Glastonbury High School
Athletics Facility
330 Hubbard Street
Glastonbury, CT 06033

Issued for Bid
November 20, 2020
GL-2021-05

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SECTION 01 1000 - SUMMARY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

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

B. Related Requirements:

1. Section 01 5000 "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.

1.2 PROJECT INFORMATION

A. Project Identification: Glastonbury High School, Athletics Facility, Project: GL-2021-05.

1. Project Location: 330 Hubbard Street, Glastonbury, CT 06033.

B. Owner: Town of Glastonbury, 2155 Main Street, Glastonbury, CT 06033.

1. Owner's Representative: Dave Sacchitella, Town of Glastonbury.

C. Architect: Id3A, LLC. 655 Winding Brook Drive, Glastonbury, CT 06033 Katie Symonds, Senior Architect.

D. Web-Based Project Software: Project software administered by Contractor will be used for purposes of managing communication and documents during the construction stage.

1. See Section 013100 "Project Management and Coordination." for requirements for using web-based Project software.

1.3 WORK COVERED BY CONTRACT DOCUMENTS

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

1. The Project consists of the demolition of the existing Athletics Building at Glastonbury High School and construction of a new Athletics Facility, including public toilets, locker rooms, and support spaces.

B. Type of Contract:

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

1.4 ACCESS TO SITE

A. 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.

B. Use of Site: Limit use of Project site to Work in areas 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 for storage of materials.

1.5 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: Limit work in the existing building to normal business working hours of 5:30 a.m. to 5:30 p.m., Monday through Friday, unless otherwise indicated.

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

1. Notify Owner not less than five days in advance of proposed utility interruptions.
2. Obtain Owner's written permission before proceeding with utility interruptions.

D. Restricted Substances: Use of tobacco products and other controlled substances on the entire Project site is not permitted.

1.6 SPECIFICATION AND DRAWING CONVENTIONS

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

1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
2. Specification requirements are to be performed by Contractor unless specifically stated otherwise.

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

END OF SECTION 01 1000

SECTION 01 2300 - ALTERNATES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for alternates.

1.2 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 the 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 alternates into the Work. No other adjustments are made to the Contract Sum.

1.3 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. Execute accepted alternates under the same conditions as other work of the Contract.

C. 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 - EXECUTION

2.1 SCHEDULE OF ALTERNATES

A. Alternate No. 1: Entryway Roof: Provide connector “breezeway” roof between Public Bathroom Building and Locker Room Building as indicated on A-301 Alternate #1 Roof Connector. Alternate includes new roof structure, asphalt shingle roof assembly, gutter and fascia assembly, exterior ceiling assembly and lighting.

B. Alternate No. 2: Existing Building Demolition: Demolish existing building as indicated on AD-101. Demolition includes all removal to complete the work, including exterior wall, roof, foundation and slab construction. Removal includes demolition of adjacent site items as indicated on AD-101 and salvage of existing signage and donor bricks.

C. Alternate No. 3: Site Work: Furnish and Install site work as indicated on C-1.0 – C-6.2 relating to the following specifications sections:
   1. Section 31 2310 - Earthwork
   2. Section 31 2313 - Preparation of Subgrade and Fine Grade
   3. Section 31 2316 - Excavation for Utilities
   4. Section 32 1216 - Bituminous Concrete Pavement
   5. Section 32 1723 - Pavement Markings
   6. Section 32 3100 - Sanitary Sewer System
   7. Section 32 4000 - Storm Drainage System

D. Alternate No. 4: Furnish and Install lockers, benches and training room equipment: Furnish and install all lockers and benches as shown on A-901 and as specified in 10 5116. Furnish and install all training room furniture and equipment, including treatment tables, storage cabinets shelving units, hydrocollator and ice machine as shown on A-901 and as specified in 11 7900 and 12 5000

END OF SECTION 01 2300

01-1401 Preservation and restoration

SECTION 01 1401

PRESERVATION AND RESTORATION OF SITE FEATURES

PART 1 GENERAL

1.1 SUMMARY

A. Section includes

1. Protection restoration of existing improvements.

2. Restoration of existing improvements.

B. Contractor shall coordinate work between all Subcontractors, sections, and trades required for the proper completion of the work.

C. Contractor is responsible for all health and safety.

PART 2 PRODUCTS

2.1 TREE PROTECTION FENCING

A. Tree protection shall be as shown on the Drawings.

PART 3 EXECUTION

3.1 IDENTIFICATION OF EXISTING FEATURES

A. Prior to commencing construction activities, Contractor shall identify and delineate those areas or specific improvements that are not to be disturbed. Areas or specific improvements within the Limits of Work/Contract Limits and general work areas which are not to be disturbed shall be clearly marked or fenced. Monuments and markers shall be protected before construction operations commence. Contractor's personnel shall be knowledgeable of the purpose for marking and/or protecting designated areas, specific improvements, monuments, and markers at the Project Site.

B. Prior to commencing construction activities, Contractor shall conduct a "walk-down" of the Project Site with Engineer and/or Owner. The purpose of such "walk-down" is to document pre-construction conditions of items/areas of concern.

1. Contractor shall make note of any damage visible on items/areas of concern, with reference to specific location.

2. Engineer or Owner must be present for "walk-down" to be considered valid.

3.2 PROTECTION OF EXISTING FEATURES

A. General

1. All areas or specific improvements, including but not limited to vegetation, brick pavers, utilities, poles, wires, fences, walls, curbing, property-line markers, and other structures, which must be preserved in-place without being temporarily or permanently relocated shall be protected from damage by Contractor.

2. As excavation approaches improvements to remain, including utilities, digging by machinery shall be discontinued and the excavation shall be done by means of hand tools.

B. Pavements

1. On paved surfaces to remain, Contractor shall not use or operate tracked heavy equipment or other power-operated equipment, or deliver, store, or stage tools, equipment, or materials, which may result in damage to such surfaces.

2. All surfaces which have been damaged by Contractor's operations shall be restored to a condition at least equal to that in which they were found immediately prior to the beginning of construction operations. Such restoration shall meet the approval of Owner and Engineer.

3. At the Owner's discretion, Contractor shall take measures to remove blemishes (scuff marks) caused by rubber-tired equipment or machinery.

C. Utilities

1. Safeguard and protect from damage any utility to remain in service. Before excavating near any utility, notify the utility owner, coordinate protective work, and comply with the utility owners' requirements.

2. All utility services shall be supported by suitable means so that the services shall not fail when tamping and settling occurs.

3. Where known utilities are encountered, notify Engineer and document location and type of utility before proceeding with work in such area.

4. When uncharted or incorrectly charted utilities are encountered, stop work and notify Engineer. Cooperate with the utility owners in maintaining their utilities in operation prior to resuming work.

D. Retaining Structures: Provide bracing, shoring, sheeting, sheet piling, underpinning or other retaining structures necessary to guard against any movement or settlement of existing or new construction, utility systems, paving, or other improvements. Contractor assumes responsibility for the strength and adequacy of retaining structures, and for the safety and support of construction, utilities or paving, and for any movement, settlement or damage thereto.

3.3 REPLACEMENT

A. In case of damage, Contractor shall notify the appropriate party so that proper steps may be taken to repair any and all damage done. When the Owner does not wish to make the repairs themselves, all damage shall be repaired by Contractor, or, if not promptly done by him, Engineer may have the repairs made at the expense of Contractor.

B. Contractor shall patch, repair and/or replace all adjacent materials and surfaces damaged through the prosecution of work at no expense to Owner. All repair and replacement work shall match the existing in-kind. Final acceptance of said work shall be at the sole judgement of Owner.

3.4 RELOCATION

A. If certain existing structures are encountered that in the opinion of Engineer require temporary or permanent relocation or removal, Engineer may order in writing that Contractor undertake all or part of such work or to assist the Owner in performing such work. For such occurrences, Contractor shall be compensated as applicable, as extra work.

1. In removing existing structures, Contractor shall use care to avoid damage to the material, and Engineer shall include for payment only those new materials, which, in his judgment, are necessary to replace those unavoidably damaged.

B. The structures to which the provisions of the preceding two paragraphs shall apply include structures which (1) are not indicated on the drawings or otherwise provided for, (2) encroach upon or are encountered near and substantially parallel to the edge of the excavation, and (3) in the opinion of Engineer will impede progress to such an extent that satisfactory construction cannot proceed until they have been changed in location, removed (to be later restored), or replaced. (See Item 3.19, “Sub-Surface Obstructions” also). Contractor shall protect items/areas of concern:

3.5 LAND RESOURCES

A. Contractor shall confine all activities to areas defined by the drawings and specifications. Prior to the beginning of any construction, Contractor shall identify any land resources to be preserved within the work area. Except in areas indicated on the drawings or specified to be cleared, Contractor shall not remove, cut, deface, injure, or destroy land resources including trees, shrubs, vines, grasses, topsoil, and land forms without approval. Contractor shall provide effective protection for land and vegetation resources at all times as defined in the following subarticles.

B. Trees, shrubs, vines, grasses, land forms and other landscape features indicated and defined on the drawings to be preserved shall be clearly identified by marking, fencing, or wrapping with boards, or any other approved techniques. Contractor shall restore any such landscape features damaged or destroyed during construction operations.

1. Trees which are to remain are shown on the Drawings. Unless specifically authorized by Engineer, no construction equipment or materials shall be placed or used within the drip line of trees shown on the drawings to be saved/to remain. No excavation or fill shall be permitted within the drip line of trees to be saved/to remain except as approved by Engineer.

2. No ropes, cables, or guys shall be fastened to or attached to any tree(s) for anchorage unless specifically authorized by Engineer. Where such special use is permitted, Contractor shall provide effective protection to prevent damage to the tree.

3.6 WIND PROTECTION

A. Should high wind warnings be issued by the U.S. Weather Bureau, Contractor shall take every precaution to minimize danger to persons, to the work, and to adjacent properties.

3.7 TREE PROTECTION FENCING

A. Install fencing completely around all trees to be protected within the project area as shown on the Drawings or as directed by Engineer. Install fencing before any construction activities commence and maintain in place until final grading and seeding is complete and accepted.

B. Contractor shall not place, or stockpile, any construction or excavation materials within the drip line of any trees. Vehicle and construction equipment shall not be parked, nor left running (idling), within the drip line of any tree.

C. Any excavation within the drip line of trees to be protected shall be performed by hand, unless otherwise directed by Engineer.

D. Where construction equipment must pass within the drip line of trees to remain, Contractor shall install wooden tree protection on the trunk of the tree, as detailed, and as directed by Engineer.

E. Where excavation requires the cutting of tree roots, roots shall be cut with sharp cutting tools and reburied as soon as possible. Until roots can be reburied, the exposed roots are to be covered with wet burlap to prevent roots from drying out. The burlap is to be kept wet until the roots can be reburied.

F. Where cutting of tree root system has occurred, Contractor shall water the tree root system to the extent of the tree canopy with at least 1/2 inch (0.25") of water within 72 hours of when the damage occurred.

G. When less than 1/2 inch (0.25") of water has fallen during a 7-day period, Contractor shall water the tree root system to the extent of the tree canopy with at least 1/2 inch (0.25") of water.

H. Trees damaged by construction activities are to be repaired within 72 hours using current arboricultural standards. Those trees determined by Engineer to be damaged beyond repair shall be removed and replaced by Contractor at no additional cost to Owner.

END OF SECTION

SECTION 01 2300 - ALTERNATES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for alternates.

1.2 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 the 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 alternates into the Work. No other adjustments are made to the Contract Sum.

1.3 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. Execute accepted alternates under the same conditions as other work of the Contract.

C. 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 - EXECUTION

2.1 SCHEDULE OF ALTERNATES

A. Alternate No. 1: Provide connector “breezeway” roof between Public Bathroom Building and Locker Room Building as indicated on A-301 Alternate #1 Roof Connector. Alternate includes new roof structure, asphalt shingle roof assembly, gutter and fascia assembly, exterior ceiling assembly and lighting.

END OF SECTION 01 2300

SECTION 01 2500 - SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for substitutions.

B. Related Requirements:

1. Section 01 6000 "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.

1.2 DEFINITIONS

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

1. 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.

1.3 ACTION SUBMITTALS

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

1. Documentation: Show compliance with requirements for substitutions and the following, as applicable:

a. Statement indicating why specified product or fabrication or installation method cannot be provided, if applicable.
b. Coordination of 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 substitutions 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 as well as 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 substitutions 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 fifteen days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.

a. Forms of Acceptance: Change Order, Construction Change Directive, or Architect's Supplemental Instructions for minor changes in the Work.
b. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.

1.4 QUALITY ASSURANCE

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

1.5 PROCEDURES

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

1.6 SUBSTITUTIONS

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

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

    a. Requested substitution is consistent with the Contract Documents and will produce indicated results.
    b. Substitution request is fully documented and properly submitted.
    c. Requested substitution will not adversely affect Contractor's construction schedule.
    d. Requested substitution has received necessary approvals of authorities having jurisdiction.
    e. Requested substitution is compatible with other portions of the Work.
    f. Requested substitution has been coordinated with other portions of the Work.
    g. Requested substitution provides specified warranty.
    h. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

B. Substitutions for Convenience: Not allowed.

END OF SECTION 01 2500

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SECTION 01 2600 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

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

1.2 MINOR CHANGES IN THE WORK

A. Architect will issue supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on form included in Project Manual.

1.3 PROPOSAL REQUESTS

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

1. 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 taxes, delivery charges, equipment rental, and amounts of trade discounts.
c. Include costs of labor and supervision directly attributable to the change.
d. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.

B. Contractor-Initiated Proposals: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to Architect.

1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.

3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
4. Include costs of labor and supervision directly attributable to the change.
5. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
6. Comply with requirements in Section 01 2500 "Substitution Procedures" if the proposed change requires substitution of one product or system for product or system specified.

1.4 CHANGE ORDER PROCEDURES

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

1.5 CONSTRUCTION CHANGE DIRECTIVE

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

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

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

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

END OF SECTION 01 2600

SECTION 01 2900 - PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

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

1.2 SCHEDULE OF VALUES

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

1. Coordinate line items in the schedule of values with items required to be indicated as separate activities in Contractor's construction schedule.
2. Submit the schedule of values to Architect at earliest possible date, but no later than seven days before the date scheduled for submittal of initial Applications for Payment.

B. Format and Content: Use 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. Arrange schedule of values consistent with format of AIA Document G703.
2. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Provide multiple line items for principal subcontract amounts in excess of five percent of the Contract Sum.
3. 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.

4. Overhead Costs: Include total cost and proportionate share of general overhead and profit for each line item.
5. Overhead Costs: Show cost of temporary facilities and other major cost items that are not direct cost of actual work-in-place as separate line items.
6. Closeout Costs. 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.
7. Schedule of Values Revisions: Revise the schedule of values when Change Orders or Construction Change Directives result in a change in the Contract Sum. Include at least one separate line item for each Change Order and Construction Change Directive.

1.3 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.

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. Transmittal: Submit three signed and notarized original copies of each Application for Payment to Architect by a method ensuring receipt. 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.

F. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's lien 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. Owner reserves the right to designate which entities involved in the Work must submit waivers.
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.

G. 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. Products list (preliminary if not final).
5. Submittal schedule (preliminary if not final).
6. List of Contractor's staff assignments.
7. List of Contractor's principal consultants.

8. Copies of building permits.
9. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
10. Initial progress report.
11. Certificates of insurance and insurance policies.
12. Performance and payment bonds.
13. Data needed to acquire Owner's insurance.

H. 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.

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

END OF SECTION 01 2900

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SECTION 01 3100 - 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. Coordination drawings.
3. RFIs.
4. Digital project management procedures.
5. Project meetings.

B. Related Requirements:

1. Section 01 7300 "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.

1.3 DEFINITIONS

A. BIM: Building Information Modeling.

B. RFI: Request for Information. 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, telephone number, and email address 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.

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.

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

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

1.6 COORDINATION DRAWINGS

A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely indicated on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.

1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:

a. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
b. Indicate dimensions shown on Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternative sketches to Architect indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.

B. Coordination Drawing Organization: Organize coordination drawings as follows:

1. Floor Plans and Reflected Ceiling Plans: Show architectural and structural elements, and mechanical, plumbing, fire-protection, fire-alarm, and electrical Work. Show locations of

visible ceiling-mounted devices relative to acoustical ceiling grid. Supplement plan drawings with section drawings where required to adequately represent the Work.

2. Plenum Space: Indicate sub-framing for support of ceiling and wall systems, mechanical and electrical equipment, and related Work. Locate components within plenums to accommodate layout of light fixtures and other components indicated on Drawings. Indicate areas of conflict between light fixtures and other components.
3. Mechanical Rooms: Provide coordination drawings for mechanical rooms showing plans and elevations of mechanical, plumbing, fire-protection, fire-alarm, and electrical equipment.
4. Structural Penetrations: Indicate penetrations and openings required for all disciplines.
5. Review: Architect will review coordination drawings to confirm that in general the Work is being coordinated, but not for the details of the coordination, which are Contractor's responsibility.

C. Coordination Digital Data Files: Prepare coordination digital data files according to the following requirements:

1. File Preparation Format: Prepare coordination drawings in BIM or AutoCAD format as original Drawings.
2. File Preparation Format: Revit 2019.
3. File Submittal Format: Submit or post coordination drawing files using PDF format.
4. Architect will furnish Contractor one set of digital data files of Drawings for use in preparing coordination digital data files.

    a. Architect makes no representations as to the accuracy or completeness of digital data files as they relate to Drawings.
    b. Digital Data Software Program: Drawings are available in Revit 2019 or AutoCAD 2019
    c. Contractor shall execute a data licensing agreement in the form of Agreement form acceptable to Owner and Architect.

1.7 REQUEST FOR INFORMATION (RFI)

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

1. Architect will return without response those RFIs submitted to Architect by other entities controlled by Contractor.
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.

C. RFI Forms: Software-generated form with substantially the same content as indicated above, acceptable to Architect.

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 by Architect 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 five 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. Use software log that is part of web-based Project software. Include 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 five days if Contractor disagrees with response.

1.8 DIGITAL PROJECT MANAGEMENT PROCEDURES

A. Use of Architect's Digital Data Files: Digital data files of Architect's BIM model or CAD drawings will be provided by Architect for Contractor's use during construction.

1. Digital data files may be used by Contractor in preparing coordination drawings, Shop Drawings, and Project record Drawings.
2. Architect makes no representations as to the accuracy or completeness of digital data files as they relate to Contract Drawings.
3. Digital Drawing Software Program: Contract Drawings are available in Revit 2019 or AutoCAD 2019.
4. Contractor shall execute a electronic file distribution agreement. Agreement included in Project Manual.

    a. Subcontractors, and other parties granted access by Contractor to Architect's digital data files shall execute a data licensing agreement in the form of Agreement included in this Project Manual.

5. The following digital data files will be furnished for each appropriate discipline:

    a. Floor plans.
    b. Reflected ceiling plans.

B. Web-Based Project Software: Provide, administer, and use web-based Project software site for purposes of hosting and managing Project communication and documentation until Final Completion.

1. Web-based Project software site includes, at a minimum, the following features:

    a. Compilation of Project data, including Contractor, subcontractors, Architect, architect's consultants, Owner, and other entities involved in Project. Include names of individuals and contact information.
    b. Access control for each entity for each workflow process, to determine entity's digital rights to create, modify, view, and print documents.
    c. Document workflow planning, allowing customization of workflow between project entities.
    d. Creation, logging, tracking, and notification for Project communications required in other Specification Sections, including, but not limited to, RFIs, submittals, Minor Changes in the Work, Construction Change Directives, and Change Orders.
    e. Track status of each Project communication in real time, and log time and date when responses are provided.
    f. Procedures for handling PDFs or similar file formats, allowing markups by each entity. Provide security features to lock markups against changes once submitted.
    g. Processing and tracking of payment applications.
    h. Processing and tracking of contract modifications.
    i. Creating and distributing meeting minutes.

j. Document management for Drawings, Specifications, and coordination drawings, including revision control.
k. Management of construction progress photographs.
l. Mobile device compatibility, including smartphones and tablets.

2. Provide up to five web-based Project software user licenses for use of Owner, Architect, and Architect's consultants.
3. At completion of Project, provide digital archive in format that is readable by common desktop software applications in format acceptable to Architect. Provide data in locked format to prevent further changes.
4. Provide one of the following web-based Project software packages under their current published licensing agreements:

a. Meridian Systems; Prolog.
b. Newforma, Inc.
c. Procore Technologies, Inc.

C. PDF Document Preparation: Where PDFs are required to be submitted to Architect, prepare as follows:

1. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
2. Name file with submittal number or other unique identifier, including revision identifier.
3. Certifications: Where digitally submitted certificates and certifications are required, provide a digital signature with digital certificate on where indicated.

1.9 PROJECT MEETINGS

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

B. Preconstruction Conference: Architect will schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than 15 days after execution of the Agreement.

1. Attendees: Authorized representatives of Owner, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
2. Agenda: Discuss items of significance that could affect progress, including the following:

a. Responsibilities and personnel assignments.
b. Tentative construction schedule.
c. Phasing.
d. Critical work sequencing and long lead items.
e. Designation of key personnel and their duties.
f. Lines of communications.
g. Use of web-based Project software.
h. Procedures for processing field decisions and Change Orders.
i. Procedures for RFIs.
j. Procedures for testing and inspecting.

k. Procedures for processing Applications for Payment.
l. Distribution of the Contract Documents.
m. Submittal procedures.
n. Preparation of Record Documents.
o. Use of the premises and existing building.
p. Work restrictions.
q. Working hours.
r. Owner's occupancy requirements.
s. Responsibility for temporary facilities and controls.
t. Procedures for moisture and mold control.
u. Procedures for disruptions and shutdowns.
v. Construction waste management and recycling.
w. Parking availability.
x. Office, work, and storage areas.
y. Equipment deliveries and priorities.
z. First aid.
aa. Security.
bb. Progress cleaning.

3. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.

C. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity when required by other sections and when required for 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. Sustainable design requirements.
i. Review of mockups.
j. Possible conflicts.
k. Compatibility requirements.
l. Time schedules.
m. Weather limitations.
n. Manufacturer's written instructions.
o. Warranty requirements.
p. Compatibility of materials.
q. Acceptability of substrates.
r. Temporary facilities and controls.
s. Space and access limitations.
t. Regulations of authorities having jurisdiction.
u. Testing and inspecting requirements.

v. Installation procedures.
w. Coordination with other work.
x. Required performance results.
y. Protection of adjacent work.
z. Protection of construction and personnel.

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

D. Progress Meetings: Conduct progress meetings at weekly 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. Review present and future needs of each entity present, including the following:

1) Interface requirements.
2) Sequence of operations.
3) Resolution of coordination drawing conflicts.
4) Status of submittals.
5) Status of sustainable design documentation.
6) Deliveries.
7) Off-site fabrication.
8) Access.
9) Site use.
10) Temporary facilities and controls.
11) Progress cleaning.
12) Quality and work standards.
13) Status of correction of deficient items.
14) Field observations.
15) Status of RFIs.
16) Status of Proposal Requests.
17) Pending changes.

18) Status of Change Orders.
19) Pending claims and disputes.
20) 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.

END OF SECTION 01 3100

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SECTION 01 3200 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 SUMMARY

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

1. Contractor's Construction Schedule.
2. Construction schedule updating reports.
3. Daily construction reports.
4. Site condition reports.

1.2 DEFINITIONS

A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction Project. Activities included in a construction schedule consume time and resources.

1. Critical Activity: An activity on the critical path that must start and finish on the planned early start and finish times.
2. Predecessor Activity: An activity that precedes another activity in the network.
3. Successor Activity: An activity that follows another activity in the network.

B. Event: The starting or ending point of an activity.

C. Float: The measure of leeway in starting and completing an activity.

1. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the successor activity.
2. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.

1.3 COORDINATION

A. Coordinate Contractor's Construction Schedule with the schedule of values, 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.

1.4 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

A. Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules.

B. Time Frame: Extend schedule from date established for the Notice of Award to date of Substantial Completion.

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

C. Activities: Treat each floor or separate area as a separate numbered activity for each main element of the Work. Comply with the following:
1. 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.
2. 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.
3. 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.

D. 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. Owner-Furnished Products: Include a separate activity for each product. Include delivery date indicated in Section 01 1000 "Summary." Delivery dates indicated stipulate the earliest possible delivery date.

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

F. 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 the Contract Time.

G. Contractor's Construction Schedule Updating: At bi-weekly intervals, update schedule to reflect actual construction progress and activities. Issue schedule two days 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.

H. 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 01 3200

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SECTION 01 3233 - PHOTOGRAPHIC DOCUMENTATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for the following:

1. Preconstruction photographs.
2. Periodic construction photographs.
3. Final completion construction photographs.

B. Related Requirements:

1. Section 01 7700 "Closeout Procedures" for submitting photographic documentation as Project Record Documents at Project closeout.
2. Section 02 4116 "Structure Demolition" for photographic documentation before selective demolition operations commence.

1.2 INFORMATIONAL SUBMITTALS

A. Digital Photographs: Submit image files within three days of taking photographs.

1. Submit photos by uploading to web-based project software site. Include copy of key plan indicating each photograph's location and direction.
2. Identification: Provide the following information with each image description in web-based project software site:

a. Name of Project.
b. Name and contact information for photographer.
c. Name of Architect.
d. Name of Contractor.
e. Date photograph was taken.
f. Description of location, vantage point, and direction.
g. Unique sequential identifier keyed to accompanying key plan.

1.3 QUALITY ASSURANCE

A. Photographer Qualifications: An individual who has been regularly engaged as a professional photographer of construction projects for not less than three years.

1.4 FORMATS AND MEDIA

A. Digital Photographs: Provide color images in JPG format, produced by a digital camera with minimum sensor size of 12 megapixels, and at an image resolution of not less than 3200 by 2400 pixels. Use flash in low light levels or backlit conditions.

B. Digital Images: Submit digital media as originally recorded in the digital camera, without alteration, manipulation, editing, or modifications using image-editing software.

C. Metadata: Record accurate date and time from camera.

D. File Names: Name media files with date and sequential numbering suffix.

1.5 CONSTRUCTION PHOTOGRAPHS

A. Photographs shall be submitted to the Owner on a weekly basis.

B. General: Take photographs with maximum depth of field and in focus.

1. Maintain key plan with each set of construction photographs that identifies each photographic location.

C. Preconstruction Photographs: Before commencement of demolition, take photographs of Project site and surrounding properties, including existing items to remain during construction, from different vantage points, as directed by Architect.

1. Take 20 photographs to show existing conditions adjacent to limit of work before starting the Work.
2. Take 20 photographs of existing conditions adjacent to limit of work to accurately record physical conditions at start of construction.

D. Periodic Construction Photographs: Take 10 photographs weekly. Select vantage points to show status of construction and progress since last photographs were taken.

E. Final Completion Construction Photographs: Take 10 photographs after date of Substantial Completion for submission as Project Record Documents. Architect will inform photographer of desired vantage points.

END OF SECTION 01 3233

SECTION 01 3300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Submittal schedule requirements.
2. Administrative and procedural requirements for submittals.

1.2 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."

1.3 SUBMITTAL SCHEDULE

A. Submittal Schedule: Submit, as an action submittal, a list 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.

1.4 SUBMITTAL FORMATS

A. Submittal Information: Include the following information in each submittal:

1. Project name.
2. Date.
3. Name of Architect.
4. Name of Contractor.
5. Name of firm or entity that prepared submittal.
6. Names of subcontractor, manufacturer, and supplier.
7. Unique submittal number, including revision identifier. Include Specification Section number with sequential alphanumeric identifier; and alphanumeric suffix for resubmittals.
8. Number and title of Specification Section, with paragraph number and generic name for each of multiple items.
9. Drawing number and detail references, as appropriate.
10. Indication of full or partial submittal.
11. Location(s) where product is to be installed, as appropriate.

12. Other necessary identification.
13. Remarks.
14. Signature of transmitter.

B. Options: Identify options requiring selection by Architect.

C. Deviations and Additional Information: On each submittal, clearly indicate deviations from requirements in the Contract Documents, including minor variations and limitations; include relevant additional information and revisions, other than those requested by Architect on previous submittals. Indicate by highlighting on each submittal or noting on attached separate sheet.

D. PDF Submittals: Prepare submittals as PDF package, incorporating complete information into each PDF file. Name PDF file with submittal number.

E. Submittals for Web-Based Project Software: Prepare submittals as PDF files, or other format indicated by Project software website.

1.5 SUBMITTAL PROCEDURES

A. Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.

1. Email: Prepare submittals as PDF package, and transmit to Architect by sending via email. Include PDF transmittal form. Include information in email subject line as requested by Architect.
2. Web-Based Project Software: Prepare submittals in PDF form, and upload to web-based Project software website. Enter required data in web-based software site to fully identify submittal.

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.

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 10 business 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. Resubmittal Review: Allow 5 business days for review of each resubmittal.

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

E. 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.

F. 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.

1.6 SUBMITTAL REQUIREMENTS

A. 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 unsuitable 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 that show 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 Shop Drawings, and before or concurrent with Samples.

B. 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.

C. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other materials.

1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
2. Identification: Permanently attach label on unexposed side of Samples that includes the following:

    a. Project name and submittal number.
    b. Generic description of Sample.
    c. Product name and name of manufacturer.
    d. Sample source.
    e. Number and title of applicable Specification Section.
    f. Specification paragraph number and generic name of each item.

3. Email Transmittal: Provide PDF transmittal. Include digital image file illustrating Sample characteristics, and identification information for record.
4. Web-Based Project Software: Prepare submittals in PDF form, and upload to web-based Project software website. Enter required data in web-based software site to fully identify submittal.
5. 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.

6. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.

    a. Number of Samples: Submit one full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return submittal with options selected.

7. 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 one Sample set; Owner will retain one Sample set; remainder will be returned.

        1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
        2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.

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

E. 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.

F. Design Data: Prepare and submit written and graphic information indicating compliance with indicated performance and design criteria in individual Specification Sections. Include list of assumptions and summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Number each page of submittal.

G. Certificates:

1. Certificates and Certifications Submittals: Submit 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. Provide a notarized signature where indicated.
2. 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.
3. 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.
4. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
5. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
6. 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.

H. Test and Research Reports:

1. 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.
2. 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.
3. 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.
4. 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.
5. 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.

6. 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:

    a. Name of evaluation organization.
    b. Date of evaluation.
    c. Time period when report is in effect.
    d. Product and manufacturers' names.
    e. Description of product.
    f. Test procedures and results.
    g. Limitations of use.

1.7 CONTRACTOR'S REVIEW

A. Action Submittals 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. Architect will not review submittals received from Contractor that do not have catalog items selected by Contractor.

B. Contractor's Approval: Indicate Contractor's approval for each submittal with a uniform approval stamp. Include 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. Architect will not review submittals received from Contractor that do not have Contractor's review and approval.

1.8 ARCHITECT'S REVIEW

A. Action Submittals: Architect will review each submittal, indicate corrections or revisions required, and return it.

    1. PDF Submittals: Architect will indicate, via markup on each submittal, the appropriate action, as follows:

        a. No Exceptions

        b. Exceptions as Noted

        c. Resubmit

        d. Rejected

        e. For Information Only

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. Architect will return without review submittals received from sources other than Contractor.

F. Submittals not required by the Contract Documents will be returned by Architect without action.

END OF SECTION 01 3300

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SECTION 01 4000 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

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

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

1. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and quality-control procedures that facilitate compliance with the Contract Document requirements.
2. Requirements for Contractor to provide quality-assurance and quality-control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.

1.2 DEFINITIONS

A. Experienced: When used with an entity or individual, "experienced" unless otherwise further described 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.

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

C. 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, assembly, 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).

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 Tests: Tests and inspections that are performed by a nationally recognized testing laboratory (NRTL) according to 29 CFR 1910.7, by a testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program (NVLAP), or by 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 Tests: Tests and inspections that are performed at the source; for example, plant, mill, factory, or shop.

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

H. 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.

I. 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. Contractor's quality-control services do not include contract administration activities performed by Architect.

1.3 CONFLICTING REQUIREMENTS

A. Conflicting Standards and Other Requirements: If compliance with two or more standards or requirements are specified and the standards or requirements 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 direction before proceeding.

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

1.4 INFORMATIONAL SUBMITTALS

A. Contractor's Statement of Responsibility: When required by authorities having jurisdiction, submit copy of written statement of responsibility submitted to authorities having jurisdiction before starting work on the following systems:

1. Seismic-force-resisting system, designated seismic system, or component listed in the Statement of Special Inspections.

B. 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.

C. Permits, Licenses, and Certificates: For Owner's record, 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.

1.5 REPORTS AND DOCUMENTS

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

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

C. 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. Statement that equipment complies with requirements.
2. Results of operational and other tests and a statement of whether observed performance complies with requirements.
3. Other required items indicated in individual Specification Sections.

1.6 QUALITY ASSURANCE

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

B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units. As applicable, procure products from manufacturers able to meet qualification requirements, warranty requirements, and technical or factory-authorized service representative requirements.

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, applying, 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 inspection 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.

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. When testing is complete, remove test specimens and test assemblies; 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.

1.7 QUALITY CONTROL

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

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

B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities, whether specified or not, to verify and document that the Work complies with requirements.

1. Engage a qualified testing agency to perform quality-control services.

a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.

2. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspection will be performed.
3. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
4. Testing and inspection requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
5. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.

C. 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.

D. 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 locations 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 duties of Contractor.

E. 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."

F. 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.

G. Associated Contractor Services: Cooperate with agencies and representatives 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 inspection. Assist agency in obtaining samples.
4. Facilities for storage and field curing of test samples.
5. Preliminary design mix proposed for use for material mixes that require control by testing agency.
6. Security and protection for samples and for testing and inspection equipment at Project site.

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

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

1.8 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, and as follows:

1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures and reviewing the completeness and adequacy of those procedures to perform the Work.
2. Notifying 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 - EXECUTION

2.1 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.

1. Submit log at Project closeout as part of Project Record Documents.

2.2 REPAIR AND PROTECTION

A. General: On completion of testing, inspection, 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 01 4000

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SECTION 01 4200 - REFERENCES

PART 1 - GENERAL

1.1 DEFINITIONS

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

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

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

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

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

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

G. "Install": 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.

1.2 INDUSTRY STANDARDS

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

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

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.

1.3 ABBREVIATIONS AND ACRONYMS

A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities 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. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list.

1. AABC - Associated Air Balance Council; www.aabc.com.
2. AAMA - American Architectural Manufacturers Association; www.aamanet.org.
3. AAPFCO - Association of American Plant Food Control Officials; www.aapfco.org.
4. AASHTO - American Association of State Highway and Transportation Officials; www.transportation.org.
5. AATCC - American Association of Textile Chemists and Colorists; www.aatcc.org.
6. ABMA - American Bearing Manufacturers Association; www.americanbearings.org.
7. ABMA - American Boiler Manufacturers Association; www.abma.com.
8. ACI - American Concrete Institute; (Formerly: ACI International); www.concrete.org
9. ACPA - American Concrete Pipe Association; www.concrete-pipe.org.
10. AEIC - Association of Edison Illuminating Companies, Inc. (The); www.aeic.org.
11. AF&PA - American Forest & Paper Association; www.afandpa.org.
12. AGA - American Gas Association; www.aga.org.
13. AHAM - Association of Home Appliance Manufacturers; www.aham.org.
14. AHRI - Air-Conditioning, Heating, and Refrigeration Institute (The); www.ahrinet.org.
15. AI - Asphalt Institute; www.asphaltinstitute.org.
16. AIA - American Institute of Architects (The); www.aia.org.
17. AISC - American Institute of Steel Construction; www.aisc.org.
18. AISI - American Iron and Steel Institute; www.steel.org.
19. AITC - American Institute of Timber Construction; www.aitc-glulam.org.
20. AMCA - Air Movement and Control Association International, Inc.; www.amca.org.
21. ANSI - American National Standards Institute; www.ansi.org.
22. AOSA - Association of Official Seed Analysts, Inc.; www.aosaseed.com.
23. APA - APA - The Engineered Wood Association; www.apawood.org.
24. APA - Architectural Precast Association; www.archprecast.org.
25. API - American Petroleum Institute; www.api.org.
26. ARI - Air-Conditioning & Refrigeration Institute; (See AHRI).
27. ARI - American Refrigeration Institute; (See AHRI).
28. ARMA - Asphalt Roofing Manufacturers Association; www.asphaltroofing.org.
29. ASCE - American Society of Civil Engineers; www.asce.org.
30. ASCE/SEI - American Society of Civil Engineers/Structural Engineering Institute; (See ASCE).
31. ASHRAE - American Society of Heating, Refrigerating and Air-Conditioning Engineers; www.ashrae.org.
32. ASME - ASME International; (American Society of Mechanical Engineers); www.asme.org.
33. ASSE - American Society of Safety Engineers (The); www.asse.org.
34. ASSE - American Society of Sanitary Engineering; www.asse-plumbing.org.
35. ASTM - ASTM International; www.astm.org.
36. ATIS - Alliance for Telecommunications Industry Solutions; www.atis.org.

37. AWEA - American Wind Energy Association; www.awea.org.
38. AWI - Architectural Woodwork Institute; www.awinet.org.
39. AWMAC - Architectural Woodwork Manufacturers Association of Canada; www.awmac.com.
40. AWPA - American Wood Protection Association; www.awpa.com.
41. AWS - American Welding Society; www.aws.org.
42. AWWA - American Water Works Association; www.awwa.org.
43. BHMA - Builders Hardware Manufacturers Association; www.buildershardware.com.
44. BIA - Brick Industry Association (The); www.gobrick.com.
45. BICSI - BICSI, Inc.; www.bicsi.org.
46. BIFMA - BIFMA International; (Business and Institutional Furniture Manufacturer's Association); www.bifma.org.
47. BISSC - Baking Industry Sanitation Standards Committee; www.bissc.org.
48. BWF - Badminton World Federation; (Formerly: International Badminton Federation); www.bissc.org.
49. CDA - Copper Development Association; www.copper.org.
50. CE - Conformite Europeenne; http://ec.europa.eu/growth/single-market/ce-marking/
51. CEA - Canadian Electricity Association; www.electricity.ca.
52. CEA - Consumer Electronics Association; www.ce.org.
53. CFFA - Chemical Fabrics and Film Association, Inc.; www.chemicalfabricsandfilm.com.
54. CFSEI - Cold-Formed Steel Engineers Institute; www.cfsei.org.
55. CGA - Compressed Gas Association; www.cganet.com.
56. CIMA - Cellulose Insulation Manufacturers Association; www.cellulose.org.
57. CISCA - Ceilings & Interior Systems Construction Association; www.cisca.org.
58. CISPI - Cast Iron Soil Pipe Institute; www.cispi.org.
59. CLFMI - Chain Link Fence Manufacturers Institute; www.chainlinkinfo.org.
60. CPA - Composite Panel Association; www.pbmdf.com.
61. CRI - Carpet and Rug Institute (The); www.carpet-rug.org.
62. CRRC - Cool Roof Rating Council; www.coolroofs.org.
63. CRSI - Concrete Reinforcing Steel Institute; www.crsi.org.
64. CSA - Group; www.csa.ca.
65. CSA - CSA International; (Formerly: IAS - International Approval Services); www.csa-international.org.
66. CSI - Construction Specifications Institute (The); www.csinet.org.
67. CSSB - Cedar Shake & Shingle Bureau; www.cedarbureau.org.
68. CTI - Cooling Technology Institute; (Formerly: Cooling Tower Institute); www.cti.org.
69. CWC - Composite Wood Council; (See CPA).
70. DASMA - Door and Access Systems Manufacturers Association; www.dasma.com.
71. DHI - Door and Hardware Institute; www.dhi.org.
72. ECA - Electronic Components Association; (See ECIA).
73. ECAMA - Electronic Components Assemblies & Materials Association; (See ECIA).
74. ECIA - Electronic Components Industry Association; www.eciaonline.org.
75. EIA - Electronic Industries Alliance; (See TIA).
76. EIMA - EIFS Industry Members Association; www.eima.com.
77. EJMA - Expansion Joint Manufacturers Association, Inc.; www.ejma.org.
78. ESD - ESD Association; (Electrostatic Discharge Association); www.esda.org .
79. ESTA - Entertainment Services and Technology Association; (See PLASA).
80. ETL - Intertek (See Intertek); www.intertek.com.
81. EVO - Efficiency Valuation Organization; www.evo-world.org.
82. FCI - Fluid Controls Institute; www.fluidcontrolsinstitute.org.
83. FIBA - Federation Internationale de Basketball; (The International Basketball Federation); www.fiba.com.
84. FIVB - Federation Internationale de Volleyball; (The International Volleyball Federation); www.fivb.org.

85. FM Approvals - FM Approvals LLC; www.fmglobal.com.
86. FM Global - FM Global; (Formerly: FMG - FM Global); www.fmglobal.com.
87. FRSA - Florida Roofing, Sheet Metal & Air Conditioning Contractors Association, Inc.; www.floridaroof.com.
88. FSA - Fluid Sealing Association; www.fluidsealing.com.
89. FSC - Forest Stewardship Council U.S.; www.fscus.org.
90. GA - Gypsum Association; www.gypsum.org.
91. GANA - Glass Association of North America; www.glasswebsite.com.
92. GS - Green Seal; www.greenseal.org.
93. HI - Hydraulic Institute; www.pumps.org.
94. HI/GAMA - Hydronics Institute/Gas Appliance Manufacturers Association; (See AHRI).
95. HMMA - Hollow Metal Manufacturers Association; (See NAAMM).
96. HPVA - Hardwood Plywood & Veneer Association; www.hpva.org.
97. HPW - H. P. White Laboratory, Inc.; www.hpwhite.com.
98. IAPSC - International Association of Professional Security Consultants; www.iapsc.org.
99. IAS - International Accreditation Service; www.iasonline.org.
100. IAS - International Approval Services; (See CSA).
101. ICBO - International Conference of Building Officials; (See ICC).
102. ICC - International Code Council; www.iccsafe.org.
103. ICEA - Insulated Cable Engineers Association, Inc.; www.icea.net.
104. ICPA - International Cast Polymer Alliance; www.icpa-hq.org.
105. ICRI - International Concrete Repair Institute, Inc.; www.icri.org.
106. IEC - International Electrotechnical Commission; www.iec.ch.
107. IEEE - Institute of Electrical and Electronics Engineers, Inc. (The); www.ieee.org.
108. IES - Illuminating Engineering Society; (Formerly: Illuminating Engineering Society of North America); www.ies.org.
109. IESNA - Illuminating Engineering Society of North America; (See IES).
110. IEST - Institute of Environmental Sciences and Technology; www.iest.org.
111. IGMA - Insulating Glass Manufacturers Alliance; www.igmaonline.org.
112. IGSHPA - International Ground Source Heat Pump Association; www.igshpa.okstate.edu.
113. ILI - Indiana Limestone Institute of America, Inc.; www.iliai.com.
114. Intertek - Intertek Group; (Formerly: ETL SEMCO; Intertek Testing Service NA); www.intertek.com.
115. ISA - International Society of Automation (The); (Formerly: Instrumentation, Systems, and Automation Society); www.isa.org.
116. ISAS - Instrumentation, Systems, and Automation Society (The); (See ISA).
117. ISFA - International Surface Fabricators Association; (Formerly: International Solid Surface Fabricators Association); www.isfanow.org.
118. ISO - International Organization for Standardization; www.iso.org.
119. ISSFA - International Solid Surface Fabricators Association; (See ISFA).
120. ITU - International Telecommunication Union; www.itu.int/home.
121. KCMA - Kitchen Cabinet Manufacturers Association; www.kcma.org.
122. LMA - Laminating Materials Association; (See CPA).
123. LPI - Lightning Protection Institute; www.lightning.org.
124. MBMA - Metal Building Manufacturers Association; www.mbma.com.
125. MCA - Metal Construction Association; www.metalconstruction.org.
126. MFMA - Maple Flooring Manufacturers Association, Inc.; www.maplefloor.org.
127. MFMA - Metal Framing Manufacturers Association, Inc.; www.metalframingmfg.org.
128. MHIA - Material Handling Industry of America; www.mhia.org.
129. MIA - Marble Institute of America; www.marble-institute.com.
130. MMPA - Moulding & Millwork Producers Association; www.wmmpa.com.
131. MPI - Master Painters Institute; www.paintinfo.com.
132. MSS - Manufacturers Standardization Society of The Valve and Fittings Industry Inc.; www.mss-hq.org.

133. NAAMM - National Association of Architectural Metal Manufacturers; www.naamm.org.
134. NACE - NACE International; (National Association of Corrosion Engineers International); www.nace.org.
135. NADCA - National Air Duct Cleaners Association; www.nadca.com.
136. NAIMA - North American Insulation Manufacturers Association; www.naima.org.
137. NBGQA - National Building Granite Quarries Association, Inc.; www.nbgqa.com.
138. NBI - New Buildings Institute; www.newbuildings.org.
139. NCAA - National Collegiate Athletic Association (The); www.ncaa.org.
140. NCMA - National Concrete Masonry Association; www.ncma.org.
141. NEBB - National Environmental Balancing Bureau; www.nebb.org.
142. NECA - National Electrical Contractors Association; www.necanet.org.
143. NeLMA - Northeastern Lumber Manufacturers Association; www.nelma.org.
144. NEMA - National Electrical Manufacturers Association; www.nema.org.
145. NETA - InterNational Electrical Testing Association; www.netaworld.org.
146. NFHS - National Federation of State High School Associations; www.nfhs.org.
147. NFPA - National Fire Protection Association; www.nfpa.org.
148. NFPA - NFPA International; (See NFPA).
149. NFRC - National Fenestration Rating Council; www.nfrc.org.
150. NHLA - National Hardwood Lumber Association; www.nhla.com.
151. NLGA - National Lumber Grades Authority; www.nlga.org.
152. NOFMA - National Oak Flooring Manufacturers Association; (See NWFA).
153. NOMMA - National Ornamental & Miscellaneous Metals Association; www.nomma.org.
154. NRCA - National Roofing Contractors Association; www.nrca.net.
155. NRMCA - National Ready Mixed Concrete Association; www.nrmca.org.
156. NSF - NSF International; www.nsf.org.
157. NSPE - National Society of Professional Engineers; www.nspe.org.
158. NSSGA - National Stone, Sand & Gravel Association; www.nssga.org.
159. NTMA - National Terrazzo & Mosaic Association, Inc. (The); www.ntma.com.
160. NWFA - National Wood Flooring Association; www.nwfa.org.
161. PCI - Precast/Prestressed Concrete Institute; www.pci.org.
162. PDI - Plumbing & Drainage Institute; www.pdionline.org.
163. PLASA - PLASA; (Formerly: ESTA - Entertainment Services and Technology Association); http://www.plasa.org.
164. RCSC - Research Council on Structural Connections; www.boltcouncil.org.
165. RFCI - Resilient Floor Covering Institute; www.rfci.com.
166. RIS - Redwood Inspection Service; www.redwoodinspection.com.
167. SAE - SAE International; www.sae.org.
168. SCTE - Society of Cable Telecommunications Engineers; www.scte.org.
169. SDI - Steel Deck Institute; www.sdi.org.
170. SDI - Steel Door Institute; www.steeldoor.org.
171. SEFA - Scientific Equipment and Furniture Association (The); www.sefalabs.com.
172. SEI/ASCE - Structural Engineering Institute/American Society of Civil Engineers; (See ASCE).
173. SIA - Security Industry Association; www.siaonline.org.
174. SJI - Steel Joist Institute; www.steeljoist.org.
175. SMA - Screen Manufacturers Association; www.smainfo.org.
176. SMACNA - Sheet Metal and Air Conditioning Contractors' National Association; www.smacna.org.
177. SMPTE - Society of Motion Picture and Television Engineers; www.smpte.org.
178. SPFA - Spray Polyurethane Foam Alliance; www.sprayfoam.org.
179. SPIB - Southern Pine Inspection Bureau; www.spib.org.
180. SPRI - Single Ply Roofing Industry; www.spri.org.
181. SRCC - Solar Rating & Certification Corporation; www.solar-rating.org.
182. SSINA - Specialty Steel Industry of North America; www.ssina.com.

183. SSPC - SSPC: The Society for Protective Coatings; www.sspc.org.
184. STI - Steel Tank Institute; www.steeltank.com.
185. SWI - Steel Window Institute; www.steelwindows.com.
186. SWPA - Submersible Wastewater Pump Association; www.swpa.org.
187. TCA - Tilt-Up Concrete Association; www.tilt-up.org.
188. TCNA - Tile Council of North America, Inc.; www.tileusa.com.
189. TEMA - Tubular Exchanger Manufacturers Association, Inc.; www.tema.org.
190. TIA - Telecommunications Industry Association (The); (Formerly: TIA/EIA - Telecommunications Industry Association/Electronic Industries Alliance); www.tiaonline.org.
191. TIA/EIA - Telecommunications Industry Association/Electronic Industries Alliance; (See TIA).
192. TMS - The Masonry Society; www.masonrysociety.org.
193. TPI - Truss Plate Institute; www.tpinst.org.
194. TPI - Turfgrass Producers International; www.turfgrasssod.org.
195. TRI - Tile Roofing Institute; www.tileroofing.org.
196. UL - Underwriters Laboratories Inc.; http://www.ul.com.
197. UNI - Uni-Bell PVC Pipe Association; www.uni-bell.org.
198. USAV - USA Volleyball; www.usavolleyball.org.
199. USGBC - U.S. Green Building Council; www.usgbc.org.
200. USITT - United States Institute for Theatre Technology, Inc.; www.usitt.org.
201. WA - Wallcoverings Association; www.wallcoverings.org
202. WASTEC - Waste Equipment Technology Association; www.wastec.org.
203. WCLIB - West Coast Lumber Inspection Bureau; www.wclib.org.
204. WCMA - Window Covering Manufacturers Association; www.wcmanet.org.
205. WDMA - Window & Door Manufacturers Association; www.wdma.com.
206. WI - Woodwork Institute; www.wicnet.org.
207. WSRCA - Western States Roofing Contractors Association; www.wsrca.com.
208. WWPA - Western Wood Products Association; www.wwpa.org.

C. 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.

D. 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; www.quicksearch.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/fdsys.
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; www.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; The National Academies; 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. USDOJ - Department of Justice; Office of Justice Programs; National Institute of Justice; www.ojp.usdoj.gov.
18. USP - U.S. Pharmacopeial Convention; www.usp.org.
19. USPS - United States Postal Service; www.usps.com.

E. 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 DLA Document Services; www.quicksearch.dla.mil.
3. DSCC - Defense Supply Center Columbus; (See FS).
4. FED-STD - Federal Standard; (See FS).
5. FS - Federal Specification; Available from DLA Document Services; www.quicksearch.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).

F. 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. CBHF; State of California; Department of Consumer Affairs; Bureau of Electronic and Appliance Repair, Home Furnishings and Thermal Insulation; www.bearhfti.ca.gov.
2. CCR; California Code of Regulations; Office of Administrative Law; California Title 24 Energy Code; www.calregs.com.
3. CDHS; California Department of Health Services; (See CDPH).
4. CDPH; California Department of Public Health; Indoor Air Quality Program; www.cal-iaq.org.
5. CPUC; California Public Utilities Commission; www.cpuc.ca.gov.
6. SCAQMD; South Coast Air Quality Management District; www.aqmd.gov.

7. TFS; Texas A&M Forest Service; Sustainable Forestry and Economic Development; www.txforestservice.tamu.edu.

END OF SECTION 01 4200

SECTION 01 5000 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

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

B. Related Requirements:

1. Section 01 1000 "Summary" for work restrictions and limitations on utility interruptions.

1.2 USE CHARGES

A. General: Installation and removal of and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities engaged in the Project to use temporary services and facilities without cost, including, but not limited to, Architect, testing agencies, and authorities having jurisdiction.

B. Water and Sewer Service from Existing System: Water from Owner's existing water system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.

C. Electric Power Service from Existing System: Electric power from Owner's existing system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.

1.3 INFORMATIONAL SUBMITTALS

A. Site Utilization Plan: Show temporary facilities, temporary utility lines and connections, staging areas, construction site entrances, vehicle circulation, and parking areas for construction personnel.

B. Project Identification and Temporary Signs: Show fabrication and installation details, including plans, elevations, details, layouts, typestyles, graphic elements, and message content.

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. 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. 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.

1.4 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 United States Access Board's ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1.

1.5 PROJECT CONDITIONS

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

PART 2 - PRODUCTS

2.1 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 Owner, Architect, and 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. Drinking water and private toilet.
3. Heating and cooling equipment necessary to maintain a uniform indoor temperature of 68 to 72 deg F (20 to 22 deg C).
4. Lighting fixtures capable of maintaining average illumination of 20 fc (215 lx) at desk height.

2.2 EQUIPMENT

A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.

B. HVAC Equipment:

1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
2. Permanent HVAC System: If Owner authorizes use of permanent HVAC system for temporary use during construction, provide filter with MERV of 8 at each return-air grille in system and remove at end of construction and clean HVAC system as required in Section 017700 "Closeout Procedures."

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 TEMPORARY FACILITIES, GENERAL

A. Conservation: Coordinate construction and use of temporary facilities 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.

3.2 INSTALLATION, GENERAL

A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.

B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.3 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.

1. Connect temporary sewers to municipal system as directed by authorities having jurisdiction.

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. Temporary Heating and Cooling: Provide temporary heating and cooling 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. Provide temporary dehumidification systems when required to reduce ambient and substrate moisture levels to level required to allow installation or application of finishes and their proper curing or drying.

F. Isolation of Work Areas in Occupied Facilities: Prevent dust, fumes, and odors from entering occupied areas.

G. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.

1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.

H. Telephone Service: Provide temporary telephone service in common-use facilities for use by all construction personnel. Install WiFi cell phone access equipment and one land-based telephone line(s) for each field office.

I. Electronic Communication Service: Provide a desktop computer in the primary field office adequate for use by Architect and Owner to access Project electronic documents and maintain electronic communications. Equip computer with not less than the following:

1. Processor: Intel Core i5 or i7.
2. Memory: 4 gigabyte.
3. Disk Storage: 500 gigabyte hard-disk drive and combination DVD-RW/CD-RW drive.
4. Display: 24-inch (610-mm) LCD monitor with 256-Mb dedicated video RAM.
5. Full-size keyboard and mouse.
6. Network Connectivity: Gigabit.
7. Operating System: Microsoft Windows 7 Professional.
8. Productivity Software:

    a. Microsoft Office Professional, 2010 or higher, including Word, Excel, and Outlook.
    b. Adobe Reader 11.0 or higher.
    c. WinZip 7.0 or higher.

9. Printer: "All-in-one" unit equipped with printer server, combining color printing, photocopying, scanning, and faxing, or separate units for each of these three functions.
10. Internet Service: Broadband modem, router and ISP, equipped with hardware firewall, providing minimum 1.0 Mbps upload and 15 Mbps download speeds at each computer.
11. Internet Security: Integrated software, providing software firewall, virus, spyware, phishing, and spam protection in a combined application.
12. Backup: External hard drive, minimum 2 terrabyte, with automated backup software providing daily backups.

3.4 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 (9 m) 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. Traffic Controls: Comply with requirements of authorities having jurisdiction.

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

C. Parking: Use designated areas of Owner's existing parking areas for construction personnel.

D. Project Signs: Provide Project signs as indicated. Unauthorized signs are not permitted.

1. Temporary Signs: Provide signs as required to inform public and individuals seeking entrance to Project.

a. Provide temporary, directional signs for construction personnel and visitors.

E. Waste Disposal Facilities: Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."

F. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction. Comply with progress cleaning requirements in Section 017300 "Execution."

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.

3.5 SECURITY AND PROTECTION FACILITIES INSTALLATION

A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other elements 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.

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, according to requirements of EPA Construction General Permit or authorities having jurisdiction.

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. Pest Control: Engage pest-control service to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular intervals so Project will be free of pests and their residues at Substantial Completion. Perform control operations lawfully, using materials approved by authorities having jurisdiction.

F. Site Enclosure Fence: Before construction operations begin, furnish and install site enclosure fence in a manner that will prevent people 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.
2. Maintain security by limiting number of keys and restricting distribution to authorized personnel.

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 workday.

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

3.6 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. 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 01 5000

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SECTION 01 5713

TEMPORARY EROSION AND SEDIMENTATION CONTROLS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Installation of temporary erosion and sedimentation control measures
2. Maintenance of temporary erosion and sedimentation control measures.
3. Monitoring of site condition and installation of supplemental temporary erosion and sedimentation control measures.
4. Sediment removal and disposal
5. Temporary seeding or other surface stabilization measures.
6. Removal of temporary erosion and sedimentation control measures.
7. Monitoring, documentation, and recordkeeping.
8. Installation of permanent erosion control materials.
9. Final cleanup.

B. Erosion and sediment control techniques include, but are in no way limited to, silt fence, hay bales, drainage structure inserts/filters, mulching with hay/straw, netting/matting, grassing, stone dikes/berms/check-dams, compost blankets and berms, barriers, diversions, traps, basins, and appurtenances which will ensure that erosion and sediment pollution will be either eliminated or maintained within acceptable limits.

C. The measures specified herein are the minimum requirements which Contractor shall comply to control erosion and siltation throughout execution of the work. Contractor shall provide additional work if necessary to control erosion and siltation throughout the duration of the construction as conditions dictate, or as directed by Engineer.

D. Contractor shall coordinate work between all Contractors, sections, and trades required for the proper completion of the work.

E. Contractor is responsible for all health and safety.

1.2 SUBMITTALS

A. Submit material specifications and shop drawings for all materials furnished under this Section.

B. Prior to the start of the construction, submit schedule for the construction of required stormwater detention basins, temporary and permanent erosion and sedimentation control measures, clearing and grubbing, grading, structures at watercourses, construction, and paving.

C. During construction, submit to Engineer schedule changes that affect timing of construction.

D. Submit copies of all inspection and maintenance report forms.

1.3 REFERENCES

A. Reference herein to any technical society, organization, group or regulation are made in accordance with the following abbreviations and, unless otherwise noted or specified, all work under this Section shall conform to the latest edition as applicable.

B. Regulations of Connecticut State Agencies (RCSA)

1. 22a-315-10 through 19, Soil and Water Conservation

C. Connecticut Department of Energy and Environmental Protection (DEEP)

1. Connecticut Guidelines for Soil Erosion and Sediment Control, DEEP Bulletin 34, State of Connecticut Council on Soil and Water Conservation, 2002.

D. State of Connecticut Department of Transportation (ConnDOT)

1. Standard Specifications for Roads, Bridges, Facilities and Incidental Construction, Form 817, 2016 and any supplements.

1.4 PERMIT CONDITIONS

A. Contractor and Subcontractors are bound to comply with any project-related permits obtained by Owner or Engineer for the work of the project. Such permits will affect performance of the work, and Contractor and Subcontractors are bound to comply with requirements of such permit and representations contained in permit application as though Contractor and Subcontrator were the Permittee/permit-holder. Requirements and conditions set forth in Owner or Engineer-obtained project-related permits and permit applications shall be binding on Contractor just as any Specification would be.

1.5 QUALITY CONTROL

A. Contractor shall be responsible for the timely installation and maintenance of all sedimentation control devices necessary to prevent the erosion of soil or movement of sediment from construction activities to off-site areas via surface runoff or underground drainage systems. Measures in addition to those shown on the Drawings necessary to prevent the movement of sediment off site shall be installed, maintained, removed, and cleaned up at the expense of Contractor.

B. Where additional erosion and sedimentation control measures are required beyond what is indicated on the Drawings or herein, comply with applicable sections of the Connecticut Guidelines for Soil Erosion and Sediment Control, DEEP Bulletin 34, State of Connecticut Council on Soil and Water Conservation, 2002.

C. If applicable, comply with applicable provisions of the Connecticut Department of Energy and Environmental Protection (DEEP) General Permit for the Discharge of Stormwater and Dewatering Wastewaters from Construction Activities, (DEEP-WPED-GP-015), latest revision thereof. Conditions of such General Permit, other conditions of approval or authorizations, and

associated Stormwater Pollution Control Plan (SWPCP) shall become part of the Contract Documents.

D. Engineer has the authority to order immediate, additional, temporary control measures to prevent contamination of adjacent streams or other watercourses, or other areas of water impoundment and damage by erosion.

E. If Engineer observes construction procedures and operations that jeopardize erosion control provisions, Engineer will notify Contractor. If such construction procedures and operations are not corrected promptly, Engineer may suspend the performance of any or all construction until corrections have been made, and such suspension shall not be the basis of any claim by Contractor for additional compensation, nor for an extension of time to complete the Work.

F. Should construction materials be washed away or otherwise rendered ineffective in the opinion of Engineer during the progression of the Work, Contractor shall replace the installations at no additional cost to the Owner.

1.6 COORDINATION WITH PERMANENT EROSION CONTROL PROVISIONS

A. Coordinate temporary erosion and sedimentation control measures with permanent erosion control features to the extent practical to ensure economical, effective and continuous erosion control throughout construction and post-construction periods.

PART 2 PRODUCTS

2.1 HAY BALES

A. Hay bales shall be made of cut hay with forty (40) pounds minimum weight and 120 pounds maximum weight. Bales shall be free of rotten or degraded hay, significant splits or voids. Hay bales shall be held together with a minimum of two bands made of either wire or heavy twine.

B. Stakes to anchor the bales shall be a minimum of 36 inches long and made of hardwood with a minimum dimension of 1½-inch by 1½-inch normal size. Metal stakes may be used instead of wooden stakes. Metal stakes shall be round, “U,” “T,” “L,” or “C” shaped with a minimum weight of 0.5 pounds per foot.

C. Replace individual hay bales upon loss of 30% of original mass or volume, whichever is less.

2.2 SILT FENCE

A. Woven Polypropylene geotextile having a minimum weight of 3.1 ounces per square yard conforming to the following:

1. Mechanical and Physical Properties of Silt Fence Geotextile

Mechanical Properties	Test Method	Unit	Minimum Average Roll Value
Weight	ASTM D3776	oz/yd^2	5.6
Grab Tensile Strength	ASTM D4632	Pounds	60
Grab Elongation (Max percent)	ASTM D4632	Percent (%)	15–30
Trapezoidal Tear	ASTM D4533	Pounds	30
Puncture	ASTM D4833	Pounds	30
Mullen Burst	ASTM D3786	psi	150–200
Permittivity	ASTM D4491	Sec^{-1}	0.15
Flow Rate	ASTM D4491	gal/min/ft2	15–20
Apparent Opening Size	ASTM D4751	(U.S. Sieve)	30–35
UV Resistance (at 500 hours)	ASTM D4355	% strength retained	70

B. Silt fence shall be constructed of a minimum thirty-six (36) inch wide continuous woven geotextile. The material shall have a high sediment filtration capacity, high slurry flow and minimum clogging characteristics. Edges of the fabric shall be finished to prevent the outer fibers from pulling away from the geotextile. Geotextile shall be free of defects or flaws that significantly affect its physical and/or filtering properties.

C. Fabric shall be securely fastened to stakes a minimum of 42 inches long and made of hardwood with a minimum dimension of 1½ inch by 1½ inch normal size such that a 6 to 8 inch length of fabric is unattached at the bottom for anchorage in soil. Metal stakes may be used instead of wooden stakes. Metal stakes shall be round, “U,” “T,” “L,” or “C” shaped with a minimum weight of 0.5 pounds per foot. Stakes shall be spaced not greater than ten feet apart. When required, wire or another type of support shall be constructed between the geotextile fabric and the posts to improve the load carrying capacity of the silt fence.

2.3 CATCH BASIN INSERT

A. Manufactured “bag type” catch basin insert of woven polypropylene geotextile with integral lifting loops or straps conforming to the following:

1. Mechanical and Physical Properties of Catch Basin Insert

Mechanical Properties	Test Method	Unit	Minimum Average Roll Value
Grab Tensile Strength	ASTM D4632	Pounds	315
Grab Elongation (Max percent)	ASTM D4632	Percent (%)	30 (max)
Trapezoidal Tear	ASTM D4533	Pounds	40x50 (min)
Puncture	ASTM D4833	Pounds	135 (min)
Mullen Burst	ASTM D3786	psi	420 (min)
Permittivity	ASTM D4491	gal/min/sq ft	0.7
Flow Rate	ASTM D4491	gal/min/ft2	50 (min)
Apparent Opening Size	ASTM D4751	(U.S. Sieve)	20-40
UV Resistance (at 500 hours)	ASTM D4355	% strength retained	80 (min)

Note: Catch basin inserts for catch basins with curb openings shall be equipped with integral curb deflector.

2.4 STRAW MULCH

A. Straw mulch shall be comprised of threshold straw of oats, wheat, barely, or rye that is free from noxious weeds, mold or other objectionable material. Straw mulch shall contain at least 50 percent by weight of material to be 10-in or longer. Straw shall be in an air-dry condition and suitable for placement with blower equipment. Straw mulch shall be utilized on all newly graded areas with slopes exceeding 5% to protect areas against washouts and erosion unless other erosion control measures are provided.

2.5 FILTER BERM COMPOST

A. Where establishing vegetation is not planned, compost shall be a decomposed, weed free organic matter source derived from agricultural, food, or industrial residuals; biosolids (treated sewage sludge); yard trimmings; or source-separated or mixed solid waste. Compost shall possess a moisture content of 30 to 60% and a organic matter content of 25 to 100%. The maximum particle length shall be 6″, and 100% passing a 3″, 90 to 100% passing a 1″, 70% to 100% passing a 3/4″, and 30% to 75% passing a 1/4″ screen. However, no more than 50% passing a 1/4″ screen in high rainfall/flow rate situations.

B. Where establishing vegetation is planned, compost shall be use a well decomposed, stable, weed free organic matter source derived from agricultural, food, or industrial residuals; biosolids (treated sewage sludge); yard trimmings; or source-separated or mixed solid waste. Compost shall possess a moisture content of 30 to 60%, a pH of 6.0 to 8.5 and an organic matter content of 25 to 65%. The maximum particle length shall be 6″, and 100% passing a 3″, 90 to 100% passing a 1″, 70% to 100% passing a 3/4″, and 30% to 75% passing a 1/4″ screen. However, no more than 60% passing a 1/4″ in high rainfall/flow rate situations. It shall contain no substances toxic to plants, shall possess no objectionable odors, and shall not resemble the raw material from which it was derived.

2.6 COMPOST SOIL BLANKET

A. Compost soil blankets may be utilized on slopes of up to 2:1.

B. Slightly scarify slopes and remove large clods, rocks, stumps, roots larger than 2 inches in diameter and debris on slopes, where vegetation is to be established. This soil preparation step

may be eliminated where approved by the Landscape Architect/Designer, or where seeding or planting isn't planned. Track (compact) slope using a bulldozer before applying compost.

C. Apply compost at the following rates:

Compost Application Rates

Annual Rainfall/Flow Rate	Total Precipitation & Rainfall Erosivity Index	Application Rate for Slopes to be Vegetated (Note 1)	Application Rate for Slopes not being Unvegetated
Low	1″–25″ & 20–90	½″–¾ ″	1″–1½″
Average	26″–50″ & 91–200	¾″–1″	1½″–2″
High	51″ and above, & 201 and above	1″–2″	2″–4″

D. Lower application rates indicated for slopes to be vegetated should only be used in conjunction with seeding, and for compost blankets applied during the prescribed planting season for the particular region.

E. Compost shall be uniformly applied using an approved spreader unit, including bulldozers, side discharge manure spreaders, etc. Track (compact) the compost layer using a bulldozer or other appropriate equipment. (This step may be eliminated where impractical or where deemed unnecessary by the Landscape Architect/Designer.) Alternatively, apply compost using a pneumatic (blower) unit, or other unit that propels the product directly at the soil surface, thereby preventing water from moving between the soil-compost interface. Thorough watering may be used to improve settling of the compost. Apply compost layer approximately 3 feet (90 cm) over the top of the slope, or overlap it into existing vegetation.

F. On highly unstable soils, use compost in conjunction with appropriate structural measures.

G. Dry or hydraulic seeding may be completed following compost application, as required, or during the compost application itself, where a pneumatic unit is used to apply the compost.

2.7 STONE CHECK DAM

A. Stone shall be graded as follows:

Gradation of Stone for Check Dam (ConnDOT M.01.01 Grading No. 3)

Sieve	Percent Passing by Weight
2 1/2″	100
2″	90–100
1 1/2″	35–70
1	0–15

1/2″	0–5

Stone shall be sound, tough, durable, angular, not subject to disintegration, on exposure to water, or weathering, be chemically stable and shall be suitable in all other respects for the purpose intended.

B. Geotextile may be used under the stone to provide a stable foundation and to facilitate removal of the stone.

2.8 EROSION CONTROL SEED MIXTURE

Erosion Control Seed

Species (Note 1)	Application Rate, Pounds Per Acre	Application rate, Pounds Per 1,000 sf	Optimum Seed Depth, inches (Note 2)	Optimum Seeding Dates (Note 3)
Annual ryegrass Lolium multiflorum	40	1.00	0.5	3/1–6/15 and 8/1–10/15
Perennial ryegrass Lolium perenne	40	1.00	0.5	3/15–7/1 and 8/1–10/15
Winter Rye Secale cereale	120	3.00	1.00	4/5–7/1 and 8/15–10/15
Oats Avena sativa	86	2	1	3/1–6/15 and 8/1–9/15
Winter Wheat Triticum aestivum	120	3	1	4/15–7/1 and 8/15–10/15
Millet Echinochloa crusgalli	20	.5	1	5/15–7/15
Sudangrass Sorghum sudanese	30	.7	1	5/15–8/1
Buckwheat Fagopyrum esculentum	15	.4	1	4/1–9/15
Weeping lovegrass Eragostis curbula	5	.2	.25	6/1–7/1
ConnDOT All Purpose Mix	150	3.4	.5	3/1–6/15 and 8/1–10/15

Notes:

1 – Listed species may be used in combinations to obtain a broader time spectrum. If used in combinations, reduce each species planting rate by 20% of that listed

2 – Seed at twice the indicated depth for sandy soils.

3 – May be planted throughout summer if soil moisture is adequate or can be irrigated. Fall seeding may be extended 15 days in the coastal towns

2.9 EROSION CONTROL MATTING

A. Temporary Erosion Control Blanket shall be 1) Curlex® Excelsior Blanket, as manufactured by American Excelsior Company, 2) ERO-MAT® V75S(FD), as manufactured by Verdyol Plant Research, Ltd., or 3) Landlok® S2 RD, as manufactured by SI® Geosolutions, or 4) approved equal.

B. Degradable Erosion Control Fabric Netting shall be Landlok® 407 GR, as manufactured by 1) SI® Geosolutions, or 2) GeoJute® as manufactured by Belton Industries, Inc., or 3) BioNet® S150BN™ Double Net Straw Blanket, as manufactured by North American Green, or 4) approved equal.

C. Long-Term and Non-degradable Turf Reinforcement Mats shall be 1) Pyramat®, as manufactured by SI® Geosolutions, or 2) Recyclex® Turf Reinforcement Matting, as manufactured by American Excelsior Company, or 3) Vmax3 C350™, as manufactured by North American Green, or 4) approved equal.

D. Erosion control matting shall be secured with staples or an alternative attachment device such as geotextile pins or plastic pegs as recommended by the manufacturer. The Contractor shall submit a sample of the alternative attachment device for the Engineer's approval prior to installation.

PART 3 EXECUTION

3.1 GENERAL

A. Install erosion and sedimentation control measures as shown on the Drawings prior to any site disturbance.

B. No work shall be started until erosion control schedules and installation have been accepted by Engineer.

C. Engineer has the authority to control the surface area of each material exposed by construction operations and to direct Contractor to immediately provide permanent or temporary pollution control measures to prevent contamination of adjacent watercourses or other areas of water impoundment. Every effort shall be made by Contractor to prevent erosion on the site and abutting properties or areas.

D. Contractor shall construct all permanent erosion and sediment control features at the earliest practical time as outlined in the accepted schedule. Temporary erosion and sediment control measures shall be used to correct conditions that develop during construction, which were unforeseen, but are needed prior to installation of permanent control features, or that are needed temporarily to control erosion or sedimentation which develops during construction operations.

E. Contractor shall limit as necessary the surface area of the earth material exposed to sufficiently maintain and protect the slopes to prevent pollution. Where erosion is likely to be a problem, clearing and grubbing operations shall be scheduled and performed so that grading operations and permanent erosion and sediment control features can follow immediately thereafter, if conditions permit; otherwise, temporary control measures will be required between successive construction stages.

F. Erosion control measures shall be maintained by Contractor, and he shall remove such installations only upon completion of the work and the site is stabilized or when authorized to do so by Engineer.

G. Contractor shall operate all equipment and perform all construction operations so as to minimize pollution. Contractor shall cease any of his operations, which will increase pollution during rainstorms.

H. Failure by Contractor to control erosion, pollution, and siltation shall be cause for the Engineer to employ outside assistance to provide the necessary corrective measures. The cost of such assistance, including engineering costs, will be charged to Contractor and appropriate deductions made to Contractor's payment.

3.2 HAY BALES

A. Hay bales shall be positioned as indicated on the Drawings and/or as necessary to prevent off site movement of sediment produced by, or as a result of, construction activities, or as direct by the Engineer.

B. Hay bales shall be utilized on all catch basins and drainage facilities on the Project Site to prevent the entry of sediments or other debris. Maintain such protection throughout execution of the work until such drainage facilities have been abandoned/removed.

C. Bales shall be placed lengthwise with ends of adjacent bales tightly abutting one another to form a continuous barrier. Bales shall be entrenched to a depth of 4 inches and backfilled, with the backfill placed toward the potential source of runoff and sediment. All bales shall be installed so that bindings are oriented around the sides rather than along the tops and bottoms. Each bale shall be anchored with a minimum of two stakes, driving the first stake in each bale towards the previously laid bale to drive the bales together. Stakes must be driven a minimum of 18 inches into the ground. Loose hay shall be inserted between bales as required to prevent water from escaping between the bales.

3.3 GEOTEXTILE SILT FENCE

A. Install a filter fabric silt fence prior to construction and remove after full surface restoration has been achieved. Install silt fence as indicated on the Drawings and/or as necessary to prevent off site movement of sediment produced by, or as a result of, construction activities.

B. Install as follows:

1. Hand shovel excavate a small trench a minimum of six inches wide by six inches deep on the upslope side of the desired fence line location.

2. Unroll the siltation fence system, position the post in the back of the trench (downhill side), and hammer the post at least 12 inches into the original ground.

3. Fabric rolls shall be spliced at posts. The fabric shall be overlapped six inches, folded over and securely fastened to posts.

4. Lay the bottom 6 inches of the fabric into the trench to prevent undermining by storm water run-off.

5. Backfill the trench and compact. Compaction is necessary to prevent the run-off from eroding the backfill.

6. For slope and swale installations, extend the ends of the trench sufficiently up slope such that the bottom end of the fence will be higher than the top of the lowest portion of the fence.

3.4 CATCH BASIN INLET SEDIMENT CONTROL

A. Install catch basin inlet sediment control devices in each exiting catch basin as long as it remains in use in accordance with manufacturer's guidelines at the locations shown on the Drawings.

B. A catch basin sediment filter shall be installed and changed/cleaned per the manufacturer's recommendations, or as directed by Engineer during construction.

C. New catch basins shall have a filter installed immediately upon completion of construction. In addition, a hay bale, or similar, barrier shall be installed around the new basin and maintained in place until binder is placed or disturbed areas draining to it are stabilized.

D. Catch basins with curb openings shall have filter fabric covering the opening and the edges of the fabric shall be secured. A filter boom shall also be placed over the opening.

3.5 TEMPORARY SEDIMENT BASINS

A. Temporary sedimentation basins shall be employed as required during construction. Sedimentation shall be periodically removed from the basins and from behind erosion and sedimentation control devices. The Contractor shall direct all possible site runoff to the temporary sedimentation basins.

B. The temporary sedimentation basins shall be maintained from the start of construction until construction of the permanent detention basins is completed and perimeter areas are stabilized.

3.6 TEMPORARY MULCHING

A. Apply temporary mulch to areas where rough grading has been completed but final grading is not anticipated to begin within 30 calendar days of the completion of rough grading or where final grading has been completed but seeding is not anticipated for 20 days.

1. Straw/Hay Mulch

   Exposure Period: 6 months

   Application Method: By hand or machine

   Application Rate: 110 lbs/1,000 square feet.

2. Bark Chips/Shredded Bark

   Exposure Period: Less than one year

   Application Method: By hand or machine

   Application Rate: 6 cubic yards /1,000 square feet.

3.7 TEMPORARY EROSION CONTROL MATS

A. Erosion control mats shall be furnished, installed, maintained, and later removed in ditches or swales, on embankment slopes, and excavation slopes at the locations shown on the Drawings in accordance with the manufacturer's recommendations.

B. All areas shall be smooth graded and compacted. Remove all rocks, dirt clods, vegetation and other obstructions that may cause damage to the mats.

C. Unroll mats parallel to the direction of water flow and lay flat against the ground. Overlap roll ends 1–2 feet with upslope mat on the top to prevent uplift of mat end by water flow. Overlay adjacent edges of mat by six inches. Extend mat 2–3 feet above the crest of steep slopes and anchor by excavating a 6-inch-deep trench, and secure end of mat in trench, backfill and compact. Secure mat to the ground using staples or pins furnished by manufacturer of mat.

D. When no longer required, as determined by the Engineer, temporary erosion control mats shall become the property of the Contractor and be removed and properly disposed.

E. Ground disturbances, including holes and depressions caused by the installation and removal of the temporary erosion control blanket shall be backfilled and repaired.

3.8 INSPECTIONS AND MAINTENANCE

A. Contractor is responsible to maintain the sediment and erosion control features at all times throughout the project duration and until the completion certification and approval has been issued.

B. Regular erosion and sediment control system inspections shall be conducted by Contractor throughout the project duration. At a minimum, Contractor shall conduct daily inspections and maintain erosion control systems in good operating condition. Report the results of the inspection and the recommended maintenance and/or repair requirements to Engineer.

C. Additional inspections may be required and/or directed prior to, or immediately following, a storm event >0.1 inches. Repairs shall be made as necessary.

D. In the event that the sedimentation and erosion control measures employed by Contractor prove to be inadequate as determined by the Engineer, Contractor shall adjust operations to the extent necessary to prevent erosion and sediment transport.

E. Surface water shall be pumped to maintain excavations free of water. Comply with applicable requirements of the Connecticut Department of Environmental Protection, specifically those requirements related to the management of stormwater and dewatering wastewaters associated with construction activities.

F. Hay bales and/or silt fences.

1. Remove accumulated sediment once it builds up to one-half of the height of the bale or fabric.

2. Replace damaged or degraded bales as necessary or when directed by the Engineer.

3. Replace damaged fabric, or patch with a 2-ft minimum overlap. Overlaps may only be made at fence posts.

4. Make other repairs as necessary to ensure that the bales/fence is filtering all runoff.

G. Erosion Control Mats shall be inspected at least once a week. Areas where the mat has become dislodged from the soil surface or become torn shall be re-graded and re-seeded as necessary and the mat re-installed. When repetitive failures occur at the same location review conditions

and modify erosion control measures to reduce failure rate. Temporary erosion control blanket damaged during the progress of work or resulting from the Contractor's vehicles, equipment, or operations shall be repaired or replaced at the expense of the Contractor.

H. Clean catch basin inlet sediment control devices in accordance with manufacturer's guidelines.

I. Any catch basins that collect sediment as a result of Contractor's work shall be thoroughly cleaned out by Contractor.

END OF SECTION

SECTION 01 5714

TEMPORARY DUST CONTROL

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Furnishing and spreading water, calcium chloride, and/or mulch on the subgrade, or in other areas of a Project Site or associated off-site areas, for the purpose of controlling dust emissions.

B. The requirements set forth in this section of the specifications apply to all phases and areas of construction.

C. Contractor is responsible for all health and safety.

1.2 REFERENCES

A. Reference herein to any technical society, organization, group or regulation are made in accordance with the following abbreviations and, unless otherwise noted or specified, all work under this Section shall conform to the latest edition as applicable.

B. Regulations of Connecticut State Agencies (RCSA)

1. RCSA Section 22a-174-1 through 43, Abatement of Air Pollution.

C. ASTM International (ASTM)

1. ASTM D98, Standard Specification for Calcium Chloride.

PART 2 PRODUCTS

2.1 MATERIALS

A. Only water, calcium chloride, and mulch are approved for dust control. No asphalt or petroleum-based products may be utilized for dust control.

B. Water used shall be clean, non-polluted water obtained from sources approved by Engineer.

C. Calcium chloride, ASTM D98. Calcium chloride in pellet form and flake form shall be acceptable.

1. Calcium chloride shall be packaged in moisture proof bags or in airtight drums with the manufacturer, name of product, net weight, and percentage of calcium chloride guaranteed by the manufacturer legibly marked on each container.

2. Engineer may reject calcium chloride failing to meet the requirements of the aforementioned specifications or which has become caked or sticky in shipment.

D. Mulch

1. Straw mulch: Threshold straw of oats, wheat, barely, or rye that is free from noxious weeds, mold or other objectionable material. Straw mulch shall contain at least 50 percent by weight of material to be 10-in or longer.

2. Wood chips: Processed tree trimmings free of trash or other physical contaminants such as metal and plastic.

PART 3 EXECUTION

3.1 GENERAL

A. Dust control shall be the responsibility of Contractor and dust control operations shall meet the requirements of the State of Connecticut Department of Environmental Protection.

B. Construction sequencing shall be organized and conducted in a manner to leave existing pavement or ground coverings in place until just prior to earth excavation for the purpose of minimizing the migration of dust beyond the Project Limits into the surrounding area.

C. Engineer reserves the right to conduct active dust monitoring using visual methods and may utilize particulate measurement equipment during the course of the work. If the amount of fugitive dust and/or particulate generated during the work is deemed unacceptable in the Engineer's judgment or exceeds baseline Project Site conditions at Engineer's monitoring locations, Engineer may require Contractor to stop work and implement corrective measures. No claim for delay will be considered for work stoppage based upon the results of Engineer's active dust monitoring results.

D. Stockpiled materials from which particle have the potential of becoming airborne shall be securely covered with a temporary waterproof covering made of polyethylene, polypropylene, hypalon, or approved equal. The covers must be in place at all times when work with the stockpiles is not occurring.

E. Subcontractor shall sweep all adjacent roads and neighboring parking lots and driveways that are impacted by the work. Whenever dirt is tracked from the site it shall be cleaned as necessary to prevent it from becoming a nuisance or hazard. At a minimum, adjacent streets shall be swept once per week.

3.2 WATER

A. The application of water shall be under the control of Engineer at all times. It shall be applied only at the locations, and at such times, and in the amount as may be directed by Engineer. Quantities of water wasted or applied without authorization will not be paid for.

B. Use of water will not be permitted when it will result in, or create, hazardous or objectionable conditions such as ice, flooding or pollution.

C. Contractor shall have available and maintain in an operable condition at all times, sufficient equipment for the purpose of applying water for dust control.

D. Watering equipment shall consist of pipelines, tanks, tank trucks, distributors, pumps, meters, hose or other devices, approved by Engineer, which are capable of applying a uniform spread of water over the surface. A suitable device for a positive shut-off and for regulating the flow of water shall be located so as to permit positive operator control.

E. Applications of water for dust suppression include, but are not necessarily limited to, the following:

1. Demolition activities, material handling, material processing, and loading.

2. Earthwork.

3. Open excavation faces and dust-prone areas of the work.

4. Temporary access roads and roadway surfaces within and around the Project Site.

3.3 CALCIUM CHLORIDE

A. Calcium chloride shall be applied only at the locations, at such times and in the amount as may be directed by the Engineer and only in areas that will not be adversely affected by the application. Refer to Section 01 3543 – Environmental Protection.

B. Calcium chloride shall be uniformly applied at the rate of one and one-half (1½) pounds per square yard (lb/yd2) or at any other rate as directed by Engineer. Application shall be by means of a mechanical spreader, or other approved methods. The number and frequency of applications shall be to Engineer's satisfaction.

3.4 MULCH FOR DUST CONTROL

A. Coordinate the use of mulch for dust control with erosion and sedimentation control measures.

B. Straw mulch shall be applied at a rate of 100 pounds per 1,000 square feet (100 lb/1,000 ft2).

C. Wood chips or wood mulch shall be applied at such a rate as to form a layer one (1) inch thick.

3.5 OTHER DUST CONTROL MEASURES

A. A temporary seed mixture may be spread in lieu of, or in addition to mulch over areas where the suspension of grading work in disturbed areas is expected to be more than 30 calendar days and as directed by Engineer.

END OF SECTION

SECTION 01 6000 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 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.

B. Related Requirements:

1. Section 01 2500 "Substitution Procedures" for requests for substitutions.

1.2 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.
3. Comparable Product: Product that is demonstrated and approved by Architect through submittal process to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

B. Basis-of-Design Product Specification: A specification in which a single manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation. In addition to the basis-of-design product description, product attributes and characteristics may be listed to establish the significant qualities related to type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other special features and requirements for purposes of evaluating comparable products of additional manufacturers named in the specification.

1.3 ACTION SUBMITTALS

A. Comparable Product Request Submittal: Submit request for consideration of each comparable product. Identify basis-of-design product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.

1. Include data to indicate compliance with the requirements specified in "Comparable Products" Article.

2. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within seven days of receipt of a comparable product request. Architect will notify Contractor of approval or rejection of proposed comparable product request within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.

    a. Form of Architect's Approval of Submittal: As specified in Section 013300 "Submittal Procedures."
    b. Use product specified if Architect does not issue a decision on use of a comparable product request within time allocated.

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

1.4 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.

1.5 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.

1.6 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.

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 meeting 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.

B. Product Selection Procedures:

1. Limited List of Products: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered unless otherwise indicated.

a. Limited list of products may be indicated by the phrase: "Subject to compliance with requirements, provide one of the following: …"

2. Non-Limited List of Products: Where Specifications include a list of names of both available manufacturers and products, provide one of the products listed, or an unnamed product, which complies with requirements.

    a. Non-limited list of products is indicated by the phrase: "Subject to compliance with requirements, available products that may be incorporated in the Work include, but are not limited to, the following: …"

3. Limited List of Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered unless otherwise indicated.

    a. Limited list of manufacturers is indicated by the phrase: "Subject to compliance with requirements, provide products by one of the following: …"

4. Non-Limited List of Manufacturers: Where Specifications include a list of available manufacturers, provide a product by one of the manufacturers listed, or a product by an unnamed manufacturer, which complies with requirements.

    a. Non-limited list of manufacturers is indicated by the phrase: "Subject to compliance with requirements, available manufacturers whose products may be incorporated in the Work include, but are not limited to, the following: …"

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 "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.

    a. For approval of products by unnamed manufacturers, comply with requirements in Section 012500 "Substitution Procedures" for substitutions for convenience.

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.

2.2 COMPARABLE PRODUCTS

A. Conditions for Consideration of Comparable Products: Architect will consider Contractor's request for comparable product when the following conditions are satisfied. If the following

conditions are not satisfied, Architect may return requests without action, except to record noncompliance with these requirements:

1. Evidence that proposed product does not require revisions to the Contract Documents, is consistent with the Contract Documents, will produce the indicated results, and is compatible with other portions of the Work. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant product qualities include attributes such as type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other specific features and requirements.
2. Evidence that proposed product provides specified warranty.
3. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
4. Samples, if requested.

END OF SECTION 01 6000

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SECTION 01 7300 - EXECUTION

PART 1 - GENERAL

1.1 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. Progress cleaning.
6. Starting and adjusting.
7. Protection of installed construction.

B. Related Requirements:

1. Section 01 1000 "Summary" for limits on use of Project site.
2. Section 01 7700 "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, replacing defective work, and final cleaning.

1.2 QUALITY ASSURANCE

A. 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.

B. 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. 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 01 3100 "Project Management and Coordination."

3.3 CONSTRUCTION LAYOUT

A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings. If discrepancies are discovered, notify Architect promptly.

3.4 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: Where possible, select tools or equipment that minimize production of excessive 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 portions of the 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. Remove and replace damaged, defective, or non-conforming Work.

3.5 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. 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.

F. 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 and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
4. Excavating and Backfilling: Comply with requirements in applicable 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.

G. 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.
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.
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.

H. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.6 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 (27 deg C).
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.

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

E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.

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

G. 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."

H. 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.

I. 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.

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

3.7 STARTING AND ADJUSTING

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

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

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

D. Manufacturer's Field Service: Comply with qualification requirements in Section 014000 "Quality Requirements."

3.8 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. Protection of Existing Items: Provide protection and ensure that existing items to remain undisturbed by construction are maintained in condition that existed at commencement of the Work.

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

END OF SECTION 01 7300

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SECTION 01 7419 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for the following:

1. Recycling nonhazardous construction waste.
2. Disposing of nonhazardous construction waste.

B. Related Requirements:

1. Section 04 2000 "Unit Masonry" for disposal requirements for masonry waste.

1.2 DEFINITIONS

A. Construction Waste: Building, structure, and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.

B. Disposal: Removal of construction waste and subsequent salvage, sale, recycling, or deposit in landfill, incinerator acceptable to authorities having jurisdiction, or designated spoil areas on Owner’s property.

C. Recycle: Recovery of construction waste for subsequent processing in preparation for reuse.

D. Salvage: Recovery of construction waste and subsequent sale or reuse in another facility.

E. Salvage and Reuse: Recovery of construction waste and subsequent incorporation into the Work.

1.3 ACTION SUBMITTALS

A. Waste Management Plan: Submit plan within 7 days of date established for the Notice to Proceed.

1.4 INFORMATIONAL SUBMITTALS

A. Waste Reduction Progress Reports: Concurrent with each Application for Payment, submit report. Include the following information:

1. Material category.
2. Generation point of waste.
3. Total quantity of waste in tons (tonnes).
4. Quantity of waste salvaged, both estimated and actual in tons (tonnes).
5. Quantity of waste recycled, both estimated and actual in tons (tonnes).

6. Total quantity of waste recovered (salvaged plus recycled) in tons (tonnes).
7. Total quantity of waste recovered (salvaged plus recycled) as a percentage of total waste.

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

C. Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills and incinerator facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

1.5 WASTE MANAGEMENT PLAN

A. General: Develop a waste management plan according to requirements in this Section. Plan shall consist of waste identification, waste reduction work plan, and cost/revenue analysis. Indicate quantities by weight or volume, but use same units of measure throughout waste management plan.

B. Waste Identification: Indicate anticipated types and quantities of demolition and construction waste generated by the Work. Include estimated quantities and assumptions for estimates.

C. Waste Reduction Work Plan: List each type of waste and whether it will be salvaged, recycled, or disposed of in landfill or incinerator. Include points of waste generation, total quantity of each type of waste, quantity for each means of recovery, and handling and transportation procedures.
1. Recycled Materials: Include list of local receivers and processors and type of recycled materials each will accept. Include names, addresses, and telephone numbers.
2. Disposed Materials: Indicate how and where materials will be disposed of. Include name, address, and telephone number of each landfill and incinerator facility.
3. Handling and Transportation Procedures: Include method that will be used for separating recyclable waste including sizes of containers, container labeling, and designated location where materials separation will be performed.

PART 2 - EXECUTION

2.1 PLAN IMPLEMENTATION

A. General: Implement approved waste management plan. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.

B. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work.

1. Distribute waste management plan to everyone concerned within three days of submittal return.
2. Distribute waste management plan to entities when they first begin work on-site. Review plan procedures and locations established for salvage, recycling, and disposal.

C. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged and recycled.
2. Comply with Section 015000 "Temporary Facilities and Controls" for controlling dust and dirt, environmental protection, and noise control.

2.2 RECYCLING CONSTRUCTION WASTE, GENERAL

A. General: Recycle paper and beverage containers used by on-site workers.

B. Recycling Incentives: Revenues, savings, rebates, tax credits, and other incentives received for recycling waste materials shall accrue to Contractor.

C. Preparation of Waste: Prepare and maintain recyclable waste materials according to recycling or reuse facility requirements. Maintain materials free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to the recycling process.

D. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical according to approved construction waste management plan.

1. Provide appropriately marked containers or bins for controlling recyclable waste until 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 from Owner's property and transport to recycling receiver or processor as often as required to prevent overfilling bins.

2.3 RECYCLING CONSTRUCTION WASTE

A. Packaging:

1. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location.
2. Polystyrene Packaging: Separate and bag materials.
3. Pallets: As much as possible, require deliveries using pallets to remove pallets from Project site. For pallets that remain on-site, break down pallets into component wood pieces and comply with requirements for recycling wood.
4. Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.

B. Wood Materials:

1. Clean Cut-Offs of Lumber: Grind or chip into small pieces.
2. Clean Sawdust: Bag sawdust that does not contain painted or treated wood.

C. Gypsum Board: Stack large clean pieces on wood pallets or in container and store in a dry location.

1. Clean Gypsum Board: Grind scraps of clean gypsum board using small mobile chipper or hammer mill. Screen out paper after grinding.

D. Paint: Seal containers and store by type.

2.4 DISPOSAL OF WASTE

A. General: Except for items or materials to be salvaged or recycled, 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.

END OF SECTION 01 7419

SECTION 01 7700 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

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

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

B. Related Requirements:

1. Section 01 7823 "Operation and Maintenance Data" for additional operation and maintenance manual requirements.
2. Section 01 7839 "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
3. Section 01 7900 "Demonstration and Training" for requirements to train the Owner's maintenance personnel to adjust, operate, and maintain products, equipment, and systems.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of cleaning agent.

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

C. Certified List of Incomplete Items: Final submittal at final completion.

1.3 CLOSEOUT SUBMITTALS

A. Certificates of Release: From authorities having jurisdiction.

B. Certificate of Insurance: For continuing coverage.

1.4 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, 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 Owner. Label with manufacturer's name and model number.
5. Submit testing, adjusting, and balancing records.
6. Submit sustainable design submittals not previously submitted.
7. 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.
6. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
7. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
8. Complete final cleaning requirements.
9. Touch up paint 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.

1.5 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.
4. Submit pest-control final inspection report.

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.

1.6 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.
2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
3. Submit list of incomplete items in the following format:

    a. MS Excel electronic file. Architect will return annotated file.
    b. Web-based project software upload. Utilize software feature for creating and updating list of incomplete items (punch list).

1.7 SUBMITTAL OF PROJECT WARRANTIES

A. Time of Submittal: Submit written warranties on request of Architect for designated portions of the Work where warranties are indicated to commence on dates other than date of Substantial Completion, or when delay in submittal of warranties might limit Owner's rights under warranty.

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

C. Warranty Electronic File: Provide warranties and bonds in PDF format. Assemble complete warranty and bond submittal package into a single electronic PDF file with bookmarks enabling navigation to each item. Provide bookmarked table of contents at beginning of document.

1. Submit by uploading to web-based project software site.

D. Warranties in Paper Form:

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 (215-by-280-mm) paper.

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

PART 2 - PRODUCTS

2.1 MATERIALS

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

PART 3 - EXECUTION

3.1 FINAL CLEANING

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

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

1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a 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. 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.
    c. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
    d. Sweep concrete floors broom clean in unoccupied spaces.
    e. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.
    f. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
    g. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
    h. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency.
    i. Leave Project clean and ready for occupancy.

C. Pest Control: Comply with pest control requirements in Section 015000 "Temporary Facilities and Controls." Prepare written report.

D. 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.

END OF SECTION 01 7700

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SECTION 01 7823 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 SUMMARY

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

1. Operation and maintenance documentation directory manuals.
2. Emergency manuals.
3. Systems and equipment operation manuals.
4. Systems and equipment maintenance manuals.
5. Product maintenance manuals.

1.2 CLOSEOUT SUBMITTALS

A. Submit operation and maintenance manuals indicated. Provide content for each manual as specified in individual Specification Sections, and as reviewed and approved 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 operation and maintenance submittals is acceptable.
2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.

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

1. Submit by uploading to web-based project software site. Enable reviewer comments on draft submittals.
2. Submit three paper copies. Architect, will return two copies.

C. 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.

D. Comply with Section 01 7700 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

1.3 FORMAT OF OPERATION AND MAINTENANCE MANUALS

A. 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: Bookmark 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.

B. Manuals, Paper Copy: Submit manuals in the form of hard-copy, bound and labeled volumes.

1. Binders: Heavy-duty, three-ring, vinyl-covered, binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch (215-by-280-mm) paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
2. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.

    a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
    b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

1.4 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

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

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

B. Title Page: Include the following information:

1. Subject matter included in manual.
2. Name and address of Project.
3. Name and address of Owner.
4. Date of submittal.
5. Name and contact information for Contractor.
6. Name and contact information for General Contractor
7. Name and contact information for Architect.
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.

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. 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."

1.5 EMERGENCY MANUALS

A. 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.

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.

1.6 SYSTEMS AND EQUIPMENT OPERATION MANUALS

A. Systems and Equipment Operation Manual: Assemble a complete set of data indicating operation of each system, subsystem, and piece of equipment not part of a system. Include

information required for daily operation and management, operating standards, and routine and special operating procedures.

B. 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.

C. 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.

D. 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.

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

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

1.7 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

A. Systems and Equipment Maintenance Manuals: Assemble a complete set of data indicating maintenance of each system, subsystem, and piece of equipment not part of a system. Include manufacturers' maintenance documentation, preventive maintenance procedures and frequency, repair procedures, wiring and systems diagrams, lists of spare parts, and warranty information.

B. 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 warranties and bonds, as described below.

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

1. Standard maintenance instructions and bulletins; 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.

    a. 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.

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

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

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

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

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

G. 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.

H. 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.

1.8 PRODUCT MAINTENANCE MANUALS

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

B. 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.

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.

END OF SECTION 01 7823

SECTION 01 7839 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for project record documents, including the following:

1. Record Drawings.
2. Record Specifications.
3. Record Product Data.

B. Related Requirements:

1. Section 01 7300 "Execution" for final property survey.
2. Section 01 7823 "Operation and Maintenance Data" for operation and maintenance manual requirements.

1.2 CLOSEOUT SUBMITTALS

A. Record Drawings: Comply with the following:

1. Number of Copies: Submit one set(s) of marked-up record prints.
2. Number of Copies: Submit copies of record Drawings as follows:

a. Initial Submittal:

1) Submit one paper-copy set(s) of marked-up record prints.
2) Submit PDF electronic files of scanned record prints and one of file prints.
3) Submit record digital data files and one set(s) of plots.
4) Architect will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.

b. Final Submittal:

1) Submit three paper-copy set(s) of marked-up record prints.
2) Submit PDF electronic files of scanned record prints and three set(s) of prints.
3) Print each drawing, whether or not changes and additional information were recorded.

B. Record Specifications: Submit one paper copy and an annotated PDF electronic file of Project's Specifications, including addenda and contract modifications.

C. Record Product Data: Submit one paper copy and an annotated PDF electronic file and directory 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.

1.3 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 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.
    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. Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked-up record prints with Architect. When authorized, prepare a full set of corrected digital data files of the Contract Drawings, as follows:

1. Format: Same digital data software program, version, and operating system as the original Contract Drawings.
2. Format: DWG, Version 2018, Microsoft Windows operating system.
3. Format: Annotated PDF electronic file.
4. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.
5. Refer instances of uncertainty to Architect for resolution.
6. Architect will furnish Contractor with one set of digital data files of the Contract Drawings for use in recording information.

    a. See Section 013100 "Project Management and Coordination" for requirements related to use of Architect's digital data files.
    b. Architect will provide data file layer information. Record markups in separate layers.

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

1. Record Prints: Organize record prints into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
2. Format: Annotated PDF electronic file.
3. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.
4. Identification: As follows:

    a. Project name.
    b. Date.
    c. Designation "PROJECT RECORD DRAWINGS."
    d. Name of Architect.
    e. Name of Contractor.

1.4 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 and record Drawings where applicable.

B. Format: Submit record Specifications as annotated PDF electronic file with a paper copy.

1.5 RECORD PRODUCT DATA

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

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

C. Format: Submit record Product Data as annotated PDF electronic file with a paper copy.

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

1.6 MAINTENANCE OF RECORD DOCUMENTS

A. Maintenance of Record Documents: Store record documents 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 01 7839

SECTION 01 7900 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 SUMMARY

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

1. Instruction in operation and maintenance of systems, subsystems, and equipment.

1.2 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.

1.3 QUALITY ASSURANCE

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

B. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Section 01 4000 "Quality Requirements," experienced in operation and maintenance procedures and training.

1.4 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 have been reviewed and approved by Architect.

1.5 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.

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. Systems and equipment operation manuals.
    c. Systems and equipment maintenance manuals.
    d. Product maintenance manuals.
    e. Project Record Documents.
    f. Identification systems.
    g. Warranties and bonds.
    h. 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.

1.6 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 01 7823 "Operation and Maintenance Data."

B. Set up instructional equipment at instruction location.

1.7 INSTRUCTION

A. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and Owner for number of participants, instruction times, and location.

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

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

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

D. 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.

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

END OF SECTION 01 7900

SECTION 02 4113

UTILITY DEMOLITION AND ABANDONMENT

PART 1 GENERAL

1.1 SUMMARY

A. Section includes:

1. Termination of utility services.

2. Demolition or abandonment of drainage, sewer, and water pipe

3. Demolition or abandonment of miscellaneous below-grade utilities and related facilities including but not necessarily limited to electric and communications ducts, steam lines, and gas lines.

4. Demolition or abandonment of manholes, catch basins, vaults, and similar utility structures.

5. Demolition or abandonment of above-grade utilities and related facilities including but not necessarily limited to electric, telephone, cable systems, and data communications.

B. Contractor shall coordinate work between all Contractors, sections, and trades required for the proper completion of the work.

C. Contractor is responsible for all health and safety.

1.2 REFERENCES

A. Reference herein to any technical society, organization, group or regulation are made in accordance with the following abbreviations and, unless otherwise noted or specified, all work under this Section shall conform to the latest edition as applicable.

B. Code of Federal Regulations (CFR).

1. 29 CFR 1926, Safety and Health Regulations for Construction.

C. State of Connecticut.

1. State of Connecticut Solid Waste Management Regulations, Sections 22a-209 including any amendments thereto.

2. Standard Specifications for Roads, Bridges, Facilities and Incidental Construction, Form 817, 2016 and any supplements.

D. ASTM International (ASTM)

1. ASTM C33 – Standard Specification for Concrete Aggregates.

2. ASTM C55 – Standard Specification for Concrete Building Brick.

3. ASTM C91 – Standard Specification for Masonry Cement.

4. ASTM C94 – Standard Specification for Ready-Mixed Concrete.

5. ASTM C144 – Standard Specification for Aggregate for Masonry Mortar.

6. ASTM C150 – Standard Specification for Portland Cement.

7. ASTM C230 – Standard Specification for Flow Table for Use in Tests of Hydraulic Cement.

8. ASTM C270 – Standard Specification for Mortar for Unit Masonry.

9. ASTM C387 – Standard Specification for Packaged, Dry, Combined Materials for Mortar and Concrete.

10. ASTM C476 – Standard Specification for Grout for Masonry.

11. ASTM C1107 – Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).

1.3 SAFETY

A. Conduct the work of this Section in conformance with applicable regulations, including those relating to warning signs, excavation safety, sheeting, shoring, and stabilization.

B. Provide and maintain barricades, signs, lights, etc., required for the protection of personnel, materials and property. Temporary barricades, etc. shall conform all applicable codes and regulations, and shall be lighted at night with lanterns, flares and reflectorized paint as required for safety. Adapt barricades, signs, lights, etc. to evolving site conditions throughout the progress of the work.

C. Provide other safety devices as required, including adaptation of such safety devices to changing site conditions, to prevent unauthorized entry to construction areas and open excavations. Provide warning signs and other temporary construction safety devices necessary for proper completion of the work in compliance with applicable safety regulations.

D. Contractor shall properly design and furnish all labor, materials, equipment, and tools necessary to construct permanent or temporary excavation support systems, including, but not necessarily limited to, sheet piling, trench shields, trench boxes, timber trench shoring, pneumatic/hydraulic shoring, steel sheeting or sheeting using other materials, sloping, and benching.

E. Any time an excavation is to remain open, at a minimum, provide full enclosure with safety barriers and fencing, warning signs, and additional safety control measures as appropriate for the condition.

1.4 SUBMITTALS

A. Abandonment procedures required by the owner of each utility prior to performing the work of utility termination/cutting/capping/plugging.

B. Material specifications and shop drawings for all materials and equipment furnished under this section, prior to performing the work of utility abandonment.

C. Schedule indicating the timing of termination for each utility.

D. Copies of permits, licenses, approvals, insurance, or bonds associated with termination of utility service.

E. Copies of utility termination letters confirming termination of service from each utility owner/operator.

F. Quality Control Submittals (prior to commencement of work)

1. Schedule of demolition activities.

2. Methods of demolition, including sequence and equipment proposed for same.

G. Contract Closeout Submittals (prior to authorization of final payment):

1. As-built drawings showing locations of all terminated/cut/capped/plugged utilities and service disconnections at or before project close-out.

1.5 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and methods required for proper performance of the work in this Section. Use equipment of adequate size, capacity and quantity to accomplish the work of this Section in a timely manner.

B. Utility Mark-out

1. Prior to commencing work, comply with utility mark-out requirements of the Call-Before-You-Dig System (1-800-922-4455).

2. Verify the location of all subsurface utilities marked through the Call-Before-You-Dig System.

3. Not all subsurface facilities or structures will be identified through the Call-Before-You-Dig System. Confirm the location of other subsurface utilities and other subsurface facilities or structures prior to commencing work. Field-mark utilities as required.

C. Utility Coordination

1. Inform all utility owners of the necessity of test pit work. Prove reasonable advance notice to allow for coordination.

2. Coordinate the excavation of all test pits with the respective utility owners having facilities in the vicinity of the test pit location.

3. If so desired by the respective utility owners, all or part of the work under this Section may be accomplished by their crews and/or supervised by them.

PART 2 PRODUCTS

2.1 MATERIALS

A. Comply with the material specifications required by the owner of each utility. Where such material specifications may conflict with this Specification, utility owner's requirements shall prevail.

B. Gravel Borrow: Conform to applicable Specifications.

C. Sand: ASTM C33.

D. Portland Cement: ASTM C150, Type II.

E. Masonry Cement: ASTM C91.

F. Mortar Aggregate: ASTM C144, standard masonry type, clean, dry, free of deleterious materials.

G. Concrete: Design of mix in accordance with ASTM C94; ASTM C150, Type II Portland Cement, washed and graded sand, and aggregate with maximum size of 1-inch; or pre-packaged concrete mix with maximum aggregate size of 1-inch, ASTM C387. Minimum 28-day compressive strength of 4,000 psi.

H. Masonry Mix: Washed and graded mason sand, lime, and Portland Cement, ASTM C270; or pre-packaged, dry, sand/lime/cement mortar mixture, ASTM C387. Minimum 28-day compressive strength of 1,800 psi (Type S).

I. Grout: Bagged, pre-mixed formulations of non-shrink grout shall meet the requirements of ASTM C1107, Grade B or site mixed, ASTM C476.

1. Unconfined compressive strength: 7,500 psi at 28 days.

2. Grout shall be non-metallic, non-gaseous, and non-shrink when tested in accordance with ASTM C1107 Grade B or C at a fluid consistency (flow cone) of 20 to 30 seconds. Thirty-minute-old grout shall flow through the flow cone after slight agitation, in temperatures of 40 degrees F to 90 degrees F.

3. Mix Design: Obtain prior written approval of Engineer for any proposed mix design. Mix design shall include the proportions of hydraulic cement, potable water, fine aggregates, expansive agent, and any other necessary additive or admixture.

4. Grout shall be mixed to a flowable consistency as determined by ASTM C230. All bagged material shall be clearly marked with the manufacturer's name, date of production, batch number, and written instructions for proper mixing, placement and curing of the product.

5. Contractor may formulate and design a grout mix for use on the project in lieu of using a pre-bagged product.

J. Water: Potable.

K. Solid Concrete Masonry Unit: ASTM C55, sized per pipe diameter to minimize requirements for cutting.

PART 3 EXECUTION

3.1 GENERAL

A. Verify site conditions before proceeding with demolition work. Field check the accuracy of the Drawings and inspect structures, utilities, and other site features prior to start of work and notify Engineer in writing, of any hazardous conditions and/or discrepancies.

B. Existing utilities at the Project Site have not been clearly defined as to location, size, and as-built condition, and all utility information shown on the Drawings or described herein must be considered approximate.

C. Primary structures and other site features are shown on the Drawings; other smaller structures and features not shown on the Drawings may exist and shall be demolished as part of the work of this Section at no additional cost.

D. Contractor shall have sole responsibility for verification of actual field conditions. Contractor shall bear full responsibility for obtaining information regarding the location, layout, and as-built configuration of existing site improvements, including aspects of such improvements which are not readily visible, including but not necessarily limited to above-ground and underground utilities, utility structures, their connections, and other above- and below-grade construction that my affect, or be affected by, the work of this Seciton.

E. Utility services to buildings outside the limits of work shall be maintained and all resulting costs or charges shall be the responsibility of Contractor.

F. Although surficial features such as manholes, catch basins, valves and junction boxes may be visible and/or shown on the Drawings, Contractor is required to perform exploratory excavations as he deems appropriate to ascertain the location and nature of all subsurface utilities components which are to be terminated, abandoned, or demolished, or otherwise affected by the work.

G. Provide all required coordination with owners of the various utilities serving, or present at, the Project Site as required to complete termination, demolition and abandonment work.

H. Prior to physically cutting, disconnecting, demolishing or abandoning any facility, verify that service has been terminated and no active connections remain.

I. Coordinate as required for permanent termination of service, temporary termination of service, relocation of facilities, abandonment of facilities, demolition of facilities, cutting, capping, plugging, and bracing.

J. Comply at all times with the procedures for terminations of utility services as required by the owner of each utility.

K. When utilities are encountered that are not indicated on the Drawings, notify Engineer before proceeding with the work.

3.2 PROTECTION OF UTILITIES

A. Locate and identify existing utilities that are to remain and protect them from damage. Provide protection as required such as marking, blocking, bracing, stabilizing, supporting, and retaining.

B. Before excavating near any utility, notify the utility owner, coordinate protective work, and comply with the utility owners' requirements.

C. When uncharted or incorrectly charted utilities are encountered during excavation, stop work and notify Engineer immediately. Cooperate with the utility owners in maintaining their utilities in operation prior to resuming work.

D. Utilities to remain which are damaged by Contractor shall be repaired/replaced to the satisfaction of the utility owner at Contractor's expense.

E. Retaining Structures

1. Provide bracing, shoring, sheeting, sheet piling, underpinning or other retaining structures necessary to guard against any movement or settlement of existing or new construction, utilities, paving, light standards, piping or conduit. Assume responsibility for the strength and adequacy of retaining structures, and for the safety and support of construction, utilities or paving, and for any movement, settlement or damage thereto.

3.3 UTILITY TERMINATION

A. Termination: Where "Terminate" is indicated, permanently terminate utility service as indicated on the Drawings in accordance with each utility owner's specific requirements, or coordinate with the utility owner in those cases where the utility owner will perform termination.

B. Coordinate and secure required permits, licenses, approvals, insurance, or bonds associated with termination of service.

C. Coordinate inspections by utility company personnel, or if privately-owned, coordinate inspections by qualified, authorized personnel on behalf of the utility owner.

D. Provide completed and executed utility termination forms as required by each utility owner's requirements.

E. Secure any required utility termination letters from each utility which confirm that service has been terminated and no active connections remain.

F. Termination Procedure

1. Water

a. Do not impact any water pipe that may be constructed of asbestos-containing materials unless asbestos abatement specifications are part of the contract documents and the work is completed by qualified personnel in accordance with the requirements contained therein.

b. Cut and cap water pipe as indicated on the Drawings or in accordance with the water utilities' requirements. Do not leave "dead-end" pipe runs.

c. Provide restraining blocks at all capped ends.

2. Electrical and Communications

a. Remove conductors to nearest structure unless otherwise indicated. Plug openings in structures per the details or in accordance with the utilities' requirements.

b. Cut and cap conduits at each end. Caps shall match conduit type.

c. Direct-Bury Cable: Comply with the cable owner's requirements.

d. Secure termination documentation.

3. Gas

a. Comply with gas company requirements.

4. Steam

a. Prior to impacting any steam pipe, confirm that no asbestos-containing materials are present, or confirm that all asbestos-containing materials have been properly abated.

b. Provide concrete plug at open ends.

3.4 UTILITY ABANDONMENT

A. Abandonment: Where "Abandon" or "Abandon in-place" is indicated, terminate utility service, cut, cap and otherwise separate the facility from portions to remain and implement abandonment procedure as defined herein.

B. Sewer and Drainage Systems

1. Less than 6 inches in diameter: Provide 6-inch concrete plug at open ends on either side of the length to be abandoned as indicated on the Drawings.

2. Greater than 6 inches in diameter: Fill abandoned section with grout/flow-fill and provide 6-inch concrete plugs on either side of the length to be abandoned as indicated on the Drawings.

a. Where the filling of pipe is called-for, submit plan of proposed procedure to the owner of such utility and Engineer for approval.

b. Filling of pipe shall be with pressure (pumping) methods.

3. Where the filling of pipe or conduit is called-for, Contractor shall submit a plan of his proposed procedure to the owner of such utility and Engineer for approval.

4. All structures which are to be abandoned in-place shall have their tops or roof slabs removed and floor slabs broken so as to permit the free passage of water.

5. Unless otherwise indicated, structures which are to be abandoned in-place may be demolished such that only that portion of the structure from finished grade to a point five feet below finished grade are removed.

C. Water Pipe

1. Do not impact any water pipe that may be constructed of asbestos-containing materials unless asbestos abatement specifications are part of the contract documents and the work is completed by qualified personnel in accordance with the requirements contained therein.

2. Cut and cap water pipe on either side of the length to be abandoned as indicated on the Drawings.

3. Provide restraining blocks at all capped ends of water pipe to remain in service.

D. Electrical and Communications

1. Remove conductors to nearest structure unless otherwise indicated.

2. Cut and cap conduits on either side of the length to be abandoned as indicated on the Drawings. Caps shall match conduit type.

E. Gas

1. Comply with gas company requirements.

F. Steam

1. Prior to impacting any steam pipe, confirm that no asbestos-containing materials are present, or confirm that all asbestos-containing materials have been properly abated.

2. Provide concrete plug on either side of the length to be abandoned as indicated on the Drawings.

G. Utility Structures

1. Comply with utility owner's requirements.

2. All structures which are to be abandoned in-place shall have their tops or roof slabs removed and floor slabs broken so as to permit the free passage of water.

3. Unless otherwise indicated, structures which are to be abandoned in-place may be demolished such that only that portion of the structure from finished grade to a point five feet below finished grade are removed.

4. Backfill to match adjacent grade and restore surface area to match adjacent grade unless otherwise indicated.

3.5 UTILITY DEMOLITION

A. Where "Remove," "Demolish," or "R&D" is indicated on the Drawings, such facility or structure shall be completely removed and disposed-of, after termination.

B. Subsurface Utilities: Demolition shall include complete removal of the utility system and any associated concrete encasement, catch basins and related structures; sanitary sewerage manholes, pumps, and related facilities; valves, backflow devices, vents, reducers, couplings, meters, hydrants, fittings, thrust blocks, anchors; vaults, pull boxes, splice boxes, and handholes; or other ancillary components of the utility located within the limits to be demolished. The plugging or capping of utilities at the limit of demolition shall be as indicated on the Drawings. Where no plugging or capping is shown, comply with the requirements for utility termination at the limit of demolition.

C. Above-grade Utilities: Demolition shall include complete removal of the utility system and any associated utility poles, guys, wires, transformers, light standards, utility and light pole foundations, supports and ancillary equipment.

D. Do not demolish any utility until termination and plugging/capping has been completed and verified.

E. Prior to the demolition of any lighting system, verify that power supplies which may be shared with other lighting systems outside the Project Limits have been segregated.

F. Asbestos-Containing Materials

1. Do not impact any asbestos-insulated utility where “Remove” or “Demolish” is indicated on the Drawings until all asbestos-containing materials have been properly abated and verification of same has been either

a. Completed and verified by qualified personnel; or

b. If asbestos abatement specifications are part of the contract documents the work has been completed by Contractor’s qualified personnel or subcontractor in accordance with the requirements contained therein.

2. Do not impact any asbestos-containing pipe where “Remove” or “Demolish” is indicated on the Drawings unless asbestos abatement specifications are part of the contract documents and the work is completed by qualified personnel in accordance with the requirements contained therein. If asbestos abatement specifications are not part of the contract documents coordinate with Owner’s abatement contractor for completion of the work.

3.6 MATERIAL DISPOSITION

A. Salvage of Utility Materials

1. If requested by the utility owner, frames and covers of manholes and catch basins to be demolished or abandoned shall remain the property of the utility owner. They shall be removed and transported to a designated storage area by Contractor.

2. Notify the utility owner at least 24 hours before salvaged materials are transport so that the exact place and time for delivery can be arranged.

3. Other utility materials which are to be salvaged or reused are indicated on the Drawings.

B. Disposal of Utility Materials

1. The loading of utility demolition materials for disposal shall be performed in a manner that prevents materials and activities from generating excessive dust and ensure minimum interference with roads, sidewalks and streets both onsite and offsite.

2. Transport of all materials off-site shall be in accordance with applicable Department of Transportation Regulations. All utility demolition materials leaving the site shall become the property of Contractor.

3. Disposal of utility demolition materials shall be conducted in accordance with all applicable regulations and occur only at facilities approved/licensed or permitted by the Connecticut Department of Energy and Environmental Protection.

4. Disposal of Demolition Materials: All materials resulting from utility demolition shall be removed from the Project Site by Contractor for disposal, reuse, salvage or recycling. Disposal shall be conducted in accordance with all applicable regulations.

3.7 FILL AND BACKFILL

A. Backfill excavations from utility work in accordance with Specification Section 31 2310 – Earthwork.

B. Backfill excavations from utility work in accordance with applicable Specification Sections.

C. [No backfill is required. Provide OSHA-compliant barriers or smooth edges of all excavations to produce a stable slope, with smooth grade transitions and no vertical cuts from top of slope to lower limits of the excavation in compliance with the requirements of OSHA. Maximum slope into any excavated area under ideal soil conditions shall be 1 Horizontal to 2 Vertical (1H:2V).]

3.8 DOCUMENTATION

A. Field Identification

1. Physically mark the location of each subsurface utility termination with a surveyor's stake, with such stake identifying the utility type and depth below grade. Where the use of stakes at a utility termination location may be inappropriate, Contractor shall provide staking at an adjacent location(s) and include appropriate offset dimensions or other suitable demarcation.

B. As-Built Drawings

1. Provide as-built documentation for each utility termination, including location, depth, and method and material of construction for termination. Such as-built documentation shall be noted on the appropriate Drawings.

2. Contractor shall be solely responsible for complying with the requirements of local permitting authorities for preparation and submittal of as-built drawings. The requirements for the preparation of as-built drawings as defined herein shall be considered the minimum requirements of Engineer, but shall in no way relive Contractor from satisfying the requirements of local permitting authorities.

3. As work progresses, record the following on two (2) sets of Drawings:

4. All changes and deviations from the design in location, grade, size, material, or other feature as appropriate.

5. Any uncharted locations of utilities or other subsurface feature encountered during installation, including the characteristics of such uncharted utility or subsurface feature such as utility type, size, depth, material of construction, etc.

6. Recording of changes shall be clearly and neatly marked in red pen or pencil. All changes shall be noted on the appropriate Drawing sheets.

7. Make measurements from fixed, permanent points on the Project Site to accurately locate the work completed. Such measurements shall consist of at least three (3) ties showing the distance of each item relative to each of the fixed, permanent points.

8. As-Built Drawings shall be complete and shall indicate the true measurement and location, horizontal and vertical, of all new construction. As-Built drawings shall also contain any additional information required by Engineer.

3.9 CLEAN UP

A. Contractor shall remove all debris, residuals, and materials at the conclusion of utility termination, demolition, and abandonment activities.

END OF SECTION

SECTION 02 4116 - STRUCTURE DEMOLITION

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. Demolition and removal of buildings and site improvements.
2. Abandoning in-place or removing below-grade construction as indicated on the drawings.
3. Disconnecting, capping or sealing, and abandoning in-place or removing site utilities as indicated on the drawings.
4. Salvaging items for reuse by Owner.

B. Related Requirements:

1. Section 01 1000 "Summary" for use of the premises and phasing requirements.
2. Section 01 3200 "Construction Progress Documentation" for preconstruction photographs taken before building demolition.
3. Section 02 4113 "Utility Demolition and Abandonment" for site clearing and removal of above- and below-grade site improvements not part of building demolition.

1.3 DEFINITIONS

A. Remove: Detach items from existing construction and dispose of them off-site unless indicated to be salvaged.

B. Remove and Salvage: Detach items from existing construction, in a manner to prevent damage, and deliver to Owner ready for reuse. Include fasteners or brackets needed for reattachment elsewhere.

1.4 MATERIALS OWNERSHIP

A. Unless otherwise indicated, demolition waste becomes property of Contractor.

B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.

1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.5 PREINSTALLATION MEETINGS

A. Predemolition Conference: Conduct conference at Project site.

1. Inspect and discuss condition of construction to be demolished.
2. Review procedures for noise control and dust control.
3. Review procedures for protection of adjacent structures.
4. Review items to be salvaged and returned to Owner.

1.6 INFORMATIONAL SUBMITTALS

A. Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for protecting individuals and property, for environmental protection, for dust control and for noise control. Indicate proposed locations and construction of barriers.

B. Schedule of Building Demolition Activities: Indicate the following:

1. Detailed sequence of demolition work, with starting and ending dates for each activity.
2. Temporary interruption of utility services.
3. Shutoff and capping or re-routing of utility services.

C. Pre-demolition Photographs or Video: Show existing conditions of adjoining construction and site improvements, including finish surfaces, that might be misconstrued as damage caused by demolition operations. Comply with Section 01 3233 "Photographic Documentation." Submit before the Work begins.

1.7 CLOSEOUT SUBMITTALS

A. Inventory: Submit a list of items that have been removed and salvaged.

1.8 FIELD CONDITIONS

A. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.

B. Hazardous Materials: Present in buildings and structures to be demolished. A report on the presence of hazardous materials is on file for review and use.

1. Hazardous materials will be removed by Owner under a separate contract.

C. On-site storage or sale of removed items or materials is not permitted.

1.9 COORDINATION

A. Arrange demolition schedule so as not to interfere with Owner's on-site operations or operations of adjacent occupied buildings.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

B. Standards: Comply with ASSE A10.6 and NFPA 241.

2.2 SOIL MATERIALS

A. Satisfactory Soils: Comply with requirements in Section 31 2310 "Earthwork."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected and capped before starting demolition operations.

B. Review Project Record Documents of existing construction or other existing condition and hazardous material information provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.

C. Perform an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during building demolition operations.

D. Verify that hazardous materials have been remediated before proceeding with building demolition operations.

E. Inventory and record the condition of items to be removed and salvaged. Provide photographs or video of conditions that might be misconstrued as damage caused by salvage operations. Comply with Section 01 3233 "Photographic Documentation.

3.2 PREPARATION

A. Salvaged Items: Comply with the following:

1. Clean salvaged items of dirt and demolition debris.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Store items in a secure area until delivery to Owner.
4. Transport items to storage area designated by Owner.
5. Protect items from damage during transport and storage.

3.3 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

A. Existing Utilities to be Disconnected: Locate, identify, disconnect, and seal or cap off utilities serving buildings and structures to be demolished.

1. Owner will arrange to shut off utilities when requested by Contractor.
2. Arrange to shut off utilities with utility companies.
3. If removal, relocation, or abandonment of utility services will affect adjacent occupied buildings, then provide temporary utilities that bypass buildings and structures to be demolished and that maintain continuity of service to other buildings and structures.
4. Cut off pipe or conduit a minimum of 24 inches (610 mm) below grade. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing according to requirements of authorities having jurisdiction.
5. Do not start demolition work until utility disconnecting and sealing have been completed and verified in writing.

3.4 PROTECTION

A. Existing Facilities: Protect adjacent walkways, loading docks, building entries, and other building facilities during demolition operations. Maintain exits from existing buildings.

B. Existing Utilities to Remain: Maintain utility services to remain and protect from damage during demolition operations.

