors.
 - 2. Plastic insulation.
 - 3. Individual aluminum foil-polyester tape shielded pairs with 100 percent shield coverage.
 - 4. Plastic jacket.
 - 5. Pairs are cabled on common axis with No. 24 AWG, stranded (7x32) tinned copper drain wire.
 - 6. Flame Resistance: Comply with NFPA 262.

2.3 RS-485 CABLE

- A. Standard Cable: NFPA 70, Type CMR.
 - 1. Paired, 2 pairs, twisted, No. 22 AWG, stranded (7x30) tinned copper conductors.
 - 2. PVC insulation.
 - 3. Unshielded.
 - 4. PVC jacket.
 - 5. Flame Resistance: Comply with UL 1581.
- B. Plenum-Rated Cable: NFPA 70, Type CMP.

1. Paired, 2 pairs, No. 22 AWG, stranded (7x30) tinned copper conductors.
2. Fluorinated ethylene propylene insulation.
3. Unshielded.
4. Fluorinated ethylene propylene jacket.
5. Flame Resistance: NFPA 262, Flame Test.

2.4 FIRE ALARM WIRE AND CABLE

- A. 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:
1. Comtran Corporation.
 2. Draka Cableteq USA.
 3. Genesis Cable Products; Honeywell International, Inc.
 4. Rockbestos-Suprenant Cable Corp.
 5. West Penn Wire; a brand of Belden Inc.
- B. General Wire and Cable Requirements: NRTL listed and labeled as complying with NFPA 70, Article 760.
- C. Signaling Line Circuits: Size as recommended by system manufacturer, but not less than No. 16 AWG. Use twisted, shielded pair where recommended by system manufacturer.
1. Circuit Integrity Cable: Twisted shielded pair, NFPA 70, Article 760, Classification CI, for power-limited fire alarm signal service Type FPL. NRTL listed and labeled as complying with UL 1424 and UL 2196 for a 2-hour rating.
- D. Non-Power-Limited Circuits: Solid-copper conductors with 600-V rated, 75 deg C, color-coded insulation.
1. Low-Voltage Circuits: No. 16 AWG, minimum.
 2. Line-Voltage Circuits: No. 12 AWG, minimum.
 3. Multiconductor Armored Cable: NFPA 70, Type MC, copper conductors, Type TFN/THHN conductor insulation, copper drain wire, copper armor with red identifier stripe, NRTL listed for fire alarm and cable tray installation, plenum rated, and complying with requirements in UL 2196 for a 2-hour rating.

2.5 IDENTIFICATION PRODUCTS

- A. 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:
1. Brady Corporation.
 2. HellermannTyton.
 3. Kroy LLC.
 4. PANDUIT CORP.
- B. Comply with UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

- C. Comply with requirements in Division 26 Section "Identification for Electrical Systems."

PART 3 - EXECUTION

3.1 INSTALLATION OF PATHWAYS

- A. Comply with TIA-569-B for pull-box sizing and length of conduit and number of bends between pull points.
- B. Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems." for installation of conduits and wireways.
- C. Install manufactured conduit sweeps and long-radius elbows whenever possible.

3.2 INSTALLATION OF HANGERS AND SUPPORTS

- A. Comply with requirements in Division 26 Section "Hangers and Supports for Electrical Systems." for installation of supports for pathways, conductors and cables.

3.3 WIRING METHOD

- A. Install wiring in metal raceways and wireways. Conceal raceway except in unfinished spaces and as indicated. Minimum conduit size shall be ½ inch. Control and data transmission wiring shall not share conduit with other building wiring systems.
- B. Install wiring in raceways except in accessible indoor ceiling spaces and in interior hollow gypsum board partitions where cable may be used. Conceal raceways and wiring except in unfinished spaces and as indicated. Minimum conduit size shall be ½ inch. Control and data transmission wiring shall not share conduit with other building wiring systems.
- C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points. Use lacing bars and distribution spools. Separate power-limited and non-power-limited conductors as recommended in writing by manufacturer. Install conductors parallel with or at right angles to sides and back of enclosure. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with intrusion system to terminal blocks. Mark each terminal according to system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.

3.4 INSTALLATION OF CONDUCTORS AND CABLES

- A. Comply with NECA 1.
- B. Conductors: Size according to system manufacturer's written instructions unless otherwise indicated.
- C. General Requirements for Cabling:

1. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
2. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
3. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.

D. Open-Cable Installation:

1. Suspend copper cable not in a wireway or pathway a minimum of 8 inches (200 mm) above ceilings by cable supports not more than 60 inches (1525 mm) apart.
2. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

3.5 FIRE ALARM WIRING INSTALLATION

A. Comply with NECA 1 and NFPA 72.

B. Wiring Method:

1. Cables and raceways used for fire alarm circuits, and equipment control wiring associated with the fire alarm system, may not contain any other wire or cable.
2. Fire-Rated Cables: Use of 2-hour, fire-rated fire alarm cables, NFPA 70, Types MI and CI, is permitted.
3. Signaling Line Circuits: Power-limited fire alarm cables shall not be installed in the same cable or raceway as signaling line circuits.

C. Wiring within Enclosures: Separate power-limited and non-power-limited conductors as recommended by manufacturer. Install conductors parallel with or at right angles to sides and back of the enclosure. Bundle, lace, and train 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.

D. Cable Taps: Use numbered terminal strips in junction, pull, and outlet boxes, cabinets, or equipment enclosures where circuit connections are made.

E. Color-Coding: Color-code fire alarm conductors differently from the normal building power wiring. Use one color-code for alarm circuit wiring and another for supervisory circuits. Color-code audible alarm-indicating circuits differently from alarm-initiating circuits. Use different colors for visible alarm-indicating devices. Paint fire alarm system junction boxes and covers red.

F. Risers: Install at least two 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 signals from other floors or zones.

- G. Wiring to Remote Alarm Transmitting Device: 1-inch (25-mm) conduit between the fire alarm control panel and the transmitter. Install number of conductors and electrical supervision for connecting wiring as needed to suit monitoring function.

3.6 POWER AND CONTROL-CIRCUIT CONDUCTORS

- A. 120-V Power Wiring: Install according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables" unless otherwise indicated.
- B. Minimum Conductor Sizes:
 - 1. Class 1 remote-control and signal circuits, No. 14 AWG.
 - 2. Class 2 low-energy, remote-control and signal circuits, No. 16 AWG.
 - 3. Class 3 low-energy, remote-control, alarm and signal circuits, No. 12 AWG.

3.7 CONNECTIONS

- A. Comply with requirements in Division 28 Section "Perimeter Security Systems" for connecting, terminating, and identifying wires and cables.
- B. Comply with requirements in Division 28 Section "Intrusion Detection" for connecting, terminating, and identifying wires and cables.
- C. Comply with requirements in Division 28 Section "Access Control" for connecting, terminating, and identifying wires and cables.
- D. Comply with requirements in Division 28 Section "Video Surveillance" for connecting, terminating, and identifying wires and cables.
- E. Comply with requirements in Division 28 Section "Digital Addressable Fire-Alarm System" for connecting, terminating, and identifying wires and cables.

3.8 FIRESTOPPING

- A. Comply with requirements in Division 07.
- B. Comply with TIA-569-B, "Firestopping" Annex A.
- C. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.9 GROUNDING

- A. For low-voltage wiring and cabling, comply with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems."

3.10 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.11 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
 - 2. Test cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors.
- C. Document data for each measurement. Print data for submittals in a summary report that is formatted using Table 10.1 in BICSI TDMM as a guide, or transfer the data from the instrument to the computer, save as text files, print, and submit.
- D. Cabling will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

END OF SECTION 280513

SECTION 283111-DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Fire-alarm control unit.
2. Manual fire-alarm boxes.
3. System smoke detectors.
4. Heat detectors.
5. Notification appliances.
6. Magnetic door holders.
7. Remote annunciator.
8. Addressable interface device.
9. Digital alarm communicator transmitter.

1.3 DEFINITIONS

- A. LED: Light-emitting diode.
- B. NICET: National Institute for Certification in Engineering Technologies.

1.4 SYSTEM DESCRIPTION

- A. Noncoded addressable system, with automatic sensitivity control of certain smoke detectors and multiplexed signal transmission, dedicated to fire-alarm service only.

1.5 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Fire-alarm control unit and raceways shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.
 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.6 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For fire-alarm system. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Comply with recommendations in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72.
 - 2. Include voltage drop calculations for notification appliance circuits.
 - 3. Include battery-size calculations.
 - 4. Include performance parameters and installation details for each detector, verifying that each detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
 - 5. Include plans, sections, and elevations of heating, ventilating, and air-conditioning ducts, drawn to scale and coordinating installation of duct smoke detectors and access to them. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators. Locate detectors according to manufacturer's written recommendations.
 - 6. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits.
- C. General Submittal Requirements:
 - 1. Submittals shall be approved by authorities having jurisdiction prior to submitting them to Architect.
 - 2. Shop Drawings shall be prepared by persons with the following qualifications:
 - a. Trained and certified by manufacturer in fire-alarm system design.
 - b. NICET-certified fire-alarm technician.
 - c. Licensed or certified by authorities having jurisdiction.
- D. Seismic Qualification Certificates: For fire-alarm control unit, accessories, and components, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- E. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 include the following:
 - 1. Comply with the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.

2. Provide "Record of Completion Documents" according to NFPA 72 article "Permanent Records" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter.
3. Record copy of site-specific software.
4. Provide "Maintenance, Inspection and Testing Records" according to NFPA 72 article of the same name and include the following:
 - a. Frequency of testing of installed components.
 - b. Frequency of inspection of installed components.
 - c. Requirements and recommendations related to results of maintenance.
 - d. Manufacturer's user training manuals.
5. Manufacturer's required maintenance related to system warranty requirements.
6. Abbreviated operating instructions for mounting at fire-alarm control unit.

F. Software and Firmware Operational Documentation:

1. Software operating and upgrade manuals.
2. Program Software Backup: On magnetic media or compact disk, complete with data files.
3. Device address list.
4. Printout of software application and graphic screens.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.
- B. Source Limitations for Fire-Alarm System and Components: Obtain fire-alarm system from single source from single manufacturer.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. NFPA Certification: Obtain certification according to NFPA 72 by a UL-listed alarm company.

1.8 PROJECT CONDITIONS

- A. Coordinate all device programming and addressing with the Owner.

1.9 SOFTWARE SERVICE AGREEMENT

- A. Comply with UL 864.
- B. Technical Support: Beginning with Substantial Completion, provide software support for two years.
- C. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within two years from date of Substantial Completion.

Upgrading software shall include operating system. Upgrade shall include new or revised licenses for use of software.

1. Provide 30 days' notice to Owner to allow scheduling and access to system and to allow Owner to upgrade computer equipment if necessary.

1.10 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Lamps for Remote Indicating Lamp Units: Quantity equal to 10 percent of amount installed, but no fewer than 1 unit.
2. Lamps for Strobe Units: Quantity equal to 10 percent of amount installed, but no fewer than 1 unit.
3. Smoke Detectors, Fire Detectors: Quantity equal to 10 percent of amount of each type installed, but no fewer than 1 unit of each type.
4. Detector Bases: Quantity equal to 2 percent of amount of each type installed, but no fewer than 1 unit of each type.
5. Keys and Tools: One extra set for access to locked and tamperproofed components.
6. Audible and Visual Notification Appliances: One of each type installed.
7. Fuses: Two of each type installed in the system.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. 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:

1. Notifier.
2. GAMEWELL; a Honeywell company.
3. Siemens.

2.2 SYSTEMS OPERATIONAL DESCRIPTION

A. Fire-alarm signal initiation shall be by one or more of the following devices and systems:

1. Manual stations.
2. Heat detectors.
3. Smoke detectors.
4. Duct smoke detectors.
5. Verified automatic alarm operation of smoke detectors.
6. Automatic sprinkler system water flow.

7. Heat detectors in elevator shaft and pit.
8. Fire-extinguishing system operation.
9. Fire standpipe system.

B. Fire-alarm signal shall initiate the following actions:

1. Continuously operate alarm notification appliances.
2. Identify alarm at fire-alarm control unit and remote annunciators.
3. Transmit an alarm signal to the remote alarm receiving station.
4. Release fire and smoke doors held open by magnetic door holders.
5. Switch heating, ventilating, and air-conditioning equipment controls to fire-alarm mode.
6. Close smoke dampers in air ducts of designated air-conditioning duct systems.
7. Recall elevators to primary or alternate recall floors.
8. Activate emergency shutoffs for gas and fuel supplies.
9. Record events in the system memory.

C. Supervisory signal initiation shall be by one or more of the following devices and actions:

1. Valve supervisory switch.
2. Low-air-pressure switch of a dry-pipe sprinkler system.
3. Elevator shunt-trip supervision.

D. System trouble signal initiation shall be by one or more of the following devices and actions:

1. Open circuits, shorts, and grounds in designated circuits.
2. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
3. Loss of primary power at fire-alarm control unit.
4. Ground or a single break in fire-alarm control unit internal circuits.
5. Abnormal ac voltage at fire-alarm control unit.
6. Break in standby battery circuitry.
7. Failure of battery charging.
8. Abnormal position of any switch at fire-alarm control unit or annunciator.
9. Fire-pump power failure, including a dead-phase or phase-reversal condition.
10. Low-air-pressure switch operation on a dry-pipe or preaction sprinkler system.

E. System Trouble and Supervisory Signal Actions: Initiate notification appliance and annunciate at fire-alarm control unit and remote annunciators. Transmit a trouble or supervisory signal to the remote alarm receiving station.

2.3 FIRE-ALARM CONTROL UNIT

A. General Requirements for Fire-Alarm Control Unit:

1. Field-programmable, microprocessor-based, modular, power-limited design with electronic modules, complying with UL 864 and listed and labeled by an NRTL.
 - a. System software and programs shall be held in flash electrically erasable programmable read-only memory (EEPROM), retaining the information through failure of primary and secondary power supplies.

- b. Include a real-time clock for time annotation of events on the event recorder.
 2. Addressable initiation devices that communicate device identity and status.
 - a. Smoke sensors shall additionally communicate sensitivity setting and allow for adjustment of sensitivity at fire-alarm control unit.
 - b. Temperature sensors shall additionally test for and communicate the sensitivity range of the device.
 3. Addressable control circuits for operation of mechanical equipment.
- B. Alphanumeric Display and System Controls: Arranged for interface between human operator at fire-alarm control unit and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.
 1. Annunciator and Display: Liquid-crystal type, 2 line(s) of 40 characters, minimum.
 2. Keypad: Arranged to permit entry and execution of programming, display, and control commands and to indicate control commands to be entered into the system for control of smoke-detector sensitivity and other parameters.
- C. Circuits:
 1. Initiating Device, Notification Appliance, and Signaling Line Circuits: NFPA 72, Class A.
 - a. Notification Appliance Circuits: Style Z.
 - b. Signaling Line Circuits: Style 6.
 - c. Install no more than 50 addressable devices on each signaling line circuit.
 2. Serial Interfaces: Two RS-232 ports for printers.
- D. Smoke-Alarm Verification:
 1. Initiate audible and visible indication of an "alarm-verification" signal at fire-alarm control unit.
 2. Activate an NRTL-listed and -approved "alarm-verification" sequence at fire-alarm control unit and detector.
 3. Sound general alarm if the alarm is verified.
 4. Cancel fire-alarm control unit indication and system reset if the alarm is not verified.
- E. Elevator Recall:
 1. Smoke detectors at the following locations shall initiate automatic elevator recall.
 - a. Elevator lobby detectors except the lobby detector on the designated floor.
 - b. Smoke detector in elevator machine room.
 - c. Smoke detectors in elevator hoistway.
 2. Elevator lobby detectors located on the designated recall floors shall be programmed to move the cars to the alternate recall floor.

3. Water-flow alarm connected to sprinkler in an elevator shaft and elevator machine room shall shut down elevators associated with the location without time delay.
 - a. Water-flow switch associated with the sprinkler in the elevator pit may have a delay to allow elevators to move to the designated floor.
- F. Door Controls: Door hold-open devices that are controlled by smoke detectors at doors in smoke barrier walls shall be connected to fire-alarm system.
- G. Remote Smoke-Detector Sensitivity Adjustment: Controls shall select specific addressable smoke detectors for adjustment, display their current status and sensitivity settings, and change those settings. Allow controls to be used to program repetitive, time-scheduled, and automated changes in sensitivity of specific detector groups. Record sensitivity adjustments and sensitivity-adjustment schedule changes in system memory, and print out the final adjusted values on system printer.
- H. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to a remote alarm station.
- I. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals, supervisory and digital alarm communicator transmitters shall be powered by 24-V dc source.
 1. Alarm current draw of entire fire-alarm system shall not exceed 80 percent of the power-supply module rating.
- J. Secondary Power: 24-V dc supply system with batteries, automatic battery charger, and automatic transfer switch.
 1. Batteries: Sealed lead calcium.
- K. Instructions: Computer printout or typewritten instruction card mounted behind a plastic or glass cover in a stainless-steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe the functional operation of the system under normal, alarm, and trouble conditions.

2.4 MANUAL FIRE-ALARM BOXES

- A. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes shall be finished in red with molded, raised-letter operating instructions in contrasting color; shall show visible indication of operation; and shall be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.
 1. Single-action mechanism, type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.
 2. Station Reset: Key- or wrench-operated switch.
 3. Indoor Protective Shield: Factory-fabricated clear plastic enclosure hinged at the top to permit lifting for access to initiate an alarm. Lifting the cover actuates an integral battery-powered audible horn intended to discourage false-alarm operation.

2.5 SYSTEM SMOKE DETECTORS

A. General Requirements for System Smoke Detectors:

1. Comply with UL 268; operating at 24-V dc, nominal.
2. Detectors shall be two-wire type.
3. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
4. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.
5. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
6. Integral Visual-Indicating Light: LED type indicating detector has operated and power-on status.
7. Remote Control: Unless otherwise indicated, detectors shall be analog-addressable type, individually monitored at fire-alarm control unit for calibration, sensitivity, and alarm condition and individually adjustable for sensitivity by fire-alarm control unit.
 - a. Rate-of-rise temperature characteristic shall be selectable at fire-alarm control unit for **15 or 20 deg F (8 or 11 deg C)** per minute.
 - b. Fixed-temperature sensing shall be independent of rate-of-rise sensing and shall be settable at fire-alarm control unit to operate at **135 or 155 deg F (57 or 68 deg C)**.
 - c. Provide multiple levels of detection sensitivity for each sensor.

B. Photoelectric Smoke Detectors:

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
 - a. Primary status.
 - b. Device type.
 - c. Present average value.
 - d. Present sensitivity selected.
 - e. Sensor range (normal, dirty, etc.).

C. Duct Smoke Detectors: Photoelectric type complying with UL 268A.

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
 - a. Primary status.
 - b. Device type.
 - c. Present average value.
 - d. Present sensitivity selected.

- e. Sensor range (normal, dirty, etc.).
3. Weatherproof Duct Housing Enclosure: NEMA 250, Type 4X; NRTL listed for use with the supplied detector.
4. Each sensor shall have multiple levels of detection sensitivity.
5. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.
6. Relay Fan Shutdown: Rated to interrupt fan motor-control circuit.

2.6 HEAT DETECTORS

- A. General Requirements for Heat Detectors: Comply with UL 521.
- B. Heat Detector, Combination Type: Actuated by either a fixed temperature of **135 deg F (57 deg C)** or a rate of rise that exceeds **15 deg F (8 deg C)** per minute unless otherwise indicated.
 1. Mounting: Twist-lock base interchangeable with smoke-detector bases.
 2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
- C. Heat Detector, Fixed-Temperature Type: Actuated by temperature that exceeds a fixed temperature of **190 deg F (88 deg C)**.
 1. Mounting: Twist-lock base interchangeable with smoke-detector bases.
 2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

2.7 NOTIFICATION APPLIANCES

- A. General Requirements for Notification Appliances: Connected to notification appliance signal circuits, zoned as indicated, equipped for mounting as indicated and with screw terminals for system connections.
 1. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly, equipped for mounting as indicated and with screw terminals for system connections.
- B. Horns: Electric-vibrating-polarized type, 24-V dc; with provision for housing the operating mechanism behind a grille. Comply with UL 464. Horns shall produce a sound-pressure level of 90 dBA, measured **10 feet (3 m)** from the horn, using the coded signal prescribed in UL 464 test protocol.
- C. Visible Notification Appliances: Xenon strobe lights comply with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum **1-inch- (25-mm-)** high letters on the lens.
 1. Rated Light Output:
 - a. 15/30/75/110 cd, selectable in the field.

2. Mounting: Wall mounted unless otherwise indicated.
3. For units with guards to prevent physical damage, light output ratings shall be determined with guards in place.
4. Flashing shall be in a temporal pattern, synchronized with other units.
5. Strobe Leads: Factory connected to screw terminals.
6. Mounting Faceplate: Factory finished, [red] [white].

2.8 MAGNETIC DOOR HOLDERS

- A. Description: Units are equipped for wall or floor mounting as indicated and are complete with matching doorplate.
1. Electromagnet: Requires no more than 3 W to develop **25-lbf (111-N)** holding force.
 2. Wall-Mounted Units: Flush mounted unless otherwise indicated.
 3. Rating: 24-V ac or dc.
 4. Rating: 120-V ac.
- B. Material and Finish: Match door hardware.

2.9 REMOTE ANNUNCIATOR

- A. Description: Annunciator functions shall match those of fire-alarm control unit for alarm, supervisory, and trouble indications. Manual switching functions shall match those of fire-alarm control unit, including acknowledging, silencing, resetting, and testing.
1. Mounting: Flush cabinet, NEMA 250, Type 1.
- B. Display Type and Functional Performance: Alphanumeric display and LED indicating lights shall match those of fire-alarm control unit. Provide controls to acknowledge, silence, reset, and test functions for alarm, supervisory, and trouble signals.

2.10 ADDRESSABLE INTERFACE DEVICE

- A. Description: Microelectronic monitor module, NRTL listed for use in providing a system address for alarm-initiating devices for wired applications with normally open contacts.
- B. Integral Relay: Capable of providing a direct signal to elevator controller to initiate elevator recall to circuit-breaker shunt trip for power shutdown.

2.11 DIGITAL ALARM COMMUNICATOR TRANSMITTER

- A. Digital alarm communicator transmitter shall be acceptable to the remote central station and shall comply with UL 632 and be listed and labeled by an NRTL.
- B. Functional Performance: Unit shall receive an alarm, supervisory, or trouble signal from fire-alarm control unit and automatically capture two telephone line(s) and dial a preset number for a remote central station. When contact is made with central station(s), signals shall be

transmitted. If service on either line is interrupted for longer than 45 seconds, transmitter shall initiate a local trouble signal and transmit the signal indicating loss of telephone line to the remote alarm receiving station over the remaining line. Transmitter shall automatically report telephone service restoration to the central station. If service is lost on both telephone lines, transmitter shall initiate the local trouble signal.

- C. Local functions and display at the digital alarm communicator transmitter shall include the following:
1. Verification that both telephone lines are available.
 2. Programming device.
 3. LED display.
 4. Manual test report function and manual transmission clear indication.
 5. Communications failure with the central station or fire-alarm control unit.
- D. Digital data transmission shall include the following:
1. Address of the alarm-initiating device.
 2. Address of the supervisory signal.
 3. Address of the trouble-initiating device.
 4. Loss of ac supply or loss of power.
 5. Low battery.
 6. Abnormal test signal.
 7. Communication bus failure.
- E. Secondary Power: Integral rechargeable battery and automatic charger.
- F. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

2.12 DEVICE GUARDS

- A. Description: Welded wire mesh of size and shape for the manual station, smoke detector, gong, or other device requiring protection.
1. Factory fabricated and furnished by manufacturer of device.
 2. Finish: Paint of color to match the protected device.

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION

- A. Comply with NFPA 72 for installation of fire-alarm equipment.
- B. Install wall-mounted equipment, with tops of cabinets not more than **72 inches (1830 mm)** above the finished floor.

1. Comply with requirements for seismic-restraint devices specified in Section 260548 "Vibration and Seismic Controls for Electrical Systems."
- C. Smoke- or Heat-Detector Spacing:
1. Comply with NFPA 72, "Smoke-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for smoke-detector spacing.
 2. Comply with NFPA 72, "Heat-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for heat-detector spacing.
 3. Smooth ceiling spacing shall not exceed **30 feet (9 m)**.
 4. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas shall be determined according to Appendix A or Appendix B in NFPA 72.
 5. HVAC: Locate detectors not closer than **3 feet (1 m)** from air-supply diffuser or return-air opening.
 6. Lighting Fixtures: Locate detectors not closer than **12 inches (300 mm)** from any part of a lighting fixture.
- D. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of duct.
- E. Heat Detectors in Elevator Shafts: Coordinate temperature rating and location with sprinkler rating and location.
- F. Remote Status and Alarm Indicators: Install near each smoke detector and each sprinkler water-flow switch and valve-tamper switch that is not readily visible from normal viewing position.
- G. Audible Alarm-Indicating Devices: Install not 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.
- H. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and at least **6 inches (150 mm)** below the ceiling.
- I. Device Location-Indicating Lights: Locate in public space near the device they monitor.
- J. Fire-Alarm Control Unit: Surface mounted, with tops of cabinets not more than **72 inches (1830 mm)** above the finished floor.
- K. Annunciator: Install with top of panel not more than **72 inches (1830 mm)** above the finished floor.
- 3.2 CONNECTIONS
- A. For fire-protection systems related to doors in fire-rated walls and partitions and to doors in smoke partitions, comply with requirements in Division 08 Connect hardware and devices to fire-alarm system.
1. Verify that hardware and devices are NRTL listed for use with fire-alarm system in this Section before making connections.

- B. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than **3 feet (1 m)** from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.
 - 1. Alarm-initiating connection to smoke-control system (smoke management) at firefighter smoke-control system panel.
 - 2. Alarm-initiating connection to stairwell and elevator-shaft pressurization systems.
 - 3. Smoke dampers in air ducts of designated air-conditioning duct systems.
 - 4. Alarm-initiating connection to elevator recall system and components.
 - 5. Alarm-initiating connection to activate emergency shutoffs for gas and fuel supplies.
 - 6. Supervisory connections at valve supervisory switches.
 - 7. Supervisory connections at low-air-pressure switch of each dry-pipe sprinkler system.
 - 8. Supervisory connections at elevator shunt trip breaker.
 - 9. Supervisory connections at fire-pump power failure including a dead-phase or phase-reversal condition.
 - 10. Supervisory connections at fire-pump engine control panel.

3.3 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- B. Install framed instructions in a location visible from fire-alarm control unit.

3.4 GROUNDING

- A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.

3.5 FIELD QUALITY CONTROL

- A. Field tests shall be witnessed by Owner's representative.
- B. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- C. Tests and Inspections:
 - 1. Visual Inspection: Conduct visual inspection prior to testing.

- a. Inspection shall be based on completed Record Drawings and system documentation that is required by NFPA 72 in its "Completion Documents, Preparation" Table in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter.
 - b. Comply with "Visual Inspection Frequencies" Table in the "Inspection" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.
2. System Testing: Comply with "Test Methods" Table in the "Testing" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
 3. Test audible appliances for the public operating mode according to manufacturer's written instructions. Perform the test using a portable sound-level meter complying with Type 2 requirements in ANSI S1.4.
 4. Test visible appliances for the public operating mode according to manufacturer's written instructions.
 5. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
- D. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.
- E. Fire-alarm system will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system.

END OF SECTION 283111

SECTION 31 10 00 – SITE CLEARING

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK:

- A. Work covered by this Section includes site clearing and grubbing as required to perform the Work as shown on Drawings.
- B. The CONTRACTOR shall limit the area of clearing and grubbing to the minimum area possible to allow for the proper installation of the Work and to preserve all plantings, trees, shrubs, grass and natural vegetation to the maximum possible extent. Clearing and grubbing shall not extend beyond the limits as identified on the Construction Drawings.

1.02 RELATED WORK: Includes, but not limited to, the following:

- A. Erosion and Sedimentation Control: Section 312513.

1.03 QUALITY ASSURANCE:

- A. Confine clearing and grubbing operations to within the following limits:
 - 1. Within the Grading Limits as shown on the Drawings.
- B. No trees, plants, shrubs, flowers or vegetables shall be removed or trimmed without the prior permission of the ENGINEER, except where otherwise specified.
- C. Protection of Existing Trees and Vegetation: Protect existing trees and other vegetation indicated to remain in place, against unnecessary cutting, breaking or skinning of roots, skinning and bruising of bark, smothering of trees by stockpiling construction materials or excavated materials within drip line, excess foot or vehicular traffic, or parking of vehicles within drip line. Provide temporary guards to protect trees and vegetation to be left standing.