1. Do not interrupt existing utilities serving adjacent occupied or operating facilities unless authorized in writing by Owner and authorities having jurisdiction.
2. Provide temporary services during interruptions to existing utilities, as acceptable to Owner and authorities having jurisdiction.

    a. Provide at least 72 hours' notice to occupants of affected buildings if shutdown of service is required during changeover.

C. Temporary Protection: Erect temporary protection, such as walks, fences, railings, canopies, and covered passageways, where required by authorities having jurisdiction and as indicated. Comply with requirements in Section 01 5000 "Temporary Facilities and Controls."

1. Protect adjacent buildings and facilities from damage due to demolition activities.
2. Protect existing site improvements, appurtenances, and landscaping to remain.
3. Erect a plainly visible fence around drip line of individual trees or around perimeter drip line of groups of trees to remain.
4. Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
5. Provide protection to ensure safe passage of people around building demolition area and to and from occupied portions of adjacent buildings and structures.
6. Protect walls, windows, roofs, and other adjacent exterior construction that are to remain and that are exposed to building demolition operations.
7. Erect and maintain dustproof partitions and temporary enclosures to limit dust, noise, and dirt migration to occupied portions of adjacent buildings.

D. Remove temporary barriers and protections where hazards no longer exist. Where open excavations or other hazardous conditions remain, leave temporary barriers and protections in place.

3.5 DEMOLITION, GENERAL

A. General: Demolish indicated buildings and site improvements completely. Use methods required to complete the Work within limitations of governing regulations and as follows:

1. Do not use cutting torches until work area is cleared of flammable materials. Maintain portable fire-suppression devices during flame-cutting operations.
2. Maintain fire watch during and for at least two hours after flame-cutting operations.
3. Maintain adequate ventilation when using cutting torches.

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

1. Do not close or obstruct streets, walks, walkways, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed trafficways if required by authorities having jurisdiction.
2. Use water mist and other suitable methods to limit spread of dust and dirt. Comply with governing environmental-protection regulations. Do not use water when it may damage adjacent construction or create hazardous or objectionable conditions, such as ice, flooding, and pollution.

C. Explosives: Use of explosives is not permitted.

3.6 DEMOLITION BY MECHANICAL MEANS

A. Salvage: Items to be removed and salvaged are indicated below:

1. Donor paving bricks

B. Below-Grade Construction: Remove or abandon foundation walls and other below-grade construction as indicated on drawings. Cut below-grade construction to a minimum of 18” below finished grade.

C. Existing Utilities: Remove or abandon existing utilities and below-grade utility structures as indicated on drawings.

3.7 SITE RESTORATION

A. Below-Grade Areas: Rough grade below-grade areas ready for further excavation or new construction.

B. Below-Grade Areas: Completely fill below-grade areas and voids resulting from building demolition operations according to backfill requirements in Section 31 2000 "Earthwork."

C. Site Grading: Uniformly rough grade area of demolished construction to a smooth surface, free from irregular surface changes in preparation of new sitework.

3.8 REPAIRS

A. Promptly repair damage to adjacent buildings caused by demolition operations.

3.9 DISPOSAL OF DEMOLISHED MATERIALS

A. Remove demolition waste materials from Project site and recycle or dispose of them according to Section 01 7419 "Construction Waste Management and Disposal."

1. Do not allow demolished materials to accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

B. Do not burn demolished materials.

3.10 CLEANING

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

1. Clean roadways of debris caused by debris transport.

END OF SECTION 02 4116

SECTION 03 3200

SITE CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.1 SUMMARY

A. Section includes

1. Site cast-in-place concrete, including but not necessarily limited to, sidewalks, ramps, driveways, curbing, pads, bases, retaining walls, and thrust blocks.

2. All facilities, labor, materials, tools, equipment, appliances, transportation, supervision, and related work necessary to complete the Work shown on the Drawings and as specified herein.

B. Contractor shall coordinate work between all Contractors, sections, and trades required for the proper completion of the work.

C. Contractor is responsible for all health and safety.

1.2 REFERENCES

A. Reference herein to any technical society, organization, group or regulation are made in accordance with the following abbreviations and, unless otherwise noted or specified, all work under this Section shall conform to the latest edition as applicable.

B. Code of Federal Regulations (CFR).

1. 29 CFR 1926, Safety and Health Regulations for Construction.

C. ASTM International (ASTM)

1. ASTM A615 – Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.

2. ASTM A706 – Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement

3. ASTM A767 – Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement

4. ASTM A775 – Standard Specification for Epoxy-Coated Steel Reinforcing Bars.

5. ASTM A996 – Standard Specification for Rail-Steel and Axle-Steel Deformed Bars or Concrete Reinforcement.

6. ASTM A1064 – Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.

7. ASTM C29 – Standard Test Method for Bulk Density (“Unit Weight”) and Voids in Aggregate

8. ASTM C31 – Standard Practice for Making and Curing Concrete Test Specimens in the Field.

9. ASTM C33 – Standard Specification for Concrete Aggregates.

10. ASTM C39 – Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.

11. ASTM C42 – Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.

12. ASTM C70 – Standard Test Method for Surface Moisture in Fine Aggregate.

13. ASTM C94 – Standard Specification for Ready-Mixed Concrete.

14. ASTM C117 – Standard Test Method for Materials Finer than 75-um (No. 200) Sieve in Mineral Aggregates by Washing.

15. ASTM C127 – Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Coarse Aggregate.

16. ASTM C128 – Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Fine Aggregate.

17. ASTM C136 – Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.

18. ASTM C138 – Standard Test Method for Density (“Unit Weight”), Yield, and Air Content (Gravimetric) of Concrete.

19. ASTM C143 – Standard Test Method for Slump of Hydraulic-Cement Concrete.

20. ASTM C150 – Standard Specification for Portland Cement.

21. ASTM C156 – Standard Test Method for Water Retention by Concrete Curing Materials.

22. ASTM C171 – Standard Specification for Sheet Materials for Curing Concrete.

23. ASTM C172 – Standard Practice for Sampling Freshly Mixed Concrete.

24. ASTM C173 – Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.

25. ASTM C192 – Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory.

26. ASTM C231 – Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.

27. ASTM C233 – Standard Test Method for Air-Entraining Admixtures for Concrete.

28. ASTM C260 – Standard Specification for Air-Entraining Admixtures for Concrete.

29. ASTM C309 – Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.

30. ASTM C311 – Standard Methods of Sampling and Testing Fly Ash and Natural Pozzolans for Use as a Mineral Admixture in Portland Cement Concrete.

31. ASTM C387 – Standard Specification for Packaged, Dry, Combined Materials for Mortar and Concrete.

32. ASTM C494 – Standard Specification for Chemical Admixtures for Concrete.

33. ASTM C566 – Standard Test Method for Total Evaporable Moisture Content of Aggregate by Drying.

34. ASTM C595 – Standard Specification for Blended Hydraulic Cements.

35. ASTM A615 – Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.

36. ASTM C618 – Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.

37. ASTM C685 – Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing.

38. ASTM C171 – Standard Specification for Sheet Materials for Curing Concrete.

39. ASTM C803 – Standard Test Method for Penetration Resistance of Hardened Concrete.

40. ASTM C920 – Standard Specification for Elastomeric Joint Sealants.

41. ASTM C979 – Standard Specification for Pigments for Integrally Colored Concrete.

42. ASTM C989 – Ground Granulated Blast-Furnace Slag for Use in Concrete Mortars.

43. ASTM C1064 – Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete.

44. ASTM A1078 – Standard Specification for Epoxy-Coated Steel Dowels for Concrete Pavement.

45. ASTM D1751 – Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).

46. ASTM D1752 – Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction.

47. ASTM D2628 – Standard Specification for Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements.

48. ASTM D4397 – Standard Specification for Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications.

49. ASTM D5249 – Standard Specification for Backer Material for Use with Cold- and Hot-Applied Joint Sealants in Portland-Cement Concrete and Asphalt Joints.

50. ASTM D5893 – Standard Specification for Cold Applied, Single Component, Chemically Curing Silicone Joint Sealant for Portland Cement Concrete Pavements.

51. ASTM E329 – Standard Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction.

D. Concrete Reinforcing Steel Institute (CRSI).

1. CRSI Manual of Standard Practice, latest edition.

E. State of Connecticut

1. 2018 Connecticut State Building Code, including all Amendments, Supplements, and Errata.

F. American Concrete Institute (ACI)

1. ACI 224R – Control of Cracking on Concrete Structures.

2. ACI 224.3R – Joints in Concrete Construction.

3. ACI 301 – Specifications for Structural Concrete.

4. ACI 302.1R – Guide for Concrete Floor or Slab Construction.

5. ACI 304R – Guide for Measuring, Mixing, Transporting, and Placing Concrete.

6. ACI 305R – Guide to Hot Weather Concreting.

7. ACI 306R – Guide to Cold Weather Concreting.

8. ACI 308R – Guide to Curing Concrete.

9. ACI 318-14 - Building Code Requirements for Structural Concrete

10. ACI 318R-14 - Commentary on Building Code Requirements for Structural Concrete

G. American Welding Society (AWS).

1. AWS A5.1/A5.1M (2004; Errata 2004) Carbon Steel Electrodes for Shielded Metal Arc Welding.

2. AWS D1.4/D1.4M (2005; Errata 2005) Structural Welding Code – Reinforcing Steel.

1.3 SUBMITTALS

A. Sampling and Testing Laboratory – Submit name and qualifications of commercial sampling and testing laboratory for Engineer's approval. Submit applicable documentation of credentials, licenses, etc.

B. Testing Agency – Submit name and qualifications of third-party in-field quality control Testing Agency for Engineer's approval. Submit applicable documentation of credentials, licenses, etc.

C. For each type of specially furnished concrete provide a description of methods and the sequence of placement.

D. Manufacturer's catalog data for the following items shall include printed instructions for admixtures, bonding agents, epoxy-resin adhesive binders, waterstops, and liquid chemical hardeners:

1. Concrete Aggregates.
2. Portland Cement.
3. Ready-Mix Concrete.
4. Form Facing Materials.
5. Reinforcement Materials.
6. Joint Materials.
7. Water-Vapor Barrier Subgrade Cover.
8. Bonding Materials.
9. Finish Materials.
10. Concrete Curing Materials.
11. Form release agent.
12. Concrete coloring additive.
13. Elastomeric joint sealant.
14. Preformed joint filler

E. Submit samples of the following:

1. Preformed joint filler.
2. Manufacturer's color charts showing full range of colors available.
3. Cured samples of elastomeric join sealants in the color(s) selected.

F. Design Data

1. Mix Design data for each class of Ready-Mix Concrete shall be submitted at least 15 calendar days prior to start of specified work.
2. Mix Design data for each type of integrally-colored concrete mix called-for shall be submitted at least 15 calendar days prior to start of specified work.

G. Test Reports

1. Submit test reports for all testing conducted under this Section.

H. Certificates

1. Submit certificates for the following:

a. Concrete Design Mixes.

b. Concrete Aggregates.

c. Welding Procedures. Welding Procedures shall be in accordance with AWS D1.4/D1.4M. Certificates for Welder Qualifications shall be in accordance with the paragraph entitled, “Qualifications for Welding Work,” of this section.

d. Mill certificates for Steel Bar.

2. Certificates for concrete shall contain project name, title/number, date, name of Contractor, name of concrete testing service, source of concrete aggregates, material manufacturer, brand name of manufactured materials, material name, values as specified for each material, and test results.

I. Manufacturer’s Instructions

1. Installation instructions shall indicate the manufacturer’s recommended method and sequence of installation for the following items:

a. Admixtures

b. Bonding Materials

c. Waterstops

d. Liquid Chemical Hardener

J. Joint Plan

1. Prior to initiation of concrete flatwork, submit proposed Construction Joint plan to Engineer for review and approval. Coordinate such plan with the joint patterns depicted on the Drawings.

K. Delivery Tickets: Ready-mixed concrete manufacturer shall provide delivery tickets with each load of concrete delivered to the Project Site. Delivery tickets shall provide the following information:

1. Project name printed on ticket.

2. Name of producer, identification of plant.

3. Date and time of day.

4. Type of material.

5. Cubic yards of material loaded into truck.

6. Project number, purchase order number, name of Contractor (if Contractor other than producer).

7. Truck number for specific identification of truck.

8. Individual aggregate, cement, water weights (masses) and any admixtures shall be printed on plant tickets.

9. Water/cement ratio.

10. Additional water allowance in gallons based on water/cement ratio for mix.

1.4 QUALITY ASSURANCE

A. Dimensions, locations, and details of equipment pads, anchors, supports, and similar features indicated on the Drawings are approximate. Manufacturer's approved shop drawings of equipment to be supported, anchored, or contained thereby shall be consulted for exact location, size and details.

B. Obtain each specified material from same source and maintain high degree of consistency in workmanship throughout Project.

C. Use adequate numbers of skilled workmen who are trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and methods required for proper performance of the work in this Section. Use equipment of adequate size, capacity and quantity to accomplish the work of this Section in a timely manner.

D. Welder qualifications: Welder qualifications shall be verified in accordance with AWS D1.4/D1.4M or under an equivalent qualification test approved in advance. Welders shall be permitted to do only the type of welding for which each is specifically qualified.

E. Concrete testing: Concrete testing shall be performed by an approved Testing Agency/Testing Laboratory experienced in sampling and testing of concrete. Testing Agency/Testing Laboratory shall meet the requirements of ASTM E329.

1.5 MOCKUPS

A. Where mockups are called-for, comply with the following:

1. At location on the Project Site selected by Engineer, place and finish 100 square foot mockup section for examination. Mockup to be constructed by the installer who will actually perform the work for the Project.

2. For accurate color, the quantity of concrete mixed to produce the sample should not be less than 3 cubic yards (or not less than 1/3 the capacity of the mixing drum on the ready-mix truck) and should always be in full cubic yard increments. Excess material shall be discarded according to local regulations.

3. For colored concrete, record the amount of integral colorant, dray colorant, or chemical stain needed per square foot of application to establish coverage rates for the work.

4. Construct mockup using processes and techniques intended for use on permanent work, including curing procedures. Include samples of control construction, and expansion joints in sample panels.

5. Retain samples of cements, sands, aggregates and color additives used in mockup for comparison with materials used in remaining work.

6. Accepted mockup provides visual standard for all work.

7. Mockup shall remain through completion of work for use as a quality standard for finished work.

8. Provide suitable protections to preclude damage to mockup.

9. Remove mockup when directed.

1.6 TESTING

A. Quality control testing during construction shall be the responsibility of Contractor via Testing Agency and Testing Laboratory as applicable. Contractor shall retain and pay for the services of such Testing Agency/Testing Laboratory to perform all testing in accordance with applicable standards.

B. Owner will retain a testing entity to perform observation and testing of the work under this Section. The testing entity's presence does not constitute supervision or direction of Contractor's work. Neither the presence of the testing entity nor any observations and testing performed by him, nor any notice or failure to give notice shall excuse Contractor from conformance with these Specifications or from defects discovered in his work.

C. Testing shall include sampling and testing concrete materials proposed for use in the work and testing the design mix for each class of concrete.

D. Tests will be required to determine whether the concrete being produced complies with the standard of quality and strength as specified.

E. Additional Tests: Additional testing of in-place concrete shall be conducted when test results indicate that specified concrete strengths and other characteristics have not been attained. Additional testing shall consist of cored cylinders to determine adequacy of concrete or other non-destructive testing methods that may be approved by Engineer. Contractor shall pay for all such additional testing. Any holes made shall be patched by the Contractor at their expense.

F. Testing Standards

1. Sampling: ASTM C172. Collect samples of fresh concrete to perform tests specified.

2. Concrete aggregate materials proposed for use in the work shall be sampled and tested in accordance with ASTM C33.

3. Portland Cement shall be sampled and tested in accordance with ASTM C150.

4. Slump Tests: ASTM C143. Take concrete samples during concrete placement. The maximum slump may be increased as specified with the addition of an approved admixture provided that the water-cement ratio is not exceeded.

   a. Frequency: Perform tests at commencement of concrete placement, when test cylinders are made, and for each batch (minimum) or every 20 cubic yards (maximum) of concrete unless otherwise specified or called-for.

5. Air Content: ASTM C231 (primary method) or ASTM C173 (secondary method).

   a. Frequency: Test air-entrained concrete for air content at the same frequency as specified for slump tests.

6. Temperature Tests: ASTM C1064.

a. Frequency: Test the concrete delivered and the concrete in the forms. Perform tests in hot or cold weather conditions (below 50 degrees F and above 80 degrees F) for each batch (minimum) or every 20 cubic yards (maximum) of concrete, unless otherwise specified or called-for, until the specified temperature is obtained, and whenever test cylinders and slump tests are made.

7. Compressive Strength Tests: ASTM C39. Make five test cylinders for each set of tests in accordance with ASTM C31. Take precautions to prevent evaporation and loss of water from the specimen. Test two cylinders at 7 days, two cylinders at 28 days, and hold one cylinder in reserve.

a. Frequency: Samples for strength tests of each mix design (class) of concrete placed each day shall be taken not less than once a day, nor less than once for each 150 cubic yards of concrete, nor less than once for each 5,000 square feet of surface area for slabs (including walks and sidewalks) or walls.

b. Standard: Each strength test result must be the average of two cylinders from the same concrete sample tested at 28 days. If the average of any three consecutive strength test results is less than f′c or if any strength test result falls below f′c by more than 450 psi, take a minimum of three cored cylinder samples from the in-place work represented by the low-test cylinder results and test. Concrete represented by core test is considered structurally adequate if the average of three cores is equal to at least 85 percent of f′c and if no single core is less than 75 percent of f′c. Retest locations represented by erratic core strengths. Remove concrete not meeting strength criteria and provide new acceptable concrete. Repair core holes with nonshrink grout. Match color and finish of adjacent concrete

8. Cored cylinders: ASTM C42.

9. Penetration: ASTM C803.

G. Concrete Replacement: Failure of any test or to follow proper installation procedures will require that the concrete be removed and properly replaced at the Contractor’s expense.

1.7 DELIVERY, STORAGE AND HANDLING

A. Schedule delivery of concrete to provide consistent mix times from batching until discharge. Mix times shall meet manufacturers’ written recommendations.

B. Packaged materials shall be delivered to the project site in their original, unopened package or container bearing label clearly identifying manufacturer’s name, brand name, material, weight or volume, and other pertinent information. Packaged materials shall be stored in their original, unbroken package or container in a weather-tight and dry place until ready for use in the work.

C. Unpackaged aggregates shall be stored to avoid excessive segregation, contamination with other materials or other size aggregates, or freezing.

D. Reinforcement and other metal items shall be protected from corrosion and shall be kept free from ice, grease, and other coatings that would destroy or reduce bond.

E. Colored Admixture: Comply with manufacturer’s instructions. Deliver colored admixtures in original, unopened packaging. Store in dry condition.

1.8 PROJECT CONDITIONS

A. Pre-Job Conference

1. One week prior to placement of concrete, Contractor shall coordinate and host a coordination meeting to discuss concrete application schedule, materials, and methods.

B. Environmental Requirements

1. Avoid placing concrete if rain, snow, or frost is forecast within 24-hours.

2. Protect fresh concrete from rain, moisture, and freezing.

3. Schedule placement to minimize exposure to wind and hot sun before curing materials are applied.

PART 2 PRODUCTS

2.1 PORTLAND CEMENT

A. Cement: ASTM C150. One brand and type of cement shall be used for formed concrete having exposed-to-view finished surfaces.

B. Unless otherwise specified, cement shall be Type IA.

2.2 READY-MIX CONCRETE

A. Ready Mix Concrete: Portland Cement Concrete, air-entrained, ASTM C94.

1. Compressive Strength:

a. Unless otherwise indicated, minimum compressive strength at 28 days shall be 4,000 psi minimum.

b. Sidewalks, stairs and landings, pedestrian and vehicle ramps, and curbing: Minimum compressive strength at 28 days shall be 4,400 psi minimum.

2. Water/cement ratio: Maximum 0.45.

3. Air content by volume: 6 percent ± 1 percent, ASTM C231 (primary method) or ASTM C173 (secondary method).

4. Slump: no less than 2 inches, not greater than 4 inches, ASTM C143.

5. Standard Color: Natural light grey.

B. Aggregate

1. Coarse aggregate: ASTM C33. Broken stone or gravel consisting of clean durable fragments of uniform quality throughout. It shall be free from soft, disintegrated pieces, mud, dirt, organic or other injurious material. Coarse aggregate of a size retained on a 1-inch square opening sieve shall not contain more than 8% of flat or elongated pieces, whose longest dimension exceeds five times their maximum thickness.

2. Fine aggregate: ASTM C33. Sand consisting of clean, hard, durable, uncoated particles of quartz or other rock, free from lumps of clay, soft or flaky material, loam, organic or other

injurious material. Fine aggregate shall contain not more than 3% of material finer than a #200 sieve, ASTM C117.

C. Water: Potable quality.

D. Admixtures

1. Concrete shall contain a water reducing agent, ASTM C494, to minimize cement and water content of the concrete mix at the specified slump.

2. Air-Entraining Admixtures: ASTM C260.

3. Pozzolan: Fly ash or other pozzolans used as admixtures shall conform to ASTM C618, Class C or Class F with 4 percent maximum loss on ignition. Pozzolan may be used to replace a maximum of 15 percent (15 %) of cement by weight.

4. No calcium chloride or admixtures containing calcium chloride shall be added to the concrete. No admixtures other than those specified shall be used in the concrete without the specific written permission of Engineer in each case.

2.3 FORMS

A. Forms shall be substantially built and adequately braced so as to withstand the liquid weight of concrete without deforming. All linings, studding, walling and bracing shall be such as to prevent bulging, spreading, or loss of true alignment while pouring and displacement of concrete while setting.

B. All edge forms for sidewalk pavements, curbs and gutters shall be of sufficient rigidity and adequately braced to accurately maintain line and grade. Form work shall be designed so that sections may be fastened together to prevent vertical or horizontal movement of ends.

C. Forms for curved sections shall be so constructed and placed that the finish surface of walls and edge of sidewalks, curbs and gutters will not deviated appreciably from the arc of the curve.

D. Exposed vertical and horizontal edges of the concrete in structures shall be chamfered as indicated on the Drawings by the placing of moldings in the forms.

E. Forms for Exposed Finish: Plywood, metal, metal-framed plywood faced, or other acceptable panel materials. Form work materials shall produce a smooth, continuous, straight, and level surface.

1. Plywood shall be APA A-A, A-B or A-C, Class 1, Exterior Grade. Thickness shall be as required to prevent movement or deformation but shall not be less than 5/8″ thick.

F. Forms for Non-Exposed Finish: Plywood, metal, metal-framed plywood faced, or other acceptable panel materials. Form work materials shall produce a generally smooth, continuous, straight, and level surface. Grain patterns or similar imperfections are acceptable. Lumber shall be dressed on at least two edges and one side.

1. Plywood shall be at least B-B, Class 1, Exterior Grade. Thickness shall be as required to prevent movement or deformation but shall not be less than 5/8″ thick.

G. Cylindrical Forms: Wax-impregnated strippable fiber forms or plastic, ABS or PVC, forms.

H. Form Ties: Provide prefabricated, adjustable length galvanized steel snap-off ties, with brackets, cones, corner locks and other accessories as necessary.

I. Form Release Agent: Commercial formulation compounds that will not bond with, stain or adversely affect concrete.

2.4 REINFORCEMENT MATERIALS

A. Reinforcing Bars: ASTM A615, Grade 60 unless otherwise indicated.

B. Galvanized Reinforcing Bars: ASTM A767, Class II with galvanizing before fabrication.

C. Weldable Reinforcing Bars: ASTM A706, Grade 60 unless otherwise indicated. Maximum carbon content shall be 0.55 percent.

D. Epoxy-Coated Reinforcing Bars: ASTM A775, Grade 60 unless otherwise indicated.

E. Steel Wire: ASTM A82, 16 gauge or heavier black annealed wire.

1. Ties for epoxy-coated bars shall be vinyl-coated or epoxy-coated.

2. Ties for zinc-coated bars shall be zinc-coated.

F. Welded Wire Reinforcement (WWR)

1. Sidewalks: Plain wire, ASTM A1064 as indicated on the Drawings.

2. Concrete Pavement: Plain wire, ASTM A1064 as indicated on the Drawings.

G. Supports for Reinforcement

1. Supports shall include bolsters, chairs, spacers, and other devices necessary for proper spacing, supporting, and fastening reinforcing bars and wire reinforcement in-place. Conform with CRSI Manual of Standard Practice for corrosion-resistant, plastic-protected wire, epoxy-coated, or stainless-steel supports.

2. For exposed-to-view concrete surfaces and where support legs are in contact with forms, provide supports with plastic protection (CRSI, Class1) or stainless steel protection (CRSI, Class 2).

H. Dowel Bars: Plain (smooth) high-chrome steel bar, ASTM A615 Grade 60 with full-length plastic sleeve as a combined unit, dimensions as indicated on the Drawings.

1. Where epoxy-coated dowels are called for: ASTM A1078.

I. Bar/Dowel Adhesive: Two component (1:1 ratio), 100% solids, high modulus, moisture-insensitive structural epoxy gel designed specifically for bonding bars, dowels, and bolts in concrete.

2.5 JOINT MATERIALS

A. Preformed Joint Filler Strips, Sidewalks and Concrete Paving.

1. Where no joint sealant is called-for: Nonextruding and resilient bituminous type conforming to ASTM D1751, 1/2-inch-thick, one piece for the full depth and width of the joint.

2. Where joint sealant is called-for: Nonextruding and resilient nonbituminous type conforming to ASTM D1752, Type I (sponge rubber) or Type II (cork), 1/2 inch thick, allowance for sealant at top and extending for the full depth and width of the joint.

B. Preformed Joint Filler Strips, General Use/Isolation Joints

1. Polyethylene, closed-cell expansion joint filler, ASTM D4819, Type II.

C. Joint Sealant Compound, ASTM C920

1. Self-Leveling (Type SL; Grade “P”)

a. Cold-applied and self-leveling, Type S or Type M elastomeric polymer sealant.

2. Gun-Grade (Non-Sage; Grade “NS”)

a. One-component (Type S) high-performance moisture-curing polyurethane sealant specifically formulated for bonding to masonry and concrete.

3. Traffic Bound areas: T sealant.

4. Non-Traffic Bound areas: NT sealant.

5. Color: As approved by Engineer.

6. Backer material: ASTM D5249, closed cell.

2.6 DETECTABLE WARNING PANEL

A. Surface-mount, UV-stabilized, polymer composite panel as indicated on the Drawings. Fasteners, adhesives, and sealants per manufacturer’s requirements. Panel shall comply with Connecticut Building Code/ADA Guidelines.

1. Color: As approved by Engineer.

B. Duralast Detectable Warning Plate with Black Asphaltic Coating, Product Number 00700570 as manufactured by East Jordan Iron Works, 301 Spring Street, East Jordan, MI or approved equal.

2.7 CONCRETE BONDING MATERIALS

A. Aqueous-phase, film-forming, nonoxidizing, freeze and thaw-resistant compound suitable for brush or spray application conforming to ASTM C932.

B. Epoxy-Resin Adhesive Binder: Two-component, penetrating high solids, epoxy-based primer/bond coat, 100% solids, moisture-tolerant, ASTM C881, Types I, II, and V, Grade-2, Class C and AASHTO M-235.

2.8 CONCRETE CURING MATERIALS

A. Curing shall be by moist curing (preferred) or by use of curing compound. Sodium Silicate curing compounds shall be used where required by the weather, approved construction schedules and construction that is not adaptable to damp curing.

B. Curing compound shall be a resin-base, white pigmented compound, ASTM C309, Type 2.

C. Curing compounds shall contain a fugitive dye or when hot weather conditions dictate, a fugitive heat reflecting pigment.

D. Moisture-Retaining Cover:

1. Waterproof paper, ASTM C171, regular or white.

2. Polyethylene sheeting, ASTM C171.

3. Polyethylene-coated burlap consisting of a laminate of burlap and a white opaque polyethylene film permanently bonded to the burlap. Burlap: ASTM C171, Class 3. Polyethylene film: ASTM C171.

4. When tested for water retention in accordance with ASTM C156, weight of water lost 72 hours after application of moisture retaining covering material shall not exceed 0.039 gram per square centimeter of the mortar specimen surface.

E. Water: Potable Quality.

F. Membrane-Forming Curing Compound

1. Liquid type, ASTM C309, Type 1, clear, Type 2, white, pigmented.

2.9 BOND BREAKER

A. Asphalt felt conforming to ASTM D2626, Type I or 6-mil polyethylene sheeting, ASTM D4397.

2.10 SEALER

A. Consolideck® Saltguard® silane/siloxane water repellent and chloride screen as manufactured by Prosoco, Inc., 3741 Greenway Circle, Lawrence, KS 66046, or approved equal. Gloss or flat sealer type as selected by Owner.

PART 3 EXECUTION

3.1 GENERAL

A. Verify site conditions before proceeding with the work. Field check the accuracy of the Drawings and inspect structures, utilities, and other site features prior to start of work and notify Engineer in writing, of any hazardous conditions and/or discrepancies.

B. Provide construction techniques in accordance with applicable provisions of ACI 224R, ACI 224.3R, and ACI 302.1R-04.

C. Engineer shall be notified of concrete placement sufficiently in advance of start of operation to allow their representative to complete preliminary inspection of the Work, including subgrade, forms, and reinforcing steel, if used.

D. Adjacent work, etc., shall be protected from stain and damage during entire operation. Damaged and stained areas shall be replaced or repaired to equal their original conditions at the contractor's expense. No concrete walks shall be poured after 12 noon unless a guard is visibly stationed nearby to prevent graffiti. Contractor shall be responsible for replacing any graffiti if he fails to provide adequate protection.

E. Concrete surface shall be protected from traffic or damage until surfaces have hardened sufficiently. If necessary, 1/2-inch thick plywood sheets shall be used to protect exposed surfaces.

F. Retempering of concrete is not permitted.

G. Contractor is responsible for the protection and resetting of all existing utility covers/castings to finish grade; as well as, setting all new utility covers/castings to finish grade prior to placement of concrete. The repair of any settlement, or protrusion above finish grade, shall be the responsibility of Contractor at no additional cost to Owner.

3.2 PREPARATION OF SUBGRADE

A. Compact and bring area to required subgrade elevation in accordance with Section 31 2310 – Earthwork. Provide for final fine grading, and compaction of areas as required to form a firm, uniform, accurate and unyielding subgrade at required elevations and to required lines.

B. Existing subgrade material, which will not readily compact as required, shall be removed and replaced with satisfactory materials in accordance with Section 31 2310 – Earthwork.

C. Subgrade of areas to receive concrete shall be recompacted as required to bring the top 8 inches of material, immediately below the base course, to a compaction at optimum moisture content of at least 95 percent (95%) of maximum density, as determined by ASTM D1557. Subgrade compaction shall extend for a distance of at least 1 foot beyond pavement edge.

D. Materials shall not be stored or stockpiled on subgrade.

E. Disposal of debris and other material excavated under this section, and material unsuitable for, or in excess of requirements for, completing work of this section shall be disposed of off-site.

F. Prepared subgrade shall be inspected and approved by Engineer Representative before installation of the gravel base course. Disturbance to subgrade caused by inspection procedures shall be repaired under this Section of the Specification.

3.3 AGGREGATE BASE COURSE

A. Prepare aggregate base course for concrete in accordance with Section 31 2310 – Earthwork and as shown on the Drawings.

B. Width of base course shall be greater than or equal to the width of concrete surface, if continuous lateral support is provided during rolling. The width of base course shall extend at least 2 x base thickness beyond the edge of the course above, if it is not so supported.

C. Aggregate shall be applied in lifts less than or equal to 6 inches thick, compacted measure. Each lift shall be separately compacted to specified density.

1. Material shall be placed adjacent to wall, manhole, catch basin, and other structures only after they have been set to required grade and level.

2. The base shall be wetted and rolled or tamped after the spreading of each lift.

3. Rolling shall begin at the sides and progress to the center of crowned areas, and shall begin on the low side and progress toward the high side of sloped areas. Rolling shall continue until material does not creep or wave ahead of roller wheels.

4. Surface irregularities, which exceed 1/2-inch, as measured by means of a 10-foot long straightedge, shall be replaced and properly re-compacted.

D. Density: Base course shall be compacted at optimum moisture content to not less than 95 percent of maximum density as determined by ASTM D1557.

E. Subgrade and base course shall be kept clean and uncontaminated. Less select materials shall not be permitted to become mixed with gravel. Materials spilled outside pavement lines shall be removed and the area repaired.

F. Portions of subgrade, or of construction above, which become contaminated, softened, or dislodged by the passing of traffic, or otherwise injured, shall be cleaned, replaced, or otherwise repaired to conform to the requirements of this specification before proceeding with the next operation.

3.4 FORMS

A. Forms shall be securely staked, braced and held firmly to the required line and grade and shall be sufficiently tight to prevent leakage of mortar. All forms shall be cleaned and oiled or wetted before concrete is placed against them.

B. Assemble formwork to permit easy stripping and dismantling without damaging concrete.

C. Complete and approve formwork. Remove debris and foreign material from interior of forms before start of concrete placing.

D. Set edge forms or bulkheads and intermediate screed strips for slabs to obtain indicated elevations and contours in finished slab surface and must be strong enough to support vibrating bridge screeds or roller pipe screeds if nature of specified slab finish requires use of such equipment. Align concrete surface to elevation of screed strips by use of strike-off templates or approved compacting-type screeds.

E. The maximum cross slope for sidewalks shall be 2.0 percent, sloped towards the gutter. Verify formwork prior to concrete placement. Make corrections as required and bring discrepancies to attention of Engineer.

3.5 JOINTS

A. Locate joints as located on the Drawings, as shown on Engineer-approved joint plan. Conform with applicable sections of ACI 224.3R.

B. Construction Joints: Effected at the end of a pour, lift, or at the end of a day's concrete placement. This type of joint is a plane surface between two distinct sections of concrete.

1. Construction Joints shall be ½ inch wide and full-depth of slab.

2. Joint filler: Unless otherwise specified, Construction Joints shall be constructed with joint filler. Joint filler shall extend the full depth of the slab and shall extend the full length of the joint. Use of multiple pieces of joint material of lesser dimensions to make up required depth and width of joint will not be permitted.

3. Where joints are to receive filler, recess joint filler 1/4-inch below finish surface or as otherwise indicated on the Drawings.

4. Where called-for on the Drawings, install dowels at Construction Joints.

C. Isolation Joints: Installed at intersections of structures on any type including but not limited to buildings, walks with steps, pre-cast concrete curb, light foundations, walls, pads, slabs at footings, or other structures. Isolation Joints shall not be required where concrete flatwork abuts granite curbing.

1. Isolation Joints shall be ½ inch wide.

2. Joint Filler: All Isolation Joints shall be constructed with joint filler. Joint filler shall extend the full depth of the slab and shall extend the full length of the joint. Use of multiple pieces of joint material of lesser dimensions to make up required depth and width of joint will not be permitted.

3. Where joints are to receive filler, recess joint filler 1/4-inch below finish surface or as otherwise indicated on the Drawings.

D. Control/Contraction Joints: Installed to form a weakened plane in a concrete member to provide a reduction in member thickness for the purpose of controlling shrinkage stresses to that specific area. Control/Contraction Joints shall be synonymous with “Dummy Joints.”

1. Control/Contraction Joints shall be tooled or saw-cut.

a. Tooled joints: Tool-form joint into the concrete 1 inch in depth, but in no case less than 25 percent of slab depth. Joint width shall be 1/4-inch. Each side of tooled joint shall be dressed to match final overall slab finish. Joint shall be made after concrete is finished and when the surface is stiff enough to support the weight of workmen without damage to the slab, but before the slab has achieved its final set.

1) Where tooled joints are to receive joint sealant, provide 1/2-inch wide tooled joint and install backer rod material to create 1/4-inch recess below finished surface.

b. Saw-cut joints: Saw-cut joint into concrete 1 inch in depth, but in no case less than 25 percent of slab depth. Joint width shall be 1/8-inch. Cut joint using rotary saw within 4 to 12 hours after the concrete has been finished.

3.6 STEEL REINFORCEMENT

A. Install steel reinforcement as shown on the Drawings in accordance with ACI 318.

B. Before being placed in position, reinforcing shall be thoroughly cleaned of loose mill and rust scale, dirt, ice, and other foreign material, which may reduce the bond between the concrete and reinforcing. Where there is a delay in placing concrete after reinforcement is in place, reinforcement shall be re-inspected and cleaned when necessary.

C. Welded Wire Reinforcement

1. Where WWR is called-for, install material in the upper 30 to 40 percent (30%–40%) of the overall slab thickness, or at the nearest depth below top of slab as required to achieve a minimum of 2-inches of cover.

2. Adjacent sheets of welded wire reinforcement shall lap 6 inches.

D. Reinforcing bar

1. Any bar showing cracks after bending shall be discarded.

2. Minimum Cover: 2 inches, except where concrete is cast against and permanently exposed to earth minimum cover shall be 3 inches.

3. For slab-type construction, reinforcing bars shall be elevated off the base material by use of supports as specified herein.

4. Adjacent reinforcement bars shall lap a distance equivalent to 40 bar diameters. All laps shall be tied.

E. Joints

1. Construction Joints: Reinforcement shall not continue through construction joints. Allow for 2-inches of cover at end of slab. Where called-for on the Drawings, install pins at Construction Joints per detail.

2. Isolation Joints/Expansion Joints: Allow for 2-inches of cover at end of slab.

3. Control/Contraction Joints: Cut at least one-half of reinforcement at joints.

F. Reinforcing shall be securely wired in the position called for, and shall be maintained in that position until concrete is placed and compacted.

3.7 PLACEMENT

A. Before placing concrete, forms and the space to be occupied by the concrete shall be thoroughly cleaned, and reinforcing steel and embedded metal shall be free from dirt, oil, mill scale, loose rust, paint, and other material which might tend to reduce bond.

B. Existing concrete, earth, forms, and other water-permeable material against which new concrete is to be placed and shall be thoroughly damp when concrete is placed. There shall be no free water on the surface.

C. Concrete shall arrive at the job site in a timely manner so that no additional water will be required to produce the desired slump. When conditions develop that require the addition of water to produce the desired slump, permission of the Engineer must be obtained. The concrete shall be transported from the mixer to its place of deposit by a method that will prevent segregation or loss of material.

D. Concrete, which has set, or partially set, before placement shall not be employed.

E. Existing concrete, earth, and other water-permeable material against which new concrete is to be placed shall be thoroughly damp when concrete is placed. There shall be no free water on surface.

F. Concrete shall be thoroughly spaded and tamped to secure a solid and homogeneous mass, thoroughly worked around reinforcement and into corners of forms.

G. When joining fresh concrete to concrete which has attained full set, the latter shall be cleaned of foreign matter, and mortar scum and laitance shall be removed by chipping and washing. Clean, roughened base surface shall be saturated with water, but shall have no free water on surface. A coat of 1:1 cement-sand grout, approximately 1/8-inch thick shall be well scrubbed

into thoroughly dampened concrete base. New concrete shall be placed immediately, before grout has dried or set.

3.8 FINISHING

A. Concrete flatwork surfaces shall be screened off and finished true to line and grade, and free of hollows and bumps. Surface shall be dense, smooth, and at exact level and slope required.

1. Finished concrete surface for concrete subbase shall be woodfloated to a slightly rough surface. Surface shall not deviate more than 1/4-inch in 10 feet.

2. Finished concrete surface for concrete pavement, walks, and pads shall be wood-floated and steel troweled to a smooth surface. Surface shall not deviate more than 1/8-inch in 10 feet.

B. Unless otherwise indicated, horizontal surfaces of concrete surfaces, which will be exposed, shall be given a light broomed finish, with direction of grooves in concrete surface perpendicular to length of concrete band, slab or pad. After concrete has set sufficiently to prevent coarse aggregate from being torn from the surface, but before it has completely set, brooms shall be drawn across it to produce a pattern of small parallel grooves. Broomed surface shall be uniform, with no smooth, unduly rough or porous spots, or other irregularities. Coarse aggregate shall not be dislodged by the brooming operation.

C. Immediately following finishing operations, arises at edges and both sides of expansion joints shall be rounded to a ¼ inch radius. Control joints to be tooled shall be scored into slab surface with scoring tool. Adjacent edges of control joint shall be same time be finished to a ¼ inch radius.

D. Where finishing is performed before the end of the curing period, concrete shall not be permitted to dry out, and shall be kept continuously moist from time of placing until end of curing period, or until curing membrane is applied.

3.9 CURING

A. Cure in accordance with ACI 308R.

B. Concrete shall be kept continuously damp from time of placement until the end of the specified curing period.

C. Water shall not be applied to curing concrete within 24 hours after initial placement. Any water shall be applied only to maintain damp conditions. Do not add water during floating and troweling operations.

D. Between finishing operations, the surface shall be protected from rapid drying by covering with a material specified herein. Surface shall be damp when the covering is placed over it, and shall be kept damp by means of fine-spray of water, applied as often as necessary to prevent drying after the initial 24-hour cure period.

E. Concrete surfaces shall be cured by completely covering them with curing paper or an application of a curing compound.

1. Concrete cured using waterproof paper shall be completely covered with paper with seams lapped and sealed with tape. Concrete surface shall not be allowed to become moistened between 24 and 36 hours after placing concrete. During curing period surface shall be

checked frequently, and sprayed with water as often as necessary to prevent drying, but not earlier than 24 hours after placing concrete.

2. If concrete is cured with a curing compound, the compound shall be applied at a rate of 200 square feet per gallon, in two applications perpendicular to each other.

3. Curing period shall be seven days minimum. Full-strength shall be considered after 28 days.

F. Only if additional protection is required, the surface should remain uncovered for at least 4 days, after which time new and unwrinkled non-staining reinforced waterproof Kraft curing paper may be used.

3.10 COLD WEATHER CONCRETING

A. Comply with ACI 306R Guide to Cold Weather Concreting.

B. Materials for concrete shall be heated for concrete, which is mixed, placed or cured when the mean daily temperature is below 40 degrees F or is expected to fall below 40 degrees F within 72 hours. The concrete, after placement, shall be protected by covering, heat, or both.

C. Details of handling and protecting concrete during freezing weather shall be subject to the approval of Engineer.

3.11 HOT WEATHER CONCRETING

A. Comply with ACI 305R: Guide to Hot Weather Concreting.

B. Concrete just placed shall be protected from the direct rays of the sun and the forms and reinforcement just prior to placement shall be sprinkled with cold water. Every effort shall be made to minimize delays that will result in excessive mixing of the concrete after arrival on the job.

C. During periods of excessively hot weather (95□F, or above), ingredients in the concrete shall be cooled insofar as possible and cold mixing water shall be used to maintain the temperature of the concrete at permissible levels all in accordance with the provisions of ACI 305R. Any concrete with a temperature below 95□F, when ready for placement, will not be acceptable, and will be rejected.

D. Temperature records shall be maintained throughout the period of hot weather giving air temperature, general weather conditions (calm, windy, clear, cloudy, etc.) and relative humidity. Records shall include checks on temperature of concrete as delivered and after placing in forms. Data should be correlated with the progress of the Work so that conditions surrounding the construction of any part of the structure can be ascertained.

3.12 PROTECTION

A. Concrete surface shall be protected from traffic or damage until surfaces have hardened sufficiently. If necessary, ½ inch thick plywood sheets shall be used to protect the exposed surface.

3.13 CLEAN UP

A. Remove all debris, residuals, and materials at the conclusion of the work. Dispose of all materials in accordance with applicable waste management regulations.

3.14 SEALANT

A. Apply concrete sealer to sidewalks, steps, and pads after cure period in accordance with manufacture's guidelines.

END OF SECTION

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SECTION 03300 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED WORK SPECIFIED ELSEWHERE:

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work specified in this section.

1.2 QUALITY ASSURANCE:

A. Codes and Standards: Comply with provisions of following Codes, Specifications and standards, except where more stringent requirements are shown or specified:

1. American Concrete Institute, ACI, "Specifications for Structural Concrete for Buildings" ACI 301 latest revision.

2. Concrete Reinforcing Steel Institute, CRSI, "Manual of Standard Practice" latest edition.

B. Concrete Testing Service: Employ at contractor's expense a testing laboratory to perform materials evaluation test and to design concrete mixes.

C. Owner: Employ separate testing laboratory to evaluate concrete delivered to and placed at site.

D. Certificates: Signed by concrete producer and Contractor, may be submitted in lieu of material testing when acceptable to Engineer.

1.3 SUBMITTALS:

A. Manufacturer's Data: Submit manufacturer's product data with installation instructions for proprietary materials including reinforcement and forming accessories, admixtures, joint materials, hardeners, curing materials and others as requested by Engineer.

B. Laboratory Reports: Submit 2 copies of laboratory test or evaluation reports for concrete materials and mix designs.

C. Shop Drawings Reinforcement: Submit shop drawings for fabrication, bending, and placement of concrete reinforcement. Comply with ACI 315 "Manual of Standard Practice for Detailing Reinforced Concrete Structures" latest edition, showing bar schedules, stirrup spacing, diagrams of bent bars, placing plans and wall elevations showing arrangement of concrete reinforcement. Include special reinforcement required and openings through concrete structures. Reproduction of the Engineers Contract Drawings are not acceptable for use as shop drawings.

PART 2 - PRODUCTS

2.1 FORM MATERIALS:

A. Provide form materials with sufficient stability to withstand pressure of placed concrete without bow or deflection.

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2.2 REINFORCING MATERIALS:

A. Reinforcing Bars: ASTM A615, Grade 60, deformed.

B. Welded wire fabric (WWF): ASTM A185, welded steel wire fabric.

2.3 CONCRETE MATERIALS:

A. Portland Cement: ASTM C 150, Type 1 use one brand of cement throughout project.

B. Normal weight aggregates: ASTM C33, Provide aggregates from a single source for exposed concrete.

C. Light-weight aggregates: ASTM C330

D. Water: Potable.

E. Air Entraining Admixture: ASTM C260.

F. Water reducing Admixture: ASTM C494, Type A. and not contain more chloride ions than are present in municipal drinking water.

2.4 RELATED MATERIALS:

A. Waterstops: Flat dumbbell or centerbulb type, size to suit joints, of either rubber (CRD C 513) or PVC (CRD C 572).

B. Moisture Barrier: Clear 10-mils thick polyethylene.

C. Membrane-Forming Curing Compound: ASTM C 309, Type 1.

2.5 PROPORTIONING AND DESIGN OF MIXES:

A. Prepare design mixes for each type and strength of concrete in accordance with ACI 301 Section 3.9 "Proportioning on the Basis of Previous Field Experience or Trial Mixtures", Chapter 3 as indicated on drawings.

B. Mix designs may be adjusted when material characteristics, job conditions, weather, test results or other circumstances warrant. Do not use revised concrete mixes until submitted to and accepted by Engineer.

C. Use air entraining admixture in all concrete, providing not less than 4% nor more than 8% entrained air for concrete exposed to freezing and thawing, and from 2% to 4% for other concrete.

D. Do not use admixtures containing calcium chloride for concrete which is to be placed on metal decking.

2.6 CONCRETE MIXING:

A. Ready mix concrete shall be in accordance with ASTM C94.

B. For Job-site mixing use drum type batch machine mixture, mixing not less than 1-1/2 minutes for one cu. yd. or smaller capacity. Increase mixing time at least 15 seconds for each additional cu. yd. or fraction thereof.

PART 3 - EXECUTION

3.1 FORMWORK:

A. Construct formwork complying with ACI 347 "Recommended Practice for Concrete Formwork", so that concrete members and structures are of correct size, shape, alignment, elevation and position.

B. Provide openings in formwork to accommodate work of other trades. Accurately place and securely support items built into forms.

C. Clean and adjust forms prior to concrete placement. Apply form release agents or wet forms, as required, re-tighten forms during concrete placement if required to eliminate mortar leaks.

3.2 PLACING REINFORCEMENT:

A. Comply with CRSI, recommended practice for "Placing Reinforcing Bars".

B. Position, support and secure reinforcement against displacement. Locate and support with metal chairs, runners, bolsters, spacers and hangers, as required. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.

C. Install welded wire fabric in as long lengths as practical, lapping at least one mesh.

3.3 JOINTS:

A. Provide construction, isolation, and control joints as indicated or required. Locate construction joints so as to not impair strength and appearance of structure. Place isolation and control joints in slabs- on-ground to stabilize differential settlement and random cracking.

3.4 INSTALLATION OF EMBEDDED ITEMS:

A. Set and build into work, anchorage devices and other embedded items required for other work that is attached to, or supported by, cast-in- place concrete. Use setting diagrams, templates and instructions provided by others for locations and setting.

3.5 CONCRETE PLACEMENT:

A. Comply with ACI 304, placing concrete in a continuous operation within planned joints or sections. Do not begin placement until work of other trades affecting concrete is completed.

B. Consolidate placed concrete using mechanical vibrating equipment with hand rodding and tamping, so that concrete is worked around reinforcement and other embedded items and into forms.

C. Protect concrete from physical damage or reduced strength due to weather extremes during mixing, placement and curing comply with ACI 318 and other ACI documents referenced therein.

3.6 CONCRETE FINISHES:

A. Provide a smooth finish for exposed concrete surfaces and surfaces that are to be covered with a coating or covering material applied directly to concrete. Remove fins and projections, patch defective areas with cement grout, and rub smooth.

B. Apply trowel finish to monolithic slab surfaces that are exposed-to-view or are to be covered with resilient flooring, paint or other thin film coating. Consolidate concrete surfaces by finish troweling, free of trowel marks, uniform in texture and appearance.

3.7 CONCRETE CURING AND PROTECTION:

A. Begin initial curing as soon as free water has disappeared from exposed surfaces. Where possible, keep continuously moist for not less than 72 hours. Continue curing by use of moisture-retaining cover or membrane-forming curing compound. Cure formed surfaces by moist curing until forms are removed. Provide protection as required to prevent damage to exposed concrete surfaces.

3.8 QUALITY CONTROL:

A. Owner's testing laboratory will perform sampling and testing during concrete placement, which may include the following, as directed by Engineer. This testing does not relieve Contractor of responsibility of providing concrete in compliance with specifications. Contractor may perform additional testing as necessary, at no expense to Owner, to ensure quality of concrete.

1. Sampling: ASTM C 172.

2. Slump: ASTM C 143, one for each set of compressive strength specimens.

3. Air content: ASTM C 173, one for each set of compressive strength specimens.

4. Compressive strength: ASTM C 39, one set for each 50 cu. yds, or fraction thereof of each class of concrete; 1 specimen tested at 7 days, 2 specimens tested at 28 days, and one retained for later testing if required.

When the total quantity of given class of concrete is less than 50 cu. yds., strength tests may be waived by Engineer if field experience indicates evidence of satisfactory strength.

B. Test results will be reported in writing to Engineer, Contractor, and concrete producer on same day tests are made.

END OF SECTION 03300

SECTION 04 2000 - UNIT MASONRY

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. Concrete masonry units.
   2. Decorative concrete masonry units
   3. Mortar and grout.
   4. Steel reinforcing bars.
   5. Masonry-joint reinforcement.
   6. Ties and anchors.
   7. Miscellaneous masonry accessories.

B. Products Installed but not Furnished under This Section:
   1. Steel lintels in unit masonry.

1.3 DEFINITIONS

A. CMU(s): Concrete masonry unit(s).

B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For the following:
   1. Reinforcing Steel: Detail bending, lap lengths, and placement of unit masonry reinforcing bars. Comply with ACI 315. Show elevations of reinforced walls.

1.5 INFORMATIONAL SUBMITTALS

A. Material Certificates: For each type and size of the following:

   1. Masonry units.

      a. Include data on material properties, material test reports substantiating compliance with requirements.
   2. Cementitious materials. Include name of manufacturer, brand name, and type.

3. Mortar admixtures.
4. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
5. Grout mixes. Include description of type and proportions of ingredients.
6. Reinforcing bars.
7. Joint reinforcement.
8. Anchors, ties, and metal accessories.

B. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.

1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C 109/C 109M for compressive strength, ASTM C 1506 for water retention, and ASTM C 91/C 91M for air content.
2. Include test reports, according to ASTM C 1019, for grout mixes required to comply with compressive strength requirement.

C. Statement of Compressive Strength of Masonry: For each combination of masonry unit type and mortar type, provide statement of average net-area compressive strength of masonry units, mortar type, and resulting net-area compressive strength of masonry determined according to TMS 602/ACI 530.1/ASCE 6.

D. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.

B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

D. Deliver preblended, dry mortar mix in moisture-resistant containers. Store preblended, dry mortar mix in delivery containers on elevated platforms in a dry location or in covered weatherproof dispensing silos.

E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.7 FIELD CONDITIONS

A. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.

B. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost

or by freezing conditions. Comply with cold-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F (4 deg C) and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.

C. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required.

B. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.

2.2 PERFORMANCE REQUIREMENTS

A. Provide unit masonry that develops indicated net-area compressive strengths at 28 days.

1. Determine net-area compressive strength of masonry from average net-area compressive strengths of masonry units and mortar types (unit-strength method) according to TMS 602/ACI 530.1/ASCE 6.

2.3 UNIT MASONRY, GENERAL

A. Masonry Standard: Comply with TMS 602/ACI 530.1/ASCE 6, except as modified by requirements in the Contract Documents.

B. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated. Do not use units where such defects are exposed in the completed Work.

C. Fire-Resistance Ratings: Comply with requirements for fire-resistance-rated assembly designs indicated.

1. Where fire-resistance-rated construction is indicated, units shall be listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction.

2.4 CONCRETE MASONRY UNITS

A. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.

1. Provide special shapes for corners, jambs, movement joints, bonding, and other special conditions.
2. Provide square-edged units for outside corners unless otherwise indicated.

B. CMUs: ASTM C 90.

1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2150 psi (14.8 MPa)
2. Density Classification: Lightweight.
3. Size (Width): Manufactured to dimensions 3/8 inch (10 mm) less than nominal dimensions.

C. Decorative CMUs: ASTM C90.

1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2150 psi (14.8 MPa)
2. Density Classification: Lightweight.
3. Pattern and Texture:

a. Standard pattern, ground-face finish.
b. Standard pattern, brick block finish.

2.5 MORTAR AND GROUT MATERIALS

A. Portland Cement: ASTM C 150/C 150M, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.

1. Alkali content shall not be more than 0.1 percent when tested according to ASTM C 114.

B. Hydrated Lime: ASTM C 207, Type S.

C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.

D. Masonry Cement: ASTM C 91/C 91M.

E. Mortar Cement: ASTM C 1329/C 1329M.

F. Aggregate for Mortar: ASTM C 144.

1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.

G. Aggregate for Grout: ASTM C 404.

H. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C 494/C 494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.

I. Water: Potable.

2.6 REINFORCEMENT

A. Uncoated-Steel Reinforcing Bars: ASTM A 615/A 615M or ASTM A 996/A 996M, Grade 60 (Grade 420).

B. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells and to hold reinforcing bars in center of cells. Units are formed from 0.148-inch (3.77-mm) steel wire, hot-dip galvanized after fabrication. Provide units designed for number of bars indicated.

C. Masonry-Joint Reinforcement, General: ASTM A 951/A 951M.

1. Interior Walls: Hot-dip galvanized carbon steel.
2. Wire Size for Side Rods: 0.148-inch (3.77-mm) diameter.
3. Wire Size for Cross Rods: 0.148-inch (3.77-mm) diameter.
4. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches (407 mm) o.c.
5. Provide in lengths of not less than 10 feet (3 m), with prefabricated corner and tee units.

D. Masonry-Joint Reinforcement for Single-Wythe Masonry: Ladder or truss type with single pair of side rods.

E. Masonry-Joint Reinforcement for Multiwythe Masonry:

1. Ladder type with one side rod at each face shell of hollow masonry units more than 4 inches (100 mm) wide, plus one side rod at each wythe of masonry 4 inches (100 mm) wide or less.

2.7 TIES AND ANCHORS

A. General: Ties and anchors shall extend at least 1-1/2 inches (38 mm) into veneer but with at least a 5/8-inch (16-mm) cover on outside face.

B. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated:
1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A 82/A 82M, with ASTM A 153/A 153M, Class B-2 coating.
2. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

C. Individual Wire Ties: Rectangular units with closed ends and not less than 4 inches (100 mm) wide.
1. Wire: Fabricate from 3/16-inch- (4.76-mm-) diameter, hot-dip galvanized steel.

D. Adjustable Anchors for Connecting to Structural Steel Framing: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.

1. Anchor Section for Welding to Steel Frame: Crimped 1/4-inch- (6.35-mm-) diameter, hot-dip galvanized steel wire.
2. Tie Section: Triangular-shaped wire tie made from 0.187-inch- (4.76-mm-) diameter, hot-dip galvanized steel wire.

E. Partition Top Anchors: Refer to Structural Drawings.

F. Rigid Anchors: Fabricate from steel bars 1-1/2 inches (38 mm) wide by 1/4 inch (6.35 mm) thick by 24 inches (610 mm) long, with ends turned up 2 inches (51 mm) or with cross pins unless otherwise indicated.

1. Corrosion Protection: Hot-dip galvanized to comply with ASTM A 153/A 153M.

2.8 MISCELLANEOUS MASONRY ACCESSORIES

A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene.

B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D 2000, Designation M2AA-805 or PVC, complying with ASTM D 2287, Type PVC-65406 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.

C. Bond-Breaker Strips: Asphalt-saturated felt complying with ASTM D 226/D 226M, Type I (No. 15 asphalt felt).

2.9 MASONRY CLEANERS

A. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.

2.10 MORTAR AND GROUT MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.

1. Do not use calcium chloride in mortar or grout.
2. Use portland cement-lime masonry cement or [mortar cement mortar unless otherwise indicated.

B. Mortar for Unit Masonry: Comply with ASTM C 270, Proportion Specification. Provide the following types of mortar for applications stated unless another type is indicated or needed to provide required compressive strength of masonry.
1. Use Type S.

C. Grout for Unit Masonry: Comply with ASTM C 476.

1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with TMS 602/ACI 530.1/ASCE 6 for dimensions of grout spaces and pour height.
2. Proportion grout in accordance with ASTM C 476, Table 1 or paragraph 4.2.2 for specified 28-day compressive strength indicated, but not less than 2000 psi (14 MPa).
3. Provide grout with a slump of 8 to 11 inches (200 to 280 mm) as measured according to ASTM C 143/C 143M.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
   1. Verify that reinforcing dowels are properly placed.
   2. Verify that substrates are free of substances that impair mortar bond.

B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Thickness: Build cavity and composite walls and other masonry construction to full thickness shown. Build single-wythe walls to actual widths of masonry units, using units of widths indicated.

B. Build chases and recesses to accommodate items specified in this and other Sections.

C. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match construction immediately adjacent to opening.

D. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

E. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures. Mix units from several pallets or cubes as they are placed.

F. Matching Existing Masonry: Match coursing, bonding, color, and texture of existing masonry.

G. Wetting of Brick: Wet brick before laying if initial rate of absorption exceeds 30 g/30 sq. in. (30 g/194 sq. cm) per minute when tested according to ASTM C 67. Allow units to absorb water so they are damp but not wet at time of laying.

3.3 TOLERANCES

A. Dimensions and Locations of Elements:

1. For dimensions in cross section or elevation, do not vary by more than plus 1/2 inch (12 mm) or minus 1/4 inch (6 mm).
2. For location of elements in plan, do not vary from that indicated by more than plus or minus 1/2 inch (12 mm).
3. For location of elements in elevation, do not vary from that indicated by more than plus or minus 1/4 inch (6 mm) in a story height or 1/2 inch (12 mm) total.

B. Lines and Levels:

1. For bed joints and top surfaces of walls, do not vary from level by more than 1/4 inch in 10 feet (6 mm in 3 m), or 1/2-inch (12-mm) maximum.
2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 1/2-inch (12-mm) maximum.
3. For vertical lines and surfaces, do not vary from plumb by more than 1/4 inch in 10 feet (6 mm in 3 m), 3/8 inch in 20 feet (9 mm in 6 m), or 1/2-inch (12-mm) maximum.
4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 1/2-inch (12-mm) maximum.
5. For lines and surfaces, do not vary from straight by more than 1/4 inch in 10 feet (6 mm in 3 m), 3/8 inch in 20 feet (9 mm in 6 m), or 1/2-inch (12-mm) maximum.
6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet (6 mm in 3 m), or 1/2-inch (12-mm) maximum.
7. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch (1.5 mm) except due to warpage of masonry units within tolerances specified for warpage of units.

C. Joints:

1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3 mm), with a maximum thickness limited to 1/2 inch (12 mm).
2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch (3 mm).
3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch (9 mm) or minus 1/4 inch (6 mm).
4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3 mm). Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 inch (3 mm).

3.4 LAYING MASONRY WALLS

A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less-than-nominal 4-inch (100-mm) horizontal face dimensions at corners or jambs.

C. Bond Pattern for Brick Block CMY: Brick Block CMU shall be laid to the manufacturer's stand specification in a ¼ - ¾ bond system. All horizontal mortar joints shall be tooled and 1/3 of each

vertical mortar joint struck flush so as to achieve a finished wall design of a brick in a running bond. All joints shall be struck with manufacturer's specially designed tool.

D. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 2 inches (50 mm). Bond and interlock each course of each wythe at corners. Do not use units with less-than-nominal 4-inch (100-mm) horizontal face dimensions at corners or jambs.

E. Stopping and Resuming Work: Stop work by stepping back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.

F. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

G. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.

H. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below, and rod mortar or grout into core.

I. Fill cores in hollow CMUs with grout 24 inches (600 mm) under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.

J. Build nonload-bearing interior partitions full height of story to underside of solid floor or roof structure above unless otherwise indicated.

1. Install compressible filler in joint between top of partition and underside of structure above.
2. Fasten partition top anchors to structure above and build into top of partition. Grout cells of CMUs solidly around plastic tubes of anchors and push tubes down into grout to provide 1/2-inch (13-mm) clearance between end of anchor rod and end of tube. Space anchors [48 inches (1200 mm)] <Insert spacing> o.c. unless otherwise indicated.
3. Wedge nonload-bearing partitions against structure above with small pieces of tile, slate, or metal. Fill joint with mortar after dead-load deflection of structure above approaches final position.
4. At fire-rated partitions, treat joint between top of partition and underside of structure above to comply with Section 078443 "Joint Firestopping."

3.5 MORTAR BEDDING AND JOINTING

A. Lay brick and CMUs as follows:

1. Bed face shells in mortar and make head joints of depth equal to bed joints.
2. Bed webs in mortar in all courses of piers, columns, and pilasters.
3. Bed webs in mortar in grouted masonry, including starting course on footings.
4. Fully bed entire units, including areas under cells, at starting course on footings where cells are not grouted.
5. Fully bed units and fill cells with mortar at anchors and ties as needed to fully embed anchors and ties in mortar.

B. Lay solid masonry units and brick with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.

C. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.

3.6 MASONRY-JOINT REINFORCEMENT

A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch (16 mm) on exterior side of walls, 1/2 inch (13 mm) elsewhere. Lap reinforcement a minimum of 6 inches (150 mm).

1. Space reinforcement not more than 16 inches (406 mm) o.c.
2. Provide reinforcement not more than 8 inches (203 mm) above and below wall openings and extending 12 inches (305 mm) beyond openings in addition to continuous reinforcement.

B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.

C. Provide continuity at wall intersections by using prefabricated T-shaped units.

D. Provide continuity at corners by using prefabricated L-shaped units.

E. Cut and bend reinforcing units as directed by manufacturer for continuity at corners, returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

3.7 ANCHORING MASONRY TO STRUCTURAL STEEL AND CONCRETE

A. Anchor masonry to structural steel and concrete, where masonry abuts or faces structural steel or concrete, to comply with the following:

1. Provide an open space not less than 1/2 inch (13 mm) wide between masonry and structural steel or concrete unless otherwise indicated. Keep open space free of mortar and other rigid materials.
2. Anchor masonry with anchors embedded in masonry joints and attached to structure.
3. Space anchors as indicated, but not more than 24 inches (610 mm) o.c. vertically and 36 inches (915 mm) o.c. horizontally.

3.8 CONTROL AND EXPANSION JOINTS

A. General: Install control- and expansion-joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.

B. Form control joints in concrete masonry using one of the following methods:

1. Fit bond-breaker strips into hollow contour in ends of CMUs on one side of control joint. Fill resultant core with grout, and rake out joints in exposed faces for application of sealant.

2. Install preformed control-joint gaskets designed to fit standard sash block.
3. Install interlocking units designed for control joints. Install bond-breaker strips at joint. Keep head joints free and clear of mortar, or rake out joint for application of sealant.
4. Install temporary foam-plastic filler in head joints, and remove filler when unit masonry is complete for application of sealant.

3.9 LINTELS

A. Install steel lintels where indicated.

B. Provide minimum bearing of 8 inches (200 mm) at each jamb unless otherwise indicated.

3.10 REINFORCED UNIT MASONRY INSTALLATION

A. Placing Reinforcement: Comply with requirements in TMS 602/ACI 530.1/ASCE 6.

B. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.

1. Comply with requirements in TMS 602/ACI 530.1/ASCE 6 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
2. Limit height of vertical grout pours to not more than 60 inches (1520 mm).

3.11 REPAIRING, POINTING, AND CLEANING

A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.

B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.

C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:

1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
3. Protect adjacent non-masonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
5. Clean brick by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.

6. Clean concrete masonry by applicable cleaning methods indicated in NCMA TEK 8-4A.
7. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.

3.12 MASONRY WASTE DISPOSAL

A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.

B. Masonry Waste Recycling: Return broken CMUs not used as fill to manufacturer for recycling.

C. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above or recycled, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION 04 2000

SECTION 044200 - EXTERIOR STONE CLADDING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Stone base trim units.

1.2 ACTION SUBMITTALS

A. Product Data: For each variety of stone, stone accessory, and manufactured product.

B. Shop Drawings: Show fabrication and installation details for stone cladding assembly, including dimensions and profiles of stone units.

1. Show locations and details of joints both within stone cladding assembly and between stone cladding assembly and other construction.
2. Show locations and details of anchors

C. Stone Samples: Sets for each variety, color, and finish of stone required; not less than 12 inches (300 mm) square.

D. Colored Pointing Mortar Samples: For each color required.

E. Sealant Samples: For each type and color of joint sealant required.

1.3 INFORMATIONAL SUBMITTALS

A. Material Test Reports:

1. Stone Test Reports: For stone variety proposed for use on Project, by a qualified testing agency, indicating compliance with required physical properties, other than abrasion resistance, according to referenced ASTM standards. Base reports on testing done within previous three years.

B. Source quality-control reports.

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM E329 for testing indicated.

1.5 FIELD CONDITIONS

A. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Remove and replace stone cladding damaged by frost or freezing conditions. Comply with cold-weather construction and protection requirements for masonry contained in TMS 602/ACI 530.1/ASCE 6.

B. Hot-Weather Requirements: Comply with hot-weather construction and protection requirements for masonry contained in TMS 602/ACI 530.1/ASCE 6.

C. Environmental Limitations for Sealants: Do not install sealants when ambient and substrate temperatures are outside limits permitted by sealant manufacturer or below 40 deg F (5 deg C) or when joint substrates are wet.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General: Design stone anchors and anchoring systems according to ASTM C1242.

1. Stone anchors shall withstand not less than two times the weight of the stone cladding in both compression and tension.

2.2 GRANITE BASE

A. Material Standard: Comply with ASTM C615/C615M.

B. Varieties and Sources: Subject to compliance with requirements, available stone varieties that may be incorporated into the Work include, but are not limited to Barre Grey Granite,

C. Finish: Thermal

D. Match Architect's samples for color, finish, and other stone characteristics relating to aesthetic effects.

2.3 ANCHORS AND FASTENERS

A. Fabricate anchors from stainless steel, ASTM A240/A240M or ASTM A666, Type 304; temper as required to support loads imposed without exceeding allowable design stresses. Fabricate dowels and pins for anchors from stainless steel, ASTM A276, Type 304.

2.4 MORTAR MATERIALS

A. Portland Cement: ASTM C150/C150M, Type I or Type II, except Type III may be used for cold-weather construction, natural color or white as required to produce mortar color indicated.

1. Low-Alkali Cement: Portland cement for use with limestone shall contain no more than 0.60 percent total alkali when tested according to ASTM C114.

B. Hydrated Lime: ASTM C207.

C. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes and complying with ASTM C979/C979M. Pigments shall have a record of satisfactory performance in mortar.

D. Aggregate: ASTM C144; except for joints narrower than 1/4 inch (6 mm), 100 percent shall pass No. 16 (1.18-mm) sieve.

E. Water: Potable.

2.5 STONE ACCESSORIES

A. Setting Shims: Strips of resilient plastic, nonstaining to stone, of thickness needed to prevent point loading of stone on anchors and of depths to suit anchors without intruding into required depths of pointing materials.

B. Concealed Sheet Metal Flashing: Fabricated from stainless steel in thicknesses indicated, but not less than 0.0156 inch (0.4 mm) thick, and complying with Section 076200 "Sheet Metal Flashing and Trim."

C. Weep and Vent Tubes: Rectangular, cellular, polypropylene or clear butyrate extrusion, 3/8 by 1-1/2 inches (9 by 38 mm), of length required to extend from exterior face of stone to cavity behind.

D. Cellular Plastic Weep Hole/Vents: One-piece, flexible extrusion made from UV-resistant polypropylene copolymer, of length required to extend from exterior face of stone to cavity behind, in color selected from manufacturer's standard.

E. Mesh Weep/Vent: Free-draining mesh; made from polyethylene strands, of length required to extend from exterior face of stone to cavity behind, in color selected from manufacturer's standard.

F. Sealants for Joints in Stone Cladding: Manufacturer's standard chemically curing, elastomeric sealants of base polymer and characteristics indicated below that comply with applicable requirements in Section 079200 "Joint Sealants" and do not stain stone:

G. Preformed Joint Seals: Preformed joint seals that comply with applicable requirements in Section 079100 "Preformed Joint Seals" and do not stain stone.

2.6 FABRICATION OF STONE

A. Control depth of stone and back check to maintain minimum clearance of 1-1/2 inches (38 mm) between backs of stone units and surfaces or projections of structural members, fireproofing (if any), backup walls, and other work behind stone.

B. Dress joints (bed and vertical) straight and at right angle to face unless otherwise indicated. Shape beds to fit supports.

C. Cut and drill sinkages and holes in stone for anchors, fasteners, supports, and lifting devices as indicated or needed to set stone securely in place.

D. Finish exposed faces and edges of stone to comply with requirements indicated for finish and to match approved samples.

E. Cut stone to produce uniform joints 3/8 inch (10 mm) wide and in locations indicated.

F. Contiguous Work: Provide chases, reveals, reglets, openings, and similar features as required to accommodate contiguous work.

G. Fabricate molded work, including washes and drips, to produce stone shapes with a uniform profile throughout entire unit length, with precisely formed arris slightly eased to prevent snipping, and with matching profile at joints between units.

2.7 MORTAR MIXES

A. General: Comply with referenced standards and with manufacturers' written instructions. Do not use admixtures, unless otherwise indicated.

B. Portland Cement-Lime Setting Mortar: Comply with ASTM C270, Proportion Specification, Type S.

C. Pointing Mortar: Comply with ASTM C270, Proportion Specification, Type N. Provide pointing mortar mixed to match Architect's sample and complying with the following:

PART 3 - EXECUTION

3.1 INSTALLATION OF STONE CLADDING, GENERAL

A. Before setting stone, clean surfaces that are dirty or stained by removing soil, stains, and foreign materials. Clean stone by thoroughly scrubbing with fiber brushes and then drenching with clear water. Use only mild cleaning compounds that contain no caustic or harsh materials or abrasives.

B. Execute stone cladding installation by skilled mechanics and employ skilled stone fitters at Project site to do necessary field cutting as stone is set. Use power saws with diamond blades to cut stone.

C. Set stone to comply with requirements indicated. Install anchors, supports, fasteners, and other attachments indicated or necessary to secure stone cladding in place. Shim and adjust anchors, supports, and accessories to set stone accurately in locations indicated, with uniform joints of widths indicated, and with edges and faces aligned according to established relationships and indicated tolerances.

D. Provide expansion, control, and pressure-relieving joints of widths and at locations indicated.

1. Sealing expansion and other joints is specified in Section 079200 "Joint Sealants."
2. Keep expansion joints free of mortar and other rigid materials.

E. Install concealed flashing at continuous shelf angles, lintels, ledges, and similar obstructions to downward flow of water, to divert water to building exterior. Extend flashing 6 inches (150 mm) at ends and turn up not less than 2 inches (50 mm) to form end dams.

F. Keep cavities open where unfilled space is indicated between back of stone units and backup wall; do not fill cavities with mortar or grout.

1. Place weep holes in joints where moisture may accumulate, including at base of cavity walls and above shelf angles and flashing. Locate weep holes at intervals not exceeding 24 inches (600 mm).
2. Place vents in cavity walls at tops of cavities, below shelf angles and flashing, and at intervals not exceeding 20 feet (6 m) vertically. Locate vents in joints at intervals not exceeding 60 inches (1500 mm) horizontally.

3.2 INSTALLATION OF STONE CLADDING WITH MORTAR

A. Set stone in full bed of mortar with head joints filled unless otherwise indicated.

1. Provide compressible filler in ends of dowel holes and bottoms of kerfs to prevent end bearing of dowels and anchor tabs on stone. Fill remainder of anchor holes and kerfs with mortar.

B. Embed ends of sills in mortar; leave remainder of joint open until final pointing.

C. Rake out joints for pointing with mortar to depths of not less than 1/2 inch (12 mm). Rake joints to uniform depths with square bottoms and clean sides.

D. Point stone joints by placing pointing mortar in layers not more than 3/8 inch (10 mm). Compact each layer thoroughly and allow to become thumbprint hard before applying next layer.

E. Tool joints with a round jointer having a diameter 1/8 inch (3 mm) larger than width of joint, when pointing mortar is thumbprint hard.

F. Rake out mortar from sealant-pointed joints to depths required for sealant and sealant backing, but not less than 1/2 inch (12 mm). Rake joints to uniform depths with square bottoms and clean sides.

3.3 INSTALLATION OF JOINT SEALANTS

A. Prepare joints and apply sealants of type and at locations indicated to comply with applicable requirements in Section 079200 "Joint Sealants."

3.4 INSTALLATION TOLERANCES

A. Variation from Plumb: For vertical lines and surfaces of walls, do not exceed 1/4 inch in 10 feet (6 mm in 3 m), 3/8 inch in 20 feet (10 mm in 6 m), or 1/2 inch in 40 feet (12 mm in 12 m) or more. For external corners, corners and jambs within 20 feet (6 m) of an entrance, expansion joints, and other conspicuous lines, do not exceed 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 3/8 inch in 40 feet (10 mm in 12 m) or more.

B. Variation from Level: For lintels, sills, water tables, parapets, horizontal bands, horizontal grooves, and other conspicuous lines, do not exceed 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 3/8 inch (10 mm) maximum.

C. Variation of Linear Building Line: For positions shown in plan and related portions of walls and partitions, do not exceed 1/4 inch in 20 feet (6 mm in 6 m) or 1/2 inch in 40 feet (12 mm in 12 m) or more.

D. Variation in Joint Width: Do not vary from average joint width more than plus or minus 1/8 inch (3 mm) or a quarter of nominal joint width, whichever is less. For joints within 60 inches (1500 mm) of each other, do not vary more than 1/8 inch (3 mm) or a quarter of nominal joint width, whichever is less from one to the other.

E. Variation in Plane between Adjacent Stone Units (Lipping): Do not exceed 1/16-inch (1.5-mm) difference between planes of adjacent units.

3.5 ADJUSTING AND CLEANING

A. In-Progress Cleaning: Clean stone cladding as work progresses. Remove excess sealant and smears as sealant is installed.

B. Final Cleaning: Clean stone cladding no fewer than six days after completion of pointing and sealing, using clean water and stiff-bristle fiber brushes. Do not use wire brushes, acid-type cleaning agents, cleaning agents containing caustic compounds or abrasives, or other materials or methods that could damage stone.

END OF SECTION 044200

SECTION 047200 - CAST STONE MASONRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cast-stone trim.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. For cast-stone units, include dimensions and finishes.

B. Shop Drawings: Show fabrication and installation details for cast-stone units. Include dimensions, details of reinforcement and anchorages if any, and indication of finished faces.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer.

B. Material Test Reports: For each mix required to produce cast stone, based on testing according to ASTM C1364**,** including test for resistance to freezing and thawing.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer of cast-stone units similar to those indicated for this Project, that has sufficient production capacity to manufacture required units, and is a plant certified by the Cast Stone Institute.

PART 2 - PRODUCTS

2.1 CAST-STONE UNITS

A. Cast Stone shall be manufactured by Continental Cast Stone or Sun Precast

B. Cast-Stone Units: Comply with ASTM C1364.

1. Units shall be manufactured using the vibrant dry tamp method.
2. Units shall be resistant to freezing and thawing as determined by laboratory testing according to ASTM C666/C666M, Procedure A, as modified by ASTM C1364.

C. Fabricate units with sharp arris and accurately reproduced details, with indicated texture on all exposed surfaces unless otherwise indicated.

1. Slope exposed horizontal surfaces 1:12 to drain unless otherwise indicated.
2. Provide raised fillets at backs of sills and at ends indicated to be built into jambs.
3. Provide drips on projecting elements unless otherwise indicated.

D. Cure Units as Follows:

1. Cure units in enclosed, moist curing room at 95 to 100 percent relative humidity and temperature of 100 deg F (38 deg C) for 12 hours or 70 deg F (21 deg C) for 16 hours.
2. Keep units damp and continue curing to comply with one of the following:

a. No fewer than five days at mean daily temperature of 70 deg F (21 deg C) or above.
b. No fewer than six days at mean daily temperature of 60 deg F (16 deg C) or above.
c. No fewer than seven days at mean daily temperature of 50 deg F (10 deg C) or above.
d. No fewer than eight days at mean daily temperature of 45 deg F (7 deg C) or above.

E. Acid etch units after curing to remove cement film from surfaces to be exposed to view.

F. Colors and Textures: As selected by Architect from manufacturer's full range.

2.2 ACCESSORIES

A. Anchors: Type and size indicated, fabricated from Type 304 stainless steel complying with ASTM A240/A240M, ASTM A276, or ASTM A666.

B. Dowels: 1/2-inch- (12-mm-) diameter round bars, fabricated from Type 304 stainless steel complying with ASTM A240/A240M, ASTM A276, or ASTM A666.

C. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cast-stone manufacturer and expressly approved by cleaner manufacturer for use on cast stone and adjacent masonry materials.

2.3 MORTAR

A. Comply with requirements in Section 042000 "Unit Masonry" for mortar mixes.

1. For setting mortar, use Type N.
2. For pointing mortar, use Type N.

2.4 SOURCE QUALITY CONTROL

A. Engage a qualified independent testing agency to sample and test cast-stone units according to ASTM C1364.

1. Include one test for resistance to freezing and thawing.

PART 3 - EXECUTION

3.1 SETTING CAST STONE IN MORTAR

A. Install cast-stone units to comply with requirements in Section 042000 "Unit Masonry."

B. Set units in full bed of mortar with full head joints unless otherwise indicated.

1. Fill dowel holes and anchor slots with mortar.
2. Fill collar joints solid as units are set.
3. Build concealed flashing into mortar joints as units are set.
4. Keep head joints in copings and between other units with exposed horizontal surfaces open to receive sealant.
5. Keep joints at shelf angles open to receive sealant.

C. Rake out joints for pointing with mortar to depths of not less than 3/4 inch (19 mm). Rake joints to uniform depths with square bottoms and clean sides. Scrub faces of units to remove excess mortar as joints are raked.

D. Point mortar joints by placing and compacting mortar in layers not greater than 3/8 inch (10 mm). Compact each layer thoroughly and allow it to become thumbprint hard before applying next layer.

E. Tool exposed joints slightly concave when thumbprint hard. Use a smooth plastic jointer larger than joint thickness.

F. Rake out joints for pointing with sealant to depths of not less than 3/4 inch (19 mm). Scrub faces of units to remove excess mortar as joints are raked.

G. Provide sealant joints at head joints of copings and other horizontal surfaces; at expansion, control, and pressure-relieving joints; and at locations indicated.

1. Keep joints free of mortar and other rigid materials.
2. Prepare and apply sealant of type and at locations indicated to comply with applicable requirements in Section 079200 "Joint Sealants."

3.2 SETTING ANCHORED CAST STONE WITH SEALANT-FILLED JOINTS

A. Set cast stone as indicated on Drawings. Set units accurately in locations indicated, with edges and faces aligned according to established relationships and indicated tolerances.

1. Install anchors, supports, fasteners, and other attachments indicated or necessary to secure units in place.
2. Shim and adjust anchors, supports, and accessories to set cast stone in locations indicated with uniform joints.

B. Fill anchor holes with sealant.

1. Where dowel holes occur at pressure-relieving joints, provide compressible material at ends of dowels.

C. Set cast stone supported on clip or continuous angles on resilient setting shims. Use material of thickness required to maintain uniform joint widths. Hold shims back from face of cast stone a distance at least equal to width of joint.

D. Prepare and apply sealant of type and at locations indicated to comply with applicable requirements in Section 079200 "Joint Sealants."

3.3 INSTALLATION TOLERANCES

A. Variation from Plumb: Do not exceed 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 1/2 inch (12 mm) maximum.

B. Variation from Level: Do not exceed 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 1/2 inch (12 mm) maximum.

C. Variation in Joint Width: Do not vary joint thickness more than 1/8 inch in 36 inches (3 mm in 900 mm) or one-fourth of nominal joint width, whichever is less.

D. Variation in Plane between Adjacent Surfaces (Lipping): Do not vary from flush alignment with adjacent units or adjacent surfaces indicated to be flush with units by more than 1/16 inch (1.5 mm), except where variation is due to warpage of units within tolerances specified.

3.4 ADJUSTING AND CLEANING

A. Remove and replace stained and otherwise damaged units and units not matching approved Samples. Cast stone may be repaired if methods and results are approved by Architect.

B. Replace units in a manner that results in cast stone matching approved Samples, complying with other requirements, and showing no evidence of replacement.

C. In-Progress Cleaning: Clean cast stone as work progresses.

1. Remove mortar fins and smears before tooling joints.
2. Remove excess sealant immediately, including spills, smears, and spatter.

D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed cast stone as follows:

1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
2. Test cleaning methods on sample; leave one sample uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of cast stone.

3. Protect adjacent surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
4. Wet surfaces with water before applying cleaners; remove cleaners promptly by rinsing thoroughly with clear water.
5. Clean cast stone by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.
6. Clean cast stone with proprietary acidic cleaner applied according to manufacturer's written instructions.

END OF SECTION 047200

SECTION 05 5200

METAL RAILINGS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Furnishing and installing steel tube guard rails and hand-rails at ramps, steps, and other location indicated on the Drawings.

B. Contractor shall coordinate work between all Contractors, sections, and trades required for the proper completion of the work.

C. Contractor is responsible for all health and safety.

1.2 REFERENCE STANDARDS

A. Reference herein to any technical society, organization, group or regulation are made in accordance with the following abbreviations and, unless otherwise noted or specified, all work under this Section shall conform to the latest edition as applicable.

B. Code of Federal Regulations (CFR).

1. 29 CFR 1926, Safety and Health Regulations for Construction.

C. ASTM International (ASTM).

1. ASTM A36 - Specification for Structural Steel.

2. ASTM A123 - Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

3. ASTM A143 - Recommended Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement.

4. ASTM A153 - Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

5. ASTM A269 - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.

6. ASTM A307 - Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile.

7. ASTM A384 - Practice for Safeguarding Against Warpage and Distortion During Hot-Dip Galvanizing of Steel Assemblies.

8. ASTM A385 - Practice for Providing High-Quality Zinc Coatings (Hot-Dip).

9. ASTM A449 - Specification for Quenched and Tempered Steel Bolts and Studs.

10. ASTM A500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes

11. ASTM A563 - Specification for Carbon and Alloy Steel Nuts.

12. ASTM A780 - Practice for Repair of Damaged Hot-Dip Galvanized Coatings.

13. ASTM C1107 - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).

14. ASTM D1640 - Standard Test Methods for Drying, Curing, or Film Formation of Organic Coatings at Room Temperature.

15. ASTM D2092 - Practices for Preparation of Zinc-Coated Galvanized Steel Surfaces for Paint.

D. National Association of Architectural Metal Manufacturers (NAAMM).

1. “Pipe Railing Manual, Including Round Tube”

E. Society of Automotive Engineers (SAE)

1. Standard J404 200901, Chemical Compositions of SAE Alloy Steels.

F. State of Connecticut

1. State Building Code, including all Amendments, Supplements, and Errata.

G. American Welding Society

1. D1.1/D1.1M:2006, Structural Welding Code - Steel

H. Master Painters Institute (MPI)

I. Steel Structures Painting Council (SSPC).

1. SSPC-SP 1 Solvent Cleaning.

2. SSPC-SP 3 Power Tool Cleaning.

3. SSPC-SP 10 Near-White Blast Cleaning.

4. SSPC-SP 11 Power Tool Cleaning to Bare Metal.

1.3 SYSTEM DESCRIPTION

A. Provide guardrail and railing systems as indicated on the Drawings as complete systems in accordance with design intent, actual site conditions, and State Building Code.

B. Performance Requirements

1. Structural Performance: Railings shall withstand all loads as required by State Building Code.

C. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1.4 SUBMITTALS

A. Shop Drawings

1. Submit shop drawings of metal guardrails, handrails, and railings, showing sizes, details of fabrication and construction, bends and radii, handrail brackets, locations of hardware, anchors, and accessories, and installation details. Shop Drawings shall be submitted to Engineer for approval prior to ordering materials.

2. Submit manufacturers' product data of railing system and railing components, handrails, and handrail brackets. Include corrosion-inhibitive shop coat painting system.

1.5 QUALITY ASSURANCE

A. General: Use adequate numbers of skilled workmen who are trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and methods required for proper performance of the work in this Section.

B. Installer Qualifications: Minimum of 3 years of experience on similar type projects / work; knowledge and understanding of standards referenced herein; skill necessary to perform in compliance with this specification. Contractors failing to demonstrate the required experience, knowledge, or skill shall be removed from the project.

C. Source Limitations: Obtain each type of handrail and railing through one source from a single manufacturer. Railing materials must be supplied in consistent quality in appearance and physical properties.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Delivery and Storage

1. Transportation carrier shall use appropriate methods to ensure materials are properly packaged, stacked, and restrained during transport. Utilize protective packaging as required.

2. Protect materials during storage against moisture, soiling, staining, and physical damage.

3. Any railing or associated component showing manufacturing flaws upon receipt at the Project Site shall be referred to Engineer for determination as to whether it shall be repaired, rejected, or used.

4. Protect railing materials during storage to avoid damage from moisture, abrasion, and other construction activities.

B. Handling

1. Handle railing materials to prevent abrasion, chipping, marring, soiling and other damage.

2. Damaged equipment shall not be installed. Contractor shall bear responsibility for damage to equipment until final acceptance by Owner. Any installed equipment exhibiting damage

shall be replaced or repaired to the satisfaction of Engineer, and Contractor shall assume all costs related thereto.

1.7 PROJECT CONDITIONS

A. Field Measurements: Verify handrail and railing dimensions by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

B. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating handrails and railings without field measurements. Coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.8 COORDINATION

A. Coordinate installation of anchorages for handrails and 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 such items to Project site in time for installation.

1.9 SCHEDULING

A. Schedule installation so handrails and railings are mounted only on completed walls or associated with concrete stem wall installation / pour. Do not support temporarily by any means that does not satisfy structural performance requirements.

PART 2 PRODUCTS

2.1 STEEL TUBING HANDRAIL

A. Steel tube, seamless, ASTM A500, Grade C, “Standard Weight” railing (Schedule 40), unless another grade and weight are required by structural loads. Diameter and dimensions as indicated on the Drawings. Special instructions shall be given the tube manufacturer to provide “Architectural Handrail Grade Pipe”.

2.2 STAINLESS STEEL TUBING HANDRAIL

A. Stainless Steel Handrails: ASTM A269, stainless steel tube: 304 or 316, welded ornamental tubing - (1.9 inches O.D. for guardrail and 1.5 inches O.D. for handrail). Special instructions shall be given the tube manufacturer to provide Architectural Handrail Grade pipe.

B. Stainless Steel Finishes

1. Stainless steel tube and tubing: #6 polish.

2. Machined stainless steel fittings: # 8 polish.

2.3 FITTINGS, BRACKETS, AND PLATES

A. Fittings, Brackets, Flanges, and Plates: Cast or formed metal of the same type of material and finish as rails unless otherwise indicated.

B. Steel: Galvanized malleable iron, manufactured for the purpose, for anchorage to concrete.

C. Stainless Steel: 304 or 316 stainless steel to match finish. Stainless steel fittings shall be used in all applications where stainless steel railings are called-for.

D. Plates: Steel plate shall be standard steel plate, ASTM A36, weldable quality.

2.4 ANCHORS, FASTENERS, AND ACCESSORIES

A. Provide all required anchors, fasteners, miscellaneous components, and accessories as required for complete and finished railing installations.

1. Bolts and studs, nuts, and washers: ASTM A307, A449, and A563, as applicable.

2. Galvanizing: ASTM A153.

B. Expansion Bolts: Where anchors are not included in the concrete construction, provide galvanized expansion type anchors with matching galvanized steel bolts or studs with nuts, of sizes as indicated or required. Provide washers under all bolt heads and nuts. Expansion bolts require approval of Engineer before they may be installed in post-tensioned slabs. Expansion bolts will not be permitted for use on concrete curbs or along the edge of concrete or a concrete joint.

2.5 FABRICATION

A. Rails

1. Metal handrails and railings shall be fabricated by firms or shops experienced and skilled in the custom fabrication of architectural metal handrails and railings, and shall meet the quality requirements of NAAMM's Pipe Railing Manual.

2. Bends in rails shall be precision-formed to a smooth continuous radius by skilled workers. Work quality and finish shall be true to detail. Butt joints shall have internal tube sleeve or dowel. Ends shall be closed with similar materials, welded and ground smooth.

3. Steel welded connections shall be made in accordance with applicable requirements of the AWS Structural Welding Code. Welding shall be performed in the shop unless otherwise indicated. Welded joints of handrails and railings shall be ground and dressed smooth to match adjacent surfaces and so that the shape and profile of the item welded is maintained.

4. Metal handrails and railings shall be prefabricated and preassembled in the factory or shop as far as practicable.

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 work true to line and level with accurate angles and surfaces.

D. 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. 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 flux immediately.

4. At exposed connections, finish exposed surfaces smooth and blended so no roughness shows after finishing and welded surface matches contours of adjoining surfaces.

E. Form changes in direction by bending or by inserting prefabricated elbow fittings.

F. Bend members in jigs to produce uniform curvature without buckling or otherwise deforming exposed surfaces.

G. Close exposed ends of railing members with prefabricated end fittings.

H. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated.

2.6 GALVANIZING

A. Ferrous metal railings and related items on the exterior of the building, or as otherwise indicated, shall be galvanized, after fabrication, by the hot-dip process in accordance with ASTM A123 and ASTM A385. Weight of zinc coating shall conform with requirements specified under “Weight of Coating” in ASTM A123.

B. Safeguarding against steel embrittlement: conform with applicable requirements of ASTM A143.

C. Safeguarding against warpage and distortion of steel members: conform with applicable requirements of ASTM A384.

D. Shop galvanized metalwork necessitating field welding which in any manner removes original galvanizing shall be restored by galvanizing repair in accordance with ASTM A780.

E. Bolts and screws for attachment of galvanized items shall be galvanized in accordance with ASTM A153, or of compatible, non-corrodible material.

2.7 FINISHES

A. Comply with NAAMM’s “Metal Finishes Manual for Architectural and Metal Products” for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: 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 exposed fasteners with finish matching appearance, including color and texture, of handrails and railings.

E. Primer

1. Galvanized Steel: Two component polyvinyl-butyral primer (Pretreatment Primer/Reactive Primer) specifically formulated for galvanized surfaces per manufacturer’s instructions, “Etch Primer”.

2. Plain Steel: Red oxide rust-inhibitive alkyd primer. Water-based acrylic and latex primers shall not be utilized. Stainless Steel: None.

F. Paint

1. Waterborne paint, acrylic or modified acrylic, suitable for use on exterior metal surfaces.

2. Color and finish: As indicated on the Drawings or as selected by Owner.

3. Drying time. Dry-to-touch time shall be a maximum of one hour, and the dry-to-recoat time shall be a maximum of 4 hours when tested in accordance with ASTM D1640.

2.8 GROUT AND ANCHORING CEMENT

A. Non-shrink, Nonmetallic Grout: Premixed, factory-packaged, non-staining, noncorrosive, nongaseous grout, ASTM C1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.

B. Interior Anchoring Cement: Factory-packaged, non-shrink, non-staining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound. Use for interior applications only.

C. Erosion-Resistant Anchoring Cement: Factory-packaged, non-shrink, non-staining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound. Provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended by manufacturer for exterior use.

PART 3 EXECUTION

3.1 GENERAL

A. Install metal handrails and railings as indicated and in accordance with the approved Shop Drawings, using workers skilled and experienced in the installation of the type of work involved. Conform with installation requirements of NAAMM's Pipe Railing Manual, as applicable.

B. Install metal handrails and railings with accessories furnished by the railing fabricator as required for complete and finished railing installations. The rail elements shall be erected to produce a smooth, continuous rail.

C. Installation of handrails and railings shall be in accordance with approved Shop Drawings, true and horizontal, perpendicular, or at the required angle, as the case may be, level and square, with angles and edges parallel with related lines of the building or structure. Include all fittings and components, sleeves, hardware, backing plates, and accessories as required for complete and finished handrail installations.

D. Fill vent and drain holes that will be exposed in finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.

3.2 INSTALLATION

A. Concrete Mounting

1. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.

2. 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.

3. Set posts plumb within a tolerance of 1/16 inch in 3 feet.

4. 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.

5. Anchor posts in concrete by inserting into formed or core-drilled holes and grouting annular space.

B. Wall Mounting

1. Attach railings to wall with wall brackets. Use type of bracket with flange tapped for concealed anchorage to threaded hanger bolt.

2. Secure wall brackets and railing end flanges to building construction as follows:

a. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.

b. For hollow masonry anchorage, use toggle bolts.

c. For steel-framed partitions, use hanger or lag bolts set into wood backing between studs.

C. Coordinate with stud installation to locate backing members.

3.3 GALVANIZING REPAIR

A. Repair galvanized surfaces which have become damaged from welding, handling, or installation immediately after installation in accordance with ASTM A780.

3.4 CLEANING AND PAINTING

A. Clean galvanized railings in accordance with ASTM D2092.

B. Prior to site surface preparation and coating applications, remove, mask, or otherwise protect, finished work, hardware, hardware accessories, and other such items not to be coated. Restore surfaces contaminated by coating materials, to original condition and repair damaged items.

C. All surfaces of metal handrails and railings shall be cleaned and treated to assure maximum paint adherence, prior to application of the shop prime coat, in accordance with SSPC-SP 1, SSPC-SP 3, SSPC-SP 10, SSPC-SP 11 as applicable for the type of substrate, exposure, and application.

D. Ferrous metalwork shall be given a shop coat of rust-inhibitive metal primer, or other approved rust-inhibitive metal primer standard with the railing manufacturer.

E. After installation, exposed painted surfaces, field welds, and other abraded or damaged primed surfaces shall be prepared as required and touched up with an additional coat of the same primers for ferrous and galvanized surfaces as hereinbefore specified for shop painting.

F. Lightly sand and feather out such damaged surfaces so that paint touch-up becomes invisible.

3.5 ADJUSTING AND CLEANING

A. Do not cut or abrade finishes that cannot be completely restored in the field. Return items with such finishes to the shop for required alterations, followed by complete refinishing, or provide new units as required.

END OF SECTION

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SECTION 061000 - ROUGH CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division - 1 Specification sections, apply to work of this section.

1.2 DESCRIPTION OF WORK:

A. The extent of Rough Carpentry work is shown on the drawings, including schedules, notes and details; it includes framing, sheathing, blocking, nailers, decking, and other carpentry work not specified as part of other sections.

B. The following work is specified elsewhere; Finished Carpentry, Wood Treatment, elsewhere in Division 6. Heavy Timber (solid wood framing 5"x 5" or larger) elsewhere in Division 6. Gypsum drywall in Division 9.

1.3 QUALITY ASSURANCE:

A. Codes and Standards: Comply with provisions of following, except as otherwise indicated.

1. Lumber standards: Comply with PS 20 "American Softwood Lumber Standard" and with applicable rules of the respective grading and inspecting agencies for species and proucts indicated.

2. Plywood Product Standards: Comply with PSI (ANSI A 199.1), with applicable APA Performance Standard.

3. National Forest Products Association, NFPA, "National Design Specification and Design Values for Wood Construction".

B. Factory-mark each piece of lumber and plywood with type, grade, mill and grading agency, except omit marking from surfaces to be exposed with transparent finish or without finish.

1.4 PRODUCT HANDLING:

A. Delivery and Storage: Keep materials dry at all times. Protect against exposure to weather and contact with damp or wet surfaces. Stack lumber and plywood, and provide air circulation within stacks.

1.5 JOB CONDITIONS:

A. Coordination: Fit carpentry to other work. Scribe and cope as required for accurate fit. Correlate location of furring, nailers, blocking grounds and similar supports to allow proper attachment of other work.

B. Time delivery and installation of carpentry work to avoid delaying other trades whose work is dependent on or attached by the carpentry work.

C. Installer must examine all parts of the supporting structure and the conditions under which the carpentry work is to be installed and notify the contractor in writing of any conditions detrimental to the proper and timely completion of the work. Do not proceed with the installation until unsatisfactory conditions have been corrected in a manner acceptable to the Installer.

PART 2 PRODUCTS

2.1 LUMBER MATERIALS:

A. Dimension Lumber General: Nominal sizes are indicated except as shown by detail dimensions; provide lumber complying with grading rules of Section 10 of PS 20, ASTM D 245, ASTM D 2555.

B. Provide dressed lumber, S4S, unless otherwise shown.

C. Provide seasoned dimension lumber with 19% maximum moisture content at time of dressing and complying with PS 20.

D. Lumber used for joists, rafters, beams, columns and 2 x 6 or 2 x 8 studs shall be entirely of one species which shall not be less than No. 2 grade and shall have a minimum modulus of elasticity (E) of 1,400,000 PSI and a single member fiber stress in bending (Fb) of 900 PSI.

E. All 2 x 4 stud framing in walls and partitions shall be not less than stud of standard grade or better and shall have a compressive stress parallel to grain (Fc) of not less than 600 PSI.

F. Concealed boards (less than 2" thick): Where boards will be concealed by other work, provide any species graded Construction Boards (WWPA). Provide sizes indicated.

G. Miscellaneous Lumber: Provide wood for support or attachment of other work including cant strips, bucks, nailers, blocking, furring, grounds, stripping, and similar members. Provide lumber of sizes shown or specified. Provide construction grade boards (WCLB) or No. 2 boards (WWPA).

2.2 PLYWOOD MATERIALS:

A. Identify each plywood panel with appropriate APA, American Plywood Association, trademark.

B. Concealed Performance - Rated Plywood: Where plywood panels will be used for the following concealed types of applications, provide APA Performance - rated panels complying with requirements indicated for grade designation, span rating, exposure durability classification, edge detail (where applicable) and thickness.

1. Wall Sheathing: APA rated sheathing, NCX fire retardant treated where shown. Exposure durability classification: Exterior; span rating: As required to suit stud spacing indicated.

2. Roof Sheathing: APA rated sheathing, NCX fire retardant treated where shown . Exposure durability classification: Exterior; span rating: As required to suit rafter spacing indicated.

3. Subflooring: APA rated plywood, NCX fire retardant treated where shown . Exposure durability classification: Exterior; span rating: As required to suit joist spacing indicated.

C. Plywood Backing Panels: For mounting electrical or telephone equipment, provide fire-retardant treated plywood panels with grade destination, APA C-D Plugged INT with exterior glue, in thickness indicted, or, if not otherwise indicated not less than 1/2".

2.3 MISCELLANEOUS MATERIALS:

A. Fasteners and Anchorages: Provide size, type, material and finish as indicted and as recommended by applicable standards, complying with applicable Federal Specifications for nails, staples, screws, bolts, nuts, washers and anchoring devices. Provide metal hangers and framing anchors of the size and type recommended by the manufacturer for each use including recommending nails.

B. Where rough carpentry work is exposed to weather, in ground contact, or in areas of high relative humidity, provide fasteners and anchorages with a hot-dip zinc coating (ASTM A 153).

C. Building Paper: Asphalt saturated felts, non-perforated, ASTM D 226.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION

A. Discard units of material with defects which might impair quality of work, and units which are too small to fabricate. Work with minimum joints or optimum joint arrangement.

B. Set carpentry work accurately to required levels and lines, with members plumb and true and accurately cut and fitted.

C. Securely attach carpentry work to substrate by anchoring and fastening as shown and as required by recognized standards. Countersink nail heads on exposed carpentry work and fill holes.

D. Use common wire nails, except as otherwise indicated. Use finishing nails for finish work. Select fasteners of size that will not penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting of wood; predrill as required.

E. Provide framing members of sizes and on spacings shown, and frame openings as shown, or if not shown, comply with recommendations of "Manual for Housing Framing" of National Forest Products Association. Do not splice structural members between supports.

F. Anchor and nail as shown, and to comply with Appendix E of Basic Building Code and "Recommended Nailing Schedule" of "Manual for House Framing" and other recommendations of the N.F.P.A.

G. Firestop concealed spaces with wood blocking not less than 2" thick, if not blocked by other framing members. Provide blocking at each building story level and at ends of joist spans.

3.02 WOOD GROUNDS, NAILERS, BLOCKING:

A. Provide wherever shown and where required for screeding or attachment of other work. Form to shapes as shown and cut as required for the line and level of work to be attached. Coordinate location with others involved.

B. Attach to substrates as required to support applied loading. Countersink bolts and nuts flush with surfaces, unless otherwise shown. Build into formwork before concrete placement.

3.3 STUD FRAMING:

A. General: Provide stud framing where shown. Unless otherwise shown, use 2" x 6" wood studs spaced 16" o.c. Provide single bottom plate and double-top plates 2" thick by width of studs, except single plates may be used for non-load-bearing partitions. Nail or anchor plates to supporting construction.

B. Construct corners and intersections with not less than 3 studs. Provide miscellaneous blocking and framing as shown and as required for support of facing materials, fixtures, specialty items and trim.

C. Frame openings with multiple studs and headers. Provide nailed header members of thickness equal to width of studs. Set headers on edge and support on jamb studs.

D. Provide continuous horizontal blocking row at 4'-0" intervals, at joints in sheathing, as shown using 2" thick members of same width as wall partitions.

3.4 JOIST FRAMING:

A. General: Provide framing of sizes and spacings shown. Install with crown edge up and support ends of each member with not less than 3-1/2" of bearing. Attach to wood bearing members by toe nailing or metal connectors; frame to wood supporting members with wood ledgers as shown, or if not shown, with metal connectors. Frame openings with headers and trimmers supported by metal joist hangers; double headers and trimmers where span of header exceeds 4'-0". Do not notch in middle third of joists; limit notches to 1/6 depth of joist, 1/3 at ends. Do not bore holes larger than 1/3 depth of joist or locate closer than 2" from top or bottom. Provide solid blocking (2" thick by depth of joist) at ends of joists unless nailed to header or band member.

B. Lap members framing from opposite sides of beams, girders or partitions not less than 4" or securely tie opposing members together. Provide solid blocking (2" thick by depth of joist) over supports.

C. Under non-load bearing partitions provide double joists separated by solid blocking equal to depth of studs above.

3.5 RAFTER AND CEILING JOIST FRAMING:

A. Ceiling Joists: Provide member size and spacing shown, and as previously specified for joist framing.

B. Provide special framing as shown for eaves, overhangs and similar conditions.

3.6 INSTALLATION OF PLYWOOD:

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A. General: Comply with applicable recommendations contained in form No. E 304 "APA Design/ Construction Guide - Residential and Commercial" for types of plywood products indicated.

3.7 FASTENING METHODS:

A. Wall sheathing: Nail edges and ends to framing.

B. Roof Sheathing: Nail along panel edges and at intermediate supports. Provide support at unsupported long edges with "Plyclips" or wood blocking.

C. Subflooring: Nail at panel ends and at intermediate supports.

END OF SECTION 061000

SECTION 06 1600 - SHEATHING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Wall sheathing.

1.2 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Resistance Ratings: As tested according to ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

2.2 WALL SHEATHING

A. Glass-Mat Gypsum Sheathing: ASTM C 1177/1177M.

1. Type and Thickness: Type X, 5/8 inch (15.9 mm) thick.

2.3 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.

1. Provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.

2.4 SHEATHING JOINT-AND-PENETRATION TREATMENT MATERIALS

A. Sealant for Glass-Mat Gypsum Sheathing: Silicone emulsion sealant complying with ASTM C 834, compatible with sheathing tape and sheathing and recommended by tape and sheathing manufacturers for use with glass-fiber sheathing tape and for covering exposed fasteners.

1. Sheathing Tape: Self-adhering glass-fiber tape, minimum 2 inches (50 mm) wide, 10 by 10 or 10 by 20 threads/inch (390 by 390 or 390 by 780 threads/m), of type recommended by sheathing and tape manufacturers for use with silicone emulsion sealant in sealing joints in glass-mat gypsum sheathing and with a history of successful in-service use.

2.5 MISCELLANEOUS MATERIALS

A. Adhesives for Field Gluing Panels to Wood Framing: Formulation complying with ASTM D 3498 that is approved for use with type of construction panel indicated by manufacturers of both adhesives and panels.

1. Adhesives shall have a VOC content of 50 g/L or less.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.

B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.

C. Securely attach to substrate by fastening as indicated, complying with the following:

1. Table 2304.9.1, "Fastening Schedule," in the ICC's International Building Code.
2. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in the ICC's International Residential Code for One- and Two-Family Dwellings.
3. ICC-ES evaluation report for fastener.

D. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.

3.2 GYPSUM SHEATHING INSTALLATION

A. Comply with GA-253 and with manufacturer's written instructions.
1. Fasten gypsum sheathing to wood framing with screws.
2. Install panels with a 3/8-inch (9.5-mm) gap where non-load-bearing construction abuts structural elements.
3. Install panels with a 1/4-inch (6.4-mm) gap where they abut masonry or similar materials that might retain moisture, to prevent wicking.

B. Seal sheathing joints according to sheathing manufacturer's written instructions.

1. Apply elastomeric sealant to joints and fasteners and trowel flat. Apply sufficient amount of sealant to completely cover joints and fasteners after troweling. Seal other penetrations and openings.

2. Apply glass-fiber sheathing tape to glass-mat gypsum sheathing joints and apply and trowel sealant to embed entire face of tape in sealant. Apply sealant to exposed fasteners with a trowel so fasteners are completely covered. Seal other penetrations and openings.

END OF SECTION 06 1600

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SECTION 061753 – SHOP FABRICATED WOOD TRUSSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division - 1 Specification sections, apply to work of this section.

1.2 DESCRIPTION OF WORK:

A. The extent of prefabricated structural wood is shown on the drawings, including trusses, beams and joists.

B. The following work is specified elsewhere; Rough Carpentry in Division 6.

1.3 QUALITY ASSURANCE:

A. Codes and Standards: Comply with provisions of following, except as otherwise indicated.

1. Truss Plate Institute, TPI, "Design Specifications for Light Metal Plate Connected Wood Trusses", and "Quality Control Manual", QCM

2. National Forest Products Association, NFPA, "National Design Specifications for Wood Construction".

3. Lumber Standards: Comply with PS 20 "American Softwood Lumber Standard" and with applicable rules of the respective grading and inspecting agencies for species and products indicated.

4. Plywood Product Standards: Comply with PSI (ANSI A 199.1), with applicable APA Performance Standard.

B. Fabricator Qualifications: Fabricator must have a minimum of 3 years successful experience in the fabrication of wood trusses similar, in configuration, to those required for this project. In addition, the fabricator shall participate in the TPI Quality Assurance program or an equivalent program acceptable to the Engineer.

Truss supplier shall have sufficient production capacity to produce required units without causing delay in work.

C. For wood trusses used in the work of this project, the licensed professional engineer responsible for the design of such members shall be responsible for the implementation of his design by reviewing the fabrication process to ensure conformance with his design specifications and parameters as required by Connecticut Public Act 89-255.

D. Special Inspection: The Owner will engage the services of a qualified "Special Inspector" for this project. The Special Inspector, as a representative of the Owner, will confirm that the provisions of Section 1307.0 of the Building Code are complied with and will provide and/or supervise inspection and testing requirements, as necessary.

E. Truss fabricator shall be subject to Special Inspection requirements of the Building Code for fabrication plants and as defined in Part A and Part B below.

Part A Inspection - Verification of Capability and Quality Control: The Special Inspector will confirm that the wood truss fabricating plant has the personnel, organization, knowledge, experience, procedures, equipment, capability, and commitment to produce fabricated trusses of the required quality of the category of truss work involved in the project. The basis of inspection will be TPI's "Quality Assurance Procedures Manual for In-Plant Inspection" and "Quality Standard for Metal Plate Connected Wood Trusses (QST)".

A wood truss fabricator that is Certified under the TPI Quality Assurance Inspection Program may be exempted from Part A.

Part B Inspection - Verification of Implementation: The Special Inspector will confirm the implementation of the design by inspecting the fabrication of wood truss load bearing connections, members or assemblies in the shop to ensure conformance with the design plans, approved shop drawings and project specifications. Inspection shall consist of one or more of the following: Observation, interviews, testing, and/or examination of records.

1.4 SUBMITTALS:

A. Shop Drawings: Submit shop drawings of trusses, showing all components and installations. Include placing drawings for all framing members indicating size, number, type, location and spacing. Indicate strapping , bracing (including sizes and connections), splices, bridging, stiffeners, accessories, connections, and details required for proper installation. **Bracing of trusses, webs and chords to be designed by the truss manufacturer or a specialty engineer retained by the contractor. Truss submittal will not be accepted without a complete bracing design.**

Reproduced copies of structural construction drawings is not acceptable. Indicate magnitude and direction of reactions at truss support locations on shop drawings. Shop drawings and calculations must bear seal and signature of structural engineer currently registered in the State of Connecticut.

1.5 PRODUCT HANDLING:

A. Trusses to be stored clear of the ground, on solid blocking located at panel points and covered from the elements. Once the covering is damaged or removed the trusses are to be installed, sheathed and protected to maintain stress graded moisture content as per specifications.

1.6 JOB CONDITIONS:

A. Coordination: Fit trusses to other work. Scribe and cope as required for accurate fit. Correlate location of furring, nailers, blocking grounds and similar supports to allow proper attachment of other work.

B. Time delivery and installation of trusses work to avoid delaying other trades whose work is dependent on or attached by the trusses work.

C. Installer must examine all parts of the supporting structure and the conditions under which the trusses are to be installed and notify the contractor in writing of any conditions

detrimental to the proper and timely completion of the work. Do not proceed with the installation until unsatisfactory conditions have been corrected in a manner acceptable to the Installer.

PART 2 PRODUCTS

2.1 LUMBER MATERIALS:

A. Framing lumber: Shall be entirely of one species which shall meet stress requirements of truss design and shall be approved by professional engineer whose seal appears on shop drawings.

B. All lumber shall be stress graded according to PS 20, ASTM D245, ASTM D2555.

C. All lumber shall be seasoned to maximum 19% moisture content.

D. Lumber shall be grade marked to show conformity to specifications and professional engineer's design.

2.2 METAL CONNECTOR PLATE MATERIALS:

A. Galvanized sheet steel: ASTM A446, Grade A, Coating G60.

B. Electrolytic zinc coated steel: ASTM A59; coating class C, with minimum structural quality equivalent to ASTM A 446, Grade A.

C. Stainless Steel; ASTM A 167, Type 304, with minimum structural quality equivalent to ASTM A446, Grade A.

2.3 FABRICATION:

A. Provide pre-engineered and shop-assembled trusses by a recognized manufacturer of wood trusses. Design for the span, loading, truss shape, and spacing shown. Fabricate in manufacturer plants or his licensed fabricator's plant.

B. Fasteners and accessories shall conform to the requirements of TPI; and manufacturer.

2.4 CERTIFICATES OF COMPLIANCE:

A. Certificates of Compliance: Submit to the Special Inspector, the fabricator's Certificate of Compliance indicating type and grade of lumber used. A Certificate of Compliance shall also be submitted to the Special Inspector for metal connector plates used in the fabrication of wood trusses provided for this project. In addition submit evidence of fabricator's participation in a quality assurance program as acceptable to the Engineer.

PART 1 - PART 3 - EXECUTION

3.1 INSTALLATION:

A. Store, handle, and erect trusses in accordance with manufacturer's printed instructions.

B. Provide temporary supports and bracing per manufacturer's and TPI "Bracing Wood Trusses: Commentary and Recommendations".

C. Refer to framing plans for proper location and spacing of trusses.

D. Do not alter any part of any truss for any reason.

E. Trusses which do not meet interior bearing walls should be shimmed. Do not pull trusses down.

3.2 FASTENING:

A. Fastening shall be to framing as shown.

END OF SECTION 061753

SECTION 06 4116 – PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior cabinets
2. Solid Surface countertops
3. Wood furring, blocking, shims, and hanging strips for installing interior architectural woodwork items that are not concealed within other construction.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For interior architectural woodwork.

1. Include plans, elevations, sections, and attachment details.

C. Samples: For each exposed product and for each color and finish specified.

1.3 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.

1.4 FIELD CONDITIONS

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

PART 2 - PRODUCTS

2.1 INTERIOR ARCHITECTURAL WOODWORK, GENERAL

A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades of interior architectural woodwork indicated for construction, finishes, installation, and other requirements.

2.2 WOOD MATERIALS

A. Composite Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of interior architectural woodwork and quality grade specified unless otherwise indicated.

1. Composite Wood Products: Products shall be made using ultra-low-emitting formaldehyde resins as defined in the California Air Resources Board's "Airborne Toxic Control Measure to Reduce Formaldehyde Emissions from Composite Wood Products" or shall be made with no added formaldehyde.
2. MDF: ANSI A208.2, Grade 130.
3. Particleboard: ANSI A208.1, Grade M-2.
4. Particleboard: Straw-based particleboard complying with requirements in ANSI A208.1, Grade M-2, except for density.
5. Softwood Plywood: DOC PS 1, medium-density overlay.
6. Veneer-Faced Panel Products (Hardwood Plywood): HPVA HP-1.

2.3 HIGH-PRESSURE DECORATIVE LAMINATE:

A. NEMA LD 3, grades as indicated or, if not indicated, as required by woodwork quality standard.
1. Available Manufacturers: Subject to compliance with requirements, provide high-pressure decorative laminate as manufactured by one of the following, or approved equal:
a. Lab Designs
b. Wilsonart International
c. Formica Corporation

2.4 CABINET HARDWARE AND ACCESSORIES

A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets. Provide cabinet hardware meeting ANSI/BHMA Grade 1 requirements.

B. Cabinet Drawer and Door Pulls at Plastic Laminate Cabinetwork: Satin Nickel wire Cabinet Pull, Hafele #116.07.622.

C. Adjustable Shelf Supports: Provide flush-mounted pilaster-type slotted stainless steel standards Knape and Vogt #87, Knape and Vogt #187 where indicated. Finish satin. Provide matching shelf brackets.

D. Shelf Pins: Knape and Vogt Anochrome 331 shelf support.

E. Hinges: Häfele Aximat 300 Series zinc alloy hinge at flush overlay doors, with integral adjustment screws and with internal catch. Provide special hinges from Häfele Aximat 300 Series for glass doors and for hinges at thin panel material. Hinges must be adjustable without removing screws.
1. Provide stainless steel hinges where non-magnetic hinges are required.

2.5 SOLID SURFACE COUNTERTOPS

A. Solid Surfacing Material: Homogeneous solid sheets of filled plastic resin complying with material and performance requirements in ANSI Z124.3 for Type 5 or Type 6, without a precoated finish

B. Quality Standard: Comply with AWS Section 11 requirements for solid surface countertops.
   1. Grade: Premium

C. Manufacturer: DuPont Corian, Wilsonart, Formica Solid Surfacing, LG Hi-Macs

2.6 PLASTIC-LAMINATE CABINETS

A. Quality Standard: Comply with AWS Section 10 requirements for laminate cabinetwork.
   1. Grade: Custom

B. AWS Type of Cabinet Construction: Style 1 flush overlay on Type A frameless cabinet body, with laminated square edges on doors and drawer fronts.

C. Panel Material: Medium density overlay, exterior type, or veneer plywood.

D. Laminate Cladding for Exposed and Semi-exposed Surfaces: High-pressure decorative laminate complying with the following requirements.
   1. Horizontal Surfaces Other Than Tops: Grade HGS.
   2. Postformed Surfaces: Grade HGP.
   3. Vertical Surfaces: Grade HGS.
   4. Edges, including all four edges of adjustable shelves: Grade HGS.
   5. Drawer Bottoms: Hardwood plywood.

2.7 COUNTERTOP SUPPORT BRACKETS

A. Material: Fabricate components from extruded aluminum sections complying with ASTM B221, 6063-T5 alloy and temper.

B. Type: Support brackets fabricated by welding miter cut extruded aluminum sections, grinding and deburring sharp edges and welds, drilling holes for field attachment, and factory finishing.

C. Manufacturer; Rakks Shelving Systems and Support Brackets by Rangine Corp. or approved equal by Architect.
   1. Description: Surface mounted counter brackets with a 2” x 2” x 1/4" L-shaped vertical leg.
      a. Model: EH-1824 – For 30-inch deep work surface.
      b. Model: EH-1818 – For 24-inch deep work surface.

D. Factory applied finishes: Exposed aluminum surfaces shall be free of scratches and other serious blemishes and be factory finished with electrostatically applied, custom color selected by Architect, powder paint coating complying with AAMA 605.2.

2.8 MISCELLANEOUS MATERIALS

A. Furring, Blocking, Shims, and Nailers: Softwood or hardwood lumber, kiln-dried to less than 15 percent moisture content.

B. Provide self-drilling screws for metal-framing supports, as recommended by metal-framing manufacturer.

C. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.

D. Adhesives: Use adhesives that meet the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

E. Installation Adhesive: Product recommended by fabricator for each substrate for secure anchorage.

1. Adhesives shall have a VOC content of 70 g/L or less.

2.9 FABRICATION

A. Sand fire-retardant-treated wood lightly to remove raised grain on exposed surfaces before fabrication.

B. Complete fabrication, including assembly, 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 allowance for scribing, trimming, and fitting.

2.10 SHOP PRIMING

A. Interior Architectural Woodwork for Transparent Finish: Shop seal with stain (if required), other required pretreatments, and first coat of finish as specified in Section 099300 "Staining and Transparent Finishing."

B. Preparations for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing interior architectural woodwork, as applicable to each unit of work.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Before installation, condition interior architectural woodwork to average prevailing humidity conditions in installation areas.

B. Grade: Install interior architectural woodwork to comply with same grade as item to be installed.

C. Install interior architectural woodwork level, plumb, true in line, and without distortion. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches (3 mm in 2400 mm).

D. Scribe and cut interior architectural woodwork to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

E. Anchor interior architectural woodwork to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing. Use fine finishing nails for exposed fastening, countersunk and filled flush with interior architectural woodwork.

1. For shop-finished items, use filler matching finish of items being installed.

F. Touch up finishing work specified in this Section after installation of interior architectural woodwork. Fill nail holes with matching filler where exposed.

END OF SECTION 06 4023

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SECTION 07 1113 - BITUMINOUS DAMPPROOFING

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. Cold-applied, emulsified-asphalt dampproofing.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 FIELD CONDITIONS

A. Weather Limitations: Proceed with application only when existing and forecasted weather conditions permit dampproofing to be performed according to manufacturers' written instructions.

B. Ventilation: Provide adequate ventilation during application of dampproofing in enclosed spaces. Maintain ventilation until dampproofing has cured.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain primary dampproofing materials and primers from single source from single manufacturer. Provide drainage panels and auxiliary materials recommended in writing by manufacturer of primary materials.

2.2 PERFORMANCE REQUIREMENTS

A. VOC Content: Products shall comply with VOC content limits of authorities having jurisdiction unless otherwise indicated.

2.3 COLD-APPLIED, EMULSIFIED-ASPHALT DAMPPROOFING

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

1. BASF Corporation; Construction Systems
2. Euclid Chemical Company (The); an RPM Company
3. Henry Company
4. Karnak Corporation
5. W.R. Meadows, Inc.

B. Trowel Coats: ASTM D 1227, Type II, Class 1.

C. Fibered Brush and Spray Coats: ASTM D 1227, Type II, Class 1.

D. Brush and Spray Coats: ASTM D 1227, Type III, Class 1.

2.4 AUXILIARY MATERIALS

A. Furnish auxiliary materials recommended in writing by dampproofing manufacturer for intended use and compatible with bituminous dampproofing.

B. Cut-Back-Asphalt Primer: ASTM D 41/D 41M.

C. Emulsified-Asphalt Primer: ASTM D 1227, Type III, Class 1, except diluted with water as recommended in writing by manufacturer.

D. Asphalt-Coated Glass Fabric: ASTM D 1668/D 1668M, Type I.

E. Patching Compound: Epoxy or latex-modified repair mortar of type recommended in writing by dampproofing manufacturer.

F. Protection Course: ASTM D 6506, semirigid sheets of fiberglass or mineral-reinforced-asphaltic core, pressure laminated between two asphalt-saturated fibrous liners.

1. Thickness: Nominal [1/8 inch (3 mm)] [1/4 inch (6 mm)].
2. Adhesive: Rubber-based solvent type recommended in writing by waterproofing manufacturer for protection course type.

G. Protection Course: Fan folded, with a core of extruded-polystyrene board insulation faced on one side with plastic film, nominal thickness 1/4 inch (6 mm), with a compressive strength of not less than 8 psi (55 kPa) per ASTM D 1621, and maximum water absorption by volume of 0.6 percent per ASTM C 272/C 272M.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements for surface smoothness, maximum surface moisture content, and other conditions affecting performance of the Work.

B. Proceed with application only after substrate construction and penetrating work have been completed and unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean, prepare, and treat substrates according to manufacturer's written instructions. Provide clean, dust-free, and dry substrates for dampproofing application.

B. Mask or otherwise protect adjoining exposed surfaces from being stained, spotted, or coated with dampproofing. Prevent dampproofing materials from entering and clogging weep holes and drains.

C. Clean substrates of projections and substances detrimental to dampproofing work; fill voids, seal joints, and remove bond breakers if any.

D. Apply patching compound to patch and fill tie holes, honeycombs, reveals, and other imperfections.

3.3 APPLICATION, GENERAL

A. Comply with manufacturer's written instructions for dampproofing application, cure time between coats, and drying time before backfilling unless otherwise indicated.

1. Apply dampproofing to provide continuous plane of protection.
2. Apply additional coats if recommended in writing by manufacturer or to achieve a smooth surface and uninterrupted coverage.

B. Where dampproofing footings and foundation walls, apply from finished-grade line to top of footing; extend over top of footing and down a minimum of 6 inches (150 mm) over outside face of footing.

1. Extend dampproofing 12 inches (300 mm) onto intersecting walls and footings, but do not extend onto surfaces exposed to view when Project is completed.
2. Install flashings and corner protection stripping at internal and external corners, changes in plane, construction joints, cracks, and where indicated as "reinforced," by embedding an 8-inch- (200-mm-) wide strip of asphalt-coated glass fabric in a heavy coat of dampproofing. Dampproofing coat for embedding fabric is in addition to other coats required.

C. Where dampproofing exterior face of inner wythe of exterior masonry cavity walls, lap dampproofing at least 1/4 inch (6 mm) onto flashing, masonry reinforcement, veneer ties, and other items that penetrate inner wythe.

1. Extend dampproofing over outer face of structural members and concrete slabs that interrupt inner wythe.
2. Lap dampproofing at least 1/4 inch (6 mm) onto shelf angles supporting veneer.

D. Where dampproofing interior face of above-grade, exterior concrete walls, continue dampproofing through intersecting walls by keeping vertical mortar joints at intersection temporarily open or by dampproofing wall before constructing intersecting walls.

3.4 COLD-APPLIED, EMULSIFIED-ASPHALT DAMPPROOFING

A. Concrete Foundations: Apply two brush or spray coats at not less than 1.5 gal./100 sq. ft. (0.6 L/sq. m) for first coat and 1 gal./100 sq. ft. (0.4 L/sq. m) for second coat, or one fibered brush or spray coat at not less than 3 gal./100 sq. ft. (1.2 L/sq. m) or one trowel coat at not less than 4 gal./100 sq. ft. (1.6 L/sq. m).

3.5 PROTECTION COURSE INSTALLATION

A. Install protection course over completed-and-cured dampproofing. Comply with dampproofing-material and protection-course manufacturers' written instructions for attaching protection course.

3.6 PROTECTION

A. Protect installed insulation drainage panels from damage due to UV light, harmful weather exposures, physical abuse, and other causes. Provide temporary coverings where panels are subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

B. Correct dampproofing that does not comply with requirements; repair substrates, and reapply dampproofing.

END OF SECTION 07 1113

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. Polyisocyanurate foam-plastic board.
3. Glass-fiber blanket.

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 (TYPE X) AT CAVITY WALLS

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 X, 15-psi (173-kPa) 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. DiversiFoam Products
   b. Dow Chemical Company (The)
   c. Owens Corning

2. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.

2.2 EXTRUDED POLYSTYRENE FOAM-PLASTIC BOARD (TYPE IV) AT FOUNDATIONS

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 (173-kPa) 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. DiversiFoam Products
   b. Dow Chemical Company (The)
   c. Owens Corning

2. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.

2.3 POLYISOCYANURATE FOAM-PLASTIC BOARD AT ROOF

A. Polyisocyanurate Board, Glass-Fiber-Mat Faced: ASTM C 1289, glass-fiber-mat faced, Type II, Class 2.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Carlisle Coatings & Waterproofings, Inc.
   b. Dow Chemical Company (The)
   c. Hunter Panels

d. Rmax, Inc.

2. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.

2.4 GLASS-FIBER BLANKET

A. Glass-Fiber Blanket Insulation, Polypropylene-Scrim-Kraft Faced: ASTM C665, Type II (nonreflective faced), Class A (faced surface with a flame-spread index of 25 or less); Category 1 (membrane is a vapor barrier).

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. CertainTeed Corporation
   b. Johns Manville; a Berkshire Hathaway Company
   c. Knauf Insulation
   d. Owens Corning

2.5 ACCESSORIES

A. Insulation for Miscellaneous Voids:

1. Spray Polyurethane Foam Insulation: ASTM C 1029, Type II, closed cell, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E 84.

B. 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.

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 vertical slab edge and 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 36 inches (915 mm) below exterior grade line.

B. On horizontal surfaces, loosely lay insulation units according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.

1. If not otherwise indicated, extend insulation a minimum of 36 inches (915 mm) in from exterior walls.

3.4 INSTALLATION OF FOUNDATION WALL INSULATION

A. Butt panels together for tight fit.

B. Anchor Installation: Install board insulation on concrete substrates by adhesively attached, spindle-type insulation anchors as follows:

1. Fasten insulation anchors to concrete substrates with insulation anchor adhesive according to anchor manufacturer's written instructions. Space anchors according to insulation manufacturer's written instructions for insulation type, thickness, and application.
2. Apply insulation standoffs to each spindle to create cavity width indicated on Drawings between concrete substrate and insulation.
3. After adhesive has dried, install board insulation by pressing insulation into position over spindles and securing it tightly in place with insulation-retaining washers, taking care not to compress insulation.
4. Where insulation will not be covered by other building materials, apply capped washers to tips of spindles.

C. Adhesive Installation: Install with adhesive or press into tacky waterproofing or dampproofing according to manufacturer's written instructions.

3.5 INSTALLATION OF CAVITY-WALL INSULATION

A. Foam-Plastic Board Insulation: Install pads of adhesive spaced approximately 24 inches (610 mm) o.c. both ways on inside face and as recommended by manufacturer. Fit courses of insulation between wall ties and other obstructions, with edges butted tightly in both directions. Press units firmly against inside substrates.

1. Supplement adhesive attachment of insulation by securing boards with two-piece wall ties designed for this purpose and specified in Section 04 2000 "Unit Masonry."

3.6 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 (76-mm) clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
4. Attics: Install eave ventilation troughs between roof framing members in insulated attic spaces at vented eaves.
5. For metal-framed wall cavities where cavity heights exceed 96 inches (2438 mm), support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.
6. For wood-framed construction, install blankets according to ASTM C 1320 and as follows:

    a. With faced blankets having stapling flanges, lap blanket flange over flange of adjacent blanket to maintain continuity of vapor retarder once finish material is installed over it.

3.7 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 07 2100

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SECTION 07 2726 - FLUID-APPLIED MEMBRANE 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:

1. Vapor-retarding, fluid-applied air barriers.

2. Vapor-permeable, fluid-applied 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 accessories 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.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include manufacturer's written instructions for evaluating, preparing, and treating each substrate; technical data; dry film thickness; and tested physical and performance properties of products.

B. Shop Drawings: For air-barrier assemblies.

1. Show locations and extent of air-barrier materials, accessories, and assemblies specific to Project conditions.
2. Include details for substrate joints and cracks, counterflashing strips, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.
3. Include details of interfaces with other materials that form part of air barrier.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. 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 the barrier.

C. Product Test Reports: For each air-barrier assembly, for tests performed by a qualified testing agency.

D. Field quality-control reports.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1. Installer shall be licensed by ABAA according to ABAA's Quality Assurance Program and shall employ ABAA-certified installers and supervisors on Project.

1.8 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing on field mockups.

B. Mockup Testing: Air-barrier assemblies shall comply with performance requirements indicated, as evidenced by reports based on mockup testing by a qualified testing agency.

1. Air-Leakage-Location Testing: Mockups will be tested for evidence of air leakage according to ASTM E 1186, chamber pressurization or depressurization with smoke tracers.
2. Air-Leakage-Volume Testing: Mockups will be tested for air-leakage rate according to ASTM E 2357.
3. Adhesion Testing: Mockups will be tested for required air-barrier adhesion to substrate according to ASTM D 4541.
4. Notify Architect seven days in advance of the dates and times when mockups will be tested.

1.9 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.

1.10 FIELD CONDITIONS

A. Environmental Limitations: Apply air barrier within the range of ambient and substrate temperatures recommended in writing 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.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Source Limitations: Obtain primary air-barrier materials and air-barrier accessories from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Air-Barrier Performance: Air-barrier assembly and seals with adjacent construction shall be capable of performing as a continuous 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, tie-ins to installed waterproofing, 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. (0.2 L/s x sq. m of surface area at 75 Pa), when tested according to ASTM E 2357.

2.3 HIGH-BUILD AIR BARRIERS, VAPOR RETARDING (MASONRY BACKUP)

A. High-Build, Vapor-Retarding Air Barrier: synthetic polymer membrane with an installed dry film thickness, according to manufacturer's written instructions, of 35 mils (0.9 mm) or thicker over smooth, void-free substrates.

1. Synthetic Polymer Type:

a. Manufacturers: Subject to compliance with requirements, provide a product by one of the following:
1) DuPont de Nemours, Inc.
2) GCP Applied Technologies
3) Henry Company
4) Tremco, Inc.

2. Physical and Performance Properties:

a. Air Permeance: Maximum 0.004 cfm/sq. ft. of surface area at 1.57-lbf/sq. ft. (0.02 L/s x sq. m of surface area at 75-Pa) pressure difference; ASTM E 2178.
b. Vapor Permeance: Maximum 0.1 perm (5.8 ng/Pa x s x sq. m); ASTM E 96/E 96M, Desiccant Method.
c. Ultimate Elongation: Minimum 500 percent; ASTM D 412, Die C.
d. Adhesion to Substrate: Minimum 30 lbf/sq. in. (207 kPa) when tested according to ASTM D 4541.
e. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.
f. UV Resistance: Can be exposed to sunlight for 180 days according to manufacturer's written instructions.

2.4 HIGH-BUILD AIR BARRIERS, VAPOR PERMEABLE (STUD BACKUP)

A. High-Build, Vapor-Permeable Air Barrier: synthetic polymer membrane with an installed dry film thickness, according to manufacturer's written instructions, of 35 mils (0.9 mm) or thicker over smooth, void-free substrates.

1. Synthetic Polymer Type:

a. Manufacturers: Subject to compliance with requirements, provide a product by one of the following:
1) DuPont de Nemours, Inc.
2) GCP Applied Technologies
3) Henry Company
4) Tremco, Inc.

2. Physical and Performance Properties:

a. Air Permeance: Maximum 0.004 cfm/sq. ft. of surface area at 1.57-lbf/sq. ft. (0.02 L/s x sq. m of surface area at 75-Pa) pressure difference; ASTM E 2178.
b. Vapor Permeance: Maximum 10 perms (580 ng/Pa x s x sq. m); ASTM E 96/E 96M, Desiccant Method, Procedure A.
c. Ultimate Elongation: Minimum 200 percent; ASTM D 412, Die C.
d. Adhesion to Substrate: Minimum 30 lbf/sq. in. (207 kPa) when tested according to ASTM D 4541.
e. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.
f. UV Resistance: Can be exposed to sunlight for 180 days according to manufacturer's written instructions.

2.5 ACCESSORY MATERIALS

A. Requirement: Provide primers, transition strips, termination strips, joint reinforcing fabric and strips, joint sealants, counterflashing strips, flashing sheets and metal termination bars, termination mastic, substrate patching materials, adhesives, tapes, foam sealants, lap sealants, and other accessory materials that are recommended in writing by air-barrier manufacturer to produce a complete air-barrier assembly and that are compatible with primary air-barrier material and adjacent construction to which they may seal.

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.
2. Verify that substrates have cured and aged for minimum time recommended in writing by air-barrier manufacturer.
3. Verify that substrates are visibly dry and free of moisture.
4. Verify that masonry joints are flush and completely filled with mortar.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SURFACE PREPARATION

A. Clean, prepare, treat, fill, and seal substrate and joints and cracks in substrate according to manufacturer's written instructions and details. 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. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.

D. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids in concrete with substrate-patching material.

E. Remove excess mortar from masonry ties, shelf angles, and other obstructions.

F. At changes in substrate plane, apply sealant or termination mastic beads at sharp corners and edges to form a smooth transition from one plane to another.

G. Cover gaps in substrate plane 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.

H. Bridge expansion joints and discontinuous wall-to-wall, deck-to-wall, and deck-to-deck joints with air-barrier accessory material that accommodates joint movement according to manufacturer's written instructions and details.

3.3 ACCESSORIES INSTALLATION

A. Install accessory materials according to air-barrier manufacturer's written instructions and details to form a seal with adjacent construction and ensure continuity of air and water barrier.

1. Coordinate the installation of air barrier with installation of roofing membrane and base flashing to ensure continuity of air barrier with roofing membrane.
2. Install transition strip on roofing membrane or base flashing so that a minimum of 3 inches (75 mm) of coverage is achieved over each substrate.
3. Unless manufacturer recommends in writing against priming, apply primer to substrates at required rate and allow it to dry.
4. Apply primer to substrates at required rate and allow it to dry. Limit priming to areas that will be covered by air-barrier material on same day. Reprime areas exposed for more than 24 hours.

B. Connect and seal exterior wall air-barrier material 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.

C. At end of each working day, seal top edge of strips and transition strips to substrate with termination mastic.

D. 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.

E. Wall Openings: Prime concealed, perimeter frame surfaces of windows, curtain walls, storefronts, and doors. Apply transition strip so that a minimum of 3 inches (75 mm) of coverage is achieved over each substrate. Maintain 3 inches (75 mm) of full contact over firm bearing to perimeter frames, with not less than 1 inch (25 mm) of full contact.

1. Transition Strip: Roll firmly to enhance adhesion.
2. Preformed Silicone Extrusion: Set in full bed of silicone sealant applied to walls, frame, and air-barrier material.

F. Fill gaps in perimeter frame surfaces of windows, curtain walls, storefronts, and doors, and miscellaneous penetrations of air-barrier material with foam sealant.

G. Seal strips and transition strips around masonry reinforcing or ties and penetrations with termination mastic.

H. Seal top of through-wall flashings to air barrier with an additional 6-inch- (150-mm-) wide, transition strip.

I. Seal exposed edges of strips at seams, cuts, penetrations, and terminations not concealed by metal counterflashings or ending in reglets with termination mastic.

J. Repair punctures, voids, and deficient lapped seams in strips and transition strips. Slit and flatten fishmouths and blisters. Patch with transition strips extending 6 inches (150 mm) beyond repaired areas in strip direction.

3.4 PRIMARY AIR-BARRIER MATERIAL INSTALLATION

A. Apply air-barrier material to form a seal with strips and transition strips and to achieve a continuous air barrier according to air-barrier manufacturer's written instructions and details. Apply air-barrier material within manufacturer's recommended application temperature ranges.

1. Unless manufacturer recommends in writing against priming, apply primer to substrates at required rate and allow it to dry.
2. Limit priming to areas that will be covered by air-barrier material on same day. Reprime areas exposed for more than 24 hours.
3. Where multiple prime coats are needed to achieve required bond, allow adequate drying time between coats.

B. High-Build Air Barriers: Apply continuous unbroken air-barrier material to substrates according to the following thickness. Apply air-barrier material in full contact around protrusions such as masonry ties.

1. Vapor-Retarding, High-Build Air Barrier: Total dry film thickness of not less than 40 mils (1.0 mm), applied in one coat.

2. Vapor-Permeable, High-Build Air Barrier: Total dry film thickness of not less than 35 mils (0.9 mm), applied in one coat.

C. Do not cover air barrier until it has been tested and inspected by testing agency.

D. Correct deficiencies in or remove air barrier that does not comply with requirements; repair substrates and reapply air-barrier components.

3.5 FIELD QUALITY CONTROL

A. ABAA Quality Assurance Program: Perform examinations, preparation, installation, testing, and inspections under ABAA's Quality Assurance Program.

B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

C. Inspections: Air-barrier materials, accessories, and installation are subject to inspection for compliance with requirements.

1. Continuity of air-barrier system has been achieved throughout the building envelope with no gaps or holes.
2. Air-barrier dry film thickness.
3. Continuous structural support of air-barrier system has been provided.
4. Masonry and concrete surfaces are smooth, clean, and free of cavities, protrusions, and mortar droppings.
5. Site conditions for application temperature and dryness of substrates have been maintained.
6. Maximum exposure time of materials to UV deterioration has not been exceeded.
7. Surfaces have been primed, if applicable.
8. Laps in strips and transition strips have complied with minimum requirements and have been shingled in the correct direction (or mastic has been applied on exposed edges), with no fishmouths.
9. Termination mastic has been applied on cut edges.
10. Strips and transition strips have been firmly adhered to substrate.
11. Compatible materials have been used.
12. Transitions at changes in direction and structural support at gaps have been provided.

13. Connections between assemblies (air-barrier and sealants) have complied with requirements for cleanliness, surface preparation and priming, structural support, integrity, and continuity of seal.
14. All penetrations have been sealed.

D. Tests: As determined by testing agency from among the following tests:

1. Air-Leakage-Location Testing: Air-barrier assemblies will be tested for evidence of air leakage according to ASTM E 1186, chamber pressurization or depressurization with smoke tracers.
2. Air-Leakage-Volume Testing: Air-barrier assemblies will be tested for air-leakage rate according to ASTM E 783 or ASTM E 2357.
3. Adhesion Testing: Air-barrier assemblies will be tested for required adhesion to substrate according to ASTM D 4541 for each 600 sq. ft. (56 sq. m) of installed air barrier or part thereof.

E. 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.

F. Repair damage to air barriers caused by testing; follow manufacturer's written instructions.

G. Prepare test and inspection reports.

3.6 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 recommended in writing by manufacturer. If exposed to these conditions for longer than recommended, remove and replace air barrier or install additional, full-thickness, air-barrier application after repairing and preparing the overexposed materials 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 in writing by manufacturer of affected construction.

C. Remove masking materials after installation.

END OF SECTION 07 2726

SECTION 07 3113 - ASPHALT SHINGLES

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. Asphalt shingles.
2. Underlayment.
3. Ridge vents.

1.3 DEFINITION

A. Roofing Terminology: See ASTM D 1079 and glossary of NRCA's "The NRCA Roofing and Waterproofing Manual" for definitions of terms related to roofing work in this Section.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each exposed product and for each color and texture specified.

1. Asphalt Shingles: Full size.

C. Samples for Initial Selection: For each type of asphalt shingle indicated.

1. Include similar Samples of accessories involving color selection.

D. Samples for Verification: For the following products, of sizes indicated:

1. Asphalt Shingles: Full size.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For each type of asphalt shingle and underlayment product indicated, for tests performed by manufacturer and witnessed by a qualified testing agency.

C. Evaluation Reports: For high-temperature, self-adhering sheet underlayment, from ICC-ES or other testing and inspecting agency acceptable to authorities having jurisdiction, indicating that product is suitable for intended use under applicable building codes.

D. Sample Warranty: For manufacturer's warranty.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For asphalt shingles to include in 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. Asphalt Shingles: 100 sq. ft. (9.3 sq. m) of each type, in unbroken bundles.

1.9 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Store roofing materials in a dry, well-ventilated location protected from weather, sunlight, and moisture according to manufacturer's written instructions.

B. Store underlayment rolls on end on pallets or other raised surfaces. Do not double stack rolls.

C. Protect unused roofing materials from weather, sunlight, and moisture when left overnight or when roofing work is not in progress.

D. Handle, store, and place roofing materials in a manner to prevent damage to roof deck or structural supporting members.

1.11 FIELD CONDITIONS

A. Environmental Limitations: Install self-adhering sheet underlayment within the range of ambient and substrate temperatures recommended in writing by manufacturer.

1.12 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace asphalt shingles that fail within specified warranty period.

1. Failures include, but are not limited to, the following:

    a. Manufacturing defects.

2. Material Warranty Period: 30 years from date of Substantial Completion, prorated, with first 10 years nonprorated.
3. Wind-Speed Warranty Period: Asphalt shingles will resist blow-off or damage caused by wind speeds of up to 100 mph (45 m/s) for 15 years from date of Substantial Completion.
4. Algae-Resistance Warranty Period: Asphalt shingles will not discolor for 15 years from date of Substantial Completion.
5. Workmanship Warranty Period: Two years from date of Substantial Completion.

B. Roofing Installer's Warranty: On warranty form at end of this Section, signed by Installer, in which Installer agrees to repair or replace components of asphalt-shingle roofing that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Exterior Fire-Test Exposure: Provide asphalt shingles and related roofing materials identical to those of assemblies tested for Class A fire resistance according to ASTM E 108 or UL 790 by Underwriters Laboratories or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify products with appropriate markings of applicable testing agency.

2.2 GLASS-FIBER-REINFORCED ASPHALT SHINGLES

A. Laminated-Strip Asphalt Shingles: ASTM D 3462/D 3462M, laminated, multi-ply overlay construction, glass-fiber reinforced, mineral-granule surfaced, and self-sealing.

1. Manufacturers: Subject to compliance with requirements, provide a product by one of the following:
    1) CertainTeed Corporation
    2) Owens Corning
    3) GAF
    4) Atlas Roofing Corporation
    5) Tamko Building Products
2. Butt Edge: Notched cut.
3. Strip Size: Manufacturer's standard.
4. Algae Resistance: Granules resist algae discoloration.
5. Impact Resistance: UL 2218, Class 4.
6. Color and Blends: Basis of design GAF Timberline, Slate.

B. Hip and Ridge Shingles: Manufacturer's standard units to match asphalt shingles.

2.3 UNDERLAYMENT MATERIALS

A. Synthetic Underlayment: UV-resistant polypropylene, polyolefin, or polyethylene polymer fabric with surface coatings or treatments to improve traction underfoot and abrasion resistance; evaluated and documented to be suitable for use as a roof underlayment under applicable codes by a testing and inspecting agency acceptable to authorities having jurisdiction.

1. Manufacturers: Subject to compliance with requirements, provide a product by one of the following:
    1) GCP Applied Technologies
    2) CertainTeed Corporation
    3) Owens Corning
    4) Tamko Building Products

B. Self-Adhering Sheet Underlayment, High Temperature: Minimum of 40-mil- (1.0-mm-) thick; with slip-resisting, polymer-film-reinforced or glass-reinforced top surface laminated to layer of butyl or SBS-modified asphalt adhesive; with release backing; cold applied; and evaluated and documented to be suitable for use for intended purpose under applicable codes by a testing and inspecting agency acceptable to authorities having jurisdiction.

1. Manufacturers: Subject to compliance with requirements, provide a product by one of the following:
    1) GCP Applied Technologies
    2) CertainTeed Corporation
    3) Owens Corning
    4) Tamko Building Products
2. Thermal Stability: Stable after testing at 240 deg F (116 deg C) according to ASTM D 1970/D 1970M.
3. Low-Temperature Flexibility: Passes after testing at minus 20 deg F (29 deg C) according to ASTM D 1970/D 1970M.

2.4 RIDGE VENTS

A. Rigid Ridge Vent: Manufacturer's standard, rigid section high-density polypropylene or other UV-stabilized plastic ridge vent for use under ridge shingles.

1. Manufacturers: Subject to compliance with requirements, provide a product by one of the following:
    1) CertainTeed Corporation
    2) Cor-A-Vent, Inc.
    3) Owens Corning
    4) GAF
    5) Tamko Building Products
2. Minimum Net Free Area: 10 inches NVFA per lineal foot.
3. Width: 11 inches.
4. Thickness: 1 inch.
5. Features:

    a. Nonwoven geotextile filter strips.
    b. External deflector baffles.

2.5 ACCESSORIES

A. Asphalt Roofing Cement: ASTM D 4586, Type II, asbestos free.

B. Roofing Nails: ASTM F 1667; aluminum, stainless-steel, copper, or hot-dip galvanized-steel wire shingle nails, minimum 0.120-inch- (3-mm-) diameter, sharp-pointed, with a minimum 3/8-inch- (9.5-mm-) diameter flat head and of sufficient length to penetrate 3/4 inch (19 mm) into solid wood decking or extend at least 1/8 inch (3 mm) through OSB or plywood sheathing.

1. Shank: Barbed.
2. Where nails are in contact with metal flashing, use nails made from same metal as flashing.

C. Synthetic-Underlayment Fasteners: As recommended in writing by synthetic-underlayment manufacturer for application indicated.

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.

1. Examine roof sheathing to verify that sheathing joints are supported by framing and blocking or metal clips and that installation is within flatness tolerances.
2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and completely anchored; and that provisions have been made for flashings and penetrations through asphalt shingles.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 UNDERLAYMENT INSTALLATION

A. General: Comply with underlayment manufacturer's written installation instructions applicable to products and applications indicated unless more stringent requirements apply.

B. Synthetic Underlayment:

1. Install on roof deck parallel with and starting at the eaves.

a. Lap sides and ends as recommended in writing by manufacturer, but not less than **4 inches (102 mm)** for side laps and 6 inches (152 mm) for end laps.
b. Stagger end laps between succeeding courses at interval recommended in writing by manufacturer, but not less than 72 inches (1829 mm).
c. Fasten with underlayment nails in accordance with manufacturer's written instructions.
d. Cover underlayment within period recommended in writing by manufacturer.

2. Install in single layer on roofs sloped at 4:12 and greater.
3. Install in double layer on roofs sloped at less than 4:12.
4. Install synthetic underlayment **on roof deck not covered** by self-adhering, polymer-modified bitumen sheet unless otherwise specified in this Section or indicated on Drawings.

    a. Lap sides of underlayment over self-adhering sheet not less than 4 inches (102 mm) in direction to shed water.
    b. Lap ends of underlayment not less than 6 inches (152 mm) over self-adhering sheet.

5. Install fasteners in a grid pattern of 12 inches (305 mm) between side laps with 6-inch (152-mm) spacing at side and end laps.
6. Terminate synthetic underlayment **extended up not less than 4 inches (102 mm)** against sidewalls, curbs, chimneys, and other roof projections

C. Self-Adhering Sheet Underlayment: Install, wrinkle free, on roof deck. Comply with low-temperature installation restrictions of underlayment manufacturer if applicable. Install lapped in direction that sheds water. Lap sides not less than 3-1/2 inches (89 mm). Lap ends not less than 6 inches (150 mm) staggered 24 inches (600 mm) between courses. Roll laps with roller. Cover underlayment within seven days.

1. Prime concrete and masonry surfaces to receive self-adhering sheet underlayment.
2. Eaves: Extend from edges of eaves 36 inches (914 mm) beyond interior face of exterior wall.
3. Rakes: Extend from edges of rake 36 inches (914 mm) beyond interior face of exterior wall.
4. Ridges: Extend 36 inches (914 mm) on each side without obstructing continuous ridge vent slot.
5. Sidewalls: Extend beyond sidewall 18 inches (450 mm), and return vertically against sidewall not less than 4 inches (100 mm).

3.3 METAL FLASHING INSTALLATION

A. General: Install metal flashings and other sheet metal to comply with requirements in Section 07 6200 "Sheet Metal Flashing and Trim."

1. Install metal flashings according to recommendations in ARMA's "Residential Asphalt Roofing Manual" and NRCA's "NRCA Guidelines for Asphalt Shingle Roof Systems."

B. Apron Flashings: Extend lower flange over and beyond each side of downslope asphalt shingles and up the vertical surface.

C. Step Flashings: Install with a headlap of 2 inches (50 mm) and extend over the underlying asphalt shingle and up the vertical surface. Fasten to roof deck only.

D. Rake Drip Edges: Install rake drip-edge flashings over underlayment and fasten to roof deck.

E. Eave Drip Edges: Install eave drip-edge flashings below underlayment and fasten to roof sheathing.

3.4 ASPHALT-SHINGLE INSTALLATION

A. General: Install asphalt shingles according to manufacturer's written instructions, recommendations in ARMA's "Residential Asphalt Roofing Manual," and recommendations in NRCA's "NRCA Guidelines for Asphalt Shingle Roof Systems."

B. Install starter strip along lowest roof edge, consisting of an asphalt-shingle strip at least 7 inches (175 mm) with self-sealing strip face up at roof edge.

1. Extend asphalt shingles 3/4 inch (19 mm) over fasciae at eaves and rakes.
2. Install starter strip along rake edge.

C. Install first and remaining courses of asphalt shingles stair-stepping diagonally across roof deck with manufacturer's recommended offset pattern at succeeding courses, maintaining uniform exposure.

D. Install first and remaining courses of asphalt shingles stair-stepping diagonally across roof deck with manufacturer's recommended offset pattern at succeeding courses, maintaining uniform exposure.

E. Install asphalt shingles by single-strip column or racking method, maintaining uniform exposure. Install full-length first course followed by cut second course, repeating alternating pattern in succeeding courses.

F. Fasten asphalt-shingle strips with a minimum of four roofing nails located according to manufacturer's written instructions.

1. Where roof slope exceeds 21:12, seal asphalt shingles with asphalt roofing cement spots after fastening with additional roofing nails.
2. Where roof slope is less than 4:12, seal asphalt shingles with asphalt roofing cement spots.
3. When ambient temperature during installation is below 50 deg F (10 deg C), seal asphalt shingles with asphalt roofing cement spots.

G. Ridge Vents: Install continuous ridge vents over asphalt shingles according to manufacturer's written instructions. Fasten with roofing nails of sufficient length to penetrate sheathing.

H. Hip and Ridge Shingles: Maintain same exposure of cap shingles as roofing shingle exposure. Lap cap shingles at ridges to shed water away from direction of prevailing winds. Fasten with roofing nails of sufficient length to penetrate sheathing.

1. Fasten ridge cap asphalt shingles to cover ridge vent without obstructing airflow.

3.5 ROOFING INSTALLER'S WARRANTY

A. WHEREAS <**Insert name**> of <**Insert address**>, herein called the "Roofing Installer," has performed roofing and associated work ("the work") on the following project:

1. Owner: <**Insert name of Owner**>.
2. Address: <**Insert address**>.
3. Building Name/Type: <**Insert information**>.
4. Address: <**Insert address**>.

5. Area of the Work: <**Insert information**>.
6. Acceptance Date: <**Insert date**>.
7. Warranty Period: <**Insert time**>.
8. Expiration Date: <**Insert date**>.

B. AND WHEREAS Roofing Installer has contracted (either directly with Owner or indirectly as a subcontractor) to warrant the work against leaks and faulty or defective materials and workmanship for designated Warranty Period,

C. NOW THEREFORE Roofing Installer hereby warrants, subject to terms and conditions herein set forth, that during Warranty Period he will, at his own cost and expense, make or cause to be made such repairs to or replacements of the work as are necessary to correct faulty and defective work and as are necessary to maintain the work in a watertight condition.

D. This Warranty is made subject to the following terms and conditions:

1. Specifically excluded from this Warranty are damages to the work and other parts of the building, and to building contents, caused by:

    a. Lightning;
    b. Peak gust wind speed exceeding <**Insert wind speed**> mph (m/sec);
    c. Fire;
    d. Failure of roofing system substrate, including cracking, settlement, excessive deflection, deterioration, and decomposition;
    e. Faulty construction of parapet walls, copings, chimneys, skylights, vents, equipment supports, and other edge conditions and penetrations of the work;
    f. Vapor condensation on bottom of roofing; and
    g. Activity on roofing by others, including construction contractors, maintenance personnel, other persons, and animals, whether authorized or unauthorized by Owner.

2. When the work has been damaged by any of foregoing causes, Warranty shall be null and void until such damage has been repaired by Roofing Installer and until cost and expense thereof have been paid by Owner or by another responsible party so designated.
3. Roofing Installer is responsible for damage to the work covered by this Warranty but is not liable for consequential damages to building or building contents resulting from leaks or faults or defects of the work.
4. During Warranty Period, if Owner allows alteration of the work by anyone other than Roofing Installer, including cutting, patching, and maintenance in connection with penetrations, attachment of other work, and positioning of anything on roof, this Warranty shall become null and void on date of the alterations, but only to the extent the alterations affect the work covered by this Warranty. If Owner engages Roofing Installer to perform the alterations, Warranty shall not become null and void unless Roofing Installer, before starting the alterations, notified Owner in writing, showing reasonable cause for claim, that the alterations would likely damage or deteriorate the work, thereby reasonably justifying a limitation or termination of this Warranty.
5. During Warranty Period, if original use of roof is changed and it becomes used for, but was not originally specified for, a use or service more severe than originally specified, this Warranty shall become null and void on date of the change, but only to the extent the change affects the work covered by this Warranty.
6. Owner shall promptly notify Roofing Installer of observed, known, or suspected leaks, defects, or deterioration and shall afford reasonable opportunity for Roofing Installer to inspect the work and to examine evidence of such leaks, defects, or deterioration.

7. This Warranty is recognized to be the only warranty of Roofing Installer on the work and shall not operate to restrict or cut off Owner from other remedies and resources lawfully available to Owner in cases of roofing failure. Specifically, this Warranty shall not operate to relieve Roofing Installer of responsibility for performance of the work according to requirements of the Contract Documents, regardless of whether Contract was a contract directly with Owner or a subcontract with Owner's General Contractor.

E. IN WITNESS THEREOF, this instrument has been duly executed this <**Insert day**> day of <**Insert month**>, <**Insert year**>.

1. Authorized Signature: <**Insert signature**>.
2. Name: <**Insert name**>.
3. Title: <**Insert title**>.

END OF SECTION 07 3113

SECTION 074646 - FIBER-CEMENT SIDING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes fiber-cement trim.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For fiber-cement trim including related accessories.

1.3 INFORMATIONAL SUBMITTALS

A. Product certificates.

B. Product test reports.

C. Research/evaluation reports.

D. Sample warranty.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.5 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace products that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 15 years from date of Substantial Completion.
2. Workmanship Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 FIBER-CEMENT SIDING

A. General: ASTM C1186, Type A, Grade II, fiber-cement board, noncombustible when tested according to ASTM E136; with a flame-spread index of 25 or less when tested according to ASTM E84.

1. Manufacturers: Subject to compliance with requirements, provide a product by one of the following:
    1) CertainTeed Corporation
    2) GAF
    3) James Hardie Building Products
    4) Nichiha Architectural Panels

B. Labeling: Provide fiber-cement siding that is tested and labeled according to ASTM C1186 by a qualified testing agency acceptable to authorities having jurisdiction.

C. Nominal Thickness: Not less than 5/16 inch (8 mm).

D. Trim: Boards 7-1/4 to 7-1/2 inches (184 to 190 mm) wide in plain style.

1. Texture: Smooth

E. Factory Priming: Manufacturer's standard acrylic primer.

2.2 ACCESSORIES

A. Siding Accessories, General: Provide starter strips, edge trim, outside and inside corner caps, and other items as recommended by siding manufacturer for building configuration.

B. Flashing: Provide stainless-steel flashing complying with Section 076200 "Sheet Metal Flashing and Trim" at window and door heads and where indicated.

C. Fasteners:

1. For fastening to wood, use siding nails of sufficient length to penetrate a minimum of 1 inch (25 mm) into substrate.
2. For fastening fiber cement, use hot-dip galvanized fasteners.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Comply with manufacturer's written installation instructions applicable to products and applications indicated unless more stringent requirements apply.

1. Install fasteners no more than 24 inches (600 mm) o.c.

B. Install joint sealants as specified in Section 079200 "Joint Sealants" and to produce a weathertight installation.

3.2 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 07 6200 - 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. Formed roof-drainage sheet metal fabrications.
   2. Formed steep-slope roof sheet metal fabrications.
   3. Formed wall sheet metal fabrications.

B. Related Requirements:

   1. Section 061000 "Rough Carpentry" for wood nailers, curbs, and blocking.

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 roof-penetration flashing.
8. Include details of edge conditions, including eaves, ridges, valleys, rakes, crickets, and counterflashings as applicable.
9. Include details of special conditions.
10. Include details of connections to adjoining work.
11. 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: 6 inches (150 mm) 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: 6 inches (150 mm) long and in required profile. Include fasteners and other exposed accessories.
3. Unit-Type Accessories and Miscellaneous Materials: Full-size Sample.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For fabricator.

B. Product Certificates: For each type of coping and roof edge flashing that is SPRI ES-1 tested and FM Approvals approved.

C. Product Test Reports: For each product, for tests performed by a qualified testing agency.

D. Sample Warranty: For special warranty.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For sheet metal flashing and trim, and its accessories, to include in maintenance manuals.

1.8 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. For copings and roof edge flashings that are SPRI ES-1 tested and FM Approvals approved, shop shall be listed as able to fabricate required details as tested and approved.

1.9 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.

1.10 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 NRCA's "The NRCA Roofing Manual" and SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.

C. FM Approvals Listing: Manufacture and install roof edge flashings that are listed in FM Approvals' "RoofNav" and approved for windstorm classification, Class 1-90. Identify materials with name of fabricator and design approved by FM Approvals.

D. SPRI Wind Design Standard: Manufacture and install roof edge flashings tested according to SPRI ES-1 and capable of resisting the following design pressure:

1. Design Pressure: As indicated on Drawings.

E. 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 (67 deg C), ambient; 180 deg F (100 deg C), 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. Stainless Steel Sheet: ASTM A240/A240M, Type 304, dead soft, fully annealed; with smooth, flat surface.
1. Finish: ASTM A480/A480M, No. 2D (dull, cold rolled).

C. Membrane Flashing: W.R. Grace Perm-A-Barrier, CCW 704 TWF by Carlisle Coatings Waterproofing, or equal by Henry. Primer is required, type as recommended by manufacturer. Use for jamb flashing, cavity wall flashing.

2.3 UNDERLAYMENT MATERIALS

A. Felt: ASTM D 226/D 226M, Type II (No. 30), asphalt-saturated organic felt; nonperforated.

B. Self-Adhering, High-Temperature Sheet: Minimum 30 mils (0.76 mm) 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 (116 deg C) or higher.
2. Low-Temperature Flexibility: ASTM D 1970; passes after testing at minus 20 deg F (29 deg C) or lower.

C. Slip Sheet: Rosin-sized building paper, 3 lb/100 sq. ft. (0.16 kg/sq. m)minimum.

2.4 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners, solder, 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 Stainless Steel Sheet: Series 300 stainless steel.

C. Solder for Stainless Steel: ASTM B32, Grade Sn60, with acid flux of type recommended by stainless steel sheet manufacturer

D. 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 (13 mm) wide and 1/8 inch (3 mm) thick.

E. Elastomeric Sealant: ASTM C 920, elastomeric polyurethane polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

F. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.

G. Epoxy Seam Sealer: Two-part, noncorrosive, aluminum seam-cementing compound, recommended by aluminum manufacturer for exterior nonmoving joints, including riveted joints.

H. Bituminous Coating: Cold-applied asphalt emulsion according to ASTM D 1187.

I. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required for application.

2.5 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 (6 mm in 6 m) on slope and location lines indicated on Drawings and within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.

C. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to tolerances specified in MCA's "Guide Specification for Residential Metal Roofing."

D. 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 (25 mm) deep, filled with butyl sealant concealed within joints.
2. Use lapped expansion joints only where indicated on Drawings.

E. Sealant Joints: Where movable, non-expansion-type joints are required, form metal to provide for proper installation of elastomeric sealant according to cited sheet metal standard.

F. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.

G. Seams: Fabricate nonmoving seams with flat-lock seams. Tin edges to be seamed, form seams, and solder.

H. Do not use graphite pencils to mark metal surfaces.

I. Isolate dissimilar materials with isolation coating or other permanent separation acceptable to the Architect.

2.6 ROOF-DRAINAGE SHEET METAL FABRICATIONS

A. Gutters: Manufactured in uniform section lengths not exceeding 12 feet (3.6 m), with matching corner units, ends, outlet tubes, and other accessories. Elevate back edge at least 1 inch (25 mm) above front edge. Furnish flat-stock gutter straps, gutter brackets, expansion joints, and expansion-joint covers fabricated from same metal as gutters.
1. Aluminum Sheet: 0.050 inch (1.27 mm) thick.
2. Gutter Profile: As indicated on drawings according to SMACNA's "Architectural Sheet Metal Manual."
3. Corners: Factory mitered and mechanically clinched and sealed watertight.
4. Gutter Supports: Gutter brackets with finish matching the gutters.
5. Gutter Accessories: Continuous screened leaf guard with sheet metal frame, Wire ball downspout strainer, Flat ends.
6.

B. Downspouts: Plain rectangular complete with machine-crimped elbows, manufactured from the following exposed metal. Furnish with metal hangers, from same material as downspouts, and anchors.
1. Formed Aluminum: 0.050 inch (1.27 mm) thick.

2.7 STEEP-SLOPE ROOF SHEET METAL FABRICATIONS

A. Apron, Step, Cricket, and Backer Flashing: Fabricate from the following materials:

1. Stainless Steel: 0.0156 inch (0.396 mm).

B. Drip Edges: Fabricate from the following materials:

1. Stainless Steel: 0.0156 inch (0.396 mm).

C. Eave and Rake Flashing: Fabricate from the following materials:

1. Stainless Steel: 0.0156 inch (0.396 mm).

D. Counterflashing: Shop fabricate interior and exterior corners. Fabricate from the following materials:

1. Stainless Steel: 0.0156 inch (0.396 mm).

E. Roof-Penetration Flashing: Fabricate from the following materials:

1. Stainless Steel: 0.0156 inch (0.396 mm).

2.8 WALL SHEET METAL FABRICATIONS

A. Through-Wall Flashing: Fabricate continuous flashings in minimum 96-inch- (2400-mm-) long, but not exceeding 12-foot- (3.6-m-) long, sections, under copings, and at shelf angles. Fabricate discontinuous lintel, sill, and similar flashings to extend 6 inches (150 mm) beyond each side of wall openings; and form with 2-inch- (50-mm-) high, end dams. Fabricate from the following materials:

1. Stainless Steel: 0.0156 inch (0.396 mm) thick.

B. Opening Flashings in Frame Construction: Fabricate head, sill, and similar flashings to extend 4 inches (100 mm) beyond wall openings. Form head and sill flashing with 2-inch- (50-mm-) high, end dams. Fabricate from the following materials:

1. Stainless Steel: 0.0156 inch (0.396 mm) 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. Felt Underlayment: Install felt underlayment, wrinkle free, using adhesive to minimize use of mechanical fasteners under sheet metal flashing and trim. Apply in shingle fashion to shed water, with lapped joints of not less than 2 inches (50 mm).

B. 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 (150 mm) staggered 24 inches (600 mm) between courses. Overlap side edges not less than 3-1/2 inches (90 mm). Roll laps and edges with roller. Cover underlayment within 14 days.

C. Apply slip sheet, wrinkle free, over underlayment before installing sheet metal flashing and trim.

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, solder, 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 (300 mm) 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. Coat concealed side of uncoated-aluminum and stainless steel sheet metal flashing and trim with bituminous coating where flashing and trim contact wood, ferrous metal, or cementitious construction.
2. 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 (3 m) with no joints within 24 inches (600 mm) of corner or intersection.

1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) 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 (32 mm) for nails and not less than 3/4 inch (19 mm) 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. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pre-tin edges of sheets with solder to width of 1-1/2 inches (38 mm); however, reduce pre-tinning where pre-tinned surface would show in completed Work.

1. Do not pre-tin zinc-tin alloy-coated copper.
2. Do not use torches for soldering.
3. Heat surfaces to receive solder, and flow solder into joint. Fill joint completely. Completely remove flux and spatter from exposed surfaces.
4. Stainless Steel Soldering:

    a. Tin edges of uncoated sheets, using solder for stainless steel and acid flux.
    b. Promptly remove acid-flux residue from metal after tinning and soldering.
    c. Comply with solder manufacturer's recommended methods for cleaning and neutralization.

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. Hanging Gutters: Join sections with riveted and soldered joints. Provide for thermal expansion. Attach gutters at eave or fascia to firmly anchor them in position. Provide end closures and seal watertight with sealant. Slope to downspouts.

1. Fasten gutter spacers to front and back of gutter.
2. Anchor and loosely lock back edge of gutter to continuous eave or apron flashing.
3. Anchor back of gutter that extends onto roof deck with cleats spaced not more than 24 inches (600 mm) apart.
4. Anchor gutter with straps spaced not more than 30 inches (760 mm) apart to roof deck, unless otherwise indicated, and loosely lock to front gutter bead.
5. Install gutter with expansion joints at locations indicated, but not exceeding, 50 feet (15.24 m) apart. Install expansion-joint caps.
6. Install continuous gutter screens on gutters with noncorrosive fasteners, removable for cleaning gutters.

C. Downspouts:

1. Join sections with 1-1/2-inch (38-mm) telescoping joints.
2. Provide hangers with fasteners designed to hold downspouts securely to walls.
3. Locate hangers at top and bottom and at approximately 60 inches (1500 mm) o.c.
4. Provide elbows at base of downspout to direct water away from building.
5. Connect downspouts to underground drainage system.

3.5 ROOF FLASHING INSTALLATION

A. General: Install sheet metal flashing and trim to comply with performance requirements, sheet metal manufacturer's written installation instructions, 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 (75-mm) centers.

C. Roof Edge Flashing: Anchor to resist uplift and outward forces according to recommendations in FM Global Property Loss Prevention Data Sheet 1-49 for FM Approvals' listing for required windstorm classification.

D. Copings: Anchor to resist uplift and outward forces according to recommendations in cited sheet metal standard unless otherwise indicated.

1. Interlock exterior bottom edge of coping with continuous cleat anchored to substrate at 24-inch (600-mm) centers.
2. Anchor interior leg of coping with washers and screw fasteners through slotted holes at 24-inch (600-mm) centers.

E. Copings: Anchor to resist uplift and outward forces according to recommendations in FM Global Property Loss Prevention Data Sheet 1-49 for specified FM Approvals' listing for required windstorm classification.

F. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending minimum of 4 inches (100 mm) over base flashing. Install stainless-steel draw band and tighten.

G. Counterflashing: Coordinate installation of counterflashing with installation of base flashing. Insert counterflashing in reglets or receivers and fit tightly to base flashing. Extend counterflashing 4 inches (100 mm) over base flashing. Lap counterflashing joints minimum of 4 inches (100 mm). Secure in waterproof manner by means of snap-in installation and sealant or lead wedges and sealant unless otherwise indicated.

H. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Seal with elastomeric sealant and clamp flashing to pipes that penetrate roof.

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. Through-Wall Flashing: Installation of through-wall flashing is specified in Section 04 2000 "Unit Masonry."

C. Opening Flashings in Frame Construction: Install continuous head, sill, and similar flashings to extend 4 inches (100 mm) beyond wall openings.

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 (6 mm in 6 m) on slope and location lines indicated on Drawings and within 1/8-inch (3-mm) 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 07 6200

SECTION 07 9200 - 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. This Section includes sealants for the following applications, including those specified by reference to this Section:
   1. Exterior joints in the following vertical surfaces and nontraffic horizontal surfaces:
      a. Joints in unit masonry.
      b. Joints in aluminum storefront and curtainwall systems.
      c. Joints between different materials listed above.
      d. Perimeter joints between materials listed above and frames of doors and windows.
      e. Perimeter joints between materials listed above and louvers.
      f. Other joints as indicated.
   2. Exterior joints in the following horizontal traffic surfaces:
      a. Control, expansion, and isolation joints in cast-in-place concrete slabs.
   3. Interior joints in the following vertical surfaces and horizontal nontraffic surfaces:
      a. Control and expansion joints on exposed interior surfaces of exterior walls.
      b. Perimeter joints of exterior openings where indicated.
      c. Tile control and expansion joints.
      d. Vertical control joints on exposed surfaces of interior unit masonry walls and partitions.
      e. Perimeter joints between interior wall surfaces and frames of exterior doors, windows, louvers, curtain wall and storefront framing systems.
      f. Perimeter joints between interior wall surfaces and frames of interior doors, windows, and elevator entrances.
      g. Joints between plumbing fixtures and adjoining walls, floors, and counters.
      h. Other joints as indicated.
   4. Interior joints in the following horizontal traffic surfaces:
      a. Control and expansion joints in tile flooring.

5. Interior joints in the following vertical surfaces and horizontal nontraffic surfaces:
   a. Vertical control joints of exposed surfaces of interior unit masonry and concrete walls and partitions.

B. Related Sections:
1. Division 04 Section "Unit Masonry" for masonry control and expansion joint fillers and gaskets.
2. Division 07 Section "Fire-Resistive Joint Systems" for sealing joints in fire-resistance-rated construction.
3. Division 08 Section "Glazing" for glazing sealants.
4. Division 08 Section "Fixed Louvers" for sealant required around louvers and vents.
5. Division 09 Section "Gypsum Board" for sealing perimeter joints of gypsum board partitions to reduce sound transmission.
6. Division 09 Section "Tiling" for sealing tile joints.

1.3 PRECONSTRUCTION TESTING

A. Preconstruction Field-Adhesion Testing: Before installing sealants, field test their adhesion to Project joint substrates as follows:
1. Locate test joints where indicated on Project or, if not indicated, as directed by Architect.
2. Conduct field tests for each application indicated below:
   a. Each kind of sealant and joint substrate indicated.
3. Notify Architect seven days in advance of dates and times when test joints will be erected.
4. Arrange for tests to take place with joint-sealant manufacturer's technical representative present.
   a. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.
      1) For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
5. Report whether sealant failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. For sealants that fail adhesively, retest until satisfactory adhesion is obtained.
6. Evaluation of Preconstruction Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing, in absence of other indications of noncompliance with requirements, will be considered satisfactory. Do not use sealants that fail to adhere to joint substrates during testing.

1.4 SUBMITTALS

A. Product Data: For each joint-sealant product indicated.

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- (13-mm-) wide joints formed between two 6-inch- (150-mm-) long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

D. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that sealants comply with requirements.

E. Warranties: Sample of special warranties.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

B. Source Limitations: Obtain each kind of joint sealant from single source from single manufacturer.

C. Mockups: Install sealant in mockups of assemblies specified in other Sections that are indicated to receive joint sealants specified in this Section. Use materials and installation methods specified in this Section.

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

1.6 PROJECT 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 (5 deg C).
   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: Manufacturer's standard form in which Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
   1. Warranty Period: Five (5) years from date of Substantial Completion.

B. Special Manufacturer's Warranty: Manufacturer's standard form in which joint-sealant manufacturer agrees to furnish joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.
   1. Warranty Period: Twenty (20) years from date of Substantial Completion.

C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:

1. Movement of the structure caused by structural settlement or errors attributable to design or construction resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
2. Disintegration of joint substrates from natural causes exceeding design specifications.
3. Mechanical damage caused by individuals, tools, or other outside agents.
4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.1 PRODUCTS AND MANUFACTURERS

A. Products: Subject to compliance with requirements, provide one of the products indicated for each type in the sealant scheduled at the end of Part 3.

2.2 MATERIALS, 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. VOC Content of Interior Sealants: Provide sealants and sealant primers for use inside the weatherproofing system that comply with the following limits for VOC content when calculated according to 40 CFR 59, Part 59, Subpart D (EPA Method 24):
   1. Architectural Sealants: 250 g/L.
   2. Sealant Primers for Nonporous Substrates: 250 g/L.
   3. Sealant Primers for Porous Substrates: 775 g/L.

C. Liquid-Applied Joint Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied joint sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.
   1. Suitability for Immersion in Liquids. Where sealants are indicated for Use I for joints that will be continuously immersed in liquids, provide products that have undergone testing according to ASTM C 1247. Liquid used for testing sealants is deionized water, unless otherwise indicated.

D. Stain-Test-Response Characteristics: Where sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.

E. Suitability for Contact with Food: Where sealants are indicated for joints that will come in repeated contact with food, provide products that comply with 21 CFR 177.2600.

F. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.3 SILICONE JOINT SEALANTS

A. Single-Component, Nonsag, Acid-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 25, for Use NT.

B. Mildew-Resistant, Single-Component, Nonsag, Neutral-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 25, for Use NT.

2.4 URETHANE JOINT SEALANTS

A. Multicomponent, Nonsag, Urethane Joint Sealant: ASTM C 920, Type M, Grade NS, Class 25, for Use NT.

B. Multicomponent, Nonsag, Traffic-Grade, Urethane Joint Sealant: ASTM C 920, Type M, Grade NS, Class 25, for Use T.

2.5 LATEX JOINT SEALANTS

A. Latex Joint Sealant: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.

2.6 ACOUSTICAL JOINT SEALANTS

A. Acoustical Sealant for Concealed Joints: For each product of this description indicated in the Acoustical Joint-Sealant Schedule at the end of Part 3, provide manufacturer's standard, nondrying, nonhardening, nonskinning, nonstaining, gunnable, synthetic-rubber sealant recommended for sealing interior concealed joints to reduce airborne sound transmission.

2.7 PRECOMPRESSED (PREFORMED) JOINT SEALANTS

A. Preformed Foam Sealant: Manufacturer's standard preformed, precompressed, open-cell foam sealant that is manufactured from alternating layers of high-density urethane foam impregnated with a nondrying, water-repellent agent; is factory produced in precompressed sizes in roll or stick form to fit joint widths indicated; is coated on one side with a pressure-sensitive adhesive and covered with protective wrapping; develops a watertight and airtight seal when compressed to the degree specified by manufacturer; and complies with the following:

B. Precompressed Joint Sealant Manufacturer: “Backerseal” manufactured by EMSEAL joint Systems, Ltd. Subject to compliance with requirements, provide the named product or a comparable product by one of the following:
1. illbruck Sealant Systems, Inc.
2. Polytite Manufacturing Corporation.
3. Sandell Manufacturing Co., Inc.

C. Properties: Permanently elastic, mildew resistant, nonmigratory, nonstaining, and compatible with joint substrates and other joint sealants.

2.8 JOINT SEALANT BACKING

A. General: Provide sealant backings of material that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are 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.

2.9 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 joint-sealant performance.

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. Porous joint substrates include the following:
      a. Concrete.
      b. Masonry.
   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.

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. Acoustical Sealant Application Standard: Comply with recommendations of ASTM C 919 for use of joint sealants in acoustical applications as applicable to materials, applications, and conditions indicated.

D. 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.

E. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

F. 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.

G. 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.
   4. Provide flush joint profile where indicated per Figure 8B in ASTM C 1193.
   5. Provide recessed joint configuration of recess depth and at locations indicated per Figure 8C in ASTM C 1193. 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 and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

3.6 ELASTOMERIC JOINT-SEALANT SCHEDULE

A. Low-Modulus Nonacid-Curing Silicone Sealant: Where joint sealants of this type are indicated, provide products complying with the following:
   1. Products: Provide one of the following:
      a. 790; Dow Corning.
      b. 864; Pecora Corporation.
      c. PSI-641; Polymeric Systems, Inc.
      d. Spectrem 1; Tremco.
   2. Type and Grade: S (single component) and NS (nonsag).
   3. Class: 25.
   4. Additional Movement Capability: 50 percent movement in extension and 50 percent movement in compression for a total of 100 percent movement.
   5. Use Related to Exposure: NT (nontraffic).
   6. Uses Related to Joint Substrates: O.
      a. Applications, Use O Joint Substrates: Exterior insulation and finish systems.
   7. Stain-Test-Response Characteristics: Nonstaining to porous substrates per ASTM C 1248.

B. Medium-Modulus Neutral-Curing Silicone Sealant: Where joint sealants of this type are indicated, provide products complying with the following:
   1. Products: Provide one of the following:
      a. 756 H.P.; Dow Corning.
      b. Silglaze II; GE Silicones.
      c. 895; Pecora Corporation.
   2. Type and Grade: S (single component) and NS (nonsag).
   3. Class: 25.
   4. Additional Movement Capability: 50 percent movement in extension and 50 percent movement in compression for a total of 100 percent movement.
   5. Use Related to Exposure: NT (nontraffic).
   6. Uses Related to Joint Substrates: G, A, and, as applicable to joint substrates indicated, O.
      a. Use O Joint Substrates: Coated glass, color anodic aluminum, aluminum coated with a high-performance coating, and galvanized steel.
   7. Applications: All exterior non-traffic joints unless otherwise specified.

C. Mildew-Resistant Silicone Sealant: Where joint sealants of this type are indicated, provide products formulated with fungicide that are intended for sealing interior ceramic tile joints and

other nonporous substrates that are subject to in-service exposures of high humidity and temperature extremes, and that comply with the following:

1. Products: Provide one of the following:
   a. 786 Mildew Resistant; Dow Corning.
   b. Sanitary 1700; GE Silicones.
   c. 898 Silicone Sanitary Sealant; Pecora Corporation.
2. Type and Grade: S (single component) and NS (nonsag).
3. Class: 25.
4. Use Related to Exposure: NT (nontraffic).
5. Uses Related to Joint Substrates: G, A, and, as applicable to joint substrates indicated, O.
   a. Use O Joint Substrates: Aluminum coated with a high-performance coating, galvanized steel, and ceramic tile.
6. Applications: Sealing perimeter joints of plumbing fixtures.

D. Multicomponent Nonsag Urethane Sealant: Provide products complying with the following:
1. Products: Provide one of the following:
   a. Vulkem 922; Mameco International.
   b. Dynatrol II; Pecora Corporation.
   c. Sikaflex - 2c NS; Sika Corporation.
   d. DYmeric 511; Tremco.
2. Type and Grade: M (multicomponent) and NS (nonsag).
3. Class: 25.
4. Additional Movement Capability: 50 percent movement in extension and 50 percent in compression for a total of 100 percent movement.
5. Use Related to Exposure: NT (nontraffic).
6. Uses Related to Joint Substrates: M, A, and, as applicable to joint substrates indicated, O.
   a. Use O Joint Substrates: Coated glass, color anodic aluminum, aluminum coated with a high-performance coating, galvanized steel, ceramic tile, and wood.
7. Applications: Interior and exterior joints as follows:
   a. Control and expansion joints in unit masonry.
   b. Sealing joints between unit masonry and frames of doors, windows, and other openings in unit masonry walls and partitions.

E. Multicomponent Pourable Urethane Sealant: Provide products complying with the following:
1. Products: Provide one of the following:
   a. Chem-Calk 550; Bostik Inc.
   b. Vulkem 245; Mameco International.
   c. NR-200 Urexpan; Pecora Corporation.
   d. SL 2; Sonneborn Building Products Div., ChemRex Inc.
   e. THC-900; Tremco.
2. Type and Grade: M (multicomponent) and P (pourable).
3. Class: 25.
4. Use Related to Exposure: T (traffic).
5. Uses Related to Joint Substrates: M, A, and, as applicable to joint substrates indicated, O.
   a. Use O Joint Substrates: Ceramic tile.
6. Applications:
   a. Sealing exterior joints in horizontal traffic surfaces.
   b. Sealing interior joints in horizontal traffic surfaces.

3.7 LATEX JOINT-SEALANT SCHEDULE

A. Latex Sealant: Provide products complying with the following:
   1. Products: Provide one of the following:
      a. Chem-Calk 600; Bostik Inc.
      b. AC-20; Pecora Corporation.
   2. Applications: Paintable interior joints at hollow metal frames and surrounding gypsum board construction, and other interior joints requiring paint application.

3.8 ACOUSTICAL JOINT-SEALANT SCHEDULE

A. Acoustical Sealant for Concealed Joints: Provide products complying with the following:
   1. Products: Provide one of the following:
      a. Pro-Series SC-170 Rubber Base Sound Sealant; Ohio Sealants, Inc.
      b. BA-98; Pecora Corporation.
      c. Tremco Acoustical Sealant; Tremco.
   2. Applications: Concealed joints at intersection of sound-reduction-rated construction.

END OF SECTION 07 9200

SECTION 08 1113 - 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:

1. Interior standard steel doors and frames.
2. Exterior standard steel doors and frames.

B. Related Requirements:

1. Section 08 7100 "Door Hardware" for door hardware for hollow-metal doors.

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.

B. Coordinate requirements for installation of door hardware, electrified door hardware, and access control and security systems.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, core descriptions, fire-resistance ratings, and finishes.

B. 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 electrical raceway and preparation for electrified hardware, access control systems, and security systems.
7. Details of anchorages, joints, field splices, and connections.
8. Details of accessories.
9. Details of moldings, removable stops, and glazing.

C. Samples for Initial Selection: For hollow-metal doors and frames with factory-applied color finishes.

D. Samples for Verification:

1. Finishes: For each type of exposed finish required, prepared on Samples of not less than 3 by 5 inches (75 by 127 mm).
2. Fabrication: Prepare Samples approximately 12 by 12 inches (305 by 305 mm) to demonstrate compliance with requirements for quality of materials and construction:

    a. Doors: Show vertical-edge, top, and bottom construction; core construction; and hinge and other applied hardware reinforcement. Include separate section showing glazing if applicable.
    b. Frames: Show profile, corner joint, floor and wall anchors, and silencers. Include separate section showing fixed hollow-metal panels and glazing if applicable.

E. Product Schedule: For hollow-metal doors and frames, 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.

1.6 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each type of hollow-metal door and frame assembly, for tests performed by a qualified testing agency.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver hollow-metal doors and frames 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 doors and frames vertically under cover at Project site with head up. Place on minimum 4-inch- (102-mm-) high wood blocking. Provide minimum 1/4-inch (6-mm) space between each stacked door to permit air circulation.

PART 2 - PRODUCTS

2.1 PERFORMANCE 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 assemblies 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 qualified testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 257 or UL 9.

C. Windborne-Debris Impact Resistance: Pass missile-impact and cyclic-pressure tests when tested according to ASTM E 1886 and testing information in ASTM E 1996 for Wind Zone 2.

1. Large-Missile Test: For glazed openings located within 30 feet (9.1 m) of grade.

2.2 INTERIOR STEEL DOORS AND FRAMES

A. Construct hollow-metal doors and frames to comply with 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; SDI A250.4, Level B.

1. Doors:

a. Type: As indicated in the Door and Frame Schedule.
b. Thickness: 1-3/4 inches (44.5 mm).
c. Face: Metallic-coated steel sheet, minimum thickness of 0.042 inch (1.0 mm).
d. Edge Construction: Model 1, Full Flush.
e. Edge Bevel: Provide manufacturer's standard beveled or square edges.
f. Core: Manufacturer's standard.
g. Fire-Rated Core: Manufacturer's standard core for fire-rated doors.

2. Frames:

a. Materials: Metallic-coated steel sheet, minimum thickness of 0.053 inch (1.3 mm).
b. Sidelite and Transom Frames: Fabricated from same thickness material as adjacent door frame.
c. Construction: Full profile welded.

3. Exposed Finish: Prime.

2.3 EXTERIOR STEEL DOORS AND FRAMES

A. Construct hollow-metal doors and frames to comply with 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; SDI A250.4, Level B.

1. Doors:

   a. Type: As indicated in the Door and Frame Schedule.
   b. Thickness: 1-3/4 inches (44.5 mm).
   c. Face: Metallic-coated steel sheet, minimum thickness of 0.042 inch (1.0 mm), with minimum A60 (ZF180) coating.
   d. Edge Construction: Model 1, Full Flush.
   e. Edge Bevel: Provide manufacturer's standard beveled or square edges.
   f. Top Edge Closures: Close top edges of doors with flush closures of same material as face sheets. Seal joints against water penetration.
   g. Bottom Edges: Close bottom edges of doors with end closures or channels of same material as face sheets. Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape.
   h. Core: Manufacturer's standard.
   i. Fire-Rated Core: Manufacturer's standard for fire-rated doors.

2. Frames:

   a. Materials: Metallic-coated steel sheet, minimum thickness of 0.053 inch (1.3 mm), with minimum A60 (ZF180) coating.
   b. Construction: Full profile welded.

3. Exposed Finish: Prime.

2.4 BORROWED LITES

A. Fabricate of metallic-coated steel sheet, minimum thickness of 0.042 inch (1.0 mm).

B. Construction: Full profile welded.

C. Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as metal as frames.

D. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.

2.5 HOLLOW-METAL PANELS

A. Provide hollow-metal panels of same materials, construction, and finish as adjacent door assemblies.

2.6 FRAME ANCHORS

A. Jamb Anchors:

1. Type: Anchors of minimum size and type required by applicable door and frame standard, and suitable for performance level indicated.
2. Quantity: Minimum of three anchors per jamb, with one additional anchor for frames with no floor anchor. Provide one additional anchor for each 24 inches (610 mm) of frame height above 7 feet (2.1 m).
3. Postinstalled Expansion Anchor: Minimum 3/8-inch- (9.5-mm-) diameter bolts with expansion shields or inserts, with manufacturer's standard pipe spacer.

B. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor.

C. Material: ASTM A 879/A 879M, Commercial Steel (CS), 04Z (12G) 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.

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.

D. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.

E. 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.

F. 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.

G. Glazing: Comply with requirements in Section 08 8000 "Glazing."

2.8 FABRICATION

A. Door Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch (19 mm) beyond edge of door on which astragal is mounted or as required to comply with published listing of qualified testing agency.

B. Hollow-Metal Frames: Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as frames.

1. Sidelite and Transom Bar 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 welding.
2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
3. 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.

C. Hardware Preparation: Factory prepare hollow-metal doors and frames to receive templated mortised hardware, and electrical wiring; 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 BHMA A156.115 for preparing hollow-metal doors and frames for hardware.

D. Glazed Lites: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted hairline joints.

1. Provide stops and moldings flush with face of door, and with square stops unless otherwise indicated.
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. Provide loose stops and moldings on inside of hollow-metal doors and frames.
4. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.
5. Provide stops for installation with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches (230 mm) o.c. and not more than 2 inches (51 mm) o.c. from each corner.

2.9 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.

2.10 LOUVERS

A. Provide louvers for interior doors, where indicated, which comply with SDI 111, with blades or baffles formed of 0.020-inch- (0.5-mm-) thick, cold-rolled steel sheet set into 0.032-inch- (0.8-mm-) thick steel frame.

1. Sightproof Louver: Stationary louvers constructed with inverted-V or inverted-Y blades.

B. Form corners of moldings with hairline joints. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.

PART 3 - EXECUTION

3.1 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. Touch up factory-applied finishes where spreaders are removed.

B. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.2 INSTALLATION

A. General: Install hollow-metal doors and frames plumb, rigid, properly aligned, and securely fastened in place. Comply with approved Shop Drawings and with manufacturer's written instructions.

B. Hollow-Metal Frames: Comply with SDI A250.11.

1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces without damage to completed Work.

a. Where frames are fabricated in sections, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces. Touch-up finishes.
b. Install frames with removable stops located on secure side of opening.

2. Fire-Rated Openings: Install frames according to NFPA 80.
3. Floor Anchors: 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.

4. Solidly pack mineral-fiber insulation inside frames.
5. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout or mortar.
6. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors flush with exposed faces of frames.

7. Installation Tolerances: Adjust hollow-metal frames to the following tolerances:

    a. Squareness: Plus or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
    b. Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.
    c. Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
    d. Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs at floor.

C. Hollow-Metal Doors: Fit and adjust hollow-metal doors accurately in frames, within clearances specified below.

1. Non-Fire-Rated Steel Doors: Comply with SDI A250.8.
2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
3. Smoke-Control Doors: Install doors according to NFPA 105.

D. Glazing: Comply with installation requirements in Section 088000 "Glazing" and with hollow-metal manufacturer's written instructions.

3.3 CLEANING AND TOUCHUP

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

B. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

C. Factory-Finish Touchup: Clean abraded areas and repair with same material used for factory finish according to manufacturer's written instructions.

D. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

END OF SECTION 08 1113

SECTION 0 83113 - ACCESS 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 access doors and frames for walls.

B. Related Requirements:
1. Division 23 sections for heating and air-conditioning duct access doors.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details**,** fire ratings, material descriptions, dimensions of individual components and profiles, and finishes.

PART 2 - PRODUCTS

2.1 ACCESS DOORS AND FRAMES

A. Flush Access Doors with Exposed Flanges:

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

a. Babcock-Davis.
b. JL Industries, Inc.; a division of the Activar Construction Products Group.
c. Karp Associates, Inc.
d. Larsens Manufacturing Company.
e. Milcor; Commercial Products Group of Hart & Cooley, Inc.

2. Description: Face of door flush with frame, with exposed flange and concealed hinge.
3. Locations: Wall.
4. Uncoated Steel Sheet for Doors of access panels in common areas and “non-wet” spaces: Nominal 0.060 inch (1.52 mm), 16 gage, factory primed.
5. Stainless-Steel Sheet for Doors of access panels in wet areas (toilet rooms): Nominal 0.062 inch (1.59 mm), 16 gage, No. 4 finish.
6. Frame Material: Same material, thickness, and finish as door.
7. Latch and Lock: Cam latch, screwdriver operated.

2.2 MATERIALS

A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

B. Steel Sheet: Uncoated or electrolytic zinc coated, ASTM A 879/A 879M, with cold-rolled steel sheet substrate complying with ASTM A 1008/A 1008M, Commercial Steel (CS), exposed.

C. Stainless-Steel Sheet, Strip, Plate, and Flat Bars: ASTM A 666, Type 304. Remove tool and die marks and stretch lines, or blend into finish.

D. Frame Anchors: Same material as door face.

E. Inserts, Bolts, and Anchor Fasteners: Hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329.

2.3 FABRICATION

A. General: Provide access door and frame assemblies manufactured as integral units ready for installation.

B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.

C. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish mounting holes, attachment devices and fasteners of type required to secure access doors to types of supports indicated.

D. Latch and Lock Hardware:

1. Quantity: Furnish number of latches and locks required to hold doors tightly closed.
2. Keys: Furnish two keys per lock and key all locks alike.

2.4 FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

D. Painted Finishes: Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

1. Factory Primed: Apply manufacturer's standard, lead- and chromate-free, universal primer immediately after surface preparation and pretreatment.

E. Stainless-Steel Finishes:

1. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
2. Polished Finish: No. 4 finish. Grind and polish surfaces to produce uniform finish, free of cross scratches.

    a. Run grain of directional finishes with long dimension of each piece.
    b. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates 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 INSTALLATION

A. Comply with manufacturer's written instructions for installing access doors and frames.

3.3 ADJUSTING

A. Adjust doors and hardware, after installation, for proper operation.

END OF SECTION 08 3113

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08 3313	Coiling Counter Doors
08 4113	Aluminum-Framed Storefronts
08 5113	Aluminum Windows
08 5653	Door Hardware
08 7100	Security Windows
08 8000	Glazing

SECTION 08 4113 - ALUMINUM-FRAMED 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. Storefront framing.

B. Related Requirements:

1. Section 08 5653 "Security Windows" for transaction window integral to storefront construction.

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 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 type of 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 Initial Selection: For units with factory-applied color finishes.

D. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.

E. Fabrication Sample: Of each vertical-to-horizontal intersection of assemblies, made from 12-inch (300-mm) 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.

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. Qualification Data: For Installer.

B. 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.

C. Product Test Reports: For aluminum-framed entrances and storefronts, for tests performed by a qualified testing agency.

D. Source quality-control reports.

E. Field quality-control reports.

F. Sample Warranties: For special warranties.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For aluminum-framed entrances and storefronts to include in maintenance manuals.

B. Maintenance Data for Structural Sealant: For structural-sealant-glazed storefront 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. Structural-Sealant Glazing: Comply with ASTM C 1401 for design and installation of storefront systems.

1.8 WARRANTY

A. Special Warranty: Installer 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 finishea, and other materials beyond normal weathering.
d. Water penetration through fixed glazing and framing areas.
e. Failure of operating components.

2. Warranty Period: Five 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 MANUFACTURERS

A. Source Limitations: Obtain all components of aluminum-framed entrance and storefront system, including framing and accessories, from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. 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, 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.

B. Structural Loads:

1. Wind Loads: As indicated on Drawings.
2. Other Design Loads: As indicated on Drawings.

C. 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. (0.30 L/s per sq. m) at a static-air-pressure differential of 1.57 lbf/sq. ft. (75 Pa).

D. 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, including entrance doors, when tested according to a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 10 lbf/sq. ft. (480 Pa).

E. 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 10 lbf/sq. ft. (480 Pa).
2. Maximum Water Leakage: According to AAMA 501.1 Water leakage does not include water controlled by flashing and gutters, or water that is drained to exterior.

F. Seismic Performance: Aluminum-framed entrances and storefronts shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

G. Energy Performance: Certify and label energy performance according to NFRC as follows:

1. Thermal Transmittance (U-factor): Fixed glazing and framing areas as a system shall have U-factor of not more than 0.41 Btu/sq. ft. x h x deg F (2.33 W/sq. m x K) as determined according to NFRC 100.
2. Solar Heat Gain Coefficient (SHGC): See section 08 8000 “Glazing”

H. Windborne-Debris Impact Resistance: Pass missile-impact and cyclic-pressure tests according to ASTM E 1996 for Wind Zone 2.

1. Large-Missile Test: For glazed openings located within 30 feet (9.1 m) of grade.

2.3 STOREFRONT SYSTEMS

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

1. Kawneer North America, an Arconic Company; “Trifab 451 UT Framing System”
2. EFCO Corporation
3. Tubelite, Inc.
4. US Aluminum, a brand of CR Laurence

B. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.

1. Exterior Framing Construction: Thermally broken.
2. Glazing System: Retained mechanically with gaskets on four sides.
3. Finish: High-performance organic finish.
4. Fabrication Method: Field-fabricated stick system.
5. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
6. Steel Reinforcement: As required by manufacturer.

C. Backer Plates: Manufacturer's standard, continuous backer plates for framing members, if not integral, where framing abuts adjacent construction.

D. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

2.4 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.

2.5 MATERIALS

A. Sheet and Plate: ASTM B 209 (ASTM B 209M).

B. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221 (ASTM B 221M).

C. Extruded Structural Pipe and Tubes: ASTM B 429/B 429M.

D. Structural Profiles: ASTM B 308/B 308M.

E. Steel Reinforcement:

1. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
2. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.
3. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011M.
4. Primer: 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.

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.

B. Anchors: Three-way adjustable anchors with minimum adjustment of 1 inch (25.4 mm) 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 containing no asbestos, formulated for 30-mil (0.762-mm) 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 interior.
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. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.8 ALUMINUM FINISHES

A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

B. Permanodic Anodic Finish: AAMA 611, AA-M10C21A44, Class I, 0.018 mm or thicker.

1. Color: Black.

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 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 08 8000 "Glazing."

G. Install weatherseal sealant according to Section 07 9200 "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 aluminum-framed entrances and storefronts to comply with the following maximum tolerances:

1. Plumb: 1/8 inch in 10 feet (3.2 mm in 3 m).
2. Level: 1/8 inch in 20 feet (3.2 mm in 6 m).
3. Alignment:

   a. Where surfaces abut in line or are separated by reveal or protruding element up to 1/2 inch (12.7 mm) wide, limit offset from true alignment to 1/16 inch (1.6 mm).
   b. Where surfaces are separated by reveal or protruding element from 1/2 to 1 inch (12.7 to 25.4 mm) wide, limit offset from true alignment to 1/8 inch (3.2 mm).
   c. Where surfaces are separated by reveal or protruding element of 1 inch (25.4 mm) wide or more, limit offset from true alignment to 1/4 inch (6 mm).

4. Location: Limit variation from plane to 1/8 inch in 12 feet (3.2 mm in 3.6 m).

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Field Quality-Control Testing: Perform the following test on representative areas of aluminum-framed storefronts:

1. Water-Spray Test: Before installation of interior finishes has begun, areas designated by Architect shall be tested according to AAMA 501.2 and shall not evidence water penetration.

    a. Perform a minimum of two tests in areas as directed by Architect.

2. Air Infiltration: ASTM E 783 at 1.5 times the rate specified for laboratory testing in "Performance Requirements" Article but not more than 0.09 cfm/sq. ft. (0.45 L/s per sq. m) at a static-air-pressure differential of 1.57 lbf/sq. ft. (75 Pa).

    a. Perform a minimum of two tests in areas as directed by Architect.

3. Water Penetration: ASTM E 1105 at a minimum [**uniform**] [**and**] [**cyclic**] static-air-pressure differential of 0.67 times the static-air-pressure differential specified for laboratory testing in "Performance Requirements" Article, but not less than 6.24 lbf/sq. ft. (300 Pa), and shall not evidence water penetration.

C. Aluminum-framed entrances and storefronts will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

END OF SECTION 08 4113

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SECTION 08 5113 - ALUMINUM WINDOWS

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 aluminum windows for exterior locations.

B. Related Requirements:

1. Section 08 4113 "Aluminum-Framed Storefronts" for coordinating finish among aluminum fenestration units.

1.3 PREINSTALLATION MEETINGS

A. 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. Review and discuss the finishing of aluminum windows that is required to be coordinated with the finishing of other aluminum work for color and finish matching.
3. Review, discuss, and coordinate the interrelationship of aluminum windows with other exterior wall components. Include provisions for anchoring, flashing, weeping, sealing perimeters, and protecting finishes.
4. Review and discuss the sequence of work required to construct a watertight and weathertight exterior building envelope.
5. Inspect and discuss the condition of substrate and other preparatory work performed by other trades.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, glazing and fabrication methods, dimensions of individual components and profiles, hardware, and finishes for aluminum windows.

B. Shop Drawings: For aluminum windows.

1. Include plans, elevations, sections, hardware, accessories, insect screens, operational clearances, and details of installation, including anchor, flashing, and sealant installation.

C. Samples: For each exposed product and for each color specified, 2 by 4 inches (50 by 100 mm) in size.

D. Samples for Initial Selection: For units with factory-applied finishes.

1. Include Samples of hardware and accessories involving color selection.

E. Samples for Verification: For aluminum windows and components required, showing full range of color variations for finishes, and prepared on Samples of size indicated below:

1. Exposed Finishes: 2 by 4 inches (50 by 100 mm).
2. Exposed Hardware: Full-size units.

F. Product Schedule: For aluminum windows. Use same designations indicated on Drawings.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and Installer.

B. Product Test Reports: For each type of aluminum window, for tests performed by a qualified testing agency.

C. Field quality-control reports.

D. Sample Warranties: For manufacturer's warranties.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: A manufacturer capable of fabricating aluminum windows that meet or exceed performance requirements indicated and of documenting this performance by test reports and calculations.

B. Installer Qualifications: An installer acceptable to aluminum window manufacturer for installation of units required for this Project.

1.7 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace aluminum windows that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Failure to meet performance requirements.
b. Structural failures including excessive deflection, water leakage, condensation, and air infiltration.
c. Faulty operation of movable sash and hardware.
d. Deterioration of materials and finishes beyond normal weathering.
e. Failure of insulating glass.

2. Warranty Period:

a. Window: 20 years from date of Substantial Completion.
b. Glazing Units: 20 years from date of Substantial Completion.
c. Aluminum Finish: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain aluminum windows from single source from single manufacturer.

2.2 WINDOW PERFORMANCE REQUIREMENTS

A. Product Standard: Comply with AAMA/WDMA/CSA 101/I.S.2/A440 for definitions and minimum standards of performance, materials, components, accessories, and fabrication unless more stringent requirements are indicated.

1. Window Certification: AAMA certified with label attached to each window.

B. Performance Class and Grade: AAMA/WDMA/CSA 101/I.S.2/A440 as follows:

1. Minimum Performance Class: CW.
2. Minimum Performance Grade: 30.

C. Thermal Transmittance: NFRC 100 maximum whole-window U-factor of 0.30 Btu/sq. ft. x h x deg F (1.71 W/sq. m x K).

D. Solar Heat-Gain Coefficient (SHGC): see Section 08 8000 “Glazing”.

E. Condensation-Resistance Factor (CRF): Provide aluminum windows tested for thermal performance according to AAMA 1503, showing a CRF of 45.

F. Thermal Movements: Provide aluminum windows, including anchorage, that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change: 120 deg F (67 deg C) ambient; 180 deg F (100 deg C).

2.3 ALUMINUM WINDOWS

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

1. Kawneer North America, an Arconic Company; “8225TLF Thermal Window”
2. EFCO Corporation
3. Graham Architectural Products Corporation

B. Operating Types: Provide the following operating types in locations indicated on Drawings:

1. Casement: Project out.

C. Frames and Sashes: Aluminum extrusions complying with AAMA/WDMA/CSA 101/I.S.2/A440.

1. Thermally Improved Construction: Fabricate frames, sashes, and muntins with an integral, concealed, low-conductance thermal barrier located between exterior materials and window members exposed on interior side in a manner that eliminates direct metal-to-metal contact.

D. Glass: Clear annealed glass, ASTM C 1036, Type 1, Class 1, q3.

1. Kind: Fully tempered.

E. Insulating-Glass Units: ASTM E 2190.: see Section 08 8000 “Glazing”.

F. Glazing System: Manufacturer's standard factory-glazing system that produces weathertight seal.

G. Hardware, General: Provide manufacturer's standard hardware fabricated from aluminum, stainless steel, carbon steel complying with AAMA 907, or other corrosion-resistant material compatible with adjacent materials; designed to smoothly operate, tightly close, and securely lock windows, and sized to accommodate sash weight and dimensions.

1. Exposed Hardware Color and Finish: As selected by Architect from manufacturer's full range.

H. Projected Window Hardware:

1. Gear-Type Rotary Operators: Complying with AAMA 901 when tested according to ASTM E 405, Method A. Provide operators that function without requiring the removal of interior screens or using screen wickets.

a. Type and Style: As selected by Architect from manufacturer's full range of types and styles.

2. Hinges: Non-friction type, not less than two per sash.
3. Lock: Dual lever handles, tie rod, and cam-action lock with keepers.
4. Limit Devices: Concealed friction adjustor, adjustable stay bar limit devices designed to restrict sash opening.

a. Limit clear opening to 4 inches (100 mm) for ventilation; with custodial key release.

I. Weather Stripping: Provide full-perimeter weather stripping for each operable sash unless otherwise indicated.

J. Fasteners: Noncorrosive and compatible with window members, trim, hardware, anchors, and other components.

1. Exposed Fasteners: Do not use exposed fasteners to greatest extent possible. For application of hardware, use fasteners that match finish hardware being fastened.

2.4 ACCESSORIES

A. Subsills: Thermally broken, extruded-aluminum subsills in configurations indicated on Drawings.

B. Interior Trim: Extruded-aluminum profiles in sizes and configurations indicated on Drawings.

C. Panning Trim: Extruded-aluminum profiles in sizes and configurations indicated on Drawings.

D. Receptor System: Two-piece, snap-together, thermally broken, extruded-aluminum receptor system that anchors windows in place.

2.5 INSECT SCREENS

A. General: Fabricate insect screens to integrate with window frame. Provide screen for each operable exterior sash. Screen wickets are not permitted.

1. Type and Location: Full, inside for project-out sashes.

B. Aluminum Frames: Manufacturer's standard aluminum alloy complying with SMA 1004 or SMA 1201. Fabricate frames with mitered or coped joints or corner extrusions, concealed fasteners, and removable PVC spline/anchor concealing edge of frame.

1. Tubular Framing Sections and Cross Braces: Roll formed from aluminum sheet.

C. Aluminum Wire Fabric: 18-by-16 (1.1-by-1.3-mm) mesh of 0.011-inch- (0.28-mm-) diameter, coated aluminum wire.

1. Wire-Fabric Finish: Black.

2.6 FABRICATION

A. Fabricate aluminum windows in sizes indicated. Include a complete system for assembling components and anchoring windows.

B. Glaze aluminum windows in the factory.

C. Weather strip each operable sash to provide weathertight installation.

D. Weep Holes: Provide weep holes and internal passages to conduct infiltrating water to exterior.

E. Provide water-shed members above side-hinged sashes and similar lines of natural water penetration.

F. Mullions: Provide mullions and cover plates, matching window units, complete with anchors for support to structure and installation of window units. Allow for erection tolerances and provide for movement of window units due to thermal expansion and building deflections. Provide mullions and cover plates capable of withstanding design wind loads of window units.

G. Complete fabrication, assembly, finishing, hardware application, and other work in the factory to greatest extent possible. Disassemble components only as necessary for shipment and installation.

2.7 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.8 ALUMINUM FINISHES

A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

B. Permanodic Anodic Finish: AAMA 611, AA-M10C21A44, Class I, 0.018 mm or thicker.

1. Color: Black.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Verify rough opening dimensions, levelness of sill plate, and operational clearances.

C. Examine wall flashings, vapor retarders, water and weather barriers, and other built-in components to ensure weathertight window installation.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with manufacturer's written instructions for installing windows, hardware, accessories, and other components. For installation procedures and requirements not addressed in manufacturer's written instructions, comply with installation requirements in ASTM E 2112.

B. Install windows level, plumb, square, true to line, without distortion or impeding thermal movement, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction to produce weathertight construction.

C. Install windows and components to drain condensation, water penetrating joints, and moisture migrating within windows to the exterior.

D. Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials.

3.3 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

1. Testing and inspecting agency will interpret tests and state in each report whether tested work complies with or deviates from requirements.

B. Testing Services: Testing and inspecting of installed windows shall take place as follows:

1. Testing Methodology: Testing of windows for air infiltration and water resistance shall be performed according to AAMA 502.
2. Air-Infiltration Testing:

   a. Test Pressure: That required to determine compliance with AAMA/WDMA/CSA 101/I.S.2/A440 performance class indicated.
   b. Allowable Air-Leakage Rate: 1.5 times the applicable AAMA/WDMA/CSA 101/I.S.2/A440 rate for product type and performance class rounded down to one decimal place.

3. Water-Resistance Testing:

   a. Test Pressure: Two-thirds times test pressure required to determine compliance with AAMA/WDMA/CSA 101/I.S.2/A440 performance grade indicated.
   b. Allowable Water Infiltration: No water penetration.

4. Testing Extent: One windows of each type as selected by Architect and a qualified independent testing and inspecting agency. Windows shall be tested after perimeter sealants have cured.
5. Test Reports: Prepared according to AAMA 502.

C. Windows will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.4 ADJUSTING, CLEANING, AND PROTECTION

A. Adjust operating sashes and hardware for a tight fit at contact points and weather stripping for smooth operation and weathertight closure.

B. Clean exposed surfaces immediately after installing windows. Avoid damaging protective coatings and finishes. Remove excess sealants, glazing materials, dirt, and other substances.

1. Keep protective films and coverings in place until final cleaning.

C. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.

D. Protect window surfaces from contact with contaminating substances resulting from construction operations. If contaminating substances do contact window surfaces, remove contaminants immediately according to manufacturer's written instructions.

END OF SECTION 08 5113

SECTION 08 5653 – SECURITY WINDOWS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Ticket Windows

1.2 RELATED SECTIONS

A. Section 07 6200 – Sheet Metal Flashing and Trim.

B. Section 07 9200 – Joint Sealants.

C. Section 08 4113 – Aluminum-Framed Entrances and Storefronts

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's product data, including materials, components, fabrication, finish, and installation instructions.

B. Shop Drawings: Submit manufacturer's shop drawings, including plans, elevations, sections, and details, indicating dimensions, tolerances, materials, fabrication, glazing, fasteners, hardware, finish, electrical wiring diagrams, options, and accessories.

C. Samples: Submit manufacturer's samples of standard finishes.

E. Manufacturer's Certification: Submit manufacturer's certification that materials comply with specified requirements and are suitable for intended application.

1.5 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Minimum of 10 years successful experience continuously manufacturing security windows.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.

B. Storage: Store materials in clean, dry area indoors in accordance with manufacturer's instructions.

C. Handling: Protect materials and finish from damage during handling and installation.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Basis of Design Product: C.R. Laurence Architectural Products, www.crlaurence.com

2.2 FLUSH-MOUNT SECURITY WINDOWS

A. Modular Security Windows: SCW 102C Ticket Window w/ Speak Thru & Half Round Ticket Window

1. Window Dimensions: 37 inches wide by 48 inches high
2. Speak Thru: Cat. No. 834 A
3. Half Round Swing Away Cover Plate – Cat. No. 720A
4. ¼" Clear Tempered Glass Window

2.5 FABRICATION

A. Assembly: Factory assembled, factory glazed.

2.6 ALUMINUM FINISH

A. Powder Coat Painted: match Architect's sample

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive security windows. Notify Architect of conditions that would adversely affect installation or subsequent use. Do not proceed with installation until unsatisfactory conditions are corrected.

3.2 PREPARATION

A. Ensure openings to receive security windows are plumb, level, square, accurately aligned, correctly located, and in tolerance.

3.3 INSTALLATION

A. Install security windows in accordance with manufacturer's instructions.

B. Install security windows plumb, level, square, true to line, and without warp or rack.

C. Install security window components weathertight.

D. Anchor security windows securely in place to supports. Use attachment methods permitting adjustment for construction tolerances, irregularities, alignment, and expansion and contraction.

E. Separate aluminum from other metal surfaces with bituminous coatings or other means approved by Architect.

F. Sheet Metal Flashing: Install sheet metal flashing as specified in Section 07620 (07 62 00).

G. Joint Sealants: Install joint sealants as specified in Section 07920 (07 92 00).

I. Repair minor damages to finish in accordance with manufacturer's instructions and as approved by Architect.

J. Remove and replace damaged components that cannot be successfully repaired as determined by Architect.

3.4 ADJUSTING

A. Adjust movable service panels to be weathertight in closed position.

B. Adjust movable service panels and security transaction drawers to function properly and for smooth operation without binding.

3.5 CLEANING

A. Clean security windows promptly after installation in accordance with manufacturer's instructions.

B. Remove excess joint sealant in accordance with sealant manufacturer's instructions.

C. Do not use harsh cleaning materials or methods that would damage glazing or finish.

3.6 PROTECTION

A. Protect installed security windows to ensure that, except for normal weathering, security windows will be without damage or deterioration at time of substantial completion.

END OF SECTION 08 5653

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SECTION 08 6000 – ATTIC STAIRS

PART 1 - GENERAL

1.1 SUMMARY

A. Attic Ladder and Doors:

1. Special attic ladders.

1.2 SUBMITTALS

A. Submit under provisions of Section 01 30 00 - Administrative Requirements.

B. Product Data:

1. Manufacturer's data sheets on each product to be used.
2. Preparation instructions and recommendations.
3. Storage and handling requirements and recommendations.
4. Typical installation methods.

C. Verification Samples: Two representative units of each type, size, pattern and color.

D. Shop Drawings: Include details of materials, construction and finish. Include relationship with adjacent construction.

1.3 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with a minimum five years documented experience.

B. Installer Qualifications: Company specializing in performing Work of this section with minimum two years documented experience with projects of similar scope and complexity.

C. Source Limitations: Provide each type of product from a single manufacturing source to ensure uniformity.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Store and handle in strict compliance with manufacturer's written instructions and recommendations.

B. Protect from damage due to weather, excessive temperature, and construction operations.

1.5 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's recommended limits.

1.6 WARRANTY

A. Manufacturer's standard limited warranty unless indicated otherwise.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design Manufacturer: FAKRO AMERICA, LLC: 39 W. Factory Rd.; Addison, IL 60101; Tel: 630-543-1010; Fax: 630-543-1011; Email:request info (sales@fakrousa.com); Web: http://www.fakrousa.com

B. Requests for substitutions will be considered in accordance with provisions of Section 01 60 00 - Product Requirements.

2.2 ATTIC LADDERS AND DOORS

A. Special Attic Ladders:

1. Model: LMP: Metal, Folding, and Insulated. 3-section, unloading mechanism hidden in handrail.
   a. Loading: 350 lbs (159 kg)
   b. Hatch U Value: 0.19 btu/ hr sq ft F (1.08 W/sq m K).
   c. Hatch Thickness: 1-3/8 inch (35 mm).
   d. Insulation thickness: 1-1/8 inch (28 mm).
   e. R-Value: 5.2
   f. Ceiling Height: 9 ft 10 inches to 12 ft. (3251 to 3658 mm).
   1) Rough Opening: 22-1/2 x 56-1/2 inch (572 x 1435 mm).
      a) Outside Frame: 22 x 56 inches (559 x 1422 mm).
      b) Approximate Weight: 102 lbs (46.3 kg).
   2) Rough Opening: 25 x 56-1/2 inch (635 x 1435 mm).
      a) Outside Frame: 24-1/2 x 56 inches (622 x 1422 mm).
      b) Approximate Weight: 108 lbs (49 kg).
   3) Rough Opening: 30 x 56-1/2 inch (762 x 1435 mm).
      a) Outside Frame: 29-1/2 x 54-3/8 inches (749 x 1381 mm).
      b) Approximate Weight: 114 lbs (51.7 kg).
   g. Projection: 77-1/8 inch (283 mm).
   h. Landing Space: 57-1/8 inch (1451 mm).
   i. Folded Ladder Height: 12-5/8 inch (321 mm).
   j. Frame Height: 7-1/8 inch (181 mm).
   k. Step Length: 13-5/8 inch (346 mm).
   l. Step Width: 3-1/8 inch (79 mm).
   m. Distance Between Steps: 9-1/2 inch (241 mm).

PART 3 - EXECUTION

3.1 EXAMINATION

A. Do not begin installation until substrates have been properly constructed and prepared.

B. If substrate preparation is the responsibility of another installer, notify Architect in writing of unsatisfactory preparation before proceeding.

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.

3.3 INSTALLATION

A. Install in accordance with manufacturer's instructions, approved submittals, and in proper relationship with adjacent construction.

3.4 FIELD QUALITY CONTROL

A. Field Inspection: Coordinate field inspection in accordance with appropriate sections in Division 01.

B. Manufacturer's Services: Coordinate manufacturer's services in accordance with appropriate sections in Division 01.

3.5 CLEANING AND PROTECTION

A. Clean products in accordance with the manufacturer’s recommendations.

END OF SECTION 08 6000

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SECTION INCLUDES

A. Furnish and deliver all finish hardware necessary for all doors, also hardware as specified herein and as enumerated in hardware sets and as indicated and required by actual conditions at the building. The hardware shall include the furnishing of all necessary screws, bolts, expansion shields, drop plates, and all other devices necessary for the proper application of the hardware.

1.3 SUBMITTALS

A. Submit under provisions of Section 01 33 00.

B. Product Data: Include manufacturers' technical product data for each item of door hardware, installation instructions, maintenance of operating parts and finish, and other information necessary to show compliance with requirements.

C. Final Hardware Schedule Content: Based on hardware indicated, organize schedule into "hardware sets" indicating complete designations of every item required for each door or opening. Include the following information:
   1. Type, style, function, size, and finish of each hardware item.
   2. Name and manufacturer of each item.
   3. Fastenings and other pertinent information.
   4. Location of each hardware set cross-referenced to indications on Drawings.
   5. Explanation of all abbreviations, symbols, and codes contained in schedule.
   6. Mounting locations for hardware.
   7. Mounting type for closers.
   8. Door and frame sizes, materials, degree of opening, handing, and fire/smoke rating.
   9. Operation descriptions for hardware sets with electrified hardware.
   10. Name and phone number for the local manufacturer's representative for each product.

D. Key Schedule: After a keying meeting between representatives of the Owner, Architect, and the hardware supplier, provide a keying schedule, listing the levels of keying, as well as an explanation of the key system's function, the key symbols used, and the door numbers controlled. This schedule can be submitted as a part of the hardware schedule or as a separate schedule.

E. Samples: If requested by the Architect, submit samples of each type of exposed hardware unit in finish indicated and tagged with full description for coordination with schedule.
   1. Samples will be returned to the supplier in like-new condition. Units that are acceptable may, after final check of operations, be incorporated in the Work, within limitations of key coordination requirements.

F. Templates: After final approval of the hardware schedule, provide templates for doors, frames, and other work specified to be factory prepared for the installation of door hardware.

G. Operations and Maintenance Data: Provide in accordance with Section 01 78 23 and include the following:
1. Complete information on care, maintenance, and adjustment; data on repair and replacement parts, and information on preservation of finishes.
2. Catalog pages for each product.
3. Name, address, and phone number of local representative for each manufacturer.
4. Parts list for each product.
5. Copy of final approved hardware schedule, edited to reflect “As installed.”
6. Copy of final keying schedule.
7. One (1) complete set of special tools required for maintenance and adjustment of hardware, including changing of cylinders.
8. Copy of warranties including appropriate reference numbers for manufacturers to identify the project.

1.4 QUALITY ASSURANCE

A. Substitutions: Submit substitutions in accordance with Division 01.

B. Supplier Qualifications: A recognized architectural hardware supplier, with warehousing facilities in the Project’s vicinity, that has a record of successful in-service performance for supplying door hardware similar in quantity, type, and quality to that indicated for this Project and that employs an accredited Architectural Hardware Consultant (AHC), who is available to Owner, Architect, and Contractor, at reasonable times during the course of the Work for consultation.

C. Product Single Source Responsibility: Obtain each type of hardware (latch and locksets, hinges, closers, etc.) from a single manufacturer.

D. Supplier Single Source Responsibility: Procure hardware for all doors from a single supplier.

E. Fire-Rated Openings: Provide door hardware for fire-rated openings that complies with NFPA 80 and requirements of authorities having jurisdiction. Provide only items of door hardware that are listed and are identical to products tested by Underwriters Laboratories, Warnock Hersey, Factory Mutual, or other testing and inspecting organization acceptable to the authorities having jurisdiction for use on types and sizes of doors indicated in compliance with requirements of fire-rated door and door frame labels.

1.5 DELIVERY, STORAGE AND HANDLING

A. Tag each item or package separately with identification related to final hardware schedule, and include basic installation instructions with each item or package.

B. Each article of hardware shall be individually packaged in manufacturer's original packaging.

C. Contractor will provide secure lock-up for door hardware delivered to the Project, but not yet installed. Control handling and installation of hardware items so that completion of the Work will not be delayed by hardware losses both before and after installation.

D. Items damaged in shipment shall be replaced promptly and with proper material and paid for by whomever did the damage or caused the damage to occur.

E. All the hardware shall be handled at this project in a manner to avoid damage, marring or scratching. Any irregularities that occur to the hardware after it has been delivered to the project shall be corrected, replaced or repaired by the Contractor at their expense. All hardware items shall be protected against malfunction due to paint, solvent, cleanser or any chemical agent.

F. No direct shipments will be allowed unless approved by the Contractor.

1.6 WARRANTY

A. Starting date for warranty periods to be date of manufacture of that hardware item.

B. No liability is to be assumed where damage or faulty operation is due to improper installation, improper usage or abuse.

C. Provide guarantee from hardware supplier as follows:
1. Hinges: Life of the building.
2. Closers: Life of the building.
3. Locksets: Life of the building.
4. Exit Devices: Five (2) years.
5. All other Hardware: One (1) year.

D. Products judged to be defective during the warranty period shall be replaced or repaired in accordance with the manufacturer’s warranty, at no additional cost to the Owner.

1.7 MAINTENANCE

A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner’s continued adjustment, maintenance, and removal and replacement of door hardware.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Approval of manufacturers other than those listed shall be in accordance with Paragraph 1.6A.

B. Note that even though an acceptable substitute manufacturer may be listed, the product must provide all the functions and features of the specified product or it will not be approved.

C. Hand of Door: Drawings show direction of slide, swing, or hand of each door leaf. Furnish each item of hardware for proper installation and operation of door movement as shown.

D. Where the exact types of hardware specified are not adaptable to the finished shape or size of the members requiring hardware, furnish suitable types having as nearly as possible the same operation and quality as the type specified, subject to Architect's approval.

2.2 MATERIALS

A. Fasteners:
1. Provide hardware manufactured to conform to published templates, generally prepared for machine screw installation.
2. Furnish screws for installation with each hardware item. Finish exposed (exposed under any condition) screws to match hardware finish or, if exposed in surfaces of other work, to match finish of this other work as closely as possible including “prepared for paint” surfaces to receive painted finish.
3. Provide concealed fasteners for hardware units that are exposed when door is closed except to the extent that no standard units of type specified are available with concealed fasteners. Do not use thru-bolts for installation where bolt head or nut on opposite face is exposed in other work unless their use is the only means of reinforcing the work adequately to fasten the hardware securely.
4. All hardware shall be installed with the fasteners provided by the hardware manufacturer.

2.3 HINGES

A. Provide five-knuckle, concealed bearing hinges of type, material, and height as outlined in the following guide for this specification:

B. 1-3/4 inch thick doors, up to and including 36 inches wide:
1. Exterior: standard weight, stainless steel, 4-1/2 inches high
2. Interior: standard weight, steel, 4-1/2 inches high

C. 1-3/4 inch thick doors over 36 inches wide:
1. Exterior: heavy weight, stainless steel, 5 inches high
2. Interior: heavy weight, steel, 5 inches high

D. 2 inches or thicker doors:
1. Exterior: heavy weight, stainless steel, 5 inches high
2. Interior: heavy weight, steel, 5 inches high

E. Provide three hinges per door leaf for doors 90 inches or less in height, and one additional hinge for each 30 inches of additional door height.

F. Hinge Pins: Except as otherwise indicated, provide hinge pins as follows:
1. Steel Hinges: Steel pins
2. Non-Ferrous Hinges: Stainless steel pins
3. Out-Swinging Exterior Doors: Non-removable pins
4. Out-Swinging Interior Lockable Doors: Non-removable pins
5. Interior Non-lockable Doors: Non-rising pins

G. The width of hinges shall be 4-1/2 inches at 1-3/4 inch thick doors, and 5 inches at 2 inches or thicker doors. Adjust hinge width as required for door, frame, and/or wall conditions to allow proper degree of opening.

H. Provide hinges with electrified option where specified. Provide with sufficient number and gage of concealed wires to accommodate electric function of specified hardware. Locate electric hinge at second hinge from bottom or nearest to the electrified locking component.

I. Provide mortar guard for each electrified hinge specified, unless specified in hollow metal frame specification.

J. Acceptable manufacturers and/or products: Stanley CB series, Hager AB series, and McKinney TCA/T4CA series.

2.4 CONTINUOUS HINGES - GEARED

A. Provide aluminum geared continuous hinges conforming to ANSI A156.25, Grade 1.

B. Provide aluminum geared continuous hinges, where specified in the hardware sets, fabricated from 6063-T5 aluminum.

C. Provide split nylon bearings at each hinge knuckle for quiet, smooth, self-lubricating operation. Provide hinge with no less than 32 bearings.

D. Hinges shall be capable of supporting door weights up to 600 pounds, and shall be successfully tested for 1,500,000 cycles.

E. On fire-rated doors, provide aluminum geared continuous hinges that are classified for use on rated doors by a testing agency acceptable to the authority having jurisdiction.

F. Install hinges with fasteners supplied by manufacturer.

G. Acceptable manufacturers and products: Stanley 661HD series, and Select SL11HD series.

2.5 FLUSH BOLTS

A. Provide automatic and manual flush bolts with forged bronze face plates, extruded brass levers, and with wrought brass guides and strikes. Provide 12 inch steel or brass rods at doors up to 90 inches in height. Top rods at manual flush bolts for doors over 90 inches in height shall be increased by 6 inches for each additional 6 inches of door height. Provide dust-proof strikes at each bottom flush bolt.

B. Acceptable manufacturers and/or products: Trimco, ABH, Don-Jo Manufacturing, Burns.

2.6 COORDINATORS

A. Provide a bar-type coordinating device, surface applied to the underside of the stop at the frame head where pairs of doors are equipped with automatic flush bolts, an astragal, or other hardware that requires synchronized closing of the doors.

B. Provide a filler bar of the correct length for the unit to span the entire width of the opening, and appropriate brackets for parallel arm door closers and surface vertical rod exit device strikes. Factory-prep coordinators for vertical rod devices if required.

C. Acceptable manufacturers and/or products: Trimco, ABH, Don-Jo Manufacturing, Burns.

2.7 MORTISE LOCKS

A. Provide mortise locks that comply with ANSI A156.13, Series 1000, BHMA Grade 1 Operational and Grade 2 Security and are ULC listed, and appear in BHMA's "Directory of Certified Locks & Latches".

B. Locks shall have stamped steel case with steel or brass parts, and levers constructed of forged or cast brass, bronze or stainless steel construction.

C. Lever design shall be Best 15R.

D. Lever trim on the secure side of doors serving rooms considered by the authority having jurisdiction to be hazardous shall have a tactile warning.

E. Provide function numbers and descriptions indicated at the end of this Section.

F. Lock throw shall comply with testing requirements for length of bolts to comply with labeled fire door requirements, and as follows:
   1. Mortise Locks: Minimum 3/4-inch latch bolt throw.
   2. Mortise Locks & Latches shall have an anti-friction, 3/4-inch throw latch bolt with anti-friction piece made of self-lubricated stainless steel. Latch bolt with plastic insert and three-piece latch bolt are unacceptable on this project.
   3. Mortise Locks & Latches shall have levers to be operated with a roller bearing spindle hub mechanism.

G. Acceptable manufacturers and/or products: Dormakaba Best 45H series, Allegion Schlage L9000 series, and ASSA Abloy Sargent 8200 series.

2.8 EXIT DEVICES

A. Provide exit devices tested to ANSI/BHMA A156.3 Grade 1, and UL listed for Panic Exit and/or Fire Exit Hardware.

B. Provide touchpad type exit devices, fabricated of stainless steel, plated to the standard architectural finishes to match the balance of the door hardware.

C. Touchpad shall extend a minimum of one half of the door width, but not the full length of the exit device rail.

D. Devices to incorporate a deadlatching feature.

E. Provide manufacturer's standard strikes.

F. Provide exit devices cut to door width and height. Locate exit devices at a height recommended by the exit device manufacturer, allowable by governing building codes, and approved by the Architect.

G. Where lever handles are specified as outside trim for exit devices, provide heavy-duty lever trims with forged or cast escutcheon plates.
   1. Lever style will match the lever style of the locksets.

2. Lever trim on the secure side of doors serving rooms considered by the authority having jurisdiction to be hazardous shall have a tactile warning.

H. Exit devices for fire rated openings shall be UL labeled fire exit hardware.

I. Provide electrical options as scheduled.

J. Removable mullions shall be a 2 inches x 3 inches steel tube. Where scheduled, mullion shall be of a type that can be removed by use of a keyed cylinder, which is self-locking when re-installed.

K. Acceptable manufacturers and/or products: Dormakaba Precision Apex series, Allegion Von Duprin 98 series, and ASSA Abloy Sargent 80 series.

2.9 DOOR CLOSERS

A. Provide door closers certified to ANSI/BHMA A156.4 Grade 1 requirements by a BHMA certified independent testing laboratory. Door closers shall have fully hydraulic, full rack and pinion action with a high strength cast iron or aluminum cylinder. Cylinder body shall be 1-1/2 inch diameter.

B. Provide hydraulic fluid requiring no seasonal closer adjustment. Fluid shall be fireproof and shall pass the requirements of the UL10C “positive pressure” fire test.

C. Spring power shall be continuously adjustable over the full range of closer sizes, and allow for reduced opening force as required by accessibility codes and standards. Closers shall have separate adjustment for latch speed, general speed, and backcheck.

D. Maximum 5-pound opening force to open an interior door, other than a fire door {ADA 404.2.9(1)]

E. Provide closers with heavy-duty forged forearms for parallel arm closers.

F. Closers shall not incorporate Pressure Relief Valve (PRV) technology.

G. Provide special templates, drop plates, mounting brackets, or adapters for arms as required for details, overhead stops, and other finish hardware items interfering with closer mounting.

H. Mount closers on room side of corridor doors, inside of exterior doors, and stair side of stairway doors from corridors. Closers shall not be visible in corridors, lobbies and other public spaces unless approved by Architect.

I. Door closers meeting this specification: Stanley Commercial Hardware QDC100 series, Allegion LCN 4040XP Series, and ASSA Abloy Sargent 280 series.

2.10 DOOR TRIM

A. Provide push plates 4 inches wide x 16 inches high x 0.050 inch thick and beveled 4 edges. Where width of door stile prevents use of 4 inches wide plate, adjust width to fit.

B. Provide offset pulls of solid bar stock, diameter and length as scheduled. Where required, mount back to back with push bar.

C. Provide pulls of solid bar stock, diameter and length as scheduled. Where required, mount back to back with push bar.

D. Provide pull plates 4 inches wide x 16 inches high x 0.050 inch thick, beveled 4 edges, and prepped for pull. Where width of door stile prevents use of 4 inches wide plate, adjust width to fit.

E. Acceptable manufacturers and/or products: Trimco, Don-Jo Manufacturing, Burns.

2.11 PROTECTION PLATES

A. Provide kick plates, and mop plates, minimum of 0.050 inch thick as scheduled. Furnish with machine or wood screws, finished to match plates. Sizes of plates shall be as follows:
1. Kick Plates – 10 inches high x 2 inches less width of door on single doors, 1 inch less width of door on pairs
2. Mop Plates – 4 inches high x 2 inches less width of door on single doors, 1 inch less width of door on pairs

B. Acceptable manufacturers and/or products: Trimco, Don-Jo Manufacturing, Burns.

2.12 DOOR STOPS

A. Provide door stops for all doors in accordance with the following requirements:
1. Provide wall stops wherever possible. Provide convex type where mortise type locks are used and concave type where cylindrical type locks are used.
2. Where wall stops cannot be used, provide dome type floor stops of the proper height.
3. At any opening where a wall or floor stop cannot be used, a medium duty surface mounted overhead stop shall be used.

B. Acceptable manufacturers and/or products: Trimco, Burns, ABH Manufacturing.

2.13 THRESHOLDS, SEALS, DOOR SWEEPS, AUTOMATIC DOOR BOTTOMS, AND GASKETING

A. Provide thresholds, weatherstripping (including door sweeps, seals, astragals) and gasketing systems (including smoke, sound, and light) as specified and per architectural details. Match finish of other items as closely as possible. Size of thresholds shall be as follows:
1. Exterior Saddle Thresholds – 1/2 inch high x jamb width x door width
2. Interior Saddle Thresholds – ¼ inch high x jamb width x door width
3. Bumper Seal Thresholds – 1/2 inch high x 5 inches wide x door width

B. Provide door sweeps, seals, astragals, and auto door bottoms only of type where resilient or flexible seal strip is easily replaceable and readily available.

C. Acceptable manufacturers and/or products: National Guard, Reese, Assa Abloy Pemko.

2.14 SILENCERS

A. Provide "Push-in" type silencers for each hollow metal or wood frame. Provide three for each single frame and two for each pair frame. Omit where gasketing is specified or required by code.

B. Acceptable manufacturers and/or products: Trimco, Burns, ABH Manufacturing.

2.15 FINISHES

A. With the exception of items listed below, the finish of hardware items shall be US26D - satin chrome or US32D - satin stainless steel.

B. Exceptions are as follows:
1. Hinges at Exterior Doors: US32D (BHMA 630).
2. Aluminum Geared Continuous Hinges: Clear Anodized Aluminum.
3. Push Plates, Pulls: US32D (BHMA 630).
4. Exit Devices: US32D (BHMA 630).
5. Protection Plates: US32D (BHMA 630).
6. Door Closers: Powder Coat to Match.
7. Wall Stops: US32D (BHMA 630).
8. Weatherstripping: Clear Anodized Aluminum.
9. Thresholds: Mill Finish Aluminum.

2.16 CYLINDERS AND KEYING

A. Provide a new key system from the same manufacturer as the locks conforming to the following requirements:
1. Provide restricted patented small formant interchangeable core cylinders at all keyed items. Restriction shall control the access to the products by requiring a signed letter of authorization and/or authorization form from the Owner or authorized agent of the Owner. Patent shall protect against the unauthorized manufacturing and duplication of the products. Restricted patented cores shall not be operable by non-patented key blanks. Restricted patented cores shall incorporate a mechanism to check for the patented features on the keys. Provide construction cores with construction master keying for use during construction. The hardware supplier, accompanied by the Owner or Owner’s security agent, shall install permanent keyed cores upon completion of the project. The temporary construction cores are to be returned to the hardware supplier.
2. Provide permanent cores and cylinders keyed by the manufacturer or authorized distributor as directed by the Owner. Provide owner with a copy of the bitting list, return receipt requested.
3. The hardware supplier, accompanied by a qualified factory representative for the manufacturer of the cores and cylinders, shall meet with Owner and Architect to review keying requirements and lock functions prior to ordering finish hardware. Submit a keying schedule to Architect for approval.
4. Provide cores and cylinders, unless noted otherwise, operated by a Grand Master Key System to be established for this project (Do not use the letter "I", “O”, or “X” for any of the grand masters). Allow for twenty-four Master Keys under each Grand Master, and sixty-four changes under each master key. All cylinders shall be keyed in alike or different sets as noted by their respective key set number. Do not use the letter "I" or “O” in any of the master key sets.
5. Provide patented restricted keys as follows:

a. Ten grand master keys for each set.
b. Ten master keys for each set.
c. Three keys per core and/or cylinder.
d. Two construction core control keys
e. Two permanent core control keys
f. Six construction master keys for each type (Contractor is to provide one set of construction keys to Architect)

6. Visual key control:
   a. Keys shall be stamped with their respective key set number and stamped “DO NOT DUPLICATE".
   b. Grand master and master keys shall be stamped with their respective key set letters.
   c. Do not stamp any keys with the factory key change number.
   d. Do not stamp any cores with key set on face (front) of Core. Stamp on back or side of cores so not to be visible when core is in cylinder.
7. Deliver grand master keys, master keys, change keys, and/or key blanks from the factory or authorized distributor directly to the Owner in sealed containers, return receipt requested. Failure to comply with these requirements may be cause to require replacement of all or any part of the keying system that was compromised at no additional cost to the Owner.
8. Approved products: Dormakaba Best Cormax, Allegion Schlage Everest 29T, and ASSA Abloy Sargent Degree DG1.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Prior to installation of any hardware, examine doors, frames, walls and related items for conditions that would prevent proper installation of finish hardware. Correct defects prior to proceeding with installation.

B. Pre-Installation Conference: Prior to the installation of hardware, manufacturer’s representatives for locksets, closers, and exit devices shall arrange and hold a jobsite meeting to instruct the installing contractor’s personnel on the proper installation of their respective products. A letter of compliance, indicating when the meeting was held and who was in attendance, shall be sent to Architect and Owner.

3.2 INSTALLATION

A. Hardware shall be installed by qualified tradesmen skilled in application of commercial grade hardware. For technical assistance if necessary, installers may contact manufacturer’s representative for the item in question, as listed in the hardware schedule.

B. Mount hardware units at heights indicated in “Recommended Locations for Builders Hardware for Standard Steel Doors and Frames” by the Door and Hardware Institute.

C. Install each hardware item in compliance with the manufacturer’s instructions and recommendations, using only the fasteners provided by the manufacturer.

D. Do not install surface mounted items until finishes have been completed on the substrate. Protect installed hardware during painting.

E. Set units level, plumb and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.

F. Operating parts shall move freely and smoothly without binding, sticking, or excessive clearance.

G. Set thresholds for exterior doors in full bed of butyl rubber or polyisobutylene mastic sealant complying with requirements specified in Section 07 92 00.

3.3 ADJUSTING, CLEANING AND DEMONSTRATING

A. Adjust and check each operating item of hardware and each door, to insure proper operation or function of every unit. Replace units that cannot be adjusted to operate freely and smoothly.

B. Where door hardware is installed more than one (1) month prior to acceptance or occupancy of a space or area, return to the installation during the week prior to acceptance or occupancy and make a final check and adjustment of hardware items in such space or area. Clean operating items as necessary to restore proper function and finish of hardware and doors. Adjust door control devices to compensate for final operation of heating and ventilating equipment.

C. Clean adjacent surfaces soiled by hardware installation. Remove bulk trash form the building, clean up any dust/debris caused by the installation of hardware.

D. Instruct Owner’s personnel in the proper adjustment, lubrication, and maintenance of door hardware and hardware finishes.

3.4 FIELD QUALITY CONTROL

A. At completion of the project, a qualified factory representative for the manufacturers of locksets, closers, and exit devices shall inspect installations of their products. After the inspections, a letter shall be sent to the Architect reporting on conditions, verifying that their respective products have been properly installed and adjusted.

B. Six-Month Adjustment: Approximately six months after the date of Substantial Completion, the installer, accompanied by representatives of the manufacturers of latchsets and locksets, door control devices, and of other major hardware suppliers, shall return to the Project to perform the following work:
   1. Examine and re-adjust each item of door hardware as necessary to restore function of doors and hardware to comply with specified requirements.
   2. Consult with and instruct Owner’s personnel in recommended additions to the maintenance procedures.
   3. Replace hardware items that have deteriorated or failed due to faulty design, materials, or installation of hardware units.
   4. Prepare a written report of current and predictable problems (of substantial nature) in the performance of the hardware.

3.5 PROTECTION

A. Provide for the proper protection of items of hardware until Owner accepts the project as complete. Damaged or disfigured hardware shall be replaced or repaired by the responsible party.

3.6 HARDWARE SCHEDULE

A. Provide hardware for each door to comply with requirements of hardware set numbers indicated in door schedule, and in the following schedule of hardware sets.

B. It is intended that the following schedule includes all items of finish hardware necessary to complete the work. If a discrepancy is found in the schedule, such as a missing item, improper hardware for a frame, door or fire codes, the preamble will be the deciding document.

C. Hardware sets:

SET #01 - SINGLE AT RESTROOM

3	Hinges	CB168 SERIES AS SPECIFIED	US26D	ST
1	Privacy Set	45H-0L15R VIN	626	BE
1	Door Closer	QDC115 BF R	689	SH
1	Kick Plate	KO050 10" X 2" LDW B4E CSK	630	TR
1	Door Stop	1270WV AS REQUIRED	626	TR
3	Door Silencers	1229A		TR

SET #02 - SINGLE WITH OFFICE LOCK

3	Hinges	CB179 SERIES AS SPECIFIED	US26D	ST
1	Office Lock	45H-7AT15R	626	BE
1	Door Closer	QDC111 BF R MOUNT PULL SIDE	689	SH
1	Kick Plate	KO050 10" X 2" LDW B4E CSK	630	TR
1	Door Stop	1211/1270WV AS REQUIRED	626	TR
3	Door Silencers	1229A		TR

SET #03 - SINGLE WITH STOREROOM LOCK

3	Hinges	CB179 NRP SERIES AS SPECIFIED	US26D	ST
1	Storeroom Lock	45H-7D15R	626	BE
1	Door Closer	QDC113 BF R	689	SH
1	Kick Plate	KO050 10" X 2" LDW B4E CSK	630	TR
3	Door Silencers	1229A		TR

SET #04 - MULTI-STALL STAFF RESTROOM

1	Continuous Hinge	661HD	AL	ST
1	Door Pull	1194-3	630	TR
1	Push Plate	1001-3	630	TR
1	Deadbolt	48H-7R	626	BE
1	Door Closer	QDC111 R PULL SIDE MOUNT	689	SH
1	Mop Plate	KM050-1 4" x 1" LDW B4E CSK	630	TR
1	Kick Plate	KO050 10" X 2" LDW B4E CSK	630	TR
1	Door Stop	1211/1270WV AS REQUIRED	626	TR
1	Door Sweep	C627 (DOOR WIDTH)	AL	NA
1	Perimeter Seal	706 E (HEAD & JAMBS)	AL	NA
1	Saddle Threshold	896ADJ V (DOOR WIDTH)	AL	NA

DEADBOLT FOR SECURE PURPOSES ONLY WHEN NOT IN USE. THUMBTURN INSIDE RETRACTS BOLT ONLY, IT DOES NOT PROJECT IT.

SET #05 – TRAINER/TICKETS

1	Continuous Hinge	661HD	AL	ST
1	Office Lock	45H-7AT15R	626	BE
1	Door Closer	QDC113 R	689	SH
1	Kick Plate	KO050 10" X 2" LDW B4E CSK	630	TR
1	Door Sweep	C627 (DOOR WIDTH)	AL	NA
1	Perimeter Seal	706 E (HEAD & JAMBS)	AL	NA
1	Saddle Threshold	896ADJ V (DOOR WIDTH)	AL	NA

SET #06 - EXTERIOR PAIR WITH STOREROOM LOCK

2	Continuous Hinge	661HD	AL	ST
2	Flush Bolt	3917-12 x 3910	626	TR
1	Storeroom Lock	45H-7D15R 7/8" LTC	626	BE
2	Door Closer	QDC113 R	689	SH
2	Kick Plate	KO050 10" X 1" LDW B4E CSK	630	TR
1	Meeting Stile Seal	600 A (2PCS @ DOOR HEIGHT)		NA
2	Door Sweep	C627 (DOOR WIDTH)	AL	NA
1	Perimeter Seal	706 E (HEAD & JAMBS)	AL	NA
1	Saddle Threshold	896ADJ V (DOOR WIDTH)	AL	NA

SET #07 - EXTERIOR SINGLE AT TEAM ROOM

1	Continuous Hinge	661HD	AL	ST
1	Exit Device	2103 x C03 CD	630	PR
1	Rim Cylinder	AS REQUIRED	626	BE
1	Mortise Cylinder	AS REQUIRED	626	BE
1	Offset Pull	1191-3	630	TR
1	Door Closer	QDC113 R	689	SH
1	Kick Plate	KO050 10" X 2" LDW B4E CSK	630	TR
1	Door Sweep	C627 A (DOOR WIDTH)		NA
1	Saddle Threshold	896ADJ V (DOOR WIDTH)	AL	NA

SET #08 - EXTERIOR SINGLE AT TEAM ROOM – EXIT ONLY

2	Continuous Hinge	661HD	AL	ST
1	Exit Device	2101	630	PR
1	Set Auto Flush Bolts	3825L X 3815L	630	TR
1	Coordinator	3094B SERIES	PC	TR
2	Door Closer	QDC113 R	689	SH
2	Kick Plate	KO050 10" X 2" LDW B4E CSK	630	TR
1	Meeting Stile Seal	600 A (2PCS @ DOOR HEIGHT)		NA
2	Door Sweep	C627 A (DOOR WIDTH)		NA
1	Perimeter Seal	706 E (HEAD & JAMBS)	AL	NA
1	Saddle Threshold	896ADJ V (DOOR WIDTH)	AL	NA

SET #09 – IND ROOMS

1	Continuous Hinge	661HD	AL	ST
1	Privacy Set	45H-0L15R VIN	626	BE
1	Deadbolt	48H-7R	626	BE
1	Door Closer	QDC111 R PULL SIDE MOUNT	689	SH
1	Kick Plate	KO050 10" X 2" LDW B4E CSK	630	TR
1	Door Sweep	200N (DOOR WIDTH)	AL	NA

1	Perimeter Seal	706 E (HEAD & JAMBS)	AL	NA
1	Saddle Threshold	896ADJ V (DOOR WIDTH)	AL	NA

DEADBOLT FOR SECURE PURPOSES ONLY WHEN NOT IN USE. THUMBTURN INSIDE RETRACTS BOLT ONLY, IT DOES NOT PROJECT IT.

SET #09 – ATTIC

3	Hinges	CB199 SERIES AS SPECIFIED	US32D	ST
1	Storeroom Lock	45H-7D15R 7/8" LTC	626	BE
1	Door Closer	QDC111 R PULL SIDE MOUNT	689	SH
1	Kick Plate	KO050 10" X 2" LDW B4E CSK	630	TR
1	Door Sweep	200N (DOOR WIDTH)	AL	NA
1	Perimeter Seal	706 E (HEAD & JAMBS)	AL	NA
1	Saddle Threshold	896ADJ V (DOOR WIDTH)	AL	NA

END OF SECTION

SECTION 08 8000 - 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 and interior borrowed lites.
2. Insulating glass.
3. Laminated glass
4. 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.

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.

1.6 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.

1.7 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 (4.4 deg C).

1.8 WARRANTY

A. Manufacturer's Special Warranty on 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.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations for Glass: Obtain from single source from single manufacturer for each glass type.

B. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer for each product and installation method.

2.2 PERFORMANCE REQUIREMENTS

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

B. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.

C. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of the IGCC.

2.3 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."

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. Thickness: Where glass thickness is indicated, it is a minimum.

D. Strength: Where fully tempered float glass is indicated, provide fully tempered float glass.

2.4 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.

2.5 INSULATING GLASS

A. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified in accordance with ASTM E2190.

1. Sealing System: Dual seal, with manufacturer's standard primary and secondary sealants.
2. Perimeter Spacer: Manufacturer's standard spacer material and.
3. Desiccant: Molecular sieve or silica gel, or a blend of both.
4. Corner Construction: Manufacturer’s standard corner construction.

B. Insulating Glass Type: Low-E-Coated, Clear Insulating Glass:

1. Basis-of-Design Product: AGC Flat Glass North America 1" Gray/Comfort E-2(3) Insulated Unit
2. Overall Unit Thickness: 1 inch (25 mm)
3. Minimum Thickness of Each Glass Lite: ¼ inch (6mm)
4. Insulating Unit Construction: ¼ inch (6mm) glass + ½ inch (13mm) air space + ¼ inch (6mm) glass.
5. Outdoor Lite: Solarshield Grey Stopsol Classic #2, Kind FT (fully tempered where required by Code
6. Interspace Content: Air

7. Indoor Lite: 1/4 inch thick; Clear Comfort Ti-AC40#3; Class 1 (clear) float glass. Kind FT (fully tempered where required by Code).
8. Reflective, Low-E Coating: sputtered on third surface
9. Performance Characteristics:
   a. Visible Light Transmittance: 14 percent.
   b. Ultraviolet Transmittance: 5 percent.
   c. Winter Nighttime U-Factor: 0.29 maximum.
   d. Summer Daytime U-Factor: 0.28 maximum.
   e. Solar Heat Gain Coefficient: 0.19 maximum.
10. Safety glazing required.

2.6 LAMINATED GLASS

A. Windborne-Debris-Impact-Resistant Laminated Glass: Comply with requirements specified above for laminated glass except laminate glass with the following to comply with interlayer manufacturer's written instructions:

1. Basis of Design Manufacturer: Kuraray America, Inc.
2. Construction: Laminate glass with ionomeric polymer interlayer to comply with interlayer manufacturer's written instructions.
3. Interlayer Thickness: Provide thickness not less than that indicated and as needed to comply with requirements.
4. Interlayer Color: Clear unless otherwise indicated.

2.7 GLAZING SEALANTS

A. Glazing Sealant for use with fire-protection-rated glazing products: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 50, Use NT. Comply with glass manufacturer’s written instructions for selecting glazing sealants suitable for applications 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 806.3 tape, for glazing applications in which tape is subject to continuous pressure.

B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:

1. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.
2. AAMA 810.1, Type 2, for glazing 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).

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.

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.

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. 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.

D. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

E. Provide spacers for glass lites where length plus width is larger than 50 inches (1270 mm).

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 (3-mm) 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.

F. 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.

G. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

H. Set glass lites with proper orientation so that coatings face exterior or interior as specified.

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. 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.

3.5 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 buildup of dirt, scum, deposits, or stains. If 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.

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.