1.04 STORAGE AND HANDLING:

- A. Obstruction of roads, driveways, sidewalks, gutters and drainage ditches, swales and channels with stored materials is not permitted.

1.05 JOB CONDITIONS:

- A. The locations of trees, plantings, vegetation, sidewalks, curbs and other living and nonliving items, as shown on the Drawings, have been determined by actual surveys at the time surveys were made. Since that time, the condition of things may have changed. Remove and replace all obstacles and obstructions, as required to complete the Work, whether shown on the Drawings or not, at no extra cost to OWNER.
- B. Explosives are not permitted for clearing and grubbing operations.

- C. Use all means necessary to protect existing objects not indicated to be removed. In the event of damage, make all necessary repairs and replacements and restore to its original condition, as acceptable to ENGINEER.

1.06 SCHEDULING:

- A. Avoid interference with the use of, and passage to and from, adjacent buildings, facilities, driveways, walks, drainage systems and road.
- B. Pavements which are required to be removed, including roads, driveways and walks, shall be saw-cut in advance, but do not remove until the Work is ready to be installed.
- C. Do not remove highway signs, guardrails and other control, safety and warning devices until just prior to the installation of the Work.
- D. All items affecting traffic, safety, lives and the containment of humans and animals and all items essential to the protection of property or the operation of a business be left in place as long as possible and replaced as soon as possible when such items must be removed.

PART 2 - PRODUCTS (not applicable)

PART 3 - EXECUTION

3.01 EXAMINATION:

- A. Verify that all limiting boundaries such as permanent and temporary easements, property lines, rights-of-way and grading limits have been accurately located and clearly marked.
- B. Verify that pipeline routings and other items of work have been accurately located and clearly marked.

3.02 PREPARATION:

- A. Mark all trees, plantings and other objects which are deemed necessary to be removed, trimmed, cut, or removed and preserved.
- B. Notify and accompany ENGINEER through the site to inspect the items which are to be trimmed, removed, and replanted prior to start of the Work.
- C. Protect existing trees and other vegetation indicated or directed by ENGINEER to remain in place, against unnecessary cutting, breaking or skinning of roots, skinning and bruising of bark, smothering of trees by stockpiling construction materials or excavating materials within drip line, excess foot or vehicular traffic, or parking of vehicles within drip line.
- D. Water trees and other vegetation which are to remain within the limits of work as required to maintain their health during the course of construction.

- E. Adjacent property and other works to remain: protect throughout the work by fences, barricades, and the exercise of special care to avoid unnecessary damage.
- F. Existing Trees, Brush, Shrubs, and Other Vegetation:
 - a. Protect existing trees to remain by the erection of 4' snow fence anchored by 8' steel fence stakes at the drip line, or as directed by ENGINEER. Maintain fencing during the full time of construction work on site. Trim any branches interfering with the work and only as directed by ENGINEER.
 - b. Protect shrubs and bushes by tying off, staking, tarpaulins, fences, or barricades.
 - c. Protect shallow-rooted plants at ground surface under and in some cases outside the spread of branches by covering, or by fences, or by bridging with timber mats to avoid overly compacting the root mass.

3.03 PERFORMANCE:

A. Clearing and Grubbing:

1. Clearing consists of cutting and disposing of all trees, down timber, stubs, brush, bushes, snags, rubbish, debris, and other objectionable matter and materials and the removal and storage of fences, signs, walks, guard rails, curbs and other items to be restored.
2. Grubbing consists of the removal and disposal of all stumps, roots, duff, foundations and other objectionable matter and materials to a minimum of 12 inches below original ground surface.
3. All operations shall be done in a manner so that present growth will blend with the limits of construction and a natural appearance will be attained.
4. Employ whatever measures are necessary to avoid erosion.

B. Topsoil:

1. Topsoil is defined as friable loam surface soil found in a depth of not less than 4 inches from the original ground surface. Satisfactory topsoil is reasonably free of subsoil, clay lumps, stones, and other objects over 2-inches in diameter, and without weeds, roots, and other objectionable material.
2. Strip topsoil within limits as designated on Drawings or required to whatever depths encountered in a manner to prevent mixing with underlying subsoil or objectionable material.
3. Where trees are indicated to be left standing, stop topsoil stripping a sufficient distance to prevent damage to main root system.
4. Stockpile topsoil in storage piles in areas shown or where directed. Construct storage piles to freely drain surface water. Cover storage piles as necessary to prevent windblown dust and erosion.

5. Surplus loam and topsoil not required for completion of the Work shall remain the property of the OWNER. Stockpile this material on-site and maintain and protect until Work is complete.

C. Trees and Plantings:

1. In grassed, planted and open areas do not remove or trim trees or plantings without the prior permission of ENGINEER. Remove and preserve small trees, plantings, flowers and similar vegetation for reuse.
2. If it is impractical to fell trees as a whole, remove them in sections according to standard practices of professional tree removal. Fall trees to the center of the area being cleared to minimize damage to trees that are to be left standing.
3. Immediately after felling a tree, remove branches, cut trunk and limbs and remove all materials from the site and dispose of in a lawful manner.
4. Property OWNER shall have the right to cut and remove any wood in advance of the CONTRACTOR'S operations. All other timber and wood which is removed shall become the property of CONTRACTOR.
5. All trees to be trimmed shall be evenly cut to achieve neat severance with the least possible damage to the tree.
6. Where roots are cut or damaged, apply wet burlap to prevent drying out.

D. Pavements, Walks, Curbs, & Rails:

1. Remove existing pavements, walks, and curbs to the limits shown on the Drawings, or if not shown, to the minimum extent possible.
2. Saw-cut asphalt and concrete paved surfaces before removal. Use a saw which will cut a neat, straight joint line.
3. Carefully remove granite and stone curbs and guard rails to the minimum extent possible. Terminate removals at a joint or guard rail post. Store and protect for reuse.

E. Walls, Fences, and Other Obstructions:

1. All guard rails, fences, signs, and other obstructions encountered shall be carefully removed and stored for subsequent reuse as depicted on the Plans or required by ENGINEER.
2. Do not disturb property markers unless absolutely necessary and approved by ENGINEER for removal. If it becomes necessary to disturb or remove a property marker, employ a Registered Land Surveyor at no extra cost to the OWNER to establish the property marker location by providing a minimum of four (4) ties to the marker. The Registered Land Surveyor shall replace the property marker as soon as possible.

F. Disposal:

1. Burning at the site is not permitted unless otherwise approved by ENGINEER. If burning is allowed, the CONTRACTOR shall be responsible for obtaining all necessary permits.
2. Materials not specified to be stored or re-used shall be promptly removed and disposed of off-site in a lawful manner.

G. Protection: Carefully protect and guard all trees, shrubs and vegetation and take every precaution to avoid damage to utilities, buildings and other property.

H. Replanting and Restoration of Surfaces: The requirements for replanting and restoration of surfaces are contained within other specification sections.

I. Replacement of pavements, walks, curbs, rails, walls, fences and other obstructions: Replace materials that have been removed in order to perform the Work to the original or better condition as directed by the ENGINEER.

END OF SECTION 31100

SECTION 312000 - EARTH MOVING

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK:

- A. Work included under this Section includes, but is not limited to, providing all labor, materials, equipment, and incidentals to conduct and complete the Work related to the planned building, parking, structures, landscaped areas, utilities and site improvements as specified herein and shown on the Drawings.
1. Thoroughly read, fully understand, and abide by all data, evaluations, and recommendations of the R.W. Gillespie & Associates, Inc. Geotechnical Engineering Services Report dated October 6, 2015. If any conflict exists between the requirements of the Geotechnical Engineering Report, these specifications, and/or the plan, request clarification from the ENGINEER prior to performing the work.
 2. Excavate all materials, including soil, boulders, abandoned utilities, pavements, curbs, granite blocks, and all other materials as necessary to construct the improvements shown on the Drawings.
 3. The CONTRACTOR shall be solely responsible for impacts and damage to structures due to his/her work, and for corrective action or repairs needed to restore the structure(s) to its original condition at no additional cost to the OWNER. Where structures are adversely affected by construction operations, they shall be repaired, restored and replaced in accordance with the requirements outlined herein.
 4. The CONTRACTOR shall note that some over-excavation and replacement of fill may be required as noted on the plans.
 5. Handle, process, re-handle, segregate, and stockpile materials during the course of the Work. Existing on-site materials may require processing prior to reuse. Processing may include crushing, blending, screening, and other measures to meet the requirements herein and as directed by the ENGINEER. Only those soils and other materials approved by the ENGINEER shall be reused on-site.
 6. Prepare, grade, shape, compact and protect all subgrades, backfills, and ground surfaces shown on the Drawings.
 7. Prepare, grade, shape, and construct gravel wetland.
 8. Dewater as necessary to enable construction of site improvements, including backfilling, in-the-dry. The CONTRACTOR shall be responsible for control, pumping, and legal disposal of groundwater, precipitation, or other water which enters or accumulates in excavations to maintain stable subgrades and allow all below-grade construction to be conducted in-the-dry.
 9. Provide, place, moisture condition, compact, and grade fill, backfill and other materials to the horizontal and vertical limits to construct the proposed site improvements and achieve the lines and grades as shown on the Drawings.
 10. Provide and place low density, controlled low strength material (LD-CLSM) as lightweight fill below the building as indicated on the plans.
 11. Place plastic separators, vapor barriers, mudmats, and geotextiles as necessary and required.
 12. Install foundation drainage system elements at the locations and elevations shown on the Drawings.
 13. Preserve and protect existing structures and utilities and new site improvements during the course of the Work.

14. Manage and legally dispose off-site all excess excavated materials, including, but not limited to, soil, rock, boulders, water, demolition waste, and debris that cannot be reused on-site.
15. Obtain, maintain and pay for all required permits, licenses, and approvals prior to commencing the Work of this and other related Sections.
16. Off-site disposal of Contaminated Material, if required, shall not be conducted without approval of the OWNER and ENGINEER.
17. Provide and install erosion control during the Work as indicated on the Drawings, as required in the Specifications, and in accordance with applicable regulations and permits.
18. The CONTRACTOR shall be solely responsible for impacts and damage to any existing structures due to their Work, and for corrective action or repairs needed to restore the structure(s) to original condition at no additional cost to the OWNER.
19. Furnish and place all fill and gravel as required to complete work for contract at the compactions specified herein.
20. Removal of all unsuitable material from site.
21. Removal of all abandoned utility lines incidental to work.

1.02 RELATED REFERENCES:

- A. R.W. Gillespie & Associates, Inc. Geotechnical Engineering Services Report dated October 6, 2015.
- B. Specification Sections:
 1. Dewatering: Section 312319.
 2. Erosion and Sedimentation Control: Section 312513.
- C. State of Maine Department of Transportation "Standard Specifications", most recent revision
- D. State of Maine Department of Transportation "Supplemental Specifications – Corrections, Additions & Revisions to Standard Specifications – Latest Edition"
- E. Manual of Accident Prevention in Construction - Associated General Contractors of America, Inc.
- F. 29 CFR 1926/1910 - OSHA Safety and Health Standards for Construction Industry

1.03 PROTECTION:

- A. Paved Surfaces: Do not operate equipment that will cause damage on paved surfaces to remain. Any damage to existing roads or other paved surfaces caused by construction equipment shall be repaired at no additional cost to OWNER.
- B. Maintain excavations with approved barricades, lights, and signs to protect life and property until excavation is filled and graded to a condition acceptable to the ENGINEER.
- C. Protect structures, utilities, monitoring wells, property monuments, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations. The CONTRACTOR shall be responsible for actual cost of repair or replacement of any items damaged as a result of construction activities, including any professional services required for inspection of repairs and replacement.

1.04 QUALITY ASSURANCE:

- A. Testing and Inspection: OWNER shall be responsible for all testing, unless otherwise noted. The cost for retesting due to failed tests shall be the responsibility of the CONTRACTOR.

The CONTRACTOR shall be responsible for coordinating with ENGINEER to allow for testing to be performed at the frequencies specified. A minimum of 48 hours notice for in-place testing shall be given to allow proper scheduling by ENGINEER.

- B. The ENGINEER may observe the CONTRACTOR'S earthwork activities, including excavation, dewatering, subgrade preparation, backfilling and on-site reuse of excavated materials. The Contractor shall provide sufficient notice to the ENGINEER to allow the ENGINEER to be present to observe the Work.
- C. The ENGINEER or OWNER'S Representative will conduct field and laboratory density testing of placed and compacted soils to confirm compliance with the requirements of this Section. Field and laboratory density testing will be conducted in general conformance with ASTM or other applicable reference standards. The CONTRACTOR shall cooperate with the ENGINEER in all respects to facilitate any testing or observations.
- D. The CONTRACTOR shall not place or compact any fill, prepare subgrades or place concrete on bearing surfaces unless the ENGINEER or OWNER'S Representative is present to observe the Work. Materials placed and/or compacted which do not conform to project specifications for the area, shall be removed and replaced with appropriate, suitable material when directed by the OWNER or the ENGINEER at no additional cost to the OWNER. Costs related to testing or replacement of nonconforming Work or materials, and/or delays caused by nonconforming Work or materials, shall be paid for by the CONTRACTOR at no additional cost to the OWNER.
- E. The presence of the ENGINEER shall not relieve the CONTRACTOR of its responsibility to perform the Work in accordance with the Contract Documents, nor shall it be construed to relieve the CONTRACTOR from full responsibility for the means and methods of construction, protection of site improvements against damage, and for safety on the construction site. The CONTRACTOR shall comply with all applicable laws, rules, ordinances and regulations of the Federal Government, the State of Maine, and the City of Portland relative to the work performed on the site and any CONTRACTOR activities on or adjacent to the site.
- F. The CONTRACTOR shall adhere to the applicable requirements of the specifications, OSHA Standards and to all other applicable ordinances, codes, statutory rules, and regulations of federal, state, and local authorities having jurisdiction over the Work of this Section.
- G. The CONTRACTOR may conduct additional field and laboratory testing or screening tests for its own information at no additional cost to the OWNER.
- H. In case of conflict between regulations or between regulations and Specifications, the CONTRACTOR shall comply with the strictest applicable codes, regulations, or Specifications.
- I. CONTRACTOR shall coordinate pre-excavation meetings with OWNER and ENGINEER.

1.05 JOB AND SUBSURFACE CONDITIONS:

- A. Site Information: A geotechnical investigation was completed for this project. A copy of the report and associated borings can be provided upon request.