END OF SECTION 08 8000

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SECTION 08 9119 - FIXED LOUVERS

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. Fixed extruded-aluminum louvers.
2. Blank-off panels for louvers

1.3 DEFINITIONS

A. Louver Terminology: Definitions of terms for metal louvers contained in AMCA 501 apply to this Section unless otherwise defined in this Section or in referenced standards.

B. Horizontal Louver: Louver with horizontal blades (i.e., the axis of the blades are horizontal).

C. Drainable-Blade Louver: Louver with blades having gutters that collect water and drain it to channels in jambs and mullions, which carry it to bottom of unit and away from opening.

D. Wind-Driven-Rain-Resistant Louver: Louver that provides specified wind-driven-rain performance, as determined by testing according to AMCA 500-L.

E. Windborne-Debris-Impact-Resistant Louver: Louver that provides specified windborne-debris-impact resistance, as determined by testing according to AMCA 540.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. For louvers specified to bear AMCA seal, include printed catalog pages showing specified models with appropriate AMCA Certified Ratings Seals.

B. Shop Drawings: For louvers and accessories. Include plans, elevations, sections, details, and attachments to other work. Show frame profiles and blade profiles, angles, and spacing.

1. Show weep paths, gaskets, flashings, sealants, and other means of preventing water intrusion.
2. Show mullion profiles and locations.

C. Samples: For each type of metal finish required.

1.5 INFORMATIONAL SUBMITTALS

A. Product Test Reports: Based on evaluation of comprehensive tests performed according to AMCA 500-L by a qualified testing agency or by manufacturer and witnessed by a qualified testing agency, for each type of louver and showing compliance with performance requirements specified.

B. Windborne-debris-impact-resistance test reports.

C. Sample Warranties: For manufacturer's special warranties.

1.6 FIELD CONDITIONS

A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.7 WARRANTY

A. Special Finish Warranty: Manufacturer agrees to repair or replace components on which finishes fail in materials or workmanship 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 MANUFACTURERS

A. Source Limitations: Obtain fixed louvers from single source from a single manufacturer where indicated to be of same type, design, or factory-applied color finish.

2.2 PERFORMANCE REQUIREMENTS

A. Windborne-Debris-Impact Resistance: Louvers located within 30 feet (9.1 m) of grade shall pass basic protection, when tested according to AMCA 540.

B. Seismic Performance: Louvers, including attachments to other construction, shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

C. Louver Performance Ratings: Provide louvers complying with requirements specified, as demonstrated by testing manufacturer's stock units identical to those provided, except for length and width according to AMCA 500-L.

D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

E. SMACNA Standard: Comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" for fabrication, construction details, and installation procedures.

2.3 FIXED EXTRUDED-ALUMINUM LOUVERS

A. Horizontal Drainable-Blade Louvers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Airolite Company, LLC (The)
   b. Air Flow Company, Inc.
   c. Ruskin Company
2. Louver Depth: 4 inches (100 mm).
3. Frame and Blade Nominal Thickness: Not less than 0.080 inch (2.03 mm)
4. Mullion Type: Exposed.
5. Louver Performance Ratings:

   a. Free Area: Not less than 8.0 sq. ft. (0.74 sq. m)] [8.5 sq. ft. (0.79 sq. m) for 48-inch- (1220-mm-) wide by 48-inch- (1220-mm-) high louver.
   b. Point of Beginning Water Penetration: Not less than 900 fpm (4.6 m/s)
   c. Air Performance: Not more than 0.10-inch wg (25-Pa) static pressure drop at 800-fpm (4.1-m/s) free-area intake velocity.

6. AMCA Seal: Mark units with AMCA Certified Ratings Seal.

2.4 LOUVER SCREENS

A. General: Provide screen at each exterior louver.

1. Screen Location for Fixed Louvers: Interior face.
2. Screening Type: Insect screening.

B. Secure screen frames to louver frames with machine screws with heads finished to match louver, spaced a maximum of 6 inches (150 mm) from each corner and at 12 inches (300 mm) o.c.

C. Louver Screen Frames: Fabricate with mitered corners to louver sizes indicated.

1. Metal: Same type and form of metal as indicated for louver to which screens are attached. Reinforce extruded-aluminum screen frames at corners with clips.
2. Finish: Same finish as louver frames to which louver screens are attached.
3. Type: Rewirable frames with a driven spline or insert.

D. Louver Screening for Aluminum Louvers:

1. Insect Screening: Aluminum, 18-by-16 (1.4-by-1.6-mm) mesh, 0.012-inch (0.30-mm) wire.

2.5 BLANK-OFF PANELS

A. Insulated Blank-Off Panels: Laminated panels consisting of an insulating core surfaced on back and front with metal sheets and attached to back of louver.

1. Thickness: 2 inches (50 mm).
2. Metal Facing Sheets: Aluminum sheet, not less than 0.032-inch (0.81-mm) nominal thickness.
3. Insulating Core: extruded-polystyrene foam.
4. Edge Treatment: Trim perimeter edges of blank-off panels with louver manufacturer's standard channel frames, with corners mitered and with same finish as panels.
5. Seal perimeter joints between panel faces and louver frames with gaskets or sealant.
6. Panel Finish: Same finish applied to louvers.
7. Attach blank-off panels with sheet metal screws.

2.6 MATERIALS

A. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), Alloy 6063-T5, T-52, or T6.

B. Aluminum Sheet: ASTM B 209 (ASTM B 209M), Alloy 3003 or 5005, with temper as required for forming, or as otherwise recommended by metal producer for required finish.

C. Fasteners: Use types and sizes to suit unit installation conditions.

1. Use tamper-resistant screws for exposed fasteners unless otherwise indicated.
2. For fastening aluminum, use aluminum or 300 series stainless-steel fasteners.
3. For color-finished louvers, use fasteners with heads that match color of louvers.

D. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.

2.7 FABRICATION

A. Factory assemble louvers to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

B. Maintain equal louver blade spacing to produce uniform appearance.

C. Fabricate frames, including integral sills, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.

D. Include supports, anchorages, and accessories required for complete assembly.

E. Provide subsills made of same material as louvers for recessed louvers.

F. Join frame members to each other and to fixed louver blades with fillet welds concealed from view, threaded fasteners, or both, as standard with louver manufacturer unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.

2.8 ALUMINUM FINISHES

A. Finish louvers after assembly.

B. High-Performance Organic Finish: Three-coat fluoropolymer finish complying with AAMA 2605 and 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: As selected by Architect from manufacturer's full range

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and openings, 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. 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.

3.3 INSTALLATION

A. Locate and place louvers level, plumb, and at indicated alignment with adjacent work.

B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.

C. Form closely fitted joints with exposed connections accurately located and secured.

D. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.

E. Protect unpainted galvanized- and nonferrous-metal surfaces that are in contact with concrete, masonry, or dissimilar metals from corrosion and galvanic action by applying a heavy coating of bituminous paint or by separating surfaces with waterproof gaskets or nonmetallic flashing.

F. Install concealed gaskets, flashings, joint fillers, and insulation as louver installation progresses, where weathertight louver joints are required. Comply with Section 079200 "Joint Sealants" for sealants applied during louver installation.

3.4 ADJUSTING AND CLEANING

A. Clean exposed louver surfaces that are not protected by temporary covering, to remove fingerprints and soil during construction period. Do not let soil accumulate during construction period.

B. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Thoroughly rinse surfaces and dry.

C. Restore louvers 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.

1. Touch up minor abrasions in finishes with air-dried coating that matches color and gloss of, and is compatible with, factory-applied finish coating.

END OF SECTION 08 9119

SECTION 09 2900 - 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.

B. Related Requirements:
1. Section 09 3000 "Tiling" for cementitious backer units installed as substrates for ceramic tile.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

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 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.

2.2 INTERIOR GYPSUM BOARD

A. Gypsum Board, Type X: ASTM C 1396/C 1396M.

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. USG Corporation

2. Thickness: 5/8 inch (15.9 mm).
3. Long Edges: Tapered.

B. Abuse-Resistant Gypsum Board: ASTM C 1396/C 1396M gypsum board, tested according to ASTM C 1629/C 1629M.

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. USG Corporation
2. Core: 5/8 inch (15.9 mm), Type X.
3. Surface Abrasion: ASTM C 1629/C 1629M, meets or exceeds Level 2 requirements.
4. Indentation: ASTM C 1629/C 1629M, meets or exceeds Level 2 requirements.
5. Soft-Body Impact: ASTM C 1629/C 1629M, meets or exceeds Level 2 requirements.
6. Long Edges: Tapered.
7. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

2.3 TILE BACKING PANELS

A. Cementitious Backer Units: ANSI A118.9 and ASTM C 1288 or ASTM C 1325, with manufacturer's standard edges.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. CertainTeed Corporation
   b. James Hardie Building Products, Inc.
   c. Custom Building Products
   d. C-Cure
   e. National Gypsum Company
   f. USG Corporation

2. Thickness: 1/2 inch (12.7 mm).
3. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

B. Water-Resistant Gypsum Backing Board: ASTM C 1396/C 1396M, with manufacturer's standard edges.

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. USG Corporation
2. Core: 5/8 inch (15.9 mm), Type X.

2.4 TRIM ACCESSORIES

A. Interior Trim: ASTM C 1047.

1. Material: Galvanized or aluminum-coated steel sheet or rolled zinc.
2. Shapes:

   a. Cornerbead.
   b. LC-Bead: J-shaped; exposed long flange receives joint compound.
   c. L-Bead: L-shaped; exposed long flange receives joint compound.
   d. Expansion (control) joint.

2.5 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 compound.

   a. Use setting-type compound for installing paper-faced metal trim accessories.

3. Fill Coat: For second coat, use setting-type, sandable topping compound
4. Finish Coat: For third coat, use setting-type, sandable topping compound.

D. Joint Compound for Tile Backing Panels:

1. Cementitious Backer Units: As recommended by backer unit manufacturer.

2. Water-Resistant Gypsum Backing Board: Use setting-type taping compound and setting-type, sandable topping compound.

2.6 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 (0.84 to 2.84 mm) thick.
2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.

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: Comply with mineral-fiber requirements of assembly.

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.

E. Thermal Insulation: As specified in Section 07 2100 "Thermal Insulation."

F. Vapor Retarder: As specified in Section 07 2600 "Vapor Retarders."

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 (1.5 mm) 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. (0.7 sq. m) 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- (6.4- to 9.5-mm-) 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- (6.4- to 12.7-mm-) 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. 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: As indicated on Drawings.
2. Abuse-Resistant 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 horizontally (perpendicular to 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.

3. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

3.4 APPLYING TILE BACKING PANELS

A. Cementitious Backer Units: ANSI A108.11, at locations indicated to receive tile.

B. Water-Resistant Backing Board: Install where indicated with 1/4-inch (6.4-mm) gap where panels abut other construction or penetrations.

C. Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.

3.5 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 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. LC-Bead: Use at exposed panel edges.
3. L-Bead: Use where indicated.

3.6 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 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 4: At panel surfaces that will be exposed to view unless otherwise indicated.

a. Primer and its application to surfaces are specified in Section 09 9123 "Interior Painting."

E. Cementitious Backer Units: Finish according to manufacturer's written instructions.

3.7 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 09 2900

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SECTION 09 3000 - 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. Porcelain tile.
2. Thinset Mortar Bed.
3. Metal edge strips.

1.3 RELATED SECTIONS

A. Section 07-9200 "Joint Sealants" for sealing of expansion, contraction, control, and isolation joints in tile surfaces.

1.4 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.

1.5 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.

1.6 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples for Verification:

1. Full-size units of each type and composition of tile and for each color and finish required.
2. Metal edge strips in 6-inch (150-mm) lengths.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match and are from same production runs as products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Tile and Trim Units: Furnish quantity of full-size units equal to 3 percent of amount installed for each type, composition, color, pattern, and size indicated.

2. Grout: Furnish quantity of grout equal to 3 percent of amount installed for each type, composition, and color indicated.

1.8 QUALITY ASSURANCE

A. Installer Qualifications:
1. Installer's supervisor for Project holds the International Masonry Institute's Foreman Certification.
2. Installer employs Ceramic Tile Education Foundation Certified Installers or installers recognized by the U.S. Department of Labor as Journeyman Tile Layers.

1.9 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.

1.10 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.

B. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from single manufacturer and each aggregate from single source or producer.

1. Obtain setting and grouting materials, except for unmodified Portland cement and aggregate, from single manufacturer.

C. Source Limitations for Other Products: Obtain each of the following products specified in this Section from a single manufacturer:
1. Waterproof membrane.
2. Crack isolation membrane.
3. Metal edge strips.

2.2 PRODUCTS, GENERAL

A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1 for types, compositions, and other characteristics 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. Basis-of-Design Product: Subject to compliance with requirements, provide the specified product or a product of another manufacturer as approved by the Architect: by one (1) of the following:
1. Porcelain Tile:
    1) Refer to Floor Finish Plans for specifications.

2.4 THRESHOLDS

A. General: Fabricate to sizes and profiles indicated or required to provide transition between adjacent floor finishes.

1. At carpet to tile transitions: Schluter®-RENO-U
   a. Description: RENO-U features a trapezoid perforated anchoring leg, which is secured in the mortar bond coat beneath the tile, and a sloped surface (approximately 25°) that eliminates trip hazards and protects tile edges. The leading edge of the profile abuts the lower surface covering.
   b. Material and Finish: EB - Brushed Stainless Steel Type 304 = V2A
   c. Height: as required edges at 1:2 slope, with lower edge of bevel aligned with or up to 1/16 inch (1.5 mm) above adjacent floor surface. Finish bevel to match top surface of threshold. Limit height of threshold to 1/2 inch (12.7 mm) or less above adjacent floor surface.

2.5 WATERPROOF MEMBRANE

A. General: Manufacturer's standard product that complies with ANSI A118.10 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. Manufacturers: Provide the following:

   a. Laticrete International, Inc., 9235 Waterproofing Membrane.

2.6 CRACK ISOLATION MEMBRANE

A. General: Manufacturer's standard product that complies with ANSI A118.12 for standard performance 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 fabric reinforcement.

1. Manufacturers: Provide one of the following:

   a. Laticrete International, Inc., Blue 92 or 9235 Waterproofing Membrane.

2.7 SETTING MATERIALS

A. Portland Cement Mortar (Thickset) Installation Materials: ANSI A108.02.

1. Cleavage Membrane: P polyethylene sheeting, ASTM D 4397, 4.0 mils (0.1 mm) thick.
2. Reinforcing Wire Fabric: Galvanized, welded-wire fabric, 2 by 2 inches (50.8 by 50.8 mm) by 0.062-inch (1.57-mm) diameter; comply with ASTM A 185/A 185M and ASTM A 82/A 82M, except for minimum wire size.

3. Latex Additive: Manufacturer's standard acrylic resin or styrene-butadiene-rubber 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: Provide the following:

a. Laticrete International, Inc., 254 Platinum Multipurpose Thinset Mortar

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. Water-Cleanable Epoxy Grout: ANSI A118.3.

1. Manufacturers: Provide the following:

a. Laticrete International, Inc.. SpectraLOCK PRO grout.

2. Provide product capable of withstanding continuous and intermittent exposure to temperatures of up to 140 and 212 deg F (60 and 100 deg C), respectively, and certified by manufacturer for intended use.

2.9 MISCELLANEOUS MATERIALS

A. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.

2.10 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 mortar beds or thinset mortar comply with surface finish requirements in ANSI A108.01 for installations indicated.
   a. 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 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 PORCELAIN 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 Porcelain 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 (200 by 200 mm) or larger.
   c. Tile floors consisting of rib-backed tiles.

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 as indicated on Finish Plan A-900. 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. 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. Porcelain Tile: 1/8”

H. 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.

I. Metal Edge Strips: Install at locations indicated and where exposed edge of tile flooring meets carpet that finishes flush with or below top of tile and no threshold is indicated.

3.4 WATERPROOFING INSTALLATION

A. Install waterproofing to comply with ANSI A108.13 and manufacturer's written instructions to produce waterproof membrane of uniform thickness that is bonded securely to substrate.

B. Allow waterproofing to cure and verify by testing that it is watertight before installing tile or setting materials over it.

3.5 CRACK ISOLATION MEMBRANE INSTALLATION

A. Install crack isolation membrane to comply with ANSI A108.17 and manufacturer's written instructions to produce membrane of uniform thickness that is bonded securely to substrate.

B. Allow crack isolation membrane to cure before installing tile or setting materials over it.

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 PORCELAIN TILE INSTALLATION SCHEDULE

1. Porcelain Tile Installation: TCNA F121 and ANSI A108.1A; cement mortar bed (thickset) on waterproof membrane.

    a. Porcelain Tile Type: Porcelain.
    b. Bond Coat for Cured-Bed Method: Latex- portland cement mortar.
    c. Grout: Water-cleanable epoxy grout.

B. Interior Floor Installations, Concrete Subfloor:

1. Porcelain Tile Installation; thinset mortar.

    a. Porcelain Tile:
    b. Thinset Mortar: Standard dry-set mortar.
    c. Grout: High-performance sanded grout.

END OF SECTION 09 3000

SECTION 09 6513 - 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. Thermoset-rubber base.

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 (300 mm) long.

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 (3 linear m) for every 500 linear feet (150 linear m 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 (10 deg C) or more than 90 deg F (32 deg C).

1.6 FIELD CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F (21 deg C) <Insert temperature> or more than 95 deg F (35 deg C), in spaces to receive resilient products during the following 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 (13 deg C) or more than 95 deg F (35 deg C).

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

PART 2 - PRODUCTS

2.1 THERMOSET-RUBBER BASE

A. Basis-of-Design Product: Subject to compliance with requirements, provide Tarkett Johnsonite Baseworks Thermoset Rubber Wall Base, or comparable product by one of the following:

1. Roppe Corporation.
2. Burke Mercer Flooring Products.
3. Flexco.

B. Product Standard: ASTM F 1861, Type TS (rubber, vulcanized thermoset), Group I (solid, homogeneous).

1. Style and Location:
   a. Style B, Cove: Provide in areas with resilient floor coverings.

C. Thickness: 0.125 inch (3.2 mm).

D. Height: 4 inches (102 mm).

E. Lengths: Cut lengths 48 inches (1219 mm) long or coils in manufacturer's standard length.

F. Outside Corners: Job formed.

G. Inside Corners: Job formed.

H. Colors: As indicated in the Finish Drawings.

2.2 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.

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 materials are the same temperature as 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. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.

G. Job-Formed Corners:

1. Outside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches (76 mm) in length.

a. Form without producing discoloration (whitening) at bends.

2. Inside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches (76 mm) in length.

3.4 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 surfaces.

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.

END OF SECTION 096513

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. Concrete.
2. Fiber-cement board.
3. Concrete masonry units (CMUs).
4. Steel and iron.
5. Galvanized metal.

1.3 DEFINITIONS

A. MPI Gloss Level 1: Not more than five units at 60 degrees and 10 units at 85 degrees, according to ASTM D523.

B. MPI Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D523.

C. MPI Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D523.

D. MPI Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D523.

E. MPI Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D523.

F. MPI Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D523.

1.4 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.

B. 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 (200 mm) 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.

C. Product List: Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules. Include color designations.

1.5 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. Paint: 5 percent, but not less than 1 gal. (3.8 L) of each material and color applied.

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 (7 deg C).

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 (10 and 35 deg C).

B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Products: Products specified on Drawings are manufactured by The Sherwin Williams Company.

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

1. Benjamin Moore & Co.
2. California Paints.
3. Glidden Professional.

2.2 PAINT, GENERAL

A. MPI Standards: Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved Products Lists."

B. 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.

C. Colors: As indicated in the color schedule on the Finish drawings.

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. Concrete: 12 percent.
2. Fiber-Cement Board: 12 percent.
3. Masonry (CMUs): 12 percent.

C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

D. Proceed with coating application only after unsatisfactory conditions have been corrected.

1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI 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.

3.3 APPLICATION

A. Apply paints according to manufacturer's written instructions and recommendations in "MPI Manual."

B. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

3.4 CLEANING AND PROTECTION

A. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

B. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.5 EXTERIOR PAINTING SCHEDULE

A. Concrete Substrates:

1. Latex System MPI EXT 3.1A

a. Prime Coat: Primer, alkali resistant, water based, MPI #3.

b. Intermediate Coat: Latex, exterior, matching topcoat.

c. Topcoat: Latex, exterior, low sheen (MPI Gloss Level 3-4), MPI #15.

B. Cement Board Substrates:

1. Latex System MPI EXT 3.3K:

a. Prime Coat: Primer, alkali resistant, water based**,** MPI #3.

b. Intermediate Coat: Latex, exterior, matching topcoat.

c. Topcoat: Latex, exterior, high performance architectural, semi-gloss (MPI Gloss Level 5)**,** MPI #11.

C. CMU Substrates:

1. High-Build Latex System MPI EXT 4.2K – G5: Dry film thickness of not less than 10 mils (0.25 mm).

a. Block Filler: Block filler, latex, interior/exterior, MPI #4.

b. Prime Coat: As recommended in writing by topcoat manufacturer.

c. Intermediate Coat: As recommended in writing by topcoat manufacturer.

d. Topcoat: Latex, exterior, high build, MPI #154.

D. Steel and Iron Substrates:

1. Water-Based Light Industrial Coating System MPI EXT 5.1M:

a. Prime Coat: Shop primer specified in Section where substrate is specified.

b. Intermediate Coat: Light industrial coating, exterior, water based, matching topcoat.

c. Topcoat: Light industrial coating, exterior, water based, gloss (MPI Gloss Level 6), MPI #164.

E. Galvanized-Metal Substrates:

1. Water-Based Light Industrial Coating System MPI EXT 5.3J:

a. Prime Coat: Primer, galvanized, water based, MPI #134.

b. Intermediate Coat: Light industrial coating, exterior, water based, matching topcoat.

c. Topcoat: Light industrial coating, exterior, water based, gloss (MPI Gloss Level 6), MPI #164.

END OF SECTION 099113

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SECTION 09 9123 - 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. Concrete masonry units (CMUs).
2. Steel and iron.
3. Gypsum board.

1.3 DEFINITIONS

A. MPI Gloss Level 1: Not more than five units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.

B. MPI Gloss Level 2: Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.

C. MPI Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.

D. MPI Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.

E. MPI Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.

F. MPI Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.

G. MPI Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product. Include preparation requirements and application instructions.

B. 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 (200 mm) 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.

C. Product List: Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules. Include color designations.

1.5 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. Paint: 5 percent, but not less than 1 gal. (3.8 L) of each material and color applied.

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 (7 deg C).

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 (10 and 35 deg C).

B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Products: Products specified on Drawings are manufactured by The Sherwin Williams Company.

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

1. Benjamin Moore & Co.
2. California Paints.
3. Glidden Professional.

2.2 PAINT, GENERAL

A. MPI Standards: Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved Products Lists."

B. 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.

C. Colors: As indicated in the color schedule on the Finish drawings.

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. Masonry (Clay and CMUs): 12 percent.
2. 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 coatings 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.

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. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

C. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

3.4 CLEANING AND PROTECTION

A. 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 Architectural Latex System MPI INT 4.2D:

a. Block Filler: Block filler, latex, interior/exterior, MPI #4.

b. Prime Coat: Primer, alkali resistant, water based, MPI #3.

c. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.

d. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 3), MPI #139.

B. Steel Substrates:

1. High-Performance Architectural Latex System MPI INT 5.1R:

a. Prime Coat: Shop primer specified in Section where substrate is specified.
b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.

c. Topcoat: Latex, interior, high performance architectural, semi-gloss (MPI Gloss Level 5), MPI #141.

C. Gypsum Board Substrates:

1. Institutional Low-Odor/VOC Latex System MPI INT 9.2M:

a. Prime Coat: Primer sealer, interior, institutional low odor/VOC, MPI #149.

b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.

c. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 3), MPI #145.

END OF SECTION 09 9123

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SECTION 10 2113 - PHENOLIC-CORE TOILET COMPARTMENTS

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. Phenolic-core toilet compartments configured as toilet enclosures and urinal screens.

B. Related Requirements:

1. Section 06 1000 "Rough Carpentry" for blocking.
2. Section 10 2800 "Toilet, Bath, and Laundry Accessories" for toilet tissue dispensers, grab bars, purse shelves, and similar accessories mounted on toilet compartments.

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 toilet compartments.

B. Shop Drawings: For toilet compartments.

1. Include plans, elevations, sections, details, and attachment details.
2. Show locations of cutouts for compartment-mounted toilet accessories.
3. Show locations of centerlines of toilet fixtures.
4. Show locations of floor drains.
5. Show overhead support or bracing locations.

C. Samples for Initial Selection: For each type of toilet compartment material indicated.

1. Include Samples of hardware and accessories involving material and color selection.

D. Samples for Verification: For the following products, in manufacturer's standard sizes unless otherwise indicated:

1. Each type of material, color, and finish required for toilet compartments, prepared on 6-inch- (152-mm-) square Samples of same thickness and material indicated for Work.
2. Each type of hardware and accessory.

E. Product Schedule: For toilet compartments, prepared by or under the supervision of supplier, detailing location and selected colors for toilet compartment material.

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of toilet compartment.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For toilet compartments 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. Door Hinges: One hinge(s) with associated fasteners.
2. Latch and Keeper: One latch(es) and keeper(s) with associated fasteners.
3. Door Bumper: One door bumper(s) with associated fasteners.
4. Door Pull: One door pull(s) with associated fasteners.
5. Fasteners: One fastener of each size and type.

1.7 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of toilet fixtures, walls, columns, ceilings, and other construction contiguous with toilet compartments by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. 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: 75 or less.
2. Smoke-Developed Index: 450 or less.

B. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities and ICC A117.1 for toilet compartments designated as accessible.

2.2 PHENOLIC-CORE TOILET COMPARMENTS

A. Basis of Design Product: Bradley, Mills Partitions, Sentinel, Series 400

B. Toilet-Enclosure Style: Floor anchored

C. Urinal-Screen Style: Floor anchored with continuous brackets.

D. Door, Panel, and Pilaster Construction: Solid phenolic-core panel material with melamine facing on both sides fused to substrate during panel manufacture (not separately laminated), and with eased and polished edges and no-sightline system. Provide minimum 3/4-inch- (19-mm-) thick doors and pilasters and minimum 1/2-inch- (13-mm-) thick panels.

E. Pilaster Shoes and Sleeves (Caps): Formed from stainless-steel sheet, not less than 0.031-inch (0.79-mm) nominal thickness and 3 inches (76 mm) high, finished to match hardware.

F. Urinal-Screen Post: Manufacturer's standard post design of 1-3/4-inch- (44-mm-) square, aluminum tube with satin finish.

G. Brackets (Fittings):

1. Full-Height (Continuous) Type: Manufacturer's standard design; stainless steel.

H. Phenolic-Panel Finish:

1. Facing Sheet Finish: One color and pattern in each room.
2. Color and Pattern: As selected by Architect from manufacturer's full range with manufacturer's standard through-color core matching face sheet.
3. Edge Color: Through-color matching facing sheet color.

2.3 HARDWARE AND ACCESSORIES

A. Hardware and Accessories: Manufacturer's heavy-duty operating hardware and accessories.

1. Hinges: Manufacturer's minimum 0.062-inch- (1.59-mm-) thick stainless-steel continuous, cam type that swings to a closed or partially open position allowing emergency access by lifting door. Mount with through-bolts.
2. Latch and Keeper: Manufacturer's heavy-duty surface-mounted cast-stainless-steel latch unit designed to resist damage due to slamming, with combination rubber-faced door strike and keeper, and with provision for emergency access. Provide units that comply with regulatory requirements for accessibility at compartments designated as accessible. Mount with through-bolts.
3. Coat Hook: Manufacturer's heavy-duty combination cast-stainless-steel hook and rubber-tipped bumper, sized to prevent in-swinging door from hitting compartment-mounted accessories. Mount with through-bolts.
4. Door Bumper: Manufacturer's heavy-duty rubber-tipped cast-stainless-steel bumper at out-swinging doors. Mount with through-bolts.
5. Door Pull: Manufacturer's heavy-duty cast-stainless-steel pull at out-swinging doors that complies with regulatory requirements for accessibility. Provide units on both sides of doors at compartments designated as accessible. Mount with through-bolts.

B. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel, finished to match the items they are securing, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use stainless-steel, hot-dip galvanized-steel, or other rust-resistant, protective-coated steel compatible with related materials.

2.4 MATERIALS

A. Aluminum Castings: ASTM B 26/B 26M.

B. Aluminum Extrusions: ASTM B 221 (ASTM B 221M).

C. Brass Castings: ASTM B 584.

D. Brass Extrusions: ASTM B 455.

E. Stainless-Steel Sheet: ASTM A 666, Type 304, stretcher-leveled standard of flatness.

F. Stainless-Steel Castings: ASTM A 743/A 743M.

G. Zamac: ASTM B 86, commercial zinc-alloy die castings.

2.5 FABRICATION

A. Fabrication, General: Fabricate toilet compartment components to sizes indicated. Coordinate requirements and provide cutouts for through-partition toilet accessories where required for attachment of toilet accessories.

B. Floor-Anchored Units: Provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling adjustment nuts at pilasters for structural connection to floor. Provide shoes at pilasters to conceal anchorage.

C. Urinal-Screen Posts: Provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling adjustment nuts at bottoms of posts. Provide shoes at posts to conceal anchorage.

D. Door Size and Swings: Unless otherwise indicated, provide 24-inch- (610-mm-) wide in-swinging doors for standard toilet compartments and 36-inch- (914-mm-) wide out-swinging doors with a minimum 32-inch- (813-mm-) wide clear opening for compartments designated as accessible.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for fastening, support, alignment, operating clearances, and other conditions affecting performance of the Work.

1. Confirm location and adequacy of blocking and supports required for installation.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.

1. Maximum Clearances:

a. Pilasters and Panels: 1/2 inch (13 mm).
b. Panels and Walls: 1 inch (25 mm).

2. Stirrup Brackets: Secure panels to walls and to pilasters with no fewer than brackets attached at midpoint and near top and bottom of panel.

a. Locate wall brackets so holes for wall anchors occur in masonry or tile joints.
b. Align brackets at pilasters with brackets at walls.

3. Full-Height (Continuous) Brackets: Secure panels to walls and to pilasters with full-height brackets.

a. Locate bracket fasteners so holes for wall anchors occur in masonry or tile joints.
b. Align brackets at pilasters with brackets at walls.

B. Urinal Screens: Attach with anchoring devices to suit supporting structure. Set units level and plumb, rigid, and secured to resist lateral impact.

3.3 ADJUSTING

A. Hardware Adjustment: Adjust and lubricate hardware according to hardware manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors and doors in entrance screens to return doors to fully closed position.

END OF SECTION 10 2113

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SECTION 102600 - WALL AND DOOR PROTECTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Stainless Steel Corner Guard Systems.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For each type of wall and door protection showing locations and extent.

C. Samples: For each exposed product and for each color and texture specified, 6 inches (150 mm) long.

1.3 INFORMATIONAL SUBMITTALS

A. Product certificates.

B. Material certificates.

C. Sample warranty.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.5 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of wall-protection units that fail in materials and manufacturing defects within specified warranty period.

1. Warranty Period: Lifetime warranty from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CORNER GUARDS

A. MANUFACTURER

1. Basis of Design Manufacturer: Western Fabricating LLC 17061 Alico Commerce Court, Ste 105, Fort Myers, LF. 33967. www.cornerguard.net
2. Provide all corner guards from a single source

2.2 MATERIALS

A. Stainless Steel: Corner Guards shall be manufactured from Type 304, 16 gauge Stainless Steel.

2.3 COMPONENTS

A. Attachment: Pre-drilled holes for Philips head screws

2.4 FINISHES

A. Stainless Steel: No. 4 brushed vertical finish

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions in which the corner guard systems will be installed.
   1. Complete all finishing operations, including painting, before beginning installation of corner guards.

B. Wall surface shall be dry and free from dirt, grease and loose paint.

3.2 PREPARATION

A. General: Prior to installation, clean substrate to remove dust, debris and loose particles.

3.3 INSTALLATION

A. General: Locate the Corner Guard as indicated on the approved detail drawing for the appropriate substrate and Install corner guard level and plumb at the height indicated on the drawings.

B. Installation of Stainless Steel Corner Guards:
   1. Surface must be dry, clean and properly sealed.
   2. Screw on: Position the corner guard on the wall and attach it using the stainless steel screws.
   3. Remove the protective plastic covering from the exposed surface of the corner guard.

3.4 CLEANING

A. At completion of the installation, clean surfaces with a neutral based, non-abrasive cleaner. Ammonia and alcohol based cleaners may be used.

END OF SECTION 102600

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SECTION 10 2800 – TOILET 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. Underlavatory guards.
3. 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. 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 OWNER-FURNISHED MATERIALS

A. Owner-Furnished Materials:
1. (T1) Toilet Tissue (Roll) Dispenser
2. (T2) Automatic Paper Towel (Roll) Dispenser
3. (T3) Sanitary-Napkin Disposal Unit
4. (T4) Waste Receptacle
5. (T5) Liquid-Soap Dispenser
6. (T6) Sanitary Napkin Vendor

2.2 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.

2.3 PUBLIC-USE WASHROOM ACCESSORIES

A. Source Limitations: Obtain public-use washroom accessories from single source from single manufacturer.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:

a. A&J Washroom Accessories, Inc.
b. American Specialties, Inc.; ASI Group.
c. Bobrick Washroom Equipment, Inc.
d. Bradley Corporation.

B. Grab Bar T7, T8, T9:

1. Mounting: Flanges with concealed fasteners.
2. Material: Stainless steel, 0.05 inch (1.3 mm) thick.

a. Finish: Smooth, No. 4 finish (satin) on ends and slip-resistant texture in grip area.

3. Outside Diameter: 1-1/2 inches (38 mm).
4. Configuration and Length:
   a. Straight, 36 inches long – Rear grab bar, horizontal.
   b. Straight, 42 inches long – Side grab bar, horizontal.
   c. Straight, 18” long – Side grab bar, vertical.

C. Mirror Unit MIR:

1. Frame: Stainless-steel channel with mitered and mechanically interlocked corners.
2. 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 made of galvanized steel, and equipped with concealed locking devices requiring a special tool to remove.
3. Size: 18 inches wide by 30 inches high.

D. Coat Hook:

1. Description: Single-prong unit capable of withstanding 300 lb. downward-pull when properly installed.
2. Material and Finish: Solid brass casting with satin nickel-plated finish.
3. Mounting: Minimum of 3 countersunk screws, furnished by manufacturer. Mount coat hook centered on back of door, with prong at 48 inches above floor.

2.4 UNDERLAVATORY GUARDS

A. Underlavatory Guard:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Truebro Lav Guard 2 EZ series undersink piping covers by IPS Corporation or comparable product by one of the following:
   a. Plumberex Specialty Products, Inc.
   b. Keeney Manufacturing Company.
2. Description: Insulating pipe covering for supply and drain piping assemblies that prevents direct contact with and burns from piping; allow service access without removing coverings.
3. Material and Finish: Antimicrobial, molded plastic, white.

2.5 CUSTODIAL ACCESSORIES

A. Source Limitations: Obtain custodial accessories from single source from single manufacturer.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
   a. A&J Washroom Accessories, Inc.

b. American Specialties, Inc.; ASI Group.
c. Bobrick Washroom Equipment, Inc.
d. Bradley Corporation.

B. Mop and Broom Holder:

1. Description: Unit with shelf, hooks, holders, and rod suspended beneath shelf
2. Length: 36 inches (914 mm)
3. Hooks: Four
4. Mop/Broom Holders: Three, spring-loaded, rubber hat, cam type.
5. Material and Finish: Stainless steel, No. 4 finish (satin).

a. Shelf: Not less than nominal 0.05-inch- (1.3-mm-) thick stainless steel.
b. Rod: Approximately 1/4-inch- (6-mm-) diameter stainless steel.

2.6 MATERIALS

A. Stainless Steel: ASTM A 666, Type 304, 0.031-inch (0.8-mm) minimum nominal thickness unless otherwise indicated.

B. Brass: ASTM B 19, flat products; ASTM B 16/B 16M, rods, shapes, forgings, and flat products with finished edges; or ASTM B 30, castings.

C. Steel Sheet: ASTM A 1008/A 1008M, Designation CS (cold rolled, commercial steel), 0.036-inch (0.9-mm) minimum nominal thickness.

D. Galvanized-Steel Sheet: ASTM A 653/A 653M, with G60 (Z180) hot-dip zinc coating.

E. Galvanized-Steel Mounting Devices: ASTM A 153/A 153M, hot-dip galvanized after fabrication.

F. 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.

G. Chrome Plating: ASTM B 456, Service Condition Number SC 2 (moderate service).

H. 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 (1112 N), 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 10 2800

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SECTION 200050 - GENERAL CONDITIONS FOR MECHANICAL AND ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. The General provisions of the Contract, including General and Supplementary Conditions, General Requirements apply to the work specified in this Section.

B. Scope of Work: This Section contains special provisions for Divisions 21, 22, 23, 26 and 28.

1.2 EXAMINATION OF SITE AND DRAWINGS:

A. Before submitting his bid, Contractor shall visit site with plans and specifications in hand, shall consult with the Engineer and shall become thoroughly familiar with all conditions under which his work will be done since he will be held responsible for any assumptions he may make in regard thereto.

B. The Contractor shall verify and obtain all necessary dimensions at the building.

C. Certain present building clearances are available for handling equipment.
All equipment shall be delivered knocked down as necessary to clear restrictions.

1.3 INTENT:

A. Finished Work: The intent of the specifications and drawings is to call for finished work, completed, tested and ready for operation.

B. Good Practice: It is not intended that the drawings show every pipe, fitting or minor detail and it is understood that while the drawings must be followed as closely as circumstances will permit, the systems shall be installed according to the intent and meaning of the Contract Documents and in accordance with good practice.

C. Work under each Section shall include giving written notice to the Owner within 15 days after the Award of the Contract of any materials of apparatus believed inadequate or unsuitable or in violation of any laws or codes, or items of work omitted. In the absence of such written notice, it is mutually agreed that work under each Section has included the cost of all required items and labor for the satisfactory functioning of the entire system without extra compensation.

D. Any apparatus, appliance, material or work not shown on drawings but mentioned in specifications or vice versa, or any incidental accessories necessary to make the work complete and perfect in all respects and ready for operation, even if not particularly specified, shall be furnished and installed by Contractor at no additional cost to Owner.

E. Prior to receipt of bids, Contractors shall give written notice to Engineer of any materials or apparatus believed inadequate, unsuitable or in violation of laws, ordinances, rules or regulations of authorities having jurisdiction and any necessary items or work omitted.
In the absence of such written notice, it is mutually agreed that Contractor has included the cost of all required items in his proposal and that he will be responsible for approved satisfactory functioning of systems without further compensation.

F. In all cases where apparatus is herein referred to in singular number, it is intended that such reference include as many such items as are required to complete work.

G. If not otherwise specified or shown on plans, apparatus and materials shall be installed in accordance with manufacturer's published recommendations and instructions and to the complete satisfaction of the Architect.

H. It is the intent of these specifications for Mechanical and Electrical Contractors and/or their subcontractors or equipment suppliers to furnish all equipment complete with all accessories.

1.4 REGULATIONS:

A. Codes: All work shall be done in strict accordance with the 2018 Connecticut State Building Code, 2018 Connecticut State Fire Safety Code, 2015 IBC, 2015 IPC, 2015 IMC, Connecticut Public Health Code, 2015 NFPA 101, all applicable NFPA Codes, NEC, UL, NEMA, O.S.H.A., with all requirements of local utility companies and the requirements of all governmental departments having jurisdiction.

B. Precedence: Requirements of the above shall take precedence over plans and specifications.

C. Equipment construction standards shall be as follows: Pressure vessels shall be constructed in accordance with the ASME Code, all electrical equipment shall be UL listed and approved and conform to the N.E.C., gas equipment shall be approved by A.G.A. and conform to N.F.P.A. Codes, piping materials, fittings, valves and accessories shall be constructed in accordance with A.S.T.M. and A.N.S.I. standards for class of work involved. All equipment and materials shall be new and of domestic manufacture. All the above codes shall be referenced and dated in the Connecticut Basic Building Code.

D. Wherever discrepancies occur between above regulations and agencies and contract drawings and specifications, the requirements of above shall take precedence, except that the contract drawings and specifications shall be minimum requirements and that contractors shall advise engineer of any required changes before proceeding with work.

1.5 APPROVED FITTINGS:

A. No material other than that contained in the "Latest List of Electric Fittings" approved by the Underwriters' Laboratories, Inc., shall be used in any part of the work. All wiring, conduit, switches and other material for which label service has been established, shall bear the label of the Underwriters' Laboratories, Inc.

1.6 PERMITS, FEES:

A. Include all necessary notices, obtain all permits and pay all governmental taxes, fees, and other costs. File all necessary plans, prepare all documents and obtain all necessary approvals of all governmental departments having jurisdiction. Obtain all required Certificates of the Owner before request for acceptance and final payment for the work.

1.7 DEFINITIONS:

A. Words "finish" or "finished" refer to all rooms and areas listed in Finished Schedule on Architect's Drawings. All rooms and areas not covered in Schedule, including underground tunnels and areas above ceilings, shall be considered not finished except as otherwise noted.

B. The word "provide" means to "furnish and install" reference item.

1.8 PROTECTION:

A. Work under each section shall include protecting the work and materials of all other sections from damage by work or workmen, and shall include making good any and all damage thus caused.

B. Each section shall be responsible for work and equipment until finally inspected, tested and accepted. Protect work against theft, weather, injury or damage and carefully store material and equipment received on site which is not immediately installed. Close open ends of work with temporary covers or plugs during construction to prevent entry of obstructing materials.

C. If so specified under the respective section, work may include receiving, unloading, uncrating, storing, protecting, setting in place and connecting up completely of any motor starters, control equipment having mechanical/electrical service connections which may be furnished by Owner or furnished under another section.

Work under each section shall include exercising special care in handling and protecting equipment and fixtures. Any of the above equipment and fixtures which are missing or damaged by reason of mishandling or failure to protect shall be replaced at no additional cost to the Owner.

1.9 EQUIPMENT SUBSTITUTIONS AND DEVIATIONS:

A. Wherever more than one manufacturer is mentioned in specifications and drawings, any of these named are considered equally acceptable to that on upon which design was based and, providing all requirements are met, insofar as performance, space requirements, noise levels and special accessories or materials are concerned, any of those named may be included in Contractor's bid.

B. Where Contractor proposes to use an item of equipment which differs from that upon which design was based, which required any redesign of structure, partitions, foundations, piping, wiring or of any other part of Mechanical, Electrical or Architectural Layout, all such redesign, new drawings or detailing required shall be prepared by Contractor at his own expense for approval of Engineer.

C. Where approved substitutions or deviations require a different quantity, size or arrange of structural supports, wiring, conduit, piping, ductwork, and equipment from that upon which design was based, all additional items required by the systems shall, with the approval of Engineer, be furnished by Contractor at no additional cost to Owner.

1.10 ELECTRICAL WORK:

A. The Electrical Section includes all power wiring for all electrical switches, motor starters and unmounted motors, furnished at the job site by other sections or furnished under the Electrical Sections as stated in other sections of the specifications.

B. The Electrical Section shall install and wire all starters, switches and controls, as specified and/or shown on drawings. This shall include all operating and safety controls.

C. Electrically operated equipment supplied by other sections which will be installed and wired by Electrical Section shall be delivered to him with detailed instructions for their installation and wiring in sufficient time and proper sequence to enable him to meet his work schedule.

D. Control devices that include mechanical elements, such as float switches, shall be installed by the section furnishing them, but be wired by the Electrical Sections.

E. Equipment which includes a number of correlated electrical control devices mounted in a single enclosure or on a common base with equipment shall be supplied for installation completely wired as unit with terminal boxes and ample leads and/or terminal strips, ready for electrical wiring.

F. Electrical Contractor shall furnish local disconnect switch for all equipment and manual motor starter for fractional HP motors.

1.11 DRAWINGS:

A. The plumbing, mechanical, electrical, structural, and architectural drawings are intended to supplement each other and are to be considered as a unit which, taken together in conjunction with the specifications, completely describes the work to be done. All drawings shall be checked to verify spaces in which work will be installed. Where headroom or space conditions appear inadequate, notification shall be given to Engineer before proceeding with installation.

B. The Engineer may without charge, make modifications in the layout as needed to prevent conflict with work of other trades or for proper execution of the work.

C. Note that the drawings are diagrammatic and indicate the general arrangement of the Mechanical and Electrical Equipment and systems, without showing every detail and fitting.

D. Where conflicts occur between drawings and specifications or within either, the item or arrangement of better quality, greater quality or highest cost shall be included in Contract price. Engineer shall determine the manner or item with which work shall be installed.

E. Keep one complete set of all drawings, specifications, shop drawings and addenda on the premises at all times in good condition and available to the Engineer and Owner.

1.12 REVIEWS:

A. The materials, workmanship, design and arrangement of all work installed under the Mechanical and Electrical sections shall be subject to the review of the Engineer.

B. Where any specific material process of method of construction or manufactured article is specified by name or by reference to the catalog number of a manufacturer, the specifications are to be used as a guide and not intended to take precedence over the basic duty and performance specified or noted on drawings. In all cases, the specific characteristics of the equipment offered for approval, shall be indicated on the shop drawings.

C. All component parts of each item of equipment or device shall bear the manufacturer's nameplate, giving name of manufacturer, description, size, type, serial or model number, electrical characteristics, etc. in order to facilitate maintenance or replacement. The nameplate of a subcontractor or distributor will not be acceptable.

D. If material or equipment is installed before it is reviewed, it shall be removed and replaced at no extra charge to the Owner if, in the opinion of the Engineer, the material or equipment does not meet the intent of the drawings and specifications.

1.13 SHOP DRAWINGS:

A. Contractor shall submit for review electronic shop drawings of all new equipment, materials, piping, lighting fixtures, devices, panels, wiring and reports. Engineer's review of shop drawings must be completed before any equipment is purchased or any work is installed.

B. Shop drawings shall consist of manufacturer's certified scale drawings, cuts or catalog, including descriptive literature and complete certified characteristics of equipment, showing dimensions, capacity, code requirements, motor and drive testing as indicated on the drawings or specifications. Also, sheet metal fabrication drawings drawn to scale of 1/4" to the foot or larger.

C. Certified performance curves for all pumping equipment shall be submitted for review.

D. Samples, drawings, specifications, catalogs, etc. submitted for review shall be properly labeled indicating specific service for which material or equipment is to be used, division and article number of specifications governing Contractor's name and name of job.

E. Catalog, pamphlets or other documents submitted to describe items on which review is being requested, shall be specific and identification in catalog, pamphlet, etc. of item submitted shall be clearly made in ink. Data of a general nature will not be accepted.

F. Review stamp rendered on shop drawings shall not be considered as a guarantee of measurements of building conditions. Where drawings are reviewed, said review does not mean that drawings have been checked in detail. Said review does not in any way relieve the Contractor from his responsibility or necessity of furnishing material or performing work as required by the Contract Drawings and Specifications.

G. Failure by the Contractor to submit shop drawings in ample time for checking shall not entitle him to an extension of Contract and no claim for extension by reason of such default will be allowed.

H. Prior to submission of shop drawings, the Contractor shall thoroughly check each shop drawing, reject those not conforming to the specifications and indicate by his signature that the shop drawings submitted in his opinion meet Contract requirements.

1.14 COORDINATED DRAWINGS:

A. The Sheet Metal Contractor shall initiate a 1/4" or 3/8" equal to one foot composite construction drawing of all areas for all the trades. He shall provide a drawing showing his proposed ductwork installation in detail including ceiling heights, duct heights, all light fixtures, all registers and diffusers and structural steel. The drawing shall be in electronic format and shall be accessible by other contractors.

B. All electrical distribution conduits, wires and panels and any other electrical work which may conflict with the sheet metal ducts and with piping will then be drawn on the transparency under Division 26. All waste and vent piping, water piping and rain leaders will then be superimposed by the Plumbing Contractor. The Fire Protection Contractor shall superimpose sprinkler piping.

C. Finally all major heating and process piping shall be superimposed by the Heating Contractor.

D. Each trade shall indicate necessary seismic restraints in accordance with later paragraph in this section.

E. Each shall use a different color code. A coordination meeting of all parties involved is then to be held and all possible conflicts are to be resolved. The Sheet Metal Subcontractor shall then include on his original tracings, any electrical or piping work in the area of his ducts as resolved, shall have all trades sign approval of the drawing and then make eight (8) prints of each drawing for review.

F. Contractor shall submit 1/4" scale floor plans showing proposed locations and sizes of all floor slab penetrations for each trade. This shall include all piping, ductwork, conduit, and cable penetrations. The floor slab penetration drawings shall be subject to approval by the Structural Engineer. No work shall commence without approval from the Structural Engineer

1.15 QUIET OPERATION:

A. Mechanical and electrical equipment shall operate without objectionable noise or vibration as determined by the Architect/Engineer. Noise level in any normally occupied area shall not exceed that of an NC-28 curve (noise criteria-28) as established in the latest edition of the ASHRAE Guide.

B. General Contractor shall carry an allowance for performing sound pressure measurements in areas designated by the Owner and/or Engineer as unacceptable. Each test shall be performed on a time and material bases. Tests shall be performed after regular working hours.

C. The Contractor shall demonstrate compliance with the design noise criteria, by measuring the sound pressure levels in octave-bands from 125Hz to 8000 Hz. Measurements shall be taken 5ft. above the floor, at four locations as directed by the Engineer. Sound pressure shall be determined as an average of these octave band readings. Contractor shall use Type 1 sound level meters with octave-band filters. Contractor shall demonstrate that the instruments used in the measuring process have been calibrated by a recognized testing facility within one year. In processing the test results, the Contractor shall follow the recommendation of ARI Standard 885-90.

D. If objectionable noise or vibration are produced and transmitted to occupied portions of the building by apparatus, piping, or other parts of the mechanical and electrical work, changes or additions, as are necessary, shall be made to the system, as approved, without extra cost to the Owner.

1.16 PAINTING:

A. Painting is specified elsewhere in the Specifications, under Division 09.

B. Refer to Division 09, for code painting of all piping in Mechanical Room.

1.17 CONCRETE WORK:

A. Concrete work is specified elsewhere in the specifications under Division 03.

1.18 EXCAVATION AND BACKFILLING:

A. Excavating and backfilling for all mechanical and electrical work inside and outside of building shall be done in accordance with Division 31 unless otherwise specified.

1.19 CUTTING AND PATCHING:

A. Cutting and patching shall be done in accordance with Division 01, section 017329 unless otherwise specified.

B. The General Contractor will leave all openings and built-in sleeves, etc. as required, provided he receive same with the proper information and cooperation from the Electrical and/or Mechanical Contractor in due time as the construction progresses.
All cutting of openings in walls, floors, partitions, etc. not thus provided for must, however, be done by the Electrical and/or Mechanical Contractor as required to install the work including all cutting of existing construction work, and this Contractor shall restore to its original condition any work disturbed.

1.20 TEMPORARY HEAT:

A. Contractor is referred to Section 015000 Construction Facilities and Temporary Controls for full description of temporary services.

B. New air distribution systems ***shall not*** be used for temporary heating, cooling or ventilation.

C. Contractor shall provide extended warranties for all equipment used for temporary services.

1.21 TEMPORARY LIGHT AND POWER:

A. Contractor is referred to Section 015000 Construction Facilities and Temporary Controls for full description of temporary services.

1.22 WATER FOR CONSTRUCTION PURPOSES:

A. Contractor is referred to Section 015000 Construction Facilities and Temporary Controls for full description of temporary services.

PART 2 - PRODUCTS

2.1 MATERIALS AND WORKMANSHIP:

A. All materials and apparatus used shall be new, of first class quality and shall be furnished, delivered, erected, connected and finished in every detail. No materials or apparatus used shall be discontinued or about to be discontinued items.

B. The Engineer shall have the right to reject any part of the work in case material or workmanship is not of satisfactory quality.

C. Any unacceptable work and material shall be replaced with acceptable work and material at no additional expense to the Owner.

D. In case there is any doubt of the acceptability of any material, submit samples to the Engineer for approval and only definite approval in writing from the Engineer shall be evidence of such approval. Such approval shall also be subject to the satisfactory installation of the material.

E. The work in each of these sections shall be constantly under the direction of a competent superintendent who shall be on the premises during such period as the work is in progress. The superintendent shall familiarize himself with the work of all other sections involved insofar as they relate to or in any way affect the work of these sections, and shall coordinate the work.

F. Unless otherwise noted, all equipment and materials shall be installed and/or applied in accordance with the recommendations of the manufacturer of said equipment, including the performance of any tests recommended by the manufacturer.

2.2 EQUIPMENT VARIATIONS:

A. In these specifications and on the accompanying drawings, one or more makes of materials, apparatus or appliances have been specified for use in this installation. This has been done for convenience in fixing the standard of workmanship performance of any materials, apparatus or appliance which shall be substituted for those mentioned herein shall also conform to these standards.

B. Where no specified make or material, apparatus or appliance is mentioned, any first class product made by a reputable manufacturer may be used, providing it conforms to the requirements of these specifications and meets the approval of the Engineer.

C. Refer to General Conditions of the contract for substitution procedures.

D. To substitute other makes of materials, apparatus or appliance, than those mentioned under the mechanical or electrical sections, a request in writing to be allowed to make the substitution shall be made. This request shall be accompanied by complete plans and specifications of the

substitution offered. If so requested by the Architect or Engineer, also submit samples of both the specified material or appliance and the substitute.

2.3 MOTOR CONTROL:

A. All motors will be fed from a motor control starter center where called for, provided by the Mechanical Contractor. Remote pushbuttons, plates and pilots will be furnished by the Electrical Contractor, unless otherwise called for under the Temperature Control Section of these specifications. All starters for motors which are to be interlocked with another motor shall have suitable auxiliary contacts.

B. All small motors without built-in thermal protection shall be furnished with thermal switches these switches and pilots shall be furnished by the Electrical Contractor.

2.4 ELECTRIC MOTORS:

A. All motors 1/2 h.p. and above shall be integral horsepower polyphase induction motors conforming to NEMA standards MG-1-1967 and shall be T-frame design in sizes 143 T through 445 T. Each shall be NEMA design B with minimum torque valves per MG 1-12.37 and 12.38. Duty shall be continuous, ambient temperature 40 degrees maximum, allowable temperature rise for open drip-proof -90 degrees, TEFC, 80 degrees C with Class B insulation rating all per MG 1-12.42.

B. Horsepower, speed and frame sized per MG 1-10, 32, 13.02 and 13.06a.

C. Enclosures - open drip-proof and TEFC per MG 1-1.25, 1.26 and 1.27.

D. All dimensions per MG 1-11.31a, 11.32a and 11.34a. All motors shall have stainless steel nameplates with NEMA voltage standards shown.

E. Locked rotor KVA per horsepower shall be designated by proper NEMA code letter per MG 1.10.37.

F. All motors shall be premium efficiency type with a full load efficiency range of 80 percent to 95 percent. High efficiency motor rating shall meet Northeast Utilities Energy Action Program in accordance with the following schedule:

MINIMUM NOMINAL MOTOR EFFICIENCIES

HP	OPEN DRIP PROOF			HP	TOTALLY ENCLOSED		
	MINIMUM EFFICIENCY				MINIMUM EFFICIENCY		
	1200	1800	3600		1200	1800	3600
1	82.5%	85.5%	80.0%	1	82.5%	85.5%	78.5%
1.5	86.5%	86.5%	85.5%	1.5	87.5%	86.5%	85.5%
2	87.5%	86.5%	86.5%	2	88.5%	86.5%	86.5%
3	89.5%	89.5%	86.5%	3	89.5%	89.5%	88.5%
5	89.5%	89.5%	89.5%	5	89.5%	89.5%	89.5%
7.5	91.7%	91.0%	89.5%	7.5	91.7%	91.7%	91.0%
10	91.7%	91.7%	90.2%	10	91.7%	91.7%	91.7%
15	92.4%	93.0%	91.0%	15	92.4%	92.4%	91.7%
20	92.4%	93.0%	92.4%	20	92.4%	93.0%	92.4%
25	93.0%	93.6%	93.0%	25	93.0%	93.6%	93.0%
30	93.6%	94.1%	93.0%	30	93.6%	93.6%	93.0%
40	94.1%	94.1%	93.6%	40	94.1%	94.1%	93.6%
50	94.1%	94.5%	93.6%	50	94.1%	94.5%	94.1%

60	95.0%	95.0%	94.1%	60	94.5%	95.0%	94.1%
75	95.0%	95.0%	94.5%	75	95.0%	95.4%	94.5%
100	95.0%	95.4%	94.5%	100	95.4%	95.4%	95.0%

G. Service Factors - open-drip-proof, 1 h.p. through 200-1.15 TEFC all horsepower - 1.0.

H. Noise level within NEMA standard MG 1-12.49.

I. In addition to the above, all motors 1 through 20 h.p. shall be TEFC with drain holes for both horizontal and vertical positions. Each shall be equipped with deep groove double shielded ball bearings pre-lubricated with provisions for re-greasing.

J. Motors smaller than 1/2 h.p. shall be capacitor-start or split-phase type designed for 120 volts, single phase, 60 cycles alternating current.

2.5 ELECTRICAL MOTOR STARTERS:

A. All electric motor starters shall conform to requirements of AIEE, NEMA, UL, NEG, and shall be suitable for required load, duty, voltage, phase, frequency, service and location.

B. When interlocking or automatic control of single phase motors is required, motors shall be furnished with magnetic across-the-line.

C. Three phase motors shall be furnished with full voltage, magnetic across-the-line starters, except where reduced voltage starters are indicated or required.

D. All magnetic starters shall have start-stop, automatic or remote control as required. Starters shall have hand-off automatic selector switches in cover.

E. All magnetic starters shall include overload and low voltage protection and one set each of normally open and normally closed contacts. Overloads shall be ambient temperature compensating type. All 3 phase legs shall have leg protection.

F. All starters shall be of same manufacturer.

G. Starters shall be furnished as part of respective equipment furnished under each Division.

H. Starters shall be combination circuit breaker disconnect and magnetic starters.

2.6 ACCESS DOORS:

A. Access doors shall be of sufficient size to permit easy replacement of complete units and all groupings of complete units and all groupings of valves and equipment shall have necessary clearance for this same purpose. Provide access doors for each valve, damper, control, fire damper, etc., not accessible (such as above a non-lift out ceiling, wall or chase). Doors shall be Milcor or equal prime coated steel, screwdriver lock for building into walls or ceilings. Doors shall be Style A in acoustic tile surfaces and Styles K, L or M for other surfaces. Doors shall bear the same or greater fire rating as the wall or ceiling in which they occur. Size of doors to be determined after valves or dampers are installed and shall be of adequate size to operate same.

B. Where access is required to dampers, valves, etc., that occur above lay-in ceilings, these access doors can be omitted, provided suitable plastic markers identifying exact location of valves, dampers, etc., on lay-in ceilings are applied directly below valve grouping and identified by a number, this number to be used as a marking on valve or damper chart. Tags shall be applied on the ceiling grid, not on the ceiling tiles.

PART 3 - EXECUTION

3.1 CONNECTING TO EXISTING UTILITIES:

A. Connections to existing utilities that will interrupt the service to the present buildings shall be made at a time agreed upon by the Owner, Architect and Contractor.

B. If it is necessary to make connections to existing utilities outside the regular working hours, this shall be noted on the written work order and the respective Contractor will be paid for the additional cost of labor over and above what it would cost at regular day time rates.

3.2 FREIGHT, CARTING AND RIGGING:

A. Contractor shall pay all freight and carting charges necessary to deliver all equipment furnished under his Contract to the site and furnish all necessary rigging to properly rig and set the apparatus on the foundations, frames, etc.

B. All scaffolding, blocks and tackle, ropes and chains and other equipment necessary to rig and set the apparatus shall be furnished by the Contractor.

C. The Contractor shall set, level and align all equipment before starting operations.

3.3 SEISMIC RESTRAINTS:

A. It is the intent of this seismic restraint portion of the specification to provide restraint of all non-structural building system components provided in Sections 15 and 16 in Seismic Zone II. Restraint systems and devices are intended to withstand, without failure, the "G" forces detailed in the chart below:

Design Level of Acceleration At Equipment Center of Gravity Seismic Zone 2)
(Av - >0.1 to 0.19)

Elevation (feet rel. to grade level)	Rigid* Mnt'd Equip	Non-Struct. Architect Component	Flexible* Mnt'd Equip	Pipe, Duct, Cable trays, Conduit, Etc.	Life Safe. Equip
Below Grade up to 20 feet above grade	0.125 "g"	0.250 "g"	0.500 "g"	0.350 "g"	1.000 "g"
21 ft. - 300 ft.	0.500 "g"	0.550 "g"	0.750 "g"	0.650 "g"	1.000 "g"
301 ft. - 600 ft.	0.750 "g"	0.900 "g"	1.000 "g"	1.000 "g"	1.000 "g"

* Rigid mounted equipment is any equipment mounted directly to structure. Flexible mounted equipment is any equipment mounted on resilient supports, ceiling suspended, roof supported or mounted on an independent frame with any primary natural frequency below 16 Hz.

B. Seismic restraints shall be as required by the 2016 Connecticut Building Code.

C. Refer to section 220548 and drawings for details.

D. Seismic Certification and Analysis

1. Seismic restraint calculations must be provided for all connections of equipment to the structure.
2. Calculations to support seismic restraint designs must be stamped by a registered professional engineer licensed in the State of Connecticut.
3. Analysis must indicate dead loads, derived loads, and materials used for connections to equipment and structure. Analysis must detail anchoring methods, bolt diameters, embedment, and weld length.
4. A seismic design errors and omissions insurance certificate must accompany submittals.

E. Submit drawings showing locations of all seismic restraints for equipment, piping, and conduit provided under Sections 21, 22, 23, 26, 27 and 28.

1. The term EQUIPMENT includes ALL non-structural components. These specifications are applicable within the facility and 5 feet outside of the foundation wall. Equipment buried underground is excluded but entry of services through the foundation wall is included. Equipment referred to below is a partial list; (equipment not listed is still included in this specification).

AC Units	Ductwork
Air Distribution Boxes	Fans (All types)
Battery Racks	
Light Fixtures	Motor Control Ctrs.
Bus Ducts	Piping
Cable Trays	Condensing Unit
Switching Gear	Unit Heaters
Conduit	All Electrical Panels

F. Submittals shall include a listing of all isolated and non-isolated equipment to be restrained.

G. Seismic restraints shall not be required for the following installations:

1. Piping in mechanical rooms less than l 1/4-inch inside diameter.
2. All other piping less than 2 1/2-inch inside diameter.
3. All electrical conduit less than 2 1/2-inch inside diameter.
4. All rectangular air-handling ducts less than 6 square feet in cross-sectional area.
5. All round air-handling ducts less than 28 inches in diameter.
6. All piping suspended by individual hangers 12 inches or less in length from the top of the pipe to the bottom of the support for the hanger.
7. All ducts suspended by hangers 12 inches or less in length from the top of the duct to the bottom of the support for the hanger.

H. Life safety systems defined:

1. All systems involved with fire protection including sprinkler piping, service water supply piping, fire dampers and smoke exhaust systems.
2. All systems involved with and/or connected to emergency power supply including all generators, transfer switches, transformers and all flow paths to fire protection and/or emergency lighting systems.
3. Fresh air relief systems on emergency control sequence including air handlers, conduit, duct, dampers, etc.

3.4 TOILET ROOM ACCESSORIES:

A. Toilet room accessories are furnished and installed under another section of the specifications.

3.5 COOPERATION WITH OTHER TRADES:

A. No piping, ducts, conduit, valves, boxes, etc., shall be installed until the entire run has been checked for clearance and the work has been coordinated between all the trades. Each tradesman shall be responsible for taking his own field measurements and maintaining proper clearance from the Owner's equipment and the work of other trades, and for coordinating his work with that of other Contractors and Owner. Furnish all necessary information, dimensions, templates, etc. in order that a perfectly coordinated job will result.

B. Contractor shall carry out his work in conjunction with other trades and shall give full cooperation to other trades. Contractor shall furnish all information necessary to permit work of all trades to be installed in a satisfactory manner.

C. Where space is so limited that Contractor's work shall be installed in close proximity to the work of other trades or where it is evident that Contractor's work will interfere with other trades, he shall assist in working out space conditions to make satisfactory adjustments. If required or directed by Engineer, the Contractor shall prepare composite working drawings and sections of not less than 3/4" -1'-0" scale clearly showing how his work is to be installed in conjunction with other trades; he shall make corrections necessary to satisfactorily complete installation at no additional cost to Owner.

D. All supports for hanging material to be connected to steel structure shall be installed prior to installation of fire proofing material. Refer to Division 7 of the specifications.
Any damage to fireproofing caused by late installation of hanging material shall be repaired by the Fire-proofing Contractor at the expense of the Contractor responsible.

E. The Plumbing and Heating Contractors shall give to the Electrical Contractor all information on switches, controls, pilots, etc. furnished under the Plumbing and Heating Contracts, together with makes and catalog numbers where required to permit the Electrical Contractor to leave the proper boxes to receive same. This information shall be given well in advance so that the Electrical Contractor may install his work as construction progresses. In the event that this information is not given in time to permit the Electrical Contractor to leave proper boxes, etc. as construction progresses, it shall be the responsibility of the Contractor to pay all costs of cutting and patching construction required because of this neglect.

3.6 INFORMATION FOR ELECTRICAL CONTRACTOR:

A. Deliver to the Electrical Contractor all information on motors and controls furnished under the Mechanical Contract, together with makes and catalog numbers, to permit the Electrical Contractor to leave the proper boxes and wiring.

B. Each electric motor of 1/2 h.p. or more shall be furnished with an automatic starter.

C. Starters shall be furnished in type to be remotely controlled and fed from dual voltage transformer 208/460 120 volts.

D. Starters to have overload and undervoltage protection. Starters shall be of the combination disconnect switch and starter type.

3.7 SLEEVES, INSERTS AND ANCHOR BOLTS:

A. Each section shall provide and shall be held responsible for the location and position of all sleeves, inserts, and anchor bolts required by the work. Failure to do so, which requires cutting and patching of finished work, shall be done at no additional cost to Contract.

B. All pipes and conduits passing through floors, walls or partitions shall be provided with sleeves sized to give a minimum of 1/2" clearance between sleeve and the outside diameter of the pipe, conduit or insulation, enclosing the pipe or conduit.

C. Sleeves through concrete floors or interior masonry walls shall be Schedule 40 steel pipe, set flush with finished wall or ceiling surfaces, but extending 2 inches above finished floors or shall be in accordance with details on drawings.

In all mechanical equipment rooms or penthouses, sleeves shall extend 6 inches above finished floor.

D. Inserts shall be individual or strip type of steel or malleable iron construction for removable nuts and threaded rods up to 3/4" diameter, permitting lateral adjustment.

E. Provide escutcheons on all pipes and conduits wherever they pass through floors, ceilings, walls, or partitions in finished areas. Escutcheons for pipes passing through floors shall be RITTER PATTERN AND CASTING COMPANY, No. 36A or approved equal split-hinged, cast brass type designated to fit pipe on one end and cover alcove projecting through floor on the other end.
Escutcheons for pipes shall be RITTER PATTERN AND CASTING COMPANY, No. 3A or approved equal - split-hinged, cast brass, chromium plated type.

3.8 FIRE STOPPING:

A. General

1. Firestopping: Material or combination of materials used to retain integrity of fire-rated construction by maintaining an effective barrier against the spread of flame, smoke, and hot gases through penetrations in fire rated wall and floor assemblies.

B. General Description of the Work : Only tested firestop systems shall be used in specific locations as follows: Penetrations for the passage of duct, cable, cable tray, conduit, piping, electrical busways and raceways through fire-rated vertical barriers (walls and partitions), horizontal barriers (floor/ceiling assemblies), and vertical service shaft walls and partitions.

C. References

1. Test Requirements: ASTM E-814, "Standard Method of Fire Tests of Through Penetration Fire Stops" (July 1997).

2. Underwriters Laboratories (UL) of Northbrook, IL runs ASTM E-814 under their designation of UL 1479 and publishes the results in their "FIRE RESISTANCE DIRECTORY" that is updated annually.

3. International Firestop Council Guidelines for Evaluating Firestop Systems Engineering Judgments

4. Test Requirements: ASTM E 84-96, "Surface burning characteristics".

5. All major building codes: ICBO, SBCCI, BOCA, and IBC.

6. Test Requirements: ASTM E-119, “Fire Test of Building Construction and Materials” (UL 263)

D. Quality Assurance

1. Firestop System installation must meet requirements of ASTM E-119, ASTM E-814, ASTM E-84-96, UL 236, UL 1479 or UL 2079 tested assemblies that provide a fire rating equal to that of construction being penetrated.

2. Firestop Systems do not reestablish the structural integrity of load bearing partitions/assemblies, or support live loads and traffic. Installer shall consult the structural engineer prior to penetrating any load bearing assembly.

E. Submittals

1. Submit Product Data: Manufacturer's specifications and technical data for each material including the composition and limitations, documentation of UL firestop systems to be used and manufacturer's installation instructions to comply with Section 013300.

2. Submit material safety data sheets provided with product delivered to job-site.

F. Installer Qualifications

1. Engage an experienced Installer who is certified, licensed, or otherwise qualified by the firestopping manufacturer as having been provided the necessary training to install manufacture’s products per specified requirements.

G. Products, General

1. Provide firestopping composed of components that are compatible with each other, the substrates forming openings, and the items, if any, penetrating the firestopping under conditions of service and application, as demonstrated by the firestopping manufacturer based on testing and field experience.

2. Provide components for each firestopping system that are needed to install fill material. Use only components specified by the firestopping manufacturer and approved by the qualified testing agency for the designated fire-resistance-rated systems.

3. Firestopping Materials are either “cast-in-place” (integral with concrete placement) or “post installed.” Provide cast-in-place firestop devices prior to concrete placement.

H. Acceptable Manufacturers

1. Subject to compliance with through penetration firestop systems (XHEZ) and joint systems (XHBN) listed in Volume II of the UL Fire Resistance Directory, provide products of the following manufacturers as identified below:

a. Hilti, Inc., Tulsa, Oklahoma 800-879-8000
b. Other manufacturers listed in the U.L. Fire Resistance Directory – Volume 2

I. Materials

1. Use only firestop products that have been UL 1479, ASTM E-814, or UL 2079 tested for specific fire-rated construction conditions conforming to construction assembly type, penetrating item type, annular space requirements, and fire-rating involved for each separate instance.

2. Provide a firestop system with a "F" Rating as determined by UL 1479 or ASTM E814 which is equal to the time rating of construction being penetrated.

3. Provide a firestop system with an Assembly Rating as determined by UL 2079 which is equal to the time rating of construction being penetrated.

J. Preparation

1. Verification of Conditions: Examine areas and conditions under which work is to be performed and identify conditions detrimental to proper or timely completion.

   a. Verify penetrations are properly sized and in suitable condition for application of materials.
   b. Surfaces to which firestop materials will be applied shall be free of dirt, grease, oil, rust, laitance, release agents, water repellents, and any other substances that may affect proper adhesion.
   c. Provide masking and temporary covering to prevent soiling of adjacent surfaces by firestopping materials.
   d. Comply with manufacturer's recommendations for temperature and humidity conditions before, during and after installation of firestopping.
   e. Do not proceed until unsatisfactory conditions have been corrected.

K Coordination

1. Coordinate location and proper selection of cast-in-place Firestop Devices with trade responsible for the work. Ensure device is installed before placement of concrete.

2. Responsible trade to provide adequate spacing of field run pipes to allow for installation of cast-in-place firestop devices without interferences.

L. Installation

1. Regulatory Requirements: Install firestop materials in accordance with UL Fire Resistance Directory.

2. Manufacturer's Instructions: Comply with manufacturer's instructions for installation of through-penetration and construction joint materials.

   a. Seal all holes or voids made by penetrations to ensure an air and water resistant seal.
   b. Consult with project manager, and damper manufacturer prior to installation of UL firestop systems that might hamper the performance of fire dampers as it pertains to duct work.
   c. Protect materials from damage on surfaces subjected to traffic.

M. Field Quality Control

1. Examine sealed penetration areas to ensure proper installation before concealing or enclosing areas.
2. Keep areas of work accessible until inspection by applicable code authorities.
3. Perform under this section patching and repairing of firestopping caused by cutting or penetrating of existing firestop systems already installed by other trades.

N. Adjusting and Cleaning

1. Remove equipment, materials and debris, leaving area in undamaged, clean condition.

2. Clean all surfaces adjacent to sealed holes and joints to be free of excess firestop materials and soiling as work progresses.

3.9 ACCESSIBILITY:

A. Locate all equipment which must be serviced, operated or maintained in fully accessible positions. Equipment shall include but not be limited to motors, controllers, switchgear, drain points, etc. If required for better accessibility, furnish access doors for this purpose. Access doors shall be selected by the Architect/Engineer to specific area finishes. Minor deviations from drawings may be made to allow for better accessibility, only if approved by the Engineer. Provide fire rated access doors in rated walls, access doors shall be provided in Milcor or equal.

B. In the event that any equipment is not installed to permit convenient servicing, disassemble, removal of parts, etc. the Contractor shall, at his own expense, make all corrections necessary to accomplish this.

3.10 LUBRICATION:

A. All equipment having moving parts and requiring lubrication which is installed under this Contract, shall be properly lubricated according to manufacturer's recommendations prior to testing and operation.
Any such equipment discovered to have been operated before lubrication is subject to rejection and replacement at no cost to the Owner. Units furnished with sealed bearings are accepted.

3.11 TAGS, CHARTS AND NAMEPLATES:

A. Each valve, control, switch, electrical panel, motor and any piece of apparatus installed under these sections shall be properly identified.

B. Each sectional shutoff valve shall have a brass tag with identifying number. Tag shall be secured to valve stem with sufficient length of copper coated jack chain to allow tag to be easily read.

C. All other equipment, including panels and switches, shall be proved with a suitable laminated plastic nameplate fastened with screws or rivets. Small equipment labels may use a pressure sensitive tape.

D. All nameplates and labels shall identify components by proper nomenclature and numbered according to equipment schedule or as designated.

E. Charts shall be furnished in duplicate and shall include the valve identification number, location and purpose. One chart shall be mounted in frame with a clear glass front and secured to wall in location directed. Second chart shall be for use throughout building and shall be provided with transparent plastic closure for top and attached 8" bead chain for hanging. Holes to be reinforced with brass grommets. Tags and closures as manufactured by Seton Name Plate Corp., New Haven, Conn., or approved equal.

3.12 INSTRUCTIONS:

A. Prepare written instructions frames for the proper maintenance and operation of any special equipment furnished and installed under this Contract.

B. Personally instruct the Owner's Custodian or official representative in addition to furnishing all manuals, diagrams, etc. in the proper operation and maintenance of all equipment and piping installed under this Contract.

C. Prepare a portfolio with all tags, operating manuals, parts lists, guarantees, etc. that are packed with all equipment furnished under this Contract and submit same to the Architect.

3.13 PIPING CODE MARKERS:

A. All service piping which is accessible for maintenance operations, except piping in finished spaces, shall be identified with vinyl plastic color bands and legends at each branch and riser take-off, at each passage through wall, floor and ceiling, adjacent to each valve and on all pipe runs marked each 20'-0".

Vinyl plastic bands shall not be used in plenum ceilings. Use self-Adhesive aluminum pipe markers or pipe stencils in plenum areas.

B. Pipe markers to conform to A.S.A. Bulletin A-13. Where pipes are too small for legends, brass identification tags 1-1/2" in diameter with depressed 1/2" high black filled letters shall be fastened with chain. Pipe markers and tags as manufactured by the Seton Name Plate Corp., New Haven, Conn., or equal approved.

3.14 EQUIPMENT NOT IN CONTACT AND FURNISHED UNDER OTHER SECTIONS:

A. Furnish all piping, wiring, sheet metal connections and miscellaneous accessories, and make all closing connections to equipment furnished by other Contractors and Owner; include installation of all special traps, control valves and supplies furnished with such equipment. Refer to section in which outlines equipment requirements and all other specifications sections as may be pertinent to comply with intent of this Article.

B. Unless otherwise detailed on drawings, roughing of proper size and capacity for equipment indicated on Architectural Mechanical or Electrical drawings as "Future" or "NIC" shall be provided and installed in such a manner and location that future final connection can be made with a minimum of work and without cutting or patching walls, partitions, ceilings or floors.

C. Engineers' drawings are, of necessity, schematic for special equipment as exact roughing and requirements may vary with different manufacturers. Contractor is also referred to Architectural drawings and details.

D. Contractor shall obtain approved shop drawings of equipment being furnished for extent of final connections and exact roughing required.

3.15 EQUIPMENT PREPURCHASED BY OWNER:

A. The Owner has purchased mechanical equipment listed elsewhere. This Contractor shall be given the purchase order and shall at that time assume full responsibility for delivery, installation and guarantee of said equipment as if he has purchased the equipment.

3.16 CLEANING PIPING, CONDUITS AND EQUIPMENT:

A. Thoroughly clean all piping and equipment of all foreign substances inside and out before being placed in operation.

B. If any part of a system should be stopped by any foreign matter after being placed in operation, the system shall be disconnected, cleaned and reconnected wherever necessary to locate and remove obstructions. Any work damaged in the course of removing obstructions shall be repaired or replaced when the system is reconnected at no additional cost to the Owner.

C. During the course of construction, all pipe and electrical conduits shall be capped in an approved manner to insure adequate protection against the entrance of foreign matter.

3.17 CLEANING UP:

A. After completion of the work, remove all waste, rubbish and other materials left as a result of operations and leave the premises in clean condition.

B. All fixtures, equipment, etc. installed under the Mechanical and Electrical Sections shall be free of dirt, grease and other foreign material and left in perfectly clean condition and ready to use.

3.18 GUARANTEE:

A. All parts of the work and all equipment shall be guaranteed for a period of at least 18 months from the date of acceptance of the job by the Owner.

B. If during that period of general guarantee, any part of the work installed fails, becomes unsatisfactory or does not function properly due to any fault in material or workmanship, whether or not manufactured or job built, each section shall upon notice from the Owner, promptly proceed to repair or replace such faulty material or workmanship without expense to the Owner, including cutting, patching and painting or any other work involved and including repair or restoration of any damaged sections of the premises resulting from such faults.

C. In the event, that a repetition of any one defect occurs, indicating the probability of further failure, and which can be traced to faulty design, material or workmanship, then repairs or replacement shall not continue to be made but, the fault shall be remedied by a complete replacement of the entire defective unit.

D. In addition to the general guarantee, obtain and transmit to the Owner any guarantees or warranties from manufacturers of specialties but only as a supplement to the general guarantee which will not be invalidated by same.

3.19 OWNER'S INSTRUCTIONS AND SYSTEM OPERATION:

A. At the time of the job's acceptance by the Owner, Contractor shall furnish one complete set of reproducible approved, certified drawings to the Owner. In addition, Contractor shall furnish maintenance and operating instructions for all equipment including parts list.
These instructions shall be written in layman's language and shall be inserted in vinyl covered three-ring loose leaf binder. This information in binder shall be first sent to the approved by the Architect/Engineer before turning over to the Owner.

B. Upon completion of all work and of all tests, each Division shall furnish the necessary skilled labor and helpers for operating the system and equipment for a period of one (1) day of eight (8) hours, or as otherwise specified. During this period, instruct the Owner or his representative fully in operation, adjustment and maintenance of all equipment furnished. Give at least forty-eight (48) hours notice to the Owner in advance of this period.

3.20 OWNER'S ACCEPTANCE TEST:

A. After the various systems are complete as determined by preliminary operating tests, the Contractor shall arrange for the Owner's final acceptance tests.

B. The Contractor shall have present at each acceptance test, representatives of the several Contractors whose work is directly or indirectly involved, with instruments as necessary in accordance with the design and to include the following.

1. All equipment installed and operating in accordance with manufacturer's instructions and performance guarantee.
2. All systems operating in accordance with specifications.

3. All distribution systems properly adjusted for distribution to equipment as specified.
4. The various systems properly flushed, cleaned, and free of entrapped air and dirt.
5. All motors installed with proper thermal overload protection and not operating under overload conditions as determined by ammeter readings.
6. All `as built` drawings, valve charts, etc. as specified in various parts of the specifications installed or ready for delivery to the Owner.

C. The date of the Owner's acceptance of the equipment shall be the start of the 18 months guarantee period.

3.21 TEST:

A. Conducting Tests: Conduct all tests called for under the various sections or as required and repair or replace any defects. Perform all tests in the presence of and to the satisfaction of the Engineer and such other parties as may have legal jurisdiction.

B. Defective Work: The Owner shall have the privilege of stopping any of the work not being properly installed. All such defective work shall be repaired or replaced and the tests shall be repeated.

C. Repair Damaged Work: Repair all damages resulting from tests and replace damaged materials.

END OF SECTION 200050

SECTION 220500 - COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. The General Provisions of the Contract, including General and Supplementary Conditions and General Requirements, apply to the work specified in this Section.

B. The General Requirements in Section 200050 shall also govern the work under this section.

1.2 SCOPE OF WORK:

Sanitary, waste and vent systems
Grease waste and vent system
Domestic water systems
Storm Water systems
Plumbing fixtures and equipment
Balancing of the domestic recirculated hot water system (please refer to Section 23 05 93)

A. This contract includes all labor, material, equipment, tests and appliances required to furnish and install all plumbing as shown on drawings, implied and herein specified.

B. The location of the building will be as shown on drawings. A visit to the site and examination of the Architectural, Structural and other Mechanical trades showing all details of construction is a requirement before submitting a proposal.

C. The drawings are diagrammatic and indicate the general arrangement of piping and equipment, and do not show all minor details and fittings. Such items shall be included, as well as reasonable modifications, in the layout as directed to prevent conflict with other trades.

D. Connect all fixtures, floor drains, and equipment shown on Architectural drawings, as well as on Plumbing drawings. Check all Architectural, Structural and Mechanical drawings and coordinate all the work accordingly.

E. Provide seismic restraints in accordance with Section 220548.

1.3 QUALITY ASSURANCE:

A. Codes and Standards:

1. 2018 Connecticut State Building Code with all the Amendments.
2. 2015 International Building Code
3. 2015 Life Safety Code- NFPA 101
4. 2015 International Plumbing Code
5. 2015 International Mechanical Code
6. current National Fuel Gas Code-NFPA 54.
7. 2015 International Energy Conservation Code
8. current State of Connecticut Public Health Code
9. 2009 Accessible and Usable Buildings and Facilities - ICC/ANSI A117.1
10. Americans with Disabilities Act – ADA

1.4 SUBMITTALS:

A. Shop Drawings: Submit the following shop drawings:
Plumbing fixtures and trim
Cleanouts
Valves
Access Doors
Backflow preventers
Identification system
Pipe guides and anchors
Pressure regulating valve
Sleeves
Thermal insulation materials
Thermometers and Gauges
Floor drains, Floor sinks
Pipe, fittings and couplings
Hose Bibbs
Thermostatic mixing valve
Water hammer arrestors
Hangers and supports
Trap primers

B. The contractor, additionally, shall submit for approval any other shop drawings as required by the Architect. No item listed above shall be delivered to the site, or installed, until approved. After the proposed materials have been approved, no substitution will be permitted except where approved by the Architect.

C. Recycled Content: Provide data showing recycled materials content of materials and fabricated items provided for this project, stated as a percentage of the materials included in these items or materials provided as part of the work of this Section.

1.5 PLUMBING SYSTEM DESCRIPTION:

A. Furnish and install all plumbing fixtures shown in the drawings and herein specified. All fixtures shall be complete and perfect and properly connected to the soil, waste, vent and water supply as required and left in complete operation satisfactory to the Architect.

B. All fixture trim shall be furnished in polished brass chrome plated, including supplies, valves, traps, wall flanges and exposed piping.

C. Before ordering fixtures, Contractor shall submit brochures of all fixtures and trim to the Architect for review.

D. Contractor shall furnish all hangers, chair carriers, bolts and other devices for all fixtures as required to make new fixtures ready for operation in a safe, strong and convenient manner. Fixtures shall be set plumb and true.

E. Contractor shall include all permit fees and connection charges.

PART 2 - PRODUCTS

2.1 PIPE AND FITTINGS:

A. Listed below are references to the specification standards or recognized authorities to which pipe and fitting materials must conform.

B. All reference shall be the current edition as recognized by the active codes. Each pipe length shall have the manufacturer's name cast, stamped or rolled on. Each fitting shall have the manufacturer's symbol and pressure rating cast, stamped or rolled on.

C. Underground Hub and Spigot Cast Iron Soil Pipe and Fittings: To conform to ASTM A 74. Joints shall be made with compression gaskets.

D. Above-ground No-Hub Cast Iron Soil Pipe and Fittings: To conform to CISPI Standard 301. Joints shall be made with neoprene sleeve, stainless steel shield and clamp assembly equal to Tyler wide body 4 clamp arrangement. Torque clamp screws to the recommended torque by code.

E. Above-ground copper drainage tube type DWV shall conform to ASTM B 306 and fittings to ASME B16.29.

F. Underground Copper Water Pipe and fittings shall conform to ASTM B 88 Standard Specification for Seamless Copper Water Tube, Type K. or or Ductile Iron complying with Standard AWWA C151/A21.51; AWWA C115/A21.15.

G. Above-ground Copper Tubing: To be Type "K" or "L" seamless conforming to ASTM B 88. Cast bronze fittings to conform to ASME B16.18 and wrought copper fittings to conform to ASME B16.22.

H. Solder: To be 95% tin, 5% antimony (lead free) conforming to ASTM B 32, grade 5A.

I. Gas Piping:

1. The pipe shall be steel pipe, Schedule 40 complying with the ASTM A 53 Specification for Pipe, Steel, Black and hot–dipped, Zinc–Coated Welded and Seamless. The fittings shall be steel, malleable iron or ductile iron.

2. Gas pipe shall be clear and free from cutting burrs and defects. Any defective pipe or fitting shall be replaced and shall not be repaired.

3. Provide gas valves at all pressure regulators, at each piece of equipment, as shown on drawings and as required by codes.

4. No branch lines shall be taken from the bottom of horizontal runs.

5. Provide drips at any points in line where condensate may collect.

6. All gas piping shall be graded not less than 1/4" in 15'-0". All horizontal piping shall be graded to risers; provide capped drip at bottom of riser.

7. Provide dirt legs, gas valves, and unions at each equipment connection.

8. All concealed piping not accessible shall be welded by an ASME certified welder.

9. Underground gas pipe shall be metal or plastic. Pipe shall be installed with 36" of cover to protect against damage and freezing. Trench shall be graded for continuous, firm bearing. Metal pipe installed underground shall be protected against corrosion. When plastic pipe is used outside, underground, an electrically continuous corrosion-resistant tracer wire (min. AWG 14) or tape shall be buried with the pipe to facilitate locating.

10. Plastic pipe shall be used only outside the building. Plastic pipe shall conform with Standard Specification for Thermoplastic Gas Pressure Pipe, Tubing and Fittings, ASTM D 2513. Pipe shall be marked "Gas" and "ASTM D 2513".

11. TracPipe flexible gas piping manufactured by Omega Flex may be used to run the new gas distribution system. Pipe shall be installed according to the manufacturer's recommendation and local Code requirements. Gas pipe installed below slab shall be installed in containment pipe. Containment pipe shall be vented to outside.

2.2 HANGERS:

A. Securely hang and anchor pipe as shown and required with proper provision for expansion, contraction and elimination of undue stress and strain on piping.

B. Provide a pipe hanger within two (2) feet of each elbow, tee, wye, valve, strainer and similar device.

C. Secure and support runs at base and at sufficiently close intervals to hold pipe at alignment and to carry safely the weight of piping and contents without undue stress thereon.

D. Except as indicated to the contrary, secure and support all horizontal piping as follows and required to prevent sagging, undue pipe movement and preserve proper alignment in each run.

Piping	Size	Maximum Interval
Cast Iron	All sizes	At each hub or joint
Copper Tubing	1 1/4" & smaller	Five (5) feet
Copper Tubing	1 1/2" & larger	Eight (8) feet

E. Hangers up to and including 2" shall be the adjustable band type equal to Empire. Figure 310 for iron pipe and Fig. 310CT for copper tubing.

F. Hangers for piping 2-1/2" and up shall be the clevis type, equal to Empire. Figure 11 for iron pipe and Figure 110CT for copper tubing.

G. Hangers shall be suspended from one of the following devices:

1. "C" clamps.
2. Trapeze hanger assemblies consisting of back-to-back horizontal steel channels with end-type rod hangers.
3. Expansion shield embedded into concrete or masonry.

H. Provide seismic restraints in accordance with Section 220548.

2.3 SLEEVES:

A. All outside piping passing through exterior walls, foundation walls and floors shall be furnished with flanged C.I. wall sleeves in Zurn, J.R. Smith, MIFAB or Josam. Furnish with flashing clamp where sleeve passes through waterproof membrane.

B. All pipes and conduits passing through floors, walls or partitions shall be provided with sleeves sized to give a minimum of 1/2" clearance between sleeve and the outside diameter of the pipe, conduit or insulation, enclosing the pipe or conduit.

C. Sleeves through concrete floors or interior masonry walls shall be Schedule 40 steel pipe, set flush with finished wall or ceiling surfaces, but extending 2 inches above finished floors or shall be in accordance with details on drawings. In all mechanical equipment rooms or penthouses, sleeves shall extend 6 inches above finished floor.

2.4 CLEANOUTS:

A. Cleanouts installed in underground lines shall be extended up to point below finished floor and Contractor shall furnish and install brass frame and flush brass cover located so as to finish flush with finished floor or finished floor covering, whichever applies.

B. Cleanout frames and covers shall be furnished equal to Josam Series Y-55000 for floors and Y-58600 and Y-58610 for walls. Type used to suit finish surface. All exposed tops, flanges and frames shall be of polished brass or stainless steel. Tops in all Mechanical rooms shall be special duty type. Cleanouts of equal quality and design in Zurn, J.R. Smith, MIFAB or Wade will be acceptable. In areas where floor covering is provided, furnish cover frame recessed to accept floor covering material such that frame of cover is flush with surrounding material.

C. The Contractor shall furnish and install all cleanouts on all sanitary and roof drainage lines at all changes in direction and on straight lines not more than 100'-0" centers, and in any other special locations to avoid dead ends or as may be required by the Architect. Each cleanout shall have a plug and ferrule. Provide access door/cover for all cleanouts installed in concealed sanitary/waste and storm stacks.

2.5 TRAPS:

A. Traps shall be of the same material, finish and size as the pipes on which they occur. All traps shall be provided with suitable openings for cleaning and every trap shall be vented unless otherwise noted, to the full approval of the Plumbing Inspector. The traps used shall in every case meet with approval of the Plumbing Inspector. All traps shall be provided with brass cleanout plug at bottom unless allowed to be omitted in special cases by the Plumbing Inspector.

2.6 FLOOR DRAINS:

A. Refer to the floor drain schedule on Drawing PL 2.1. Floor drains shall be furnished in J.R. Smith, Josam, Zurn, MIFAB or Wade.

B. All floor drains on slab or grade floors shall be furnished with flashing clamp. All floor drains shall be provided with deep seal trap, for min. 4” water seal and trap sealer by Sure Seal.

2.7 ROOF DRAINS:

A. Refer to the roof drain schedule on Drawing P-1. Roof drains shall be furnished in J.R. Smith, Josam, Zurn, MIFAB or Wade.

B. All Roof drains including overflow roof drains shall be furnished with underdeck clamp, sump receiver, and cast iron dome.

2.8 WALL HYDRANTS:

A. Furnish and install in locations shown on drawings Woodford 67 3/4" non-freeze type wall hydrants with bronze casing and finish and loose key shut off, or approved equal. Install according to manufacturer's instructions.

B. Contractor shall place wall hydrants in locations where supply pipe will not be in finished rooms. Install hydrant 30 inches above grade. Coordinate with architectural.

2.9 HOSE BIBBS:

A. Furnish and install in toilet chase locations shown on drawings Woodford B26 3/4" wall faucets with polished bronze casing and finish and loose key shut off, or approved equal. Install according to manufacturer's instructions. Install faucets 24 inches above grade. Coordinate with architectural.

2.10 NON-FREEZE ROOF HYDRANT

A. Post Hydrant: Provide Non-freeze roof post hydrant with ¾" hose adapter connection, galvanized casing and adjustable flow wheel lock handle with deck flange and under deck clamp. A tapped 1/8" drain hole is furnished in the valve body and must be piped and discharged to an acceptable discharge point for proper draining of the casing to prevent freezing.

2.11 ACCESS DOORS AND PANELS:

A. Furnish and install one flush type access panel or access door for each and every shutoff valve or group of valves located above ceiling or in furred spaces; also for each cleanout located in furred space above ceiling, concealed walls or chases and below floor. Panels shall have metal frames, hinges, and latch.

Access door shall be fire rated as required.

B. All panels occurring in ceilings which are of special finish shall be furnished with 7/8" or 1" depth panel filled in with material to match ceiling. Where panels occur in walls or ceilings which are of plaster, furnish flush panels with metal frame complete.

C. No access panels will be required where "lay-in" ceilings occur, provided suitable plastic markers identifying exact location of valves, cleanouts, etc., on lay-in ceilings are applied directly below valve grouping and identified by a number, this number to be used as a marking on valve chart.

2.12 WATER-HAMMER ARRESTOR:

A. Contractor shall furnish and install water hammer arrestors at ends of headers of all batteries of fixtures and at all individual fixtures on all hot and cold water lines.

The water hammer arrestors shall extend full size of headers.

B. Water hammer arrestors shall be constructed of same type of pipe as used on the system on which it is installed and shall be located so as to be most effective to prevent water hammer or vibration in piping. PPP Water Hammer Arrestors, Wolverine "Tap-Traps" or Nibco Air Chambers may be used.

2.13 INSULATION:

A. Refer to Section 220700.

2.14 VALVES:

A. This Contractor shall furnish and install valves where shown on plans and also wherever necessary to make the system complete in its operation. All valves shall be as manufactured by Stockham, Jamesbury, Appollo, Centerline or Milwaukee as specified.

Hot water and cold water (domestic)

2" and smaller	
Ball valves	Apollo - 71-100/200
Check valves	Stockham B-310-T

2.15 BACKFLOW PREVENTER:

A. 4” Reduced pressure Zone Assembly: Watts Model 957RPDA with non-rising stem gate valves, UL classified and FM approved. Provide with air gap fitting.

B. ¾”, 1”, & 2” Reduced pressure Zone Assemblies: Watts Model 909 with ball valves. Provide with air gap fitting.

2.16 PLUMBING FIXTURES:

A. Furnish all hangers, carriers, bolts and other devices for all fixtures as required to make new fixtures ready for operation in a safe, strong and convenient manner. Fixtures shall be set plumb and true.

B. Provide all hangers, supports, brackets and carriers for proper installation of the lavatories, sinks, and water closets requiring support. Such supports shall be in accordance with the recommendations of the manufacturers of the fixtures, and if built into partitions or walls, shall be set as the wall progresses. All carrier supports shall be bolted to the floor.

Carriers equal approved will be accepted in Jay R. Smith, Josam, Zurn or Mifab

C. All fittings, escutcheons, faucets, traps, and exposed piping shall be brass, chrome plated over nickel plate with polished finish. Any hanger visible shall likewise be chrome plated over nickel plate.

D. Provide lavatories with chrome plated stops supply pipes, traps and tail pieces.

E. Refer to drawings for plumbing fixture specifications.

F. Fixtures shall be American Standard or equal approved will be accepted in Kohler or Toto.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Check all architectural, plumbing and electrical drawings as well as the structural drawings to make sure that his piping will not conflict with such work.

B. All piping work shall be installed with provisions to allow for expansion and contraction of lines so as to prevent any undue strains on pipe and fittings, any trapping of lines or lifting or dislocating of any appliances. Rectify without cost to the Agency any conditions of noisy circulation due to trapped or air bound lines, including the expense of cutting and repairing of the building structure incident to making such alterations.

C. Install the work to conform to space conditions and the work of other trades. The drawings indicate generally the runs and the sizes of piping and although the size must not be decreased, nor the drawings deviated from except as unforeseen space conditions may require, the right is reserved to make minor changes in the arrangement of the work to meet the conditions arising during construction.

3.2 TESTS:

A. Furnish all labor and materials for the performance of all tests on water piping, sewers, waste piping, vent piping as may be required by the authorized inspectors having jurisdiction or as may be required by the Architect or his authorized representative.

3.3 GRADES:

A. Pipes shall be laid to a uniform grade not less than 1/8" to the foot unless otherwise indicated on plans. Consult with the Contractor under other Sections concerning the pipes to be laid in trenches. All vertical lines shall be set plumb and true. All changes in direction shall be made with Y-1/8 or 1/16 bends with cleanouts at every change in direction greater than 45 deg.

3.4 UNDERGROUND WASTE AND VENT PIPING:

A. All work below floors and in fill inside building shall be cast iron bell and spigot, unless otherwise noted. All underground pipe shall be pitched at least 1/8" per foot. Openings through outside walls shall be provided for all lines running through walls at proper elevation. Drainage piping shall be minimum 3”. Vent piping shall be minimum 2”.

3.5 ABOVEGROUND WASTE AND VENT PIPING:

A. All soil, waste and vent, unless otherwise specified herein or shown on plans, shall be no-hub cast iron. DWV or Type "L" copper tubing and drainage fittings shall be allowed for branch and 2” and smaller piping.

B. Traps of all plumbing fixtures shall be vented to prevent loss of trap seal.

C. All vents shall be minimum 1 ½”. All vent terminals shall be 4”.

D. All soil, waste and vent pipes to be concealed in finished areas.

E. All soil, waste and vent piping shall be subject to the full approval of the local Plumbing Inspector.

F. In special cases, because of appearance or limited space conditions, install wastes in copper-nickel alloy steel screwed pipe, or copper tubing of weight required by local codes.

G. All vent pipes shall be properly connected to the vertical vent stacks and extended through the roof. Vent lines from various stacks may be connected together in the space between ceiling and roof so that the number of vents passing through roof may be kept at a minimum.

The location of all vents passing through the roof shall be approved by the Architect before being installed.

3.6 COLD WATER PIPING:

A. All water piping shall be run concealed in ceilings and in pipe spaces in ceilings and in finished area.

B. At low points, provide valved drain with hose connection. Arrange piping to pitch to low points or fixtures so that entire system may be drained.

C. Provide ball valves on all branches off main and sectional valves on main. Provide stops at each individual fixture. All valves shall be tagged.

D. All cold water piping shall be Type "L" hard tempered copper tubing with wrought copper sweat fittings or pro-press fittings

E. All exposed un-insulated water piping to individual fixtures in finished rooms shall be chrome plated.

3.7 HOT WATER PIPING:

A. Extend the hot water piping as shown on plans which, in general, will follow the cold water. All piping in finished rooms shall be run concealed throughout. Extend piping to fixtures and equipment as shown on the plans, providing ball valve shutoffs in all branches and drains with hose cocks at all low points.

B. All hot water piping shall be Type "L" hard tempered copper tubing with wrought copper sweat fittings or pro-press fittings.

C. All exposed piping to individual fixtures, in finished rooms, shall be chrome plated.

3.8 HOT WATER RECIRCULATING PIPING:

A. Install recirculation from ends of hot water supply back to the recirculating pump properly valved and provide with check valves to prevent back circulation. At recirculating loop connections provide balance valve assemblies on start of each loop.

B. All recirculation lines shall be Type "L" copper tubing hard tempered.

3.9 FUEL GAS PIPING:

A. Pressure Testing

1. The customer piping shall be pressure tested in accordance with the National Fuel Gas Code (NFPA_54), current edition. The test medium shall be nitrogen (N2), carbon dioxide (CO2) or air. The test pressure and duration shall conform to NFPA-54 Section 4.14 and must be approved by the local authority having jurisdiction and the Local Gas Distribution Company (LDC).

B. Purging and Placing Gas Piping into Operation

1. Upon notification and meter being turned on by Local Distribution Gas Company, the house line can be placed in operation. All purging shall be done in accordance with NFPA-54 Section 4.3.2.

   a. The air can be safety displaced with natural gas provided that a moderately rapid and continuous flow of gas is introduced at the meter and air is vented to the outside of the building by means of connecting a rigid pipe or a semi-rigid metallic tubing with appropriate fittings.
   b. The purge piping must be located outside of the building at a safe distance away from fresh air intakes and away from any source of ignition.
      The end of the purge riser must be equipped with a flash back arrestor. The purge riser must be manned at all times. A fire extinguisher must be placed nearby while purging is in operation. A combustion gas indicator (CGI) can be used to assure the house line is purged properly to 100% gas.
   c. In the event of multi-floor house lines, the longest house line (furthest from the meter) must be purged first, followed by the next longest, until all sections of house lines have been purged to 100% gas.

C. Odorant Level

1. All house lines must be continuously purged until such time that the Odorant level is sufficiently detachable by smell and confirmed with an ordinary level instrument such as Bacharach Model 5110-200, or equivalent.

   The instrument shall have a range of to 1.2% gas in air. The line must be purged until a readily detachable Odorant reading of 0.25% or less gas in air is maintained.

   a. As soon as the acceptable level reading is maintained at all purging locations, turnoff the ends of house lines, disconnect the purging tubing, permanently plug all ends and leak test all plugs. Gas utilization equipment can now be purged and placed into operation.
   b. Odorant level readings shall be re-taken periodically to ensure proper level of Odorant is maintained. Odorant level may decay especially in low flow house lines. If this occurs purling procedure must be repeated as needed.

3.10 PIPING JOINTS:

A. Soldered Joints in Copper Tube: Cut the ends of tubes square, remove burrs, clean tube ends and fitting sockets with emery cloth, and remove all particles before applying flux and making the joint. Insert tubes to full socket depth. Use the following solders at the given conditions.

B. All solder joints shall be made up with 95/5 solder.

C. Plumbing Contractor shall be held responsible for any damages caused by water from poorly made joint.

3.11 CAST IRON JOINTS:

A. All joints on buried cast iron shall be with compression type gaskets.

B. All joints on above ground cast iron shall be with no-hub couplings.

3.12 REAMING OF PIPES:

A. All pipes to be carefully reamed after cutting and threading.

B. All pipes on brass, iron or steel pipe lines shall be reamed carefully before they are threaded. They shall be reamed smooth on the inside to give the full area of pipe in all cases.

C. All copper tubing shall be carefully cut square and true, carefully reamed and thoroughly cleaned. The inside of fittings shall be carefully cleaned. On tubing 1-1/2" and larger, the end of tubing shall be thoroughly tinned. All tubing shall be inserted fully to the shoulder of fittings.

3.13 TESTING:

A. All piping testing to be performed in accordance with all applicable Codes including, but not limited to IPC.

B. All involved parties are to be notified at least two weeks in advance of a scheduled test.

3.14 DISINFECTION:

A. Disinfect new water piping in accordance with AWWA C651.

1. The pipe system shall be flushed with clean, potable water until dirty water does not appear at the points of outlet.

2. The system or part thereof shall be filled with a water/chlorine solution containing at least 50 parts per million (50mg/L) of chlorine, and the system or part thereof shall be valved off and allowed to stand for 24 hours; or the system or part thereof shall be filled with water/chlorine solution containing at least 200 parts per million (200mg/L) of chlorine and allowed to stand for 3 hours.

3. Following the required standing time, the system shall be flushed with clean potable water until the chlorine is purged from the system.

4. The procedure shall be repeated where shown by a bacteriological examination that contamination remains present in the system.

END OF SECTION 220500

SECTION 220700 - PLUMBING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. The General Provisions of the Contract, including General and Supplementary Conditions and Division 01, General requirements, apply to the work specified in this Section.

B. The General Requirements in Section 200050 shall also govern the work under this Section.

C. Scope of Work: This Section contains details for the insulation of pipe, ductwork and equipment installed under Division 22.

D. Recycled Content: Provide data showing recycled materials content of materials and fabricated items provided for this project, stated as a percentage of the materials included in these items or materials provided as part of the Work of this Section.

E. Connecticut High Performance Building Submittals:

1. Product Data for Credit IEQ 4.1: For adhesives and sealants, documentation including printed statement of VOC content and chemical components.
2. Laboratory Test Reports for Credit IEQ 4: For adhesives and sealants, documentation indicating that product complies 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."

1.2 SUBMITTALS:

A. In accordance with Section 200050, the following items shall be submitted for approval.

Piping insulation
Fitting insulation
Equipment insulation

B. Recycled Content: Provide data showing recycled materials content of materials and fabricated items provided for this project, stated as a percentage of the materials included in these items or materials provided as part of the Work of this Section.

1.3 MECHANICAL SYSTEMS INSULATION:

A. Furnish and install all thermal and protective insulation as specified herein for piping, and equipment as shown on the drawings.

B. The following mechanical items shall be insulated:
Piping - hot and cold
Fittings - Valve bodies, Victaulic couplings, elbows, tees, etc.
Equipment insulation

1.4 SYSTEM PERFORMANCE

A. Insulation materials furnished and installed hereunder should meet the minimum thickness requirements of ASHRAE 90.1 (2013), "Energy Efficient Design of New Buildings," of the American Society of Heating, Refrigeration, and Air Conditioning Engineers. However, if other factors such as condensation control or personnel protection are to be considered, the selection of the thickness of insulation should satisfy the controlling factor.

B. Insulation materials furnished and installed hereunder shall comply with NFPA 255 and shall have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with the following testing standard:

Underwriters' Laboratories, Inc. UL 723

Adhesives used for applying the sealed jackets shall also conform to these same ratings. The use of wheat paste or any other material not meeting these requirements will not be allowed.

1.5 QUALITY ASSURANCE

A. Insulation materials and accessories furnished and installed hereunder shall, where required, be accompanied by manufacturers' current submittal or data sheets showing compliance with applicable specifications.

B. Insulation materials and accessories shall be installed in a workmanlike manner by skilled and experienced workers who are regularly engaged in commercial insulation work.

C. All covering and insulating materials shall be manufactured by Owens-Corning, Knauf, Johns Manville or Armstrong.

1.6 SEAMS:

A. On exposed insulation, all longitudinal seams shall be kept at the top and back of the pipe and circumferential joints shall be kept to a minimum. Raw end of insulation shall be concealed by neatly folding the ends of the jackets. Fittings, valve bodies and flanges shall be furnished with the same jacket materials used on adjoining insulation.

1.7 PRIOR TESTING:

A. Covering shall not be applied until all parts of the work have been tested by the Contractor and reviewed by the Engineer.

1.8 VAPOR BARRIER:

A. Vapor barrier shall be applied in accordance with the manufacturer's instructions to maintain the integrity of the vapor barrier on cold systems.

B. An approved vapor retarder mastic compatible with PVC must be applied between pipe insulation and fitting cover, and on fitting cover and throat overlap seam.

C. For fittings where operating temperature is below 45 deg. For where pipe insulation thickness is greater than 1 ½”, two or more layers of Hi-Lo temp insulation inserts shall be installed beneath fitting cover.

1.9 METAL SHIELDS:

A. Metal shields, 16 gauge galvanized, shall be applied between hangers or supports and the pipe insulation. Shields shall be roll formed to fit the insulation and shall extend up to the center line of the pipe and the length specified for the insert. Insulation shall be rigid type for length of shield to prevent crushing.

1.10 DELIVERY AND STORAGE OF MATERIALS

A. 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.

B. The contractor shall use whatever means are necessary to protect the insulation materials and accessories (wick material, sealing tape, etc) 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.

PART 2 - PRODUCTS

2.1 PIPING:

A. Insulate all new domestic hot, cold and recirculating hot water lines with Johns Manville Fiberglass ASJ with S.S.L. II, pipe insulation with double self-sealing lap having a factory applied jacket. All horizontal and vertical insulated piping located below 8'-0" AFF level and not protected with enclosures shall be protected with Zeston 2000 P.V.C. 30 Mil jacketing. Outdoor, exposed piping shall be protected with aluminum jacket.

B. All concealed piping shall be covered as follows: Apply insulation to clean dry pipe with side and end joints butted tightly. Seal lap of jacket and butt joint strips with Benjamin Foster 82-07 vapor barrier lap adhesive. Insulate fittings, flanges and valves of piping with mitered pipe insulation, or F/G premolded fittings made smooth with insulating cement and jacket with glass cloth saturated with Benjamin Foster 30-60 lagging adhesive. Vinyl or plastic fitting jackets will be allowed.

C. Insulate domestic cold water, water cooler waste, rain leaders, roof drain pans (70 degrees F. and below) in the same as for hot piping above except vapor seal all joints, seams, elbows and fittings.

D. Insulate horizontal rain leaders with A.S.J. - S.S.L. II pipe insulation with double self-sealing lap and vapor barrier. Include roof drain bowl and first vertical drop.

E. For pipes exposed to weather apply a 16 mil embossed aluminum jacket with 2" overlap at longitudinal and circumferential joints. Secure in place with 3/4" x .015" aluminum band 18" on centers. All seams shall be sealed weather tight.

F. Foam insulation:

1. Piping and Fittings. Microiok plain pipe insulation shall be wired or taped in place over clean, dry pipe with all joints butted firmly together. Vapor retarder shall be Micro-Lok AP-T plus.

2. The insulation shall be finished with metal jacketing with a laminated moisture retarder. Metal jacketing shall be overlapped 2 to 3 inches (51 to 76 mm) and held in place with sheet metal screws or metal bands.

3. Elbows and tees shall be finished with matching metal fitting covers. Other fittings in metal-jacketed systems shall be finished with conventional weather-resistant insulating materials with painted aluminum finish.

G. Provide minimum insulation thickness in accordance with the following table.

Minimum Pipe Insulation

Piping System Types	Fluid Temp. Range	Runouts 2 in +	1 in. and less	1-1/4 to 2 in.	2-1/2 to 4 in.	5 and Larger
	F	in.	in.	in.	in.	in.
Plumbing Systems						
Hot Water, Grease Waste	100-200	1.0	1.0	1.0	1.5	1.5
Cold Water Rainleader Cond. Drains	Below 70	0.5	1.0	1.5	1.5	1.5

Reinsulate piping where insulation has been disturbed under this contract and feather to remaining insulation.

2.2 HANDICAP SINKS:

A. Provide Trubro Handi-Lav Guard insulation kits on drain tailpiece, traps, angle valves and water pipes below handicap sinks.

2.3 FITTING COVERS:

A. Fitting covers may be used in lieu of insulating cement and jacket. Provide fitting covers in Zeston - 2000 P.V.C. (20 Mil thickness) by Johns Manville.

B. General - The matching insert (fiberglass) should either be wrapped completely around the fitting or snugly positioned inside the fitting for proper fit. The insert shall cover the full inner surface area of the fitting cover. The fitting cover is then to be applied over the fitting and insert, and the throat secured by either tack fastening, taping, or banding.

C. Cold Pipe - Fitting systems below ambient temperature must have a continuous vapor barrier, either with pressure sensitive PVC Tape, or an approved adhesive system. When PVC Tape is used, a 2" downward lap is required. On cold lines in severe ambient temperatures, the fiberglass insert shall be the same thickness as the adjacent pipe insulation. All joints shall then be sealed with PVC Tape.

D. Hot Pipe - For hot piping which requires pipe insulation over 1-1/2" wall, an extra inch of wall thickness in the pipe insulation shall be applied. If the surface temperature of insulation exceeds 155 degrees F. fitting covers should not be used. The throat seam shall be riveted or tacked on hot piping.

PART 3 – EXECUTION

3.1 SITE INSPECTION

A. 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.

B. Verify that all materials and accessories can be installed in accordance with project drawings and specifications and material manufacturer's recommendations.

C. Verify, by inspecting product labeling, submittal data, and/or certifications which may accompany the shipments, that all materials and accessories to be installed on the project comply with applicable specifications and standards and meet specified thermal and physical properties.

3.2 PREPARATION

A. Ensure that insulation is clean, dry, and in good mechanical condition and that all factory-applied facings are intact and undamaged. Wet, dirty, or damaged insulation is not acceptable for installation.

B. Ensure that pressure testing of piping, duct and fittings has been completed prior to installing insulation.

3.3 INSTALLATION

A. General

1. Install all insulation materials and accessories in accordance with manufacturer's published instructions and recognized industry practices to ensure that it will serve its intended purpose.
2. Install insulation on piping/duct subsequent to painting, and acceptance tests.
3. Install insulation materials with smooth and even surfaces. Insulate each continuous run of piping with full-length units of insulation, with single cut piece to complete run. Do not use cut pieces or scraps abutting each other. Butt insulation joints firmly to ensure complete, tight fit over all piping surfaces.

B. Fittings

1. Wrap valves, fittings, and similar items in each piping system with wicking material to ensure a continuous path (100% coverage) for the removal of condensation.
2. Cover valves, fittings, and similar items in each piping system using one of the following:

    a. Mitered sections of insulation equivalent in thickness and composition to that installed on straight pipe runs.
    b. PVC Fitting Covers insulated with material equal in thickness and composition to adjoining insulation.

3. Seal all fitting joints with contractor supplied VaporWick Sealing Tape or approved vapor retarder mastic compound.

C. Penetrations

Extend piping without interruption through walls, floors and similar piping penetrations.

3.4 FIELD QUALITY ASSURANCE

A. Upon completion of all insulation work covered by this specification, visually inspect the work and verify that it has been correctly installed. This may be done while work is in progress, to assure compliance with requirements herein to cover and protect insulation materials during installation.

B. Replace any ceiling damage caused by condensation due to improper covering and sealing during the guarantee period of this job.

3.5 PROTECTION

A. Replace damaged, removed or disturbed insulation with appropriate fiberglass insulation.

B. The insulation contractor shall advise the general and/or the mechanical contractor as to requirements for protection of the insulation work during the remainder of the construction period, to avoid damage and deterioration of the finished insulation work.

3.6 SAFETY PRECAUTIONS

A. Insulation contractor's employees shall be properly protected during installation of all insulation. Protection shall include proper attire when handling and applying insulation materials, and shall include (but not be limited to) disposable dust respirators, gloves, hard hats, and eye protection.

B. The insulation contractor shall conduct all job site operations in compliance with applicable provisions of the Occupational Safety and Health Act, as well as with all state and/or local safety and health codes and regulations that may apply to the work.

END OF SECTION 220700

SECTION 230593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. The General Provisions of the Contract, including General and Supplementary Conditions and General Requirements, apply to the work specified in this Section.

B. The General Requirements in Section 200050 shall also govern the work under this Section.

C. Examine all drawings and data and coordinate the work of this Section with all related and adjoining work.

1.2 SCOPE OF WORK:

A. Provide all labor, materials, equipment and tools required to complete the work described and shown on the contract drawings.

PART 2 -PRODUCTS

2.1 PRODUCTS:

A. None required.

PART 3 - EXECUTION

3.1 GENERAL:

A. Work shall be performed only by a firm which employs certified testing, adjusting and balancing technicians as listed by the National Environmental Balancing Bureau (NEBB), Associated Air Balance Council (AABC) and the Sheet Metal Industry National Certification Board of TABB Technicians. The work may be performed by a certified Test, Adjusting and Balancing technician who may be assisted by other TAB technicians. This firm shall provide personnel trained and experienced in system balancing. This requirement will not be waived under any condition.

B. Before submitting system performance data for approval or acceptance, the firm shall perform all necessary tests and make all necessary adjustments as required to obtain the flow and distribution of air as called for on the Contract Documents.

C. The balance reports shall include the names, signatures and registration numbers of the technicians assigned to the project.

3.2 ACCEPTABLE FIRMS:

A. The following listed firms are approved to perform this work:

James Brennan Company
Environmental Testing and Balance
Wing's Testing and Balancing
Technical Associates Group, Inc.

B. Request to employ any other balancing and testing firm must be accompanied by a complete brochure of the firm listing previous installations successfully balanced, length of time in business, names and qualifications of employees and list of instruments available for use on the project.

3.3 AIR HANDLING SYSTEMS:

A. Prior to the start of balancing the firm shall check the rotation of all fans.

B. Check to verify that all backdraft dampers are free to open and close. All filters must be checked and, if dirty, they must be replaced before commencing balancing so as not to create excessive resistance to the system. The firm shall make any necessary changes in fan speed to obtain design system conditions and shall realign all belts when necessary.

C. This Section shall be responsible for identifying any necessary changes in pulleys and belts required to obtain proper air delivery and shall request additional dampers, splinters, turning vanes, turbulence vanes and other devices if necessary to obtain the correct air balance, all as directed by the Town or his Representative.

This Contractor shall advice the Mechanical Contractor of the required corrections to the air distribution system, so that the system will perform as designed. All corrective work shall be done at no additional cost to the Town.

D. The firm shall compile the following data for each air system insofar as they apply and shall include it on the final submittal:

FAN DESCRIPTIVE DATA

System Number
Location Served
Fan Size
Fan Make
Fan Horsepower
Motor Safety Factor
Heater Manufacturer & Size

FAN DESIGN & DELIVERED CONDITIONS

Fan Rpm
Motor Rpm
Total and/or external static pressure
Amperage
Voltage & Phase
Brake Horsepower
Cfm Supply
Cfm Return
Cfm Exhaust
Fresh Air Percent and quantity
Return Air Percent and quantity
System Static Pressure profile
Final damper Settings
VFD drive Speeds, Static Pressure control points

SYSTEM DESIGN & DELIVERED CONDITIONS

Each outlet shall be identified as to location and area
Register or diffuser size
Register or diffuser factor
Register or diffuser free area, core area, or neck area
Design Cfm

Design Rpm
Final Rpm Reading
Final Cfm
Outlet manufacturer and type
Type of instrument and method used

E. The firm shall set all dampers of all types for proper air flow. No system causing objectionable air noise will be accepted. All hand volume dampers shall be marked at their final position. Balancing Contractor shall adjust blades on all the supply registers for the deflection indicated on drawings, so that the desired air circulation is achieved.

F. The firm shall provide all instruments and accessories required to perform the tests and shall make their own provisions for inserting the instruments. This section shall patch/plug all test holes that were made in the ducts/AHU/RTU/ERU to perform the test.

G. The firm shall notify the Town's Representative when they will start work. Prior to this time, the firm shall submit qualifications and intended testing procedure and shall send their supervising engineer to the office of the Town or his Representative to review the design, desired operation, and method of balancing of the job.

H. Upon completion of the work, the firm shall certify that all systems are properly balanced and are delivering, returning or exhausting the required quantities. The firm shall deliver to the subcontractor five (5) copies of the test report for transmittal to the Owner's Representative.

I. Check all safety controls and record control sequences.

J. Check and record air temperatures.

K. Check scheduled air control record the operation by simulating complete operating cycle.

L. After completion of balancing, mark location of all final positions of dampers.

M. In addition to the above requirements, the final report shall include the following:

1. Static pressure reading across filters, coils, of each air handling system showing design and actual readings.
2. Measured suction, discharge and total static pressure for each fan.
3. Design and actual CFM from each outlet and return/exhaust.
4. Outside air, air on and off heating furnaces, air off cooling coils and terminal air supply temperatures for each air handling system.
5. Rated and actual motor current, in amperes, of every motor at full load conditions.

3.5 INSTALLATION TOLERANCES:

A. Adjust air handling systems to the following tolerances:

1. Supply systems shall be balanced so that:

a. The total quantity to each space is within -5% to +10% of design values.
b. If two outlets in space, each outlet is within -10% to +10% of design value.
c. If three or more outlets in space, each outlet is within -15% to +15% of design value.

2. Exhaust and return systems shall be balanced so the total quantity from each space is -10% to +10% of design values.

3.5 FIELD VERIFICATION:

A. The design Engineer may request verification of data contained in the balancing report. If requested the TAB technician whose initials appear on the data sheets shall take outlet and inlet readings selected at random by the Engineer who will compare these readings to those in the submitted report. If the field verification is not satisfactory, the firm doing the TAB work shall completely rebalance the system and a new report shall be prepared and submitted for approval.

END OF SECTION 230593

SECTION 230700 - HVAC INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. The General Provisions of the Contract, including General and Supplementary Conditions and Division 01, General requirements, apply to the work specified in this Section.

B. The General Requirements in Section 200050 shall also govern the work under this Section.

C. Scope of Work: This Section contains details for the insulation of pipe, ductwork and equipment installed under Division 23.

1.2 SUBMITTALS:

A. In accordance with Section 200050, the following items shall be submitted for approval.

Refrigerant pipe insulation
Ductwork insulation
Equipment insulation

B. Recycled Content: Provide data showing recycled materials content of materials and fabricated items provided for this project, stated as a percentage of the materials included in these items or materials provided as part of the Work of this Section.

C. Connecticut High Performance Building Submittals:

1. Product Data for Credit IEQ 4.1: For adhesives and sealants, documentation including printed statement of VOC content and chemical components.
2. Laboratory Test Reports for Credit IEQ 4: For adhesives and sealants, documentation indicating that product complies 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."

1.3 MECHANICAL SYSTEMS INSULATION:

A. Furnish and install all thermal and protective insulation as specified herein for piping, ductwork and equipment as shown on the drawings.

B. The following mechanical items shall be insulated:
Fittings - Valve bodies, Victaulic couplings, elbows, tees, etc.
Ductwork, supply and outside air
Equipment insulation

1.4 SYSTEM PERFORMANCE

A. Insulation materials furnished and installed hereunder should meet the minimum thickness requirements of ASHRAE 90.1 (2013), "Energy Efficient Design of New Buildings," of the American Society of Heating, Refrigeration, and Air Conditioning Engineers. However, if other factors such as condensation control or personnel protection are to be considered, the selection of the thickness of insulation should satisfy the controlling factor.

B. Insulation materials furnished and installed hereunder shall comply with NFPA 255 and shall have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with the following testing standard:

Underwriters' Laboratories, Inc. UL 723

Adhesives used for applying the sealed jackets shall also conform to these same ratings. The use of wheat paste or any other material not meeting these requirements will not be allowed.

1.5 QUALITY ASSURANCE

A. Insulation materials and accessories furnished and installed hereunder shall, where required, be accompanied by manufacturers' current submittal or data sheets showing compliance with applicable specifications.

B. Insulation materials and accessories shall be installed in a workmanlike manner by skilled and experienced workers who are regularly engaged in commercial insulation work.

C. All covering and insulating materials shall be manufactured by Johns Manville, Owens-Corning, Knauf, or Armstrong.

1.6 SEAMS:

A. On exposed insulation, all longitudinal seams shall be kept at the top and back of the pipe and circumferential joints shall be kept to a minimum. Raw end of insulation shall be concealed by neatly folding the ends of the jackets. Fittings, valve bodies and flanges shall be furnished with the same jacket materials used on adjoining insulation.

1.7 PRIOR TESTING:

A. Covering shall not be applied until all parts of the work have been tested by the Contractor and reviewed by the Engineer.

1.8 VAPOR BARRIER:

A. Vapor barrier shall be applied in accordance with the manufacturer's instructions to maintain the integrity of the vapor barrier on cold systems.

B. An approved vapor retarder mastic compatible with PVC must be applied between pipe insulation and fitting cover, and on fitting cover and throat overlap seam.

C. For fittings where operating temperature is below 45 deg. For where pipe insulation thickness is greater than 1 ½", two or more layers of Hi-Lo temp insulation inserts shall be installed beneath fitting cover.

1.9 METAL SHIELDS:

A. Metal shields, 16 gauge galvanized, shall be applied between hangers or supports and the pipe insulation. Shields shall be roll formed to fit the insulation and shall extend up to the center line of the pipe and the length specified for the insert. Insulation shall be rigid type for length of shield to prevent crushing.

1.10 DELIVERY AND STORAGE OF MATERIALS

A. 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.

B. The contractor shall use whatever means are necessary to protect the insulation materials and accessories (wick material, sealing tape, etc) 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.

PART 2 - PRODUCTS

2.1 PIPING:

A. Insulate all new hot and chilled water and condensate lines with Owens-Corning Fiberglass ASJ with S.S.L. II, pipe insulation with double self-sealing lap having a factory applied jacket. All horizontal and vertical insulated piping located below 8'-0" AFF level and not protected with enclosures shall be protected with Zeston 2000 P.V.C. 30 Mil jacketing. Outdoor, exposed piping shall be protected with aluminum jacket.

B. All concealed piping shall be covered as follows: Apply insulation to clean dry pipe with side and end joints butted tightly. Seal lap of jacket and butt joint strips with Benjamin Foster 82-07 vapor barrier lap adhesive. Insulate fittings, flanges and valves of piping with mitered pipe insulation, or F/G pre-molded fittings made smooth with insulating cement and jacket with glass cloth saturated with Benjamin Foster 30-60 lagging adhesive. Vinyl or plastic fitting jackets will be allowed.

C. Insulate chilled water, condensate piping the same as for hot piping above except vapor seal all joints, seams, elbows and fittings.

D. For all insulated pipes, including refrigerant piping, exposed to weather apply a 16 mil embossed aluminum jacket with 2" overlap at longitudinal and circumferential joints. Secure in place with 3/4" x .015" aluminum band 18" on centers. All seams shall be sealed weather tight.

E. Foam insulation:
1. Piping and Fittings. MicroLok plain pipe insulation shall be wired or taped in place over clean, dry pipe with all joints butted firmly together. Vapor retarder shall be Micro-Lok AP-T plus.
2. The insulation shall be finished with metal jacketing with a laminated moisture retarder. Metal jacketing shall be overlapped 2 to 3 inches (51 to 76 mm) and held in place with sheet metal screws or metal bands.
3. Elbows and tees shall be finished with matching metal fitting covers. Other fittings in metal-jacketed systems shall be finished with conventional weather-resistant insulating materials with painted aluminum finish.

F. Insulate all refrigerant lines with Armacell foam insulation with vinyl protective coating. Acceptable substitutions are by Imcolock or Aeroflex.

G. Provide minimum insulation thickness in accordance with the following table.

Minimum Pipe Insulation

Piping System Types	Conductivity	Mean Rating temp	Fluid Temp. Range	Runout 2 in +	1 in. and less	1-1/4 to 1 1/2	2 to 4 in.	5 and Larger
	BTUin/hsqftF	F	F	in.	in.	in.	in.	in.
Heating Systems								
Low Temp	.25-.29	125	120-200	0.5	1.0	1.0	2	2

Cooling Systems								
Chilled Water or Refrigerant	.22-.28 .22-.28	100 100	40-60 Below 40	.75 1.0	1.0 1.0	1.0 1.5	1.5 1.5	1.5 1.5

Reinsulate duct where insulation has been disturbed under this contract and feather to remaining insulation.

2.2 REFRIGERANT PIPE INSULATION

A. Insulation shall be a flexible, closed-cell elastomeric pipe insulation: AP Armaflex, AC Accoflex. Adhesive shall be Armaflex 520, 520 Black or 520 BLV Adhesive. The insulation must conform to ASTM C534 Grade 1, Type I.
Insulation materials shall have a closed cell structure to prevent moisture from wicking which makes it an efficient insulation.
Insulation materials shall be manufactured without the use of CFC's, HFC's or HCFC's. It is also formaldehyde free, low VOCs, fiber free, dust free and resists mold and mildew.
Insulation materials shall have a flame-spread index of less than 25 and a smoke-developed index of less than 50 as tested in accordance with ASTM E 84. In addition, the products, when tested, shall not melt or drip flaming particles, and the flame shall not be progressive.
Insulation materials shall have a maximum thermal conductivity of 0.27 Btu-in./h-ft^2-°F at a 75°F mean temperature as tested in accordance with ASTM C 177 or ASTM C 518.
Insulation materials shall have a maximum water vapor transmission of 0.08 perm-inches when tested in accordance with ASTM E 96, Procedure A.

B. All liquid and suction lines shall be insulated continuously from a point 6" inside the display case to the suction service valve at the compressor.
All low temperature lines (+10°F and below) shall be insulated with a minimum of 1" wall thickness.
All medium and high temperature lines (above +10°F) shall be insulated with a minimum of 3/4" wall thickness.
Heat reclaim lines shall be insulated from the condensing unit to the heat reclaim units with 3/4" thickness.
All refrigerant copper lines must be free of extraneous chemicals such as corrosive cleaners or building materials' dust prior to the installation of the insulation. The insulation must be clean and dry prior to installation.
Refrigerant pipe shall be sealed while slipping on insulation to prevent foreign matter from entering the tube.

C. Insulation is to be slid onto pipe; longitudinal slitting of the insulation is not allowed except on mitered sections. Insulation shall be pushed onto pipe, not pulled.
Insulation shall be mitered, preadhered and longitudinally slit inside throat to fit over all P-traps, tees and elbows or bends over 90°.
All butt joints and mitered seams shall be adhered with full coverage of adhesive on both surfaces. Insulation shall not be stretched when adhering.

D. Insulation must be installed in an adequately ventilated area. It may be necessary to increase insulation thickness if adequate ventilation is not present, Do not crowd the insulation, allow for adequate air movement.
At the beginning, at every 12 to 18 feet, and at the ends of piping runs, the insulation shall be adhered directly to the copper using a 2" strip of adhesive. Insulation should not be adhered to the pipe at the extreme low points in any piping run.
Saddles shall be installed under all insulated lines at unistrut clamps, clevis hangers, or locations where insulation may be compressed.

E. Armafix IPH or NPH insulation pipe hangers can be installed at the compression loca- tions and the seams shall be sealed with Armaflex 520, 520 Black or 520 BLV contact adhe- sive. To minimize the movement of Armafix, it is recommended that a pair of non-skid pads be

adhered to the clamps. In addition, to prevent loosening of the clamps, use of an anti-vibratory fastener, such as a nylon-locking nut, is also recommended.
Wood dowels or blocks, of a thickness equal to the insulation, can be inserted and must be completely sealed into the insulation at the saddle locations. All seams shall be sealed with Armaflex 520, 520 Black or 520 BLV contact adhesive.
Hangers clamped directly to the pipe shall be insulated over the hanger; insulation shall be fully adhered to the hanger. In addition, hangers with double rods shall be insulated between the rods. All seams of the insulation shall be sealed with adhesive.
All insulation exposed to sunlight or installed outdoors shall be protected with two coats of WB Armaflex Finish or weather resistant coating and aluminum jacket.

2.3 FITTING COVERS:

A. Fitting covers may be used in lieu of insulating cement and jacket. Provide fitting covers in Zeston - 2000 P.V.C. (20 Mil thickness) by Manville.

B. General - The matching insert (fiberglass) should either be wrapped completely around the fitting or snugly positioned inside the fitting for proper fit. The insert shall cover the full inner surface area of the fitting cover. The fitting cover is then to be applied over the fitting and insert, and the throat secured by either tack fastening, taping, or banding.

C. Cold Pipe - Fitting systems below ambient temperature must have a continuous vapor barrier, either with pressure sensitive PVC Tape, or an approved adhesive system. When PVC Tape is used, a 2" downward lap is required. On cold lines in severe ambient temperatures, the fiberglass insert shall be the same thickness as the adjacent pipe insulation. All joints shall then be sealed with PVC Tape.

2.4 DUCTWORK:

A. Insulate all plenums, intake ducts, air conditioning ducts and warm air supply ducts in concealed locations with 1" thick fiberglass faced duct wrap type IV with factory applied flame retardant foil reinforced Kraft (FRK-25 U.L. labeled). Exhaust duct in the locker rooms shall be insulated the same as the supply ducts (including steam and sauna rooms exhaust ducts).

B. Insulation shall be wrapped tightly on the ductwork with all circumferential joints butted and longitudinal joints overlapped a minimum 2". Adhere insulation with 4" strips of Benjamin Foster 85-15 bonding adhesive at 8" o.c.

Additionally secure insulation to the bottom of concealed rectangular ductwork over 24" wide with suitable mechanical fasteners at not more than 18" o.c.

C. On circumferential joints, the 2" flame on the facing shall be stapled with 9/16" flare-door staples on 6" centers and taped with minimum 3" wide foil reinforced Kraft tape. On longitudinal joints, the overlap shall be stapled on 6" centers and taped with minimum 3" wide foil reinforced Kraft tape. All pin penetrations or punctures in facing shall also be taped.

D. Insulate air conditioning ducts or warm air ducts, all fresh air intake ducts, louver blanks, plenums in finished spaces or Mechanical Equipment Rooms, with 1" thick fiberglass ASJ-25 equipment insulation.

E. Insulation shall be cut to fit the shape and contour of the equipment. All voids between equipment surface and insulation shall be packed with light density fiberglass. Impale insulation over welded pins on 12" centers and secure in place with speed washers.

F. The insulation shall be vapor sealed to provide a complete airtight envelope. Vapor barrier shall consist of one layer of Ludlow Foil Barrier Paper smoothly adhered to the insulation or cement surface with Benjamin Foster 82-07 Vapor Barrier Lap Adhesive.

Lap all joints a minimum of 3" and seal with B.F. 82-07.

G. It is not necessary to cover exhaust ductwork, return duct or ductwork which is called for to be lined. However, exhaust ductwork from motorized damper to exhaust louver shall be covered as called for above, or exhaust ductwork located on cold side of building insulation shall be covered as called for above.

H. Supply ducts located in vented/unvented attic shall be insulated with duct insulation with min. R-8 value. Return ducts and exhaust ducts associated with energy recovery systems located in vented/unvented attics shall be insulated with R-3.5 insulation.

I. Cover ducts, exposed to outside weather, with Johns Manville 817 Series Spin-Glas rigid fiber glass board insulation, complying with ASTM C 612, Type II, rigid board, non- combustible, and meeting the following requirements:

1. Asbestos free.
2. Furnished in standard lengths and widths with ends cut square, conforming with the dimensional requirements of ASTM C 612, Types lA and 18.
3. Nominal density
   817 6.0 pcf (96 kg/m^3)
4. Maximum thermal conductivity, k (ksi), at
   817 0.22 (0.032)
5. Rated maximum service temperature: not less than 450°F (232°C).
6. Material shall have a flame spread no greater than 25 and a smoke developed no greater than 50 when tested as in accordance with ASTM E 84, UL 723 or NFPA 255.
7. Vapor Retarder Jacketing: Aluminum foil reinforced with a glass fiber yam and laminated to fire- resistant kraft complying with ASTM C 1136 Type II. Cover outside insulated duct with VentureClad 1577CW jacketing system. Product shall have 10-year warranty.
8. UL listed, with UL compliance label on the carton.
9. Acceptable substitutions are by CertainTeed or Knauf.

PART 3 – EXECUTION

3.1 SITE INSPECTION

A. 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.

B. Verify that all materials and accessories can be installed in accordance with project drawings and specifications and material manufacturer's recommendations.

C. Verify, by inspecting product labeling, submittal data, and/or certifications which may accompany the shipments, that all materials and accessories to be installed on the project comply with applicable specifications and standards and meet specified thermal and physical properties.

3.2 PREPARATION

A. Ensure that insulation is clean, dry, and in good mechanical condition and that all factory-applied facings are intact and undamaged. Wet, dirty, or damaged insulation is not acceptable for installation.

B. Ensure that pressure testing of piping, duct and fittings has been completed prior to installing insulation.

3.3 INSTALLATION

A. General

1. Install all insulation materials and accessories in accordance with manufacturer's published instructions and recognized industry practices to ensure that it will serve its intended purpose.

2. Install insulation on piping/duct subsequent to painting, and acceptance tests.

3. Install insulation materials with smooth and even surfaces. Insulate each continuous run of piping with full-length units of insulation, with single cut piece to complete run. Do not use cut pieces or scraps abutting each other. Butt insulation joints firmly to ensure complete, tight fit over all piping surfaces.

B. Fittings

1. Wrap valves, fittings, and similar items in each piping system with wicking material to ensure a continuous path (100% coverage) for the removal of condensation.

2. Seal all fitting joints with contractor supplied VaporWick Sealing Tape or approved vapor retarder mastic compound.

C. Penetrations

Extend piping and duct insulation without interruption through walls, floors and similar piping or duct penetrations.

3.4 FIELD QUALITY ASSURANCE

A. Upon completion of all insulation work covered by this specification, visually inspect the work and verify that it has been correctly installed. This may be done while work is in progress, to assure compliance with requirements herein to cover and protect insulation materials during installation.

B. Replace any ceiling damage caused by condensation due to improper covering and sealing during the guarantee period of this job.

3.5 PROTECTION

A. Replace damaged, removed or disturbed insulation with appropriate fiberglass insulation.

B. The insulation contractor shall advise the general and/or the mechanical contractor as to requirements for protection of the insulation work during the remainder of the construction period, to avoid damage and deterioration of the finished insulation work.

3.6 SAFETY PRECAUTIONS

A. Insulation contractor's employees shall be properly protected during installation of all insulation. Protection shall include proper attire when handling and applying insulation materials, and shall include (but not be limited to) disposable dust respirators, gloves, hard hats, and eye protection.

B. The insulation contractor shall conduct all job site operations in compliance with applicable provisions of the Occupational Safety and Health Act, as well as with all state and/or local safety and health codes and regulations that may apply to the work.

END OF SECTION 230700

SECTION 233113 - METAL DUCTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. The General Provisions of the Contract, including General and Supplementary Conditions and General Requirements, apply to the work specified in this Section.

B. The General Requirements in Section 200050 shall also govern the work under this Section.

C. Examine all drawings and data and coordinate the work of this Section with all related and adjoining work.

1.2 SCOPE OF WORK:

A. Contract includes all labor, material, equipment accessories and test required to furnish and install all air distribution systems as shown on drawings, implied and herein specified, complete and ready to operate.

B. Contractor is requested to examine all of the Architectural plans and all details of construction and visit the site of the proposed addition and alterations so as to thoroughly acquaint himself with all conditions before submitting his bid.

C. Work shall include but is not limited to the following:

1. Ductwork
2. Exhaust Fans
3. Energy Recovery Ventilators

D. Contractor shall be responsible for wiring of all temperature controls.

1.3 SUBMITTALS:

A. Refer to Section 200050

B. Submit the following shop drawings.
Ductwork
Fans
Grilles and Diffusers
Vibration Isolators
Fan Dampers
Access Doors

B. Recycled Content: Provide data showing recycled materials content of materials and fabricated items provided for this project, stated as a percentage of the materials included in these items or materials provided as part of the Work of this Section.

1.4 AIR DISTRIBUTION SYSTEM DESCRIPTION:

A. Furnish and install all supply, return and exhaust air system as indicated on the drawings. Systems to be complete with fans, motors, controls, starters, unless otherwise specifically omitted, ducts, filter banks, registers, grilles, diffusers, vibration eliminating bases, balancing dampers, fire dampers, automatic dampers, acoustical lining, insulation and other accessories to make the system complete and ready to operate to the full intent of the plans and specifications. The capacities and characteristics of fans, air handling equipment, shall be as indicated on the drawings.

B. All ductwork shall be run on warm side of building insulation.

C. Design is based on equipment as described in the drawing equipment schedules. Any changes in foundations, connections, piping, controls, electrical equipment, wiring and connections and openings required by alternate equipment submitted and approved shall be made at no additional cost to the Owner.

PART 2 - PRODUCTS

2.1 DUCTWORK:

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. 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."

E. All sheet metal used throughout, except as specifically noted, shall be constructed of galvanized steel sheets as follows:

Rectangular Ducts		Alum.		Copper	
Duct up to 12"		26 ga.		24 ga.	16 oz.
Duct 13" to 30"	24 ga.		22 ga.		24 oz.
Duct 31" to 60"	22 ga.		20 ga.		32 oz.
Duct 60" and beyond	20 ga.				
Casings up to 72"	16 ga.				
Casings beyond 72"	14 ga.				

Bracings for Ducts

Up to 24" None
25" to 40 1" x 1" x 1/8" 4 ft. from joint
41" to 60" 1-1/2" x 1-1/2" x 1/8" 4 ft. from joint
61" to 90" 1-1/2" x 1-1/2" x 1/8" diagonal angles
or 1-1/2" x 1-1/2" x 1/8" angles 2 ft. from joint

F. All fittings, joints, seams and connections shall be made up in accordance with standard recommended practice as described in Air Duct Design, latest ASHRAE Guide and SMACNA Low Pressure Standards, using Class B construction with all seams sealed. Snap lock joints will not be permitted.

G. Carbon-Steel Sheets: Comply with ASTM A 1008/A 1008M, with oiled, matte finish for exposed ducts.

H. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304 or 316, as indicated in the "Duct Schedule" Article; cold rolled, annealed, sheet. Exposed surface finish shall be No. 2B, No. 2D, No. 3, or No. 4 as indicated in the "Duct Schedule" Article.

2.2 MEDIUM PRESSURE ROUND DUCT:

A. All medium pressure and round ductwork shall be manufactured by the same firm to assure tight fit of all ductwork and components. Provide ductwork in United McGill or Semco.

B. Submit the round duct test data covering leakage rate, bursting strength, collapsing strength, seam strength, and friction loss. Friction loss test data shall cover both the duct and the assembled coupling joints. This friction loss data used in the design of this system, include information on fittings used in system.

C. Round and oval duct shall be manufactured of galvanized steel meeting ASTM A-525 and A-527-67 by the following methods and in the minimum gauges listed:

Diameter	Minimum Gauge	Method of Manufacture
3" thru 14"	24 Ga.	Longitudinal Seam
15" thru 26"	22 Ga.	Longitudinal Seam
27" thru 36"	20 Ga.	Longitudinal Seam
37" thru 50"	20 Ga.	Longitudinal Seam
51" thru 60"	18 Ga.	Longitudinal Seam
61" and Up	16 Ga.	Longitudinal Seam

Longitudinal seam duct shall have a fusion-welded butt seam.

D. Fittings and couplings shall be of the following minimum gauges:

Diameter	Gauge
3" thru 36"	20 Gauge
38" thru 50"	18 Gauge
Over 50"	16 Gauge

1. All fittings are to have continuous welds along seams. All divided flow fittings are to be manufactured as separate fittings, not as tap collars welded into spiral duct sections.
2. All 90 degrees tees and 45 degrees laterals (wyes) up to and including 12" diameter tap size shall have a radiused entrance into the tap, produced by machine or press forming. The entrance shall be free of weld buildup, burrs, or irregularities.

3. Elbows in diameters 3" through 8" shall be two section stamped elbows. All other elbows shall be gored construction with all seams continuous/welded.
4. Where it is necessary to use 2-piece mitered elbows, they shall have turning vanes in accordance with the following schedule.

Diameter	Number of Vanes
3" thru 9"	2
10" thru 14"	3
15" thru 19"	4
20" thru 60"	5
Over 60"	12" Spacing

E. Registers to be mounted directly to duct shall be provided with boots for mounting to round spiral duct.

F. Galvanized areas that have been damaged by welding shall be coated with corrosion resistant aluminum paint.

G. Pipe-to-pipe joints in diameters to 36" shall be by the use of sleeve couplings, reinforced by rolled beads. Use welded angles for 37" diameter and above.

2.3 FLEXIBLE AIR DUCT:

A. Flexible air ducts shall be used to connect supply ducts with air distribution outlets where shown. Flexible air ducts shall be all metal construction consisting of a bonded two ply laminate mechanically corrugated for strength and air tightness and shall be able to withstand 12" W.G. pressure.

Flexible air duct shall be of semi- rigid construction capable of being easily hand preformed without subsequent sagging or droop. Duct connections to equipment outlet collars shall be made in accordance with the duct manufacturer's recommendations. Insulated flexible duct shall be Clevaflex Type 12 as manufactured by Clevepak Corporation, New York, New York 10022, or approved equal in Metalaire.

B. Flexible duct shall meet the requirements or NFPA 90A.

C. All flexible duct shall be preinsulated. The maximum length of flex duct shall not exceed 6’-0”.

2.4 JOINT SEALING:

A. Duct joints shall be assembled and sealed as follows:

B. Approved sealer is applied to the male end of the couplings and fittings. After the joint is slipped together, sheet metal screws are place 1/2" from the joint bead for mechanical strength. Sealer is applied to the outside of the joint extending 1" on each side of the joint bead and covering the screw heads. Plastic-backed tape is immediately applied over the wet sealer.

C. The duct sealer must be specifically formulated for the job of sealing the field joints for high pressure systems. The sealer shall be compatible with plastic-backed duct tape so the two shall cure and bond together. Samples of sealer and tape and the specification data sheets shall be submitted to the engineer for approval.

D. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.

E. Two-Part Tape Sealing System:

Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
Tape Width: 4 inches.
Sealant: Modified styrene acrylic.
Water resistant.
Mold and mildew resistant.
Maximum Static-Pressure Class: 10-inch wg, positive and negative.
Service: Indoor and outdoor.
Service Temperature: Minus 40 to plus 200 deg F.
Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
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."

F. Water-Based Joint and Seam Sealant:

Application Method: Brush on.
Solids Content: Minimum 65 percent.
Shore A Hardness: Minimum 20.
Water resistant.
Mold and mildew resistant.
VOC: Maximum 75 g/L (less water).
Maximum Static-Pressure Class: 10-inch wg, positive and negative.
Service: Indoor or outdoor.
Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

G. Solvent-Based Joint and Seam Sealant:

Application Method: Brush on.
Base: Synthetic rubber resin.
Solvent: Toluene and heptane.
Solids Content: Minimum 60 percent.
Shore A Hardness: Minimum 60.
Water resistant.
Mold and mildew resistant.
For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
VOC: Maximum 395 g/L.
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."
Maximum Static-Pressure Class: 10-inch wg, positive or negative.
Service: Indoor or outdoor.
Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

H. Flanged Joint Sealant: Comply with ASTM C 920.

General: Single-component, acid-curing, silicone, elastomeric.
Type: S.

Grade: NS.
Class: 25.
Use: O.
For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
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."

I. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

J. Round Duct Joint O-Ring Seals:

Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for10-inch wg static-pressure class, positive or negative.
EPDM O-ring to seal in concave bead in coupling or fitting spigot.
Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.5 ACCESS DOORS IN DUCTWORK:

A. Furnish hinged and reinforced access doors with wire glass observation port in door in sheet metal work for observation or maintenance of all dampers, controls in sheet metal ducts and housings. This applies to fresh air ducts, exhaust ducts, etc. Furnish doors of tight fitting construction. All duct access doors shall be furnished in Ventlok or equal in Air balance, Advanced Air, Inc. or Louvers & Dampers, Inc.

B. For access doors in architectural finishes refer to Section 200050.

2.6 FIRE DAMPERS:

A. Furnish and install all fire dampers and smoke dampers in Ruskin, Inc. or equal in Air Balance Inc or Controlair, as required by all local and state codes. On all central air supply and exhaust systems, furnish approved fire dampers in accordance with NFPA Bulletin 90A, latest edition, where required by local and state codes.

B. Fire dampers shall possess a 1-1/2 hour dynamic fire protection rating in accordance with UL-555, continuing inspection service and bear the UL label. Fire damper shall be Ruskin Model DIBD2 vertical or horizontal, Style B Curtain type, as noted on plans.

1. The blades are to be interlocking design mounted in a frame having two folded guides that serve as stops. Blades shall be 24GA galvanized steel.
2. The mounting shall be 1-1/2" x 1-1/2" x 18" retaining angles on both sides of partition as per UL test. Sleeves and frame shall be 20GA per UL test.

2.7 SMOKE DAMPERS:

A. Furnish and install at locations shown on plans, or as described in schedules, smoke dampers meeting or exceeding the following specifications. Frame shall be a minimum of 16 gauge galvanized steel formed into a structural hat channel shape with tabbed corners for reinforcement. Bearings shall be stainless steel turning in an extruded hole in the frame. The blades shall be airfoil shaped double skin construction with 14 gauge equivalent thickness. Blade edge seals shall be silicone rubber designed to withstand 450 deg. F and jamb seal shall be stainless steel flexible metal compression type. Blade action must be parallel blade or opposed as shown on the schedule.

B. Each smoke damper shall be classified by Underwriters Laboratories as a Leakage Rated Damper for use in smoke control systems under the latest version of UL555S, and bear a UL label attesting to same. Damper manufacturer shall have tested, and qualified with UL, a complete range of damper sizes covering all dampers required by this specification. Testing and UL qualifying a single damper size is not acceptable. The leakage rating under UL555S shall be leakage Class I (1/4 cfm/ft. at 1" w.g.)

As part of the UL qualification, dampers shall have demonstrated a capacity to operate (to open and close) under HVAC system operating conditions, with pressure of at least 4" w.g. in the closed position, and 4000 fpm air velocity in the open position.

C. In addition to the leakage ratings already specified herein, the smoke dampers and their actuators shall be qualified under UL555S to an elevated temperature of 250 deg. F, 350 deg. F, or 450 deg. F depending upon the actuator. Appropriate electric/pneumatic actuators shall be installed by the damper manufacturer at time of damper fabrication. Damper and actuator shall be supplied as a single entity which meets all applicable UL555S qualifications for both dampers and actuators. Factory supplied caulked sleeve shall be 20 gauge for dampers through 84" wide or high and 18 gauge above 84"wide. Damper and actuator assembly shall be factory cycled 10 times to assure operation. All wiring or piping material required to interconnect the actuator with detection and/or alarm or other systems shall be furnished by others as detailed elsewhere in the specification. Damper shall be Ruskin Model SD60 or equal in Air Balance Inc. or Controlair.

D. Blade Position Indicator. Each smoke damper shall be equipped with Ruskin SP100 Switch Package or equal. The Switch Package shall include two position indicator switches linked directly to the damper blade to provide the capability or remotely indicating damper blade position.

E. Damper actuator shall be UL listed and furnished by Fire- Smoke and Smoke Dampers Manufactures.

2.8 VOLUME DAMPERS:

A. Volume dampers with locking quadrants shall be provided on all supply, exhaust and return ducts, on all branches and at all take-off's to registers and diffusers.

B. Dampers shall be constructed of #20 gauge steel properly stiffened and to have locking quadrants outside covering of ducts. Opposed blade multi-lead dampers shall be used wherever damper blade is larger than 12".

2.9 SPLITTERS AND DUCTURNS:

A. Furnish and install splitter dampers in ductwork made of #20 gauge steel for proper control of air, where ductwork branches off from main supply ducts.

B. Refer to "Access Doors" for type of access doors required for access to ceiling dampers.

C. Install ducturns based on Barber Colman non-adjustable 90 degree double wall type in all square elbows.

D. Provide on all branch duct takeoffs as shown in Barber Colman adjustable airturns.

2.10 REGISTERS, GRILLES AND DIFFUSERS:

A. Registers, grilles and ceiling diffusers shall be furnished of size and type as shown on drawings, in Titus and Seiho or equal in Krueger or Metalaire. The cat. no.'s refer to equipment as manufactured by Titus.

B. All registers and wall grilles furnished in steel shall be furnished in prime coat except where specified herein or shown on drawings to be aluminum construction or factory baked enamel.

C. Refer to schedule on drawings for type and finish of each grille.

D. Provide all wall grilles and registers with all purpose frame.

E. All registers and diffusers shall be compatible with ceiling specified under Architectural.

2.11 ROOF EXHAUST FANS:

A. This Contractor shall furnish and install all power roof ventilators and wall fans (exhaust fans) complete with starters and controls, in accordance with schedule shown on plans, with weatherproof motors and controls where located in the air stream.

B. Furnish disconnect switches, factory mounted, in housing with flexible heavy duty cords to motor with extra grounding wire, color coded.

C. The capacities of all power roof ventilators are based on Cook make and power roof ventilators shall be furnished in this make or approved equal in Acme or Greenheck. All fan housings shall be furnished with base in heavy gauge aluminum, unless otherwise indicated. Provide adjustable pulleys. Fans shall have AMCA certified ratings.

D. Provide 18" high companion pre-fabricated sound curb as called for in schedule.

2.12 FAN DRIVES:

A. Furnish each V-belt drive with variable pitch motor pulley unless otherwise specified.

B. Fan manufacturer shall furnish factory standard belt guard for all exposed drives. Field constructed guards will not be approved. Furnish all belt guards with prime coat.

2.13 CANVAS JOINTS:

A. On each side of each centrifugal or centriline fan and at each air handling unit having duct connections, furnish Ventfabric Tape for expansion and elimination of sound travel in ductwork.

B. Furnish and install Doro-Dyne Insuflex, insulated flexible duct connector at all locations where the duct crosses an expansion joint.

2.14 OUTSIDE WALL LOUVERS:

A. All outside louvers for air handling units, fan inlets and exhaust fan outlets in outside wall shall be furnished complete with 1/2" mesh copper screens.

B. On outside air intake louvers serving air handling units, provide manual opposed blade balancing damper between louver and motorized damper.

2.15 VIBRATION ISOLATION:

A. All mechanical equipment shall be mounted on or suspended from approved and specified foundations and supports.

B. All floor mounted equipment shall be erected on 4" high reinforced concrete house - keeping pads (by General Contractor)

C. All vibration isolation systems shall be guaranteed to have the static deflections required to warrant a 98% isolation efficiency. The vibration isolation system shall be installed in accordance with the manufacturer's instructions.

PART 3 - EXECUTION

3.1 GENERAL FOR EQUIPMENT:

A. Refer to schedule on drawings for size, type, design capacities and characteristics of fans. Also required accessories shall be indicated in schedule or listed herein.

B. Provide and install all additional structural supports for fans, and air handling equipment, not provided for by the General Contractor.

C. Provide and install vibration eliminators of type and size approved and recommended by the fan manufacturer for the particular application and arrangement of fan installation.

D. Provide and install flexible joints on either side of fan.

E. Furnish all combination disconnect switches and starters for fans unless otherwise called for.

F. This Contractor is responsible for all internal wiring between separate air handling equipment sections.

G. All equipment on base drawings, including roof top units, have been dimensionally coordinated with the architectural and structural drawings. If this Contractor proposes to substitute any equipment other than which is on the basic bid drawings, for review, he shall first verify that the proposed equipment will fit dimensionally.
This Contractor shall be responsible for any additional costs to changes incurred because of the above substitution even after review by the Engineer.

H. Provide service disconnect switches mounted on all rooftop equipment.

3.2 DUCT INSTALLATION

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 according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.

C. Install round and flat-oval ducts in maximum practical lengths.

D. Install ducts with fewest possible joints.

E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.

I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.

J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.

K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers.

L. 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."

3.3 INSTALLATION OF EXPOSED DUCTWORK

A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.

B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.

C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.

D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.

E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.4 ADDITIONAL INSTALLATION REQUIREMENTS FOR COMMERCIAL KITCHEN HOOD EXHAUST DUCT

A. Install commercial kitchen hood exhaust ducts without dips and traps that may hold grease, and sloped a minimum of 2 percent to drain grease back to the hood.

B. Install fire-rated access panel assemblies at each change in direction and at maximum intervals of 12 feet in horizontal ducts, and at every floor for vertical ducts, or as indicated on Drawings.

C. Do not penetrate fire-rated assemblies except as allowed by applicable building codes and authorities having jurisdiction.

3.5 DUCT SEALING

A. Seal ducts to the following seal classes according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":

Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
Outdoor, Supply-Air Ducts: Seal Class A.
Outdoor, Exhaust Ducts: Seal Class C.
Outdoor, Return-Air Ducts: Seal Class C.
Unconditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class B.
Unconditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class A.
Unconditioned Space, Exhaust Ducts: Seal Class C.
Unconditioned Space, Return-Air Ducts: Seal Class B.
Conditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class C.
Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class B.
Conditioned Space, Exhaust Ducts: Seal Class B.
Conditioned Space, Return-Air Ducts: Seal Class C.

3.6 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Leakage Tests:

Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Submit a test report for each test.
Test the following systems:

1 Ducts with a Pressure Class Higher Than 3-Inch wg: Test representative duct sections totaling no less than 25 percent of total installed duct area for each designated pressure class.
2. Supply Ducts with a Pressure Class of 2-Inch wg or Higher: Test representative duct sections totaling no less than 50> percent of total installed duct area for each designated pressure class.
3. Return Ducts with a Pressure Class of 2-Inch wg or Higher: Test representative duct sections totaling no less than 50 percent of total installed duct area for each designated pressure class.
4. Exhaust Ducts with a Pressure Class of 2-Inch wg or Higher: Test representative duct sections totaling no less than 50 percent of total installed duct area for each designated pressure class.
5. In addition to above, test any VAV system duct of 1”and ½” construction class that is upstream of the VAV box.

Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
Test for leaks before applying external insulation.
Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.
Give seven days' advance notice for testing.

C. Duct System Cleanliness Tests:

Visually inspect duct system to ensure that no visible contaminants are present.

3.7 STRUCTURAL SUPPORT:

A. Main dunnage steel shall be provided under another section; however, this Contractor shall provide all supplementary steel for the complete support of equipment.

3.8 DESCRIPTION OF SUPPLY AND RETURN AIR/EXHAUST SYSTEM:

A. Furnish and install the complete horizontal and vertical ducts for each system between all Energy Recovery Units, and registers and grilles. For all centrifugal fans, furnish flexible joints either side of fan and extend the fan discharge ducts to wall openings and louvers or other openings as indicated; near wall outlet provide hinged access door with lock for access to damper.

B. Furnish automatic fire dampers with fusible link on all ducts passing through floors or fire walls, and motorize smoke dampers in all ducts passing through smoke partitions and at each such damper, furnish accessible access door.

C. Friction dampers shall be installed in all branch ducts made accessible for adjustment near registers or grilles. For exact type of grilles or registers, refer to drawings.

D. Furnish angle frames to suit construction for all registers and grilles complete with plaster stops.

E. Furnish on each fresh air intake an opposed blade manual damper between louver and motorized damper.

F. Sizes and approximate locations of all ducts are shown on the drawings. Check carefully with the architectural and structural drawings and drawings showing work of other trades to make sure that there will be no conflict between these trades and the ducts.

G. Coordinate the installation of setting frames and registers in order that details as shown on drawings are adhered to. Wood rounds shall be furnished and installed as shown on architectural detail.

H. All ductwork shall be installed as shown on drawings and is to be rigidly braced and supported to prevent vibration and sagging.

I. All hangers and supports are to be fastened securely to concrete, wood or steel construction. Under no circumstances will hangers be inserted supported on suspended ceilings, conduits or pipe be permitted.

J. All vertical ducts shall be supported at each floor level by means of angle iron riveted securely to ducts.

K. Refer to Section 200050 for coordinated drawings.

L Contractor shall provide all labor and materials as required to assist the Balancing Contractor in proper balancing of the air systems. Contractor shall return to the job and shall make the necessary adjustments and corrections to the systems as required by the Balancing Contractor in order to achieve satisfactory system performance in accordance with design parameters.

M. This Section shall be responsible for any necessary changes in pulleys and belts required to obtain proper air delivery and shall provide additional dampers, splinters, turning vanes, turbulence vanes and other devices if necessary, to obtain the correct system performance, all as directed by the Owner's or its Representative.

END OF SECTION 233113

SECTION 235513 - INDIRECT GAS-FIRED DUCT FURNACE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The General Provisions of the Contract, including General and Supplementary Conditions and General Requirements, apply to the work specified in this Section.

B. The General Requirements in Section 200050 shall also govern the work under this section.

1.2 SUMMARY

A. This section includes indirect gas-fired duct furnace(s).

1.3 ACTION SUBMITTALS

A. Product Data: For each type of indirect gas-fired duct furnace(s) indicated. Include rated capacities, operating characteristics, and accessories.
B. Shop Drawings: For indirect gas-fired duct furnace(s). Include plans, elevations, sections, details, and attachments to other work.
    - Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
    - Wiring Diagrams: Signal and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans, elevations, and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
    - Structural members to which equipment will be attached.
B. Items penetrating roof and the following:
    - Duct, vent, and gas piping rough-ins and connections.

C. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
D. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
E. Field quality-control test reports.
F. Warranty: Special warranty specified in this Section.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For indirect gas-fired duct furnace(s) to include in installation, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

A. 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.
B. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

1.7 WARRANTY

A. Burner and components to be warranted for two years from date of installation. Heat exchanger is warranted for ten (10) years on a pro-rated basis.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

A. Provide RenewAire Indirect Gas-Fired Duct Furnace(s) models listed by Intertek Testing Services (ITS / ETL), a Nationally Recognized Testing Laboratory (NRTL), to the current edition of ANSI Z83.8 / CSA 2.6 Standard for Gas-Fired Duct Furnace(s) for installation on the positive pressure side of the circulating air blower only and provide a minimum combustion efficiency of 80%.
B. Indirect Gas-Fired Duct Furnace(s) shall be listed for indoor installation in accordance with Category I and Category III venting systems.
C. Indirect Gas-Fired Duct Furnace(s) provided shall have a tubular heat exchanger constructed of Type 409 Stainless Steel (.044 min. wall thickness) produced to ASTM A268. Heat exchanger tubes shall be mechanically secured to vestibule panels and design shall be suitable to withstand 3.0" w.c. total external static pressure.
D. Indirect Gas-Fired Duct Furnace(s) shall be listed for application downstream of energy recovery ventilators or refrigeration and cooling systems and shall provide means for removal of condensate that occurs in the heat exchanger tubes during cooling operation. Heat exchanger tubes shall have (integral formed dimpled restrictors; formed turbulators) to provide for an unobstructed drainage path and tubes shall be formed to provide a positive pitch to promote condensate drainage. Drainage shall be configured so that burners are not exposed to condensate.
E. The Indirect Gas-Fired Duct Furnace(s) shall employ:
    - A 20 gauge galvanized steel cabinet
    - 1 inch thick, minimum 1 1/2 lb/cu.ft. density thermal insulation for exterior cabinets
    - Inshot gas burners, with integral carryovers
    - Combustion air pressure switch to prove air supply for combustion
    - Direct spark ignition of the gas burners with remote flame sensor to prove carryover across all burners
    - Listed Combination Gas Valve incorporating redundant (two) electric safety shut-off valves, manual shut-off, and gas regulator which regulates gas pressure to burner supply manifold.
    - An automatic reset type high limit switch to limit maximum outlet air temperature to less than 250 F
    - Manual reset flame rollout switch(es).
    - A Class II step down transformer to provide 24 VAC control voltage at selected supply voltage

- Indirect Gas-Fired Duct Furnace(s) shall incorporate a Direct Spark Ignition control module that is design certified by a NRTL to ANSI Z21.20 and CAN/CSA-C22.2. The control shall provide:
  - 100% safety shut-off
  - A minimum 15 second pre-purge to provide a minimum of four (4) air changes
  - A maximum 0.8 second flame failure response time
  - Two additional ignition retrials preceded by an inter-purge period
  - A minimum 30 second post-purge
  - An automatic reset after one hour should a lockout occur
  - A LED indicator light to provide a flash code to identify operating condition of control
  - An alarm capable contact
- A 1/8" NPT tapped test gauge connection in the gas manifold for measuring gas pressure
- A union fitting downstream of gas control to facilitate installation and service
- Provision for attachment of a vent system to exhaust flue gases to outdoors.
- A circulating air flow switch to prove that sufficient air flow is present

F. All electrical components shall be listed or recognized by a NRTL (ETL, UL, CSA, etc.).
G. Indirect Gas-Fired Duct Furnace(s) and burners provided are listed for use on Natural Gas as specified at the time of order.
H. Ratings listed in Submittal Tables are for installations between 0 and 2000 feet (0 to 610m). For installations above 2000 feet, unit must be de-rated in accordance with National Standards. Consult Factory.
I. The fully assembled Indirect Gas-Fired Duct Furnace(s) shall be factory fire tested prior to shipment.
J. Indirect Gas-Fired Duct Furnace(s) shall be accompanied by wiring diagrams for the control system supplied and printed instructions for proper installation, start-up, operation and maintenance.
K. Initial on-site start-up must be completed by qualified installation and service agency. A start-up data sheet is provided for recording operating data and the final furnace(s) adjustments. The indicated portion of the start-up data sheet must be returned to RenewAire to validate factory warranty.
L. Type of Venting: An induced-draft combustion air blower to provide for positive venting of flue gases.
   - Indoor Installation - Field Installed
   - Vertical Vent - Category I - B Vent - Size per ANSI Z223.1 / NFPA 54
   - Horizontal Vent - Category III - Maximum Vent length - 50 equivalent feet
   - Use approved Cat. III venting materials.
   - Refer to Installation Instructions for vent pipe diameter
M. Internal Casing: Galvanized steel, arranged to contain airflow.
N. Heat Exchanger: 409 Stainless Steel
O. Burner Material: 409 Stainless Steel
P. Controls: Regulated redundant gas valve containing pilot solenoid valve, electric gas valve, pilot filter, pressure regulator, pilot shutoff, and manual shutoff all in one body.
   - Gas Control Valve: Modulating
   - 5:1 Continuous Electronic Modulation - 0-10 VDC analog input with manufacturer provided duct mounted 24 VAC thermostat.
   - Ignition: Electronically controlled electric spark with flame sensor.
   - Fan Thermal Switch: Operates fan on heat-exchanger temperature.
   - Vent Flow Verification: Flame rollout switch.
   - Control transformer.
   - High Limit: Thermal switch or fuse to stop burner.

Q. Capacities and Characteristics:
    - Gas Service: Natural Gas
        - 5.0" w.c. Minimum Inlet Pressure
        - 13.5" w.c. (1/2 PSI) Maximum Inlet Pressure
        - 3/4" NPT service connection to gas valve
    - Flue Outlet: Refer to Installation Instructions for vent pipe diameter
    - Input Capacity: AS MENTIONED ON DRAWINGS
    - Minimum Combustion Efficiency: 80 percent

PART 3 - EXECUTION

3.1 INSTALLATON

A. Install and connect indirect gas-fired duct furnace(s) and associated fuel and vent features and systems according to NFPA 54, applicable local codes and regulations, and manufacturer's written installation instructions.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
B. Install piping adjacent to indirect gas-fired duct furnace(s) to allow service and maintenance.
C. Gas Piping: Comply with Section 220500 "Common Work Results for Plumbing". Connect gas piping to gas train inlet; provide union with enough clearance for burner removal and service.
D. Electrical Connections: Comply with applicable requirements in electrical Sections.
    - Install electrical devices furnished with furnace(s) but not specified to be factory mounted.
    - 115V / 1 Phase / 60 Hz. / Less than 6 amps
E. Indirect gas-fired duct furnace(s) shall be provided with a 3/8" diameter 304 stainless steel condensate drain connection.

3.3 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. Perform tests and inspections and prepare test reports.
    - 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:
    - Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
    - Verify bearing lubrication.
    - Verify proper motor rotation.
    - Test Reports: Prepare a written report to record the following:
        - Test procedures used.
        - Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.
        - Test results that comply with requirements.
D. Remove and replace malfunctioning units and retest as specified above.

3.4 ADJUSTING

A. Adjust initial temperature set points.
B. Adjust burner and other unit components for optimum heating performance and efficiency.

3.5 DEMONSTRATION

A. Train owner's maintenance personnel to adjust, operate, and maintain indirect gas-fired duct furnace(s).

END OF SECTION 235416

SECTION 237200 – AIR TO AIR ENERGY RECOVERY VENTILATOR

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes Air-to-Air Energy Recovery Ventilators for indoor installation.
B. Within this document, these units may be referred to as Energy Recovery Ventilator (ERV) for brevity.

1.2 RELATED

Drawing and general provisions of the contract, including General Requirements Division 01, Division 23, Division 23 Specifications Sections, and common work requirements for HVAC apply to work specified in this section.

1.3 SUBMITTALS

A. Product data: For each type or model of Energy Recovery Ventilator, include the following:
    - Unit performance data for both Supply Air and Exhaust Air, with system operating conditions indicated.
    - Enthalpy plate performance data for both summer and winter operation.
    - Motor ratings and unit electrical characteristics.
    - Dimensioned drawings for each type of installation, showing isometric and plan views, to include location of attached ductwork and service clearance requirements.
    - Estimated gross weight of each installed unit.
    - Filter types, quantities, and sizes
    - Installation, Operating and Maintenance manual (IOM) for each model.
B. LEED Submittals:
    - Provide data for prerequisite E01: Documentation indicating that units comply with ASHRAE 62.1-2010, Section 5 - "Systems and Equipment".
C. Shop Drawings: For air-to-air energy recovery ventilators, include plans, elevations, sections, details, and attachments to other work.
    - Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
    - Wiring Diagrams: For power, signal, and control wiring.
D. Operation and maintenance data for air-to-air energy recovery ventilator

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain Air-to-Air Energy Recovery Ventilator with all appurtenant components or accessories from a single manufacturer.
B. For the actual fabrication, installation, and testing of work under this section, use only thoroughly trained and experienced workers completely familiar with the items required and with the manufacturer's current recommended methods of installation.
C. 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 (10) 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 (2) years from the date of installation.

D. 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 NFPA90A 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.
E. Certifications:
    - 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 manufacturer'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. OACF shall be no more than 1.02 and EATR shall be at 0% against balanced airflow.
    - Entire unit shall be listed under UL 1812 Standard for Ducted Air to Air Heat Exchangers and comply with CSA Standard 22.2.
F. Every unit to be factory tested prior to shipping: Motor Dielectric Voltage-Withstand Bench Test, Unit Dielectric Voltage-Withstand Test, Continuity of Internal Control Circuits Test, Unit Amperage Test

1.5 COORDINATION

A. Coordinate size and location of all building penetrations required for installation of each Energy Recovery Ventilator and associated electrical systems.
B. Coordinate sequencing of construction for associated plumbing, HVAC, electrical supply.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with specifications contained within this document, manufacturers offering products that may be incorporated into the work include, but are not limited to:
    - RenewAire
B. Manufacturer should be in business for minimum 10 years manufacturing energy recovery ventilators.

2.2 MANUFACTURED UNITS

A. Air-to-Air Energy Recovery Ventilators shall be fully assembled at the factory and consist of a fixed-plate cross-flow heat exchanger with no moving parts, an insulated double wall G90 galvanized 20-gauge steel cabinet, motorized outside air intake damper, filter assemblies for both intake and exhaust air, enthalpy core, supply air blower assembly, motorized return air damper, exhaust air blower assembly and electrical control box with all specified components and internal accessories factory installed and tested and prepared for single-point high voltage connection. Entire unit with the exception of field-installed components shall be assembled and test operated at the factory.

2.3 CABINET

A. Materials: Formed double wall insulated metal cabinet, fabricated to permit access to internal components for maintenance.
B. Outside casing: 20 gauge, galvanized (G90) steel meeting ASTM A653 for components that do not receive a painted finish.
C. Access doors shall be hinged with airtight closed cell foam gaskets. Door pressure taps, with captive plugs, shall be provided for cross-core pressure measurement allowing for accurate airflow measurement.
D. Unit shall have factory-installed duct flanges on all duct openings.
E. Cabinet Insulation: Unit 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 a minimum R-value of 4.3 (hr-ft^2-F/BTU).
F. Enthalpy core: Energy recovery core shall be of the total enthalpy type, capable of transferring both sensible and latent energy between airstreams. Latent energy transfer shall be accomplished by direct water vapor transfer from one airstream to the other, without exposing transfer media in succeeding cycles directly to the exhaust air and then to the fresh air. No condensate drains shall be allowed. The energy recovery core shall be designed and constructed to permit cleaning and removal for servicing. The energy recovery core shall have a ten year warranty. Performance criteria are to be as specified in AHRI Standard 1060.
G. Control center / connections: Energy Recovery Ventilator shall have an electrical control center where all high and low voltage connections are made. Control center shall be constructed to permit single-point high voltage power supply connections to the non-fused disconnect.
H. 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.
I. Motorized isolation dampers: Return and outside air motorized dampers of an AMCA Class I low leakage type shall be factory installed.

2.4 BLOWER SECTION

A. Blower section construction, Supply Air and Exhaust Air: Blower assemblies consist of a 208-230V / 1 Phase / 60 HZ, TEFC motor, and a belt driven forward-curved blower.
B. Blower assemblies: Shall be statically and dynamically balanced and designed for continuous operation at maximum rated fan speed and horsepower.

2.5 MOTORS

A. Blower motors shall be Premium Efficiency, EISA compliant for energy efficiency. The blower motors shall be totally enclosed (TEFC) and be shall be supplied with factory installed motor starters.
B. Belt drive motors shall be provided with adjustable pulleys and motor mounts allowing for blower speed adjustment, proper motor shaft orientation and proper belt tensioning.

2.6 UNIT CONTROLS

A. Fan control: Motor starters and contactors
B. Timeclock: Digital Time Clock [wall mount] [mounting in outdoor, enclosed NEMA 3R enclosure], with up to 8 on/off cycles per day or 50 per week, 24VAC power, with battery backup protection of program settings against power failure to energize unit.

C. Motion (Occupancy) Sensor: Passive infrared sensor for [wall][ceiling] mounting with adjustable time-off delay to 30 minutes, 24VAC power to energize unit
D. Carbon Dioxide: Adjustable control from 600 - 2000 PPM for [wall][duct] mounting with digital display
E. Factory-installed microprocessor controller and sensors, Premium ERV controls that:
    1. Comply with requirements in Division 23 Section "Sequence of Operations for HVAC Controls"
    2. Has factory-installed hardware and software to enable the building automation interface via [Modbus][BACnet] to monitor, control, and display status and alarms
    3. The microprocessor controller shall be capable of operating at temperatures between -20F to 160F
    4. The microprocessor controller shall be a DIN rail mounting type
    5. Factory-installed microprocessor controller shall come with backlit display that allows menu-driven display for navigation and control of unit
    6. The microprocessor controller shall have the ability to communicate with the BMS via Modbus RTU/TCP and BACnet MSTP/IP
    7. The microprocessor controller shall have integrated ethernet interface and a web server for displaying unit parameters
    8. The microprocessor shall have near field communication (NFC) capability for android devices
    9. The microprocessor controller shall have an internal programmable time clock that will allow the user to add up to different occupancy schedules and add holidays
    10. The microprocessor control shall be capable of integral diagnostics
    11. The microprocessor control shall be capable of IP or SI unit display
    12. The microprocessor controller shall have a battery powered clock
    13. The microprocessor controller shall at a minimum offer the ability for three modes of determining occupancy: a dry contact, the internal time clock or the BMS
    14. A remote user terminal to allow for remote monitoring and adjustment of parameters, allowing ease of control access without going outdoors or into the mechanical room if desired by the user
    15. The microprocessor controller shall have at a minimum (10) universal inputs/outputs (AI, DI, AO) and have (6) six relay outputs (DO)
    16. The microprocessor controller shall have an Integrated fieldbus port
    17. The microprocessor controller shall have the capability for I/O expansion
    18. The microprocessor controller shall have a micro USB port to load the application program, the unit parameters, saving logs, etc.
    19. The sensors that will be required for control are:
        a. (2) Temperature sensors for fresh air and exhaust air
        b. (2) Temperature and humidity sensors for outside air, return air
        c. (2) Differential pressure sensors for filter alarms
        d. (2) Differential pressure sensors for measuring pressure drop across energy recovery core and for determining airflow in both airstreams
        e. (2) Adjustable current switches
    20. The microprocessor controller shall have the capability to monitor the unit conditions for alarm conditions. Upon detecting an alarm, the microprocessor controller shall have the capability to record the alarm description, time, date, available temperatures, and unit status for user review. A digital output shall be reserved for remote alarm indication. Alarms to be also communicated via BMS as applicable. Provide the following alarm functions:
        a. Outside air temperature sensor alarm
        b. Outside air humidity sensor alarm
        c. Return air temperature sensor alarm
        d. Return air humidity sensor alarm

e. Fresh air sensor alarm
f. Exhaust air sensor alarm
g. Dirty filter alarm
h. Supply and exhaust air proving alarm
i. Airflow out of range alarm

21. Display the following on the face of microprocessor controller:
    a. Unit on
    b. Heating status
    c. Outdoor air temperature
    d. Outdoor air humidity
    e. Return air temperature
    f. Return air humidity
    g. Supply air temperature
    h. Airflows in both airstreams
    i. Unit on/off
    j. Fan on/off
    k. Damper status
    l. Alarm digital display
22. The microprocessor controller shall have factory pre-programmed multiple operating sequences for control of the ERV. Factory default settings shall be fully adjustable in the field.

SEQUENCE OF OPERATIONS

DDC CONTROLLER:

1. Controller with integral LCD readout for changing set points and monitoring unit operation.
2. Provided with required sensors and programming.
3. Factory programmed, mounted, and tested.
4. Integral USB and Ethernet ports for updating programs and retrieving log files.

GENERAL OPERATION

POWER UP:

1. When the unit main disconnect is closed a delay of 10 seconds (adjustable) occurs for the controller to come online.

ERV UNIT START COMMAND:

1. An input signal is required to enable the unit operation. The unit will be commanded on by:
    a. Enable via controller display
2. All types of input that are enabled must be true before the unit will start.
    a. The exhaust fan starts after a 3 second delay (adjustable). The exhaust fan will not start until the damper actuator end switch closes.
    b. The supply fan starts after a 6 second delay (adjustable). The supply fan will not start until the damper actuator end switch closes.
    c. The supply fan, exhaust fan, heating are controlled based on the chosen unit operating modes and air conditions.

ERV UNIT STOP COMMAND (OR DE-ENERGIZED):

1. The unit can then be commanded off by:
    - Disable via controller display
2. Supply fan and exhaust fan are de-energized.
3. All dampers are unpowered and spring return to their default position after a 10 second delay (adjustable).

SUPPLY FAN OPERATION:

1. The supply fan will operate at a constant speed.
2. The unit will attempt to start the supply fan when the supply fan delay timer expires. When the supply fan starts the supply fan adjustable current switch should close and remain closed until the fan is turned off.

SUPPLY FAN STATUS:

Once the supply fan current switch closes heating operation is allowed. After a delay of 90 seconds (adjustable) from supply fan start signal, if the supply fan current switch is still open the supply fan alarm should be set to true and heating operation shall be prohibited. The supply fan status shall be set to true only when the supply fan output is on and supply fan current switch is closed. The supply fan status shall be false in all other circumstances.

EXHAUST FAN OPERATION:

1. The exhaust fan will operate at a constant speed.
2. The unit will attempt to start the exhaust fan when the exhaust fan delay timer expires. When the exhaust fan starts the exhaust fan adjustable current switch should close and remain closed until the fan is turned off.

EXHAUST FAN STATUS:

After a delay of 90 seconds (adjustable) from exhaust fan start signal, if exhaust fan current switch is still open the exhaust fan alarm should be set to true. The exhaust fan status shall be set to true only when the exhaust fan output is on and exhaust fan current switch is closed. The exhaust fan status shall be false in all other circumstances.

HEATING OPERATION:

Heating will be locked out if the outdoor air temperature is above 70 degrees (adjustable). The temperature set point can be configured as constant (adjustable) or can be reset by the outside air temperature. Heating will be controlled using the supply air temperature.

CONSTANT TEMPERATURE OPTION:

The controller will stage the heaters or adjust the 0 to 10 VDC analog output to the heating device to maintain the air temperature at a set point. The air temperature set point is entered and adjusted from the unit controller display or. The minimum and maximum values for the air temperature set point are unit dependent and are adjustable. An adjustable PI (proportional & integral) loop will compare the measured air temperature to the air temperature set point and adjust the analog

output. A digital output that indicates a call for heating will also be provided. The analog and digital output can be used to control a hot water valve, electric heater, gas heater, or heat pump.

RESET AIR TEMPERATURE OPTION:

The controller will adjust the 0 to 10 VDC analog output to the heating device to maintain the air temperature at a set point. The air temperature set point is calculated based on the outdoor air temperature. The air set point is adjusted between the 100 degree F maximum (adjustable) and the 70 degree F minimum (adjustable) as the measured temperature varies from the 20 degree F minimum (adjustable) to the 70 degree F maximum (adjustable). These values are entered and adjusted from the unit controller display. An adjustable PI (proportional & integral) loop will compare the measured supply air temperature to the supply air temperature set point and adjust the 0 to 10 VDC analog output. A digital output that indicates a call for heating will also be provided. The analog and digital output can be used to control a hot water valve, electric heater, gas heater, or heat pump. Coil freeze protection must be provided by others in the field.

2.7 FILTER SECTION

ERV shall have 2" thick [MERV 8][MERV 13] disposable pleated filters located in the outdoor air and exhaust airstreams. All filters shall be accessible from the exterior of the unit.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Prior to start of installation, examine area and conditions to verify correct location for compliance with installation tolerances and other conditions affecting unit performance. See unit IOM.
B. Examine roughing-in of plumbing, electrical and HVAC services to verify actual location and compliance with unit requirements. See unit IOM.
C. Proceed with installation only after all unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Installation shall be accomplished in accordance with these written specifications, project drawings, manufacturer's installation instructions as documented in manufacturer's IOM, Best Practices and all applicable building codes.
B. Install unit with clearances for service and maintenance.

3.3 CONNECTIONS

In all cases, industry Best Practices shall be incorporated. Connections are to be made subject to the installation requirements shown above.

A. Duct installation and connection requirements are specified in Division 23 of this document.
B. Electrical installation requirements are specified in Division 26 of this document.

3.4 FIELD QUALITY CONTROL

Contractor to inspect field assembled components and equipment installation, to include electrical and piping connections. Report results to Architect/Engineer in writing. Inspection must include a complete startup checklist to include (as a minimum) the following: Completed Start-Up Checklists as found in manufacturer's IOM. Insert any other requirements here.

3.5 START-UP SERVICE

Contractor to perform startup service. Clean entire unit, comb coil fins as necessary, and install clean filters. Measure and record electrical values for voltage and amperage. Refer to Division 23 "Testing, Adjusting and Balancing" and comply with provisions therein.

3.6 DEMONSTRATION AND TRAINING

Contractor to train owner's maintenance personnel to adjust, operate and maintain the entire Make-Up Air unit. Refer to Division 01 Section Closeout Procedures and Demonstration and Training.

END OF SECTION 237200

SECTION 260000- GENERAL ELECTRICAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. The General Provisions of the Contract, including Division 0, Contract Requirements, and Division 1, General Requirements, are a part of this Section and shall be binding on the Contractor and /or Subcontractor who performs this work. Note also all addenda.

B. The requirements in Section 26 00 00 shall govern the work under all Sections of Divisions 26 and 28.

1.2 SCOPE OF WORK:

A. Scope of work consists of installation of materials to be furnished under these Specifications and without limiting generality thereof consists of furnishing labor, materials, equipment, hoisting, plant, transportation, rigging, staging, appurtenances, and services necessary and/or incidental to properly complete all electrical work as shown on drawings, as described in the Specifications or as reasonably inferred from either as being required in opinion of the Architect and Engineer.

B. Work Included: Provide complete electrical services where shown on the drawings, as specified herein and as needed for a complete and proper installation including but not necessarily limited to:

1. Demolition
2. Temporary power (see Division 1).
3. Secondary electric service.
4. Panelboard(s).
5. Complete feeder distribution system.
6. Complete branch circuit wiring system for lighting, motors, receptacles, and other noted loads.
7. Lighting fixtures.
8. Switches, receptacles, and other similar wiring devices.
9. Raceways and boxes for telephone, data, catv outlets, audio/visual (A/V) outlets, security/access control devices.
10. Call-For-Aid systems.
11. Fire alarm system.
12. Vibration isolation and seismic restraints for electrical equipment.

1.3 SITE CONDITIONS:

A. Prior to submitting bid, visit the site and identify existing conditions and difficulties that will affect work called for by the Contract Documents.

B. No compensation will be granted for additional work caused by unfamiliarity with site conditions that are visible or readily construed by experienced observers.

C. The Contractor shall verify and obtain all necessary dimensions at the site.

1.4 DEFINITIONS:

A. Furnish: The word "furnish" is used to mean "supply and deliver the referenced item to the project site, ready for unloading, unpacking, assembly, and installation".

B. Install: The word "install" is used to describe operations at the project site involving the referenced item including the actual "unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations".

C. Normally Occupied: The words "normally occupied" are used to mean "all rooms within a building except for crawlspaces, underground tunnels, attic spaces, mechanical rooms, telephone rooms, data distribution rooms, and electrical rooms".

D. Or Approved Equal: The words "or approved equal" are used to mean "any product which in the opinion of the Engineer is essentially equal in quality, size, arrangement, appearance, construction, and performance to that product specified or shown on the drawings".

E. Provide: The word "provide" means "to furnish and install the referenced item, complete and ready for the intended use".

F. Remove: The word "remove" means "to disconnect from its present position, remove from the project site, and to dispose of in a legal manner".

1.5 QUALITY ASSURANCE:

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of the Contract Documents.

B. Codes and Regulations:

1. In addition to complying with the specified requirements, comply with all Federal, State and Local Codes wherever applicable including the following: 2018 Connecticut State Building Code, 2015 IBC, 2018 Connecticut Fire Safety Code , 2015 International Fire Code, 2013 NFPA 72 National Fire Alarm Code, 2017 NFPA 70 National Electrical Code, 2015 International Energy Conservation Code, ICC/ANSI A117.1-2009 Accessible and Usable Buildings and Facilities, and ADA.
2. Comply with the requirements of the Local Authority Having Jurisdiction.
3. Materials and equipment shall be UL listed where standard has been established.
4. Perform tests required by specifications, Engineer's instructions, laws, ordinances or public authorities, approvals, and give Owner timely notice. Notify the Owner of dates for inspection by other authorities.
5. In the event of conflict between or among specified requirements and pertinent regulations, the more stringent requirement will govern.
6. Reference made to codes and standards shall be interpreted as minimum requirements. Provide and perform work in excess of codes and standards as indicated by drawings or specifications.

C. Prior to bidding, the Contractor shall give written notice to the Engineer of any materials, equipment, or apparatus believed in the opinion of said Contractor, to be inadequate or unsuitable for the installation, or in violation of laws, ordinances, rules, or regulations of authorities having jurisdiction. The Contractor shall also give written notice to the Engineer of any items, materials, equipment, or work believed in the opinion of said Contractor, to be omitted from the Contract Documents. In the absence of such written notice, it is mutually agreed that Contractor has

included the cost of all required items in his bid and that he will be responsible for approved satisfactory functioning of systems without further compensation.

1.6 SUBMITTALS:

A. Comply with the requirements of Division 1 for submittal procedures.

B. Product data: after the Contractor has received the Owner's Notice to Proceed, submit six copies of the following:

1. Materials list of all items proposed to be provided.

2. Manufacturer's specifications, catalog cuts, performance curves, electrical characteristics, wiring diagrams, equipment dimensions and weights, and other data for each item proposed to be provided as needed to prove compliance with the specified requirements.

3. Shop drawings and other data as required to indicate method of installing and attaching equipment.

C. Place a permanent label or title block on each submittal for identification. Indicate the name of the entity that prepared each submittal on the label or title block.

1. Include the following information on the label for processing and recording action taken:

a. Project name, location, and address
b. Date
c. Name and address of Architect
d. Name and address of Engineer
e. Name and address of Contractor
f. Name and address of Sub-Contractor
g. Name and address of supplier(s)
h. Name of manufacturer(s)
i. Number and title of appropriate Specification section.

D. Data sheets and catalog cuts, etc. contained in submittals shall be clearly marked in ink indicating specific service or application for which material or equipment is to be used. Data of a general nature and not clearly defining the service or application for which the proposed item is to be used will not be accepted.

E. Submit for review complete diagrams of systems prepared by equipment manufacturer showing connections and equipment. Standard wiring diagrams shall be modified where necessary to specific system.

F. Prior to forwarding submittals and shop drawings for review by the Architect and Engineer, the Contractor shall thoroughly check each submittal, reject those not conforming to the specifications, and indicate by his signature that the submittals in his opinion meet the contract requirements.

G. Intent of Shop Drawings and product data review is to check for capacity, rating and certain construction features, ensure that work meets requirements of Contract Documents regarding information that pertains to fabrication processes or means, methods, techniques, sequences and procedures of construction, and for coordination of work between trades.

H. Submittal review shall not diminish responsibility under this contract for dimensional coordination, quantities, installation, piping, supports, access, service and errors, nor for deviations from requirements of contract documents. Noting errors while overlooking others will not excuse proceeding in error. Requirements of contract documents are not limited, waived, nor superseded by shop drawing review.

I. Equipment variations: Where no specific make or material, apparatus or appliance is mentioned in the Contract Documents, any first class product made by a reputable manufacturer may be used, providing it conforms to the requirements of these specifications and meets the approval of the Engineer.

J. Equipment alternates, substitutions, and deviations:

1. Wherever more than one manufacturer is mentioned in the specifications or on the drawings, any of those named shall be considered equally acceptable to that on upon which design was based, and providing all aspects of the specification are met insofar as quality, construction, performance, space requirements, noise levels and special accessories or materials, any of those named may be included in Contractor's bid.
2. Bidders wishing to obtain approval on brands other than those specified by name shall submit their request to the Architect and Engineer not less than ten (10) business days before the date fixed for opening of bids. No substitutions will be entertained after this time. Approval by the Architect and Engineer will be in the form of an Addendum to the specifications issued to all prospective bidders, indicating that the additional brand or brands are approved as equal to those specified so far as the requirements of the project are concerned.
3. Alternate equipment to that specified or shown on the drawings, as proposed to be provided by the contractor, must be essentially equal in quality, size, construction, and performance to that item specified or shown on the drawings.
4. Submittals for alternate equipment shall list all deviations and differences from the specified equipment. Failure to submit this list will result in rejection of the submittal. Any deviations and differences not listed but discovered after installation shall be rectified as directed by the Engineer at the Contractor’s cost.
5. Furnish samples of alternate equipment proposed to be provided when so requested by the Architect or Engineer.
6. Where the Contractor proposes to use an item of equipment which differs from that upon which design was based, which requires any redesign of the structure, partitions, foundations, piping, wiring or of any other part of Mechanical, Electrical or Architectural Layout, all such redesign, new drawings or detailing required shall be prepared by Contractor at his own expense for approval of the Architect and Engineer.
7. Where approved substitutions or deviations require a different quantity, size or arrangement of structural supports, wiring, conduit, piping, ductwork, and equipment from that upon which design was based, all additional items required by the systems shall, with the approval of the Architect and Engineer, be furnished by Contractor at no additional cost to Owner.

K. Allow sufficient time so that the delivery and installation of equipment will not be delayed as a result of the time required to review, process and transmit submittals, including resubmittals. Failure by the Contractor to transmit submittals to the Architect and Engineer in ample time for review and processing shall not entitle him to an extension of the Contract Time and no claim for an extension of time by reason of such default will be allowed.

L. Submittals, shop drawings, and samples will be reviewed with reasonable promptness and will be stamped indicating appropriate action as follows:

1. “No Exceptions Taken” means that fabrication, manufacture, or construction may proceed providing submittal complies with contract documents.

2. "Amend as Noted" means that fabrication, manufacture, or construction may proceed, providing the submittal complies with Engineer's notations and contract documents.

3. "Resubmit" means that submittal, or equipment proposed to be provided, does not comply fully with the contract documents and that fabrication, manufacture, or construction shall not proceed. Resubmit in accordance with the Engineer's notations and contract documents.

4. "Rejected" means that submittal does not comply with contract documents, or that equipment proposed to be provided does not comply with the specified requirements or is not equal or better in quality and performance than that item specified. Fabrication, manufacture, or construction shall not proceed. Resubmit in accordance with the contract documents and specified requirements.

M. If material or equipment is installed prior to review, or without review, it shall be removed and replaced at no extra charge to the Owner if, in the opinion of the Architect and Engineer, the material or equipment is not in compliance with the Contract Documents.

1.7 AS-BUILT DRAWINGS:

A. Maintain a clean, undamaged set of black line white-prints of Contract Drawings and Shop Drawings at the job site. Protect as-built drawings from deterioration and loss in a secure location. Provide access to as-built drawings for reference during normal working hours by the Owner, Architect, Engineer, and Authority Having Jurisdiction.

B. As work progresses mark the As-built drawings to show the actual installation where the installation varies from the work as originally shown, whether resulting from Addenda, Change Order, approved submittals, or changes made due to field conditions. Mark whichever drawing is most appropriate for showing conditions fully and accurately. Where shop drawings are used, record a cross reference at the corresponding location on the Contract Drawings. Give particular attention to items concealed within the structure or buried below grade.

1. Mark as-built drawing sets with colored erasable pencils: using separate colors to distinguish between different systems.
2. Include dimensioned locations of conduit runs buried below floor slabs and buried beyond the building footprint.
3. Note related change order numbers where applicable.

C. At the completion of work prepare a new set of black line white-print As-built Drawings, of work as actually installed, incorporating addenda, changes made due to approved submittals, change order work, field changes, and added data, all as shown on the marked-up record drawings maintained at the site. Date the set and clearly mark it as "As-built Drawings".

D. Furnish two sets of the As-built Drawings to the Architect and Engineer.

1.8 OPERATING AND MAINTENANCE MANUALS:

A. Comply with requirements of Division 1 and as follows:

B. Upon completion of the work of this Contract, deliver to the Architect and Engineer four (4) copies of an Operation and Maintenance (O & M) Manual. Organize operating and maintenance data into suitable sets of manageable size. Bind properly indexed data in individual heavy-duty 2-inch, 3-ring vinyl covered binders, with pocket folders for folded sheet information. Include a separate section for each system or sub-system. Sections shall be separated by heavy plastic

dividers with tabs that identify the material in each section. Place a permanent label or title block on each binder for identification.

1. Include the following information on the label:

    a. O & M Manual for: Athletics Building, Glastonbury High School, Glastonbury, CT.
    b. Date
    c. Name and address of Architect
    d. Name and address of Engineer
    e. Name and address of Contractor
    f. Name and address of Sub-Contractor

C. Provide the following in each manual:

1. Table of Contents
2. Listing of all service agents with addresses and telephone numbers
3. Description of systems operation
4. Emergency instructions for equipment and/or systems where appropriate
5. Wiring diagrams and piping diagrams specific to systems installed.
6. Manufacturers' operating and maintenance instructions for each piece of equipment installed
7. Inspection procedures
8. Spare parts list
9. Copies of all panelboard circuit indexes.
10. Copies of measurements taken where specified elsewhere in the Contract Documents
11. Copies of all warranties and guarantees.
12. Copies of submittals and shop drawings.

1.9 GUARANTEE AND WARRANTIES:

A. Obtain in Owner’s name written equipment and material warranties offered in manufacturer’s published product data without exclusion or limitation.

B. Guarantee work of this Contract in writing for a period of 18 months from the date of substantial completion. Repair or replace defective materials, equipment, workmanship and installation that develop within this period, promptly and to Owner’s satisfaction and correct damage caused in making necessary repairs and replacements under guarantee within contract price.

C. Replace material or equipment that requires excessive service during guarantee period, as defined and as directed by the Architect and Engineer.

D. Submit guarantee to the Owner before final payment.

1.10 LAWS, ORDINANCES, PERMITS, AND FEES:

A. Give all necessary notices, obtain all permits and pay all taxes, fees and other costs in connection with the work; file all necessary plans, prepare all documents and obtain all necessary approvals of all Regulation Authorities; obtain all required Certificates of Occupancy and/or Inspections required for the work and deliver same to the Owner before requests for acceptance and final payment for the work.

B. Include in the work, without extra cost to the Owner, all labor, materials, services, apparatus, drawings (in addition to Contract Documents and Drawings) required to comply with all applicable laws, ordinances, rules and regulations.

1.11 CORRELATION OF DRAWINGS AND SPECIFICATIONS

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

B. In case of disagreement between Drawings and Specifications, or within either document itself, the better quality or greater quantity of work shall be estimated and the matter drawn to the Architect’s and Engineer's attention for decision and/or adjustment. Any work done by any Contractor without consulting the Architect and Engineer, when the same requires a decision and/or adjustment, shall be done at the Contractor’s risk.

C. Drawings are diagrammatic and indicate general arrangement of systems and work included in Contract. Information and components shown on diagrams but not on plans, and vice versa, shall apply or shall be provided as though expressly required on both. It is not intended that every fitting or component be specified or shown on drawings; however, Contract Documents require provision of all components and materials necessary for a complete and operational installation, whether or not indicated or specified.

D. Do not scale Drawings. Scale indicated on Drawings is for establishing reference points only. Actual field conditions shall govern all dimensions. The Contractor shall verify all dimensions at the project site.

E. In all cases where the Contract Documents refer to equipment or apparatus in singular number, it is intended that such reference include as many such items that are required to complete the work.

1.12 ELECTRICAL VOLTAGES:

A. The electrical service to the building is 120/208V, 1 phase, 3 wire.

B. All equipment shall be suitable for this electrical supply. It is the responsibility of the Contractor to study the electrical drawings to determine the supply for any particular piece of equipment.

C. If equipment requires other electrical characteristics (voltage and phase) than that supplied and shown on the electrical drawings, transformers and wiring shall be provided with that equipment at no extra cost to the Owner.

PART 2 - PRODUCTS

2.1 MATERIALS AND WORKMANSHIP:

A. Provide only materials that are new and of type and quality specified. Where Underwriters’ Laboratories, Inc. have established standards for such materials, provide only materials bearing the UL label.

B. Provide accessories, materials and equipment necessary to make installation complete in every detail, and to conform to manufacturers' latest installation instructions, under this Contract whether or not specifically shown on drawings or specified herein.

C. All component parts of each item of equipment shall bear the manufacturers' nameplate, giving name of manufacturer, description, size, type, serial or model number, electrical characteristics, etc. in order to facilitate maintenance or replacement. Contractors or Distributors nameplates

shall not be fixed to items of equipment and are not an acceptable alternate to the manufacturer's nameplate data.

D. No materials or equipment used shall be discontinued or about to be discontinued items.

E. The Architect and Engineer shall have the right to reject any part of the work in case the material or workmanship is not of satisfactory quality. Any work or material deemed unacceptable by the Architect and Engineer shall be removed and replaced with acceptable work and material as defined by the Architect and Engineer, and at no additional expense to the Owner.

2.2 PROTECTION:

A. Work performed by the Contractor shall include protecting the work and materials of all other Contractors from damage by work or workmen, and shall include making good any and all damage thus caused.

B. The Contractor shall be responsible for work and equipment until finally inspected, tested and accepted. Protect work against vandalism, theft, weather, injury or damage, and carefully store material and equipment received on site which is not immediately installed. Close open ends of work with approved covers, caps or plugs during construction to exclude dust, dirt, moisture, plaster, mortar, or general construction debris. Note - duct tape is not an acceptable means of protecting open conduit and pipe ends.

C. Work shall include receiving, unloading, uncrating, storing, protecting, setting in place and completely connecting any motor starters and/or control equipment having mechanical/electrical service connections which are furnished by Owner or furnished by others.

D. Work shall include exercising special care in handling and protecting equipment and fixtures. Any equipment and fixtures which are missing, lost, stolen, or damaged by reason of the Contractor's failure to provide adequate protection shall be replaced by that Contractor at no additional cost to the Owner.

2.3 TEMPORARY FACILITIES:

A. Provide temporary power and lighting as specified under Division 1, and as required for the performance of the work of this Contract.

B. Provide new materials and equipment; if acceptable to the Architect, undamaged previously used materials in serviceable condition may be used. All materials shall be suitable for the service intended.

C. Maintain temporary services and facilities in a neat and clean manner. Operate in a safe and efficient manner. Do not allow hazardous, dangerous, or unsanitary conditions to develop or persist on site.

D. Do not overload temporary facilities, or permit them to interfere with progress of the work.

E. Scaffolding and other temporary construction shall be rigidly built in accordance with Local, State, and Federal regulations.

F. Remove each temporary facility when no longer needed, when replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete and/or restore permanent construction that may have been delayed because of interference with the temporary facility. Repair damaged work, clean exposed surfaces, and replace construction that can not be repaired to the satisfaction of the Owner.

G. Do not allow temporary wiring to become enclosed within the building structure. All temporary wiring and conduit shall be removed from the building. Where temporary wiring or conduit becomes enclosed within walls or ceilings, the Contractor shall disassemble, remove, and replace the walls or ceilings as required to remove the wiring and conduit.

2.4 SCAFFOLDING, RIGGING, HOISTING:

A. Work shall include all scaffolding, rigging, hoisting and services necessary for delivery and erection of equipment into or onto the site and/or building. Remove all scaffolding, rigging, and hoisting equipment from the site when no longer needed.

2.5 EXCAVATION AND BACKFILLING:

A. Excavation and backfilling for all electrical work inside and outside of the building shall be performed in accordance with Division 31 of these Specifications.

2.6 CUTTING AND PATCHING:

A. Cutting and patching for all electrical work shall be performed in accordance with Division 1 of these Specifications.

2.7 SLEEVES AND OPENINGS:

A. The Electrical Contractor shall provide all necessary sleeves and openings as required to permit the installation of the electrical systems.

2.8 PAINTING:

A. All painting of electrical work shall be performed in accordance with Division 9 of these Specifications, unless otherwise specified.

2.9 ELECTRICAL MOTOR STARTERS AND VARIABLE FREQUENCY DRIVES (VFD'S):

A. Motor starters and variable frequency drives (VFD'S) shall be furnished by each respective trade for motor driven equipment provided by them. The Electrical Contractor shall install the starters and VFD'S, and shall provide all power wiring to the starters and VFD'S, and from the starters and VFD'S to the motors they control.

B. Motor starters and VFD'S shall conform to requirements of NEC, NEMA, UL, CSA, and ANSI and shall be suitable for the required horsepower, duty, voltage, phase, frequency, service, and location. All starters and VFD'S shall be furnished in NEMA enclosures suitable for the environment in which they are to be located.

C. All starters shall be of the same manufacture and shall be furnished in Eaton (Cutler-Hammer), Square D, or Allen Bradley.

D. Thermal Overloads:
1. All motors 1/8 horsepower or larger shall be provided with thermal-overload protection. Thermal overloads shall be melting alloy ambient temperature compensating type.
2. Thermal overloads shall be sized in accordance with NEC requirements for the nameplate data of the motor(s) as actually delivered to the site.

E. Starters for manual control of single phase motors up to one (1) horsepower furnished without integral thermal overloads shall be combination manual disconnect switch and starters with thermal overload protection for each ungrounded leg. Starters shall be inoperable if a thermal unit

is removed. These starters shall be 2-pole and shall be provided with green neon pilot light and handle guard/lock-off.

F. Starters for three phase motors shall be full voltage, circuit breaker combination magnetic starters. All circuit breaker combination magnetic starters shall include melting alloy type thermal overload protection, low voltage protection, and two (2) sets of auxiliary normally open and normally closed contacts. Thermal overload protection shall be provided in each ungrounded leg. Starters shall be inoperable if a thermal unit is removed. All circuit breaker combination magnetic starters shall be equipped with control power circuits. Provide starters with control power transformers of secondary voltage required for the control power circuitry. Provide control power transformers with primary and secondary fusing. The disconnect handle on circuit breaker combination magnetic starters shall always be in control of the disconnect device with the door opened or closed. The disconnect handle shall be clearly marked as to whether the disconnect device is "on" or "off", and shall include a two-color handle grip, the black side visible in the "off" position, and the red side visible in the "on" position.

1. All circuit breaker combination magnetic starters for manual control of three phase motors shall have start-stop push buttons in the cover and shall be provided with red and green pilot lights.
2. All circuit breaker combination magnetic starters for automatic or interlocking control of three phase motors shall have hand-off-automatic selector switches in the cover and shall be provided with red and green pilot lights.

2.10 BASES AND SUPPORTS:

A. Provide all necessary supports, rails, framing, bases, and piers required for the installation of equipment provided under this contract.

B. Unless otherwise shown, all equipment shall be securely attached to the building structure in an acceptable manner. Attachments shall be of a strong and durable nature; any attachments that are insufficient in the opinion of the Architect or Engineer shall be replaced as directed at no additional cost to the Owner.

2.11 SEISMIC RESTRAINTS:

A. Provide seismic restraints for all electrical system components in accordance with the 2018 Connecticut State Building Code.

B. Contractor shall have the following responsibilities:
1. Determine seismic restraint sizes and locations required by code.
2. Provide and install isolation systems and seismic restraints.
2. Provide installation instructions, drawings and field supervision to assure proper installation and performance.

C. Installations shall be designed to safely accept external forces of one-half “G” load in any direction for all rigidly supported equipment without failure and permanent displacement of the equipment. Life safety equipment such as the emergency generator, transfer switches, emergency power feeders, and emergency power panelbaords shall be capable of safely accepting external forces up to one “G” load in any direction without permanent displacement of the supported equipment.

2.12 SLEEVES, INSERTS AND ANCHOR BOLTS:

A. The Contractor shall provide and shall be held responsible for the location and position of all sleeves, inserts, and anchor bolts required by his work. Failure to do so, which requires cutting and patching of finished work, shall be done at no additional cost to the Owner.

2.13 FIRE STOPPING:

A. All sleeves shall be packed with damming material and sealed. Sealant shall allow for movement without cracking and shall be 3M brand Fire Barrier Caulk CP25 or approved equal.

B. Provide fire stopping at all fire or smoke rated wall or fire rated floor penetrations in order to maintain its original integrity. The materials and methods must be tested and listed or approved by Underwriters Laboratories, Factory Mutual or some other recognized authority. The fire stopping performance must be evaluated in accordance with ASTM-E814 test method. The Contractor shall use 3M Family of Products including, but not limited to the following:

1. CP25 caulk fire barrier compound.
2. CS-195 fire resistive composite panel for large openings.
3. FS-195 wrap/strip to fire stop plastic pipe.
4. PSS-7900 systems for circular, rectangular, and square openings.
5. MPP-4S+ moldable putty pads for electrical outlet boxes.

C. The above 3M products and systems shall be submitted for review by the Engineer and properly applied in the field in accordance with the Manufacturer's recommended procedures.

2.14 LUBRICATION:

A. All equipment installed under this contract having moving parts shall and requiring lubrication shall be properly lubricated according to the manufacturer’s instructions prior to operation and testing. Any such equipment discovered to have been operated prior to lubrication by the Contractor shall be subject to rejection and replacement at no additional cost to the Owner.

2.15 ACCESS PANELS:

A. Provide access panels for electrical equipment which is not readily accessible. Such equipment includes items above hung ceilings which are not readily removable and items installed within walls, inside chases, or inside dead cavity spaces.

B. Access panels shall be of sufficient size to permit easy replacement and servicing of electrical equipment.

C. Access panels shall bear the same or greater fire rating as the wall or ceiling in which they are installed.

2.16 OTHER MATERIALS:

A. Provide other materials, not specifically described but required for a complete and proper installation, as selected by the Contractor subject to the approval of the Architect and Engineer.

B. Provide miscellaneous hardware and support accessories, including channels, support rods, nuts, bolts, screws, and other such items, with galvanized or cadmium plated finish, or other approved rust inhibiting coatings.

PART 3 - EXECUTION

3.1 GENERAL:

A. Unless specifically noted or shown otherwise, install all equipment and material specified herein or shown on drawings whether or not specifically itemized herein.

B. Check equipment and material delivered to the project site and verify that it is in conformance with the approved submittals prior to installation.

3.2 SURFACE CONDITIONS:

A. Examine the areas and conditions under which work of this Contract will be performed. Correct conditions detrimental to timely and proper completion of the work. Do not proceed until unsatisfactory conditions are corrected.

3.3 PREPARATION:

A. Coordinate:

1. Coordinate as necessary with other trades to assure proper and adequate provisions in the work of those trades for interface with the work of this Contract. Each Contractor shall furnish all information necessary to permit work of other trades to be installed in a satisfactory manner.

2. Coordinate delivery of equipment to project prior to installation. Any equipment stored for an extended period of time prior to installation may be subject to rejection by the Architect or Engineer.

3. Coordinate the installation of items with the schedule for work of other trades to prevent unnecessary delays in the total work.

4. Where electrical equipment is shown in conflict with locations of structural members or other equipment, provide required supports, offsets, bends, or tees as required to clear the encroachment.

5. No conduit, cable(s), boxes, etc., shall be installed until the entire run has been checked for clearances and the work has been coordinated between all the trades. Each tradesman shall be responsible for taking his own field measurements and maintaining proper clearance from the Owner's equipment and the work of other trades, and for coordinating his work with that of other Contractors. Furnish all necessary information, dimensions, templates, etc. in order that a properly coordinated job will result.

6. Prior to roughing, the contractor shall obtain exact electrical equipment, fixture, and device locations from the Architect and Owner. Equipment, fixture, and device locations shown on the drawings are to be used for general reference only. Roughing of equipment, fixtures, and devices shall not proceed until the exact locations, heights, and orientations of same have been agreed upon with the Architect and Owner.

7. If due to lack of coordination and foresight by the Contractor, equipment must be relocated or extra work performed, all costs shall be the responsibility of the Contractor and may not be passed through to the Owner.

B. Unload equipment and materials delivered to the site. Pay cost for rigging, hoisting, lowering and moving electrical equipment on site, in building, or on roof. During construction provide

protection against moisture, dust accumulation, and physical damage of equipment. Provide temporary heaters within units as required to evaporate excessive moisture and provide ventilation as required.

C. Certain present building clearances are available for handling equipment. All equipment shall be delivered knocked down as required to clear space limitations on site and within the building.

D. Unless noted otherwise the Contractor shall set all equipment level, plumb, and secure prior to making connections to other equipment or systems.

E. Data indicated on the drawings and in these Specifications are as exact as could be secured, but their absolute accuracy is not warranted. The exact locations, distances, levels and other conditions will be governed by actual construction and the drawings and specifications should be used only for guidance in such regard.

F. Verify all measurements at the building. No extra compensation will be allowed because of differences between work shown on the drawings and actual measurements at the site of construction.

G. The drawings are diagrammatic, but are required to be followed as closely as actual construction and work of other trades will permit. Where deviations are required to conform to actual construction and the work of other trades, make such deviations without additional cost to the Owner.

3.4 ACCESSIBILITY:

A. Locate all equipment which must be serviced, operated or maintained, in fully accessible positions including but not limited to: controllers, motor starters, disconnect switches, transformers, panelboards, switchgear, etc. Provide access panels as required for equipment access.

B. Failure by the Contractor to locate equipment and arrange the installation to allow for adequate access and clearance for maintenance and servicing shall result in rejection of the installation and the disassembly, relocation and re-assembly of the installation shall be done by the Contractor at no additional cost to the Owner.

3.5 CLEANING AND PROTECTING PIPING, CONDUITS AND EQUIPMENT:

A. Thoroughly clean all piping, conduit, and equipment of all foreign substances inside and out before installation.

B. Plug open pipe and conduit ends during construction with approved plugs or caps to exclude dust, moisture, plaster or mortar etc. Note - using duct tape to cover conduit and pipe ends is not an acceptable means of excluding construction debris and may result in rejection of the installation with remedial action to be taken by the Contractor at no additional cost.

C. If any part of a conduit system should be blocked by any foreign matter after being placed in operation, the system shall be disconnected, cleaned and reconnected wherever necessary in order to locate and remove the obstruction(s). Any work damaged in the course of removing obstructions shall be repaired or replaced at no additional cost to the Owner.

3.6 PROJECT COMPLETION:

A. Upon completion of the work, remove all waste, rubbish and other materials left as a result of operations and leave the premises in clean condition.

B. Thoroughly clean all exposed portions of the electrical installation, removing all traces of soil, labels, grease, oil and other foreign material, and using only the type cleaner recommended by the manufacturer of the item being cleaned.

C. Vacuum all exteriors of equipment and interiors of equipment having accessible interior compartments to remove all dust, dirt, cable clippings, construction debris, etc.

D. Equipment with damage to painted finish shall be repaired to satisfaction of the Owner. Equipment that cannot be satisfactorily repaired shall be replaced at no cost to the Owner.

E. Upon completion of all work and of all tests, the Contractor shall furnish the necessary skilled labor and helpers for operating the system and equipment for a period of one (1) day or eight (8) hours, or as otherwise specified. During this period, instruct the Owner or his representative fully in the operation, adjustment and maintenance of all equipment furnished. Provide at least forty-eight (48) hours notice to the Owner in advance of this period.

F. Thoroughly indoctrinate the Owner's operation and maintenance personnel in the contents of the as-built drawings and the operations and maintenance manual required to be submitted under these Specifications.

3.7 INSTRUCTION PERIOD:

A. Prepare written instruction frames for the proper maintenance and operation of any special equipment furnished and installed under this Contract.

B. The contractor shall arrange for on-site instruction of the Owner's representatives by manufacturers of all major items of equipment. The instruction periods shall be consecutive and shall be held after the installations are complete, tested and balanced and the approved documentation is available. The contractor shall be responsible for attendance of the manufacturer's technical representatives and shall coordinate program timing with the Owner.

C. In addition to normal operation, the Owner's representatives shall be instructed on routine maintenance and trouble-shooting.

END OF SECTION 260000

SECTION 260500 – BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. The General Provisions of the Contract, including Division 0, Contract Requirements, and Division 1, General Requirements, are a part of this Section and shall be binding on the Contractor and /or Subcontractor who performs this work. Note also all addenda.

B. Section 26 00 00 General Electrical shall also govern the work under this Section.

C. This Section includes requirements that are binding on other Sections of Divisions 26 and 28.

D. Examine all drawings, data, and coordinate the work of this Section with all related and adjoining work.

1.2 SCOPE OF WORK:

A. Scope of work consists of installation of materials to be furnished under this Section, and without limiting generality thereof consists of furnishing labor, materials, equipment, hoisting, plant, transportation, rigging, staging, appurtenances, and services necessary and/or incidental to properly complete all electrical work as shown on the drawings, as described in these specifications or as reasonably inferred from either as being required in opinion of the Architect and Engineer.

B. Work Included: Provide complete electrical services where shown on the drawings, as specified herein and as needed for a complete and proper installation including but not necessarily limited to:

1. General
2. Conduits, Raceways
3. Equipment Labeling
4. Wire and Cables
5. Devices, Switches and Receptacles
6. Outlet Boxes, Junction Boxes, Pull Boxes, Wireways
7. Cabinets
8. Disconnect Switches
9. Supporting Devices
10. Fuses
11. Grounding
12. Backboards.

1.3 QUALITY ASSURANCE:

A. Refer to Section 26 00 00.

B. Comply with the testing and inspection requirements in Specification paragraphs 26 05 00, 3.12, A through H.

1.4 SUBMITTALS:

A. Shop Drawings, Product Data, and Certifications that products conform to requirements: Submit for all items provided as part of the Work of this Section, including but not limited to those items listed in Paragraph 1.2, B above.

PART 2 - PRODUCTS

2.1 GENERAL:

A. Provide only materials that are new and of type and quality specified, or approved equal. Where Underwriters' Laboratories, Inc. have established standards for such materials, provide only materials bearing the UL label.

B. Provide materials and equipment necessary to make installation complete in every detail, and to conform to manufacturers' latest installation instructions, under this contract whether or not specifically shown on drawings or specified herein.

2.2 TEMPORARY FACILITIES:

A. Refer to the requirements of Division 1 regarding temporary facilities.

B. Scaffolding and other temporary construction shall be rigidly built in accordance with Local and State requirements. Remove from premises upon completion of work.

C. Provide temporary construction required for electrical work as directed by the Architect and Engineer.

2.3 RACEWAYS:

A. Rigid Steel Conduit:

1. Shall be manufactured from high strength strip steel, shall be hot dipped galvanized with threads galvanized after cutting, and shall be chromated to form an additional protective layer. Rigid steel conduits shall be UL listed, shall meet the requirements of ANSI C80.1, and shall be as manufactured by Allied Tube and Conduit, Wheatland, or Calconduit.
2. Shall be used for work in hazardous (classified) locations.
3. Shall be used in outdoor locations where conduit is exposed to physical damage, sunlight or weather.
4. Shall be used for underground work.
5. Shall be used for horizontal and vertical underground sweeps, horizontal and vertical sweeps below concrete slabs, and for penetrations through concrete slabs.
6. Fittings, couplings and connectors shall be threaded and galvanized or cadmium plated.

B. Rigid PVC Conduit:

1. Shall be heavy wall schedule 40 PVC for underground work and extra heavy wall schedule 80 PVC for underground work below vehicular traffic areas. Joints and fittings shall be solvent welded all to ASTM standards for underground installation and in accordance with Article 352 of the National Electric Code.
2. May be used in lieu of rigid steel conduit except as noted in paragraph 2.3, A, 5 above.
3. The minimum size for running below slabs shall be 1 1/4" for both feeders and branch circuits.
4. Joints shall be made watertight.

5. Shall not be embedded in concrete slabs.
6. Shall not be used above ground.
7. Shall not be used for underground horizontal and vertical sweeps, horizontal and vertical sweeps below concrete slabs, or for penetrations through concrete slabs.
8. Furnish conduit system in Prime Conduit, Cantex, or JM Eagle.

C. Intermediate Steel Conduit:

1. Shall be manufactured from high strength flat steel that is cold-formed and electrically welded into a uniform tube, shall be hot dipped galvanized with threads galvanized after cutting, and shall be chromated to form an additional protective layer. Intermediate steel conduit shall be UL listed, shall meet the requirements of ANSI C80.6, and shall be as manufactured by Allied Tube and Conduit, Wheatland, or Republic Conduit.
2. Shall be used in interior locations where conduit is exposed to physical damage, or corrosive or wet environments.
3. Fittings, couplings and connectors shall be threaded and galvanized or cadmium plated.

D. Electrical Metallic Tubing:

1. Shall be manufactured from high grade mild strip steel, shall be hot dipped galvanized, and shall be chromated and lacquered to form additional protective layer. EMT conduit shall conform to UL 797 and ANSI C80.3 and shall be as manufactured by Allied Tube and Conduit, Wheatland, or Republic Conduit.
2. Connectors and couplings shall be galvanized steel set screw type. Provide gland compression type couplings and connectors for exposed work in wet locations.
3. Shall be used for all interior feeders except where specified differently or noted differently on the drawings. Provide insulated throat grounding bushings for all feeder conduit connections to switchboards, panelboards, transformers, disconnect switches, wireways, and pull boxes.
4. Shall be used for all interior wiring in masonry partitions, above non-accessible ceilings, and where exposed to view.
5. Shall be used for all branch circuit homeruns and closing connections to panelboards.
6. Shall be used for all branch circuits feeding HVAC equipment and equipment requiring 3-Phase power.
7. Shall not be embedded in concrete slabs.

E. Flexible Steel Conduit:

1. Shall be full wall steel flexible conduit, shall be manufactured from high grade strip steel and shall be hot dipped in a molten zinc bath. The steel strip shall be formed into interlocking convolutions that are continuously joined, metal to metal, assuring continuous grounding contact. Flexible steel conduit shall be UL listed and shall be as manufactured by AFC Cable Systems, Greenfield, Anaconda, or Electri-Flex.
2. Flexible steel conduit fittings shall be zinc plated malleable iron squeeze type connectors and zinc plated malleable iron combination couplings
3. May be used in short lengths where EMT cannot be installed due to interferences and obstacles.
4. Provide for final connections to motor driven equipment, transformers, recessed light fixtures, chain hung light fixtures, or where subject to vibration.

F. Liquidtight Flexible Steel Conduit:

1. Shall be similar to flexible steel conduit, but with pressure-extruded moisture and oil-proof outer jacket of gray polyvinyl chloride plastic. Liquidtight flexible steel conduit shall be UL listed (UL 360) and shall be as manufactured by AFC Cable Systems Anaconda, or Electri-Flex.
2. Fittings, couplings and connectors shall be threaded, zinc plated, malleable iron liquidtight type.
3. Provide where located outdoors or in damp or wet areas for final connections to motor driven equipment, or where subject to vibration.
4. Do not use in environmental air plenum spaces.

G. Surface Steel Wireway:

1. Wireways shall be code gauge galvanized steel, manufactured standard sections and fittings, with hinged and/or screw covers, indoors NEMA Type 1/Outdoors NEMA Type 3R, and shall be manufactured by Hoffman, Cooper, Square D, or Wiremold. Wireways shall be sized to code conductor fill requirements and shall be provided as required for job conditions.

H. Sleeves:

1. Provide EMT sleeves for each conduit and cable passing through interior walls, partitions, and floors.
   a. Set pipe sleeves in place before wall, floor, or partition is finished.
   b. Support conduit and cable free from sleeves.
   c. Provide sleeves two pipe sizes larger than the conduit or cable passing through, or provide a minimum of ½" clearance.
2. Provide chrome plated escutcheon plates for each sleeve where exposed to view in finished areas.
3. Provide GPT Industries WSG galvanized steel wall sleeves for each conduit passing through foundation walls. Galvanized steel wall sleeves shall be schedule 40 steel pipe in sizes through 10" diameter and shall have a 0.375" wall thickness for sizes 12" diameter and larger. WSG galvanized steel wall sleeves shall have a 2" collar (water stop) at the mid-point of the sleeve. The 2" collar shall be continuously welded on both sides to the sleeve. Provide GPT Industries Link-Seal modular waterproof seals at all foundation wall sleeves. Where penetrating existing foundation walls provide a core drilled penetration and Link-Seal modular waterproof seal without the galvanized steel wall sleeve.

2.4 METHODS AND MATERIALS FOR LABELING EQUIPMENT:

A. Panelboards, Safety Switches, Contactors:

1. Non-metallic engraved nameplates shall be used to identify device. Nameplates shall be secured to equipment with two screws or rivets. Adhesive nameplates are not acceptable.
2. Letters shall be white on black background.
3. Nameplate letters shall be 1/4" high.
4. Identification nomenclature shall be in accordance with plans. All name nomenclature shall be submitted for approval.
5. Nameplates for panelboards shall include panel designation and voltage.

B. Identify all fused disconnect switches with installed fuse size, i.e: Maximum fuse size = xxx amps. Identification shall be of the same method as specified in paragraph 2.4.A, except white letters on red background.

C. Identify the covers of all junction boxes, wireways, and pull boxes installed above ceilings and in unfinished spaces with branch circuit or feeder designations. Identification shall be done with black felt tip permanent marker in a neat and readily legible manner.

D. Provide a typewritten adhesive label with an identification legend at each panelboard identifying the color coding of the ungrounded conductors being supplied by the panelboard.

E. Identify all receptacles with its branch circuit designation. Identification shall be done with DYMO typewritten adhesive labels, ¼" width, 3/16" character height, black letters on clear background. Affix labels to the bottom of the receptacle wallplates. Labels shall be affixed plumb on the wallplates.

F. Provide Arc Flash labeling for the panelboards in accordance with NFPA-70 paragraph 110.16.

2.5 SAFETY SWITCHES:

A. All safety disconnect switches shall be furnished in heavy duty quick-make, quick-break, interlocking fusible or non-fusible, type as indicated on the drawings. Manufacturer shall be the same as provided for panelboards.

B. Provide enclosures clearly marked for maximum voltage, current and horsepower rating, and:

1. Indoors: NEMA Type 1.
2. Outdoors or Damp or Wet Locations: NEMA Type 3R.
3. Hosedown and Splashing Water Locations: NEMA Type 4.

C. Furnish and install disconnect switches at each motor location except where combination switches and starters are furnished with equipment by others but are mounted by this contractor.

D. Furnish and install a weatherproof disconnect switch at each exterior located fan, motor, or HVAC unit location.

E. Disconnect switches shall be of "lock-out" design to prevent opening of switch when in "ON" position.

2.6 MOTOR STARTER/DISCONNECTS AND VFD'S:

A. Combination motor starter/disconnects and variable frequency drives (VFD's) will be supplied by other trades for motor driven equipment provided by them.

B. The electrical contractor shall install the starter/disconnects and VFD's, and shall provide all power wiring to the units and from the units to the motors they control.

2.7 CONTACTORS:

A. Provide mechanically held and electrically held contactors in manufacture and model as called out on the drawings.

2.8 CONDUCTORS:

A. Conductors shall be provided in Cerro Wire manufacture or comparable product in General Cable or Republic Wire.

B. All feeder conductors shall be copper, rated 600 volts, 90 deg. C., dry and wet locations, type XHHW-2, color coded.

C. All branch lighting and power conductors shall be copper rated 600 volts, 90 deg. C., dry and wet locations, type THWN-2 for sizes #12 AWG and #10 AWG, and type XHHW-2 for sizes #8 AWG and larger, color coded. Branch lighting and power conductors shall be soft drawn copper with conductivity of not less than 98 percent of ANSI Standard for annealed copper.

D. Photovoltaic (PV) conductors shall be tinned coated compressed copper, Class C stranding per ASTM B8 and B33, rated 2000 volts, 90 deg. C. dry and wet locations, type XPLE insulation (flame retardant), sizes #12 AWG through #8 AWG.

E. Grounding electrode conductors and bonding conductors shall be soft drawn copper, ASTM B3 solid bare copper for sizes smaller than #8AWG, ASTM B8 stranded bare copper for sizes #8AWG and larger.

F. Light fixture connections to be copper, Type SF-1, 200 deg. C.

G. Minimum gauge conductors for power and lighting shall be #12 AWG. Increase to #10 AWG for runs exceeding 75'-0", and #8AWG for runs exceeding 150'-0".

H. Wire Size #8 AWG and larger shall be stranded. Wire of size smaller than #8 AWG shall be solid.

I. Type 'MC' Cable:

1. Shall be a factory assembly of copper type THHN conductors including a green insulated equipment grounding conductor, with a mylar tape overall assembly covering, housed in a continuous interlocking galvanized steel sheath. Provide with optional insulated bushings.
2. May only be used in dry locations for single phase lighting and receptacle branch circuit wiring where concealed from view above accessible ceilings or in stud walls.
3. Shall not be used in damp or wet locations, where exposed to view, in masonry walls, above non-accessible ceilings, for HVAC equipment, for equipment requiring 3-phase power, for branch circuit homeruns, or for closing connections to panelboards.
4. Shall be as manufactured by AFC Cable Systems, Southwire, or CME.
5. Metal clad cable connectors shall be malleable iron set screw type connectors.

2.9 OUTLET, JUNCTION AND PULL BOXES:

A. Provide outlet boxes as required for a complete installation including, but not limited to the following: switches, receptacles, telephone/voice outlets, data outlets, video/CATV outlets, lighting fixtures, special lighting control outlets, fire detection system outlets, special systems outlets, audio/visual (A/V) outlets, CCTV camera outlets, security/access control outlets, etc.

B. Outlet boxes for flush (concealed) work shall be code gauge galvanized steel and shall be of shapes and sizes to suit their respective locations and installations, and shall be provided with covers to suite their function and installation. Provide outlet boxes with interior partitions where emergency and normal power devices are ganged together. Outlet boxes shall be equipped with fixture stud or straps where required.

E. The minimum box size for all flush wall outlet boxes shall be nominal 4 11/16” square x 2 1/8” deep (2-gang) except where noted differently on the drawings. Provide boxes with single gang or two gang covers as required for the particular application. Provide larger size outlet boxes, or gangable type boxes where required for the installation.

D. For lighting outlets, provide standard 4" octagon units with 4" round flat covers. Provide 3/8" malleable iron fixture studs and box hangers where required. For lighting fixtures make final connection with flexible conduit of sufficient length to allow fixtures to be repositioned.

E. For exposed work in unfinished areas, provide drawn-type boxes with galvanized steel crushed corner exposed work covers. Provide cast boxes for work exposed to wet locations and where called for on the drawings.

F. For above ground pull boxes, provide galvanized code-gauge sheet steel units with screwed on covers, of size and shape required to accommodate wires without crowding, and to suit the location. Provide pull boxes as specified herein, as required for job conditions, and as follows:

1. Indoors: NEMA Type 1.
2. Outdoors or Damp or Wet Locations: NEMA Type 3R.
3. Hosedown and Splashing Water Locations: NEMA Type 4.

G. Provide polymer concrete in-ground pull boxes where indicated on the drawings. Polymer concrete pull boxes shall be Quazite boxes as manufactured by Hubbell or comparable product in Armorcast or Highline manufacture. Pull boxes shall be constructed of Polymer concrete consisting of sand and aggregate bound together with a Polymer resin and reinforced by a heavy weave fiberglass. Pull box covers shall have a skid resistant finish and shall be secured with stainless steel bolts. Provide in-ground pull boxes of size and shape required to accommodate the service and suit the location.

H. Provide H-20 rated in-ground pre-cast concrete pull boxes with cast iron frame and cover where indicated on the drawings. Pre-cast boxes shall be provided with adequate provisions for drainage.

2.10 WIRING DEVICES:

A. All devices shall be furnished in Hubbell or comparable product in Cooper, Pass & Seymour, or Leviton. Devices specified herein are based on Hubbell unless otherwise noted. Receptacle and switch colors shall be as directed by the Architect and Owner.

B. Lighting Switches:

1. Toggle Type: Extra Heavy Duty industrial grade, flush mounting, quiet operation AC type with abuse resistant colored nylon toggle operator, heat resistant composition plastic housing, silver cadmium oxide contacts and copper alloy spring contact arm. Rated at 120-277 VAC, capable of full capacity on tungsten, fluorescent, or LED lamp load. Designed for side or back wiring with up to No. 10 wire, and with #8 brass terminal screws.

	20 AMP	30 AMP
Single Pole	#HBL1221	#HBL3031
Two Pole	#HBL1222	#HBL3032
Three way	#HBL1223	#HBL3033
Four way	#HBL1224	-

2. Switch with lighted toggle pilot or pilot light toggle: same as toggle type except with clear polycarbonate lighted toggle (light on with load off) or red polycarbonate pilot light toggle (light on with load on).

	20 AMP	30 AMP
Lighted Toggle	#HBL1221ILC	-

Single Pole Pilot Light	#HBL1221PL	#HBL3031PL
Two Pole Pilot Light	#HBL1222PL	#HBL3032PL
Three Way Pilot Light	#HBL1223PL	-

3. Lock Key Type: Same as toggle type except with key operator.

	20 AMP
Single Pole	#HBL1221L
Two Pole	#HBL1222L
Three Way	#HBL1223L
Four Way	#HBL1224L

4. Dimmer Switches: Provide linear slide type dimmers of types and capacities as required for the loads served. Fluorescent and LED dimmers shall be compatible with the dimming ballasts and LED drivers provided with the light fixtures. Allow 30% overload when sizing dimmers for LED fixtures. Where multiple dimmer switches are shown grouped together set in gangs with a common wall plate. Do not gang dimming and non-dimming switches together. Provide dimmer switches in Lutron, Leviton, or Hunt manufacturer.

C. Receptacles:

1. Single and duplex convenience receptacles shall be extra heavy duty specification grade, 2 pole, 3 wire grounding, NEMA 5-20R, rated 20AMP at 125 Volts AC. Receptacles shall have a one-piece all brass wrap around mounting strap with integral ground contacts and ground tension retaining clips, tandem bypass contact, heat resistant thermoplastic rynite base, and high impact nylon face. Receptacles shall be back and side wired, shall have a back wired green ground terminal, automatic ground clip, and threaded brass square head center rivet assembly.

Single Receptacle #HBL5361
Duplex Receptacle #HBL5362WR
Duplex Tamper Resistant Controlled Receptacle #HBL5362C2TR

2. Ground Fault Duplex convenience receptacles shall be extra heavy duty specification grade, 2 pole, 3 wire grounding, NEMA 5-20R, rated 20AMP at 125 volts AC. Receptacles shall have a solid brass wrap around mounting strap with pre-tensioned ground contacts, tandem modified bypass contacts, all glass circuit board with conformal coating for superior moisture immunity, 7 noise filtering capacitors, heat resistant thermoplastic base and high impact nylon face. Receptacles shall be side wired and shall have a green ground terminal.

Duplex GFCI Receptacle #GFR5362SG

3. Specialty receptacles: Provide receptacles of voltage, amperage, and NEMA configuration listed below as shown on the drawings and as required for appliances and equipment furnished by others. Confirm NEMA configurations required with the supplier(s) of appliances and equipment prior to receptacle installation.

Straight Blade Devices

NEMA#	Type	Amperage/Voltage	Model #
5-15R	2P, 3W, GR	15A, 125V	HBL5235
6-20R	2P, 3W, GR	20A, 250V	HBL5461
5-30R	2P, 3W, GR	30A, 125V	HBL9308
6-30R	2P, 3W, GR	30A, 250V	HBL9330
7-30R	2P, 3W, GR	30A, 277V	HBL9315

5-50R	2P, 3W, GR	50A, 125V	HBL9360
6-50R	2P, 3W, GR	50A, 250V	HBL9367
7-50R	2P, 3W, GR	50A, 277V	HBL9365
14-20R	3P, 4W, GR	20A, 125/250V	HBL8410
15-20R	3P, 4W, GR	20A, 3-PH, 250V	HBL8420
14-30R	3P, 4W, GR	30A, 125/250V	HBL9430A
14-50R	3P, 4W, GR	50A, 125/250V	HBL9450A
14-60R	3P, 4W, GR	60A, 125/250V	HBL9460A
15-30R	3P, 4W, GR	30A, 3-PH, 250V	HBL8430A
15-50R	3P, 4W, GR	50A, 3-PH, 250V	HBL8450A
15-60R	3P, 4W, GR	60A, 3-PH, 250V	HBL8460A

Twist Lock Devices

NEMA#	Type	Amperage/Voltage	Model #
L5-20R	2P, 3W, GR	20A, 125V	HBL2310
L6-20R	2P, 3W, GR	20A, 250V	HBL2320
L7-20R	2P, 3W, GR	20A, 277V	HBL2330
L8-20R	2P, 3W, GR	20A, 480V	HBL2340
L5-30R	2P, 3W, GR	30A, 125V	HBL2610
L6-30R	2P, 3W, GR	30A, 250V	HBL2620
L7-30R	2P, 3W, GR	30A, 277V	HBL2630
L8-30R	2P, 3W, GR	30A, 480V	HBL2640
L14-20R	3P, 4W, GR	20A, 125/250V	HBL2410
L15-20R	3P, 4W, GR	20A, 3-PH, 250V	HBL2420
L16-20R	3P, 4W, GR	20A, 3-PH, 480V	HBL2430
L14-30R	3P, 4W, GR	30A, 125/250V	HBL2710
L15-30R	3P, 4W, GR	30A, 3-PH, 250V	HBL2720
L16-30R	3P, 4W, GR	30A, 3-PH, 480V	HBL2730
L21-20R	4P, 5W, GR	20A, 3-PHY, 120/208V	HBL2510
L22-20R	4P, 5W, GR	20A, 3-PHY, 277/480V	HBL2520
L21-20R	4P, 5W, GR	30A, 3-PHY, 120/208V	HBL2810
L22-30R	4P, 5W, GR	30A, 3-PHY, 277/480V	HBL2820

D. Wall Plates:

1. Wall plates for flush outlets shall be specification grade smooth metal stainless steel type 302/304, satin finish. Where multiple devices are ganged together they shall be mounted under a common wall plate. Provide switch and receptacle combination plates where switches and receptacles are located together. Cover plates shall be furnished in same manufacturer as devices.

2. Weatherproof enclosures for outdoor GFCI receptacles shall be cast aluminum, single gang vertical Hubbell #WP26M or single gang horizontal Hubbell #WP26MH. Enclosures shall include gasket and mounting screws, shall have ¼" diameter padlock holes, and shall have large cord openings for use with cover closed.

E. Outlet and Switch Sealers:

1. Provide electrical outlet and switch sealers for all receptacles, switches, and data/telephone/catv outlets installed at exterior walls. Sealers shall be fire resistant plastic foam, 2 ½"W x 4"H, and shall have pre-punched receptacle, switch toggle, and screw openings. Outlet and switch sealers shall be as manufactured by Frost King.

F. Stand-Alone (Non-System) Occupancy Sensors for Lighting Control:

1. Provide dual technology passive infrared/microphonics occupancy sensors in Sensor Switch manufacture, or comparable product in Hubbell or WattStopper. Wall switch occupancy sensor colors shall be as directed by the Architect.

a. Line voltage dual technology wall switch sensor: Sensor Switch #WSX PDT LT.
b. Line voltage dual technology wide view sensor: Sensor Switch #WVR PDT 16.

G. Stand-Alone (Non-System) Occupancy Sensors for Plug Load Control:

1. Provide dual technology passive infrared/microphonics occupancy sensors in Sensor Switch manufacture or comparable product in Hubbell or WattStopper.

a. Low voltage dual technology wide view corner mount sensor: Sensor Switch #WV PDT 16. Sensors shall provide line of sight PIR detection of small movements up to 40 feet away and large movements (walking) up to 70 feet away. Sensors shall combine overlapping Microphonics detection around obstructions.

2. Power Packs:

a. Provide Sensor Switch #PP20 Power Packs where shown on the drawings for use with the low voltage occupancy sensors. Power Packs shall be plenum rated, shall have universal 120/277VAC input voltage with low voltage output for sensor power, and shall have a 20 amp relay for load switching. Power Packs shall be plenum rated.

2.11 FUSES:

A. Provide current limited, non-renewable fuses in Littelfuse manufacture or comparable product in Bussman or Gould. Fuses shall be UL class J up to 600 Amp and Class L over 600 Amp.

B. Fuses shall be rated 600V or less A.C., UL listed, and have minimum interrupting rating of 200,000 rms amperes with peak let-through current and maximum clearing values within prescribed UL limits. Fuses for motor feeders or motor circuits shall be Class RK-5 of voltage classification rated for motor with minimum interrupting capacity of 200,000 rms amperes and with minimum time delay of ten seconds at 500%.

C. Provide one complete set of three spare fuses for each size and type used.

2.12 EXOTHERMIC WELDS:

A. All grounding/bonding connections to building steel shall be made with exothermic welds. Provide in Cadweld or comparable product in Thermoweld or JMV manufacture.

2.13 BACKBOARDS:

A. Backboards shall be constructed of fire retardant plywood sheets, 4’ x 8’ x ¾”.

1. Paint backboards on all sides with two coats of light gray fire-retardant paint prior to mounting equipment.

2. Mount backboards on unistrut channel supports.

B. Provide backboards where indicated on the drawings and for mounting all surface mounted electrical panels, disconnect switches, motor starters, and VFD's.

2.14 ACCESS PANELS:

A. Provide access panels for electrical equipment and wiring splices which are not readily accessible. This includes electrical equipment and wiring splices installed above hung ceilings which are not readily removable, within walls, inside chases, or inside dead cavity spaces.

2.15 OTHER MATERIALS:

A. Provide other materials, not specifically described but required for a complete and proper installation, as selected by the contractor subject to the approval of the engineer.

B. Provide miscellaneous hardware and support accessories, including unistrut, channels, jack chain, support rods, nuts, bolts, screws, and other such items, with galvanized or cadmium plated finish, or other approved rust inhibiting coatings.

PART 3 - EXECUTION

3.1 GENERAL:

A. Unless specifically noted or shown otherwise, install all equipment and material specified herein or shown on drawings whether or not specifically itemized herein. PART 3 covers particular installation methods and requirements peculiar to certain items and classes of materials and equipment.

B. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the work. Do not proceed until satisfactory conditions are corrected.

C. The electrical drawings are diagrammatic, but are required to be followed as closely as actual construction and work of other trades will permit. Where deviations are required to conform with actual construction and the work of the other trades, make such deviations without additional cost to the Owner.

D. Data indicated on the drawings and in these specifications are as exact as could be secured, but their absolute accuracy is not warranted. The exact locations, distances, levels and other conditions will be governed by actual construction and the drawings and specifications should be used only for guidance in such regard.

E. Verify all measurements at the building. No extra compensation will be allowed because of differences between work shown on the drawings and actual measurements at the site of construction.

F. Do not scale drawings. Scale indicated on drawings is for establishing reference points only. Actual field conditions shall govern all dimensions.

G. Coordinate:

1. Coordinate as necessary with other trades to assure proper and adequate provisions in the work of those trades for interface with the work of this Section.
2. Coordinate delivery of electrical equipment to project prior to installation. Equipment stored for an extended period of time prior to installation may be subject to rejection by Architect.

3. Coordinate the installation of electrical items with the schedule for work of other trades to prevent unnecessary delays in the total work.
4. Where electrical items are shown in conflict with locations of structural members and mechanical or other equipment, provide required supports and wiring to clear the encroachment.
5. Prior to roughing, the contractor shall obtain exact fixture and device locations from the Architect and Owner. Outlet and fixture locations shown on the drawings are to be used for general reference only. Roughing of fixtures and outlets shall not proceed until exact locations, heights, and orientations of fixtures and outlets have been agreed upon with the Architect and Owner.
6. Arrange installation to provide access to equipment for easy maintenance and repair.

3.2 INSTALLATION OF RACEWAYS AND FITTINGS:

A. Install wire and cable in approved raceways as specified and as approved by authorities having jurisdiction.

B. All conduits shall be concealed from view above ceilings, in chases, and in walls. Conduits may only be installed exposed to view where run overhead in rooms without ceilings and in mechanical and electrical rooms.

C. Run conduit and cable parallel to or at right angles with lines of the building, to present a neat appearance.

1. Make bends with standard conduit elbows or conduit bent to not less than the same radius.
2. Make bends free from dents and flattening.

D. Provide code sized conduit unless a larger size is shown on the drawings or specified herein. Minimum conduit size shall be ¾" diameter.

E. Securely and rigidly support conduit and MC cable throughout the work with approved conduit clips and hangers all in conformance with code seismic requirements.

1. Do not use mechanics wire for supporting conduit or cable.
2. Do not support conduits on hung ceilings or from mechanical or electrical equipment.
3. Steel supports and racks shall be galvanized steel channel and fittings, unistrut or approved equal.
4. Provide clamps and support rods as required.
5. Steel support rods or support bolts for conduits shall be 1/8 inch diameter for each inch or fraction thereof of diameter of conduit size, but no rod or bolt shall be less than ¼" in diameter.
6. Horizontal and vertical conduit supports shall not be more than 10' apart or more than 1' from any fitting.
7. Install conduit and cable so it is not in contact with, or resting on, plumbing, fire protection, or HVAC equipment, piping, or ductwork.

F. Do not install conduit runs exposed on the building exterior.

G. Maintain at least 3" clearance between conduits and heating pipes when running parallel to these pipes, and at least 1" clearance when running perpendicular to these pipes.

H. Provide double locknuts on all conduits terminating in sheet metal enclosures. Provide insulated throat grounding bushings on all feeder conduits.

I. Provide expansion couplings for rigid metallic and non-metallic conduits where such conduits are subject to thermal expansion and contraction. Provide combination deflection/expansion couplings for rigid metallic and non-metallic conduits where such conduits cross through building expansion joints.

J. Provide full wall steel flexible conduit for all conduit penetrations through fire walls. Full wall steel flexible conduit shall be 3-hour through penetration fire wall rated.

K. Install link-seal waterproof seals around all conduit penetrations through basement walls, floors, or foundation walls.

L. Where conduit is installed underground or is exposed to weather or wet areas make all joints watertight. Seal all site work open conduit ends containing conductors water tight. Cap all site work open conduit ends that do not contain conductors.

M. Provide necessary sleeves and chases where conduits and cables pass through floors, walls, ceilings, and roofs, and provide other necessary openings and spaces, all arranged for in proper time to prevent unnecessary cutting. Perform cutting and patching in accordance with the provisions for the original work.

N. Provide offsets prior to entrance into outlet boxes and other electrical equipment for proper adjustment to finished building surfaces. Exercise care when roughing-in conduits which turn up or down to surface mounted panelboards or cabinets, so that conduit extensions to cabinet will be fitted close to wall. Where possible, provide back entry into surface mounted boxes or equipment items.

O. Install rigid galvanized steel conduit with ends cut square without sharp edges, threaded, and I.D. reamed to remove any burrs. Field made bends shall be of equivalent radius as factory made bends. Exposed threads shall be kept to a minimum.

P. Install conduit sealing fittings and conduit seals for work in classified locations in accordance with NEC requirements for Class 1, Division 1 and Class 1, Division 2 locations.

Q. Feeder, branch circuit, fire alarm, or special systems conduits shall not be run below concrete slabs or in concrete slabs unless specifically indicated so on the drawings, or unless there is no other way to feed the outlet, device, or equipment.

1. Where conduits are run underground below concrete slabs they shall be kept a minimum of 12” below bottom of slab. Provide rigid steel conduit for horizontal and vertical sweeps below concrete floor slabs and for penetrations through concrete floor slabs.
2. Where conduits turn out of concrete slab in open areas, provide threaded couplings flush with floor line for extending exposed conduit to equipment, outlet, fitting or box.

R. Carefully clean and dry all conduit before installation of conductors. Do not pull wires into conduit system until building roof and walls are weather-tight and all rough plastering is completed. Provide Prime Conduit conduit plugs and end caps to exclude dust, moisture, plaster, or mortar while building is under construction.

S. Lubricants or cleaning agents which might have deleterious effect on conductor coverings shall not be used for drawing conductors into raceways.

T. Provide minimum 3/16 inch diameter twisted nylon fish cord in all empty raceways. Provide tag on each end indicating location of other end. Fish cord shall have minimum of 200 pounds tensile strength.

U. All wiring shall be installed in electrical metallic tubing unless otherwise specified herein or called for on the drawings.

1. Where conduit is installed underground (buried) in non-classified locations, provide PVC conduit.
2. Where conduit is installed underground (buried) or aboveground in classified locations, provide rigid steel conduit.
3. Where conduit is installed embedded in cinder concrete, provide rigid galvanized steel conduit.
4. Provide intermediate steel conduit for exposed conduit installed below 7 feet in mechanical rooms, or where subject to physical abuse.
5. Use flexible conduit for final connections to motor driven equipment, recessed light fixtures, chain hung light fixtures, transformers, or where subject to vibration. Where such equipment is located in wet areas or exposed to weather use liquid-tight flexible conduit. Flexible connections shall be minimum of 18 inches and maximum of 6 feet long with grounding conductor. Flexible connections shall be used prior to attachment of conduit to equipment housing.

3.3 SLEEVES:

A. Provide EMT sleeves for each conduit and cable passing through walls, partitions, and floors.

1. Set pipe sleeves in place before wall, floor, or partition is finished.
2. Support conduit and cable free from sleeves.
3. Provide sleeves two pipe sizes larger than the conduit or cable passing through, or provide a minimum of ½" clearance.

B. Provide chrome plated escutcheon plates for each sleeve where exposed to view in finished areas.

C. Provide GPT Industries WSG galvanized steel wall sleeves for each conduit passing through basement walls or foundation walls. Galvanized steel wall sleeves shall be schedule 40 steel pipe in sizes through 10" diameter and shall have a 0.375" wall thickness for sizes 12" diameter and larger. WSG galvanized steel wall sleeves shall have a 2" collar (water stop) at the mid-point of the sleeve. The 2" collar shall be continuously welded on both sides to the sleeve. Provide GPT Industries Link-Seal modular waterproof seals at all foundation wall sleeves. Where penetrating existing basement or foundation walls provide a core drilled penetration and Link-Seal modular waterproof seal without the galvanized steel wall sleeve.

3.4 CONDUCTOR INSTALLATION:

A. General:

1. The interior of all conduits shall be cleared of burrs, moisture, dirt and obstructions before wires are pulled.

2. Lubricant for pulling wires shall be inert to cable and conduit, shall not in any way restrict ease of pulling through conduit with passage of time, and shall be special lubricant designed specifically for cable pulling and shall be chemically compatible with cable.

B. Color Coding:

1. Consistent phase identification of all conductors shall be maintained as follows:

	120/208V	277/480V
Phase A	Black	Brown
Phase B	Red	Orange
Phase C	Blue	Yellow
Neutral Wire	White	Natural Gray

Provide colored plastic tape of specified color code identification for large size conductors available only in black. Wrap tape three complete turns around conductor, at ends and at connections and splices. Provide same color coding for switch legs as corresponding phase conductor.

C. Minimum Conductor Sizes:

1. The minimum branch circuit conductor size shall be #12AWG. Provide #10AWG conductors for branch circuits where the conductor run exceeds 75 feet, and #8AWG conductors where the conductor run exceeds 150 feet.

D. Provide the number of conductors required for a given branch circuit, or as required for circuitry, whether indicated on the drawings or not.

E. Neutral Conductors:

1. All branch circuits shall be installed with a separate neutral conductor. Shared neutrals for groups of branch circuits shall not be permitted.

F. Provide each circuit with a dedicated ground wire back to its respective panel ground bar. Size all ground wires in accordance with NEC requirements. Use #12AWG minimum size.

F. MC cable may only be used in dry locations for single phase lighting and receptacle circuits where concealed from view above accessible ceilings and in stud walls. Homeruns shall be conductors in conduit. MC cable shall not be used in masonry partitions, above non-accessible ceilings, or for branch circuit homeruns.

1. MC cable shall be supported from the building structure using hangers, clips, and approved plenum rated plastic ties. In lay-in ceiling areas the cable shall not rest on ceiling grid or tiles, and shall not be tied or clipped to the ceiling grid wire hanging system. Do not use mechanics wire for supporting or securing MC or HCF cable.

H. Identify conductors passing through pull boxes, junction boxes, and wireways to indicate circuit designation. Identify pull boxes and junction boxes as specified herein.

I. Phase conductors shall be connected to phase supply mains in proper rotation to assure balanced condition on panel. Circuit numbers assigned on drawings are for convenience only. Provide typed circuit directories for all panelboards at conclusion of work, representing circuits as actually connected to panelboard. Directories shall note the equipment, devices and rooms served by each branch circuit.

J. Branch circuit wiring and arrangement of home runs have been designed for maximum economy consistent with adequate sizing for voltage drops, circuit ampacities and other considerations.

1. Install the wiring with circuits arranged as shown on the drawings, except as otherwise approved in advance by the Architect and Engineer.