The CONTRACTOR may make his own borings, hand probes, explorations, and observations to determine soil, water levels, and other subsurface conditions at no additional cost to OWNER. Coordinate with OWNER prior to start of additional investigative work.

- B. Existing Utilities: Locate existing underground utilities in areas of excavation work. If utilities are indicated to remain in place, provide adequate means of support and protection during earthwork operations. Coordinate with utility companies for actual locations and shut-off services. If utilities are encountered that are not shown or that are shown incorrectly on the Drawings, notify ENGINEER immediately. Repair damaged utilities to satisfaction of ENGINEER and utility.

1.06 LINES, GRADES AND TOLERANCES:

- A. The CONTRACTOR shall be responsible for establishing all lines, grades and other survey control to complete the Work as shown on the Drawings.
- B. Maintain the moisture content of backfill materials as necessary to allow for the material to be readily placed to the degree of compaction specified herein.
- C. Construct finished soil and backfill surfaces to the elevations indicated on the Drawings.
- D. Compact backfill materials to the specified degree of compaction.

PART 2 - MATERIALS

2.01 MATERIALS:

- A. General: All materials utilized for this Project shall be obtained from a source that has been licensed or permitted for such use by local and state authorities. The CONTRACTOR shall be required to submit evidence of such if so requested.
 1. Suitable materials: Suitable soil materials are defined as those complying with ASTM D2487 soil classification groups GW, SM, SW, and SP.
 2. Unsuitable materials: Materials containing excessive amounts of water, clay, vegetation, organic matter, debris, pavement, stones or boulders over 6-inches in greatest dimension, frozen material, and material which, in the opinion of the ENGINEER, will not provide a suitable foundation or subgrade.
 3. On-Site Material: Any suitable material from on-site excavation.
 4. Material for embankments and general site fills outside of the building envelope may contain pieces of excavated ledge having a greatest dimension of up to 6-inches, unless otherwise approved by ENGINEER.

5. Inspection: The ENGINEER may inspect off-site sources of materials and order tests of these materials to verify compliance with these Specifications.
 6. Sieve Analysis: Submit sieve analysis in accordance with ASTM D422 for all materials prior to start of construction.
- B. Gravel/Aggregate Base: Hard, durable gravel equal to MDOT 703.06 Type B material as specified on the drawings. Sieve analyses by weight:

Sieve Size	% Passing by Weight
4"	100
1/2"	35 - 75
1/4"	25 - 60
No. 40	0 - 25
No. 200	0 - 5

- C. Aggregate Subbase: Sand or gravel of hard, durable particles; equal to MDOT 703.06 Type D material. Aggregate subbase shall not contain particles that will not pass the 6-inch sieve. The part that passes the 3-inch sieve shall meet the following gradation requirements:

Sieve Size	% Passing by Weight
3"	100
1/2"	35 - 80
1/4"	25 - 65
No. 40	0 - 30
No. 200	0 - 7

- D. Structural Fill: Well-graded sand and gravel mixture meeting the following gradation requirements:

Sieve Size	% Passing by Weight
6"	100
3"	70 - 100
No. 4	35 - 70
No. 40	5 - 35
No. 200	0 - 5

Structural fill is recommended for use as fill below ground floor slabs and as backfill within 4 feet of footings and foundation walls only where they are located outside the limites of low-density, LD-CLSM as noted on the Construction Documents and within the Geotechnical Report by R.W. Gillespie & Associates. Maximum partical size should be limited to three inches within 2 feet of foundation walls, footings, and floor slabs.

- E. Low Density, Controlled Low Strength Material (LD-CLSM): LD-CLSM shall be Conntrolled Low-Strength Materials using preformed foam as described in American Concrete Institute's (ACI's) Report on Controlled Low-Strength Materials, Document 229R-13. The in-service unit weight should be between 36 and 42 pounds per cubic foot, and minimum recommended compressive strength is 80 pounds per square inch.

- G. Granular Borrow: Imported materials consisting of a mixture of sand, gravel and silt or reclaimed asphalt, concrete, brick, crushed rock that is crushed and blended with sand to create a compactable fill meeting the following gradation:

Sieve Size	% Passing by Weight
6 inch	100
¼ inch	25 to 90
No. 40	0 to 50
No. 200	0 to 20

Granular borrow shall be used to raise exterior parking areas to bottom of subbase materials; backfill after removal of relic foundation elements and other deleterious materials outside of the building footprints; and in other locations as identified in the Construction Documents.

- H. ¾" Crushed Stone: Durable, clean angular rock fragments obtained by breaking and crushing rock material. Gradation shall be:

Sieve Size	% Passing by Weight
1"	100
¾"	90 – 100
3/8"	20 – 55
No. 4	0 – 10
No. 200	0 – 1.5

Crushed stone shall be used beneath walkways and exterior slabs and in all other areas as indicated on the plans.

- H. Sand: Sand shall be well-graded coarse sand without excessive fines and free from loam, clay, and organic matter. Beach sand shall not be used. The grading requirements are as follows:

Sieve Size	% Passing by Weight
3/8"	100
No. 4	95 – 100
No. 8	80 – 100
No. 16	50 – 85
No. 30	25 – 60
No. 50	10 – 30
No. 100	2 – 10

Sand shall be used beneath interior building slabs and in all other areas as indicated on the plans.

- I. Underdrain backfill: In accordance with MDOT 703.22 underdrain backfill, Type C:

Sieve Size	% Passing by Weight
1"	100
3/4"	90 – 100
3/8"	0 – 75
No. 4	0 – 25
No. 10	0 – 5

- J. Riprap: In accordance with MDOT 703.26 – Plain and Hand Laid Riprap, or as otherwise noted.
- K. Refill Material: Use 3/4" crushed stone for refilling excavation below normal grade, rock excavation or refilling excavations of unsuitable material, unless otherwise directed by ENGINEER.
- L. Fabric Protection Layer: As specified on the Contract Plans.
- M. Gravel Wetland – Reservoir Course: Use quarried crushed stone conforming to the requirements of Maine DOT Specification 703.12 Aggregate for Crushed Stone Surface with no more than 5% fines passing the #4 sieve.
- N. Gravel Wetland – Wetland to Reservoir Transition Course: Use pea gravel with 100% passing the 3/4" sieve and meeting the following gradations:

Sieve Size	% Passing by Weight
3/8"	85 – 95
No. 4	5 – 15
No. 8	0 – 2

- O. Gravel Wetland – Wetland Soil: Manufacture soil using compost, sand, and fine soils to blend to a minimum of 15% organic matter content soil. The soil should avoid clay content in excess of 15%. Surface infiltration rates shall be 0.1-0.01 ft/day.
- P. Gravel Wetland – Embankment Soil: Gravel wetland embankments shall be constructed utilizing high clay-content or other non-conductive soil with a minimum 15% passing the #200 sieve and a minimum permeability of 1×10^{-5} cm/sec.

PART 3 - EXECUTION

3.01 EXCAVATION:

- A. General: Excavation shall include the removal of all encountered materials, including but not limited to, soil, boulders, asphalt pavement, concrete (reinforced and unreinforced), miscellaneous debris, buried and abandoned foundations and utilities, site improvements, incidental structures and all other materials encountered to the limits shown on the Drawings, or designated in the Specifications.
- B. All topsoil, peat, organic material, debris, rubbish, frozen soils, muck, loose, or disturbed soils and other unsuitable materials should be removed from the area of new construction. Topsoil may be stockpiled outside the construction area for reuse in landscaped areas. Topsoil may not be used as common fill below pavements or as fill below proposed building.
- C. Call Dig Safe prior to beginning any excavation.
- D. Rock Excavation includes removal and disposal of materials and obstructions encountered that cannot be excavated with modern, track-mounted, heavy-duty excavating equipment without drilling or ripping; includes boulders larger than 2 cubic yards each.

Do not perform rock excavation or excavation of unsuitable materials until material to be excavated has been cross-sectioned and classified by ENGINEER.

- E. Earth Excavation: Remove and dispose of obstructions visible on ground surface, underground structures, utilities, and items indicated to be demolished and removed, and other materials encountered that are not classified as rock excavation or unauthorized excavation.
- F. Excavation in Paved Areas: Cut pavement prior to excavation to provide a clean, uniform edge. Minimize disturbance of remaining pavement. Cut and remove the minimum amount of pavement required to do the Work. Use shoring and bracing where sides of excavation will not stand without undermining pavement.
- G. Excavation for Structures: Conform to elevations and dimensions shown within a tolerance of plus or minus 0.10 foot, and extending a sufficient distance from foundations to permit placing and removal of concrete formwork, installation of services, other construction, and for inspection.

In excavating for foundations, take care not to disturb bottom of excavation. Excavate the final 1.0 feet to foundation subgrade level using methods and equipment designed to prevent disturbance to the bearing soils (by hand or by smooth bucket excavator). Trim bottoms to required lines and grades to leave solid base to receive other Work. When excavating in clay material, use a smooth-edged bucket to avoid disturbance of the bottom of the excavation. Use shoring and bracing as required by OSHA standards.

- H. Excavation for Utility Trenches: Excavate to widths shown on the Drawings and depths indicated or required to establish indicated slope and invert elevations. Produce an evenly graded, flat trench bottom at the subgrade elevation required for installation of pipe and bedding material. Place backfill material directly into trench or excavation. Do not stockpile material to be used as backfill along edges of trenches. Load excavated material directly into trucks, unless otherwise permitted by the ENGINEER.
- I. Unauthorized Excavation: Removal of materials beyond indicated subgrade elevations or dimensions without specific direction of ENGINEER. Unauthorized excavation, as well as remedial work directed by ENGINEER, including refilling, shall be at CONTRACTOR's expense.
- J. Refilling Unauthorized Excavation: For trenches, use 3/4-inch crushed stone. A geotextile barrier may be required at the discretion of the ENGINEER. Elsewhere, backfill and compact unauthorized excavations as specified for authorized excavations of same classification, unless otherwise directed by ENGINEER.
- K. Excavation of Unsuitable Materials: When excavation has reached required subgrade elevations, notify ENGINEER who will make an inspection of conditions. If unsuitable bearing materials are encountered at required subgrade elevations, carry excavations deeper only at the direction of the ENGINEER and replace excavated material with 3/4" crushed stone on a non-woven geotextile fabric (Mirafi 140N or approved equal).
- L. Material Storage: Stockpile and maintain suitable surplus excavated materials for re-use as backfill within the Project limits, as directed by ENGINEER. Place, grade, and shape stockpiles for proper drainage. Locate and retain soil materials away from edge of excavations.

3.02 STABILITY OF EXCAVATIONS:

- A. General: Side slopes of excavations shall comply with OSHA Regulations and Local Codes. Shore and brace where sloping is not possible due to space restrictions or stability of material excavated. Maintain sides and slopes of excavations in safe condition until completion of backfilling.

3.03 DEWATERING:

- A. General: Perform all Work in the dry. Prevent surface water and subsurface or groundwater from flowing into excavations and from flooding project site and surrounding area.

Do not allow water to accumulate in excavations. Provide and maintain pumps, sumps, suction and discharge lines, and other dewatering system components necessary to convey water away from excavations.

Dewatering should be continuous until the permanent foundation drainage system is installed and foundations are built and backfilled.

A layer of crushed stone underlain with geotextile might be needed to protect subgrades from disturbance during construction.

Establish and maintain temporary drainage ditches and other diversions outside excavation limits to convey water removed from excavations and rainwater to collecting or run-off areas. Do not use trench excavations as temporary drainage ditches.

Utilize discharge filter systems to remove sediment prior to discharge to receiving waters.

3.04 SUBGRADE PREPARATION:

- A. General

1. Care shall be taken to avoid disturbance to subgrades.
2. Provide a firm, smooth, stable, undisturbed subgrade as judged by the ENGINEER. Loose, disturbed soil shall be removed by hand shovel.
3. Subgrades consisting of cohesive soils shall not be “backbladed” or compacted to prepare a smooth surface.
4. Subgrades shall be prepared as recommended in the geotechnical report.
5. Stripped subgrades beneath planned building and paved area and composed of granular soil should be proof-rolled with a minimum of two passes of a 10-ton roller in each of two perpendicular directions to improve the density of suitable soils. Silty clay to sandy silt subgrades should not be proof-rolled. Rolling of subgrades should be observed for areas of soil rutting or weaving, indicative of unsuitable underlying materials. Unsuitable fill and/or soft, loose, and/or disturbed native soil materials should be excavated and replaced with structural fill. If high groundwater is present during subgrade preparation, the vibratory roller should be operated in the “static” mode to avoid liquefying the soil.
6. Movement of construction equipment directly over exposed final subgrades, except for compaction equipment, shall not be permitted.

7. The exposed subgrade will be examined in the field by the ENGINEER to observe the strength and bearing capacity of the soils. Disturbed or soft or unstable soils, as judged by the ENGINEER, shall be excavated and replaced with lean concrete, granular fill, or other acceptable materials at no additional cost to the Owner.
8. Prevent soil subgrades from freezing and frost. Soil subgrades that freeze prior to concrete or backfill placement shall be thawed and recompact, or removed and replaced with non-frozen backfill, lean concrete or other acceptable material as directed by the ENGINEER.
9. Excavations shall not undermine existing foundations, streets, sidewalks, or structures.

3.05 BACKFILL AND FILL:

- A. General: Place suitable soil material in layers to required elevations as shown on the Drawings. Fill, backfill, and compact to produce minimum subsequent settlement of the material and provide adequate support for the surface treatment or structure to be placed on the material. Place material in approximately horizontal layers of beginning at lowest area to be filled. Do not impair drainage.
- B. Placement: Place backfill and fill materials in layers not more than 9-inches in loose depth in uncompacted thickness. In confined areas, within 4 feet of foundation walls, and in areas where self-propelled compaction equipment should not be used based on vibration considerations, fill shall be placed in lifts not exceeding 6-inches in uncompacted thickness and be compacted with hand-operated compaction equipment. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.

Place backfill and fill materials evenly adjacent to structures to required elevations. Take care to prevent wedging action of backfill against structures or displacement of piping or conduit by carrying material uniformly around structure, piping, or conduit to approximately same elevation in each lift.

Do not allow heavy machinery within 5 feet of structure during backfilling and compacting.

- C. Backfill excavations as promptly as work permits, but not until completion of the following:
 - Acceptance of construction below finish grade including dampproofing, and/or waterproofing.
 - Inspection, approval and recording locations of underground utilities.
 - Removal of concrete formwork.
 - Removal of shoring and bracing, and backfilling of voids with suitable materials.
 - Removal of trash and debris from excavation.
 - Permanent or temporary horizontal bracing is in place on horizontally supported walls.
 - Backfill cast-in-place concrete structures when the concrete has developed adequate strength.
 - Use care in backfilling to avoid damage or displacement of underground structures and pipe.

D. Backfilling Trenches: See Trench Detail on the Drawings.

Bed pipe in 3/4-inch crushed stone, unless otherwise indicated. Limits of bedding and requirements for remaining trench backfill shown on Drawings. Backfill under all existing utility pipes crossed by new utility pipes or work with 3/4" crushed stone. The crushed stone backfill shall extend continuously from the bedding of the new pipe to the utility pipe crossed, including a 6" thick envelope of crushed stone all around the existing utility pipe(s). The 3/4" crushed stone backfill shall stand at its own angle of repose. No "haunching" or "forming" with common fill will be allowed.

E. Replacement of Unsuitable Materials:

Below normal grade: See paragraph 3.01J.

Above normal grade: Replace unsuitable material with suitable material from on-site. All excess suitable material must be used before additional material from off-site is used.

3.06 LD-CLSM:

- A. Existing fill and naturally deposited soils below the proposed building should be removed and replaced with LD-CLSM to a depth of 3 feet below pre-development ground surface or elevation 64 feet, whichever is lower. LD-CLSM should be used as fill from the current ground surface up to the bottom of the ground floor slab base layer. The LD-CLSM should extend laterally a minimum of three feet outside the bottom outside edge of perimeter footings. LD-CLSM should only be placed over approved subgrade and should not be placed on frozen ground, snow, or ice.
- B. Maximum recommended lift-thickness for LD-CLSM is 3 feet, unless thicker lift is approved by the ENGINEER. Additional lifts and concrete should not be placed on top of in-place LD-CLSM until it has a minimum unconfined compressive strength of 20 pounds per square inch.
- C. Minimum recommended air and material temperature at the time of placement is 40 degrees. LD-CLSM should be protected from freezing temperatures in accordance with American Concrete Institute's cold-weather concreting procedures, except that LD-CLSM temperature shall be maintained at 50 degrees Fahrenheit or above for a minimum period of 24-hours after placement.
- D. Unit weight of LD-CLSM should be determined in the field during placement in general accordance with ASTM D6023, Standard Test Method for Unit Weight, Yield, Cement Content, and Air Content (Gravimetric) of Controlled Low-Strength Material (CLSM). A minimum of one unit weight test should be conducted per 50 cubic yards, or one test per placement per day, whichever is greater.
- E. LD-CLSM should be sampled and tested for unconfined compressive strength. Sampling and testing should be conducted in general accordance with ASTM D4832, Standard Test Method for Preparation and Testing of Controlled Low-Strength Material (CLSM) Test Cylinders. A minimum of one set of six test cylinders should be made per 50 cubic yards, or one set per placement per day, whichever is greater. Three test cylinders should be tested at 7-days and three test cylinders should be tested at 28-days.
- F. LD-CLSM should be protected from freezing temperatures. Rigid insulation should be placed at the top and sides of LD-CLSM exposed to freezing temperatures. Rigid insulation should be

extended vertically to an insulated exterior wall to create a continuous layer of insulation and down a minimum of 4 feet below surfaces exposed to freezing temperatures. Rigid insulation should be Type IV extruded polystyrene insulation and a minimum 2 inches thick.

3.07 COMPACTION:

A. Methods: Use methods which produce the required degree of compaction throughout the entire depth of material placed without damage to new or existing facilities and which are approved by the ENGINEER. In the parking lot and other open areas, compact with self-propelled compaction equipment. Within the building, utility trenches, and other confined areas, compact with hand-operated compaction equipment. Adjust moisture content of soil as required. Remove and replace material that is too wet to compact to required density. Compact each horizontal layer of fill and slope as Work progresses.

B. Degree of Compaction: Compact to the following minimum densities:

FILL AND BACKFILL LOCATION	DENSITY	TESTING FREQUENCY ONE TEST PER LIFT PER:
Building and pavement subgrade (top 18")	100% of max.	1,000 SF
Pavement below 18" of subgrade	95%	5,000 SF
Structures and walkways	95%	2,000 SF
Trenches	95%	150 LF
Lawn or Unimproved Areas	92%	20,000 SF

Maximum density: ASTM D1557.

Field density tests: ASTM D1556 (sand cone) or ASTM D6938 (nuclear methods).

C. Testing: In-place densities using field tests will be determined by the ENGINEER or the OWNER's Representative. Perform additional work to obtain proper compaction if in-place densities do not meet specified densities at no additional cost to the OWNER.

D. Protection of Fill

1. The CONTRACTOR shall take the necessary steps to avoid disturbance of subgrade and underlying soils during excavation and backfilling operations. Procedures for excavating and backfilling shall be revised as necessary to avoid disturbance of subgrade and underlying soils, including restricting the use of certain types of construction equipment and their movement over sensitive or unstable materials, dewatering, and other acceptable control measures. Disturbance shall include the deterioration of backfill (after placement and satisfactory compaction) due to the Contractor's operations, such as moving equipment, hauling trucks, etc. All excavated or backfilled areas or subgrades that become disturbed during construction shall be removed and replaced with acceptable materials.
2. Prevent materials below constructed foundations from freezing. Materials that become frozen shall be removed and replaced, including foundations, at no additional cost to the OWNER.
3. At the completion of Work, all ground surfaces shall be left in a firm, stable, unyielding, reasonably uniform condition, free of ruts and surface irregularities, in accordance with grading requirements shown on the Drawings.

3.08 GRADING:

- A. Grading: Uniformly grade areas within limits of grading under this section, including adjacent transition areas. Smooth finish surface within specified tolerances and compact with uniform levels or slopes between points where elevations are shown, or between such points and existing grades.
- B. Grading Outside Structure Lines: Grade areas adjacent to structure to drain away from structures and to prevent ponding.
- C. Finish surfaces free from irregular surface changes and as follows:
 - Lawn or Unpaved Areas: Finish areas to receive topsoil to within not more than 0.10' above or below required subgrade elevations.
 - Pavements: Shape areas under pavement to line, grade and cross-section, with finish surface not more than 1/2 inch above or below required top of base gravel elevation.
 - Fill Under Slabs: Grade smooth and even, free of voids, compacted as specified, and to required elevation. Provide final grades within a tolerance of 1/2-inch when tested with a 10-foot straightedge.
- D. Compaction: After grading, compact subgrade surfaces as required.

3.09 GRAVEL WETLAND CONSTRUCTION:

- A. Gravel wetlands shall be constructed conforming to the lines and grades depicted on the plans and detailed within the Contract Documents. Any modifications to the elevation, shape, or location of the Gravel Wetlands, or any component of the Gravel Wetlands, shall be at the direction of and approval of the Engineer.
- B. The Contractor shall be responsible for contacting Engineer during key times of construction to ensure that gravel wetland components are inspected prior to backfill; refer to "Construction Oversight Notes" on the project detail sheets for key elements requiring inspection by the Engineer.

3.10 EROSION CONTROL: Provide erosion control measures as specified in Section 312513 and as shown on Drawings.

3.11 MAINTENANCE:

- A. Protection of Graded Areas: Protect newly graded areas from traffic and erosion. Keep free of trash and debris. Repair and re-establish grades in settled, eroded, and rutted areas to specified tolerances.
- B. Reconditioning Compacted Areas: Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify surface, re-shape, and compact to required density prior to further construction.
- C. Settling: Where settling is measurable or observable at excavated areas during warranty period; remove surface, base gravel, fill material, and add required backfill material, compact, and

replace surface. Restore appearance, quality, and condition of surface to match adjacent work, and eliminate evidence of restoration work to greatest extent possible.

- 3.12 DISPOSAL OF EXCESS MATERIALS: Remove excess excavated material and dispose of it off-site in a lawful manner, unless otherwise directed by ENGINEER.

END OF SECTION 312000

SECTION 312319 - DEWATERING

PART 1 - GENERAL

1.01 DESCRIPTION

This section specifies performance of dewatering required to lower and control ground water table levels and hydrostatic pressures to permit excavation, backfill, and construction to be performed in the dry. Control of surface water shall be considered as part of the work under this specification.

1.02 SUMMARY

- A. The work to be completed by the Contractor includes, but is not necessarily limited to the following:
 - 1. Implementation of the Erosion and Sedimentation Control Plan.
 - 2. Dewater excavations, including seepage and precipitation.
- B. The Contractor shall be responsible for providing all materials, equipment, labor, and services necessary for care of water and erosion control. Excavation work shall not begin before the Erosion and Sedimentation Control Plan is in place.

1.03 REQUIREMENT

- A. Dewatering system shall be of sufficient size and capacity necessary to lower and maintain ground water table to an elevation at least 1 foot below lowest foundation subgrade or bottom of pipe trench and to allow material to be excavated in a reasonably dry condition. Materials to be removed shall be sufficiently dry to permit excavation to grades shown and to stabilize excavation slopes where sheeting is not required. Operate dewatering system continuously until backfill work has been completed.
- B. Reduce hydrostatic head below any excavation to the extent that water level in the construction area is a minimum of 1 foot below prevailing excavation surface.
- C. Prevent loss of fines, seepage, boils, quick conditions or softening of foundation strata.
- D. Maintain stability of sides and bottom of excavation.
- E. Construction operations are performed in the dry.
- F. Control of surface and subsurface water is part of dewatering requirements. Maintain adequate control so that:
 - 1. The stability of excavated and constructed slopes are not adversely affected by saturated soil, including water entering prepared subbase and subgrades where underlying materials are not free draining or are subject to swelling or freeze-thaw action.
 - 2. Erosion is controlled.
 - 3. Flooding of excavations or damage to structures does not occur.
 - 4. Surface water drains away from excavations.
 - 5. Excavations are protected from becoming wet from surface water, or insure excavations are dry before additional work is undertaken.

- G. Permitting Requirements: The contractor shall comply with all local, state and federal regulations.
- H. Dewatering plan shall be approved by ENGINEER prior to start of work.
- I. Discharge water from dewatering operation shall be sufficiently clean of sediment and shall incorporate the use of one or more technologies to control sediment, including settling basins, frac tanks and filter bags on the discharge end of the dewatering outlet. At minimum, all dewatering discharge shall pass through a filter system such as a Dirtbag by ACF Environmental or equal. ENGINEER shall observe the condition of discharge water and may require additional controls to ensure that an appropriate level of sediment removal is occurring prior to reaching receiving waters.

1.04 SUBMITTALS

A. Drawings and Design Data:

1. Submit drawings and data showing the method to be employed in dewatering excavated areas 5 days before commencement of excavation.
2. Material shall include: location, depth and size of wellpoints, headers, sumps, ditches, size and location of discharge lines, capacities of pumps and standby units, and detailed description of dewatering methods to be employed to convey the water from site to adequate disposal.
3. Include a written report outlining control procedures to be adopted if dewatering problem arises.
4. Materials submitted shall be in a format acceptable for inclusion in required permit applications to any and all regulatory agencies for which permits for discharge water from the dewatering system are required due to the discharge reaching regulated bodies of water.

B. Inspection Reports.

C. All required permits.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install a dewatering system to lower and control ground surface water in order to permit excavation, construction of structure, and placement of backfill materials to be performed under dry conditions. Make the dewatering system adequate to pre-drain the water-bearing strata above and below the bottom of structure foundations, utilities and other excavations.
- B. In addition, reduce hydrostatic pressure head in water-bearing strata below structure foundations, utility lines, and other excavations, to extent that water levels in construction area are a minimum of 1 foot below prevailing excavation surface at all times.

3.02 OPERATION

- A. Prior to any excavation below the ground water table, place system into operation to lower water table as required and operate it continuously 24 hours a day, 7 days a week until utilities and structures have been satisfactorily constructed, which includes the placement of backfill materials and dewatering is no longer required.

- B. Place an adequate weight of backfill material to prevent buoyancy prior to discontinuing operation of the system.

3.03 WATER DISPOSAL

- A. Dispose of water removed from the excavations in such a manner as:

1. Will not endanger portions of work under construction or completed.
2. Will cause no inconvenience to Owner, City or to others working near site.
3. Will comply with the stipulations of required permits for disposal of water.
4. Will Control Runoff: The Contractor shall be responsible for control of runoff in all work areas including but not limited to: excavations, access roads, parking areas, laydown, and staging areas. The Contractor shall provide, operate, and maintain all ditches, basins, sumps, culverts, site grading, and pumping facilities to divert, collect, and remove all water from the work areas. All water shall be removed from the immediate work areas and shall be disposed of in accordance with applicable permits.
5. Will be sufficiently clean of sediment by incorporating the use of one or more technologies to control sediment, including settling basins, frac tanks and filter bags on the discharge end of the dewatering outlet. At minimum, all dewatering discharge shall pass through a filter system such as a Dirtbag by ACF Environmental or equal.

- B. Excavation Dewatering:

1. The Contractor shall be responsible for providing all facilities required to divert, collect, control, and remove water from all construction work areas and excavations.
2. Drainage features shall have sufficient capacity to avoid flooding of work areas.
3. Drainage features shall be so arranged and altered as required to avoid degradation of the final excavated surface(s).
4. The Contractor shall utilize all necessary erosion and sediment control measures as described herein to avoid construction related degradation of the natural water quality.

- C. Dewatering equipment shall be provided to remove and dispose of all surface and ground water entering excavations, trenches, or other parts of the work during construction. Each excavation shall be kept dry during subgrade preparation and continually thereafter until the structure to be built, or the pipe to be installed therein, is completed to the extent that no damage from hydrostatic pressure, flotation, or other cause will result.

3.04 STANDBY EQUIPMENT

Provide complete standby equipment, installed and available for immediate operation, as may be required to adequately maintain de-watering on a continuous basis and in the event that all or any part of the system may become inadequate or fail.

3.05 CORRECTIVE ACTION

If dewatering requirements are not satisfied due to inadequacy or failure of the dewatering system (loosening of the foundation strata, or instability of slopes, or damage to foundations or structures), perform work necessary for reinstatement of foundation soil and damaged structure resulting from such inadequacy or failure by Contractor, at no additional cost to Government.

3.06 DAMAGES

Immediately repair damages to adjacent facilities caused by dewatering operations.

3.07 REMOVAL

Insure compliance with all conditions of regulating permits.