2. Do not make changes and rearrange circuits without prior approval.

3. If more than 3 current carrying conductors are installed in one conduit they shall be derated in accordance with the National Electric Code. Do not install more than three 30 Amp single phase or four 20 Amp single phase circuits in the same conduit. Do not run emergency and normal power wiring in the same conduit.

K. All low voltage and signal wiring for fire alarm, intercom, clocks, and special systems in normally occupied (finished) areas of the building shall be installed concealed from view within the building structure. Wiring may only be exposed to view in mechanical and electrical rooms, and rooms without ceilings (exposed to the structure above). Provide minimum ¾" conduit for all wiring run within walls and where exposed to view in mechanical and electrical rooms, and rooms without ceilings. Wiring shall be plenum rated where installed without conduit and may be non-plenum type where installed in conduit. Sizes and types of different wires shall be as specified by manufacturer unless noted differently on the drawings or specified herein. Color code shall be used throughout.

L. Splices and Connections:

1. Make splices electrically and mechanically secure with pressure-type connectors.

a. For wires size #8AWG and smaller, provide solderless, screw-on connectors, 600V rating, of size and type to manufacturer's recommendation, with temperature ratings equal to the conductor insulation.

b. Make splices and terminations to conductors #6AWG and larger with corrosion-resistant, high conductivity, pressure indent, hex screw or bolt clamp connectors, with or without tongues, designed specifically for intended service. Connectors for cables 250 kcmil and larger shall have two clamping elements or compression indents. Terminals for bus connections shall have two bolt holes. Splitbolt connectors, Burndy, Ilsco or Greaves, shall be acceptable for all splices of conductors #6AWG and larger.

2. Insulate splices with a minimum of two layers of all weather, heavy duty, abrasion resistant, 8.5 mil thick, 105 degree C. rated vinyl electrical tape where insulation is required. Tape splices 1 ½ times the thickness of the conductor insulation.

3. Provide high conductivity copper alloy bolt-on lugs with pressure plate and socket set screw or hex head screw to attach wire and cable to disconnect switches, transformers, and other electrical equipment as required.

4. Provide cable reducing adaptor plugs where required for terminating oversize cable to standard size equipment lugs. Conductor strands shall not be cut in order to fit equipment lugs.

5. Provide antioxidant joint compound for all conductor connections.

3.5 OUTLET BOXES:

A. Obtain exact locations of outlets and fixtures from Architect prior to roughing. Make reasonable changes, as defined by Architect in location of outlets and equipment prior to roughing, at no additional cost. Give particular attention to outlets installed in and around casework.

B. All outlet boxes in finished areas shall be concealed from view above hung ceilings or recessed (flush) in walls and floors. Outlet boxes may only be exposed to view or surface mount type for feeding surface mount outlets and devices on existing walls or for surface mount outlets and devices in unfinished areas.

C. Install outlet boxes at uniform heights and straight and true with reference to walls, floors, ceilings and casework.

D. Provide knockout plugs in boxes with unused openings.

E. Secure all outlet boxes to building structure with metal straps, rods, or bolts independently of entering conduits or cables.

F. Provide bar hanger outlets in hollow framed partitions with bar hanger secured to partition studs with self-threading screws, or drill through hangers with Caddy or equal clips.

G. Provide horizontal separation for outlet boxes mounted on opposite sides of common wall. Back to back or thru-wall boxes will not be permitted.

3.6 PULL BOXES AND JUNCTION BOXES:

A. Provide pull boxes and junction boxes where shown on the plans and where required to facilitate proper pulling of wires and cables. Install pull boxes no less than one every 100 ft. of straight horizontal conduit run, or three 90 degree bends, unless otherwise noted.

B. For site work provide pull boxes no less than one every 400 feet of straight run or two 90 degree bends, unless shown or noted differently.

3.7 WIRING DEVICES:

A. Wherever possible install switches directly adjacent to the strike side of door. Check architectural drawings for door swing.

C. Device mounting heights indicated below are general. Refer to drawings for special cases.

Receptacles	1’-6” AFF to bottom of device.
Switches	4’-0” AFF to top of device.
Fire Alarm-Pull Stations	4’-0” AFF to top of device.
Fire Alarm Strobes	7’-6” AFF to centerline of device.
Fire Alarm Speaker/Strobes	7’-6” AFF to centerline of device.
Data/Voice Outlets	1’-6” AFF to bottom of device.
Wall Telephone Outlets	4’-0” AFF to top of device.

C. Where receptacles and outlets are shown over counters, refer to architectural drawings for mounting heights.

D. Install receptacles vertically with grounding posts at top of device, except locate grounding post to left for horizontal mounting.

3.8 WIRING DEVICE PLATES:

A. Set plates so that all edges are in contact with mounting surface. Provide common device plate for multi-device locations.

B. Provide electric outlet and switch sealers for all receptacles, switches and technology outlets installed at exterior walls.

C. Align all wall plate screws with screw slots aligned in the vertical position.

3.9 MOTOR POWER AND CONTROL WIRING:

A. Contractor shall provide and be responsible for the complete power wiring of all motors and motorized equipment.

B. Furnish proper overload and short circuit protection for all new motors. Provide a combination thermal overload and disconnect switch for all equipment using fractional horsepower motors.

C. Check electrical connections and sizing of motor circuit protection and prevent damage to motor and equipment from incorrect direction of rotation.

D. Provide mounting for motor and equipment disconnect switches adjacent to motor and supported independent of motor.

E. Motor starters and disconnects, where grouped, shall be mounted on ¾" thick fire retardant plywood mounting boards painted with light gray fire resistant paint.

F. Provide interlock wiring where required for motors and controllers, whether shown on the drawings or not.

G. Connections to miscellaneous building equipment:

1. Wire to and connect to, all items of building equipment not specifically described in this Section but to which electrical power is required.

2. Coordinate as necessary with other trades and suppliers to verify types, numbers and locations of equipment.

3.10 GROUNDING SYSTEM:

A. Provide a complete grounding system which will thoroughly ground the non-current carrying metal parts of every piece of installed equipment, as described herein and as indicated on the drawings.

B. System shall be mechanically and electrically connected to provide an independent return path to the grounding sources.

C. Each grounding conductor shall have a minimum capacity of 25 percent of the rated capacity of the equipment it grounds, unless otherwise indicated.

D. The minimum size of grounding conductors shall be No. 12 AWG copper. Insulation color of grounding conductors shall be green.

E. Provide insulated throat grounding bushings at all feeder conduit connections to switchboards, panelboards, transformers, disconnect switches, wireways, and pull boxes. Connect grounding bushings within each enclosure, backbox, or pull box by #4 AWG bare copper bonding conductor connected to a grounding lug welded to the enclosure, backbox, wireway, or pull box.

F. Provide a separate green ground conductor for each feeder and branch circuit.

G. Grounding of Motors: Motors shall be grounded by connecting a green covered conductor from a grounding bushing in the starter to the motor frame. Conductor shall be installed in the conduit with the circuit conductors and terminated in the motor connection box, providing the terminal is mechanically connected to the frame. If this is not feasible, grounding conductor from the starter shall be extended through an insulated bushed opening in the connection box and connected to motor base.

H. Provide separately derived system grounds for transformers as called for on the drawings.

I. Provide exothermic weld ground connections as specified herein and as called for on the drawings.

J. Tests: Entire system shall be thoroughly tested on completion for ground continuity and capacity. Provide not more than 10 ohms resistance between main ground system and equipment frame system neutral and/or derived neutral point.

3.11 SPECIAL REQUIREMENTS:

A. Wiring shall be bundle tied where passing through pull boxes, wireways, and panelboards in neat and orderly manner with plastic cable ties. Cable ties shall be Ty-Raps as manufactured by Thomas & Betts, or comparable product in 3M or Leco Plastics manufacture.

B. Plenum rated cable shall be bundle tied above ceilings with plenum rated plastic cable ties in a neat and orderly manner. Cables shall be bundle tied by system to form individual cable groups for each system. Maximum distance between cable ties shall be 4 feet. Provide additional cable ties as required to prevent sagging and maintain neatness. Support cable bundles for each system separate from each other with strap hangers.

Maximum distance between strap hangers shall be 8 feet. Provide additional hangers as required to prevent sagging of cable bundles. Identify cable bundles by system with bundle tags spaced at intervals not exceeding 16 feet. Identify individual cables with numbered wire markers at termination points and at intervals not exceeding 32 feet.

C. Turn branch circuit and auxiliary system wiring out of wiring gutters at 90 degrees to circuit breakers and terminal lugs.

D. Provide two spare 1 1/2 inch conduits for flush panels. Conduits shall extend from top of each panel to one foot above hung ceilings, turn out from wall toward panel access side and terminate with nylon bushing.

E. Architectural reflected ceiling plans shall take precedence over locations of lighting fixtures shown on electrical drawings. Locate lighting switches to conform to door swings shown on architectural drawings.

F. The location of light fixtures, switches or outlets may vary due to structural considerations or due to minor changes in millwork or architectural layout. Adjustments to height or reasonable adjustments to locations of switches, outlets, lights, etc. as shown on the drawings shall be done at no additional charge.

G. Provide miscellaneous hardware and support accessories, including channels, unistrut, jack chain, support rods, nuts, bolts, screws, and other such items, with galvanized or cadmium plated finish, or other approved rust inhibiting coatings.

I. Unload electrical equipment and materials delivered to site. Pay cost for rigging, hoisting, lowering and moving electrical equipment on site, in building or on roof. During construction, provide additional protection against moisture, dust accumulation and physical damage of electrical equipment. Provide temporary heaters within units, as approved to evaporate excessive moisture and provide ventilation as required.

3.12 TESTING AND INSPECTION:

A. Provide personnel and equipment, make required tests, and secure required approvals from the Architect and governmental agencies having jurisdiction.

B. When material and/or workmanship is found to not comply with the specified requirements, within three days after receipt of notice of such non-compliance remove the non-complying items from the job site and replace them with items complying with the specified requirements, all at no additional cost to the Owner.

C. Perform all required adjustments and settings. Verify and correct deficiencies as necessary including voltages, tap settings, trip settings and phasing of equipment from distribution system to point of use.

D. Provide all necessary testing equipment.

E. Test wiring, buswork, and connections for continuity and ground by “megger” test. Minimum insulation resistance between conductors and ground shall be as follows:

1. For circuits of #14 or #12 AWG wire: 1,000,000 ohms.
2. Conductor current carrying capacities from 25 to 50 amperes, inclusive: 250,000 ohms.
3. Conductor current carrying capacities from 51 to 100 amperes, inclusive: 100,000 ohms.
4. Conductor current carrying capacities from 101 to 200 amperes, inclusive: 50,000 ohms.
5. Conductor current carrying capacities from 201 to 400 amperes, inclusive: 25,000 ohms.
6. Conductor current carrying capacities from 401 to 800 amperes, inclusive: 12,000 ohms.
7. Conductor current carrying capacities over 800 amperes: 5,000 ohms.

Submit “megger” test results to the Engineer for review.

F. Main ground electrode system shall not exceed 10 ohms unless specified otherwise.

1. Verify ground resistance by ground continuity test between main ground system and equipment frame system neutral and/or derived neutral point.

2. Perform ground continuity test by passing minimum of ten Amps DC between ground reference system and ground point. Calculate resistance by voltage drop method.

G. In the Engineer’s presence:

1. Test all parts of the electrical system and prove that all such items provided under this Section function electrically in the required manner.

H. Balance all panels as follows:

1. Turn on all lighting and equipment served by a panel and measure the current in each branch circuit phase and neutral conductor and in each phase and neutral bus-bar. Log all measurements taken and then correct imbalance by substituting branch circuits from phase to phase until optimum balance is achieved. Log all final current measurements and submit for the Engineer’s review.

2. Also measure and log voltages between each phase bus-bar and between each phase bus-bar and neutral bus-bar and submit measurements for the Engineer's review.

3.13 PROJECT COMPLETION:

A. Upon completion of the work of this Section, thoroughly clean all exposed portions of the electrical installation, removing all traces of soil, labels, grease, oil and other foreign material, and using only the type cleaner recommended by the manufacturer of the item being cleaned.

B. Vacuum all exteriors and interiors of switchboards, panelboards, safety switches, and equipment racks to remove all dust, dirt, cable clippings, etc.

C. Equipment with damage to painted finish shall be repaired to satisfaction of the Architect.

D. On the first day the facility is in operation, for at least eight hours, at a time directed by the Architect, provide a qualified foreman and crew to perform such electrical work as may be required by the Architect.

E. Thoroughly instruct the Owner's operation and maintenance personnel in the contents of the operations and maintenance manual required to be submitted under these Specifications.

END OF SECTION 260500

SECTION 262000 – SERVICE AND DISTRIBUTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. The General Provisions of the Contract, including Division 0, Contract Requirements, and Division 1, General Requirements, are a part of this Section and shall be binding on the Contractor and /or Subcontractor who performs this work. Note also all addenda.

B. Section 26 00 00, General Electrical, shall also govern the work under this Section.

C. Section 26 05 00, Basic Electrical Materials & Methods, includes requirements that are binding on this Section.

D. Examine all drawings, data, and coordinate the work of this Section with all related and adjoining work.

1.2 SCOPE OF WORK:

A. Scope of work consists of installation of materials to be furnished under this Section, and without limiting generality thereof consists of furnishing labor, materials, equipment, hoisting, plant, transportation, rigging, staging, appurtenances, and services necessary and/or incidental to properly complete all electrical work as shown on the drawings, as described in these specifications or as reasonably inferred from either as being required in opinion of the Architect and Engineer.

B. Work Included: Provide complete electrical services where shown on the drawings, as specified herein and as needed for a complete and proper installation including but not necessarily limited to:

1. Secondary electric service.
2. Panelboards.
3. Surge suppression equipment (SPD devices).
4. Starters.
5. Feeder Distribution.
6. Grounding.
7. Plywood mounting backboards.

1.3 QUALITY ASSURANCE:

A. Codes and Standards: Refer to Section 260000.

1.4 SUBMITTALS:

A. Shop Drawings: Submit for all items listed in paragraph 1.2, B.

B. For panelboard manufacturers other than the basis of design manufacturer, the Contractor shall provide ¼" scale autocad drawings of each Electrical Room showing proposed layout of transformers and panelboards along with relevant code clearances. The purpose of this requirement is to demonstrate that the proposed equipment will fit in the room allowing for code required working spaces.

1.5 METHOD OF CONDUCTOR IDENTIFICATION:

A. Provide a typewritten adhesive label with an identification legend at each panelboard identifying the color coding of the ungrounded conductors being supplied by each panelboard.

PART 2 – PRODUCTS

2.1 SERVICE APPLICATION:

A. The Contractor shall contact the utility company and shall submit a Contractors Request for Service (CRS) application for the project. All information required for this application shall be obtained and provided by the Contractor. The Contractor shall submit any additional forms that may be required by the Utility Company. The Contractor shall review the proposed installation with the Utility Company prior to starting work and shall comply with all Utility Company Construction Standards and any other requirements that may be peculiar to this project.

2.2 PRIMARY SERVICE:

A. The existing overhead primary electrical service for the building shall remain in place and shall be reused.

2.3 UTILITY COMPANY POLE MOUNTED TRANSFORMER:

A. The existing Utility Company pole mounted transformer shall be removed and replaced as required by the Utility Company.

2.4 SECONDARY ELECTRICAL SERVICE:

A. The existing overhead secondary electric service conductors shall be disconnected and removed.

B. Provide a new underground secondary electric service for the building. The new secondary electrical service will be 400 amp, 1 phase, 3 wire, 120/208 volts.

C. The new secondary service conductors will be furnished and installed by the Utility Company. Provide an underground 3” schedule 40 PVC conduit for the secondary service. Provide a 90 degree, minimum 24 inch radius, 3” galvanized steel conduit sweep at the base of the Utility pole. Provide a ¼ inch diameter nylon pulling line in the conduit. Cap the conduit and leave for connection by the Utility company.

2.5 GROUNDING:

A. Provide #2 AWG copper service ground cable in conduit and extend and connect to the domestic water service entrance pipe. If a water meter is present at this location, provide a conductor of the same type and size and bond to water pipe on both sides of the water meter. Provide #2 copper service ground cable and bond the water service entrance pipe to

the fire protection service entrance pipe and the natural gas service entrance pipe. Provide bronze ground clamps for grounding and bonding connections to the pipes.

B. Provide #2 AWG copper service ground cable in conduit to concrete encased steel reinforcing bar located within or near the bottom of a concrete foundation or footing that is in direct contact with the earth. Reinforcing bar shall consist of at least 20 feet of one bar or the equivalent length in multiple bars bonded together by steel tie wires. Reinforcing bars shall be ½" diameter or larger. Provide an exothermic weld connection to the reinforcing bar(s).

C. Refer to Section 260500 for equipment, conduit, and panelboard grounding.

2.6 PANELBOARDS:

A. Panelboards shall be furnished in Eaton (Cutler-Hammer) manufacture or comparable product in Square D or Siemens, AIC ratings as noted in the panel schedules.

B. Panelboards shall be equipped with the following features:

1. Bolt-on circuit breakers.
2. Symmetrical interiors.
3. Surface or flush trim as called for in schedule, door-in-door type.
4. Flush key catch lock.
5. Painted finish, ANSI-61 gray.
6. Metal frame/plastic cover index card holder.
7. Separate equipment ground bus.
8. Fast latch trim and jacking screw adjustment.
9. Split neutral.
10. Connection accessible from front.
11. 1000 amps per square inch density rated silver plated copper busses.
12. CU/AL ground bar.
13. 100kA surge protective device (SPD) where scheduled
13. Black face/white core engraved nameplate fixed to panel w/ two screws or rivets.

C. Indexing and Identification: After installations are complete, provide and mount under sturdy transparent shield in the directory frame of each panel door a neat, accurate and carefully typed directory properly identifying the lighting, receptacles, outlets, equipment and rooms which each branch circuit breaker controls.

D. All circuit breakers feeding mechanical equipment shall be 'HACR' rated.

E. All 15 amp and 20 amp single pole circuit breakers serving receptacle circuits shall have ground fault circuit interrupter protection for personnel (GFCI type).

2.2 CIRCUIT BREAKERS:

A. Circuit breakers shall be bolt-on type with short circuit interrupting rating as indicated in panel schedule. Circuit breakers shall be fully rated.

B. Circuit breakers shall be provided with AL/Cu lugs (cable connectors).

C. Circuit breakers serving motorized equipment shall be 'HACR' rated.

D. All 15 amp and 20 amp single pole circuit breakers serving receptacle circuits shall have ground fault circuit interrupter protection for personnel (GFCI type).

E. 20 Amp, 1-Pole circuit breakers shall be listed by the Manufacturer for use with #12AWG through #10AWG conductor sizes.

2.3 MOTOR STARTERS AND VFD'S:

A. Motor starters and variable frequency drives (VFD'S) shall be furnished by each respective trade for motor driven equipment provided by them. The Electrical Contractor shall install the starters and VFD'S, and shall provide all power wiring to the starters and VFD'S, and from the starters and VFD'S to the motors they control.

B. Motor starters and VFD'S shall conform to requirements of NEC, NEMA, UL, CSA, and ANSI and shall be suitable for the required horsepower, duty, voltage, phase, frequency, service, and location. All starters and VFD'S shall be furnished in NEMA enclosures suitable for the environment in which they are to be located.

C. All starters shall be of the same manufacture and shall be furnished in Eaton (Cutler-Hammer), Siemens, Square D, or Allen Bradley.

D. Thermal Overloads:

1. All motors 1/8 horsepower or larger shall be provided with thermal-overload protection. Thermal overloads shall be melting alloy ambient temperature compensating type.
2. Thermal overloads shall be sized in accordance with NEC requirements for the nameplate data of the motor(s) as actually delivered to the site.

E. Starters for manual control of single phase motors up to one (1) horsepower furnished without integral thermal overloads shall be combination manual disconnect switch and starters with thermal overload protection for each ungrounded leg. Starters shall be inoperable if a thermal unit is removed. These starters shall be 2-pole and shall be provided with green neon pilot light and handle guard/lock-off.

F. Starters for three phase motors shall be full voltage, circuit breaker combination magnetic starters. All circuit breaker combination magnetic starters shall include melting alloy type thermal overload protection, low voltage protection, and two (2) sets of auxiliary normally open and normally closed contacts. Thermal overload protection shall be provided in each ungrounded leg. Starters shall be inoperable if a thermal unit is removed. All circuit breaker combination magnetic starters shall be equipped with control power circuits. Provide starters with control power transformers of secondary voltage required for the control power circuitry. Provide control power transformers with primary and secondary fusing. The disconnect handle on circuit breaker combination magnetic starters shall always be in control of the disconnect device with the door opened or closed. The disconnect handle shall be clearly marked as to whether the disconnect device is "on" or "off", and shall include a two-color handle grip, the black side visible in the "off" position, and the red side visible in the "on" position.

1. All circuit breaker combination magnetic starters for manual control of three phase motors shall have start-stop push buttons in the cover and shall be provided with red and green pilot lights.
2. All circuit breaker combination magnetic starters for automatic or interlocking control of three phase motors shall have hand-off-automatic selector switches in the cover and shall be provided with red and green pilot lights.

2.5 BACKBOARDS:

A. Backboards shall be constructed of fire retardant plywood sheets 4’ x 8’ x 3/4”.

1. Paint backboards on all sides with two coats of light gray fire retardant paint prior to mounting equipment.
2. Mount backboards on unistrut channel supports.

B. Provide backboards for mounting all surface mounted electrical panels, disconnect switches, VFD’S, and motor starters.

PART 3 - EXECUTION

3.1 INSTALLATION OF CONDUITS:

A. Conduit runs overhead in building shall be run in a neat and orderly manner, parallel with and at right angles to walls. Conduits shall be racked and properly supported.

B. The contractor shall coordinate the location of all conduit runs with other trades before proceeding with installation.

3.2 PANELBOARDS:

A. Mount panels 4'-0" to panel center but with maximum height of 6'-7" to handle of topmost switching device when in its highest position.

B. Provide double locknuts and insulated throat grounding bushings on each feeder conduit entering panel, switchboard, transformer, disconnect switch, pull box, or wireway. Run No. 4 stranded bare copper ground wire through each grounding lug and connect to enclosure grounding lug.

C. For each flush mounted panel install two (2) spare 1 1/2" conduits from panel box to point above finished accessible ceiling for future use.

3.3 START-UP, TESTING, AND TRAINING

A. The contractor shall engage the equipment manufacturer’s service group to perform manufacturer’s recommended start-up procedures for the panelboards and transformer including checking cable connector/lug torques, insulation resistance testing and necessary field adjustments.

B. The equipment manufacturer’s service group shall perform a thermal scan of all breaker to cable connections, breaker to bus connections, and cable to panel chassis connections. Scope is to include transformer and panelboards. Tests are to be done with the building normally loaded for a minimum of 2 hours, not with partial or unloaded condition.

Thermal scans temperatures shall be evaluated as follows (based on comparable size or adjacent phases and loaded breakers, bus connections, and terminations)

1. 1-3 degrees C rise, Investigate as to the cause of temp rise.
2. 4 – 15 degree C rise, Repair as soon as possible.

16 or higher degree C rise, Repair immediately.

C. The contractor shall retain the equipment manufacturer's factory service group to provide a 4-hour training session for the Owners personnel. The training session will be conducted at a time designated by the Owner.

END OF SECTION 262000

SECTION 265000 - LIGHTING

PART I - GENERAL

1.1 RELATED DOCUMENTS:

A. The General Provisions of the Contract, including Division 0, Contract Requirements, and Division 1, General Requirements, are a part of this Section and shall be binding on the Contractor and /or Subcontractor who performs this work. Note also all addenda.

B. Section 26 00 00, General Electrical, shall also govern the work under this Section.

C. Section 26 05 00, Basic Electrical Materials & Methods, includes requirements that are binding on this Section.

D. Examine all drawings, data, and coordinate the work of this Section with all related and adjoining work.

1.2 SCOPE OF WORK:

A. Scope of work consists of installation of materials to be furnished under these Specifications and without limiting generality thereof consists of furnishing labor, materials, equipment, hoisting, plant, transportation, rigging, staging, appurtenances, and services necessary and/or incidental to properly complete all electrical work as shown on drawings, as described in the Specifications or as reasonably inferred from either as being required in opinion of the Architect and Engineer.

B. Work Included: Provide complete electrical services where shown on the drawings, as specified herein and as needed for a complete and proper installation including but not necessarily limited to:

1. Lighting Fixtures

1.3 QUALITY ASSURANCE:

A. Refer to Section 26 00 00.

B. All lighting fixtures shall be U.L. labeled.

1.4 WARRANTY:

A. LED Fixture Warranties: Warrant complete LED systems, including LED's, drivers, and all other system components for a period of 5 years from the date of substantial completion, against failure, variation in color temperature beyond plus/minus 200 degrees Kelvin, and depreciation of output below 70%.

1.5 SUBMITTALS:

A. Shop Drawings: Submit for all items listed in Paragraph 1.2.B.

B. Submit manufacturers catalog cuts, specifications, and lighting distribution curve for each fixture.

C. Provide fully operating samples of light fixtures for review when requested by the Engineer.

PART 2 - PRODUCTS

2.1 LAMPS:

A. Solid State Lighting/Light Emitting Diodes (LED's)

1. All individual LED's used within a luminaire must be manufactured by a reputable LED manufacturer such as Cree, Osram Sylvania, Nichia, Philips, or comparable product. LED modules shall be manufactured by Bridgelux, Philips (Fortimo), Xicato, or Cree.
2. Testing: All products shall be tested by a Nationally Recognized Testing Laboratory (NRTL) in accordance with IES LM-79 testing methods and shall carry a UL, ETL, or CSA label. Fixture manufacturer shall confirm in writing that the LED's within the fixture will not exceed the maximum temperature to which the LED die was tested using IES LM-80 testing methods.
3. Drive Current, Thermal Management, and LED Rated Life: Drivers must not overdrive the LED's beyond the LED manufacturer's recommendations and shall adhere to device manufacturer's recommendations, certification programs, and test procedures for thermal management of LED's within their fixtures. Drive current and luminaire thermal design must ensure minimum 50,000 hour rated life for the LED's.
4. Color Consistency: All LED's from the same manufacturer, both within each luminaire and from luminaire to luminaire, must be batch sorted for visual color and brightness consistency. All luminaires of the same type shall be supplied at the same time and shall come from the same batch. Spare luminaires, when required, shall be provided from the same batch.
5. Dimming: Luminaire manufacturer must provide specific data on the means of dimming for coordination of the proper control device (specified elsewhere). Acceptable methods include electronic low voltage dimming and 0-10V 4-wire dimming protocol. Dimming must provide uniform, smooth, flicker free, full range dimming. LED's must maintain consistent brightness and color throughout the dimming range.
6. Maintenance: Luminaires must be designed, except where noted differently, so that the LED components may be removed from the fixture housing and replaced if required due to component failure.
7. Technology Upgrades: Supply the newest LED technologies that are available for the specified products when the orders are released, as long as there are no increases in input watts or cost.

2.2 LED DRIVERS:

A. Provide line voltage LED product, where available, to eliminate the need for drivers. If the LED product is not available as line voltage, then the LED drivers shall meet the following requirements:

1. Drivers shall have a minimum efficiency of 85%.
2. Starting Temperature: -40 degrees Celsius.
3. Input Voltage: capable of 120 to 277 volts (+/-10%), or as required by the site.
4. Power supplies can be Class 1 or Class 2 output.
5. Surge Protection: The system must survive 250 repetitive strikes of "C Low" (6kV/1.2 x 50ms, 10kA/8 x 20ms) waveforms at 1 minute intervals with less t6han 10% degradation in clamping voltage. "C Low" waveforms are as defined in IEEE/ANSI C62.41.2-2002, Scenario 1 Location Category C.
6. Drivers shall have a Power Factor (PF) equal to or greater than 0.90.
7. Drivers shall have a Total Harmonic Distortion (THD) equal to or less than 20%.
8. Drivers shall comply with FCC 47 cfr part 18 non-consumer RFI/EMI standards.
9. Drivers shall be Reduction of Hazardous Substances (RoHS) compliant.
10. Drivers external to luminaires shall be plenum rated for use in environmental air plenums.

2.3 ACCEPTABLE LIST OF LIGHTING FIXTURE MANUFACTURERS:

A. The light fixture schedule on the drawings is intended to indicate style, quality and performance for each fixture type listed. For each light fixture type, provide the basis of design fixture, comparable product #1, or comparable product #2 as scheduled in the Light Fixture Schedule on the drawings.

B. Lighting fixture submittals shall include dimensioned diagrams, photometric data, photographs or illustration of fixture, and written specifications for each fixture type. Incomplete submittals will not be reviewed by the Engineer. At the engineer's request, the contractor shall provide table top samples of comparable product fixtures for comparison to the basis of design fixture. Failure to provide samples in a timely manner shall result in rejection of the submittal.

2.4 LIGHT FIXTURE SCHEDULE:

A. Refer to the Drawings.

B. Provide frame kits as required for fixtures recessed in sheet rock ceilings. Frame kits have not been scheduled on the drawings, but are to be provided by the Contractor as required for the installation. Refer to the architectural reflected ceiling plans for ceiling types.

2.5 EXIT SIGNS:

A. Units shall be LED light source, single or double face capability.

B. Units shall be suitable for top, end, or wall mounting.

C. Directional indicators (arrows) shall be provided where scheduled or indicated on the drawings, and shall be identifiable from a distance of 100'. Size and location of directional indicators (arrows) shall be in accordance with the Connecticut Fire Safety Code.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Each fixture shall be furnished with all necessary trims, brackets, fittings, and any other required accessories to properly install fixture.

B. Light fixtures shall be installed plumb.

C. Lay-in grid type fixtures shall be securely fastened to the framing members of the grid system in accordance with N.E.C. Article 410.

1. Fixtures shall be independently supported from the building structure at all four corners with safety wire supports. Use minimum 16 gauge galvanized steel wire.

D. Refer to the Architectural Reflected Ceiling Plans for final location of all ceiling mounted light fixtures.

END OF SECTION 265000

SECTION 283100 - FIRE ALARM SYSTEM

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.

B. Section 260000, General Electrical shall also govern the work under this Section.

C. Section 260500, Basic Electrical Materials & Methods, includes requirements that are binding on this Section.

D. Examine all drawings, data, and coordinate the work of this Section with all related and adjoining work.

1.2 DESCRIPTION:

A. This section of the specification includes the furnishing, installation, connection and testing of equipment and devices to the existing building fire alarm system. It shall include, but not be limited to alarm initiating devices, alarm notification appliances, booster power supplies, amplifiers, and wiring as shown on the drawings and specified herein.

B. The installation shall comply with requirements of NFPA Standard 72 for Protected Premises Signaling Systems except as modified and supplemented by this specification. The system shall be electrically supervised and monitor the integrity of all conductors.

C. The fire alarm manufacturer shall be of the highest caliber and insist on the highest quality. The system shall be manufactured by an ISO 9001 certified company and meet the requirements of BS EN9001: ANSI/ASQC Q9001-1994.

D. The fire alarm equipment and devices shall be manufactured 100% by a single U.S. manufacturer (or division thereof).

E. The system components shall be Underwriters Laboratories, Inc. listed under the appropriate UL testing standard as listed herein for fire alarm applications and shall be in compliance with the UL 9th listing.

F. The installing company shall employ NICET (minimum Level III Fire Alarm Technology) technicians on site to guide the final check-out and to ensure the systems integrity.

1.3 SCOPE:

A. Basic Performance:

1. Alarm, trouble and supervisory signals from all intelligent reporting devices shall be encoded on NFPA Style 7 (Class A) Signaling Line Circuits (SLC).
2. Initiation Device Circuits (IDC) shall be wired Class B (NFPA Style B) as part of an addressable device connected by the SLC Circuit.
3. Notification Appliance Circuits (NAC) shall be wired Class B (NFPA Style Y) as part of an addressable device connected by the SLC Circuit.
4. Digitized electronic signals shall employ check digits or multiple polling.

5. A single ground or open on the system signaling line circuit shall not cause system malfunction, loss of operating power or the ability to report an alarm.
6. Alarm signals arriving at the main FACP shall not be lost following a primary power failure (or outage) until the alarm signal is processed and recorded.

B. Basic System Functional Operation

The activation of any manual pull station, automatic detection device or sprinkler flow switch shall cause the fire alarm control panel to go into alarm and the following functions shall immediately occur:

1. The system alarm LED on the FACP shall flash.
2. A local piezo electric signal in the control panel shall sound.
3. A backlit 80 character LCD display on the FACP shall indicate all information associated with the fire alarm condition, including the type of alarm point and its location within the protected premises.
4. Printing on the FACP and history storage equipment shall log the information associated each new fire alarm control panel condition, along with time and date of occurrence.
5. All system output programs assigned via control-by-event interlock programming to be activated by the particular point in alarm shall be executed, and the associated system outputs (alarm notification appliances and/or relays) shall be activated.
6. All audible alarm indicating appliances shall sound a continuous signal until silenced by the alarm silence switch at the CPU.
7. System speakers shall sound an alert tone of 5 to 10 seconds duration and then shall broadcast a prerecorded English Language message which shall be repeated a minimum of four times. After completion of the prerecorded message the alert tone will return and continue until manually acknowledged or the system is reset
8. All visible alarm indicating appliances shall flash continuously within the associated building until the system is reset.

1.4 SUBMITTALS:

A. General:

1. Eight copies of all submittals shall be submitted to the Architect/Engineer for review.
2. All references to manufacturer's model numbers and other pertinent information herein is intended to establish minimum standards of performance, function and quality.

B. Shop Drawings:

1. Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications.
2. Include manufacturer's name(s), model numbers, ratings, power requirements, equipment layout, device arrangement, complete wiring point-to-point diagrams, conduit layouts, and battery calculations.
3. Submit riser diagram showing all devices and wiring requirements for the entire system. Typical diagrams will not be accepted.

C. Manuals:

1. Submit simultaneously with the shop drawings, complete operating and maintenance manuals listing the manufacturer's name(s), including technical data sheets.

2. Wiring diagrams shall indicate internal wiring for each device and the interconnections between the items of equipment.
3. Provide a clear and concise description of operation that gives, in detail, the information required to properly operate the equipment and system.

D. Software Modifications

1. Provide the services of a factory trained and authorized technician to perform all system software modifications, upgrades or changes. Response time of the technician to the site shall not exceed 4 hours.
2. Provide all hardware, software, programming tools and documentation necessary to modify the fire alarm system on site. Modification includes addition and deletion of devices, circuits, zones and changes to system operation and custom label changes for devices or zones.
3. Include in the Bid the necessary labor and equipment required to provide four (4) system wide software programming changes to meet the requirements of the Owner, Engineer, or local Fire Department.
4. The system structure and software shall place no limit on the type or extent of software modifications on-site. Modification of software shall not require power-down of the system or loss of system fire protection while modifications are being made.

E. Certifications:

1. Together with the shop drawing submittal, submit a certification from the major equipment manufacturer indicating that the proposed supervisor of the installation and the proposed performer of contract maintenance is an authorized representative of the major equipment manufacturer. Include names and addresses in the certification.

1.5 GUARANTEE:

A. All work performed and all material and equipment furnished under this contract shall be free from defects and shall remain so for a period of at least eighteen months from the date of substantial completion. The full cost of maintenance, labor and materials required to correct any defect during this 18 month period shall be included in the submittal bid.

1.6 POST CONTRACT MAINTENANCE:

A. Complete maintenance and repair service for the fire alarm system shall be available from a factory trained authorized representative of the manufacturer of the major equipment for a period of five (5) years after expiration of the guaranty.

B. As part of the submittal process, include a quote for a maintenance contract to provide all maintenance, tests, and repairs described below.

C. Maintenance and testing shall be on a semiannual basis or as required by the AHJ. A preventive maintenance schedule shall be provided by the contractor describing the protocol for preventive maintenance. The schedule shall include:

1. Systematic examination, adjustment and cleaning of all detectors, manual fire alarm stations, control panels, power supplies, relays, water flow switches and all accessories of the fire alarm system.
2. Each circuit in the fire alarm system shall be tested semiannually.

3. Each smoke detector shall be tested in accordance with the requirements of NFPA 72.

1.7 POST CONTRACT EXPANSIONS:

A. The contractor shall provide parts and labor to expand the system specified, if so requested, for a period of five (5) years from the date of acceptance.

1.8 APPLICABLE STANDARDS AND SPECIFICATIONS:

A. The specifications and standards listed below form a part of this specification. The system shall fully comply with the latest issue of these standards.

B. National Fire Protection Association (NFPA) - USA:

No. 12	CO2 Extinguishing Systems
No. 12A & 12B	Halon Extinguishing Systems
No. 15	Water Spray Systems
No. 16	Foam/Water Deluge and Spray Systems
No. 72	National Fire Alarm Code
No. 101	Life Safety Code

C. Underwriters Laboratories Inc. (UL) - USA: must comply with 9th UL Listing.

No. 268	Smoke Detectors for Fire Protective Signaling Systems
No. 864	Control Units for Fire Protective Signaling Systems
No. 268A	Smoke Detectors for Duct Applications
No. 521	Heat Detectors for Fire Protective
No. 464	Audible Signaling Appliances
No. 38	Manually Actuated Signaling Boxes
No. 346	Water flow Indicators for Fire Protective Signaling Systems
No. 1076	Control Units for Burglar Alarm Proprietary Protective Signaling Systems
No. 1971	Visual Notification Appliances

D. International Fire Code.

E. Connecticut State Fire Safety Code.

F. All requirements of the Authority Having Jurisdiction (AHJ).

1.9 APPROVALS:

A. The system shall have proper listing and/or approval from the following nationally recognized agencies:

UL	Underwriters Laboratories Inc., 9th Listing
FM	Factory Mutual
ULC	Underwriters Laboratories Canada
MEA	Material Equipment Acceptance (NYC)
CSFM	California State Fire Marshal

B. The fire alarm control panel shall meet UL Standard 864 (Control Units) and UL Standard 1076 (Proprietary Burglar Alarm Systems).

PART 2- PRODUCTS

2.1 EQUIPMENT AND MATERIAL, GENERAL:

A. All equipment shall be provided in Notifier manufacture or comparable product in EST or Siemens manufacture. All components shall be new, and the manufacturer's current model. The materials, appliances, equipment and devices shall be tested and listed by a nationally recognized approvals agency for use as part of a protected premises protective signaling (fire alarm) system. The authorized representative of the manufacturer of the major equipment shall be responsible for the satisfactory installation of the complete system.

B. All equipment and components shall be installed in strict compliance with manufacturers' recommendations. Consult the manufacturer's installation manuals for all wiring diagrams, schematics, physical equipment sizes, etc., before beginning system installation.

C. All equipment shall be attached to walls and ceiling/floor assemblies and shall be held firmly in place (e.g., detectors shall not be supported solely by suspended ceilings). Fasteners and supports shall be adequate to support the required load.

2.2 CONDUIT AND WIRE:

A. Conduit:

1. Conduit shall be in accordance with The National Electrical Code (NEC), local and state requirements.
2. Wiring shall be run in conduit for runs and drops within walls, where run overhead in rooms without ceilings (open to structure), where concealed above non-accessible ceilings (gypsum ceilings), and where exposed to view.
3. Cable must be separated from any open conductors of power, or Class 1 circuits, and shall not be placed in any conduit, junction box or raceway containing these conductors, per NEC Article 760-29.
4. Wiring for 24 volt DC control, alarm notification, emergency communication and similar power-limited auxiliary functions may be run in the same conduit as initiating and signaling line circuits. All circuits shall be provided with transient suppression devices and the system shall be designed to permit simultaneous operation of all circuits without interference or loss of signals.
5. Conduit shall be EMT with galvanized steel set screw type connectors and couplings. Conduits shall be 3/4 inch diameter minimum.

B. Wire:

1. All fire alarm system wiring shall be plenum rated type ‘FPLP’.
2. Wiring shall be in accordance with local, state and national codes (e.g., NEC Article 760) and as recommended by the manufacturer of the fire alarm system. Number and size of conductors shall be as recommended by the fire alarm system manufacturer, but not less than 16 AWG (1.02 mm) for initiating device circuits and signaling line circuits, and 14 AWG (1.63 mm) for notification appliance circuits.
3. All wire and cable shall be listed and/or approved by a recognized testing agency for use with a protective signaling system.
4. Wiring used for the SLC multiplex communication loop shall be twisted and support a minimum wiring distance of 10,000 feet. The system shall permit use of IDC and NAC wiring in the same conduit with the SLC communication loop.

5. All field wiring shall be completely supervised.

C. Terminal Boxes, Junction Boxes and Cabinets:

1. All boxes and cabinets shall be UL listed for their use and purpose.
2. All junction box covers shall be painted fire alarm red.

D. Initiating circuits shall be arranged to serve like categories (manual, smoke, water flow). Mixed category circuitry shall not be permitted except on signaling line circuits connected to intelligent reporting devices.

2.3 FIRE ALARM SYSTEM EQUIPMENT:

A. Provide fire alarm system equipment and devices where shown and called for on the drawings.

B. Fire Alarm Control Panel shall be a Notifier NFS-320 intelligent addressable fire alarm control panel.

C. Horns:

1. All horns shall operate on 25 VRMS.

D. Strobe lights shall meet the requirements of the ADA, UL Standard 1971 and shall meet the following criteria:

1. The maximum pulse duration shall be 2/10 of one second.
2. Strobe intensity shall meet the requirements of UL 1971.
3. The flash rate shall meet the requirements of UL 1971.
4. Provide DSM Sync Control Modules for all horn and strobe circuits. Sync. control modules shall provide synchronized temporal patterns (code 3) horns and synchronized strobes on all circuits.

E. Addressable Devices - General

1. Addressable devices shall use simple to install and maintain address switches.
2. Detectors shall be intelligent (analog) and addressable, and shall connect with two wires to the fire alarm control panel signaling line circuits.
3. Addressable smoke and thermal detectors shall provide dual alarm and power/polling LEDs. Both LEDs shall flash under normal conditions, indicating that the detector is operational and in regular communication with the control panel. Both LEDs shall be placed into steady illumination by the control panel, indicating that an alarm condition has been detected. If required, the LED flash shall have the ability to be removed from the system program. An output connection shall also be provided in the base to connect an external remote alarm LED.
4. Smoke detector sensitivity shall be set in the fire alarm control panel and shall be adjustable in the field through the field programming of the system. Sensitivity may be automatically adjusted by the panel on a time-of-day basis.
5. Using software in the FACP, detectors shall automatically compensate for dust accumulation and other slow environmental changes that may affect their performance. The detectors shall be listed by UL as meeting the calibrated sensitivity test requirements of NFPA Standard 72, Chapter 7.
6. The detectors shall be ceiling-mount and shall include a separate twist-lock base with tamper proof feature.

7. Detectors will operate in an analog fashion, where the detector simply measures its designed environment variable and transmits an analog value to the FACP based on real-time measured values. The FACP software, not the detector, shall make the alarm/normal decision, thereby allowing the sensitivity of each detector to be set in the FACP program and allowing the system operator to view the current analog value of each detector.
8. Detectors shall provide address-setting means using decimal switches and shall also store an internal identifying code that the control panel shall use to identify the type of device. LEDs shall be provided that shall flash under normal conditions, indicating that the device is operational and is in regular communication with the control panel.
9. A magnetic test switch shall be provided to test each detector for 100% obscuration, reported to the FACP.
10. Addressable devices shall provide address-setting means using decimal switches and shall also store an internal identifying code that the control panel shall use to identify the type of device. LED(s) shall be provided that shall flash under normal conditions, indicating that the device is operational and is in regular communication with the control panel.
11. A magnetic test switch shall be provided to test detectors and modules. Detectors shall report an indication of an analog value reaching 100% of the alarm threshold.

F. Addressable Pull Box

1. Addressable pull boxes shall, on command from the control panel, send data to the panel representing the state of the manual switch and the addressable communication module status. They shall use a key operated test-reset lock, and shall be designed so that after actual emergency operation, they cannot be restored to normal use except by the use of a key.
2. All operated stations shall have a positive, visual indication of operation and utilize a key type reset.
3. Manual stations shall be constructed of Lexan with clearly visible operating instructions provided on the cover. The word FIRE shall appear on the front of the stations in raised letters, 1.75 inches or larger.
4. Stations shall be suitable for surface mounting or semiflush mounting as shown on the plans, and shall be installed not less than 42 inches, nor more than 48 inches above the finished floor.

G. Intelligent Photoelectric Smoke Detector

1. The detectors shall use the photoelectric (light-scattering) principal to measure smoke density and shall, on command from the control panel, send data to the panel representing the analog level of smoke density.

H. Intelligent Thermal Detectors

1. Thermal detectors shall be intelligent addressable devices rated at 135 degrees Fahrenheit (58 degrees Celsius). It shall connect via two wires to the fire alarm control panel signaling line circuit. Up to 99 intelligent heat detectors may connect to one SLC loop.

I. Intelligent Duct Smoke Detector

1. The in-duct smoke detector housing shall accommodate either an intelligent ionization detector or an intelligent photoelectric detector, of that provides continuous analog monitoring and alarm verification from the panel.
2. When sufficient smoke is sensed, an alarm signal is initiated at the FACP, and appropriate action taken to change over air handling systems to help prevent the rapid distribution of toxic smoke and fire gases throughout the areas served by the duct system.
3. Each duct smoke detector shall be furnished with a remote test station and status light.

J. Addressable Dry Contact Monitor Module

1. Addressable monitor modules shall be provided to connect one supervised IDC zone of conventional alarm initiating devices (any N.O. dry contact device) to one of the fire alarm control panel SLC loops.
2. The monitor module shall mount in a 4-inch square, 2-1/8 inch deep electrical box.
3. The IDC zone may be wired for Style D or Style B operation. An LED shall be provided that shall flash under normal conditions, indicating that the monitor module is operational and in regular communication with the control panel.
4. For difficult to reach areas, the monitor module shall be available in a miniature package and shall be no larger than 2-3/4 inch x 1-1/4 inch x 1/2 inch.

K. Addressable Control Module

1. Addressable control modules shall be provided to supervise and control the operation of one conventional NACs of compatible, 24 VDC powered, polarized audio/visual notification appliances. For fan shutdown and other auxiliary control functions, the control module may be set to operate as a dry contract relay.
2. The control module shall mount in a standard 4-inch square, 2-1/8 inch deep electrical box, or to a surface mounted backbox.
3. The control module NAC may be wired for Style Z or Style Y (Class A/B) with up to 1 amp of inductive A/V signal, or 2 amps of resistive A/V signal operation, or as a dry contact (Form-C) relay. The relay coil shall be magnetically latched to reduce wiring connection requirements, and to insure that 100% of all auxiliary relay or NACs may be energized at the same time on the same pair of wires.
4. Audio/visual power shall be provided by a separate supervised power loop from the main fire alarm control panel or from a supervised, UL listed remote power supply.
5. The control module shall be suitable for pilot duty applications and rated for a minimum of .6 amps at 30 VDC.

2.4 BATTERIES:

A. The batteries shall be 55 amp-hour sealed Gel Cell type, 12 volt nominal in quantity or as required to meet project needs.

B. The battery shall have sufficient capacity to power the fire alarm system for not less than twenty-four hours supervision plus 10 minutes of alarm upon a normal AC power failure.

C. The batteries are to be completely maintenance free. No liquids are required. Fluid level checks for refilling, spills, and leakage shall not be required.

D. If necessary to meet standby requirements, external battery and charger systems may be used.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Installation shall be in accordance with the NEC, NFPA 72, local and state codes, as shown on the drawings, and as recommended by the major equipment manufacturer.

B. All conduit, junction boxes, conduit supports and hangers shall be concealed in finished areas and may be exposed in unfinished areas. Smoke detectors shall not be installed prior to the system programming and test period. If construction is ongoing during this period, measures shall be taken to protect smoke detectors from contamination and physical damage.

C. All fire detection and alarm system devices, control panels and remote annunciators shall be flush mounted when located in finished areas and may be surface mounted when located in unfinished areas.

D. Furnish and install a line isolation module at all 'T'-taps.

3.2 TEST:

A. The service of a competent, factory-trained engineer or technician authorized by the manufacturer of the fire alarm equipment shall be provided to technically supervise and participate during all of the adjustments and tests for the system. All testing shall be in accordance with NFPA 72, Chapter 7.

1. Before energizing the cables and wires, check for correct connections and test for short circuits, ground faults, continuity, and insulation.
2. Close each sprinkler system flow valve and verify proper supervisory alarm at the FACP.
3. Verify activation of all water flow switches.
4. Open initiating device circuits and verify that the trouble signal actuates.
5. Open and short signaling line circuits and verify that the trouble signal actuates.
6. Open and short notification appliance circuits and verify that trouble signal actuates.
7. Ground all circuits and verify response of trouble signals.
8. Check presence and audibility of tone at all alarm notification devices.
9. Check installation, supervision, and operation of all intelligent smoke detectors using the walk test.
10. Each of the alarm conditions that the system is required to detect should be introduced on the system. Verify the proper receipt and the proper processing of the signal at the FACP and the correct activation of the control points.
11. When the system is equipped with optional features, the manufacturer's manual shall be consulted to determine the proper testing procedures. This is intended to address such items as verifying controls performed by individually addressed or grouped devices, sensitivity monitoring, verification functionality and similar.

3.3 FINAL INSPECTION:

A. At the final inspection, a factory trained representative of the manufacturer of the major equipment shall demonstrate that the system functions properly in every respect.

3.4 PROGRAMMING:

A. System device addresses shall be based on the owners chosen room numbering system. The contractor shall obtain the final room numbers from the architect and owner prior to system programming. All system devices shall be labeled by the contractor with the device address using a Dymo labeling machine. Labels shall be black numerals (3/32” numeral height) on clear background.

B. Provide all system programming as required to meet the specified operation. In Addition, include in the bid for 4 additional system-wide software programming changes to meet the requirements of the Owner, Engineer, or local Fire Department.

3.5 INSTRUCTION:

A. Instruction shall be provided as required for operating the system. Hands-on demonstrations of the operation of all system components and the entire system including program changes and functions shall be provided.

B. The contractor and/or the systems manufacturer's representatives shall provide a typewritten "Sequence of Operation" to the owner.

END OF SECTION 283100

SECTION 31 2310

EARTHWORK

PART 1 GENERAL

1.1 SUMMARY

A. Section includes:

1. Preparation and grading subgrades for slabs-on-grade, walks, pavements, and landscaping.

2. Excavating and backfilling for structures.

3. Excavation and backfilling for underground utilities and associated appurtenances.

4. Excavation, backfill and compaction for the demolition/removal of subsurface utilities and improvements.

5. Earth retention systems.

B. Contractor shall coordinate work between all Subcontractors, sections, and trades required for the proper completion of the work.

C. Contractor is responsible for all health and safety.

1.2 GENERAL

A. Contractor is advised that lines and grades, as shown on the Drawings, are subject to change. Although it is intended to adhere to what is shown on Drawings, Engineer reserves the right to make changes in lines and grades of utilities or other subsurface construction when such changes may be necessary or advantageous.

B. In open trenching on public roadways, Contractor shall be governed by the conditions, restrictions and regulations made by the local or state authority as applicable. All such regulations shall be in addition to those set down in the Specifications.

1.3 EXCAVATION CLASSIFICATIONS

A. Excavation - Excavation shall be unclassified and no consideration will be given to the nature of the materials. Excavation shall comprise and include the satisfactory removal and disposal of all materials encountered regardless of the nature of the materials and shall be understood to include but not limited to earth, fill, boulders, foundations, pavements, curbs, piping, cobbles, stones, footings, bricks, concrete, previously abandoned drainage structures and utility structures abandoned and not removed by the utility and debris.

B. Common Excavation - Excavation of all materials that can be excavated, moved, loaded, transported, and unloaded using heavy equipment or that can be excavated and dumped into place or loaded onto hauling equipment by excavation equipment (shovel, bucket, backhoe, dragline, or clam shell) or moved with dozer-type equipment, appropriate to the material type, character, and nature of the materials. The presence of isolated boulders or rock fragments larger than 1 cubic yard is not in itself sufficient cause to change the classification of the surrounding material. All Common Excavation shall be included in the Base Bid.

C. Rock Excavation - Rock Excavation as defined herein. The excavation and removal of isolated boulders or rock fragments larger than 1 cubic yard encountered in materials otherwise conforming to the definition of Common Excavation shall be classified as rock excavation. The presence of isolated boulders or rock fragments larger than 1 cubic yard is not in itself sufficient cause to change the classification of the surrounding material.

1.4 REFERENCES

A. Reference herein to any technical society, organization, group or regulation are made in accordance with the following abbreviations and, unless otherwise noted or specified, all work under this Section shall conform to the latest edition as applicable.

B. State of Connecticut Department of Transportation (ConnDOT)

1. Standard Specifications for Roads, Bridges, Facilities and Incidental Construction, Form 817, 2016 and any supplements.

C. Code of Federal Regulations (CFR)

1. 29 CFR 1926, Safety and Health Regulations for Construction

D. American Concrete Institute (ACI)

1. ACI 229R-99 - Controlled Low-Strength Materials (CLSM).

E. American Association of State Highway and Transportation Officials (AASHTO)

1. AASHTO Method T 90 - Determining the Plastic Limit and Plasticity Index of Soils.

2. AASHTO T104 - Standard Method of Test for Soundess of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate.

3. AASHTO Method T146 - Standard Method of Test for Wet Preparation of Disturbed Soil Samples for Test.

F. ASTM International (ASTM).

1. ASTM D422 - Standard Test Method for Particle-Size Analysis of Soils.

2. ASTM D1556 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method.

3. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3(2,700 kN-m/m3)).

4. ASTM D2487 - Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System).

5. ASTM D2922 - Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

6. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).

7. ASTM D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

1.5 DEFINITIONS

A. Backfill: Soil material or flowable concrete used to fill an excavation.

B. Bedding Course: Layer placed over the excavated sub-grade in a trench before laying pipe.

C. Benching: A method of limiting cave-in potential by excavating the sides of an excavation to form one or a series of horizontal levels or steps, usually with vertical or near-vertical surfaces between levels.

D. Borrow: Satisfactory soil imported from off-site for use as fill or backfill.

E. Clearing: Clearing shall consist in the felling, cutting up, and satisfactory disposal of trees and other vegetation designated for removal in accordance with these specifications.

F. Drainage Course: Layer supporting basement grade used to minimize capillary flow of pore water.

G. Earth Retention Systems: Any structural system, such as sheeting and bracing or cofferdams, designed to retain in-situ soils in place and prevent the collapse of the sides of an excavation in order to protect employees and adjacent structures.

H. Excavation: Any man-made cut, cavity, trench, or depression in an earth surface, formed by earth removal.

1. Additional Excavation: Excavation beyond required dimensions or below subgrade elevations that is requested and/or directed by Engineer. Additional Excavation and replacement material will be paid for according to Contract provisions for changes in the Work.

2. Bulk Excavation: Excavations more than 10 feet in width and pits more than 30 feet in either length or width.

3. Unauthorized Excavation: Excavation below the elevations specified on the plans, beyond the limits indicated on the plans, or where no dimensions are indicated, beyond depths, elevations, and dimensions reasonably necessary for construction of the work without the request and/or direction of the Engineer. Unauthorized excavation, as well as any remedial work directed by Engineer, or if applicable Geotechnical Engineer, shall be without additional compensation.

I. Fill: Soil materials used to raise existing grades.

J. Finished Grade: The proposed final elevations shown on the Drawings or called for in the Specifications.

K. Geotechnical Engineer: A qualified and licensed entity designated for the project as the authority on the assessment, design, and oversight of soil and/or rock conditions and construction affected by such conditions.

L. Geotechnical Testing Agency: An independent testing agency employed by Owner, or by Contractor is called-for, and qualified according to ASTM E 329 to conduct soil materials and rock-definition testing, as documented according to ASTM D 3740 and ASTM E 548.

M. Grubbing: Grubbing shall consist of the removal of roots 1 ½ inch and larger, organic matter and debris, and stumps having a diameter of three inches or larger, to a depth of at least 18 inches below the surface and or subgrade; whichever is lower, and the disposal thereof.

N. Protective System: A method of protecting employees from cave-ins, from material that could fall or roll from an excavation face or into an excavation, or from the collapse of adjacent structures. Protective systems include earth retention systems, sloping and benching systems, shield systems, and other systems that provide the necessary protection.

O. Regular Excavation: Removal and disposal of any and all material above subgrade elevation, except solid rock and undercut excavation, located within the limits of construction.

P. Rock: Solid ledges, bedded deposits, unstratified masses and conglomerations of material so firmly cemented as to possess the characteristics of solid rock which cannot be removed without systematic drilling or hoe ramming. All boulders containing a volume of more than one (1) cubic yard shall be considered rock.

Q. Rock Excavation: Removal and satisfactory disposal of Rock, which, in the opinion of Engineer, cannot be excavated except by drilling, wedging, jack hammering or hoe ramming or the excavation of boulders or rock fragments containing a volume of more than one (1) cubic yard. The presence of isolated boulders or rock fragments larger than 1 cubic yard is not in itself sufficient cause to change the classification of the surrounding material.

R. Licensed Professional Engineer: A person who is licensed as a professional engineer in the state where the work is to be performed. However, a professional engineer, registered in any state is deemed to be a "registered professional engineer" within the meaning of this standard when approving designs for "manufactured protective systems" or "tabulated data" to be used in interstate commerce.

S. Satisfactory Materials: Earth material that meets the classification, use, and/or gradation requirements herein that does not contain limestone, shale, clay, ash, slag, friable material, organic or vegetative materials, topsoil, wood, trash, broken concrete, masonry rubble, trash, refuse, or frozen materials.

T. Shield System: A structure that is designed to withstand the forces imposed on it by a cave-in and thereby protects employees within the structure. Shields can be permanent structures or can be designed to be portable and moved along as work progresses. Additionally, shields can be either pre-manufactured or job-built in accordance with 29 CFR 1926.652(c)(3) or (c)(4). Shields used in trenches are usually referred to as "trench boxes" or "trench shields."

U. Sloping: A method of protecting employees from cave-ins by excavating to form sides of an excavation that are inclined away from the excavation so as to prevent cave-ins. The angle of incline required to prevent a cave-in varies with differences in such factors as the soil type, environmental conditions of exposure, and application of surcharge loads.

V. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

W. Sub-grade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below drainage fill.

X. Surplus Material: Excavated acceptable material that cannot be utilized elsewhere on the site as backfill or embankment fill, or as otherwise directed by the Engineer.

Y. Temporary Dewatering System: A system to lower and control water to maintain stable, undisturbed subgrades at the lowest excavation levels. Dewatering shall be provided for all pipelines, structures and for all other miscellaneous excavations.

Z. Testing Laboratory: A qualified entity engaged to perform specific laboratory tests.

AA. Testing Agency: A qualified entity engaged to collect samples, perform specific in-field tests, and/or inspections. The Testing Laboratory may provide the services of the Testing Agency.

BB. Trench: A narrow excavation (in relation to its length) made below the surface of the ground. In general, the depth is greater than the width, but the width of a trench (measured at the bottom) is not greater than 15 feet.

CC. Unsatisfactory Material: Soil material that contains organic silt, peat, vegetation, wood or roots, stones or rock fragments over six (6) inches in diameter or exceeding 40 percent by weight of the backfill material, porous biodegradable matter, loose or soft fill, construction debris, or refuse, or material which cannot be compacted to the specified or indicated density.

1.6 SUBMITTALS

A. Testing Laboratory - Submit name and qualifications of commercial testing laboratory for Engineer's approval. Submit applicable documentation of credentials, licenses, etc.

B. Testing Agency - Submit name and qualifications of third-party in-field quality control Testing Agency for Engineer's approval. Submit applicable documentation of credentials, licenses, etc.

C. Site Characterization of Off-Site Borrow Sources: The following information shall be submitted to Engineer for review at least two weeks prior to use of an off-site borrow source:

1. Location and name of the borrow source site.

2. Owner and contact information for the borrow source site.

3. Present and past usage of the source site and materials.

4. Any previously existing report(s) associated with an assessment of the source site as relates to the presence of oils, hazardous materials, or other organic and non-organic constituents which may be considered contaminants.

5. Location within the site from which the material will be obtained.

D. Chemical Testing Data: For each type/classification of earth material proposed and each source of earth material proposed: Submit a letter signed by an authorized representative of material supplier stating that such proposed material is free of oils, hazardous materials, or other organic and non-organic constituents which may be considered contaminants.

E. Material Testing Data: Provide results for all proposed bedding, fill, aggregates, and backfill. Submit complete laboratory reports.

1. Gradation analysis.

2. Soil classification and Moisture-Dry Density Curve.

3. Loss on Abrasion.

4. Soundness.

F. Samples: 50-pound sample of each type of off-site bedding, fill, aggregates, and backfill that are proposed for use at the Project Site in an air-tight container for the testing laboratory, a minimum of two weeks prior to delivery of such material to the site. Use of these proposed materials by Contractor prior to testing and approval or rejection shall be at Contractor's risk.

G. Product Data

1. Plastic warning tape.

2. Separation fabric, filter fabric, geogrids, or similar geotextiles.

H. Field Testing Results

1. Compaction test results keyed to date and specific location of testing. Provide Engineer with copies of testing reports within 24 hours of field test.

1.7 SAFETY

A. Contractor shall conduct all excavation activities in conformance with applicable regulations, including those relating to warning signs, excavation safety, sheeting, shoring, and stabilization.

B. Contractor shall provide and maintain barricades, signs, lights, etc., required for the protection of personnel, materials and property. Temporary barricades, etc. shall conform all applicable codes and regulations, and shall be lighted at night with lanterns, flares and reflectorized paint as required for safety. Adapt barricades, signs, lights, etc. to evolving site conditions throughout the progress of the work.

C. Provide other safety devices as required, including adaptation of such safety devices to changing site conditions, to prevent unauthorized entry to construction areas and open excavations. Provide warning signs and other temporary construction safety devices necessary for proper completion of the work in compliance with applicable safety regulations.

D. Contractor shall properly design and furnish all labor, materials, equipment, and tools necessary to construct permanent or temporary excavation support systems, including, but not necessarily limited to, sheet piling, trench shields, trench boxes, timber trench shoring, pneumatic/hydraulic shoring, steel sheeting or sheeting using other materials, sloping, and benching.

E. Any time an excavation is to remain open, at a minimum, provide full enclosure with safety barriers and fencing, warning signs, and additional safety control measures as appropriate for the condition.

1.8 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and methods required

for proper performance of the work in this Section. Use equipment of adequate size, capacity and quantity to accomplish the work of this Section in a timely manner.

B. Utility Mark-out

1. Prior to commencing work, comply with utility mark-out requirements of the Call-Before-You-Dig System (1-800-922-4455).

2. Verify the location of all subsurface utilities marked through the Call-Before-You-Dig System.

3. Not all subsurface facilities or structures will be identified through the Call-Before-You-Dig System. Confirm the location of other subsurface utilities and other subsurface facilities or structures prior to commencing work. Field-mark utilities as required.

C. Codes and Standards: Perform the work of this Section in accordance with all applicable codes, standards, and the requirements of authorities having jurisdiction.

D. Engineer reserves the right to perform all in-field testing specified in this Section and reserves the right to determine the suitability of all materials to be used for fills and reject any fill not meeting the specifications.

E. Field Density testing and subgrade observation shall be performed by the designated entity

F. Weather Limitations:

1. Material excavated when frozen or when air temperature is less than 32 degrees Fahrenheit (32 F) shall not be used as fill or backfill until material completely thaws.

2. Material excavated during inclement weather shall not be used as fill or backfill until after material drains and dries sufficiently for proper compaction.

G. Vibration

1. Vibration producing activities such as operation of heavy construction equipment, vibratory compaction, etc. may be required. Contractor is advised that structures are located close to the proposed work and that construction activities shall be conducted so as to preclude damage to these structures and undue annoyance to occupants.

2. Contractor has liability for, and shall bear all costs associated with, any damage caused to existing structures, buildings and/or services as a result of any construction activity. This extends to responding to any claims of vibration-induced damage. It is Contractor's sole decision how to manage the risk of vibration-induced damage, and what, if any, surveys, monitoring, or other activities are undertaken.

1.9 TESTING

A. All sampling and testing shall be the responsibility of Contractor via Testing Agency and Testing Laboratory as applicable. Contractor shall retain and pay for the services of such Testing Agency/Testing Laboratory to perform all pre-construction testing and field testing in accordance with applicable standards.

B. The Owner will retain a testing entity to perform sampling and testing of the work under this Section during construction. The testing entity's presence does not constitute supervision or direction of Contractor's work. Neither the presence of the testing entity nor any observations and testing performed by him, nor any notice or failure to give notice shall excuse Contractor from conformance with these Specifications or from defects discovered in his work. Contractor shall remain responsible for all pre-construction sapling and testing.

C. Borrow and Fill: Contractor shall provide testing as defined below.

1. Gradation analysis for each type of borrow and on-site fill materials by ASTM D422.

2. Soil classification (ASTM D2487) and Moisture-Dry Density Curve (Proctor Test-Modified) by ASTM D1557 for all proposed fill and backfill materials at the frequency specified below:

a. For suitable soil materials removed during Trench Excavation, perform one test for every 1,000 cubic yards of similar soil type. Similarity of soil types will be as determined by the Engineer.

b. For borrow materials, perform tests from each proposed source, at a rate of one test for every 1,000 cubic yards of soil type. Similarity of soil types will be as determined by the Engineer.

3. Loss on Abrasion: Where called-for, AASHTO Method T 96.

4. Soundness: Where called-for, AASHTO Method T 104.

D. Compaction Testing: [Contractor shall conduct] [Owner will conduct] compaction testing (i.e. ASTM D2922 and ASTM D3017 or ASTM D1556) at the frequency indicated below.

1. Trench: 1 test per lift, every 1,000 square feet or 200 feet of trench.

2. Embankment: 1 test per lift, every 1,000 square feet.

3. Additional compaction testing may be required when there is evidence of a change in the quality of moisture control or the effectiveness of compaction.

4. If all compaction test results within the initial 25% of the total anticipated number of tests indicate compacted field densities equal to or greater than 95% of maximum dry density at optimum moisture content, Engineer may reduce frequency of compaction testing. In no case will the frequency be reduced to less than one test for every 500 cubic yards of material backfilled.

5. Contractor is cautioned that compaction testing by nuclear methods may not be effective where trenches are so narrow that trench walls impact the attenuation of the gamma radiation or where oversize particles (i.e. large cobbles or coarse gravels) are present. In these cases, other field density testing methods may be required.

6. If testing indicates that compacted subgrade, backfill, or fill are below specified density, additional compaction and/or replacement of material shall be provided at no expense to Owner.

E. Chemical Testing: Prior to delivery of any earth material to the Project Site, Contractor shall conduct chemical testing to demonstrate that such material is free of oils, hazardous materials, or other organic and non-organic constituents which may be considered contaminants.

1.10 EXCAVATED MATERIAL

A. Placement

1. Excavated material shall be so placed as not to interfere with travel or movement on existing streets, driveways, sidewalks or other areas designated to remain undisturbed. Excavated material shall not be deposited on private property without the written consent of the property owner(s) and approval of Engineer.

2. No excavated material shall be stored on top of installed pipe, other subsurface construction, or within the drip-line of trees.

3. Contractor shall consider surcharge loads when stockpiling excavated material adjacent to excavations, and take any measure required to prevent cave-in, including but not limited to, excavation support systems and/or alternative stockpiling locations.

B. Satisfactory Material excavated at the Project Site may be used for Common Fill or Backfill on other parts of the Work, if specifically approved by Engineer. Engineer or Geotechnical Engineer shall determine what is Satisfactory Material or Unsatisfactory Material where questions arise.

C. Contractor shall be responsible for the proper disposal of all Unsatisfactory Material. Engineer or Geotechnical Engineer shall determine what is Satisfactory Material or Unsatisfactory Material where questions arise.

1.11 SHEETING, SHORING AND BRACING

A. Provide earth retention systems as required by federal, state and local regulations. Shoring and bracing of trenches and other excavations shall be in accordance with the latest OSHA Standards and interpretations, and all other applicable codes, rules and regulations of federal, state and local authorities.

1.12 DRAINAGE

A. At all times during construction, Contractor shall temporarily provide, place and maintain ample means and devices with which to remove promptly, and dispose of properly, all water entering trenches and other excavations, or water that may flow along or across the site of the Work, and keep said excavations dry until the structures, pipes, and appurtenances to be built therein have been completed to such extent that they will not be damaged. At the conclusion of the work, Contractor shall remove such temporary means and devices.

B. All groundwater which may be found in the trenches and foundation excavations, and any water which may get into them from any cause whatsoever, shall be pumped or bailed out, so that the trench shall be dry during pipe laying and backfilling and during the placement of concrete.

C. All water pumped or drained from the Work shall be managed in accordance with applicable discharge permits, without undue interference with other work or damage to pavements, other surfaces, or property.

1.13 COORDINATION

A. Prior to commencing earthwork operations, meet with representatives of governing authorities, Engineer, testing entity, and other pertinent entities.

1. Review earthwork procedures and responsibilities including Contractor's schedule of operations, scheduling observation and testing procedures and requirements.

2. Notify participants at least three (3) working days prior to convening conference. Record discussions and agreements and furnish copies to each participant.

3. Contractor shall at all times so conduct his work as to insure the least possible inconvenience to the general public and the residents in the vicinity of the work. Fire hydrants on or adjacent to the work shall be kept accessible to firefighting equipment at all times. Temporary provisions shall be made by Contractor to ensure the proper functioning of all gutters, sewer inlets, and drainage ditches, which shall not be obstructed except as approved by Engineer.

B. Benchmark/Monument Protection: Protect and maintain benchmarks, monuments or other established reference points and property corners. If disturbed or destroyed, replace at no cost to Owner.

C. Provide five (5) days advance notice to Engineer and testing entity for any proposed earthwork operation requiring observation and/or testing.

PART 2 PRODUCTS

2.1 SOIL MATERIALS

A. All materials used in the work of this Section shall be Satisfactory Material, and any material that does not meet this classification shall be considered an Unsatisfactory Material and shall not be used.

B. Unsatisfactory Soils: Soil materials not meeting the requirements for Satisfactory Soils.

1. Unsatisfactory soils also include satisfactory soils not maintained within two (2) percent of optimum moisture content at time of compaction.

2.2 COMMON FILL/ORDINARY BORROW

A. Earth materials classified by ASTM D 2487 as GW, GP, GM, GP-GM, GW-GM, GP-GC, SW, SP, and SM that are free of clay and with less than twenty (20) percent of material by weight that passes the No. 4 sieve passing the No. 200 sieve.

B. Common Fill material is subject to the approval of Engineer and may be either material removed from excavations or borrow from off site. It shall have physical properties such that it can be readily spread and after it has been placed and properly compacted, it will form a dense, stable fill.

C. Common Fill shall not be used at locations where use of a specific earth material is called-for.

2.3 BANK RUN GRAVEL

A. Granular material, well graded from fine to coarse, obtained from approved natural deposits and unprocessed, except for the removal of unacceptable material and stones larger than the maximum size permitted.

B. Bank Run Gravel shall be graded as follows:

Gradation of Bank Run Gravel (ConnDOT Grading “C”)

Sieve	Percent Passing by Weight
1 ½”	100
¾”	45-80
¼	25-60
No. 10	15-45
No. 40	5-25
No. 100	0-10
No. 200	0-5

2.4 GRANULAR FILL

A. Broken or crushed stone, gravel, or a mixture thereof.

B. Broken or crushed stone

1. The product resulting from the artificial crushing of rocks, boulders or large cobblestones, substantially all faces of which have resulted from the crushing operation. Broken or crushed stone shall consist of sound, tough, durable stone, reasonably free from soft, thin, elongated, laminated, friable, micaceous or disintegrated pieces.

C. Bank or crushed gravel

1. Sound, tough, durable particles of crushed or uncrushed gravel, free from soft, thin, elongated or laminated pieces and vegetable or other deleterious substances. Crushed gravel shall be the manufactured product resulting from the deliberate mechanical crushing of gravel with at least 50% of the gravel retained on the No. 4 sieve having at least one fractured face.

D. Granular Fill shall be graded as follows:

Gradation of Granular Fill (ConnDOT Grading “A”)

Sieve	Percent Passing by Weight
3 ½”	100
1 ½”	55-100
1/4”	25-60
No. 10	15-45
No. 40	5-25
No. 100	0-10
No. 200	0-5

E. Reclaimed material shall not be considered acceptable for use as granular fill.

2.5 SCREENED GRAVEL AND CRUSHED STONE

A. Screened gravel, well graded in size from 3/8 inch to 3/4 inch. The gravel shall consist of clean, hard, and durable particles or fragments. Crushed rock of suitable size and grading may be used instead of screened gravel.

B. Screened Gravel shall be graded as follows:

Gradation of Screened Gravel (ConnDOT Gradation No. 6)

Sieve	Percent Passing by Weight
1”	100
3/4”	90-100
1/2”	20-55
3/8”	0-15
No. 4	0-5

2.6 SUBBASE

A. Bank or Crushed Gravel

1. Sound, tough, durable particles of crushed or uncrushed gravel, free from soft, thin, elongated or laminated pieces. It shall be hard and durable enough to resist weathering, traffic abrasion and crushing.

2. Bank or crushed gravel for subbase shall be graded as follows:

Gradation of Bank or Crushed Gravel Subbase (ConnDOT Gradation “B”)

Sieve	Percent Passing by Weight
5”	100
3 1/2”	90-100
1 1/2”	55-95
1/4”	25-60
No. 10	15-45
No. 40	5-25
No. 100	0-10
No. 200	0-5

B. Crusher-Run Stone

1. Sound, tough, durable broken stone. It shall be reasonably free from soft, thin, elongated, laminated, friable, micaceous or disintegrated pieces.

2. Loss on Abrasion: The crusher-run stone shall show a loss on abrasion of not more than fifty percent using AASHTO Method T 96.

3. Crusher-run stone shall for subbase shall be graded as follows:

Gradation of Crusher Run Stone Subbase (ConnDOT Gradation “A”)

Sieve	Percent Passing by Weight
3 1/2”	100
1 1/2”	55-100
1/4”	25-60
No. 10	15-45
No. 40	5-25
No. 100	0-10
No. 200	0-5

2.7 PROCESSED AGGREGATE BASE

A. Coarse aggregates and fine aggregates shall be combined and mixed by approved methods so that the resulting material shall conform to the following gradation:

Gradation of Processed Aggregate Base

Sieve	Percent Passing by Weight
2 1/2”	100
2”	95-100
3/4”	50-75
1/4”	25-45
No. 40	5-20
No. 100	2-12

B. Coarse Aggregate: Either gravel, broken stone or a combination thereof. When tested by means of the Los Angeles Machine, using AASHTO Method T 96, the coarse aggregate shall not have a loss of more than 50%.

1. If gravel is used for the coarse aggregate, it shall consist of sound, tough, durable particles of crushed or uncrushed gravel or a mixture thereof, free from soft, thin, elongated or laminated pieces, lumps of clay, loam and vegetable or other deleterious substances.

2. If broken stone is used for the coarse aggregate, it shall consist of sound, tough, durable fragments of rock of uniform quality throughout. It shall be free from soft disintegrated pieces, mud, dirt, organic or other injurious material.

3. Soundness for Gravel and Broken Stone: When tested by magnesium sulfate solution for soundness using AASHTO Method T 104, the coarse aggregate shall show a loss of not more than 15% at the end of 5 cycles.

C. Fine Aggregate: Natural sand, stone sand, screenings or any combination thereof. The fine aggregate shall be limited to material 95% of which passes a No. 4 (4.75-mm) sieve having square openings and not more than 8% of which passes a No. 200 (75-µm) sieve. The material shall be free from clay, loam and deleterious materials.

1. Plasticity: When natural sand is used, the fine aggregate shall conform to the following:

a. When the fraction of the dry sample passing the No. 100 mesh sieve is 4% or less by weight (mass), no plastic limit test will be made.

b. When the fraction of the dry sample passing the No. 100 mesh sieve is greater than 4% and not greater than 8% by weight (mass), that fraction shall not have sufficient plasticity to permit the performing of the plastic limit test using AASHTO Method T 90.

c. When the fraction of the dry sample passing the No. 100 mesh sieve is greater than 8% by weight (mass), the sample will be washed; and the additional material passing the No. 100 mesh sieve shall be determined by AASHTO Method T 146, except that the No. 100 mesh sieve will be substituted for the No. 40 mesh sieve where the latter is specified in AASHTO Method T 146. The combined materials that passed the No. 100 mesh sieve shall not have sufficient plasticity to permit the performing of the plastic limit test using AASHTO Method T 90.

2. Plasticity: When screenings or any combination of screenings and natural sand or any combination of stone sand and natural sand are used, the following requirements shall apply:

a. When the fraction of the dry sample passing the No. 100 mesh sieve is 6% or less by weight (mass), no plastic limit test will be made.

b. When the fraction of the dry sample passing the No. 100 mesh sieve is greater than 6% and not greater than 10% by mass, that fraction shall not have sufficient plasticity to permit the performing of the plastic limit test, using AASHTO Method T 90.

c. When the fraction of the dry sample passing the No. 100 mesh sieve is greater than 10% by weight (mass), the sample shall be washed; and additional material passing the No. 100 mesh sieve shall be determined by AASHTO Method T 146,

except that the No. 100 mesh sieve shall be substituted for the No. 40 mesh sieve where the latter is specified in AASHTO Method T 146. The combined materials that have passed the No. 100 mesh sieve shall not have sufficient plasticity to permit the performing of the plastic limit test using AASHTO Method T 90.

2.8 BEDDING

A. Slabs on grade

1. Granular Fill unless otherwise indicated.

B. [Utilities- Refer to applicable utility Specifications.]

C. [Utilities]

1. [Unless otherwise indicated, bedding shall consist of screened gravel, maximum size 3/4 inches and minimum size 3/8 inches.]

2. [Unless otherwise indicated, naturally or artificially graded mixture of natural or crushed gravel, crushed stone and natural or crushed sand; ASTM D 2940; except with 100 percent passing a 1-inch sieve and not more than 8 percent passing a No. 200 sieve.]

3. [Thermoplastic Pipe: Unless otherwise indicated, ASTM D2321, bedding, haunching, and initial backfill material shall be placed in six-inch lifts and be Class IA, IB, or II embedment material unless otherwise approved by Engineer.]

4. [When clay, wet, soft or silty soil conditions prevail, 3/4-inch crushed stone shall be used for bedding of pipe.]

2.9 SAND

A. Sand shall consist of clean, hard, durable, uncoated particles of quartz or other rock. It shall not contain more than 3% of material finer than a #200 sieve.

B. Organic Impurities: Fine aggregate subjected to the colorimetric test shall not produce a color darker than Gardner Color Standard No. 11, using AASHTO T 21. If the fine aggregate fails to meet this requirement, the provisions of AASHTO M 6, Section 5.2, will govern.

C. Sand shall be uniformly graded as follows:

Gradation of Sand

Sieve	Percent 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

D. The above gradation represents the extreme limits which shall determine suitability for use from all sources of supply. The gradation from any one source shall be reasonably uniform and not

subject to the extreme percentages of gradation specified above. For the purpose of determining the degree of uniformity, a fineness modulus determination will be made upon representative samples from any source. Fine aggregate from any one source having a variation in fineness modulus greater than 0.20 either way from the fineness modulus of the representative sample will be rejected.

2.10 FLOWABLE CONCRETE FILL/BACKFILL (FLOWFILL)

A. Cementitious material, ACI 229R, comprised of cement, aggregates, fly ash, water, and admixtures, capable of being poured or pumped, self-leveling, self-curing to specified strengths.

B. Excavatable flowfill: Concrete strength shall be liquid enough to flow, be self-leveling and excavatable by hand methods. Unless otherwise specified, excavatable flowfill shall have a minimum 28 day compressive strength of 30 psi, and shall not exceed 100 psi.

C. Non-excavatable flowable: Concrete strength shall be liquid enough to flow and be self-leveling and excavatable by machine equipment. Unless otherwise specified, non-excavatable flowfill shall have a minimum 28-day compressive strength of 125 psi, and shall not exceed 200 psi.

2.11 DETECTABLE WARNING TAPE

A. Acid and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, minimum 6 inches wide and 4 mils thick, continuously inscribed with a description of utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored as follows:

1. Red: Electric power lines, electric power conduits and other electric power facilities.

2. Yellow: Gas, oil petroleum products, steam, compressed air, compressed gas and all other hazardous materials.

3. Blue: Water.

4. Orange: Communication lines or cables, including but not limited to telephone, fire signals, cable television, and electronic controls.

5. Green: Storm drainage and sanitary sewer systems, including force mains and other non-hazardous materials.

6. Brown: Chilled Water and Other.

PART 3 EXECUTION

3.1 PREPARATION

A. Notify “Call-Before-You-Dig” to request a utility mark-out for the Project Site prior to any earth disturbance. Provide written confirmation to Engineer that such mark-out has been completed.

B. Verify site conditions before proceeding with demolition work. Field check the accuracy of the Drawings and inspect structures, utilities, and other site features prior to start of work and notify Engineer in writing, of any discrepancies or hazardous conditions.

C. Take precautions for preventing injuries to persons or damage to property in or about the work. Protect structures, utilities, sidewalks, pavements and other improvements from damage caused by settlement, lateral movement, undermining, washout and other hazards created by earthwork operations.

D. Protect sub-grades and foundation soils against freezing temperatures or frost. Provide protective insulating materials as necessary.

E. Provide erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

F. When excavations are to be made in paved surfaces, the pavement shall be removed so as to provide a clean uniform edge with a minimum disturbance of remaining pavement. Saw cutting the pavement to provide a clean, uniform edge shall unless otherwise indicated.

G. If pavement is removed in large pieces, it shall not be mixed with other excavated material, but shall be disposed of away from the site of the Work before the remainder of the excavation is made.

3.2 CLEARING AND GRUBBING

A. Clear, grub, remove, and dispose of all vegetation and debris within the limits of construction, as designated on the plans or as required by Engineer. Contractor shall remove only those trees and shrubs absolutely necessary to allow for the construction. The work shall also include the preservation from injury of defacement of all vegetation or object designated to remain.

3.3 PROTECTION OF EXISTING FEATURES

A. General

1. Protect all existing improvements from damage unless those improvements are specifically designated for permeant removal, relocation, or temporary removal and replacement.

2. As excavation approaches underground structures, digging by machinery shall be discontinued and the excavation shall be done by means of hand tools.

3. Pavements: On paved surfaces to remain, do not use or operate tractors, bulldozers, or other power operated equipment, the treads or wheels of which are so shaped as to cut or otherwise damage such surfaces. All surfaces, which have been damaged by Contractor's operations, shall be restored to a condition at least equal to that in which they were found immediately prior to the beginning of operations. Suitable materials and methods shall be used for such restoration.

B. Utilities

1. Existing utilities remaining in service, including those remaining in service until after relocation, and relocated utilities shall be protected from damage. Before excavating near any existing utilities, notify the utility owner, coordinate protective work and comply with the utility owners' requirements. Coordinate with respective utility owners/operators as required.

2. Safeguard and protect from damage or movement any existing services, utilities, and utility structures uncovered or encountered which are to remain in service.

3. All utility services shall be supported by suitable means so that the services shall not fail when tamping and settling occurs.

4. Where known utilities are encountered, notify Engineer and document location and type of utility before proceeding with work in such area.

5. When uncharted or incorrectly charted piping or utilities are encountered during excavation, stop work and notify Engineer immediately. Cooperate with the utility owners in maintaining their utilities in operation prior to resuming work.

C. Retaining Structures: Provide bracing, shoring, sheeting, sheet piling, underpinning or other retaining structures necessary to guard against any movement or settlement of existing or new construction, utility systems, paving, or other improvements. Assume responsibility for the strength and adequacy of retaining structures, and for the safety and support of construction, utilities or paving, and for any movement, settlement or damage thereto. Retain the services of a licensed engineer as required to design bracing, shoring, sheeting, sheet piling, underpinning or other retaining structures.

D. Replacement and Relocation

1. In case of damage, Contractor shall notify the appropriate party so that proper steps may be taken to repair any and all damage done. When the Owner does not wish to make the repairs themselves, all damage shall be repaired by Contractor, or, if not promptly done by him, Engineer may have the repairs made at the expense of Contractor.

2. If certain existing structures are encountered that in the opinion of Engineer require temporary or permanent relocation or removal, Engineer may order in writing that Contractor undertake all or part of such work or to assist the Owner in performing such work. For such occurrences, Contractor shall be compensated as applicable, as extra work.

3. In removing existing structures, Contractor shall use care to avoid damage to the material, and Engineer shall include for payment only those new materials, which, in his judgment, are necessary to replace those unavoidably damaged.

4. The structures to which the provisions of the preceding two paragraphs shall apply include structures which (1) are not indicated on the Drawings or otherwise provided for, (2) encroach upon or are encountered near and substantially parallel to the edge of the excavation, and (3) in the opinion of Engineer will impede progress to such an extent that satisfactory construction cannot proceed until they have been changed in location, removed (to be later restored), or replaced. (See Item 3.19, "Sub Surface Obstructions" also).

3.4 DEWATERING

A. Comply with all applicable permit requirements.

B. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrade and from flooding Project site and surrounding area.

C. Protect sub-grades from softening, undermining, washout and damage by rain or water accumulation.

1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.

2. Install de-watering system to keep subgrades dry and convey ground water away from excavations.

3.5 EXCAVATION

A. Dust Control: During the progress of the Work, Contractor shall conduct his operations and maintain the area of his activities in order to minimize the creation and dispersion of dust. Refer to Section 01 5714- Temporary Dust Control.

B. Excavate to the exact elevations shown on the plans, or as directed by Engineer. Where no dimensions are indicated, make excavations in such manner, and to such depths, elevations, and dimensions, that will give suitable room for construction of the work indicated on the Drawings. As applicable for utility installations, comply with trench limits shown on the Drawings.

C. Furnish and place all sheeting, bracing, and supports, and render the bottom of the excavation firm and dry, and in all respects, acceptable for construction of the work.

D. If Contractor excavates below the elevations specified on the plans, beyond the limits indicated on the plans, or where no dimensions are indicated, beyond depths, elevations, and dimensions reasonably necessary for construction of the work, Contractor shall bring the excavation back to the proper elevation and/or dimension by backfilling with Suitable Material that is approved by Engineer in accordance with the backfilling provisions specified herein. Engineer, or if applicable Geotechnical Engineer, shall have sole authority in determining the specific composition of such Suitable Material.

1. Any increase in cost resulting from Unauthorized Excavation, including but not necessarily limited to backfilling, haul-off, increasing the size of footings or foundations, testing, schedule impact, or administrative impact shall be at Contractor's sole expense.

E. If utilities are to be laid in new embankments, or other new fill areas which are more than 12 inches deep below the invert of the pipe, the fill material shall be placed and properly compacted to final grade or to a height of at least 3 feet above the top elevation of the pipe, whichever is the lesser, before laying pipe. Particular care shall be taken to ensure maximum consolidation of material under the pipe location. The pipe trench shall then be excavated as though in undisturbed material.

3.6 TRENCH EXCAVATION

A. In general, trenches shall be excavated to such depth as will provide a cover depth as indicated on the Drawings from finished grade to the top of the pipe barrel. Deeper trenches shall be provided where necessary on account of the conformation of the ground and to permit the alignment of the pipe without undue deflection of joints.

B. Trenches shall be excavated by hand or machinery to the width and depth indicated on the Drawings and specified herein. Depth shall account for thickness of the pipe and thickness of bedding. All loose materials shall be removed from the bottom of the trench so that the bottom of the trench will be in an undisturbed condition.

C. If in the opinion of Engineer, the material at or below the depth to which excavation for structures and pipes would normally be carried is unsuitable for foundation, it shall be removed to such widths and depths as directed and replaced with suitable material.

D. Trench widths shall be 3 feet greater than the nominal inside diameter of pipe for such diameters of 36 inches or less. For diameters greater than 36 inches, the width shall be 4 feet greater than nominal inside diameter. Trench excavation for manholes, catch basins, drop inlets, etc. shall be two (2) feet outside the neat lines of the foundations. These limits may be adjusted for field conditions at the direction of Engineer.

E. Bedding for pipe and utility structures will be as detailed on the Drawings.

3.7 APPROVAL OF SUBGRADE

A. Notify Engineer, and Geotechnical Engineer if applicable, when excavations have reached required subgrade elevation.

B. If Engineer and, if applicable, Geotechnical Engineer determines that Unacceptable Material is present, continue excavation of such Unacceptable Material and replace with approved Satisfactory Materials as directed. The replacement of Unacceptable Material with Satisfactory Materials will be paid for as a change in the work according to applicable provisions of the contract.

C. Protect subgrade from disturbance at all times. Reconstruct sub-grades damaged by freezing temperatures, frost, rain, accumulated water or construction activities, as directed by Engineer. Excavation and replacement with structural fill of any disturbed or softened materials resulting from inadequate preparation, inadequate dewatering, or inadequate protection, shall be at Contractor's sole expense.

3.8 TUNNELING

A. In general, excavation shall be made in open cut from the surface and Contractor shall not be allowed to do any tunneling without obtaining permission from Engineer, and then only according to methods approved by him, and at no additional cost to the Owner. This permission will only be given where a line is to be laid to a point behind the curb, across a paved street, or where, in the opinion of the Engineer, it is necessary to tunnel short sections on account of proximity of adjacent walls, utilities, structures, to avoid important roots of trees or large masses of roots, or to ensure against root damage endangering the life of trees near the pipeline location. Such excavations then can be made in alternate sections of open cut and tunnel, the length of the tunnel sections to be specified by Engineer. These tunnel sections shall be cut underneath to a wedge with its edge horizontally across the pipe, and backfilled tightly by ramming and tamping from each end.

3.9 FILL AND BACKFILL

A. Fill: Contractor shall remove loam and topsoil, loose vegetable matter, stumps, large roots, etc., from areas upon which embankments will be built or material will be placed as fill to adjust subgrade prior to final grading. The subgrade shall be prepared by forking, furrowing, or plowing such that the first layer of the new material placed thereon, will be well bonded to it.

B. Backfill: Common Fill material may be used as backfill when indicated on the Drawings or when authorized by Engineer (or as applicable Geotechnical Engineer) if Contractor can achieve required minimum dry density after compaction. Backfilling shall be done as promptly as is consistent with non-injury to pipe or structures, but no backfilling shall be done before Engineer (or as applicable Geotechnical Engineer) gives permission.

C. Frozen material shall not be placed in any fill or backfill, nor shall any fill or backfill be placed upon frozen material. Previously frozen material shall be removed, or shall be otherwise treated as required, before new fill or backfill is placed.

D. After the subgrade has been prepared, fill material shall be placed thereon and built up in successive layers not exceeding twelve (12) inches before compaction until it has reached the required elevation.

1. When gravel fill or other material is used for foundation of structures, it shall be spread in layers of uniform thickness not exceeding six (6) inches before compaction.

E. Upon completion of filling and backfilling, all surplus material shall be removed and surfaces to remain which are affected in any way by the work restored to the condition in which they were before ground was broken. All surplus materials shall become the property of Contractor. If Contractor fails to promptly remove such surplus materials, Engineer may have the same done and charge all associated costs to Contractor, including deduction from payments due.

3.10 BACKFILLING UTILITIES

A. As soon as practical after utility has been placed into bedding and joints properly made, backfilling shall begin, and shall continue without delay.

B. Placement of bedding over pipe prior to placement of backfill shall be as indicated on the Drawings. Hand-place bedding at the sides of the pipe and to the limits indicated on the Drawings over the pipe. Bedding placed over pipe shall be in 6-inch layers, leveled along the length and width of the trench and thoroughly compacted with approved tampers.

C. Install warning tape as indicated o the Drawings unless otherwise specified by the utility owner/operator.

3.11 BACKFILLING AT STRUCTURES

A. No backfill shall be deposited against concrete until the concrete has obtained sufficient strength to withstand the earth pressure placed upon it and in no case less than seven days, nor before carrying out and satisfactorily completing the tests for watertight structures specified elsewhere.

B. Prior to placing backfill, subgrade shall be thoroughly compacted. Soft or loose material evident during compaction shall be removed and replaced with Granular Fill.

C. Fill placed around arches, rigid frames, box culverts and piers shall be deposited on both sides of the structure to approximately the same elevation at the same time. Each layer of backfill shall be spread to a thickness not exceeding 6 inches deep after compaction and shall be thoroughly compacted by the use of power rollers or other motorized vehicular equipment, by tamping with mechanical rammers or vibrators, or by pneumatic tampers. Any equipment not principally manufactured for compaction purposes or which is not in proper working order in all respects shall not be used within the area described above.

D. Bring backfill to sub-grade elevations. Slope backfill at exterior of building to drain water away from building.

3.12 COMPACTION

A. Each layer of fill or backfill material shall be compacted by the use of compaction equipment consisting of rollers, compactors or a combination thereof. Earth-moving and other equipment not specifically manufactured for compaction purposes will not be considered as compaction equipment. At such points as cannot be reached by mobile mechanical equipment, or where such equipment is not permitted, the materials shall be thoroughly compacted by the use of suitable power- driven tampers.

B. Previously placed or new materials shall be moistened by sprinkling, if required, to ensure proper bond and compaction. No compacting shall be done when the material is too wet, from either rain or application of water, to compact it properly. At such times the work shall be suspended until the previously placed and new materials have dried out sufficiently to permit proper compaction, or such other precautions shall be taken as may be necessary to obtain proper compaction.

C. Special attention shall be given to compaction in places close to walls where motorized vehicular compaction equipment cannot reach. Within 3 feet of the back face of walls and within a greater distance at angle points of walls, each layer of backfill shall be compacted by mechanical rammers, vibrators or pneumatic tampers.

D. Each layer of fill or backfill shall be compacted at optimum moisture content. No subsequent layer shall be placed until the specified compaction is obtained for the previous layer.

E. Compaction Density: Compaction density shall be expressed as a percentage of maximum dry density at optimum moisture content according to ASTM D 1557 Method C. Density indicated is minimum required.

1. Under structures, building slabs, and steps: 95 %

2. At building foundations: 95 %

3. Utilities, below pipe centerline: 95%

4. Utilities below unpaved surface, above pipe centerline: 92%

5. Utilities below paved surface, above pipe centerline: 95%

6. Embankments: 92%

7. Landscaped areas: 90 %.

8. Natural grass athletic fields and similar recreational fields: 93%

3.13 SUBSURFACE OBSTRUCTIONS

A. As a general rule, sub-surface obstructions encountered along the route of the pipeline shall be considered as follows:

1. Crossing Obstruction: All pipes, conduits, wires, etc. of whatever nature whose centerline lies at an angle of 20 degrees or greater to the centerline of the pipe being installed shall

be considered as crossing obstructions and shall be protected, or repaired or replaced if damaged, or relocated, all at no additional cost to the Owner.

2. Interfering Obstructions: All pipes, conduits, wires, etc. of whatever nature whose centerline lies at an angle of less than 20 degrees, but more than 5 degrees to the centerline of the pipe being installed, shall be considered as interfering obstructions. Costs for supporting such obstructions in place during installation of the new pipe shall be paid for by the Owner. Costs for supporting interfering obstructions shall not be construed to include any costs for excavation. Repairing or replacing damaged interfering obstructions, or relocation shall be accomplished at no additional cost to the Owner.

3. Parallel Obstructions: All pipes, conduits, wires, etc. of whatever nature whose centerline lies at an angle of 5 degrees or less, or is truly parallel and less than 0.5 feet offset from outside the normal trench limits, as specified in Subarticle 3.5 B. of this Section, of the pipe being installed, shall be considered parallel obstructions. Costs for supporting such obstructions in place during installation of the new pipe, including excavation, may be paid for by the Owner, or Owner may elect to pay for the cost of replacing such obstructions. Should Owner first elect to pay the cost of supporting the obstruction and then elect to pay the cost of replacing the obstruction, approved costs for supporting the obstruction, including excavation, incurred prior to electing replacement costs shall also be paid. After Owner elects to pay replacement costs, only replacement costs will be paid for all additional work in the vicinity of the parallel obstruction.

4. Angle measurement between centerline of obstructing pipe, conduit, wire, etc. and centerline of the pipe being installed shall be taken from between the horizontal projection of the centerlines at ground surface. Parallel offset distance between centerline of obstructing pipe, conduit, wire, etc. and the outside of normal trench limits of the pipe being installed shall be taken from between the horizontal projection of the centerlines and outside trench limit at ground surface.

END OF SECTION

SECTION 31 2313

PREPARATION OF SUBGRADE/FINE GRADE

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. Preparation of the top surface of the roadbed, after all grading has been substantially completed and all pipes/conduits laid, to accommodate the placement of the pavement structure and gutters in accordance with these specifications and in conformity with the lines, grades and typical cross-sections as shown on the Contract Drawings.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.1 PREPARATION OF SUBGRADE

A. All soft and yielding material, and other portions of the subgrade which will not compact readily when rolled, vibrated or tamped, shall be removed and replaced with suitable material. The surface shall be compacted uniformly with a minimum of four (4) complete coverages using an approved power roller having a minimum compression of 300 pounds per inch of width of tread on the rear wheel, and weighing not less than 10 tons, or with an equivalent vibratory roller or compactor.

B. When more than one compacting unit is used, the unit exerting the greatest compactive effort shall be used to make the initial compaction. Any portion of the subgrade, which is not accessible to a roller or other compacting unit, shall be compacted thoroughly with hand tampers or with approved mechanical vibrators.

C. Contractor shall notify the engineer for inspection of the subbase in driveway prior to placement of the base course.

3.2 FINE GRADING

A. After compaction, the top surface of the subgrade shall be fine graded so that it shall not extend above, nor more than 1/2 -inch below, true grade and surface at any location. The subgrade shall not be muddy or otherwise unsatisfactory when pavement/base/subbase is placed upon it. If the fine grade of the subgrade becomes rutted or displaced due to any cause whatsoever, the Contractor shall regrade same at his own expense.

3.3 PROTECTION OF SUBGRADE

A. Contractor shall protect the subgrade from damage by exercising such precautions, as Engineer may deem necessary. At all times, the subgrade surface shall be kept in such condition that it will drain readily and correctly. The subgrade shall be checked and approved before any pavement structure is placed thereon.

END OF SECTION

SECTION 312316

EXCAVATION FOR UTILITIES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. Excavation, backfill and compaction for the installation of utilities.

B. Contractor shall coordinate work between all Subcontractors, sections, and trades required for the proper completion of the work.

1.2 GENERAL

A. Contractor shall make all excavations for utility structures and trenches as required for installation of the various facilities. The locations of utilities are shown on the Drawings.

B. Contractor is advised that lines and grades, as shown on the plans, are subject to change. Although it is intended to adhere to what is shown on plans, Engineer reserves the right to make changes in lines and grades of pipe and locations of manholes when such changes may be necessary or advantageous.

C. Trench excavation, sheeting, and bracing shall be carried out in such a manner as to eliminate any possibility of undermining or disturbing the foundations of any existing structure or any work previously completed under this Contract, or as specified herein.

D. Contractor shall backfill all excavations as necessary, as indicated on the Drawings and as specified herein.

E. In open trenching on local roadways, Contractor shall be governed by the conditions, restrictions and regulations made by the local or state authority as applicable. All such regulations shall be in addition to those set down in the specifications.

1.3 EXCAVATION CLASSIFICATIONS

A. Excavation - Excavation shall be unclassified and no consideration will be given to the nature of the materials. Excavation shall comprise and include the satisfactory removal and disposal of all materials encountered regardless of the nature of the materials and shall be understood to include but not limited to earth, fill, foundations, pavements, curbs, piping, railroad track and ties, cobblestones, footings, bricks, concrete, previously abandoned drainage structures and utility structures abandoned and not removed by the utility and debris.

B. Rock Excavation - Rock shall be defined for payment purposes as stone or hard shale in original ledge, boulders over two (2) cubic yards in volume in open areas and one (1) cubic yard in volume in trenches, and masonry or concrete that cannot be broken or removed by normal job equipment (power shovels, scoops, or bulldozers with ripper attachment) without the use of explosives or drills. The classification does not include materials that can be removed by means other than drilling and blasting or drilling and wedging but which, for reasons of economy in excavating, the Contractor prefers to remove by drilling and blasting. The word "trenches" shall mean excavation having vertical sides the depths of which exceed the width, made for drain, sewer, water, and gas pipes; electric and steam conduits; and the like.

1.4 REFERENCES

A. Code of Federal Regulations (CFR)

1. 29 CFR 1926, Safety and Health Regulations for Construction.

B. State of Connecticut Department of Transportation (ConnDOT)

1. Standard Specifications for Roads, Bridges and Incidental Construction, Form 816, 2004.

C. ASTM International (ASTM)

1. ASTM D698 - Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 [600 kN-m/m3]).
2. ASTM D1556 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method.
3. ASTM D1557-02e1 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3(2,700 kN-m/m3)).
4. ASTM D2487 - Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System).
5. ASTM D2922 - Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
6. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).

1.5 DEFINITIONS

A. Benching - A method of protecting employees from cave-ins by excavating the sides of an excavation to form one or a series of horizontal levels or steps, usually with vertical or near-vertical surfaces between levels.

B. Earth Retention Systems - Any structural system, such as sheeting and bracing or cofferdams, designed to retain in-situ soils in place and prevent the collapse of the sides of an excavation in order to protect employees and adjacent structures.

C. Excavation - Any man-made cut, cavity, trench, or depression in an earth surface, formed by earth removal.

D. Protective System - A method of protecting employees from cave-ins, from material that could fall or roll from an excavation face or into an excavation, or from the collapse of adjacent structures. Protective systems include earth retention systems, sloping and benching systems, shield systems, and other systems that provide the necessary protection.

E. Registered Professional Engineer - A person who is registered as a professional engineer in the state where the work is to be performed. However, a professional engineer, registered in any state is deemed to be a "registered professional engineer" within the meaning of this standard when approving designs for "manufactured protective systems" or "tabulated data" to be used in interstate commerce.

F. Shield System - A structure that is designed to withstand the forces imposed on it by a cave-in and thereby protects employees within the structure. Shields can be permanent structures or can be designed to be portable and moved along as work progresses. Additionally,

shields can be either pre-manufactured or job-built in accordance with 29 CFR 1926.652(c)(3) or (c)(4). Shields used in trenches are usually referred to as "trench boxes" or "trench shields."

G. Sloping - A method of protecting employees from cave-ins by excavating to form sides of an excavation that are inclined away from the excavation so as to prevent cave-ins. The angle of incline required to prevent a cave-in varies with differences in such factors as the soil type, environmental conditions of exposure, and application of surcharge loads.

H. Trench - A narrow excavation (in relation to its length) made below the surface of the ground. In general, the depth is greater than the width, but the width of a trench (measured at the bottom) is not greater than 15 feet (4.6 m).

I. Unacceptable Material - Soil material that contains organic silt, peat, vegetation, wood or roots, stones or rock fragments over 6 inches in diameter or exceeding 40 percent by weight of the backfill material, porous biodegradable matter, loose or soft fill, construction debris, or refuse, or material which cannot be compacted to the specified or indicated density.

J. Surplus Material - Excavated acceptable material that cannot be utilized elsewhere on the site as backfill or embankment fill, or as otherwise directed by the Engineer.

1.6 DESCRIPTION OF THE WORK

A. Contractor shall make excavations in such manner, and to such widths, as will give suitable room for installation of utilities, laying and joining pipe, but complying with the trench limits shown on the drawings; shall furnish and place all sheeting, bracing, and supports; and shall render the bottom of the excavation firm and dry, and in all respects, acceptable.

B. In no case, except as provided for in the paragraph titled "Trench Limits", shall the earth be plowed, scraped, or dug by machinery so near to the finished grade as to result in disturbance of material below said grade. The last of the material to be excavated shall be removed with pick and shovel just before placing pipe, masonry, or other structures.

C. All excavations, except as otherwise specified or permitted, shall be open cut. The extent of excavation open at any one time will be controlled by Engineer. Contractor shall not have more than fifty (50) feet of trench open at any one time at each location during daylight hours or twenty (20) feet at night, unless otherwise approved. Excavation geometry should conform to OSHA Regulations contained in 29 CFR, Part 1926, dated October 1989, or the latest revision thereof.

D. No tunneling will be permitted, except as provided elsewhere in these specifications.

1.7 SAFETY REQUIREMENTS

A. Contractor shall conduct all excavation activities in conformance with applicable regulations, including those relating to excavation safety, sheeting, shoring, and stabilization.

B. Contractor shall provide and maintain barricades, signs, lights, etc., required for the protection of personnel, materials and property. Temporary barricades, etc. shall conform all applicable codes and regulations, and shall be lighted at night with lanterns, flares and reflectorized paint as required for safety. Adapt barricades, signs, lights, etc. to evolving site conditions throughout the progress of the work.

C. Provide other safety devices as required, including adaptation of such safety devices to changing site conditions, to prevent unauthorized entry to construction areas and open excavations. Provide warning signs and other temporary construction safety devices

necessary for proper completion of the work in compliance with applicable safety regulations.

1.8 QUALITY CONTROL

A. Use adequate numbers of skilled workmen who are trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and methods required for proper performance of the work in this Section. Use equipment of adequate size, capacity and quantity to accomplish the work of this Section in a timely manner.

B. Engineer reserves the right to perform all in-field testing specified in this Section and reserves the right to determine the suitability of all materials to be used for fills and reject any fill not meeting the specifications.

C. All excavation, filling and compacting operations shall be monitored by the designated entity.

D. Field Density testing and subgrade observation shall be performed by the designated entity

E. Weather Limitations:

1. Material excavated when frozen or when air temperature is less than 32 degrees Fahrenheit (32° F) shall not be used as fill or backfill until material completely thaws.

2. Material excavated during inclement weather shall not be used as fill or backfill until after material drains and dries sufficiently for proper compaction.

1.9 PROTECTION OF EXISTING UTILITIES

A. Existing utilities remaining in service, including those remaining in service until after relocation, and relocated utilities shall be protected from damage. Before excavating near any existing utilities, notify the utility owner, coordinate protective work and comply with the utility owners' requirements. Safeguard and protect from damage or movement any existing services, utilities and utility structures uncovered or encountered which are to remain in service.

1. Where known utilities are encountered, notify Engineer and document location and type of utility before proceeding with work in such area.

2. When uncharted or incorrectly charted piping or utilities are encountered during excavation, stop work and notify Engineer immediately. Cooperate with the utility owners in maintaining their utilities in operation prior to resuming work.

B. Retaining Structures: Provide bracing, shoring, sheeting, sheet piling, underpinning or other retaining structures necessary to guard against any movement or settlement of existing or new construction, utilities, paving, light standards, piping or conduit. Assume responsibility for the strength and adequacy of retaining structures, and for the safety and support of construction, utilities or paving, and for any movement, settlement or damage thereto.

1.10 SEPARATION OF SURFACE MATERIALS

A. When excavations are to be made in paved surfaces, the pavement shall be removed so as to provide a clean uniform edge with a minimum disturbance of remaining pavement. Saw cutting the pavement to provide a clean, uniform edge shall normally be required, unless otherwise approved in the Contract.

B. If pavement is removed in large pieces, it shall not be mixed with other excavated material, but shall be disposed of away from the site of the Work before the remainder of the excavation is made.

C. The attention of the Contractor is directed to the specifications for replacing pavement.

1.11 EXCAVATED MATERIAL

A. Excavated material shall be so placed as not to interfere with travel or movement on existing streets, driveways, sidewalks or other areas designated to remain undisturbed. Excavated material shall not be deposited on private property until written consent of the owner, or owners thereof, has been filed Engineer.

B. It is expressly understood that no excavated materials shall be removed from the site of the Work or disposed of by Contractor, except as directed or approved by Engineer, or as noted below.

C. Suitable excavated material may be used for common fill or backfill on other parts of the Work, if specifically approved by Engineer.

D. Upon completion of the backfilling, the streets or property shall be cleaned, surplus material removed and the surfaces restored to the condition in which it was before ground was broken. All materials left over in public roadways shall become the property of the Contractor. If the Contractor fails to promptly remove such surplus material, Engineer may have the same done, and charge the cost thereof as money paid to the Contractor.

E. Material excavated from private property shall belong to the property Owner, or his representative, and shall be disposed of by the Contractor, as required by said Owner or his representative. If the Contractor fails to promptly remove such surplus material, Engineer may have the same done and charge the cost thereof as money paid to the Contractor.

F. Contractor shall be responsible for the proper disposal of all unsuitable excavated materials. Engineer shall determine what is suitable or unsuitable material where questions arise. Generally, unsuitable material shall include, but not be limited to, pavement (bituminous and concrete), large boulders, pipe, conduit and metal.

G. Contractor shall submit to Engineer, for approval, the location(s) to be utilized during the Contract period for waste material disposal. This approval must occur before any export of waste material from the project site. Any change in the disposal site during construction shall be submitted for approval.

1.12 SHEETING, SHORING AND BRACING

A. Provide earth retention systems as required by federal, state and local regulations. Shoring and bracing of trenches and other excavations shall be in accordance with the latest OSHA Standards and Interpretations, and to all other applicable codes, rules and regulations of federal, state and local authorities.

1.13 DRAINAGE

A. At all times during construction, Contractor shall temporarily provide, place and maintain ample means and devices with which to remove promptly, and dispose of properly, all water entering trenches and other excavations, or water that may flow along or across the site of the Work, and keep said excavations dry until the structures, pipes, and appurtenances to be built therein have been completed to such extent that they will not be damaged. At the conclusion of the work, Contractor shall remove such temporary means and devices.

B. Every precaution necessary to obtain watertight construction of all joints in pipe must be taken. The same precaution must be taken for all connections with hand holes, manholes and "Y" branches, extensions of laterals and construction of drop connections.

C. All groundwater which may be found in the trenches, and any water which may get into them from any cause whatsoever, shall be pumped or bailed out, so that the trench shall be dry during pipe laying and backfilling and during the placement of concrete.

D. All water pumped or drained from the Work shall be filtered in a Dewatering Settling Basin prior to discharge to existing storm drains, or to ground, and in a manner satisfactory to Engineer, without undue interference with other work or damage to pavements, other surfaces, or property.

1.14 SUBMITTALS

A. Submit to Engineer, material specifications for all earthen materials furnished under this Section.

B. If requested by Engineer, submit representative samples of earthen materials furnished under this Section.

PART 2 PRODUCTS

2.1 SOIL MATERIALS

A. Satisfactory fill materials shall include materials classified by ASTM D 2487 as GW, GP, GM, GP-GM, GW-GM, GC, GP-GC, SW, and SP.

B. Satisfactory fill materials shall not contain shale, clay, slag, friable material, trash, refuse, vegetation, roots, frozen materials, or stones over 6 inches in diameter. Organic matter shall not exceed minor quantities and shall be well distributed.

1. Materials for grading comprise stones less than eight (8) inches, except for fill material for pavements and railroads which comprise stones less than three (3) inches in any dimension.

C. Excavated surface and/or pavement materials such as gravel or trap rock that are salvaged may be used as a sub-grade material. In no case shall salvaged materials be substituted for required gravel base.

2.2 COMMON FILL/ORDINARY BORROW

A. Common Fill material is subject to the approval of Engineer and may be either material removed from excavations or borrow from off site. Material shall be mineral soil substantially free from organic materials, topsoil, wood, trash, and other objectionable materials which may be compressible or which cannot be properly compacted. It shall have physical properties such that it can be readily spread and compacted during filling.

1. Common Fill shall not contain rocks or lumps larger than six (6) inches in largest dimension, and not more than 15 percent of the rocks or lumps shall be larger than 2-½ inches in largest dimension. It shall not contain granite blocks, broken concrete, masonry rubble, or other similar materials.

2. Common Fill material, whether from excavations or from borrow, shall be of such nature that after it has been placed and properly compacted, it will make a dense, stable fill.

Percent of material by weight passing Number 200 sieve shall not exceed twenty percent (20%).

3. Common Fill shall not be used at locations where use of select fill is indicated.

2.3 BANK RUN GRAVEL

A. Granular material, well graded from fine to coarse, obtained from approved natural deposits and unprocessed, except for the removal of unacceptable material and stones larger than the maximum size permitted.

B. Bank Run Gravel shall be graded as follows:

Gradation of Bank Run Gravel (ConnDOT Grading “C”)

Sieve	Percent Passing by Weight
1 ½”	100
¾”	45-80
¼	25-60
No. 10	15-45
No. 40	5-25
No. 100	0-10
No. 200	0-5

2.4 GRANULAR FILL

A. Broken or crushed stone, gravel, reclaimed miscellaneous aggregate or a mixture thereof.

1. Broken or crushed stone shall be the product resulting from the artificial crushing of rocks, boulders or large cobblestones, substantially all faces of which have resulted from the crushing operation. Broken or crushed stone shall consist of sound, tough, durable stone, reasonably free from soft, thin, elongated, laminated, friable, micaceous or disintegrated pieces, mud, dirt or other deleterious material and shall be sized as indicated in this Article.

2. Bank or crushed gravel shall consist of sound, tough, durable particles of crushed or uncrushed gravel, free from soft, thin, elongated or laminated pieces and vegetable or other deleterious substances. It shall be sized to ConnDOT Grading “A” as indicated in this Article and the requirements for plasticity and resistance to abrasion indicated herein. Crushed gravel shall be the manufactured product resulting from the deliberate mechanical crushing of gravel with at least 50% of the gravel retained on the No. 4 (4.75-millimeter) sieve having at least one fractured face.

3. Granular Fill shall be graded as follows:

Gradation of Granular Fill (ConnDOT Grading “A”)

Sieve	Percent Passing by Weight
3 ½”	100
1 ½”	55-100
1/4”	25-60
No. 10	15-45
No. 40	5-25
No. 100	0-10
No. 200	0-5

2.5 SCREENED GRAVEL AND CRUSHED STONE

A. Screened gravel, well graded in size from 3/8 inch to 3/4 inch. The gravel shall consist of clean, hard, and durable particles or fragments, free from dirt, vegetable, or other objectionable matter. Crushed rock of suitable size and grading may be used instead of screened gravel.

B. Screened Gravel shall be graded as follows:

Gradation of Screened Gravel (ConnDOT Gradation No. 6)

Sieve	Percent Passing by Weight
1”	100
3/4”	90-100
1/2”	20-55
3/8”	0-15
No. 4	0-5

2.6 SAND

A. Sand shall consist of clean, hard, durable, uncoated particles of quartz or other rock, free from lumps of clay, soft or flaky material, loam, organic or other injurious material. In no case shall sand containing lumps of frozen material be Used. It shall not contain more than 3% of material finer than a #200 (75 µm) sieve, using AASHTO T 11.

B. Organic Impurities: Fine aggregate subjected to the colorimetric test shall not produce a color darker than Gardner Color Standard No. 11, using AASHTO T 21. If the fine aggregate fails to meet this requirement, the provisions of AASHTO M 6, Section 5.2, will govern.

C. Gradation: Fine aggregate shall be uniformly graded from coarse to fine and shall meet the following gradation requirements.

Gradation of Sand

Sieve	Percent 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

D. The above gradation represents the extreme limits which shall determine suitability for use from all sources of supply. The gradation from any one source shall be reasonably uniform and not subject to the extreme percentages of gradation specified above. For the purpose of determining the degree of uniformity, a fineness modulus determination will be made upon representative samples from any source. Fine aggregate from any one source having a variation in fineness modulus greater than 0.20 either way from the fineness modulus of the representative sample will be rejected.

2.7 PROCESSED AGGREGATE

A. Coarse and fine aggregates shall be combined and mixed by approved methods to produce Processed Aggregate.

B. Processed Aggregate shall meet the following gradation requirements.

Gradation of Processed Aggregate

Sieve	Percent Passing by Weight
2 1/2"	100
2”	95-100
3/4”	50-75
1/4”	25-45

No. 40	5-20
No. 100	2-12

C. Coarse Aggregate: Coarse aggregate shall be either gravel, broken stone or reclaimed miscellaneous aggregate containing no more than 2% by weight (mass) of asphalt cement, at the option of the Contractor. When tested by means of the Los Angeles Machine, using AASHTO Method T 96, the coarse aggregate shall not have a loss of more than 50%.

1. If gravel is used for the coarse aggregate, it shall consist of sound, tough, durable particles of crushed or uncrushed gravel or a mixture thereof, free from soft, thin, elongated or laminated pieces, lumps of clay, loam and vegetable or other deleterious substances.

2. If broken stone is used for the coarse aggregate, it shall consist of sound, tough, durable fragments of rock of uniform quality throughout. It shall be free from soft disintegrated pieces, mud, dirt, organic or other injurious material.

3. If the reclaimed miscellaneous aggregate is used for the coarse aggregate, it shall consist of sound, tough, durable fragments of uniform quality throughout. It shall be free from soft disintegrated pieces, mud, dirt, glass, organic or other injurious material.

4. Soundness for Gravel, Broken Stone and Reclaimed Miscellaneous Aggregate: When tested by magnesium sulfate solution for soundness using AASHTO Method T 104, the coarse aggregate shall show a loss of not more than 15% at the end of 5 cycles.

D. Fine Aggregate: The fine aggregate shall be natural sand, stone sand, screenings or any combination thereof. The fine aggregate shall be limited to material 95% of which passes a No. 4 (4.75-mm) sieve having square openings and not more than 8% of which passes a No. 200 (75-µm) sieve. The material shall be free from clay, loam and deleterious materials.

1. Plasticity: When natural sand is used, the fine aggregate shall conform to the requirements of Article M.02.06-2.

2. Plasticity: When screenings or any combination of screenings and natural sand or any combination of stone sand and natural sand are used, the following requirements shall apply:

    a. When the fraction of the dry sample passing the No. 100 (150-µm) mesh sieve is 6% or less by weight (mass), no plastic limit test will be made.

    b. When the fraction of the dry sample passing the No. 100 (150-µm) mesh sieve is greater than 6% and not greater than 10% by mass, that fraction shall not have sufficient plasticity to permit the performing of the plastic limit test, using AASHTO Method T 90.

    c. When the fraction of the dry sample passing the No. 100 (150-µm) mesh sieve is greater than 10% by weight (mass), the sample shall be washed; and additional material passing the No. 100 (150-µm) mesh sieve shall be determined by AASHTO Method T 146, except that the No. 100 (150-µm) mesh sieve shall be substituted for the No. 40 (425-µm) mesh sieve where the latter is specified in AASHTO Method T 146. The combined materials that have passed the No. 100 (150-µm) mesh sieve shall not have sufficient plasticity to permit the performing of the plastic limit test using AASHTO Method T 90.

PART 3 EXECUTION

3.1 GENERAL

A. Contractor is required to call "Call Before You Dig" (telephone number 1-800-922-4455), to have all existing underground utilities identified in the field prior to commencing work.

3.2 STRUCTURE EXCAVATION

A. Contractor shall excavate to the exact elevations shown on the plans, or as directed by Engineer. If the Contractor excavates below the elevations specified on the plans, he shall bring the excavation back to the proper elevation (except as hereinafter noted) by backfilling with granular fill, free of organic matter, and tamping to provide a compact base, as specified in the backfill specification. The backfill material must be approved by Engineer before being placed. Any increase in cost resulting from backfilling, or increasing the size of the footings or foundations, because of over-excavation in depth, unless the over-excavation is at the direction of Engineer, shall be borne by the Contractor. Excavation and replacement with structural fill of any disturbed or softened materials below the bottom of footing, resulting from inadequate preparation, dewatering, or protection of the bearing surface, shall be at the Contractor’s expense.

3.3 TRENCH EXCAVATION

A. In general, trenches shall be excavated to such depth as will provide a cover depth as indicated on the drawings from finished grade to the top of the pipe barrel. Deeper trenches shall be provided where necessary on account of the conformation of the ground and to permit the alignment of the pipe without undue deflection of joints.

B. Trenches shall be excavated by hand or machinery to the width and depth indicated on the drawings and specified herein under "Trench Limits". All loose materials shall be removed from the bottom of the trench so that the bottom of the trench will be in an undisturbed condition.

C. Particular care shall be taken that no stone 6 inches or larger in any diameter, protrudes more than 3 inches from the bottom or side of the trench.

D. Suitable bell holes shall be made in the trench at joints as required.

3.4 TRENCH EXCAVATION IN FILL

A. If pipe is to be laid in new embankments, or other new fill areas which are more than 12 inches deep below the invert of the pipe, the fill material shall be placed and properly compacted to final grade or to a height of at least 3 feet above the top elevation of the pipe, whichever is the lesser, before laying pipe. Particular care shall be taken to ensure maximum consolidation of material under the pipe location. The pipe trench then shall be excavated as though in undisturbed material.

3.5 TRENCH LIMITS

A. Trenches shall be excavated to the required depths, adding, however, to such depths the thickness of the pipe and, where applicable, the thickness of the stone bedding. If in the opinion of Engineer, the material at or below the depth to which excavation for structures and pipes would normally be carried is unsuitable for foundation, it shall be removed to such widths and depths as directed and replaced with suitable material. Such work shall be paid for under appropriate items. The width of the trench at the bottom shall always be wide enough to make the joints properly. When, in the option of Engineer, it is necessary to lay a

concrete foundation, the excavation shall be made 1/4 O.D. or (6" min.) deeper, or as ordered by Engineer.

B. Trench widths shall be 3 feet greater than the nominal inside diameter of pipe for such diameters of 36 inches or less. For diameters greater than 36 inches, the width shall be 4 feet greater than nominal inside diameter. Trench excavation for manholes, catch basins, drop inlets, etc. shall be two (2) feet outside the neat lines of the foundations. These limits may be adjusted for field conditions at the direction of Engineer.

C. In earth excavation, in Sections where stone backfill is excluded, the bottom of the trench shall be shaped so as to conform to the outside of the pipe, particular care being taken to recess the bottom of the trench in such a manner as to relieve the bell of all load.

D. Where the bottom of the trench, by mistake of the Contractor, has been taken out to a greater depth than specified above, it shall be refilled to the proper grade, using screened gravel or crushed stone. This additional material shall be placed by the Contractor with no additional compensation allowed. Refilling with earth to bring the bottom of the trench to the proper grade will not be permitted.

E. Contractor shall at all times exercise care not to excavate outside the trench limiting lines indicated above, unless otherwise authorized by Engineer.

F. Bedding for pipe and utility structures will be as detailed on the drawings.

3.6 UTILITY EXCAVATION NEAR EXISTING STRUCTURES

A. Attention is directed to the fact that there are water pipes, storm drains, and other indicated utilities in certain locations. The location, type and number of utilities is based upon record plan information provided by Engineer. Some utility information is based upon field survey. The completeness or accuracy of the information given is not guaranteed.

B. All water, or other utility conduits, shall be located on the ground by the applicable utility company with pipe finding equipment well ahead of the Work at all times. All such locations shall be plainly marked by coded paint symbols on pavement or by marked stakes in the ground. Such locations shall be established at least 2,000 ft. in advance of all trench excavation. All such location work shall be coordinated between utility companies by the Contractor to the satisfaction of Engineer at no extra cost. Once utility lines have been marked, it will be the responsibility of the Contractor to maintain the markings until he completes his work in that area.

C. As the excavation approaches pipes, conduits, or other underground structures, digging by machinery shall be discontinued and the excavation shall be done by means of hand tools, as directed. Such manual excavation, where incidental to normal trenching excavation, shall be done to the satisfaction of Engineer at no extra cost.

3.7 PROTECTION OF EXISTING STRUCTURES

A. All existing pipes, poles, wires, fences, curbings, property-line markers, and other structures which, in the opinion of Engineer, must be preserved in place without being temporarily or permanently relocated, shall be carefully supported and protected from damage by the Contractor, and in case of damage, the Contractor shall notify the appropriate party so that proper steps may be taken to repair any and all damage done. When the Owner does not wish to make the repairs themselves, all damage shall be repaired by the Contractor, or, if

not promptly done by him, Engineer may have the repairs made at the expense of the Contractor.

B. All utility services shall be supported by suitable means so that the services shall not fail when tamping and settling occurs. No separate item is provided for service supports and the Contractor must cover it in the price bid for utility construction.

3.8 RELOCATION AND REPLACEMENT OF EXISTING STRUCTURES

A. Whenever the Contractor encounters certain existing structures as described below, and is so ordered in writing, he shall do the whole, or such portions of, work as he may be directed, to change the location, or remove and later restore, or replace such structures, or to assist the Owner thereof in so doing. For all such work, the Contractor shall be paid under such items of work, as may be applicable, otherwise as extra work.