END OF SECTION 312319

SECTION 312513 - EROSION AND SEDIMENT CONTROLS

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK:

- A. Provide, inspect, and maintain devices to control erosion, siltation, sedimentation, and dust that occur during construction operations. Undertake every reasonable precaution and do whatever is necessary to avoid erosion of soil and to prevent silting of wetland areas, drainage ditches, and rivers.
- B. Furnish and install stabilized construction entrances, culvert and catch basin inlet sediment filters, mats, temporary seeding, dormant seeding, haybale and siltation fence, and coffer dams.
- C. Provide measures to control dust caused on and off the Project site.
- D. Deficiencies in erosion control measures indicated by failures or erosion shall be immediately corrected by providing additional measures or different techniques to correct the situation and prevent subsequent erosion.
- E. Exposure of soils on embankments, excavations, and graded areas shall be kept as short as possible. Initiate seeding and other erosion control practices as soon as reasonably possible.
- F. Provide erosion control measures in any ditch, swale or channel before water is allowed to flow in the waterway.
- G. Mechanized Equipment will not be permitted in water courses unless specifically required in the Contract Documents.

1.02 QUALITY ASSURANCE:

- A. Conform to all requirements of applicable federal, state and local permits, and Contract Documents, and conform to the recommendations of the Standards whether the measures are specifically noted herein, or not.
- B. Meet with the ENGINEER to discuss erosion control requirements prior to the start of construction.

1.03 REFERENCES:

- A. "Maine Erosion and Sedimentation Control BMPs" prepared by the Maine Department of Environmental Protection, most recent updated version.

1.04 SUBMITTALS:

- A. Erosion Control Program: Prepare and submit to ENGINEER for approval prior to construction startup.

PART 2 - PRODUCTS

2.01 MATERIALS:

- A. General: Use the following materials in construction of sediment traps, erosion control devices, and slope protection as specified on the DRAWINGS. Other materials require approval of the ENGINEER.
- B. Mats: Erosion Control Blanket shall be North American Green S150BN, or approved equal.
- C. Mulches:
 - 1. Long fibered hay or straw in dry condition and which are relatively free of weeds and foreign matter detrimental to plant life.
 - 2. Mulch binder: A synthetic mulch binder of type acceptable to the ENGINEER.
 - 3. Mulch netting: Plastic or nylon mesh netting with approximate openings of 1/4- to 1- inch; or other netting approved by the ENGINEER.
- D. Temporary Seed: Seed variety and composition percentages are as determined by the following table. Application Rates are selected based upon the date of application. Equivalent seed mixture based on its suitability for use in controlling erosion of the various soil types and slopes may be used as approved by the ENGINEER.

For Lawn Areas:

Percent	Seed
10%	Creeping Red Fescue
25%	Kentucky Bluegrass
60%	Perennial Rye Grass
5%	Annual Rye Grass

For Non-Lawn Areas:

Percent	Seed
50%	Creeping Red Fescue
25%	Tall Fescue
10%	Annual Rye Grass
10%	White Clover
5%	Red Top

- E. Siltation Fence: MIRAFI Envirofence, or approved equal.
- F. Hay Bale Barrier: Rectangular shaped bales of hay or straw weighting at least 40 pounds per bale; free from noxious weed seeds and rough or woody materials.
- G. Catch Basin Inlet Sediment Barrier: ACF Environmental, Inc. High Flow Siltsack®, Siltsaver Inlet Filter, or approved equal.
- H. Temporary Frame and Fabric Cofferdam: Portadam, or approved equal.

PART 3 - EXECUTION

3.01 TEMPORARY EROSION DEVICES:

- A. General: Provide the following devices to control erosion. Other devices require approval of the ENGINEER.
- B. Hay Bale Barrier: Provide temporary hay bale fence as shown on DRAWINGS, and in ditches at 100-foot minimum intervals or where designated by the ENGINEER for erosion checks.
1. Bales shall be placed in a row with ends tightly abutting the adjacent bales.
 2. Each bale shall be embedded in the soil a minimum of 4 inches.
 3. Bales shall be securely anchored in place by stakes or re-bars driven through the bales. The first stake in each bale shall be angled toward previously laid bale to force bales together.
 4. Inspection shall be frequent and repair or replacement shall be made promptly as needed.
 5. Bales shall be removed when they have served their usefulness so as not to block or impede storm flow or drainage.
- C. Silt Fence:
1. Install silt fence prior to any earthwork including grubbing.
 2. Place where shown on Drawings or as directed by the ENGINEER. Install parallel to contours where possible, prior to site clearing and grading activities.
 3. Bury lower edge of fabric at least 4 inches below ground surface to prevent underflow.
 4. Curve ends of fence uphill to prevent flow around ends.
 5. Inspect frequently; repair or replace any damaged sections.
 6. Remove fence only when adequate grass catch has been established as determined by the ENGINEER.
- D. Mulch:
1. Undertake immediately after each area has been properly prepared.
 2. When seed for erosion control is sown prior to placing the mulch, place mulch on the seeded areas within 48 hours after seeding.
 3. Apply mulch at rates indicated on plans.
 4. Blowing chopped mulch will be permitted.
 5. Hay mulch should cover the ground enough to shade it, but the mulch should not be so thick that a person standing cannot see ground through the mulch.
 6. Remove matted mulch or bunches.
- E. Temporary Erosion Control Matting:
1. Install on all permanent slopes steeper than 3:1 in the base of ditches and any disturbed areas within 100 feet of a protected natural resource (wetlands and water resources).
 2. Install in accordance with the Manufacturer's recommendations.

F. Temporary Seeding:

1. Seed with appropriate seeds from specified in paragraph 2.01D of this Section. Seed shall be sown on the pure live seed basis and at a rate based on the date of application, per the recommendation of the Maine Department of Environmental Protection's Erosion and Sedimentation Control BMPs.
2. Mulch areas where temporary seeding has been applied. Do not mulch seeded areas where matting will be immediately installed.
3. If temporary seeding does not achieve adequate growth by December 1, an additional layer of mulch shall be applied at that time.

G. Topsoil Storage:

1. Topsoil which is stockpiled on the site for use in loam applications shall be placed out of natural drainages, in piles not more than 8 feet in height, which have side slopes of 2:1 to 1.5:1.
2. A trench, depth as required, shall be constructed around the base of the pile to prevent eroding soil from washing into drainages.
3. Any topsoil piles shall be covered with temporary seed and mulch immediately following stockpiling if not in active use.

H. Temporary berms: Construct temporary barriers along the toe of embankments using side drains as required.

I. Sediment Traps: Construct sediment traps in runoff ditches, using hay bale fence, at a minimum of 100-foot intervals or as required.

J. Catch Basin Inlet Sediment Barrier: Install, check, and clean or replace per manufacturer's recommendations.

K. Temporary Frame & Fabric Cofferdam: Install around work area per manufacturer's recommendations.

3.02 REMOVAL OF TEMPORARY EROSION CONTROL:

- A. Remove temporary materials and devices when permanent soil stabilization has been achieved. Re-use materials in good condition if approved by the ENGINEER.
- B. Remove unsuitable materials from site and dispose of in a legal manner.

3.03 SUBGRADE PREPARATION:

- A. Grade and compact, where possible, areas to receive protection to a uniform slope. Allow for depth of protection stone layer.

3.04 FILTER FABRIC PLACEMENT:

- A. General: Place filter fabric as shown on the DRAWINGS. Filter fabric is to be placed in one continuous piece. Sew all seams as per manufacturer's recommendation.

3.05 MAINTENANCE:

- A. Inspect erosion control practices immediately after each rainfall and at least daily during prolonged rainfall or snowmelt for damage. Provide maintenance and make appropriate repairs or replacement at no additional cost to the OWNER, until Project acceptance or as required to comply with maintenance requirements if longer.
- B. Remove silt from silt fence when it has reached one half the height of the barrier or prior to expected heavy runoff or siltation.
- C. Repair matting if any staples become loosened or raised, or if any matting becomes loose, torn, or undermined, make satisfactory repairs immediately.
- D. Following temporary and/or final seeding, the contractor shall inspect the work area semimonthly until the seedlings have vegetated 85% - 90% of the area. Reseeding shall be carried out by the CONTRACTOR with follow-up inspections in the event of any failures until vegetation is adequately established.

END OF SECTION 312513

SECTION 321200 - FLEXIBLE PAVING

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK:

- A. Provide and install hot mix asphalt (HMA) pavement as specified and as directed by the ENGINEER. This work includes:
 - 1. HMA pavement including driveways, roadways, trench patches, parking, and sidewalks
 - 2. Painting and pavement markings

1.02 REFERENCES:

- A. Specification Sections:
 - 1. Earth Moving: Section 312000.
- B. State of Maine Department of Transportation "Standard Specifications," most recent revision
- C. State of Maine Department of Transportation "Supplemental Specifications – Corrections, Additions & Revisions to Standard Specifications – Latest Edition"
- D. AASHTO M320-Standard Specification for PGAB.

1.03 SUBMITTALS:

- A. Material Certificates: Certificates signed by material producer and CONTRACTOR stating that each material complies with specified requirements.
- B. Design Mix: Provide design mix for each grade of pavement to be used at least 20 days prior to start of paving.
- C. Certified Weigh Slips: If required by the ENGINEER, provide for each truck load of bituminous material.

1.04 QUALITY ASSURANCE:

- A. Comply with any road opening permits issued for the Work.

1.05 JOB CONDITIONS:

- A. Weather and Seasonal Limitations: Follow MDOT "Standard Specification" Section 401.06.
- B. Tack Coat Limitations:
 - 1. Apply bituminous prime and tack coats only when the ambient temperature in the shade is at least 50°F for 12 hours immediately prior to application.
 - 2. Do not apply when the base surface is wet or contains an excess of moisture which would prevent uniform distribution and the required penetration.

PART 2 - PRODUCTS

2.01 AGGREGATE BASE AND SUBBASE: Refer to Section 312000.

2.02 ASPHALT CEMENT:

- A. General: Comply with materials requirements, MDOT "Standard Specification", Section 702.

2.03 BITUMINOUS PAVEMENTS:

- A. Comply with materials requirements, MDOT "Standard Specification", current revision, Section 401, Superpave Mixes, used as indicated on the Drawings.

- 1. HMA 19mm
- 2. HMA 12.5mm

2.04 BITUMINOUS TACK COAT:

- A. General: MDOT "Standard Specifications" Section 702.04.

2.05 MARKING PAINT:

- A. General: Alkyd-resin type, ready-mixed complying with AASHTO M 248, Type I.
- B. Color: White for shoulder striping, bicycle lane demarcation, and directional arrows; blue for handicapped parking symbols; yellow for other lane demarcation striping.

PART 3 - EXECUTION

3.01 BASE AND SUBBASE:

- A. General: Do not begin paving operations until base and subbase have been accepted.

3.02 BITUMINOUS PAVEMENTS:

- A. General: MDOT Standard Specifications.
- B. Base Course: Section 401.
- C. Surface Course: Section 403.
- D. Saw cuts and butt joints shall be used in existing pavement as indicated on the Drawings to facilitate the installation of new pavement.

3.03 BITUMINOUS TACK COAT:

- A. General: Apply tack coat immediately prior to placing pavement adjacent to curbing, gutters, manholes, pavement, etc. for adequate bond. Generally a tack coat will not be required for pavement placed immediately following the rolling of the underlying course.

- B. MDOT Standard Specification Section 409.
- C. Rate of Application: 0.05 to 0.15 gallons per square yard.

3.04 TRENCH PATCHING:

A. Permanent Patching:

1. Remove all existing pavement and regrade base material and compact as required.
2. Provide base and surface courses to the depths shown on the Drawings. No surface pavement placement shall be without the prior approval of the ENGINEER.

3.05 TRAFFIC AND PARKING LOT MARKINGS:

- A. Cleaning: Sweep and clean surface to eliminate loose material and dust.
- B. Striping: Use chlorinated-rubber base traffic lane-marking paint, factory-mixed, quick-drying, and non-bleeding.

Do not apply marking paint until layout and placement have been verified with ENGINEER and OWNER.

Apply paint with mechanical equipment to produce uniform straight edges. Apply at manufacturer's recommended rates to provide minimum 12 to 15 mils dry thickness.

END OF SECTION 321200

SECTION 321600 - CURBS AND GUTTERS

PART 1 – GENERAL

1.01 DESCRIPTION OF WORK:

- A. Remove, stockpile, dispose/deliver existing granite curbing to the Town as directed by ENGINEER.
- B. Provide all new Type 1 granite curbing, Type 5 stone edging for sloped granite curbing, and tipdowns as shown on the Drawings.

1.02 REFERENCES:

- A. Specification Sections:
 - 1. Earth Moving: Section 312000.
 - 2. Flexible Paving: Section 321200.
 - 3. Sidewalks: Section 322000.
- B. State of Maine Department of Transportation “Standard Specifications,” most recent revision.
- C. State of Maine Department of Transportation “Supplemental Specifications – Corrections, Additions & Revisions to Standard Specifications –Latest Edition”
- D. American Society for Testing and Materials (ASTM): C 615-68 (1972), Structural Granite.

1.03 SUBMITTALS:

- A. Shop Drawings:
 - 1. Dimensions of cut curbing.
 - 2. Manufacturers construction data for granite curbs.
 - 3. Manufacturers printed data on recommended installation procedures for granite curb.
 - 4. Manufacturers printed data on recommended installation procedures for Slipform concrete curbing.
- B. Certificates: Manufacturer's certification that products meet specification requirements.

PART 2 – PRODUCTS

2.01 GRANITE CURB:

- A. Vertical face curb, Type 1, straight sections.
- B. Vertical face curb, Type 1, circular sections.
- C. Tip-down curb, Type 1.
- D. Stone edging, Type 5, for sloped granite curbing.

- E. MDOT Specification, Paragraph 712.04.

2.02 JOINT PAD:

- A. Bituminous Fiber Joint Filler: Preformed strips of composition below, complying with ASTM D1751: Asphalt saturated fiber board.
- B. MDOT Specification, Paragraph 609.03

PART 3 – EXECUTION

3.01 INSPECTION:

- A. Verify that earthwork is completed to correct line and grade.
- B. Check that subgrade is smooth, compacted, and free of frost or excessive moisture.
- C. Do not commence work until conditions are satisfactory.

3.02 INSTALLATION:

- A. For installation of granite Type 1 and Type 5 sloped granite curbing, comply with appropriate Paragraphs of MDOT Specification, 609 and the details provided on the Construction Drawings.

3.03 CLEANING:

- A. Clean completed work with appropriate agent and rinse thoroughly.