B. In removing existing structures, the Contractor shall use care to avoid damage to the material, and Engineer shall include for payment only those new materials, which, in his judgment, are necessary to replace those unavoidably damaged.

C. The structures to which the provisions of the preceding two paragraphs shall apply include structures which (1) are not indicated on the drawings or otherwise provided for, (2) encroach upon or are encountered near and substantially parallel to the edge of the excavation, and (3) in the opinion of Engineer will impede progress to such an extent that satisfactory construction cannot proceed until they have been changed in location, removed (to be later restored), or replaced. (See Item 3.19, "Sub-Surface Obstructions" also).

3.9 CARE AND RESTORATION OF PROPERTY

A. Excavating machinery and cranes shall be operated with care to prevent damage to adjacent structures, trees, fences, etc.

B. On paved surfaces to remain, the Contractor shall not use or operate tractors, bulldozers, or other power-operated equipment, the treads or wheels of which are so shaped as to cut or otherwise damage such surfaces. All surfaces, which have been damaged by the Contractor's operations, shall be restored to a condition at least equal to that in which they were found immediately prior to the beginning of operations. Suitable materials and methods shall be used for such restoration.

C. The restoration of existing property or structures shall be done as promptly as practicable and shall not be left until the end of the construction period.

3.10 MISCELLANEOUS EXCAVATION

A. If Engineer orders excavation for work not indicated on the drawings or in the Specification, Contractor shall be paid for the Work performed as extra work. This Section of the Specifications does not include the additional excavation involved if Engineer lowers a sewer line below the grade as shown on the set of drawings issued to the bidders.

3.11 DUST CONTROL

A. During the progress of the Work, Contractor shall conduct his operations and maintain the area of his activities in order to minimize the creation and dispersion of dust. If Engineer decides that it is necessary to use calcium chloride, or approved equal, for more effective dust control, the Contractor shall furnish the material, load, deliver, and spread it as directed. In addition, site work may require the use of a street sweeper to minimize dust tracked off-site by construction equipment. If Engineer decides that it is necessary to use a street

sweeper, the Contractor shall furnish the street sweeper and provide for an operator at no cost to the Owner.

B. Refer to Section 015714- Temporary Dust Control.

3.12 BACKFILLING FOR UTILITIES – GENERAL

A. In general, or unless other material is indicated on the drawings or elsewhere specified, material used for backfilling trenches and excavations beyond building limits and around utility structures shall be common fill. Backfilling shall be done as promptly as is consistent with non-injury to the pipe or structures, but no backfilling shall be done before Engineer gives permission. Where the trench is in a paved area, or an area to be paved, backfill shall be bank-run gravel as shown on the drawings.

B. Backfill material shall be free from cinders, ashes, refuse, boulders, rocks, or stones greater than 3" in any dimension, unsuitable organic material or other material which, in the opinion of Engineer, is unsuitable.

C. Frozen material shall not be placed in the backfill, nor shall backfill be placed upon frozen material. Previously frozen material shall be removed, or shall be otherwise treated as required, before new backfill is placed.

D. Common Fill material may be used as backfill, when authorized by Engineer, if the Contractor can achieve a minimum dry density after compaction of 95 percent of the maximum dry density as determined in accordance with ASTM D1557-02.

E. In landscaped areas, the minimum dry density after compaction shall be 90 percent, unless otherwise detailed or specified.

3.13 BACKFILLING UTILITIES AROUND STRUCTURES

A. No backfill shall be deposited against concrete until the concrete has obtained sufficient strength to withstand the earth pressure placed upon it and in no case less that seven days, nor before carrying out and satisfactorily completing the tests for watertight structures specified elsewhere. Compaction of backfill against concrete structures shall not be carried out by motorized equipment closer to the structure than the depth of the structure below grade.

B. Where pipe is connected to the structure, the backfilling procedure shall be carried out as specified in "Backfilling in Open Trench".

3.14 BACKFILLING IN OPEN TRENCH BEYOND BUILDING LIMITS

A. As soon as practical after the pipe has been placed in accordance with the appropriate sections and the pipe joints have been properly made, the backfilling shall begin, and shall continue without delay. If a screened gravel or concrete envelope is not used, the selected material*, free from large lumps and stones having any dimension greater than 2-inches, shall be placed simultaneously on both sides of the pipe, so that there will be no tendency to displace the pipe alignment. In placing the material, care shall be taken that stones do not strike the pipe.

B. The backfill at the sides of the pipe and up to the top of the pipe, shall be hand-placed and thoroughly compacted using approved hand-operated tampers.

C. The backfill up to a level of 1-foot above the top of the pipe* shall be placed in 6-inch layers, leveled along the length and width of the trench and thoroughly compacted with approved tampers.

D. Backfill placement and compaction for utility trenches inside the building limits shall be in accordance with 3.19 of this Section.

E. Install warning tape twelve (12) inches to twenty-four (24) inches above crown in all proposed underground utilities outside building limits following the standard color system below**.**

1. Green - Storm drainage and sanitary sewer systems, including force mains and other non-hazardous materials.

2. Blue - Water.

3. Red - Electric power lines, electric power conduits and other electric power facilities.

4. Orange - Communication lines or cables, including but not limited to telephone, fire signals, cable television, and electronic controls.

5. Yellow - Gas, oil petroleum products, steam, compressed air, compressed gas and all other hazardous materials.

6. Brown – Chilled Water and Other.

3.15 SUBSURFACE OBSTRUCTIONS

A. As a general rule, sub-surface obstructions encountered along the route of the pipeline shall be considered as follows:

1. Crossing Obstruction: All pipes, conduits, wires, etc. of whatever nature whose centerline lies at an angle of 20 degrees or greater to the centerline of the pipe being installed shall be considered as crossing obstructions and shall be protected, or repaired or replaced if damaged, or relocated, all at no additional cost to the Owner.

2. Interfering Obstructions: All pipes, conduits, wires, etc. of whatever nature whose centerline lies at an angle of less than 20 degrees, but more than 5 degrees to the centerline of the pipe being installed, shall be considered as interfering obstructions. Costs for supporting such obstructions in place during installation of the new pipe shall be paid for by the Owner. Costs for supporting interfering obstructions shall not be construed to include any costs for excavation. Repairing or replacing damaged interfering obstructions, or relocation shall be accomplished at no additional cost to the Owner.

3. Parallel Obstructions: All pipes, conduits, wires, etc. of whatever nature whose centerline lies at an angle of 5 degrees or less, or is truly parallel and less than 0.5 feet offset from outside the normal trench limits, as specified in Subarticle 3.5 B. of this Section, of the pipe being installed, shall be considered parallel obstructions. Costs for supporting such obstructions in place during installation of the new pipe, including excavation, may be paid for by the Owner, or Owner may elect to pay for the cost of replacing such obstructions. Should Owner first elect to pay the cost of supporting the obstruction and then elect to pay the cost of replacing the obstruction, approved costs for supporting the obstruction, including excavation, incurred prior to electing replacement costs shall also be paid. After Owner elects to pay replacement costs, only replacement costs will be paid for all additional work in the vicinity of the parallel obstruction.

4. Angle measurement between centerline of obstructing pipe, conduit, wire, etc. and centerline of the pipe being installed shall be taken from between the horizontal projection of the centerlines at ground surface. Parallel offset distance between centerline of obstructing pipe, conduit, wire, etc. and the outside of normal trench limits of the pipe being installed shall be taken from between the horizontal projection of the centerlines and outside trench limit at ground surface.

END OF SECTION

SECTION 31 2319

DEWATERING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Removal of surface water and ground water as necessary to perform the construction required by the contract.

2. Constructing, installing, building, and maintaining all necessary temporary water extraction and management facilities.

3. Furnishing, installing, and operating all necessary pumps, piping, and other equipment.

4. Complying with all applicable approvals, authorizations or permits associated with the management of dewatering wastewaters.

5. Removing all such temporary works and equipment after their intended function is no longer required.

B. Contractor shall coordinate work between all Subcontractors, sections, and trades required for the proper completion of the work.

C. Contractor is responsible for all health and safety.

1.2 REFERENCES

A. Reference herein to any technical society, organization, group or regulation are made in accordance with the following abbreviations and, unless otherwise noted or specified, all work under this Section shall conform to the latest edition as applicable.

B. Code of Federal Regulations (CFR)

1. 29 CFR 1926, Safety and Health Regulations for Construction.

C. Connecticut Department of Energy and Environmental Protection (DEEP)

1. Connecticut Guidelines for Soil Erosion and Sediment Control, DEP Bulletin 34, State of Connecticut Council on Soil and Water Conservation, 2002.

2. Connecticut Department of Energy and Environmental Protection General Permit for the Discharge of Stormwater and Dewatering Wastewaters Associated with Construction Activities, (DEEP-WPED-GP-015), latest issue.

3. Connecticut Department of Energy and Environmental Protection General Permit for the Discharge of Groundwater Remediation Wastewater to a Sanitary Sewer (DEP-WD-GP-007), latest issue.

4. Connecticut Department of Energy and Environmental Protection General Permit for the Discharge of Groundwater Remediation Wastewater Directly to Surface Water (DEP-PED-GP-020), latest issue.

5. Connecticut Department of Energy and Environmental Protection General Permit for the Discharge of Groundwater Remediation Wastewater Directly to Surface Water (DEP-PED-GP-020), latest issue.

D. Regulations of Connecticut State Agencies (RCSA)

1. RCSA Section 22a-372-1, 22a-377(b)-1, 22a-377(c)-1, 22a-377(c)-2, Water Diversion.

2. RCSA Section 22a-430-3 through 4, General Conditions Applicable to Water Discharge Permits and Procedures and Criteria for Issuing Water Discharge Permits.

3. RCSA Section 22a-430-8, Underground Injection Control.

1.3 DESCRIPTION OF THE WORK

A. Prevent surface water and subsurface or groundwater from flowing into excavations or earthwork areas which would cause flooding of the Project Ste and surrounding area, or softening or loosening of the soil at excavation or earthwork subgrade.

B. Provide adequate and satisfactory dewatering and drainage of excavations and furnish all materials and equipment and do all incidental work required in conjunction with the furnishing, installing, and maintaining of same to permit proper and timely completion of all work required.

C. Contractor may choose any satisfactory dewatering method he wishes subject to the approval of Engineer, provided such method performs the dewatering required and complies with applicable approvals, authorizations and permits.

D. Contractor shall assume all responsibility for the adequacy of the methods, materials, and equipment employed. Contractor shall take all precautions necessary to prevent loosening or softening of the subgrade. In this regard, Contractor shall at all times be prepared to alter his construction method or sequence.

E. The work shall be maintained dry until the structures (building slabs and footings, paved area, pipe, drainage structure, embankments, etc.) are completed.

F. All dewatering required by pumping and drainage shall be performed without damage to the excavation, pipe trench, pavements, pipes, electrical conduits, other utilities and any other work or property. Existing or new sanitary sewers shall not be used to dispose of drainage.

1.4 SUBMITTALS

A. Dewatering Plan: Prior to installation of the dewatering system, submit design data showing the following, for review by Engineer:

1. Locations and associated construction where dewatering is required.

2. Specific methods and devices proposed for dewatering.

3. Details on protection at the inlet and outlet of pumps, method for floating the pump intake, or other methods to minimize and retain the sediment.

4. Proposed location of dewatering discharge and details of infiltration basins or other discharge location. Per the General Permit, where feasible and appropriate, dewatering wastewaters will be infiltrated into the ground.

5. Details on any containment berm construction when dewatering earth materials.

6. Identification of a contingency plan for emergency operations should the dewatering operation prove inadequate to meet the dewatering need or is found to be causing unacceptable turbidity problems (e.g., alternative discharge locations or use of a portable sediment tank). If turbidity or siltation problems are not adequately controlled by the contingency plan, then the operation will be ceased and a revised dewatering plan submitted for approval prior to further implementation.

1.5 REGULATORY COMPLIANCE

A. Comply at all times with the following as applicable to the Project:

1. Connecticut Department of Energy and Environmental Protection General Permit for the Discharge of Stormwater and Dewatering Wastewaters Associated with Construction Activities, (DEP-PED-GP-015), latest revision. Conditions of such permit, other conditions of approval or authorizations, and any Stormwater Pollution Prevention Plans shall become part of the Contract Documents.

2. Connecticut Department of Energy and Environmental Protection General Permit for the Discharge of Groundwater Remediation Wastewater to a Sanitary Sewer (DEP-PERD-GP-007), latest revision. The conditions of such permit, other conditions of approval or authorizations, and any supplemental plans shall become part of the Contract Documents.

3. Connecticut Department of Energy and Environmental Protection General Permit for the Discharge of Groundwater Remediation Wastewater Directly to Surface Water (DEP-PED-GP-020), latest revision. The conditions of such permit, other conditions of approval or authorizations, and any supplemental plans shall become part of the Contract Documents.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION

3.1 JOB CONDITIONS

A. Surface Drainage: Intercept and divert precipitation, and surface water, away from excavations through the use of temporary diversion swales, temporary sediment traps, pipes, sumps or other approved means.

B. Drainage of Excavated Areas: Provide and maintain ditches of adequate size to collect surface and seepage water, which may enter the excavations. Divert the water into sumps and storm drains or pump into drainage channels or storm drains. When water is to be diverted into a storm drain, provide dewatering settling basins, or other accepted apparatus, such as fractionation tanks, as required to reduce the amount of fine particles, which may be carried into the drain. If a storm drain becomes blocked due to dewatering operation, it shall be cleaned by the Contractor at his own expense.

3.2 DEWATERING

A. Where feasible and appropriate, dewatering wastewaters will be infiltrated into the ground. Dewatering wastewaters discharged to surface waters will be discharged in a manner that minimizes the discoloration of the receiving waters. The following measures will be employed to ensure that dewatering wastewaters will not cause scouring or erosion or contain suspended solids in amounts that could reasonably be expected to cause pollution:

B. Divert surface waters away from areas needing dewatering.

C. Consider if well points and sumps can be used to lower the groundwater table reducing the need for settling facilities.

D. For sites that don't require continuous pumping, pump work areas before construction activities begin each work day.

E. Provide filtration near the suction intake.

F. Locate pumps, intake sumps, and other intake structures in areas which will not require constant moving, when possible.

G. Locate pump discharge facilities (portable, permanent, or bio-filtering structures) such that a minimum disturbance of existing wetlands and watercourses is incurred.

H. Provide protection at outlets from pumping operations to dissipate pumping surges and prevent erosion at the point of discharge.

I. Maintain the water level at such lowered elevations that no danger to structures can occur because of the buildup of excessive hydrostatic pressure on the subgrade, or bottom of trench, unless otherwise permitted by Engineer.

J. Do not allow water to accumulate in excavations. At all times during construction, provide ample means and devices with which to remove promptly and dispose properly of all water entering roadway, trench, and structure excavations and keep them dry until the structures to be built thereon are completed.

K. No pipe/culvert/structure shall be laid in water. No masonry shall be laid in water, and no water shall be allowed to rise over masonry (either concrete or brick) in 24 hours after being placed. Nor shall moving water be allowed to rise over masonry for four days. In no event shall water be allowed to rise so as to set up unequal pressures in the structures until the concrete or mortar has set at least 24 hours. The Contractor shall constantly guard against the possibility of flotation of pipe or structures after installation. He shall place adequate backfill promptly in accordance with Section 31 2310 - Earthwork to prevent this occurrence, and his method of handling drainage and carrying on these operations shall always be adequate to prevent flotation.

END OF SECTION

SECTION 31 2543

GEOTEXTILES

PART 1 GENERAL

1.1 SUMMARY

A. Section includes:

1. Furnishing and installation geotextile materials for the separation of earth materials.

2. Furnishing and installation geotextile materials for the stabilization of earth materials.

B. Contractor shall coordinate work between all Subcontractors, sections, and trades required for the proper completion of the work.

C. Contractor is responsible for all health and safety.

1.2 REFERENCES

A. State of Connecticut Department of Transportation (ConnDOT)

1. Standard Specifications for Roads, Bridges, Facilities and Incidental Construction, Form 817, 2016 and any supplements.

B. ASTM International (ASTM).

1. ASTM D4355 – Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon Arc Type Apparatus.

2. ASTM D4491 – Standard Test Methods for Water Permeability of Geotextiles by Permittivity.

3. ASTM D4533 – Standard Test Method for Trapezoid Tearing Strength of Geotextiles.

4. ASTM D4632 – Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.

5. ASTM D4751 – Standard Test Method for Determining Apparent Opening Size of a Geotextile.

6. ASTM D4873 – Guide for Identification, Storage, and Handling of Geotextiles.

7. ASTM D6241 – Standard Test Method for Static Puncture Strength of Geotextiles and Geotextile-Related Products Using a 50-mm Probe.

8. ASTM D6706 – Standard Test Method for Measuring Geosynthetic Pullout Resistance in Soil.

C. Code of Federal Regulations (CFR)

1. 29 CFR Part 1926 Subpart P – OSHA Excavation Regulations 1926.560 through 1926.562 including Appendices A through F.

1.3 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and methods required for proper performance of the work in this Section.

1.4 SUBMITTALS

A. Submit to Engineer for approval material specifications, manufacturer's product data, manufacturer's installation guidelines, and shop drawings for all materials furnished under this Section.

B. Connection details for geotextile.

C. Proposed mechanical connection devices.

1.5 DELIVERY, STORAGE AND HANDLING

A. Geotextile labeling, shipment, and storage shall follow ASTM D4873. Product labels shall be clearly labeled and/or marked to specifically identify each product and clearly show the manufacturer's name, style name, and roll number.

B. Each geotextile roll shall be wrapped with a material that will protect the geotextile from damage due to shipment, water, sunlight, and contaminants. Protect rolls from crushing or abrasion during shipping and hauling.

C. Geotextile shall be stored on a prepared surface (not wooden pallets) and should not be stacked more than two rolls high. Storage shall be such that the geotextile is protected from puncture, dirt, grease, water, moisture, mud, mechanical abrasions, excessive heat or cold, or other damaging circumstances. Temporary storage at the Project Site shall be away from standing water such that crushing or flattening of roll goods does not occur.

PART 2 PRODUCTS

2.1 SEPARATION GEOTEXTILE

A. Separation Geotextile shall be utilized to separate layers of earth materials in utility trenches, drains, layered systems and similar installations in a non-structural configuration.

1. Composition: Woven geotextile made of 100% polypropylene slit film yarns.

2. Physical properties:

Mechanical and Physical Properties of Separation Geotextile

Mechanical Properties	Test Method	Unit	Minimum Average Roll Value
Grab Tensile Strength, Ultimate	ASTM D4632	Pounds	120
Grab Tensile Strength, Elongation at Ultimate	ASTM D4632	Percent (%)	50
Trapezoid Tear Strength	ASTM D4533	Pounds	50
CBR Puncture Strength	ASTM D6241	Pounds	310
Apparent Opening Size (AOS)	ASTM D4751	(U.S. Sieve)	70
Permittivity	ASTM D4491	sec^{-1}	1.7
Flow Rate	ASTM D4491	$gal/min/ft^2$	135
UV Resistance (at 500 hours)	ASTM D4355	% strength retained	70

2.2 LIGHT-DUTY STABILIZATION GEOTEXTILE

A. Light-Duty Stabilization Geotextile shall be utilized under temporary sidewalks and unit pavers when called-for.

1. Composition: Woven geotextile made of 100% polypropylene slit film yarns.

2. Physical properties:

Mechanical and Physical Properties of Light-Duty Stabilization Geotextile

Mechanical Properties	Test Method	Unit	Minimum Average Roll Value
Tensile Strength @2% Strain (MD/CD)	ASTM D4595	Pounds/foot	600/600
Tensile Strength @5% Strain (MD/CD)	ASTM D4595	Pounds/foot	1620/1620
Flow Rate	ASTM D4491	$Gal/min/ ft^2$	70
Permittivity	ASTM D4491	sec^{-1}	90
Apparent Opening Size (AOS)	ASTM D4751	(U.S. Sieve)	40
Interaction Coefficient	ASTM D6706	-	0.89
UV Resistance (at 500 hours)	ASTM D4355	% strength retained	90

MD – Machine Direction
CD – Transverse (Crosswise) Direction

2.3 STABILIZATION GEOTEXTILE

A. Stabilization Geotextile shall be utilized for stabilization of subgrades where unsuitable subsurface soil conditions are present. Stabilization geotextile shall only be utilized with the approval of Engineer.

1. Composition: Woven geotextile made of 100% polypropylene slit film yarns.

2. Physical properties:

Mechanical and Physical Properties of Stabilization Geotextile

Mechanical Properties	Test Method	Unit	Minimum Average Roll Value
Grab Tensile Strength, Ultimate (MD/CD)	ASTM D4595	Pounds/foot	7200/5760
Tensile Strength at 2% Strain	ASTM D4595	Pounds/foot	1370/1560
Tensile Strength at 5% Strain	ASTM D4595	Pounds/foot	3600/3600
Tensile Strength at 10% Strain	ASTM D4595	Pounds/foot	6600/5760
Flow Rate	ASTM D4491	Gal/min/ ft^2	15
Permittivity	ASTM D4491	sec^{-1}	0.23
Apparent Opening Size (AOS)	ASTM D4751	(U.S. Sieve)	20
UV Resistance (at 500 hours)	ASTM D4355	% strength retained	80

MD – Machine Direction
CD – Transverse (Crosswise) Direction

PART 3 EXECUTION

3.1 GENERAL

A. Install geotextile as shown on the Drawings or as called-for in the Specifications. Follow manufacture's guidelines.

B. Ensure that geotextile is protected during installation from clogging, tears, and other damage.

3.2 PIPE OR DRAINAGE SYSTEMS

A. Provide smooth side and bottom trench surfaces so the fabric does not bridge depressions in the soil and is not damaged by rock projections.

B. Use fabric of a width to permit a minimum trench-width overlap across the backfill at the trench top.

C. Lay the fabric flat in the prepared trench without stretching. Lay the top of the fabric back on the sides to allow for the placement of the aggregate backfill and pipe.

D. Overlap ends of rolls an amount equal to the trench width prior to fabric placement. Where pockets or cavities occur in the trench bottom or sides, fill them with acceptable granular material to prevent distortion or damage to the fabric.

E. Backfill aggregate and install pipe in a manner to prevent damage to the fabric. Compact aggregate backfill and overlap the fabric across the trench top. Do not allow the fabric to be exposed for more than 2 weeks without covering with backfill.

3.3 LAYER SEPARATION AND/OR STABILIZATION

A. Place fabric on a normally prepared subgrade area attending the full width of the sub-base layer being protected.

B. Place fabric in a loose and unstretched condition to minimize shifting, puncture, and/or tearing. Overlap fabric roll-ends and edges a minimum of 12 inches with adjacent material.

C. Place subbase material within 2 weeks after placement of fabric to minimize exposure. Place sub-base material in a manner to minimize slippage of the fabric. If excessive slippage occurs, use steel securing pins per manufacturer's guidelines.

END OF SECTION

SECTION 32 12 16 – BITUMINOUS CONCRETE PAVEMENT

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Work Included: Bituminous concrete drives, parking, and patching, complete in place, as shown on the Drawings and as specified herein including:

1. Saw cut existing pavement as required.

2. Painted pavement markings and legends.

3. Maintenance and protection of pedestrian traffic as required.

B. Related Sections:

1. Section 31 20 00 – Earth Moving;

2. Section 31 25 00 – Erosion and Sedimentation Controls;

3. Section 33 10 00 – Water Utilities;

4. Section 33 30 00 – Sanitary Sewerage Utilities;

5. Section 33 40 00 – Storm Drainage Utilities.

1.3 QUALITY ASSURANCE

A. Qualifications of Workmen

1. Provide at least one person who shall be thoroughly trained and experienced in the skills required, who shall be completely familiar with the design and application of work described for this Section, and who shall be present at all times during progress of the work of this Section and shall direct all work performed under this Section.

2. For actual finishing of bituminous concrete surfaces and operation of the required equipment, use only personnel who are thoroughly trained and experienced in the skills required.

1.4 REFERENCES

A. Wherever reference is made to the DOT Specifications, it shall mean the Connecticut Department of Transportation Standard Specifications for Roads, Bridges and Incidental Construction Form 817 (2016) as modified by Supplemental Specifications issued by the Connecticut Department of Transportation.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Subbase crusher-run stone conforming to the requirements of Article M.01.01, for No. 6 stone (3/8" crushed stone), DOT Specifications or to the following:

Sieve Size	Percent Passing
3.5"	100
¾"	50-100
No. 4	25-75

The fraction, passing the No.4 sieve shall have less than 15% passing the No. 200 sieve.

B. Base: Processed aggregate for the base shall conform to the requirements of Article M.05.01, DOT Specifications. Coarse Aggregate shall be broken stone conforming to the requirements of Article M.05.01-2 (b).

C. Pavement Materials:

1. Bituminous concrete mixtures conforming to the requirements of Section M.04 of the DOT Specifications.

2. In Section M.04, reference is made to the Chief, Materials Testing Section, to the Materials Testing Section, and to the Laboratory; none will be involved in this work. Do the work of the Chief, the Section, and the Laboratory; or arrange for the producer of the bituminous concrete to do this work. Make the determinations, verifications, rejections, approvals, tests, and inspections as specified by Section M.04 and as necessary to produce satisfactory bituminous mixtures.

D. Tack Coat: Section M.04 of the DOT Specifications.

E. Joint Sealer: A rubber compound of the hot-poured type conforming to the requirements of Article M.04.02 of the DOT Specifications.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions under which work of this Section will be installed. Correct conditions detrimental to proper and timely completion of the Work. Do not proceed until unsatisfactory conditions have been corrected.

3.2 FINAL PREPARATION OF SUBGRADE

A. After preparation of subgrade as specified in Section 31 20 00 – Earth Moving of these Specifications, thoroughly scarify and sprinkle the entire area to be paved, and then compact by rolling to a smooth, hard, even surface of 95 percent of modified optimum density to receive subbase. Finish to the required grades, with due allowance for the thickness of bituminous concrete courses to be placed thereon.

B. Equipment: Compact by rolling with a 15-Ton vibratory roller.

3.3 CONSTRUCTION OF SUBBASE AND BASE COURSE

A. After subgrade has been completed and accepted by the Architect, construct the subbase and base over all areas to be paved.

B. Construct subbase in accordance with the requirements of Article 2.12.03 of the DOT Specifications, however compact with four passes of a 15-Ton (static weight) roller.

C. Construct base in accordance with the applicable requirements of Article 3.04.03 of the DOT Specifications. Compact to at least 98 percent of modified optimum density.

3.4 CONSTRUCTION OF BITUMINOUS CONCRETE PAVEMENT

A. Construct pavement in courses as called for on the Drawings. Use a class of bituminous concrete for each course as indicated on the Drawings. Thickness of each course: As shown on the Drawings.

B. Construct the bituminous concrete pavement in accordance with Article 4.06.03 of the DOT Specifications, except as modified below:

1. Article 4.06.03-1 Samples: Samples will not be taken by Materials Testing Section. Arrange for the producing plant to take its own samples to ascertain that mixtures are proper. Provide certifications. The Contractor will have the ultimate responsibility.

2. Article 4.06.03-2 Mixing Plant Inspection:

   a. Inspections, verifications, determinations, and approvals at the mixing plants will not be made by the Chief, Materials Testing Section. The Contractor will be responsible for mixtures and shall take whatever steps are required to ensure production of satisfactory mixtures. He shall certify that mixtures do meet specifications.

   b. Weights of completed mixtures will not be required.

3. Article 4.06.03-3 Mixing Plant Inspection - Field Laboratory: Delete in its entirety.

4. Article 4.06.03-4: Delete "Assistant Manager of Materials Testing" and substitute "Contractor."

5. Article 4.06.03-5: Delete "Assistant Manager of Materials Testing" wherever it appears and substitute "Contractor."

C. Certifications: Furnish certified test reports, material certificates, and certificates of compliance in accordance with the requirements of Article 1.06.07 of the DOT Specifications.

3.6 PROTECTION

A. Protect from traffic during all operations.

3.7 FINISH TOLERANCES

A. Finish surfaces to the following tolerances.

1. Subbase and Base: Plus 0.00 feet to minus 0.10 feet from line and grade shown on the Drawings.

2. Bituminous Concrete Surface Course: Plus or minus 0.05 feet at any point from line and grade shown on the Drawings. No variations in surface more than 1/8 inch in a 10-foot plane.

END OF SECTION 32 12 16

SECTION 32 1623

CURBING

PART 1 GENERAL

1.1 SUMMARY

A. Section includes:

1. Granite curb.
2. Precast concrete curb.
3. Cast-in-place concrete curb.
4. Bituminous concrete lip curb.

B. Work shall also include all associated items and operations necessary and required to complete the installations, including, but not limited to, surface preparation, finishing and cleanup.

C. Contractor shall coordinate work between all Subcontractors, sections, and trades required for the proper completion of the work.

D. Contractor is responsible for all health and safety.

1.2 REFERENCES

A. Reference herein to any technical society, organization, group or regulation are made in accordance with the following abbreviations and, unless otherwise noted or specified, all work under this Section shall conform to the latest edition as applicable.

B. United States Code of Federal Regulations (CFR)

1. 29 CFR 1926, Safety and Health Regulations for Construction.

C. State of Connecticut Department of Transportation (ConnDOT)

1. Standard Specifications for Roads, Bridges, Facilities and Incidental Construction, Form 817, 2016 and any supplements.

D. ASTM International (ASTM).

1. ASTM C33 – Standard Specification for Concrete Aggregates.
2. ASTM C94 – Standard Specification for Ready-Mixed Concrete.
3. ASTM C150 – Standard Specification for Portland Cement.
4. ASTM D235 – Standard Specification for Mineral Spirits (Petroleum Spirits).
5. ASTM C207 – Standard Specification for Hydrated Lime for Masonry Purposes

6. ASTM C260 – Standard Specification for Air-Entraining Admixtures for Concrete.

7. ASTM C309 – Standard Specification for Liquid Membrane - Forming Compounds for Curbing Concrete.

8. ASTM C494 – Standard Specification for Chemical Admixtures for Concrete.

9. ASTM C989 – Standard Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars.

10. ASTM D1751 – Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).

11. ASTM D1752 – Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction

12. American Concrete Institute (ACI)

13. ACI 304 – Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete.

E. American Association of State High and Transportation Officials (AASHTO)

1. AASHTO M 6 – Standard Specification for Fine Aggregate for Portland Cement Concrete.

2. AASHTO M 85 – Standard Specification for Portland Cement (Chemical and Physical).

3. AASHTO M 133 – Standard Specification for Preservatives and Pressure Treatment Processes for Timber.

4. AASHTO M 213 – Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type).

5. AASHTO M 233 – Standard Specification for Boiled Linseed Oil Mixture for Treatment of Portland Cement Concrete.

6. AASHTO M 240 – Standard Specification for Blended Hydraulic Cement.

7. AASHTO T11 – Standard Method of Test for Materials Finer Than 75-um (No. 200) Sieve in Mineral Aggregates by Washing.

8. AASHTO T21 – Standard Method of Test for Organic Impurities in Fine Aggregate for Concrete.

1.3 SUBMITTALS

A. Submit Shop Drawings, manufacturer's literature, material certificates or other data indicating compliance with these Specifications.

B. Precast Curbing: Submit for approval, data indicating size, shape and dimensions, finish and setting method.

C. Stone Curbing: Submit for approval, the name of the quarry and the type of curb which the Contractor proposes to use. Samples of curbing shall be submitted for approval only when

requested by the Engineer. Such submission shall be made sufficiently in advance of ordering so that the Engineer may have an opportunity to judge the granite, both as to quality and appearance.

D. Precast Curbing: Submit representative test specimens of the cured concrete used in precast units showing a compressive strength of 4,000 pounds prior to shipping any units.

E. Submit testing data for concrete as required by Section 03 3200 – Site Cast-in-Place Concrete.

1.4 DELIVERY, STORAGE AND HANDLING

A. Granite and precast concrete curb units shall be delivered to the job adequately protected from damage during transit.

B. Curbing shall be protected against staining, chipping, and other damage. Cracked, badly chipped, or stained units will be rejected and shall not be employed in the Work.

PART 2 PRODUCTS

2.1 GRANITE CURBING

A. Stone for this work shall be hard and durable granite, fundamentally light grey in color, of general uniform texture, of smooth splitting appearance, free from seams or imperfections that would impair its structural reliability and containing only such color variations as in the opinion of Engineer would reasonably be characteristic of the material source.

B. No granite from any other quarry as indicated in Contractor's submittal shall be used unless it has been properly approved.

C. Finish and surface dimensions for granite curbing shall conform to the following:

1. The curbstone shall have a top surface free from wind; it shall be pointed, peen-hammered or sawed to an approximately true plane, and shall have no projections or depressions greater than ⅛ inch. The front and back arris lines shall be pitched straight and true.

2. On the back surface of the curbstone there shall be no projection for 3 inches down from the top which would fall outside of a plane having a batter of 4 inches in 12 inches from the back arris line. The front face shall be at right angles to the plane of the top and shall be smooth quarry-split, free from drill holes in the exposed face.

3. There shall be no projections greater than ¾ inch, or depressions greater than ½ inch, measured from the vertical plane of the face through the top arris line for a distance of 8 inches down from the top. For the remaining distance, there shall be no projections or depressions greater than 1 inch measured in the same manner. The arris lines at the ends shall be pitched with no variation from the plane of the face greater than ⅛ inch.

4. The ends of all stones shall be square with the planes of the top and face and so finished that, when the stones are placed end to end as closely as possible, no space more than ½ inch shall show in the joint for the full width of the top or down on the face for 8 inches.

5. On curbstones having a length of 6 feet or more, the remainder of the end may break back not over 9 inches; whereas, on shorter curbstones, they shall not break back more than 6 inches.

6. If sawed, the curbstones shall be thoroughly cleaned of any iron rust or iron particles. For straight curbing, 80% of the stones shall be furnished in lengths of not less than 6 feet, and the remaining 20% in lengths of not less than 4 feet, interspersed at random, to allow for closures.

7. Curbstones to be set on a radius of 100 feet or less shall be cut to the curve required, and their ends shall be cut on radial lines.

8. Requirements for length of individual stones in curved curbing vary with radii of curves.

2.2 BLUESTONE CURBING

A. Stone for this work shall be of a good grade, free from structural defects, and shall be approved by Engineer.

B. Stone shall conform to the requirements contained herein for stone granite curbing, except that the top surface and the top 8 inches of the front face shall be “fine-pointed” in conformity with the following:

1. Projections on fine-pointed finished surfaces shall not exceed ½ inch.

2.3 PRECAST CONCRETE CURB

A. Concrete for precast concrete curbing shall have a minimum compressive strength of 4,000 psi at 28 days, and shall contain 5 to 7 percent entrained air.

B. Precast concrete curb shall be treated with a protective coating of Linseed Anti-Spalling Compound. Boiled linseed oil mixture shall conform to AASHTO M 233 and shall be composed of 50 percent (50 %) double boiled linseed oil and 50 percent (50%) petroleum spirits, ASTM D235, by volume.

C. Finish and Color: Precast curb units shall be rub-finished in the following manner:

1. After the concrete has properly hardened, the exposed surfaces shall be rubbed with a No. 16 carborundum stone or an abrasive of approved equal in a manner to fully remove cement enamel finish and expose a durable sand grain finish satisfactory to Engineer. No cement shall be used in the rubbing process.

2. The finish of these units shall be uniform and shall conform to those of adjacent work in their final position.

D. Precast concrete curb sections shall be furnished with sockets in each end to receive dowels to maintain the horizontal and vertical alignment of the curb. The dowel socket shall be $^{11}/_{16}$ inch by 2½ inches.

E. Dowels: Steel, ⅝ inch by 4 inch with minimum yield strength of 36,000 psi. Dowels shall be supplied by the curb manufacturer.

2.4 CAST-IN-PLACE CONCRETE CURB

A. Concrete and reinforcement for cast-in-place concrete curbs shall be as specified in Section 03 3200 – Site-Cast-in-Place Concrete.

2.5 BITUMINOUS CONCRETE LIP CURBING

A. Bituminous concrete for curbing shall be as specified in Section 32 1216 – Bituminous Pavement.

2.6 CEMENT MORTAR

A. Mortar shall be composed of one part Portland Cement, ASTM C150, and two parts, by volume, of surface dry fine aggregate. Hydrated lime, ASTM C207, in an amount not to exceed 4 pounds of lime to each bag of Portland Cement, may be added at the option of Engineer. Cement and hydrated lime shall conform to the following requirements:

1. Portland cement: Types I, II or IS.

   a. Cement having a temperature exceeding 160°F (71°C) at the time of delivery to the mixer shall not be used in the concrete.

   b. Types I, II, and III portland cement shall conform to the requirements of AASHTO M 85.

   c. Type IS, Portland blast-furnace slag cement and Type IP, portland-pozzolan cement shall conform to the requirements of AASHTO M 240. The use of other approved cementitious material as a partial replacement for Type IS or Type IP cement will not be permitted.

   d. Type I and Type III portland cement shall be used only when required or expressly permitted by Contract or Engineer.

2. Hydrated lime: ASTM C6.

3. Fine aggregate: Fine aggregate shall be sand consisting of clean, hard, durable, uncoated particles of quartz or other rock, free from lumps of clay, soft or flaky material, loam, organic or other injurious material. In no case shall sand containing lumps of frozen material be used.

   a. Fine aggregate shall contain not more than 3% of material finer than a No. 200 (75 µm) sieve, using AASHTO T 11.

   b. Organic Impurities: Fine aggregate subjected to the colorimetric test shall not produce a color darker than Gardner Color Standard No. 11, using AASHTO T 21. If the fine aggregate fails to meet this requirement, the provisions of AASHTO M 6, Section 5.2, will govern.

   c. Gradation: For laying stone or precast units, fine aggregate shall be uniformly graded from coarse to fine and shall meet the following gradation requirements:

Aggregate Gradation (Cement Mortar for Laying Stone or Precast Units)

Sieve	Percent Passing
⅜″	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

d. Gradation: For pointing stone or precast units, fine aggregate shall be uniformly graded from coarse to fine and shall meet the following gradation requirements:

Aggregate Gradation (Cement Mortar for Pointing Stone or Precast Units)

Sieve	Percent Passing
No. 8	100
No. 50	10–40
No. 100	0–10

4. Water: Potable quality.

2.7 JOINT FILLER

A. Preformed expansion joint filler or wood joint filler as indicated on the plans.

B. Preformed expansion joint filler shall be the bituminous cellular type and shall conform to the requirements of AASHTO M213.

C. Boards for wood joint filler shall be planed on two sides and shall be either redwood, cypress or white pine. Redwood and cypress boards shall be of sound heartwood. White pine boards shall be of sound sapwood.

1. Occasional small, sound knots and medium surface checks will be permitted provided the board is free of any defects that will impair its usefulness for the purpose intended. The joint filler may be composed of more than one length of board in the length of the joint, but no board of a length less than 6 feet may be used; and the separate boards shall be held securely to form a straight joint. Boards composed of pieces that are jointed and glued shall be considered as one board.

2. Dimensions shall be as specified or shown on the plans; and tolerances of plus 1/16-inch thickness, plus 1/8-inch depth and plus 1/4-inch length will be permitted.

3. All wood joint filler boards shall be given a preservative treatment by brushing with a creosote oil conforming to AASHTO M133. After treatment, the boards shall be stacked in piles, each layer separated from the next by spacers at least 1/4 inch thick; and the boards shall not be used until 24 hours after treatment.

2.8 TRANSITION SECTIONS

A. Horizontal transition sections shall be provided at all locations where curb sections change (i.e., vertical to sloped). Vertical transition sections shall also be provided for precast curb sections at handicapped ramps to create a smooth transition with a doweled joint. Vertical transition sections for stone curb shall be made as shown on the Drawings.

PART 3 EXECUTION

3.1 GENERAL

A. Trenching, excavation, backfilling, and compaction shall be completed in accordance with Section 31 2310 – Earthwork, except as modified within this Section.

B. Cement Mortar Bedding, if required, shall be placed as indicated in details in accordance with Section 03 3200 – Site Cast-In-Place Concrete.

3.2 GRANITE CURB

A. Excavation shall be made in accordance with details on the plans and shall extend 6 inches below and behind finished curb section.

1. Screened gravel base shall be compacted to a firm, even surface.

B. Curbing shall be set on edge and settled into place with a heavy wooden hand-rammer, to the line and grade required, straight and true for the full depth.

1. Joints of the stone curbing or curbing shall be filled with mortar for the full depth of the curbing, and neatly pointed on the top and front exposed portions. After pointing, the curbstone or curbing shall be satisfactory cleaned of all excess mortar that have been forced out of the joints.

2. Ends of the stone curbing at driveways and intersections shall be cut at a bevel or rounded, as directed by Engineer.

3. Handicap ramps shall be placed in the curb line by lowering the curb as shown on the drawings. The depressed sections of curbing shall be mitered as required.

C. Immediately after curb is set and jointed, the trench shall be backfilled with approved material; the first layer to be 4 inches in depth, thoroughly rammed; the other layers to be not more than 6 inches in depth and thoroughly rammed until the trench is filled.

D. Curbing excavation and installation procedures at existing roadway shall be as specified above with the following additions:

1. Prior to excavation for existing stone curb removal, the pavement surface shall be cut a maximum of two (2) feet from the face of curb with appropriate pavement cutting equipment. Pavement patching shall conform to Asphalt Paving: Section 321216.

2. Existing curb shall be cut, carefully excavated, and removed in such a manner to protect the existing pavement to remain.

3. New stone curb shall be set to match top of existing stone curb at abutting sections and, if required, transitioned to a typical section shown on drawings within the first section of curb.

4. Where new curb is to be installed at existing paved areas, curb shall be set as specified except that cement concrete shall be placed along the front face of the curb as shown on the details in the Drawings.

3.3 PRECAST CONCRETE CURB

A. Precast units delivered to the site shall be inspected for damage, unloaded and placed along excavated trench or other designated location with the minimum amount of handling.

1. Materials shall be handled in such a manner as to insure delivery to trench in a sound and undamaged condition.

2. All individual pieces of curbed curbing shall be marked to correspond to the radius and location where curbing is to be set.

B. Excavation shall be made in accordance with details on the plans and shall extend 6 inches below and behind finished curb sections.

1. Screened gravel base shall be compacted to a firm, even surface.

C. Installation of precast concrete curb shall be completed within the prepared trench such that each section is doweled to the next continuously and conforming to the line, grade, and cross-section shown on the plans, unless otherwise directed by Engineer. Installation shall be completed in such a manner as to prevent damage to the precast units.

D. After the curb is set, trench shall be backfilled immediately with approved material. The first layer to be 4 inches in depth, thoroughly rammed, the other layers to be not more than 6 inches in depth and thoroughly rammed until the trench is filled. Care is to be taken not to affect the line or grade of the curb during this procedure.

E. All curb joints shall be filled with caulking compound (color-cement mortar grey). One joint every 50 feet shall be left clean of caulk to allow for expansion.

3.4 CAST-IN-PLACE CONCRETE CURB

A. General Requirements: Concrete curb shall be constructed of concrete and shall be cast-in-place on the prepared subbase in accordance with the dimensions and details line and grade shown on the Drawings. Curbing shall be constructed using conventional forms and in segments separated by construction joints and expansion joints as specified herein. This item shall consist of concrete curbing constructed or as ordered and in conformity with these specifications.

B. Forms: Forms shall be metal or acceptable planed and matched lumber, straight and free from warp or other irregularities that will adversely affect the installation. Forms shall conform to the curb cross-section shown on the Drawings and shall be carefully set to line and grade and thoroughly braced and secured in place so that there will be no displacement during placement of the concrete. All forms shall be thoroughly cleaned prior to reuse.

C. Placing of Concrete: Prior to placement of the concrete, the subgrade shall be moistened and the contact surfaces of the forms shall be given a light coating of oil that will not discolor the concrete. Concrete shall then be placed in the form as near to its final position as practicable, struck off with a template, spaded to prevent “rock-pockets” or “honey combing” adjacent to the forms and finished to a smooth even surface. The concrete may be compacted by mechanical vibrators if approved by Engineer. Placing by slip form methods shall be approved by Engineer.

D. Expansion Joints: Vertical expansion joints shall be located approximately every seventy-five (75) feet and shall be so arranged that they shall match expansion joints in any adjacent concrete pavements and sidewalks. Unless directed otherwise, expansion joints shall also be installed at the PC and PT of all radius curb. Expansion joints shall be constructed vertical, plumb, and at right angles to the face of the curb.

1. Prior to concreting, all exposed surfaces of the wood filler shall be given a light brush coating of form oil.

2. They shall be one-half (½) inch in width and formed with premolded bituminous joint filler cut to conform to the cross-section of the curb/curb gutter.

E. Construction Joints: Vertical construction joints shall be located approximately every fifteen (15) feet being equally spaced between expansion joints. The length of these curb/curb gutter segments may be varied slightly for closures but in no case shall they be less than eight (8) feet. Construction joints shall be vertical, plumb and at right angles to the face of the curb and shall be formed by approved method that will provide complete separation of the curb segments during the placing of the concrete. If curb is formed by slip form methods, the joints shall be sawed as soon as practicable after the concrete has set to preclude raveling during the sawing and before any shrinkage cracking occurs in the concrete.

F. Finishing: Forms shall be left in place for twenty-four (24) hours or until the concrete has sufficiently hardened as determined by Engineer so that they can be removed without injury to the curb. Upon removal of the forms, the exposed faces of the curb/curb gutter shall be immediately rubbed to a uniform surface. Rubbing shall be performed by experienced and competent concrete finishers. No plastering will be permitted.

3.5 BITUMINOUS CONCRETE LIP CURB

A. General Requirements

1. Bituminous curbing shall be constructed by the use of an approved self-propelled extruding curb machine equipped with a material hopper, distributing screw and curb forming device capable of placing the bituminous mixture to the required lines, grades and proper curb cross-section. Prior to the placement of any curb, Contractor shall submit a detail of the cross-section of the curb mold that he proposes to use to Engineer for approval.

B. Surface Preparation

1. When curbing is to be placed on existing bituminous pavements, concrete pavements or newly laid bituminous pavements which have been in place more than twenty-four (24) hours, the surface on which the curb is to be placed shall be swept and cleaned, thoroughly dried, and immediately prior to placement of the curb, the surface to be occupied by the curb shall be given an application of tack coat material.

2. Prevent spread of tack coat material beyond the area to be occupied by the curb.

3. Recently placed bituminous concrete pavement, which have been placed less than twenty-four (24) hours prior to placement of the curb need only be thoroughly swept and cleaned.

C. Placing and Compaction

1. The hot bituminous mixture shall be placed in the hopper of the curb paver without segregation and extruded through the mold form to provide the proper compaction and surface texture.

2. The curb paver shall be properly supported and weighted during operation along the edge of the pavement and shall be guided along string or chalk lines to maintain the proper alignment and level of the completed curb.

3. Any portions of the completed curb, which are not satisfactorily compacted, or show signs of sagging, cracking, or distortion, or do not conform to the required lines, grades or cross-section for any reason, and which cannot be satisfactorily repaired during construction, shall be removed and replaced at no additional cost to the Owner.

D. Joints

1. Bituminous curb construction shall be a continuous operation in one direction only, to eliminate joints. Excessive joints will be cause for rejection of entire length of installation.

2. When the placing of the curb is discontinued for a length of time that permits the mixture to become chilled, the curb shall be cut in a true vertical plane and the exposed end painted with a thin uniform coat of hot asphalt cement just prior to placing the fresh curb mixture against the previously constructed curb to insure a continuous bond. Joints that are not smooth and uniform, exhibit distortion, or are patched will be rejected.

END OF SECTION

SECTION 32 1723

PAVEMENT MARKINGS

PART 1 GENERAL

1.1 SUMMARY

A. Section includes:

1. Temporary or permanent painted pavement markings, including but not limited to center lines, lane lines and shoulder lines, stop bars, crosswalks, parking stalls, lane arrows, legends, markings within gore areas, and painting of paved islands or medians.

2. Temporary plastic pavement marking tape.

3. Black line mask pavement marking tape.

4. Maintaining access for vehicular and pedestrian traffic as required for other construction activities. Utilize flagmen, barricades, warning signs, and warning lights as required.

B. Contractor shall coordinate work between all Subcontractors, sections, and trades required for the proper completion of the work.

C. Contractor is responsible for all health and safety.

1.2 SUBMITTALS

A. Submit material specifica¬tions and shop drawings for all materials furnished under this Section.

B. Submit material certificates signed by the material producer and Contractor, certifying that materials comply with these Specifications.

1.3 REFERENCES

A. Reference herein to any technical society, organization, group or regulation are made in accordance with the following abbreviations and, unless otherwise noted or specified, all work under this Section shall conform to the latest edition as applicable.

B. State of Connecticut Department of Transportation (ConnDOT)

1. Standard Specifications for Roads, Bridges and Incidental Construction, Form 817, 2016 and any supplements.

C. Code of Federal Regulations (CFR)

1. 29 CFR 1926, Safety and Health Regulations for Construction

D. ASTM International (ASTM)

1. ASTM C501 - Standard Test Method for Relative Resistance to Wear of Unglazed Ceramic Tile by the Taber Abraser.
2. ASTM D211 - Standard Specification for Chrome Yellow and Chrome Orange Pigments.
3. ASTM D476 - Standard Classification for Dry Pigmentary Titanium Dioxide Products.
4. ASTM D562 - Standard Test Method for Consistency of Paints Measuring Krebs Unit (KU) Viscosity Using a Stormer-Type Viscometer.
5. ASTM D605 - Standard Specification for Magnesium Silicate Pigment (Talc).
6. ASTM D638 - Standard Test Method for Tensile Properties of Plastics.
7. ASTM D695 - Standard Test Method for Compressive Properties of Rigid Plastics.
8. ASTM D711 - Standard Test Method for No-Pick-Up Time of Traffic Paint.
9. ASTM D869 - Standard Test Method for Evaluating Degree of Settling of Paint.
10. ASTM D1475 - Standard Test Method for Density of Liquid Coatings, Inks, and Related Products.
11. ASTM D1763 - Standard Specification for Epoxy Resins.
12. ASTM D2240 - Standard Test Method for Rubber Property- Durometer Hardness.
13. ASTM D2486 - Standard Test Methods for Scrub Resistance of Wall Paints.
14. ASTM D4060 - Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser.
15. ASTM D4505 - Standard Specification for Preformed Retroreflective Pavement Marking Tape for Extended Service Life.
16. ASTM E303 - Standard Test Method for Measuring Surface Frictional Properties Using the British Pendulum Tester.
17. ASTM G153 - Standard Practice for Operating Enclosed Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials.

E. American Association of State High and Transportation Officials (AASHTO)

1. AASHTO M 247 - Standard Specification for Glass Beads Used in Traffic Paints.

F. American Concrete Institute

1. ACI 503R - Use of Epoxy Compounds with Concrete.

G. United States General Services Administration, Federal Specifications.

1. Federal Specification TT-P-1952D - Paint, Traffic and Air Field Marking, Water Emulsion Base.

H. United States General Services Administration, Federal Standards.

1. Federal Standard No. 595 - Colors Used in Government Procurement.

1.4 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and methods required for proper performance of the work in this Section. Use equipment of adequate size, capacity and quantity to accomplish the work of this Section in a timely manner.

B. Contractor shall furnish one technical expert, who shall be fully knowledgeable about all equipment operations and application techniques, to oversee the work of this Section.

PART 2 PRODUCTS

2.1 WATERBORNE PAVEMENT MARKING PAINT

A. General

1. White and yellow fast-drying waterborne pavement marking paint, low VOC, ready-mixed, one component, 100 percent acrylic, Federal Specification TT-P-1952D.

2. Paint shall be capable of being applied with paint striping equipment at ambient temperatures.

3. Weight per gallon shall not be less than 12.5 pounds/gallon when tested in accordance with ASTM D1475.

4. Colors: ASTM D211 and per Federal Standard No. 595.

B. Manufacture

1. Paint shall be formulated and manufactured from first-grade raw materials and shall be free from defects and imperfections that might adversely affect the serviceability of the finished product. The materials shall not exhibit settling or jellying after storage in the sealed containers as received that will affect the performance of the products. The paint shall provide the proper anchorage, refraction and reflection for the finished glass spheres when applied as specified.

C. Composition

1. Composition of the paint shall be at the discretion of the manufacturer, provided that the finished product meets the requirements of any applicable Federal, State or Local regulations for products of this type and the requirements as follows:

    a. Paint shall not contain more than 0.06% lead.

    b. Total nonvolatile shall not be less than 70% by weight (mass).

    c. Pigment shall be 45–55% by weight (mass).

    d. Resin solids shall be composed of 100% acrylic emulsion polymer.

    e. Volatile organic compounds shall not exceed 150 grams/liter, excluding water.

    f. Closed-cup flash point shall not be less than 100°F (38°C), and weight per gallon shall not be less than 12.5 pounds/gallon when tested in accordance with ASTM D1475.

D. Viscosity

1. Consistency of the paint shall not be less than 80, nor more than 90 Kreb units when tested in accordance with ASTM D562. The paint shall have good spraying characteristics when the material is heated to application temperature of 130°F to 145°F.

E. Flexibility

1. Paint shall not show cracking or flaking when subjected to the TT-P-1952D flexibility test in which the panels used shall be tin plates that are 3 inches x 5 inches in area and 35 – 31 U.S. Gauge in thickness. The tin panels shall be lightly buffed with steel wool and thoroughly cleaned with solvent before being used for tests.

F. Dry Opacity

1. Both white and yellow paints shall have a minimum contrast ratio of 0.96. Contract ratio shall be determined by applying a wet film thickness of 0.005 inches (127 microns) to a standard hiding power chart. After drying, the black and white reflectance values shall be determined using a suitable reflectometer and the contrast ratio determined.

G. Bleeding

1. Paints shall have a minimum bleeding ratio of 0.97 when tested in accordance with FS TT-P-1952D.

H. Abrasion Resistance

1. No less than 210 liters of sand shall be required to remove paint film when tested in accordance with TT-P-1952D.

I. Color

1. Yellow: FS 595, No. 13538, latest issue.

2. White: No darker or yellower than FS 595, No. 17778, latest issue, when the material is placed in a type EH weatherometer for a period of 500 hours and weathered according to ASTM G153.

3. Color determination shall be made without beads, after a minimum of 24 hours. If not a visual match, the diffuse day color of the paint shall conform to the CIE Chromaticity coordinate limits as follows:

Paint CIE Chromaticity Coordinate Limits

	x	Y	x	y	x	y	x	y	Brightness
White	0.305	0.295	0.360	0.360	0.388	0.377	0.280	0.310	84.0 Min
Yellow	0.485	0.455	0.506	0.452	0.484	0.428	0.477	0.438	50.0 Min

4. Paint shall not discolor in sunlight and shall maintain colorfastness throughout its life, approximately two years.

J. Glass Bead Adhesion

1. Paint with glass beads conforming to M.07.30, applied at the rate of 6.0 pounds/gallon of paint, shall require not less than 150 liters of sand to remove paint film and glass beads.

K. Scrub Resistance

1. Paint shall pass 300 cycles minimum when tested in accordance with ASTM D2486.

L. Drying time

1. Reflectorized line shall dry to no pick up in 15 minutes or less as tested by ASTM D711 when applied at the ratio provided for specified glass spheres to paint (the paint at 15+ 1 mil (381 millimeters + 25 millimeters) wet film thickness equivalent to 100–115 square foot/gallon and the glass spheres at the equivalent rate of 6.0 pounds/gallon.

2.2 HOT-APPLIED WATERBORNE PAVEMENT MARKING PAINT

A. General

1. White and yellow fast-drying waterborne pavement marking paint, low VOC, ready-mixed, one component, 100 percent acrylic, Federal Specification TT-P-1952D.

2. Paint shall be capable of being applied with paint striping equipment at an application temperature of 130°F to 145°F.

3. Color: ASTM D211 and per Federal Standard No. 595.

4. Glass Beads: AASHTO M 247, Type 1.

B. Manufacture

1. Paint shall be formulated and manufactured from first-grade raw materials and shall be free from defects and imperfections that might adversely affect the serviceability of the finished product. The materials shall not exhibit settling or jellying after storage in the sealed containers as received that will affect the performance of the products. The paint shall provide the proper anchorage, refraction and reflection for the finished glass spheres when applied as specified.

C. Composition

1. Composition of the paint shall be at the discretion of the manufacturer, provided that the finished product meets the requirements of any applicable Federal, State or Local regulations for products of this type and the requirements as follows:

a. Paint shall not contain more than 0.06% lead.

b. Total nonvolatile shall not be less than 76% by weight (mass).

c. Pigment shall be 58–63% by weight (mass).

d. Resin solids shall be composed of 100% acrylic emulsion polymer.

e. Volatile organic compounds shall not exceed 150 grams/liter, excluding water.

f. Closed-cup flash point shall not be less than 100°F, and weight per gallon shall not be less than 12.5 pounds/gallon when tested in accordance with ASTM D1475.

D. Viscosity

1. Consistency of the paint shall not be less than 80, nor more than 90 Kreb units when tested in accordance with ASTM D562. The paint shall have good spraying characteristics when the material is heated to application temperature of 130°F to 145°F.

E. Flexibility

1. Paint shall not show cracking or flaking when subjected to the TT-P-1952D flexibility test in which the panels used shall be tin plates that are 3 inches x 5 inches (76 millimeters x 127 millimeters) in area and 35 – 31 U.S. Gauge in thickness. The tin panels shall be lightly buffed with steel wool and thoroughly cleaned with solvent before being used for tests.

F. Dry Opacity

1. Both white and yellow paints shall have a minimum contrast ratio of 0.96. Contract ratio shall be determined by applying a wet film thickness of 0.005 inches (127 microns) to a standard hiding power chart. After drying, the black and white reflectance values shall be determined using a suitable reflectometer and the contrast ratio determined.

G. Bleeding

1. Paints shall have a minimum bleeding ratio of 0.97 when tested in accordance with FS TT-P- 1952D.

H. Abrasion Resistance

1. No less than 210 liters of sand shall be required to remove paint film when tested in accordance with TT-P-1952D.

I. Color

1. Yellow: FS 595, No. 13538, latest issue.

2. White: No darker or yellower than FS 595, No. 17778, latest issue, when the material is placed in a type EH weatherometer for a period of 500 hours and weathered according to ASTM G153.

3. If not a visual match, the diffuse day color of the paint shall conform to the CIE Chromaticity coordinate limits as follows:

Paint CIE Chromaticity Coordinate Limits

	x	Y	x	y	x	y	x	y	Brightness
White	0.305	0.295	0.360	0.360	0.388	0.377	0.280	0.310	84.0 Min
Yellow	0.485	0.455	0.506	0.452	0.484	0.428	0.477	0.438	50.0 Min

4. Paint shall not discolor in sunlight and shall maintain colorfastness throughout its life, approximately two years. Color determination shall be made without beads, after a minimum of 24 hours.

J. Glass Bead Adhesion

1. Paint with glass beads shall require not less than 150 liters of sand to remove paint film and glass beads.

K. Scrub Resistance

1. Paint shall pass 300 cycles minimum when tested in accordance with ASTM D2486.

L. Drying time

1. Reflectorized line shall dry to no pick up in 120 seconds or less when applied at the ratio provided for specified glass spheres to paint (the paint at 15+ 1 mil (381 millimeters + 25 millimeters) wet film thickness equivalent to 100–115 square foot/gallon (2.45–2.82 square meters/liter) and the glass spheres at the equivalent rate of 6.0 pounds/gallon (0.72 kilograms/liter). The paint shall be applied with equipment so as to have the paint at a temperature of 130°F to 145°F (54°C to 63°C) at the spray gun.

2.3 EPOXY RESIN PAVEMENT MARKINGS

A. Epoxy Resin Material: The material shall be composed of epoxy resins and pigments only.

B. Composition:

1. White (percent by weight): 20% +/- 2% Titanium Dioxide, ASTM D476 Type 3 and 80% +/- 2% Epoxy Resins.

2. Yellow (percent by weight): 25% +/- 2% Chrome Yellow, ASTM D211 Type 3 and 75% +/- 2% Epoxy Resins.

3. Epoxy Resins: ASTM D1763.

C. Color

1. Yellow: FS 595, No. 13538, latest issue.

2. White: No darker or yellower than FS 595, No. 17778, latest issue, when the material is placed in a type EH weatherometer for a period of 500 hours and weathered according to ASTM G153.

D. Adhesion Capabilities

1. When the adhesion of the material to portland cement concrete (test concrete shall have a minimum of 300 psi tensile strength) is tested according to ACI 503R testing procedure, the failure of the system must take place in the concrete. The concrete shall be 90 °F when the material is applied, after which the material shall be allowed to cure for 72 hours at 73 +/- 3.5 °F.

E. Abrasion Resistance

1. When the abrasion resistance of the material is tested according to ASTM C501 with a CS-17 wheel under a load of 1000 grams for 1000 cycles, the wear index shall be no greater than 82. (The wear index is the weight (mass) in milligrams that is abraded from the sample under the test conditions).

F. Hardness

1. The Type D durometer hardness of the material shall be not less than 75 nor more than 90 when tested according to ASTM D2240 after the material has cured for 72 hours at 73 +/- 3.5 °F.

G. Tensile Strength

1. Tensile strength of the material, when tested according to ASTM D638, shall not be less than 6,000 psi after 72 hours cure at 73 +/- 3.5 °F.

H. Compressive Strength

1. Compressive strength of the material, when tested according to ASTM D695, shall not be less than 12,000 psi after 72 hours cure at 73 +/- 3.5 °F.

I. Shelf Life

1. Individual components shall not require mixing prior to use when stored for a period of 12 months.

2.4 GLASS BEADS

A. Beads shall be transparent, clean, colorless glass, smooth and spherically shaped, free of milkiness, pits, or excessive air bubbles.

B. Quality Assurance Control

1. Beads shall be segregated into maximum lots of 2,500 pounds (1125 kilograms) and lot numbers shall be stamped onto each lot. Each lot shall be tested for gradation, rounds and embedment coating.

C. Gradation - The glass spheres shall meet the following gradation requirements:

Glass sphere gradation (ConnDOT Grading “A”)

Sieve Size	% Passing
20 (850 um)	100
30 (600 um)	80–95
50 (300 um)	9–42
80 (180 um)	0–10

Glass sphere gradation (ConnDOT Grading “B”)

Sieve Size	% Retained
10 (2.0 mm)	0
12 (1.7 mm)	0–5

14 (1.4 mm)	5–20
16 (1.18 mm)	40–80
18 (1.0 mm)	10–40
20 (850 um)	0–5
Pan	0–2

D. Roundness: Glass beads shall have a minimum of 80% rounds per screen for two highest sieve quantities and no more than 3% angular particles per screen for Grading “B”. The remaining sieve fractions shall typically be no less than 75% rounds.

E. Refractive Index: Glass beads shall have a refractive index of 1.50 to 1.52.

2.5 TEMPORARY PLASTIC PAVEMENT MARKING TAPE

A. Materials for this work shall be commercially available pavement marking tape, ASTM D4505.

B. Tape shall be pre-coated with a pressure sensitive adhesive and shall be capable of being adhered to existing markings, on bituminous concrete pavement or portland cement concrete in accordance with the manufacturer’s instructions without the use of heat, solvents or other additional adhesives, and shall be immediately ready for traffic use after application.

1. Tape shall be reflective with the use of glass beads throughout the pigments.

2. Tape shall be durable, flexible, formable and following application shall remain in contact with the pavement surface.

C. Adhesion: Tape shall adhere to the pavement and existing pavement markings under climatic and traffic conditions normally encountered in the construction work zone. The tape shall be reinforced by a nonmetallic medium and pre-coated with a pressure sensitive adhesive.

D. Removability: Tape shall be removable after its intended use, intact or in large pieces, manually, at temperatures above 40°F without the use of heat, solvents, grinding or sand or water blasting. The black line mask pavement marking tape shall be totally removed from existing markings that are adequately adhered to the pavement surface, without damage to the underlying markings.

E. Tape shall be readily visible during daylight and when viewed with vehicular headlights at night.

2.6 PREFORMED BLACK LINE MASK PAVEMENT MARKING TAPE

A. General

1. Tape shall consist of a matte black, non-reflective tape in widths or sizes sufficiently large to mask the existing markings which are to be temporarily covered.

2. Patterned masking tape shall be pre-coated with a pressure sensitive adhesive and shall be capable of being adhered to existing markings, on bituminous concrete pavement or portland cement concrete in accordance with the manufacturer's instructions without the use of heat, solvents or other additional adhesives, and shall be immediately ready for traffic use after application.

B. Composition: The non-reflective, patterned black line mask pavement marking tape shall not contain metallic foil and shall consist of a mixture of high quality polymeric materials, pigments and inorganic fillers distributed throughout its base cross-sectional area, with a matte black non-reflective top layer. The patterned surface shall have a minimum of 20% of the surface area raised and coated with non-skid particles. The channels between the raised areas shall be substantially free of particles. The film shall be pre-coated with a pressure sensitive adhesive. A non-metallic medium shall be incorporated to facilitate removal.

C. Skid Resistance: The surface of the patterned, nonreflective black line mask pavement marking tape shall provide an initial average skid resistance value of 60 BPN when tested in accordance with ASTM E303.

D. Thickness

1. Patterned material, without adhesive, shall have a minimum thickness of 0.065 inch at the thickest portion of the patterned cross-section and a minimum thickness of 0.02 inch at the thinnest portion of the cross-section.

E. Adhesion: Tape shall adhere to the pavement and existing pavement markings under climatic and traffic conditions normally encountered in the construction work zone.

F. Removability: Tape shall be removable after its intended use, intact or in large pieces, manually, at temperatures above 40°F without the use of heat, solvents, grinding or sand or water blasting. The black line mask pavement marking tape shall be totally removed from existing markings that are adequately adhered to the pavement surface, without damage to the underlying markings.

2.7 BLACK EPOXY RESIN PAVEMENT MARKINGS

A. Epoxy Resin Material: Material shall be composed of epoxy resins and pigments only.

1. Carbon Black: ASTM D476.

B. Composition: Black Epoxy Resin shall conform to the following:

Composition of Black Epoxy Resin

Component	Percent by Mass
Carbon Black	7 +/- 2

Talc	14 +/- 2
Epoxy Resins	79 +/- 4

1. Carbon Black: ASTM D476 Type 3.
2. Talc: ASTM D605.
3. Epoxy Resins: ASTM D1763.

C. Black Aggregate: Angular with no dry dispensement pigment, urethane coated.

1. Moisture resistant aggregate shall meet the following gradation requirements:

Gradation of Black Moisture Resistant Aggregate

Sieve Size	Percent Retained
No. 20 (850 um)	23–38
No. 50 (300 um)	58–74
No. 270 (53 um)	1–6
Pan	0–5

D. Adhesion: Black epoxy resin pavement marking material shall be formulated so as to adhere to the pavement and existing pavement markings under climatic and traffic conditions normally encountered in the construction work zone.

E. Abrasion Resistance: When the abrasion resistance of the material is tested according to ASTM D4060 with a CS-17 wheel under a load of 1,000 grams for 1,000 cycles, the wear index shall be no greater than 82.

F. Hardness: The Type D durometer hardness of the material shall not be less than 75 nor more than 90 when tested according to ASTM D2240 after the material has cured for 72 hours at 73.5 ± 3.5°F.

G. Compressive Strength: The compressive strength of the material, when tested according to ASTM D695, shall not be less than 12,000 psi after 72 hours cured at 73.5 ± 3.5°F.

PART 3 EXECUTION

3.1 GENERAL

A. Pavement markings shall be applied in accordance with the details shown on the plans and the control points established by the Contractor and approved by the Engineer.

B. No paint shall be applied to new bituminous pavement until the top course has cured at least one week minimum.

C. Pavement areas to be painted shall be dry and sufficiently cleaned of sand and road debris so as to provide an acceptable bond between the paint and the pavement.

D. All painting shall be performed in a neat and workmanlike manner. The lines shall be sharp and clear with no feathered edging or fogging and precautions shall be taken to prevent tracking by tires of the striping equipment. Paint shall be applied as shown on the Drawings with no unsightly deviations.

E. Contractor shall protect the buildings, walks, pavement, curbing, trees, shrubs, mulch, etc. from over-spray of paint and damage by his operations.

F. Operations shall be conducted only when the road surface temperature is at least 40°F or as allowed by Engineer. They shall be discontinued during periods of rain, and shall not continue until Engineer determines that the pavement surface is dry enough to achieve adhesion.

G. After application, paint shall be protected from crossing vehicles using traffic cones or other acceptable method for a time at least equivalent to the drying or curing time of the paint.

H. The material shall be applied to the pavement by equipment used specifically for the application of pavement markings and shall be of a standard commercial manufacturer.

I. Contractor shall provide survey control for layout of pavement markings by utilizing his own surveyor or hiring a registered land surveyor. The cost of this survey control shall be included in other items of work.

3.2 WATERBORNE PAVEMENT MARKINGS

A. Painted legend, arrows, and markings includes paint installed with a hand striping machine such as: stop bars, crosswalks, parking stalls, lane arrows, legends, markings within gore areas, and painting of paved islands or medians.

B. Painted pavement markings and hot applied painted pavement markings include paint installed with a truck-mounted painting machine such as center lines, lane lines and shoulder lines.

C. Waterborne Paint, Ambient Temperature

1. Apply paint at a rate of 100 to 115 square feet per gallon, with glass beads applied at a rate of 6 pounds per gallon of paint for painted pavement markings and painted legend, arrows, and markings

D. Waterborne Paint, Hot-Applied

1. Hot-applied paint shall be applied at a temperature of 130°F to 145°F at the spray gun.

2. Apply paint at a rate of 8 pounds per gallon of paint for hot-applied painted pavement markings.

3.3 EPOXY RESIN PAINTED PAVEMENT MARKINGS

A. Epoxy resin pavement markings includes epoxy resin installed with a truck-mounted machine such as center lines, lane lines, and shoulder lines.

B. Epoxy resin pavement markings, symbols and legends include stop bars, crosswalks, parking stalls, lane arrows, legends, and markings within areas such as paved islands, gore areas and paved medians.

C. Equipment

1. Equipment furnished shall include an applicator truck of adequate size and power, together with the following:

a. Remote application equipment designed to apply an epoxy resin material in a continuous pattern.

b. Portable glass bead applicators, one for each size bead, designed to provide uniform and complete coverage of the epoxy binder by a controlled free-fall method. Pressurized glass bead application shall not be used. Before epoxy color is changed, equipment shall be cleaned out sufficiently to ensure that the color of material applied will be correct.

2. When working on a highway with more than one lane in either direction, the applicator truck (striper) shall have a permanently mounted direction variable illuminated arrow board, fully operational and visible to approaching traffic. There will be no additional payment for the arrow board. Its cost shall be included in the bid price for this item.

3. For markings applied on pavements over one year old, equipment furnished shall also include a power washing machine capable of cleaning the pavement with a pressure of 2,400 to 2,800 psi with water heated to 180°F – 195°F. No chemicals shall be added to the water used in the process. The power washer shall be equipped with a turbo blast tip with an oscillating head and shall be capable of supplying a minimum of 5 gallons/minute gun.

4. All guns on the spray carriages shall be in full view of the operator(s) during operation.

D. Procedures

1. The road surface shall be cleaned at the direction of the Engineer just prior to application. Pavement cleaning shall consist of power washing using clean water heated to 180°F – 195 °F at a pressure of 2,240 – 2,800 psi. The areas to be power washed shall include all areas where epoxy marking symbols and legends (including stop bars and crosswalks) are to be applied and at least 1 inch beyond the area to be marked. The surface shall be cleaned to the satisfaction of the Engineer.

a. For other pavement areas, cleaning shall consist of brushing with rotary broom (non-metallic), and any additional work as recommended by the material manufacturer and acceptable to the Engineer.

b. New portland cement concrete surfaces shall be cleaned by abrasive blasting to remove any surface treatments and/or laitance.

c. New bituminous concrete surfaces are not to be power washed.

2. All surfaces that are power washed shall be allowed to dry sufficiently prior to the application of the epoxy markings. The areas to be marked shall be broom cleaned

immediately prior to the application of the epoxy markings. Glass beads shall be applied immediately after application of the epoxy resin marking to provide an immediate notrack system.

3. Contractor will place necessary “spotting” at appropriate points to provide horizontal control for striping and to determine necessary starting and cutoff points. Broken line intervals will not be marked. Longitudinal joints, pavement edges and existing markings shall serve as horizontal control when so directed.

4. A tolerance of 0.25 inch under or 0.25 inch over the specified width shall be allowed for striping provided the variation is gradual and does not detract from the general appearance. Alignment deviations from the control guide shall not exceed 2 inches provided the variation is gradual and does not detract from the general appearance. Material shall not be applied over a longitudinal joint. Establishment of application tolerances shall not relieve Contractor of the responsibility to comply as closely as practicable with the planned dimensions.

5. Glass beads conforming to the requirements of Grading “B” (larger beads) as specified herein shall be applied at a rate of 12 pounds per gallon of epoxy pavement marking material, immediately followed by a second drop of glass beads conforming to the requirements of Grading “A” (smaller beads) as specified herein applied at a rate of 13 pounds per gallon of epoxy pavement marking material.

6. Time to No-Track: The material shall be in “no-tracking” condition within 15 minutes, or as allowed by Engineer. The no-tracking time shall be determined by passing over the line with a passenger car or pickup truck in the simulated passing maneuver. A marking showing no visual deposition of the material to the pavement surface when viewed from a distance of 50 feet (15 meters) shall be considered as showing “no-tracking” and conforming to this requirement for time to no-track.

7. When stencils are used during the application of epoxy markings, care must be used when removing the stencils so that the epoxy resin does not drip on the road, sidewalk, grass, etc., and so that the applied markings have edges which are clean, straight and neat.

8. Epoxy resin pavement markings may be applied over existing painted markings provided they are sufficiently worn to allow adequate adhesion. If required by the Engineer, existing plastic, thermoplastic, epoxy or freshly painted markings shall be removed prior to the application of epoxy markings.

E. Crosswalks

1. Only glass beads conforming to the requirements of Grading “A” (smaller beads) as specified herein shall be applied at a rate of 25 pounds per gallon of epoxy pavement marking material.

F. Performance

1. In order to be accepted, the applied markings must meet the following minimum retroreflectivity reading as measured using an LTL 2000 Retrometer with 30-meter geometry 1 to 2 weeks after installation:

   a. White Epoxy 250 millicandelas per square foot per foot candle (millicandelas per square meter per lux).

b. Yellow Epoxy 175 millicandelas per square foot per foot candle (millicandelas per square meter per lux).

3.4 TEMPORARY PLASTIC PAVEMENT MARKING TAPE

A. Contractor will pre-mark the pavement prior to application of the marking and use a string line if required to produce a neat appearing line.

B. Install temporary plastic pavement marking tape in accordance with manufacturer's procedures.

C. Promptly replace marking tape which has become dislodged, torn or otherwise damaged.

3.5 PAVEMENT MARKING REMOVAL

A. Pavement markings shall be removed before any change is made in the traffic pattern.

B. Pavement markings shall be removed from the pavement by any method that does not materially damage the surface or texture of the pavement. Any damage to the pavement surface caused by pavement marking removal shall be repaired by Contractor at its expense by methods acceptable to Engineer.

1. Removal of temporary plastic pavement marking tape shall be accomplished without the use of heat, solvents, grinding or sandblasting and in such a manner that no damage to the pavement results.

C. Sand or other material deposited on the pavement as a result of removing pavement markings shall be removed as the work progresses. Accumulations of sand or other material which might interfere with drainage or might constitute a hazard to traffic will not be permitted.

D. Where blast cleaning is used for the removal of pavement markings and such removal operation is being performed within 10 feet of a lane occupied by traffic, the residue including dust shall be removed immediately after contact between the sand and the surface being treated. Such removal shall be by a vacuum attachment operating concurrently with the blast cleaning operation, or by other methods approved by Engineer.

END OF SECTION

SECTION 32 3113

CHAIN LINK FENCES AND GATES

PART 1 GENERAL

1.1 SUMMARY

A. Section includes

1. Furnishing and installing woven wire fencing systems of the type and height specified and supported by metal posts erected where indicated on the Drawings and as specified herein, including fence and gates.

B. Contractor shall coordinate work between all Subcontractors, sections, and trades required for the proper completion of the work.

C. Contractor is responsible for all health and safety.

1.2 REFERENCES

A. Reference herein to any technical society, organization, group or regulation are made in accordance with the following abbreviations and, unless otherwise noted or specified, all work under this Section shall conform to the latest edition as applicable.

B. Code of Federal Regulations (CFR).

1. 29 CFR 1926, Safety and Health Regulations for Construction.

C. ASTM International (ASTM).

1. ASTM A90 – Standard Test Method for Weight (Mass) of Coating on Iron or Steel Articles with Zinc or Zinc Alloy.

2. ASTM A123 – Zinc (Hot Dip Galvanized) Coatings on Iron and Steel Products.

3. ASTM A153 – Standard Specification for Zinc Coating (Hot Dip) on Iron and Steel Hardware.

4. ASTM A307 – Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 PSI Tensile Strength.

5. ASTM A392 – Standard Specification for Zinc-Coated Steel Chain-Link Fence Fabric.

6. ASTM A428 – Standard Test Method for Weight (Mass) of Coating on Aluminum-Coated Iron or Steel Articles.

7. ASTM A491 – Standard Specification for Aluminum Coated Steel Chain Link Fence Fabric.

8. ASTM A780 – Standard Specification for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.

9. ASTM A817 – Standard Specification for Metallic-Coated Steel Wire for Chain Link Fence Fabric and Marcelled Tension Wire.

10. ASTM A824 – Standard Specification Metallic-Coated Steel Marcelled Tension Wire for Use with Chain Link Fence.

11. ASTM B211 – Standard Specification for Aluminum and Aluminum-Alloy Bar, Rod and Wire.

12. ASTM C94 – Standard Specification for Ready-Mixed Concrete.

13. ASTM F552 – Standard Terminology Relating to Chain Link Fencing.

14. ASTM F567 – Standard Practice for Installation of Chain Link Fence.

15. ASTM F626 – Standard Specification for Fence Fittings.

16. ASTM F668 – Specification for Polymer Coated Chain Link Fence Fabric.

17. ASTM F900 – Standard Specification for Industrial and Commercial Swing Gates.

18. ASTM F934 – Specification for Standard Colors for Polymer-Coated Chain Link.

19. ASTM F1043 – Strength and Protective Coatings on Metal Industrial Chain Link Fence Framework.

20. ASTM F1083 – Standard Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures.

21. ASTM F1183 – Standard Specification for Aluminum Alloy Chain Link Fence Fabric.

22. ASTM F1664 – Standard Specification for Poly(Vinyl Chloride) (PVC) and Other Conforming Organic Polymer-Coated Steel Tension Wire Used with Chain-Link Fence.

D. Chain Link Fence Manufacturer's Institute

1. Chain Link Fence Manufacturer's Institute Product Manual, latest revision.

1.3 SYSTEM DESCRIPTION

A. Temporary Construction Fence:

1. Fence Height: 8 feet.

2. Mesh Size: 2 inches.

3. Mesh Gage: 12

4. Gates: Height of gates shall match that of fence. Width of gates shall be as shown on the Drawings.

5. Anchored post or driven posts where indicated. No top or bottom rails required.

6. Panelized/modular units where indicated. Two stabilizers per panel.

B. Chain Link Fence:

1. Fence Height: Varies, refer to the Drawings.

2. Mesh Size: 2 inches.

3. Mesh Gage: 9, measured prior to application of any coating.

4. Gates: Height of gates shall match that of fence. Type and size of gates shall be as shown on the Drawings.

5. Top and bottom rails between posts unless otherwise indicated.

1.4 SUBMITTALS

A. Shop drawings showing the plan layout, spacing of components, post foundation dimensions, hardware anchorage, gates and a schedule of components.

B. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for chain-link fences and gates.

1. Fence and gate posts, rails, and fittings.

2. Chain-link fabric, fabric coatings, reinforcements, and attachments.

3. Accessories: Privacy slats.

4. Gates, locking mechanisms and hardware.

5. Gate operators, including operating instructions.

6. Motors (if applicable): Show nameplate data, ratings, characteristics, and mounting arrangements.

C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work. Show accessories, hardware, gate operation, and operational clearances.

1. Gate Operator (if applicable): Show locations and details for installing operator components, switches, and controls. Indicate motor size, electrical characteristics, drive arrangement, mounting, and grounding provisions.

2. Wiring Diagrams (if applicable): For power, signal, and control wiring.

D. Samples for Initial Selection: For components with factory-applied color finishes.

E. Samples for Verification: Prepared on Samples of size indicated below:

1. Polymer-Coated Components: In 6-inch lengths for components and on full-sized units for accessories.

F. Delegated-Design Submittal: For chain-link fences and gate framework indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

G. Warranty: Sample of special warranty.

H. Operation and Maintenance Data: Submit manufacturer’s materials for operation and maintenance of components, mechanisms, operators, or motors.

1.5 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. Supply material in accordance with Chain Link Fence Manufacturer's Institute Product Manual and this Specification.

C. Perform installation in accordance with ASTM F567.

D. Maintain all facilities installed under this Section in proper and safe condition throughout the progress of the work.

1.6 PROJECT CONDITIONS

A. Field Measurements: Verify layout information for chain-link fences and gates shown on Drawings in relation to existing improvements and/or proposed construction. Verify dimensions by field measurements. Notify Engineer of any dimensional discrepancies prior to proceeding with the work. Coordinate with Engineer regarding any adjustment or modification.

1.7 DELIVERY, STORAGE AND HANDLING

A. Deliver fence fabric and accessories in packed cartons or firmly tied rolls.

B. Packages shall be labeled with the manufacturer's name.

C. Store fence fabric and accessories in a secure and dry place.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which Installer agrees to repair or replace components of chain-link fences and gates that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Faulty operation of gate operators and controls.

b. Deterioration of metals, metal finishes, and other materials beyond normal weathering.

c. Deterioration of coatings beyond normal weathering.

B. Warranty Period: Five years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 GENERAL

A. All posts and rails shall be straight, true to section and of sufficient length for proper installation.

B. Unless otherwise specified, hardware and accessories shall conform to the requirements of ASTM F626 and ASTM A123 or ASTM A153 as applicable for zinc-coating.

2.2 POSTS AND RAILS

A. Extruded steel tube, ASTM F1083 or rolled/welded tube, ASTM F1043, minimal yield strength 50,000 pounds per square inch (psi), hot dipped galvanized.

1. Extruded steel tube: Average zinc coating of 2.0 ounces per square foot (oz/ft^2) interior/exterior, ASTM F1083.

2. Rolled/welded tube: External zinc coating 1.0 oz/ft² with a clear polymeric overcoat, Type D interior 90% zinc-rich coating having a minimum thickness of 0.30 mils.

B. Post size per Table 1.

Table 1 – Post and Rail Sizes

Item	Fence Height	Outside Diameter, Inches	F1083 Schedule 40 weight lb/ft	F1043-IC WT-40 weight lb/ft
Line Posts	up to 8 ft. 8 to 12 ft.	2.375 2.875	3.65 5.79	3.12 4.64
Terminal Posts	up to 8 ft. 8 to 12 ft.	2.875 4.000	5.79 9.11	4.64 6.56
Rails		1.660	2.27	1.84

C. Truss rod shall be ⅜-inch zinc-coated steel with adjustable turnbuckles or truss tightener.

2.3 CHAIN-LINK FENCE FABRIC

A. General: Provide fabric in one-piece heights measured between top and bottom of outer edge of selvage knuckle or twist. Comply with CLFMI Product Manual and with requirements indicated below:

1. Fabric Height: As indicated on Drawings.

2. Mesh Size: 2 inches.

3. Selvage: Knuckled at both selvages (KK).

4. Wire Fabric

a. Zinc-Coated Steel Fabric, 9-gauge, ASTM A817, hot-dip galvanized, ASTM A392 Class 2 – 2.0 oz/ft², coated after weaving (GAW).

1) Coat selvage ends of fabric that is metallic coated before the weaving process with manufacturer's standard clear protective coating.

b. Polymer-Coated Steel Fabric: ASTM F668, 9-gauge core wire, 0.3 oz/ft^2 zinc-coated with Class 2b (thermally fused and bonded) PVC coating.

1) Color: Black, ASTM F934.

2.4 TENSION WIRE

A. Match coating type to that of the chain link fabric.

1. Metallic-coated steel wire: Marcelled (spiraled or crimped), 7 gage, (0.177 inches) diameter, ASTM A824, zinc-coated, ASTM A817 Class 5 – 2.0 oz/ft².

2. Polymer-coated steel wire: Marcelled (spiraled or crimped) 7 gage, (0.177 inches) diameter (before coating), ASTM F1664.

a. Color: Black, ASTM F934.

2.5 HARDWARE AND FITTINGS

A. Tension and Brace Bands: Galvanized pressed steel complying with ASTM F626, minimum steel thickness of 12 gauge (0.105 in.), minimum width of ¾ in. and minimum zinc coating of 1.20 oz/ft². Secure bands with $^{5}/_{16}$ in. hot-dip galvanized steel carriage bolts.

B. Terminal Post Caps, Line Post Loop Caps, Rail and Brace Ends, Boulevard Clamps, and Rail Sleeves: In compliance to ASTM F626, pressed steel galvanized after fabrication having a minimum zinc coating of 1.20 oz/ft².

1. Rail sleeves shall not be less than 6 inches long.

C. Truss Rod Assembly: In compliance with ASTM F626, ⅜ in. diameter steel truss rod with a pressed steel tightener, minimum zinc coating of 1.2 oz/ft², assembly capable of withstanding a tension of 2,000 lbs.

D. Tension Bars: In compliance with ASTM F626. Galvanized steel one-piece length 2 in. less than the fabric height, minimum cross section of $^{3}/_{16}$ in. by ¾ in. and minimum zinc coating of 1.2 oz./ft².

E. Miscellaneous hardware, including but not limited to nuts, bolts, washers, clips, bands, rail ends, brackets, and straps shall be provided as required, hot-dip galvanized steel, ASTM F626.

F. Brace bands shall be formed from flat or beveled steel and shall have a minimum thickness after galvanizing of 0.108 inches and a minimum width of ¾ inch.

G. Polymer-Coated Fittings: ASTM F626, PVC or polyolefin coating, minimum thickness 0.006 in., fused and adhered to the zinc-coated fittings. Color to match fence system.

2.6 TIE WIRE AND HOG RINGS

A. Tie Wire and Hog Rings: Galvanized minimum zinc coating 1.20 oz/ft², 9-gauge (0.148 in) steel wire, ASTM F626.

B. Polymer coated materials shall match the coating, class and color to that of the chain link fabric.

2.7 FASTENERS

A. All fasteners shall be hot-dip galvanized, ASTM F2329.

B. Bolts: Steel, ASTM A307, Grade A min, Hex.

C. Nuts: Steel, ASTM A563, Grade A min, Hex.

D. Washers: Steel, round, ASTM F844.

E. Polymer Coated Color Fittings: In compliance with ASTM F626, PVC or polyolefin coating minimum thickness 0.006 in. fused and adhered to the zinc-coated fittings. Color to match fence system.

2.8 MODULAR OR PANELIZED CHAIN LINK FENCE

A. Free-standing fence panels, minimum ten (10) foot panels of the height specified.

B. Fabric as specified.

C. Welded tubular steel frame.

D. Stands: Four-sided welded tubular steel frame with center bar and tubular sleeves.

2.9 GATES

A. Gate Construction: ASTM F900. Corners welded or assembled with special malleable or pressed-steel fittings and rivets or bolts to provide rigid connections.

B. Pipe and Tubing: Zinc-Coated Steel: Comply with ASTM F1043 and ASTM F1083; protective coating and finish to match fence framing.

C. Posts (Hing Posts): Round tubular steel.

1. Up to 4-foot fencing: 2⅞-inch OD Pipe.

2. Over 4-foot to 6-foot fencing: 4-inch OD Pipe.

3. Over 6-foot to 12-foot fencing: 6.625-inch OD Pipe.

D. Frames and Bracing: Round tubular steel.

1. Framing:

a. 2.375 inch OD Pipe

b. Gate Leaves: Configured with intermediate members and diagonal truss rods or tubular members as necessary to provide rigid construction, free from sag or twist. When width of gate leaf exceeds 10 feet, install mid-distance vertical tubing of the same size and weight as frame members. When either horizontal or vertical bracing is not required, provide truss rods as cross-bracing to prevent sag or twist.

c. Horizontal bid bracing shall be used on all gates.

E. Wire Fencing Fabric: Fabric shall match that of fence, attached securely to frame at intervals not exceeding 15 inches.

F. Hardware:

1. Latches, hinges, stops, keepers and other hardware items shall be furnished as required for proper operation. These elements may not be shown on the Drawings, but shall be supplied and installed as required for a complete gate system.

2. Hinges: 360-degree inward and outward swing. Set screw shall be installed drilled into the steel post to lock each hinge to the gate post and prevent rotation. No-lift-off type. Box type hinges are not acceptable.

3. Latches: permitting operation from both sides of gate with provision for padlocking accessible from both sides of gate.

4. Double gates and single gates with leaf width 4 feet and greater shall be equipped with a minimum ½″ drop bar and gate hold-backs.

5. Latches, hinges, stops, keepers and other hardware items shall be furnished as required for proper operation.

2.10 PRIVACY SLATS (IF APPLICABLE)

A. Material: PVC, UV-light stabilized, flame resistant, four ply, not less than 0.023 inch (0.58 mm) thick; sized to fit mesh specified for direction indicated.

B. Material: Redwood, $5/16$ inch (7.9 mm) thick, sized to fit mesh specified for direction indicated.

C. Color: As selected by Owner.

2.11 CONCRETE

A. Concrete shall conform to ASTM C94; or pre-packaged concrete mix, ASTM C387. Minimum 28-day compressive strength of 3,000 psi. No air entrainment.

2.12 GROUT AND ANCHORING CEMENT

A. Nonshrink, Nonmetallic Grout: Premixed, factory-packaged, non-staining, noncorrosive, nongaseous grout complying with ASTM C1107. Provide grout, recommended in writing by manufacturer, for exterior applications.

B. Erosion-Resistant Anchoring Cement: Factory-packaged, non-shrink, non-staining, hydraulic-controlled expansion cement formulation for mixing with potable water at Project site to create pourable anchoring, patching, and grouting compound. Provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended in writing by manufacturer, for exterior applications.

PART 3 EXECUTION

3.1 GENERAL

A. Install fence with properly trained crew as shown on the drawings in accordance with ASTM F567.

B. Install all nuts for tension bands and hardware bolts on the side of the fence opposite the fabric.

C. The temporary chain link fence shall be removed at the conclusion of the work.

3.2 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for a verified survey of property lines and legal boundaries, site clearing, earthwork, pavement work, and other conditions affecting performance of the Work.

1. Do not begin installation before final grading is completed unless otherwise permitted by Architect.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 PREPARATION

A. Stake locations of fence lines, gates, and terminal posts. Do not exceed intervals of 500 feet or line of sight between stakes. Indicate locations of utilities, lawn sprinkler system, underground structures, benchmarks, and property monuments.

3.4 INSTALLATION, GENERAL

A. Install chain-link fencing to comply with ASTM F567 and more stringent requirements indicated.

1. Install fencing on established boundary lines inside property line.

3.5 CHAIN-LINK FENCE INSTALLATION

A. Post Excavation: Drill or hand-excavate holes for posts to diameters and spacings indicated, in firm, undisturbed soil.

B. Post Setting: Set posts in concrete at indicated spacing into firm, undisturbed soil.

1. Verify that posts are set plumb, aligned, and at correct height and spacing, and hold in position during setting with concrete or mechanical devices.

2. Concrete post footings shall have a plan diameter 12 inches greater than the post diameter. Holes shall be clean and free of loose soil and debris. Concrete shall be placed continuously in one operation and tamped or vibrated for consolidation. Tops of the concrete footings shall be crowned to shed water.

3. Gate post/footings shall be installed a minimum of 42 inches below grade.

4. All corner, end posts, and gate posts shall be braced.

a. Brace each gate and corner post to adjacent line post with horizontal center brace rail and diagonal truss rods. Install brace rail one bay from end and gate posts.

b. Corner and terminal posts are to be braced horizontally and diagonally. The braces are to extend over one adjacent panel. Changes in line of 30 degrees or more shall be considered as corners.

c. Braces and truss rods shall be securely fastened to posts with appropriate hardware.

d. Pull posts with two braces shall be provided for all heights where changes in horizontal or vertical alignment of ten (10) degrees or more occur.

5. Concrete Fill: Place concrete around posts to dimensions indicated and vibrate or tamp for consolidation. Protect aboveground portion of posts from concrete splatter.

a. Concealed Concrete: Top 3 inches below grade as indicated on Drawings to allow covering with surface material.

b. Posts Set into Concrete in Sleeves: Use steel pipe sleeves preset and anchored into concrete for installing posts. After posts have been inserted into sleeves, fill annular space between post and sleeve with non-shrink, nonmetallic grout, mixed and placed to comply with anchoring material manufacturer's written instructions, and finished sloped to drain water away from post.

c. Posts Set into Voids in Concrete: Form or core drill holes not less than 5 inches deep and ¾ inch larger than OD of post. Clean holes of loose material, insert posts, and fill annular space between post and concrete with non-shrink, nonmetallic grout, mixed and placed to comply with anchoring material manufacturer's written instructions, and finished sloped to drain water away from post.

C. Terminal Posts: Locate terminal end, corner, and gate posts per ASTM F567 and terminal pull posts at changes in horizontal or vertical alignment of 15 degrees or more.

D. Line Posts: Space line posts uniformly as indicated on the Drawings. Unless indicated otherwise, spacing shall be 8 feet on-center.

E. Post Bracing and Intermediate Rails: Install according to ASTM F567, maintaining plumb position and alignment of fencing. Diagonally brace terminal posts to adjacent line posts with truss rods and turnbuckles. Install braces at end and gate posts and at both sides of corner and pull posts.

1. horizontal braces at midheight of fabric 72 inches or higher, on fences with top rail and at two-third fabric height on fences without top rail. Install so posts are plumb when diagonal rod is under proper tension.

F. Tension Wire: Install according to ASTM F567, maintaining plumb position and alignment of fencing. Pull wire taut, without sags. Fasten fabric to tension wire with 0.120-inch-diameter hog rings of same material and finish as fabric wire, spaced a maximum of 24 inches on-center. Install tension wire in locations indicated before stretching fabric. Provide horizontal tension wire at the following locations:

1. Extended along top and bottom of fence fabric. Install top tension wire through post cap loops. Install bottom tension wire within 6 inches (152 mm) of bottom of fabric and tie to each post with not less than same diameter and type of wire.

G. Top Rail: Install according to ASTM F567, maintaining plumb position and alignment of fencing. Run rail continuously through line post caps, bending to radius for curved runs and terminating into rail end attached to posts or post caps fabricated to receive rail at terminal posts. Provide expansion couplings as recommended in writing by fencing manufacturer.

H. Intermediate and Bottom Rails: Install and secure to posts with fittings.

I. Chain-Link Fabric: Apply fabric to outside of enclosing framework. Leave 1 inch between finish grade or surface and bottom selvage unless otherwise indicated. Pull fabric taut and tie to posts, rails, and tension wires. Anchor to framework so fabric remains under tension after pulling force is released.

J. Tension or Stretcher Bars: Thread through fabric and secure to end, corner, pull, and gate posts with tension bands spaced not more than 15 inches on-center.

K. Tie Wires: Use wire of proper length to firmly secure fabric to line posts and rails. Attach wire at one end to chain-link fabric, wrap wire around post a minimum of 180 degrees, and attach other end to chain-link fabric per ASTM F626. Bend ends of wire to minimize hazard to individuals and clothing.

1. Maximum Spacing: Tie fabric to line posts at 12 inches on-center and to braces at 24 inches on-center.

L. Fasteners: Install nuts for tension bands and carriage bolts on the side of the fence opposite the fabric side.

M. Privacy Slats: Install slats in direction indicated, securely locked in place.

1. Diagonally, for privacy factor of 80 to 85.

N. Fabric:

1. Do not install fabric until concrete post footings have cured seven (7) days. Provide fabric of the height specified. Install fabric on the public side of the fence, with bottom no greater than 2 inches above the ground surface. Fabric shall be pulled taut to prevent sagging and provide a uniform smooth appearance. Fasten fabric to line posts at intervals not exceeding 15 inches with ties as specified.

2. Install tension wire in one continuous length between pull posts, weaved through fence fabric at top. Tension wire shall be applied to provide a wire without visible sag between posts. Fasten fabric to tension wire at intervals not exceeding 24 inches with ties or hog rings as specified.

3. Where it is not practicable to conform the fence to general contour of the ground, as at ditches, channels, etc., the opening beneath the fence shall be enclosed with chain link fabric and sufficiently braced to preclude access, but not to restrict the flow of water.

3.6 GATE INSTALLATION

A. Install gates according to manufacturer's written instructions, level, plumb, and secure for full opening without interference. Attach fabric as for fencing. Attach hardware using tamper-resistant or concealed means. Install ground-set items in concrete for anchorage. Adjust hardware for smooth operation and lubricate where necessary.

B. Provide swing gates at the locations and dimensions shown on the Drawings. Do not install gates until concrete post footings have cured seven (7) days.

C. Gates shall be installed plumb, level, and secure, with full opening without interference. Hardware shall be installed and adjusted for smooth operation and lubricated where necessary.

D. Provide concrete center drop to footing depth and suitable drop rod sleeve at center of double gate openings.

3.7 GATE OPERATOR INSTALLATION (IF APPLICABLE)

A. General: Install gate operators according to manufacturer's written instructions, aligned and true to fence line and grade.

B. Excavation for Support Posts Pedestals Equipment Bases/Pads: Hand-excavate holes for bases/pads, in firm, undisturbed soil to dimensions and depths and at locations as required by gate-operator component manufacturer's written instructions and as indicated.

3.8 GROUNDING AND BONDING

A. Fence Grounding: Install at maximum intervals of 1,500 feet except as follows:

B. Fences within 100 feet of buildings, structures, walkways, and roadways: Ground at maximum intervals of 750 feet.

1. Gates and Other Fence Openings: Ground fence on each side of opening.

2. Bond metal gates to gate posts.

3. Coordinate subparagraph below with Drawings in projects where intentional discontinuities are provided in metal fencing conductivity to localize lightning effects to the vicinity of strikes. See Evaluations.

4. Bond across openings, with and without gates, except openings indicated as intentional fence discontinuities. Use No. 2 AWG wire and bury it at least 18 inches below finished grade.

C. Protection at Crossings of Overhead Electrical Power Lines: Ground fence at location of crossing and at a maximum distance of 150 feet on each side of crossing.

D. Plans and details on Electrical Drawings and requirements in Division 26 Sections may revise or illustrate application of requirement below or may require grounding that exceeds minimum requirements in IEEE C2. Fences enclosing electrical substations are often bonded to a station grounding mat.

E. Fences Enclosing Electrical Power Distribution Equipment: Ground as required by IEEE C2 unless otherwise indicated.

F. Grounding Method: At each grounding location, drive a grounding rod vertically until the top is 6 inches below finished grade. Connect rod to fence with No. 6 AWG conductor. Connect conductor to each fence component at the grounding location, including the following:

1. Make grounding connections to each barbed wire strand with wire-to-wire connectors designed for this purpose.

2. Make grounding connections to each barbed tape coil with connectors designed for this purpose.

G. Bonding Method for Gates: Connect bonding jumper between gate post and gate frame.

H. Connections: Make connections to minimize possibility of galvanic action or electrolysis. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.

1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer in order of galvanic series.

2. Make connections with clean, bare metal at points of contact.

3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.

4. Make aluminum-to-galvanized-steel connections with tin-plated copper jumpers and mechanical clamps.

5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

I. Bonding to Lightning Protection System: If fence terminates at lightning-protected building or structure, ground the fence and bond the fence grounding conductor to lightning protection down conductor or lightning protection grounding conductor complying with NFPA 780.

3.9 FIELD QUALITY CONTROL

A. Grounding-Resistance Testing: Engage a qualified testing agency to perform tests and inspections.

1. Grounding-Resistance Tests: Subject completed grounding system to a megger test at each grounding location. Measure grounding resistance no fewer than two full days after last trace of precipitation, without soil having been moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural grounding resistance. Perform tests by two-point method according to IEEE 81.

2. Excessive Grounding Resistance: If resistance to grounding exceeds specified value, notify Architect promptly. Include recommendations for reducing grounding resistance and a proposal to accomplish recommended work.

3. Report: Prepare test reports certified by a testing agency of grounding resistance at each test location. Include observations of weather and other phenomena that may affect test results.

3.10 ADJUSTING

A. Gates: Adjust gates to operate smoothly, easily, and quietly, free of binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.

B. Lubricate hardware and other moving parts.

3.11 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's personnel to adjust, operate, and maintain chain-link fences and gates.

END OF SECTION

SECTION 32 3324 - SITE DRINKING FOUNTAINS

PART 1 GENERAL

1.1 SUMMARY

A. Section includes:

1. Procurement and installation of site (exterior) drinking fountains of the style and configuration indicated.

B. Contractor shall coordinate work between all Subcontractors, sections, and trades required for the proper completion of the work.

C. Contractor is responsible for all heath and safety.

1.2 COORDINATION WITH JURISDICTIONAL AUTHORITY

A. Contractor shall notify and coordinate the work of this Section with the local authority having jurisdiction over water supply, whether public or private system owner/operator.

B. Obtaining permits or approvals which may be required to perform the work of this section, including all costs, fees and taxes required or levied.

C. Contractor shall obtain all required approvals for connection to, or extension of, any portion of the water supply system.

1.3 REFERENCES

A. Reference herein to any technical society, organization, group or regulation are made in accordance with the following abbreviations and, unless otherwise noted or specified, all work under this Section shall conform to the latest edition as applicable.

B. Code of Federal Regulations (CFR)

1. 29 CFR 1926, Safety and Health Regulations for Construction.

C. ASTM International (ASTM)

1. ASTM B211 - Standard Specification for Aluminum and Aluminum-Alloy Bar, Rod and Wire.

2. ASTM C94 - Standard Specification for Ready-Mixed Concrete.

3. ASTM D2967 - Standard Test Method for Corner Coverage of Powder Coating.

4. ASTM D3451 - Standard Guide for Testing Coating Powders and Powder Coatings.

5. ASTM D4217 - Standard Test Method for Gel Time of Thermosetting Coating Powder.

6. ASTM A123 - Zinc (Hot Dip Galvanized) Coatings on Iron and Steel Products.

7. ASTM A428 - Standard Test Method for Weight (Mass) of Coating on Aluminum-Coated Iron or Steel Articles.

D. State of Connecticut

1. 2018 Connecticut State Building Code, including all Amendments, Supplements, and Errata.

E. Water Company Standards

1. The standards of the local water company, including administrative and technical requirements, standards, specifications, and details of construction are incorporated into this Section by reference.

1.4 SUBMITTALS

A. Shop drawings for all equipment furnished under this Section. Shop drawings shall indicate the configuration, dimensions, layout, and spacing of major and minor equipment components such as connections to water supply, drains, winterization details, pads, fasteners, anchors, and a schedule of such equipment components. Show in large-scale details any unique fabrication, assembly, and/or installation requirements.

B. Material certificates or other data indicating compliance with these Specifications for style, size, finish type, color, fittings, hardware, and accessories.

C. Copies of manufacturer-provided installation instructions, operation instructions, and maintenance material for all equipment furnished under this Section.

D. Written approvals of authorities having jurisdiction.

E. Written copies of any inspections by authorities having jurisdiction indicating drinking fountain has met applicable requirements and may be commissioned for use.

F. Manufacturer’s warranties and associated warranty registration data in Owner’s name. Submit two (2) copies of each warranty to Engineer in the manufacture’s/supplier's standard form or if there is no standard form available, in a form specified by Engineer.

1.5 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Delivery and Storage

1. Transportation carrier shall use appropriate methods to ensure materials are properly packaged, stacked, and restrained during transport. Utilize protective packaging as required.

2. Protect materials during storage against moisture, soiling, staining, and physical damage.

3. Any product or associated component showing manufacturing flaws upon receipt at the Project Site shall be referred to Engineer for determination as to whether it shall be repaired, rejected, or used.

4. Protect materials during storage to avoid damage from moisture, abrasion, and other construction activities.

B. Handling

1. Handle railing materials to prevent abrasion, chipping, marring, soiling and other damage.

2. Damaged equipment shall not be installed. Contractor shall bear responsibility for damage to equipment until final acceptance by Owner. Any installed equipment exhibiting damage shall be replaced or repaired to the satisfaction of Engineer, and Contractor shall assume all costs related thereto.

1.7 WARRANTY

A. Provide manufacturer's standard warranty, as applicable, for all products furnished under this Section. Warranty shall be registered in Owner's name.

B. Bind warranties in heavy-duty, commercial-quality, durable 3-ring, vinyl-covered loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper.

C. Provide heavy paper dividers with celluloid covered tabs for each separate warranty. Mark the 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 the Installer.

D. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project title or name, and name of Contractor.

E. When warranted construction requires operation and maintenance manuals, provide additional copies of each required warranty, as necessary, for inclusion in each required manual.

PART 2 PRODUCTS

2.1 DRINKING FOUNTAIN

A. Murdock Outdoor Pedestal Bottle Filler with Barrier-Free Drinking Fountain (Freeze Resistant, Color: Silver Sage Patina) or approved equal.

2.2 CONCRETE FOOTINGS

A. Ready-Mix, ASTM C94; or pre-packaged concrete mix, ASTM C 387. Minimum 28-day compressive strength of 4,000 psi.

2.3 HARDWARE

A. Supply anchors, bolts, nuts and other hardware per the manufacturer's requirements, but in all cases, at a minimum, hardware shall be Type 305 stainless steel.

2.4 WATER SUPPLY

A. Provide all required components as indicated on the Drawings, as called-for in the Specifications, and as required by the standards of the local water company.

PART 3 EXECUTION

3.1 FOOTINGS/PADS

A. Where concrete mounting pad(s) is/are called-for, verify fountain location(s) before proceeding.

B. Install concrete footings/pads as indicated on the Drawings. Verify horizontal location and top elevation relative to finished grades and adjust as required prior to forming/pouring concrete.

C. Where installation on a concrete pad is called-for, verify all dimensions, and pad finishes before drilling operations for mounting.

3.2 INSTALLATION

A. Verify mounting location before proceeding. Bring discrepancies to the attention of Engineer.

B. Examine conditions at the installation area for compliance with requirements for correct and level finished grade, mounting surfaces, installation tolerances, and other conditions affecting installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

D. Use manufacturer's templates or similar guides prior to drilling for anchorage. Control dust and protect adjacent areas.

E. Comply with manufacturer's written installation instructions for installation, unless more stringent requirements are indicated. Complete field assembly where required.

F. Fasteners

1. Grind and smooth all exposed threaded fasteners to remove sharp edges. Limit threaded exposure about nuts to 1/4-inch.

2. Apply a coat of self-priming exterior-grade paint to exposed fasteners. Match drinking fountain finish color and type.

3.3 PROTECTION AND CLEAN UP

A. After completing installation, inspect components. Remove spots, dirt, and debris.

B. Protect until acceptance of project. Repair any damaged finishes to match original finish or replace component.

END OF SECTION

SECTION 32 9000

PLANTING

PART 1 GENERAL

1.1 SUMMARY

A. Provide all labor, materials, equipment, services, and perform all operations necessary to complete the work of this section as indicated within the drawings and specified herein which shall include, but is not limited to, the following:

1. Supplying Trees, Shrubs, Perennial, and Groundcover
2. Landscape Edging
3. Mulch
4. Maintenance including watering
5. Warranty

B. The contractor is responsible for all health and safety.

1.2 DEFINITIONS

A. Backfill: The earth used to replace or the act of replacing earth in an excavation.

B. Balled and Burlapped Stock: Plants dug with firm, natural balls of earth in which they were grown, with ball size not less than sizes indicated; wrapped with burlap, tied, rigidly supported, and drum laced with twine with the root flare visible at the surface of the ball as recommended by ANSI Z60.1.

C. Balled and Potted Stock: Plants dug with firm, natural balls of earth in which they are grown and placed, unbroken, in a container. Ball size is not less than sizes indicated.

D. Bare-Root Stock: Plants with a well-branched, fibrous-root system developed by transplanting or root pruning, with soil or growing medium removed, and with not less than minimum root spread according to ANSI Z60.1 for type and size of plant required.

E. Container-Grown Stock: Healthy, vigorous, well-rooted plants grown in a container, with a well-established root system reaching sides of container and maintaining a firm ball when removed from container. Container shall be rigid enough to hold ball shape and protect root mass during shipping and be sized according to ANSI Z60.1 for type and size of plant required.

F. Fabric Bag-Grown Stock: Healthy, vigorous, well-rooted plants established and grown in-ground in a porous fabric bag with well-established root system reaching sides of fabric bag. Fabric bag size is not less than diameter, depth, and volume required by ANSI Z60.1 for type and size of plant.

G. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. This includes insecticides, miticides, herbicides, fungicides, rodenticides, and

molluscicides. It also includes substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.

H. Pests: Living organisms that occur where they are not desired, or that cause damage to plants, animals, or people. These include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.

I. Planting Area: Areas to be planted.

J. Plant; Plants; Plant Material: These terms refer to vegetation in general, including trees, shrubs, vines, ground covers, ornamental grasses, bulbs, corms, tubers, or herbaceous vegetation.

K. Root Flare: Also called “trunk flare.” The area at the base of the plant’s stem or trunk where the stem or trunk broadens to form roots; the area of transition between the root system and the stem or trunk.

L. Stem Girdling Roots: Roots that encircle the stems (trunks) of trees below the soil surface.

1.3 SUBMITTALS

A. Plant Materials: Include quantities, sizes, quality, and sources for plant materials.

1. Plant Photographs: Include color photographs in 3- by 5-inch print format of each required species and size of plant material as it will be furnished to the Project. Take photographs from an angle depicting true size and condition of the typical plant to be furnished. Include a scale rod or other measuring device in each photograph. For species where more than 20 plants are required, include a minimum of three photographs showing the average plant, the best quality plant, and the worst quality plant to be furnished. Identify each photograph with the full scientific name of the plant, plant size, and name of the growing nursery.

B. Pesticides and Herbicides: Include product label and manufacturer’s application instructions specific to the Project.

1. Contractor shall follow all Connecticut DEEP regulations for pesticide and herbicide applications.

C. Qualification Data: For qualified landscape Installer. Include list of similar projects completed by Installer demonstrating Installer’s capabilities and experience. Include project names, addresses, and year completed, and include names and addresses of owners’ contact persons.

D. Product Data: For each type of product indicated, including soils.

E. Product Certificates: For each type of manufactured product, from manufacturer, and complying with the following:

1. Submit material specifications, manufacturer’s literature and installation instructions where applicable attesting that the following materials meet the requirements specified:

a. Fertilizer

b. Anti-Desiccant

c. Mulch

d. Soil Amendments

e. Edging

f. Weed Control Barrier

2. Manufacturer's certified analysis of standard products.

3. Analysis of other materials by a recognized laboratory made according to methods established by the Association of Official Analytical Chemists, where applicable.

F. Maintenance Manual

1. The landscape contractor shall submit a written manual, prepared for the Owner that outlines a schedule for proper maintenance of the plantings. This schedule should include timing and methods for watering, fertilization, mulching, pruning and other maintenance operations to be conducted after the three month maintenance contract period.

G. Warranty: Sample of special warranty.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: A qualified landscape Installer whose work has resulted in successful establishment of plants including the preparation, mixing and installation of soil mixes to support planting.

1. Professional Membership: Installer shall be a member in good standing of either the Professional Landcare Network or the American Nursery and Landscape Association.

2. Experience: Five years' experience in landscape installation of size and scope similar to this project.

3. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.

4. Personnel Certifications: Installer's field supervisor shall have certification in one of the following categories from the Professional Landcare Network:

a. Certified Landscape Technician – Exterior, with installation maintenance specialty area(s), designated CLT-Exterior.

b. Certified Landscape Technician – Interior, designated CLT-Interior.

c. Certified Ornamental Landscape Professional, designated COLP.

5. Pesticide Applicator: State licensed, commercial.

B. Provide quality, size, genus, species, and variety of plants indicated, complying with applicable requirements in ANSI Z60.1.

C. Measurements: Measure according to ANSI Z60.1. Do not prune to obtain required sizes.

1. Trees and Shrubs: Measure with branches and trunks or canes in their normal position. Take height measurements from or near the top of the root flare for field-grown stock and container grown stock. Measure main body of tree or shrub for height and spread; do not measure branches or roots tip to tip. Take caliper measurements 6 inches above the root flare for trees up to 4-inch caliper size, and 12 inches above the root flare for larger sizes.

2. Other Plants: Measure with stems, petioles, and foliage in their normal position.

D. Plant Material Observation: Landscape Architect may observe plant material either at place of growth or at site before planting for compliance with requirements for genus, species, variety, cultivar, size, and quality. Landscape Architect retains right to observe trees and shrubs further for size and condition of balls and root systems, pests, disease symptoms, injuries, and latent defects and to reject unsatisfactory or defective material at any time during progress of work. Remove rejected trees or shrubs immediately from Project site.

1. Notify Landscape Architect of sources of planting materials seven days in advance of delivery to site.

E. Preinstallation Conference: Conduct conference at Project site.

F. Work to be done shall be coordinated with all other trades on site. Work includes furnishing all labor, materials, equipment and services required to complete all planting indicated on the drawings, as specified in this section.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of conformance with state and federal laws if applicable.

B. Bulk Materials:

1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.

2. Provide erosion-control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.

3. Accompany each delivery of bulk fertilizers, lime, and soil amendments with appropriate certificates.

C. Deliver bare-root stock plants freshly dug. Immediately after digging up bare-root stock, pack root system in wet straw, hay, or other suitable material to keep root system moist until planting.

D. Do not prune trees and shrubs before delivery. Protect bark, branches, and root systems from sun scald, drying, wind burn, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy their natural shape. Provide

protective covering of plants during shipping and delivery. Do not drop plants during delivery and handling.

E. Handle planting stock by root ball.

F. Store bulbs, corms, and tubers in a dry place at 60 to 65 deg F until planting.

G. Deliver plants after preparations for planting have been completed, and install immediately. If planting is delayed more than six hours after delivery, set plants and trees in their appropriate aspect (sun, filtered sun, or shade), protect from weather and mechanical damage, and keep roots moist.

1. Heel-in bare-root stock. Soak roots that are in dry condition in water for two hours. Reject dried-out plants.

2. Set balled stock on ground and cover ball with soil, peat moss, sawdust, or other acceptable material.

3. Do not remove container-grown stock from containers before time of planting.

4. Water root systems of plants stored on-site deeply and thoroughly with a fine-mist spray. Water as often as necessary to maintain root systems in a moist, but not overly-wet condition.

1.6 PROJECT CONDITIONS

A. Field Measurements: Verify actual grade elevations, service and utility locations, irrigation system components, and dimensions of plantings and construction contiguous with new plantings by field measurements before proceeding with planting work.

B. Interruption of Existing Services or Utilities: Do not interrupt services or utilities to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary services or utilities according to requirements indicated:

1. Notify Construction Manager no fewer than seven days in advance of proposed interruption of each service or utility.

2. Do not proceed with interruption of services or utilities without Construction Manager's written permission.

C. Planting Restrictions: Plant during one of the following periods. Coordinate planting periods with maintenance periods to provide required maintenance from date of Substantial Completion.

1. Spring:

a. Deciduous materials: March 1 to May 15

b. Evergreen Materials: March 1 to June 1

2. Fall:

a. Deciduous materials: From September 1 until the ground freezes.

b. Evergreen Materials: August 15–October 15

D. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions and warranty requirements.

E. Coordination with Turf Areas (Lawns): Plant trees, shrubs, and other plants after finish grades are established and before planting turf areas unless otherwise indicated.

1. When planting trees, shrubs, and other plants after planting turf areas, protect turf areas, and promptly repair damage caused by planting operations.

1.7 PLANT WARRANTY

A. Plant Warranty: Installer agrees to repair or replace plantings and accessories that fail in materials, workmanship, or growth within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Death and unsatisfactory growth, except for defects resulting from abuse, lack of adequate maintenance, or neglect by Owner, or incidents that are beyond Contractor's control.

b. Structural failures including plantings falling or blowing over.

c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.

2. Warranty Periods from Date of Substantial Completion:

a. Trees, Shrubs, Vines, and Ornamental Grasses: 12 months

b. Ground Covers, Biennials, Perennials, and Other Plants: 12 months

c. Annuals: Three months

3. When the work is accepted in parts, the warranty periods shall extend from each of the partial Substantial Completion Acceptances to the terminal date of the last warranty period. Thus, all warranty periods for each class of plant warranty, shall terminate at one time.

4. Include the following remedial actions as a minimum:

a. Immediately remove dead plants and replace unless required to plant in the succeeding planting season.

b. Replace plants that are more than 25 percent dead or in an unhealthy condition at end of warranty period.

c. A limit of one replacement of each plant will be required except for losses or replacements due to failure to comply with requirements.

d. Provide extended warranty for period equal to original warranty period, for replaced plant material.

5. Replacements shall closely match adjacent specimens of the same species. Replacements shall be subject to all requirements stated in this specification. Make all necessary repairs due to plant replacements. Such repairs shall be done at no extra cost to the Owner.

1.8 MAINTENANCE SERVICE

A. Initial Maintenance Service for Trees and Shrubs: Provide maintenance by skilled employees of landscape installer. Maintain as required in Part 3. Begin maintenance immediately after plants are installed and continue until substantial completion but for not less than maintenance period below if substantial complete comes earlier.

1. Maintenance Period: Three months from date of planting completion.

B. Initial Maintenance Service for Ground Cover and Other Plants: Provide maintenance by skilled employees of landscape Installer. Maintain as required in Part 3. Begin maintenance immediately after plants are installed and continue until substantial completion but for not less than maintenance period below if substantial completion comes earlier.

1. Maintenance Period: Three months from date of planting completion.

C. Continuing Maintenance Proposal: From Installer to Owner, in the form of a standard yearly (or other period) maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.

1.9 PLANT SUBSTITUTIONS FOR PLANTS NOT AVAILABLE

A. Submit all requests for substitutions of plant species, or size to the Owner's Representative, for approval, prior to purchasing the proposed substitution. Request for substitution shall be accompanied with a list of nurseries contacted in the search for the required plant and a record of other attempts to locate the required material. Requests shall also include sources of plants found that may be of a smaller or larger size, or a different shape or habit than specified, or plants of the same genus and species but different cultivar origin, or which may otherwise not meet the requirements of the specifications, but which may be available for substitution.

PART 2 PRODUCTS

2.1 PLANT MATERIAL

A. General: Furnish nursery-grown plants true to genus, species, variety, cultivar, stem form, shearing, and other features indicated on the Drawings and complying with ANSI Z60.1; and with healthy root systems developed by transplanting or root pruning. Provide well-shaped, fully

branched, healthy, vigorous stock, densely foliated when in leaf and free of disease, pests, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.

1. Trees with damaged, crooked, or multiple leaders; tight vertical branches where bark is squeezed between two branches or between branch and trunk ("included bark"); crossing trunks; cut-off limbs more than ¾ inch in diameter; or with stem girdling roots will be rejected.

2. Collected Stock: Do not use plants harvested from the wild, from native stands, from an established landscape planting, or not grown in a nursery unless otherwise indicated.

B. Provide plants of sizes, grades, and ball or container sizes complying with ANSI Z60.1 for types and form of plants required. Plants of a larger size may be used if acceptable to Landscape Architect, with a proportionate increase in size of roots or balls.

C. Root-Ball Depth: Furnish trees and shrubs with root balls measured from top of root ball, which shall begin at root flare according to ANSI Z60.1. Root flare shall be visible before planting.

D. Labeling: Label at least one plant of each variety, size, and caliper in each planting bed with a securely attached, waterproof tag bearing legible designation of common name and full scientific name, including genus and species. Include nomenclature for hybrid, variety, or cultivar, if applicable for the plant as shown on Drawings.

E. If formal arrangements or consecutive order of plants is shown on the Drawings, select stock for uniform height and spread, and number the labels to assure symmetry in planting.

F. Annuals: Provide healthy, disease-free plants of species and variety shown or listed, with well-established root systems reaching to sides of the container to maintain a firm ball, but not with excessive root growth encircling the container. Provide only plants that are acclimated to outdoor conditions before delivery and that are in bud but not yet in bloom.

G. Plant List: If there is any discrepancy between quantities shown on the Plant Schedule and work shown on the drawings, the Landscape Contractor shall supply the plants necessary to complete the work as intended on the drawings. Where the size of a plant on the Plant Schedule is a variation between a minimum and maximum dimension, the sizes of the plants furnished will be equal to the average of the two dimensions. Where a single dimension is given, this dimension represents the minimum size of the plants to be furnished.

2.2 PLANTING SOIL

A. See Specification Section 32 9100 – Planting Soil

2.3 MULCHES

A. Organic Mulch: Free from deleterious materials and suitable as a top dressing of trees and shrubs, perennials and groundcovers, consisting of one of the following:

1. Type: Aged double-shredded bark.

2. Size Range: 2 inches maximum, ½ inch minimum.

3. Color: Natural.

2.4 PESTICIDES

A. General: Pesticide registered and approved by EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.

B. Pre-Emergent Herbicide (Selective and Non-Selective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.

C. Post-Emergent Herbicide (Selective and Non-Selective): Effective for controlling weed growth that has already germinated.

2.5 WATERING BAGS

A. Plastic tree watering bags holding a minimum of 15 gallons of water and with a slow drip hole(s) water release system, specifically designed to water establishing trees. Water should release over a several day period, not within a few hours.

B. Watering bags shall be:

1. Treegator Irrigation Bags sized to the appropriate model for the requirements of the plant, manufactured by Spectrum Products, Inc., Youngsville, NC 27596.

2. Ooze Tube sized to the appropriate model for the requirements of the plant, manufactured by Engineered Water Solutions, Atlanta, GA.

3. Or approved equal.

C. Submit manufacturer's product data for approval.

2.6 LANDSCAPE EDGING

A. Heavy Duty Straight Profile Edging: $^{3}/_{16}$″ x 6″ high, extruded aluminum, 6063 alloy, T-6 hardness, landscape edging for straight-line and curvilinear applications in corrugated straight profile.

B. Section shall have loops on side of section to receive stakes spaced approximately 2 to 3 feet apart along its length.

C. Thickness: $^{3}/_{16}$ inch gage section at 0.116 inch minimum thick with 0.187 inch exposed top lip.

D. Connection Method: Section ends shall splice together with an interlocking stakeless snap-down design.

E. Stake: 12″ extruded aluminum stake. Stakes to interlock into section loops.

F. Finish: Mill Finish. Paint finish shall comply with AAMA 2603 for electrostatically baked on paint.

2.7 MISCELLANEOUS PRODUCTS

A. Wood Pressure-Preservative Treatment: AWPA C2, with waterborne preservative for soil and freshwater use, acceptable to authorities having jurisdiction, and containing no arsenic; including ammoniacal copper arsenate, ammoniacal copper zinc arsenate, and chromated copper arsenate.

B. Antidesiccant: Water-insoluble emulsion, permeable moisture retarder, film forming, for trees and shrubs. Deliver in original, sealed, and fully labeled containers and mix according to manufacturer's written instructions.

C. Burlap: Non-synthetic, biodegradable.

D. Mycorrhizal Fungi: Dry, granular inoculant containing at least 5300 spores per lb of vesicular-arbuscular mycorrhizal fungi and 95 million spores per lb of ectomycorrhizal fungi, 33 percent hydrogel, and a maximum of 5.5 percent inert material.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine the surface grades and soil conditions to confirm that the requirements of the Specification Section – Planting Soil – and the soil and drainage modifications indicated on the Planting Soil Plan and Details (if applicable) have been completed. Notify the Owner's Representative in writing of any unsatisfactory conditions.

B. Planting shall only be performed when weather and soil conditions are suitable for planting the materials specified in accordance with locally accepted practice. Install plants during the planting time as described below unless otherwise approved in writing by the Owner's Representative. In the event that the Contractor request planting outside the dates of the planting season, approval of the request does not change the requirements of the warranty.