END OF SECTION 321600

SECTION 322000 - SIDEWALKS

PART 1 - GENERAL

1.01 SUMMARY:

This work shall consist of providing and installing bituminous concrete sidewalks in accordance with these specifications and in reasonably close conformity with the lines and grades as shown on the plans.

This work shall consist of providing and installing reinforced concrete sidewalks in accordance with these specifications and in reasonably close conformity to the lines and grades as shown on the plans.

This work shall include the construction of sidewalk ramps at locations as shown on the plans and shall be in accordance with the sidewalk pedestrian ramp typical details and with current Americans with Disabilities Act requirements.

1.02 REFERENCES:

A. Specification Sections:

1. Earth Moving: Section 312000.
2. Flexible Paving: Section 321200.
3. Curbs and Gutters: Section 321600.

B. State of Maine Department of Transportation "Standard Specifications," latest revision

C. State of Maine Department of Transportation "Supplemental Specifications – Corrections, Additions & Revisions to Standard Specifications – Latest Edition"

D. City of Portland Technical and Design Standards, latest edition (available online <http://me-portland.civicplus.com/757/Technical-Design-Standards>)

1.03 SUBMITTALS:

- A. Design Mix: Provide mix design for concrete to be used for reinforced concrete sidewalks at least 20 days prior to start of placement.

PART 2 - PRODUCTS

2.01 REINFORCED CONCRETE:

- A. MATERIALS: Material for reinforced concrete shall be as identified on the Plans and shall conform to the requirements of the various subsections of the specifications listed below:
 1. Portland Cement Concrete shall conform to the requirements of Section 502 of the Maine Department of Transportation Standard Specifications for Structural Concrete, Class "A".
 2. Prefomed Expansion Joint Fill shall conform to the requirements of subsection 705.01 of the Maine Department of Transportation Standard Specifications.

3. Welded Steel Wire Fabric shall be 6" x 6" mesh with No. 2.0 wire and shall conform to the requirements of AASHTO designation M55, Welded Steel Wire Fabric for Concrete Reinforcement.
4. Sealants: Joint sealants shall be color-matched to the concrete and specially formulated for high-performance in pedestrian and vehicular traffic areas.

2.02 BITUMINOUS CONCRETE:

- A. MATERIALS: Bituminous pavement, as identified on the Construction Drawings and as defined in Specification Section 32 12 00 Flexible Paving.

2.03 GRAVEL BASE AND SUBBASE:

- A. MATERIALS: Gravel/aggregate base and subbase, as identified on the Construction Drawings and as defined in Specification Section 31 20 00 Earth Moving.

PART 3 - EXECUTION

3.01 REINFORCED CONCRETE:

- A. Subgrade: The subgrade shall be shaped parallel to the proposed surface of the walks and drives and shall be thoroughly compacted. All depressions occurring shall be filled with suitable material and again compacted until the surface is smooth and hard.
- B. Installation: For installation of Portland Cement Concrete Sidewalks, comply with appropriate Paragraphs of MDOT Specification, 608.03.
- C. Reinforcing: Welded wire fabric shall be placed two inches above the crushed gravel, and two inches from all finished edges, expansion joints and curbs. All fabric joints shall be overlapped a minimum of one foot and be properly tied.
- D. Construction: As per Drawings.

3.02 BITUMINOUS CONCRETE:

- A. Subgrade: The subgrade shall be shaped parallel to the proposed surface of the walks and drives and shall be thoroughly compacted. All depressions occurring shall be filled with suitable material and again compacted until the surface is smooth and hard.
- B. Installation: For installation of bituminous concrete for sidewalks, comply with Specification Section 311200 Flexible Paving.
- C. Construction: As per Drawings.

3.02 HANDICAPPED ACCESSIBLE CURB RAMPS:

- A. Construction: As per Drawings.

END OF SECTION 322000

SECTION 331100 - WATER UTILITY DISTRIBUTION PIPING

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK: Water distribution piping includes:

- A. Furnishing and installing all main piping, service piping, and associated water utility appurtenances as noted on the Drawings.
- B. Verifying location of existing utilities prior to construction.
- C. Coordinating with the Portland Water District MEANS Group (207.774.5961) for new service and construction activities.
- D. Flushing, testing and disinfection of all water distribution piping.
- E. Repair of water piping damaged during construction.

1.02 REFERENCES:

- A. Specification Sections:
 - 1. Earth Moving: Section 312000.
 - 2. Erosion and Sedimentation Controls: Section 312513.
- B. Portland Water District Construction Specifications, latest version (available online <https://www.pwd.org/document-library>)

1.03 QUALITY ASSURANCE:

- A. Code Compliance: Comply with State Plumbing Code and local plumbing codes where more stringent. Comply with Maine Department of Human Services, Division of Health Engineering rules.
- B. AWWA Standards: Comply with requirements of Section 4 of AWWA C601, "Preventive Measures During Construction" for cleanliness.
- C. Other Standards: Comply with requirements of the Portland Water District specifications.
- D. Testing: CONTRACTOR shall pay for all flushing, pressure and leakage testing, disinfection, and fire flow testing. CONTRACTOR shall pay for all inspections by the Portland Water District.

1.04 SUBMITTALS:

- A. Submit manufacturer's product data and installation instructions for each product specified for water service piping, tapping, valving, risers, and fittings.

PART 2 - PRODUCTS

All products and materials shall be as identified in the Construction Drawings, and shall be in accordance with the Portland Water District Construction Specifications.

PART 3 - EXECUTION

The following construction related section is intended to apply to ALL new construction, both public and private. For the purposes of ensuring overall proper workmanship and compliance to these specifications, the District makes no distinction between extensions that are to be owned and maintained by the District, and private extensions installed to serve commercial, industrial or multi-unit type projects. All work shall be performed in accordance with the Portland Water District Construction Specifications.

3.01 INSTALLATION:

- A. All water mains shall be installed in accordance with the final approved plans and in accordance with the Portland Water District Construction Specifications. Any variation to the plans must have prior approval in writing by the District.
- B. Pipe, fittings, valves, hydrants, and associated appurtenances shall be installed in accordance with the latest American Water Works Association Standards, Portland Water District Standards and as directed herein.
- C. Fittings and hydrants shall be blocked for horizontal and/or vertical movement in accordance with American Water Works Association Standards and the Portland Water District Construction Specifications.
- D. All main line gate boxes, service gate boxes and blow-off appurtenances shall be properly installed and raised to grade at the completion of paving or grading operations. Any gate box found to be improperly installed or not raised to grade at any point prior to the end of the one year warrantee period will be the responsibility (and cost) of the contractor to repair.
- E. The trench will be kept dewatered during pipe installation. Every effort shall be made to avoid any situation where groundwater or surface water runoff is allowed to enter the main. The District reserves the right to issue a stop work order upon a project if this situation cannot be controlled.
- F. Every effort and precaution must be undertaken to prevent the introduction of any foreign material (insects, rodents or other animals, sediment, organic material, etc.) from entering the pipeline, either before construction or during installation. Each pipe section shall be visibly inspected on the inside and outside prior to lowering into the trench. Failure to follow proper housekeeping during installation will result in a stop work order or rejection of the pipe system.

3.02 BEDDING & BACKFILL:

- A. Pipe bedding and backfill shall be in accordance with the Construction Drawings and Portland Water District Construction Specifications.
- B. No backfill material which is frozen shall be placed in the trench.

- C. Trench Compaction: Compaction of backfill material shall be done in 12-inch maximum lifts achieving 95% proctor, or in accordance with the specifications and requirements of the State or Municipality responsible for the street or highway involved (whichever is the more stringent). Under no circumstance shall the District authorize the start of construction for any water main without a pre-approved compaction plan in place. The Portland Water District reserves the right to hire an independent testing firm, at the expense of the contractor, to verify compliance to the approved compaction plan.

END OF SECTION 331100

SECTION 333000 – SANITARY SEWERAGE UTILITIES

PART 1 GENERAL

- 1.01 DESCRIPTION OF WORK: Furnish and install sanitary sewer system as shown on the Drawings and in accordance with all City of Portland Technical Design Standards. This includes:
- A. Sanitary sewer pipe
 - B. Sanitary sewer service pipe
 - C. Repairs to existing pipe damaged during construction
 - D. Precast manholes and precast concrete structures and their appurtenances
 - E. Sanitary sewer cleanouts
 - F. Insulation and/or concrete encasement as necessary for utility crossings
 - G. Back flow preventers
 - H. Connection to existing systems
- 1.02 REFERENCES:
- A. Specification Sections:
 - 1. Earth Moving: Refer to Section 312000.
 - 2. Erosion and Sedimentation Controls: Refer to Section 312513.
 - B. State of Maine Department of Transportation “Standard Specification,” latest edition
 - C. State of Maine Department of Transportation “Supplemental Specifications – Corrections, Additions & Revisions to Standard Specifications – Latest Edition”
 - D. City of Portland Technical and Design Standards, latest edition (available online <http://me-portland.civicplus.com/757/Technical-Design-Standards>)
- 1.03 SUBMITTALS:
- A. Manufacturer's product data and installation instructions.
 - B. Certified copies of tests on pipe units.
 - C. Antifloatation calculations for all below grade structures.
 - D. Construction Records: Record depth and location of the following:

1. Sanitary sewer pipe and service locations, cleanouts, bends in services, connection points to sewer main.
2. Repairs to existing pipes.

Record neatly in a permanently bound notebook and submit at Substantial Completion. Provide access to records for ENGINEER at all times. Submit copies to ENGINEER on a weekly basis.

PART 2 - PRODUCTS

2.01 PIPE AND FITTINGS:

- A. General: Provide fittings of same type and class of materials as pipe. Provide commercially manufactured wyes or tee/yses for service connections. Fitting must have single piece gasket.
- B. PVC Non-Pressure Pipe and Services (Sewer): 6-inch Diameter: ASTM D3034 or ASTM D3033, strength requirement SDR 35; push-on joints, ASTM D3212; gaskets, ASTM F477.

2.02 PRECAST CONCRETE STRUCTURES

- A. Base Sections: Precast monolithic construction with steps.
- B. Barrel Sections: Precast with steps.
- C. Top Sections: Precast eccentric cone with steps.
- D. Steps: Polypropylene reinforced with steel rod. Meet OSHA requirements, minimum width 16-inches. Cast into concrete.
- E. Pipe to Structure Connections: Connections shall be watertight, expandable pipe sleeve with adjustable expansion ring equal to Press-Boot by Press-Seal Gasket Corp., Fort Wayne, Indiana.
- F. Joints Between Precast Sections: Watertight, shiplap-type seal with two rings of one-inch diameter butyl rubber sealant.
- G. All brick masonry surfaces with mortar shall be waterproofed with one coat of DEHYDRATINE 6 TROWEL MASTIC, DEHYDRATINE 10 SEMI-MASTIC or approved equal.
- H. All poured concrete or precast concrete surfaces shall be waterproofed with two heavy coats of bituminous waterproofing materials. The material shall be MINWAX FIBROUS BRUSH COAT made by the Minwax Company, New York, New York; TREMCO 121 FOUNDATION COATING, made by the Tremco Manufacturing Company, Cleveland, Ohio; INERTOL NO-7 made by Inertol Company, Newark, New Jersey or approved equal. All waterproofing material shall be applied according to the manufacturer's specifications and directions.

2.03 FRAMES, COVERS, AND GRATES

- A. Material: Cast iron, ASTM A48 Class 30
- B. Provide frames, covers and grates as identified on the plans

- C. Frames, covers and grates shall be classified as H-20 load rated and shall be manufactured in the United States. Acceptable manufacturers include Neenah Foundry, Etheridge Foundry and East Jordan Iron Works.
- D. Sewer covers shall be clearly marked with the word "SEWER" in 3" high raised letters on the cover.

2.04 MISCELLANEOUS:

- A. Flexible Couplings: Use and location shall be approved by ENGINEER.
 - 1. Type A: Dresser Style 253 as manufactured by Dresser, or approved equal.
 - 2. Type B: Neoprene sleeve with stainless steel bands by Fernco, or approved equal.
- B. Pipe Supports: Saddle type, steel, painted, adjustable, by ITT Grinnell, or approved equal.
- C. Marking Tape: Lineguard III by Tri-Sales, Inc., 2-inch wide, green; detectable with magnetic locators, or approved equal.
- D. Rigid Insulation: Extruded closed-cell rigid foamed polystyrene, 2-inch thickness, width of trench, Styrofoam HI-60, by Dow Chemical, or approved equal.
- E. Frost Barrier: U.V. resistant, high grade polyethylene, minimum thickness six (6) mils.
- F. Joint Sealants:
 - 1. Butyl Rubber Sealant: One (1) inch diameter strips manufactured by Kent Seal, or approved equal.
 - 2. Butyl Rubber Caulking: Conform to AASHTO M-198, Type B.
- G. Sewer Manhole Inverts: Provide inverts as shown on the Drawings. Configuration to be as required by connecting pipes and as shown on Drawings.

PART 3 - EXECUTION

3.01 INSTALLATION OF GRAVITY PIPE AND FITTINGS:

- A. Methods: Install in accordance with manufacturer's recommendations. Use a laser beam for line and grade unless otherwise permitted by the ENGINEER. Secure each length of pipe with bedding before placing next length. Plug open ends when work is suspended. Bed pipe as shown on Drawings. A 30-inch minimum cover over the top of PVC pipe and DI pipe should be provided before the trench is wheel-loaded.
 - 1. Backfill under all existing utility pipes crossed by new utility pipes or work with $\frac{3}{4}$ " crushed stone. The crushed stone backfill shall extend continuously from the bedding of the new pipe to the utility pipe crossed, including a 6" thick envelope of crushed stone all around the existing utility pipe(s). The $\frac{3}{4}$ " crushed stone backfill shall stand at its own angle of repose. No "haunching" or "forming" with common fill will be allowed.

B. Grade and Line:

1. Lay pipe to line and grade shown on the Drawings. If grade is not shown, determine elevations of start and finish points for each run of pipe. Lay pipe to a uniform grade between these points.
2. Line and grade may be adjusted by the ENGINEER as required by field conditions.

C. Conditions: Lay pipe in the dry. Do not use installed pipe to remove water from work area.

D. Flush and clean all pipe and remove all debris and materials. Flushing and cleaning methods approved by ENGINEER. Gravity flushing is not acceptable.

E. Connections to Manholes and Catchbasins: Provide short length of pipe so that joints are located within 3 feet of inside surface of manholes and catch basins for all pipe.

F. Sanitary Sewer Service Fittings and Leads:

1. Size of service leads 6-inch unless otherwise indicated.
2. Depth and location of service to be determined by ENGINEER in field.
3. Provide tee/wye or wye fittings on main line pipe.
4. Provide clean outs as shown and detailed on Drawings.
5. Plug, or cap, and stake ends of new service. Provide stake which extends from plug or cap to 1-foot above ground surface. Assist ENGINEER in measurement of pipe installed and in obtaining swing ties to ends of leads.

3.02 INSTALLATION OF MANHOLES:

A. Antifloatation Design & Submittal Requirements: The CONTRACTOR shall prepare antifloatation calculations for all below grade concrete structures to identify the need for and design of antifloatation slabs. If a structure requires an antifloatation slab, the CONTRACTOR, under the review and stamp of a Professional Engineer licensed in the State of Maine, shall prepare a design and submit the stamped, signed design for review by ENGINEER. If a structure does not require an antifloatation slab, the CONTRACTOR, under the review and stamp of a Professional Engineer licensed in the State of Maine, shall prepare and submit stamped, signed antifloatation slab calculations indicating that a slab is not required for the structure for review by ENGINEER. The CONTRACTOR shall prepare calculations following these criteria:

1. Groundwater elevation shall be set at rim grade at the structure.
2. Factor of safety shall be 1.1; downward forces from the weight of the structure and soils over slab shall be 1.1 times the buoyant uplift forces.
3. Structure weight shall only include the weight of the structure and slab. The structure shall be considered empty. Calculations shall not consider the weight of pipes, internal water, or internal structure components.

B Placement: Place precast bases and structures on compacted bedding material so bottom of structure is plumb and pipe inverts are at proper elevations. Place manhole barrel and top sections in the appropriate height combinations. Plug all lifting holes inside and out with non-shrink grout. Construct manhole inverts in accordance with the Drawings.

- C. Joints: Follow manufacturer's instructions for sealing joints between precast sections. Provide two rings of 1 inch diameter butyl rubber sealant. Point joints inside and out with butyl caulk.
- D. Frame and Covers:
 - 1. Set to final grade as shown on the Drawings and as specified. Provide adequate temporary covers to prevent accidental entry until final placement of frame and cover is made.
 - 2. Use two rings of 1 inch diameter butyl rubber sealant between frame and rubber riser. Provide downward force to frame so as to compress the joint, provide a watertight seal, and prevent future settlement. Point compressed joint with butyl rubber caulk sealant.
 - 3. Set manhole frames and covers to final grade only after pavement base course has been applied, or after final grading of gravel roads.
- E. Inverts: As specified in paragraph 2.04G of this section
- F. Steps: Replace any steps that are out of plumb and proper horizontal placement.
- G. Frost Barriers: Wrap each manhole to the maximum excavation depth or not less than 6 feet below grade, with a minimum of four layers of 6 mils each of the polyethylene.
 - 1. Clean manhole exterior of all dirt and remove any protrusions.
 - 2. Apply a 6-inch wide vertical strip of bituminous waterproofing adhesive from the top of manhole to the greatest excavation depth, but not in excess of 6 feet.
 - 3. Start poly wrap at adhesive strip and proceed around manhole continuously, overlapping adhesive strip a minimum of 24 inches on the final layer.
 - 4. Tuck and pleat poly at top in a continuous manner, minimizing size of folds. Extend poly past top of manhole frame and temporarily tuck remainder inside frame, until final backfill and paving.
 - 5. Paved areas: Cut poly flush with manhole rim after pavement is in place.
 - 6. Unpaved areas: Pull loose ends of poly together, remove excess air and tie off end with galvanized wire. Bury with manhole below grade.

3.03 UTILITIES TO BE ABANDONED:

- A. Close open ends of abandoned underground utilities which are not indicated to be removed. Provide sufficiently strong closures, such as caps or brick and mortar, acceptable to ENGINEER to withstand hydrostatic or earth pressure which may result after ends of abandoned utilities have been closed. CONTRACTOR may remove abandoned utilities with written permission of ENGINEER.

3.04 INSULATION:

- A. Install as shown on Drawings.
- B. Provide 2-inch minimum thickness compacted sand layers for sanitary sewer, directly above and below insulation.

3.05 TESTING OF SANITARY SEWERS:

- A. General: Test all sanitary sewer pipes after backfilling. Install service leads on main line before testing. Perform tests in presence of ENGINEER. A maximum of 1000 feet of pipe may be installed but not tested at any time.
- B. Gravity Sewer Leakage Tests: Use low pressure air test as follows:
 - 1. Plug ends of section to be tested.
 - 2. Supply air slowly to the pipe to be tested until the air pressure inside the pipe is 4.0 psi greater than the average back pressure of any groundwater submerging the pipe.
 - 3. Disconnect air supply and allow a minimum of two minutes for stabilization of pressure.
 - 4. Following stabilization period measure drop in pressure over the test period within the following times:

Nominal Pipe Size (in.)	Test Period (min.)
4	4
6	4
8	6
10	6
12	7
15	8
18	9
21	11
24	13

- 5. Acceptable drop: No more than 1.0 psi.
- C. Deflection Test for PVC Gravity Sewer Pipe: Test 100% of pipe with "GO-NO-GO" gauge allowing maximum deflection per ASTM D3034.
- D. TV Inspection: All sewers may be inspected by the OWNER using TV pipe inspection. Defects in materials and/or workmanship found during the inspection shall be corrected by the CONTRACTOR.
- E. Repair all pipes not passing tests, using materials and methods approved by the ENGINEER, and retest.

3.06 TESTING OF SEWER STRUCTURES.

- A. General: Tests must be observed by the ENGINEER. Manholes must be complete, including backfill, for final test acceptance except for shelf and invert brickwork. Plug all pipes and other openings in the manhole walls prior to test.
- B. Exfiltration Test:
 - 1. Plug pipes into and out of MH and secure plugs.
 - 2. Lower groundwater table (GWT) to below MH. Maintain GWT at this level throughout test. Provide means of determining GWT level at any time throughout test.
 - 3. Fill MH with water to top of cone.
 - 4. Allow a period of time for absorption (determined by CONTRACTOR).

5. Refill to top of cone.
6. Determine volume of leakage in an 8 hour (min) test period and calculate rate.
7. Acceptable leakage rate: Not more than 1 gallon per vertical foot per 24 hours.
8. ENGINEER reserves the right to require an infiltration test if he is not satisfied with the exfiltration test.

C. Vacuum Test:

1. Manholes may be vacuum tested in lieu of the exfiltration test. The vacuum tests must be performed prior to backfilling the manhole, filling joints, and constructing the manhole inverts and benches. All pipe connections shall be made prior to the test.
2. Plug pipe openings and securely brace the plugs and pipe.
3. Set the tester onto the top section of the manhole and inflate the compression band to effect a seal between the structure and the vacuum base.
4. Connect the vacuum pump to the outlet port, open the valve, start the motor and draw a vacuum of 10-inch mercury.
5. Close the valve and monitor the vacuum gauge.
6. The test shall pass if the vacuum holds at 10-inch mercury or drops no lower than 9 inches within the following times:

Depth of Manhole (feet)	Time (min.)
0 - 10	3.0
10 - 15	3.5
15 - 20	4.0
20 - 25	4.5
>25	5.0

7. If the vacuum drops in excess of the prescribed rate, the CONTRACTOR shall locate the leak, make proper repairs, and retest the manhole.
8. If the unit fails the test after repair, the unit shall be water exfiltration tested.

END OF SECTION 333000

SECTION 334000 - STORM DRAINAGE UTILITIES

PART 1 GENERAL

1.01 DESCRIPTION OF WORK: Furnish and install storm sewer system as shown on the Drawings. This includes:

- A. Underdrain pipe/foundation drain and associated cleanouts
- B. Storm drain culvert piping
- C. Gravel wetland piping and structures

1.02 REFERENCES:

- A. Specification Sections:
 - 1. Earth Moving: Refer to Section 312000.
 - 2. Erosion and Sedimentation Controls: Refer to Section 312513.
- B. State of Maine Department of Transportation "Standard Specifications – Revision of December 2002"
- C. State of Maine Department of Transportation "Supplemental Specifications – Corrections, Additions & Revisions to Standard Specifications – Latest Edition"

1.03 SUBMITTALS:

- A. Manufacturer's product data and installation instructions.
- B. Certified copies of tests on pipe units.
- C. Construction Records: Record depth and location of the following:
 - 1. Structure locations and elevations
 - 2. Repairs to existing pipes.
 - 3. Underdrain pipe locations and connection points to storm drainage system, and elevations.

Record neatly in a permanently bound notebook and submit at Substantial Completion. Provide access to records for ENGINEER at all times. Submit copies to ENGINEER on a weekly basis.

PART 2 - PRODUCTS

2.01 PIPE AND FITTINGS:

- A. General: Provide fittings of same type and class of materials as pipe. Fitting must have single piece gasket.
- B. Underdrain Pipe shall be perforated SDR 35 PVC pipe. Coiled pipes shall not be used.

- D. Storm drain pipe shall be SDR 35 PVC or ductile iron as identified on the Construction Drawings. Ductile iron pipe used for storm drainage shall be equivalent to and meet all standards of ductile iron pipe used for water utilities. PVC pipe used for storm drainage shall conform to all aspects of ASTM specification D3034-73A and/or ASTM Specification F789.

2.02 PRECAST CONCRETE STRUCTURES

- A. Base Sections: Precast monolithic construction with steps.
- B. Barrel Sections: Precast with steps.
- C. Top Sections: Precast eccentric cone with steps.
- D. Steps: Polypropylene reinforced with steel rod. Meet OSHA requirements, minimum width 16-inches. Cast into concrete.
- E. Pipe to Structure Connections: Connections shall be watertight, expandable pipe sleeve with adjustable expansion ring equal to Press-Boot by Press-Seal Gasket Corp., Fort Wayne, Indiana.
- F. Joints Between Precast Sections: Watertight, shiplap-type seal with two rings of one-inch diameter butyl rubber sealant.
- G. Inverts: Provide inverts as shown on the Drawings. Configuration to be as required by connecting pipes and as shown on Drawings.
- H. Outlet Control Structure: Provide precast concrete structure with perforations as shown in the Construction Drawings.

2.03 FRAMES, COVERS, AND GRATES

- A. Material: Cast iron, ASTM A48 Class 30
- B. Provide frames, covers and grates as identified on the plans

2.04 MISCELLANEOUS:

- A. Area Drain: Area drains shall be as detailed on the Construction Drawings and shall be 24" Nyloplast drain basins, or equal. Area drains shall have ductile iron integrated frame and beehive grate or solid cover as identified on the Construction Drawings. Provide anti-floatation as identified on the Construction Drawings
- B. Marking Tape: Lineguard III by Tri-Sales, Inc., 2-inch wide, green; detectable with magnetic locators, or approved equal.
- C. Rigid Insulation: Extruded closed-cell rigid foamed polystyrene, 2-inch thickness, width of trench, Styrofoam HI-60, by Dow Chemical, or approved equal.

PART 3 - EXECUTION

3.01 INSTALLATION OF GRAVITY PIPE AND FITTINGS:

- A. Methods: Install in accordance with manufacturer's recommendations. Use a laser beam for line and grade unless otherwise permitted by the ENGINEER. Secure each length of pipe with bedding before placing next length. Plug open ends when work is suspended. Bed pipe as shown on Drawings. A 30-inch minimum cover over the top of PVC pipe and DI pipe should be provided before the trench is wheel-loaded.
- B. Grade and Line:
 - 1. Lay pipe to line and grade shown on the Drawings. If grade is not shown, determine elevations of start and finish points for each run of pipe. Lay pipe to a uniform grade between these points.
 - 2. Line and grade may be adjusted by the ENGINEER as required by field conditions.
- C. Conditions: Lay pipe in the dry. Do not use installed pipe to remove water from work area.
- D. Flush and clean all pipe and remove all debris and materials. Flushing and cleaning methods approved by ENGINEER. Gravity flushing is not acceptable.
- E. Underdrain: All work shall conform to the Drawings and MDOT SECTION 605 – UNDERDRAINS
- F. Foundation Drain: Provide 4-inch diameter, perforated PVC pipe around perimeter of proposed building. Wrap drain in minimum of 6 inches of crushed stone bedding and nonwoven filter fabric as detailed.

3.02 INSTALLATION OF MANHOLES/CATCH BASINS:

- A. Placement: Place precast bases and structures on compacted bedding material so bottom of structure is plumb and pipe inverts are at proper elevations. Place manhole barrel and top sections in the appropriate height combinations. Plug all lifting holes inside and out with non-shrink grout. Construct manhole inverts in accordance with Drawings.
- B. Joints: Follow manufacturer's instructions for sealing joints between precast sections. Provide two rings of 1 inch diameter butyl rubber sealant. Point joints inside and out with butyl caulk.
- C. Frame and Covers:
 - 1. Set to final grade as shown on the Drawings and as specified. Provide adequate temporary covers to prevent accidental entry until final placement of frame and cover is made.
 - 2. Use two rings of 1 inch diameter butyl rubber sealant between frame and rubber riser. Provide downward force to frame so as to compress the joint, provide a watertight seal, and prevent future settlement. Point compressed joint with butyl rubber caulk sealant.
 - 3. Set manhole frames and covers to final grade only after pavement base course has been applied, or after final grading of gravel roads.
- D. Inverts: As specified in paragraph 2.02G of this section.

- E. Steps: Replace any steps that are out of plumb and proper horizontal placement.
- F. Frost Barriers: Wrap each manhole to the maximum excavation depth or not less than 6 feet below grade, with a minimum of four layers of 6 mils each of the polyethylene.
 - 1. Clean manhole exterior of all dirt and remove any protrusions.
 - 2. Apply a 6-inch wide vertical strip of bituminous waterproofing adhesive from the top of manhole to the greatest excavation depth, but not in excess of 6 feet.
 - 3. Start poly wrap at adhesive strip and proceed around manhole continuously, overlapping adhesive strip a minimum of 24 inches on the final layer.
 - 4. Tuck and pleat poly at top in a continuous manner, minimizing size of folds. Extend poly past top of manhole frame and temporarily tuck remainder inside frame, until final backfill and paving.
 - 5. Paved areas: Cut poly flush with manhole rim after pavement is in place.
 - 6. Unpaved areas: Pull loose ends of poly together, remove excess air and tie off end with galvanized wire. Bury with manhole below grade.

3.03 GRAVEL WETLANDS:

- A. Install all piping and structures for gravel wetlands as shown on Construction Drawings.

3.04 INSULATION:

- A. Install as shown on Drawings.

END OF SECTION 334000