3.2 LAYOUT AND PLANTING SEQUENCE

A. Relative positions of all plants and trees are subject to approval of the Owner's Representative.

B. Notify the Owner's Representative, one (1) week prior to layout. Layout all individual tree and shrub locations. Place plants above surface at planting location or place a labeled stake at planting location. Layout bed lines with paint for the Owner's Representative's approval. Secure the Owner's Representative's acceptance before digging and start of planting work.

C. When applicable, plant trees before other plants are installed.

D. It is understood that plants are not precise objects and that minor adjustments in the layout will be required as the planting plan is constructed. These adjustments may not be apparent until some or all of the plants are installed. Make adjustments as required by the Landscape Architect including relocating previously installed plants.

3.3 SOIL PROTECTION DURING PLANT DELIVERY AND INSTALLATION

A. Protect soil from compaction during the delivery of plants to the planting locations, digging of planting holes and installing plants.

1. Where possible deliver and plant trees that require the use of heavy mechanized equipment prior to final soil preparation and tilling. Where possible, restrict the driving lanes to one area instead of driving over and compacting a large area of soil.

2. Till to a depth of 6 inches, all soil that has been driven over during the installation of plants

3.4 SOIL MOISTURE

A. Volumetric soil moisture level, in both the Planting Soil and the root balls of all plants, prior to, during and after planting shall be above permanent wilt point and below field capacity for each type of soil texture within the following ranges.

Soil Texture	Permanent Wilting Point	Field Capacity
Sand, Loamy sand, Sandy loam	5–8%	12–18%
Loam, Sandy clay, Sandy clay loam	14–25%	27–36%
Clay loam, Silt loam	11–22%	31–36%
Silty clay, Silty clay loam	22–27%	38–41%

B. The Contractor shall confirm the soil moisture levels with a moisture meter (Digital Soil Moisture Meter, DSMM500 by General Specialty Tools and Instruments, or approved equivalent). If moisture is found to be too low, the planting holes shall be filled with water and allowed to drain before starting any planting operations. If the moisture is too high, suspend planting operations until the soil moisture drains to below field capacity.

3.5 INSTALLATION OF PLANTS – GENERAL

A. Observe each plant after delivery and prior to installation for damage of other characteristics that may cause rejection of the plant. Notify the Owner's Representative of any condition observed.

B. Excavation of the Planting Space: Using hand tools or tracked mini-excavator, excavate the planting hole into the Planting Soil to the depth of the root ball measured after any root ball modification to correct root problems, and wide enough for working room around the root ball or to the size indicated on the drawing or as noted below.

1. For trees and shrubs planted in soil areas that are NOT tilled or otherwise modified to a depth of at least 12 inches over a distance of more than 10 feet radius from each tree, or 5 feet radius from each shrub, the soil around the root ball shall be loosened as defined below or as indicated on the drawings.

a. The area of loosening shall be a minimum of 3 times the diameter of the root ball at the surface sloping to 2 times the diameter of the root ball at the depth of the root ball.

b. Loosening is defined as digging into the soil and turning the soil to reduce the compaction. The soil does not have to be removed from the hole, just dug, lifted and turned. Lifting and turning may be accomplished with a tracked mini excavator, or hand shovels.

C. If an auger is used to dig the initial planting hole, the soil around the auger hole shall be loosened as defined above for trees and shrubs planted in soil areas that are NOT tilled or otherwise modified.

D. The measuring point for root ball depth shall be the average height of the outer edge of the root ball after any required root ball modification.

E. If motorized equipment is used to deliver plants to the planting area over exposed planting beds, or used to loosen the soil or dig the planting holes, all soil that has been driven over shall be tilled to a depth of 6 inches.

F. For trees to be planted in prepared Planting Soil that is deeper than the root ball depth, compact the soil under the root ball using a mechanical tamper to assure a firm bedding for the root ball. If there is more than 12 inches of planting soil under the root ball excavate and tamp the planting soil in lifts not to exceed 12 inches.

G. Set top outer edge of the root ball at the average elevation of the proposed finish. Set the plant plumb and upright in the center of the planting hole. The tree graft, if applicable, shall be visible above the grade. Do not place soil on top of the root ball.

H. The Owner's Representative or Landscape Architect may request that plants orientation be rotated when planted based on the form of the plant.

I. Backfill the space around the root ball with the same planting soil or existing soil that was excavated for the planting space.

J. Brace root ball by tamping Planting Soil around the lower portion of the root ball. Place additional Planting Soil around base and sides of ball in six-inch (6″) lifts. Lightly tamp each lift using foot pressure or hand tools to settle backfill, support the tree and eliminate voids. DO NOT over compact the backfill or use mechanical or pneumatic tamping equipment. Over compaction shall be defined as greater than 85% of maximum dry density, standard proctor when the volumetric soil moisture is lower than field capacity.

1. When the planting hole has been backfilled to three quarters of its depth, water shall be poured around the root ball and allowed to soak into the soil to settle the soil. Do not flood the planting space. If the soil is above field capacity, allow the soil to drain to below field capacity before finishing the planting. Air pockets shall be eliminated and backfill continued until the planting soil is brought to grade level.

K. Where indicated on the drawings, build a three-inch-high, level berm of Planting Soil around the outside of the root ball to retain water. Tamp the berm to reduce leaking and erosion of the saucer.

L. Thoroughly water the Planting Soil and root ball immediately after planting.

M. Remove all nursery plant identification tags and ribbons.

N. Remove corrugated cardboard trunk protection after planting.

3.6 TREE, SHRUB, AND VINE PLANTING

A. Before planting, verify that root flare is visible at top of root ball according to ANSI Z60.1. If root flare is not visible, remove soil in a level manner from the root ball to where the top-most root emerges from the trunk. After soil removal to expose the root flare, verify that root ball still meets size requirements.

B. Remove stem girdling roots and kinked roots. Remove injured roots by cutting cleanly; do not break.

C. Set balled and burlapped stock plumb and in center of planting pit or trench with root flare flush with adjacent finish grades.

1. Use planting soil for backfill.

2. After placing some backfill around root ball to stabilize plant, carefully cut and remove burlap, rope, and wire baskets from tops of root balls and from sides, but do not remove from under root balls. Remove pallets, if any, before setting. Do not use planting stock if root ball is cracked or broken before or during planting operation.

3. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.

4. Place planting tablets in each planting pit when pit is approximately one-half filled; in amounts recommended in soil reports from soil-testing laboratory. Place tablets beside the root ball about 1 inch from root tips; do not place tablets in bottom of the hole.

5. Continue backfilling process. Water again after placing and tamping final layer of soil.

D. Set container-grown stock plumb and in center of planting pit or trench with root flare flush with adjacent finish grades.

1. Use planting soil for backfill.

2. Carefully remove root ball from container without damaging root ball or plant.

3. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.

4. Place planting tablets in each planting pit when pit is approximately one-half filled; in amounts recommended in soil reports from soil-testing laboratory. Place tablets beside the root ball about 1 inch from root tips; do not place tablets in bottom of the hole.

5. Continue backfilling process. Water again after placing and tamping final layer of soil.

E. Set and support bare-root stock in center of planting pit or trench with root flare flush with adjacent finish grade.

1. Use planting soil for backfill.

2. Spread roots without tangling or turning toward surface, and carefully work backfill around roots by hand. Puddle with water until backfill layers are completely saturated. Plumb before backfilling, and maintain plumb while working backfill around roots and placing layers above roots.

3. Place planting tablets in each planting pit when pit is approximately one-half filled; in amounts recommended in soil reports from soil-testing laboratory. Place tablets beside soil-covered roots about 1 inch from root tips; do not place tablets in bottom of the hole or touching the roots.

4. Continue backfilling process. Water again after placing and tamping final layer of soil.

F. When planting on slopes, set the plant so the root flare on the uphill side is flush with the surrounding soil on the slope; the edge of the root ball on the downhill side will be above the surrounding soil. Apply enough soil to cover the downhill side of the root ball.

3.7 TREE, SHRUB, AND VINE PRUNING

A. Remove only dead, dying, or broken branches. Do not prune for shape.

B. Prune, thin, and shape trees, shrubs, and vines as directed by Architect.

C. Prune, thin, and shape trees, shrubs, and vines according to standard professional horticultural and arboricultural practices. Unless otherwise indicated by Architect, do not cut tree leaders; remove only injured, dying, or dead branches from trees and shrubs; and prune to retain natural character.

D. Do not apply pruning paint to wounds.

3.8 GROUND COVER AND PLANT PLANTING

A. Set out and space ground cover and plants other than trees, shrubs, and vines as indicated in even rows with triangular spacing.

B. Use planting soil for backfill.

C. Dig holes large enough to allow spreading of roots.

D. For rooted cutting plants supplied in flats, plant each in a manner that will minimally disturb the root system but to a depth not less than two nodes.

E. Work soil around roots to eliminate air pockets and leave a slight saucer indentation around plants to hold water.

F. Water thoroughly after planting, taking care not to cover plant crowns with wet soil.

G. Protect plants from hot sun and wind; remove protection if plants show evidence of recovery from transplanting shock.

3.9 PLANTING BED FINISHING

A. After planting, smooth out all grades between plants before mulching.

B. Separate the edges of planting beds and lawn areas with a smooth, formed edge cut into the turf with the bed mulch level slightly lower, 1 and 2 inches, than the adjacent turf sod or as directed by the Owner's Representative. Bed edge lines shall be as depicted on the Drawings.

3.10 LANDSCAPE EDGING INSTALLATION

A. Preparation: Ensure that all underground utility lines are located and will not interfere with the proposed edging installation before beginning work. Locate border line of edging with string or other means to assure border straightness and curves as designed. Bed edge lines shall be as depicted on the Drawings. Dig trench 1 inch deeper than set of edging bottom.

B. Set edging into trench with top at ½ inch above compacted finish grade on turf side with side having loops for stakes placed on opposite side of turf. Drive stakes through edging loops until locked in place. Requires 3 stakes evenly spaced for each 8 feet section with a total of 8 stake loops available in each 16 feet section if necessary. Provide additional stakes at approximately 24 inches apart, longer stakes, heavier gage stakes, or any combination of previously mentioned as necessary to firmly secure edging for permanent intended use.

C. Where edging sections turn at corners and at angled runs, cut edging partially up through its height from bottom and turn back to desired angle to form rounded exposed radius.

D. Backfilling and Cleanup: Backfill both sides of edging, confirm and adjust if necessary that sections are securely held together, and compact backfill material along edging to provide top of edging at 1 inch above turf finish grade. Cleanup and remove excess material from site.

3.11 PLANTING AREA MULCHING

A. Mulch backfilled surfaces of planting areas and other areas indicated.

1. Trees in Turf Areas: Apply organic mulch ring of 3-inch average thickness, with four-foot radius around trunks or stems. Do not place mulch within 3 inches of trunks or stems.

2. Organic Mulch in Planting Areas: Apply 2-inch average thickness of organic mulch extending 12 inches beyond edge of individual planting pit or trench and over whole surface of planting area, and finish level with adjacent finish grades. Do not place mulch within 3 inches of trunks or stems.

3.12 WATERING

A. The Contractor shall be fully responsible to ensure that adequate water is provided to all plants from the point of installation until the date of Substantial Completion Acceptance. The Contractor shall adjust the automatic irrigation system, if available, and apply additional or adjust for less water using hoses as required.

B. Hand water root balls of all plants to assure that the root balls have moisture above wilt point and below field capacity. Test the moisture content in each root ball and the soil outside the root ball to determine the water content.

C. The Contractor shall install 15 gallon watering bag for each tree to be maintained and used for tree watering during the warranty period.

D. The watering bags shall remain the property of the Owner at the completion of the work.

3.13 CLEANUP AND PROTECTION

A. During planting, keep adjacent paving and construction clean and work area in an orderly condition.

B. Protect plants from damage due to landscape operations and operations of other contractors and trades. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged plantings.

C. After installation and before Substantial Completion, remove nursery tags, nursery stakes, tie tape, labels, wire, burlap, and other debris from plant material, planting areas, and Project site.

D. Remove surplus soil and waste material including excess subsoil, unsuitable soil, trash, and debris and legally dispose of them off Owner's property.

3.14 PLANT MAINTENANCE PRIOR TO SUBSTANTIAL COMPLETION

A. During the project work period and prior to Substantial Completion Acceptance, the Contractor shall maintain all plants.

B. Maintain plantings by pruning, cultivating, watering, weeding, fertilizing, mulching, restoring planting saucers, adjusting and repairing tree-stabilization devices, resetting to proper grades or vertical position, and performing other operations as required to establish healthy, viable plantings. Spray or treat as required to keep trees and shrubs free of insects and disease.

C. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace mulch materials damaged or lost in areas of subsidence.

D. Apply treatments as required to keep plant materials, planted areas, and soils free of pests and pathogens or disease. Use integrated past management practices whenever possible to minimize the use of pesticides and reduce hazards. Treatments include physical controls such as hosing off foliage, mechanical controls such as traps, and biological control agents.

3.15 SUBSTANTIAL COMPLETION ACCEPTANCE

A. Upon written notice from the Contractor, the Owners Representative shall review the work and make a determination if the work is substantially complete.

1. Notification shall be at least 7 days prior to the date the contractor is requesting the review.

B. The date of substantial completion of the planting shall be the date when the Owner's Representative accepts that all work in Planting, Planting Soil, and Irrigation installation sections is complete.

C. The Plant Warranty period begins at date of written notification of substantial completion from the Owner's Representative. The date of substantial completion may be different than the date of substantial completion for the other sections of the project.

3.16 END OF WARRANTY FINAL ACCEPTANCE

A. At the end of the Warranty period the Owner's Representative shall observe the work and establish that all provisions of the contract are complete and the work is satisfactory.

B. If the work is satisfactory, the maintenance period will end on the date of the final observation.

C. If the work is deemed unsatisfactory, the maintenance period will continue at no additional expense to the Owner until the work has been completed, observed, and approved by the Owner's Representative.

END OF SECTION

SECTION 32 9100

PLANTING SOIL

PART 1 GENERAL

1.1 SUMMARY

A. The scope of work includes all labor, materials, tools, supplies, equipment, facilities, transportation and services necessary for, and incidental to performing all operations in connection with furnishing, delivery, and installation of Planting Soil and/or the modification of existing site soil for use as Planting Soil, complete as shown on the drawings and as specified herein.

1. Supplying and placing Planting Soil and soil amendments
2. Modifying existing stockpiled topsoil suitable for Planting Soil
3. Fine grade Planting Soil
4. Clean up and disposal of all excess and surplus material.

B. The contractor is responsible for all health and safety.

1.2 DEFINITIONS

A. Amendment: material added to Topsoil to produce Planting Soil Mix. Amendments are classified as general soil amendments, fertilizers, biological, and pH amendments.

B. Biological Amendment: Amendments such as Mycorrhizal additives, compost tea or other products intended to change the soil biology.

C. Compacted soil: soil where the density of the soil is greater that the threshold for root limiting, and further defined in this specification.

D. Compost: well decomposed stable organic material as defined by the US Composting Council and further defined in this specification.

E. Drainage: The rate at which soil water moves through the soil transitioning the soil from saturated condition to field capacity. Most often expressed as saturated hydraulic conductivity (Ksat; units are inches per hour).

F. Duff Layer: The surface layer of native topsoil that is composed of mostly decayed leaves, twigs, and detritus.

G. Existing Soil: Mineral soil existing at the locations of proposed planting after the majority of the construction within and around the planting site is completed and just prior to the start of work to prepare the planting area for soil modification and/or planting, and further defined in this specification.

H. Fertilizer: amendment used for the purpose of adjusting soil nutrient composition and balance.

I. Fine grading: The final grading of the soil to achieve exact contours and positive drainage, often accomplished by hand rakes or drag rakes other suitable devices, and further defined in this specification, and further defined in this specification.

J. Finished grade: surface or elevation of Planting Soil after final grading and 12 months of settlement of the soil, and further defined in this specification.

K. Installed soil: Planting soil and existing site soil that is spread and or graded to form a planting soil, and further defined in this specification.

L. Owner's Representative: The person or entity, appointed by the Owner to represent their interest in the review and approval of the work and to serve as the contracting authority with the Contractor. The Owner's Representative may appoint other persons to review and approve any aspects of the work.

M. Manufactured Topsoil: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.

N. Planting Area: Areas to be planted.

O. Planting Soil: Standardized topsoil; existing, native surface topsoil; existing, in-place surface soil; imported topsoil; or manufactured topsoil that is modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.

P. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

Q. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.

R. Surface Soil: Soil that is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil; but in disturbed areas such as urban environments, the surface soil can be subsoil.

S. Scarify: Loosening and roughening the surface of soil and sub soil prior to adding additional soil on top, and further defined in this specification.

T. Soil Fracturing: Deep loosening the soil to the depths specified by using a backhoe, and further defined in this specification.

U. Undisturbed soil: Soils with the original A horizon intact that have not been graded or compacted. Soils that have been farmed, subjected to fire or logged but not graded, and natural forested land will be considered as undisturbed.

1.3 SUBMITTALS

A. Product data and certificates: For each type of manufactured product, submit data and certificates that the product meets the specification requirements, signed by the product manufacturer, and complying with the following:

B. Submit manufacturers or supplier's product data and literature certified analysis for standard products and bulk materials, complying with testing requirements and referenced standards and specific requested testing.

C. For each Compost product submit the following analysis by a recognized laboratory:

1. pH
2. Soluble Salts (Electrical Conductivity)
3. Moisture Content Percent; wet weight basis
4. Particle Size
5. Stability
6. Maturity
7. Physical Contaminants
8. US EPA Class A Standard

D. For Coarse Sand product submit the following analysis by a recognized laboratory:

1. pH
2. Particle Size distribution (percent passing) the following sieve sizes: ⅜ inch, No. 4, No. 8, No. 16, No. 30, No. 50, No. 100, No. 200

E. Samples: Submit samples of each product and material, where required by Part 2 of the specification, to the Owner's Representative for approval. Label samples to indicate product, characteristics, and locations in the work. Samples will be reviewed for appearance only.

1. Submit samples a minimum of 8 weeks prior to the anticipated date of the start of soil installation.
2. Samples of all Topsoil, Coarse Sand, Compost and Planting Soil shall be submitted at the same time as the particle size and physical analysis of that material.

F. Soil Tests for existing in-place or stripped and stockpiled topsoil, existing site soil to be modified as planting soil and planting soil mixes.

1. Topsoil, existing site soil and Planting Soil Mix testing: Submit soil test analysis report for each sample of Topsoil, existing site soil and Planting Soil from an approved soil-testing laboratory and where indicated in Part 2 of the specification as follows:
    a. Submit Topsoil, Compost, and Coarse Sand for testing at least 8 weeks before scheduled installation of Planting Soil Mixes. Submit Planting Soil Mix test no more than 2 weeks after the approval of the Topsoil, Compost and Coarse Sand. Do not submit to the testing laboratory, Planting Soil Mixes, for testing until all Topsoil, Compost and Coarse Sand have been approved.
    b. If tests fail to meet the specifications, obtain other sources of material, retest and resubmit until accepted by the Owner's Representative.
    c. All soil testing will be at the expense of the Contractor.

d. Provide a mechanical gradation (sieve analysis) and USDA soil texture analysis. Soil testing of Planting Soil Mixes shall also include USDA gradation (percentage) of gravel, coarse sand, medium sand, and fine sand in addition to silt and clay.

e. Provide test results for the following soil properties:

1) pH

2) Percent organic content

3) Nutrient levels by parts per million including: phosphorus, potassium, magnesium, manganese, iron, zinc and calcium. Nutrient test shall include the testing laboratory recommendations for supplemental additions to the soil for optimum growth of the plantings specified.

4) Soluble salt by electrical conductivity of a 1:2 soil water sample measured in Milliohm per cm.

5) Cation Exchange Capacity (CEC).

G. Provide a particle size analysis (% dry weight) and USDA soil texture analysis. Soil testing of Planting Soil Mixes shall also include USDA gradation (percentage) of gravel, coarse sand, medium sand, and fine sand in addition to silt and clay.

H. Qualification Data: For qualified Installer. Include list of similar projects completed by Installer demonstrating Installer's capabilities and experience. Include project names, addresses, and year completed, and include names and addresses of owners' contact persons.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: The installer shall be a firm having at least 5 years of experience of a scope similar to that required for the work, including the preparation, mixing and installation of soil mixes to support planting. The installer of the work in Section 32 9000 Planting, shall be the same firm installing the work in this section.

1. Professional Membership: Installer shall be a member in good standing of either the Professional Landcare Network or the American Nursery and Landscape Association.

2. Experience: Five years' experience in landscape installation of size and scope similar to this project.

3. Installer's field supervisor shall have a minimum of five years experience as a field supervisor installing soil, shall be trained and proficient in the use of field surveying equipment to establish grades and can communicate in English with the Owner's Representative.

4. The installer's crew shall be experienced in the installation of Planting Soil, plantings, and irrigation (where applicable) and interpretation of planting plans, soil installation plans, and irrigation plans (where applicable).

B. Soil-Testing Laboratory Qualifications: An independent or university laboratory, recognized by the State Department of Agriculture, with the experience and capability to conduct the testing indicated and that specializes in types of tests to be performed. Geotechnical engineering testing labs shall not be used.

1. All testing shall be performed by the same soil lab that performed the original soil testing.

2. Testing results shall be within 10% plus or minus of the values measured in the approved Planting Soil Mixes.

3. Any Planting Soil that fails to meet the above criteria, if requested by the Owner's Representative, shall be removed and new soil installed

4. Report suitability of tested soil for plant growth.

    a. Based upon the test results, state recommendations for soil treatments and soil amendments to be incorporated. State recommendations in weight per 1000 sq. ft. or volume per cu. yd. for nitrogen, phosphorus, and potash nutrients and soil amendments to be added to produce satisfactory planting soil suitable for healthy, viable plants.

C. Density Tests: In-place density testing is required in all areas. Placed planting soils must be inspected for compaction level by the soil scientist or by the following: ASTM D1556 Density of Soil and Rock In Place Using Sand Cone Method, ASTM D6398-10 Nuclear Methods or ASTM D2167-08 Rubber Balloon method. ASTM D698 Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort. In-place density tests shall be carried out at a rate of one test per 1,000 square feet for each type of material placed.

1. Acceptable Compaction: Good rooting anticipated, but increasing settlement expected as compaction is reduced and/or in soil with a high organic matter content.

    a. Standard Proctor Method – 75–85%; soil below 75% is unstable and will settle excessively.

2. Root limiting Compaction: Root growth is limited with fewer, shorter and slower growing roots.

    a. Standard Proctor Method – above approximately 85%.

3. Excessive Compaction: Roots not likely to grow but can penetrate soil when soil is above field capacity.

    a. Standard Proctor Method – Above 90%.

D. Work to be done shall be coordinated with all other trades on site. Work includes furnishing all labor, materials, equipment and services required to complete all planting indicated on the drawings, as specified in this section.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect soil and soil stockpiles, including the stockpiles at the soil blender's yard, from wind, rain and washing that can erode soil or separate fines and coarse material, and contamination by chemicals, dust and debris that may be detrimental to plants or soil drainage. Cover stockpiles with plastic sheeting or fabric at the end of each workday.

B. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of conformance with state and federal laws if applicable.

C. Bulk Materials:

1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.

2. Provide erosion-control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.

3. Accompany each delivery of bulk fertilizers, lime, and soil amendments with appropriate certificates.

1.6 PROJECT CONDITIONS

A. It is the responsibility of the Contractor to be aware of all surface and subsurface conditions, and to notify the Owner's Representative, in writing, of any circumstances that would negatively impact the health of plantings. Do not proceed with work until unsatisfactory conditions have been corrected.

B. Weather Limitations: Proceed with soil installation only when existing and forecasted weather conditions permit soil installation to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions and requirements.

C. Do not mix, deliver, place or grade soils when frozen or with moisture above field capacity.

PART 2 PRODUCTS

2.1 TOPSOIL

A. Topsoil definition: Fertile, friable soil containing less than 5% total volume of the combination of subsoil, refuse, roots larger than 1 inch diameter, heavy, sticky or stiff clay, stones larger than 2 inches in diameter, noxious seeds, sticks, brush, litter, or any substances deleterious to plant growth. The percent (%) of the above objects shall be controlled by source selection not by screening the soil. Topsoil shall be suitable for the germination of seeds and the support of vegetative growth. Imported Topsoil shall not contain weed seeds in quantities that cause noticeable weed infestations in the final planting beds. Imported Topsoil shall meet the following physical and chemical criteria:

1. Soil texture: ASTM A422, USDA loam, sandy clay loam or sandy loam with clay content between 15 and 25% and a combined clay/silt content of no more than 55%.

2. pH value shall be between 5.5 and 7.0.

3. Percent organic matter (OM): 2.0–5.0%, by dry weight.

4. Soluble salt level: Less than 2 mmho/cm

5. Soil chemistry suitable for growing the plants specified.

B. Imported Topsoil shall be a harvested soil from fields or development sites. The organic content and particle size distribution shall be the result of natural soil formation. Manufactured soils where Coarse Sand, Composted organic material or chemical additives has been added to the soil to meet the requirements of this specification section shall not be acceptable.

C. Stockpiled Existing Topsoil at the site meeting the above criteria may be acceptable.

2.2 COMPOST

A. Organic Matter for amending planting soils shall be a stable, humus-like material produced from the aerobic decomposition and curing of Leaf Yard Waste Compost, composted for a minimum of one year (12 months). The leaf yard waste compost shall be free of debris such as plastics, metal, concrete or other debris. The leaf yard waste compost shall be free of stones larger than 3\8″, larger branches and roots. Wood chips over 1″ in length or diameter shall be removed by screening. The compost shall be a dark brown to black color and be capable of supporting plant growth with appropriate management practices in conjunction with addition of fertilizer and other amendments as applicable, with no visible free water or dust, with no unpleasant odor, and meeting the following criteria as reported by laboratory tests.

Parameter	Range
pH	6.5 to 7.4
Soluable Salt	<2.5 mmhos/cm(dS/m)
Moisture	30–60%
Organic Matter	20% Minimum (Dry Weight)
Particle Size	100% passing ½ inch screen Max. 3% passing 0.002mm
Stability	>80% relative to positive control
Maturity	>80% (>6 on Solvita Scale)
Biological Contaminants	Meet or exceed US EPA Class A, CFR 503.32(a) levels

2.3 COURSE SAND

A. Clean, washed, sand, free of toxic materials

B. Coarse concrete sand, ASTM C33 Fine Aggregate, with a Fines Modulus Index of 2.8 and 3.2.

C. Coarse Sands shall be clean, sharp, uniformly graded medium to Coarse Sands free of limestone, shale and slate particles. Manufactured Coarse Sand shall not be permitted.

D. pH shall be lower than 7.5.

E. Provide Coarse Sand with the following particle size distribution:

Sieve Size	Percent Passing
⅜ inch	100
No. 4	95–100
No. 8	80–100
No. 16	50–85
No. 30	25–60
No. 50	10–30
No. 100	0–8
No. 200	0–5

F. The ratio of the particle size for 70 percent passing (D70) to the particle size for 20 percent passing (D20) shall be 3.0 or less.

2.4 INORGANIC SOIL AMENDMENTS

A. Lime: ASTM C602, agricultural liming material containing a minimum of 80 percent calcium carbonate equivalent and as follows:

1. Class: T, with a minimum of 99 percent passing through No. 8 sieve and a minimum of 75 percent passing through No. 60 sieve.

2. Class: O, with a minimum of 95 percent passing through No. 8 sieve and a minimum of 55 percent passing through No. 60 sieve.

3. Provide lime in form of ground dolomitic limestone or calcitic limestone depending on recommendations from soil analysis.

B. Sulfur: Granular, biodegradable, and containing a minimum of 90 percent sulfur, with a minimum of 99 percent passing through No. 6 sieve and a maximum of 10 percent passing through No. 40 sieve.

C. Iron Sulfate: Granulated ferrous sulfate containing a minimum of 20 percent iron and 10 percent sulfur.

D. Aluminum Sulfate: Commercial grade, unadulterated.

E. Perlite: Horticultural perlite, soil amendment grade.

F. Agricultural Gypsum: Minimum 90 percent calcium sulfate, finely ground with 90 percent passing through No. 50 sieve.

G. Diatomaceous Earth: Calcined, 90 percent silica, with approximately 140 percent water absorption capacity by weight.

H. Zeolites: Mineral clinoptilolite with at least 60 percent water absorption by weight.

2.5 FERTILIZERS

A. Bonemeal: Commercial, raw or steamed, finely ground; a minimum of 1 percent nitrogen and 10 percent phosphoric acid.

B. Superphosphate: Commercial, phosphate mixture, soluble; a minimum of 20 percent available phosphoric acid.

C. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:

1. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.

D. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:

1. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.

E. Planting Tablets: Tightly compressed chip type, long-lasting, slow-release, commercial-grade planting fertilizer in tablet form. Tablets shall break down with soil bacteria, converting nutrients into a form that can be absorbed by plant roots.

1. Size: 5-gram tablets.

2. Nutrient Composition: 20 percent nitrogen, 10 percent phosphorous, and 5 percent potassium, by weight plus micronutrients.

F. Chelated Iron: Commercial-grade FeEDDHA for dicots and woody plants, and commercial-grade FeDTPA for ornamental grasses and monocots.

2.6 PLANTING SOIL MIXES

A. General definition: Mixes of Existing Soil or Imported Topsoil, Coarse Sand, and Compost to make a new soil that meets the project goals for the indicated planting area. These may be mixed off site or onsite, and will vary in Mix components and proportions as indicated.

B. Tree & Shrub Planting Soil: shall consist of a combination of approximately equal parts by volume Topsoil, Coarse Sand and Compost (1T:1S:1C).

1. The final mix shall have an organic content between 5 percent and 7 percent by weight.

2. The final mix shall have a hydraulic conductivity of not less than 1.5 inches per hour, ASTM D5856, when compacted to a minimum of 86 percent Standard Proctor, ASTM 698.

3. At the time of final grading, add fertilizer if required to the Planting Soil at rates recommended by the testing results for the plants to be grown.

C. Lawn Soil: Topsoil, Sand and Compost, each as specified above, shall be combined in an approximate mix ratio of two parts by volume Sand to one part by volume Topsoil to one part by volume Compost (2S:1T:1C) to create a uniform blend which meets the following requirements.

1. The final mix shall have an organic content between 4.5 percent and 5.5 percent by weight.

2. The final mix shall have a hydraulic conductivity of not less than 3.0 inches per hour, ASTM D5856, when compacted to a minimum of 88 percent Standard Proctor, ASTM 698.

3. pH shall be between 6.2 and 6.8.

4. At the time of final grading, add fertilizer if required to the Planting Soil at rates recommended by the testing results for the plants to be grown.

2.7 MISCELLANEOUS PRODUCTS

A. Mycorrhizal Fungi: Dry, granular inoculant containing at least 5300 spores per lb of vesicular-arbuscular mycorrhizal fungi and 95 million spores per lb of ectomycorrhizal fungi, 33 percent hydrogel, and a maximum of 5.5 percent inert material.

PART 3 EXECUTION

3.1 EXAMINATION

A. Prior to installation of Planting Soil, examine site to confirm that existing conditions are satisfactory for the work of this section to proceed.

1. Confirm that the subgrade is at the proper elevation and compacted as required.

2. Confirm that all surface areas to be filled with Planting Soil are free of construction debris, refuse, compressible or biodegradable materials, stones greater than 2 inches diameter, soil crusting films of silt or clay that reduces or stops drainage from the Planting Soil into the subsoil; and/or standing water. Remove unsuitable material from the site.

3. Do not mix or place soils and soil amendments in frozen, wet, or muddy conditions.

4. Suspend soil spreading, grading, and tilling operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.

5. Uniformly moisten excessively dry soil that is not workable and which is too dusty.

6. Confirm that utility work has been completed per the drawings.

B. If unsatisfactory conditions are encountered, notify the Owner's Representative immediately to determine corrective action before proceeding.

C. Examine areas to receive plants for compliance with requirements and conditions affecting installation and performance.

1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

E. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Architect and replace with new planting soil.

3.2 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities and turf areas and existing plants from damage caused by planting operations.

B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

C. Confirm that the subgrade is at the proper elevation and compacted as required. Subgrade elevations shall slope approximately parallel to the finished grade and/or toward the subsurface drain lines as shown on the drawings.

D. In areas where Planting Soil is to be spread, confirm subgrade has been scarified.

E. The Contractor shall coordinate with all other work that may impact the completion of the work.

3.3 SOIL MOISTURE

A. Volumetric soil moisture level, in both the Planting Soil and the root balls of all plants, prior to, during and after planting shall be above permanent wilt point and below field capacity for each type of soil texture within the following ranges.

Soil texture	Permanent wilting point	Field capacity
Sand, Loamy sand, Sandy loam	5–8%	12–18%
Loam, Sandy clay, Sandy clay loam	14–25%	27–36%
Clay loam, Silt loam	11–22%	31–36%
Silty clay, Silty clay loam	22–27%	38–41%

B. The Contractor shall confirm the soil moisture levels with a moisture meter (Digital Soil Moisture Meter, DSMM500 by General Specialty Tools and Instruments, or approved equivalent). If moisture is found to be too low, the planting holes shall be filled with water and allowed to drain before starting any planting operations. If the moisture is too high, suspend planting operations until the soil moisture drains to below field capacity.

3.4 MIXING OF PLANTING SOIL MIXES

A. Soil blends shall be produced with equipment that blends together each component in a thorough and uniform manner. This may be accomplished by a minimum of three handling events on a hard surfaced area with earth moving equipment or by alternately passing soil components through a screener.

3.5 PLANTING SOIL INSTALLATION

A. All equipment utilized to install or grade Planting Soils shall be wide track or balloon tire machines rated with a ground pressure of 4 psi or less. All grading and soil delivery equipment shall have buckets equipped with 6 inch long teeth to scarify any soil that becomes compacted.

B. In areas of soil installation above existing subsoil, scarify the subgrade material prior to installing Planting Soil.

1. Scarify the subsoil of the subgrade to a depth of twelve inches with the teeth of the back hoe or loader bucket, tiller or other suitable device.

2. Immediately install the Planting Soil. Protect the loosened area from traffic. DO NOT allow the loosened subgrade to become compacted.

3. In the event that the loosened area becomes overly compacted, loosen the area again prior to installing the Planting Soil.

C. Install the Planting Soil in eight inch lifts to the required depths. Apply compacting forces to each lift as required to attain the required compaction. Scarify the top of each lift prior to adding more

Planting Soil by dragging the teeth of a loader bucket or backhoe across the soil surface to roughen the surface.

D. Phase work such that equipment to deliver or grade soil does not have to operate over previously installed Planting Soil. Work in rows of lifts the width of the extension of the bucket on the loader. Install all lifts in one row before proceeding to the next. Work out from the furthest part of each bed from the soil delivery point to the edge of the each bed area.

E. Where possible place large trees first and fill Planting Soil around the root ball.

F. Installing soil with soil or mulch blowers or soil slingers shall not be permitted due to the over mixing and soil ped breakdown caused by this type of equipment.

G. Where travel over installed soil is unavoidable, limit paths of traffic to reduce the impact of compaction in Planting Soil. Each time equipment passes over the installed soil it shall reverse out of the area along the same path with the teeth of the bucket dropped to scarify the soil. Comply with the paragraph “Compaction Reduction” in the event that soil becomes over compacted.

H. Finish Grading: Grade planting areas to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

I. Before planting, obtain Landscape Architect’s acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

J. Application of Mycorrhizal Fungi: As recommended my manufacturer.

3.6 COMPACTION REQUIREMENTS OF INSTALLED PLANTING SOIL

A. Installed Planting Soil Mix and re-spread existing soil shall have a soil density through the required depth of the installed layers of soil and comply with the following:

1. Tree and Shrub Planting Soil: 82–85 percent Standard Proctor, ASTM D698.

2. Lawn Soil: 84–86 percent Standard Proctor, ASTM D698.

B. Planting Soil compaction shall be tested at each lift.

C. Maintain moisture conditions within the Planting Soil during installation or modification to allow for satisfactory compaction. Suspend operations if the Planting Soil becomes wet. Apply water if the soil is overly dry.

D. Provide adequate equipment to achieve consistent and uniform compaction of the Planting Soils. Use the smallest equipment that can reasonably perform the task of spreading and compaction.

E. Do not pass motorized equipment over previously installed and compacted soil except as authorized below.

1. Light weight equipment such as trenching machines or motorized wheel barrows is permitted to pass over finished soil work.

2. If work after the installation and compaction of soil compacts the soil to levels greater than the above requirements, follow the requirements of the paragraph “Over Compaction Reduction” below.

F. Following the installation of each soil and prior to fine grading, apply chemical additives as recommended by the soil test, and appropriate to the soil and specific plants to be installed.

3.7 OVER COMPACTION REDUCTION

A. Any soil that becomes compacted to a density greater than the specified density shall be dug up and reinstalled. This requirement includes compaction caused by other sub-contractors after the Planting Soil is installed and approved.

B. Surface roto tilling shall not be considered adequate to reduce over compaction at levels 6 inches or greater below finished grade.

3.8 FINISH GRADING

A. Grade the finish surface of all planted areas to meet the grades shown on the drawings, allowing the finished grades to remain higher than the grades on the grading plan, as defined in paragraph Planting Soil Installation, to anticipate settlement over the first year.

B. Utilize hand equipment, small garden tractors with rakes, or small garden tractors with buckets with teeth for fine grading to keep surface rough without further compaction. Do not use the flat bottom of a loader bucket to fine grade, as it will cause the finished grade to become overly smooth and or slightly compressed.

C. Provide for positive drainage from all areas toward the existing inlets, drainage structures and or the edges of planting beds. Adjust grades as directed to reflect actual constructed field conditions of paving, wall and inlet elevations. Notify the Owner’s Representative in the event that conditions make it impossible to achieve positive drainage.

D. Provide smooth, rounded transitions between slopes of different gradients and direction. Modify the grade so that the finish grade before adding mulch and after settlement is one or two inches below all paving surfaces or as directed by the drawings.

E. Fill all dips and remove any bumps in the overall plane of the slope. The tolerance for dips and bumps in shrub and ground cover planting areas shall be a 2 inch deviation from the plane in 10 feet. The tolerance for dips and bumps in lawn areas shall be a 1 inch deviation from the plane in 10 feet.

3.9 CLEANUP AND PROTECTION

A. During installation, keep the site free of trash, pavements reasonably clean and work area in an orderly condition at the end of each day. Remove trash and debris in containers from the site no less than once a week.

B. Once installation is complete, wash all soil from pavements and other structures. Ensure that mulch is confined to planting beds and that all tags and flagging tape are removed from the site.

The Owner's Representative seals are to remain on the trees and removed at the end of the warranty period.

C. The Contractor shall protect installed and/or modified Planting Soil from damage including contamination and over compaction due to other soil installation, planting operations, and operations by other Contractors or trespassers. Maintain protection during installation until acceptance. Utilize fencing and matting as required or directed to protect the finished soil work. Treat, repair or replace damaged Planting Soil immediately.

D. Make all repairs to grades, ruts, and damage to the work or other work at the site.

3.10 DISPOSAL

A. Remove surplus soil and waste material including excess subsoil, unsuitable soil, trash, and debris and legally dispose of them off Owner's property.

END OF SECTION

SECTION 32 9200

TURF AND GRASS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Provide all labor, materials, equipment, services, and perform all operations necessary to complete the work of this section as indicated within the drawings and specified herein which shall include, but is not limited to, the following:

1. Supplying screened loam.
2. Supplying root zone mix.
3. Preparation and spreading of stockpiled topsoil (if available).
4. Fine grading.
5. Fertilizers and additives as necessary.
6. Seeding.
7. Sodding.
8. Erosion Control Matting.
9. Maintenance including watering.

B. Contractor is responsible for all health and safety.

1.2 QUALITY ASSURANCE

A. The Contractor must be a member in good standing of the Associated Landscape Contractors of America.

B. The Contractor must show previous evidence of having successfully installed and maintained landscape projects of similar scope to the subject project with regard to quantities of seeding involved, complexity and a minimum of five (5) years experience on projects similar to this one. The Owner's Representative shall have the right to review the qualifications and references of the Contractor for approval to work on this project.

C. Source Quality Control:

1. Analysis and standards: Package standard products with manufacturers certified analysis. For other materials, provide analysis by recognized laboratory made in accordance with methods established by the Association of Official Agriculture Chemists, wherever applicable.

D. Within 30 days after award of Contract and before any seeding materials are delivered to the job site, submit to the Owner a complete list of all seeding and other items proposed to be installed. At least 10 days prior to shipment delivery of materials, the Contractor shall submit to

the Owner a one (1) cubic foot representative sample, certifications, certified test results for materials as specified below. The Contractor shall provide a listing of the addresses (locations) identifying the origin of the soil to be delivered. If the origin is from multiple locations, test results must be provided for each source as well as the blended final product and all locations shall be provided at the time of submission of required information specified above. No material shall be ordered or delivered until the required submittals have been submitted and approved by the Owner. Delivered materials shall closely match the approved samples. Approval shall not constitute final acceptance. The Owner reserves the right to reject, on or after delivery, any material that does not meet these specifications.

E. Existing Topsoil from Stockpile may be used providing it can be made to comply with the specifications for screened loam. The Contractor shall provide representative samples for testing and approval. Two (2) test samples of shall be taken and analyzed from each potential loam borrow pit and two each shall be taken and analyzed of existing topsoil stockpiled on site. Site of sample shall comply with testing lab requirements. Contractor shall deliver samples to testing laboratory, have testing report sent directly to the Owner's Representative and pay all costs. Report shall be submitted at least one (1) month before any loaming is to be done.

1. Mechanical and chemical analysis shall be by a public extension service agency or a certified private testing laboratory in accordance with the current "Standards" of the Association of Official Agriculture Chemists and acceptable to the Landscape Architect.

2. Soil test report shall include a mechanical sieve analysis with soil classification. Organic content shall be reported. Chemical analysis shall include pH (1:1 soil-water ratio), buffer pH, Soluble Salts (1:2 soil-water ratio), Nitrate Nitrogen, Ammonium Nitrogen, Phosphorus, Potassium, Calcium, Aluminum, Magnesium, Manganese, Ferric Iron and Sulfate.

3. Test report shall clearly recommend appropriate additives including limestone and fertilizer requirements.

1.3 RELATED SECTIONS

A. Section 31 2313—SUBGRADE PREPARATION

1.4 RELATED REQUIREMENTS (ADDENDUM 8)

A. Section 01 3329—SUSTAINABLE DESIGN REPORTING: Special administrative and procedure requirements related to the Owner's *LEED 2009 New Construction and Major Renovation* certificate goals of energy conservation and efficiency, indoor air quality, and natural resource efficiency.

B. Section 01 6000—PRODUCT REQUIREMENTS: Listing of VOC requirements for adhesives, cleaning/maintenance materials, paints, coatings, and sealants.

C. Section 01 7419—CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL: Procedural and administrative requirements for construction and demolition recycling.

1.5 SUBMITTALS

A. Submit the following under provisions of Section 01 3300—SUBMITTAL PROCEDURES:

1. Sod—statement of composition percentages of purity and germination of each variety.

2. Soil analysis in accordance with the current “Standards of the Association of OFFICIAL Agricultural Chemists”.

3. Provide watering and fertilizing schedule to Landscape Architect for approval.

4. Provide two marked up prints to the Landscape Architect indicating square footages for all lawn areas with quantities of all soil additives and sod for each area prior to beginning work.

5. Sustainable Design Submittals: (addendum 8)

   a. Recycled content (LEED Credit MRc4): Provide manufacturer’s written certification of recycled content as defined in accordance with International Standard ISO 14021–1999, Environmental Labels and Declarations—Self-Declared Environmental Claims (Type II Environmental Labeling). Indicate post-consumer and pre-consumer recycled content and provide documentation certifying products are from recycled sources.

   b. Local/regional materials (LEED Credit MRc5):

      1) Indicate location of content of extraction, harvesting, and recovery; indicate the distance between extraction, harvesting, and recovery and the project site. Indicate percentage of product content from qualified locations.

      2) Indicate location of manufacturing facility; indicate distance between manufacturing facility and the project site.

1.6 PROJECT CONDITIONS

A. All areas to be seeded shall be inspected by the Contractor before starting work and any defects, such as incorrect grading, etc., shall be reported to the Landscape Architect prior to beginning this work. The commencement of work by the Contractor shall indicate his acceptance of the areas to be seeded, and he shall assume full responsibility for the work of this Section.

1.7 REFERENCES

A. The work shall conform to the codes and standards of the following agencies, publications as further cited herein:

B. AAN: American Association of Nurserymen, Inc., “Standards for Nursery Stock” ANSI Z60.1—1980, or current edition.

C. ASTM: ASTM International (ASTM), 1916 Race Street, Philadelphia, Pennsylvania, 19103, USA as Published in “Compilation of ASTM Standards in Building Codes”.

D. BHCU: Bailey Hortorium of Cornell University, 1976, Hortus Third, A Concise Dictionary of Plants Cultivated in the United States and Canada (for nomenclature).

E. NAA: National Arborist Association, 3537 Stratford Road, Wantagh, New York, 11793, USA, as published in “Standards for Pruning Shade Trees...”, 1979, or latest edition (for pruning standards).

F. USDA: United States Department of Agriculture, 1941 Yearbook, “Climate and Man” (for average last frost date at locality).

1.8 QUALITY CONTROL/QUALIFICATIONS

A. Provide affidavits from manufacturers major suppliers where required by these Specifications.

B. Fine grading and installation of sod shall be done under the supervision of a qualified foreman acceptable to the Landscape Architect.

1.9 DELIVERY, STORAGE AND HANDLING

A. Deliver all items to the site in their original containers with all labels intact and legible at time of Owner's inspection.

B. Immediately remove from the site all seeding materials, which are not true to name, and all materials, which do not comply with the provisions of this Section of these Specifications.

C. Use all means necessary to protect seeding materials before, during, and after installation and to protect the installed work and materials of all other trades.

D. Packaged Materials: Deliver packaged materials in containers showing weight, analysis, and name of manufacturer. Protect materials from deterioration during delivery, and while stored at site.

PART 2 PRODUCTS

2.1 SCREENED LOAM

A. Screened Loam shall be "coarse sandy loam" determined by mechanical analysis (ASTM D422) and based on the "USDA Classification System". Screened Loam has the following mechanical analysis:

Textural Class	Percentage of Total Weight	Average Percentage
Sand (0.05–2.0 mm dia. range)	45–75	60
Silt (0.002–0.05 mm dia. range)	15–35	25
Clay (Less than 0.002 mm dia. range)	5–20	15

Coarse Sandy loam shall have: less than 30% fine/very fine sand, and 50% or more medium/coarse/very coarse sand.

B. Screened Loam shall be a natural product consisting primarily of natural topsoil, free from subsoil, and obtained from an area which has never been stripped, as noted above, the location of the source of the Loam must be submitted to the Landscape Architect. Screened Loam shall not contain less than 3 percent nor more than 10 percent organic matter as determined by the loss on ignition of oven-dried samples, at 100°C ± 5°C. To adjust organic matter content, the soil may be amended, prior to site delivery, by the addition of composted leaf mold or peat moss. Use of organic amendments is accepted only if random soil sampling indicates a through incorporation of these materials. No mixing or amending of Loam will be permitted on site. The Loam shall not be delivered when in a wet or frozen condition.

C. Screened Loam shall consist of fertile, friable, natural loam capable of sustaining vigorous plant growth. Loam shall be without admixture of subsoil, and refuse, resulting in a homogeneous material free of stones greater than ½″ in the longest dimension, be free of lumps, plants, glass, roots, sticks, excessive stone content, debris, and extraneous matter. Screened Loam shall fall

within the pH range of 6.0 to 6.5 except as where noted on plans and details. It shall be uncontaminated by salt water, foreign matter and substances harmful to plant growth. The maximum soluble salt index shall be 100. Screened Loam shall not have levels of aluminum great than 200 parts per million.

D. If limestone is required to amend the screened loam to bring it within a pH range of 6.0 to 6.5 no more than 200 pounds of limestone per 1,000 square feet of loam, incorporated into the soil, or 50 pounds of limestone per 1,000 square feet of loam, surface application, within a single season.

E. The Owner will reject any material delivered to the site that, after post-delivery testing, does not meet these specifications. If the delivered screened loam does not meet the specifications stated in this document the delivered screened loam will be removed by the Contractor at the Contractor's expense and at the time of rejection.

F. The Contractor shall take representative samples of topsoil from the site and from topsoil to be hauled in and shall submit samples to a Soil Testing Laboratory for chemical analysis, and physical analysis. The Contractor shall indicate to the testing agencies that turf is to be planted and who the Owner is. The Contractor shall forward to the Owner two copies of analysis and recommendations of the testing agencies.

G. Topsoil, which has been stockpiled on the site, may be used provided it can be made to comply with these Specifications herein for screened loam.

H. All loam provided from off-site sources shall be brought to the site meeting all specification requirements. There must be no mixing or amending of soil on site. No loam shall be spread prior to screening. The loam must not be handled or moved when in a wet or frozen condition.

I. To assure loam borrow purchased and topsoil stockpiled fulfills specified requirements regarding textural analysis, organic matter content, and pH, soil testing results will be obtained by the Contractor and submitted to the Owner's Representative for approval one (1) month before any soil is delivered to the site.

2.2 SOIL ADDITIVES

A. Sand shall be clean sand, free of deleterious materials. Sand shall meet AASHTO M-6 or ASTM C33 with grain size of 0.02″–0.04″.

B. Commercial fertilizer, peat, humus or other additives shall be used to counteract soil deficiencies as recommended by the soil analysis and as directed by the Owner's Representative.

C. If stored at the site, protect fertilizer from the elements at all times.

D. Fertilizer shall be commercial fertilizer, based upon soil tests. Fertilizer mixture containing at least sixty percent (60%) of organic material.

1. Percentages of nitrogen, phosphorous and potash shall be based on laboratory test recommendations as approved by the Landscape Architect. For purpose of bidding, assume ten percent (1 0%) nitrogen, twenty percent (20%) phosphorus and six percent

(6%) potash by weight. At least fifty percent (50%) of the total nitrogen shall contain no less than three percent (3%) water-insoluble nitrogen.

2. Fertilizer shall be delivered to the site, mixed as specified, in the original unopened standard size bags showing weight, analysis and name of manufacturer. Containers shall bear the manufacturer's guaranteed statement of analysis, or a manufacturer's certificate of compliance covering analysis shall be furnished to the Landscape Architect. Store fertilizer in a weatherproof place and in such a manner that it will be kept dry and its effectiveness will not be impaired.

3. Fertilizer shall be applied in two (2) applications. The first application shall be within one (1) week before the sodding at the rate of thirty-five (35) pounds per thousand (1,000) square feet harrowed into the top two (2) inches of sod bed. The second application shall be done as a maintenance application.

4. At least four (4) days shall lapse after the application of lime and fertilizer before sodding shall begin.

E. Humus shall be natural humus, reed peat or sedge peat. It shall be free from excessive amounts of zinc, low in wood content, free from hard lumps and in a shredded or granular form. According to the methods of testing of A.O.A.C., latest edition, the acidity range shall be approximately 5.5 pH to 7.5 pH and the organic matter shall be not less than 85% as determined by loss on ignition. The minimum water absorbing ability shall be 200% by weight on an oven-dry basis.

F. Manure shall be well-rotted, unbleached stable manure not less than eight months and not more than two years old. It shall be free from sawdust, shavings or refuse of any kind and shall not contain over twenty-five (25) percent straw. The Contractor shall furnish information as to the kind of disinfectant or chemicals, if any, that may have been used in storage of the manure.

G. Lime: Natural dolomitic limestone containing not less than 85 percent of total carbonates with a minimum of 30 percent magnesium carbonates, ground so that not less than 85 percent of total carbonates with a minimum of 30 percent magnesium carbonates, ground so that not less than 90 percent passes a 10-mesh sieve and not less than 50 percent passes a 100-mesh sieve.

H. Superphosphate shall be composed of finely ground phosphate rock as commonly used for agricultural purposes containing not less than 18% available phosphoric acid. Superphosphate shall be applied with the fertilizer at the rate of twenty (20) pounds per thousand (1,000) square feet. At least four (4) days shall lapse after the application of lime and fertilizer before sodding shall begin.

I. Aluminum Sulfate: Commercial grade.

J. Bonemeal: Commercial, raw, finely ground; 4 percent nitrogen and 20 percent phosphoric acid.

K. Water: The Contractor shall be responsible for furnishing his own supply of water to the site at no extra cost. If possible, the Owner will furnish the Contractor upon request with an adequate source and supply of water at no charge. However, if the Owners water supply is not available or not functioning, the Contractor will be held responsible to furnish water.

1. Water shall be free from impurities injurious to vegetation.

2.3 SEED

A. Lawn Areas

1. Seed mixture shall be fresh, clean, new crop seed. Grass shall be of the previous year's crop and in no case shall weed seed content exceed 1% by weight. The seed shall be furnished and delivered in the proportion specified below in new, clean, sealed and properly labeled containers. All seed shall comply with State and Federal seed laws. Submit manufacturers Certificate of Compliance. Seed that has become wet, moldy or otherwise damaged will not be acceptable.

    a. Manufacturer: Pearl's Premium or an equivalent seed blend to the following:

Purity	Seed Species	Germination Rate
19.75%	Dakota Tall Fescue	90%
19.75%	Frontier Perennial Ryegrass	92%
19.65%	Deepblue Kentucky Bluegrass	88%
19.65%	Harpoon Hard Fescue	80%
19.65%	Carmen Chewings Fescue	90%
01.47%	Inert Matter	
00.05%	Other Crop Seed	
00.03% (max.)	Weed Seed	

2. Seed mixture to be applied at the following rate:

    a. Five (5) pounds per 1,000 square feet.

3. Seed shall be mixed by a dealer.

2.4 SOD

A. After the preparation of the areas to be sodded has been approved by the Landscape Architect, the Contractor shall sod the areas as specified herein. The Contractor shall sod with nursery-grown sod composed of Bluegrass as follows:

Rye Grass and Gettysburg Perennial Ryegrass	20% (Endophytic)
P 104 Kentucky Bluegrass	16%
America Kentucky Bluegrass	16%
Glade Kentucky Bluegrass	16%
Challenger Kentucky Bluegrass	16%
Touchdown Kentucky Bluegrass	16%

B. Submit blend percentages and names to Landscape Architect for approval. The sod shall be grown by a recognized turf farm which meets the approval of the Landscape Architect. The approved farm must, in turn, certify in writing that they are the Contractor's selected supplier.

C. Sod shall be furnished in either of the following dimensions:

1. In rectangular sod strips measuring twelve (12) inches or sixteen (16) inches in width and from four (4) feet or six (6) feet in length, stored in rolls with the grass top side inverted so that the topsoil side is to the exterior. Note: These smaller strips will only be acceptable for filling in smaller areas if needed.

D. All sod furnished shall be living sod containing at least seventy percent (70%) of thickly matted grasses as specified, and free from noxious weeds.

E. Any sod with growth of more than two (2) inches in height shall be mowed to a height of from one and one-half (1½%) to two (2) inches not more than five (5) days prior to harvesting. The sod shall be machine cut at a uniform soil thickness of from one-half (½) to three-quarter (¾) inches, excluding top growth and thatch at time of cutting. The maximum allowable deviation from the widths and lengths specified shall be five percent (5%). No broken pads or torn and uneven ends shall be accepted. Standard size sections of sod shall be strong enough to support their own weight and retain their size and shape when suspended vertically with a firm grasp on the upper eighteen percent (18%) of the section. Sod shall not be harvested when its moisture content (excessively wet or dry) may adversely affect its survival.

F. Sod shall be harvested, delivered and installed within a period of thirty-six (36) hours. Sod not installed within this time period shall be inspected by the Landscape Architect and shall not be installed prior to his approval. Any sod not approved by the Landscape Architect shall be removed from the site by the Contractor and a fresh sod supply shall be furnished at no extra cost to the Owner.

2.5 EROSION CONTROL MATTING

A. Shall be on all slopes 2:1 and greater in slope.

B. Jute mesh shall be a uniform, open, plain weave cloth of undyed and unbleached single jute yarn. The yarn shall be of a loosely twisted construction and it shall not vary in thickness more than one-half its normal diameter. Jute mesh shall be furnished in rolled strips and shall meet the following requirements:

Width—48 inches, plus or minus one inch
78 warp—ends per width of cloth (minimum)
41 weft—ends per yard (minimum)
Weight shall average 1.22 pounds per linear yard with a tolerance of plus or minus 5%.

C. Staples shall be U-shaped and shall be approximately six inches long and one inch wide. Machine made staples shall be of No. 11 gauge or heavier steel wire. Handmade staples shall be made from 12-inch lengths of No. 9 gauge or heavier steel wire.

PART 3 EXECUTION

3.1 PREPARATION OF PLANTING SOIL

A. Mix specified soil amendments and fertilizers with topsoil and/or loam borrow at rates specified by testing agency. Delay mixing of fertilizer if planting will not follow placing of planting soil within a few days.

B. Loam, organic material and bonemeal for plant backfill for both planting beds and individual plants shall be thoroughly premixed in the proportions of one (1) part of organic material with seven (7) parts of loam together with ten (10) pounds of bonemeal per cubic yard of mixture.

C. Maintain at all times during the planting operations one or more stockpiles of approved loam borrow or topsoil from stockpile.

3.2 BIORETENTION AND RAIN GARDEN AREA EXCAVATION

A. No heavy equipment shall operate within the perimeter of a bioretention or rain garden areas during excavation, backfilling, planting, or mulching of the areas.

B. The bioretention and rain garden facilities shall be excavated to the dimensions, side slopes, and elevations shown on the Contract Plans. The method of excavation shall minimize the compaction of the bottom of the bioretention and rain garden facilities. Excavators and backhoes, operating on the ground adjacent to the bioretention and rain garden facilities, shall be used to excavate the areas if possible. Low ground-contact pressure equipment may also be used for excavation. No heavy equipment shall be allowed on the bottom of the bioretention and rain garden facilities.

C. Excavated materials shall be removed from the bioretention and rain garden facilities.

3.3 FINE GRADING AND LOAMING

A. After the areas to be loamed have been brought to rough grade, and immediately prior to spreading the loam borrow or topsoil, the subgrade shall be loosened by disking or rototilling to a depth of at least three inches to permit bonding of the loam to the subsoil. Remove all stones greater than one (1) inch in diameter and all debris or rubbish. Such material shall be removed from the site, at no additional cost to the Owner.

B. Provide a minimum depth of six (6) inches of planting soil in all areas indicated for seeding and all areas disturbed by excavation and construction operations.

C. Screened loam borrow or screened topsoil from stockpile shall be placed and spread over approved areas to a depth sufficiently greater than six inches so that after natural settlement and light rolling, the completed work will conform to the lines, grades, and elevations indicated. Supply additional loam, after testing and approval as may be needed, to give the specified depths and finished grades under the Contract without additional cost to the Owner.

D. Disturbed areas outside the limit of seeding shall be spread with six (6) inches of screened loam or screened topsoil to the finished grade as specified herein above.

E. No subsoil or loam shall be handled in any way if it is in a wet or frozen condition.

F. Sufficient grade stakes be set for checking the finished grades. Stakes must be set in the bottom of swales and at top of slopes. Grades shall be established which are accurate to one tenth of a foot either way. Connect contours and spot elevations with an even slope.

G. After loam has been spread, it shall be carefully prepared by scarifying or harrowing and hand raking. All large stiff clods, lumps, brush, glass, roots, stumps, litter and other foreign matter,

and stones over one inch in diameter shall be removed from the loam. Loam shall also be free of smaller stones in excessive quantities as determined by the Owner's Representative.

H. The whole surface shall then be rolled with a hand roller weighing not more than 100 pounds per foot of width. During the rolling, all depressions caused by settlements or rolling shall be filled with additional loam and the surface shall be regraded and rolled until it presents a smooth and even finish to the required grade.

I. Contractor shall obtain Owner's Representatives written approval of fine grading and bed preparation before doing any seeding or sodding.

3.4 SEEDING

A. All areas indicated on the plan shall be loamed and seeded only after written approval of the Owner's Representative of bed preparation. All disturbed areas outside the limit of seeding shall be seeded.

B. Immediately before seeding, the ground shall be restored, as necessary, to a loose friable condition by dicing or other approved method to a depth of not less than 2″. The surface shall be cleared of all debris and of all stones 1″ or more in diameter.

C. Seeding shall be done only during the period from April 1 to May 30 or August 15 to October 15. The actual planting of seed shall be done, however, only during periods within this season which are normal for such work as determined by weather conditions and by accepted practice in this locality. At his option, and on his responsibility, the Contractor may plant seed under unseasonable conditions at no increased cost to the Owner.

D. Seeding of lawns shall be done only by experienced workmen under the supervision of a qualified foreman.

E. Soil additives shall be spread and thoroughly incorporated into the layer of loam by harrowing or other methods approved by the Owner's Representative. The following soil additives shall be incorporated.

1. Spread ground limestone as required by soil analysis to achieve a pH of 6 to 6.5, but the maximum amount applied shall be one pound per square yard.

2. Spread fertilizer at the rate of forty (40) pounds per one thousand (1,000) square feet or more as required by soil analysis.

3. Spread Superphosphate at the rate of twenty (20) pounds per one thousand (1,000) square feet.

4. Incorporate humus in the soil as required by soil analysis prior to delivery to site. Contractor shall have loam retested with organic matter incorporated and shall obtain approval prior to brining any loam on the site.

F. Seed only when the bed is in a friable condition, not muddy or hard.

G. Seed all areas to be seeded with specified grass seed, sowing evenly with an approved mechanical seeder at the rate of 6 pounds per 1,000 square feet. Sow 3 pounds per 1,000 square feet in one direction and 3 pounds per 1,000 square feet at right angles to the first

seeding. Spread seed when soil is moist. Cultipacker, or approved similar equipment, may be used to cover the seed and to firm the seedbed in one operation. In areas inaccessible to cultipacker, the seeded ground shall be lightly raked and rolled in two directions with a water ballast roller. Extreme care shall be taken during seeding and raking to insure that no change shall occur in the finished grades and that the seed is not raked from one spot to another. Hydroseeding is an acceptable manner of seeding, providing the Contractor certifies in writing that the hydro-seed fertilizer mix is as herein specified and applied at the equivalent rate of 6 pounds per 1,000 square feet.

H. If covering and rolling is not properly accomplished by the seeding machine, the seed shall be lightly raked into the ground, after which the ground shall be rolled with a five hundred pound roller and thoroughly and evenly watered with a fine spray to penetrate the soil to a depth of at least two (2) inches.

I. Promptly after seeding, wet the seedbed thoroughly, keeping all areas moist throughout the germination period.

J. Mulch shall be placed immediately after seeding. Straw or salt marsh hay that has been thoroughly fluffed shall be spread evenly and uniformly at the rate of two to three tons per acre. Lumps and thick mulch materials shall be thinned. All mulch anchor stakes, strings and matting shall be removed before final acceptance of lawns. In addition, following mulching, all slopes of 3:1 or greater shall be covered with jute, biodegradable tobacco netting or approved equal. Securely stapled in place. Overlap all joints in netting a minimum of 6″.

K. Hydroseed mix: All work shall be installed using an approved spraying machine specifically used for this purpose. Amounts of fertilizer used shall be as the testing agency recommendations prescribe and as directed by the Owner’s Representative. The Contractor shall submit to the Owner’s Representative for approval prior to the start of any seeding work, a certified statement as to the number of pounds and types of fertilizer, amounts and types of grass seed and processed fiber per one hundred (100) gallons of water.

1. Hydromulch shall be Terra-Sorb GB or approved equal

a. Add Terra-Sorb to the hydroseed tank at the rate of sixty (60) pounds per acre.

3.5 SODDING

A. SOD BASE PREPARATION

1. Personnel for lawn work shall be familiar with sodding and lawn construction and be under the constant supervision of a qualified foreman.

2. After acceptance of sub-base as prepared, the Contractor shall do whatever additional grading is necessary to bring the sub-base to a true smooth slope, parallel and six (6) inches below finished grade for all areas to be sodded.

3. The top four (4) inches of the sub-base immediately prior to being covered with topsoil shall be raked or otherwise loosened and shall be free from stones, rock, and other foreign material three (3) inches or greater in dimensions.

4. There shall be sufficient grade stakes as determined by the Landscape Architect to insure correct line and grade of sub-base and of finished grade.

5. Sub-base shall be inspected and approved by the Landscape Architect before placing of topsoil.

6. Topsoil shall be placed and spread over approved areas to a depth sufficiently greater than necessary for the required thickness so that after natural settlement and light rolling, the completed work will conform to the lines, grades and elevations indicated. Supply additional loam, after testing and approval as may be needed to give the specified depths and finished grades under the contract without additional cost to the Owner.

7. After topsoil has been spread, it shall be carefully prepared by scarifying or harrowing and band raking. All large still clods, lumps, brush, roots, stumps, litter and other foreign matter, and stones over one (1) inch in diameter shall be removed from the topsoil and also be free of smaller stones in excessive quantities as determined by the Landscape Architect.

B. SODDING

1. After the preparation of the areas to be sodded has been reviewed by the Landscape Architect, the Contractor shall sod the areas as specified herein.

2. In accordance with the rectangular sod strips measuring twelve (12) inches or sixteen (16) inches in width and from four (4) feet to six (6) feet in length the following provisions shall apply:

   a. All sod shall be placed with close joints and no overlapping by whatever method is chosen. Sod shall be laid in strips, edge to edge, with the lateral joints staggered. All minor or unavoidable openings in the sod shall be closed with sod plugs. However, sod laid with joints determined by the Landscape Architect to be too large shall be lifted and re-laid to the Landscape Architect's satisfaction at no extra cost to the Owner. On slope areas exceeding twenty-five percent (25%) gradient, the Contractor shall secure sod by pegging each strip five (5) feet on center.

3. In accordance with the "Big Roll" method of furnishing and installing sod, the following provisions shall apply:

   a. Only sod harvested with a "Big Roll" (Sod-O-Matic) harvester as supplied by the Tuckahoe Turf Farm or the Kingston Turf Farm, or equal, shall be permitted.

   b. Sod so harvested shall be stored, delivered and unloaded while rolled on the manufacturer's specially made tubes which permit the rolling and storage of three (3) sixteen (16) inch wide sod strips, a maximum of fifty (50) feet in length and stored side by side.

   c. The topsoil shall not be moist at the time of installation; however, it shall contain sufficient moisture so as not to be powdery or dusty, both as determined by the supplier's representative.

   d. The sod shall be uniformly distributed over the prepared topsoil bed and pulled tightly against the edges of previously laid sections by laborers with garden rakes so as to insure tight joints and to prevent drying of the sod at the joints.

   e. All sod shall be placed with close joints with no overlapping by whatever method is chosen. The overlapping of existing lawn with new sod along limit of work lines shall

not be permitted. All new work shall abut existing lawn to match existing grades along a cut and prepared edge. Sod shall be laid in strips, edge to edge, with the lateral joints staggered. All minor or unavoidable openings in the sod shall be closed with sod plugs or with topsoil. However, sod laid with joints determined by the Landscape Architect to be too large shall be lifted and re-laid in accordance with these specifications at no extra cost to the Owner. On slope areas exceeding a twenty-five percent (25%) gradient, the Contractor shall secure sod by pegging each strip five (5) feet on center.

f. The sod must be watered on the same working day on which it is installed. If necessary, the Contractor shall provide special crews after normal working hours to accomplish such watering at no extra cost to the Owner. After this initial watering, the Contractor shall be required to provide or install and maintain a system of temporary pipe, sprinklers and service connections which are adequate to water the sod weekly with the equivalent of one (1) inch rainfall. During the first week of the sod installation, watering shall be accomplished daily with a sufficient quantity of water to penetrate through the sod and into the sub-base. If the sod is watered by normal rainfall or if weather conditions dictate, the Contractor may, at his discretion, eliminate or increase watering during a given week. However, such action by the Contractor shall in no way waive the Contractor's responsibility for the growth and health of the grass until final acceptance of the sodding.

g. If, in the opinion of the Landscape Architect, rolling of the sod is required to properly joint the sod to the bed after the sod is laid and twenty-four (24) to forty-eight (48) hours after initial watering, the Contractor shall roll the required area with a roller which weighs from seventy-five (75) to one hundred (100) pounds per square foot of roller width at no extra cost to the Owner.

h. The completed sodded surface shall be true to finish grades shown and even and firm at all points.

3.6 EROSION CONTROL MATTING

A. Jute mesh shall be placed within 48 hours after finish grading or topsoiling of an area is completed. If seeding is specified, within 24 hours after seeding of an area is completed. The jute mesh shall be placed in a manner that will minimize disturbance of the underlying soil. All equipment and application processes shall be approved by the LANDSCAPE ARCHITECT prior to use.

B. The surface shall be smoothed and all gullies and potholes backfilled prior to applying jute mesh. All rocks or clods larger than two inches in size and all sticks and other foreign material that will prevent contact of the jute mesh with the surface shall be removed. If the surface is extremely dry, the ENNGINEER may require watering prior to placement.

C. Jute mesh shall be placed uniformly, in contact with the underlying soil, at the locations shown on the Drawings or directed by the LANDSCAPE ARCHITECT. The top edge of each strip shall be anchored by placing a tight fold of mesh vertically in a six inch deep slot or trench in the soil and tamping and stapling in place. Edges of adjacent strips shall be lapped six inches with a row of staples at a maximum interval of three feet in the lapped area. Bottom edges shall be lapped 12 inches over the next lower strip, if applicable, or buried as specified for top edges.

D. Check slots shall consist of separate four foot strips of jute mesh placed at right angles to the direction of water flow immediately prior to placing the general covering of jute mesh. Check slots shall be anchored by burying the top edge of the strip as described above.

E. Check slots shall be spaced so that one check slot, or junction slot of the jute mesh occurs every 75 feet on gradients of less than 4% and every 50 feet on gradients of more than four percent. On slope drains, a check slot or an end slot shall occur every 25 feet unless otherwise specified.

F. Edges of jute mesh shall be buried around the edges of catch basins and other structures.

G. Jute mesh shall be held in place by wire staples driven vertically into the soil. The mesh shall be fastened at intervals not more than three feet apart in three rows for each strip of mesh, with one row along each edge and one row alternately spaced in the middle. All ends of the mesh and check slots shall be fastened at six inch intervals across their width.

H. The Contractor shall maintain the areas covered by jute mesh until final acceptance of the project. Prior to final acceptance, any damaged areas shall be reshaped as necessary, reseeded, if applicable; and the jute mesh satisfactorily repaired or replaced.

3.7 MAINTENANCE FOR SEEDED AREAS

A. Maintenance shall begin immediately after any area is seeded and shall continue until final acceptance, but in no case, less than the following period.

1. Sixty (60) days after substantial completion of seeding.

a. Maintenance may continue until the next growing season if in the opinion of the Owner's Representative the season enters a winter dormancy and no maintenance should continue.

b. Seeded lawns shall be maintained until all areas have a close stand of grass which has received a minimum of three mowings, has no bare spots greater than two inches in diameter, and at least 90% of the grass established shall be permanent grass species.

B. Maintenance shall include reseeding, mowing, watering, weeding and fertilizing.

C. Watering of Seeded Areas:

1. First Week: The Contractor shall provide all labor and arrange for all watering necessary to establish an acceptable lawn. In the absence of an adequate rainfall, watering shall be performed daily or as often as necessary during the first week and in sufficient quantities to maintain moist soil to a depth of at least two inches.

2. Second and Subsequent Weeks: Water seeded areas as necessary to supplement natural rain to the equivalent of one (1) inch rainfall per week The Contractor shall water the lawn as required to maintain adequate moisture, in the upper two inches of soil, necessary for the promotion of deep root growth.

3. Watering shall be done in a manner, which will provide uniform coverage, prevent erosion due to application of excessive quantities over small areas, and prevent damage to the finished surface by the watering equipment. The Contractor shall furnish sufficient watering equipment to apply one complete coverage to the seeded areas in an eight (8) hour period.

D. Protection:

1. Seeded areas shall be protected by stakes and caution tape or snowfence as directed by the Landscape Architect. Wire shall not be used.

2. Barriers must be raised immediately after seeding and shall be maintained until acceptance.

E. Reseeding: After the grass in seeded areas has appeared, all areas and parts of areas which, in the opinion of the Owner's Representative, fail to show a uniform stand of grass, for any reason whatsoever, shall be reseeded and such areas and parts of areas shall be seeded repeatedly until all areas are covered with a satisfactory growth of grass. Reseeding together with necessary grading, fertilizing, and trimming shall be done at the expense of the Contractor.

F. Mowing:

1. At the time of the first cutting, there shall be a uniform stand between 3″ and 3½″ high, and mower blades shall be set between 2½″ and 3″ high.

2. Mowing shall include removal of clippings.

G. Fertilizing: A second application of fertilizer, as specified herein, shall be applied after one (1) season of growth of a minimum of two (2) months duration, but only during the months of April, May, August or September. Fertilizer shall be applied at the rate of thirty (30) pounds per one thousand (1,000) square feet.

H. Liming: If more than one initial application of limestone is required by the soils analysis to bring the pH of the stockpiled topsoil/loam borrow to a specified range, the Contractor shall be responsible for all additional required lime applications.

3.8 MAINTENANCE FOR SODDED AREAS

A. Maintenance shall begin immediately after sod is installed and shall continue in accordance with the following:

1. Sod shall be maintained until final acceptance of the project or a minimum of eight weeks, whichever is longer.

2. In the event that lawn operations are completed too late in the fall for adequate growth of grass, maintenance shall continue into the following spring growing season at least eight weeks.

3. Water sodded areas as necessary to supplement natural rain to the equivalent of one (1) inch rainfall per week and as follows:

a. Lawns shall be watered in a satisfactory manner during and immediately after installation and not less than twice per week, until acceptance.

b. Suitable water for planting and maintenance of lawns shall be provided by the General Contractor.

c. The Contractor shall furnish his own hose and hose connections from the outlets where water is furnished. Provide all necessary watering equipment.

d. Adjust approved schedule to fit weather and soil conditions.

e. Mow grass as required. Remove grass clippings.

f. Apply specified fertilizer over entire lawn area after six (6) weeks at rate of fifteen (15) pounds per one thousand (1,000) square feet.

g. Eliminate weeds by methods approved by the Landscape Architect; pre-emergent and post-emergent herbicides, EPA approved, are preferred.

h. Repair bare spots and/or damage resulting from erosion, gullies, washouts, or other causes by filling with topsoil, tamping, re-fertilizing and re-sodding by the Contractor at his expense, if such damage occurs prior to acceptance. Sod shall be of same seed mixture as specified. If not weed-free, spraying shall be required.

4. At no time after the placement of the root-zone-mix or sod shall heavy equipment or vehicles not intended for the express purpose of turf maintenance be driven over the turf establishment area. If this occurs, sod shall be removed from the entire compacted area, the root-zone-mix shall be scarified, compacted to the specified compaction level, and sod shall be replaced as outlined in this section of the specifications at no cost to the owner.

3.9 CLEANUP AND PROTECTION

A. During seeding work, keep pavements clean and work area in an orderly condition.

B. Protect seeding work and materials from damage due to landscape operations, operations by other Contractors or trades, and trespassers.

1. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged landscape work as directed.

3.10 ACCEPTANCE

A. The Owner shall inspect all work for Acceptance upon written request of the Contractor. The request shall be received at least 10 calendar days before the anticipated date of inspection. Upon completion and re-inspection of all repairs or renewals necessary in the judgment of the Owner, he shall certify in writing to the Contractor as to the Acceptance of the work.

3.11 ACCEPTANCE IN PART

A. The work may be accepted in parts when it is deemed to be in the Owner’s best interest to do so and when approval is given to the Contractor in writing to complete the work in parts. Acceptance and use of such areas by the Owner shall not waive any other provisions of this Contract.

3.12 CLEANUP

A. When any of this work is done while buildings are occupied, pavements shall be kept clear at all times, broom cleaned to prevent tracking dirt into buildings.

B. After completion of all planting operations, dispose of all debris and excess material to the satisfaction of the Owner. All pavements shall be swept and hosed clean.

3.13 FINAL INSPECTION AND ACCEPTANCE

A. At the end of the guarantee period, the Owner will inspect all guaranteed work for the Final Acceptance upon written request of the Contractor. The request shall be received at least 10 calendar days before the anticipated date for final inspection.

B. Upon completion and re-inspection of all repairs or renewals necessary in the judgment of the Owner at that time, he shall certify in writing to the Contractor as to the Final Acceptance of the project.

END OF SECTION

SECTION 33 1900

WATER SUPPLY SYSTEM

PART 1 GENERAL

1.1 SUMMARY

A. Section includes requirements for water systems, water service, pipe, fittings, and appurtenances in accordance with the requirements of The Metropolitan District (MDC).

B. The requirements herein regulate the sizes, materials, methods and workmanship to be used in the construction of domestic and fire water mains, services, and appurtenances connected or intended to be connected directly or indirectly to any public water mains of the MDC.

C. Contractor shall coordinate work between all Contractors, sections, and trades required for the proper completion of the work.

D. Contractor is solely responsible for obtaining permits or approvals which may be required to perform the work of this section, including all costs, fees and taxes required or levied. Notify and obtain such permits or approvals from all agencies having jurisdiction prior to starting work.

E. Contractor is responsible for all health and safety.

1.2 REFERENCES

A. Reference herein to any technical society, organization, group or regulation are made in accordance with the following abbreviations and, unless otherwise noted or specified, all work under this Section shall conform to the latest edition as applicable.

B. Code of Federal Regulations (CFR)

1. 29 CFR 1926, Safety and Health Regulations for Construction

C. The Metropolitan District

1. Water Service Connection Manual, January 2017
2. Project Manual, January 2017
3. Standard Details Manual, January 2017
4. The Metropolitan District Approved Materials, March 6, 2017

D. State of Connecticut Department of Transportation (ConnDOT), Standard Specifications for Roads, Bridges, Facilities and Incidental Construction, Form 817, 2016 and any supplements.

1.3 COORDINATION WITH MDC

A. Contractor shall notify and coordinate the work of this Section with the MDC as required.

1.4 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and methods required for proper performance of the work in this Section.

B. Use equipment of adequate size, capacity and quantity to accomplish the work of this Section in a timely manner.

C. Maintain all temporary facilities and controls in proper and safe condition throughout the progress of the work.

1.5 SUBMITTALS

A. Shop Drawings

1. Submit Shop Drawings or descriptive literature, or both, showing dimensions, joints and other details of all pipe materials and appurtenances to be furnished. Shop Drawings shall be submitted to Engineer for approval prior to ordering materials.

B. As-Built Drawings

1. Submit As-Built Documents in accordance with MDC requirements.

PART 2 PRODUCTS

2.1 GENERAL

A. The Drawings are diagrammatic only and are intended to indicate the extent, but not all details, of the system, which shall be constructed. All materials and fittings are not shown; but the Contractor shall furnish and install all materials and fittings required for the complete system.

B. All materials furnished under the Section shall conform the requirements of the MDC.

2.2 HYDRANTS

A. Hydrants shall conform to MDC-approved materials and to the configuration requirements of the local fire department, including but not limited to thread type, number and size of connections, operating nut type, direction of open, and color.

PART 3 EXECUTION

3.1 GENERAL

A. All Work under this Section shall be completed in accordance with the requirements of the MDC.

END OF SECTION

SECTION 33 3100

SANITARY SEWER SYSTEM

PART 1 GENERAL

1.1 SUMMARY

A. Section includes requirements for sanitary sewer systems, fittings, and appurtenances in accordance with the requirements of The Metropolitan District (MDC).

B. The requirements herein established regulate the sizes, materials, methods and workmanship to be used in the construction of sewer drains, house connections and other similar work and appurtenances thereto connected or intended to be connected or to discharge, directly or indirectly, to any public sewer or drain of the MDC.

C. Contractor shall coordinate work between all Contractors, sections, and trades required for the proper completion of the work.

D. Contractor is solely responsible for obtaining permits or approvals which may be required to perform the work of this section, including all costs, fees and taxes required or levied. Notify and obtain such permits or approvals from all agencies having jurisdiction prior to starting work.

E. Contractor is responsible for all health and safety.

1.2 REFERENCES

A. Reference herein to any technical society, organization, group or regulation are made in accordance with the following abbreviations and, unless otherwise noted or specified, all work under this Section shall conform to the latest edition as applicable.

B. Code of Federal Regulations (CFR)

1. 29 CFR 1926, Safety and Health Regulations for Construction

C. The Metropolitan District

1. Sewer Service Connection Manual, January 2017
2. Project Manual, January 2017
3. Standard Details Manual, January 2017
4. The Metropolitan District Approved Materials, March 6, 2017

D. State of Connecticut Department of Transportation (ConnDOT), Standard Specifications for Roads, Bridges, Facilities and Incidental Construction, Form 817, 2016 and any supplements.

1.3 COORDINATION WITH MDC

A. Contractor shall notify and coordinate the work of this Section with the MDC as required.

1.4 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and methods required for proper performance of the work in this Section.

B. Use equipment of adequate size, capacity and quantity to accomplish the work of this Section in a timely manner.

C. Maintain all temporary facilities and controls in proper and safe condition throughout the progress of the work.

1.5 SUBMITTALS

A. Shop Drawings

B. Submit Shop Drawings or descriptive literature, or both, showing dimensions, joints and other details of all pipe materials and appurtenances to be furnished. Shop Drawings shall be submitted to Engineer for approval prior to ordering materials.

C. As-Built Drawings

1. Submit As-Built Documents in accordance with MDC requirements.

PART 2 PRODUCTS

2.1 GENERAL

A. The Drawings are diagrammatic only and are intended to indicate the extent, but not all details, of the system, which shall be constructed. All materials and fittings are not shown; but the Contractor shall furnish and install all materials and fittings required for the complete system.

B. All materials furnished under the Section shall conform the requirements of the MDC.

PART 3 EXECUTION

3.1 GENERAL

A. All Work under this Section shall be completed in accordance with the requirements of the MDC.

END OF SECTION

SECTION 33 4000

STORM DRAINAGE SYSTEM

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Installation of new storm drain pipe, manholes and catch basins.
2. Relocation and/or replacement of existing storm drain pipe and catch basins.
3. Connection of exterior building roof drains and perimeter drains.
4. Installation of under-drains.
5. Installation of stormwater treatment units.

B. Contractor shall coordinate work between all Contractors, sections, and trades required for the proper completion of the work.

C. Contractor is responsible for all health and safety.

D. Contractor is solely responsible for obtaining permits or approvals which may be required to perform the work of this section, including all costs, fees and taxes required or levied. Notify and obtain such permits or approvals from all agencies having jurisdiction prior to starting work.

1.2 REFERENCE STANDARDS

A. Reference herein to any technical society, organization, group or regulation are made in accordance with the following abbreviations and, unless otherwise noted or specified, all work under this Section shall conform to the latest edition as applicable.

B. Code of Federal Regulations (CFR)

1. 29 CFR 1926, Safety and Health Regulations for Construction.

C. ASTM International (ASTM)

1. ASTM A36—Standard Specification for Carbon Structural Steel.
2. ASTM A48—Standard Specification for Gray Iron Castings.
3. ASTM A123—Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
4. ASTM A307—Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength.
5. ASTM A536—Standard Specification for Ductile Iron Castings.

6. ASTM A615—Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.

7. ASTM C12—Standard Practice for Installing Vitrified Clay Pipe Lines.

8. ASTM C14—Standard Specification for Concrete Sewer, Storm Drain, and Culvert Pipe.

9. ASTM C55—Standard Specification for Concrete Building Brick.

10. ASTM C76—Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.

11. ASTM C94—Standard Specification for Ready-Mixed Concrete.

12. ASTM C139—Standard Specification for Concrete Masonry Units for Construction of Catch Basins and Manholes.

13. ASTM C150—Standard Specification for Portland Cement.

14. ASTM C207—Standard Specification for Hydrated Lime for Masonry Purposes.

15. ASTM C270—Standard Specification for Mortar for Unit Masonry.

16. ASTM C387—Standard Specification for Packaged, Dry, Combined Materials for Mortar and Concrete.

17. ASTM C425—Standard Specification for Compression Joints for Vitrified Clay Pipe and Fittings.

18. ASTM C443—Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.

19. ASTM C443—Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.

20. ASTM C478—Standard Specification for Precast Reinforced Concrete Manhole Sections.

21. ASTM F493—Standard Specification for Solvent Cements for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe and Fittings.

22. ASTM C507—Standard Specification for Reinforced Concrete Elliptical Culvert, Storm Drain, and Sewer Pipe.

23. ASTM C564—Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.

24. ASTM F656—Standard Specification for Primers for Use in Solvent Cement Joints of Poly(Vinyl Chloride) (PVC) Plastic Pipe and Fittings.

25. ASTM C700—Standard Specification for Vitrified Clay Pipe, Extra Strength, Standard Strength, and Perforated.

26. ASTM C877—Standard Specification for External Sealing Bands for Concrete Pipe, Manholes, and Precast Box Sections.

27. ASTM C890—Standard Practice for Minimum Structural Design Loading for Monolithic or Sectional Precast Concrete Water and Wastewater Structures.

28. ASTM C913—Standard Specification for Precast Concrete Water and Wastewater Structures.

29. ASTM C923—Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals.

30. ASTM C990—Standard Specification for Joints for Concrete Pipe, Manholes and Precast Box Sections Using Preformed Flexible Joint Sealants.

31. ASTM C1479—Standard Practice for Installation of Precast Concrete Sewer, Storm Drain, and Culvert Pipe Using Standard Installations

32. ASTM C 1628—Standard Specification for Joints for Concrete Gravity Flow Sewer Pipe, Using Rubber Gaskets.

33. ASTM D1784—Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.

34. ASTM D1785—Standard Specification for Poly(Vinyl Chloride) (PVC), Plastic Pipe, Schedules 40, 80, and 120.

35. ASTM D2235—Standard Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings.

36. ASTM D2241—Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series).

37. ASTM D2321—Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.

38. ASTM D2412—Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading.

39. ASTM D2466—Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.

40. ASTM D2467—Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.

41. ASTM D2564—Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems.

42. ASTM D2855—Standard Practice for Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings.

43. ASTM D2665—Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings.

44. ASTM D2729—Standard Specification for Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.

45. ASTM D2855—Standard Practice for Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings.

46. ASTM D3212—Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.

47. ASTM D3350—Standard Specification for Polyethylene Plastics Pipe and Fittings Materials.

48. ASTM D4396—Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds for Plastic Pipe and Fittings Used in Nonpressure Applications.

49. ASTM F402—Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings.

50. ASTM F405—Corrugated Polyethylene (PE) Tubing and Fittings.

51. ASTM F477—Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

52. ASTM F656—Standard Specification for Primers for Use in Solvent Cement Joints of Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings.

53. ASTM F679—Standard Specification for Poly (Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings.

54. ASTM F714—Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter.

55. ASTM F758—Smooth-Wall Poly (Vinyl Chloride) (PVC) Plastic Underdrain Systems for Highway, Airport, and Similar Drainage.

56. ASTM F894—Standard Specification for Polyethylene (PE) Large Diameter Profile Wall Sewer and Drain Pipe.

57. ASTM F1803—Standard Specification for Poly (Vinyl Chloride)(PVC) Closed Profile Gravity Pipe and Fittings Based on Controlled Inside Diameter.

58. ASTM F2306—Standard Specification for 12 to 60 inch [300 to 1500 mm] Annular Corrugated Profile-Wall Polyethylene (PE) Pipe and Fittings for Gravity-Flow Storm Sewer and Subsurface Drainage Applications.

59. ASTM F2648—Standard Specification for 2 to 60 inch [50 to 1500 mm] Annular Corrugated Profile Wall Polyethylene (PE) Pipe and Fittings for Land Drainage Applications.

D. American Concrete Pipe Association (ACPA).

1. ACPA 01-103—Concrete Pipe and Box Culvert Installation (latest revision and applicable supplements thereto).

E. American Association of State High and Transportation Officials (AASHTO).

1. AASHTO H20—Standard Specifications for HS-20, Highway Loading.

2. AASHTO M105—Standard Specification for Gray Iron Castings.

3. AASHTO M198—Joints for Circular Concrete Sewer and Culvert Pipe Using Flexible Watertight Gaskets.

4. AASHTO M252—Standard Specification for Corrugated Polyethylene Drainage Pipe.

5. AASHTO M294—Standard Specification for Corrugated Polyethylene Pipe, 300- to 1500-mm Diameter.

F. Corrugated Polyethylene Pipe Association (CPPA), division of the Plastics Pipe Institute (PPI).

1. Recommended Installation Practices for Corrugated Polyethylene Pipe and Fittings (latest revision and applicable supplements thereto).

G. State of Connecticut Department of Transportation (ConnDOT)

1. Standard Specifications for Roads, Bridges, Facilities, and Incidental Construction, Form 817, 2016 and any supplements.

1.3 SUBMITTALS

A. Shop Drawings:

1. Submit shop drawings, descriptive literature, or both, showing pipe materials and appurtenances to be furnished. Shop drawings shall be submitted to Engineer for approval prior to ordering materials.

2. Shop drawings showing the configuration, dimensions, layout, and spacing of major and minor components such as pipe, joints, couplings, restraints, and other proposed details of assembly. Show in large-scale details any unique assembly, pipe/pipe transitions, pipe/structure transitions, and/or installation requirements.

B. Copies of manufacturer-provided installation instructions, operation instructions, and maintenance material for all equipment furnished under this Section.

C. Manufacturer’s warranties and associated warranty registration data in Owner’s name. Submit two (2) copies of each warranty to Engineer in the manufacture/supplier standard form or if there is no standard form available, in a form specified by Engineer.

D. As-Built Drawings.

1.4 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and methods required for proper performance of the work in this Section. Use equipment of adequate size, capacity and quantity to accomplish the work of this Section in a timely manner.

B. Codes and Standards: Perform earthwork complying with requirements of authorities having jurisdiction.

C. Sample pipe for testing, when requested by Engineer, shall be furnished by Contractor in sufficient numbers. The Contractor and/or the pipe manufacturer shall make the facilities and services for making the load tests available.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Delivery and Storage

1. Manufacturer shall package the pipe and other drainage materials in a manner designed to deliver the pipe to the Project Site neatly, intact, and without physical damage. Transportation carrier shall use an appropriate method to ensure the pipe is properly supported, stacked, and restrained during transport. Inspect materials delivered to site for damage; store with minimum of handling.

2. Unloading of the pipe and other drainage materials should be controlled so as not to collide with the other pipe sections or fittings, and care should be taken to avoid chipping or spalling, especially to the spigots and bells. For manhole sections, cone sections, bases, fittings and other precast appurtenances, utilize lifting holes or lifting eyes provided.

3. In cold weather conditions, use caution to prevent impact damage. Handling methods considered acceptable for warm weather may be unacceptable during cold weather.

4. Storage:

a. Store materials on site in enclosures or under protective coverings. Do not store materials directly on the ground. Keep inside of pipes and fittings free of dirt and debris.

b. Pipe shall be stored on clean, level ground to prevent undue scratching or gouging.

c. Store solvents, solvent compounds, lubricants, elastomeric gaskets, and any similar materials under cover out of direct sunlight. Provide additional storage measures in accordance with the manufacturer's recommendations. Discard materials if storage period exceeds the recommended shelf life. Solvents in use shall be discarded when the recommended pot life is exceeded.

d. Metal Items: Check upon arrival; identify and segregate as to types, functions, and sizes. Store off the ground in a manner affording easy accessibility and not causing excessive rusting or coating with grease or other objectionable materials.

e. Cement, Aggregate, and Reinforcement: As specified in Section 033200—Site Cast-in-Place Concrete.

f. Store manhole units in an upright position.

PART 2 MATERIALS

2.1 GENERAL

A. Products furnished under this Section which are damaged or found defective in any way prior to being set in place and final acceptance, may be rejected. Engineer may reject an entire lot of pipe should the sample pipe from such lot fail to meet requirements.

2.2 CONCRETE GRAVITY PIPE

A. Reinforced concrete pipe:

1. Pipe less than 12 inches in diameter: ASTM C14, Class 3.

2. Pipe greater than 12 inches in diameter: ASTM C76, Class 3.

3. Class 4 pipe shall be required when cover is less than 12 inches.

B. Fittings and specials: conform to the applicable requirements specified for the pipe.

C. Gaskets and pipe ends for rubber gasket joint: ASTM C443.

2.3 CORRUGATED POLYETHYLENE PIPE

A. Pipe: High density polyethylene, corrugated, smooth interior, ASTM D3350, Cell Classification 424420C.

1. Four (4) inch through 10 inch diameter pipe: AASHTO M252, Type S.

2. 12 inch through 60 inch diameter pipe: AASHTO M294, Type S or ASTM F2306.

B. Joints: Bell-and-spigot joint, AASHTO M252, AASHTO M294, or ASTM F2306. Bell shall be an integral part of the pipe and provide a minimum pull-apart strength of 400 pounds. Bell-and-spigot joint shall incorporate a gasket making it silt-tight. Gaskets shall be installed in the bell, or on the pipe by the pipe manufacturer.

1. Four-inch (4″) through 60-inch (60″) diameter pipe joint, watertight, ASTM D3212. Gaskets: polyisoprene, ASTM F477. Gaskets shall be installed by the pipe manufacturer and covered with a removable, protective wrap to ensure the gasket is free from debris. A joint lubricant available from the manufacturer shall be used on the gasket and bell during assembly.

2. 12-inch (12″) through 60-inch (60″) diameter pipe shall have a reinforced bell with a bell tolerance device. The bell tolerance device shall be installed by the manufacturer.

3. Coupling bands shall conform to the manufacturer’s specifications. Couplers shall cover not less than one corrugation on each section of pipe.

C. Fittings: AASHTO M252, AASHTO M294, or ASTM F2306. Bell and spigot connections shall utilize a spun-on or welded bell and valley or saddle gasket meeting the watertight joint performance requirements of AASHTO M252, AASHTO M294 or ASTM F2306.

D. Saddle Tee

1. Saddle tees shall be manufactured saddle tees designed to connect to the corrugated polyethylene pipe.

2. Fittings shall conform to AASHTO M 294. Fabricated fittings shall be welded on the interior and exterior of all junctions.

3. A soil-tight seal shall be obtained with the coupling at the saddle tee stub to the storm service pipe.

2.4 POLYVINYL CHLORIDE (PVC) GRAVITY PIPE

A. Polyvinyl Chloride Pipe formulated for drainage application:

1. Pipe 4-inch to 15-inch diameter: ASTM D3034, SDR-35. Elastomeric gasket joints, retained gaskets, part of a complete pipe section and supplied as such.

2. Pipe 18 inch to 36 inch diameter: ASTM F679. Elastomeric gasket joints, retained gaskets, part of a complete pipe section and supplied as such.

B. PVC Cell classification: 12454 or 12364, ASTM D1784.

C. Pipe shall have a minimum pipe stiffness that equals or exceeds 46 psi ($lbs/in.^2$).

D. Pipe shall be marked along the outside of the barrel with the following:

1. The manufacturer's name or trademark.

2. The standard to which it conforms/ASTM Designation.

3. Pipe size.

4. Material designation code/PVC cell classification.

5. SDR number or schedule number.

E. Standard length of pipe: maximum of 20 feet with the following exceptions.

1. Length of 6-inch pipe shall be a maximum of 13 feet unless otherwise approved by Engineer.

2. Pipe used in house connections and/or laterals shall not exceed 6.5 feet in length unless otherwise approved by Engineer.

F. PVC Plastic Gravity Joints and Jointing Material.

1. Joints: ASTM D3213, gasketed, bell-and-spigot, push-on type.

2. Gaskets: ASTM F477. Since each pipe manufacturer has a different design for push-on joints, gaskets shall be part of a complete pipe section and provided as such. Gaskets may be factory installed or field installed as recommended by the pipe manufacturer. Lubricant shall be as recommended by the pipe manufacturer.

G. Fittings: SDR-35, ASTM D3034 and ASTM F1336, specifications as pipe.

H. The manufacturer shall provide waterstops acceptable to Engineer, which shall be applied to the outside of the plastic pipe where the pipe is to be enclosed in any structure where concrete or mortar is used to prevent leakage along the outer wall of the barrel of the pipe.

I. No single piece of pipe shall be laid on any project covered by these specifications unless it is found to be generally straight. Such pipe shall have a maximum ordinate as measured from the concave side of the pipe not to exceed $\frac{1}{16}$ inch per foot of length. If the deviation from straightness exceeds this requirement, then the particular piece of pipe shall be rejected.

2.5 CORRUGATED ALUMINIZED STEEL PIPE

A. Aluminized steel pipe: Type 2, metallic coated, AASHTO M36. Material: AASHTO M274. The ends of helically corrugated pipe shall have a minimum of two annular corrugations reformed to provide a minimum of two (2) annular end corrugations.

1. Gauge: 16, unless otherwise indicated.

2. Pipe shall be round, pipe arch, or slotted drain as indicated on the Drawings.

3. Slotted drain pipe shall have 1.75 inch wide drain waterway opening and solid web spacer spaced 6 inches on center.

B. Slotted Corrugated Plastic Pipe for Subdrain: Materials, dimensions, physical properties and fabrication of pipe or tubing, couplings and fittings shall be in conformance with AASHTO M252.

1. Piping and fittings (3″–6″ diameters): ASTM F405.

2. Piping and fittings (8″, 10″, 12″, 15″, 18″, 24″): ASTM F667.

2.6 VITRIFIED CLAY PIPE (V.C.P.)

A. Pipe: ASTM C700.

B. All pipe shall be bell and spigot pattern, first quality, free from fractures, large or deep cracks, and blisters, laminations, and surface roughness.

C. Straight clay pipe shall, in general, be provided in 5 foot or 6 foot lengths, except that not over two pieces of 2 foot lengths may be inserted at one point where needed to provide the correct length of pipe between two fittings or between a fitting and end of connection or section without cutting pipe. Wye and tee sections may be furnished in 2-foot lengths at option of Contractor. Bends shall be 24-inch minimum radius bends. Stubs, slants, etc. built into walls of manholes or sides of pipe, when capped, should be only long enough to pass through the wall where set and to bring their sockets or bells clear on the outside of the structure into which they are built.

D. At the discretion of Engineer, pipe shall be tested for Crushing Strength, Absorption and Acid Resistance as described in ASTM C301.

E. Clay Piping Jointing Materials: ASTM C425.

2.7 DUCTILE IRON PIPE

A. Ductile Iron Pipe: ASTM A746 and ANSI/AWWA C151/A21.51. Thickness Class 52, ANSI/AWWA C150/A21.50, unless indicated otherwise on the Drawings or directed otherwise by Engineer.

1. Push-on joints, except as otherwise specified. Mechanical joints shall only be used where indicated. Push-on joint pipe ends and fitting ends, gaskets, and lubricant for joint assembly shall conform to ANSI/AWWA C111/A21.11.

2. Mechanical joint requirements for pipe ends, glands, bolts and nuts, and gaskets shall conform to ANSI/AWWA C111/A21.11.

3. Cement Lining: Double Thickness, ANSI/AWWA C104/A21.4.

4. Corrosion Control: Polyethylene wrap in tube or sheet form, ANSI/AWWA C105/A21.5.

B. Fittings

1. Bituminous coated inside and outside, furnished complete with necessary accessories including plain rubber gaskets, ductile-iron glands, bolts and nuts. Fittings shall have strength at least equivalent to that of the pipe and shall be installed as called-for on the Drawings or required to complete the work.

2. Flanged Fittings: ANSI/AWWA C110/A21.10, flange drilling 125.

3. Mechanical Joint Fittings: ANSI/AWWA C110/A21.10 or ANSI/AWWA C153/A21.53 where applicable.

C. Tees for capped outlets shall be installed and capped where called for on the Contract Drawings or as ordered by Engineer.

D. All cuttings of ductile iron pipe shall be done with a pipe cutter or saw (not by chisel or other unapproved methods) at 90 degrees to the pipe. All cut edges shall be smoothed by filing/grinding.

2.8 UNDERDRAIN

A. Pipe: Perforated Polyvinyl Chloride (PVC) Gravity Pipe or Corrugated Polyethylene Pipe as indicated on the Drawings.

1. Perforated Polyvinyl Chloride (PVC) Gravity Pipe: ASTM F758.

a. Perforations shall be uniformly spaced along the length and circumference of the pipe.

b. Joints: Solvent weld with primer (ASTM F656) and solvent cement (ASTM F493) per ASTM D2855 or integrally-formed bell and spigot gasketed connections with elastomeric seals (gaskets) meeting the requirements of ASTM F477.

2. Corrugated Polyethylene Pipe: AASHTO M252 Type SP (Double Wall).

a. Perforations: Class 2 slotted perforations per AASHTO M252. Perforations shall be uniformly spaced along the length and circumference of the pipe.

b. Joints: Joint: Silt-tight, ASTM D3212.

2.9 JOINT LUBRICANT

A. As specified by pipe manufacturer, ANSI/AWWA C111/A21.11.

2.10 CATCH BASINS

A. Reinforced precast concrete base, sump, transition, riser, corbel, and top: ASTM C913 for precast rectangular catch basins, ASTM C478 for precast circular catch basins. Type, construction, and dimensions as indicated on the Drawings.

1. Concrete: 4,000 psi minimum, 4%–7% entrained air.

2. Reinforcement: ASTM C890. Steel bars, ASTM A615. Welded-wire fabric, ASTM A185. Additional reinforcing at openings.

3. Precast sections shall consist of smooth sections in standard nominal inside diameters. All precast concrete sections shall be free from cracks, damaged joints, exposed reinforcing, aggregate pockets, spalls, and dimensional distortions or other irregularities. Lifting holes shall be filled with mortar, or other approved material.

4. Openings or “knockouts” in precast units shall be located as shown on the Drawings and to accommodate the inflow and outflow pipe orientation required. Openings shall be sized sufficiently to permit passage of the largest outside dimension of pipe or fittings. Prior to ordering precast manhole bases, all angles between incoming pipes are to be field checked to incorporate possible line changes required in the field layout.

B. Gaskets for joints between sections: Butyl rubber, ASTM C443.

C. Grade Rings: ASTM C478, precast reinforced concrete, 1-inch to 4-inch thickness, dimensions to match basin and top section.

D. Frame and Grate.

1. Cast iron: AASHTO M 105, Class 25 for frames and Class 30 for grates.

2. Cast steel: ASTM A27, Grade optional, thoroughly annealed.

3. Structural Steel: ASTM A36, or A283, Grade B or better, as to quality and details of fabrication, except that in the chemical composition of the steel, the 2/10 of 1% of copper may be omitted.

4. Grate type: ConnDOT “Type A” unless otherwise specified.

5. Covers and gratings shall bear uniformly on their supports.

6. Frame and grate shall be **painted** or **galvanized, ConnDOT Form 817 M.06.03.** Cast Iron frames and grates shall not be galvanized.

2.11 YARD DRAIN/AREA DRAIN

A. Configured as indicated on the Drawings. Pre-formed PVC unit with integral inlets/outlets or PVC pipe stock assembled to provide a complete unit. Provide pipe adaptors as required to connect to drainage piping of the type specified.

B. Frame and Grate: Ductile iron as an integral part of the surface drainage inlet and furnished by the same manufacturer of the drain, frame and grate set manufactured for use on PVC pipe, or insert-type grate manufactured for use on PVC pipe.

1. Grates for drain basins shall be capable of supporting H-20 wheel loading for traffic areas or H-10 loading for pedestrian areas.

2. 12″ and 15″ square grates will be hinged to the frame using pins. Metal used in the manufacture of the castings shall conform to ASTM A536 grade 70-50-05 for ductile iron.

3. Grates shall be provided painted black.

2.12 CONCRETE MANHOLE

A. Precast concrete manhole risers, base sections, and tops: ASTM C478. Precast manhole sections shall consist of smooth circular sections in standard nominal inside diameters. All precast concrete manhole sections shall be free from cracks, damaged joints, exposed reinforcing, aggregate pockets, spalls, and dimensional distortions or other irregularities. Lifting holes, when provided, shall be filled with mortar, or other approved material.

1. Concrete: 4,000 psi minimum, 4%–7% entrained air.

2. Diameter: 48 inches unless otherwise indicated.

3. Base and first riser: Monolithic and built to the dimensions and requirements indicated on the Drawings.

    a. Bottoms shall be integrally cast unless specialty bases at points of connection to existing piping (“Dog-House”) is indicated on the Drawings or otherwise proposed for use. Unless indicated on the Drawings, any special bases or riser used must be detailed in shop drawings and submitted for approval.

4. Riser sections: As required to provide depths indicated.

5. Top Section: Concentric-cone type, unless eccentric-cone or flat-slab-top type is indicated. Cones shall have the same wall thickness and reinforcement as riser sections. If required or called-for, flat slab shall be a minimum of 8 inches thick designed to carry AASHTO H-20 loading with one foot cover and conform to ASTM C478.

6. External damp-proofing: Asphalt, ASTM D449, Type A.

7. [Internal waterproofing: Where required, 60-mil polyvinylchloride or polyethelene sheet with webs or ribs to mechanically lock the sheet to the manhole wall. Joint strips shall be ribless and shall be a minimum of 4 inches wide.]

8. Openings or “knockouts” in precast units shall be located as shown on the Drawings and to accommodate the inflow and outflow pipe orientation required. Openings shall be sized sufficiently to permit passage of the largest outside dimension of pipe or fittings. Prior to ordering precast manhole bases, all angles between incoming pipes are to be field checked to incorporate possible line changes required in the field layout.

B. Gaskets for joints between manhole sections: Butyl rubber, ASTM C443.

C. Grade Rings: ASTM C478, precast reinforced concrete, 1 inch to 4 inch thickness, diameter to match manhole and frame.

D. Mortar: Packaged, ASTM C387 or as Specified in Section 033200—Site Cast-in-Place Concrete.

E. [Frame and Cover: Ductile Cast Iron, ASTM A536, Grade 60-40-18.]

F. [Frame and Cover: Grey Cast Iron, ASTM A48, Class 25B (Frame) and Class 30B (Covers), uncoated.]

1. Cover: 26 inch diameter, non-vented with non-penetrating pickholes. Unless otherwise detailed or indicated, covers shall be cast with 1½ inch wide, raised letters, indicating "STORM SEWER" unless other lettering is called-for.

2. Frame and cover shall be supplied as a pair from the same manufacturer. Castings shall be of tough, even-grained iron, free from scale, lumps, blisters, sand-holes and other injurious defects, and of the size and type shown on the Drawings. Frames and covers shall have machined bearing surfaces to seat firmly and prevent rocking and rattling under traffic loads. Before leaving the foundry, castings shall be thoroughly cleaned, subjected to hammer tests for soundness and given two coats of coal tar pitch varnish.

G. Resilient connectors for joints between manhole and pipes entering manhole: Continuous boot of ⅜ inch minimum thickness neoprene, ASTM C923 or ASTM C990. Boots shall be either cast into the manhole wall or installed into a cored opening using internal compression rings. Installed boot shall result in a water-tight connection meeting the performance requirements of ASTM C443.

H. Manhole Steps: ASTM C478 and OSHA 29 CFR 1910.27, drop front or equivalent. Steps shall be nine inches in depth and at least twelve inches in width with an abrasive step surface.

1. [Cast Aluminum Alloy: Aluminum alloy, 6061-T6, tensile 38,000 psi, yield 35,000 psi. Drop front design with upturned embedded ends. All parts of aluminum steps to be embedded in concrete or masonry shall be coated with bituminous paint or zinc chromate primer.]

2. [Composite Plastic-Steel: One-half (½) inch deformed steel reinforcing rod, ASTM A615, Grade 60, encapsulated in a co-polymer polypropylene plastic, ASTM D2146, Type II, Grade 16906.]

3. Steps shall be placed in vertical alignment as indicated on the Drawings. Steps shall be uniformly spaced not more than sixteen inches (16″) on center, including the spacing between the top step and the manhole cover. Steps shall be embedded in the wall a minimum distance of 4 inches in either cast or drilled holes. Steps shall not be driven or vibrated into fresh concrete and shall withstand a pullout resistance of 2000 lbs when tested in accordance with ASTM C497. Each step shall project a minimum of 5 inches from the wall measured from the point of embedment.

2.13 DROP MANHOLE

A. Drop inlet shall be constructed with ductile iron gravity pipe laid in undisturbed soil in conformance with ASTM A746-82. Adapt to PVC with Fernco coupling or approved equivalent.

B. Vertical drop pipe shall be 8″, 10″, or 12″ maximum SDR 35 PVC with 90 degree short bend radius shall conform to ASTM D3034.

C. Vertical drop pipe shall be anchored a minimum of every 4 feet with ⅛″ x 1½″ type 304 stainless steel pipe straps set as ordered with lag bolts and shields.

2.14 MASONRY UNITS

A. Brick: ASTM C32 Grade MS or ASTM C62 Grade SW.

B. Concrete block: Solid block, ASTM C139.

2.15 MORTAR

A. Mortar: ASTM C387.

1. Portland Cement: ASTM C150, Type I.

2. Sand: ASTM C144.

3. Hydrated Lime: ASTM C207.

4. Water: Potable.

5. Mix proportions for manhole rims and covers: 1 part portland cement, 2 parts sand, and ¼ part hydrated lime by dry volume. Hydrated lime shall not exceed 10 percent by weight of the total dry mix. Quantity of water in mixture shall be sufficient to produce a stiff, workable mortar, but in no case shall exceed 5½ gallons of water per sack of cement.

6. Mix Proportions for invert construction: 1 part portland cement and 2 parts sand by volume. Quantity of water in mixture shall be sufficient to produce a stiff, workable mortar, but in no case shall exceed 5½ gallons of water per sack of cement.

2.16 STORMWATER TREATMENT UNIT

A. Stormwater Treatment Units shall be hydrodynamic separators made of precast concrete sections and shall have the capacity and dimensions indicated on the Drawings. Treatment units shall be Vortechs®, as manufactured by CONTECH Stormwater Solutions, Scarborough, Maine (877-907-8676); Stormceptor® by CSR—Farmington, CT (860-677-1374); or approved equivalent.

B. Units shown on the Drawings have been sized to meet specific criteria as indicated. Contractor shall submit only those units that are sized and manufactured to meet such criteria as shown with the details and/or listed below:

1. Unit 1

a. Conveyed flow = xxxxxx c.f.s. (total flow to the treatment system)

b. Treated flow = xxxxx c.f.s. (total flow actually subjected to treatment)

c. Removal efficiency particle size = maximum of 100 microns

d. Evidence of Independent Third Party field testing

e. Evidence of full scale laboratory testing

f. Minimum removal of 80% Total Suspended Solids (TSS) for 1 inch of rainfall on the impervious surfaces within its drainage area.

C. Precast Sections: portland cement shall be Type II, ASTM C150, 4,000 psi minimum.

D. Loading requirements:

1. H-20 loading, manhole riser with frame and cones, plus the weight of soil above.

2. Weight of precast concrete structure.

3. Initial handling and erection loadings.

E. Construction joints shall be sealed with a butyl rubber based sealant.

F. Manhole riser sections, manhole steps, frames and covers shall be as detailed on the Drawings.

2.17 BEDDING

A. Bedding for concrete and PVC pipes: Bedding, Haunching and Initial Backfill shall consist of screened gravel, maximum size ¾ inches and minimum size ⅜ inches.

B. Bedding for HDPE pipes: Bedding, Haunching and Initial Backfill shall consist of ConnDOT No. 6, No. 67, or No. 8 aggregate, or other materials meeting the requirements of ASTM D2321 for Class IA, Class IB, Class II, or Class III unless otherwise specified by the pipe manufacturer.

C. Bedding for Catch Basins: Screened Gravel or Crushed Stone, well graded in size from ¾ inch to ⅜ inch consisting of clean, hard, and durable fragments. No limestone shall be permitted.

PART 3 EXECUTION

3.1 PIPE INSTALLATION

A. As soon as the excavation is completed to the normal grade of the bottom of the trench, the Contractor shall immediately place the bedding material in the trench. Then the pipe shall be firmly bedded in the compacted bedding material to conform accurately to the lines and grade indicated on the Drawings.

B. Install pipe, fittings, and accessories in accordance with manufacturer's instructions.

1. Concrete pipe shall be installed per ASTM C1479, as may be modified by the pipe manufacturer's instructions.

2. HDPE pipe shall be installed per ASTM D2321, as may be modified by the pipe manufacturer's instructions.

C. Notch under pipe bells and joints, where applicable to provide for uniform bearing under entire length of pipe.

D. Excavation, backfilling and compaction shall be as specified in Section 312310—Earthwork of these Specifications.

E. Maintain optimum moisture content of bedding material to attain required compaction density.

3.2 MANHOLES AND CATCH BASINS

A. Manholes and Catch Basins shall be constructed at the locations and to the lines, grades and dimensions noted on the Drawings, or as required.

B. Precast concrete construction shall be done in a manner to insure watertight construction and all leaks in precast concrete shall be sealed. If required, precast concrete shall be repaired or replaced to obtain watertight construction.

C. Concrete barrels and cones shall be precast concrete sections.

1. Bases shall be either precast with a barrel integrally cast with the base, or poured concrete suitably shaped by means of accurate bell-rung forms to receive the barrel sections. Manhole invert channels in manholes shall be formed in concrete.

2. Precast manholes shall have an adjustment ring at the top of the cone to permit the frame and cover to meet the finished surface. This shall consist of courses of brick or reinforced grading rings not to exceed 11 inches.

D. Stubs shall be short pieces cut from the bell ends of the appropriate size and class of pipe. Concrete stubs shall be plugged with brick masonry unless otherwise directed.

E. Manhole inverts shall conform accurately to the size of the adjoining pipes.

1. Manhole inverts shall be constructed of concrete developing 3,500 psi with the concrete being placed to the spring line of the pipe form.

2. Smooth plastic pipe, matching the dimension of the outlet pipe, shall be used to form the invert.

3. Side inverts and main inverts, where the direction changes, shall be laid out in smooth curves of the longest possible radius, which is tangent, within the manhole, to the centerline of adjoining pipelines.

4. Invert shelves shall be graded to provide a 1-inch per 1-foot wash from the manhole walls.

F. Manhole sections shall contain manhole steps accurately positioned and embedded in the concrete when the section is cast. Precast-reinforced concrete manhole sections shall be set so as to be vertical and with sections and steps in true alignment.

G. All holes in sections used for their handling shall be thoroughly plugged with rubber plugs, made specifically for this purpose, or with mortar. The mortar shall be one part cement to 1½ parts sand, mixed slightly damp to the touch (just short of “balling”), hammered into the holes until it is dense and an excess of paste appears on the surface, and then finished smooth and flush with the adjoining surfaces.

H. The Contractor may, as an alternate to suitable nonshrink mortar joints, use premolded elastomeric-sealed joints for pipe into precast manhole bases.

1. All materials, accessories and construction methods used in making the joints shall be supplied or approved by the manufacturer of the premolded elastomeric-sealed joint.

I. Openings for pipe and materials to be embedded in the walls of the base for these joints shall be cast in the base at the required locations during the manufacturer of the base. Incorrectly cast and patched pipe openings will be rejected.

J. Manhole risers and tops shall be installed using approved “o-ring” type, neoprene gaskets for sealing joints. Units shall be installed level and plumb. Water shall not be permitted to rise over newly made joints nor until after inspection as to their acceptability. All jointing shall be done in a manner to insure water tightness.

K. Openings shall be provided in the risers to receive entering pipes. These openings may be made at the place of manufacture. The openings shall be sized to provide a uniform 1 inch

maximum annular space between the outside of the pipe wall and the opening in the riser. After the pipe is in position, the annular space shall be solidly filled with nonshrink mortar. Care shall be taken to assure that the openings are located to permit setting of the entering pipe at its correct elevation as indicated.

L. Openings, which are cut in the risers in the field, shall be carefully made by coring so as not to damage the riser. Damaged risers will be rejected and shall be replaced at no additional expense to the Owner.

M. Where required by the Drawings, a slot and opening shall be cast in the catch basin wall suitable for mounting the cast iron hood and discharge pipe. The hood hinge may be furnished to the precast supplier by the Contractor for incorporation into the casting during manufacture.

3.3 BRICK MASONRY

A. Brick Masonry Construction shall be done in a manner to insure watertight construction and all leaks in brick masonry shall be sealed. All workmanship shall conform to the best standard practice and all brick masonry shall be laid by skilled workmen.

B. All beds on which masonry is to be laid shall be cleaned and wetted properly. Brick shall be wetted as required and shall be damp but free of any surface water when placed in the Work. Bed joints shall be formed of a thick layer of mortar, which shall be smoothed or furrowed slightly. Head joints shall be formed by applying to the brick to be laid a full coast of mortar on the entire end, or on the entire side as the case requires, and then shoving the mortar covered end or side of the brick tightly against the bricks laid previously. The practice of buttering at the corners of the brick and then throwing the mortar or crappings in the empty joints will not be permitted. Dry or butt joints will not be permitted. Joints shall be uniform in thickness and shall be approximately 1¼ inch thick.

C. Brickwork shall be constructed accurately to dimensions and brickwork at top of manholes shall be to the dimensions of the flanges of the cast-iron frames.

D. Joints on the inside face of walls shall be tooled slightly concave with an approved jointer when the mortar is thumbprint hard. The mortar shall be compressed with complete contact along the edges to seal the surface of the joints.

E. All castings to be embedded in the brickwork shall be accurately set and built-in as the Work progresses. Cast-iron frames and manhole covers shall be well bedded in mortar and accurately set to finished graded indicated or as directed.

F. Water shall not be allowed to flow against brickwork or to rise on the masonry for 60 hours after it has been laid, and any brick masonry damaged in this manner shall be replaced as directed at no additional expense to the Owner. Adequate precautions shall be taken in freezing weather to protect the masonry from damage by frost.

3.4 CONCRETE MASONRY UNITS

A. Concrete Masonry unit construction shall be soaked in water before laying. As circular concrete block walls are laid-up, the horizontal joints and keyways shall be flushed full with mortar. As rectangular blocks are laid-up, all horizontal and vertical joints shall be flushed full with mortar. Plastering of the outside of block structures will not be required. The joints in precast units shall

be wetted and completely mortared immediately prior to setting a section. No structure shall be backfilled until all mortar has completely set.

3.5 MANHOLE STEPS

A. Placement of steps into the precast walls shall be by a proven method as recommended by the supplier of the precast manhole sections. Details of the steps and method of placement shall be submitted for approval.

B. Plastic steps shall be placed into the wet concrete wall during manufacture or if designed for press fit installation shall be driven into a wall opening according to the manufacturer's specifications. Steps shall not be mortared into place after the concrete has set.

C. All manholes, catch basins, lawn inlets, etc., which are in excess of five feet in depth, shall be constructed with standard aluminum steps, spaced at 12-inch on center.

3.6 DROP INLETS

A. Drop inlets shall be constructed to the lines, grades, dimensions and design at the locations indicated on the Drawings or as required.

B. Construction shall conform to requirements outlined in Section 033013—Site Cast-in-Place Concrete.

C. Engineer may permit brick or concrete masonry construction. If this alternate is being employed, construction shall be done in accordance with paragraphs 3.04 or 3.05 in this Section.

3.7 CASTINGS

A. Cast-iron frames for grates and covers shall be well bedded in cement mortar and accurately set to the grades indicated or as directed. The frames shall be encased with a thick cement-mortar collar around the entire perimeter of the frames.

B. All voids between the bottom flange shall be completely filled to make a watertight fit. A ring of mortar, at least one inch thick and pitched to shed water away from the frame shall be placed over and around the outside of the bottom flange. The mortar shall extend to the outer edge of the masonry all around its circumference and shall be finished smooth. No visible leakage will be permitted.

C. Structures within the limits of bituminous concrete pavement shall be temporarily set at the elevation of the bottom of the binder course or as ordered. After the binder course has been compacted, these structures shall be set at their final grade. Backfill necessary around such structures after the binder course has been completed shall be made with Class A concrete unless otherwise ordered.

3.8 TRENCH DRAINS/SLOTTED DRAINS

A. Precast, pre-sloped trench drain metals, accessories, and installation methods shall be in accordance with the manufacturer's recommendations and the details shown on the Drawings.

B. Slotted drains shall be installed in accordance with the manufacturer's recommendations and the details shown on the Drawings.

C. Contractor shall furnish to Engineer the manufacturer's written instructions for installation prior to such installation.

3.9 STORMWATER TREATMENT UNIT

A. Stormwater Treatment Units shall be installed in accordance with the manufacturer's instructions.

B. Vaults shall be placed on a minimum foundation of 12 inches of gravel material. If groundwater is encountered, the foundation base shall be a minimum of 12 inches of crushed stone.

C. If precast sections are to be field assembled, adequate waterproofing shall be used at the joints.

D. Stormwater Treatment Units installed on interior floor drain discharges from parking garages shall have gasoline trapping capabilities in accordance with local and state regulations.

3.10 CLEANING

A. At the completion of the Work, clean all piping, structures and open drainage courses, through and to which water from this construction is directed, to the satisfaction of Engineer.

3.11 AS-BUILT DRAWINGS

A. Contractor shall be solely responsible for complying with the requirements of local permitting authorities for preparation and submittal of as-built drawings. The requirements for the preparation of as-built drawings as defined herein shall be considered the minimum requirements of Engineer, but shall in no way relive Contractor from satisfying the requirements of local permitting authorities.

B. As work progresses, record the following on two (2) sets of Drawings:

1. All changes and deviations from the design in location, grade, size, material, or other feature as appropriate.

2. Any uncharted locations of utilities or other subsurface feature encountered during installation, including the characteristics of such uncharted utility or subsurface feature such as utility type, size, depth, material of construction, etc.

C. Recording of changes shall be clearly and neatly marked in red pen or pencil. All changes shall be noted on the appropriate Drawing sheets.

D. Make measurements from fixed, permanent points on the Project Site to accurately locate the work completed. Such measurements shall consist of at least three (3) ties showing the distance of each item relative to each of the fixed, permanent points.

E. As-Built drawings shall be complete and shall indicate the true measurement and location, horizontal and vertical, of all new construction. As-Built drawings shall also contain any additional information required by Engineer.

END OF SECTION

SECTION 33 5100

NATURAL GAS DISTRIBUTION

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Natural gas piping and appurtenance

2. Coordination with local gas provider.

B. Contractor shall coordinate work between all Subcontractors, sections, and trades required for the proper completion of the work.

C. Contractor is responsible for all health and safety.

1.2 COORDINATION WITH JURISDICTIONAL AUTHORITY

A. Contractor shall notify and coordinate the work of this Section with the local authority having jurisdiction over gas supply, whether public or private system owner/operator.

B. Obtaining permits or approvals which may be required to perform the work of this section, including all costs, fees and taxes required or levied.

C. Contractor shall obtain all required approvals for connection to, or extension of, any portion of gas supply systems.

1.3 REFERENCES

A. Reference herein to any technical society, organization, group or regulation are made in accordance with the following abbreviations and, unless otherwise noted or specified, all work under this Section shall conform to the latest edition as applicable.

B. Code of Federal Regulations (CFR).

1. 29 CFR 1926, Safety and Health Regulations for Construction.

C. State of Connecticut.

1. Standard Specifications for Roads, Bridges, Facilities and Incidental Construction, Form 817, 2016 and any supplements.

1.4 SUBMITTALS

A. Copies of all permits and/or approvals from Jurisdictional Authority.

B. Shop Drawings:

C. Submit shop drawings, descriptive literature, or both, showing pipe materials and appurtenances to be furnished. Shop Drawings shall be submitted to Engineer for approval prior to ordering materials.

D. Shop drawings showing the configuration, dimensions, layout, and spacing of major and minor components such as pipe, joints, restraints, valves, and other proposed details of assembly. Show in large-scale details any unique assembly, and/or installation requirements.

E. Copies of manufacturer-provided installation instructions, operation instructions, and maintenance material for all equipment furnished under this Section.

F. Manufacturer's warranties and associated warranty registration data in Owner's name. Submit two (2) copies of each warranty to Engineer in the manufacture's/supplier's standard form or if there is no standard form available, in a form specified by Engineer.

G. As-Built Drawings.

PART 2 PRODUCTS

2.1 GENERAL

A. The drawings are diagrammatic only and are intended to indicate the extent, but not all details, of the system, which shall be constructed. All materials and fittings are not shown; but Contractor shall furnish and install all materials and fittings required for the complete system.

PART 3 EXECUTION

3.1 GENERAL

A. Gas system to be installed in accordance with the local gas company.

END OF SECTION